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City of Wichita Final Environmental Impact Statement

Submitted January 7, 2004

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FINAL ENVIRONMENTAL IMPACT STATEMENT FOR INTEGRATED LOCAL WATER SUPPLY PLAN WICHITA, KANSAS

Prepared by
City of Wichita, Department of Water and Sewer

CITY OF WICHITA

2003

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January 27, 2004

Mr. Jim Bagley
Kansas Dept. Agriculture, Div. Water Resources
901 S. Kansas Ave.
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Final Environmental Impact Statement, Integrated Local Water Supply Plan
City of Wichita, Kansas

The City of Wichita, Water and Sewer Department, has developed a water supply plan to meet the water supply needs for the greater metropolitan area of Wichita, Kansas through the year 2050 that develops and enhances multiple local water sources. This plan, the Integrated Local Water Supply Plan (ILWSP), is described in the attached Final Environmental Impact Statement (FEIS). The plan includes:

- Changes in the operation of Cheney Reservoir to take advantage of water available in the reservoir during normal and wet weather periods.
- Diverting from the Little Arkansas River during periods of higher flow and storing it in the Equus Beds aquifer in the vicinity of the City's wells for use during extended dry periods. The recharged water would also provide protection to the well field from saltwater migrating from the Burton Oil Fields and the Arkansas River.
- Expanding the capacity of the Local Well Field by placing additional wells in the vicinity of Oak Park and the Wichita-Valley Center Floodway.
- Redeveloping an abandoned well field south of Bentley (the Bentley Reserve Well Field). High chloride content water from this well field would be blended with low chloride water from the other sources to produce water of acceptable quality.

To meet peak-day demand through the year 2050, the City needs a maximum capacity of 223 million gallons per day (MGD). The ILWSP 100 MGD alternative was selected by the City for implementation. The Plan also includes a water conservation component.

The FEIS evaluated potential impacts to land, water, air, noise, wetlands, vegetation, wildlife, threatened or endangered species, socioeconomics, recreation, cultural resources, and hazardous wastes. The FEIS concluded that the projects included in the ILWS Plan will not significantly impact the natural environment of the Little Arkansas, Arkansas, and North Fork of the Ninnescah rivers, or the Equus Beds Aquifer. During construction of the project, there is a potential that stormwater runoff from construction sites could degrade water quality in nearby streams; however, water quality degradation can be avoided by implementation of Stormwater Pollution Prevention Plans as required by the State of Kansas.

Comments on the Draft EIS were received from public hearings held in Halstead, Kansas at the Halstead High School Auditorium on April 23, 2002 and at the Wichita City Hall at 455 North Main Street on April 24, 2002. Those comments have been included in the FEIS. Revisions

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needed to address comments on the DEIS have been included in the FEIS.

Copies of the FEIS have been placed in the Wichita, Halstead, and Valley Center libraries, and in the Water and Sewer Department offices in City Hall in Wichita, and are available for public review.

Water and Sewer Department
City of Wichita, Kansas

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR INTEGRATED LOCAL WATER SUPPLY PLAN WICHITA, KANSAS

Prepared by
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FINAL ENVIRONMENTAL IMPACT STATEMENT

for the

INTEGRATED LOCAL WATER SUPPLY PLAN
WICHITA, KANSAS

prepared by the

WATER AND SEWER DEPARTMENT,
CITY OF WICHITA, KANSAS

The Wichita Water and Sewer Department proposes to develop and enhance multiple local sources of water for the greater metropolitan area of Wichita, Kansas. This plan, identified as the Integrated Local Water Supply Plan (ILWSP), is designed to meet peak-day demand through the year 2050, a maximum of 223 million gallons per day (MGD). With the ILWSP in place, Cheney Reservoir would experience increased withdrawals of water during normal and wet weather periods. Surface water would be diverted from the Little Arkansas River during periods of higher river flow and stored in the Equus Beds aquifer in the vicinity of the City's wells for use during extended dry periods. The capacity of the Local Well Field would be expanded by placing four collector wells and five vertical wells in the vicinity of Oak Park and the Wichita-Valley Center Floodway. The old Bentley Reserve Well Field would be reactivated. High chloride content water from this well field would be blended with low chloride water from the other sources to produce water of acceptable quality.

Three alternatives were evaluated: the ILWSP 150 MGD; the ILWSP 100 MGD; and the No-Action. A water conservation plan is included in all the alternatives. Impacts to land, water, air, noise, wetlands, vegetation, wildlife, threatened or endangered species, socioeconomics, recreation, cultural resources, and hazardous wastes were evaluated. Except for water quality, wetlands, and threatened or endangered species in and on the Little Arkansas, Arkansas, and North Fork of the Ninnescah rivers, the project would not significantly impact the natural environment. Stormwater runoff from construction sites could degrade water quality in nearby streams. Water quality degradation would be avoided by implementation of Stormwater Pollution Prevention Plans as required by the State of Kansas.

The Water and Sewer Department, City of Wichita, Kansas, supports the implementation of the ILWSP as a means of meeting peak-day demand through the year 2050, a maximum of 223 MGD. The development and enhancement of multiple local sources of water for the greater metropolitan area of Wichita, Kansas will have minimum impacts on the environment. Most adverse impacts will be avoided or minimized where avoidance would not be practical.

Inquiries may be directed to: Jerry Blain, P.E., Water Supply Projects Administrator, Water and Sewer Department, City Hall, Eighth Floor, 455 North Main Street, Wichita, Kansas 67202-1677; (316) 268-4578; Fax (316) 268-4950; E-mail: jblain@ci.wichita.ks.us.

Approved By:

David Warren, P.E.
Director, Water and Sewer Department

7/14/03
Date

INTEGRATED LOCAL WATER SUPPLY PLAN
FINAL ENVIRONMENTAL IMPACT STATEMENT

2003

LEAD AGENCY

None at this time.

COOPERATING AGENCIES:

U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
U.S. Geological Survey
Groundwater Management District No. 2
Kansas Water Office
Kansas Department of Health and Environment
Kansas Department of Wildlife and Parks
Kansas Department of Agriculture, Division of Water Resources

ADDITIONAL INFORMATION AND COPIES OF THIS DOCUMENT CAN BE OBTAINED FROM:

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ABSTRACT

This Final Environmental Impact Statement (EIS) discloses the environmental impacts from the Wichita Water & Sewer Department (Department) plans to develop and enhance multiple local sources of water for the greater metropolitan area of Wichita, Kansas. This plan is identified as the Integrated Local Water Supply Plan (ILWSP). With the ILWSP in place, Cheney Reservoir would experience increased withdrawals of water during normal and wet weather periods. Surface water would be diverted from the Little Arkansas River during periods of higher river flow and stored in the Equus Beds aquifer in the vicinity of the City's wells for use during extended dry periods. The capacity of the Local Well Field would be expanded by placing four collector wells and five vertical wells in the vicinity of Oak Park and the Wichita-Valley Center Floodway. The old Bentley Reserve Well Field would be reactivated. High chloride content water from this well field would be blended with low chloride water from the other sources to produce water of acceptable quality. To meet peak-day demand through the year 2050, the Department needs a maximum capacity of 223 million gallons per day (MGD). Three alternatives were evaluated: the ILWSP 150 MGD, the ILWSP 100 MGD, and No-action. A water conservation plan is included in all the alternatives. Impacts to land, water, air, noise, wetlands, vegetation, wildlife, threatened or endangered species, socioeconomics, recreation, cultural resources, and hazardous wastes were evaluated. Except for water quality, wetlands, and threatened or endangered species in and on the Little Arkansas, Arkansas, and North Fork of the Ninnescah rivers, the project would not significantly impact the natural environment. Stormwater runoff from construction sites could degrade water quality in nearby streams. Water quality degradation would be avoided by implementation of Stormwater Pollution Prevention Plans as required by the State of Kansas.

COMMENTS were solicited on all aspects of the Draft EIS and were considered in the preparation of this Final EIS.

EXECUTIVE SUMMARY

INTRODUCTION AND PROPOSED ACTION

The Wichita Water & Sewer Department (Department) proposes to develop and enhance multiple, local sources of water by construction of a surface water intake structure, new diversion and recharge/recovery wells, pre-sedimentation plant, and transmission pipelines in Sedgwick and Harvey counties, Kansas. This course of action is required to supply additional drinking water to the Department's customers primarily in the metropolitan area of Wichita, Kansas, through the year 2050. Because installation of the surface water intake structure could necessitate disturbing the channel of the Little Arkansas River, the Department may apply to the U.S. Army Corps of Engineers (Corps) for a permit, pursuant to Section 404 of the Clean Water Act to discharge dredged or fill materials into the waters of the United States. The consideration of this permit application by the Corps constitutes a federal action that requires the preparation of an environmental impact disclosure document pursuant to the National Environmental Policy Act of 1969 (NEPA).

The proposed ILWSP – 100 MGD with the aquifer storage and recovery (ASR) 75/25 option will include changes in withdrawal rates from Cheney Reservoir that would provide for greater use of water from the reservoir during normal and wet weather periods. Surface water would be diverted from the Little Arkansas River during periods of "above base flow," treated, and recharged or stored in the Equus Beds aquifer in the vicinity of the City's wells for use during dry periods. The capacity of the Local Well Field would be expanded by placing additional wells in the vicinity of Oak Park and the Wichita-Valley Center Floodway. The old Bentley Reserve Well Field would be reactivated. High chloride content water from this well field would be blended with low chloride water from the other sources to produce water of acceptable quality.

This EIS was prepared in accordance with Council of Environmental Quality regulations 40 CFR Parts 1500 through 1508 implementing NEPA and provides a complete and objective analysis of environmental impacts of the proposed project.

PURPOSE AND NEED

The purpose of the proposed project is 1) to provide a reliable supply of potable water to the customers of the Department through the year 2050, which requires delivering water to a growing service area, and 2) protect the Equus Beds aquifer's water quality. The project is intended to provide a firm water supply to meet the maximum daily, or peak, demand within the projected service area. The Equus Beds aquifer, a principal groundwater supply source for the City of Wichita, is currently threatened by saltwater intrusion, a result from the natural brine seepage from the Arkansas River and as a by-product of past oil field activities. Recharging the aquifer would help prevent further water quality degradation and provide a large volume of stored groundwater for future use during dry periods.

The Department's existing water supply includes two well fields and a reservoir. These facilities are the Equus Beds Well Field, Local Well Field, and Cheney

Reservoir. **With all systems combined, the Department currently has a maximum daily supply capacity of 178 MGD.** In 2000, the Equus Beds Well Field supplied 32 percent; the Local Well Field, 7 percent; and Cheney Reservoir, 61 percent of the water. Prior to implementation of the ILWSP, the City received 60 percent of its water from the Equus Beds, 37 percent from Cheney Reservoir, and 3 percent form the Local Well Field.

Water use varies by year and throughout the year, with peaks typically occurring in summer. Long-term climatic cycles are the major determinant of annual water usage, while short-term fluctuations affect the peak demand in a given year. The maximum amount of water used in one day is a key factor in determining water production requirements and sizing of water treatment and transmission facilities. Average daily usage between 1960 and 1996 has ranged from a low of 24.9 MGD in 1960 to 64.2 MGD in 1990. The peak year for water use was 1991 when the maximum daily delivery by the Department was 125.7 MGD. In 1989, the total pumping and average daily use were the third highest on record. The maximum daily use in 1988 was the second highest at 112.3 MGD. Average daily and maximum daily demands both show increasing trends over the 36-year period.

The peak demand in 1991 would have been higher if not for the City implementing watering restrictions. This was due to a limited available supply caused by deteriorating physical conditions of the Equus Beds wells. Physical repairs and replacements to the Equus Beds wells were completed between 1992 and 1998.

Estimates of future water demands, based on number of anticipated users, consumption pattern, and water conservation, revealed a deficit would occur about the year 2016 for average day usage and the year 2026 for the maximum day usage. **The projected water demand by the year 2050 will be approximately 112 MGD for the average day and 223 MGD for the maximum day.** In 2050, the net water needs, which are the total water demand projections less the firm yield of potential water supply sources, will be 22 MGD for the average day and 28 MGD for the maximum day.

ALTERNATIVES

Twenty-seven water supply sources, both conventional and non-conventional, were identified for potential consideration. Of the 27 sources, 11 were considered viable; 3 water supply plans were developed from these sources. The three plans were: Milford Reservoir Plan, the ILWSP with 250 MGD Diversion Option, and the ILWSP with 150 MGD Diversion Option. These plans were required to meet two goals, 1) the demand for additional water and 2) provide protection to the Equus Beds aquifer's water quality. The Milford Reservoir Plan was eliminated from further consideration because it could not meet the established need to protect the Equus Beds aquifer.

Both of the ILWSP options include a component for recharging the Equus Beds aquifer, but further engineering studies were required to determine the best method. Therefore, the Department designed and implemented an aquifer storage and recovery (ASR) or recharge demonstration project. Results proved the capability of the ILWSP options to meet the goal of protecting the aquifer. Refinement of these two plans, based on information learned from the demonstration project and engineering studies, resulted in renaming the plans to ILWSP 150 MGD Diversion and ILWSP 100 MGD Diversion. Three alternatives—ILWSP 150 MGD, ILSWP 100 MGD, and No-action—were examined in detail for environmental impacts.

Both of the ILWSP alternatives contain the same components; however, the Equus Beds recharge and the Local Well Field (LWF) components include several options. The ILWSPs components are:

- Water Conservation
- Bentley Reserve Well Field
- Local Well Field Expansion
- Cheney Reservoir
- Equus Beds Aquifer

Conservation. The Department's current water conservation plan includes an inverted water rate for water use, a public education program, and an emergency operating plan with three action thresholds. It is clear that conservation by itself cannot meet the Department's future needs because, even with the inclusion of a 16 percent water demand reduction attributable to conservation, projection of future demand still indicated shortfalls of 28 MGD by the year 2050. **Because conservation was included in the projections upon which the 223 MGD need was established, conservation will be a necessary and integral part of any action taken to meet the Department's future water supply needs.** Additional activities proposed involve periodic review and modification of the inverted water rate structure; maintenance of watering restrictions; encouragement to use flow-restricting plumbing fixtures; restriction of lawn watering or car washing activities; and continuation of education program, leak detection surveys, meter repair and replacement, and cooperative efforts with industries.

Bentley Reserve Well Field. This well field, located adjacent to the Arkansas River and south of the town of Bentley, was developed in the 1956 and abandoned at a later date due to poor water quality. Redevelopment could supply up to 10 MGD of relatively high chloride water to blend with low chloride water from the Equus Beds well field and meet demands. The wells would be constructed adjacent to the Arkansas River and the City of Wichita's existing water transmission line. Design and construction could start in 2003 and end in 2004. Estimated costs for redevelopment, and annual operation and maintenance are respectively $1,250,000 and $26,000.

Local Well Field. Expansion of the LWF would use above base flow water from the Little Arkansas River and any leakage water from the Equus Beds aquifer. Water from both sources would be transferred directly to the City's Central Water Treatment Plant. New components include horizontal collector wells, vertical wells, support facilities, and collection pipelines. Wells would be located in northwest Wichita, along and above the confluence of the Arkansas and Little Arkansas rivers and along the Wichita-Valley Center Floodway. Collection piping for the lower section of the LWF has two options. Option 1 conveys diverted water from the wells south to Vertical Well 5 in the Central

Riverside Park area, where it is then routed through City property to the Central Water Plant. Option 2 conveys water to Vertical Well 3 near the northern boundary of Oak Park then to an existing 48-inch waterline for conveyance to the Central Water Plant.

Construction and design would start in 2004 and end in 2008. Estimated costs for the expansion, and annual operation and maintenance is $13,537,000 and $63,000, respectively.

Cheney Reservoir. Use of this existing surface water reservoir will continue with only administrative or procedural changes or modifications of facility capacities. With the new conjunctive use water right permit and larger capacity water withdrawal facilities at the dam in place, the City would be able to withdraw up to 80 MGD from the reservoir when there is water stored in the flood control pool (between elevations 1,421.6 and 1,429.0 feet). This will allow the City to capture more of the water that would otherwise be released downstream by the Corps, thereby reducing withdrawals from the Equus Beds aquifer. At surface water pool elevations below 1,421.6 feet, the maximum withdrawal rate from the reservoir will revert to its current flow rate of 47 MGD.

Equus Beds Aquifer Recharge and Recovery Component (ASR). Two alternatives were considered for the Equus Beds ASR component. Both alternatives have three options for capturing, pre-treating, and recharging ground and surface water with an additional option to capture, pre-treat, and transfer 60 MGD of surface water directly to the City's water treatment facilities. The primary difference between these alternatives is the amount of water that is diverted for storage. The following table shows the breakdown of the alternatives with options. The first number in the option title represents the amount of induced infiltration water for recharge and the second number represents the amount of surface water for treatment and recharge. For example, the 60/90 ASR captures 60 MGD of induced infiltration water for recharge and 90 MGD of surface water for treatment and recharge.

ILWSP 150 MGD Alternative	ILWSP 100 MGD Alternative
60/90 ASR Option	60/40 ASR Option
75/75 ASR Option	75/25 ASR Option
100/50 ASR Option	100/0 ASR Option

Both alternatives include a surface water intake, induced infiltration wells, and facilities to transfer and recharge the captured water to the Equus Beds aquifer, and to recover the stored water. A pre-sedimentation plant is proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment plants. The surface water intake structure would divert water from the Little Arkansas River to the pre-sedimentation plant for treatment. The pre-sedimentation plant will be located south of Sedgwick, Kansas, on the Little Arkansas River. The total area needed for the pre-sedimentation plant is estimated to be 29 acres. Treated water would then be conveyed to the well field or to the City's Water Treatment Plant, depending on the option chosen. Of the 37 to 41 total new recharge wells, 35 to 39 would be in Harvey County and 2 would be located in Sedgwick County. A 1.9-mile long, 48-inch diameter raw water pipeline would deliver water from the surface intake structure to the pre-sedimentation plant. The wells would be connected to a collector pipeline system consisting of an approximately 44-mile network of pipes ranging in diameter from 12 to 60 inches.

Approximately 53 to 42 induced infiltration wells will be installed along the Little Arkansas River, such that approximately half of the total diversion capacity is located above Halstead and the remaining one-half located between Valley Center and Halstead. The diversion system would only divert water when the flow in the Little Arkansas River at Halstead and Valley Center is above 40 cubic feet per second (cfs). Approximately four new horizontal collector wells and five new vertical wells will be located just upstream of the mouth of the Little Arkansas River, within the city limits of Wichita. Operation of these wells will be restricted to flows greater than 20 cfs.

The alternatives are scheduled for implementation over several years to facilitate planning and administrative needs, project funding, engineering, permitting, land acquisition, and construction. The implementation for each of the three options is very similar. Each option's implementation has four phases with the exception of the 100/50, which has five phases. Phases 1-3 are basically the same for each option. They differ only in the number of recharge wells and basins, in the amount of piping, and in the capacity and number of induced infiltration wells required. Phase 4 of the 100/0 ASR and 100/50 ASR option contains several additional tasks similar to Phase 3. Phase 5 of the 100/50 option contains the same tasks as Phase 4 for the 60/90 and 75/75 options.

The estimated construction costs for the ILWSP 150 MGD alternative range from $334 to $312 million (2000 dollars) depending on which option is used and whether 60 MGD is diverted to the City's Water Treatment Plant. Annual operation, maintenance, and energy (OMR&E) costs are estimated to range from $6.82 to $5.24 million (2000 dollars) depending on which option is used and whether 60 MGD is diverted to the City's Water Treatment Plant (2000 dollars).

The construction costs for the ILWSP 100 MGD alternative is estimated to range from $307.0 to $283.5 million depending on which option is used and whether 60 MGD is diverted to the City's Water Treatment Plant. Annual OMR&E costs are estimated to range from $5.82 to $3.50 million depending on which sub-option is used and whether 60 MGD is diverted to the City's Water Treatment Plant.

Under the **No-action** alternative, no permits would be issued; therefore, no new facilities to provide additional drinking water could be constructed. If No-action were taken, the existing water supply sources would be unable to meet the maximum daily needs for the expected future growth of metropolitan Wichita. Without additional capacity, the Department would be required to limit new customers as much as possible by not providing water to customers outside its present service area boundaries. This action would limit, but not completely stop, growth in demand because the Department is required by statute to serve new customers within its service area boundaries. Eventually, the Department would not be able to maintain system pressure during maximum use periods.

ENVIRONMENTAL CONSEQUENCES

The **ILWSP –150 MGD Alternative** would not affect land resources such as the general setting and geology. A total of 91 acres of prime farmland would be removed from potential agricultural production for the life of the project. However, this impact is not considered significant given approximately 770,000 acres of Harvey and Sedgwick counties, where most of the prime farmland would be affected, are classified as prime farmland. A total of 360 acres of land would be taken out of agricultural production for the life of the project. This impact would not be significant because approximately 880,000 acres of land in Harvey and Sedgwick counties are used for agriculture.

Slight, temporary increases in already turbid rivers and streams could occur from installation of the surface intake structure at the Little Arkansas River, installation of transmission pipelines crossing other smaller streams, and from stormwater runoff during construction of the other project facilities.

Recharge to the Equus Beds aquifer would increase aquifer water storage thereby raising the groundwater level. Wetlands currently affected by lower groundwater levels may experience renewal. An insignificant amount of crops, hayfield, and pastures, and upland forests, would be lost for the life of the project because of the installation of project facilities. These losses of vegetation are not expected to significantly impact wildlife.

Surface water flows of the Little Arkansas River would increase for both median and low flows, except during May and June when the recharge system is expected to operate more frequently and at higher diversion rates. During these two months, median flows would decrease by 20 to 44 cfs but would still be greater than the historic median flows in the other 10 months.

The ILWSP 150 MGD alternative would not affect current trends in human population or economic growth, significant cultural resources, or hazardous waste sites. The aesthetics of the pre-sedimentation plant site and the well field would be disrupted by project facilities.

Impacts from the **ILWSP 100 MGD Alternative** would be similar to the ILWSP 150 MGD alternative because the two alternatives would have the same pre-sedimentation plant, and much of the same transmission pipeline routes. A total of 65 acres of prime farmland would be removed from potential agricultural production for the life of the project; however, this impact is not considered significant given approximately 770,000 acres of Harvey and Sedgwick counties, where the prime farmland would be affected, are classified as prime farmland. A total of 310 acres of land would be taken out of agricultural production for the life of the project. This impact would not be significant given that approximately 880,000 acres of land in Harvey and Sedgwick counties are used for agriculture.

Similar to the 150 MGD alternative, the 100 MGD alternative would reduce median flows in the Little Arkansas River during May and June. These are the two months with the highest historic flows and the months when the recharge system is expected to operate more frequently. The magnitude of these reductions would be 20 to 44 cfs. The other ten months of the year, implementation of this alternative would actually increase median and lower flows.

Because no construction activity would occur, the **No-action** alternative would not adversely impact natural resources. However, continued used of the Equus Beds aquifer at the current rate would diminish the quantity and quality of the water. As the water level in the aquifer declines, the threat of saltwater intrusion rises, therefore increasing the potential for contamination of the aquifer. The No-action alternative would require the Department to stop expanding its service area. This would tend to slow residential and business development in areas outside the Department's current service area. As a result, the current rate of the conversion of farmland and the filling of wetlands that result from suburban development also would be slowed. The population inside the Department's service area would continue to grow for some time. Eventually, peak-day water shortages would become more frequent and current trends of increasing population growth, economic expansion, and tax revenues would slow as a result of declining quality of life, discouraged in-migration, and encouraged out-migration.

MITIGATION

Impacts to surface water quality from erosion caused by construction site stormwater runoff would be minimized by the implementation of Stormwater Pollution Prevention plans as required by the Kansas Department of Health and Environmental under the National Pollution Discharge Elimination System program. These plans would detail the erosion control practices such as silt fences, sedimentation ponds, and rapid regrading and reseeding that would be used at each construction site.

MAJOR CONCLUSIONS

Major conclusions of the EIS are based on the impacts and/or benefits to the environment resulting from the proposed project. The goals of the proposed project are to meet the need for an additional 28 MGD of peak day production capacity to meet anticipated demands through the year 2050 and to provide protection to the Equus Beds aquifer from saltwater intrusion. The calculation of need included an assumption that 16 percent of future demand could be met by water conservation.

- The applicant's preferred alternative is the ILWSP – 100 MGD Alternative with the ASR 75/25 option.

- The induced infiltration wells, located along the Little Arkansas River, will be operated only when the discharge in the Little Arkansas River exceeds 40 cfs from April through September at Halstead and Valley Center and 20 cfs from October through March within the city limits of Wichita. The number of wells operating concurrently will vary depending on the flow in the river. The wells will be operated slightly less than half of the time and periods with all wells running would range from 11 to 15 percent of the time.

- Changes in the flow regime of the lowest reaches of the Little Arkansas River would be significant at low to intermediate flows. The collector wells associated with the Local Well Field expansion would be capable of limiting the discharge at the mouth of the river to 20 cfs, 78 percent of the time. This low flow should be sufficient to sustain the current habitat and use of this section of the river.

- Surface diversion from the Little Arkansas River will occur only on an "as available" basis from above-base flows. Therefore, the optimum discharges and maximum available habitat for fish species will still be reached and the critical threshold for fish species habitat and recruitment in the river will not be threatened.

AREAS OF CONTROVERSY

There are no known areas of controversy at this time.

ISSUES TO BE RESOLVED

Develop a Hydrobiological Monitoring Plan in association with FWS and KDWP to accurately document specific impacts.

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ACRONYMS

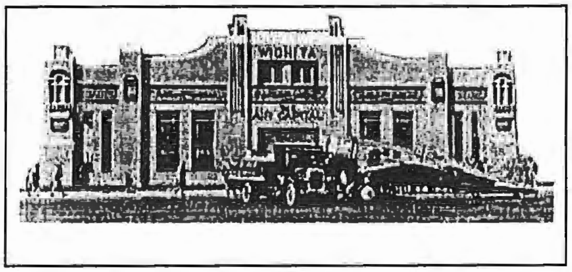
CBWA	Cheyenne Bottoms Wildlife Area
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
E&S	Emergency and Sim
gpcd	gallons per capita per day
gpd	gallons per day
HUD	Housing and Urban Development
IGUCA	Intensive Groundwater Use Control Area
ILWSP	Integrated Local Water Supply Plan
KAR	Kansas Administrative Regulation
KDHE	Kansas Department of Health and Environment
KDWP	Kansas Department of Wildlife and Parks
KWO	Kansas Water Office
MAPD	Metropolitan Area Planning Department
MDS	Minimum Desirable Streamflow
MGD	million gallons per day
mg/l	milligram per liter
msl	mean sea level
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NWI	National Wetlands Inventory
NO_x	nitrogen oxides
OBERS	U.S. Department of Commerce – Bureau of Economic Analysis
OMR&E	Operation, Maintenance, Replacement, and Energy
O_3	ozone
Pb	lead
QNWR	Quivira National Wildlife Refuge
PM_{10}	particulate matter smaller than $10\mu m$
RESNET	Reservoir Network, computer program
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SO_2	sulfur dioxide
SWQUA	Special Water Quality Use Area
USBOR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds

CHAPTER 1

PURPOSE AND NEED

1.1 INTRODUCTION

In 1993, the City of Wichita, Kansas, completed a comprehensive master plan for community development. This study evaluated water, sewer, storm water, solid waste systems, fire protection, transportation, law enforcement, schools and libraries, medical services, parks, housing neighborhoods, land use planning, community appearance and historic preservation through the year 2010. Using this information, the City conducted a water supply study in 1993 to evaluate future water demands and possible water sources available to meet that demand. These studies projected growth in the city and surrounding county and provided information to plan facilities necessary to maintain and improve the quality of life and encourage future economic development in the Wichita area.



Historically, the City's mix of water sources has been heavily dependent on groundwater, particularly from the Equus Beds aquifer. During the last 60 years, withdrawal of water from the Equus Beds aquifer for agricultural, industrial, municipal, and domestic use has exceeded recharge. As a result, the water table dropped as much as 50 feet in some areas from the predevelopment level and saltwater contamination from natural and manmade sources to the north and west is moving into the aquifer because of the change in groundwater flow directions. Water quality degradation is currently occurring in the well field and surrounding areas. Groundwater in areas near the Arkansas River have been seriously degraded and the saltwater has the potential to degrade the well field to a level where the water would not be suitable for some existing agricultural uses. Recharging the well field area will reduce future deterioration of the aquifer's water quality by slowing or preventing migration of the saltwater into the well field and assures water availability, especially during extended dry weather periods. Therefore, another goal of any new water development project is the protection of the aquifer's water quality, in addition to the replenishment of the Equus Beds aquifer.

Specifically, this chapter characterizes the anticipated need for an expanded water supply system for the City of Wichita and includes information on historical water use, existing supply and demand, and projections of future water demand and water conservation. Included is a description of the net water needs for the metropolitan area to the year 2050. This chapter includes: a statement of the purpose of and need for the proposed action; the location of the proposed action; a statement of the decision to be made; a summary of the environmental review; a statement about the applicable regulatory requirements; and a description of the organization of this environmental impact statement (EIS).

1.2 PURPOSE

The purpose of the proposed project is to provide a reliable supply of potable water to the customers of the City of Wichita Water Service Area (Service Area) through the year 2050, which requires delivering water to a growing population and service area. In developing the plans for a larger supply, the City of Wichita Water and Sewer Department (Department) used population and water use projections to determine future water demands. This information was used in turn to determine the necessary water system expansions or additions needed to accommodate the increased demands. These water demands can be met by increasing water system capacity, expanding the use of existing water sources or by developing new water supplies. The project is intended to provide a firm reliable water supply to meet either the average day[1] or the maximum day[2], or peak demand, within the Service Area through 2050.

If groundwater levels remain at their current levels or decline further, the Equus Beds will continue to be contaminated by saltwater intrusion.

1.3 NEED

The City of Wichita's current water service population is approximately 348,000, of which about 32,000 people are served outside the city limits. To meet its future responsibilities, the Department initiated a water supply study in 1993. This study compared projected future water demands with existing raw water supply and system capacity, and found that water supply shortfalls during extended dry weather periods could begin occurring by 2016 for the average day supply, and by 2026 for the maximum day supply. The projected water needs for the Department for the year 2050 are as follows:

- Average day demand of 112 million gallons per day (MGD) and
- Maximum day demand of 223 MGD

Implementation of water supply plans to provide these projected water needs may require up to 15 years of lead time to complete planning, permitting, design, construction, start-up and operational activities. As a result, if system improvements or additions are to be undertaken, the timing of the analysis, planning and approval process required for implementation becomes more urgent.

In addition to the projected water needs for the Service Area, there is also the need to protect the principal groundwater supply source for the City of Wichita from saltwater intrusion. This source is the Equus Beds Well Field. If groundwater levels remain at their current levels or decline further, the Equus Beds aquifer will continue to be contaminated by saltwater intrusion. This saltwater intrusion will result from the natural brine seepage from the Arkansas River drainage and as a by-product of past oil field activities, which will affect both water for agricultural uses and the City of Wichita's drinking water supply (Burns & McDonnell, 1993). Recharging the Equus Beds aquifer would help prevent further water quality degradation and provide a large volume of stored groundwater for future use during drought

[1] *Average day demand* – total amount of raw water used in a calendar year divided by number of days.
[2] *Maximum day demand* – highest raw water demand on a given day in a calendar year; usually occur in July or August.

conditions for both the City and the agricultural community.

The following section provides background information on the City's facilities, existing water supply and demand, conservation programs, and water use projections. These are the components that form the basis for defining the City's future water supply requirements.

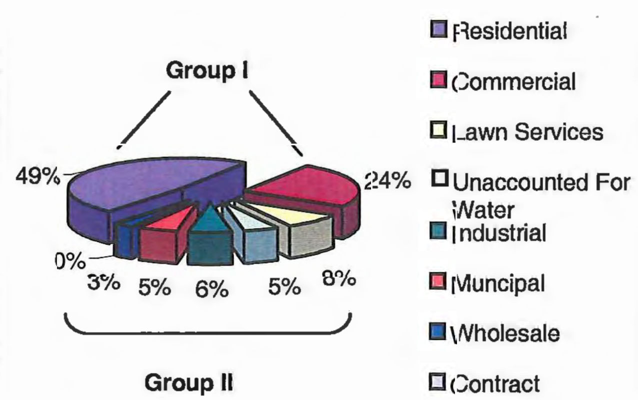
1.3.1 CURRENT SYSTEM - CITY OF WICHITA WATER & SEWER DEPARTMENT

The City of Wichita Water and Sewer Department is the water supply entity of the city government. The City currently supplies water to 124,000 residential and commercial customers within the city limits of Wichita, and to 10 wholesale customers and several residential/commercial customers outside the city limits. The City also provides water to the Cities of Bentley (untreated water only), Andover, Benton, Bel Aire, Eastborough, Kechi, Oaklawn, Rosehill, Park City, Sunview, Valley Center, Sedgwick County Rural Water District #1, and Butler County Rural Water District #8.

1.3.1.1 Existing Demand

In 1999, the average day water demand in the service area was 55.2 MGD and the maximum day water demand was 115.4 MGD. During the year, water use was distributed as follows: 49 percent by residential customers, 24 percent by commercial customers, 6 percent by industrial customers, 3 percent by wholesale customers and 18 percent by all other customer classifications, including lawn service, fire protection, contract, municipal, water utility and unaccounted-for water (Figure 1-1). Group I customers (residential and commercial) accounted for the majority of the water used, at 73 percent. Group II customers (industrial, wholesale, and all other) accounted for the remaining water used at 27 percent. The service area boundaries for 1999 and the projected 2050 growth areas are shown in Figure 1-2.

Figure 1-1 1999 Water Distribution by Customer Type



1.3.1.2 Existing Water Supply Facilities

The City maintains water supply, treatment, distribution and storage facilities to serve its customers. The existing water supply sources include: the Equus Beds Well Field, located approximately 25 miles northwest of Wichita; the Emergency & Sim (E&S) Well Field also referred to as the Local Well Field, located next to the Water Treatment Plant in Wichita on the north bank of the Arkansas River; and Cheney Reservoir, located 20 miles west of Wichita (Figure 1-3). The existing water treatment plant for Wichita's Service Area is the Water Treatment Plant, located near the confluence of the Arkansas and Little Arkansas River in downtown Wichita.

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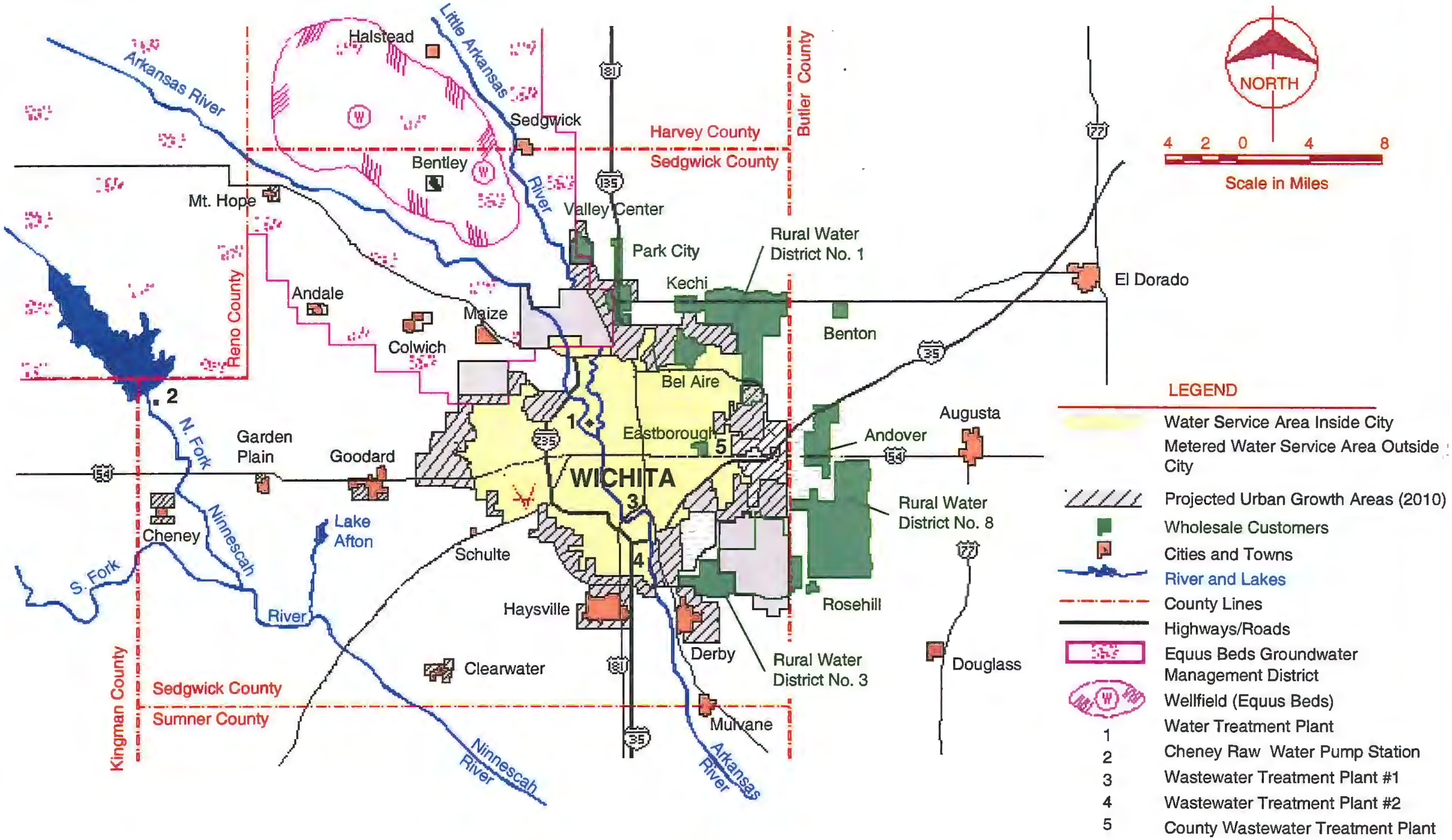
Figure 1–2 Water System Service Area



Note: Projected growth areas from information provided by the Wichita-Sedgwick County Metropolitan Area Planning Department

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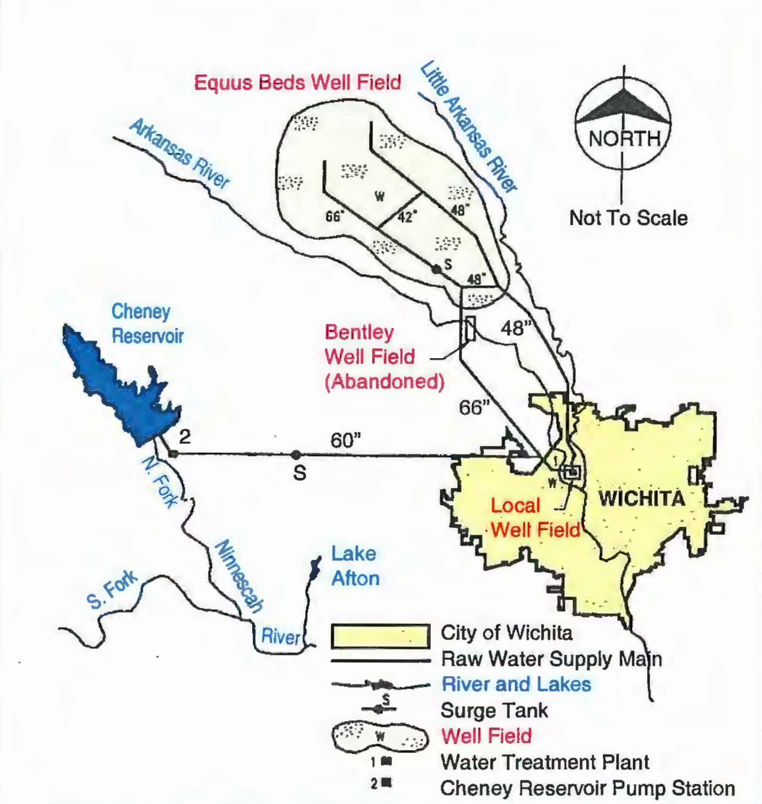
Figure 1-3 Raw Water Supply System Schematic



The existing Equus Beds Well Field contains 55 wells which draw groundwater from the High Plains aquifer system. Twenty-five wells were initially constructed in the late 1930's, and another 30 wells were added in the 1950's. Current water rights[3] allow the City of Wichita to pump at an average day rate of 35.7 MGD and a maximum day rate of 78.1 MGD. Existing pumping and pipeline facilities are capable of delivering 65 MGD to the treatment plant with the current hydraulic configuration. Prior to 1993, the City obtained about 60 percent of this water from the Equus Beds Well Field to meet the water demand; in 1994 the City decreased Equus Beds groundwater use to 40 percent and increased the use of surface water.

The 16 existing wells in the Local (E&S) Well Field pump alluvial water from the Arkansas and Little Arkansas rivers within the city limits of Wichita. These wells were originally constructed in 1949 and 1953. Current water rights allow the City of Wichita to pump wells within the Local Well Field at an average day rate of 5.8 MGD and a maximum day rate of 37.1 MGD.

During the 1950's drought, the Department developed several wells 22 miles northwest of the City of Wichita along the Arkansas River, which were referred to as the Bentley Reserve wells. Six wells were constructed in 1956 to provide a maximum of 13 MGD of additional water during a drought. Water produced from these wells was high in chlorides; the wells were subsequently abandoned due to poor water quality and the water rights were dismissed.

Cheney Reservoir was built in the early 1960's as an additional water supply for the City of Wichita. It was built in cooperation with the U.S. Bureau of Reclamation (Reclamation). The City of Wichita currently has water rights for an average day rate of 47 MGD and a maximum day rate of 120 MGD. The reservoir was originally designed to

[3] *Water rights* – Kansas Department of Agriculture, Division of Water Resources administers water rights in Kansas and permits annual quantities and the maximum rate of diversion.

provide a firm yield[4] of 47 MGD, however, several years of severe drought in the 1950's caused Reclamation to recalculate the firm yield at 38.2 MGD. In 1998, the City of Wichita procured a second reevaluation and that yield study determined a firm yield of 43.7 MGD. The City expanded the Cheney Reservoir pumping station in 1996 so that a firm pumping capacity of 80 MGD could be attained. Additional water can be pumped when lake levels are higher than an elevation of 1,420 ft mean sea level. The total pumped from the Equus Beds and Cheney Reservoir is restricted to 92,638 acre-feet/year. Prior to 1993, the City used about 40 percent surface water from Cheney Reservoir to meet the water demand; then in 1994 the City increased use of Cheney Reservoir surface water to 60 percent.

The American Waterworks Company, a private entity, constructed the City's original water facilities in 1886. The City constructed the Water Treatment Plant in 1940 and purchased the distribution system in 1957. The treatment plant was expanded in 1995 and currently has a maximum day production capacity of 160 MGD.

Pipelines of various diameters deliver water from the three current water supply sources to the Water Treatment Plant (Figure 1-3). Water pumped from the Equus Beds is transferred to the treatment plant through 48-inch cast iron and 66-inch concrete pipelines that are connected via cross-ties. Water is pumped from Cheney Reservoir to the treatment plant via a 60-inch diameter concrete pipeline. Water pumped from the Local (E&S) Well Field is transferred to the treatment plant through a 24-inch pipeline. Hydraulic capacities for the existing raw water pumping, transmission and treatment facilities are listed in Table 1- 1.

Table 1-1 Facility Capacities

Facility	Existing Capacity	Maximum Capacity
Cheney Reservoir Raw Water Pump Station	80 MGD	80 MGD
Cheney Reservoir Raw Water Transmission Piping	80 MGD	80 MGD
Equus Beds Well Field/Transmission Piping	65 MGD	72 MGD
E&S (Local) Well Field/Transmission Piping	30 MGD	30 MGD
Water Treatment Plant	160 MGD	160 MGD

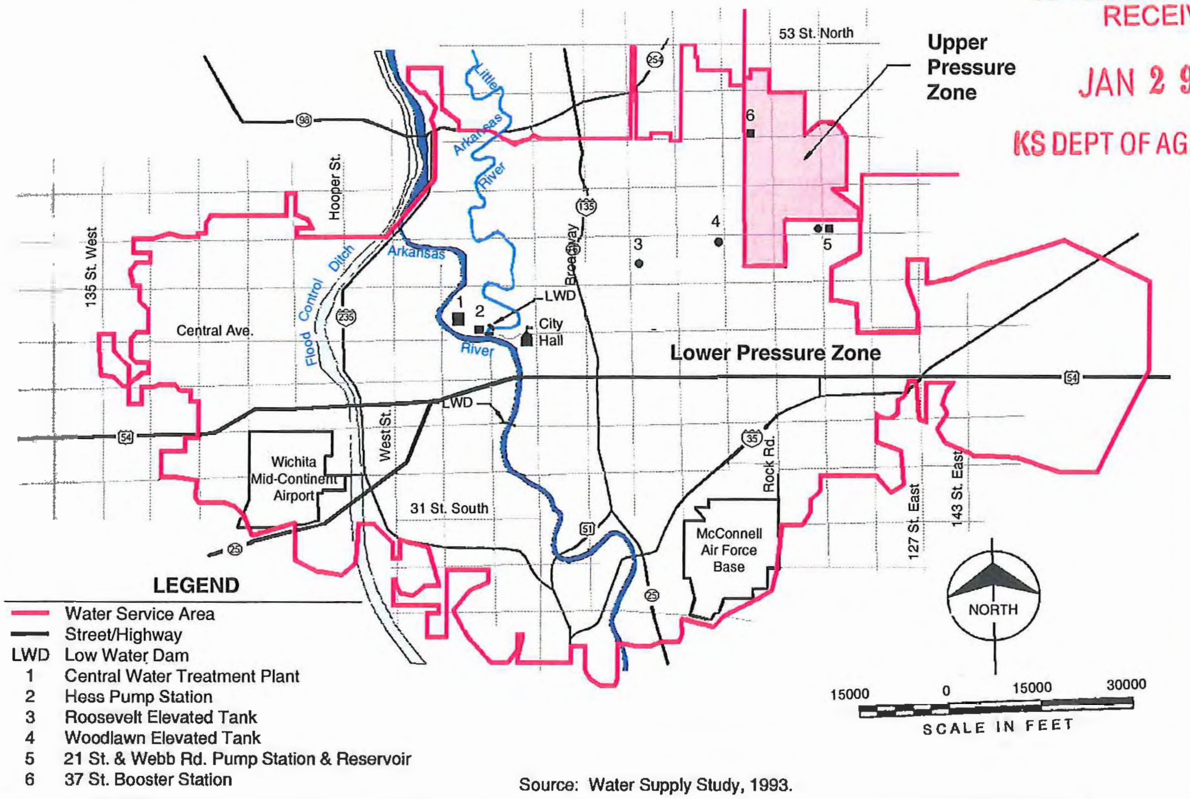
The City's current water delivery system transports water from the Water Treatment Plant to pumping stations and storage tanks throughout the Wichita metro area (Figure 1-4). The Hess Pumping Station is the primary facility distributing water to the Service Area. It is located adjacent to the treatment plant. The Hess Pumping station contains eight pumps which have a total pumping capacity[5] of 236 MGD and a firm capacity[6] of 200 MGD. Other pumping

[4] *Firm yield* - yield of reservoir during most severe drought of record.

[5] *Total pumping capacity* – summation of capacity with all units working.

[6] *Firm capacity* – capacity with largest unit out of service, in large number of units – 10% out of service for planning purposes.

Figure 1-4 Existing Water Distribution System Major Components



stations are located in the northeast portion of the city to maintain adequate water pressure and accommodate peak day demand. There are also two above ground storage tanks. One storage reservoir is also located in the metro area (Figure 1-4).

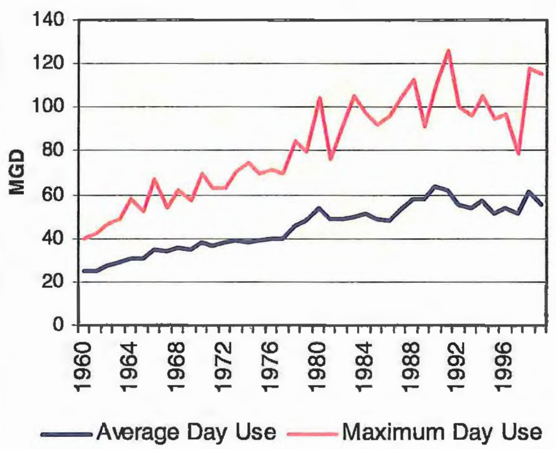
1.3.2 HISTORIC WATER USE

Water use varies by year and throughout the year, with peaks typically occurring during the summer. Long-term climatic cycles are the major determinant of annual water usage, while short-term climatic fluctuations affect the peak demand in a given year. Figure 1-5 shows the historical water production for the City of Wichita in terms of average daily and maximum daily production for the Department's service area from 1960-1999. The maximum amount of water used in one day is a key factor in determining water production requirements.

Average daily usage between 1960 and 1996 has ranged from a low of 24.9 MGD in 1960 to 64.2 MGD in 1990 (Figure 1-5). The peak water use day was in 1991, at 125.7 MGD. The peak demand would have been higher if not for the City implementing watering restrictions. This was due to a limited available supply caused by deteriorating physical conditions of the Equus Bed wells. Physical repairs and replacements to the Equus Bed wells were completed between 1992 and 1998. The maximum daily use in 1998 was the second highest on record at 117.4 MGD. In 1989, the total pumpage and average daily use were the third highest levels on record. Average daily and maximum daily demands show increasing trends over the

36-year period of record as population and customers increased.

Figure 1-5 Historical Water Use



Review of annual usage from 1970 to 1998 shows Groups I and II have been steadily increasing. Since 1970, unaccounted-for water[7] (UAF) ranged from 0 percent to 12 percent. Percentages below seven percent are considered not easily attainable and are caused by inconsistencies associated with reading meters every two months and other data collection/entry errors. The City staff believes that a realistic range for UAF is 11 percent to 13 percent. Since July 1992, meters are read on a monthly basis. Meter rehabilitation and replacement programs began in 1970 to help reduce UAF. As a result the UAF has declined to 8 percent since enactment of these programs.

The City has completed annual leak detection surveys since 1991. One hundred to 225 miles of pipe are surveyed each year. Also, water treatment facilities are operated to minimize water losses through recycling of the water used to clean filters and screens and other water treatment processes.

The City uses public awareness and education programs to encourage water conservation practices. These include local talks to school children, water conservation booths at various local events, development of demonstration projects in landscaping irrigation, and radio and TV commercials. In addition the City also uses an inverted rate structure to promote water conservation, which is discussed further in Chapter 2.

1.3.3 PROJECTED DEMAND

Estimating future water demand depends on the number of anticipated users, their consumption pattern, and efforts to reduce consumption through conservation. This section provides the basis for the projection of water demands through 2050 for the City's expanding service area. The year 2050 provides a 50-year planning horizon for the City.

Future demands for water were based on several sets of population projections.

1.3.3.1 Population and Customer Projection

The City of Wichita's water service area is slightly larger than the city limits of Wichita and smaller than Sedgwick County and the metropolitan statistical area. Population data for the City includes the area defined by the city limits. Population data for Sedgwick County includes the area defined by the

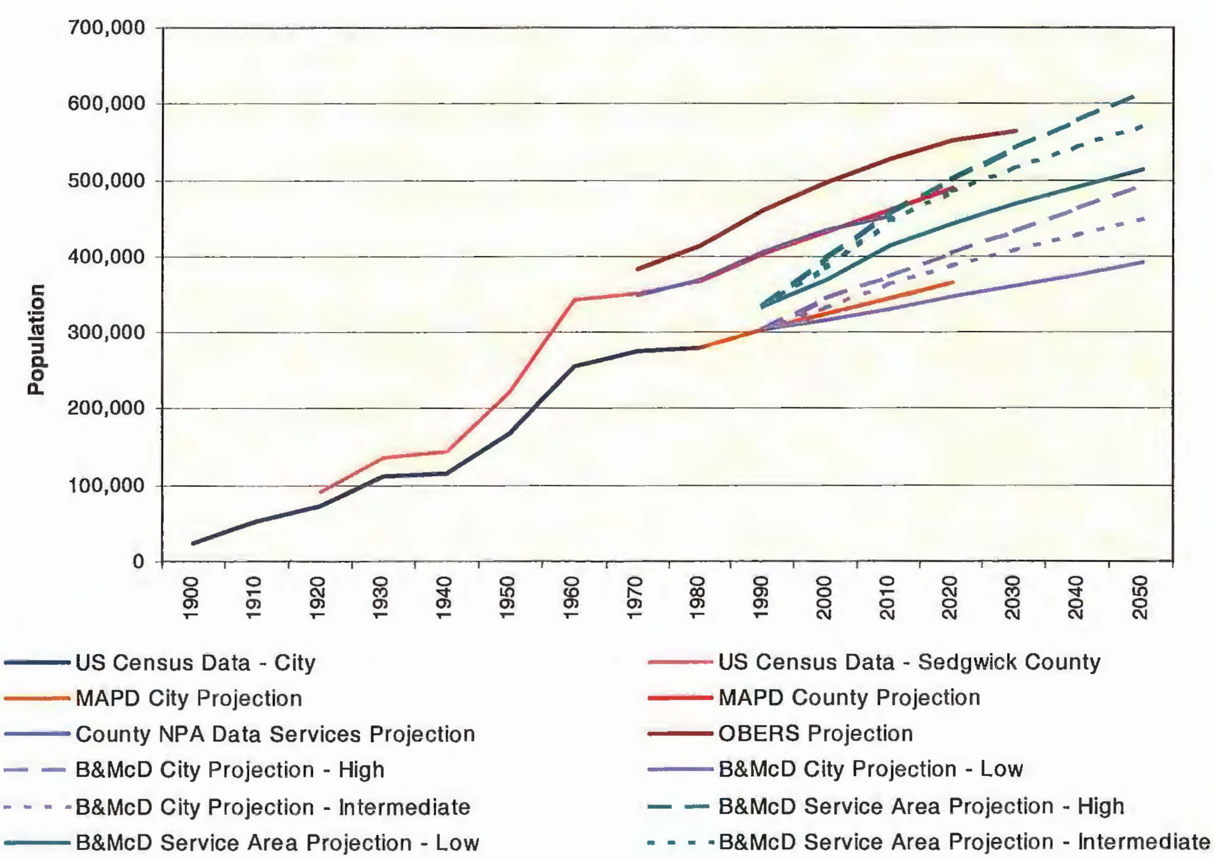
[7] *Unaccounted-for water* - treated water that is lost in the system because of pipe leakage, inaccurate meters and unaccounted-for uses.

Estimating future water demand depends on the number of anticipated users, their consumption pattern, and efforts to reduce consumption through conservation.

county boundary. Population data for the statistical metropolitan area includes the City of Wichita, in addition to the remaining areas in Sedgwick County and adjoining Butler County. Population projections for the water service area were developed from U.S. Census Bureau data, Wichita water department customer data, U.S. Department of Commerce – Bureau of Economic Analysis (OBERS) data, Wichita-Sedgwick County Metropolitan Area Planning Department (MAPD) studies and engineering studies by others (Figure 1-6). Projections include consideration for the availability of land, water, and sewer systems, current and future transportation plans, zoning, area topography, and socioeconomic factors.

According to the 1990 U.S. Census, the total population of Sedgwick County was 403,662. That total represented an increase of 37,131, or 10 percent, from 1980. Population growth nationally from 1980 to 1990 was 9.8 percent. During

Figure 1-6 Population Projections



the same time period the 1990 population for the City of Wichita was 304,011, up 24,739 from 1980 U.S. Census estimate, an increase of 8.9 percent. Future demands for water were based on several sets of population projections. MAPD, a technical planning assistance agency serving the Wichita metropolitan area in Sedgwick and Butler counties, prepared one set of projections. These projections were developed considering birth, death, and migration rates. The population in 2020 for the City of Wichita was predicted by MAPD to be 365,688, and for Sedgwick County, 489,363.

Burns & McDonnell (1997) developed population projections through the year 2050 for the City of Wichita and its service area (Figure 1-6). These projections were developed at high, low and intermediate estimates. High range estimates were developed using a linear regression of population data from 1950 to 1990, and low range estimates were made using data from 1960 to 1990.

An OBERS (1985) population projection for the statistical metropolitan area for the year 2035 is 574,200 (Figure 1-6). Evaluations of the upper and lower range estimates (Burns & McDonnell 1997) with the OBERS projection, MAPD (1996) study, and projections by other studies, show the population increasing by an average of 3,000 people per year (1,280 residential connections) to the year 2015 and then by 2,000 people per year (910 residential connections) from 2016 to 2050. This projection would result in a year 2050 city population of about 448,000.

In addition to the City of Wichita's residential population, the projected service area also includes existing and anticipated wholesale customers and individually metered customers outside the city limits. Figure 1-7 shows the projected population growth for the wholesale and individually metered customers outside the city limits (existing wholesale category) increasing from approximately 31,000 in 1990 to 54,000 in 2050.

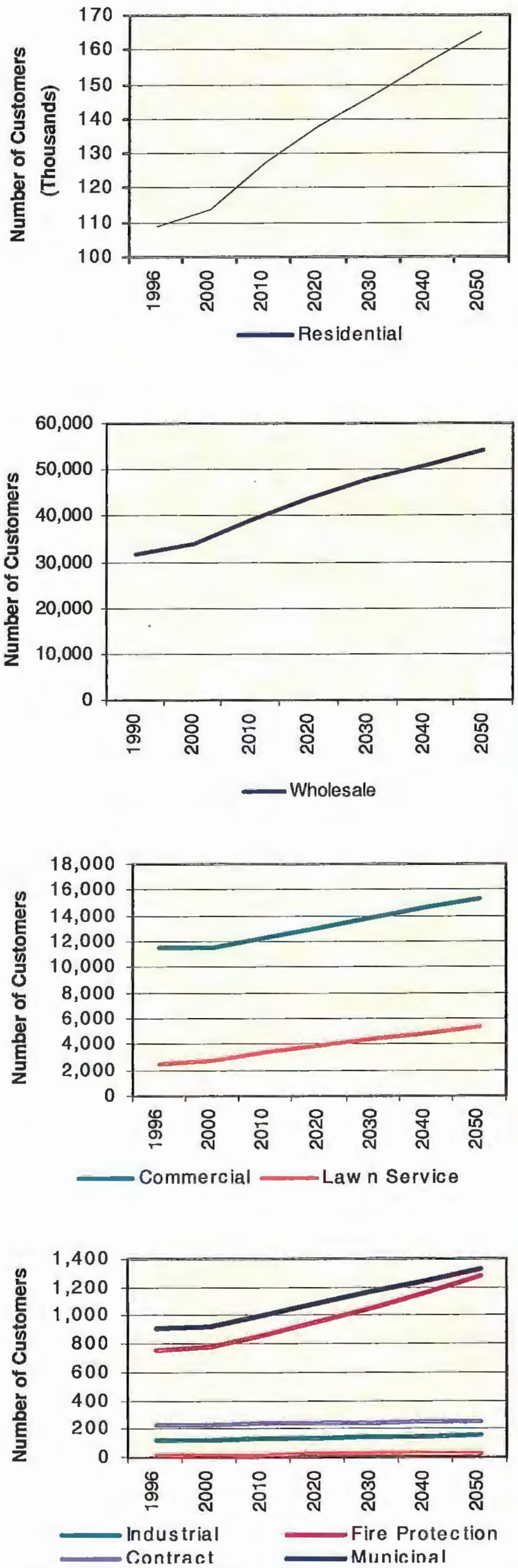
Anticipated wholesale customers include additional town/areas in Sedgwick County not currently served by the Department's water system. These areas include Mt. Hope, Andale, Cheney, Garden Plain, Goodard, Clearwater, Haysville, and Derby (Figure 1-2). Connection of these customers to the system would add about 68,000 people to the year 2050 projected service area.

The City developed a service area customer and water usage projection computer model to help forecast the number of customers, usage and water conservation savings by customer class to the year 2050. Historical data included in the model from 1970 to 1996 shows recent trends in customer growth, gallons per meter day usage, and average day and maximum day usage. Customer data from 1970 to 1996 used in this analysis and customer projections by the model are shown in Figure 1-7. Residential customers are expected to increase between 1996 and 2050 by approximately 56,200, or about 52 percent. Total customers are expected to increase during the same time period by approximately 63,918, or about 51 percent.

1.3.3.2 Water Projections

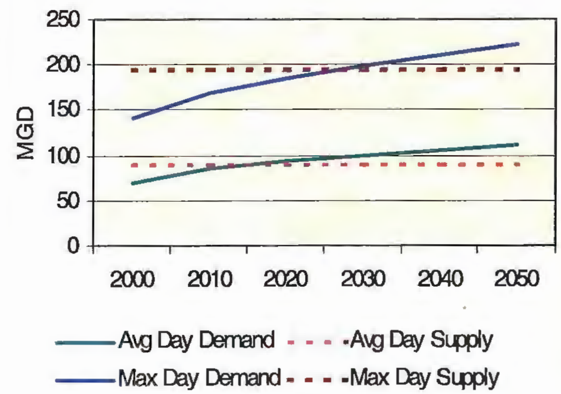
A review of the existing water supply sources, and water delivery and treatment facilities showed that sufficient firm capacity was present to meet average daily demands to the year 2016

Figure 1-7 Customer Projections



(Figure 1-8). Shortfalls in meeting maximum daily demand are expected in 2026 (Figure 1-8).

Figure 1-8 Projected Water Needs



According to industry standards, water sources and water supply facilities such as intakes, wells, and treatment plants should be sized to supply the customers' anticipated maximum daily demand. Without reliable water supply sources and facilities capable of meeting the maximum daily demand, water deficits would occur, resulting in low system pressures, inadequate flows for fire fighting, and inadequate supply for drinking and other purposes.

Average Day Demand. Projections of average day demand were based upon projected population estimates of the residential portion of the service area to the year 2050 multiplied by the projected gallons per meter-day for year 2050. Gallons per meter-day was used in place of gallons per capita-day as a means of estimating changes in consumption resulting from population changes because of the number of classifications within the City's water systems. Average meter use was projected to increase to 300 gallons per meter-day in 2050, up from 223 in 1996. Customer growth was based on an average of 1,040 new customers per year between 1997 and 2050. Approximately 1,280 new customers per year are expected between 1997 to 2015 and 910 new customers per year between 2016 to 2050.

Based on a conservation goal of 16 percent, the average day usage in year 2050 would be 112 MGD and the maximum day usage would be 223 MGD.

Table 1-2 illustrates the total average and maximum day projected use in 2050 with and without water conservation for the service area. Projected demands include water for residential, commercial, wholesale customer classifications and unaccounted-for water.

Maximum Day Demand. As indicated above, a reliable water system should be capable of meeting maximum day demand to provide an adequate water supply essential for public services related to health and human safety (i.e. firefighting and sewage treatment). Projections of maximum day demand for residential customers were based upon multiplying demand factors of 2.14, 2.0, and 1.8 representing no conservation level, low conservation level and high conservation level respectively, by the projected average day demands. A value of 2.0 was used for planning purposes. Demand factors are the ratio of a specific year's highest maximum day use to annual average day use. The maximum day water demand was intentionally controlled by the Department in 1990 and 1991 through water restrictions and limited pumping of water to water plant storage. Table 1-2 shows the maximum day water demand projections with and without water conservation.

1.3.4 WATER CONSERVATION MEASURES

One factor that can affect water demand is conservation. The degree of water conservation achieved is influenced largely by the amount of emphasis a city places on water conservation, including enforcement activities during dry periods. Two levels of conservation are considered in this study for planning

Table 1-2 Average and Maximum Day Water Demand Projections

	Estimated Service Area	Avg. Day Demand (MGD)			Max. Day Demand (MGD) (2.0 factor)		
		Conservation Level			Conservation Level		
Year	Population	None	Low	High	None	Low	High
2000	385,694	88.0	70.4	57.6	176.1	140.9	115.1
2010	445,652	101.2	84.6	70.4	202.3	169.1	140.9
2020	484,825	110.9	92.8	77.8	221.7	185.5	155.6
2030	516,080	118.6	99.4	83.8	237.2	198.8	167.6
2040	543,760	126.0	105.7	89.4	252.0	211.3	178.9
2050	570,260	133.0	111.6	94.7	265.9	223.1	189.5

purposes, a low range and a high range. The low range conservatively estimates potential savings from conservation activities and more closely reflects case studies by other cities (Lehman, 1991 and Featherstone, 1991). The high range estimates potential savings from conservation activities based on theoretical values.

Low range water conservation is anticipated to reduce demand by approximately 16 percent while high range conservation is anticipated to reduce demand by approximately 29 percent. Literature on water conservation indicates that 15 percent conservation is an obtainable goal for most cities and could be a reasonable goal for the City of Wichita (Schlette, 1991). Based on a conservation goal of 16 percent, the average day usage in year 2050 would be 112 MGD and the maximum day usage would be 223 MGD.

Programs Currently in Use. The City has implemented a variety of conservation measures, such as limiting lawn watering to two days a week during drought conditions, conducting leak tests, and repairing or replacing meters on an eight-year basis. There are also a variety of public awareness and education programs in place to promote water conservation to consumers. The City gives talks to students approximately once a month or 12 to 15 times a year on water conservation. Water conservation booths are presented at the Home Show each year, as is an interactive booth with display boards at the yearly Earth Day Celebration. The City also provides brochures and articles for local newspapers. Currently under construction is a water well interpretive area to teach people about groundwater. In addition, the City has prepared radio and television commercials and has sponsored local events such as the Drum and Bugle Corp. The City continues to encourage local industries to implement conservation measures.

An inverted water rate structure was initiated January 1, 1993. This rate structure system is designed to encourage water conservation by providing lower water costs to customers using less water. These potential water savings would be considered economically significant to the City of Wichita. In order to obtain significant reductions in customers' annual water use, and more efficient use of Wichita's water resources, the Director of Water and Sewer is empowered to negotiate and execute contracts with retail customers which provide for a significant annual water savings by customers in return for charging all water use at the retail volume conservation contract rate. Customers seeking to qualify for the conservation contract rate must make written application detailing methods to conserve water, time frame for implementing methods, and the expected annual water savings. Each year, customers report the results of their conservation initiatives. If the goals were not met then the customer must reconcile charges for the proportion of the customer's prior year total annual consumption volume that did not qualify for the conservation rate. Customers exceeding their water conservation goals may use such excess savings as credit toward the next year's water savings goal.

Programs to be Implemented in the Future. Programs under consideration in the future include methods to encourage the recycling and/or treatment and reuse of various industrial and municipal wastewaters in nonpotable reclaimed water systems. Such reclaimed water could be used in cooling, irrigation, or other operational systems where potable water quality is not required. The use of zero liquid discharge water management systems (systems where water is reused over and over and not discharged into the waste stream) in industrial complexes to supplement available water supplies is another method available to conserve water and to reduce or eliminate liquid waste streams.

Conservation at the consumer level essentially consists of continuing to encourage more efficient use of water. For domestic consumers, this may be achieved by promoting use of flow-restricting faucets and showerheads, reducing toilet tank capacity, or restricting lawn watering or car washing activities. For commercial and industrial consumers, water conservation may be achieved by optimizing product or process water and cooling water, reducing landscape watering, recycling or treating and reusing waste streams, and installing more efficient sanitary waste handling facilities.

Regulation and enforcement efforts would also be needed for an effective water conservation program. Revisions to local building and plumbing codes, requiring installation of water conserving devices, has proven helpful in reducing use whenever new water/sanitary fixtures are required. In critical water shortage situations, prohibition of outdoor water uses for lawn watering and washing cars and reduction of sanitary water for domestic needs may be required. Enforcement of regulations or restrictions by fines or termination of water service is necessary to assure compliance by all water users.

Some water conservation will occur without specific programs because of federal regulations concerning water pollution control. These programs, which may require industrial wastewater pretreatment before discharge to the municipal sewer system, will promote industrial water recycling, treatment and reuse because of economic conditions which influence the relative cost of water and wastewater treatment.

The City of Wichita has a water supply emergency plan in the event the demand for water is greater than what the City can provide. This plan has three levels, water supply watch, warning or emergency and the implementation of voluntary and mandatory water conservation measures. There are five classes of water use, they are:

- **Class 1** - Lawn and turf grass irrigation, except for those plantings and areas included in Class 2; refilling fountains not using re-circulated water; and washing driveways
- **Class 2** - Outdoor watering, either public or private, for trees, shrubs, plants, new planting of lawn and turf grass, green and tees for golf courses, swimming pools or other recreational areas; or the washing of motor vehicles, boats, trailers, or the exterior of any building or structure

- **Class 3** - Any commercial or industrial, including agricultural, purposes; except water necessary to maintain the health and personal hygiene of bona fide employees while such employees are engaged in the performance of their duties at their place of employment
- **Class 4** - Domestic usage, other than that which would be included in either Classes 1 or 2
- **Class 5** - Water necessary only to sustain human life and the lives of domestic pets and maintain standards of hygiene and sanitation

Should the city council or city manager determine that conditions indicate the probability of a drought or other condition causing a major water supply shortage, they shall declare that a water watch exists and take steps to inform the public and ask for voluntary reduction in water use. Should conditions indicate supplies are starting to decline, the city council and city manager shall declare that a water warning exists and establish mandatory restrictions on Class 1 water usage and voluntary restriction on Classes 2 and 3. If conditions continue to deteriorate, the city council or the city manager shall declare that an emergency exists and may impose mandatory restriction of Classes 1, 2, 3, and 4 water uses.

1.3.5 PROJECTED WATER REQUIREMENTS

Based on the information presented earlier in the chapter, water supply deficits will occur in the City of Wichita as follows in Table 1-3.

1.3.6 SUMMARY OF SYSTEM NEED

Net water needs (Table 1-4 and Figure 1-9) are the total water demand projections less the firm yields of potential water

Table 1-3 City of Wichita Water Supply Deficits

		Year Deficit Occurs
Existing Pumping Capacity:		
Average Day	91 MGD	2018
Maximum Day	182 MGD	2018
Water Rights:[1]		
Average Day	88.4 MGD	2026
Maximum Day	235 MGD	2045
Potential Pumping Capacity:[2]		
Average Day	90.0 MGD	2016
Maximum Day	194.4 MGD	2026

Notes:
[1]Based on full utilization of existing and pending water rights
[2]Based on firm capacity of Cheney Reservoir of 43.7 MGD.

supply source alternatives. Based on 100 percent utilization of existing and pending water rights and a firm yield of Cheney Reservoir of 43.7 MGD, the year 2050 net need is approximately 22 MGD for the average day and 28 MGD for the maximum day. Based on firm yield, an average day usage deficit would occur about the year 2016 and the maximum day usage deficit would occur about the year 2026 (Figure 1-9).

1.4 DECISION TO BE MADE

The decision to be made by the City of Wichita Water and Sewer Department is whether to implement a:

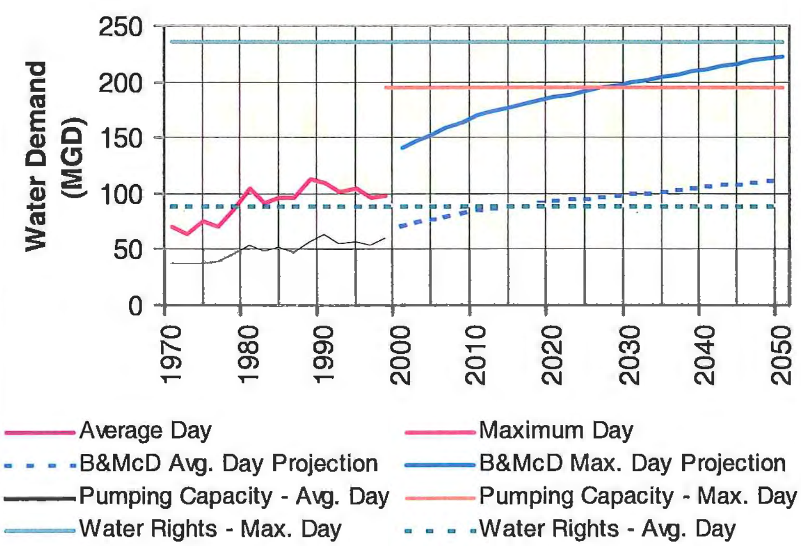
- Integrated Local Water Supply Plan with 150 MGD Capacity
- Integrated Local Water Supply Plan with 100 MGD Capacity
- Continued water conservation program and system upgrades on an as need basis (No-action alternative)

Table 1-4 Required Net Water Needs

	Water Rights		Existing Pumping Capacity		Potential Pumping Capacity	
	Avg. Day (MGD)	Max. Day (MGD)	Avg. Day (MGD)	Max. Day (MGD)	Avg. Day (MGD)	Max. Day (MGD)
Project Year 2050 Usage w/Low Range Conservation	112	223	112	223	112	223
Existing Supply Sources[1]	-88	-235	-78	-130	-79	-171
Net Need Subtotal	24	0	34	93	33	52
Undeveloped Available Sources[2]	-11	-24	0	0	-11	-24
Required Net Need	13	0	34	93	22	28

Notes:
[1]Existing supply sources include Cheney Reservoir, Equus Beds Wells, and Local (E&S) Wells.
[2]Undeveloped available sources include additional supplies from Cheney Reservoir up to a firm yield of 43.7 MGD.

Figure 1-9 Projected Water Use With Conservation



1.5 SCOPE OF THE ENVIRONMENTAL REVIEW

The National Environmental Policy Act (NEPA) of 1969 is the nation's charter for protecting the environment and establishes the nation's environmental goals and policies. It requires federal agencies to take into consideration the environmental consequences of proposed actions in the decision-making process. Regulations developed by the President's Council on Environmental Quality (CEQ) implement NEPA (40CFR 1500-1508, 1978). The CEQ regulations require that an EIS provide a detailed written statement as required by section 102(2)(C) of the Act.

This EIS identifies, describes and evaluates the potential environmental impacts that could result from the proposed actions, as well as possible cumulative impacts. The EIS also identifies environmental permits relevant to the proposed action. The EIS describes, in terms of a regional overview or a site-specific description, the affected environment and environmental consequences of the action. Finally, the EIS identifies mitigation measures to prevent or minimize environmental impacts.

The biophysical resources identified for the study areas are: air quality; biological, cultural, earth, water, socioeconomic, recreational, and visual resources; infrastructure/utilities; hazardous materials; and land use.

The baseline conditions used in this EIS will be the affected environment as it existed in 1997. If data is not available for 1996, information will be a 12-month period as close as possible to 1997. Calendar year 1992 may reflect the baseline conditions for some resources.

Public involvement has been emphasized throughout the development of this EIS. In order to disseminate project information to the public and solicit public participation, numerous public meetings were held in the area of the proposed project.

Over the past five years, while the Department has developed the Integrated Local Water Supply Plan (ILWSP) and implemented an Equus Beds Groundwater Recharge Demonstration Project, the public and government agencies have been kept informed through public meetings, tours, press releases, monthly and annual progress reports, project reports, and formal agency consultations. In early October 1997, through published and broadcast public notices, press releases, and direct mail, the Department invited the public and federal, state, and local agencies to participate in the scoping process for the ILWSP's environmental document.

Three public meetings were held on October 20, 21, and 22, 1997 in Wichita, Cheney, and Halstead, Kansas, respectively, to solicit input on the scope of the environmental document. A total of 36 individuals attended these meetings. Attendees had the opportunity to view displays about the proposed plan and the framework for the environmental document; ask questions about the plan with knowledgeable representatives from the Department and the Department's design and environmental consultant; and register their comments and suggestions concerning the proposed plan and the environmental document. The public was also invited to submit written comments by mail or fax by November 22, 1997.

Three similar meetings were held for cooperating government agencies. The first meeting was held in Wichita on October 21, 1997 and was attended by representatives of Reclamation, the Kansas Corporation Commission, the Kansas Department of Agriculture-Division of Water Resources, the Kansas Department of Health and Environment (KDHE), the Kansas Water Office, Groundwater Management District No. 2, and the Sedgwick County Conservation District. The second meeting was held in Kansas City, Missouri on November 5, 1997 and was attended by the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey, and KDHE. The third meeting was held in Emporia, Kansas on November 6, 1997 and was attended by the U.S. Fish and Wildlife Service (FWS) and the Kansas Department of Wildlife and Parks (KDWP). Agency representatives provided initial comments at these meetings and were requested to submit written comments by November 22, 1997.

1.6 APPLICABLE REGULATORY PERMIT REQUIREMENTS

Based on discussions with the State of Kansas, Division of Water Resources, surface and groundwater water rights could possibly be issued to the City with conditions, allowing the use of preset quantities of water from groundwater and surface water sources. Such a permit would allow the City to manage the operations of its water supplies to maximize use of runoff from surface water sources with accompanying groundwater recovery and storage until needed during drought conditions. Permits, such as state and federal permits, will be identified during implementation of the proposed action; the City will coordinate the action for the permit(s).

1.7 ORGANIZATION OF THE DOCUMENT

This EIS contains six chapters and four supporting appendices. Chapter 1 is a statement of the purpose of and need for action; identifies the location of the proposed action; states the decision to be made and the decision maker; summarizes the analysis process; lists the applicable regulatory requirements; and describes the organization of the EIS. Chapter 2 provides alternatives selection criteria and alternatives considered including the no-action alternative; describes the proposed action; describes the no-action alternative; details other action alternatives; summarizes the environmental impacts; identifies the preferred alternative; and lists mitigation. Chapter 3 is a general description of the biophysical resources that the proposed action and alternatives could potentially affect. Chapter 4 is an analysis of the environmental consequences of the proposed action and alternatives. Chapter 5 discusses the public involvement, agency coordination, issues identified during scoping process, lists the preparers and other contributors of the document. Chapter 6 is a list of source documents relevant to the preparation of this EIS. Appendix A is a discussion of the alternative screening process including criteria used and water supply sources considered; Appendix B is a biological assessment; Appendix C is a discussion of the Operations Model developed for the ILWSP. Appendix D is the scoping summary.

economic and political constraints. The planning horizon is to meet the water needs from 2000 to 2050. Environmental issues involved biological resources, cultural resources, relocations, land or right-of-way requirements, timber removal, wetlands, state forests and natural areas and inundation of rivers and streams. Project cost estimates and costs per unit of available flow estimates were developed for the purpose of comparing each water supply alternative to determine the most economically viable alternative(s).

The existence of major deficiencies or fatal flaws eliminated an alternative from further study. The most promising or viable alternatives were carried forward and evaluated in more detail. A brief description of criteria developed to screen each water supply alternative is presented in Appendix A.

Each water supply source must be able to operate in conjunction with existing water system components and the combined facilities must furnish the projected 2050 average day and maximum day demand to the City of Wichita's water service area. Water quality was also an important consideration in determining if the raw water could be treated to drinking water quality with existing conventional water treatment processes. Drinking water must comply with the federally mandated 1974 Safe Drinking Water Act (SDWA) and the Amendments to the act.

Project cost estimates and costs per unit of available flow estimates were acquired for the purpose of comparing each water supply source to determine the most economically viable sources. Estimates of cost per unit of available flow were based on the total project cost divided by the total available flow over a 55-year period from 1996 through 2050. The existence of major deficiencies or fatal flaw(s) eliminated a water source from further study.

The 27 water supply sources consisted of 14 conventional and 13 non-conventional sources throughout the regional area in and around Wichita. Conventional water supply sources included existing and proposed reservoirs, groundwater and surface water flow. Non-conventional water supply sources included use of reservoir overflows, above average or flood stream flow, treated wastewater reuse, groundwater bank storage[1], rain harvesting and water conservation. Of the 27 water supply sources, 11 were considered viable water supply sources and only 2 sources required further detailed study. Appendix A contains additional information on supply sources.

From the eleven viable water supply sources, three water supply plans were developed: the Milford Reservoir Plan, the Integrated Local Water Supply Plan (ILWSP) with 250 MGD Diversion Option and the ILWSP with 150 MGD Diversion Option. Both of the ILSWPs used a combination of water supply sources to meet the 2050 water needs. All three water supply plans were selected based on engineering feasibility, economics or cost, and water quality. A comparison of the three plans is provided in Appendix A.

To meet the second goal of a new water development project, the three alternatives (ILWSP 250 MGD option, ILWSP 150 MGD option, and Milford Reservoir) were evaluated for the capability to protect the Equus Beds

[1] *Bank storage* – the temporary increase in groundwater levels in the alluvial river bank during periods of high river flows.

aquifer's water quality. Under the Milford Reservoir alternative, no protection would be provided to the aquifer; the City would continue to withdraw water from the aquifer with continued use by local irrigators and only a natural recharge would occur. This natural recharge is insufficient to maintain a safe water quality level within the aquifer and prevent inflow of natural and manmade high chloride water in the well field area.

Both of the ILWSP options include a component to recharge the aquifer. Further engineering studies were required to determine the best method for recharge. Therefore, the City designed and implemented a recharge demonstration project, from 1994 to 2000, to determine:

- if overall groundwater quality would be acceptable
- economic validity of operation and maintenance requirements
- validity and potential problems associated with long-term recharge operations
- full-scale design criteria

Results of the demonstration project proved the capability of the ILWSP options to meet the second goal of protecting the Equus Beds aquifer. Further hydrologic investigations revealed that the amount of recharge needed to maintain a safe water level within the aquifer was lower than originally estimated; therefore, several options were reviewed with regard to the recharge component in the ILWSPs.

Thus only two alternatives remained to be analyzed for this project—the ILWSP 250 MGD and the ILWSP 150 MGD. Refinement of these two alternatives resulted from information learned from the demonstration project and various engineering studies. These studies included a re-evaluation of the water demand needs for Wichita, hydrogeologic field tests, soil borings, groundwater modeling, system operation modeling, and surface water treatment investigations. Based on the modifications to the plans, they were renamed ILWSP 150 MGD Diversion and ILWSP 100 MGD Diversion. The following section gives the details of these two plans.

2.3 ALTERNATIVES CONSIDERED IN DETAIL

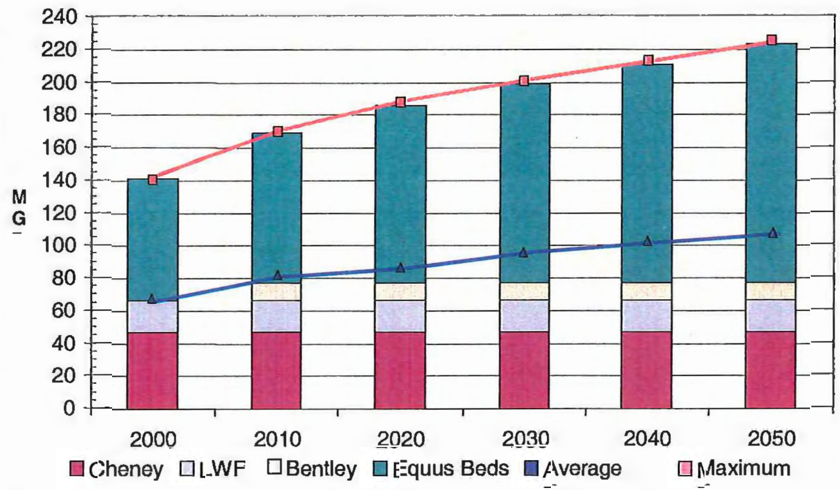
The basic strategy of the ILWSPs is to shift the priority of use and primary makeup of the City's raw water supply from groundwater to surface water when it is available. This allows water to be conserved in the aquifer both for growing water demands and water needs during extended dry weather conditions. Both ILWSP alternatives contain the same components; however, the Equus Beds recharge and the Local (E&S) Well Field (LWF) components include several options. The ILWSPs components are:

1. **Water Conservation** - rates and pubic education to influence water demands by all customer classes.
2. **Bentley Reserve Well Field** – redevelopment of an existing well field along the Arkansas River for use in meeting short-term peak water demands.
3. **LWF Expansion** - to more effectively use "above-base" flow water from the Little Arkansas River and "leakage"

water[2] from the upstream, recharged Equus Beds aquifer.

4. **Cheney Reservoir** - greater use of spillage[3] and flood storage water
5. **Equus Beds Aquifer**
   - continued use of the city's existing rights to pump water from the Equus Beds aquifer
   - capture of "above-base" flow water from the Little Arkansas River to be used for recharge of the Equus Beds aquifer or direct supply to water treatment facilities in the City
   - recovery of stored water in the Equus Beds aquifer during extended dry weather conditions for conveyance to the City's water treatment plants

Figure 2-2 Projected Average and Maximum Day Demand & Available Component Water Supply



Projections of the average and maximum day water demand and available component water supply are shown in Figure 2–2. Review of this figure shows current and future supply capacities for each water source. Year 2010 represents the short-term future by which time major facilities of the plan would be operational. Year 2050 represents the long-term future at the end of the planning period. The ILWSPs are based on an optimized priority of water use on an "as available" basis from several sources to meet demand from storage during dry periods. The priority of use and maximum capacities for various water supply sources operated by the City, as envisioned in the ILWSPs, are shown in Table 2–1.

The physical features of each of the alternatives, including the amount of water supplied, plan components, implementation, and costs are discussed below. A summary of environmental impacts for each viable water supply alternative is presented at the end of the chapter.

2.3.1 WATER CONSERVATION COMPONENT

Water conservation is achieved through the continuous use of various management and technological activities, public awareness and education programs, and enforcement efforts. A thorough water conservation program encourages more effective use of water resources and the most efficient use of water by consumers. Conservation activities associated with the two water

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[2] *Leakage water* – is stored water that has migrated from the Equus Beds aquifer and re-entered the Little Arkansas River due to the natural gradient of the groundwater system.
[3] *Spillage* – water that overflows into the spillway of a dam.

Table 2-1 Allocation Order of Plan Components

Allocation Order	Source	Maximum Supply Rate (MGD)	Remarks
1	LWF Expansion	45	Used only when water flow in Little Arkansas River exceeds assumed minimum flow requirements.
2	Equus Beds Aquifer -Little Arkansas River	60	Availability depends on river flow and minimum desirable stream flow requirement. This direct surface water diversion from the Little Arkansas River to the water treatment plant is **not** included in all development alternatives.
3	Cheney Reservoir	80 47 See Note (1)	If pool level is at or above 1,422 feet If pool level in the range 1,417 – 1,422 feet If pool level below 1,417
4	LWF	30	Availability depends on water flow in the Arkansas River at Wichita. Withdrawals are limited at lower river flows for water quality reasons. Withdrawals limited to 5 MGD when river flow is less than 500 cfs and 10 MGD when flow is less than 1,500 cfs.
5	Bentley Reserve/Equus Beds Well Fields	43.2	Mix of one part Bentley Reserve Well Field water (up to 10.8 MGD) and three parts Equus Beds water (up to 32.4 MGD).
6	Equus Beds Well Field	146	If Cheney Reservoir is above elevation 1,417 feet, use only as source of last resort unless Equus Beds are full. If Cheney Reservoir is below 1,417 feet, use in combination with Cheney Reservoir to balance drawdowns in both sources. Withdrawal rate limited to 78 MGD unless City has recharge credits.
7	Cheney Reservoir	47	If Cheney Reservoir level is below 1,417 feet, use in combination with Equus Beds to balance drawdowns as described above.

Notes: (1) Refer to numbers 6 and 7 in allocation order.

supply plans would involve the following:

- Review and modification of the inverted water rate structure on an annual basis to help achieve and maintain conservation goals
- Maintenance of watering restrictions (twice per week by address) during drought periods
- Encouragement of domestic consumers to use flow-restricting faucets and showerheads, reduce toilet tank capacity, and restrict lawn watering or car washing activities
- Continuation of public awareness and education programs
- Continuation of leak detection surveys to reduce water distribution system losses
- Continuation of meter repair and replacement programs to increase the accuracy of water quantity monitoring. All meters would be tested, repaired or replaced on an eight-year cycle
- Continuation of cooperative efforts with industries to encourage conservation of cooling, process and irrigation water
- Operation of surface water and groundwater supplies to minimize water losses or yield reductions. Groundwater supplies would be managed to reduce aquifer declines

and deterioration due to over-pumping

- Continue operating water treatment facilities to minimize water losses through recycling of water used to clean filters in water treatment processes

Water conservation would occur without specific programs because of federal regulations concerning water pollution control. These programs, which may require industrial wastewater pretreatment before discharge to the municipal sewer system, would promote industrial water recycling, treatment, and reuse because of economic conditions which influence the relative cost of water and wastewater treatment.

Ten Ways to Conserve

1. **Avoid Over-Watering Plants and Lawns.** Apply water at a rate that matches soil absorption.
2. **For Best Results Try Morning Watering.** Evaporation loss is at a minimum.
3. **Avoid Washing Down Paved Areas.** Sweep driveway and sidewalks in garden cleanup.
4. **When Washing the Car...** Use a bucket for water. Hose off only to rinse.
5. **Repair Faucet Leaks.** As much as 15 gallons of water can be lost each day with a slow drip.
6. **Avoid Toilet Water Waste.** Do not use toilet as a trash disposal.
7. **Reduce Shower time.** An extra five minutes in the shower could mean another 50 gallons down the drain.
8. **Use the Automatic Dishwasher Wisely.** Half-loads cheat you out of full-water use.
9. **Watch Those Laundry Loads, Too.** Some 50 gallons of water are used to wash a load of clothes. Make every load count.
10. **Avoid Running the Faucet.** Don't run water continuously while shaving, brushing teeth, peeling vegetables, or washing dishes.

Source: California Water Service Group

2.3.2 REDEVELOPMENT OF THE BENTLEY RESERVE FIELD COMPONENT

The Bentley Reserve Well Field is located adjacent to the Arkansas River, south of the town of Bentley and along the right-of-way for the 66-inch well field pipeline (Figure 1–3). The original wells have been abandoned and the water rights have been terminated. Redevelopment of the abandoned Bentley Reserve Well Field could supply up to 10 MGD of relatively high chloride water to meet peak demands. The high chloride water would be blended with water from other sources to maintain a level less than 200 mg/l to meet short-term peak water demands during dry weather conditions.

2.3.2.1 Implementation

Redevelopment of the abandoned Bentley Reserve Well Field would start design and construction in 2004 and end in 2005. Field studies and permitting would take place prior to the design and would start in 2003.

2.3.2.2 Costs

The estimated cost for the vertical wells in the redevelopment of the Bentley Reserve Well Field is $1,250,000. Annual operating and maintenance costs are estimated at $26,000.

2.3.3 LOCAL WELL FIELD COMPONENT

The LWF lies downstream of the Equus Beds Well Field at the confluence of the Arkansas and Little Arkansas rivers, near the City's Central Water Treatment Plant. Currently, the LWF is used only during periods of peak demand.

The existing LWF is comprised of 17 wells constructed between 1949 and 1953, plus three redrilled wells constructed in 1997.

The expanded LWF, which incorporates the City's original E & S Well Field, is expected to supply up to 39 percent of the City's raw water needs.

Expansion of the LWF would use "above base flow"[4] water from the Little Arkansas River. In addition, any "leakage water" from the Equus Beds aquifer would also be collected by the new system. Water from both sources would be transferred directly to the Water Treatment Plant. New components would include:

Expansion of the LWF along the Little Arkansas River and Floodway is expected to improve water quality and provide higher production rates.

- Four horizontal collector wells with pump houses
- Five vertical wells with pumps and motors (underground discharge configuration)
- Collecting pipelines (with easements)

[4] *Above base flow* – the volume of flow in the river, which is generated from rainfall runoff that is above the base river flow as established by the State or local regulatory agencies.

The conceptual design for the collector wells is 10 MGD for high river stage conditions (2 feet above average flow). On average, approximately 25,000 acre-feet per year would be available, assuming that water can be diverted to the 20 cfs minimum desirable streamflow (MDS) limit. Actual yield would depend on how close to the river the wells can be constructed.

Water rights for the existing wells allow an average day withdrawal rate of 5.4 MGD and a maximum day withdrawal rate of 37.1 MGD. Based on 79 years of historical flow data, approximately 27 MGD would be diverted from the Little Arkansas River about 50 percent of the time and 37 MGD would be diverted about 40 percent of the time. Although the proposed expansion does not provide a firm water supply, it has the potential to divert up to 37 MGD from the Little Arkansas when it is available, saving the stored water for times of low river flow.

High chloride levels in the Arkansas River influence groundwater quality in the LWF area. Here, groundwater flows away from the Arkansas River southeast toward the Little Arkansas River. Water obtained from the existing LWF typically has high calcium hardness and relatively high chloride levels, and is therefore used primarily during peak water demand periods. Expansion of the LWF along the Little Arkansas River and floodway is expected to improve water quality and provide higher production rates with less chloride loading. Proposed expansion sites maximize infiltration of better quality water from the Little Arkansas River. Wells would be located in northwest

Wichita, along and above the confluence of the Arkansas and Little Arkansas rivers and along the Little Arkansas floodway (Figure 2–3). Well location and spacing were adjusted based on modeling results to prevent over-pumping, which can result in excessive drawdown. Pumping rates would be controlled to reduce potential for high-salt migration towards the well field from the Arkansas River.

Piping for the upper section of the LWF is common for both options and includes connections to three horizontal collector wells. These wells pump the diverted water into a dedicated pipeline routed through the floodway, which connects to an existing 48-inch raw water line for conveyance to the Central Water Treatment Plant (Figure 2–3).

Two options exist for the Lower Section of the LWF. Option 1 conveys diverted water from the wells south to Vertical Well 5 in the Central Riverside Park area. The final section of waterline to the Central Water Treatment Plant is routed through city property and is about 4,000 linear feet longer than the final pipeline section in Option 2 (Figure 2–4).

Option 2 conveys water to Vertical Well 3 near the northern boundary of Oak Park. The final section of waterline connects the lower section of the well field from Vertical Well 3 to the existing 48-inch raw waterline for conveyance to the Central Water Treatment Plant (Figure 2–4).

2.3.3.1 LWF Implementation

The proposed layout of the LWF Expansion allows for phased construction of both vertical and horizontal collector wells and makes use of the existing 48-inch pipeline. Phase 1 of the project involves construction of a scale-up facility to initiate state permitting activities and to obtain operational data for the final design. Phase 2 consists of the full-scale project design and construction based on the results of the prototype.

Installation of the Phase 1 project and LWF Expansion will be coordinated with other improvements planned in the Equus Beds Well Field. Figure 2–5 provides an implementation schedule for the LWF Expansion including the prototype (Phase 1) and the full-scale project design and construction (Phase 2).

2.3.3.2 LWF Costs

Estimated costs for the proposed expansion range from $13.5 million to $14.3 million, based on July 1999 dollars (Table 2–2). Project costs include construction costs, a contingency allowance[5] and other costs for engineering and special services. Costs for Options 1 and 2 for the well field diversions were identified.

Table 2-2 LWF Project Cost Summary

	Option 1	Option 2
Upper Section Pipeline	$2,103,000	$2,103,000
Lower Section Pipeline	$3,076,000	$2,443,000
Horizontal Collector Wells	$5,431,000	$5,431,000
Vertical Wells	$680,000	$680,000
Land	$44,000	$44,000
15% Contingency	$1,700,000	$1,605,000
10% Other costs	$1,303,000	$1,231,000
Total	$14,338,000	$13,537,000

Note: Other costs include fees and expenses associated with technical, professional and special services.

[5] *Contingency allowance* – a percent dollar amount added to all costs to account for unknown and unaccounted-for items.

Figure 2-3 Piping Option 1 Local Well Field Expansion

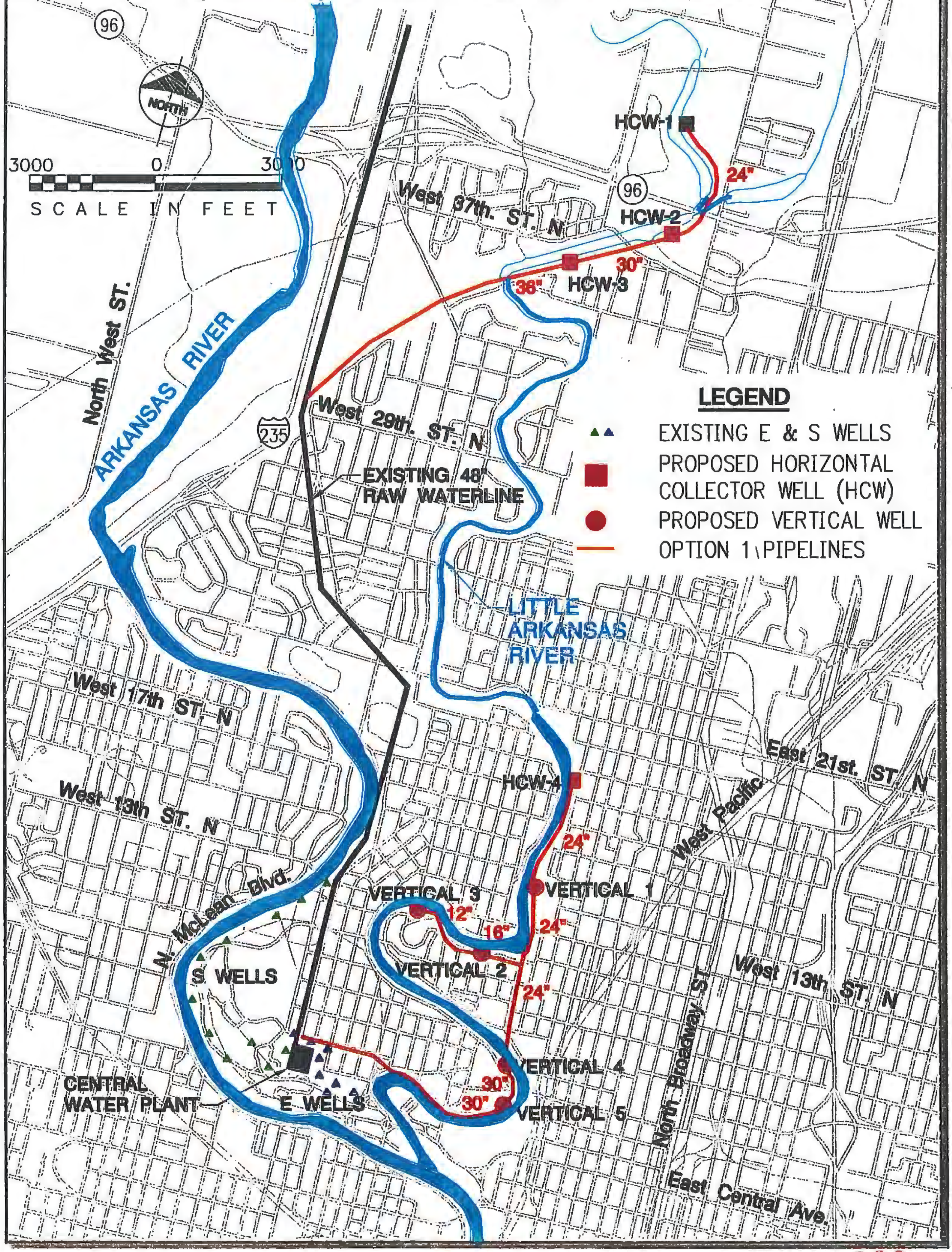


Figure 2-4 Piping Option 2 Local Well Field Expansion

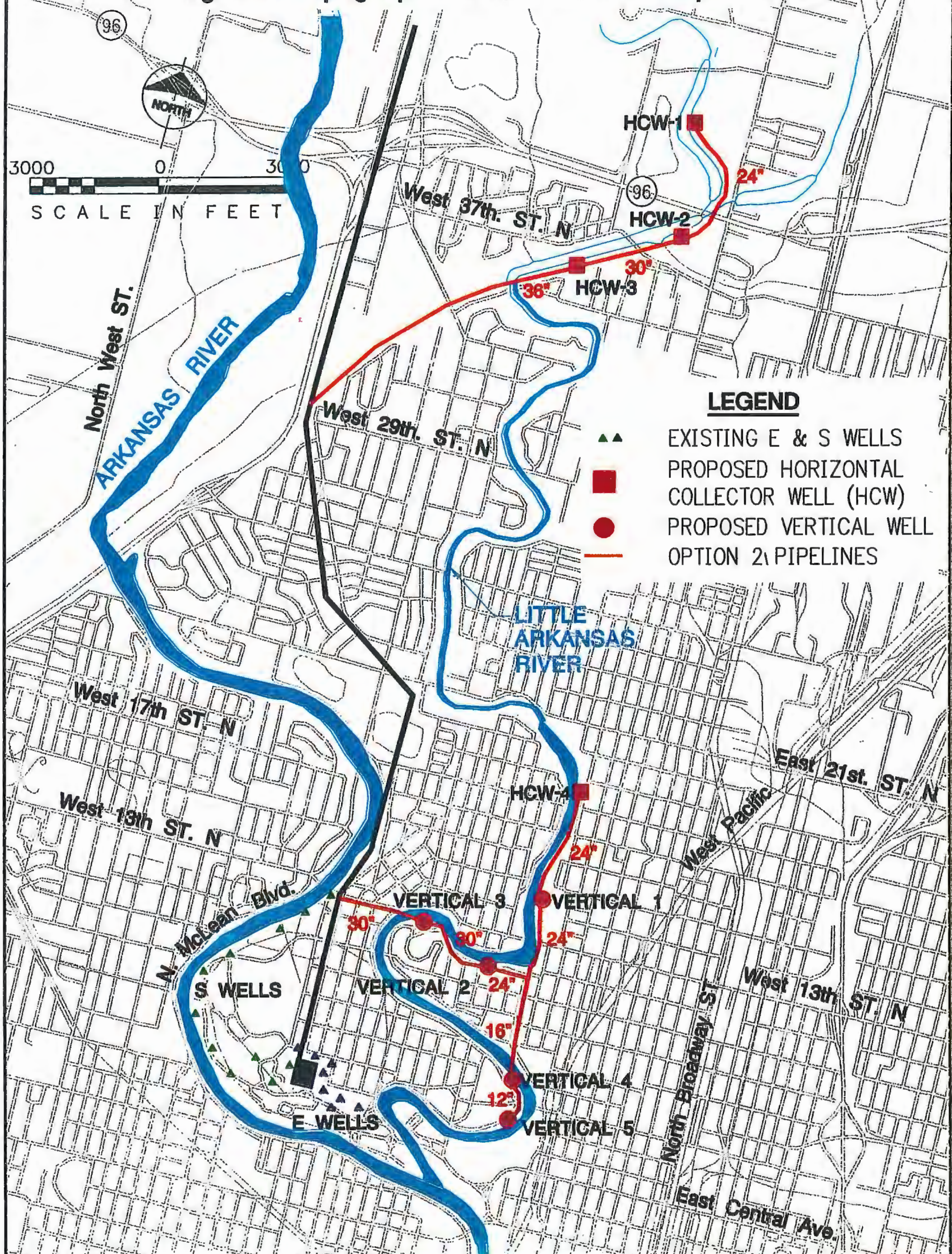
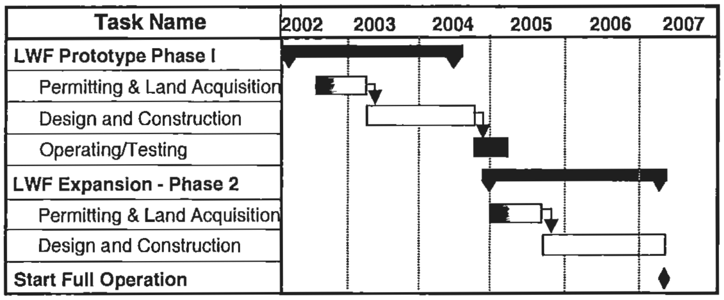


Figure 2-5 LWF Implementation Schedule



Piping for the upper section of the well field is common for both options and includes connections to three horizontal collector wells. Piping for the lower section of the LWF, which conveys water from five vertical wells and one horizontal collector well, differs for Options 1 and 2; Option 1 requires a pipeline about 4,000 linear feet longer than that of Option 2. The main transmission pipeline for the collector wells and vertical wells includes the existing 48-inch well field pipeline with improvements. Project cost figures do not include the improvements to the 48-inch pipeline, which is considered to be a separate pipe rehabilitation project.

2.3.4 <u>CHENEY RESERVOIR COMPONENT</u>

Use of this existing surface water reservoir will continue with only administrative or procedural changes or modifications of facility capacities. With the new conjunctive use water right permit and larger capacity water withdrawal facilities at the dam in place, the City would be able to withdraw up to 80 MGD from the reservoir when there is water stored in the flood control pool (between elevations 1,421.6 and 1,429.0 feet). At pool elevations below 1,421.6 feet, the maximum withdrawal rate from the reservoir will revert to its current limit of 47 MGD.

These changes in operating criteria will permit the City to capture more of the water in the flood control pool of the reservoir that would otherwise be released downstream by the U.S. Army Corps of Engineers (Corps) as the flood control pool is evacuated. Use of this surface water from Cheney Reservoir when it is available will allow the City to reduce withdrawals from the Equus Beds aquifer, therefore maximizing the amount of aquifer recharge that may be occurring at the time. This additional amount of aquifer recharge water will then be available for use during drier or drought conditions when water levels in Cheney Reservoir are lower and surface water inflow to the reservoir is low. The use of water from these two water sources in a balanced manner will minimize the need for the City to acquire and develop additional water supply sources from outside the local area to meet projected water demands.

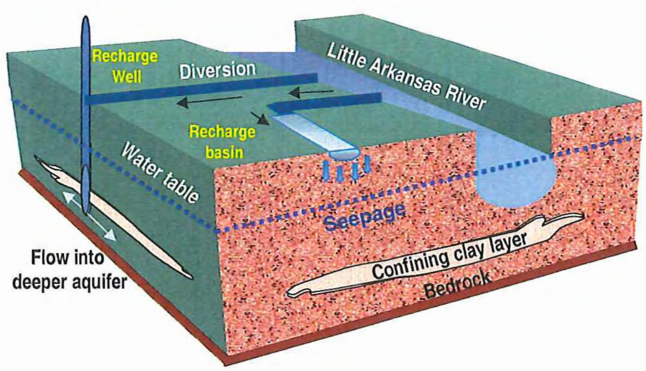
The City's conjunctive use permit and the increased pumping capacity on the Cheney pipeline have increased the City's legal and physical capability to deliver water from Cheney Reservoir on both a daily and annual basis.

Should the City's need for more water arise at a time that water is available in the reservoir's flood storage pool, the capability would exist to pump water to the City's Central Water Treatment Plant. When water levels in the flood storage pool drop to a predetermined low level, the Equus Beds aquifer (water from the existing permit or recovered recharge water) would be used. The objective is to maximize the use of storage in Cheney Reservoir, and to maximize the opportunities to recharge water into the aquifer, with use of water from the aquifer minimized except in drought conditions. Use of these waters "as-available" allows the Equus Beds aquifer to be recharged for later use during drought conditions and minimizes the need for additional water supply sources from outside the region.

After a flood event has occurred, the amount of water the City would be able to capture from the flood control pool before it is released will depend primarily on how long this water is retained or remains in the flood control pool. The faster this water is evacuated, the less time the City would have to withdraw water from the flood control pool; therefore, the less benefit this water would have to the City from a water supply perspective.

2.3.5 EQUUS BEDS AQUIFER RECHARGE, STORAGE AND RECOVERY COMPONENT (ASR)

Two alternatives were investigated for the Equus Beds Recharge, Storage, and Recovery Project. Alternative 1 includes three options for capturing, pre-treating, and recharging 150 MGD of ground and surface water with an additional option to capture, pre-treat, and transfer 60 MGD of surface water direct to the City's water treatment facilities. Alternative 2 also has three options which would capture, pre-treat, and recharge approximately 100 MGD of ground and surface water with an option to capture, pre-treat, and transfer 60 MGD of surface water directly to the City's water treatment facilities.



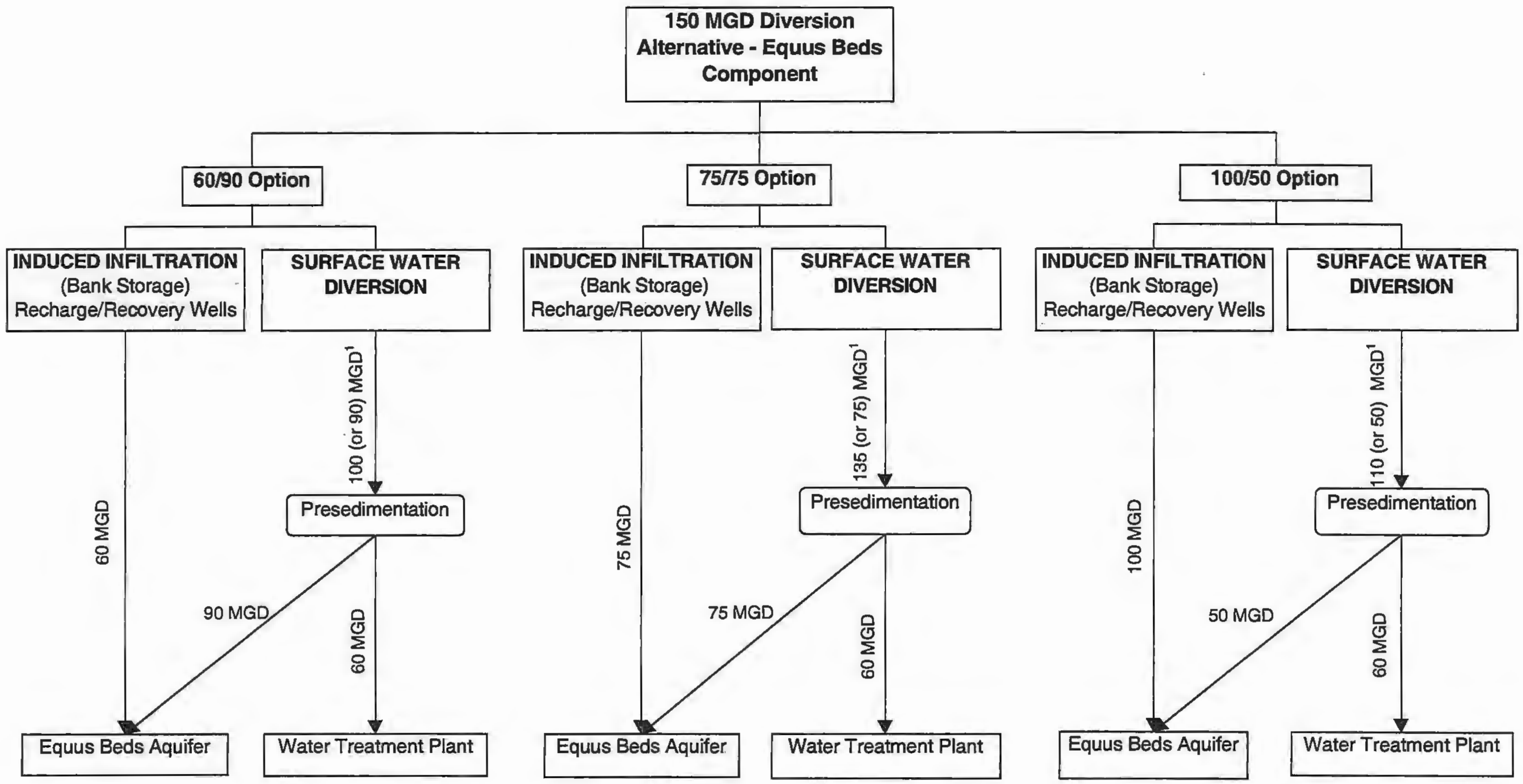
Schematic of Recharge Process

2.3.5.1 Alternative 1 – 150 MGD ASR

This component consists of three options for capturing 150 MGD of surface water from the Little Arkansas River and groundwater from bank storage adjacent to the river. This includes a surface water intake, induced infiltration wells, facilities to transfer and recharge the captured water to the Equus Beds aquifer, and to recover the stored water. A pre-sedimentation plant is proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment plants. Each of the three options is considered with and without diverting 60 MGD of treated surface water to the City treatment facilities. Figure 2–6 illustrates each of the three options, which are:

- 60/90 ASR Option: Capture of 60 MGD of induced infiltration water for recharge and 90 MGD of surface water for treatment and recharge with an additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facilities.
- 75/75 ASR Option: Capture of 75 MGD of induced infiltration water for recharge and 75 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facility.

Figure 2-6 150 MGD ASR Alternative Options



1. Each of the three options is considered with and without 60 MGD of treated surface water to be conveyed to the City treatment facilities. Therefore, the amount diverted increases when 60 MGD is conveyed to the City.

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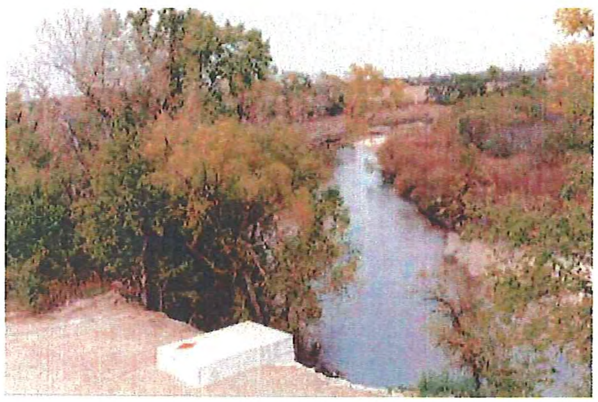
- 100/50 ASR Option: Capture of 100 MGD of induced infiltration water for recharge and 50 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facilities.

2.3.5.1.1 <u>60/90 ASR Option</u>

This option would capture 60 MGD of induced infiltration water and 90 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be directly recharged into the Equus Beds aquifer while the captured surface water would be treated for recharge into the aquifer. An additional 60 MGD of surface water, if designed, could be diverted from the Little Arkansas River, pretreated through a new pre-sedimentation plant and conveyed to the City's water treatment facility.



Example of Intake Structure on the Little Arkansas River

With the 60/90 ASR Option, 42 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. These wells would be divided into two groups of 21 wells with each well field requiring 4.2 miles of transmission pipeline. Other facilities necessary for the operation of the well and pipeline system would include a gravel access road, located immediately adjacent to the riparian vegetation in agricultural fields. "Bank storage" water captured from these wells would be moved via 42 miles of pipeline to 15 recharge wells at existing well sites, 18 new recharge well sites, and 4 recharge basins in the Equus Beds Well Field at existing water supply well sites.

A new surface water intake on the Little Arkansas River near Sedgwick, Kansas would have a maximum capacity of up to 150 MGD and would remove 90 MGD of surface water during above base flow periods. Approximately 2 miles of pipeline would transfer this untreated surface water to a new pre-sedimentation plant; another 12.5 miles of pipeline would transfer the treated water to 28 new recharge basins, 8 basins located at existing well sites, in the Equus Beds Well Field. If implemented, an additional 60 MGD of surface water would pass through the pre-sedimentation plant, and would be piped directly to the City of Wichita's water treatment plants for further treatment and distribution.

Also required are overhead power lines and SCADA[6] system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 75 miles of fiber optic cable along new and existing pipeline

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[6] *SCADA system* – Supervisory Control and Data Acquisition system

alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plan in Wichita.

The addition of 30 recovery wells would be required to meet the projected year 2050 maximum worst dry case condition. These recovery and recharge wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 5 miles of fiber optic cable and 3 miles of transmission piping.

Figure 2–7 illustrates the general layout of the project option and implementation of the construction.

2.3.5.1.2 <u>75/75 ASR Option</u>

This option would capture 75 MGD of induced infiltration water and 75 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be used to recharge the Equus Beds aquifer while the surface water would be pretreated before being recharged into the aquifer.

Example of Recharge basin

An additional 60 MGD of surface water, if necessary, would be diverted from the Little Arkansas River, treated in a new pre-sedimentation plant and conveyed to the City's water treatment facility.

With the 75/75 ASR Option, 53 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The 53 induced infiltration wells would be divided into two groups of 28 and 25 wells with each well field using 5.6 and 5.0 miles of transmission pipeline, respectively. Other facilities necessary for the operation of the well and pipeline system would also be immediately adjacent to the riparian vegetation in agricultural fields, including a gravel access road immediately adjacent to the wells and pipelines. The bank storage water captured from the wells would be moved via 34 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 28 new recharge well sites, and 4 recharge basins at existing supply well sites.

A new surface water intake near Sedgwick, Kansas would directly remove 75 MGD of water from the Little Arkansas River. Approximately 2 miles of pipeline would transfer this untreated surface water to a proposed pre-sedimentation plant; another 9.5 miles of pipeline would transfer 75 MGD of treated water to 22 new recharge basins in the Equus Beds Well Field. If implemented, an additional 60 MGD of surface water from the Little Arkansas River could pass through 2 miles of pipe to the pre-sedimentation plant. This pretreated water would be conveyed through 2 miles of transmission pipe to the south side of the existing well field for

Figure 2-1 Alternative Selection Process

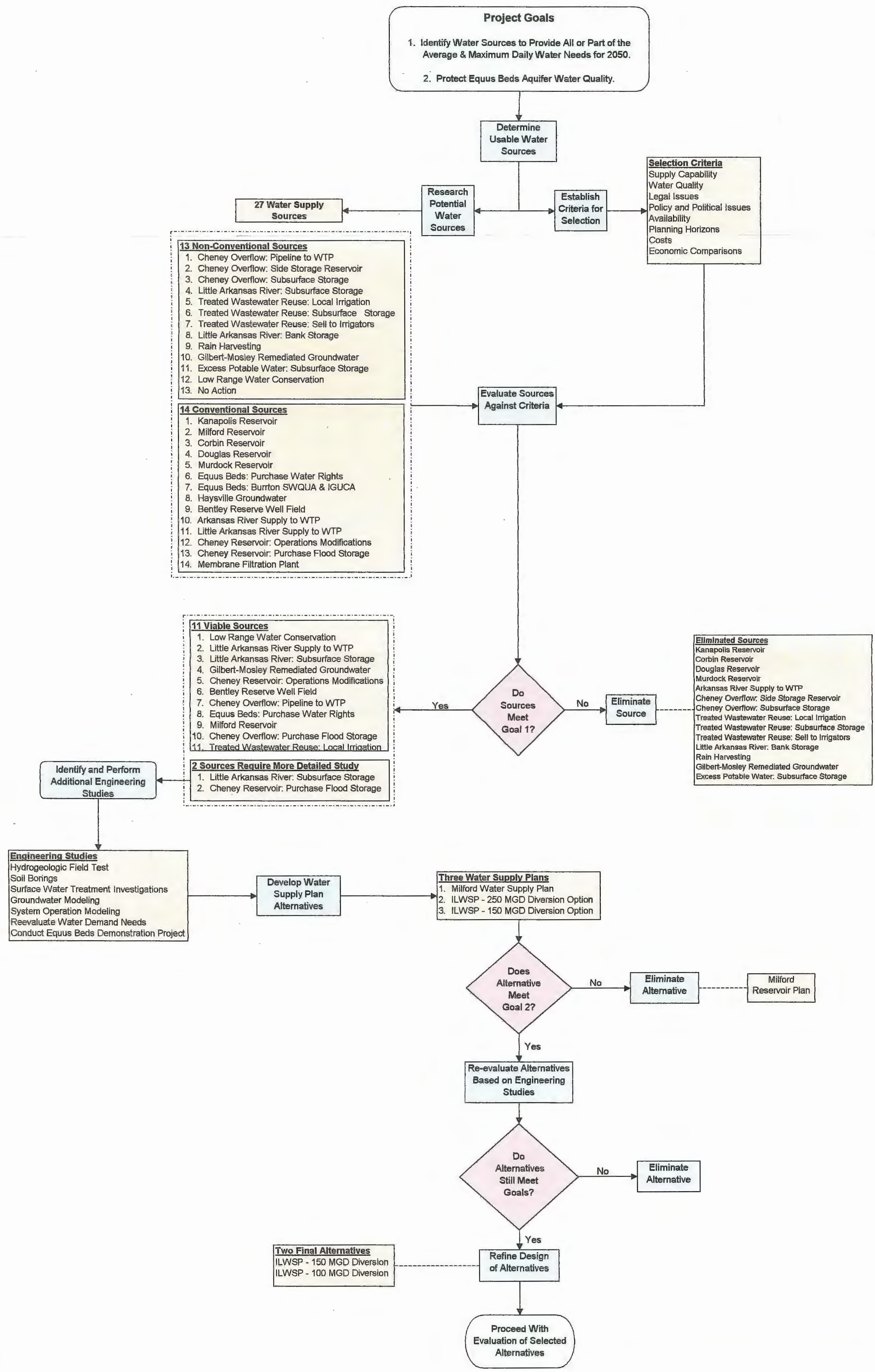

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Table 2-3 150 MGD Alternative - Options Phase Implementation

Phases	60/90 Option							75/75 Option							100/50 Option						

Phase 1

Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
	10 MGD			7				10 MGD			7				10 MGD			7			
Transmission piping to the recharge facilities (in miles)	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
	1.2	1.4	0.4	3	1.2	1	2	1	1	0.2	3.6	1.4	1	2	1	1	0.2	3.6	1.4	1	2
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	3							3							3						
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	2			1				2			1				2			1			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	10							10							11						

Phase 2

Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
	20 MGD			15				30 MGD			21				30 MGD			21			
Transmission piping to the recharge facilities (in miles)	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
	0.2	0.2	5.2	0.6	1			0.4	0.8	6	1.6	1			0.4	0.8	6	1.6	1		
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4			
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
				1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	21							25							24						

Phase 3

Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
	30 MGD			20				35 MGD			25				30 MGD			21			
Transmission piping to the recharge facilities (in miles)	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
	0.4	2.8	8.7	2.6	4.4		4	0.9	3.3	8.7	3.3	4.6		4	0.4	2.8	6.2	1	3.7		4
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	14							24							10						
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
															1			2			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	12							21							11						

Phase 4 - Option 100/50

Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
															30 MGD			21			
Transmission piping to the recharge facilities (in miles)	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
															1.4	1.8	4.2	2.6	1.1		3
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
															10						
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
															2			3			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)															15						

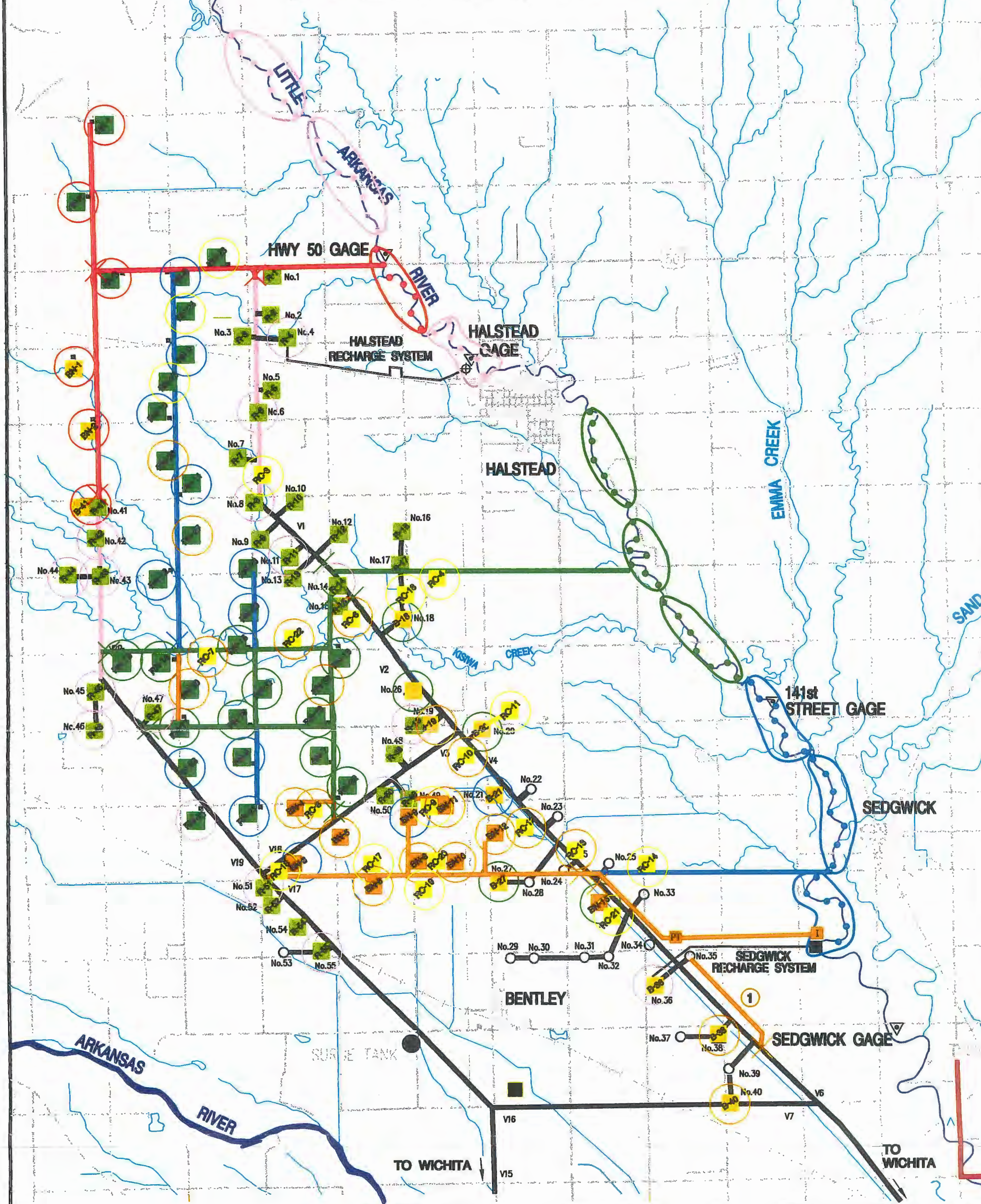
Phase 4 - Option 60/90 and 75/75, Phase 5 - Option 100/50

Installation of surface water intake, transmission piping from the intake to the pre-sedimentation plant, and overhead power lines	150 MGD Intake Structure Capacity							135 MGD Intake Structure Capacity							110 MGD Intake Structure Capacity						
Transmission piping to the pre-sedimentation plant to the recharge basins (in miles)	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
		2.5	4			7.5			2	1.5			7.5			1	1.5		1	4.5	1.5
Transmission piping to the pre-sedimentation plant to City's water treatment plant (in miles)	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
							2							2							2
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
															4						
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	18			9				14			7				7			2			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	43							42							36						

Recovery Wells

Installation of future recovery wells	Number of Wells	Number of Wells	Number of Wells
2010	0	0	0
2020	6	0	0
2030	9	4	0
2040	8	9	6
2050	7	12	9
Installation of fiber optic cable (in miles)	5	16	9
Installation of transmission piping (in miles)	3	2	0.3

Figure 2-9 100/50 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:
OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

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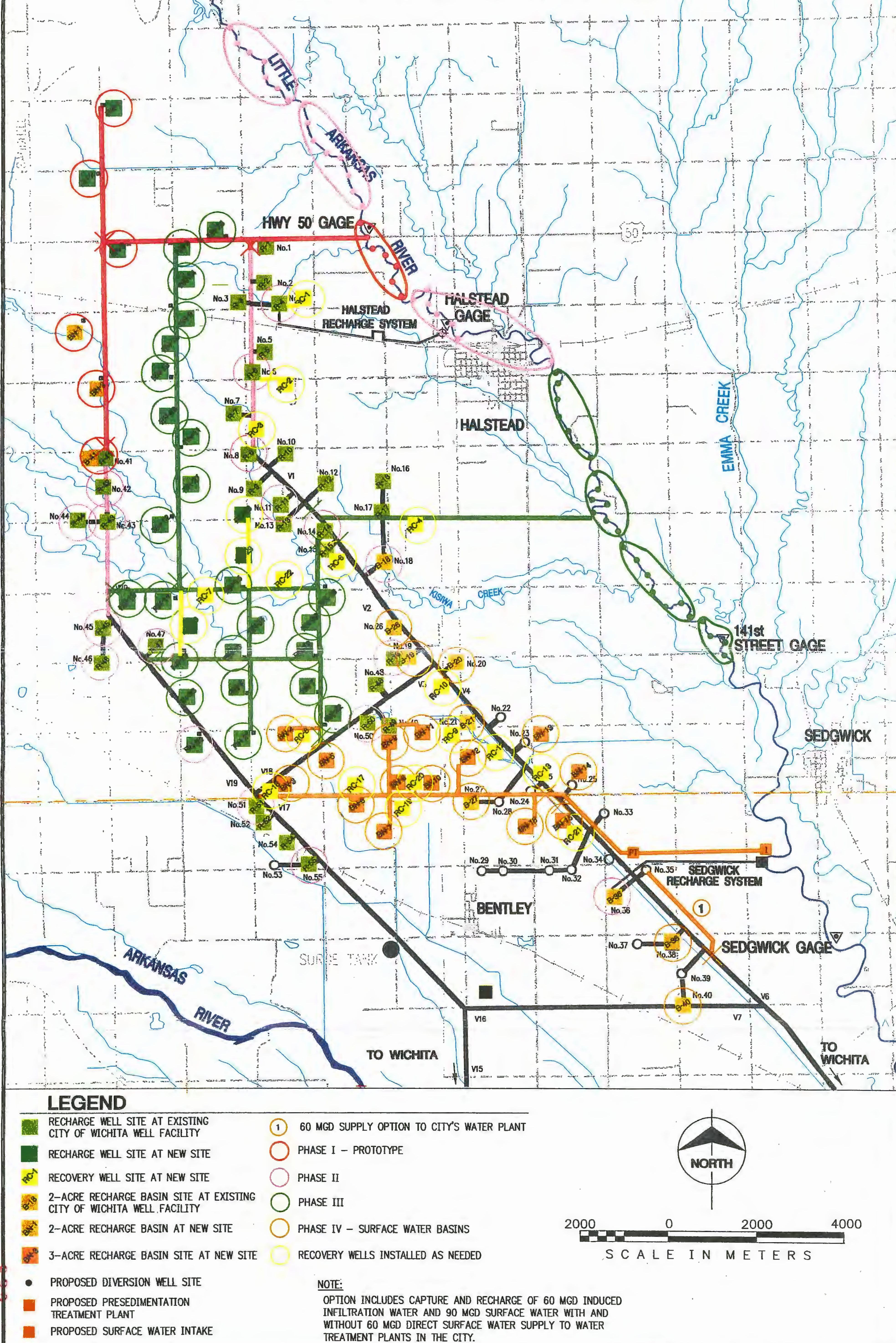
Figure 2-8 75/75 ASR Option Layout and Implementations



If necessary, an additional 60 MGD of surface water could be diverted from the Little Arkansas River. This water would be piped 2 miles to a new pre-sedimentation plant before being conveyed through an existing pipe to the City of Wichita's water treatment plants for further treatment and distribution.

Also required are overhead power lines and SCADA system, including a radio/antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 97 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 14 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 9 miles of fiber optic cable and 0.3 miles of transmission piping.

Figure 2–9 illustrates the general layout of the project option and implementation of the construction.

2.3.5.1.4 <u>150 MGD ASR Option Implementation.</u>
Components of the ASR project are scheduled for implementation over several years to facilitate planning and administrative needs, project funding, engineering, permitting, land acquisition, and construction. Figure 2–10 illustrates the implementation schedule that would be used for both alternatives.

The implementation for each of the three options is very similar. Each option's implementation has four phases with the exception of the 100/50, which has five phases. Phases 1-3 are basically the same for each option. They differ only in the number of recharge wells and basins, in the amount of piping, and in the capacity and number of induced infiltration wells required. Option 100/50 includes an additional phase similar to Phases 1 through 3. Phase 5 of the 100/50 option contains the same tasks as Phase 4 for the 60/90 and 75/75 options. Table 2–3 details the number of wells, recharge basins, miles of pipe and fiber optic cable, and size of intake structure for each of the options per phase.

Phase 1 - includes construction of a 10 MGD ASR system. Components include:

- Installation of induced infiltration (diversion) wells and the required transmission piping, and overhead power lines.
- Transmission piping to the recharge facilities including use of various diameters of pipe, i.e. 12-inch, 16-inch, 24-inch, 30-inch, 36-inch, 48-inch pipe.
- Installation of new recharge wells (RN wells).
- Installation of recharge basins at new sites (BN) and existing sites (B).
- SCADA system, including a radio/antenna set-up at each recharge location, plus various miles of fiber optic cable along pipe alignment.

Phase 2 - includes the installation of additional diversion wells, recharge wells at existing sites, use of recently redrilled wells with let-down casings, use of the existing demonstration project recharge facilities, and expanded use of the transmission piping installed in Phase 1.

Phase 3 - includes installation of additional diversion wells, recharge wells delivery through existing pipe to the City's water treatment plant.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 91 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 20 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 16 miles of fiber optic cable and 2 miles of transmission piping.

Example of Recovery Well

See Figure 2–8 for general layout of the project and phased implementation.

2.3.5.1.3 __100/50 ASR Option__

This option would capture 100 MGD of induced infiltration water and 50 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be directly recharged into the Equus Beds aquifer while the captured surface water would be treated before being recharged into the aquifer. An additional 60 MGD of surface water, if necessary, could be diverted from the Little Arkansas River, pretreated in a new pre-sedimentation plant and conveyed to the City's water treatment facility.

With the 100/50 ASR Option, 70 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The induced infiltration wells would be divided into 3 well fields, 1 well field of 28 wells and 5.6 miles of transmission pipeline and 2 well fields of 21 wells and 4.2 miles of transmission pipeline each. Other facilities necessary for the operation of the well and pipeline system would be immediately adjacent to the riparian vegetation in agricultural fields, including a gravel access road immediately adjacent to the wells and pipelines. The bank storage water would be moved via 42 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 28 new recharge well sites, and 9 recharge basins in the Equus Beds Well Field at existing water supply well sites.

A new surface water intake near Sedgwick, Kansas would directly remove 50 MGD of water from the Little Arkansas River. Approximately 2 miles of pipeline would transfer this untreated surface water to a pre-sedimentation plant; another 8 miles of pipeline would transfer the treated water to 12 new recharge basins in the Equus Beds Well Field.

Figure 2-7 60/90 ASR Option Layout and Implementations

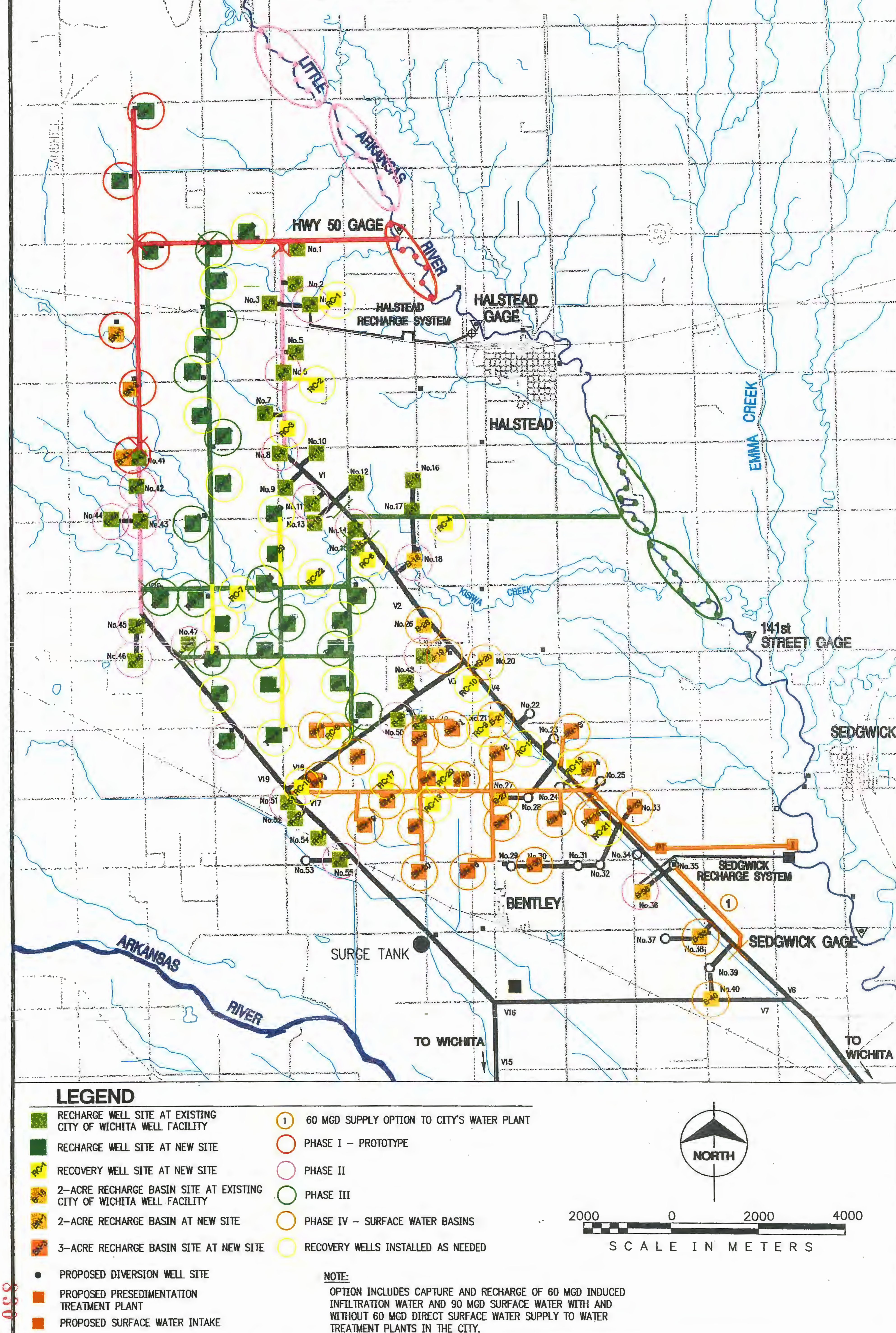
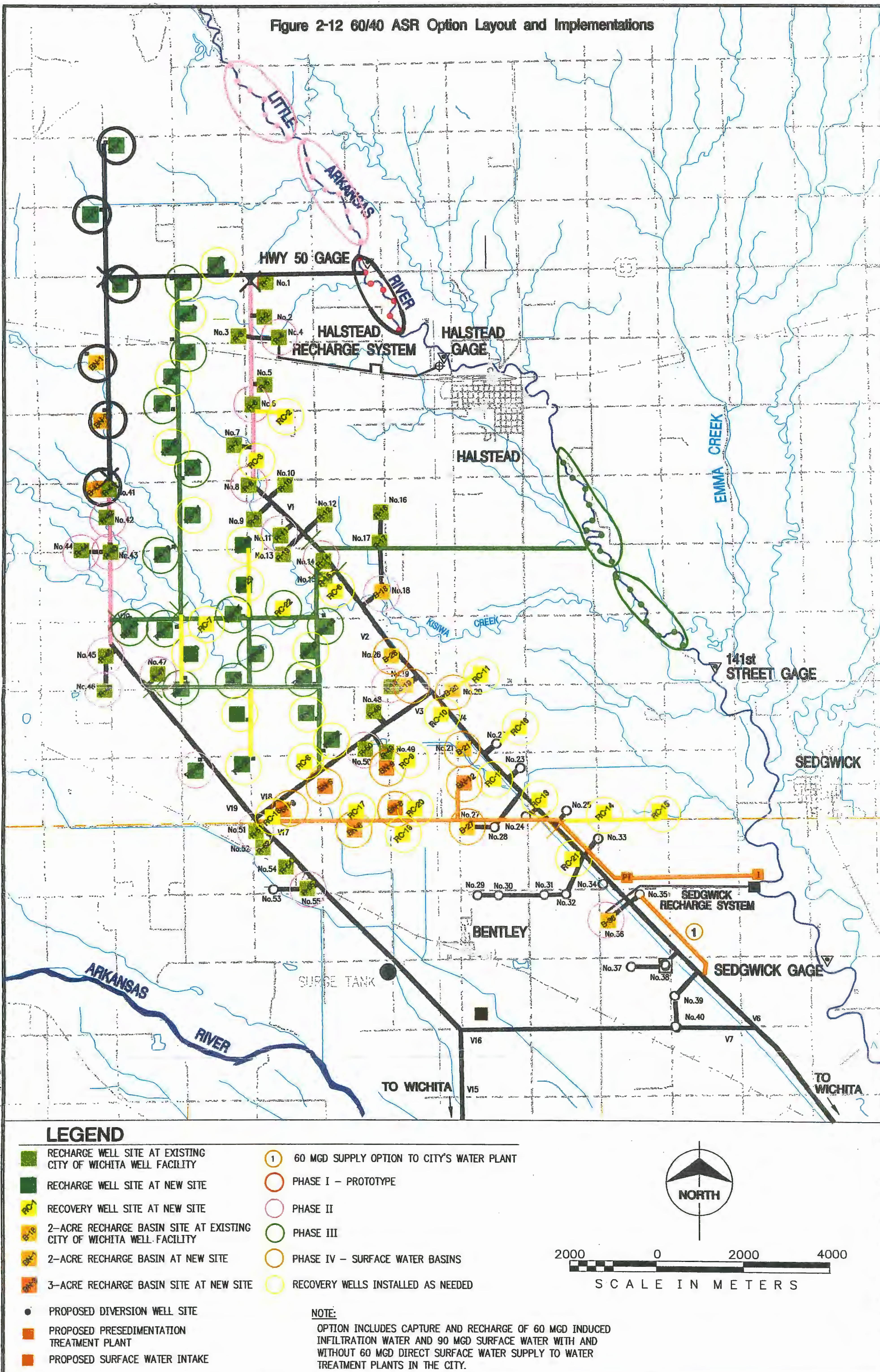


Figure 2-12 60/40 ASR Option Layout and Implementations



existing pipe to the City of Wichita's water treatment plants for further treatment and distribution.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 71 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 21 recovery wells would be required to meet the projected year 2050 maximum dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 9 miles of fiber optic cable and 2 miles of transmission piping.

Figure 2–13 illustrates the general layout of the project option and implementation of the construction.

2.3.5.2.3 <u>100/0 ASR Option</u>

This option would capture 100 MGD of induced infiltration water during above base flow conditions. No surface water from the Little Arkansas River will be used for recharge. All of the water removed using the induced infiltration wells would be used to recharge the Equus Beds aquifer. This option includes an option to capture an additional 60 MGD of surface water from the Little Arkansas River, which would be conveyed through a new pre-sedimentation plant and on to the City's water treatment facility.

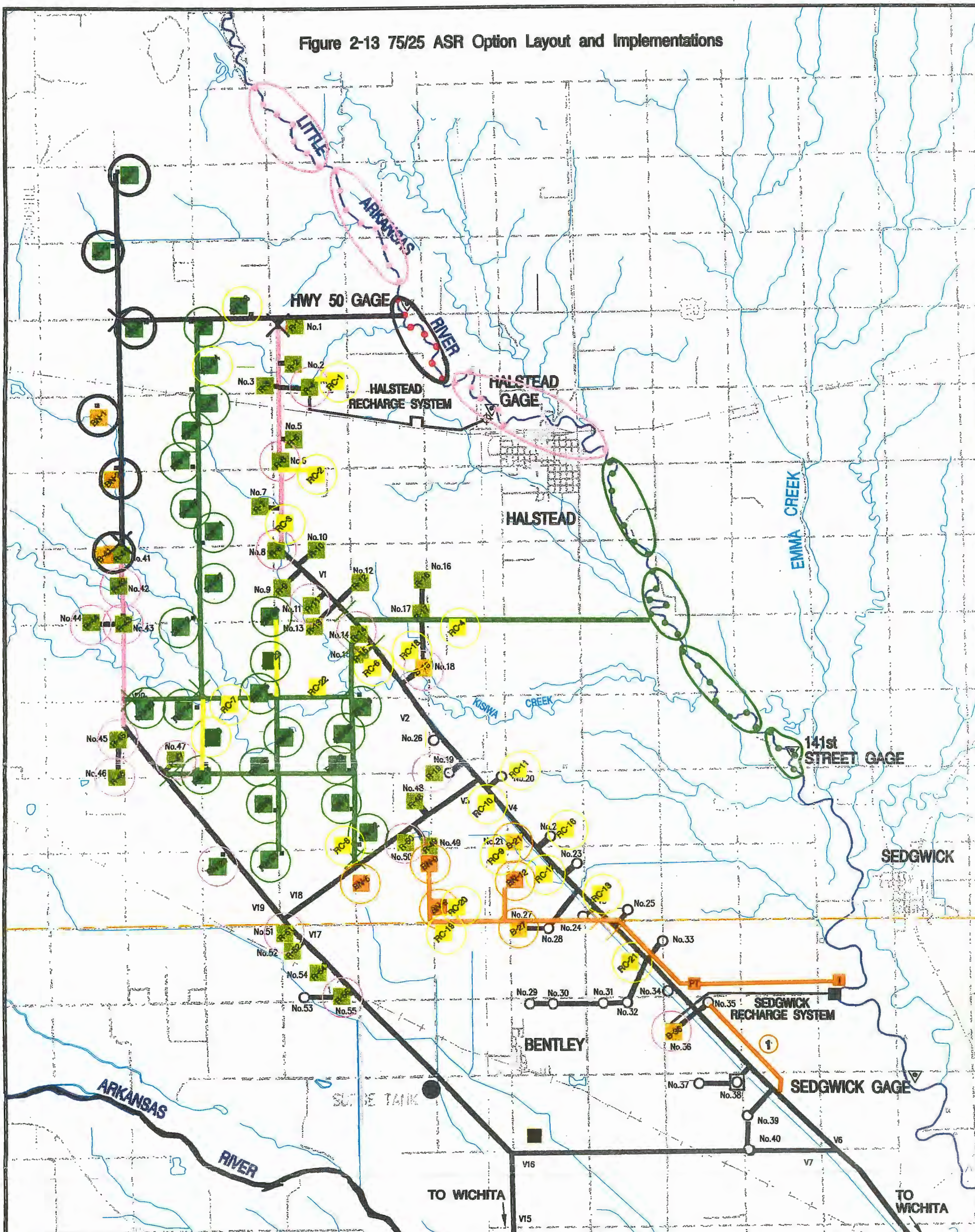
With the 100/0 ASR Option, 70 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The induced infiltration wells would be divided into three well fields, one well field of 28 wells and 5.6 miles of transmission pipe and two well fields of 21 wells and 4.2 miles of transmission pipe each. A transmission pipe would connect each group of induced infiltration wells to the Equus Beds Well Field, and a gravel access road would be located immediately adjacent to the wells and pipelines. Other facilities necessary for the operation of the well and pipeline system would also be immediately adjacent to the riparian vegetation in agricultural fields. The "bank storage" water would be moved via 47 miles of pipeline to 16 recharge wells at existing City of Wichita well sites, 28 new recharge well sites, and 11 recharge basins at existing water supply well sites.

An optional surface water intake near Sedgwick, Kansas, would directly remove 60 MGD of water from the Little Arkansas River. The surface water passes through 2 miles of pipe to the pre-sedimentation plant, and is then piped 2 miles to existing pipe and onto the City of Wichita's water plants for further treatment and distribution.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 89 miles of fiber optic cable along new and existing pipe alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 21 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed

Figure 2-13 75/25 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- (1) 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

between 2010 and 2050 and require additional SCADA radio/antenna equipment, 23 miles of fiber optic cable and 1 mile of transmission piping. Figure 2–14 illustrates the general layout of the project option and implementation.

2.3.5.2.4 <u>100 MGD ASR Option Implementation</u>

The implementation for each of the three options is very similar. Each option implementation has four phases. Phase 1 through Phase 3 are basically the same for each option but differ in the numbers of recharge wells and basins and the amount of piping as well as the capacity and number of induced infiltration wells required. Phase 4 of the 100/0 ASR option contains several additional tasks similar to Phase 3. Table 2–5 details the number of wells, recharge basins, miles of pipe and fiber optic cable, and size of intake structure for each of the options per phase.

Phase 1 includes the construction of the ASR prototype and would contain the following components:

- installation of induced infiltration (diversion) wells, transmission piping and overhead power lines;
- transmission piping to the recharge facilities using various diameter pipes;
- installation of recharge wells at new sites (RN wells);
- installation of recharge basins, at new sites (BN) and existing sites (B); and
- SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable placed along pipe alignments.

Phase 2 - includes the installation of additional diversion wells, recharge wells at existing sites, use of recent redrilled wells with let-down casings, use of the existing demonstration project recharge facilities, and expanded use of the transmission piping installed in Phase 1.

Phase 3 - includes installation of additional diversion wells, recharge wells at new sites, and additional transmission piping.

Phase 4 - includes construction of a surface water intake, pretreatment plant and additional recharge basins.

Recovery wells would be required to supply raw water to the City's water plants to meet maximum day demands during dry worst case conditions. The schedule for the installation of recovery wells for the 60/40 ASR Option is listed in Table 2–5.

2.3.5.2.5 <u>100 MGD ASR Alternative Costs</u>

The construction costs for this alternative is estimated to range from $307.0 to $283.5 million depending on which option is used and whether 60 MGD is diverted to the City 's Water Treatment Plant (2000 dollars). Annual OMR&E costs are estimated to range from $5.82 to $3.50 million (2000 dollars) depending on which sub-option is used and whether 60 MGD is diverted to the City 's Water Treatment Plant (2000 dollars). Table 2–6 provides the construction and OMR&E costs for each option.

2.3.6 <u>NO-ACTION</u>

The No-action alternative is an essential part of every Environmental Impact Statement (EIS) as set forth in the National Environmental Policy Act of 1969 (NEPA). In terms of NEPA, the "No-action" alternative is defined as how the project need would be met with the

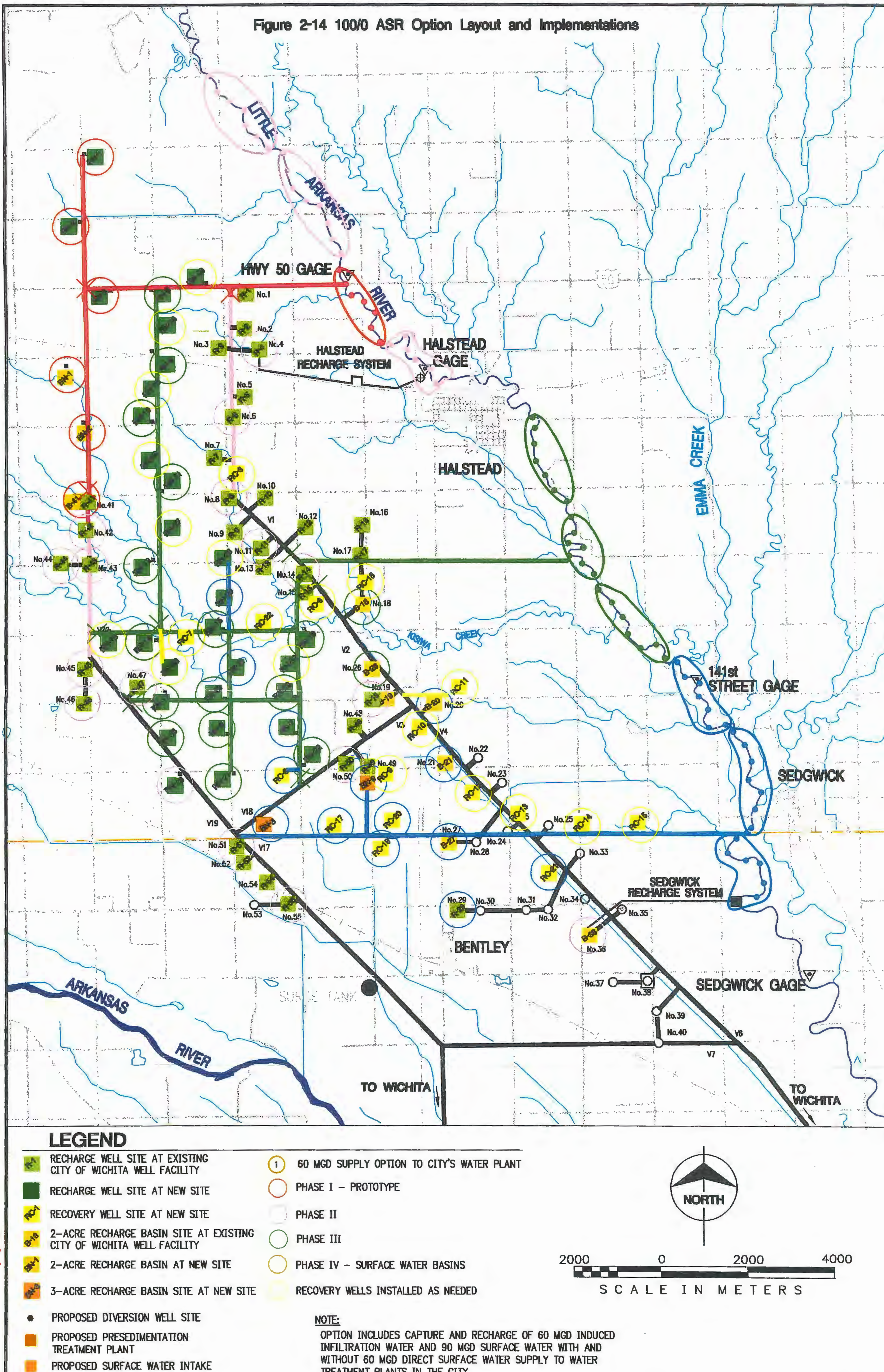


Figure 2-14 100/0 ASR Option Layout and Implementations

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Table 2-5 100 MGD Alternative - Options Phase Implementation

Phases	60/40 Option							75/25 Option							100/0 Option						
Phase 1																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines	10 MGD			7				10 MGD			7				10 MGD			7			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	1.2	1.4	0.4	3	1	1	2	1	1	0.2	3.6	1.4	1	2	1	1	0.2	3.6	1.4	1	2
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells	3							3							3						
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins	2			1				2			1				2			1			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	10							11							11						
Phase 2																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines	20 MGD			14				30 MGD			21				30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	0.2	0.2	5.2	0.6	1			0.4	0.8	6	1.6	1			0.4	0.8	5.9	0.6	1		
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells	1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4			
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins				1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	21							25							24						
Phase 3																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines	30 MGD			21				35 MGD			25				30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	0.4	2.8	8.7	2.6	4.4		4	0.9	3.3	8.7	3.3	4.6		4	0.9	3.3	8.7	3	4.2		4
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells	14							23							16						
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins																		2			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	12							21							13						
Phase 4																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines															30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)															1.4	1.8	1.7	0.6	0.6	4.5	3
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells															8			1			
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins	6			5				4			2				2			3			
Installation of surface water intake, transmission piping from the intake to the pre-sedimentation plant, and overhead power lines	100 MGD Intake Structure Capacity							85 MGD Intake Structure Capacity							60 MGD Intake Structure Capacity						
	12"	16"	24"	30"	36"	48"	54"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the pre-sedimentation plant to the recharge basins (in miles)		1.5				4.5	1.5		1.5		2.5			6							
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the pre-sedimentation plant to City's water treatment plant (in miles)							2							2							2
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	29							22							33						

Recovery Wells

Installation of future recovery wells	Number of Wells	Number of Wells	Number of Wells
2010	0	0	0
2020	6	0	0
2030	9	4	4
2040	8	9	9
2050	8	8	8
Installation of fiber optic cable (in miles)	5	9	23
Installation of transmission piping (in miles)	5	2	1

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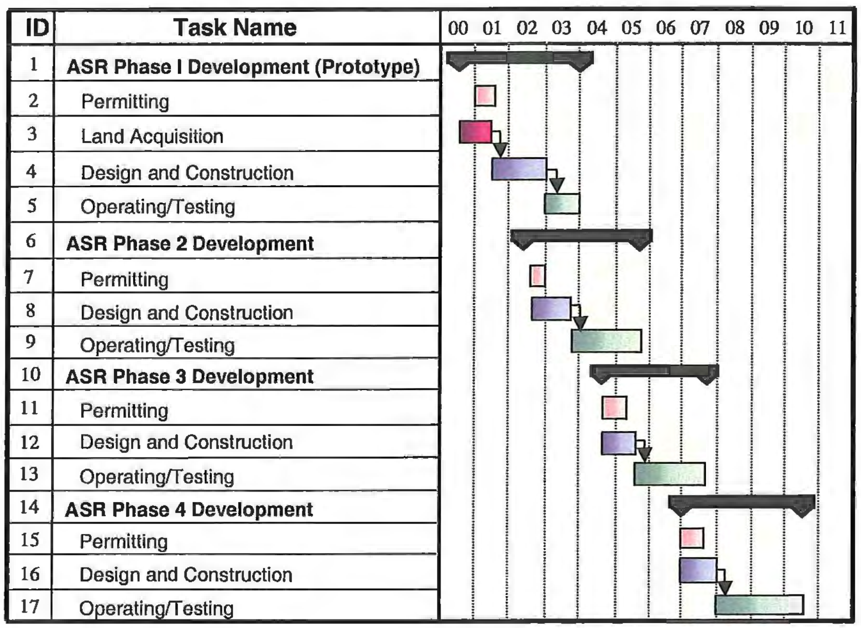
at new sites, and additional transmission pipe.

Phase 4 - includes construction of the surface water intake, pretreatment plant, and recharge basins.

Recovery wells would be required to supply raw water to the city's water plants to meet maximum day demands during worst case conditions. The schedule for the installation of recovery wells for the 60/90 ASR Option is listed in Table 2–3. The recovery wells would require additional SCADA radio/antenna equipment and fiber optic cable.

Figure 2-10 ASR Project Implementation Schedule



2.3.5.1.5 <u>150 MGD ASR Alternative Costs</u>

The estimated construction costs for this alternative range from $334 to $312 million (2000 dollars) depending on which option is used and whether 60 MGD is diverted to the City's Water Treatment Plant (Table 2-4). Annual operation, maintenance, and energy (OMR&E) costs are estimated to range from $6.82 to $5.24 million (2000 dollars) depending on which option is used and whether 60 MGD is diverted to the City 's Water Treatment Plant (2000 dollars).

2.3.5.2 Alternative 2 – 100 MGD ASR

This component consists of three options for capturing 100 MGD of above base flow water from the Little Arkansas River. This includes surface water intake, induced infiltration wells, facilities to transfer and recharge the captured water to the aquifer, and to recover the stored water. A pre-sedimentation plant is proposed to treat

Table 2-4 ILWSP 150 ASR Alternative Costs* per Option

Option	Construction Costs		OMR&E Costs	
	With 60 MGD	Without 60 MGD	With 60 MGD	Without 60 MGD
60/90	$333,300,000	$314,700,000	$6,823,000	$5,909,000
75/75	$332,300,000	$312,700,000	$6,541,000	$5,614,000
100/50	$334,000,000	$314,200,000	$6,169,000	$5,239,000

*Note these cost include all the components of the ILWSP.

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surface water before recharging into the aquifer or piping to the City's water treatment plants.
Each of the three options are considered with and without capturing and diverting 60 MGD of treated surface water to the City's treatment facilities. Only 100 MGD of above base flow from the Little Arkansas River would be captured without the additional 60 MGD surface water intake. This 100 MGD of captured water would be used for recharge, storage, and recovery in the Equus Bed aquifer.

Options to Alternative 2 for a 100 MGD capture and recharge system include:

- 60/40 ASR Options: Capture of 60 MGD of induced infiltration water for recharge and 40 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities.
- 75/25 ASR Options: Capture of 75 MGD of induced filtration water for recharge and 25 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities.
- 100/0 ASR Option: Capture of 100 MGD of induced infiltration water for recharge and no surface will be used for recharge; however, there is an additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities. The pre-sedimentation plant in this plan could be located adjacent to the Central Water Treatment Plant.

Figure 2–11 illustrates each of the three options.

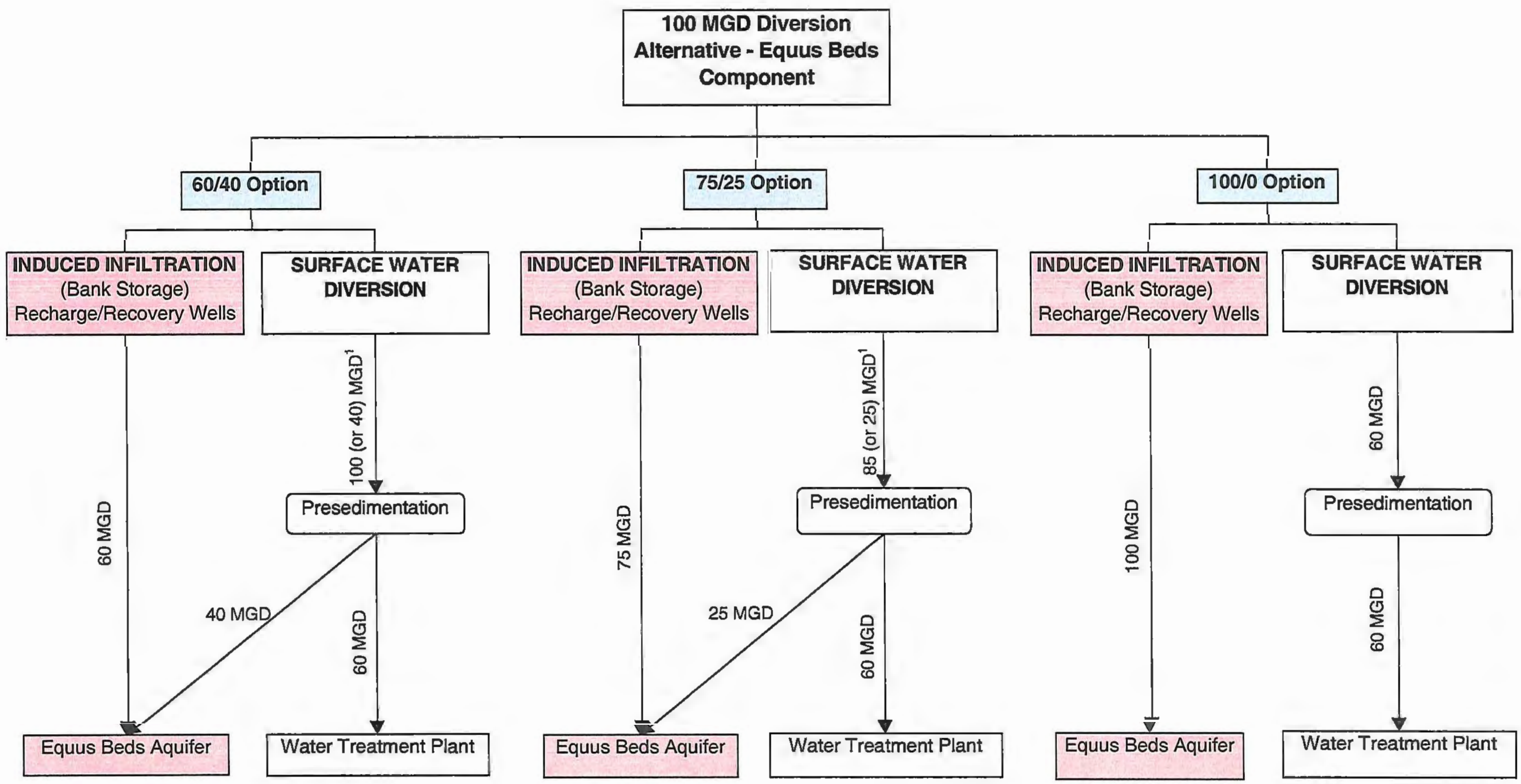
2.3.5.2.1 <u>60/40 ASR Option</u>

This option would capture 60 MGD of induced infiltration groundwater and 40 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be recharged into the Equus Beds aquifer while the captured surface water would be pretreated before recharge into the aquifer. An additional 60 MGD of surface water, if necessary, would be diverted from the Little Arkansas River, piped to a new pre-sedimentation plant and then conveyed to the City's water treatment facilities.

With the 60/40 ASR Option, 42 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The 42 induced infiltration wells would be divided into two groups of 21 wells with each well field requiring 4.2 miles of transmission pipe. A transmission pipe connects each group of 21 induced infiltration wells to the Equus Beds Well Field, and a gravel access road is immediately adjacent to the wells and pipelines. Other facilities necessary for the operation of the wells and pipeline system are located immediately adjacent to the riparian vegetation in the agricultural fields. The bank storage water would be moved via 42 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 18 new recharge well sites, and 4 recharge basins in the Equus Beds Well Field near existing water supply wells.

A surface water intake near Sedgwick, Kansas, would directly remove 40 MGD of water from the Little Arkansas River. Approximately 2 miles of pipe would

Figure 2-11 100 MGD ASR Alternative Options



1. Each of the three options is considered with and without 60 MGD of treated surface water to be conveyed to the City treatment facilities. Therefore, the amount diverted increases when 60 MGD is conveyed to the City.

transfer this untreated surface water to a pre-sedimentation plant; another 7.5 miles of pipeline transfers the pretreated water to 12 new recharge basins in the Equus Beds Well Field. If the option of diverting an additional 60 MGD of surface water is implemented, then a total of 100 MGD of water would be diverted from the river. The additional flow would be piped approximately 2 miles through new pipe to a pre-sedimentation plant for pretreatment. The pretreated water is then conveyed 2 miles to existing pipe, which would carry the water to the City's water treatment facilities.

Also required are overhead power lines and SCADA system, including a radio/antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 62 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 31 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 5 miles of fiber optic cable and 5 miles of transmission piping.

See Figure 2–12 for an illustration depicting the general layout of the project option and implementation.

2.3.5.2.2 75/25 ASR Option

This option would capture 75 MGD of induced infiltration water and 25 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be used to recharge the Equus Beds aquifer while 25 MGD of captured surface water would be pretreated for recharge into the aquifer. This option includes the possibility of an additional 60 MGD of surface water to be treated and conveyed to the City's water treatment facility.

With the 75/25 ASR Option, 53 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The 53 induced infiltration wells would be divided into two groups of 28 and 25 wells with the well fields using 5.6 and 5.0 miles of transmission pipeline, respectively. A transmission pipe would connect each group of induced infiltration wells to the Equus Beds Well Field, and a gravel access road would be immediately adjacent to the wells and pipelines. Other facilities necessary for the operation of the well and pipeline system would be immediately adjacent to the riparian vegetation in agricultural fields. The bank storage water would be moved via 34 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 27 new recharge well sites, and 4 recharge basins.

A diversion facility near Sedgwick, Kansas would directly remove 25 MGD of water from the Little Arkansas River via a new surface water intake. Approximately 2 miles of pipeline transfer this untreated surface water to a proposed pre-sedimentation plant; another 10 miles of pipeline would transfer 25 MGD of the treated water to 7 new recharge basins in the Equus Beds Well Field. If selected, an additional 60 MGD of surface water could be diverted from the Little Arkansas River, pass through 2 miles of pipe to the pre-sedimentation plant, and then through

Table 2-6 ILWSP 100 ASR Alternative Costs per Option

Option	Construction Costs		OMR&E Costs	
	With 60 MGD	Without 60 MGD	With 60 MGD	Without 60 MGD
60/40	$305,900,000	$285,300,000	$5,815,000	$4,877,000
75/25	$303,800,000	$283,500,000	$5,600,000	$4,643,000
100/0	$307,000,000	$285,400,000	$4,473,000	$3,497,000

Note these costs include all ILWSP components in 2000 dollars.

status quo. In this case, the No-action alternative is defined as no construction and no provision of an expanded water supply to meet projected population growth needs. The No-action alternative is included to help establish the baseline from which the final action alternatives are evaluated. Water conservation alternatives have also been included in the EIS as a result of input received during project scoping meetings.

The No-action alternative reduces the net water need through self-imposed growth limitations. The City would continue water service to their existing retail and wholesale customers, but would not serve any additional wholesale customers, and would not provide for projected population increases outside of their existing service area.

2.4 SUMMARY OF ENVIRONMENTAL IMPACTS

Chapter 4 identifies the environmental impacts associated with the proposed action. Table 2–7 summarizes the impact of the proposed actions and the No-action alternatives at Wichita, Kansas in the area of the Equus Beds Well Field, Bentley Reserve Well Field, Cheney Reservoir and along the Little Arkansas River. No significant impacts are expected for the evaluated resources from water conservation or the No-action alternative.

2.5 PREFERRED ALTERNATIVE

The City of Wichita's preferred alternative is the ILWSP with 100 MGD ASR with the 75/25 ASR Option. The ILWSP would help to preserve the Equus Beds aquifer for use by future generations. Recharging the aquifer would protect the ground water from chloride plumes migrating towards the well field and provide a large volume of stored groundwater for future use.

Table 2-7 Summary of Beneficial and Adverse Environmental Impacts

Resources	Integrated Local Water Supply Plans		No-Action
	150 MGD Diversion Alternative	100 MGD Diversion Alternative	
Geology	Minor surface changes due to excavation of foundations and access road.	Minor surface changes due to excavation of foundations and access road	None
Soils	Temporary soil disturbance and increased erosion potential during construction.	Temporary soil disturbance and increased erosion potential during construction.	None
Land Use	Conversion of approximately 200 acres in the area of the Equus Beds Well Field to non-farm use.	Conversion of approximately 200 acres in the area of the Equus Beds Well Field to non-farm use.	Slow current rate of conversion from agricultural lands to residential developments.
Water Resources *Surface Water* Quantity			
Little Arkansas River	Above Wichita, low flows will increase. Median flows will increase, except during May and June when the flows will decrease. High flows will remained unchanged. Below local well field expansion, flow will be reduced to 20 cfs 80 percent of time.	Above Wichita, low flows will increase. Median flows will increase, except during May and June when the flows will decrease. High flows will remained unchanged. Below local well field expansion, flow will be reduced to 20 cfs 80 percent of time.	Lower flows that occur a majority of the time will continue to decline.
Arkansas River	The median flows will be equal expect in June when the flow would decrease due to diversion of water for recharge.	The median flows will be equal expect in June when the flow would decrease due to diversion of water for recharge.	None
Ninnescah River Basin	Flows will increase downstream of Cheney Reservoir during more frequent reservoir releases.	Flows will increase downstream of Cheney Reservoir during more frequent reservoir releases.	Flows will decrease due to less frequent releases from Cheney Reservoir.
Cheney Reservoir	Increased volume of water stored in reservoir.	Increased volume of water stored in reservoir.	Decrease in volume of water stored in reservoir.
Surface Elevations and Depths			
Little Arkansas River	Median water levels and depths will increase 0.1 foot in most months.	Median water levels and depths will increase 0.1 foot in most months.	Median water levels will decrease 0.05 foot every month.
Arkansas River	Median stage values will decrease 0.2 foot each month.	Median stage values will decrease 0.2 foot each month.	Median river stages will decrease 0.05 – 0.20 foot.
Ninnescah River	None	None	Slight decrease in median stages in some months.
Cheney Reservoir	Water Levels will be 0.4 - 0.6 foot higher.	Water Levels will be 0.4 - 0.6 foot higher.	Water levels will be 2-3 feet lower.
Quality			
Little Arkansas River	None	None	Decrease in groundwater discharge, reducing quantity of better-quality water.

Table 2-7 Summary of Beneficial and Adverse Environmental Impacts

Resources	Integrated Local Water Supply Plans		No-Action
	150 MGD Diversion Alternative	100 MGD Diversion Alternative	
Arkansas River	Total dissolved solids concentrations will increase by 6 percent, suspended sediment will increase by 4 percent, and chloride concentrations will increase by 7 percent.	Total dissolved solids concentrations will increase by 6 percent, suspended sediment will increase by 4 percent, and chloride concentrations will increase by 7 percent.	None
Ninnescah River	None	None	Water releases from Cheney Reservoir will decline, providing less water for dilution downstream.
Cheney Reservoir	Slight improvement due to more water in storage.	Slight improvement due to more water in storage.	Modest decline in water quality due to less storage.
Groundwater			
Water Levels			
Equus Beds aquifer	Water levels are generally higher and recover faster after drought.	Water levels are generally higher and recover faster after drought.	Water levels decline with little hope of recovering.
Little Arkansas River alluvium	Declines up to 30 feet adjacent to operating wells but wells do not operate continuously and water levels recover quickly when wells are inactive.	Declines up to 30 feet adjacent to operating wells but wells do not operate continuously and water levels recover quickly when wells are inactive.	None
Arkansas River alluvium	Declines up to 30 feet within Bentley Reserve well field but these wells will be operated infrequently.	Declines up to 30 feet within Bentley Reserve well field but these wells will be operated infrequently.	None
Quality			
Equus Beds aquifer	Infiltration rate and rate of salinity contamination will decrease.	Infiltration rate and rate of salinity contamination will decrease.	Infiltration rate and rate of salinity contamination will increase dramatically.
Little Arkansas River alluvium	None	None	None
Arkansas River alluvium	None	None	None
Water Rights	None	None	None
Air Quality	Temporary localized increases in NOx, CO, SO_2, and PM_{10} during construction.	Temporary localized increases in NOx, CO, SO_2, and PM_{10} during construction.	None
Noise	Temporary localized increased level during construction.	Temporary localized increased level during construction.	None
Biological Resources			None
Wetlands	Temporary impact due to construction	Temporary impact due to construction	None
Vegetation	Permanent loss of 360 acres of vegetation	Permanent loss of 266 acres of vegetation	None
Wildlife	Temporary displacement of species during construction.	Temporary displacement of species during construction.	None
Fish			
Little Arkansas River	Slight decrease in habitat due to periodic water diversion	Slight decrease in habitat due to periodic water diversion	None

Table 2-7 Summary of Beneficial and Adverse Environmental Impacts

Resources	Integrated Local Water Supply Plans		No-Action
	150 MGD Diversion Alternative	**100 MGD Diversion Alternative**	
North Fork Ninnescah River	Slight increase in habitat due to increased frequency of discharge	Slight increase in habitat due to increased frequency of discharge	None
Arkansas River	Slight decrease in habitat immediately below confluence with the Little Arkansas River due to periodic decrease in flows in the Little Arkansas River.	Slight decrease in habitat immediately below confluence with the Little Arkansas River due to periodic decrease in flows in the Little Arkansas River.	None
Threatened, Endangered, and Candidate Species	Temporary displacement of species during construction.	Temporary displacement of species during construction.	None
Species of Special Concern	Temporary displacement of species during construction.	Temporary displacement of species during construction.	None
Socioeconomics			
Population and Housing	Facilitation of the current trend in population growth and new housing.	Facilitation of the current trend in population growth and new housing.	Slowing of population growth with decline in quality of life, discourage in-migration and encourage out-migration of residents and businesses.
Economic Activity	Provide temporary employment during construction; facilitate continued expansion of area economy.	Provide temporary employment during construction; facilitate continued expansion of area economy.	As water shortages become common, water prices would rise and discourage future business expansion or relocation.
Public Services	Temporary increase in traffic density on rural roads in Sedgwick and Harvey counties, as well as city streets in the vicinity of the Local Well Field.	Temporary increase in traffic density on rural roads in Sedgwick and Harvey counties, as well as city streets in the vicinity of the Local Well Field.	Limited water supplies resulting in population and economic decline could limit local tax revenues for public services.
Environmental Justice	None	None	None
Cultural Resources	No known site would impacted; unknown sites would be avoided	No known site would impacted; unknown sites would be avoided	None
Visual Resources	Increase of structures to landscape and creation of night lighting in area of pre-sedimentation plant.	Increase of structures to landscape and creation of night lighting in area of pre-sedimentation plant.	None
Recreational Resources	More consistent lake levels in Cheney Reservoir provide for better recreational opportunities.	More consistent lake levels in Cheney Reservoir provide for better recreational opportunities.	Lower lake levels would limit use of recreational activities at Cheney Reservoir.

CHAPTER 3

AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The purpose of Chapter 3 is to describe the natural resources, such as geology, water, vegetation, and wildlife; and the human resources, such as socioeconomics and cultural resources, of the areas which could be affected by the proposed project. These discussions will address the natural resources of the affected areas for each of the alternatives carried forward from Chapter 2. The affected environment for the ILWSP 150 MGD Option and the 100 MGD Option is within four counties: Sedgwick, Harvey, Reno, and Kingman. Within Sedgwick and Harvey counties, the affected environment is the Equus Beds Well Field, Bentley Reserve Well Field, and Local Well Field. Within most of Reno County, and small portions of Kingman and Sedgwick Counties is Cheney Reservoir. In the case of human resources, the relevant affected environment study area is the Wichita metropolitan area. Discussions of the affected environments will be restricted to only what is relevant.

3.2 GENERAL SETTING

The project area includes and surrounds the City of Wichita in south-central Kansas. The majority of the project area is in Sedgwick, Harvey, and Reno counties, with a small portion lying in Kingman County.

Geographically, the City of Wichita is centered on the confluence of the Little Arkansas and Arkansas rivers, which enter the City from the north and northwest, respectively. The North Fork of the Ninnescah River and Cheney Reservoir are approximately 20 miles west of the City. The mainstem of the Ninnescah River is located approximately 15 miles southwest of the City, and empties into the Arkansas River about 30 miles south of the City of Wichita.

The project area is in the mixed grass prairie vegetation region. Today, agriculture and urban development have replaced most of the natural vegetation. Land in the project area is primarily used for agricultural activities. These activities include growing crops, raising livestock, and producing hay and pasture. Reservoirs and rivers in the project area are used for recreational activities such as fishing, boating, and swimming.

Topography. The topography varies from extremely flat areas along the major rivers to gently rolling uplands adjacent to the river lowlands. Drainage for this area is by way of the Arkansas River and its tributaries. Surface elevations range from approximately 1,200 feet above mean sea level (msl) in the valleys to 1,600 feet msl on the high plains.

Climate. The climate in the area is characterized by daily and seasonal variations. The winters are cold and typically last from December to February. Hot humid summers last for approximately six months while spring and fall are short transitional seasons between winter and summer. Thunderstorms, tornadoes, and drought characterize the general precipitation regime in the area. The average annual precipitation for Wichita is 29.33 inches (Slater and Hall 1996). The average temperature in the area is 68.1 degrees Fahrenheit (°F) with extreme lows of -10°F and highs of 108°F.

3.2.1 GEOLOGY

The physiographic regions in the project area include the Flint Hills, High Plains, Arkansas River Lowlands, and Wellington McPherson Lowlands.

Permian-age limestone and shale underlie the Flint Hills region. The limestone in the Flint Hills contains numerous bands of chert and flint deposited 245 to 286 million years ago, during the Permian Period, when shallow seas covered a large portion of the state (Kansas Geological Survey 1999).

The High Plains region formed from eroded material carried into the area primarily by streams from the Rocky Mountains to the west approximately 1.6 to 66 million years ago. This mass of eroded gravel, sand, and other rock debris that lies below the surface in the High Plains is known as the Ogallala Formation (Kansas Geological Survey 1999). In the study area, this formation is comprised predominantly of unconsolidated material.

The Arkansas River Lowland and Wellington-McPherson Lowland regions have very similar geographic characteristics. The regions are relatively flat, alluvial plains comprised of sand, silt, and gravel that was deposited by streams and rivers. The Arkansas River Lowland was formed during the last 10 million years while the Wellington-McPherson Lowland was formed between 1 and 2 million years ago. The Wellington-McPherson region is comprised of alluvial material which overlays the Hutchinson salt bed, one of the largest salt beds in the world (Kansas Geological Survey 1999). The salt bed is thought to extend as deep as 400 feet and is found under much of central Kansas. The unconsolidated alluvial material contains the Equus Beds aquifer which, is an important source of water for Wichita and the surrounding communities. The aquifer is comprised of saturated sand, silt, and gravel deposited during the Pliocene and Pleistocene Age.

3.2.2 SOILS

Soil is defined as a collection of natural bodies composed of mineral, organic, and living materials that have the capability to support plant life (Soil Conservation Service 1971, 1974). Soil properties are the result of the integrated effects of climate and living matter acting upon parent material over periods of time. When similar soil properties occur in the same area, a soil association is formed.

A soil association is a group of soils geographically associated in a characteristic repeating pattern, defined and described as a single map unit. An association normally consists of one or more major soils and at least one minor soil. The name of the association is derived from the composition of the major soils. Each association has distinctive soil type, relief, and drainage.

The soil associations identified in the project area are described below by county.

Sedgwick County. The project area in Sedgwick County consists primarily of the Equus Beds aquifer and a small portion of Cheney Reservoir dam. Approximately 82 percent of Sedgwick County is covered by soils classified as prime farmland. Sedgwick County has four soil associations within the project area (SCS 1979). The bottomlands adjacent to the Little Arkansas River and North Fork of the Ninnescah consist of the Elandco-Canadian-Elandco soil association. These alluvial soils are deep, nearly level, and well-drained with loamy subsoil. They occupy about 8 percent of the county and are mainly used for growing cultivated crops.

The soil associated with the Arkansas River is of the Lesho-Lincoln-Canadian association. These alluvial soils are shallow to deep, nearly level, moderately poorly to excessively well-drained, and have a sandy subsurface. This association also makes up 8 percent of the county and growing cultivated crops is the main use.

Another soil association in the Arkansas River valley is the Naron-Farnum-Carwile association. These old alluvial soils consists of deep, nearly level, poorly- to well-drained soils, which have a loamy subsurface. This association covers about 9 percent of the county and is mainly used for growing cultivated crops.

A small amount of the Goessel-Tabler-Farnum association exists in the project area south of the town of Sedgwick. These alluvial soils are deep, nearly level, gently sloping, and moderately drained to well-drained, with a clay- to loam-like subsoil. It covers 9 percent of the county and is used mainly to grow cultivated crops.

Harvey County. The project area in Harvey County consists of the Equus Beds. Within Harvey County, there are five soil associations that are in the project area (SCS, 1974). The Farnum-Slickspots-Naron association is found in southwest Harvey County. It consists of deep, nearly level to gently sloping, poorly to well-drained loams and fine sandy loams. This association occupies about 10 percent of the county and is commonly used to grow wheat and sorghum.

The floodplain of the Little Arkansas River consists of the Detroit-Hobbs association. These soils are deep, nearly level, well-drained silt and silty clay loams. This association occupies about 6 percent of the county. Almost all of this association is cropland mainly used for growing wheat and sorghum.

The Crete-Ladysmith association is found west of the Little Arkansas River. The soils are deep, nearly level to gently sloping, moderately well-drained to well-drained silt, and silty clay loams on uplands. This association is in the western part of the county on broad ridges and side slopes. It occupies about 13 percent of the county. About 90 percent of this association is used for growing crops, primarily wheat and sorghum with some alfalfa. Small areas of native grass are scattered throughout the association.

The Carwile-Pratt association is scattered throughout the western portion of the project area in this county. It consists of deep, nearly level, poorly-drained fine sandy loams, and deep well-drained loamy fine sands on the uplands. This association is in four areas in the central and western parts of the county. It occupies about 7 percent of the county, most used for wheat and sorghum, with a small part in native grass.

The Farnum-Hobbs-Geary association contains deep, nearly level to gently sloping, well-drained loams and silt loams on both uplands and floodplains. This association is along streams in the central and eastern parts of the county. It occupies about 10 percent of the county and is mostly used for growing crops, such as wheat and sorghum. Approximately 72 percent of the surface area of Harvey County are covered by soils classified as prime farmland.

Reno County. The majority of Cheney Reservoir is in Reno County. There are two major soil associations around the reservoir (SCS, 1966). These include the Farnum-Shellabarger association and the Renfrow-Vernon association. The Farnum-Shellabarger association is deep brown loamy soils, which often overlay sandy/gravelly material on sloping, dissected plains. This association occupies a large area along the southern boundary of the county and is mainly used for cultivation of crops. The Renfrow-Vernon soils consist of deep and shallow reddish soils over clayey white shale. This association occupies a large area in the southeastern part of the county and consists of 85 percent Renfrow and Vernon and 15 percent minor soils. The main use is cultivation of crops. Approximately 67 percent of the surface area of Reno County is covered by soils classified as prime farmland.

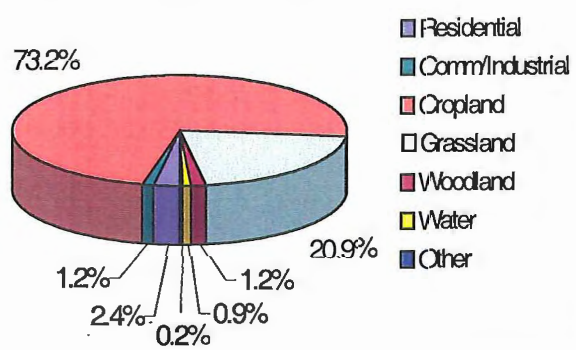
Kingman County. A small portion of Cheney Reservoir is located in the northeast corner of Kingman County. The soil in this area is of the Shellabarger-Milan-Renfrow association. These gently sloping soils are on the uplands and occupy the more sloping part of the landscape. They are primarily used for growing crops, but some small areas are still in native range.

3.2.3 LAND USE

Sedgwick, Harvey, and Reno counties have land areas totaling 1.8 million acres. The City of Wichita occupies approximately one-tenth of the area in Sedgwick County and is an important transportation and distribution center. The metropolitan area includes important industries such as production and refinery of petroleum products, military and private aircraft, chemical manufacturing, and milling and storage of grain.

Approximately 1.28 million acres of land in the above counties are used for growing crops. Wheat and sorghum are better suited for the climate of this area and have historically been the main crops harvested. Approximately 375,000 acres are used as pasture in the three counties. Raising livestock is an important source of income for the rural areas of the project area. Animals typically raised on farms in the area include cattle, swine, sheep and lamb, and poultry. The remainder of the land in these counties is in other uses such as woodland, urban, residential, and commercial development (Figure 3–1).

Figure 3-1 Land Cover Use for Affected Counties



Cheney State Park and Cheney Wildlife Management Area are both located at Cheney Reservoir approximately 25 miles west of Wichita. Cheney State Park land currently encompasses 1,913 acres while another 5,439 acres of land and 4,109 acres of water make up the Cheney Wildlife Management Area. Cheney Reservoir covers approximately 9,600 surface acres and has about 67 miles of shoreline. The State of Kansas Department of Wildlife and Parks (KDWP) lease all the land and surface water areas except for the reserved tracts.

A portion of the project area includes the Equus Beds well field in portions of Sedgwick and Harvey counties. The land use in this area is predominantly made up of croplands, warm season pasture, and riparian[1] woodlands. Small amounts of cool season pasture, native grassland, wood lots, fence rows, shelter belts, and residential areas can be found in the area. Approximately 10 acres are occupied by municipal well facilities.

3.3 WATER RESOURCES

The major water resources of the ILWSP project area include both surface and groundwater sources. The major components of these resources are discussed in the following sections.

3.3.1 SURFACE WATER

The principal streams of the ILWSP project area are the Arkansas River, the Little Arkansas River, and the North Fork of the Ninnescah River (North Fork). Both the Little Arkansas River and North Fork are tributaries of the Arkansas River.

3.3.1.1 General

The Arkansas River originates in the Rocky Mountains of central Colorado. From its headwaters in Colorado, it travels generally east to the ILWSP project area, and then turns southeast across the northeastern corner of Oklahoma before flowing through central Arkansas and joining the Mississippi River. Its drainage basin covers portions of Colorado, Kansas, Oklahoma, New Mexico, Texas, and Arkansas.

The major tributaries of the Arkansas River in Kansas are the Pawnee River, Walnut Creek, Rattlesnake Creek, Cow Creek, Little Arkansas River, Ninnescah River, and Walnut River. Flow in the Arkansas River is somewhat regulated by

[1] *Riparian* – pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water.

Arkansas River

John Martin Reservoir, which is located in Bent County, Colorado, and is also affected by extensive diversions for irrigation. The river has a predominantly sandy bottom.

The Little Arkansas River is found in five counties in south-central Kansas including Lyons, McPherson, Reno, Harvey, and Sedgwick counties. This river travels generally southeast from its headwaters near Geneseo to its confluence with the Arkansas River in Wichita. Major tributaries of the Little Arkansas River include Turkey, Kisiwa, Emma and Sand creeks. The river has a predominantly clayey bottom in the northern portion of the study area, becoming progressively sandier to the south. There are no large reservoirs in the Little Arkansas basin but discharge in

Little Arkansas River

the river is heavily influenced by diversions for irrigation and by groundwater withdrawals. There are also diversion structures located near Valley Center and Wichita that divert a portion of higher discharges into the Little Arkansas and Chisholm Creek Floodways. These floodways help alleviate flooding in the City of Wichita by diverting floodwaters to the Arkansas River.

The North Fork travels through five counties in south-central Kansas including Stafford, Pratt, Reno, Kingman and Sedgwick. From its headwaters in

North Fork of the Ninnescah River

Pratt and Stafford counties, the North Fork flows generally east and southeast to its confluence with the Ninnescah River in Sedgwick County. The streambed of the North Fork is predominantly sandy.

Cheney Reservoir is formed by a dam located on the North Fork about 15 miles upstream of its confluence with the Ninnescah River. The reservoir occupies land in Reno, Kingman and Sedgwick counties. The U.S. Bureau of Reclamation (Reclamation) began construction of Cheney Reservoir in 1962 and the first water was stored in the reservoir in November 1964. The reservoir is used as a water supply for the

Cheney Reservoir

City of Wichita, and for fish and wildlife conservation, flood control, and recreation.

Reclamation originally computed and published Cheney Reservoir's firm yield as 52,600 acre-feet per year. This firm yield number was based on streamflow data through May 1956, when Reclamation was required to finalize the various planning reports for the Wichita Project for submission to the U.S. Congress for project authorization. In the 1957 report that went to Congress, Reclamation stated that "as of May 1956, the critical period has not yet ended and the storage-yield relationship at Cheney Reservoir should be reviewed prior to construction in light of the hydrologic data available at that time."

The critical period subsequently ended in 1959. In 1960, Reclamation did review the complete critical period data and, using that data, recomputed a revised firm yield of 42,900 acre-feet per year for Cheney Reservoir.

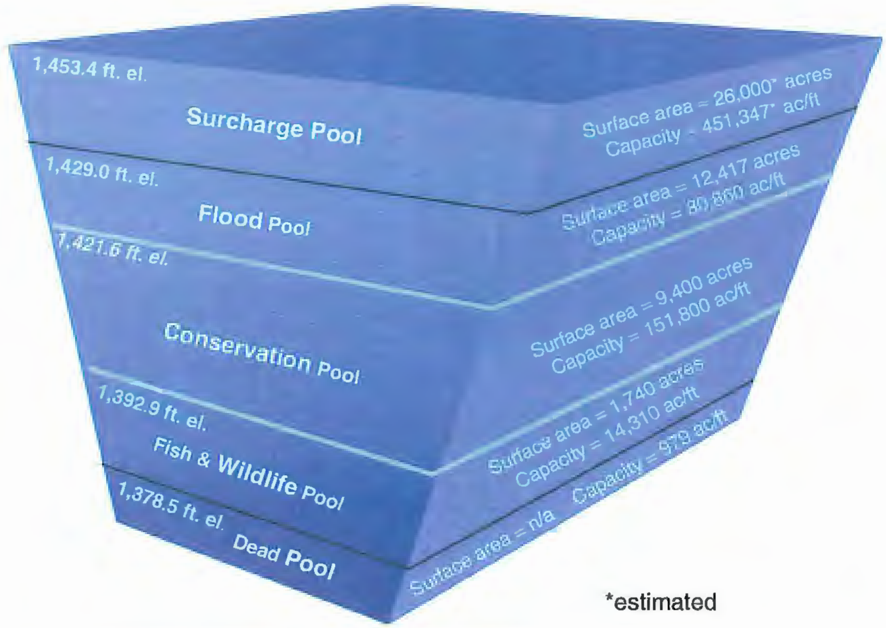
With the ILWSP in place, the City could operate Cheney Reservoir by withdrawing a daily maximum from the conservation pool of 47 MGD (the average daily equivalent of 52,600 acre-feet per year) rather than the 38.2 MGD (the average daily equivalent of 42,900 acre-feet per year). In theory, if all the firm yield assumptions are valid and the City were to pump 47 MGD from Cheney Reservoir during a "critical period", Cheney Reservoir would run out of water before the critical period ended.

The reservoir has a total storage of 566,300 acre-feet, which is allocated in a series of defined "pools" or areas as shown in Figure 3–2. Each pool serves a different purpose and is defined by top and bottom elevations developed during Reclamation's planning and design process for the Wichita Project. For example, the surcharge pool is designed to temporarily store flows from the probable maximum flood, a result from a worst-case storm; release of water from the surcharge pool would be directed by Reclamation. The flood control pool is positioned immediately beneath the surcharge pool and is designed to temporarily store flood waters that occur more commonly. The size of the flood control pool is determined by the amount of downstream flood protection benefits provided; releases from the flood control pool is directed by the U.S. Army Corps of Engineers (Corps). The conservation pool lies directly under the flood control pool and is designed to store municipal and industrial water for the City. The fish and wildlife pool or minimum pool lies under the conservation pool; and the last or dead pool is the lower most pool in the reservoir. No releases can be made from the dead pool, for it is located below the lowest release structure elevation (USGS 1999; Reclamation 2002).

3.3.1.2 Quantity

The quantity of water discharged to the Arkansas, Little Arkansas and North Fork rivers was estimated using streamflow data collected by the U.S. Geological

Figure 3-2 Cheney Reservoir Storage Pools



*estimated

Survey (USGS). The USGS has operated stream gaging stations at several locations in the ILWSP project area. Those of interest in this analysis are listed in Table 3–1, along with other pertinent data on these gages. The locations of these gages are shown on Figure 3–3. The recorded streamflow data available at these gages were used to develop a set of historic flow data with a common period of record for use in an operations model for the ILWSP project. This common period of record was water years 1923–1996 (October 1, 1922–September 30, 1996).

The flow discharge in project area streams is primarily a function of direct runoff, which results due to precipitation that falls within the stream's watershed. As a result, the rate of discharge in these streams is highly variable and can change dramatically from day-to-day as well as seasonally and annually. Figure 3–4 contains graphs of the historic annual discharge in the Little Arkansas, Arkansas and North Fork rivers which illustrates this variability on an annual basis. Review of these graphs will show the drought periods of the 1930's and mid-1950's contrasted with the floods of 1951, 1973 and 1993.

Some flow discharge statistics for project area streams are listed in Table 3–2. The minimum and maximum recorded discharges for these three streams are surprisingly similar given the difference in the size of their drainage areas. The other statistics listed in Table 3–2 are more as expected. On an average, or mean basis, the flow in the Arkansas River is roughly three times that of the Little Arkansas River, which in turn is about twice that of the North Fork.

From the peak flow records available for the locations listed in Table 3–2, frequency analyses indicate that the 100-year flood on the North Fork is actually higher than that of either the Arkansas or Little Arkansas rivers. This results

Table 3-1 USGS Stream Gages

Station Number & Name	Location (Latitude/ Longitude)	Drainage Area (miles^2)	Period of Record
07143330 Arkansas R near Hutchinson, KS	37° 56' 47" 97° 45' 29"	38,910	10/01/59–present
07143375 Arkansas R near Maize, KS	37° 46' 53" 97° 23' 33"	39,110	03/01/87–present
07143400 Arkansas R near Wichita, KS	37° 42' 30" 97° 21' 50"	39,072	10/01/21–03/31/35
07143665 Little Arkansas R at Alta Mills, KS	38° 06' 44" 97° 35' 30"	736	06/06/73–present
07144100 Little Arkansas R near Sedgwick, KS	37° 52' 59" 97° 25' 27"	1,239	10/01/93–present
07144200 Little Arkansas R at Valley Center, KS	37° 49' 56" 97° 23' 16"	1,327	06/10/22–present
07144300 Arkansas R at Wichita, KS	37° 38' 41" 97° 20' 06"	40,490	10/01/34–present
07144550 Arkansas R at Derby, KS	37° 32' 34" 97° 16' 31"	40,830	10/01/68–present
07144780 NF Ninnescah R above Cheney Res, KS	37° 43' 17" 97° 47' 39"	787	07/01/65–present
07144800 NF Ninnescah R near Cheney, KS	37° 40' 00" 97° 46' 00"	930	10/01/50–09/30/64
07145500 Ninnescah R near Peck, KS	37° 27' 26" 97° 25' 20"	2,129	04/01/38–present
07146500 Arkansas R at Arkansas City, KS	37° 03' 23" 97° 03' 32"	43,713	10/01/21–present

Source: USGS website (http://water.usgs.gov).

primarily from a single peak flow of 87,000 cfs that was recorded on theNorth Fork above Cheney Reservoir on October 30, 1979. On this same date, the average flow was only 47,900 cfs—the overall maximum listed in Table 3–2. The high ratio between peak and mean discharge on this date indicates this extreme flood resulted from a very intense but short duration thunderstorm.

When there is little or no direct runoff to a stream, any discharge is primarily a result of groundwater discharge — also known as base flow. The low flow statistics listed in Table 3–2 give a good indication of the base flow in these streams. The interaction between area streams and aquifers is discussed further below.

An indication of the seasonal variability of discharge in project area streams is provided by the monthly median flow data presented in Table 3–3. Median flows are those which fall in the statistical middle of historic values. Actual daily flow discharges will be higher than the median half the time and less than the median the other half of the time.

The Kansas Water Office (KWO), in collaboration with the Kansas Division of Water Resources, KDWP, and the

Figure 3-3 USGS Stream Gage Locations

Figure 3–4 Historic Annual Discharge for Project Area Streams

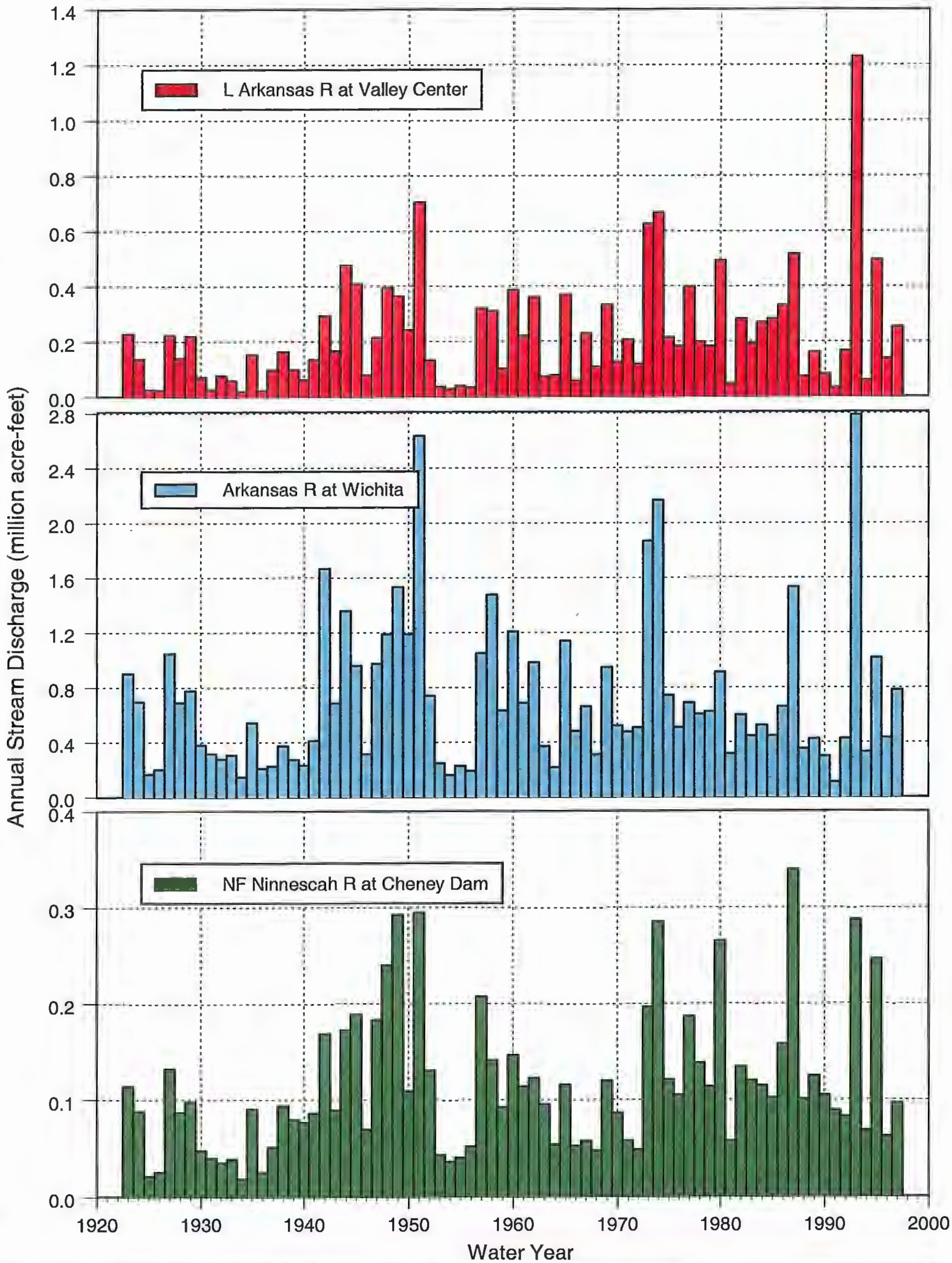


Table 3–2 Discharge Statistics for Project Area Streams

Statistic		Mean Daily Discharge (cfs) Arkansas River at Wichita	Little Arkansas River at Valley Center	North Fork Ninnescah River at Cheney Dam
Overall Minimum		5	1	0
Overall Maximum		41,100	28,600	47,900
Mean (Average)		986	305	159
Percent of Time Discharge Equaled or Exceeded	90%	101	20	19
	50%	402	58	79
	10%	2,030	456	257
Floods	2-year	10,600	6,830	3,920
	10-year	27,500	19,900	20,700
	100-year	48,600	37,200	84,900
7-Day Average Low Flows	2-year	92.2	18.9	10.3
	10-year	29.4	8.6	5.4
	100-year	10.3	2.5	0.7

Source: Statistics based on estimated mean daily discharges, which were derived from USGS streamflow records, for water years 1923–1996. Flood discharges estimated from analysis of recorded annual instantaneous peak discharges.

Table 3–3 Median Flow by Month for Project Area Streams (cfs)

Month	Arkansas River			Little Arkansas River		North Fork Above Cheney
	Hutchinson	Wichita	Arkansas City	Alta Mills	Valley Center	
Jan	124.9	249.9	571.1	23.3	53.8	60.2
Feb	169.4	327.1	645.5	26.0	61.1	60.1
Mar	207.2	387.7	801.0	31.0	70.4	62.4
Apr	216.8	459.7	947.1	35.0	76.4	60.5
May	273.5	573.4	1,198.2	45.5	107.6	63.2
Jun	405.1	825.1	1,515.8	57.0	129.4	82.8
Jul	248.4	504.5	959.6	31.5	75.6	102.3
Aug	166.5	321.6	659.7	22.7	54.7	96.9
Sep	150.0	293.2	555.5	21.6	53.5	72.8
Oct	117.6	226.9	520.6	18.7	49.6	81.1
Nov	149.6	306.0	634.2	26.0	58.8	60.1
Dec	142.3	287.8	595.8	24.5	58.4	58.4

Kansas Department of Health and Environment, has established minimum desirable streamflow (MDS) rates at various locations in the Little Arkansas and Ninnescah River basins. The MDS values for the points of interest in this analysis are listed in Table 3–4. As listed in this table, the MDS at Valley Center is 20 cfs year-round. However, the KDWP's regional recommendations were substantially higher at 60 cfs during April,

Table 3–4 Minimum Desirable Streamflow Values

Month	Little Arkansas River		North Fork Ninnescah River above Cheney Res.	Ninnescah River near Peck
	at Alta Mills	at Valley Center		
Jan	8	20 (34)	40	100
Feb	8	20 (34)	50	100
Mar	8	20 (34)	50	100
Apr	8	20 (60)	50	100
May	8	20 (60)	40	100
Jun	8	20 (60)	30	70
Jul	8	20 (34)	10	30
Aug	8	20 (34)	5	30
Sep	8	20 (34)	5	30
Oct	8	20 (34)	10	50
Nov	8	20 (34)	40	100
Dec	8	20 (34)	40	100

Source: Kansas Water Office, 1983 and 1985. Values in parentheses are values recommended by Kansas Department of Wildlife and Parks.

May and June, and 34 cfs the remainder of the year (KWO 1983, 1985).

Figure 3–5 contains graphs that compare the historic median flows in the Little Arkansas and Ninnescah rivers with the specified MDS values. As expected, historic median discharges for each of these streams exceeds the established MDS in each month, although to differing degrees.

3.3.1.3 Water Surface Elevations and Depths

The elevation of the water surface in a stream is dependent on the discharge at the point in question, the physical characteristics of the stream, and potentially, the water surface elevations of points downstream as well. Using the most recently available rating tables and mean daily discharges at the corresponding USGS stream gages, water surface elevations were estimated for water years 1923–1996. These water surface elevation estimates were then used to calculate the median monthly water surface elevations listed in Table 3–5. The corresponding water depths listed in Table 3–5 are the estimated maximum depths measured at the lowest point in the stream cross section.

3.3.1.4 Quality

The quality of surface waters in the ILWSP project area can vary significantly with time and location. Table 3–6 contains a summary of surface water quality data for the vicinity that have been collected by the USGS. Although the number of samples and their respective collection periods vary, the data shown in Table 3–6 are considered representative of surface water quality in the project area.

Though moderately hard, the water from these streams is generally acceptable for delivery to the City's water treatment plant for subsequent treatment and distribution to customers. The one exception is found in the elevated salinity levels in the Arkansas River. Several natural and man-made sources of salinity that contribute to these elevated salinity levels exist in the Arkansas River basin

Figure 3–5 Comparison of Historic Median Flow and MDS Values

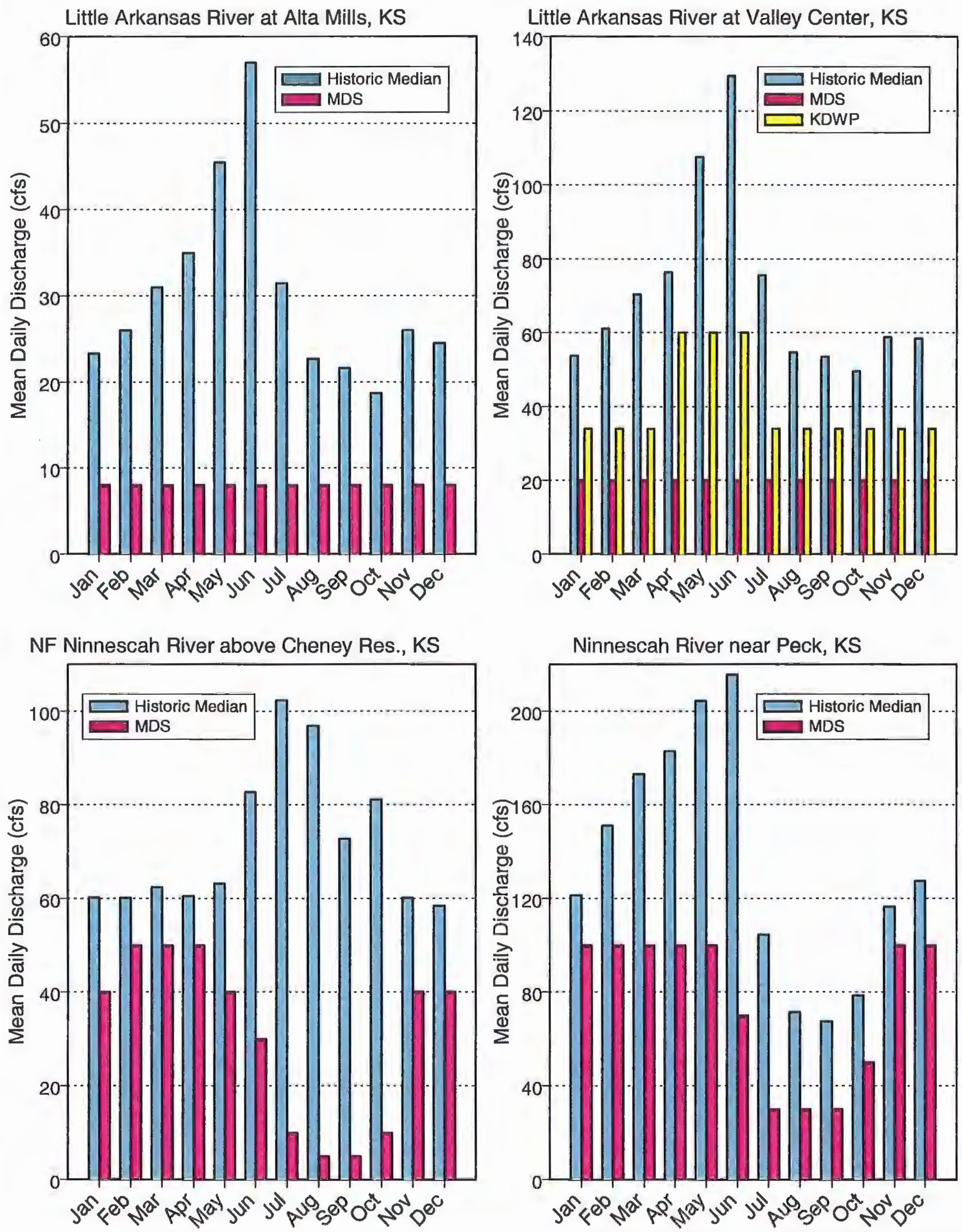


Table 3–5 Median Monthly Water Surface Elevations (and Flow Depths) for Project Area Streams (feet)

Month	Arkansas River			Little Arkansas River		North Fork
	Hutchinson	Wichita	Arkansas City	Alta Mills	Valley Center	Above Cheney
Jan	1,457.10 (0.27)	1,266.47 (1.25)	1,059.48 (1.10)	1,392.84 (1.08)	1,326.95 (0.71)	1,463.25 (0.56)
Feb	1,457.19 (0.36)	1,266.68 (1.46)	1,059.57 (1.19)	1,392.92 (1.15)	1,327.00 (0.77)	1,463.25 (0.56)
Mar	1,457.26 (0.43)	1,267.85 (1.63)	1,059.72 (1.34)	1,393.02 (1.26)	1,327.08 (0.84)	1,463.26 (0.57)
Apr	1,457.28 (0.45)	1,267.00 (1.79)	1,059.86 (1.48)	1,393.10 (1.34)	1,327.12 (0.89)	1,463.25 (0.56)
May	1,457.39 (0.56)	1,267.21 (2.00)	1,060.09 (1.71)	1,393.32 (1.56)	1,327.33 (1.10)	1,463.27 (0.58)
Jun	1,457.64 (0.81)	1,267.60 (2.38)	1,059.88 (1.94)	1,393.52 (1.76)	1,327.47 (1.24)	1,463.40 (0.71)
Jul	1,457.34 (0.51)	1,267.09 (1.87)	1,059.88 (1.50)	1,393.03 (1.27)	1,327.12 (0.88)	1,463.54 (0.85)
Aug	1,457.18 (0.35)	1,266.67 (1.45)	1,059.58 (1.20)	1,392.83 (1.06)	1,326.95 (0.72)	1,463.50 (0.81)
Sep	1,457.15 (0.32)	1,266.59 (1.37)	1,059.45 (1.07)	1,392.79 (1.03)	1,326.94 (0.71)	1,463.33 (0.64)
Oct	1,457.09 (0.26)	1,266.40 (1.18)	1,059.40 (1.02)	1,392.70 (0.94)	1,326.91 (0.68)	1,463.39 (0.70)
Nov	1,457.15 (0.32)	1,266.62 (1.41)	1,059.56 (1.18)	1,392.92 (1.15)	1,326.99 (0.75)	1,463.25 (0.56)
Dec	1,457.14 (0.31)	1,266.57 (1.36)	1,059.51 (1.13)	1,392.88 (1.12)	1,326.98 (0.75)	1,463.24 (0.55)

upstream of Wichita. Conventional water treatment processes cannot economically remove salinity; as a result, it is important to find a water source that contains acceptable levels of salinity.

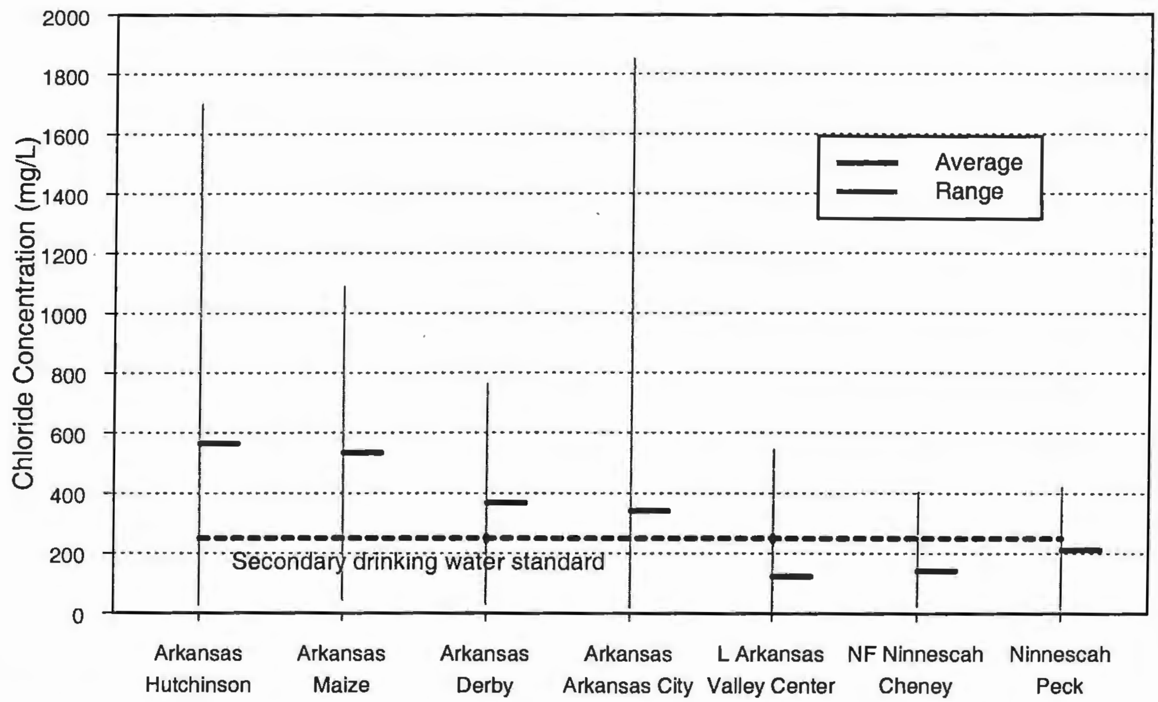
The concentration of chloride ions in the Arkansas River, which is a measure of salinity, can range up to 1,700 mg/L upstream of Wichita (see Table 3–6). The U.S. Environmental Protection Agency (EPA) has established secondary drinking water standards that recommend limiting chloride concentrations to 250 mg/L (40 CFR 143). The contaminants that are included in the secondary drinking water standards, like chloride, are those that primarily affect the aesthetic qualities of drinking water, such as taste, odor and color.

Figure 3–6 is a graph showing the range and average of chloride concentrations for those stations listed in Table 3–6 that have at least 50 data points. This graph shows that water in the Little Arkansas, North Fork and Ninnescah rivers has significantly lower chloride concentrations than that of the Arkansas River. Comparison of average chloride concentrations in the Arkansas River near Maize, which is just above Wichita, with that at Derby, which is just below Wichita, shows a distinct water quality improvement as the river flows through Wichita. This is primarily a result of

Table 3-6 Surface Water Quality Data

Station	Conductivity	Dissolved Oxygen	pH	Dissolved Concentrations									Suspended Solids
				Hardness	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Fluoride	Dissolved Solids	
	µseimens	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Arkansas River													
07143330 near Hutchinson, KS	300 - 5900	1.3 - 13.6	6.9 - 9.1	0 - 805	22 - 214	3.5 - 72	23 - 1110	6.2 - 23	27 - 1700	18 - 918	0.2 - 1.2	208 - 3470	5 - 6120
07143375 near Maize, KS	235 - 4150		7.1 - 9.4		19 - 160	3.9 - 70	26 - 500	6.5 - 13	45 - 1088	11 - 800		162 - 1750	
07144200 at Wichita, KS	200 - 2620		6.8 - 9.2										76 - 2500
07144550 at Derby, KS	185 - 3560	5.8 - 13.4	6.8 - 8.9	80 - 717	25 - 187	3.4 - 64	22 - 536	4 - 16	33 - 765	20 - 738	0.3 - 1	193 - 2150	1340 - 1560
07146500 at Arkansas City, KS	213 - 6540	1 - 17.1	6.6 - 10	24 - 760	17 - 216	3.5 - 56	18 - 1180	0.6 - 28	20 - 1850	15 - 630	0 - 1.1	132 - 4090	0.8 - 74
Little Arkansas River													
07143665 at Alta Mills, KS	105 - 3200		7 - 8.7	330 - 452	105 - 142	17 - 24	152 - 258	5.3 - 6	274 - 532	54 - 125	0.4	820 - 1380	9 - 2130
07144100 near Sedgwick, KS	85 - 1467	4.2 - 18.8	3.99 - 8.6		11.6 - 113	2.2 - 20.3	4.82 - 123	5.24 - 10.55	8 - 218	7 - 211	0.12 - 0.82	92 - 759	12 - 3680
07144200 at Valley Center, KS	79 - 7300	5.7 - 14.6	6.6 - 8.7	1 - 474	9.6 - 142	0.2 - 32	3 - 260	3.3 - 10	5 - 545	5 - 110	0.1 - 0.8	64 - 1250	9 - 9990
North Fork of the Ninnescah River													
07144780 above Cheney Reservoir, KS	152 - 1560	7.5 - 10.4	7.2 - 9.1	188 - 266	54 - 83	9.1 - 16	137 - 190	3.6 - 8.2	196 - 282	49 - 88	0.4 - 0.5	628 - 776	1 - 2460
07144800 near Cheney, KS	260 - 1770		7.2 - 8.3	84 - 307	26 - 87	4.6 - 30	16 - 265	1.6 - 8	23 - 402	11 - 85	0.2 - 0.5	158 - 967	27 - 1740
Ninnescah River													
07145500 near Peck, KS	15 - 4020		6.8 - 8.8	48 - 320	14 - 99	3.2 - 23	7.5 - 273	1.4 - 8.2	12 - 421	6 - 82	0 - 0.7	95 - 936	11 - 4000

Figure 3–6 Surface Water Chloride Concentrations



dilution by the better-quality water from the Little Arkansas River.

The herbicide, atrazine, is typically applied to agricultural lands where crops are grown primarily in spring and fall. Coincidentally, this application occurs when precipitation is most intense and runoff can be greatest. Atrazine concentrations and loading in runoff in the Little Arkansas River is greatest during the spring and early summer months (May through July). During this 15- to 40-day period, runoff used for recharge of the Equus Beds aquifer may have to be treated to remove atrazine and other herbicides.

3.3.2 GROUNDWATER

Groundwater is a very important resource within the ILWSP project area. It is used to supply water for municipal, industrial, irrigation, domestic and livestock uses. Groundwater aquifers, levels and quality in the project area are discussed below.

3.3.2.1 Geologic Formations and Aquifers

An aquifer is a geologic formation, group of formations, or portion of a formation that is water-bearing. The project area is underlain by a number of geologic formations that can yield water to wells. The major formations and aquifers, and their water-bearing properties, are discussed below.

3.3.2.1.1 Wellington Formation

The Wellington Formation forms the bedrock surface over much of the project area. It crops out, or is exposed at the surface, to the east of Wichita and the Arkansas River Valley but is covered by more recent rocks and sediments to the west. The thickness of this formation ranges from about 80 feet in the eastern portion of the project area to about 550 feet farther west (Lane and Miller 1965). This formation consists chiefly of gray and blue-gray shale with small thin beds of maroon shale, limestone, gypsum and anhydrite. There is also a thick salt bed within this formation that can attain a thickness of 350 feet. This salt bed has been removed by solution within the Arkansas Valley and to the east but still exists under the more westerly portions of the project area (Lane and Miller 1965).

East of the Arkansas Valley and Wichita, where it is not covered by more recent sediments, the Wellington Formation is the only source of groundwater. The quantity and quality of groundwater available varies widely in this area. In most cases, this water is very hard or has other undesirable properties such as a high sulfate content. Farther west, where the salt bed still exists, this formation can contain saturated brine, making this water unusable for most purposes (Lane and Miller 1965).

3.3.2.1.2 Ninnescah Shale

The Ninnescah Shale overlies the Wellington Formation and is composed of alternating beds of reddish-brown silty shale and siltstone. In its lower part, it can also contain thin beds of gray-green silty shale. The Ninnescah Shale forms the bedrock in areas generally west of the Arkansas Valley. It ranges in thickness from a featheredge to about 175 feet (Lane and Miller 1965).

The Ninnescah Shale yields water to wells in its outcrop area where it is not overlain by more recent sediments. Yields are generally small and most of its water is believed to originate from its weathered surface zone. Water from this zone is generally of good quality although it typically has high concentrations of nitrates. Water from deeper parts of the formation usually contains large concentrations of dissolved solids, with sulfate being the most objectionable constituent (Lane and Miller 1965).

3.3.2.1.3 Ogallala Formation

There is a broad depression in the bedrock surface in the project area that generally follows the current course of the Arkansas River. This depression ranges up to about 10 miles wide and its floor is up to about 150 feet lower than the surrounding bedrock surface. The lower portions of this depression are occupied by rocks believed to be equivalent in age to those of the Ogallala Formation. This formation is composed of calcareous, gray to pink-tan silt and clay, fine to coarse sand, and fine to coarse gravel. Where present, this formation ranges in thickness from a featheredge to a maximum of about 150 feet. It does not crop out in the project area but is covered by younger sediments (Lane and Miller 1965).

The Ogallala Formation consists of finer grained sediments, and is less permeable than the overlying sediments. Where present, this formation is hydraulically connected to the more permeable beds that overlie it so that a portion of the water yielded to wells in this area is derived from the Ogallala Formation. Most of the wells with large yields in the project area penetrate the complete section of unconsolidated rocks, including the Ogallala and overlying sediments. The water from this formation is only moderately hard and generally suitable for most uses. The exception to this is localized areas near the base of this formation that may be contaminated with salt (Lane and Miller 1965).

3.3.2.1.4 Lower Pleistocene Deposits
The Pleistocene Series in Kansas is divided into four glacial stages and three interglacial stages. Sediments derived from the two earliest glacial stages — the Lower Pleistocene, or Nebraskan, and Kansan ages — are found primarily within the Arkansas Valley. At one time, these deposits probably covered the entire project area but were later removed by erosion. Where present, these undifferentiated deposits are composed of silt, clay, sand, and gravel, and range in thickness from a featheredge to about 150 feet.

The water derived from these Lower Pleistocene deposits is moderately hard but suitable for most uses. Although most large wells in the vicinity penetrate several formations, the well yields from these deposits are estimated to range from 50 to 1,000 gallons per minute (gpm) (Lane and Miller 1965).

3.3.2.1.5 Illinoisan Terrace Deposits
Illinoisan terrace deposits, a member of the Upper Pleistocene Series, underlie large portions of the project area west of the Arkansas Valley and north of the Ninnescah valley. These deposits consist of fine to coarse sand and fine to coarse gravel, grading into sandy silt in their upper extremities. Within the Arkansas valley, these terrace deposits range in thickness from 0 at the valley wall to a maximum of about 75 feet (Lane and Miller 1965).

The Illinoisan terrace deposits supply water to many stock and domestic wells in the project area and some municipal, industrial and irrigation wells. In the Arkansas valley, well yields of 500 gpm are readily obtainable in these deposits, with yields possibly as high as 1,000 gpm in more favorable areas. Within the Ninnescah valley, these deposits are thinner, and have lesser saturated thicknesses, so yields are correspondingly lower (Lane and Miller 1965).

3.3.2.1.6 Wisconsinan Terrace Deposits and Recent Alluvium
The youngest sediments in the project area are the Wisconsinan terrace deposit and recent alluvium. These deposits underlie a broad, flat surface — ranging from four to nine miles wide — adjacent to the Arkansas and Little Arkansas rivers, with an average thickness of about 45 feet. These deposits consist of fine to coarse sand and fine to coarse gravel with only small amounts of silt and clay (Lane and Miller 1965).

The Wisconsinan terrace deposits and recent alluvium are the most widely used source of groundwater within the project area, although most large capacity wells penetrate these deposits and lower unconsolidated deposits as well. Well yields up to 2,000 gpm are possible from these formations. The quality of water from these deposits varies, generally improving with greater distances from the Arkansas River (Lane and Miller 1965).

3.3.2.1.7 Equus Beds Aquifer
The Equus Beds aquifer is the eastern-most part of the aquifer system known as the High Plains aquifer in Kansas. The Equus Beds are named for the equine fossils of Pleistocene age found in the unconsolidated sediments of the area. The Equus Beds aquifer underlies an area of about 900,000 acres within portions of Sedgwick, Harvey, McPherson, and Reno counties. The extent of the Equus Beds aquifer generally corresponds to the boundaries of Groundwater Management District No. 2 (GMD2) as shown on Figure 3–7.

The Equus Beds aquifer generally includes all of the unconsolidated sediments deposited within the bedrock depression noted above. As such, it is comprised of portions of: the Ogallala Formation; Lower Pleistocene deposits; Illinoisan and Wisconsinan terrace deposits; and recent alluvium.

3.3.2.2 Groundwater Levels

Prior to 1940, there was little utilization of groundwater within the ILWSP project area except for domestic use and stock watering. The local water table was near the ground surface in many areas so shallow wells, many hand-dug, were typical. In the early 1940's, the City of Wichita began development of the Equus Beds Well Field as a water supply source for the City. Subsequent to this, large areas within the well field area were converted from dry land to irrigated cropland. The annual withdrawal of groundwater by the City, other municipalities, industries and irrigators has exceeded the natural recharge to the underlying aquifers in most years. Most natural recharge is a direct function of precipitation so it can vary widely from year to year, as can groundwater withdrawals. In wet years, there tends to be more recharge and less withdrawals, and the converse is true in dry years.

Since groundwater withdrawals often exceed natural recharge, large declines in groundwater levels, as much as 40 feet, have occurred in some areas. Figure 3–8 is a map showing the saturated thickness of the Equus Beds aquifer under pre-development conditions and the declines that have occurred since then.

As mentioned in Section 3.3.1.2, the base flow in area streams is a result of the interaction with local aquifers. Due to the sandy nature of soils along the Arkansas and Little Arkansas rivers, there is a strong hydraulic connection between these two streams and the Equus Beds aquifer. Figure 3–9 shows the relationship between water levels and infiltration (gains) to and discharge (losses) from the Equus Beds aquifer. In Figure 3–9, water levels are expressed in terms of storage deficits as compared to pre-development conditions. As the Equus Beds aquifer is depleted (that is, as storage deficits increase and water levels decline), infiltration to the aquifer from the Arkansas River increases and discharge to the Little Arkansas River decreases.

As shown in Figure 3–9, under pre-development conditions — zero storage deficit — the Equus Beds aquifer and the Arkansas River were nearly in equilibrium, with an infiltration rate estimated to be less than 8 cubic feet per second (cfs). Under these same conditions, the aquifer discharged about 38 cfs to the Little Arkansas River. Under recent conditions, with a storage deficit estimated to be near 200,000 acre-feet, there is about 26 cfs of infiltration from the Arkansas River and discharge to the Little Arkansas River has declined to about 14 cfs, a decrease of about 24 cfs.

3.3.2.3 Quality

The quality of groundwater in the project area varies greatly depending on the geologic formation it is derived from and its depth. In general, groundwater tends to become more mineralized with increasing depth. Table 3–7 lists the chemical constituents of groundwater samples from various wells located in the project area (see Figure 3–10).

Review of Table 3–7 shows that the total dissolved solids content of these waters

Figure 3–7 Groundwater Management District No. 2 Boundaries

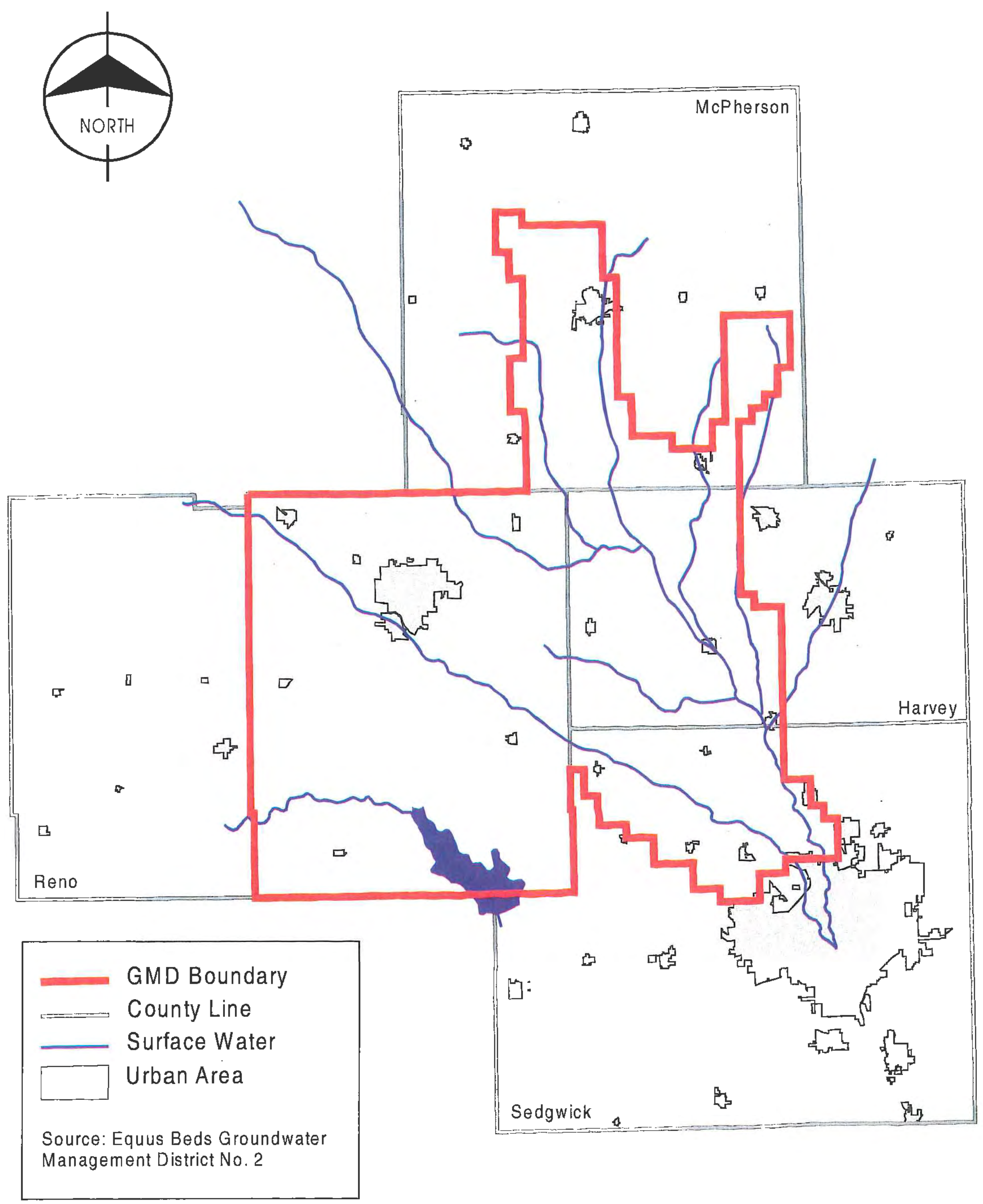
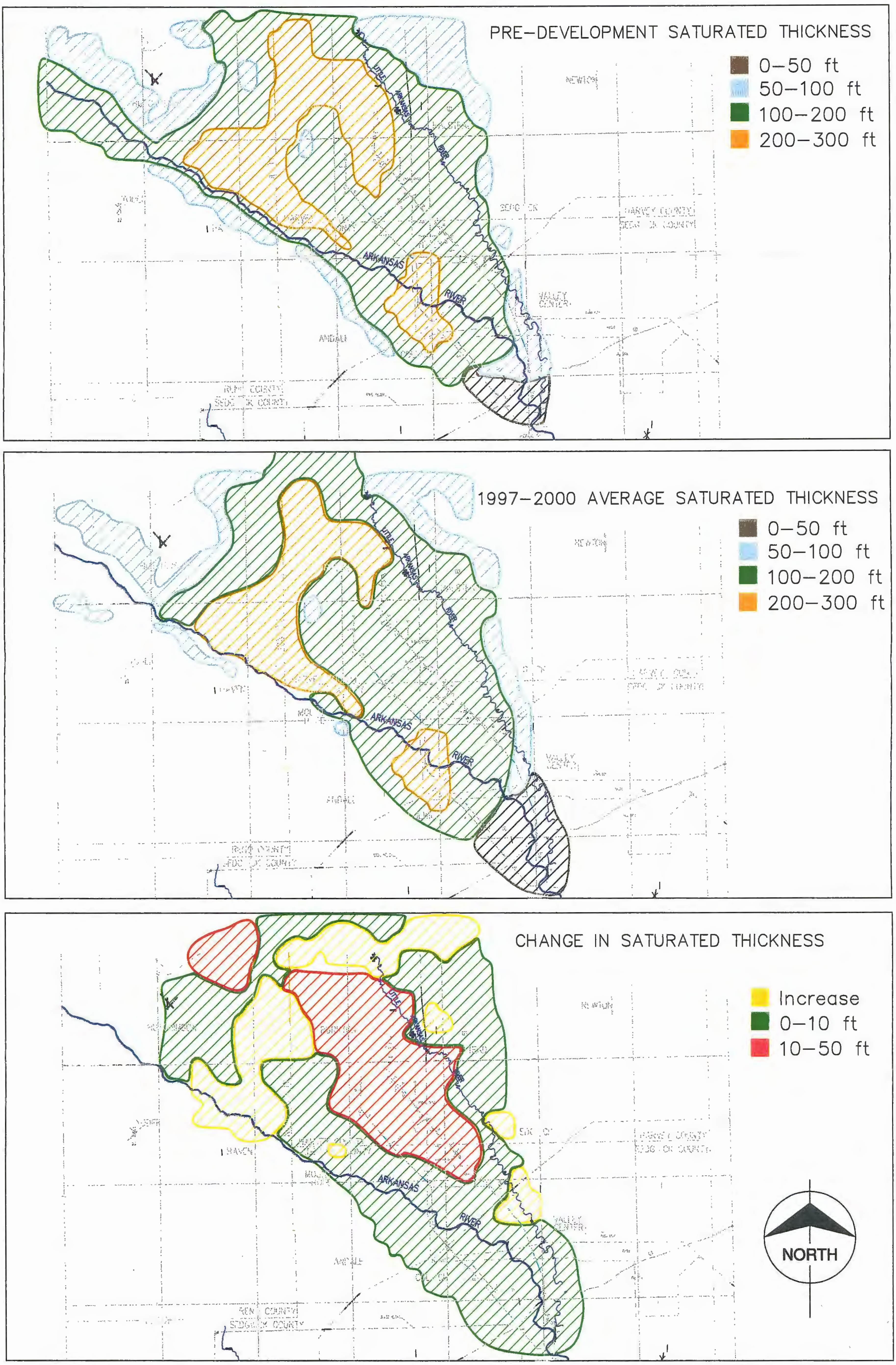


Figure 3–8 Equus Beds Aquifer Saturated Thickness



NOTE: SATURATED THICKNESS APPROXIMATED FROM USGS KANSAS DISTRICT MAPS project. K.A.R. defines "Beneficial uses of water" as dcmestic, stock watering, municipal, irrigation, industrial, recreational, water power, artificial recharge, hydraulic dredging, and contamination remediation (K.A.R. 5-1-1(f)). "Recreational use" is further defined as a use of water in accordance with a water right which provides entertainment, enjoyment, relaxation, and fish and wildlife benefits (K.A.R. 5-1-1(w)).

A large number of water appropriation applications have been filed to use groundwater in the Equus Beds Well Field area. Some surface water applications have been approved to divert from the Little Arkansas River adjacent to the well field area. Early use of groundwater, developed in the late 1930's and early 40's, was mainly for municipal supplies. A total of 16,417.3 acre-feet of water are vested water rights, water use that was in place at the time that the Kansas Water Appropriation Act was implemented in 1945. Throughout the 1960's and 70's, large increases in the number of water appropriation applications resulted mainly from irrigation development.

At the present time, approximately 120,000 acre-feet per year (acre-ft/yr.) of water rights have been filed in the Equus Beds Well Field study area. This study area contains approximately 175 square miles. Of the total, 51,000 acre-ft/yr. are for municipal use and 52,000 acre-ft/yr. are for irrigation purposes. The remaining water rights are for industrial and recreational use.

The area groundwater rights are significantly over-allocated in relation to ground water recharge values. The estimated safe yield of water is 50,240 acre-ft/yr. based on early recharge estimates of 6 inches per year (in/yr.). Revised recharge values are 3.2 in/yr according to a recent USGS study. (Hansen, 1991). Based upon this figure, the actual safe yield is about 29,900 acre-ft/yr.

The City's water rights for the Equus Beds Well Field currently allow for 40,000 acre-feet of water to be used each year, with a maximum daily withdrawal rate of 78 MGD.

The City of Wichita has water rights of approximately 99,300 acre-ft/yr, from all current sources, including the Equus Beds Well Field, Cheney Reservoir and the Local Well Field. This volume is estimated to be sufficient to supply the City's water demands until the year 2016 when additional water rights will be required.

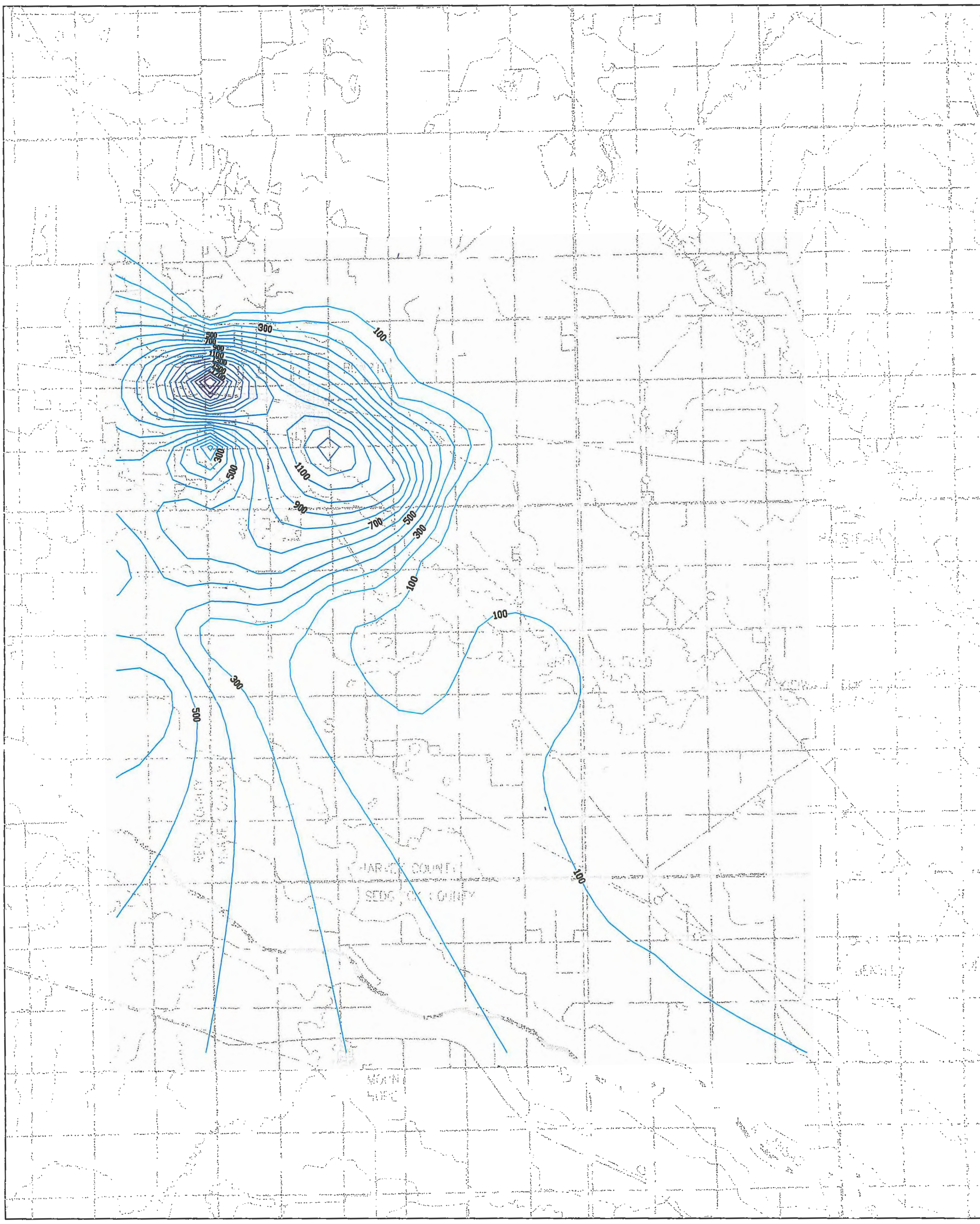
Because of falling water table levels, the Equus Beds Groundwater Management District No.2 was formed in 1974 to manage the aquifer's resources. Accordingly, a safe yield policy was adopted which resulted in closing most areas within the City's well field to development of additional water rights.

Current groundwater rights for the Local Well Field are 6,604.7 acre-ft/yr. Surface water rights for Cheney Reservoir total 52,641 acre-ft/yr. Table 3–8 provides a breakdown of the current water rights.

3.4 AIR QUALITY

The project area contains both rural and urban areas. The area north of Wichita is predominantly farmland and smaller towns. Air pollution sources in the rural areas are for the most part, dust from unpaved roads and farming activities. Smoke from occasional grass fires or

Figure 3–11 Year 2000 Equus Beds Chloride Levels



LEGEND

EXISTING CITY OF WICHITA SUPPLY WELL AND CHLORIDE CONCENTRATION

EXISTING CITY OF WICHITA RECHARGE LOCATION AND CHLORIDE CONCENTRATION

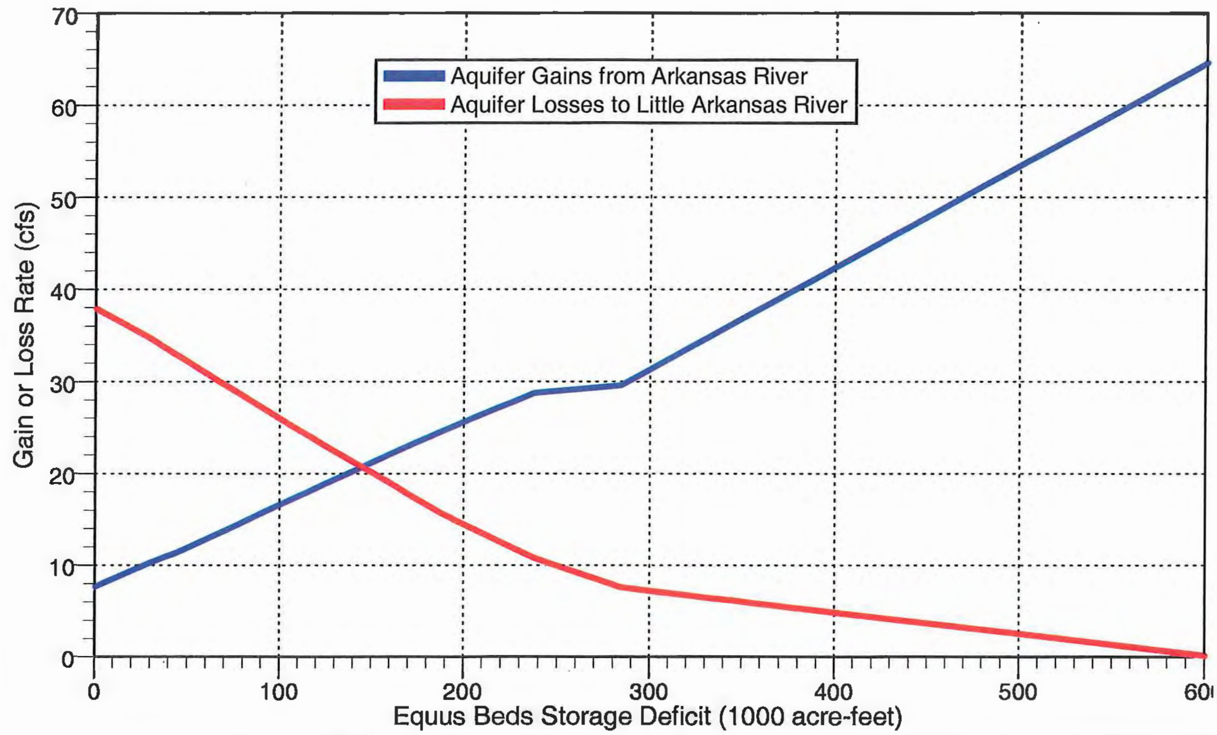
1000 CHLORIDE CONCENTRATION CONTOUR IN MILLIGRAMS PER LITER

NORTH

2 0 2 4

SCALE IN MILES

Figure 3–9 Gains To and Losses From the Equus Beds Aquifer



is a minimum of about 300 milligrams per liter (mg/L) and ranges as high as about 2,700 mg/L. Water with a total dissolved solids content below 500 mg/L is generally suitable for domestic use. With a total dissolved solid content above 1,000 mg/L, water will generally contain enough constituents that it has an objectionable taste or odor.

As discussed above for surface water, one of the primary quality issues for groundwater is high salinity. The quality of groundwater in the project area is generally good, except where salinity, as indicated by the presence of chlorides, from natural and manmade sources has entered the groundwater. Naturally occurring sources of salinity include Arkansas River water and water from deeper geologic formations. Brine from oil field and salt-refining operations are sources of manmade salinity (Reclamation 1993).

Figure 3–11 shows chloride concentrations in groundwater for the area northwest of Wichita. As shown in this figure, the highest chloride concentrations, ranging over 2,000 mg/L, occur near Burrton and result primarily from past oil field operations. This plume of saline groundwater has been migrating to the southeast in the direction of the prevailing groundwater gradient. Chloride concentrations are also generally higher near the Arkansas River and result from migration of higher chloride water from the river into the Equus Beds aquifer.

3.3.3 WATER RIGHTS

Chapter 5, Article 3 of the Kansas Administrative Regulations (K.A.R.) regulates the appropriation of the State's water resources for beneficial use, which is administrated by the Department of Agriculture, Division of Water Resources. Several articles of these regulations are particularly relevant to this water supply

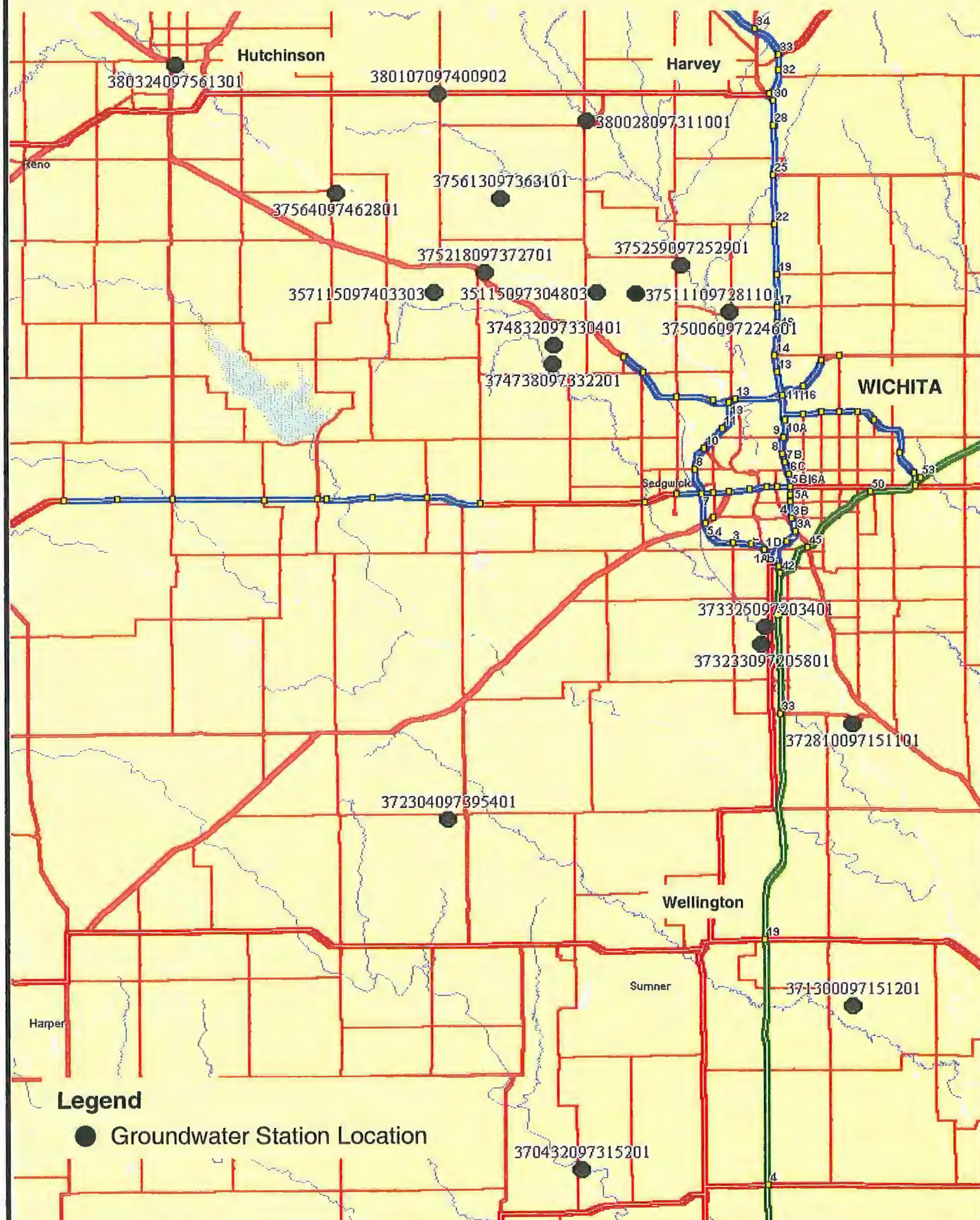
Table 3- 7 Groundwater Quality Data

Station	Conductivity (µseimens)	pH (Std. Unit)	Dissolved Concentrations (mg/L)							
			Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Fluoride	Total Solids
Harvey County										
375613097363101	1098 - 1510	6.8 - 7.4	133 - 162	23.1 - 29.0	122 - 142	3.4 - 5.4	77 - 112	226 - 310	0.42 - 0.61	
355628097270201	622 - 997	6.5 - 7.5	62 - 73	9.8 - 12.5	55 - 72	2.4 - 5.7	30 - 44	44 - 64	0.28 - 0.38	332 - 449
380028097310901	942 - 1224	6.3 - 6.9	111 - 140	13.6 - 18.6	92 - 112	2.8 - 3.6	161 - 190	3 - 5	0.17 - 0.21	602 706
380028097311001	686 - 1390	6.3 - 7.0	66 - 141	8.6 - 19.8	59 - 125	2.2 - 6.2	85 - 264	5 - 35	0.31 - 0.52	408 - 942
380028097311002	476 - 580	6.5 - 7.3	49 - 62	6.9 - 8.8	50 - 57	1.8 - 2.1	14 - 36	27 - 40	0.30 - 0.32	286 - 351
380028097311101	1094 - 1237	6.4 - 6.8	124 - 151	16.3 - 19.2	85 - 99	2.6 - 3.2	128 - 178	8 - 24	0.15 - 0.20	637 - 714
380031097311001	1 - 782	4.3 - 7.4	57 - 87	8.2 - 12.1	51 - 65	1.8 - 2.4	22 - 66	31 - 45	0.24 - 0.30	292 - 438
380107097400902	567 - 1004	6.4 - 7.0	62 - 81	14.9 - 18.8	59 - 85	6.0 - 8.1	82 - 119	61 - 105	0.20 - 0.33	472
Reno County										
375340098111701	462 - 608	7.0 - 7.6	32 - 44	3.5 - 5.2	40 - 64	1.8 - 2.0	43 - 80	16 - 69	0.20 - 0.30	293
375647097462801			203 - 272	45 - 67	606 - 1067	7.2	1138 - 1860	155 - 241		
375647097462802			107 - 134	20.7 - 25.6	193 - 220	4.0	367 - 487	50 - 61		
375647097462803			286 - 657	58.2 - 128	431 - 654	15.0	1016 - 2320	127 - 233		
375741098245101	460 - 614	6.8 - 7.4	30 - 65	5.0 - 6.6	30 - 33	2.7 - 3.0	42 - 55	11 - 18	0.20 - 0.30	
380324097561301	1590 - 1829	7.2 - 7.5	122 - 143	19.0 - 22.5	184 - 217	5.3 - 6.0	228 - 280	143 - 179	0.47 - 0.60	1000
Sedgwick County										
373233097205801	525 - 735	7.0 - 7.9	40 - 84	11.0 - 18.0	44 - 53	1.5 - 2.1	14 - 25	23 - 48	0.10 - 0.40	314 - 362
373325097203401	1060 - 1300	7.1 - 7.4	100 - 144	19.0 - 21.9	85 - 100	3.2 - 4.2	93 - 150	150 - 170	0.50 - 0.65	780
374738097332201			83 - 86	16.7 - 19.1	48 - 61	3.6	29 - 32	29 - 44	0.23 - 0.33	
Sedgwick County (cont.)										

Table 3- 7 Groundwater Quality Data

Station	Conductivity (µseimens)	pH (Std. Unit)	Dissolved Concentrations (mg/L)							
			Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Fluoride	Total Solids
374743097201601	948 - 1140	7.1 - 7.4	100 - 136	30.0 - 35.3	45 - 51	2.3 - 2.7	32 - 42	150 - 196	0.28 - 0.43	
374832097330401			33 - 38	7.9 - 8.8	340 - 380	1.6	314 - 381	101 - 122		
374832097330402			33 - 36	5.8 - 6.6	159 - 182	2.5	135 - 148	57 - 72		
374832097330403			44 - 73	7.2 - 11.6	118 - 150	3.9	99 - 125	26 - 96	0.46 - 0.59	
375006097224601	706 - 932	7.0 - 7.4	91 - 121	21 - 28	25 - 41	1.7 - 3.1	13 - 21	77 - 153	0.30 - 0.50	409 - 546
375111097281101	638 - 805	6.0 - 7.4	71 - 96	10.9 - 14.0	48 - 58	2.7 - 9.7	41 - 58	49 - 60	0.40 - 0.50	
375115097304803			122 - 147	27.7 - 32.4	402 - 466	4.6	515 - 613	280 - 352	0.51 - 0.60	
375115097403303			31 - 58	6.4 - 11.4	13 - 23	2.4	8 - 26	11 - 22	0.17 - 0.27	
375218097372701	1725 - 2380	6.9 - 7.5	120 - 168	26 - 32	190 - 270	3.0 - 5.6	310 - 510	123 - 190	0.43 - 0.50	1220
375259097252901	605 - 677	6.3 - 7.0	67 - 77	10.8 - 12.2	41 - 45	2.8 - 3.3	22 - 25	76 - 88	0.39 - 0.41	369 - 391
Sumner County										
370432097315201	547 - 683	7.0 - 7.8	55 - 76	15.9 - 22.0	34 - 39	2.0 - 3.3	28 - 45	47 - 64	0.2 - 0.3	352 - 372
371300097151201	930 - 3480	6.8 - 7.7	2 - 450	0.5 - 115.2	61 - 318	0.6 - 7.1	41 - 530	111 - 1240	0.1 - 0.6	732 - 2720
372304097395401	235 - 304	7.2	26.5	5.2	13 - 16	0.5 - 1.0	7 - 9	26	0.3	169
372810097151101	794 - 1350	6.8 - 7.5	74 - 101	13 - 19	43 - 140	2.0 - 5.4	24 - 200	108 - 140	0.40 - 0.52	506

Figure 3-10 Location of Groundwater Stations



crop stubble being burned is also a factor. These sources of air pollution are generally temporary in nature.

Table 3-8 Current Wichita Water Rights

Water Right No.	Annual Quantity (acre-feet)	Maximum Rate of Diversion (MGD)
Equus Beds Aquifer		
HV-006 00388 1006	40,000	78
Cheney Reservoir		
05033 40126 42824[1]	30,668 21,973	120
Local Well Field		
SG-001 42879 42880 42881 540	1,120.1 42.82 42.39 42.39 5,357.00	37

[1]Water Right 42824 allows for pumping water from Cheney Reservoir when the pool level is above 1,420 ft. elevation and the total Equus Beds and Cheney pumping cannot exceed 92,641 acre-ft/yr.

The pollutants present in urban air come from many sources. The major contributors are mobile sources such as automobiles, trucks, buses, and trains. Other contributors are stationary sources (industrial), area sources (smaller sources such as boilers, dry cleaners, paint shops, residential fireplaces, and print shops), and natural sources (pasture fires, wheat stubble fires, and wind blown dust). The primary urban area is the City of Wichita.

The Wichita-Sedgwick County Health Department monitors air quality in Wichita and the surrounding area for both criteria pollutants and air toxins. Wichita's prevailing southwest winds dilute urban pollutants and help reduce emission concentrations from air pollution sources.

National Ambient Air Quality Standards (NAAQS) exist for six pollutants: carbon monoxide (CO), ozone (O_3), particulate matter smaller than 10μm (PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (No_x), and lead (Pb). These "criteria pollutants" are the only ones for which standards have been established. The EPA assigns designations, based on an area's meeting, or "attaining" these standards. The designations are:

- Attainment - Monitoring data available for the area shows attainment with standards.
- Non-Attainment - Monitoring data shows pollutant levels above standard. (Ozone has different levels of non-attainment: marginal, moderate, serious, severe and extreme.)
- Unclassified - Monitoring data unavailable for the area, *but presumed to be attainment.*

The Wichita/Sedgwick county area has been designated "In Attainment" since 1989. Results of monitoring for criteria pollutants in the Wichita area are shown in Table 3–9.

Air toxins are generally defined as those pollutants that are known or suspected of causing cancer or other serious health effects, such as birth defects or developmental effects. Since 1989, the Wichita-Sedgwick County Health Department has been conducting a monitoring program for EPA toxins. The program consists of two parts:

(1) measuring site-specific concentrations of approximately 60

Table 3–9 Air Quality Monitoring

Chemical	Status	Monitoring Results	Comments
Carbon Monoxide	Ongoing	(continuous) Average = 40% of standard	--
Ozone	Ongoing	(continuous) Current attainment of both old and new standards; however, trend is upward for ozone, creating concern for non-attainment in 5 years if VOCs are not controlled	Allowable concentrations lowered in 1997. Trend is toward increasing levels.
Particulate Matter	Continuous and periodic PM_{10} - ongoing $PM_{2.5}$ - started in 1999	(continuous) Consistent attainment for PM_{10}. Newer standard of $PM_{2.5}$ places levels "toward the upper limit".	
Lead	Discontinued *	In Attainment	--
Sulfur Dioxide	Discontinued *	In Attainment	--
Nitrogen Oxides	Reinstated 1999	--	Monitoring reinstated in 1999, since these compounds are involved in the formation of ozone

* Airborne lead levels are monitored by occasional checking of particulate sample filters
Source: Wichita-Sedgwick County Department of Community Health

commonly-found air toxic compounds near major air pollution sources, and

(2) measuring background levels of pollutants typical of urban areas.

Monitoring results are provided to both EPA Region VII and Kansas Department of Health and Environment (KDHE), which is conducting trend analysis to determine whether air toxic levels in Wichita have changed in type or amount in the last ten years. Monitoring results show the Wichita area to be in attainment for air toxins, as well as for criteria pollutants.

3.5 NOISE

The environments potentially affected by the proposed project range from urban to suburban to rural and have correspondingly different noise conditions.

As population density increases from rural to urban environment, so does the density of sensitive noise receptors. Rural areas are characterized by isolated residences and farmsteads, and have densities of sensitive noise receptors of roughly 1 to 10 per square mile. Suburban areas have residential densities of 3 to 4 per acre with an occasional school, business area, church, or health care facility. Urban areas can have residential densities of 6 to 8 per acre and greater concentrations of schools, businesses, churches, and health care facilities.

Background noise levels increase with increasing human population density. Low noise levels characterize rural environments, where major noise sources are farm equipment and light vehicular traffic on roadways. Typical daytime and nighttime sound levels in rural areas are approximately 35 and 25 decibels (dB(A)), respectively. The majority of the project areas are in rural settings. The Equus Beds Well Field is located in rural Sedgwick and Harvey counties. The Bentley Reserve Well Field is located in rural Sedgwick County and Cheney Reservoir is located in rural Reno County.

In suburban environments, noise sources are primarily from vehicular traffic and small gasoline engines. Typical daytime and nighttime suburban sound levels are 45 and 33 dB(A), respectively. Daytime and nighttime sound levels in urban areas are typically 65 and 55 dB(A), respectively, and are generated primarily by vehicular traffic. The local well fields in the City are in suburban/urban settings. These sound levels can be put in perspective by comparison to common sound levels listed in Table 3–10.

Table 3–10 Common Sounds and Sound Levels

Source	Sound level (dB(A))
Threshold of hearing	5
Quiet rural night	23
Library	32
Quiet suburban nighttime	33
Rural daytime	35
Soft whisper at 2 m (6.6 ft.)	35
Small theater background	40
Suburban daytime	45
Dishwasher in next room	50
Large business office	55
Normal speech at 1 m (3.3 ft.)	65
Gas lawn mower at 30 m (98 ft.)	70
Shouting at 1 m (3.3 ft.)	80
Diesel truck at 15 m (49 ft.)	85
Gas lawn mower at 1 m (3.3 ft)	95
Jet flyover at 300 m (980 ft.)	105
Rock band at 5 m (16 ft.)	110

3.6 BIOLOGICAL RESOURCES

3.6.1 WETLANDS

Wetlands are valuable and sensitive areas. They provide resting, feeding, nesting and brooding habitat for a variety of fish and wildlife; support a wide diversity of plants; enhance water quality by filtering pollutants and sediment from runoff; prevent erosion; and store floodwaters. This unique combination of valuable functions has resulted in the classification of wetlands as special aquatic sites that are afforded an extra measure of protection under the Clean Water Act (CWA). Section 404 of the CWA gives the U.S. Army Corps of Engineers (Corps) the authority to regulate discharges of dredged or fill materials into waters of the United States which include wetlands, rivers, creeks, ponds, and lakes. For regulatory purposes, wetlands are defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas which may occur along streams, lakes, and other low-lying areas (40 CFR 230.3, 33 CFR 328.3).

Wetlands regulated by the Corps are considered to be jurisdictional and may or may not be identical to Cowardin classified wetlands (Cowardin et al. 1979) shown on U.S. Fish And Wildlife Service's (FWS) National Wetland

Inventory (NWI) maps. The Corps considers palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) to be jurisdictional. The remaining NWI wetlands, e.g., palustrine aquatic bed (PAB) and unconsolidated bottom (PUB), riverine lower perennial unconsolidated shore (R2US), and riverine intermittent stream bed (R4SB) are considered to be waters of the U.S.

Wetlands outside of the floodplain are less abundant and consist primarily of fringes along streams and other drainage ways, or as the remnants of old farm ponds.

Kansas Wetland

3.6.1.1 Wetland Summary

The study area within the vicinity of the eight Equus Beds ASR options, has a range of 91 to 128 wetlands as shown in Table 3–11. There are approximately 89 to 103 linear wetlands associated with the Little Arkansas River depending on the alternative. The wetlands associated with the river are located directly adjacent to the river channel. There are isolated wetlands, and wetlands associated with drainage ways, intermittent streams and creeks, which total approximately 20 acres. In addition to the wetlands, there are five ponds, which may have wetlands. These areas are located within the limits of the option areas of the Equus Beds and the Local Well Field.

The types of wetlands located within the ILWSP alternative area include emergent, forested, scrub-shrub, and combinations of those mentioned. Emergent wetlands are situated in nearly level drainage ways and depressions. Emergent wetland vegetation may include bulrushes (*Scirpus* spp.), reed canary grass (*Phalaris arundinacea*), cattails (*Typha* spp.), sedges (*Carex* spp.) and rushes (*Juncus* spp.). Forested wetlands are located on nearly level drainage ways. The composition of the forested wetlands includes silver maple (*Acer*

Table 3–11 Number of Wetlands in the ILWSP Components

Component	PAB	PEM	PSS	R4SB	R2US	PFO	PUB	Total
Equus Beds Well Field ASR Options								
100/0	3	19	13	6	83	1	2	127
100/50	3	20	13	6	83	1	2	128
75/25	3	19	6	6	55	0	2	91
75/75	3	20	6	6	55	0	2	92
60/40	3	19	6	6	40	0	2	76
60/90	3	20	6	6	40	0	2	77
Local Well Field Options								
Option 1	1	8	1	0	1	1	0	12
Option 2	1	8	1	0	1	1	0	12

saccharinum), willows (*Salix* spp.), and eastern cottonwood (*Populus deltoides*). Scrub-shrub wetlands are located in drainage ways and depressional areas. The composition of the scrub-shrub wetlands includes rose (*Rosa* spp.) willows, and dogwoods (*Cornus* spp.).

3.6.2 VEGETATION

Pre-settlement vegetation communities of south-central Kansas consisted of mixed-grass prairies, wet meadows, emergent wetlands, and some riparian forests adjacent to streams and rivers. Today, most of these communities have been converted to cropland, warm season pasture, cool season pasture, and shelter belts. Most of the fields in the project area are planted in wheat, corn, soybeans or sorghum.

Historically, mixed prairies consisted primarily of the dominant little bluestem (*Andropogon scoparius*), buffalo grass (*Buchloe dactyloides*), gama grass (*Tripsacum dactyloides*), big bluestem (*Andropogon gerardi*), and needlegrasses (*Stipa* spp.). The wide expanses of prairie were maintained by fire, grazed by large herbivores, and had well-established, dense root systems. Wet meadow communities were typically transitional zones between lowland floodplains and mixed prairie grasslands, as well as smaller swales within more upland areas. This community type consisted of such species as prairie cordgrass (*Spartina pectinata*), big bluestem (*Andropogon gerardi*), switch grass (*Panicum virgatum*), rushes (*Juncus* spp.), and sedges (*Carex* spp.).

Lowland riparian forests dominated areas immediately adjacent to rivers and streams in this part of Kansas. Today, riparian forests still exist along the edges of streams and rivers in thin bands of trees and shrubs consisting primarily of common species such as cottonwoods (*Populus deltoides*), willow (*Salix* spp.), catalpa (*Catalpa speciosa*), hackberry (*Celtis occidentalis*), elm (*Ulmus* spp.), and maple (*Acer* spp.).

3.6.3 WILDLIFE

The two alternatives, ILWSP 150 and 100 MGD, would occur in a project area contained within Reno, Harvey, Kingman, and Sedgwick counties in the State of Kansas.

Changes in land use from native and cool-season grass to both grass and woody plants have resulted in a change in wildlife within the area. Bison (*Bison bison*), once abundant in the area, are no longer found in free-ranging populations while exotic ring-necked pheasants *(Phasianus colchicus)* and fox squirrels *(Sciurus niger)*, now common, did not historically inhabit the area. General habitat types found within these counties include openland, woodland, wetland, rangeland, and lakes, streams and farm ponds. The information on habitat types found within these counties was taken from county soil surveys published by the U.S. Soil Conservation Service (1966, 1974, 1975, 1979, 1980, 1983, and 1992).

Cropland, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines characterize openland habitat. Cropland is typically planted to corn, wheat, sorghum, or soybeans. Grasses and legumes such as fescue (*Festuca* spp.), lovegrass (*Eragrostis* spp.), bromegrass (*Bromus* spp.), clover, and alfalfa provide food and cover for a variety of wildlife species as do wild herbaceous plants like golden-rod (*Solidago* spp.), beggarweed (*Meibomia purpurea*), and grama. Rangeland habitat consists primarily of wild herbaceous plants and shrubs.

Woodland habitat consists of areas composed of hardwood and coniferous trees, shrubs, or some mixtures thereof. Most wooded habitat in the area occurs along waterways in riparian zones. Coniferous plants such as cedar provide food in the form of browse, seeds, or cones. Hardwoods such as the eastern cottonwood (*Populus deltoides*), oaks (*Quercus* spp.) elms (*Ulmus* spp.), hickories (*Carya* spp.), and sycamores (*Platanus occidentalis*) are often intermixed with conifers and shrubs. Shrubs produce fruit, buds, twigs, bark, or foliage used for food, cover, and shade for many species. Some shrubs found in the area include sand plum (*Prunus angustifolia*), buttonbush (*Cepalanthus occidentalis*), gooseberry (*Ribes* spp.), and golden currant (*Ribes* spp.).

Wetland habitat includes ponds, streams, ditches, marshes, and swamps.

Animal damage control in the area is widespread and handled by individual landowners or through private enterprise. People with wildlife problems in urban areas generally expect governmental assistance in contrast to rural inhabitants who do not. Common nuisance species include beavers, foxes, skunks, raccoons, coyotes, and deer.

3.6.3.1 Mammals

A variety of native mammals, which live in south-central Kansas, are expected to occur in the project area. Openland or grassland mammals include the eastern cottontail rabbit *(Sylvilagus floridanus),* thirteen-lined ground squirrel *(Spermophilus tridecemlineatus),* badger *(Taxidea taxus*), striped skunk (*Mephitis mephitis),* marmot *(Marmota monax),* red fox *(Vulpes vulpes),* and deer mouse (*Peromyscus maniculatus*). The black-tailed jack rabbit (*Lepus californicus*), blacktail prairie dog (*Cynomys ludovicianus*), and badger (*Taxidea taxus*) are commonly found in rangeland habitats.

Species that use both grassland and forest riparian areas to varying degrees (edge species) include the coyote (*Canis latrans*), raccoon (*Procyon lotor),* eastern cottontail rabbit, fox squirrel, striped skunk, little brown bat (*Myotis lucifigus*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), red fox, and white-tail deer (*Odocoileus virginianus*). The opossum (*Didelphis virginiana*) and occasionally mule deer (*Odocoileus hemionus*) may also be found in wooded areas (Burt and Grossenheider 1976).

Mammals that use lake, stream, river, and wetland habitats include muskrats *(Ondatra zibethica),* beaver *(Castor canadensis),* and mink *(Mustela vison).*

3.6.3.2 Birds

A variety of birds breed and/or migrate in south-central Kansas and could occur in the project area. A variety of ducks, geese, herons, and shore birds inhabit wetland areas. Specifically, birds that can be found in stream, river, and wetland habitats include the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), cattle egret (*Bubulcus ibis*), killdeer (*Charadrius vociferus*), red-winged blackbird (*Agelaius phoeniceus*), mallard (*Anas platyrhynchos*), northern shoveler (*Anas clypeata*), and blue-winged teal (*Anas discors*).

Grasslands and adjacent wooded edges provide habitat for the American goldfinch (*Carduelis tristis*), American kestrel (*Falco sparverius*), northern harrier (*Circus *cyaneus*), bobwhite quail (*Colinus virginianus)*, eastern bluebird (Sialia sialis), dickcessel, red-tailed hawk (*Buteo jamaicensis*), morning dove *(Zenaida macroura)*, eastern kingbird (*Tyrannus tyrannus*), northern cardinal (*Cardinalis cardinalis*), American robin (*Turdus migratorius*), eastern and western meadowlarks (*Sturnella magna* and *Sturnella neglecta)*, field sparrow (*Spizella pusilla*),and ring-necked pheasant. Bird species frequenting rangeland habitat are similar to grassland species and include hawks, eastern and western meadowlark, lark bunting (*Calamospiza melanocorys*), horned lark (*Eremophila alpestris*), dickcessel (*Spiza americana*), and greater prairie-chicken (*Tympanuchus cupido*).

Birds that are common in forest communities include a variety of owls, hawks, and thrushes, the red-headed woodpecker (*Melanerpes erythrocephalus*), common flicker (*Colaptes auratus*), downy woodpecker (*Picoides pubescens*), red-eyed vireo (*Vireo olivaceus*) and wild turkey (*Meleagris gallopavo*) (Peterson 1980, Bray et al. 1986).

3.6.3.3 Reptiles and Amphibians

Numerous species of amphibians and reptiles live in south-central Kansas and could occur on lands used by the water supply project.

Reptiles that can be found in grasslands and woodlands include the ornate box turtle (*Terrapene ornata*), prairie racerunner (*Cnemidophorus sexlineatus*), great plains skink (*Eumeces obsoletus*), garter snake (*Thamnophis sirtalis*), plains garter snake (*Thamnophis radix*), brown snake (*Storeria dekayi*), prairie kingsnake (*Lampropeltis calligaster*), central plains milksnake (*Lampropeltis triangulum*), bullsnake (*Pituophis melanoleucus*), ringneck snake (*Diadophus punctatus*), and eastern yellowbelly racer (*Coluber constrictor*).

Common native amphibians that use wetland and forested habitat include the tiger salamander (*Ambystoma tigrinum*), Woodhouse's toad (*Bufo woodhousei*), great plains toad (*Bufo cognatus*), plains leopard frog (*Rana blairi*), western chorus frog (*Pseudacris triseriata*), Blanchard's cricket frog (*Acris crepitans*), and bullfrog (*Rana catesbeiana*). Common native reptiles found in streams, rivers and wetlands include the northern water snake (*Nerodia sipedon*), snapping turtle (*Chelydra serpentina*), western painted turtle (*Chrysemys picta*), spiny softshell turtle (*Apalone spinifera*), and smooth softshell turtle (*Apalone mutica*) (Conant and Collins 1991).

3.6.3.4 Fish

As part of the Equus Beds Groundwater Recharge Demonstration Project, an aquatic monitoring study was conducted to establish baseline fisheries data on the Arkansas River, the Little Arkansas River, the North Fork of the Ninnescah River, and the Ninnescah River. Collection of the fisheries data included estimating biomass and abundance for fish species, and measuring and recording the habitat available to fish species (e.g. cover, food, etc.). The study for the Arkansas River system was initiated in 1995 and continued through 1997, while the Ninnescah River system was studied from 1997 to 1998.

Results of the study showed aquatic macroinvertebrate and fish communities within the Little Arkansas, Arkansas, North Fork of the Ninnescah, and the Ninnescah rivers are typical of sandy bottom streams in Kansas. The macroinvertebrate community is composed of various taxa that are suited for warm-water streams having turbid water and shifting sand substrates. In general, the majority of the fish community is composed of forage species such as red shiners (*Cyprinella lutrensis*) and sand shiners (*Notropis ludibundus*), game species such as channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and green sunfish (*Lepomis cyanellus*), and rough fish species such as the common carp (*Cyprinus carpio*). Common fish species are "generalists," which are not limited by any specific habitat requirements to survive. The forage species are found in all available habitats in the Little Arkansas River; whereas, the game species and rough species are more typically associated with available in-stream cover. Both the macroinvertebrate and the fish communities fluctuate naturally, continually adjusting to the changing environment existing in the river.

Some of the fish species that are more common to these river systems include the river carpsucker (*Carpiodes carpio*), common carp, channel catfish, flathead catfish, green sunfish, red shiner, sand shiner, bluntnose minnow (*Pimephales notatus*), suckermouth minnow (*Phenacobius mirabilis*), and mosquito fish (*Gambusia affinis*) (Page and Burr 1991, Cross and Collins 1995). Fish species more common to the Little Arkansas River include the orange-spotted sunfish (*Lepomis humilis*), largemouth bass (*Micropterous salmoides*), white crappie (*Pomoxis annularis*), freshwater drum (*Aplodinotus grunniens*), and slenderhead darter (*Percina phoxocephala*). Fish species more common to the North Fork of the Ninnescah are the gizzard shad (*Dorosoma cepedianum*) and the plains killifish (*Fundulus zebrinus*). Many other fish species can be found in these river systems, but are not listed here (Page and Burr 1991, Cross and Collins 1995).

A few fish species were collected less frequently in sampling efforts on the Arkansas River system. Although these fish species were collected less frequently, most are still typically common to sandy bottom streams similar to the Arkansas River system. These species include the black buffalo, emerald shiner (*Notropis atherinoides*), yellow bullhead (*Ameiurus natalis*), freckled madtom (*Noturus nocturnus*), speckled chub, and black bullhead (*Ameiurus melas*).

A number of fish species were also collected less frequently in sampling efforts on the Ninnescah River system. Again, although these fish species were collected less frequently, most are still typically common to sandy bottom streams similar to the Ninnescah River system. These species include the black buffalo (*Ictiobus niger*), bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*Ictiobus bubalus*), white crappie, shortnose gar (*Lepisosteus platostomus*), Arkansas darter (*Etheostoma cragini*), orange spotted/green sunfish hybrid (*Lepomis humilis* x *L. cyanellus*), and speckled chub (*Extrarius aestivalis*). Another species not commonly found in the Ninnescah River system was the spotted gar (*Lepisosteus oculatus*), which to date has only been collected in a few Kansas counties east of Sedgwick County.

Cheney Reservoir, formed on the Ninnescah River system, is one of the largest fisheries resources in the four-county area with 9,540 fishing acres. Anglers annually fish for such species as the wiper (hybrid of the striped bass and white bass), striped bass, walleye, channel catfish, white crappie, black crappie (*Pomoxis nigromaculatus*) and white bass. The lake is stocked with wipers, striped bass, and walleye, of various sizes (fry, fingerling, and adults). Almost 21 million individuals of stocking fish, totaling almost 3100 pounds, were released in the reservoir from 1981-1996. No fisheries studies were conducted on Cheney Reservoir. However, the reservoir does contribute to fisheries populations downstream in the project area. Four species that are not typically common to the Ninnescah River system but are present due to fisheries management plans used in Cheney Reservoir, include the white bass (*Morone chyrsops*), striped bass (*Morone saxatilis*) white bass/striped bass hybrid (*M. chrysops* x *M. saxitilis*) also known as the wiper, and walleye (*Stizostedion vitreum*).

3.6.4 THREATENED, ENDANGERED, OR CANDIDATE SPECIES

Eight federally listed threatened, endangered, or proposed endangered (candidate) species were identified by FWS as potentially being impacted by the project. The peregrine falcon, initially included in this list of threatened and endangered species, was removed following the Federal delisting of this species in August 1999.

- Interior Least Tern (Endangered)
- Piping Plover (Threatened)
- Bald Eagle (Threatened)
- Eskimo Curlew (Endangered)
- Whooping Crane (Endangered)
- Arkansas River Shiner (Threatened)
- Topeka Shiner (Endangered)
- Arkansas Darter (Candidate)

Each species has been documented to occur or historically occurred within the four county project area. The following discussion provides both general information on each species and more specific information related to each species' usage of the Arkansas River system and associated Equus Beds aquifer, the Ninnescah River system, and Cheney Reservoir.

3.6.4.1 Interior Least Tern

The interior least tern (*Sterna antillarum athalassos*) is federally listed as endangered (50 FR 21784). This designation applies to populations in Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, Montana, Nebraska, New Mexico, North Dakota, South Dakota, Oklahoma, and Tennessee; Mississippi River populations in Louisiana and Mississippi; and populations over 80 kilometers (50 miles) from the Gulf Coast in Texas (FWS 1990). The interior least tern is also listed as endangered by KDWP. Population size of the interior least tern in 1990 was estimated at 5,000 individuals (FWS 1990).

The interior least tern breeds along large rivers within the interior of the United States during the summer months and retreats to more southerly areas during the winter. Historically, breeding habitat included the Mississippi and Red rivers, the Rio Grande, and their major tributaries. Breeding and nesting range included the area from Texas north to Montana and from eastern Colorado and New Mexico eastward to southern

Least Tern

Indiana. Currently, the interior least tern is still known to nest in all these areas where river banks are relatively unaltered by human activities.

Least terns spend four to five months at their breeding sites, arriving from late April to early June. Egg laying begins in late May. Nests are constructed on unvegetated or sparsely vegetated sand or gravel bars within wide river channels, along salt flats, or on artificial habitats such as sand pits (FWS 1990, Dryer and Dryer 1985, Haddon and Knight 1983, Kirsch 1987,1988,1989, Larkins 1984, Morris 1980). Nests are shallow, inconspicuous depressions in the substrate, scratched out by adults and located in the open. Terns are colonial nesters and several nests may be located in the same area. The sandbar habitats used by least terns for nesting are ephemeral and nests, eggs, and chicks are highly susceptible to loss because of high water.

The interior least tern feeds primarily on small fish, which it plucks from the surface of the shallow waters of large rivers or other water bodies. Crustaceans, insects, mollusks, and annelids are also occasionally eaten (Whitman 1988). Foraging areas are usually near nesting sites (Talent and Hill 1985). Terns will gather at low, wet sand or gravel bars at the mouths of tributaries, streams, and floodplain wet-lands with high concentrations of fish to rest and eat prior to migration.

Least terns are considered transients and occasional summer visitants in Kansas, where they can be found on barren flats and sandbars (KDWP 1993). Kansas also supports populations of breeding least terns (FWS 1990). A portion of the population in Kansas nests at Quivira National Wildlife Refuge (QNWR), which has been designated critical habitat for the least tern (Collins et al. 1995).

3.6.4.2 Piping Plover

Piping plover (*Charadrius melodus*) populations have declined dramatically since the early 1900s as a result of hunting and habitat loss (FWS 1994). In 1991, the North American population was estimated at 5,482 breeding adults (Campbell 1995). Piping plovers continue to breed throughout the Great Plains region of Canada and the United States, extending as far north as Manitoba and Alberta and as far south as

Credit: USFWS / Richard Kuzminski

Piping Plover

Nebraska. However, breeding populations have all but disappeared from the Great Lakes region where they are listed as endangered (Haig and Plissmer 1993). Piping plovers breeding on the Great Plains have been listed as federally and state threatened, but are being considered for federal endangered status. These birds winter along the Gulf coast and adjacent barrier islands.

Piping plovers are migratory shorebirds that inhabit sand beaches and sandbars of inland rivers and lakes. Nests, constructed on bare sand or gravel, consist of shallow depressions scratched in the sand or gravel and are frequently lined with small pebbles or shells (FWS 1994). Plovers begin arriving at their breeding grounds in late March and stay three to four months.

Credit: Mid America Eagle Watch

Bald Eagle

Piping plovers feed on a variety of invertebrates, such as worms, insects, crustaceans, mollusks, beetles, and grasshoppers, which they capture by picking and gleaning. Foraging activity generally occurs within a few inches on either side of the water's edge (Bent 1929, Lingle 1988).

Piping plovers may rarely be found in the project area on sandbars and barren flats on rivers during spring and fall migrations, but are more likely to be found at QNWR or Cheyenne Bottoms Wildlife Area (CBWA). Nesting was documented for the first time in 1996 along the Kansas River.

3.6.4.3 Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) occurs throughout North America and once maintained breeding populations in Canada, Alaska, and 45 of the lower 48 states. For a variety of reasons including hunting, habitat loss, pesticides (Grier et al. 1983), human disturbance (Murphy 1965, Retfalvi 1965, Juenemann 1973, Weekes 1974, Grubb 1976, Stalmaster and Newman 1978, Russell 1980, Skagen 1980, Knight and Knight 1984, Smith 1988 Anthony and Isaacs 1989), and heavy metals (Grier et al. 1983), bald eagle populations declined significantly during the 19th and 20th centuries. This decline prompted the species to be listed as federally endangered in 1978. Through research, conservation, management, and protection, the species population and breeding range is increasing. These improvements led to the species being down-listed to threatened in 1995 (60 FR 36000). Populations have been thriving enough in recent years that it is currently being considered for de-listing by the FWS. It is listed as threatened in Kansas.

Habitat requirements for bald eagles revolve around food preference and nesting behavior. The bald eagle's primary food source is fish (Grier et al.

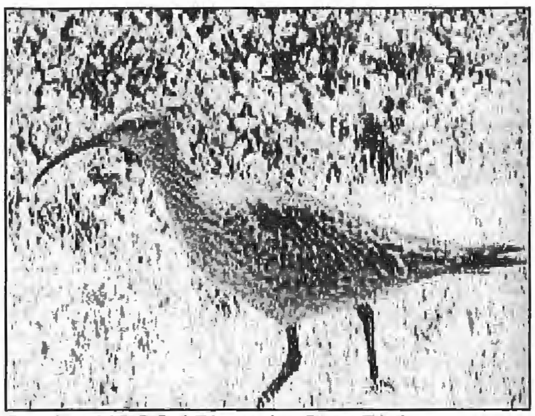
1983). Because of their reliance on fish, eagles nest close to large water bodies including lakes, rivers, reservoirs, and oceans where large trees with strong branches or rock cliffs are present. Nests are found in a variety of tree species, including cottonwood, American elm, and sycamore. Nesting begins in mid-March and eggs are laid in late March to early April. Eagles will return year after year to the same nesting area, and often reuse a previous year's nest.

Eagles also need roosting sites consisting of large trees with horizontal limbs and open branches. Often roosting sites are located near water, but they may also be found away from eagles' feeding areas.

The majority of North American bald eagles migrate to coastal or more southerly climates during the winter. The extent of migration depends partly on the severity of the winter. Bald eagles will move as far south as necessary to find open-water feeding areas. Wintering bald eagles are found throughout the United States but are most abundant in the Midwest and West. Bald eagles are regular migratory visitors to Kansas and are known to nest in several locations throughout the state. They are most commonly observed during the winter months along the rivers or reservoirs in the state. The first recorded nest was at Clinton Lake in 1989. Nest sites have been recorded in eastern Kansas at reservoirs (Collins et al. 1995).

3.6.4.4 Eskimo Curlew

The eskimo curlew (*Numenius borealis*) is one of the rarest birds in North America. The species was federally listed endangered in 1967, and is thought to be close to extinction today, with only 70 confirmed sitings in the last 50 years. Historically, it occurred in enormous flocks during spring migrations from South America to the Alaskan and Canadian Arctic. Populations rapidly dwindled from 1870 to 1890 due to unrestricted market hunting. This species' lack of fear of humans and habits of traveling in large flocks made it an easy target. Conversion of grasslands to croplands further added to the decline of this species.



Credit: USGS / Photo by Don Bleitz

Eskimo Curlew

This species was last reported in Kansas in 1902, and thus is considered extirpated from the state. It is listed as endangered in Kansas (Collins et al. 1995).

The eskimo curlew feeds on grass-hoppers, grubs, and a variety of grassland insects. The species breeds on the arctic tundra, and over-winters on the Pampas grasslands of Argentina. The nest has been described as a shallow depression in the ground on open Arctic tundra. Nests were typically found from late May to mid-June (Campbell 1995). Curlews moved northwesterly through the midwestern tall-grass prairies during their spring migration in February to arrive at their Arctic breeding grounds by May.

3.6.4.5 Whooping Crane

The whooping crane is another rare North American bird. Historically, this species ranged from the arctic coast to central Mexico, and from Utah east to New Jersey, into South Carolina, Georgia, and Florida. It once was found near lakes, ponds, sloughs, and streams and also ranged into plains and prairies. The historic breeding grounds of the migrating population extended across north-central United States into the Canadian provinces of Manitoba, Saskatchewan, and Alberta. A non-migratory population existed in southwest Louisiana. Today, the only self-sustaining wild population breeds at Wood Buffalo National Park in Canada and over winters along the Texas Gulf Coast at Aransas National Wildlife Refuge (ANWR). The migratory corridor for this population extends through north-eastern Montana, western North Dakota, western South Dakota, central Nebraska and Kansas, and into west-central Oklahoma and east-central Texas (USFWS, 1994). The population was estimated at 146 individuals in 1994.

Credit: USFWS photo

Whooping Crane

The species was officially listed as endangered in 1967. A recovery plan is currently being coordinated between the FWS and the Canadian Wildlife Service. Critical habitat has been designated in Kansas, where it is also listed as endangered, at QNWR and CBWA (Collins et al. 1995). Current major threats to this species include hurricanes and contaminant spills along their winter habitat on the Texas coast. Powerlines and fences also pose threats to this species (FWS Red Book 1995).

The whooping crane's diet consists of the larval forms of insects, frogs, rodents, small birds, berries, plant tubers, crayfish, and waste grains from harvested cropland. An attempt was made to establish an experimental population of whooping cranes in Idaho in 1975, but it failed. An experimental reintroduction of a non-migrating population was initiated in Florida in 1993. Causes for declines of whooping cranes include hunting, specimen collection, human disturbance, and conversion of nesting habitat to various agricultural uses. Other factors which have also accelerated whooping crane declines include low reproductive potential, low hatchling survivability, and delayed successful egg fertilization (approximately 4 years) (FWS Red Book 1995).

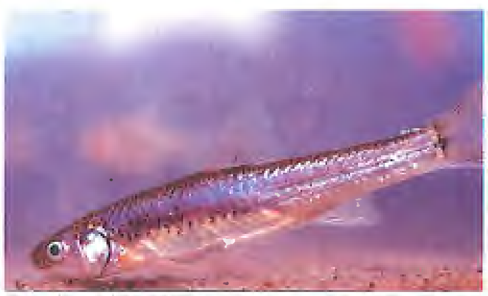
Nesting habitat of the whooping crane includes bulrushes of the numerous poorly drained potholes of Wood Buffalo National Park. One to three eggs are laid beginning in late April and incubated over a 29-31 day period. Both parents share in the incubation and brood-rearing duties. Usually only one chick is fledged. The autumn migration starts in mid-September and lasts until mid-November. The whooping crane will migrate singly, in pairs, family groups or small flocks, and are sometimes accompanied by sandhill cranes. Over wintering habitat at ANWR includes salt marshes, grasslands, swales, and ponds (FWS Red Book 1995). Whooping cranes also roost in riverine habitat, on isolated submerged sandbars, and in large palustrine wetlands such as those found at QNWR and CBWA. Spring migration begins in late March and continues through early May.

3.6.4.6 Arkansas Darter

The Arkansas darter (*Etheostoma cragini*) occurs only in the Arkansas River basin and in southeast Kansas. The species is currently a federal candidate species. KDWP has designated this species as state threatened, and has designated portions of the project area as critical habitat. Critical habitat within the project area has been designated on the North Fork of the Ninnescah River, starting at the Reno-Stafford county line, extending to its confluence with the South Fork of the Ninnescah River in Sedgwick County, as well as numerous perennial spring-fed reaches of named and unnamed streams south of the Arkansas River in Reno, Kingman, and Sedgwick counties. The major cause for the decline in Arkansas darter populations is water depletion from irrigation, but chemical and feedlot runoff has also contributed (Collins et al. 1995).

© Missouri Conservation Commission

Arkansas Darter



Credit: USFWS / Photo by Ken Collins

Arkansas River Shiner

The Arkansas darter prefers small prairie streams, seeps and springs that are partially overgrown with watercress and other broad-leaved aquatic plants. It also prefers shallow water with little current, as well as areas with aquatic vegetation and exposed willow roots used for cover. This species is most abundant near headwaters. Aquatic insects and other arthropods comprise the majority of the darter's diet (Pflieger 1975). This species breeds March to May and lays eggs in sandy substrate. The female abandons the eggs once deposited.

3.6.4.7 Arkansas River Shiner

Historically, the Arkansas River shiner (*Notropis girardi*) was abundant in the tributaries of the Arkansas River system throughout southwest Kansas. It may be extirpated from the state, however, and may be almost entirely restricted to a 500-mile stretch of the Canadian River system in Oklahoma, Texas, and New Mexico.

The species is currently federally threatened with federal critical habitat designated in the mainstem of the Arkansas River above and below the City of Wichita. KDWP has designated this species as state endangered, and has designated portions of the project area, including all of the Arkansas River in Harvey and Sedgwick counties, as critical habitat. The portion of the main stem of the Ninnescah River in Sedgwick County is also designated critical habitat (Collins et al. 1995). The major cause for this species' decline is water depletion from irrigation, but competition with nonnative fishes (Collins et al. 1995) probably also contributed to its decline.

The Arkansas River shiner's preferred habitat is the protected "leeward" sides of sand ridges, formed by steady shallow water flow. It historically inhabited the main channels of wide, shallow, sandy-bottomed rivers and larger streams of the Arkansas River basin.

The Arkansas River shiner spawns from June to August when streams approach flood stage. The eggs drift near the surface in the swift current of open channels. The eggs develop rapidly and the hatchlings swim to sheltered areas within three to four days (Collins et al. 1995). This species feeds facing upstream and captures organisms washed out of shifting sand (Cross and Collins 1995).


Credit: Photo by Jim Rathert

Topeka Shiner

3.6.4.8 Topeka Shiner

The Topeka shiner is currently federally listed as an endangered species (FWS 1999). The Topeka shiner was once wide-spread in Kansas, but is now restricted to small streams in the Flint Hills (both Kansas and Neosho drainages) and a few streams elsewhere in the state (Willow Creek, Wallace County; Cherry Creek, Cheyenne County; and single streams in Jefferson and Johnson counties). Most of the remaining populations of this species are in Kansas. It formerly occurred in at least twelve counties in central and western Kansas, where it has not been found recently (Cross and Collins 1995). The species primarily occurs as isolated, fragmented populations now inhabiting less than ten percent of its original range (FR 63, vol. 240).

The Topeka shiner prefers open pools near the headwaters of streams that maintain a stable water level due to weak springs or percolation through riffles. The water in these pools is usually clear, except for plankton blooms that develop through the summer months. The Topeka shiner spawns from late May to July, and the young mature in one year. The maximum life span is two or three years (Cross and Collins 1995). Its diet consists of insects and zoo-plankton.

3.6.5 <u>STATE-LISTED SPECIES</u>

In addition to the aforementioned species, four species occurring within the project area are listed as state threatened or endangered by KDWP: the speckled chub (*Extrarius aestivalis*), eastern spotted skunk (*Spilogale putorius interrupta*), white-faced ibis (*Plegadis chihi*), and snowy plover (*Charadrius alexandrinus*).

3.6.5.1 Speckled Chub

The southern population of the speckled chub is currently listed as state endangered in the Arkansas River drainage. This population has been decreasing because of de-watering of Kansas rivers and streams, but feedlot, oil, and pesticide runoff have also contributed to its decline. Low water dams and other stream obstructions have fragmented the habitat of the speckled

Credit: Wisconsin Dept. of Natural Resources

Speckled Chub

chub, thus making recolonization of upstream areas difficult if not impossible (Collins et al. 1995).

Critical habitat of the speckled chub in the project area includes all of the Arkansas River in Harvey and Sedgwick counties, the mainstem of the North Fork of the Ninnescah River from Cheney Reservoir Dam to its confluence with the South Fork of the Ninnescah, Sedgwick County, and the main-stem of the Ninnescah River from its origin to its confluence with the Arkansas River in Sumner County (Collins et al. 1995).

The species inhabits the shallow channels of large, permanent flowing, sandy streams of the lower Arkansas River watershed. Its preferred habitat is a substrate of clean, fine sand, and it avoids areas of calm water and silted stream bottoms. The breeding season of the speckled chub is May to August when water temperatures exceed 70 degrees Fahrenheit. The diet of the speckled chub is unknown, but probably consists of larval insects (Collins et al. 1995).

3.6.5.2 Eastern Spotted Skunk

The eastern spotted skunk is currently state listed as threatened. Critical habitat has been designated outside the project area, in Sedgwick County's Cowskin Creek and Big Slough drainage basins, west and south of Wichita. Changes in agricultural practices are the primary reason for this species' decline in recent years.

The preferred habitat of the spotted skunk in central and western Kansas is riparian habitat. It uses fence rows, out-buildings, hollow logs, and rock and brush piles as den sites. The spotted skunk breeds in March and April, and two to nine kittens are born in May or June. It eats a variety of foods, including berries, carrion, seeds, fruits, birds, bird eggs, and mice (Collins et al. 1995). It is almost entirely nocturnal.

Eastern Spotted Skunk

3.6.5.3 White-faced Ibis

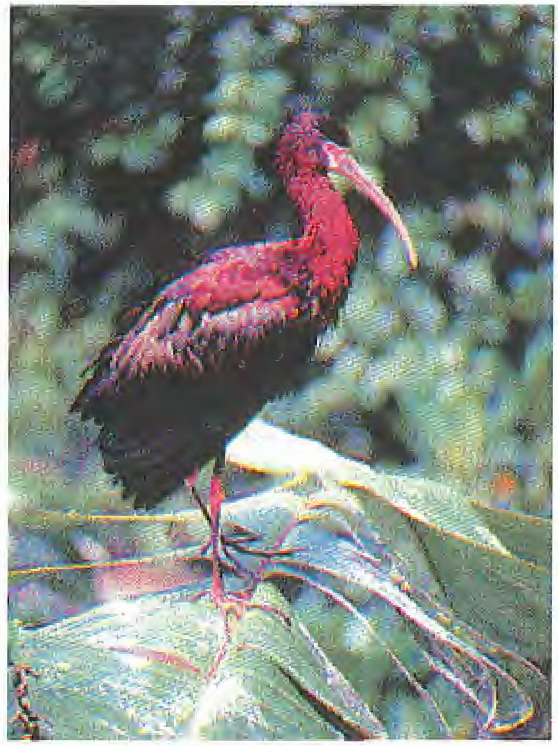
The white-faced ibis (*Plegadis chihi*) is currently listed as state threatened. In Kansas this species is a rare spring and fall migrant and summer resident. Preferred habitat includes permanent wetland areas, but the ibis will use scattered temporary pools. This species is most likely to be found at CBWA and at QNWR, both of which have been designated critical habitat, and are northwest and west of the counties in the project area (Collins et al. 1995). This species may, however, utilize temporary wetlands around the streams and rivers in the project area as well as wetland habitat at Cheney Reservoir.

Though white-faced ibis populations have been declining in recent years due to wetland drainage and pesticide use around wetlands, the populations in Kansas have been increasing. It nests at both CBWA and QNWR. The white-faced ibis is a colonial nester and it builds nests in cattail and bulrush marshes. Three to five eggs are laid and incubated for 21 days. The young fledge in six weeks. The white-faced ibis feeds on a variety of insects, salamanders, leeches, snails, crayfish, and small fishes (Collins et al. 1995).

3.6.5.4 Snowy Plover

The snowy plover (*Charadrius alexandrinus*) is currently listed as state threatened in Kansas, and can be found in appropriate sparsely vegetated salt flats, sandbars, and beaches during migrations in the spring and fall. Their numbers have been reduced dramatically throughout the range due to de-watering, river channelization, and river damming. These activities have reduced flooding and sand-bar formation, and allow vegetation to encroach upon existing habitats (Collins et al. 1995).

The species primarily nests in Kansas at QNWR, and occasionally at CBWA and along rivers and stream of southwest and central Kansas where appropriate habitat is available. The nest is scratched out as a depression in the sand and nesting occurs from mid-March through late summer. Incubation takes 24-28 days. The snowy plover feeds upon insects and aquatic invertebrates picked from open flats. Critical habitat exists for this species at QNWR and on the Cimarron



Credit: Texas Wetland Information Network (WetNet)

White-faced Ibis

River in Clark, Comanche, and Meade counties (Collins et al. 1995).

3.7 SOCIOECONOMICS

The social and economic conditions within the Wichita area and surrounding region are the factors ultimately responsible for the increased demand for water and the need to expand water production capacity. The region of influence (ROI) for this socioeconomic study includes the counties of Harvey, Sedgwick and Butler, although the primary focus will be in Sedgwick County.

3.7.1 POPULATION AND HOUSING

Population. The Wichita metropolitan area has experienced steady population growth over the last 10 years. Since 1990, the metropolitan area has grown on average 1.3 percent annually, compared to 0.7 percent for Kansas and 1 percent for the United States. Butler County, with an average annual population growth of 2.4 percent, is the fastest growing county in Kansas. Sedgwick and Harvey counties rank 11^{th} and 12^{th} in population growth with each averaging 1.2 percent annual increases in population (CEDBR, 1999). The estimated 1999 population for the ROI is 548,714 (US Census Bureau). Sedgwick County makes up more than 80 percent of the total. Population in the ROI grew 13 percent from 1990 to 1999, an increase of slightly over 63,400. Butler County experienced the largest increase at 24 percent. The estimated 1999 population for the City of Wichita's Water Service Area is 380,674.

Housing. Housing includes all apartments, houses, and mobile homes available whether they are owner-occupied, rented, or vacant. In 1990, there were 202,521 housing units in the ROI, of which 92.2 percent were occupied and 7.8 percent were vacant. The number of housing units (single and multi-family) in Sedgwick County alone was 170,159 (Slater and Hall, 1996). The number of housing units (single and multi-family) within the city of Wichita in 1990 was 123,249 (Slater and Hall, 1996). In 1997, the estimated number of housing units in the Wichita Metropolitan Area was 217,472 (CEDBR, 1997), an increase of 7.4 percent.

Residential and commercial construction has been thriving in Wichita for several years. Compared to these record-setting years, construction activity slowed in 1999; yet the amount of construction activity is still at historically high levels. In 1999, activity was due to remodeling and repairs; of which the value in the first half was 19 percent above the same period in 1998. This increase was generated by the destruction caused by the May 1999 tornadoes in Haysville and south Wichita. About 3,500 residential units were damaged and 600 were destroyed (CEDBR, 1999).

Recent data on residential and total construction permits issued by the City of Wichita is provided in Table 3–12. In 1998, 1,535 permits were issued for singe-family structures. More than one-third of these housing starts were in the northwest quadrant of the city. More dwelling units were added in 1998 (3,137) than in any year since 1984. More large multi-family dwelling units were added in 1998 (1,468) than in the previous eight years combined. At least three new apartment complexes were to be completed in 1999, which would add approximately 1,000 units to the market.

Table 3–12 Construction Permits Issued by City of Wichita

	1996	1997	1998
Residential Permits	1,639	1,733	2,104
Total Construction Permits[1]	5,744	6,600	6,566

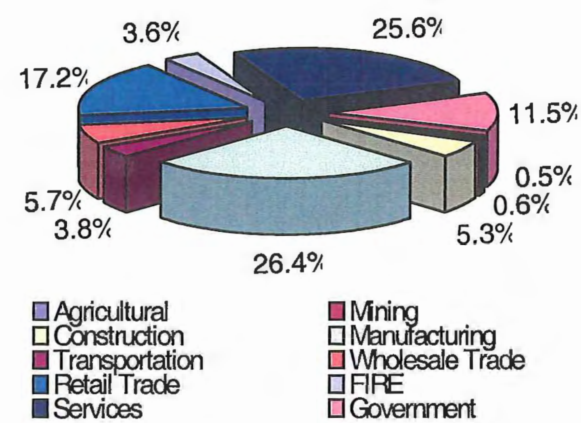
[1]Includes residential, non-residential, additions, remodels, and repairs
Source: CEDBR, 1999

A significant change in the construction pattern of the Wichita metropolitan area is the growth occurring in the unincorporated areas of Sedgwick County. In 1980, only 16.5 percent of the county's construction activity was in the unincorporated area. In 1997, that figure had grown to 32 percent. Construction totaled $314.7 million in 1997, up 16.1 percent from 1996. The City of Wichita accounted for 42 percent of the construction activity in the metropolitan area. (Nickel, 2000)

3.7.2 ECONOMIC ACTIVITY

The economy of the ROI is diverse, including services, agricultural, government, and manufacturing sectors. Wichita's employment includes a broad mix of business types, with a strong base of relatively high paying manufacturing jobs. A list of Wichita's major employers includes the Boeing Co., Raytheon Aircraft Co., Cessna Aircraft Co., Coleman Co. Inc., Bank of America, Bombardier Aerospace Learjet, Via Christi Regional Medical Center, Wesley Medical Center, Koch Industries and Southwestern Bell Telephone. However, any listing of the area's largest private employers cannot reveal the large numbers of small and mid-sized companies providing a wide variety of goods and services to markets around the globe. The 1996 County Business Patterns show approximately 11,206 business establishments in Sedgwick County with fewer than 100 employees (City of Wichita).

Figure 3-12 1998 Percent Employment by Industry



The largest industrial employment sector consists of manufacturing, accounting for 26.4 percent of the 1998 employment. Services account for 25.6 percent; followed by Wholesale and Retail Trade at 22.8 percent. Government is also a large part of the economy at 11.5 percent (Figure 3–12). (IPPBR, 1999)

Employment from 1989 to 1998 in the ROI increased by 47,498 or 20.5 percent. Services reported the largest gain, 18,951, at 36.2 percent. Manufacturing recorded an increase of 10,261. Government, Construction and Retail Trade all added over 5,000 workers while Wholesale Trade expanded by 2,707. Agriculture witnessed an increase of 570. Three areas that experienced losses were Mining; Transportation, Communications and Public Utilities (TCPU); and Finance, Insurance and Real Estate (FIRE). FIRE declined 974, or 8.8 percent. Mining lost 445 workers while Transportation and Public Utilities saw a drop of 155.

The estimated labor force for the Wichita Metropolitan Statistical Area (MSA) in 1999 was 290,160 (KDHR, 2000). The 1999 unemployment rates for Sedgwick County, the City of Wichita, and the Wichita MSA were 3.4 percent, 3.7 percent, and 3.3 percent respectively (Table 3–13). February 2000 unemployment rates for Sedgwick County, the City of Wichita, and the Wichita MSA were 4.1 percent, 4.5 percent, and 4.0 percent respectively (KDHR, 2000). Wichita's unemployment rate has been lower than the national average, 4.5 percent, since 1995.

Table 3–13 February 2000 Labor Force Estimates

County/City	Labor Force	Employment	Unemployment Rate	1999 Average Unemployment Rate
Harvey	18,117	17,498	3.4	2.6
Sedgwick	241,628	231,674	4.1	3.4
City of Wichita	183,316	175,121	4.5	3.7
Wichita MSA	291,862	280,199	4.0	3.3

Total employment grew 3.9 percent in 1998 in the Wichita MSA. Total employment is expected to continue to grow at an average annual rate of 1.1 percent between 1999 and 2004.

Agriculture. The top five commodities by crop area in Kansas are wheat, sorghum, hay, corn and soybeans. Sedgwick County annually ranks in the top 10 percent in acres of crops harvested and value of crops produced. Approximately 22 million acres are harvested each year in Kansas; of that, 5 percent is in Sedgwick, Harvey, and Reno counties. Wheat is the largest crop harvested, followed by corn, sorghum, and soybeans.

Crop production in Sedgwick, Harvey, and Reno counties has risen 8 percent over the last five years with wheat showing the largest increase (Figure 3–13). Average yield per acre for wheat, corn, soybeans, and sorghum is 41, 146, 39, and 70 bushels, respectively.

Prices received by farmers for their wheat, corn, and soybean crops increased in 1996, but have since fallen below prices received in 1991 (Figure 3–14). The average price for wheat, corn, and soybeans from 1991 to present is $3.34, $2.38, and $5.95 per bushel, respectively.

Figure 3-13 Crop Yield Trends for Sedgwick, Reno, and Harvey Counties

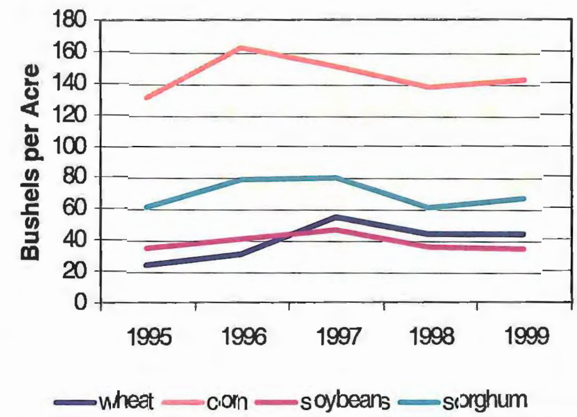
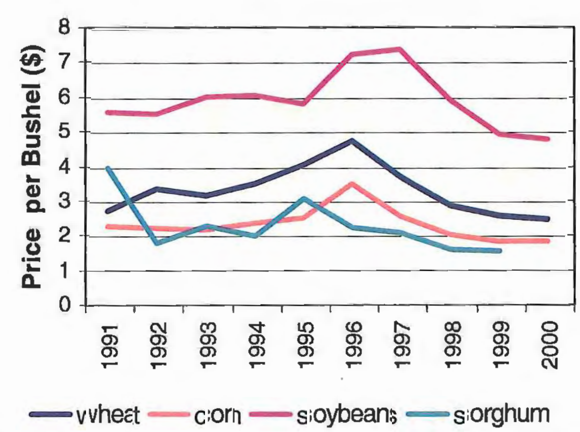


Figure 3-14 Price Trends per Commodity



Personal Income. Total personal income for Sedgwick County had an average annual growth rate of 5.2

percent for the decade ending in 1996. For 1998 through 2004, total personal income is expected to grow at an average annual rate of 4.7 percent. If inflation remains in the range of 1.5 percent, real growth of personal income would average 3.2 percent for the period 1998-2004 (CEDBR, 1999).

Personal income is affected by a number of factors, including social security, farm income, rental income, stocks, interest, and employee earnings. The largest share by far is the earnings of employees. Downturns in manufacturing employment have historically been offset by more rapid growth in other sectors. This pattern could be expected to continue, blunting the impact of any unexpected downturn in manufacturing. Receipts of unemployment insurance also moderate personal income during periods when workers may be temporarily displaced.

Income. Comprehensive income statistics were available for the city, county, and metropolitan area of Wichita (Slater and Hall, 1996). Table 3–14 shows the per capita income and the median household income for each of the affected counties, the City of Wichita, and the Wichita MSA.

Table 3–14 Income Statistics for Both ILWSP Alternatives

	Per capita Income (1997) ($)[2]	Median Household Income ($)[1 & 2]
Harvey	23,148	37,405
Sedgwick	24,870	36,845
Butler	21,991	41,667
City of Wichita	36,218	N/A
Wichita MSA	24,434	38,057

[1]Slater and Hall 1996
[2]CEDBR, 1999

3.7.3 PUBLIC SERVICES

Public services entail transportation, education, healthcare, and law enforcement. The following sections give a brief description of these services for the Wichita metropolitan area.

Transportation. The major transportation routes in the Wichita metropolitan area are three interstate highways and one U.S. highway. Interstate 35 is located along the southwest edge of Wichita, running in a southwest/north-east direction. Interstate 135 is located in central Wichita, running north/south, connecting with Highway 96 and I-35 on each end. Interstate 235 forms a loop around the west side of Wichita connecting with Highway 96 and I-135. U.S. Highway 54 is located in central Wichita, running east/west.

Wichita has a public transportation system serving approximately 6,500 people per day, and over 2 million passengers on a fixed route bus service, and over 172,000 disabled passengers on paratransit vans annually. The transit system currently operates 50 buses and 25 wheel-chair lift vans; on 18 fixed routes, 1 point deviation route, 13 demand-response paratransit routes operated by the Wichita Transit Department, and 8 paratransit vans operated under a lease program with other social service agencies (City of Wichita).

Rail freight companies in Wichita include two major rail companies, Union Pacific and Burlington Northern-Santa Fe, and several smaller companies. Passenger service is available from Amtrak through Newton, Kansas, which is less than 30 miles north of Wichita and 33 miles east of Hutchinson.

Scheduled air transportation services are provided at Mid-Continent Airport, which is located in southwest Wichita. The airport has three main runways that are 10,300 feet, 7,302 feet and 6,301 feet long. The airport is currently used by 12 major airlines for passenger and freight operations, and seven cargo air companies. Passenger volume during 1997 was 1,414,334. Airfreight during 1997 was 38,737 tons.

There are five other airports in the Wichita metropolitan area, which serve a variety of small companies and individual plane owners. Jabara Airfield is located northeast of Wichita and has one concrete runway that is 6,100 feet. Beech Airfield is located east of Wichita, has one 8,000-foot runway, and is open to limited public use. Riverside Airfield is located northwest of Wichita and has one 2,900-foot runway that will be expanded in the future. The Maize Airfield is also located northwest of Wichita. It is an unpaved and unlighted grass strip used by student pilots and antique airplane pilots. The Westport Airfield is located in southwest Wichita and has a 2,500-foot asphalt runway, and a 3,200-foot grass runway.

Law Enforcement. The Wichita Police Department is the largest police agency in the State of Kansas with an authorized staff of 626 commissioned officers and 201 civilian employees. State, county, and city law enforcement officials serve the Wichita metropolitan area. The Kansas Highway Patrol has approximately 34 commissioned officers in the Wichita area. Park City has 13 officers and noncommissioned reserves. The Rosehill police department has 7 officers. The Andover police department has 12 officers.

Healthcare. Wichita is a first-class regional medical center with five acute-care hospitals, including the two campuses of the Via Christi Regional Medical Center. In addition to these major treatment facilities, Wichita has five freestanding specialty or rehabilitation hospitals and dozens of outpatient clinics. Wichita is also home to the Center for Improvement of Human Functioning, an international bio-medical research and educational organization specializing in nutritional medicine and preventive care (City of Wichita).

The Wichita metropolitan area has 14 hospitals with a total of 2,648 beds, and an occupancy rate of 528/100,000 (Slater and Hall, 1996). Given a population of approximately 500,000 people, the proportion of hospital beds filled is nearly 100 percent. There are 28 nursing homes and assisted living facilities in Wichita, which have a total of 2,280 beds. The Sedgwick County Health Department offers a variety of services at six locations. These services include a family planning clinic, sexually transmitted diseases (STD) clinic, childhood immunizations, and pre-natal care and child dental care.

Education. Eight unified school districts (USD) serve the City of Wichita. USD 259 is the largest in the city. It experienced steady enrollment declines from the 1991/92 school year through the 1995/96 school year, losing more than 2,500 students. Since that time, enrollment has started to rebound, with an increase of more than 1,700 students over the past 3 years.

In addition to the public school districts, there are approximately 40 private schools serving preschool through high school students, as well as those needing special education. Twelve colleges and universities in the local area serve Wichita, including Wichita State University, University of Kansas-School of Medicine, Friends University, Newman University, and the Wichita Area Technical College (City of Wichita).

The Wichita Public School system has 56 grade schools, 17 middle schools and 14 high schools. Total enrollment as of February 1998 was approximately 47,450. Pre-kindergarten enrollment was 1,199 students, kindergarten enrollment was 4,286 students, grade school enrollment was 19,121 students, middle school enrollment was 10,406 students, and high school enrollment was 12,430 students.

The Bentley/Halstead school district has two grade schools, one middle school and one high school. There was a total enrollment of 810 students as of February 1998. Bentley grade school had 210 students, with an average classroom size of 15 students, and Halstead grade school had 194 students. There were a total of 120 students in the middle school. The high school had 286 students, with an average classroom size of 24 students.

Benton public school district has four schools, three elementary schools serving grades K-8, and one high school. The elementary school enrollment as of February 1998 was 1,488 students, with an average classroom size of 24 students per classroom. The high school enrollment was 438 students, with an average of 22 students per classroom.

The Andover public school district has two primary schools, one intermediate school, one high school, and one middle school. The primary school enrollment as of February 1998 was 819 students, with an average of 23 students per classroom. The intermediate school enrollment was 445 students, with an average of 25 students per classroom. The middle school enrollment was 706 students, with an average of 24 students per classroom. The high school enrollment was 840 students, with an average of 24 students per classroom.

The Rosehill public school district has one primary school, one intermediate school, one middle school, and one high school. Primary school enrollment was 409 students, intermediate school enrollment was 431 students, middle school enrollment was 452 students, and high school enrollment was 490 students. Mean classroom size for grades K-12 was 23-26 students. Average classroom size in 1995 was 21 students in the grade schools and 16 students in the middle and high schools.

Surrounding Communities. Halstead is a small community located on U.S. Highway 50, which runs east and west, with a total population of 2,243 in 1998. The community has 844 housing units, one hospital, one nursing home with 17 beds, and three schools with a student enrollment of 761.

Sedgwick is a small community located just minutes off a major intersection on I-135, U.S. 50, and Highway 96 with a total population of 1,599 in 1998. The community has 517 housing units, and one nursing home with 79 beds, and two schools with a student enrollment of 482.

3.7.4 WATER RATES

In 1996, the City established an inverted water rate structure. This structure set a monthly minimum water service charge, regardless of whether or not any water was used, based on water service size. In addition, the water rate structure uses an Average Winter Consumption (AWC) rate. This rate is defined as the arithmetic mean monthly consumption computed by adding the metered consumption on bills rendered during the months of December, January, February, and March and then dividing this sum by the number of billings rendered during these same months. Each customer's AWC is recalculated in April of each year.

To encourage water conservation, the Director of Water and Sewer has the authority to negotiate and execute contracts with retail customers seeking to qualify for the conservation contract rate. This rate provides for a significant annual water savings by charging all water use at the retail volume conservation contract rate.

Customers seeking to qualify for the conservation contract rate must make written application detailing methods to be employed to conserve water, the time frame for implementation, and the expected savings derived from that implementation. Each January, those customers that entered in the agreement are to report the results of their efforts. The Director determines if the customer met the goal and a billing is rendered to the customer reconciling charges for the proportion of the customer's prior year consumption that did not meet that goal. Customers exceeding the water conservation goals may use the excess savings as a credit toward next year's water savings goal. This rate is only made available to customers who can demonstrate potential water savings considered economically significant to the City of Wichita as determined by the Director.

Since 1990 the water rates have experienced an average increase of approximately 3.4 percent each year. From 1990 to 1995, the water rates increased 3 to 6 percent, then remained unchanged until 1998. The rates from 1998 to 2000 have increased at 5 percent per year.

Sewer rates have experienced a similar trend to the water rates. Table 3–15 shows the historic water rate increases between 1990 and 2000 for the City of Wichita.

Table 3–15 Historical Water Rate Increases

Year	Rate Increase
1990-1991	6%
1991-1992	6%
1992-1993	3%
1993-1994	6%
1994-1995	3%
1995-1996	0%
1996-1997	0%
1997-1998	0%
1998-1999	5%
2000	5%

3.8 ENVIRONMENTAL JUSTICE

The purpose of an environmental justice analysis is to insure that predominantly low-income and minority communities do not suffer a disproportionate share of any adverse environmental impacts resulting from [federal] actions that are not offset by project benefits. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" requires each Federal agency to identify and address such potential impacts of its programs, policies, and activities. This process also requires that these parties have had adequate access to participate in project planning.

In accordance with "Final Guidance for Incorporating Environmental Justice concerns in EPA's NEPA Compliance Analyses" (USEPA 1998), this determination is made by reviewing demographic data for the study area, and comparing the percentages of both minority and low-income persons in that population to the percentage present at national levels. Standardized guidelines provide percentages for comparison. The guidelines for determining low-income were identified from the Bureau of the Census, Series P-60 on Income and Poverty. The poverty rate for the nation in 1990 was 13.1 percent. If the percentage of persons below the poverty level equals or exceeds 13.1 in an area, the area is then considered to be "low-income".

Minority populations, as defined by the Council for Environmental Quality, include members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin, and Hispanic. For purposes of Environmental Justice analyses, the Council states that a minority population should be identified where either: "a minority population in the affected area exceeds 50 percent, or the minority population in the affected area is meaningfully greater than the minority population percentage in the general population."

Table 3–16 summarizes 1990 census data on minority and low-income populations in the areas that would be impacted by each component of the proposed project. The components include the Equus Beds Well Field and Recharge Basin, the Bentley Reserve Well Field, and both options of the Local Well Fields, in addition to the general project area. Figure 3–15 indicates the locations of the well sites for the Local Well Field Component in relation to the various census tracts that were included in the analysis.

The City of Wichita had a 1990 population of 304,011, of which 11.3 percent were Black, 1.2 percent were American Indian or Alaska Native, 2.6 percent were Asian and Pacific Islander, and 5 percent were Hispanic of all races. These percentages serve as the bench-mark for comparison to the study areas. The percentage of persons below the poverty level in Wichita in 1990 was 12.5 percent, 1 percent higher than the state of Kansas, but less than that of the nation.

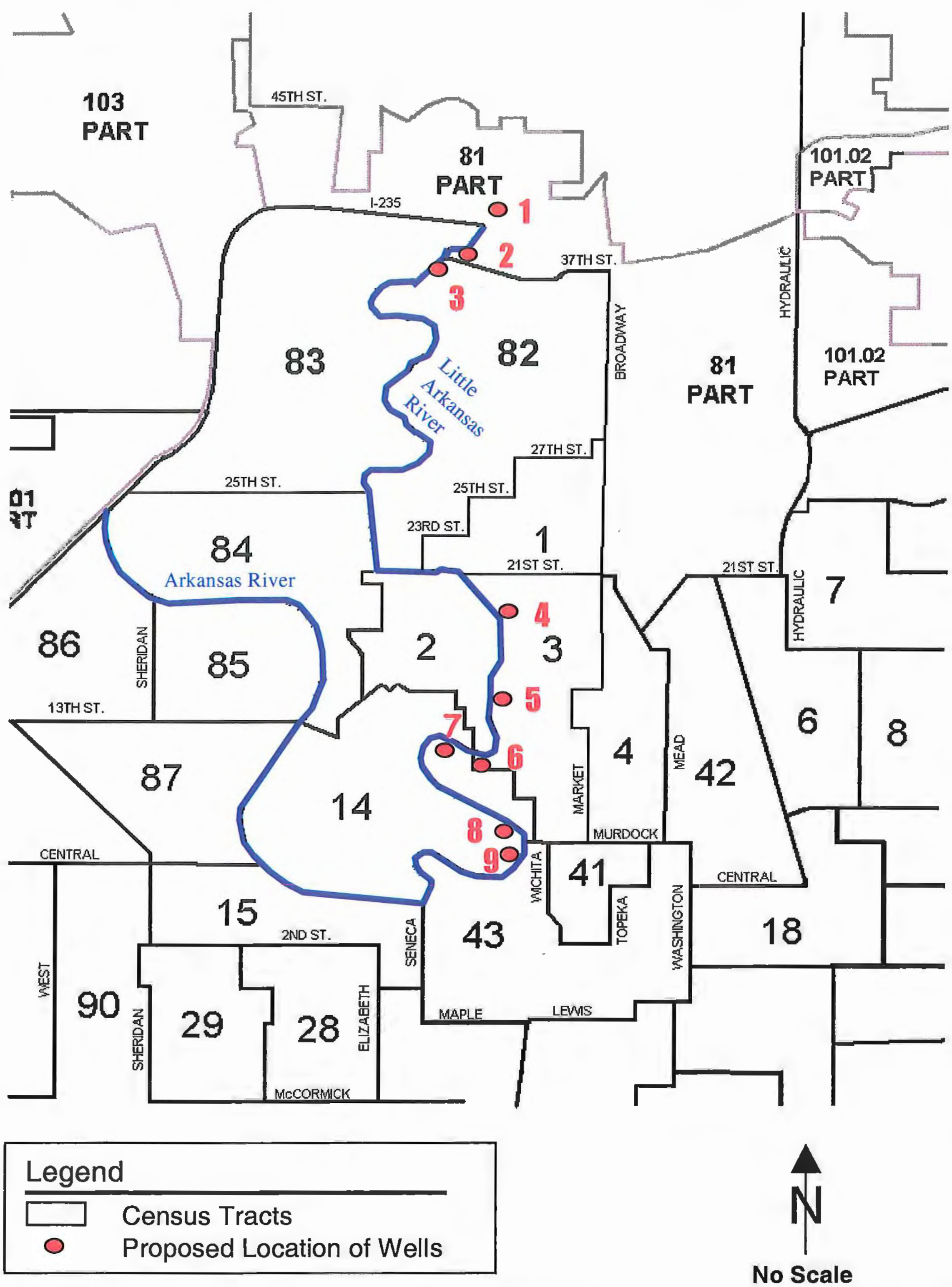
3.9 CULTURAL RESOURCES

To understand the history of human occupation in the project area, it must be considered within the prehistory of the larger Central Great Plains region of the United States. This region is bounded on the west by the Rocky Mountains, on the east by the Missouri River, on the north by the Niobrara River, and on the south by the Arkansas River. The area includes the modern states of Kansas and Nebraska, the eastern plains of Colorado, and the southeastern portion of Wyoming. Within the state of Kansas, the Central Great Plains region is divided

Table 3-16 1990 Minority and Low-Income Populations

Location	Portion of ILWSP Impacting the Location	Total Population	White	Black	American Indian and Alaska Native	Asian and Pacific Islander	Hispanic (all races)	Percentage of Persons Below Poverty Level	Percentage of Families Below Poverty Level	Disadvantaged Community
State of Kansas	-	2,477,574	2,231,986 (90.1%)	143,076 (5.8%)	21,965 (0.9%)	31,750 (1.3%)	93,670 (3.8%)	11.5	7	-
City of Wichita	Location of Local Well Field Expansion	304,011	250,176 (82.3%)	34,301 (11.3%)	3,527 (1.2%)	7,773 (2.6%)	15,250 (5%)	12.5	9.5	NO
Sedgwick County	Location of Local Well Field Expansion and southern end of Equus Beds Well Field; also Bentley Reserve Well Field and minor portion of Cheney Reservoir	403,662	34,5173 (85.5%)	36,061 (8.9%)	4,556 (1.1%)	8,728 (2.2%)	17,435 (4.3%)	10.9	8.3	NO
Harvey County	Location of majority of Equus Beds Well Field and Little Arkansas River Wells	31,028	29,300 (94.4%)	551 (1.8%)	145 (0.5%)	212 (0.7%)	1,616 (5.2%)	8.5	5.5	NO
Butler County	Location of portion of Cheney Reservoir	50,580	49,311 (97.5%)	367 (0.7%)	459 (0.9%)	169 (0.3%)	742 (1.5%)	7	5.9	NO
Reno County	Location of major portion of Cheney Reservoir	62,389	58,612 (93.9%)	1,712 (2.7%)	359 (0.6%)	210 (0.3%)	2,478 (4%)	10.8	7.9	NO
Kingman County	Location of minor portion of Cheney Reservoir	8,292	8,213 (99%)	9 (0.1%)	24 (0.3%)	10 (0.1%)	77 (0.9%)	1.6	9	NO
City of Bentley	Adjacent to 3-acre Recharge Basin Site	360	353 (98.1%)	2 (0.6%)	2 (0.6%)	0	8 (2.2%)	7	5	NO
City of Burrton	Northwest of Equus Beds	866	848 (97.9%)	11 (1.3%)	6 (0.7%)	1 (0.1%)	6 (0.7%)	9	6	NO
City of Halstead	West of Intake Wells on Little Arkansas River	2,015	1,962 (97.4%)	19 (0.9%)	8 (0.4%)	6 (0.3%)	59 (2.9%)	6.2	8.5	NO
City of Sedgwick	East of Intake Wells on Little Arkansas River	1,438	1,402 (97.5%)	10 (0.7%)	7 (0.5%)	2 (0.1%)	53 (3.7%)	14.1	0	percentage of persons below poverty level greater than standard of 13.1
Equus Beds Well Field and Recharge Basin Component										
Includes Lake, Lakin, and Eagle Townships	Location of Recharge Wells and Recharge Basin in the Equus Beds Well Field	1,413	1,382 (97.8%)	4 (0.3%)	20 (1.4%)	3 (0.2%)	15 (1.1%)	11.9	3.7	NO
Bentley Reserve Well Field										
Eagle Township	Location of Bentley Reserve Well Field	895	878 (98.1%)	2 (0.2%)	11 (1.2%)	0	14 (1.6%)	6.1	0	NO
Local Well Field Component (Option 1)										
Census Tracts 3, 14, 81, 82, and 83 in the City of Wichita (See Figure 3-14).	Well Sites 1-9 and piping for the Upper and Lower Sections. The piping for the Lower Section of Option 1 is the same as Option 2, but also heads west along Stackman Road, and ends further west at the Water Treatment Plant near Botanica and Sim Memorial Park (additional 4,000 linear feet).	23,832	20,526 (86.1%)	858 (3.6%)	308 (1.3%)	354 (1.5%)	2,747 (11.5%)	14	10.8	Percentage of persons below poverty level is greater than the standard of 13.1 %. Percenage of Hispanics in the area is larger than that in the City of Wichita (11.5% vs. 5%).
Local Well Field Component (Option 2)										
Census Tracts 3, 14, 81, 82, and 83 in the City of Wichita (See Figure 3-14).	Well Sites 1-9 and piping for Upper and Lower Sections. Proposed pipeline for Option 2 runs along west side of Little Arkansas River, from about East 19th Street, south through Minisa Park, south to 12th Street N & Jefferson, then west, between North Oak Park Road and the Little Arkansas River, ending in Oak Park. Same pipeline also splits near East 13th Street south of Minisa Park, south along Jefferson, then crosses the river, continues along the river through Central Riverside Park, ending between Stackman Road and Little Arkansas River.	23,832	20,526 (86.1%)	858 (3.6%)	308 (1.3%)	354 (1.5%)	2,747 (11.5%)	14	10.8	Percentage of persons below poverty level is greater than the standard of 13.1 %. Percentage of Hispanics in the area is larger than that in the City of Wichita (11.5% vs. 5%).

Figure 3-15 Census Tracts in Area of Local Well Field



into a number of smaller physiographic regions based upon differences in landforms. Of these areas, the proposed project cuts through three: the Flint Hills, the Arkansas River Lowland, and the Wellington-McPherson Lowland.

Human occupation of the Central Great Plains can be divided into six broad time periods or stages based upon differences in how people interacted with their environment. Through time, different adaptations produced variations in settlement patterns, cultural materials, and subsistence economics. These time periods, from earliest to latest are: Paleo-Indian, Archaic, Early Ceramic, Middle Ceramic, Late Ceramic, and Historic. Particular artifacts, settlement patterns and house types, as well as the exploitation of different plant and animal species characterize each period. Although each period has been given a name, and is identified by a number of particular characteristics, the periods do not represent isolated cultures, but rather a continuation of cultural development through time. Each period was influenced by those proceeding it as well as the development of new technologies, innovations, and the influx of materials and ideas from neighboring regions.

3.9.1 THE PALEO-INDIAN PERIOD (10,000-6,000 BC)

The start of this period is traditionally marked by a noticeable warming trend toward the end of the Ice Age. People of this period typically traveled together in small bands, hunting now-extinct, large Ice Age animals, and collecting various types of plants and smaller animals. The typical hunting tool was a spear, tipped with a large leaf-shaped chipped-stone projectile point. Groups were highly mobile, and collected berries, seeds, roots, small game, clams, and other locally available plant and animal resources to supplement their diet. This period has been divided into three stages, based primarily upon changes in projectile point forms over time: Llano (10,000 - 9,000 BC); Folsom (9,000 - 8,000 BC); and Plano (8,000 - 6,000 BC).

The earliest well-documented evidence of human activity in the Central Great Plains is based on several sites attributed to the Llano complex (10,000-9,000 BC). This culture is identified by a distinctive projectile point type with a centrally flaked flute known as "Clovis" found near the remains of large Ice Age animals, particularly the mammoth. The Clovis point is the earliest known projectile point in North America and is identified as a spear point rather than an arrow point. Other artifacts recovered from Llano sites and related to the hunting and butchering of mammoth are cylindrical bone and ivory fore-shafts/projectile points, scrapers, knives, cobble choppers, gravers, bifaces, and hammerstones (Brown and Simmons 1987:IX-4). No sites attributed to the Llano culture have yet been excavated in Kansas. This phase is represented only by isolated surface finds of Clovis projectile points, and no direct association of extinct Ice Age animal remains and Llano artifacts has been documented (Logan 1998:33; O'Brien 1984:28).

The Folsom complex (9,000-8,000 BC) follows Llano, and is also characterized by the presence of a distinctive projectile point in association with extinct Ice Age animal remains. In this case, however, the leaf-shaped "Folsom" point, with an extended central flute, has replaced the Clovis point, and a now-extinct form of bison has replaced mammoth as the primary source of food and raw materials. Surface finds of Folsom projectile points have been recorded throughout Kansas, although they appear to be concentrated in the northeast and southwest corners of the state (Brown and Simmons 1987: figure 9.7). The Twelve-Mile Creek site (14LO2) located in Scott County, west-central Kansas, may represent the only excavated Folsom complex in the state. This site has produced several skeletons of extinct bison in direct association with a leaf-shaped projectile point. The identification of the point as Folsom, however, is uncertain (O'Brien 1984:28).

The next phase of cultural development dates from 8,000-6,000 BC and is called Plano. It is characterized by a wide variety of chipped stone projectile point and knife forms. The most widely hunted animal resources are now-extinct forms of bison, horse, and camel at early sites, and the modern form of bison at sites dated to 7,000 BC and later. The Plano complex consists of a group of Paleo-Indian cultures each represented by a characteristic chipped stone projectile point/knife form. Those present in the Kansas area are: Plainview, Hell Gap, Meserve/Dalton, Milnesand, Midland, Agate Basin, Scottsbluff, and Eden. The new forms are characterized by parallel flaking along the tool edges, but lack the central flute of the Clovis and Folsom types. The fluted projectile point is no longer the preferred type throughout the region; rather, this wide variety of new leaf-shaped forms is present.

Due to the scarcity of excavated Plano sites in Kansas, almost all of the information regarding this phase is observed from nearby states. Six well-documented Paleo-Indian sites in Kansas are the Tim Adrian, the DB, the Norton Bone Bed, the Laird, the Sutter, and an unnamed site in Sedgwick County. The Tim Adrian site (14NT604) is a possible Hell Gap quarry site in northwestern Kansas (Brown and Simmons, 1987). In northwestern Kansas is the DB site, a briefly occupied upland site (Logan 1998). Another western Kansas Paleo-Indian site is the Norton Bonebed (14SC6) in Scott County (Hill 1993). The Sutter site (14JN309) is a possible Fredrick complex containing leaf-shaped projectile points with parallel flaking. Site (14SG515), a possible Cody complex containing Scottsbluff and Eden points and a Cody knife, is located in Sedgwick County near Wichita (Brown and Simmons 1987). Although the Paleo-Indian period is poorly known in the Central Great Plains and in Kansas, the absence of known sites does not exclude their existence in the state, and within the project area. It has been suggested that the absence of recorded sites may be due to two factors: 1) a lack of intensive surveys in the western two-thirds of the state; and 2) the difficulty of locating Paleo-Indian sites in the eastern two-thirds of the state due to their burial beneath other soil deposits (Brown and Simmons 1987:IX-11). Although the majority of Paleo-Indian sites are butchering and kill sites of large game, Wheat (1978) has defined four types of human behavior which would result in the formation of different types of sites: 1) mass kill sites; 2) butchering sites; 3) long-term campsites; and 4) short-term campsites. It is possible that all of these forms are present in Kansas.

Mastodon, mammoth and bison remains have been recorded in Harvey and Sedgwick counties. The presence of Paleo-Indian projectile points and the remains of Ice Age animals hunted by these peoples indicates the potential for Paleo-Indian sites in these areas of Kansas. Brown and Simmons (1987:XX-6) suggest the "probability for bison jump and animal trap sites being present [particularly in western Kansas] is high."

3.9.2 THE ARCHAIC PERIOD (6,000 BC TO AD 1)

The people of the Archaic period practiced a way of life centered on hunting and gathering, with a dependence at least in part on bison as a key component of their diet (Hofman 1996:80). Due to the extinction of Ice Age animals in the late Pleistocene approximately 9,000-8,000 years ago, hunting strategies shifted to smaller game animals including the modern bison, as well as deer and elk, and a greater dependence upon wild plant foods. This change is characterized as a shift from an economy focused on large game, to one based on a wide variety of resources (Logan 1998:34). During this period, hunter-gatherer groups were dependent entirely on the exploitation of wild plant and animal resources. Populations continued a high level of nomadism, but became more focused on the seasonal exploitation of resources located in specific areas. Settlements became more regional through this period and populations increased. Pit houses appeared in upland hunting-processing camps (bison kill areas), and new food storage and processing technologies developed. Grinding slabs became a common feature of the prehistoric tool kit as seed processing became important. At approximately 5,500 BC, people began to experiment with the manufacture of ceramic objects. The number of chipped-stone tool types increased as tools were manufactured for a variety of specialized uses, and the atlatl, or throwing stick, became common.

Evidence of human occupation in Kansas during the Archaic is as difficult to come by as that of the previous period. Few Archaic cultures have been defined for the area, and those that have are based on only a few excavated sites. With the exception of the Flint Hills region, which contains a fairly well-known Archaic complex, there are no clearly defined cultures within the project area. Within the Flint Hills region, five cultural complexes/phases have been defined: the Logan Creek complex; Munkers Creek phase; Nebo Hill phase; Chelsea phase; El Dorado phase; and Walnut phase.

3.9.3 THE EARLY CERAMIC PERIOD (AD 1-1000)

In the Plains, the Early Ceramic Period, or Plains Woodland, is the equivalent of the Woodland stage farther east. It was during this period that there was a trend toward increased sedentism, intensified horticultural activity, expanding regional exchange networks, and the elaboration of ceremonial activities and mortuary practices which characterizes the Woodland stage (Griffin 1967). The origins of these trends can be traced to the Late Archaic, but the elaboration of cultural elements became the hallmark for the period. In addition to these trends, technological changes were also occurring such as the adoption of bow and arrow weaponry and widespread use of ceramic vessels for storage and cooking. These developmental trends form the basis for distinguishing the Early, Middle, and Late Woodland substages. Regional variations in the time and extent to which these traditions were expressed make this tripartite subdivision used in the east difficult to employ in certain areas such as the Plains.

Unlike the Late Archaic settlement system, small, short duration camps adjacent to specific environmental locales typify the Early Woodland occupations in the Midwest. This suggests that small social groups using seasonally occupied specialized extraction camps were exploiting resources within defined localities (Roper 1979; Emerson and Fortier 1986; Seeman 1986).

The Early Ceramic stage is generally associated with the initial development of ceramic technology. The ceramics are generally described as thick, stone-tempered with cordmarked exteriors (Montet-White 1968; Farnsworth and Asch 1986; Adair 1996), similar to the Fox Lake ware and Crawford ware types of the Midwest. Other characteristics of the stage include development of the bow and arrow technology and subsistence adaptations (Adair 1996).

Most of the eight cultural manifestations found in Kansas that are attributed to Early Ceramic stage are poorly understood. Keith complex sites are found on the High Plains, generally between the Arkansas and Platte rivers (Johnson and Johnson 1998). The ceramic technology is unique in that the vessels were conical in shape and generally had very thick, cord-marked walls. The tempering agent in the pottery vessels tended to be calcite in those sites northwest of the project domain. Projectile points range in styles from large dart points, typically associated with use of an atlatl, to small corner notched arrow points associated with the use of a bow. Keith complex sites are generally small campsites or special purpose sites on ridges and terraces overlooking rivers and tributary streams.

On the eastern periphery of the project domain are the Greenwood and Butler phases. The Butler phase was defined by the excavations at the Snyder site in El Dorado Reservoir and dates between A.D. 200-800 (Grosser 1970, 1973); but, a review of the cultural materials suggest that the Greenwood and Butler phases are connected. The Greenwood phase, as defined by Witty (1980), covers much of the Flint Hills and western Osage Cuestas. The main diagnostic artifact of this phase is the limestone-tempered Verdigris type pottery.

Several Plains Woodland sites have been recorded, many as yet unofficially, within the Little Arkansas River valley of the project domain. Many of these sites have characteristics of both Keith complex and Greenwood/Butler phases, yet may be distinct enough to be identified as a distinct cultural manifestation. These sites are generally campsites on terraces or sand dunes near the Little Arkansas River channel, or on ridges overlooking many of the small playa lakes in the area. The ceramics are sand-tempered, conical vessels made from the locally available sandy clays. Chipped stone tools include dart points and small, corner-notched arrow points made from locally available river cobbles and upland quartzite cobbles. A few items have been identified as being from chert sources in the Flint Hills, but these are very few.

3.9.4 THE MIDDLE CERAMIC PERIOD (AD 1000-1500)

The Middle Ceramic stage is probably the best understood prehistoric stage in Kansas. Sites attributed to this stage are typically grouped under the Central Plains Tradition or Village Tradition. During some of the original archaeology conducted in the region, archaeologists focused on this stage (Wedel 1959; Strong 1939). Until recently, it was thought that these sites contained villages of several contemporaneous houses. Recent work on the Solomon

River phase of north-central Kansas shows that these people did not live in villages, but were in broadly scattered homesteads (Latham 1996; Blakeslee 1999).

The Smoky Hill phase is found in the north and northeastern segments of the project domain. Smoky Hill peoples resided in semi-rectangular earth lodges situated on terraces along rivers and tributary streams. These Swidden-foragers exploited nearly every edible animal and plant found in their respected localities (Logan 1998; Blakeslee 1999). Smoky Hill phase ceramics include globular jars and bowls. The exterior of the pottery is generally cord-marked and tempered with sand or grit.

Other Middle Ceramic cultures in the area of the project includes the Pratt Complex in the Arkansas River lowlands. Recent research of this complex has shown that the Pratt Complex people were likely associated with the Southern Plains Village Tradition (C. Tod Bevitt, personal communication, 1999).

South of the project domain is another Middle Ceramic culture referred to as the Bluff Creek complex. Little in-depth research has been published on this complex, but appears to be related to the Southern Plains Village Tradition.

A few Middle Ceramic sites have been recorded in or near the project area. These sites are generally small material scatters on terraces of the Little Arkansas, Saline, Smoky Hill, and Solomon rivers and their tributaries. It is likely that house remains are present at several of these sites and a number of other sites yet unrecorded are within the project area.

3.9.5 THE LATE CERAMIC PERIOD (AD 1500-1800)

The Late Ceramic stage is essentially the proto-historic period in Kansas. Post-contact sites are generally those that date from the time of the first appearance of Euro-American trade goods. These early trade items are viewed as horizon markers, including a wide range of materials made from copper, brass, iron, glass and even stone in the form of gunflints. Throughout this period trade relations waxed and waned between the various tribes and the Euro-Americans. Certain groups became more prominent in the trade networks. Cultures identified in this stage represent direct association with historic groups like the Wichita, Kansa, and Pawnee, among others. The most common Late Ceramic culture found in and around the project area are Great Bend aspect village sites. The most prominent sites of this aspect are villages found in the upper Little Arkansas River drainage in Rice and McPherson counties. Other concentrations of these sites are found in Marion and Cowley counties. These large villages included wood framed, grass-covered houses and a variety of other features including arbors and numerous subsurface storage pits.

Campsites and other special purpose sites associated with the Late Ceramic stage have also been recorded in and near the project area. These camps are usually identified by light to moderate scatters of chipped stone, pottery, and faunal debris. The northern edge of the project area was well known as the preferred bison hunting ground for the historic Pawnee, but recent work in this region has identified Great Bend aspect hunting camps in this area as well (Latham 1996). Other Late Ceramic sites in this area is affiliated with the White Rock phase, a western Oneota component. White Rock could be associated with a historic group like the Kansa or Otoe.

In addition to evidence of a Native American presence in the area, Euro-American sites begin to appear in the archaeological record during this period. Coronado's *entrada* into the Central Great Plains began in 1541, and French trappers/explorers arrived in the area about 1740. These explorations into the region left evidence in the form of campsites, hunting sites, refuse piles, discarded weapons and armament, trails, etc.

3.9.6 THE HISTORIC PERIOD (POST 1800)

Although documented exploration of the Central Great Plains region begins with the Spanish expedition of 1541, a substantial number of Euro-American sites do not appear in the area until after AD 1800. This date, therefore, effectively records the onset of the Historic period. Although historic Native American tribes represented by the Wichita, Cheyenne, Comanche, Kiowa, and Kiowa Apache were still present in the area, the largest number of archaeological sites of this period can be attributed to Euro-American settlement. Euro-American sites are represented by agricultural settlements, bridges and fords, civic sites, 19th and 20th century artifact scatters, historic trails, isolated finds of agricultural implements, cemeteries, agricultural outbuildings, and other sites (Logan 1998:44-45). Two 19th century military forts, Ellsworth and Harker, are present near the project area as are a number of historic trails.

With Kansas given territorial status in 1854, Euro-American settlement increased, as did the number of Euro-American sites. Indian removal policies of the period resulted in the removal of the Potawatomi, Kickapoo, and other tribes first to reservations and later to Oklahoma. With the granting of state status in 1861 and the end of the Civil War in 1865, Euro-American settlement in the region increased dramatically. In the 1870s, the cattle business boomed, and the "cowboy era" arrived in Kansas along with the railroad. These developments also left their mark in the form of recorded historic sites.

3.9.7 RECORDED SITES AND SPECIFIC SITE TYPES

Recorded Sites. As of August 8, 2002, the number of recorded archaeological sites within the counties affected by the alternatives of the proposed project are as follows: Harvey - 59; Reno - 32; and Sedgwick - 123. These numbers provide a rough comparison of the density of known sites within the project area as of that date. Although helpful in predicting the possibility of encountering unrecorded sites in some areas, these figures do not indicate the presence or absence of sites in any given location.

A number of specific site types have also been documented within the area crossed by the proposed project, and within the surrounding area utilized by indigenous peoples. These are: lithic quarries/collection stations; rock shelters; tipi rings, stone alignments, and earthen construction; human burial areas; and rock art sites.

Lithic Quarries/Collection Stations. Although little systematic excavation of quarry sites has taken place in Kansas, a number of sites have been recorded in the Flint Hills region of the project area. This region is known for the presence of chert or flint outcrops utilized by Native American peoples; and, although only one of the recorded sites is close to the project area, there is the potential for locating as yet unrecorded quarry sites in the area. Butler County has four sites located within the region of the project. (Brown and Simmons 1987:XX-2).

Rock shelters. Rock shelters have been recorded primarily in the southeast and north-central half of Kansas. There are no recorded sites within the region of the project area (Brown and Simmons 1987:XX-2). The potential for locating unrecorded sites of this type is dependent upon the presence of rock outcrops of sufficient size to offer protection to Native peoples, and therefore locations suitable for habitation.

Tipi Rings, Stone Alignments, and Earthen Construction. The occurrence of recorded tipi rings, stone alignments, and earthen construction are rare due to extensive cultivation of the Kansas landscape. Prior to Euro-American occupation these features were undoubtedly more common and sites may still occur in more arid or dissected regions less subject to destructive cultivation. Earthen "council circles" attributed to astronomical registers have been recorded in McPherson county at the Paint Creek or Udden site (14MP1), and at the Sharps Creek or Swenson site (14MP301). These two sites are represented by a low central mound 20-30 meters in diameter surrounded by a shallow ditch or a series of oblong depressions. The maximum relief of the features is 44-88 centimeters (Brown and Simmons 1987:XX-6).

Human Burial Areas. Earthen mounds and ossuaries, or areas set aside for the placement of human remains, are usually attributed to the Late Archaic and Ceramic periods. A number of human burial areas have been recorded near the project area, and a significant number of burial sites have been previously excavated in Kansas. Additionally, numerous isolated occurrences of fragmentary human bones have been recorded. Reno County has one burial site recorded within the region of the proposed project area (Brown and Simmons 1987:XX-7). Although isolated human burials and fragmentary remains can be found in almost any setting, the larger burial sites tend to occur in conjunction with large village sites, often located on the banks of major rivers or their tributaries.

Rock Art Sites. A number of rock art sites have been recorded in Kansas, particularly along the eastern edge of the Smoky Hills region. Smaller concentrations are also found in the southeast corner and the south-central portion of the state. The distribution of sites appears to correspond to the availability of suitable rock outcrops. All recorded rock art sites represent petroglyphs (figures pecked into the rock), except for the presence of one pictograph (figures painted on the rock). Nearly all of the rock art is considered part of the pan-Plains incised rock art tradition dating from just before European contact through the Historic period. None of the counties affected by the proposed project contains recorded rock art sites (Brown and Simmons 1987:XXI-1 to XXI-4).

Habitation Sites. Habitation sites contain cultural deposits related to the seasonal occupation and may include subsurface features. Residential structures and task-specific activities may be represented by organic staining of the soil. Site size can range from moderate to extensive and may include multiple landforms. Density of cultural debris and diversity of tool classes are generally moderate to high. Two types of habitation sites may be found in the project corridor.

Residential Base or Village. Residential base sites form the hub of subsistence activities, the locus out of which foraging parties originate and where most processing, manufacturing, and maintenance activities take place. Residential base camps may be identified archaeologically as large sites with a high artifact density and a wide diversity of tools and other artifacts. Features related to site activities are usually present.

Field Camp. These camps serve as temporary operational centers for a task group that maintains itself while away from the residential base. The individual sites may be further differentiated according to the nature of the resources to be procured and the size of the social group the task force is supplying. Subsurface features may be present at such sites.

Lithic Scatters/Task Specific Sites. These sites are associated with the procurement of a limited number of locally available resources and/or the reduction of raw lithic materials. Subsurface features, structures, organic staining, or cultural deposits of substantial integrity related to seasonal occupation are not generally found at such sites. Site size is generally small, a result of a short-term occupation. Density of cultural debris and diversity of artifact classes are limited severely due to the nature of the activities evident. Artifact content often consists entirely of task-specific expedient tools, occasionally supplemented with broken or discarded, curated tools. Lithic scatters often fall below the threshold of visibility even with excellent survey conditions. Cultural resources identified as isolated finds often may be examples of lithic scatters. In rugged terrain, these sites often occur on landforms that offer only a small area suitable for occupation, such as small benches and ridge spurs. Sites included in this category may include some preliminary food processing sites, lithic procurement and/or reduction sites, small kill and processing sites, and artifact scatters.

Bison Kill Sites. Bison kill sites are essentially task sites, since they are just that "bison kill sites"; therefore, due to the uniqueness of these sites, they are treated separately when categorizing sites. Such sites can have great range in size and number of individuals present. They are usually associated with favorable terrain for impoundments or jumps. Impoundments can often be traps found in the natural environment, including steep-walled ravines, draws, or arroyos and other areas where the animals can be trapped or become bogged down. Jump sites are generally found at the bases of steep to moderately steep ravines and canyons where the herd can be driven off. Kill sites with significant integrity are generally found buried in sediments. Many such kill sites have been recorded in the Panhandle region, but none within the project domain.

Sacred, Specialized Ceremonial, or Mortuary Sites. Sites in this category are those that served specialized ceremonial functions. Examples include cemeteries, cairns, mounds, and petroglyph and pictograph sites. Such sites may or may not be spatially separated from habitation sites. Sacred sites are often difficult to recognize archaeologically. According to the *Handbook of American Indian Religious Freedom,* Native Americans have historically observed the following as sacred sites where:

- the ancestors arose from the earth
- the clan received its identity
- ones ancestors are buried
- the people receive revelation
- the culture hero left ritual objects for the people
- the people make pilgrimages and vision quests
- the gods dwell
- animals, plants, minerals, or waters with special powers are found (Vecsey 1991:222)

Additional categories for sacred sites have been added by Linea Sundstrom (1996:2), including:

- places frequented by the spirits of ones' ancestors
- where esteemed members of a group died or were buried
- where miraculous or mythical events took place
- where ceremonies were held in the past
- places recognized as sacred by other groups

Sacred sites found across the landscape can be of two types, general and specific. These places often included springs, round stones (especially in areas at some distance from streams and other water sources), fossil outcrops, or places with rock art or stone effigies (Sundstrom 1996).

3.10 VISUAL RESOURCES

Topography, vegetation, and land use are the primary determinants of visual character. The unique combination of vegetation, topography, and manmade features create the aesthetic quality of a site. These components work together to create the landscape of a specific area.

The various components of the water supply alternatives are located in places with differing visual characteristics. The Equus Beds and Bentley Reserve well fields are located on a flat to gently rolling area and in a rural setting consisting of row crops and pasture. The landscape is currently dotted with existing well structures as well as other structures such as small barns, metal sheds, irrigation systems, and oil pump jacks. East of the well fields is the Little Arkansas River with its braided channel, sand bars, and forested islands; to the west is the Arkansas River. The location of the Local Well Field expansion is in the west to northwestern portion of Wichita along the Little Arkansas River and the Wichita Valley Center Floodway, a mostly urban to suburban area.

Cheney Reservoir is located in a rural setting. Few trees are present along the east shore because of the shallow soils; those found are fast growing, short-lived varieties such as cottonwood and willow. More trees can be found along the west shore due to better soils.

With the exception of the City of Wichita, and the towns of Sedgwick, Bentley, and Halstead, land in the project area is primarily used for agricultural activities; over 93 percent of the area is classified agricultural or grassland. These activities include growing crops, raising livestock, and producing hay. Of the remainder, less than 3 percent is residential. Reservoirs and rivers in the project area are used for recreational activities such as fishing, boating, and swimming.

3.11 RECREATIONAL RESOURCES

Major recreational facilities in the City of Wichita include 97 park facilities, each of which have varied and multiple uses. Such facilities include amphitheaters (2), basketball courts (37), children's play areas (62), drinking fountains (106), picnic areas (33), fishing ponds (11), recreation centers (11), restroom facilities (74), swimming pools (14), tennis courts (79), and an assorted variety of other facilities (Wichita Department of Parks and Recreation, 1995). Other public and privately owned recreation resources in Wichita and the surrounding area are found in Table 3–17.

3.11.1 CHENEY RESERVOIR

Constructed by the U.S. Bureau of Reclamation (Reclamation) in 1965, Cheney Reservoir is second only to El Dorado Lake in size and annual recreational use. Although no minimum pool for recreation is included in Cheney Reservoir, recreation was an authorized secondary purpose of the original Wichita Project. The initial funding for recreation facility development using 1960 price levels was $338,000. In recent years, public recreation use of the reservoir has averaged around 1 million visitors annually (Reclamation 2002).

Cheney Reservoir and associated facilities are a major source of recreation for residents in regional area, particularly those of Wichita. Most of the reservoir (75 percent) is located in Reno County. Cheney Reservoir State Park currently encompasses almost 2,000 acres, while nearly 10,000 acres of land and water comprise the Wildlife Management Area. The reservoir itself covers approximately 9,600 acres and has about 67 miles of shoreline. The City of Wichita operates the dam, outlet area, and pumping station area. Except for those areas, all other land and water surface areas are leased to the State of Kansas for wildlife and parks purposes through the year 2014.

Known for its wind, Cheney Reservoir is one of the top ten windsurfing and sailing areas in the world. The reservoir draws many windsurfers from Canada, and is home to the largest sailing club in Kansas.

Table 3–17 Major Recreational Facilities in Wichita Metropolitan Area

81 Speedway
Botanica, The Wichita Gardens
Century II Convention Center
Cheney Reservoir, State Park and Wildlife Management Area
Exploration Place
Golf Courses (17)
Joyland Amusement Park
Lake Afton
Omnisphere & Science Center
Sedgwick County Park
Sedgwick County Zoo & Botanical Gardens
Wichita Center for the Arts
Wichita Greyhound Park
Wichita International Raceway
Wichita Symphony Orchestra
Wichita Thunder Hockey Team
Wichita Wings Indoor Soccer
Wichita Wranglers Baseball

Source: Wichita Area Chamber of Commerce, 1998

The City of Wichita has an active bike trail development program and is considering a proposed bike link between the reservoir's northern tip and Hutchinson, approximately 14 miles away. In its 1989 Comprehensive Bicycle Plan, the City proposed a link between Cheney Reservoir along 21st Street to the Sedgwick County Zoo, and on to the Arkansas River, Northeast Expressway, and Canal Route bikeway system.

Considered an important state resource, the KDWP spent over $3.5 million in the last 6 years for facility renovations at Cheney Reservoir. The Master Plan for Cheney Reservoir, in conjunction with the Bureau of Reclamation, was revised in 1997. Recommendations of the 1997 master plan were to increase or improve several types of facilities within the park. These recommendations included adding 659 camping sites, 158 picnic tables, 5 boat ramps (lanes), 11 miles of biking trails, 2 dump stations, 2 fish cleaning stations, 15 fishing docks/jetties/piers, and 6 courtesy docks. A list of facilities at the Cheney Reservoir are in Table 3–18.

Visitor Characterization **-** Cheney Reservoir, located close to major population centers, is expected to continue to experience heavy use. Accessible to a large population base, it tends to draw high numbers of users in short periods of time and experience overcrowding on peak days. Most visitors travel from within a 50 to 75-mile radius, including the cities of Wichita, Hutchinson, or Kingman, and counties of Reno, Sedgwick, or Kingman. Visitor count for the park (excluding the Wildlife Area) was 619,221 persons in 2001 generating $524,251.00 in revenue. Visitors and associated revenue collected for the last five years at Cheney Reservoir State Park are presented in

Table 3–18 Major facilities at Cheney Reservoir State Park and Wildlife Management Area

Waterborne Facilities	7
Vault Restrooms	8
Showers w/ Restrooms	1
Number of Areas	3
Dump Stations	2
Group Picnic Areas	1
# Tabled Picnic Areas	15
Campsites - All & Inclusive	282 + 250 non-designated areas
Picnic Sites – individual tables	207
Campsites with Water Hookups	185
Campsites with Electric Hookups	185
Swim Areas	4
Bath Change House	1
Road Miles Unpaved	12.7
Road Miles Paved	20.1
Miles of Bicycle Trails	0.96
Miles of Hiking Trails	0.27
Marinas	2
Fishing Docks, Jetties, Piers	5
Launching Lanes	20
Courtesy Docks	1
Boat Ramps	9

Source: Cheney Reservoir Master Plan, 1997

Table 3-19. Visitors of the park for the year 2002 including the holidays of Memorial Day, 4th of July, and Labor Day are presented in Table 3-20.

Table 3–19 Cheney Reservoir State Park Visitors and Revenue Collected 1997-2001

Year	Visitors	Revenue
1997	556,502	$369,250.00
1998	480,120	$384,865.00
1999	581,467	$428,165.00
2000	592,656	$425,036.00
2001	619,221	$524,251.00

Table 3–20 Visitors at Cheney Reservoir State Park through September of 2002 & Major Holidays

Year	Visitors
January	13,826
February	12,693
March	12,857
April	23,532
May	94,501
June	125,068
July	98,025
August	80,876
September	57,476
Memorial Day	35,895
4th of July	34,159
Labor Day	26,442

An active lake association enjoys membership of over 350 families, with a sailing club membership of over 200 families. Peak-season is Memorial Day to the Fourth of July, the time when park admission receipts provide 50 percent of the year's revenue.

Unlike El Dorado, Cheney Reservoir also serves the City of Hutchinson, further intensifying day-use demand. Because of its proximity to more urban recreationalists, Cheney Reservoir is more suitable for additional group-use activities that involve camping or picnicking. Indications are that the demand for group camping from scouting, church, YM/YWCA's, RV clubs, and other organizations is unmet.

Cheney Reservoir is and will continue to be a major fishing and hunting area. As indicated by Annual Permit holders and comments at public meetings in the cities of Cheney, Hutchinson, and Wichita, shoreline and streambed conditions are major issues at Cheney Reservoir. The following recreational issues identified are:

- Need to create fisheries through enhanced shoreline and stream bed (riffles) habitat
- Better access for shoreline fishermen
- Stabilization of shoreline to prevent loss of land area due to wind/wave erosion

The KDWP has undertaken a five-year $450,000 shoreline stabilization contract with Reclamation. Shallow water in the upper reaches and in nearly every cove limit these areas to fishing activities, while higher density recreation activities, including personal watercraft use, focus on the main, open body of water. User surveys indicate the number of shoreline fishing access points and boat ramps in both the upper reaches and the main body of the reservoir should be increased.

Water levels in the reservoir vary, according to season, rainfall, and other factors. If climate conditions cause evaporation and transpiration to accelerate, water levels are reduced. In the latter part of the summer, Cheney Reservoir is a shallow lake. The need for more boat ramps and fishing access points becomes more acute with the likelihood of a wider range of future water drawdown levels. However, improving the water depth near the reservoir's shore can be accomplished through dredging.

Key factors impacting Cheney Reservoir's future development are reservoir water elevations and projected fluctuations at full water supply demand. The extent of the downward fluctuations at full demand could increase in the future (during drought periods), while the flatness of the shoreline would continue to magnify typical flooding, water access and proximity problems.

3.11.2 BENTLEY RESERVE WELL FIELD

The City of Wichita owns the 80-acre, now-abandoned Bentley Reserve Well Field in rural Eagle Township, just north of Highway 96. Since its abandonment as a water source, the City had constructed picnic shelters, provided maintenance, and used part of the site as a camping and riverside picnic area for city employees. In 1999, the City leased the picnic site to the KDWP for use as a fishing area, while property closer to the actual well sites was leased as pasture land to a local farmer.

Additional recreational activities as reported by the City's Well Field maintenance staff in this area include the illegal discharge of firearms by highway users at picnic and well field facilities for target practice, and other various forms of vandalism on the property. Public access to this site will be restricted when the site is developed as a water supply source.

3.11.3 LOCAL WELL FIELD

Sites currently identified for the Local Well Field expansion are along the Little Arkansas River. According to the Comprehensive Plan for the City of Wichita, most of the river corridor is designated "Open Space", meaning recreational and aesthetic is the desired use. The City owns about half of this corridor, while the other half is privately owned. In some areas, homes are situated within 50 feet of the river's edge.

3.11.4 EQUUS BEDS WELL FIELD

The City of Bentley, located south of the Equus Beds well field, currently has organized recreation which is limited to Little League baseball. The City of Bentley is currently considering annexation of approximately 61 acres to the north, for residential use and would include a recreational facility as part of the development.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

The purpose of this chapter is to describe the impacts to the natural resources, such as geology, water, vegetation, and wildlife; and the human resources, such as socioeconomic and cultural resources, which could be impacted by the alternatives still under consideration.

4.2 GENERAL SETTING

The general setting of an area consists of its geographic location, topography, climate, and land cover. Selection of alternatives in different locations could result in different types and levels of impact to the general setting. Climate can only be changed by human activity on a massive scale. Topography and physiography[1] can be altered or modified by extensive human activities conducted on a local scale.

Site visits and best professional judgement were used to determine the effects the water supply projects would have on topography, climate, and land cover. Impacts to the general setting of the project area would be significant if a dramatic change in the overall character of the area resulted.

A water supply alternative would alter a specific portion of the existing project area through the construction of a surface intake structure, wells, basins, a pre-sedimentation plant, and delivery system. Changes to the general setting would be limited to the lands temporarily disturbed or permanently modified by construction. No changes in climatic conditions would result.

Construction of either alternative would not create new stream channels, alter watershed boundaries, or change the direction of flow in existing streams. No significant changes in area topography would result.

No major changes in land cover are expected as a result of construction in the Equus Beds and Local Well Fields. Minor changes in land cover would occur from construction of the gravel service road along the Little Arkansas River for access to the diversion wells.

No significant changes to climate, topography, or land cover would occur as a result of construction of any of the water supply alternatives. Therefore, the overall impacts on the general setting would not be significant.

The No-action alternative also would not change the climate, topography, or land cover of the local area; therefore, it would not significantly impact the general setting.

No mitigation is proposed for the minor impacts to the general setting of the project area resulting from the water supply alternatives.

4.3 GEOLOGY

Geologic formations and their physical properties combine to form the geology of an area. Excavation of soils, sediments, and rock could temporarily alter the local geology in the areas of pipeline construction, road construction, and well placement. Localized minor permanent

[1] *Physiography* - The study of the earth's surface and oceans, atmosphere, etc.

changes could occur due to the pre-sedimentation plant and facilities construction.

Site visits and best professional judgement were used to gauge the effects the water supply projects would have on the geology of the area. Impacts would be significant if they altered natural geologic processes.

Minor changes in surficial[2] geology would occur at new or upgraded facilities because of excavation of foundations. Some additional areas would be disturbed for construction of roads. These impacts would result in relatively superficial and temporary impacts to surficial geology. These would not affect natural geologic processes or local area geology. Overall, no significant impacts to geology would result.

Because the No-action alternative would not disturb area geology, no impacts would occur. No mitigation is proposed for local area geology for the water supply alternatives.

4.3.1 SOILS

The potential impacts to soils resulting from the construction of recharge basins, well fields, pre-sedimentation plant, and associated pipelines include the disturbance and mixing of soil profiles and erosion. Soil mixing would be most likely to occur during pipeline construction where soils are removed then replaced. Erosion could occur in areas where vegetative cover has been temporarily removed for construction or where water is discharged during well tests. Traffic from construction vehicles could further erode and compact soils. Impacts to prime farmland, which are considered important agricultural lands, could also occur.

Published soil surveys and prime farmland listings for Sedgwick, Harvey, and Reno counties were consulted for soils information (Soil Conservation Service (SCS, now Natural Resources Conservation Service) 1979, 1974, and 1966). Impacts on soils would be significant if countywide important soil resources were eliminated.

Soils could be impacted by the water supply alternatives from the construction of new wells, recharge basins, pre-sedimentation plant, and water pipelines.

Harvey and Sedgwick counties, where most of the impacts to prime farmland soils that would be impacted through construction of any of the alternatives would occur, contain approximately 770,000 acres of soils classified as prime farmland (NRCS 1979, 1974). Compared to this amount, the acres of prime farmland disturbed or lost by the proposed water supply alternatives are less than 0.01 percent and considered to be insignificant. The total impacts on soils from any of the water supply alternatives would also be insignificant compared to the total land area in the two counties.

During construction of the water supply alternatives, vegetative cover would be temporarily disturbed which would increase the potential for wind and water erosion of soil. Uncontrolled erosion could cause a loss of soil and degrade aquatic habitats.

[2] Surficial – characteristic of, pertaining to formed on, situated at, or occurring on the earth's surface; especially, consisting of unconsolidated residual, alluvial, or glacial deposits lying on the bedrock.

Adoption of the No-action alternative would not immediately impact soils. In the long-term, the lack of a new water supply would require the City of Wichita to stop expanding its service area. This action could reduce the current rate of prime farmland soils conversion from agricultural to residential and business uses in the project area.

Soil loss caused by construction would be minimized and mitigated by the preparation and implementation of erosion and sedimentation control plans. Best management practices, such as silt fences, silt traps, sedimentation basins, reshaping, and reseeding, would be used where appropriate to control soil erosion during construction. Because the construction activities for any of the water supply alternatives would disturb more than five acres, a National Pollution Discharge Elimination System permit would be required for construction. This permit would be obtained from the Kansas Department of Health and Environment and would contain a specific plan to prevent and control erosion from stormwater runoff and subsequent downstream water quality degradation. When testing wells, water that will be discharged will be piped to the nearest waterway to prevent erosion.

4.3.1.1 Equus Beds Well Field

Construction in the Equus Beds Well Field would temporarily disturb approximately 900 to 1,200 acres of soils during construction of the wells, transmission pipelines, basins, pre-sedimentation plant, and access road depending on the option selected. The access road and diversion and recharge well heads would, for the duration of their existence, cover about 200 acres. The recharge/recovery wells and the recharge basins in the Equus Beds Well Field would permanently impact up to 65 acres of prime farmland. At the pre-sedimentation plant site, 12 to 29 acres of prime farmland would be removed from production for the life of the project.

Construction of the transmission pipelines for each option would disturb approximately 500 to 800 acres. The impacts of pipeline installation are temporary and no prime farmland would be lost. Approximately 100 acres of prime farmland soils could be affected pending the alternative selected. Refer to Table 4–1 for a breakdown of acres temporarily disturbed and permanently lost by each option. If improperly discharged, water from well testing could cause locally severe erosion. Approximately 20 percent of the soils impacted by the Equus Beds Well Field would be prime farmlands.

4.3.1.2 Local Well Field

The expansion of the Local Well Field would temporarily disturb about 17 acres during construction of the wells and

Table 4-1 Temporary and Permanent Soil Disturbance

Alternative	Option	Temporary (acres)	Permanent (acres)	Prime Farmland Lost (acres)
150 MGD Alternative	60/90	880	345	91
	75/75	990	360	79.5
	100/50	1,190	340	70.5
100 MGD Alternative	60/40	870	266	65
	75/25	1,050	290	61
	100/0	1150	310	52

transmission pipelines. The well heads would permanently cover about 10 acres for the duration of the project. Erosion due to water discharged during well testing is also a possibility.

4.3.2 LAND USE

The primary land uses within all alternatives are cropland, pasture, residential, business and green space. Cropland is the most dominant land use.

Impacts to land use were evaluated by quantifying the changes in land use that would occur with each of the alternatives. Impacts would be considered significant if a large portion of the project area is converted to new land uses, if the amount of land devoted to a unique or unusual use is greatly diminished or eliminated, or if the new land use is inconsistent with local land use plans.

The well fields and pre-sedimentation plant for the Equus Beds Well Field would occupy portions of about 1,200 acres of land. Most of this land is in agricultural production. The most significant change in land use would be on approximately 29 acres used for the pre-sedimentation plant. Only approximately 200 acres of the well field would be converted to non-farm uses by the installation of an access road, well heads and basins. An additional 65 acres of land in the well fields could be temporarily disturbed for construction of recharge and recovery wells and recharge basins.

Approximately 800 acres of land would be disturbed by construction of the transmission pipeline. The majority of this land would revert back to its previous uses following construction; a portion would be maintained as right-of-way. Because over half of the land area in Sedgwick and Harvey counties is used for agriculture, the loss of agricultural land caused by the project would be insignificant.

While the additional water from the project would facilitate the continued expansion of the City of Wichita and its water service area, the availability of water would not dictate whether this expansion is contiguous and compact, or scattered and low-density. By meeting peak-day demands, the new water supply would help maintain the efficient and equitable provision of drinking water.

With the No-action alternative, the City would have to stop expanding its service area. This action could slow the current rate of conversion of agricultural lands into residential and business developments. In terms of land use only, this impact would not be considered adverse or significant. The socioeconomic implications are discussed in Section 4.6 that follows.

No mitigation is proposed for impacts to land use due to construction and operation of the water supply alternatives.

4.4 WATER RESOURCES

The major water resources of the ILWSP project area include both surface and groundwater sources. The anticipated impacts to the quantity and quality of water resources in the general project area are discussed in the following sections.

4.4.1 SURFACE WATER

The principal streams of the ILWSP project area are the Arkansas River, the Little Arkansas River, and the North Fork of the Ninnescah River (North Fork). Both the Little Arkansas River and North Fork are tributaries of the Arkansas River.

4.4.1.1 ILWSP Operations Model

A computer model of the ILWSP was developed to simulate the operation of the system under various development scenarios. This computer model uses estimates of the following hydrologic data:

- Historic daily stream discharge, for water years 1923–1996, at selected points within the project area
- Historic reservoir evaporation rates;
- The City's current and projected water demands
- Irrigation demands
- Available storage and other physical data for Cheney Reservoir
- Available storage, natural recharge and other parameters for the Equus Beds aquifer
- Minimum desirable streamflow requirements
- The supply capability and other operating parameters for all current and potential water supply sources
- The preferred allocation order for each water supply source

A description of the operations model is included in Appendix C. The operations model produces estimates of stream discharge, and reservoir and aquifer contents for each day during the 74-year simulation period. Several distinct model runs were made using different assumptions for water demand, recharge system diversion capacity, conservation levels, etc. The specific alternatives discussed in detail in this section are listed below.

- Current — The City's existing water supply system, without construction of any of the proposed ILWSP components, with year 2000 water demands
- No-action — Same as Current except using water supply demands projected for the year 2050[3]
- ILWSP–100 MGD — Implementation of all planned ILWSP components with a recharge system diversion capacity of 100 MGD from the Little Arkansas River and projected year 2050 water supply demands
- ILWSP–150 MGD — Same as above ILWSP alternative except with a total recharge system diversion capacity from the Little Arkansas River of 150 MGD

All of the statistics discussed below to characterize anticipated streamflow quantities, water levels and other hydrologic data, are derived from the results of the operations modeling for these four scenarios.

The historic streamflow and other hydrologic data employed in the operations model are considered to be representative of conditions that will reoccur in the future. However, meteorologists cannot predict climatic conditions with any certainty beyond a few weeks into the future. Therefore, these historic hydrologic conditions could reoccur in the future in almost any random order and the operations

[3] Under the No-action alternative, the existing water supply system is unable to meet the City's full water demands in 2050 over 9 percent of the time. As a result, this alternative actually delivers less water to the City than either of the ILWSP alternatives.

modeling results cannot be used to predict exactly when some future condition may occur. Instead, these results give a range of possible future conditions that can be used to develop descriptive statistics, such as average, median, minimum and maximum conditions.

4.4.1.2 Quantity

The potential impacts to surface water quantities were analyzed at six locations within the ILWSP project area. Three of these locations are on the Little Arkansas River, one on the Arkansas River and two within the Ninnescah River basin.

4.4.1.2.1 Little Arkansas River

The proposed induced infiltration wells along the Little Arkansas River will be installed such that approximately half of the total diversion capacity is located above Halstead (see Figure 2-12). Figure 4–1 shows the estimated median flow in the Little Arkansas River near Halstead by month under current and possible future conditions. In most months, the median flow at this location will increase with implementation of the ILWSP. This happens because increased water levels in the Equus Beds aquifer will increase groundwater discharge to the Little Arkansas River, resulting in a larger base flow in this river. As compared to the No-action alternative, these increases in median flow average about 10 cubic feet per second (cfs) in every month except May and June. During May and June, the median flow in the river at Halstead would decrease by from 9 to 19 cfs, a decrease between 12 and 25 percent. These two months have the highest historic median flow and, therefore, are the months when the recharge system is expected to operate more frequently and at higher diversion rates.

The median flow in the Little Arkansas River is higher under the 150-MGD alternative than for the 100-MGD alternative, which seems contradictory to reason. However, the ILWSP alternative with the higher diversion rate will provide more recharge to the Equus Beds aquifer and help keep aquifer storage at higher levels. Increasing the amount of water stored in the Equus Beds aquifer increases base flow to the Little Arkansas River. This increased base flow has a more significant impact on median flows than the larger diversion rates they result from.

Flow duration curves for the Little Arkansas River at Valley Center are shown in Figure 4–2 for the four scenarios. Flows above 250 cfs are excluded from these graphs to better represent the differences in lower flows. At Halstead, these flow duration graphs indicate flows in the river will be reduced by diversions for recharge of the Equus Beds about one-third of the time, or for flows above about 55 cfs. Lower flows, which occur about two-thirds of the time, are expected to increase with implementation of the ILWSP.

With the No-action alternative, there will be no significant changes in the flow of the Little Arkansas River near Halstead at higher flows since there would be no diversions from the river. However, the lower flows that occur the majority of the time will continue to decline as the Equus Beds aquifer is further depleted and groundwater discharges to the Little Arkansas River are reduced.

With implementation of either ILWSP alternative, changes in the flow regime of the Little Arkansas River at Halstead at higher flows would be relatively insignificant since the capacity of the

Figure 4-1 Median Discharge by Month, Little Arkansas River at Halstead

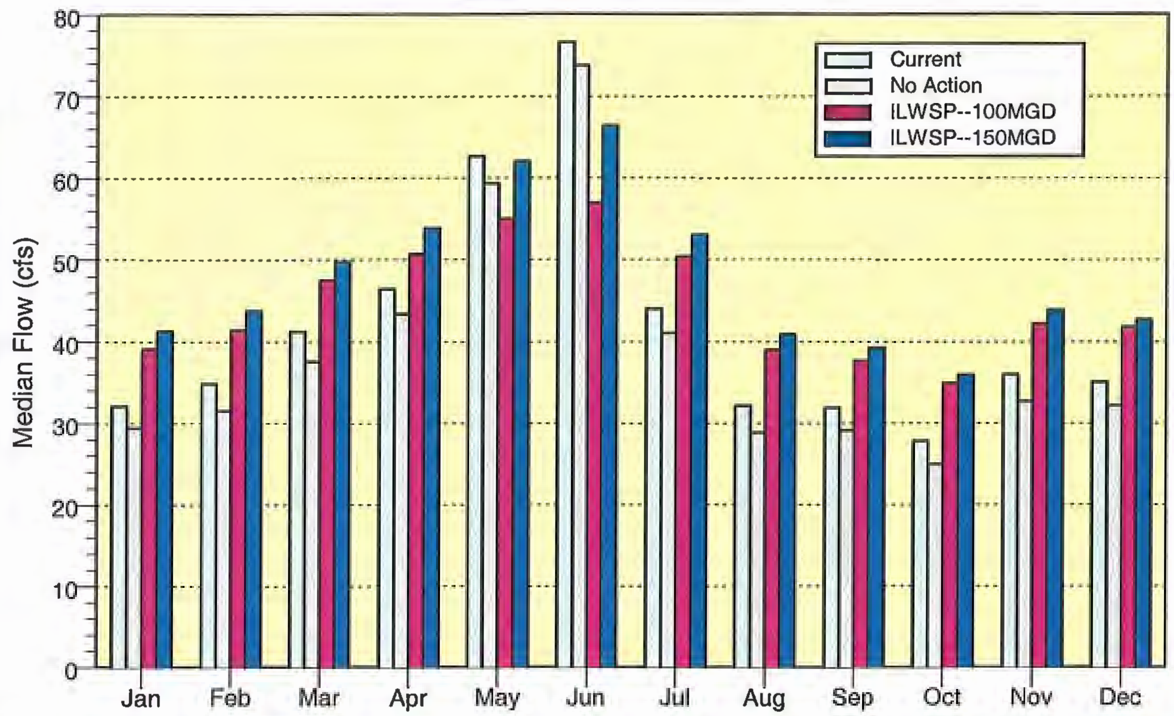
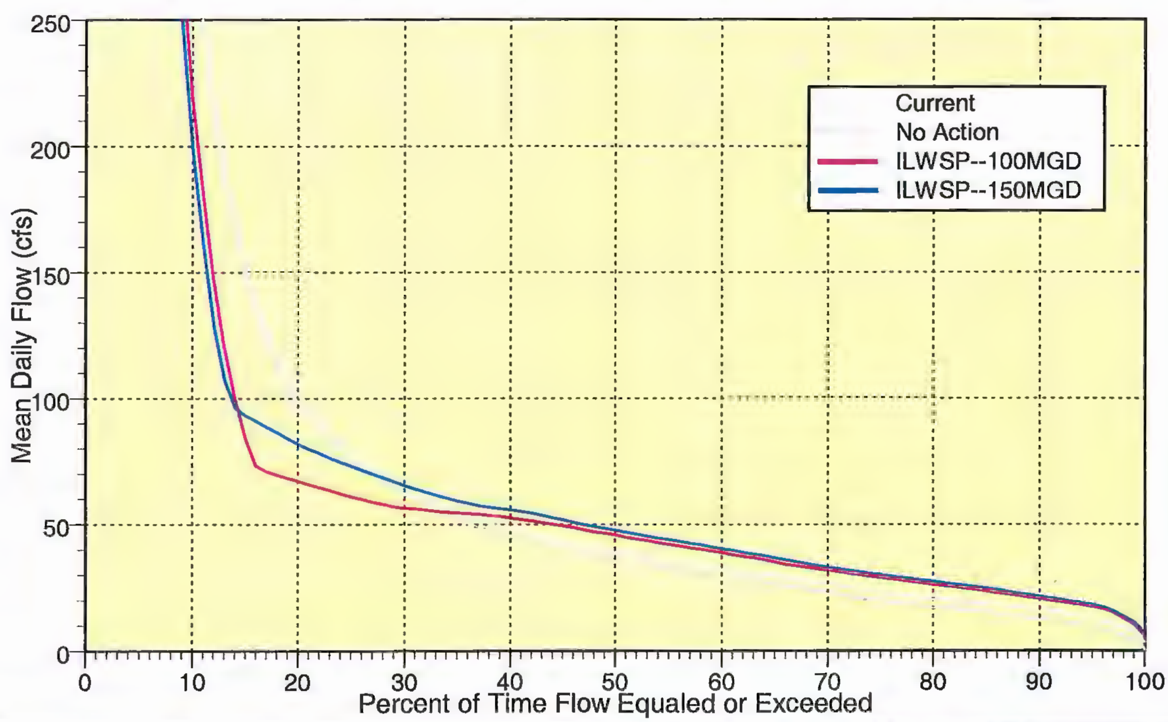


Figure 4-2 Flow Durations, Little Arkansas River at Halstead



diversion system is small in comparison. Average daily flows over 1,000 cfs will still occur about 4 percent of the time, and over 200 cfs about 10 percent of the time. It is these larger, high-energy flows which have the most influence on bedload transport and stream morphology.

At low flows, which are much more common, implementation of either ILWSP alternative is expected to increase the flow in the Little Arkansas River at Halstead. At flows less than about 50 cfs, the increased groundwater discharge from the Equus Beds aquifer will increase flows in the river by 8 to 10 cfs, increases ranging from 10 to 25 percent. This would be a positive impact, as increased baseflow would enhance the habitat available to fish, wildlife and riparian vegetation.

Changes in the flow regime of the Little Arkansas River would be most apparent at medium flow levels, those which occur from about 10 to 40 percent of the time, or roughly in the range of 50 to 200 cfs (see Figure 4–2). In the operations model, it was assumed that the aquifer storage and recovery (ASR) system would not operate if the flow in the Little Arkansas River at Halstead was less than 40 cfs and, for larger flows, only that portion above 40 cfs could be diverted. When fully operational, the ASR system could divert up to approximately 77 cfs (116 cfs) above Halstead for the 100-MGD (150-MGD) ILWSP alternative. Therefore, in the extreme case, it is possible that operation of the ASR system could divert as much as 65 to 75 percent of the total flow in the river. Such conditions would, however, be relatively infrequent and interspersed between periods of higher and lower flows. Since these medium flows are not considered critical to maintenance of the natural regime of the river, as lower and higher flows are, the impacts due to operation of the ASR diversion system are considered to be relatively insignificant. Also, any negative impacts resulting from river diversions should be offset by the benefits arising from increased baseflow.

Further downstream at Valley Center, the potential impacts to the quantity of flow in the Little Arkansas River are similar to Halstead, but on a larger scale. Because there are intervening tributaries and additional groundwater discharge, natural flows in the river at Valley Center are higher than at Halstead.[4] Overall, the median flow at Valley Center under current conditions is about 59 cfs compared to about 38 cfs at Halstead. Partially offsetting this increase in natural flow is the larger cumulative diversion capacity at Valley Center. Approximately half of the proposed ASR diversion wells will be installed between Halstead and Valley Center.

Figure 4–3 shows the estimated median flow in the Little Arkansas River at Valley Center by month under current and possible future conditions. In most months, the median flow at this location will increase with implementation of the ILWSP. This occurs because increased water levels in the Equus Beds aquifer will increase groundwater discharge to the Little Arkansas River and increase the baseflow in the river. As compared to the No-action alternative, these increases in median flow average about 24 cfs in every month except May and June.

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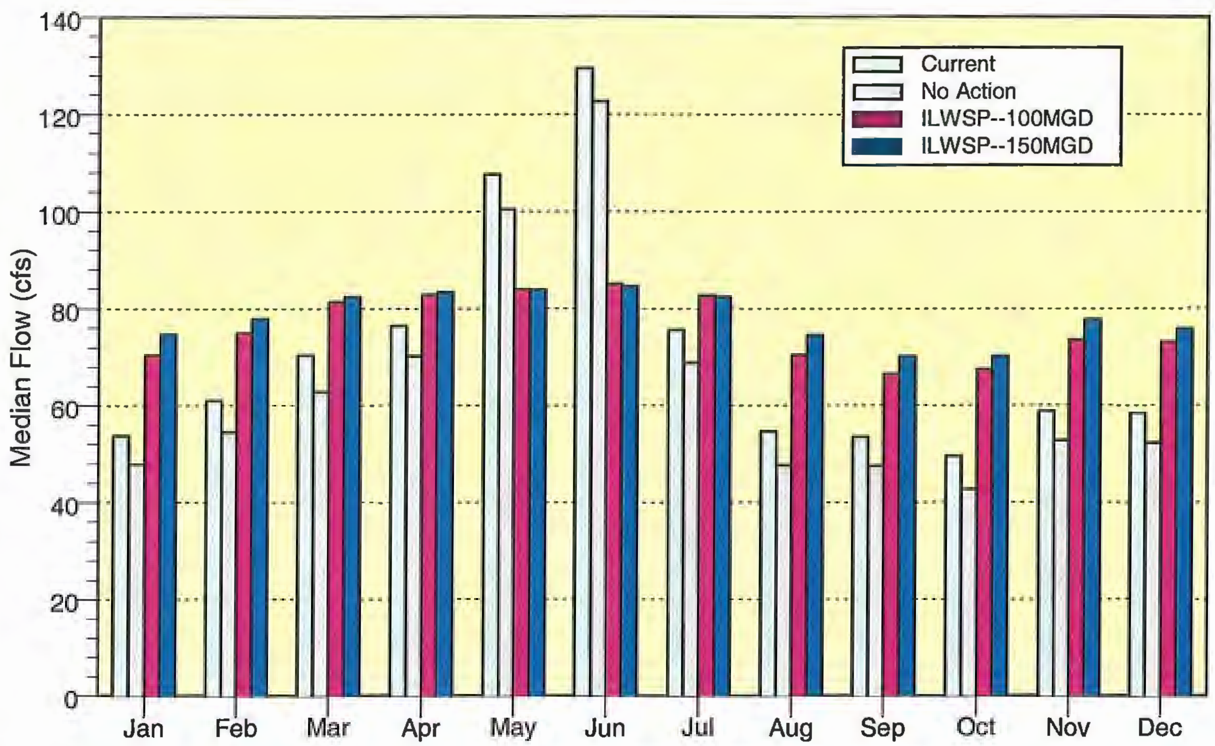
[4] From groundwater modeling for the Equus Beds aquifer, it is estimated that 40 percent of the groundwater discharge to the Little Arkansas River occurs above Halstead and 60 percent between Halstead and Valley Center.

Figure 4-3 Median Flow by Month, Little Arkansas River at Valley Center



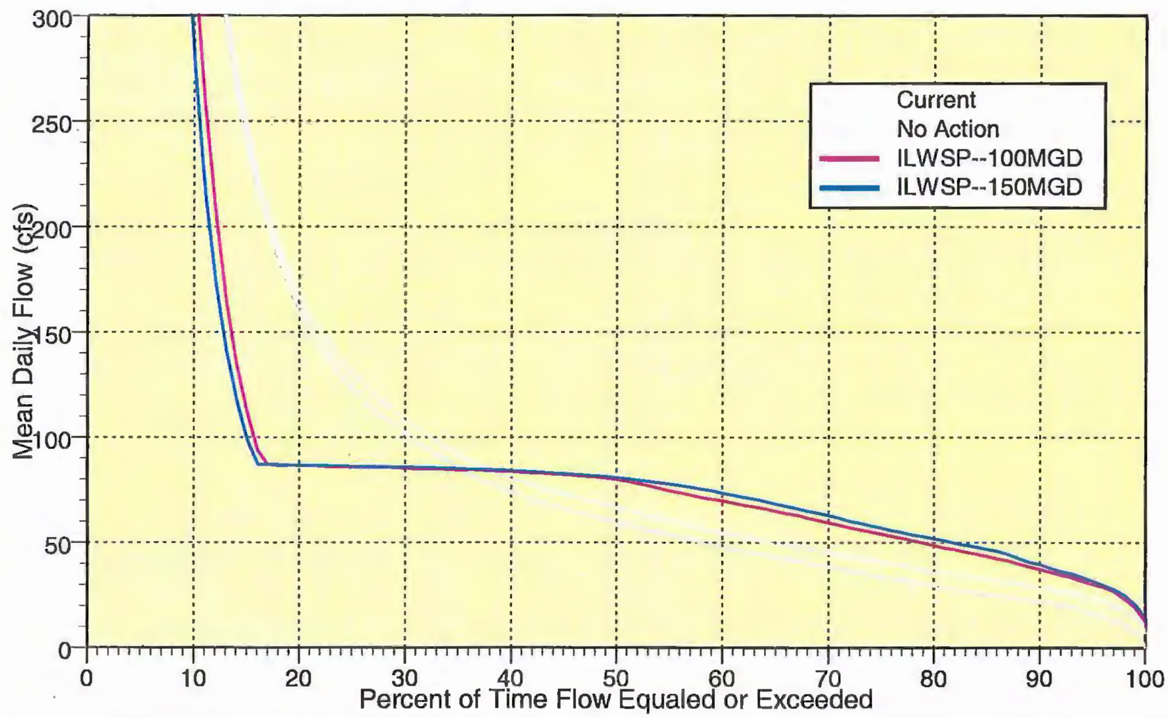
During May and June, the median flow in the river at Valley Center would decrease by 23 to 45 cfs or about 22 to 35 percent respectively. These two months have the highest historic median flow and, therefore, are the months when the recharge system is expected to operate more frequently and at higher diversion rates.

Flow duration curves for the Little Arkansas River near Halstead are shown in Figure 4–4 for the four scenarios. Flows above 300 cfs are excluded from these graphs to better represent the differences in lower flows. At Valley Center, these flow duration graphs indicate flows in the river will be reduced by diversions for recharge of the Equus Beds about 36 percent of the time, or for flows above about 84 cfs. Lower flows, which occur about 64 percent of the time, are expected to increase with implementation of the ILWSP.

As shown previously in Chapter 3, the Kansas Water Office has established the minimum desirable streamflow (MDS) at Valley Center to be 20 cfs. Figure 4–3 shows the median (50 percent) flow at Valley Center is above 20 cfs in all months regardless of alternative. In 1983, KDWP (formerly the Kansas Fish and Game Commission) recommended higher minimum flow values, 60 cfs in April, May and June, and 34 cfs otherwise. Figure 4–3 shows that median flows will also exceed KDWP recommendations in all months.

Of course, the MDS recommendations are for minimum, not median, flows. Figure 4–5 shows the percent of time in each month that flows at Valley Center are equal to or greater than the

Figure 4-4 Flow Durations, Little Arkansas River at Valley Center

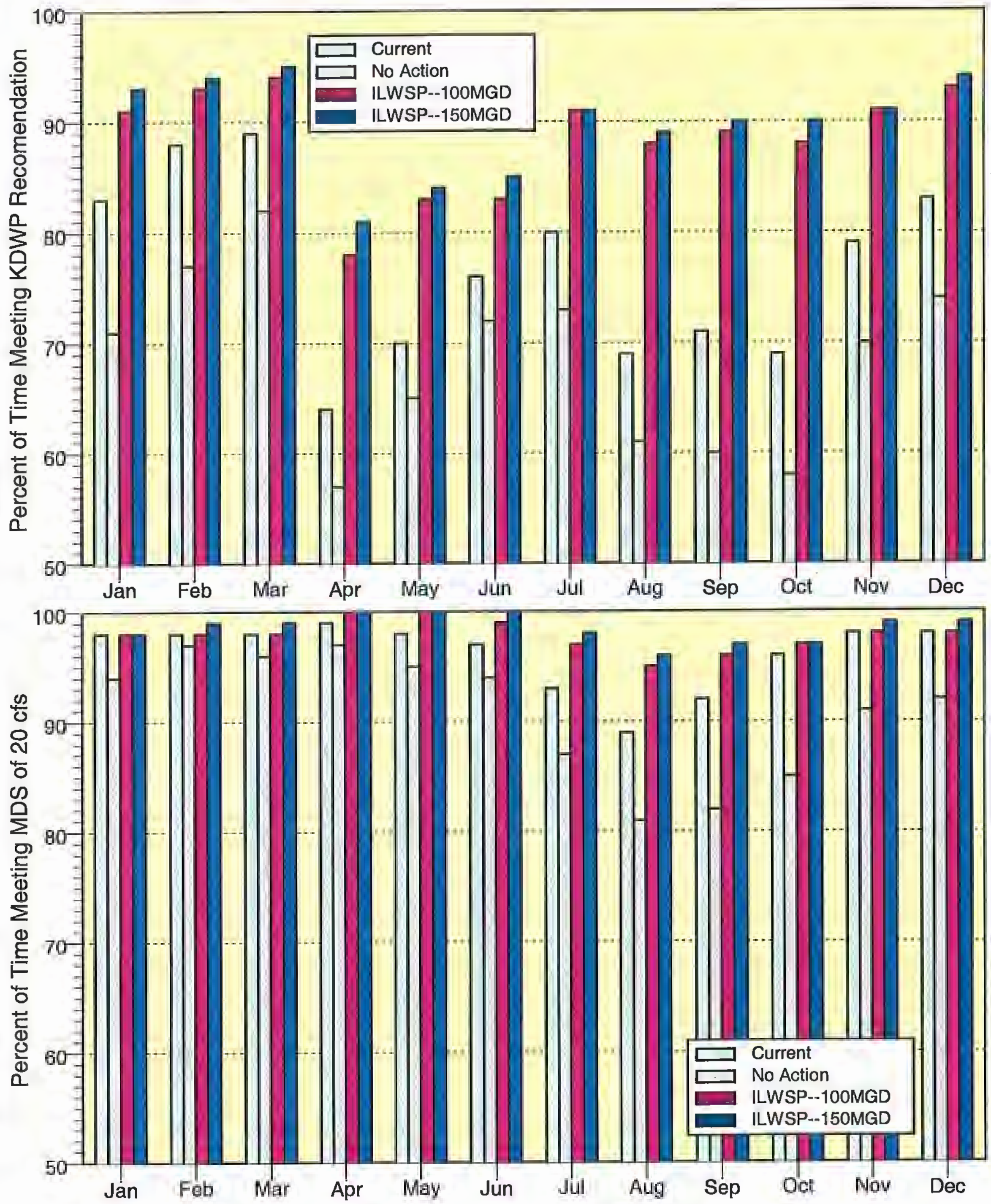


recommended minimums. The lower portion of this figure shows how often each month the flow at Valley Center is at least 20 cfs. The success rate for meeting the MDS is fairly high, generally over 90 percent. However, this graph shows that, compared to current conditions, the success rate will decline under the No-action alternative and increase with implementation of either of the ILWSP alternatives. Since the KDWP recommendations are higher than the MDS, the success rates for meeting these recommendations are lower, as shown in the top graph in Figure 4–5. For the No-action alternative, the success rate varies from a low of 57 percent of the time in April to 82 percent in March. With either ILWSP alternative, this success rate increases to near 80 percent in April, May and June, and near 90 percent otherwise.

With adoption of the No-action alternative, there will be no changes in the flow of the Little Arkansas River at Valley Center at higher flows since there would be no diversions from the river. However, the lower flows that occur the majority of the time will continue to decline as the Equus Beds aquifer is further depleted and groundwater discharges to the Little Arkansas River are reduced. These declines would average 6 to 7 cfs as compared to current conditions.

With implementation of either ILWSP alternative, changes in the flow regime of the Little Arkansas River at Valley Center at higher flows would be relatively insignificant since the capacity of the diversion system is small in comparison. Average daily flows over 1,000 cfs will still occur about 5 percent of the time, and over 300 cfs about 13 percent of the time.

Figure 4–5
Success Rates for Meeting MDS Requirements, Little Arkansas River at Valley Center



As stated earlier, it is these higher, high energy flows which have the most influence on stream morphology.

At low flows, which are much more common, implementation of either ILWSP alternative is expected to increase the flow in the Little Arkansas River at Valley Center. This would be a positive impact, as increased baseflow would enhance the habitat available to fish, wildlife and riparian vegetation.

Changes in the flow regime of the Little Arkansas River would be most apparent at medium flow levels, those which occur from about 13 to 60 percent of the time, or roughly in the range of 50 to 300 cfs (see Figure 4–4). As at Halstead, it was assumed that the ASR diversion system would not operate if the flow in the Little Arkansas River at Valley Center was less than 40 cfs and, for larger flows, only that portion above 40 cfs could be diverted. When operational, the ASR system could divert up to approximately 154 cfs (232 cfs) above Valley Center for the 100-MGD (150-MGD) ILWSP alternative. Therefore, in the extreme case, it is possible that operation of the ASR system could divert as much as 80 to 85 percent of the total flow in the river. Such conditions would, however, be relatively infrequent and interspersed between periods of higher and lower flows. Any negative impacts resulting from river diversions should be offset by the benefits arising from increased baseflow.

For the Little Arkansas River, the most significant changes in flow would occur just upstream of its mouth, generally within the city limits of Wichita itself. It is here where the proposed Local Well Field expansion can divert up to 45 MGD, or about 70 cfs, from the Little Arkansas River. These diversions are in addition to any diversions for recharge of the Equus Beds aquifer that occur upstream. The Local Well Field expansion will be operated so that it does not reduce the flow in the Little Arkansas River to less than 20 cfs. Figure 4–6 shows the impact of these diversions on monthly median flows at the mouth of the Little Arkansas River. Under either ILWSP alternative, the median flow is reduced to 20 cfs, the designated MDS, in every month.

Figure 4–7 contains flow duration curves for the Little Arkansas River at its mouth for the four alternatives. Flows above 300 cfs are excluded from these graphs to better represent the differences in lower flows. At this location, these flow duration graphs indicate flows in the river will be reduced by diversions to the expanded local well field and for recharge of the Equus Beds over 90 percent of the time, or for all flows above 20 cfs. This 20-cfs flow would be maintained in the river about 75 percent of the time, or three days out of every four.

With adoption of the No-action alternative, there will be no changes in the flow of the Little Arkansas River at higher flows since there would be no diversions from the river. However, the lower flows that occur the majority of the time will continue to decline as the Equus Beds aquifer is further depleted and groundwater discharges to the Little Arkansas River are reduced. These declines would average 6 to 7 cfs as compared to current conditions. With implementation of either ILWSP alternative, changes in the flow regime of the lowest reaches of the Little Arkansas River would be relatively significant at low to intermediate flows. The collector wells associated with the Local Well Field expansion would be capable of limiting the discharge at the mouth of the Little

Figure 4-6 Median Flow by Month, Little Arkansas River at Mouth

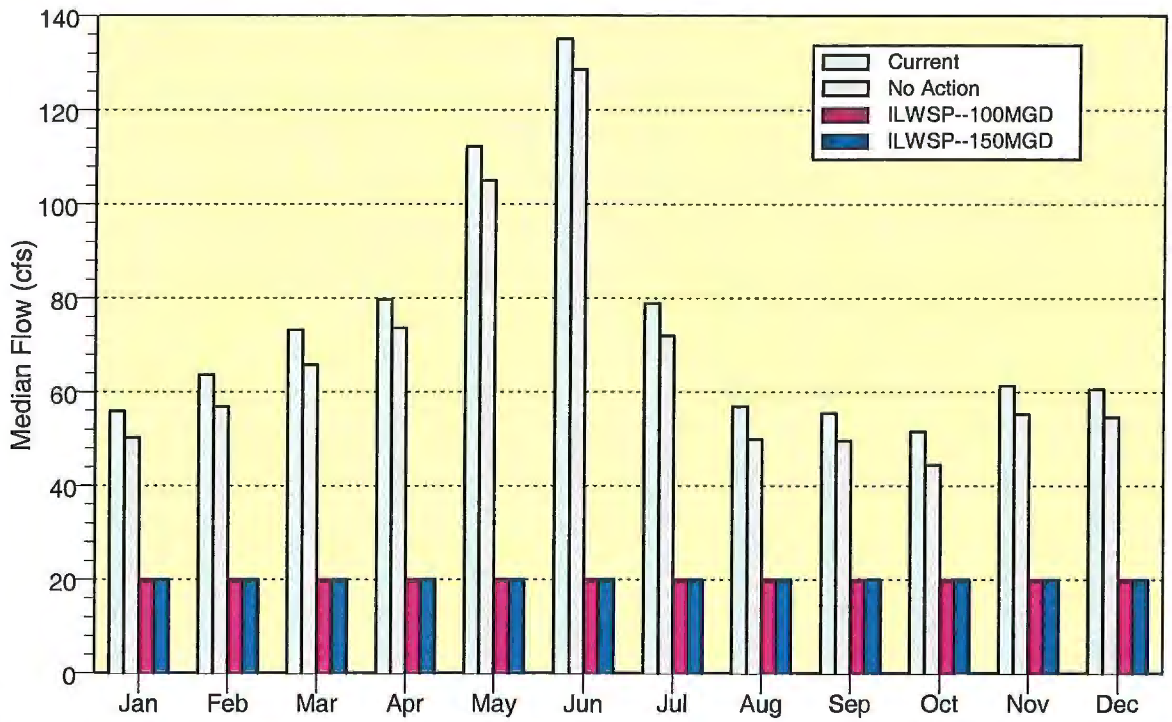
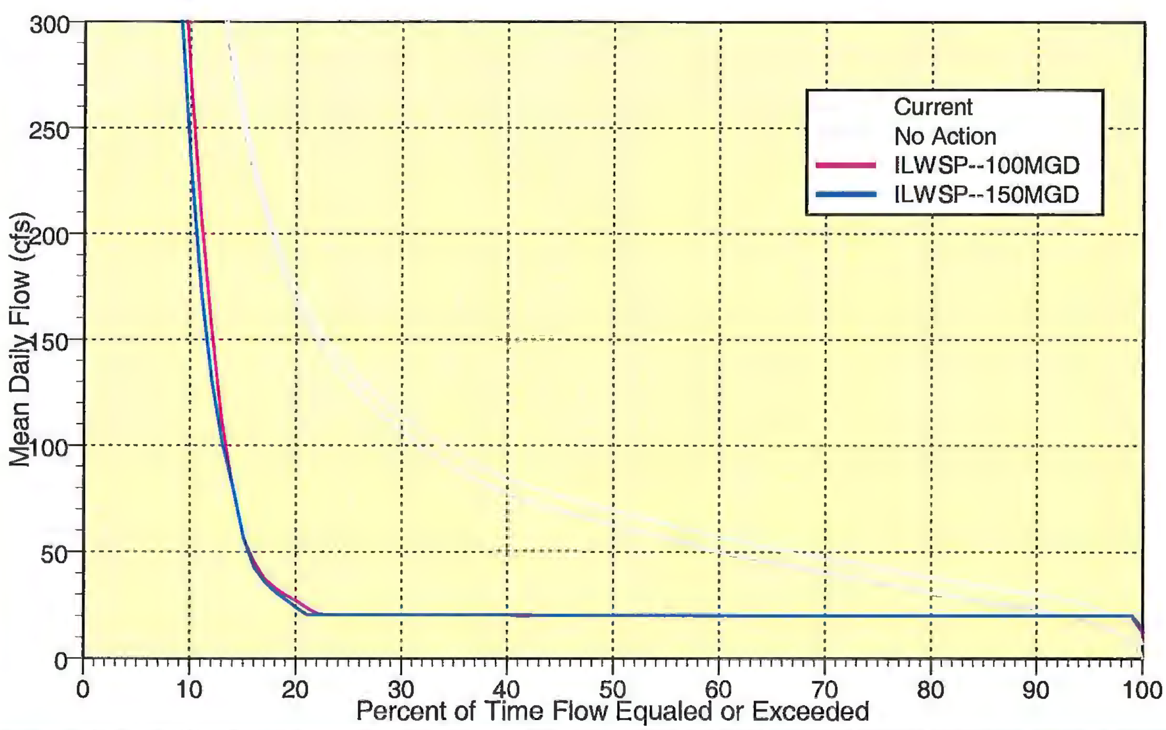


Figure 4–7 Flow Durations, Little Arkansas River at Mouth



Arkansas River to 20 cfs or less the majority, about 78 percent, of the time (see Figure 4–8).

Although these flow reductions would be relatively significant, a flow of 20 cfs should be sufficient to sustain the current habitat and uses of this section of the Little Arkansas River. The lowest reaches of this river are located in an urban setting and have been extensively modified by man. There are floodway diversions, low-head diversion dams and other channel modifications that have reduced the utility of and habitat found in this stream. At higher flows, the potential impacts are much less significant on a relative basis. Average daily flows over 1,500 cfs will still occur about 4 percent of the time. The duration of intermediate-range flows of 1,000 cfs or more would decrease slightly from 6 to 5 percent of the time. Similarly, flows over 500 cfs would decrease in duration from 9 to 7 percent of the time. Since the duration of these higher flows would not be reduced significantly, there should be no significant changes in stream morphology.

A water balance for the Little Arkansas River was developed that summarizes the anticipated changes to the flow in this river. This water balance, which is included as Figure 4-8, shows average flows in the river at various locations, and average withdrawals from and discharges to the river. The table on this figure lists the average flows at those locations that change between alternatives.

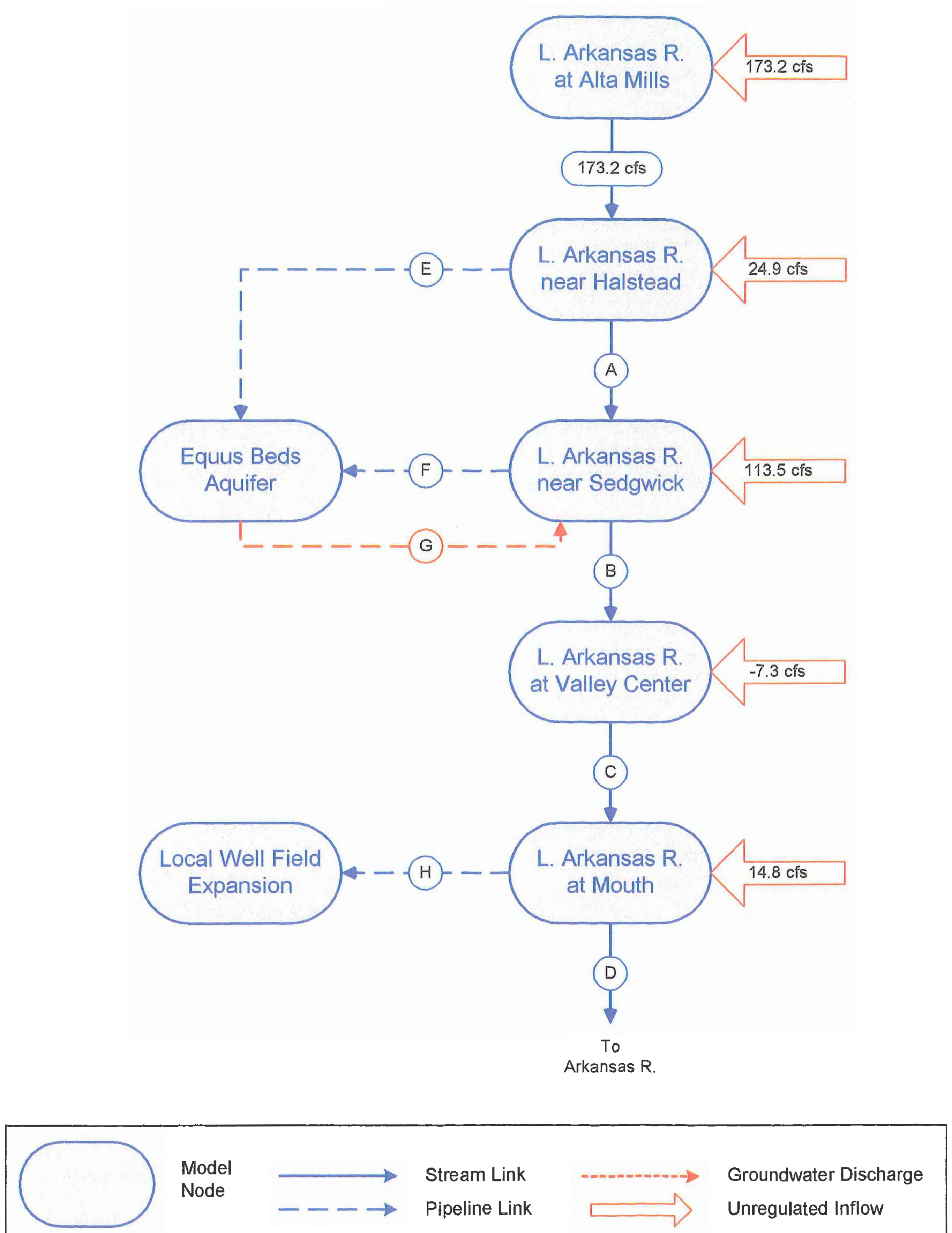
As shown in Figure 4-8, flows in the Little Arkansas River between Sedgwick and its mouth are expected to decline slightly from current conditions under the No-action alternative. These declines in flow, which average close to 7 cfs, occur as a direct result of estimated decreases in groundwater discharge to the river. Average groundwater discharges are expected to decline under the No-action alternative because continued stress on the Equus Beds aquifer, without the benefit of artificial recharge, will result in significant future aquifer depletions.

For both ILWSP alternatives, diversions for recharge of the Equus Beds aquifer and depletions due to the local well field expansion will cause larger flow reductions than anticipated for the No-action alternative. Above Wichita, these reductions average about 25 to 30 cfs, or 8 to 10 percent, as compared to current conditions. The more significant reductions occur due to operation of the local well field expansion. At the mouth of the Little Arkansas River, flow reductions averaging about 76 to 82 cfs are predicted. While sizable, these reductions still represent only about 23 to 25 percent of the average river flow at this location.

Average river diversions for recharge of the Equus Beds Aquifer will total about 38 cfs for the 100 MGD ILWSP alternative and approximately 48 cfs for the 150 MGD alternative. There will be long periods when the diversion system is either shut down or operated at partial capacity because there is insufficient flow in the river. Therefore, these average diversion rates represent less than 25 percent of the maximum diversion capacity under both scenarios.

The beneficial impact of ILWSP development on the Little Arkansas River is an increase in groundwater discharge to the river. This discharge is estimated to increase by an average of nearly 14 cfs for the 100 MGD alternative and over 17 cfs for the 150 MGD alternative.

Figure 4-8 Water Balance for Little Arkansas River



Schematic Location	Description	Average Flow for Alternative (cfs)			
		Current	No-action	ILWSP 100	ILWSP 150
A	Flow in Little Arkansas River below Halstead	198.1	198.1	180.4	178.9
B	Flow in Little Arkansas River below Sedgwick	320.0	313.1	295.4	289.6
C	Flow in Little Arkansas River below Valley Center	312.7	305.8	288.1	282.3
D	Flow in Little Arkansas River at Mouth	327.5	320.6	251.9	245.2
E	Equus Beds Recharge Diversions above Halstead	0.0	0.0	17.7	19.2
F	Equus Beds Recharge Diversions between Halstead and Sedgwick	0.0	0.0	20.7	28.7
G	Groundwater Discharge from Equus Beds to Little Arkansas River	8.4	1.5	22.1	25.8
H	Diversions to Local Well Field Expansion	0.0	0.0	51.1	51.9

Notes:

- All stated values are average flows, in cubic feet per second, over the entire 74-year model simulation period, 10/01/1922 - 9/30/1996.
- Flows may not balance exactly due to rounding.

While these increases in groundwater discharge contribute only about 5 percent to the average flow in the river at Valley Center, they have a significant impact on low flows. For example, as shown in Figure 4-4 at Valley Center, the increase in groundwater discharge will increase the flow in the river over 60 percent of the time.

The changes in Little Arkansas River flow that result from ILWSP implementation would occur gradually over time. The diversion facilities associated with the ASR component would be installed in phases so the associated flow reductions would occur incrementally. The expected increases in groundwater discharge would occur as the Equus Beds aquifer is replenished, and the rate of aquifer replenishment would depend on climatic conditions.

4.4.1.2.2 Arkansas River

The operations model makes estimates of the flow in the Arkansas River at the location of the USGS stream gage "Arkansas River at Wichita, Kansas." This stream gage is located at the Broadway Street Bridge in Wichita, 3.7 miles downstream of the mouth of the Little Arkansas River. As a result, the flow at this location can be impacted by diversions from the main stem of the Arkansas River upstream of Wichita, and by diversions from the Little Arkansas River. These diversions include the following:

- Induced infiltration from the Arkansas River resulting from redevelopment of the Bentley Reserve Well Field
- Changes in the rate at which flow infiltrates into the Equus Beds aquifer from the Arkansas River
- Induced infiltration from the Arkansas River resulting from operation of the existing Local (E&S) Well Field
- Diversions from the Little Arkansas River for recharge of the Equus Beds aquifer
- Changes in the amount of groundwater discharge from the Equus Beds aquifer to the Little Arkansas River; and induced infiltration from the Little Arkansas River that results from operation of the expanded Local Well Field

The estimated median flows by month at the Wichita gage are shown in Figure 4–9 for each of the four scenarios. Under current conditions, these median flows range from a low of about 225 cfs in October to a high of about 825 cfs in June. These values are four to six times larger than comparable values for the Little Arkansas River discussed previously. Figure 4–9 shows that the highest median flows are expected under current conditions. Comparing the No-action and ILWSP alternatives, median flows are approximately equal except in the higher flow months when diversions for recharge of the Equus Beds aquifer would typically be the highest. The largest differential occurs in June when the median flow would decrease by about 100 cfs from 800 to 700 cfs.

Flow duration curves for the Arkansas River at Wichita are shown in Figure 4–10. At flows less than the median — about 325 cfs — these graphs show that development of the ILWSP alternatives will have little effect on flow in the Arkansas River when compared against the No-action alternative. At higher flows, the impact of diversions, principally from the Little Arkansas River, begin to

Figure 4–9 Median Discharge by Month, Arkansas River at Wichita

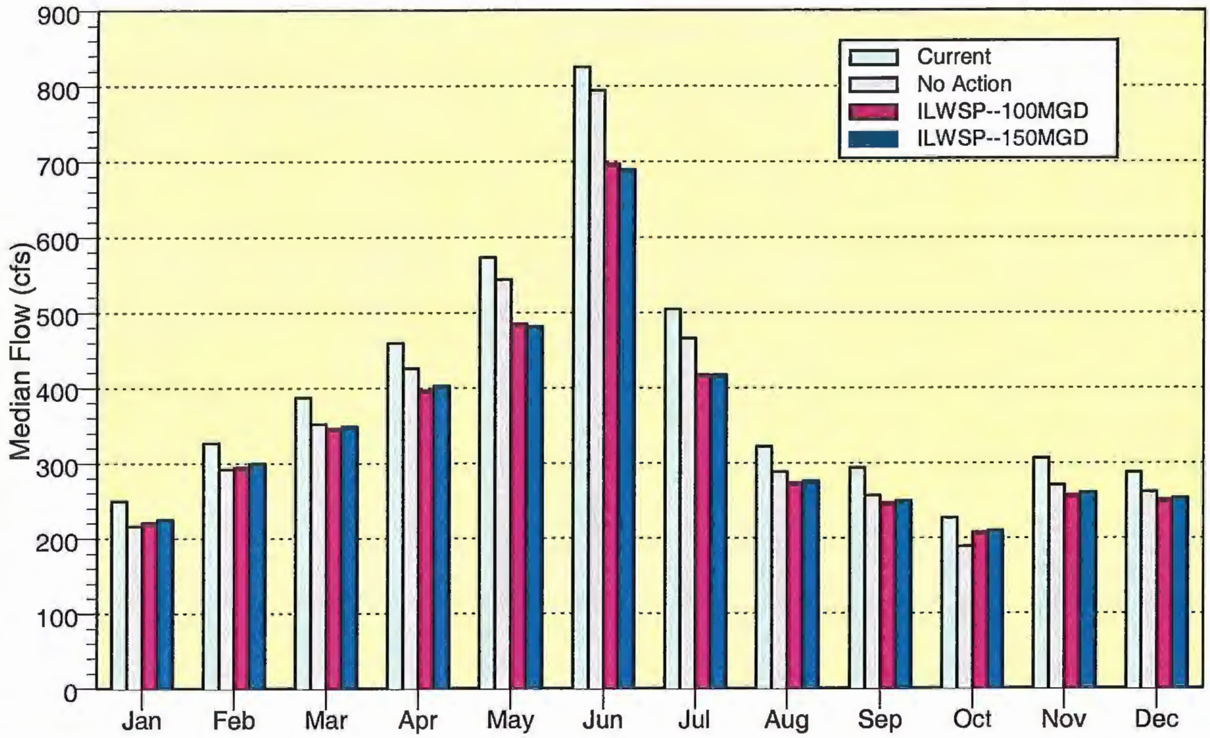
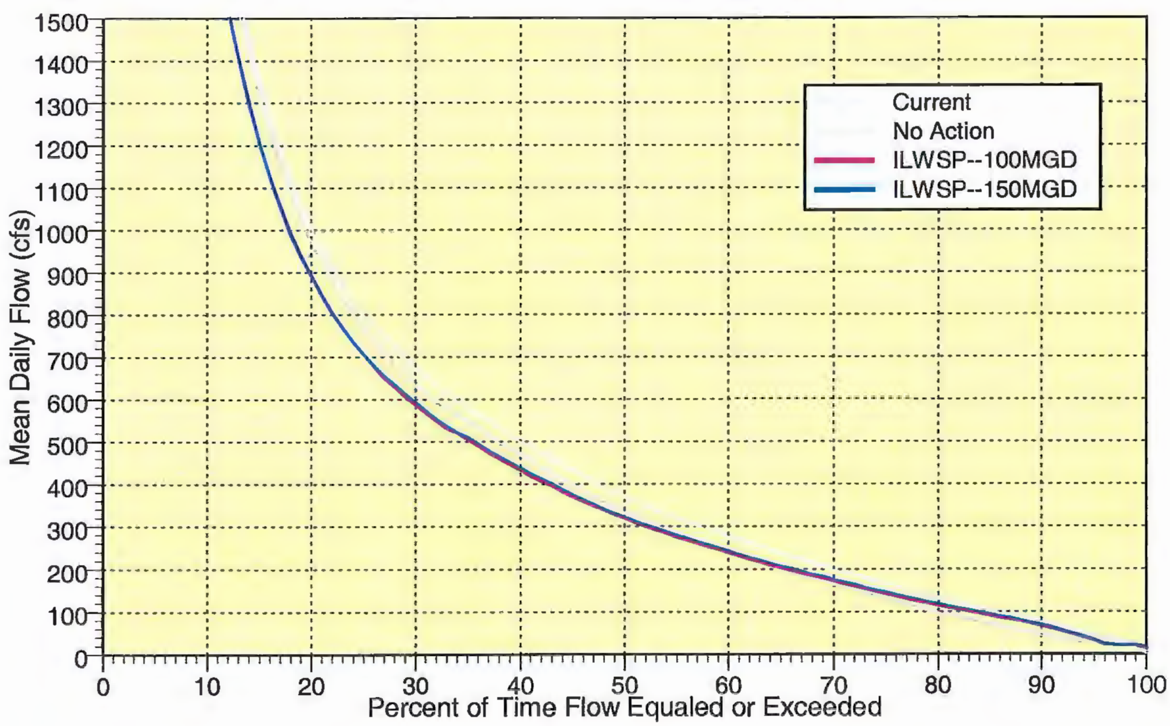


Figure 4–10 Flow Durations, Arkansas River at Wichita



become apparent. However, these differentials are relatively small and should not significantly change the rate of bedload transport or influence channel morphology.

4.4.1.2.3 Ninnescah River Basin
The Ninnescah River is a tributary of the Arkansas River. The confluence of these two rivers is located just north of Oxford, which is approximately 30 air miles south of the central portion of the City of Wichita. Cheney Reservoir, which is located on the North Fork of the Ninnescah River (North Fork), is the principal feature in this basin that is of interest in this study. This reservoir serves as a supplemental water source for the City of Wichita.

Since there are no minimum release requirements from Cheney Reservoir, reservoir releases, or spills, generally occur only after a significant rainfall event and after the reservoir has filled to its normal pool elevation - the top of the conservation pool, elevation 1,421.6 feet. As a result, there are often no releases from Cheney Reservoir except for the water used to backwash the intake screens. This backwash water is released intermittently but averages about 1.0 MGD, or 1.5 cfs. As a result, the North Fork below Cheney Reservoir has a median flow of essentially zero in every month. Figure 4-11 was developed to illustrate the potential impacts to this stream and shows the frequency of discharge from Cheney Reservoir (excluding screen backwash water), or durations of non-zero flow, by month. As expected, releases are most common during the wetter spring months and rarest during the summer. In August, releases will occur about 5 percent of the time, or 1.6 days per month on average. In May, releases will occur anywhere from about 14 to 28 percent of the time, or 4.3 to 8.7 days per month on average.

Flow duration curves for the North Fork below Cheney Dam are included in Figure 4–12. The scale for this graph has been truncated at 30 percent because these flows are zero much of the time. Review of these curves show that discharge is expected in the North Fork about 15 percent of the time under current conditions, but could either decrease significantly with the No-action or increase slightly depending on which of the two ILWSP alternatives is selected.

With adoption of the No-action alternative, releases from Cheney Reservoir are expected to decrease in frequency to about 8 percent of the time. This is about half as often as under current conditions. This phenomenon occurs because without development of other sources, Cheney Reservoir will have to be more heavily relied on in the future to supply water to the City. As result, it will generally contain less water, take longer to fill and spill less often.

Implementation of either ILWSP alternative will significantly increase the frequency of releases from Cheney Reservoir, when compared to the No-action alternative (Appendix C, Operations Model Description). The ILWSP includes development of several new water supply sources, or the enhancement of existing sources. As a result, the City's future water supply demands can be satisfied with less reliance on Cheney Reservoir. This will generally increase the amount of water stored in the reservoir, causing it to fill sooner and spill more often. Without doubt, these more frequent spills will be beneficial to North Fork and the flora and fauna that depend on it.

Figure 4-11 Frequency of Discharge from Cheney Dam

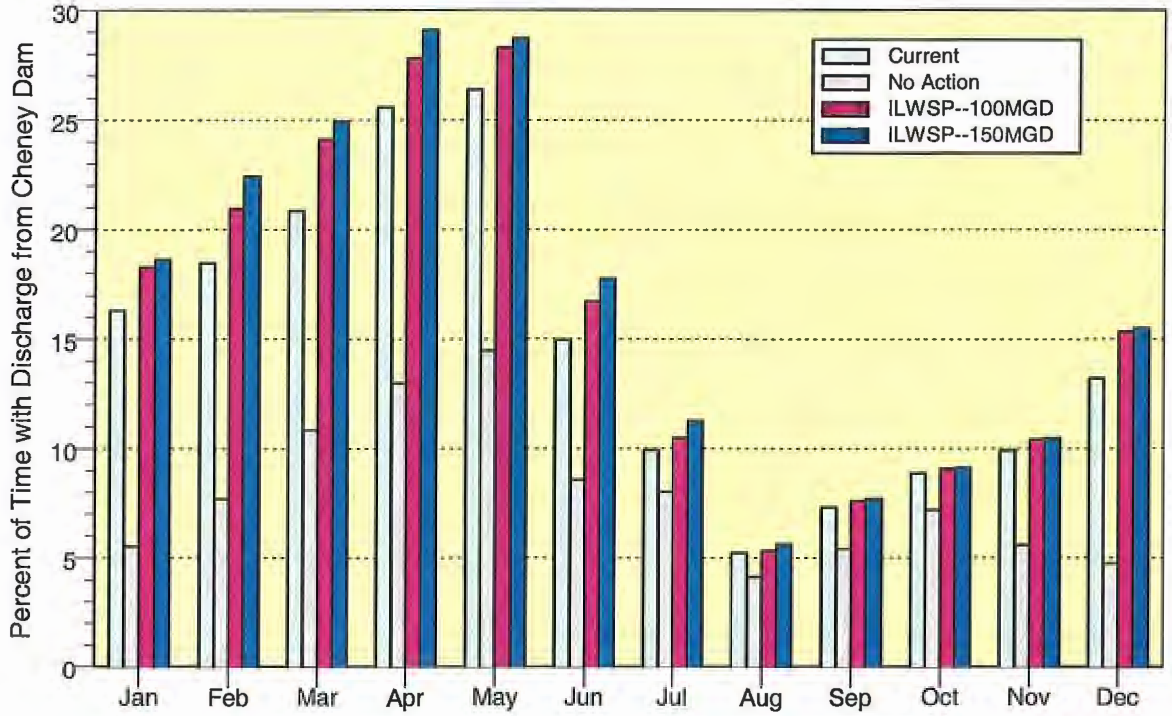
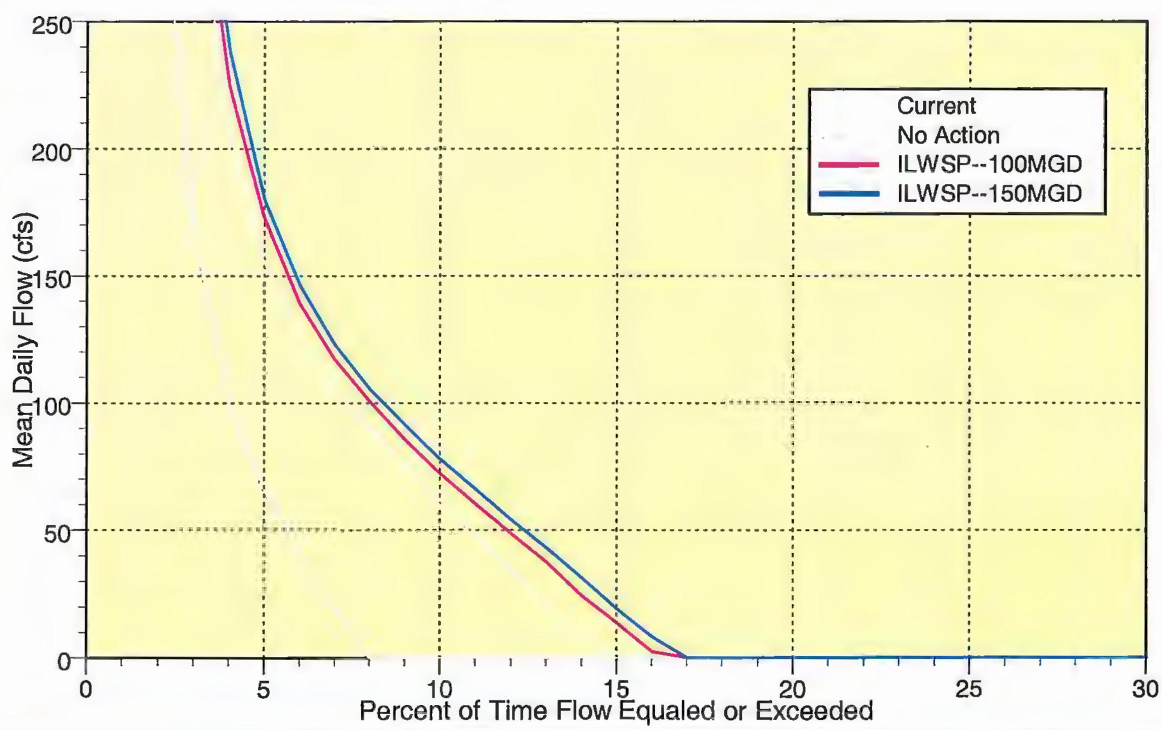


Figure 4–12 Flow Durations, North Fork Ninnescah River below Cheney Dam



There will be little difference in the frequency and magnitude of releases from Cheney Reservoir between current conditions and with ILWSP implementation. Therefore, there should be little change in the rate of bedload transport or changes in channel morphology.

Figure 4–13 shows the estimated median flow in the Ninnescah River near the City of Peck by month under current and possible future conditions. As can be seen in these graphs, there are only minor differences between the four scenarios. Any impacts to the flow in the Ninnescah River at this location are dampened by the fact that only a relatively small portion of this flow comes from Cheney Reservoir releases under current conditions.

Flow duration curves for the Ninnescah River near Peck are included in Figure 4–14. In this figure, the graphs for the current and ILWSP alternatives are nearly indistinguishable. The only differences are between the graphs for these three scenarios and the No-action alternative. For example, at a 20 percent chance of exceedance, the No-action alternative has a discharge about 24 cfs less than the other three (330 cfs verses a range of 352 to 358 cfs).

As shown previously in Chapter 3, the Kansas Water Office has established the MDS for the Ninnescah River near Peck. These MDS values vary by month and are as follows:

- 100 cfs in November – May
- 70 cfs in June
- 30 cfs in July – September
- 50 cfs in October

Figure 4-13 Median Flow by Month, Ninnescah River near Peck

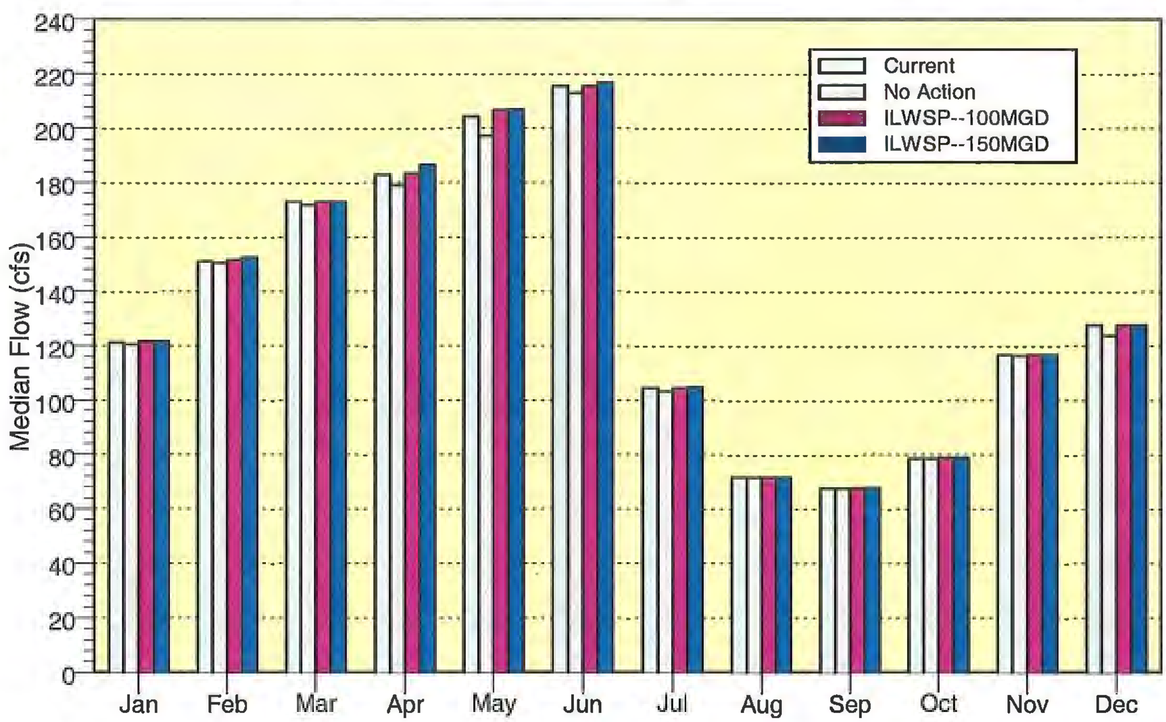


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Figure 4–15 shows the percent of time in each month that flows near Peck are equal to or greater than the recommended minimums. The success rate for meeting the MDS varies from about 55 percent in November to about 85 percent in July. What is more relevant however, is that there are almost no differences in these success rates between the various scenarios.

4.4.1.3 Water Surface Elevations and Depths

The elevation of the water surface in a stream is dependent on the discharge at the point in question, the physical characteristics of the stream, and potentially, the water surface elevation of points downstream as well. Since stream cross sections and other conditions are assumed to be reasonably stable, the impacts to water surface elevations in project area streams are considered to be largely a function of changing stream flow. As a result, the potential impacts to water surface elevations and flow depths closely mirror the impacts in the quantity of flow discussed previously.

The potential impacts to water surface elevations and flow depths were analyzed at four locations within the ILWSP project area. These locations include one each on the Little Arkansas, Arkansas, and Ninnescah rivers plus Cheney Reservoir.

4.4.1.3.1 Little Arkansas River

Water surface elevations in the Little Arkansas River at Valley Center were estimated for the four scenarios under consideration. Figure 4–16 shows the estimated median water surface elevations at Valley Center by month. The base elevation of the bars shown in this graph is at the same elevation as the estimated low point in the stream cross section. Therefore, the heights of these bars also give an indication of flow depths. As compared to current conditions, median water levels will decrease about 0.05 foot in every month under the No-action alternative. For the two ILWSP alternatives, median water surface elevations and flow depths will increase about 0.1 foot in most months, which is a reflection of increases in base flow. The only months with potential declines in median water levels are May and June when diversions for aquifer recharge are generally highest.

Overall duration curves for water surface elevations, or stages, in the Little Arkansas River are shown in Figure 4–17. Again, these graphs show slight stage increases of about 0.1 foot at lower flows with adoption of either ILWSP alternative. During higher flows, diversions for aquifer recharge could lower water levels by about 0.2 foot about 25 percent of the time.

4.4.1.3.2 Arkansas River

For the ILWSP alternatives, the flow and water levels of the Arkansas River will decrease slightly. The primary cause of this would be the decreased flow contribution from the Little Arkansas River. Median stage values, as shown in Figure 4–18, will decrease about 0.2 foot each month from current conditions.

Monthly median stages for the No-action alternative vary from slightly lower to slightly higher than those for the ILWSP alternatives. As a percentage of flow depth, these decreases in median stage range from 6 to 7 percent.

Figure 4–19 includes stage duration curves for the Arkansas River at Wichita. In this figure, the curves that represent each of the four scenarios are indistinguishable much of the time. This

Figure 4-14 Flow Durations, Ninnescah River near Peck

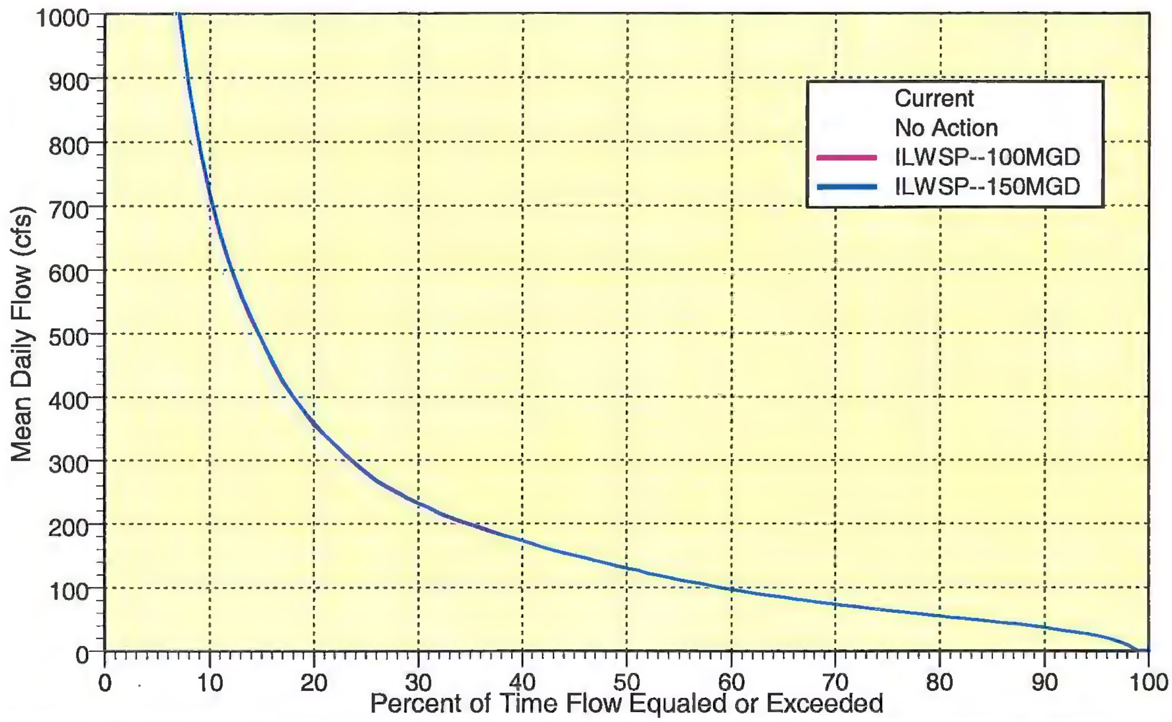


Figure 4-15
Success Rates for Meeting MDS Requirements, Ninnescah River near Peck

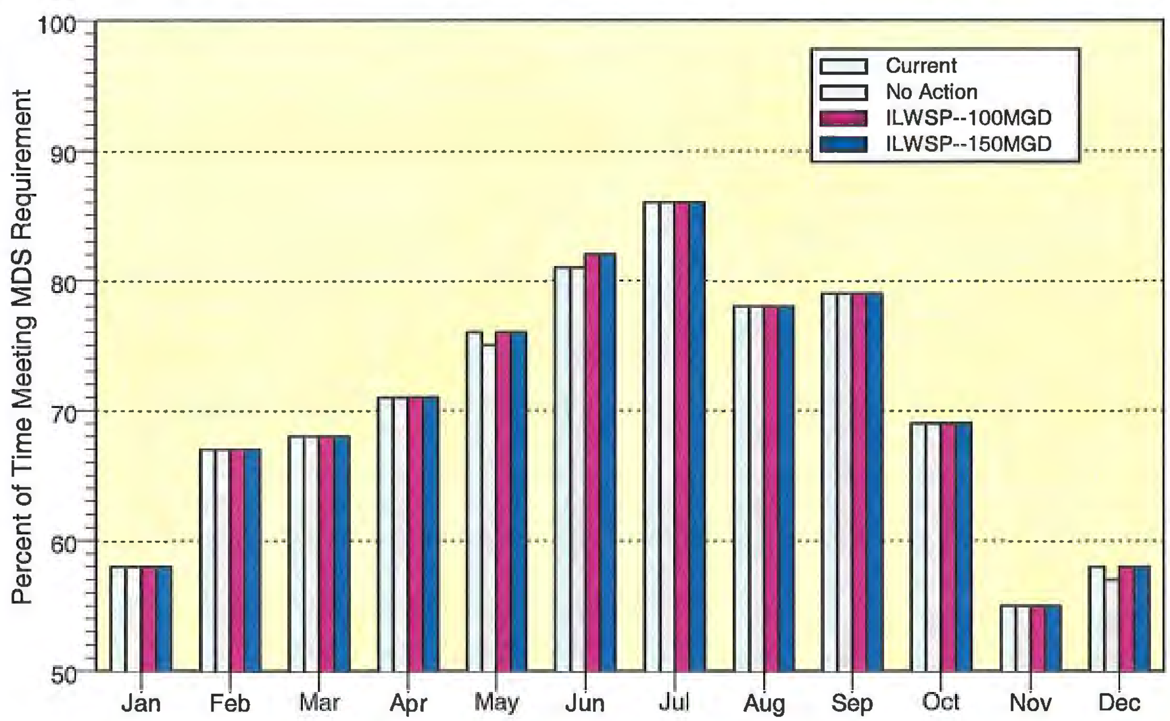


Figure 4–16 Median Water Surface Elevations by Month, Little Arkansas River at Valley Center

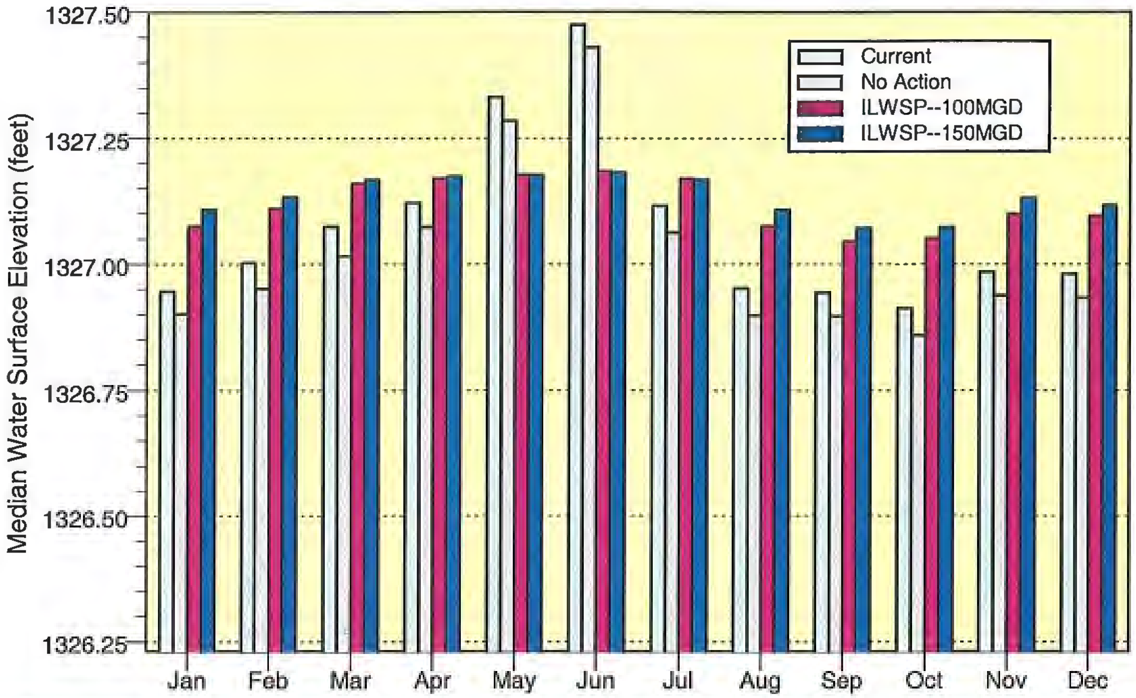
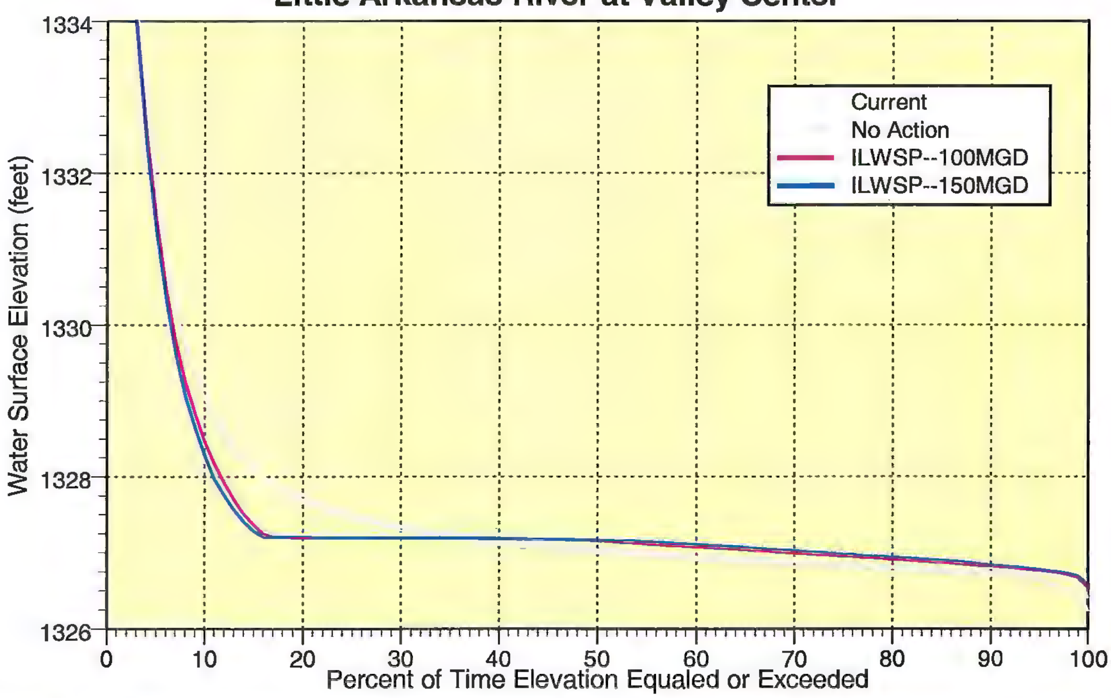


Figure 4-17 Water Surface Elevation Durations, Little Arkansas River at Valley Center



Note: At flows approaching 2,000 cfs, which corresponds to a water surface elevation of about 1,333 ft., a portion of the flow in the Little Arkansas River is diverted above Valley Center to the Arkansas River through the Little Arkansas Floodway. As a result, any estimates of water surface elevations above 1,333 ft. are not considered reliable.

indicates that potential changes in river stage, and corresponding changes in flow depth, width and velocity should be relatively insignificant.

4.4.1.3.3 Ninnescah River

Median monthly stages and overall stage duration graphs for the Ninnescah River near Peck are shown in Figures 4–20 and 4–21. Both of these figures show that no significant water level changes are expected in the mainstem of the Ninnescah River.

4.4.1.3.4 Cheney Reservoir

As shown above, the potential changes in water levels are not considered significant for any project area streams. However, this is not the case for Cheney Reservoir. Since the primary purpose of Cheney Reservoir is to supply water to the City, large water level fluctuations can be expected during a drought situation regardless of which alternative is selected. Figure 4–22 contains graphs showing simulated pool elevations verses time for all four scenarios. These graphs show that the conservation pool in Cheney Reservoir — water stored between elevations 1,392.9 and 1,421.6 ft. would be fully utilized during a major drought, even under current conditions. Using the historic period of record employed in the operations model, severe drawdowns would have occurred during the droughts of the 1930's, mid-1950's, and even the late 1960's.

Figure 4–23 includes a chart showing median monthly water levels in Cheney Reservoir. Median water levels are expected to be lowest with the No-action alternative. If there are no new or enhanced supply sources, and the City's water demands continue to increase, the stress on Cheney Reservoir will increase dramatically. As a result, the storage contents of the reservoir will often be less and water levels lower, typically in the range of two to three feet lower. With development of either ILWSP alternative, the City will have additional supply sources to draw on, such as the expanded Local Well Field and the redeveloped Bentley Reserve Well Field. These new or enhanced sources will reduce the City's reliance on Cheney Reservoir and help maintain higher water levels in the reservoir. Figure 4–23 shows that median water levels could be 0.4 to 0.6 ft. higher than under current conditions with development of either ILWSP alternative.

Stage duration curves for Cheney Reservoir are included in Figure 4–24. These curves also show that Cheney Reservoir should stay relatively fuller with implementation of the ILWSP. Water levels could be two to five feet higher a good deal of the time as compared to the No-action alternative, a significant project benefit.

As discussed above, the potential changes in water levels for Cheney Reservoir with the No-action alternative may easily be ten times larger than predicted changes in the water levels of area streams. This is significant because reservoirs are shaped like a funnel or inverted pyramid — that is, they are wider at the top. For this reason, even relatively small changes in pool elevation can have a dramatic impact on the surface area of a reservoir. A shrinking reservoir pool can leave behind mud flats, change the hydrology of riparian wetlands, and reduce the utility of recreational facilities, such as boat docks and ramps.

Figure 4–25 presents a comparison of monthly median pool areas for Cheney

Figure 4-18
Median Water Surface Elevations by Month, Arkansas River at Wichita

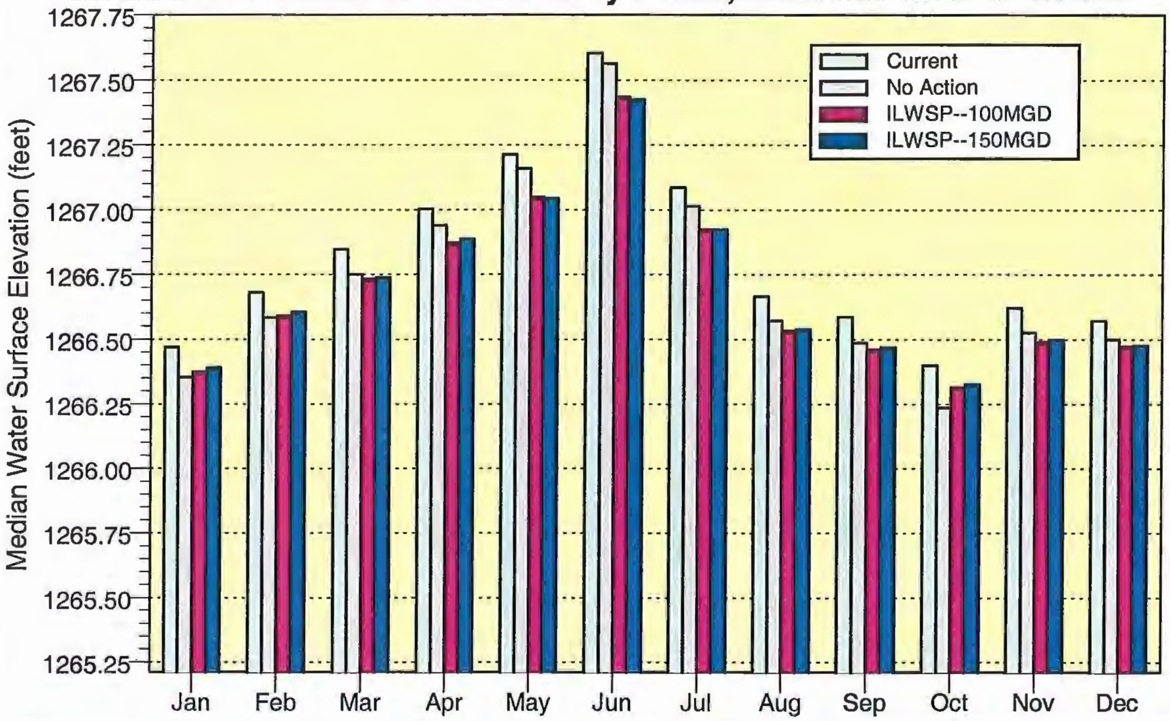
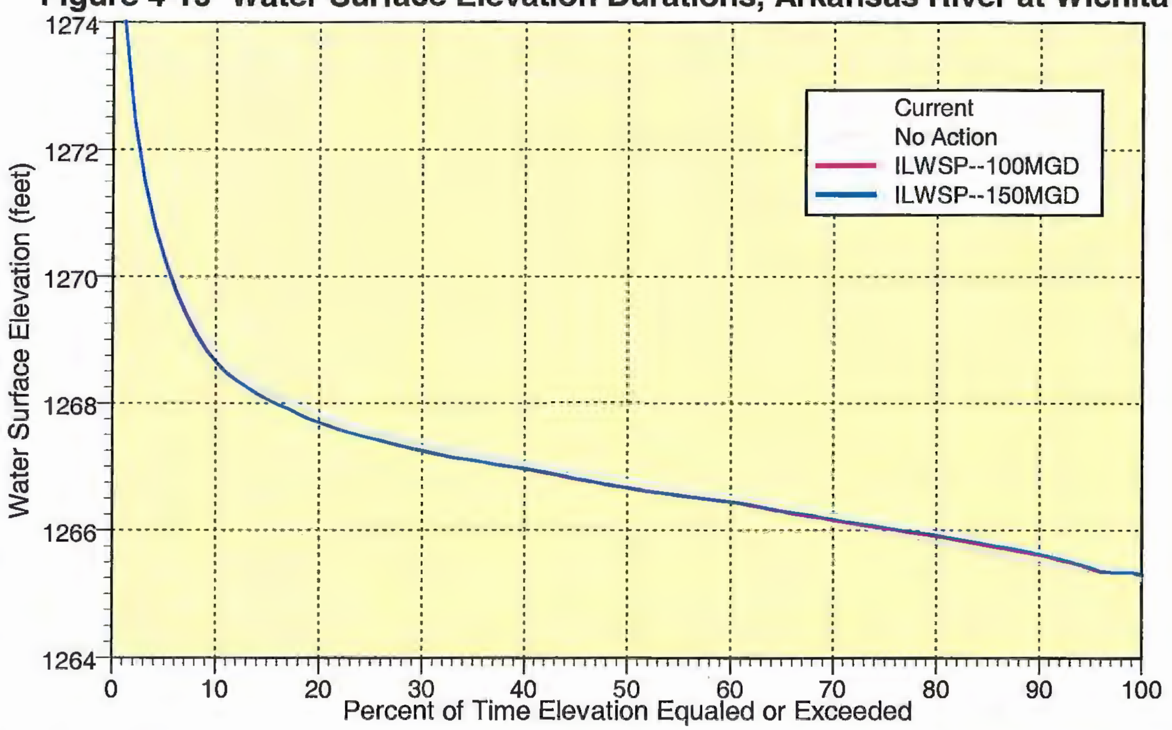


Figure 4-19 Water Surface Elevation Durations, Arkansas River at Wichita



Note: At flows over 4,000 cfs, which corresponds to a water surface elevation of about 1,270.5 ft., a portion of the flow in the Arkansas River is diverted around Wichita through the Big Slough-Cowskin Floodway. As a result, any estimates of water surface elevations above 1,270.5 ft. are not considered reliable.

Figure 4–20
Median Water Surface Elevations by Month, Ninnescah River near Peck

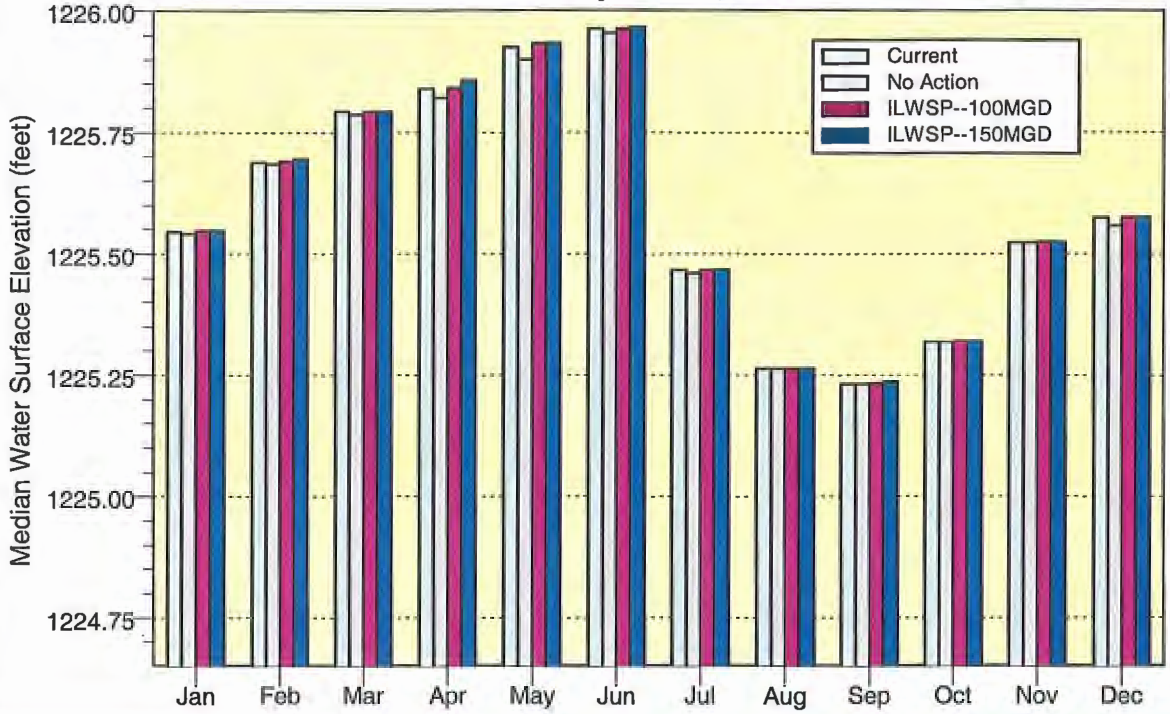


Figure 4–21 Water Surface Elevation Durations, Ninnescah River near Peck

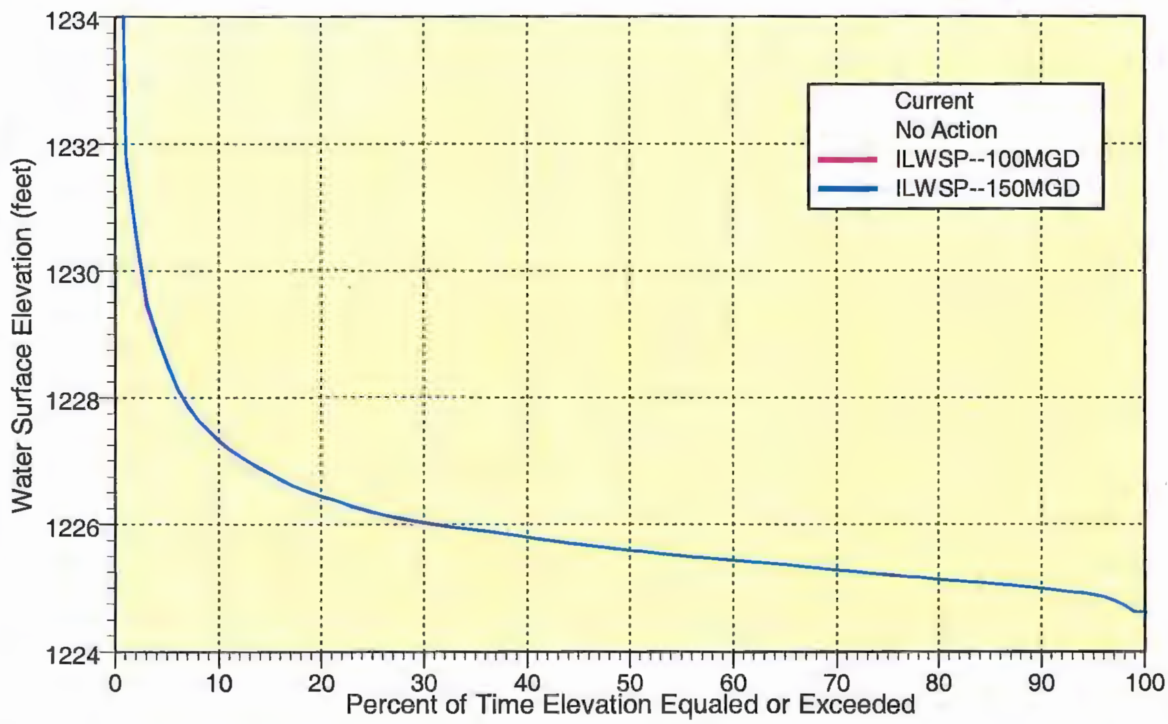


Figure 4-22 Simulated Pool Elevations in Cheney Reservoir

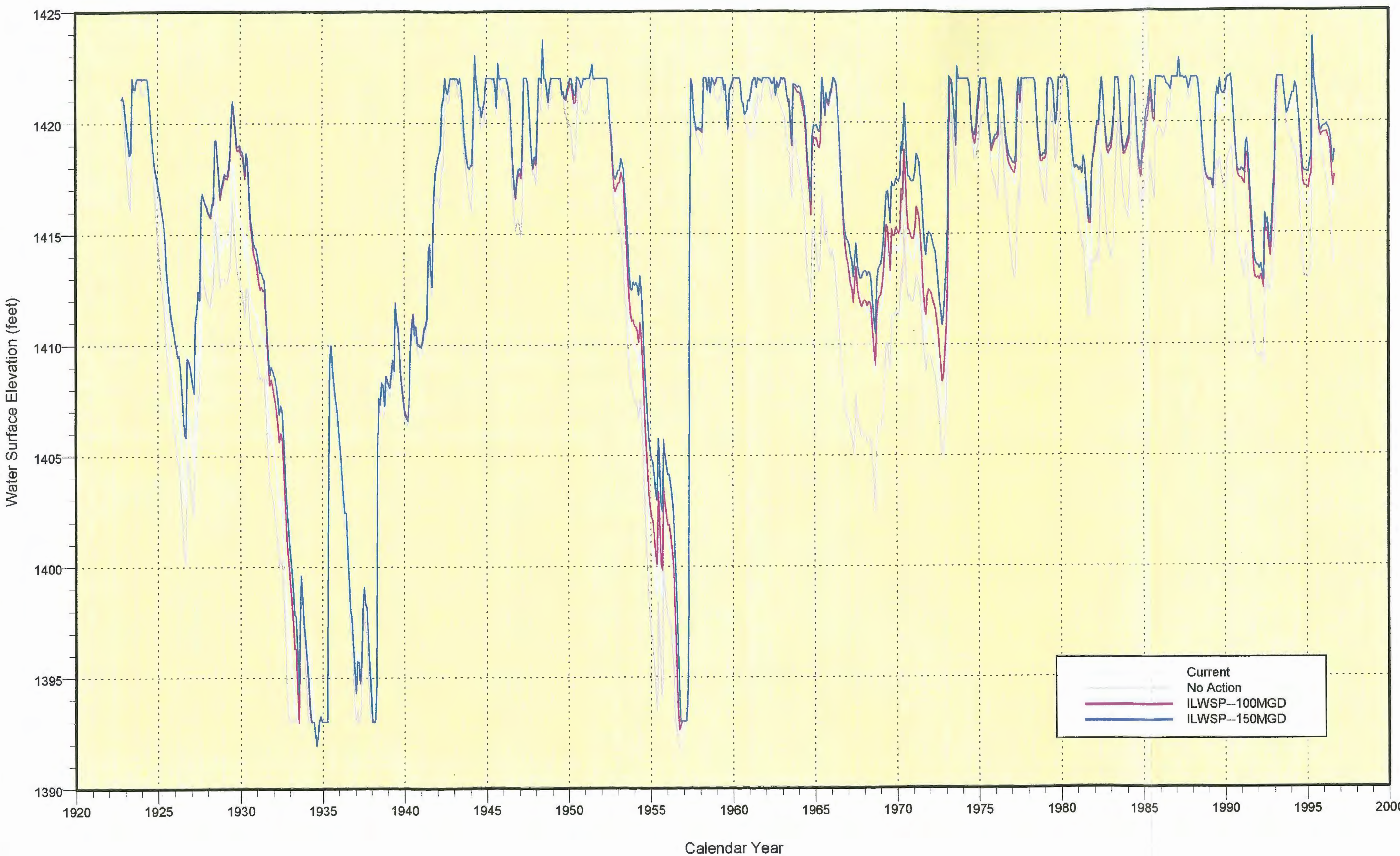


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Figure 4–23 Median Water Surface Elevations by Month, Cheney Reservoir

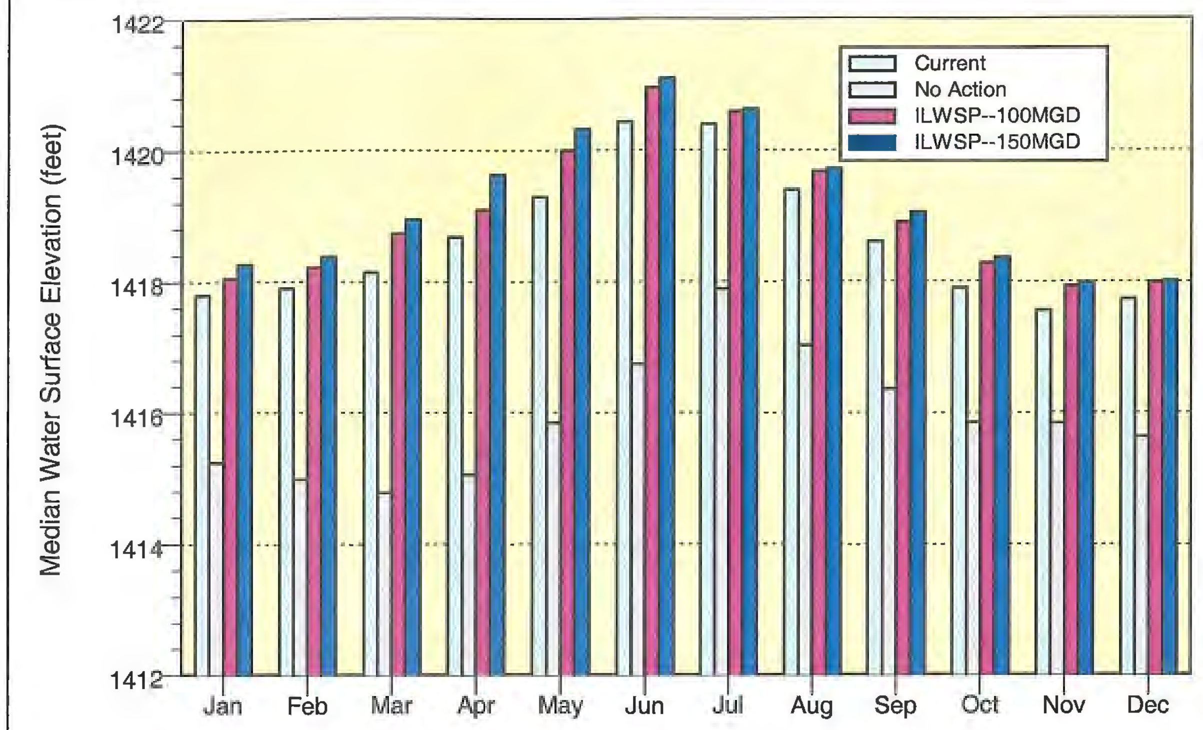
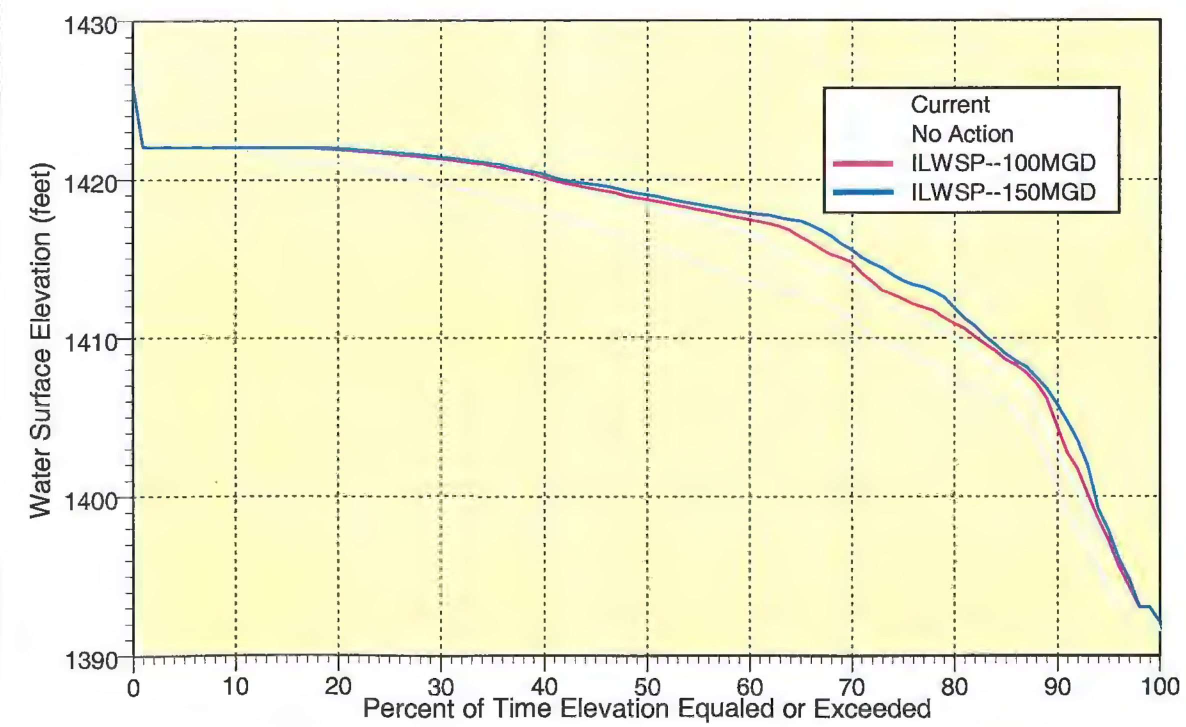


Figure 4–24 Water Surface Elevation Durations, Cheney Reservoir



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Reservoir for the four scenarios. Under the No-action alternative, median pool areas are expected to decline from current conditions by up to about 1,300 surface acres. Development of either ILWSP alternative will increase median monthly pool areas by 70 to 360 surface acres. Pool area durations for Cheney Reservoir are shown in Figure 4–26. The curves in this figure indicate that the reservoir's conservation pool will range from empty to full — about 2,000 to 9,500 surface acres — with all alternatives. However, in between the periods when the conservation pool may be full or empty, the pool size under the No-action alternative would be several hundred acres smaller than for the two ILWSP alternatives about two-thirds of the time.

4.4.1.4 Quality

The quality of surface waters in the ILWSP project area can vary significantly with time and location. There are many factors that influence the concentration of a particular water quality parameter such as stream flow rate, season, rainfall intensity and antecedent conditions. The interaction between these factors is complex and dynamic so that accurate predictions of future water quality characteristics are difficult. For this reason, much of the discussion below about surface water quality impacts is qualitative and based on professional judgement.

While changes to existing water quality constituents will likely not affect aquatic or terrestrial species that are found in or use the riverine systems in the project area, a hydrobiological sampling plan will be developed and implemented to help understand if or how water quality changes would affect fish and wildlife habitat.

4.4.1.4.1 Little Arkansas River

Comparing available water quality data for the Little Arkansas River at Alta Mills and Valley Center (see Table 3–6) indicates that the water quality of this river generally improves as one travels downstream. This is an indication that the flow that enters the river between Alta Mills and Valley Center is of somewhat better quality than at Alta Mills. This phenomenon is partly a result of the groundwater discharge that enters the river from the Equus Beds aquifer.

Under the No-action alternative, there will be no diversions from the Little Arkansas River. The only fundamental change in the flow of the river will be a decrease in groundwater discharge that will occur because, without the proposed ASR system, water levels in the Equus Beds aquifer will likely decline further with time. This will reduce the quantity of better-quality water available for dilution and increase constituent concentrations somewhat.

With implementation of either ILWSP alternative, a portion of any flow above 40 cfs may be diverted from the river for aquifer recharge. These diversions will be accomplished by installation of a series of vertical induced infiltration wells between Alta Mills and Valley Center.

For most water quality parameters, these withdrawals will have no impact on the quality of the water that remains in the river. The one exception to this is for suspended solids. Any suspended solids will tend to be filtered out as the diverted water passes into the streambed. These solids will then tend to be resuspended in the flow, which will increase suspended sediment concentrations slightly.

Figure 4–25 Median Pool Area by Month, Cheney Reservoir

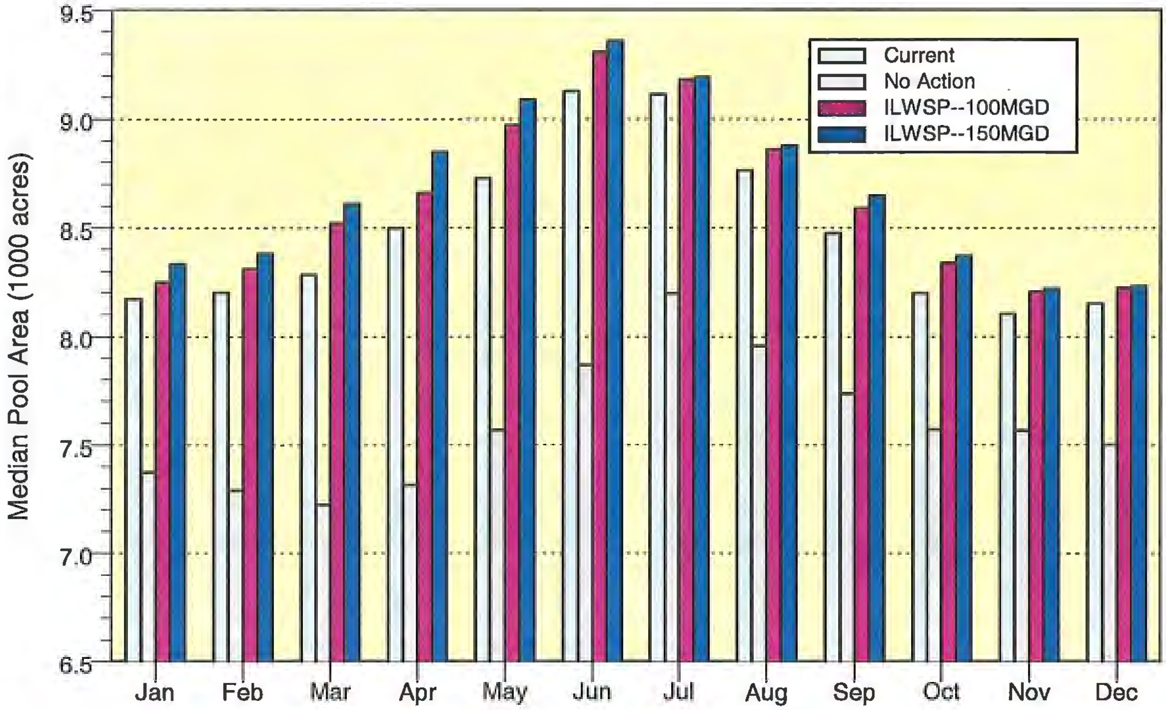
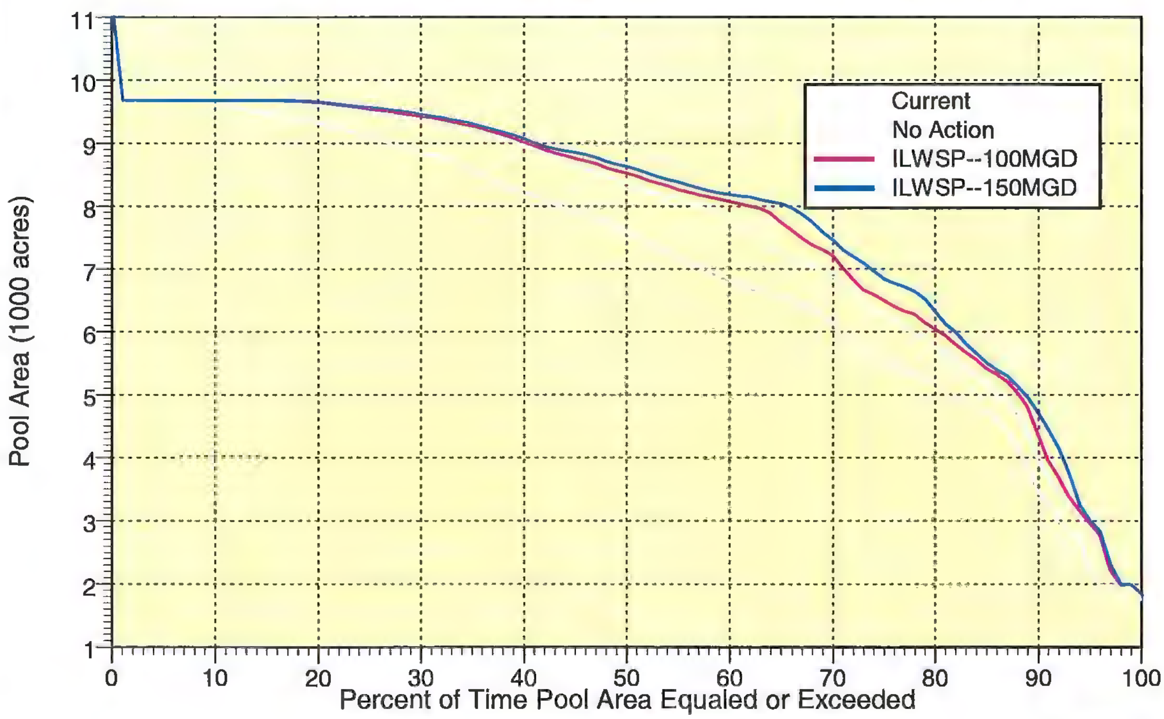


Figure 4–26 Pool Area Durations, Cheney Reservoir



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However, this resuspension may not occur until the next higher flow event when suspended sediment concentrations tend to rise anyway.

Streamflow directly removed from the Little Arkansas River will need to be chemically treated prior to being recharged to the Equus Beds aquifer. Water quality samples taken and analyzed through a cooperative effort by the City and the USGS indicate that turbidity and the herbicide atrazine are the constituents that need to be removed from Little Arkansas River water prior to recharge into the Equus Beds aquifer. The study examined the atrazine concentrations in the Little Arkansas River water near Halstead and Sedgwick, Kansas.

The State of Kansas has adopted EPA's Maximum Contaminant Level (MCL) of 3 micrograms per liter (μg/l) for atrazine as calculated on an annual mean basis. Annual mean atrazine concentrations in the Little Arkansas River did not exceed the MCL for atrazine and annual mean concentrations ranged between 0.90 and 2.6 μg/l. No other herbicides or pollutants occurred in the Little Arkansas River in concentrations that would have required treatment.

A polymer will be used to remove turbidity from waters directly diverted from the river. In addition, powder activated carbon (PAC) may also be required seasonally to remove atrazine or other herbicides. In general, PAC will only by necessary during a 15- to 40-day period in the May through July period when atrazine concentrations in higher flow runoff events are relatively large. Chorine can also be added to control biological activity prior to recharge into the Equus Beds aquifer.

4.4.1.4.2 Arkansas River

From a water quality perspective, the Arkansas River will experience few changes under the No-action alternative. Above Wichita, the only differences in the flow regime will be increased infiltration losses to the Equus Beds aquifer due to declining aquifer water levels. As discussed above for the Little Arkansas River, withdrawals by infiltration will impact only suspended sediment concentrations. Since the infiltration rate is generally much less than the total discharge in the Arkansas River, these potential changes in suspended sediment concentration will be insignificant.

In Wichita and below, water quality impacts to the Arkansas River will result only from changes in the quantity and quality of water that enters it from the Little Arkansas River. This water will tend to be slightly lower in quantity and have slightly higher concentrations of water quality parameters, resulting in similar changes to the Arkansas River.

The ILWSP includes redevelopment of the Bentley Reserve Well Field. This well field straddles the Arkansas River above Wichita and will withdraw water from the river via induced infiltration. At least partially offsetting these withdrawals will be decreasing infiltration losses to the Equus Beds aquifer. Any water quality impacts above Wichita will be fairly insignificant and similar to those discussed above for the No-action alternative.

The most significant water quality impacts to the Arkansas River will occur in and downstream of Wichita. Water will be diverted from the Little Arkansas River at several places for aquifer recharge and direct usage under the ILWSP. While these diversions will only occur when the flow in the Little Arkansas River is above baseflow, they will still reduce the quantity of better-quality water that is available for dilution of the Arkansas River.

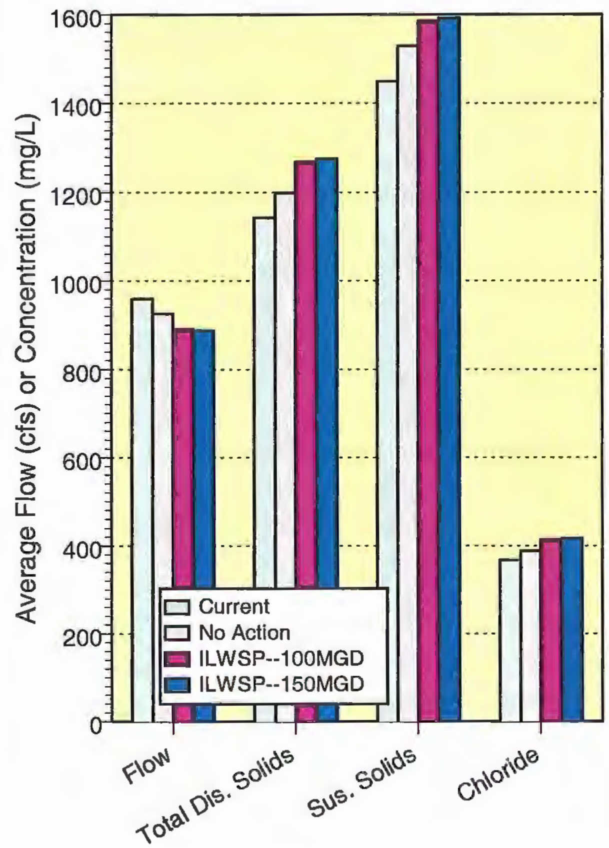
Using long-term averages for discharge and water quality parameters, a simple mass balance was used to model potential water quality impacts in the Arkansas River at Wichita. The results of this mass balance model are shown in Figure 4–27 for flow, and the concentrations of total dissolved solids, suspended solids and chloride. As compared to the No-action alternative, Figure 4–27 indicates the following changes with implementation of the ILWSP:

- Average flow will decrease by about 4 percent
- Average total dissolved solids concentrations will increase by about 6 percent
- Average suspended sediment concentrations will increase by about 4 percent
- Average chloride concentrations will increase by about 7 percent

On a relative basis, these predicted changes in the water quality of the Arkansas River are not considered very significant.

4.4.1.4.3 Ninnescah River
Predicted changes in the flow regime of the Ninnescah River and its tributaries are modest under the No-action alternative and with development of either ILWSP alternative. For this reason, any water quality impacts will be similarly modest.

Figure 4–27
Estimated Water Quality Impacts
Arkansas River at Wichita



The least attractive alternative, with respect to the North Fork below Cheney Reservoir and the mainstem of the Ninnescah River, is the No-action alternative. As discussed in Section 4.3.1.2.3 above, releases from Cheney Reservoir will decline under the No-action alternative. This will provide somewhat less water for dilution downstream although there do not appear to be major differences in the water quality of North Fork above Cheney Reservoir as compared to points downstream on the mainstem.

Development of the ILWSP will increase the frequency of releases from Cheney

Reservoir, both as compared to current conditions and the No-action alternative. These additional releases are expected to have a neutral or positive impact on water quality.

4.4.1.4.4 Cheney Reservoir

As discussed earlier, the State of Kansas has designated Cheney Reservoir as water quality impaired due to eutrophication and siltation under the Clean Water Act, Section 303(d). None of the proposed development scenarios or alternatives include modifications to the watershed above Cheney Reservoir. Therefore, the mass loading of any water quality constituents to the reservoir due to ILWSP implementation will remain unchanged as well. As shown in the operations model, water quantity moving through the total system with the ILWSP in place should generally increase, thereby potentially lowering nutrient and organic concentrations and possibly decreasing turbidity that could result with more stable reservoir water levels. Also, the frequency of reservoir releases should increase, providing more opportunity for moving or flushing these constituents through the reservoir. Any changes in constituent concentrations will be modest and result only because of changing water levels in the reservoir. Generally, the amount of water stored in Cheney Reservoir, and that available for dilution of incoming constituents, will be least under the No-action alternative and greatest with implementation of the ILWSP. Therefore, water quality impacts in Cheney Reservoir, while modest, are expected to be generally positive with development of the ILWSP.

4.4.2 GROUNDWATER

Groundwater is a very important resource within the ILWSP project area. It is used to supply water for municipal, industrial, agricultural, domestic and live stock uses. Potential impacts to groundwater levels and quality in the project area are discussed in the following paragraphs.

4.4.2.1 Groundwater Levels

Prior to 1940, there was little use made of groundwater within the ILWSP project area except for domestic use and stock watering. Consequently, groundwater levels were near the surface in many areas. Since this time, the City of Wichita, other municipalities, industries and irrigators have extensively developed the existing groundwater supplies. The amount of natural recharge to area aquifers is a direct function of precipitation while groundwater withdrawals are inversely related to precipitation amounts. That is, natural recharge is higher and withdrawals less during wet years. The annual withdrawal of groundwater by the various entities has exceeded the natural recharge to the underlying aquifers in many years so groundwater levels have declined dramatically in some areas. The following sections discuss potential impacts to groundwater sources in the project area.

4.4.2.1.1 Equus Beds Aquifer

The Equus Beds Well Field is, and will continue to be, one of the City's principal water sources. Without development of the proposed ASR system, the amount of water withdrawn by the City, irrigators and others will generally cause aquifer water levels to decline further in the future and water quality to degrade by increased in-flow from the Arkansas River. Figure 4–28 shows simulated storage deficits in the Equus Beds aquifer for each of the scenarios.[5] Review of this figure shows that under the No- action alternative, storage deficits are potentially much larger than any of the other alternatives. Maximum storage deficits for current conditions and ILWSP alternatives, which occur during an extreme 1930's-type drought, are nearly equal. However, development of the ASR system will significantly improve the rate that aquifer storage is replenished after a major drought. Storage deficit durations for the Equus Beds aquifer are shown in Figure 4–29. The duration curves in this figure dramatically show the benefits of the ASR component of the proposed ILWSP. Under the No-action alternative, the amount of water stored in the aquifer will be drawn down significantly from current levels resulting in lower water levels and increased poor quality water entering from the Arkansas River. In contrast, development of either ILWSP alternative will help replenish aquifer storage quickly following drought events. Approximately half of the time, aquifer storage can be kept within 100,000 acre-feet of pre-development conditions.

Storage deficits and water levels in the Equus Beds aquifer also impacts the amount of water exchanged between the aquifer and area streams. Figure 4–30 contains duration curves that show how these exchange rates may vary between development alternatives. Infiltration losses from the Arkansas River to the Equus Beds aquifer are represented in Figure 4–30(a). As shown in this figure, infiltration into the Equus Beds is consistently 20 to 30 cfs higher under the No-action alternative than for current conditions, and 20 to 50 cfs higher than either ILWSP alternative. Before extensive development of groundwater resources in the area, the Arkansas River and the Equus Beds were in near equilibrium (that is, infiltration rates were near zero). Due to the elevated chloride content of the Arkansas River, this infiltration is considered undesirable even though it serves as a source of aquifer recharge.

Figure 4–30(b) shows the durations for discharge from the aquifer to the Little Arkansas River. This groundwater discharge is the source of baseflow in the Little Arkansas River and is vital to the maintenance of the river's ecosystem. These groundwater discharges will be the lowest under the No-action alternative, near zero much of the time, and only slightly better under current conditions. With the additional aquifer recharge provided under the ILWSP alternatives, median groundwater discharges will be more than 20 cfs higher.

As shown in Figure 4-28, the amount of water stored in the Equus Beds aquifer will fluctuate significantly over time due to changing climatic conditions, even with implementation of the ILWSP. For this reason, it is not possible to accurately estimate how long it may take to replenish the current storage deficits in aquifer after installation of the ASR system. From the operations model, the average net recharge rates of the Equus Beds aquifer for the 100 MGD and 150 MGD alternatives are 12,700 and 15,200 acre-feet per year, respectively. With a current storage deficit of approximately 250,000 acre-feet, this initial replenishment is expected to take 21 years for the 100 MGD alternative and

[5] Storage deficits are defined as the change in total aquifer storage from pre-development conditions.

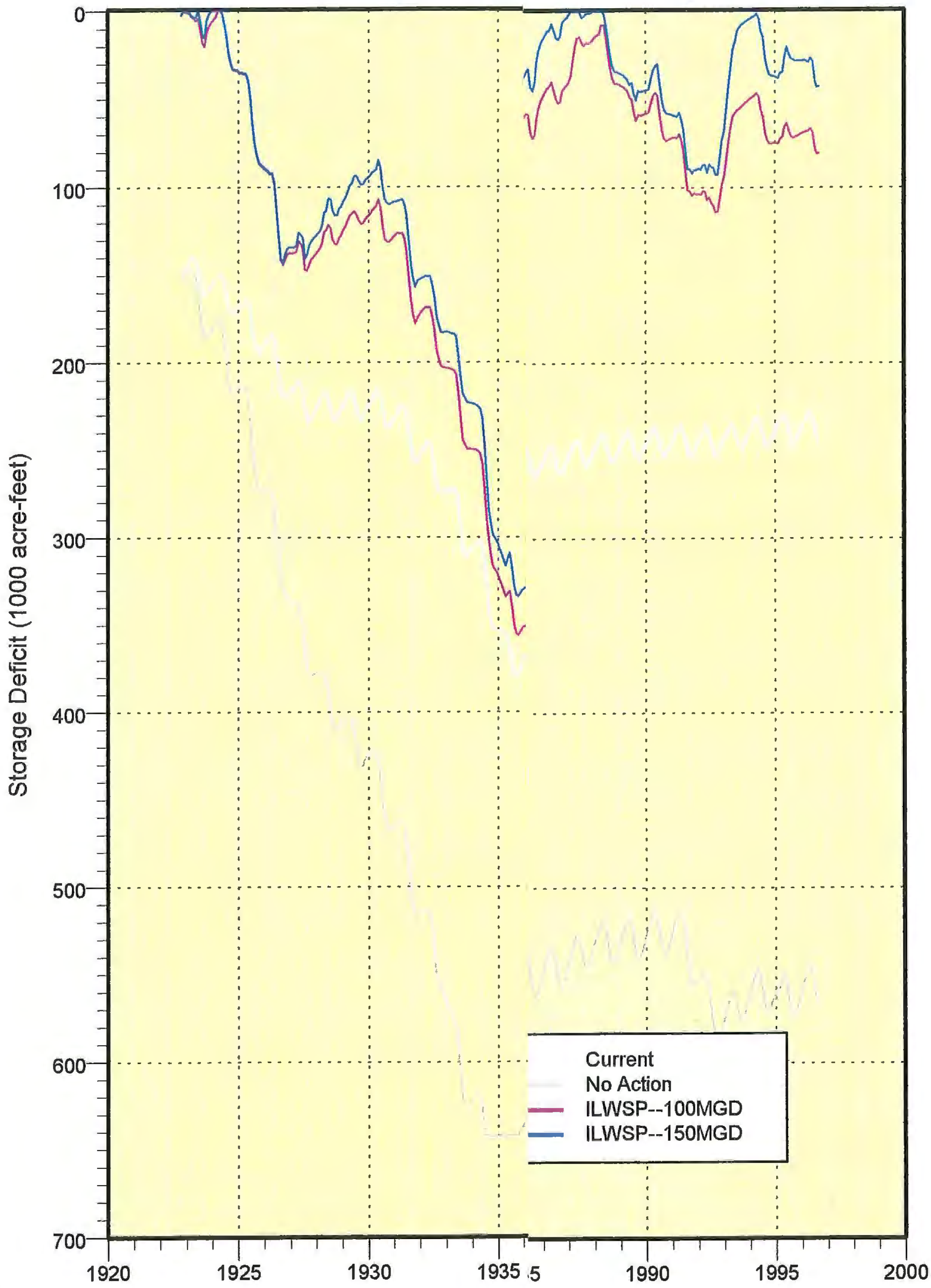
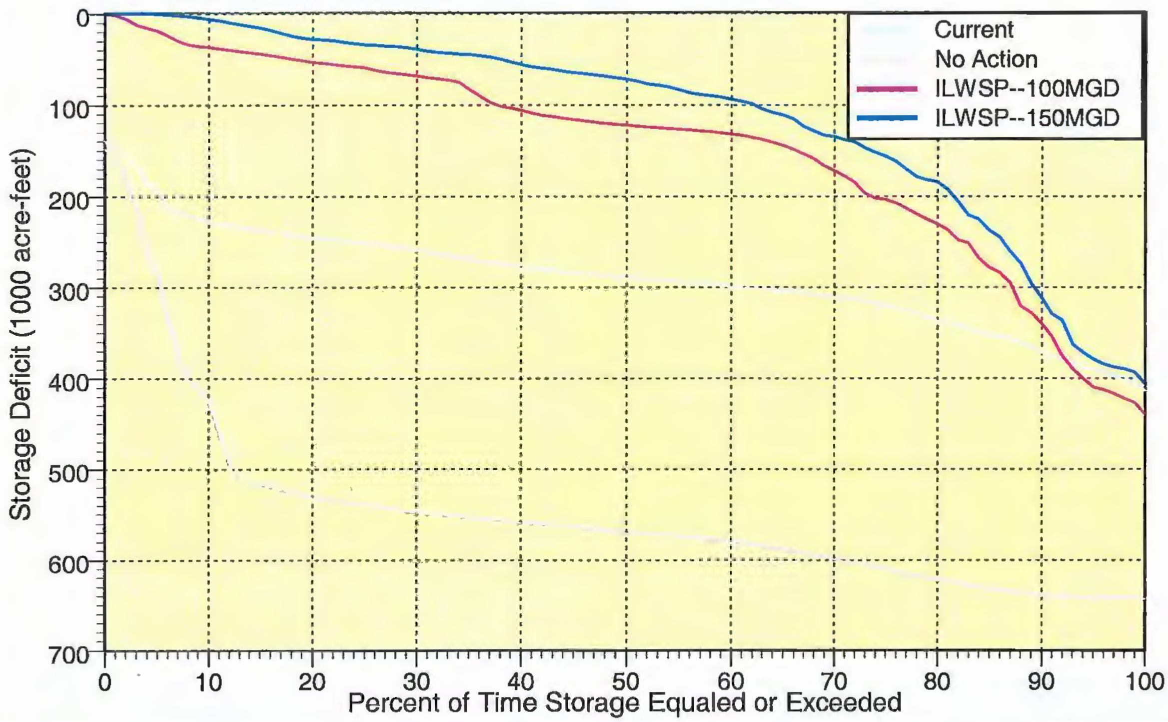

Storage Deficit (1000 acre-feet)
0
100
200
300
400
500
600
700
1920
1925
1930
1935
5
1990
1995
2000
Current
No Action
ILWSP--100MGD
ILWSP--150MGD

Figure 4–29 Storage Deficit Durations, Equus Beds Aquifer



nearly 18 years for the 150 MGD alternative.

4.4.2.1.2 Little Arkansas River Alluvium

With development of the ILWSP, the water used to recharge the Equus Beds aquifer will be withdrawn from the Little Arkansas River via a series of vertical wells installed along the river. The operation of these wells will depress local groundwater levels and induce infiltration from the river. The drawdown adjacent to an operating well could be 20 to 30 ft. but these drawdowns will dissipate quickly as the distance from the well increases. At distances of a half-mile, drawdowns are likely to be less than one foot. With adjacent wells operating, which are assumed to be installed with quarter-mile spacing, drawdowns may be somewhat larger due to the combined effects from both wells.

The induced infiltration wells will be operated only when the discharge in the Little Arkansas River exceeds 40 cfs. The nominal capacity of each induced infiltration well will be about 1,000 gpm, or about 2.2 cfs. The number of wells operating concurrently will vary depending on the current flow in the Little Arkansas River. Figure 4–31 includes duration curves for aquifer recharge. As shown by these duration curves, the induced infiltration wells will be operated slightly less than half of the time, and that periods with all wells running will total from about 11 to 15 percent of the time.

Review of diversion duration curves alone does not give a complete picture of the operation of the induced infiltration wells because even though diversions may occur about half the time, operating periods are dispersed between periods of inactivity. Figure 4–32 is a graph that shows the simulated flow in the Little

Figure 4-30 Interaction Between Equus Beds Aquifer and Area Streams

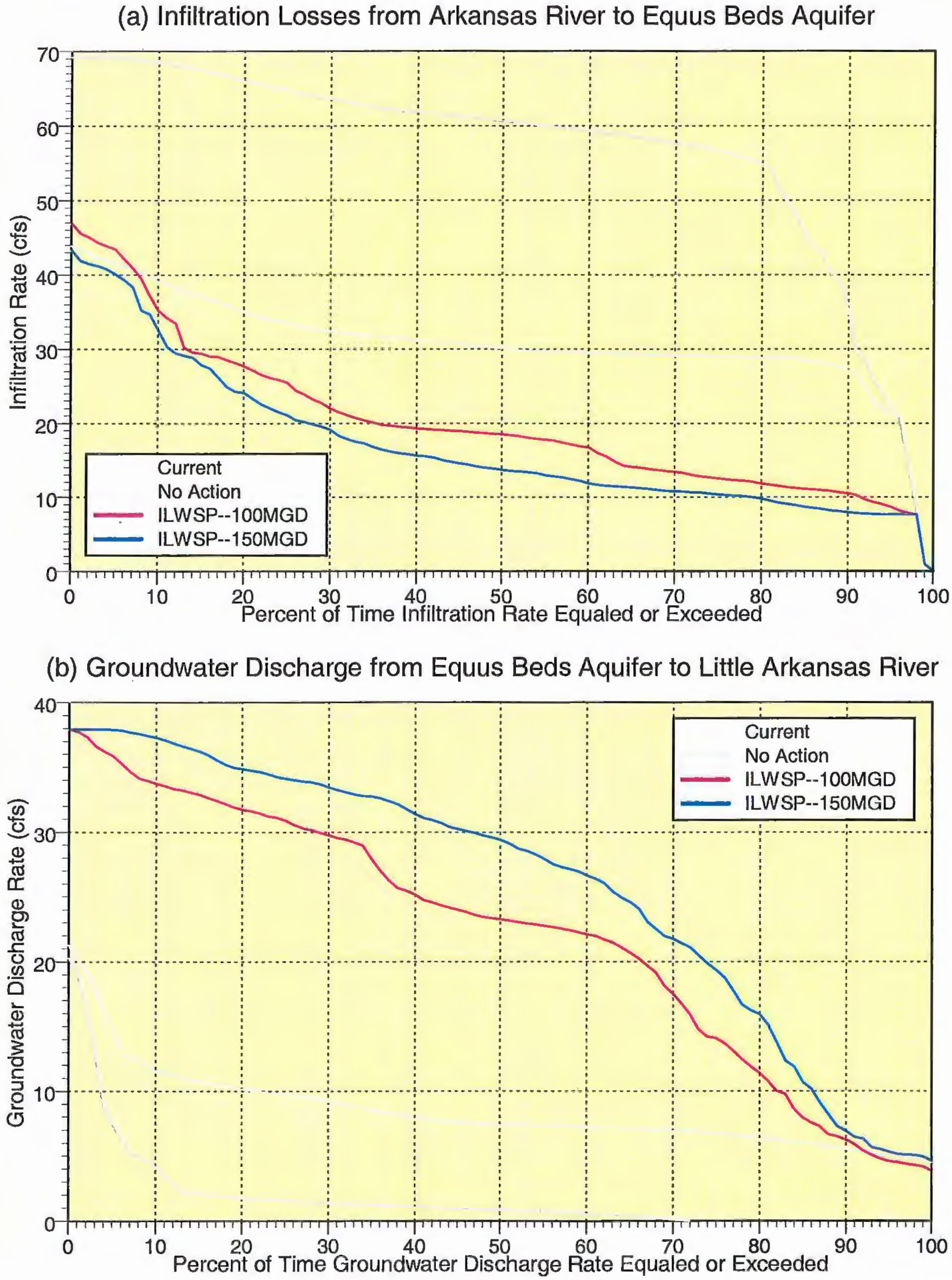


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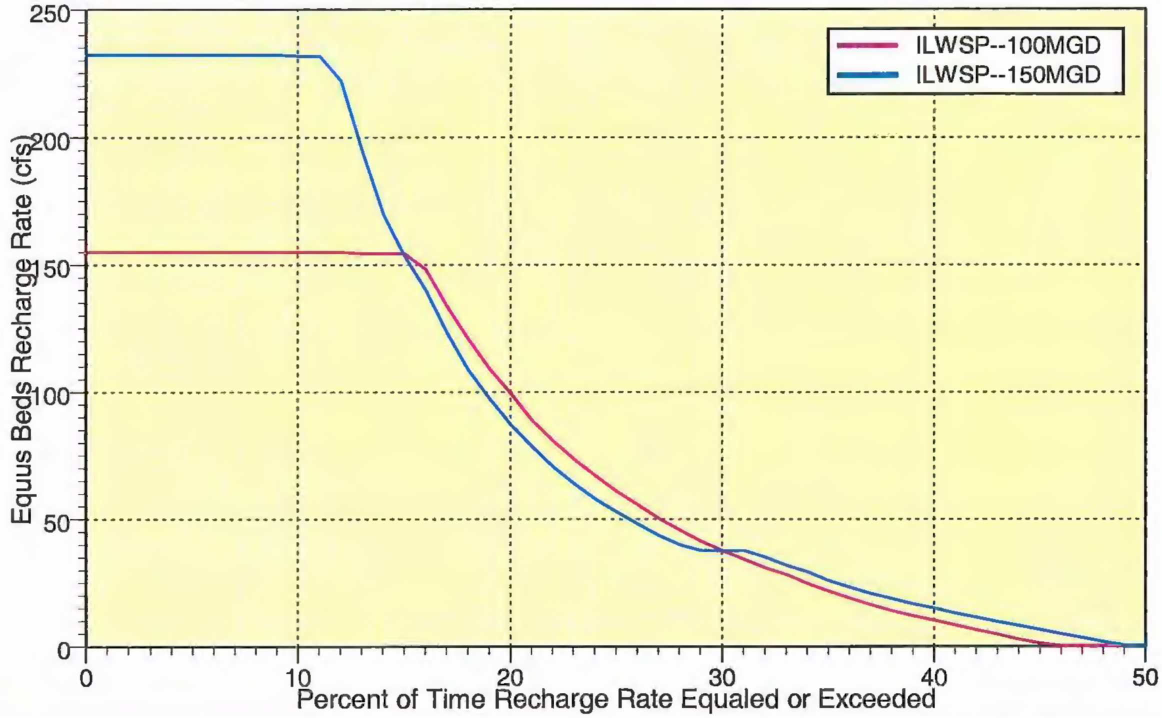
Figure 4–31 Durations of Recharge to Equus Beds Aquifer



Arkansas River at Valley Center for the current and 100 MGD ILWSP alternatives for water year 1992. This is the median water year, as ranked by total annual flow. In this chart, the flow at Valley Center for the ILWSP alternative is superimposed on the flow under current conditions. As a result, the current condition bars are only visible when there are depletions due to operation of the ASR system. Examination of this graph shows there are frequent periods when the system is not operated at all and, when it does operate, it does not usually operate continuously for long periods. In this median flow year, there were two periods when the system operated continuously for about 30 days each, with the remaining operational periods no longer than 5 days.

Groundwater levels in the Little Arkansas River alluvium will also be impacted due to development of the expanded Local Well Field. This development will consist of installation of up to four horizontal collector wells along the river within the Wichita city limits. These collector wells would be operated when the flow in the Little Arkansas River exceeds 20 cfs.

Figure 4–33, which shows the supply durations from these collector wells, indicates that these wells will operate at some capacity almost all of the time and at full capacity about 40 percent of the time.

Drawdowns in the vicinity of these collector wells will depend on a number of factors including the current pumping rate and water surface elevations in the adjacent river. With typical, non-flood flow rates in the Little Arkansas River, drawdowns adjacent to a collector well could be as high as 10 to 15 ft. when pumping at full capacity. At a half-mile from a collector well, these drawdowns

Figure 4-32 Potential Impacts in Median Flow Year for Little Arkansas River at Valley Center

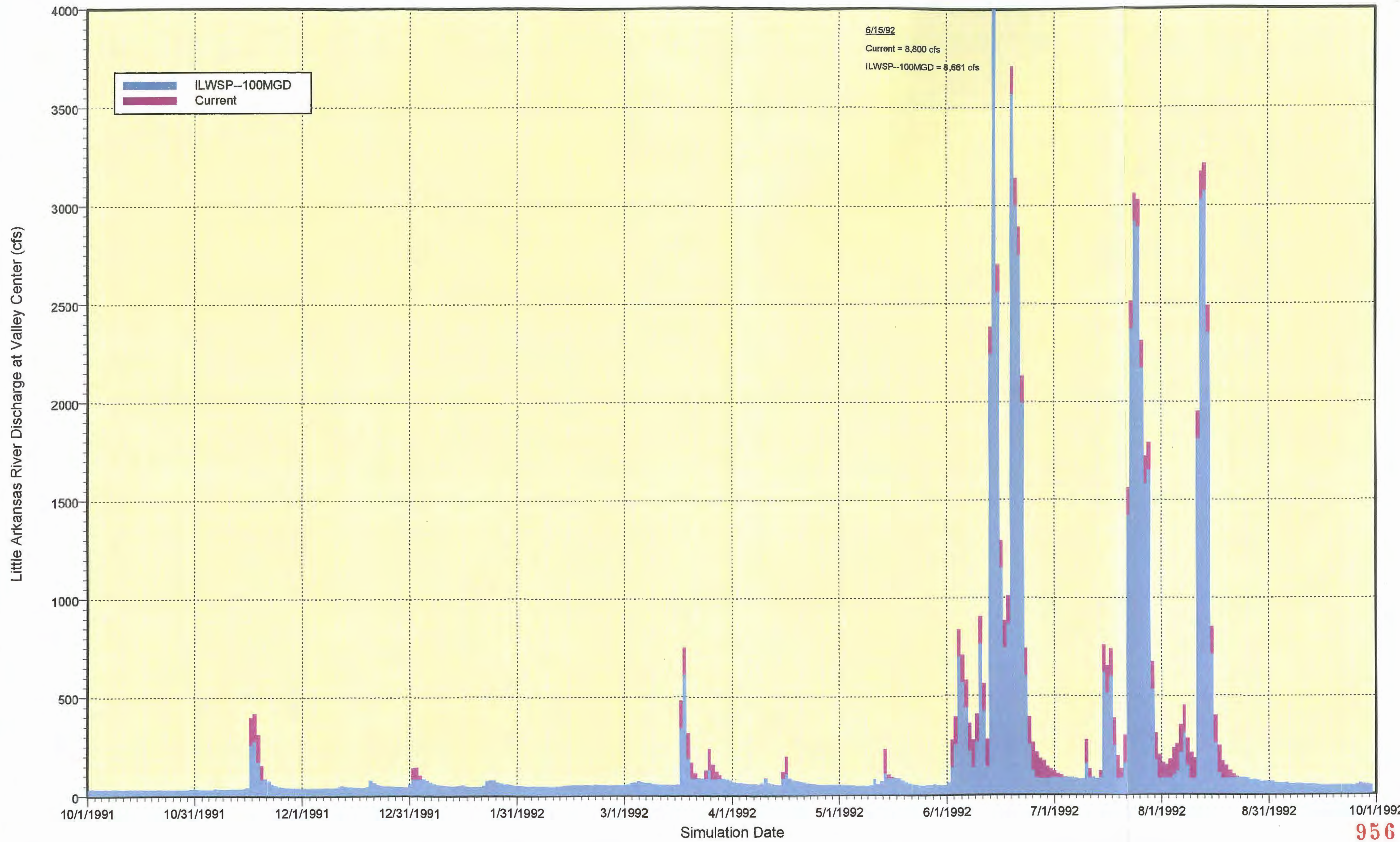
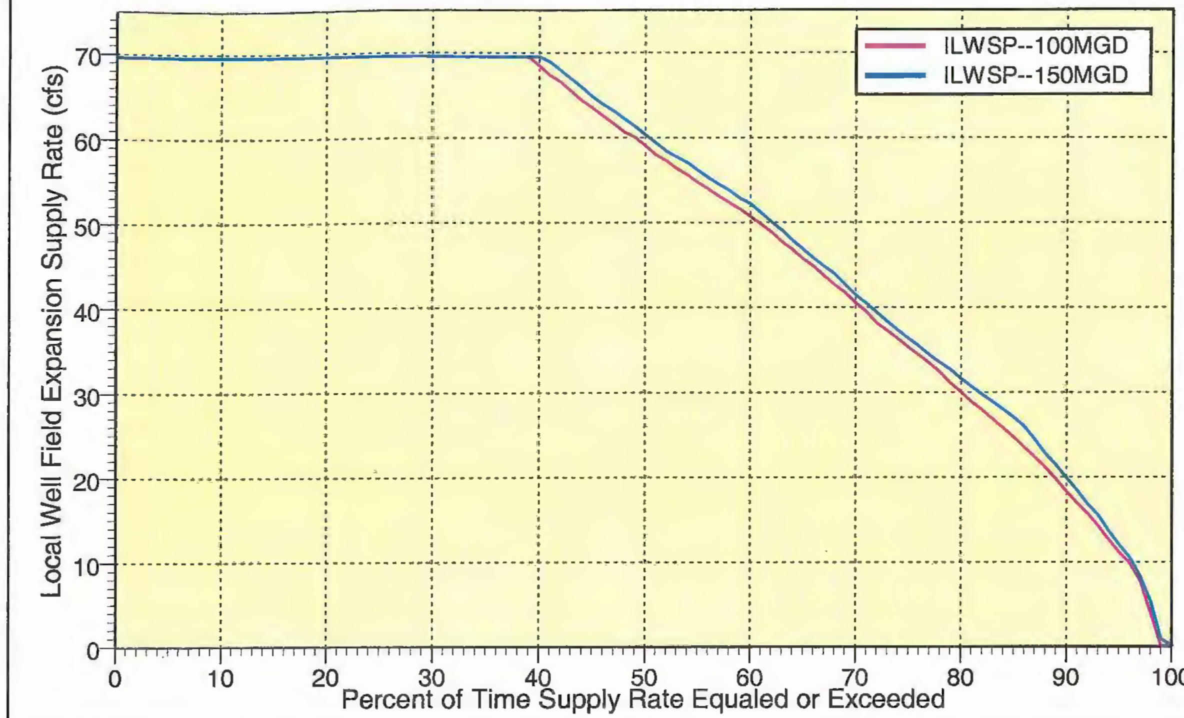


Figure 4-33 Local Well Field Expansion Supply Durations



will have decreased to about one foot. The facilities that would be constructed with the ILWSP and the Local Well Field expansion will be located to avoid impacting existing wells or other City or private facilities that could have an impact to water quality.

Some City residents have private wells that they use for irrigation of lawns and gardens. If there are any private wells in close proximity to a collector well, they could be adversely impacted but these impacts should not be significant unless these wells are quite shallow.

Operation of the induced infiltration wells or collector wells will cause local groundwater level declines that could impact riparian wetlands along the Little Arkansas River. Since these drawdowns will be relatively small and intermittent, it is difficult to predict whether any wetlands will suffer significant impacts.

Under current conditions and the No-action alternative, there will be no additional wells installed in the Little Arkansas River alluvium and, therefore, no localized groundwater impacts.

4.4.2.1.3 Arkansas River Alluvium

The Bentley Reserve Well Field straddles the Arkansas River about 10 miles northwest of Wichita. The ILWSP includes the redevelopment of this well field, which will impact groundwater levels in the Arkansas River alluvium in the immediate vicinity of the well field. Drawdowns adjacent to an operating well may approach 20 to 30 ft. but these drawdowns will decrease rapidly as the distance from the well increases. At a half-mile, drawdowns will likely be less than one foot. Also, the Bentley Reserve Well Field is intended only for peaking use, primarily during the summer months when water demands are normally highest. Therefore, any potential impacts from the operation of this well field will occur rather infrequently, on an annual basis. For the No-action alternative, this well field will not be redeveloped.

Further downstream, within the City of Wichita, is the City's existing Local Well Field.[6] The City also uses this well field for peaking use. No significant operational changes are expected for Arkansas River alluvial wells in this well field with any of the possible alternatives. As a result, no significant new impacts are anticipated.

4.4.2.2 Quality

The quality of groundwater in the project area varies greatly depending on the geologic formation it is derived from and its depth. Implementation of ILWSP alternatives for this project will primarily impact the aquifers as discussed below.

4.4.2.2.1 Equus Beds Aquifer

The quality of the water in the Equus Beds aquifer is currently quite good but is very vulnerable to future degradation, especially by salinity. There are numerous natural and man-made sources of salinity in the vicinity that could contribute to the aquifer's contamination and resulting degradation.

One source of salinity that could pollute the Equus Beds aquifer is the Arkansas River. Chloride concentrations in the Arkansas River average over 500 mg/L, about eight times the chloride content of the water produced by the City's current water supply wells. Before development of the aquifer for water supply and irrigation, the river and aquifer were nearly in equilibrium; there was little migration of chlorides from the river into the aquifer. Because of the depressed water levels found today in the aquifer, water from the Arkansas River infiltrates into the aquifer at a rate of about 25 cfs (see Figure 3–10). Using this infiltration rate and an average chloride concentration of 500 mg/L is equivalent to dumping about 170 tons of salt into the Equus Beds aquifer every day.

Under the No-action alternative, the infiltration rate and rate of salinity contamination, will increase dramatically. As shown in Figure 4–30(a), the median infiltration rate is expected to double over current conditions. However, with development of either ILWSP alternative, aquifer water levels will rebound and the infiltration rate from the Arkansas River will diminish as compared to current values.

The other potential source of chloride contamination for the Equus Beds aquifer comes from the Burrton area to the northwest. In this area, past oil field development and production have introduced large quantities of brine into the unconsolidated surficial aquifer. It has been estimated that over 90,000 tons of salt were discharged into the aquifer during the oil production period. In the immediate area surrounding Burrton, chloride concentrations over 2,000 mg/L have been discovered. Because of the existing groundwater gradient, these highly saline waters will tend to migrate southeastward into the Equus Beds Well Field area.

4.4.2.2.2 Little Arkansas River

The quality of groundwater adjacent to the Little Arkansas River is expected to closely match that of the adjacent river because of the strong hydraulic

[6] Also known as the Emergency and Sims, or E&S, well fields.

connection between the two sources. At higher river flows, water migrates into the aquifer materials and at low river flows, the process reverses.

With development of the ILWSP, a large number of wells will be installed in the aquifer material to divert water from the Little Arkansas River for recharge of the Equus Beds aquifer. When operating, these wells induce infiltration from the river, mixing river water with in-situ groundwater. With long-term pumping, the river water will replace the groundwater and discharge water quality will approach that of the river. However, since the quality of water in the Little Arkansas River is generally good, this is not considered to be a significant project impact.

Similarly, expansion of the Local Well Field by installation of horizontal collector wells along the Little Arkansas River will have the same water quality impacts as those located further upstream. The water quality in the aquifer will become nearly identical to that of the river.

4.4.2.2.3 Arkansas River Alluvium
In the Arkansas River alluvium, existing groundwater quality is similar to that of the adjacent river, again because of the strong hydraulic connection between the two. Also, the existing groundwater gradient encourages water to infiltrate into the aquifer. As a result, this groundwater tends to have high salinity making it unsuitable for irrigation and most other uses. Under the No-action alternative, the water quality of the alluvial aquifer will continue to decline but at an accelerated pace.

The proposed redevelopment of the Bentley Reserve Well Field will induce additional infiltration of water from the Arkansas River into the alluvial aquifer. This will cause the water quality of the river and the aquifer to become nearly identical in the immediate vicinity of the well field. This is not viewed as a significant adverse impact because the City would be the only entity using this water. The City is able to use this water with high salinity because it will be blended with much larger quantities of better-quality water. Therefore, the dilution effect will keep the chloride content of the water delivered to the City lower than the levels recommended under drinking water standards.

4.4.3 WATER RIGHTS
Impacts to existing and/or potential water right holders may result from the two proposed ILWSP alternatives. Additional water rights will be needed by both alternatives to meet the future water demand. Table 4-2 shows the water rights needed by water source.

Neither ILWSP alternative would make additional water available for appropriators or water users in the Equus Beds aquifer. As discussed in Chapter 3, groundwater development by municipal and agriculture water users is significantly greater than the safe yield of the Equus Beds aquifer. Therefore, most areas in the Equus Beds well field area are closed to applications for new water rights.

An exception may be in the proposed Bentley Reserve Well Field area where poor water quality has limited agricultural use. All or part of the proposed 10-MGD development may be met by development of water available under the safe yield policy.

Additional water rights for the proposed ILWSP, in connection with the Equus Beds aquifer and issued to the City, will

Table 4–2 Additional Required Water Rights

Area	Annual Quantity ac-ft	Maximum Rate of Diversion, MGD
Bentley Reserve Well Field (new water right required)	5,000	10
Expanded Local Well Field (new water right required)	35,000[1]	45
Aquifer Storage & Recovery[3]		
Source water diversion	100,000[2]	100
Storage recovery rights	depends on volume stored[4]	126

Notes:
1. Well Field will only be pumped when "excess" water is available over the minimum desired streamflow of 40 cfs.
2. Diversion will be operated only when river flows are 50 cfs.
3. The Kansas Division of Water Resources and the local groundwater management district are currently developing regulations and permitting requirements.
4. The amount in storage, available for recovery will be reviewed annually and certified by the groundwater management district.

contain criteria to ensure the existing water right holders will not be adversely impacted. These criteria will include adherence to the minimum well spacing standards so that interference drawdown due to pumping will be minimized. Additionally, diversion water rights for the Little Arkansas River will limit operation to periods of above-base flow. The minimum level of operation will include consideration of minimum desired streamflow and existing surface water rights downstream of the ASR diversion area , including the Little Arkansas River and the Arkansas River below Wichita.

Regulations for Aquifer Storage and Recovery projects, such as included in the ILWSP alternatives, are not finalized by Groundwater Management District No. 2. However, it is anticipated that water rights for the recovery of stored water will be evaluated and adjusted annually to determine the amount of water that could be recovered from each individual facility.

Benefits to be gained by current water rights holders due to the recharge element of the ILWSP alternatives include:

- higher groundwater levels which would result in lower power costs to pump water, and
- reduced migration of high-chloride water into the aquifer from the Arkansas River to the southwest and from the Burrton oil field area from the northwest.

As the aquifer is refilled, there will be increased seepage from the aquifer to the Little Arkansas River, increasing base flow. As shown in Figure 4-30(b), the median rate of groundwater discharge to the Little Arkansas River is expected to increase by about 15 cfs or more.

Additionally, there is a potential that Kisiwa Creek may regain surface flow. Changed conditions from pre-development times that may adversely influence the potential for increased return flows include:

- Channel modification – that may have been made by farming or other "improvements."
- Channel siltation that would raise the base elevation or clog the channel. Because there is currently no flow, sediment buildup is likely.
- Vegetation and phreatophyte growth.

4.5 AIR QUALITY

Criteria pollutants include lead (Pb), particulate matter of 10 microns diameter or smaller (PM_{10}), ozone (O_3), sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon monoxide (CO). Levels for these pollutants have been established to protect human health. Air quality in the counties and major cities in the project area has been classified by the U.S. Environmental Protection Agency (40 CFR 81.328).

The Equus Beds Well Field, Bentley Reserve Well Field and Cheney Reservoir associated with the alternatives are located in rural areas. The expansion of the Local Well Field is located in an urban/suburban area.

In evaluating the significance of project impacts to air quality, Prevention of Significant Deterioration (PSD) increments and significant impact levels were reviewed. Levels have been established for significant increases in certain criteria pollutants over ambient air concentrations (Table 4–3). Under these PSD levels, significant impacts to air quality would occur if these criteria are exceeded because of project activities.

The ILWSP alternatives are not expected to have any long-term impacts on local or

Table 4–3 Prevention of Significant Deterioration Increments for Air Pollutants

Pollutant	Averaging period	Significance criteria ($\mu g/m^3$)
SO_2	Annual	20
	24-hour	91
	3-hour	512
PM_{10}	Annual	17
	24-hour	30
NO_x	Annual	25

Source: 42 USC 7473(b)(2)

regional ambient air quality. If any long-term increases in fugitive dust or engine emissions from operation and maintenance activities would occur, they would be minimal.

Construction activities in the immediate vicinity of each water supply alternative would have a temporary effect on local ambient air quality. Increases in dust levels from excavation and vehicle traffic could temporarily increase PM_{10} levels. Diesel engine exhaust from construction equipment could temporarily increase NO_x, CO, and SO_2 levels. The actual decrease in ambient air quality and increase in PM_{10}, NO_x, CO, and SO_2 levels would depend on the particular construction activity being performed, the type and amount of construction equipment being used, the prevailing wind direction and speed, and the soil moisture conditions existing at the time. These pollutants could temporarily exceed PSD levels, thereby resulting in a impact to local ambient air quality.

The No-action alternative would not have any impact on ambient air quality in the project area, because no construction or operational activities would be associated with this alternative.

Several measures would be implemented to reduce or prevent significant impacts to air quality. Dust levels generated during construction would be minimized by spraying water or other approved dust control compounds on haul roads. Disturbed areas would be revegetated as soon as possible. To minimize emissions, all construction vehicles would be maintained in good working conditions. Construction contractors would be required to comply with all local, state, and federal air pollution rules.

4.6 NOISE

Construction and operation activities associated with the ILWSP alternatives could increase noise levels in the surrounding local area. Noise sources during construction would include heavy construction equipment, blasting, and increased vehicular traffic to and from the construction site. Following cessation of construction, most noise would come from operation and maintenance activities. Sensitive noise receptors such as residences, businesses, recreationists, livestock, and wildlife would likely be most impacted.

Most individuals would notice an incremental increase in noise levels. For the purposes of this analysis, the impact would be considered significant if permanent area residences were to experience an increase of 3 dBA or more above ambient noise levels. Construction equipment could cause this level to be exceeded at a residence located within 600 ft. of pipeline, well, or basin construction.

Construction activities would entail the development of vertical recharge/recovery wells on new or existing well sites. The number of wells would vary by alternative selected. A typical construction period for a vertical well would require two weeks continuous activity, followed one week later by an "acceptance test". The acceptance test would require one to three days of continuous operation. Equipment used for well construction and testing can be considered loud; however, decibel levels vary widely between various types of equipment and their condition and cannot be specified at this point. Should an ASR well and acceptance test be required in an area where residences, business, or recreational activities are nearby, noise mitigation devices, i.e., engine mufflers, etc., may be specified. Once construction is complete, well operation would be virtually noiseless; pump motors used for the wells would be electric submersible or located in buildings (pump houses) constructed for that purpose.

Construction of a horizontal collector well involves the development of a facility about 16 feet to 20 feet in diameter including the cap. The construction period is estimated to be six to nine months. The "acceptance test" would require another three to seven days of continuous operation of a test pump. For horizontal collector wells, a "direct electric feed" device may be used, reducing noise levels considerably. As with the vertical recharge/recovery wells, equipment used to construct the horizontal collector wells would use noise mitigation devices (i.e., engine mufflers, etc.), in areas where residences, business, or recreational activities are nearby.

Vehicular noise during construction of a horizontal collector well would increase due to two or three trucks delivering concrete to the site each week for five to six weeks, and an estimated 10–15 semi-trucks delivering other items anticipated for each well.

The anticipated construction period for a single recharge basin would be approximately two weeks, but total site development would probably take three to four months. During this period, drilling equipment would be in operation, along with typical heavy construction equipment. Traffic noise should be similar to that for the construction of the horizontal collector well. Once basin and site development is complete, no additional noise impact is anticipated, as basin operation emits no noise. A residential development, near one of the basins located north of the City of Bentley, is currently under consideration for potential expansion. Should temporary construction noise and activity become a concern, planners would work with residents to develop a mitigation plan.

Pipeline construction would typically involve clearing, digging a trench, laying the pipe, filling the trench, and regrading. Noise from this activity is not expected to affect any one point for more than a few days. Most of the area within the well fields would be relatively undisturbed by this type of construction.

Human activity and the noise associated with construction of the wells and associated pipelines have the potential to adversely impact area wildlife. Should increases in ambient noise result in significant redistribution or disturbance to wildlife, noise impacts would be considered significant.

With few exceptions, the areas that would be impacted by construction activities for the proposed water supply alternatives have already been disturbed by agricultural, suburban, or urban development. The use of these areas by wildlife is relatively low. Even so, the noise generated by construction activities may cause some wildlife to temporarily abandon these areas.

After construction, increased noise levels in the vicinity of the well fields would be caused by increased traffic attributable to operation and maintenance. These noise levels, however, would be intermittent and comparable with noise generated by current agricultural activities in the rural areas and local traffic within the urban or suburban areas. Impacts to wildlife due to noise are not expected to be significant.

No construction or operational activities would be associated with the No-action alternative, thus no noise impacts to either human or wildlife populations would occur.

4.7 BIOLOGICAL RESOURCES

Biological resources could be impacted by the proposed water supply alternatives by the construction of water treatment plants, pipelines, and access roads, and by changes in groundwater levels and river flows.

4.7.1 WETLANDS

Wetlands are transitional communities between aquatic and terrestrial systems and are determined by the presence of appropriate soils, plants, and hydrology. Changes to one or more of these criteria have the potential to impact the functions and values of a wetland. In the project area, wetlands are found primarily in lowland areas in the Little Arkansas River floodplain and along the edges of lakes such as Cheney Reservoir and streams. Construction activities and alteration of hydrology caused by lowering groundwater levels may not impact wetlands associated with the Little Arkansas River and its tributaries.

To understand the potential for impacts caused by construction and operation of the proposed project, wetlands were identified using the National Wetland Inventory maps (NWI) near each water supply alternative. The NWI maps were used to determine the extent and type of wetlands that could be impacted by the project. Possible impacts to wetlands by the horizontal collector wells near the Wichita Flood Canal and proposed wells along the Little Arkansas River were evaluated. The impacts were evaluated by comparing the distribution of wetlands on and around the canal and river to existing depth to groundwater and the maximum groundwater level drawdown caused by the proposed pumping scenarios.

Saturated soils within the upper one-foot for an extended duration is essential for the development and maintenance of wetlands. If extended periods of pumping groundwater were to occur in an otherwise stable groundwater table, wetland functions and values may be impacted.

The proposed horizontal collector wells and Equus Beds ASR wells may not draw down the groundwater table, if the pumping period is not sustained. Significant impacts could occur if the source of the wetland's hydrology is not maintained by groundwater.

To assess the connection between groundwater and wetland areas, the depth to groundwater at each site was determined using a groundwater level map prepared from historic monitoring well data. The resulting depth to groundwater is assumed to represent average conditions.

Detailed groundwater modeling has been done for the Equus Beds Well Field and along the Little Arkansas River. The criteria for assessing possible wetland impacts included a qualitative determination of the drawdown and the capture zone in the vicinity of the well field and river. These levels were determined based on the Little Arkansas River flowing at a rate of 20 cfs or greater. The semi-confined nature of the aquifer would tend to reduce the areal extent of the drawdown but increase the depth of the drawdown.

The proposed construction of transmission pipelines and access roads could cross wetlands located in the vicinity of the proposed recharge area north of Wichita. These wetlands, however, would be impacted only temporarily. For transmission pipelines, wetlands were considered to be lost within the 50-foot wide permanent easement and temporarily disturbed within an additional 50-foot wide construction easement. Pipelines within the well fields were considered to temporarily disturb wetlands within a 50-foot wide construction zone. Access roads would be planned to avoid wetlands, if possible. In the event that access roads could not avoid wetlands, the impact would be permanent. The access road width would be approximately 20 ft. Based on spot observations, wetlands were assumed to exist along the banks of all streams and river channels that would be crossed by pipelines, even if no wetlands were shown on the NWI maps.

Wetlands and aquatic beds are afforded an extra measure of protection under the Clean Water Act. Any unavoidable loss to these special aquatic sites would be a significant impact.

The proposed construction of transmission pipelines from the horizontal collector wells and the Equus Beds Well Field to the recharge areas to the north will have temporary wetlands impacts at Kisiwa Creek and the North Branch of Kisiwa Creek. The transmission pipelines will cross the creeks in 17 locations. Approximately 0.50 acre of temporary impacts to emergent wetlands will occur at each of the creek crossings.

Based on City monitoring wells, the average annual groundwater elevation in the areas around the Sedgwick and Harvey county well fields is 1305 feet. The highest groundwater elevations occurred in the winter and spring months. The lowest groundwater elevations occurred in the summer and fall months. Fluctuations in groundwater elevation are caused by changes in Little Arkansas River water levels, by the operation of local irrigation wells and the City's water wells.

Currently, floodway wetlands adjacent to the proposed horizontal collector wells receive surface water and groundwater as sources of hydrology. The floodway wetland hydrology is dynamic, based on a review of local groundwater monitoring well data. Another intermittent source of surface water occurs as run-off from surrounding areas during significant precipitation events. The wetland hydrology can range in depth from 1 foot above ground surface to saturated soils 1 foot below, during normal conditions. The well field, pumping at a rate of 45 MGD (8 MGD per individual collector well) when the water in the floodway is flowing at greater than 20 cfs, may not cause an adverse effect. The steady state groundwater modeling results show decreased groundwater levels within the floodway wetland area. The decrease in groundwater levels would not be visible because of the 20 cfs surface water flow in the floodway and the pumping rates would not be sustained for a sufficient period of time to de-water the floodway wetlands. Groundwater levels would lower if the pumping periods were sustained for long periods of time, especially when flow rates in the floodway are less than 20 cfs. These decreased groundwater levels should not be obtained, because the proposed withdrawal rates will not be sustained for sufficient periods of time to de-water the floodway wetlands. Significantly decreased groundwater levels would occur if the pumping periods in the well fields were sustained for long periods of time, especially during low flow periods.

The City recognizes the discussions of wetland impacts are rather generic. As a result, a generic comparison of impacts can be made. However, specifically identifying how many acres wetlands would be impacted during construction or operation is not possible at this time nor included in this EIS since project facilities have not been located on the ground. Possible operational environmental impacts are further complicated by establishment of the final conditions under which some of the ILWSP components will be "turned on" and the frequency, duration and intensity with which the project will actually be operated.

As a potential project benefit, increased groundwater levels in the Equus Beds Well Field area may restore some wetland areas that have been dry in recent decades. Therefore, the net impacts to wetlands due to this project are not expected to be significant and could be positive.

4.7.2 VEGETATION

Permanent and temporary impacts to vegetation would result from implementation of either of the water supply alternatives. Existing vegetation would be permanently lost or altered at the sites of new wells, basins, pre-sedimentation plant and access road, or the new surface water intake. Construction of pipelines would temporarily and permanently disturb additional areas of existing vegetation.

Vegetation communities at each water supply location were assessed using topographic maps and aerial photos. For transmission pipelines, half of the acres disturbed inside the 100-foot wide construction easement in forested areas were assumed to be permanently altered for maintenance of the right-of-way. Each well was estimated to cause temporary loss of 1.5 acres of vegetation. The significance of the impacts of the proposed water supply alternatives on vegetation communities was determined by evaluating the overall quality of the habitat, regional abundance, importance to wildlife, and permanence of the impact. Significant impacts would occur if the vegetation loss was permanent, of high value to wildlife, and relatively scarce in the surrounding area.

Most of the areas that would be disturbed by the project contain vegetation communities that have already been greatly altered by human activity for agriculture or urban and suburban development.

The Equus Bed Well field ASR facilities for each alternative cover approximately 900 to 1,200 acres of land which is now predominantly used for agriculture (Table 4–4). This type of vegetation community, with its extremely low plant species diversity, has relatively little value to wildlife and is one of the dominant land covers in Harvey and Sedgwick counties. The vegetation at the ASR sites would be converted to buildings and settling ponds. The permanent loss of 266 to 360 acres, depending on which option is chosen, would not significantly impact area vegetation since the lost acreage is characterized in small parcels scattered over a large area. Table 4–4 provides the amount of acreage disturbed and lost for each alternative and option.

Most of the impacts to vegetation from these alternatives are temporary and impact agricultural vegetation. The permanent impacts to existing natural vegetation are relatively small. Overall, no significant impacts to vegetation would occur as a result of the ILWSP alternatives.

If a new water supply is not built, the availability of water for the maintenance of landscaping will decrease. This could spur a decrease in the amount of traditional grass yards and landscaping. Water provided by the City is not used for the irrigation of croplands or the maintenance of natural vegetation. However, local farmers use the Equus Beds aquifer for cropland irrigation during dry periods. The No-action alternative would impact agricultural resources; without recharge to the aquifer, water levels would decrease along with water quality thus making the water unusable and/or unavailable for irrigation. The loss of irrigation on farmland would reduce crop yields and lower property values.

No mitigation is proposed for the impacts to vegetation resources caused by the proposed project.

Table 4-4 Summary of Impact to Vegetation

ILWSP 150 MGD Alternative	60/90 Option		75/75 Option		100/50 Option		Local Well Field Option 1		Local Well Field Option 2	
	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)
Diversion wells and associated access road along the Little Arkansas River	180	124	250	170	330	200	NA	NA	NA	NA
Recharge of induced infiltration water through recharge wells, recharge basins, and associated pipeline	500	39	550	50	650	40	NA	NA	NA	NA
New surface water intake, presedimentation plant, recharge basins, and associated pipeline	160	132	160	110	170	80	NA	NA	NA	NA
Pipeline from presedimentation plant to existing City of Wichita treatment facilities	40	0	30	0	40	0	NA	NA	NA	NA
Projected additional recovery wells	0	50	0	30	0	20	NA	NA	NA	NA
Horizontal collector and vertical wells and associated pipeline	NA	NA	NA	NA	NA	NA	94	5.25	85	5.25
TOTAL	**880**	**345**	**990**	**360**	**1190**	**340**	**94**	**5.25**	**85**	**5.25**

ILWSP 100 MGD Alternative	60/40 Option		75/25 Option		100/0 Option		Local Well Field Option 1		Local Well Field Option 2	
	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)
Diversion wells and associated access road along the Little Arkansas River	180	124	250	170	330	220	NA	NA	NA	NA
Recharge of induced infiltration water through recharge wells, recharge basins, and associated pipeline	500	39	580	50	750	60	NA	NA	NA	NA
New surface water intake, presedimentation plant, recharge basins, and associated pipeline	150	53	180	40	70	10	NA	NA	NA	NA
Pipeline from presedimentation plant to existing City of Wichita treatment facilities	40	0	40	0	0	0	NA	NA	NA	NA
Projected additional recovery wells	0	50	0	30	0	20	NA	NA	NA	NA
Horizontal collector and vertical wells and associated pipeline	NA	NA	NA	NA	NA	NA	94	5.25	85	5.25
TOTAL	**870**	**266**	**1050**	**290**	**1150**	**310**	**94**	**5.25**	**85**	**5.25**

4.7.3 WILDLIFE

In this discussion, wildlife is considered to be the more common species of mammals, birds, reptiles, amphibians, and fish that occur in the project area. The principal impacts of this project on wildlife would be a temporary disturbance during construction and the loss of habitat. Impacts to endangered, threatened, or rare species are discussed in Section 4.7.4.

Impacts on terrestrial wildlife were evaluated based on the quantity, quality, and scarcity of the habitats temporarily disturbed by or lost to construction. Impacts would be significant if high quality, relatively rare wildlife habitat is lost.

The drawdown in the groundwater caused by the well field could de-water some wetlands and displace mammals such as beaver and muskrat; birds such as egrets, herons, killdeer, redwing blackbird, teal, and mallards; amphibians and numerous species of frogs and toads. Wetlands are a relatively rare and valuable habitat for wildlife and their unavoidable loss or alteration would be a significant impact.

As discussed in Section 4.4.1.2.1, withdrawal of water from the Little Arkansas River for recharge would reduce flow; however, these reductions will occur only when the flow in the river exceeds 40 cfs. Compared to the No-action alternative, implementation of the ILWSP will actually increase the median flow in the Little Arkansas River by about 10 cfs in every month except May and June. During May and June, the median flow would decrease from 4 to 18 cfs. These two months have the highest historic median flow and therefore are the months when the recharge system is expected to operate more frequently and at higher diversion rates. Correspondingly, median water levels will also increase most months, by approximately 0.1 foot. In May and June, median water levels will decrease by about 0.15 and 0.25 feet, respectively.

Since there are no minimum release requirements from Cheney Reservoir, the flow in the North Fork of the Ninnescah River below the dam is zero, or near zero, much of the time. However, implementation of the ILWSP will actually increase the frequency of discharges every month as compared to the No-action alternative (see Section 4.3.1.2.3). Therefore, the impacts to fish and aquatic species living in this reach of the North Fork should be positive as well.

The disturbances to wildlife caused by construction of the transmission pipelines would be primarily temporary. Some woodland habitat would be lost for the maintenance of pipeline rights-of-way. These corridors would fragment some existing tracts of woodlands. However, these corridors are probably not wide enough to create barriers to movement for most species of forest dwelling wildlife. The original forests in the project area have been highly fragmented and reduced primarily to locations, such as stream channels, that are too steep for agricultural purposes. These patches are generally of low value to true forest dwelling wildlife because they have a high edge to area ratio. Overall, a pipeline corridor through this type of woodland would not significantly impact terrestrial or aquatic wildlife.

Power lines may adversely impact area wildlife. The greatest potential impact of power lines to wildlife is electrocution of raptors and collision with large migrating birds such as cranes. Raptors are attracted to power lines and towers because they are suitable perches for hunting, resting, feeding and territorial defense. When electric conductors and ground wires are close enough together, raptors can simultaneously touch them, causing electrocution. Construction of power lines will be such that the spacing between phase conductors is a wide enough distance to prevent phase to phase electrocution.

The City recognizes the discussion of wildlife and impacts to associated habitat are rather generic. As a result, a generic comparison of impacts can be made. However, specifically identifying how many species or acres of associated habitat would be impacted during construction or operation is not possible at this time nor included in this EIS since project facilities have not been located on the ground. Possible operational environmental impacts are further complicated by establishment of the final conditions under which some of the ILWSP components will be "turned on" and the frequency, duration and intensity with which the project will actually be operated.

The No-action alternative would not require any construction activities and would not change existing wildlife habitats. Therefore, the No-action alternative would have no impacts on local wildlife.

4.7.4 THREATENED, ENDANGERED, OR CANDIDATE SPECIES

Nine federally threatened, endangered, or candidate species were identified by the FWS as potentially being impacted by this project. Since contacting FWS, one of these species, the peregrine falcon, has been delisted due to its recovery and is therefore not included in the following discussion.

The remaining eight species either occur or historically occurred near or within the project's study area. Species common to the area but not threatened or endangered will be similarly impacted by the project. However, listed species are of special concern because their declining populations make impacts more critical. Following is a discussion how the alternatives (the ILWSP 100 MGD and 150 MGD) may impact each species.

4.7.4.1 General Impacts

The ILWSP alternatives include several components that could impact the environment in different ways. Drawing additional water from the flood pool of Cheney Reservoir will alter the flow released to the North Fork of the Ninnescah River downstream from the reservoir. However, this river has already been impacted by reservoir flow regulations and the species inhabiting it have adapted. Habitats available in the North Fork of the Ninnescah have been developed and maintained by reservoir flow regulations and alterations. The amount of additional water withdrawn from the reservoir is not expected to be sufficient to significantly impact those species that have adapted to prior alterations.

An In-stream Flow Incremental Modeling (IFIM) study was completed on the Little Arkansas River in 1996, 1997, and 1998 and the North Fork of the Ninnescah in 1997 and 1998 (Burns & McDonnell 1999, 2000). The studies were designed to help identify potential impacts resulting from withdrawal of above-base flows from the river. The optimum discharges for maximum available habitat and the peak-modeled flow fell far below historic recorded peak flows for all investigated species. The proposed project would result in a maximum removal of approximately 325 cfs from the Little Arkansas River, reducing high flows by approximately 5 percent through surface diversions. These diversions will only occur on an "as available" basis from above-base flows and will be regulated by the Kansas Division of Water Resources to limit the total, annual average and maximum withdrawal. The model indicated that optimum discharges and resulting maximum available habitat for fish species in the Little Arkansas River will still be easily reached even with the planned removal of above-base flow. Thus, the critical threshold for a given fish species in terms of its habitat and presence or absence in the river will not be approached.

If the above-base water from the Little Arkansas River is transferred into the Equus Beds aquifer, the hydrologic character of the overlying surface features such as wetlands could be altered over the long-term. Impacts from recharging the aquifer would likely be more beneficial than detrimental. Overall, there will be a short-term reduction in stream flow during moderate-flow events, but these alternatives have the potential to increase base-flow over several years resulting from the aquifer recharge.

Construction of well fields, pipelines, access roads, and sedimentation structures could result in a loss of available habitat for some species and a temporary disturbance to their normal activities resulting from construction noise and human activity. These facilities will be installed outside the riparian area along the Little Arkansas River and generally within agricultural cropland or pastures.

4.7.4.2 Interior Least Tern

The loss of natural nesting habitat due to river channelization, irrigation, and construction of reservoirs and pools has caused declines in the population of interior least tern and many other shorebirds. The unpredictability of flows released from dams further impacts wetland species. High flow periods may extend into the nesting season and inundate potential shorebird nesting areas, forcing birds to utilize poor quality areas for nesting. Feeding areas may also be dewatered and nests flooded from dam discharges. The storage of flows in reservoirs also allows encroachment of vegetation into areas naturally scoured by river flows and reduces channel width. Sediment loads in reservoirs cause further degradation of the riverbed downstream and reduce available shoreline habitat. In addition, the least tern is sensitive to human disturbance. These birds will not nest in areas with frequent human activity, and increasing recreational use of our nation's rivers and lakes reduces available nesting areas for the interior least tern.

Interior least terns are generally transients or summer visitants to Kansas and can be found on barren flats and sandbars near large rivers. The QNWR, located 34 miles northwest of Cheney Reservoir and 57 miles northwest of the Little Arkansas River near Sedgwick, has been designated critical habitat for nesting least terns. Both the North Fork of the Ninnescah River and the Little Arkansas River are typical sandy bottom streams, and sandbar habitat can be found scattered along the length of both waterways.

Because of the proximity of QNWR, there is a possibility that least terns may occasionally use portions of either river during the summer for short periods of time. Neither river is likely large enough or has sufficient sandbar habitat to support nesting least tern colonies, however. No survey for least terns has been completed on either river to document their presence or absence.

Drawdown of the Little Arkansas River and reduced flows through the North Fork of the Ninnescah could reduce the scouring process that cleans vegetation from sandbars and riverbanks, thereby reducing available nesting habitat. However, discharges of only 100 cfs or less may be necessary to inundate sandbars along the North Fork. Peak discharges were estimated by the IFIM to exceed 100 cfs about 73 percent of the time. These conditions are expected to remain unchanged or slightly improve with implementation of the ILWSP. If water is available to recharge the Equus Beds aquifer, wetland areas overlying the aquifer could increase and create additional habitat for a variety of species over the long term. Drawdown during moderate flow conditions may also expose additional habitat found along these sandy-bottomed rivers.

Any terns possibly present in the area along the Little Arkansas River would likely be displaced during construction of intake structures and wells by human activity and construction noise. These impacts, most of which will occur outside the riparian area of the river, would be short-term and temporary.

4.7.4.3 Piping Plover

Threats to the piping plover are similar to those facing the interior least tern. In addition to habitat loss, piping plovers are also subject to high predation rates and nest abandonment.

Like the interior least tern, piping plovers inhabit sand beaches and sandbars of inland rivers and lakes. These birds are most likely to be found at QNWR and CBWA located 73 miles northwest of the project area, though they may also be found along rivers during spring and fall migrations. No critical habitat has been designated in Kansas, and there is no record of piping plovers breeding in Kansas, making impacts of this project on breeding plovers unlikely.

The proximity of the project area to QNWR and CBWA and the presence of some sandbar habitat along both impacted rivers suggest a possibility of transient piping plovers occurring near the project area during their spring or fall migrations. Because of the similarity in habitats for the piping plover and least tern, the impacts to both species are expected to be similar. Flow and discharge reductions are not expected to significantly affect sandbar habitat occurring along the banks of the Little Arkansas and North Fork where piping plovers could be found because frequent flows sufficient to inundate and scour the sandbars will continue to occur annually. Drawdowns could also slightly increase the surface area of available sandbar habitat.

Migrating plovers, if present, could be temporarily displaced by construction noise and human activity near potential feeding areas during the installation of intake structures, wells, access roads, and pipelines. Because of the transitory nature of these stopovers, impacts to the piping plover would be minimal.

4.7.4.4 Bald Eagle

The use of pesticides such as DDT is the major cause of bald eagle population declines. Bald eagle populations have also suffered from habitat loss, shooting, lead poisoning, and human disturbance.

Eagles require relatively undisturbed areas around lakes, rivers, and reservoirs to feed and nest. Trees such as cottonwoods or sycamores that are at least 50 ft. tall and sturdy enough to support a nest must be available near water. These trees provide a wide field of view for adults and shelter for their chicks. Nests may be very large, ranging up to eight feet in diameter and weighing several hundred pounds. Bald eagles are generally intolerant of human disturbance. Such disturbance has been attributed as the cause of nesting failure and reduced usage of wintering areas (Grier et al. 1983).

Eagles feed on fish in the open water areas created by dam tailwaters, warm water effluents from power plants and other discharges, in power plant cooling ponds, and along rivers and lakes. At night they roost in groups of trees near feeding areas that are protected from harsh weather.

A loss of open water may concentrate migratory waterfowl and increase the potential for avian cholera outbreaks. Expected reservoir levels will not be altered significantly to concentrate waterfowl and would not be expected to increase the incidence of avian cholera. KDWP manages approximately 5,400 acres of water at Cheney Reservoir. Surface withdrawals will alter, to some degree, the characteristics of tailwater flow in the North Fork, potentially altering the supply of fish available for eagles in the area. The relation between the number of eagles that may use the reservoir and associated rivers for feeding and the concentration of fish and waterfowl would not be a limiting factor. If fish and waterfowl were slightly reduced as a result of this project, the reduction would not significantly impact eagle survivability.

Installation of infiltration wells, recharge wells, recovery wells, surface water intake structures, recharge basins, and pipelines to connect all components will occur primarily in agricultural areas outside the riparian area of the rivers. Consequently, no direct impacts to potential roosting sites or nests would be expected. No surveys of construction sites have been completed to document the absence of eagles or potential nesting trees in the area.

It is likely that bald eagles occur in the project area, especially along the Arkansas River and at Cheney Reservoir. All lands and waters within a corridor extending 100 yards landward from the Arkansas River's ordinary high water mark is designated by the State of Kansas as critical habitat for the Bald Eagle. Critical habitat along the Arkansas River, with exception of the Bentley Reserve Wellfield, is approximately four miles from the project area and would not be directly impacted during construction.

During design and layout of the Bentley Reserve Well Field, riparian corridors within 100 yards of the Arkansas River will be avoided. If riparian areas within 100 yards of the Arkansas River cannot be avoided and if any part of the project affects critical habitat for the Bald Eagle, an action permit will be required from the KDWP. Removal of individual trees at least 50 feet tall or 24 inches or more in diameter at breast height, or removal of 10 or more trees greater than 12 inches in diameter at breast height, all within 100 feet of the water's edge, will also require an action permit from KDWP. An action permit would include mitigation measures that would be negotiated with KDWP and FWS.

The bald eagle has become an increasingly more common nester and is more commonly seen in Kansas, primarily from October to March. Nesting pairs have recently been documented in the project area. However, because nests are conspicuous, it is not likely there are any nesting eagles that may be impacted. If a nest is located during construction, the FWS will be contacted for avoidance instructions.

4.7.4.5 Arkansas Darter

Due to intensive agricultural demands for the available water supply, natural droughts, construction of reservoirs and the resulting flow regulations, and a specialized habitat, the Arkansas darter is being considered by FWS for protection under the Endangered Species Act (ESA). As a candidate species, it is currently afforded no legal protection under the ESA, but its designation indicates it will likely be listed in the near future. Because this is a long-term project, the Arkansas darter may be legally listed before this project is completed so potential impacts are being considered pro-actively to avoid future complications.

The primary threat to the Arkansas darter is the loss of habitat through groundwater mining for crop irrigation. As water tables drop, the spring-fed habitats essential for this species' survival disappear. River damming, construction of reservoirs, and natural drought have also contributed to this species' decline.

The North Fork has been designated by KDWP as critical habitat for this species. An Arkansas darter was collected during an aquatic survey completed to obtain baseline environmental data for this river in 1997 (Burns & McDonnell 1998). This fish is endemic to the Arkansas River system where it is concentrated in small sandy streams continuously fed by seepage from high water tables. It has also survived by occupying lower quality habitats.

One goal of this project is to recharge the Equus Beds aquifer with above-base flow surface water, which would help protect available habitat for this species by raising the water table and potentially improving overlying streams and wetlands. The removal of surface water from the Little Arkansas River and Cheney Reservoir should have little impact on downstream resources. The IFIM indicated the proposed withdrawals would not reduce flows beyond the critical threshold necessary to maintain fish species. Only during years with excess precipitation will water be removed.

The Arkansas darter and the other fish found within the North Fork waterway have adapted to the irregularity of flows released from Cheney Reservoir. Changes in flows resulting from this project would be insignificant compared to historic alterations following dam construction. Flows into the North Fork have been regulated since 1964.

4.7.4.6 Arkansas River Shiner

The Arkansas River shiner is threatened primarily due to inundation and modification of stream discharge by impoundments, channel desiccation by water diversion and groundwater pumping, stream channelization, degradation in water quality, and the introduction of the non-native Red River shiner (*Notropis bairdi*). Although the

Arkansas River shiner evolved in rapidly fluctuating, harsh environments, channelization of the Arkansas River has permanently altered and eliminated suitable habitat for this species. Inundation following impoundments in the Arkansas River system eliminates spawning habitat, isolates populations, and favors increased abundance of predators.

This species, which may be extirpated from Kansas, was most commonly found on the lee side of sand ridges formed by steady shallow water flow. A reduction in stream flows has severely impacted this habitat. While the proposed project calls for removing additional water for consumptive use, the amount of water to be used is not likely sufficient to significantly impact the already-altered downstream habitats. If this water were not withdrawn, there is the potential that the additional flow during wet years could increase stream flows and improve stream quality for the Arkansas River shiner and other fish. However, the recharging of the Equus Beds aquifer could offset this potential over time.

To address the possible impact of the project to the Arkansas River shiner, the City of Wichita is planning to implement a monitoring program to determine pre- and post-project impacts to aquatic resources resulting from modification to flows in the Little Arkansas and Arkansas rivers.

4.7.4.7 Eskimo Curlew

The primary cause for the Eskimo curlew's decline is loss of significant grassland habitat. It is very rare throughout North America, including Kansas. The last reported sighting in Kansas was in 1902. There is also no record of the curlew breeding in Kansas, nor is there any designated critical habitat that could be affected by the project.

Given the extremely rare status of this bird, it is highly unlikely that any Eskimo curlews will be impacted by this project, either directly or indirectly. There is also little grassland habitat available in the project area and most construction of wells and basins will occur in agricultural fields that are not preferred curlew habitat.

4.7.4.8 Whooping Crane

Whooping cranes are endangered primarily due to hunting, specimen collection, human disturbance, conversion of their nesting habitat such as potholes and prairies to agriculture, contaminant spills along their wintering range in Texas, collisions with power transmission lines, and severe weather during migrations that may impede navigation and food availability. In addition, whooping cranes have a delayed sexual maturity and a small clutch size that prevent a rapid population recovery.

These birds may be found in Kansas during their spring and fall migration between their breeding grounds in Canada and their wintering habitat in Texas. Whooping cranes may be found in a variety of habitats during their migration. They typically roost in riverine habitat, on isolated submerged sandbars, and in large palustrine wetlands, such as those found in QNWR and CBWA. They also may be found feeding on waste grains from harvested cropland.

Because of the proximity of the project area to the QNWR and CBWA, it is possible whooping cranes may occasionally be found near the North Fork or the Little Arkansas River during their migrations. Cropland is plentiful in the area as a potential food source. However, both rivers contain only marginal habitat for this species and there are few other wetlands in the project area, so the likelihood of occurrence is remote.

Whooping cranes are only occasional visitors at the QNWR and CBWA during their migrations, further reducing the likelihood of their presence during ILWSP construction activities. If whooping cranes stop in the project area during their migrations, it is likely that they would stop in the QNWR or CBWA, avoiding any construction in the area. According to QNWR and CBWA management personnel, designated whooping crane critical habitat does occur at these locations and satisfactory quantities of this habitat exists at either location to temporarily satisfy any needs additional whooping crane populations might require.

4.7.4.9 Topeka Shiner

The Topeka shiner has suffered from habitat destruction, degradation, modification and fragmentation resulting from siltation, eutrophication[7], tributary impoundments, and stream channelization and dewatering. Removal of the protective vegetation within a stream's watershed from agricultural and urban development results in accelerated stream sedimentation from soil runoff. The Topeka shiner is an indicator of water quality because it is dependent upon high quality aquatic habitats. It is also threatened from introduced predaceous fishes.

The Topeka shiner typically occurs in small headwater prairie streams that are usually perennial, but may also be intermittent during the summer. In these cases, groundwater seepage must maintain water levels for the fish to survive. It prefers stream substrates, such as sand and clean gravel, like those found within the Little Arkansas River and North Fork. The species is primarily restricted to small streams in the Flint Hills region of Kansas. It is possible that no Topeka shiners occur in the Little Arkansas River or North Fork and thus would not be impacted by the proposed project.

If present, this species, like the Arkansas River shiner and Arkansas darter, could be impacted by the decrease in flows released from Cheney Reservoir and withdrawals from the Little Arkansas River under the No-action alternative. The magnitude of this decrease may become significant enough to seriously affect populations of the Topeka shiner as indicated by the IFIM, especially during dry years. Some riparian vegetation along the banks of the Little Arkansas River may be removed to make way for installation of intake structures. This could result in a slight increase in siltation of the river.

Recharging the Equus Beds aquifer would certainly benefit this species by providing additional groundwater to maintain the intermittent streams in the area upon which this species depends.

4.8 STATE-LISTED SPECIES

The KDWP is responsible for listing protected species in the State of Kansas. Impacts to state-listed species are

[7] *Eutrophication* – overfertilization of a water body due to increases in mineral and organic nutrients, producing an abundance of plant life, which uses up oxygen, sometimes creating an environment hostile to higher forms of marine animal life.

regulated and may require permits and/or mitigation. Four species, the speckled chub, eastern spotted skunk, white-faced ibis, and snowy plover occur within the project area and are listed as state threatened or endangered by KDWP. The impacts to these species are listed below.

4.8.1 Speckled Chub

The southern population of the speckled chub is currently listed as state endangered in the Arkansas River drainage. Critical habitat of the speckled chub in the project area includes all of the Arkansas River in Harvey and Sedgwick counties.

Predicting the direct and indirect impacts the ILWSP might have on the speckled chub and its critical habitats is difficult. To determine possible impacts resulting from withdrawals from the proposed alternatives, median peak monthly flows were analyzed for the Little Arkansas and Arkansas rivers (See Section 4.4.1.2). This analysis considered historical flows of the past 74 years of hydrologic record.

Because the month of June is the spawning season for the speckled chub, the peak flow statistics for this month were of particular interest (KDWP, 2001). Reducing peak flows in the river could alter or reduce the microhabitats of the speckled chub. During the summer spawning season, the speckled chub relies on higher flows to drift and disperse fertilized eggs. There is concern that reducing these higher stream shaping flows could alter and reduce fish and aquatic wildlife habitat.

The minimum, maximum, and median flow conditions in the Arkansas River immediately below the confluence with the Little Arkansas River were developed to estimate changes in flow within the Arkansas River as a result of the proposed ILWSP alternatives. Median flow conditions represent the flow conditions that occur most frequently in the river and were used to estimate impacts to the speckled chub and its critical habitat. The peak flow statistics under maximum flow conditions are presented to estimate the impacts of the alternatives on future shaping of the stream channel.

As shown earlier in Chapter 3, the Kansas Water Office has established the minimum desirable streamflow (MDS) at Valley Center to be 20 cfs. Figure 4–3 shows the median (50 percent) flow at Valley Center is above 20 cfs in all months regardless of the ILWSP alternative considered.

Flows in the Little Arkansas River, a tributary of the Arkansas River, will be maintained at the state designated minimum stream flow of 20 cfs. In 1983, KDWP recommended that higher minimum flow values be maintained, 60 cfs in April, May and June, and 34 cfs otherwise. Figure 4–3 shows that median flows will also exceed KDWP recommendations in all months.

Median flows in the Little Arkansas River with the ILWSP in place will reduce the median flow in the Arkansas River downstream of their confluence by about 4 percent. Statistically, this is considered an insignificant impact; therefore, it is unlikely that reductions in stream flow as a result of the proposed project will impact the speckled chub and its critical habitat.

Statistical analyses indicate the habitat of the speckled chub will likely not adversely be impacted as a result of construction and operation of the proposed ILWSP. Regardless, a hydrobiological monitoring program will be developed to determine if, following the implementation of surface water withdrawals, flows in the Little Arkansas and Arkansas rivers deviate from the normal rate and range of fluctuation of flows to the extent that water quality, vegetation, and animal populations are adversely impacted. If impacts do occur as a result of the water withdrawals, appropriate mitigation will be recommended to eliminate or mitigate unacceptable adverse impacts.

4.8.2 Eastern Spotted Skunk

The eastern spotted skunk is currently state listed as threatened. Critical habitat that has been designated is located outside the project area, in Sedgwick County's Cowskin Creek basin, west and south of Wichita. Therefore, it is unlikely that implementation of the proposed ILWSP alternative would adversely impact the eastern spotted skunk.

4.8.3 White-faced Ibis.

The white-faced ibis is currently listed as state threatened. Preferred habitat primarily includes permanent wetland areas; however, the ibis will use scattered temporary pools. Designated critical habitat for this species includes the CBWA and QNWR located northwest and west of the project area. This species may, however, inhabit temporary wetlands around streams and rivers in the project area as well as Cheney Reservoir.

Impacts to the white-faced ibis will likely not occur as a result of the proposed ILWSP. To determine if and to what extent impacts occur to water quality, vegetation, and animal populations, a hydrobiological monitoring program is being established. If impacts do occur to critical habitat of the white-faced ibis as a result of the ILWSP water withdrawals, appropriate mitigation will be developed and recommended to eliminate or mitigate unacceptable adverse impacts.

4.8.4 Snowy Plover

The snowy plover is currently listed as state threatened in Kansas, and can be found in sparsely vegetated salt flats, sandbars, and beaches during migration in the spring and fall. Critical habitat for the plover has been identified by the KDWP; however, none of this habitat exists in the ILWSP project area.

4.9 SOCIOECONOMICS

The construction and operation of the ILWSP alternatives would have both positive and negative impacts from a social and economic perspective. The construction phase would take place over approximately 10 years and would create some short-term employment in the area. New long-term employment would consist primarily of personnel for operation and maintenance of the water supply components. The construction of pre-sedimentation basins, ASR wells, surface intake structures and associated facilities would take a small amount of land out of agricultural production in the well fields.

Existing social and economic conditions and trends within the project region were documented and impacts caused by the project were evaluated. Based on existing conditions and trends, project impacts would be significant if changes in the social and economic environment of the area would exceed the ability of the area to absorb the change and result in hardships for a segment of the population, the economy, or public services.

Existing trends in socioeconomic conditions in the project area include steadily increasing population, low unemployment, and a rapidly expanding housing sector.

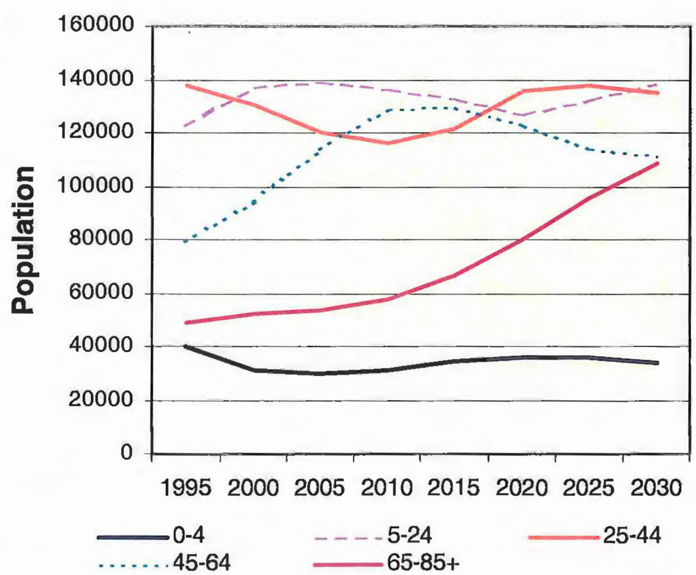
4.9.1 POPULATION AND HOUSING

Population. As part of a water supply study for Wichita, Burns and McDonnell developed population projections for the City of Wichita, and the water service area. These projections were based on data collected from the US Census Bureau, Wichita's Water Department customer data, US Department of Commerce – Bureau of Economic Analysis and the Wichita-Sedgwick County Metropolitan Area Planning Department (MAPD) studies and engineering studies by others. Projections included consideration for the availability of land, water, and sewer systems, current and future transportation plans, zoning, area topography, and socioeconomic factors. Figure 4–34 shows the population projections for various age groups in the ROI. Evaluation of the studies indicated the city population is anticipated to increase by 3,000 people per year to the year 2015 and then increase by 2,000 people per year from 2016 to 2050. This results in a city population of 363,000 and 448,000 in 2010 and 2050, respectively.

In addition to the City's residential population, the projected service area also includes existing and anticipated wholesale customers and individually metered customers outside the city limits. The projected growth for the wholesale and individually metered customers outside the city limits are estimated to increase by approximately 20,000 from 2000 to 2050. Anticipated wholesale customers include additional towns/areas in Sedgwick County not currently served by the City's water system. Connection of these customers to the system would add about 68,000 people to the projected service area by 2050.

The 1995 - 2030 projected population by age class for Sedgwick County is illustrated in Figure 4–34. Sedgwick County is expected to experience large shifts in population between 1995 and 2030. The number of seniors 65 years and over will more than double from 49,000 to 108,200. In 1995, 11 out of 100 county residents were over 65 years of age; by 2030 that will climb to 21 out of every 100 residents. On the other hand, persons between the ages of 25 and 44 will decline by 2 percent and the number of preschoolers will decline by 23

Figure 4-34 Population Projection by Age in Sedgwick County



Source: CEDBR, 1997

978

percent. See Appendix A for further information on the population projection by age group in Sedgwick County.

Projected areas of growth by the year 2050 around Wichita and Sedgwick County include most of the outer fringes of the current Wichita city limits and the towns of Valley Center, Derby, Haysville, Clearwater, Goodard, Garden Plain, Cheney, and Mt. Hope (Burns & McDonnell, 1997). The growth in these towns will most likely be from commuters who work in Wichita.

The primary long-term effect of the ILWSP alternatives would be the facilitation of the current trend in area population growth, which would not be a significant impact.

Under the No-action alternative, no new water supply sources would be used. The City would no longer supply water to new areas, but water use would continue to grow because the City would still have to supply new customers within its existing service area. Eventually, peak day water shortages would become common and water prices would rise to further discourage use. The current rate of population growth would likely slow as the declining quality of life in the Wichita area began to discourage in-migration and encourage out-migration of families and businesses. Such a change in the quality of life would be a significant adverse impact.

Housing. No increases in housing demands are expected from the temporary and permanent work forces needed for the project because most of the labor would come from local sources.

Construction of new housing is continuing at a rapid pace in the Wichita area, particularly in the northwestern suburbs. The ILWSP alternatives are designed to serve this growing region and allow the City to continue to expand its service area. This expansion would prevent water availability from limiting the growth of housing.

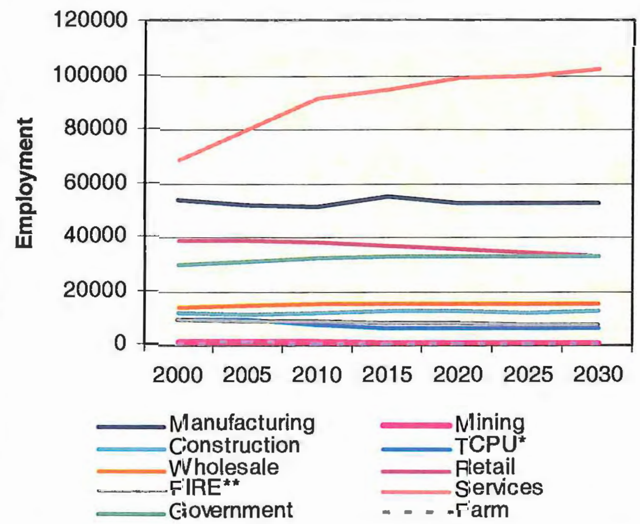
Under the No-action scenario, if new water sources are not developed, the City's short-term solution to limit increasing demand for water would be to stop expanding its service area. This action would stifle housing development in the outlying areas provided these areas could not locate water supplies elsewhere. The reduction in the supply of new homes could force the price of existing homes to increase, which would have a significant negative impact on housing.

4.9.2 ECONOMIC ACTIVITY

Employment. The construction and operation of a new water supply would provide temporary and long-term employment within the study area. Most of the new employment would be in the construction sector of the economy. Demands for construction materials could also stimulate job growth in the manufacturing sector; however, this growth would not necessarily be local because some construction materials would likely be imported from outside the project area (e.g., structural steel, pre-sedimentation plant equipment, pipe). The purchase of materials, fuel, food, and services by construction workers would contribute to local employment and income, particularly in the rural communities of Sedgwick, Halstead, and Bentley near the Equus Bed Well Field. Overall, the project construction would tend to reduce local unemployment.

Limited gains in permanent employment would occur directly as a result of constructing a new pre-sedimentation facility. The work force needed to operate the new water supply would be small relative to the size of the construction work force and the available work force in the Wichita area. Indirectly, the additional water provided by the plant would facilitate the continued expansion of the area economy. This expansion would result in increasing employment and income in most sectors of the local economy.

Figure 4-35 Sedgwick County Employment Forecast by Industry



*Transportation, Communications and Public Utilities
**Finance, Insurance and Real Estate

Overall employment is expected to grow 17.7 percent (264,156) between 1995 and 2030 for Sedgwick County (CEDBR, 1997). The service sector (Figure 4–35) is expected to grow faster than the other sectors from 27.0 percent (1995) to 38.6 percent (2030). Construction and Wholesale Trade is expected to increase the number of employees slightly. Mining, TCPU, Retail Trade, FIRE, and Farm sectors are expected to decrease in the number of employees through 2030 (Figure 4–35). Manufacturing and Government sectors are expected to be fairly level.

Most of the construction labor will be drawn from Sedgwick County and neighboring counties in Kansas. At this time, five peak construction periods are anticipated over the 10-year construction period. The first construction period would be in 2004 and involve the Bentley Reserve Well Field redevelopment. The second construction period would be the later part of 2004 and consist of the ASR Phase I Prototype and LWF Prototype. The third peak construction period is planned for 2006 and be composed of the ASR Phase 2 and the final LWF phase. From 2007-2008 would be the fourth construction period and consist of ASR Phase 3. The final or fifth peak construction period would be during 2010-2011 and include the ASR Phase 4. The number of employees for each of these peak periods has not been determined. Once the project is operational, employment requirements will be primarily for the operation and maintenance of the differing water components. The employment of personnel to conduct operation and maintenance (O&M) would have little to no effect upon the Sedgwick County economy.

No short-term employment or economic benefit would result from implementation of the No-action alternative. Without additional water, however, peak-day water shortages would eventually become common. Water prices would be raised to discourage use. Businesses water is more abundant and less expensive. This could ultimately lead to an increase in unemployment and downward pressure on wages and salaries. This decline in employment and income would be a significant adverse impact.

Agriculture. Farming is an important industry in the area of the Equus Beds Well Field. The Equus Bed Well Field, located in Sedgwick and Harvey counties, is currently used primarily for cropland with small tracts of pasture. Due to the construction of wells and basins, a small amount cropland will be permanently lost for production. Table 4–5 denotes the amount of cropland that will be lost for each Equus Bed ASR option. This loss of crop production would result in the loss of approximately 2250 to 4000 bushels of grain with an estimated value between $7,800 to $13,600. This estimate is based on a calculated average of the crop yield and prices received by farmers from 1991 to 2000 in Sedgwick, Reno, and Harvey counties. Figure 4–36 and 4–37 illustrate the losses by commodity. The loss of crop production for the five top commodities in the three counties represents 0.02 percent of the total crop production. Therefore the impact to crop production is not significant.

Table 4-5 Lost Cropland Acres

Equus Beds ASR Options	Lost Cropland Acres
60/40	74.5
75/25	68.5
100/0	62.5
60/90	109
75/75	97
100/50	97.5

Figure 4-36 Lost Crop Production

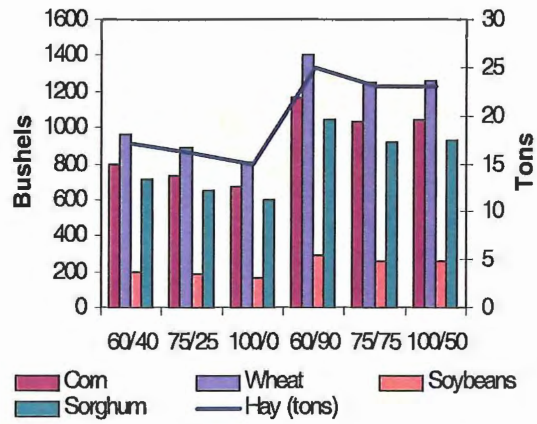
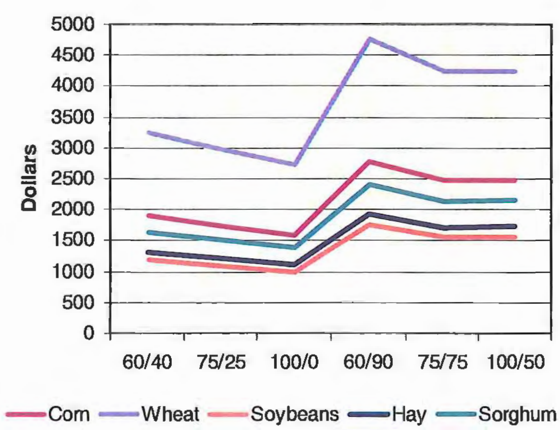


Figure 4-37 Lost Crop Revenue



4.9.3 PUBLIC SERVICES

Transportation. Transportation resources are vital to the metropolitan area functions. Roads and highways provide a convenient means of conducting daily activities. The installation of the transmission pipelines in the Equus Beds Well Field would temporarily block roads, primarily at intersections, and driveways. Construction of the pre-sedimentation basins, wells, etc. would result in a temporary increase in traffic density on rural roads in northern Sedgwick County and southern Harvey County for the

Equus Beds component. Construction of wells and pipelines for the Local Well Field expansion would also result in a temporary increase on city streets in the vicinity of the Local Well Field. Construction of the transmission pipelines would temporarily block roads and driveways. Blockage of any one road or driveway is anticipated to last no more than a few days. These impacts would not be significant.

Under the No-action scenario, no roads, railroads, or driveways would be crossed by the new pipelines. New areas of increased local traffic would not develop. Overall, no disruptions to traffic would occur. If the No-action alternative were to result in a decline of the area population, traffic densities could also decline. These impacts would not be significant. However, if the No-action alternative were to result in a population and economic decline, which reduced tax revenues, public transportation systems and maintenance of the transportation infrastructure could suffer. Any decrease in the safety of the area transportation system caused by a lack of maintenance would be a significant adverse impact.

Law Enforcement. Law enforcement is crucial to public safety and presenting positive public images of an area. Adequate law enforcement is necessary to maintain law and order. Some additional police patrol of the water supply alternative facilities could be required. The existing police force for Sedgwick, Harvey, and Butler counties would be able to accommodate the additional patrols and police services associated with project construction and operation. However, additional police may be necessary to accommodate the continued growth in northwestern Wichita, which would occur with an increase in the water supply. The impact on law enforcement would not be significant because the project would not change current trends in the need for police services.

Initially, the No-action alternative would have no impact on law enforcement. In the long-term, limited water supplies could ultimately limit local tax revenues, which could have a significant adverse affect on public services such as law enforcement.

Health Care. Health care resources provide vital needs for a large and growing metropolitan area. Adequate bed space in hospitals is important for maintaining the growing needs of an area. No impacts to hospitals and other health care facilities from the new water supply would occur assuming the supply of facilities would keep pace with the currently projected increases in the area population. The No-action alternative would have no impact on health care. In the long-term, limited water supplies could limit local tax revenues, which could have a significant adverse affect on public health care services.

Public Schools. Public schools would be affected by the changes in population, which would continue if a new water supply is built. Impacts to public schools would be similar to health care facilities. No impacts from the ILWSP alternatives would occur, provided the supply of classrooms increases in accordance with currently projected increases in population. Initially, the No-action alternative would have no impact on public schools, however long-term, limited water supplies could limit local tax revenues which could have a significant adverse affect on public education.

4.10 WATER RATES

Future water rates for the City of Wichita are expected to increase at the same rate as in the past three years, approximately 5 to 6 percent annually. This increase will result due to increases in cost for maintenance of the current system and the additional costs associated with the ILWSP alternative.

4.11 ENVIRONMENTAL JUSTICE

A review of the minority and low-income data for the proposed project area presented in Table 3–15 identified two low-income or minority areas with potential to be impacted by the project. All other areas analyzed did not contain an identifiable minority nor did they have a percentage of persons below the poverty level that was higher than the standard being used for comparison.

The City of Sedgwick is located east of the intake wells that would be installed on the Little Arkansas River. Sedgwick's 1990 population was 1,438, of which 97.5 percent of the population was white with no identifiable minority group present. However, the percent of persons below the poverty level for Sedgwick was 14.1, which is 1 percent higher than that for the nation in 1990.

The second low-income and minority area with potential to be impacted is that falling within the Local Well Field component of the proposed project. There are two options being considered for the Local Well Field, however both options fall within the same census tracts included in this analysis. The census tracts that were included for the analysis of the Local Well Field component were Tracts 3, 14, 81, 82, and 83 (Figure 3–14). All of these tracts are located along the Little Arkansas River and Wichita - Valley Center Floodway. The total population for these five census tracts in 1990 was 23,832. The percentage of Hispanics of all races in this population was 2,747, which is 11.5 percent of the total population. The City of Wichita had a Hispanic population of 15,250 in 1990, 5 percent of the total population. The Hispanic population in the area of the Local Well Field component is two times that of the City of Wichita, representing a "meaningfully greater" percentage of that minority group. In addition, the percentage of persons below the poverty level in this area is 14 percent, which is higher than the standard of 13.1 percent representing an identifiable "low-income" community.

The potential negative impacts to the two communities identified would be temporary and mainly due to construction activities within the areas. Impacts related to the intake wells near Sedgwick would include construction activities that would produce dust and diesel engine exhaust, temporarily decreasing air quality, and increasing noise. Well construction periods are expected to last about three weeks, two weeks for basins, with basin site development taking up to four months. The Sedgwick Recharge System enlargement would take two and one-half years to complete.

The impacts related to the Local Well Field component of the project would include activities due to the installation of vertical and horizontal collector wells. Installation would require a three-week construction period for vertical wells and 6 to 9 months for horizontal wells. Also, with Option One of the Local Well Field expansion project, a 30-inch pipeline would be routed along West River Blvd., then along Murdock to tie into an existing pipeline close to the water plant. Under Option Two, a 30-inch pipeline would tie to the existing pipeline near 13th and Amidon or Perry. With either Option, a four-day construction period (two days pipeline installation and two days asphalt repair) would be required.

There is potential for the benefits of the proposed project to outweigh the negative impacts in the two identified communities. For instance, the construction and operation of a new water supply would provide temporary and long-term employment within the study area. The construction period for the entire project is projected to last ten years. Most of the construction work force would be drawn from Sedgwick County and neighboring areas, which would provide potential job opportunities to residents of the communities. The most important benefit of the project would be a reliable water supply for residents of these communities. The project would provide a reliable supply of potable water to the customers of the City of Wichita water service area through the year 2050, which would be a significant benefit to the residents of the communities discussed previously. In addition, mitigation measures would minimize the negative impacts experienced by the communities.

The location of the Local Well Field component that is impacting the two identified communities is limited by the physical constraints of the project. The intake wells must be located along the Little Arkansas River and close to the pre-sedimentation plant in order to divert water from the river and facilitate transport of the water. By locating the intake wells close to the pre-sedimentation plant, the length of new pipeline and construction disturbance for the project is minimized. Therefore the location options for this component are severely limited and it would not be feasible to locate the Local Well Field in any other community.

Residents of the communities have been given adequate access to participate in project planning through a public involvement plan that includes public meetings, informational handouts, publication of public meeting notices, and media releases and briefings. The details of the activities included in the public involvement plan are discussed in Chapter 5.

Under the No-action alternative, new water supply sources would not be used. The City would no longer supply water to new areas, but water use would continue to grow because the City would still have to supply new customers within its existing service area. Eventually, peak day water shortages would become common and water prices would rise to further discourage use. Such a change in the quality of life would be a significant adverse impact to these communities.

4.12 CULTURAL RESOURCES

The water supply alternatives could destroy culturally significant or historically important sites through the construction of new wells, basins, surface water intake structure, pre-sedimentation plant and pipelines.

Existing information was reviewed to determine if any known cultural resources were present within portions of the ILWSP alternatives. Research was conducted to determine if any known sites were located in and/or near the various water supply components. The Kansas State Historic Preservation Office (SHPO) was also contacted for their input and concerns regarding these alternatives. All of the sites were evaluated for their potential for listing on the National Register of Historic Places (NRHP). The criteria used to determine the inclusion of a site on the NRHP is in accordance with the Department of the Interior's regulations 36 CFR 60.4. Impacts to cultural resources would be considered significant if the project would damage or destroy any sites eligible for the NRHP.

All cultural resource inventories in the project area to date have been in response to development of the Equus Beds Groundwater Recharge Demonstration Project, construction of various testing and monitoring facilities, and location of Phase I ASR Project facilities, the first phase of the ILWSP. Each of these inventories have been evaluated through record and literature reviews and field surveys of proposed facility locations. Reports detailing each of these surveys have been filed with the Kansas State Historic Preservation Officer. Letters of concurrence have been received from the SHPO and are on file.

To date, the Equus Beds Demonstration Project has been the only portion of the ILWSP that has used federal funds for facility development and operation. NEPA compliance for this portion of the ILWSP was provided through the 1995 EA completed by Reclamation. Additional cultural resource surveys of areas where project facilities will be located will be completed as the proposed locations become known. If required, a Memorandum of Agreement or Programmatic Agreement with the SHPO will be developed. At the present time, the SHPO has declined to participate in the development of a MOA or PA because of the absence of federal agency involvement. The water conservation component, redevelopment of the Bentley Well Field, and expansion of the Local Well Field would have no adverse impacts to known cultural resources in the project area. These alternative water sources either do not disturb any cultural resource properties or are located in areas that are currently urbanized or have been disturbed by past construction activities.

Ten archaeological sites have been recorded with the Kansas State Historical Society as of August 8, 2002 within or adjacent to Cheney Reservoir. Current investigations, being conducted by the Anthropology Department at Wichita State University, of the shoreline around Cheney Reservoir have not been reported to date, but should be consulted for and Section 106 issues in the reservoir area after December 2002, the project completion date. Of the ten known sites in the reservoir area, nine are prehistoric (14RN301, 14RN302, 14KM301, 14RN103, 14RN105, 14RN102, 14RN104, 14RN503, 14RN501) and two are historic (14RN101 and 14RN502). Four of the prehistoric sites have been completely or partially inundated by the reservoir. None of the recorded sites are listed on the National Register of Historic Places (NRHP) or considered for inclusion in the NRHP.

Most of the prehistoric sites are classified as unknown prehistoric. These unknown prehistoric sites are classified as lithic scatters, consisting mostly of flakes and a few discarded tools. At least three of the sites are lithic workshops, where cores of raw chert or quartzite were reduced during the early stages of chipped stone tool production.

Identified prehistoric components were identified at three sites. They include two

Middle Ceramic sites and a Plains Woodland site, but all three have been inundated by the reservoir.

The historic sites were surface scatters of nineteenth century farmsteads.

No construction activities will occur from Cheney Reservoir to the City of Wichita with the ILWSP. The Equus Beds ASR component has several possible options or phases that would require construction of pipelines, wells, holding ponds, overhead transmission lines and access roads in an area of high archaeological site density. The distribution of the sites is primarily limited to terraces along the major streams and tributaries. Typically, sites found more than 0.5 mile from these water resources are historic farmsteads or other Euroamerican sites, dating from the late nineteenth through the twentieth centuries. Under the No-action alternative, agricultural practices would remain the same and no disturbances from construction would occur. Therefore, cultural resources would not be impacted by the No-action alternative.

In summary, the ILWSP project area includes numerous known archaeological resources and potential for many more. None of the sites known in the area are included in the NRHP, but most are considered unevaluated. All of the known cultural resources would not be directly or indirectly impacted by this project.

4.13 VISUAL RESOURCES

The main elements of visual character are landform, land cover, land use, visual variety, and uniqueness. These elements combine to create a variety of landscapes. Impact to visual character is a function of how the project changes these aspects of the landscape.

Landscape management deals with the visual harmony or disharmony of the components of the landscape, including the topography, vegetation, land use, and any human intrusions. The basic concepts considered are landscape character, visual variety, and deviations from the landscape character (U.S. Department of Agriculture 1973). Impacts on the landscape generally result when human alterations to the topography, vegetation, or land use contrast with the natural character of an area. In general, strong contrast with these components results in visual disharmony, while changes that conform to the existing visual components are less noticeable.

Significant visual impacts would result if any of the alternatives would create visual disharmony. Such disharmony would result from dramatic changes in the visual character of the viewshed, a noticeable reduction in visual variety, or sharply contrasting deviation. Visual impacts would be significant if the disharmony created would be viewed by large numbers of people, alter current points of recognized scenic value, or alter state or federally designated scenic areas.

The construction of additional wells and basins within the existing well fields, pre-sedimentation plant and associated facilities, or new river intake would impact all components of landscape character. Removal of vegetation and loss of cropland would alter the viewshed of some areas. Little of the land in the well field would be converted from crops to wells. The well structures will be enclosed in 21-foot by 33-foot buildings that would rise 9 to 10 ft. above the existing grade elevation (Burns & McDonnell, 2000) and would add vertical contrast to the landscape. The proposed new intake for the Little Arkansas River could contrast with the riparian landscape. The lighting on the pre-sedimentation plant could create a visual contrast at night where none currently exists. The well field, however, would not contribute to light pollution because the wells would not be routinely lighted.

The appearance of a basin will not be incongruous with the appearance of other facilities typically found in agricultural areas, i.e., farm ponds, although the basins would be more rectangular in shape and surrounded by an eight-foot fence and lit at night for security. For the most part, these sites would not be located near any residences. Should it develop that a lighted area need be located near a residence, planners would work with those residents to mitigate any adverse effect.

No areas designated as scenic by state or federal agencies are located in the area, therefore, none would be impacted by this project.

Overall, the only significant impact to the visual character of the area would be the addition of an industrial component to an agricultural landscape. Overall, significant adverse impacts to the visual character of the area would be local.

The No-action alternative would not change the landscape or visual character or create large deviations from surrounding landscape character. Therefore, it would have no significant impact on the aesthetics of the area.

Visual impacts caused by the pre-sedimentation plant would be mitigated by adding berms and vegetation around the building and treatment ponds to screen the structures from view, breaking up the strong rectangular and geometric visual elements, and return a natural aspect to the landscape. Painting the structures earthtone colors would mitigate the visual impact of the well structures. Lighting on the outside of the pre-sedimentation plant would be kept to the minimum necessary to provide adequate safety and security.

4.14 RECREATIONAL RESOURCES

Impact to recreational resources will primarily occur at Cheney Reservoir. No recreational impacts are expected to occur in the Equus Beds Well Field, or result from the expansion of the Local Well Field or the Bentley Reserve Well Field. The following discussion will be primarily concerned with the anticipated impacts to Cheney Reservoir.

Cheney Reservoir. The City has the capability to pump up to 80 MGD of water from Cheney Reservoir to the City's water treatment plant. Should this need for additional water arise at a time when Cheney Reservoir is operating in the flood control pool, the City would be able to withdraw up to 80 MGD for delivery to the City's water treatment plant, thereby decreasing the total amount of water that would normally be released downstream to the North Fork through the river outlet works under the direction of the Corps. Use of flood water as a water supply could be continued up to a maximum capacity of 80 MGD. When water levels in the flood control pool are evacuated, the City could decrease withdrawals from Cheney Reservoir and increase withdrawals from the Equus Beds. Any impacts to recreational facilities at Cheney Reservoir would be slowed, since water from several of the City's sources would be used simultaneously.

As would be expected, diversion of water from the flood pool will have some impacts on water levels at Cheney Reservoir. However, as stated in Section 4.4.1.3.4, the development of either ILWSP alternative would increase the median water levels from 0.4 to 0.6 feet compared to current conditions (Figure 4-22). Therefore under normal operating scenarios, day-to-day recreational activities at Cheney Reservoir would not be impacted by the implementation of either of the ILWSP alternatives.

Should drought conditions occur, rather than being forced to pump the reservoir to lower levels, the City would instead be able to use water from the recharged Equus Beds aquifer, reducing demand on the reservoir. Therefore, demands on the reservoir during a drought would be less severe than they would have been without the ILWSP in place.

Recreation was considered to be a secondary project purpose at Cheney Reservoir; the initial funding allocated by Congress totaled $338,000 at a 1960 price level. Water supply is the primary purpose for Cheney Reservoir and the Wichita Project. The ILWSP is designed to limit withdrawals from the reservoir to a maximum of 47 MGD when the reservoir water surface elevation is at or below 1,421.6 ft. (the top of the conservation pool). Maintenance of this condition would minimize the impact to public recreation use.

Since the primary purpose of Cheney Reservoir is to supply water to the City, large water level fluctuations can be expected during a drought situation regardless of which alternative is selected. Figure 4-22 contains graphs showing simulated pool elevations verses time for all four alternatives. These graphs show that water stored in the conservation pool, the water level associated with day-to-day recreation activities, would be fully used during a major drought. Using the historic period of record employed in the operations model, under the proposed operation scenarios, severe drawdowns would have occurred during the droughts of the 1930's, mid-1950's, and even the late 1960's. Under severe drought conditions such as these, regardless of the alternative evaluated, recreation would be significantly impacted.

Impacts to Cheney Reservoir and the Wildlife Management Area due to implementation of any of the proposed alternatives will be positive compared to the No-action alternative. Given the fact that water levels with each of the proposed alternatives will be as high and more stable than without alternative implementation indicates that the overall net impact to the Wildlife Management Area and Cheney Reservoir in general will be positive.

Water levels would also be impacted under the No-action alternative. If neither of the ILWSP alternatives are implemented, the No-action alternative would result in a shrinking conservation pool with exposed mud flats, changing the hydrology of riparian wetlands, and reducing the utility of recreation facilities, such as boat docks and ramps (Figures 4-22, 23, 24 and 25).

4.15 MITIGATION SUMMARY

Many of the mitigation activities proposed for use with the ILWSP are a result of the environmental commitments included and made by the City in Reclamation's 1995 EA and FONSI for the Equus Beds Groundwater Recharge Demonstration Project. Since several of the potential environmental impacts are difficult to accurately and concisely describe prior to ILWSP implementation, the City has committed to the development of a Hydrobiological Monitoring Program in cooperation with the FWS, KDWP, and others. As a result, the following is a summary of the mitigation proposed for implementation:

- Construction activities will avoid or minimize impacts to wetlands, riparian areas, native grasslands, undisturbed old areas, woodlands, lakes and ponds by completing field surveys to relocate project facilities prior to initiating final design and land acquisition activities.
- Electrical transmission facilities will be constructed to reduce the potential for the electrocution of birds and other wildlife by using KDWP and FWS recommended designs and construction techniques.
- Where feasible, stream crossings will be bored under rather than trenched.
- A hydrobiological monitoring program will be developed to help understand if and how the impacts associated with the construction and operational activities for the proposed ILWSP will affect aquatic and terrestrial wildlife and their associated habitats.
- Best management practices such as silt fences, silt traps, sedimentation basins, reshaping, and reseeding would be used where appropriate to control soil erosion during construction. Because the construction activities for any of the ILWSP alternatives would disturb one acre or greater, a National Pollution Discharge Elimination System permit would be required for construction. A City of Wichita Land Disturbance Permit may also be required for lands within the city limits.
- Dust levels generated during construction would be minimized by spraying water or other approved dust control compounds on haul or access roads.
- All construction vehicles would be maintained in good working condition and construction contractors would be required to comply with all local, state, and federal air pollution rules.
- Visual impacts caused by the pre-sedimentation plant would be mitigated by adding berms and vegetation around the building and treatment ponds to screen the structures from view, breaking up the strong rectangular and geometric visual elements, and return a natural aspect to the landscape.
- Painting the structures earthtone colors would mitigate the visual impact of project facilities and structures.
- Lighting on the outside of the pre-sedimentation plant would be kept to the minimum necessary to provide adequate public safety and security.

4.16 HYDROBIOLOGICAL MONITORING PROGRAM

The Hydrobiological Monitoring Program (HBMP) will be a comprehensive environmental monitoring program that would be developed in coordination with KDWP and FWS to provide for the integrated sampling of hydrobiological parameters in the project area. The HBMP would specify the schedule for the preparation and dissemination of data reports, the posting of those reports, and the review of data generated from the HBMP to make any necessary adjustments to the sampling program and/or the data analysis and reporting procedures.

The HBMP would also define a process by which adverse impacts could be evaluated and described. This process would also develop management actions that could be implemented in response to detected hydrobiological changes to avoid or minimize adverse environmental impacts resulting from the surface water withdrawals.

The goal of the HBMP is to determine if, following the construction of project facilities and initiation of operations (i.e., surface water withdrawals), flows in the Little Arkansas and Arkansas rivers deviate from the baseline rate and range of fluctuation to the extent that water quality, vegetation, and animal populations are adversely impacted. In addition, the HBMP would contain an established monitoring schedule to determine baseline conditions prior to permitted withdrawals for streamflow rates, selected water quality parameters, and biological variables within the identified study area. The appropriate agencies that have in the past or are currently collecting data in the local area would be contacted and coordinated with to avoid duplication of effort and to facilitate the most efficient use of available resources.

In conclusion, the objectives of the HBMP are to:

- Document existing conditions in the potentially affected water bodies.
- Enable the detection of changed conditions in the potentially affected water bodies.
- If changes are detected, determine if these changed conditions are attributable to reductions in stream flow.
- Provide a scientifically defensible means to evaluate whether the surface water withdrawals are causing or significantly contributing to the detected changed conditions.
- Determine whether the detected changed conditions constitute, or could result in, unacceptable adverse impacts.
- Recommend appropriate management actions or operational changes designed to eliminate or mitigate unacceptable adverse impacts, if they occur or are expected to occur.

4.17 UNAVOIDABLE ADVERSE IMPACTS

The construction and operation of recharge/recovery wells, recharge basins and associated pre-sedimentation plant would have unavoidable adverse impacts that could not be completely mitigated. These impacts are listed in the following sections.

4.17.1 ILWSP 150 MGD ALTERNATIVE

Unavoidable adverse impacts associated with the 150 MGD ILWSP alternative are as follows:

- The agricultural use of 1190 acres, including 79.5 acres of prime farmland, would be lost for the life of the project.
- Sedimentation and turbidity in the Little Arkansas River would temporarily increase during transmission pipeline and access road construction.

- Construction would temporarily decrease air quality and temporarily increase noise and soil erosion in the immediate project area.
- 109 acres of row crops, hay fields, and pasture would be lost for the life of the project.
- Wildlife would be displaced at the pre-sedimentation plant site for the life of the project.
- Vehicular access to residences and businesses would be temporarily disrupted during pipeline construction.
- Industrial visual elements would be added to a rural landscape for the life of the project.

4.17.2 ILSWP 100 MGD ALTERNATIVE

Implementation of the 100 MGD ILWSP alternative would have the following adverse environmental impacts:

- The agricultural use of 310 acres, including 65 acres of prime farmland, would be lost for the life of the project.
- Sedimentation and turbidity in the Little Arkansas River would temporarily increase during transmission and access road construction.
- Construction would temporarily decrease air quality and temporarily increase noise and soil erosion in the immediate project area.
- 74.5 acres of row crops, hay fields, and pasture would be lost for the life of the project.
- Wildlife would be displaced at the pre-sedimentation plant site for the life of the project.
- Vehicular access to residences and businesses would be temporarily disrupted during pipeline construction.
- Industrial visual elements would be added to a rural landscape for the life of the project.

4.17.3 NO ACTION

With the No-action alternative, the following adverse impacts would be expected to occur:

- Flows in the Little Arkansas River would decline an average of 6 to 7 cfs as the Equus Beds aquifer is further depleted and groundwater discharges are reduced.
- Releases from Cheney Reservoir would decrease in frequency to about 8 percent of the time or about half as often as under current conditions.
- The amount of water stored in the Equus Beds aquifer will be drawn down significantly from current levels and remain depressed with little hope of recovery.
- Infiltration rate and rate of salinity contamination in the Equus Beds aquifer will increase dramatically.

4.18 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The water supply alternatives identified in this EIS would have varying degrees of effect on the use of resources and productivity. The short-term is defined as the period of project construction through the time when the success of the mitigation measures can be ascertained. The short-term is estimated to be 5 to 10 years. The long-term would be the remainder of the life of the project.

Short-term resource commitments include the manpower, energy, and construction equipment required for the duration of construction activities. Some soil, vegetation, wetland, and stream resources would be temporarily disturbed for the construction of pipelines. This disturbance would represent soil loss through erosion, vegetation removal, a decrease in soil moisture, and the displacement of wildlife through loss of habitat. Suitable habitat adjacent to the project site would be temporarily lost to those wildlife species that are intolerant of construction. Short-term gains in productivity would include a temporary economic stimulation in nearby towns and in the construction industry.

Long-term commitments of resources would include the conversion of project area lands from agricultural uses to project purposes. Undisturbed land converted to project uses would result in a long-term loss of wildlife habitat. Current habitat resource utilization patterns would be modified by the presence of the pre-sedimentation plant and access roads. The dependable, long-term water supply for customers of the City of Wichita, provided by the proposed water supply alternatives would allow for long-term gains in productivity in the form of continued growth in the area population, economy, and residential, commercial, and infrastructure development.

4.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction and operation would result in the permanent commitment to the project of building materials and supplies, such as borrow material, steel, and concrete. Energy expended on the project would not be available for other uses. Petroleum-based products, including gasoline, diesel fuel, and lubricants would be consumed during construction. Operation and maintenance of the project facilities would also require the long-term commitment of energy resources for moving water and for chemical resources for treating water. The project would result in a commitment of manpower. Considerable efforts and funds have already been expended on planning and design of the project.

4.20 CUMULATIVE IMPACTS

Cumulative impacts are those effects on resources from the proposed action or alternative added to the effects on those same resources from the past, present, and reasonably foreseeable actions of others.

4.20.1 IMPACTS FROM PAST AND PRESENT ACTIONS

Since settlement of Arkansas River watershed by Euro-Americans, flows in the Arkansas River have been altered by damming and depleted by withdrawals, primarily for irrigation. Although many of these changes have been individually insignificant, the cumulative impacts have raised concerns for fish and wildlife, which depend on the river for their existence.

Urbanization, suburbanization, and agricultural activities have reduced the amount of wetlands in the project area relative to pre-settlement times. Residential and business development is probably continuing this trend.

4.20.2 IMPACTS FROM OTHER FUTURE ACTIONS

Suburban development is expected to continue around Wichita, Kansas. This development would be facilitated by the construction of the proposed water supply project.

4.20.3 SIGNIFICANCE OF CUMULATIVE IMPACTS

The quantity of wetlands has been declining on a national scale and changes in the flow of the Little Arkansas, Arkansas, and the North Fork of the Ninnescah Rivers have been occurring since settlement of the area by Euro-Americans. With mitigation, the ILWSP alternatives would not contribute to the on-going, cumulative destruction of wetlands and the aquatic habitat of the previously mentioned rivers.

CHAPTER 5

COORDINATION AND PUBLIC INVOLVEMENT

5.1 INTRODUCTION

The National Environmental Policy Act (NEPA) requires federal agencies to follow a process of environmental analysis, consultation, disclosure, and public involvement when taking actions such as construction, funding, or permitting. The process is intended to identify the significant impacts to the human environment and provide an opportunity for interested individuals, organizations, and government agencies to participate in the analysis and to be informed of the proposed action and its effects. For actions with a high probability of significant adverse environmental impact, the centerpiece of NEPA analysis is the Environmental Impact Statement (EIS). Although the Wichita ILWSP would be constructed without federal funding, federal action could be required for issuance of a permit pursuant to Section 404 of the Clean Water Act. In this case, flow would be diverted from the Little Arkansas River and will require the issuance of a Section 404 permit from the U.S. Army Corps of Engineers (Corps).

5.2 PUBLIC INVOLVEMENT

The initial mechanism for public participation in NEPA is the scoping process. The purpose of scoping is to identify significant environmental issues, which require study, sort out insignificant issues, and thereby focus the scope of the environmental document. High priority was given to public involvement from the early stages of this study.

Since the inception of the ILWSP in 1993, the City has pursued an active program to inform the public and governmental agencies about the aquifer recharge, storage and recovery project. Presentations and informational materials have been provided to the City Council, Chamber of Commerce and Groundwater Management District No.2. Public meetings have been held in the Cities of Wichita, Halstead and Sedgwick, and agency meetings have been held in the City of Topeka with attendees from federal, state and local governmental entities. Tours of the demonstration facilities have been conducted and informational brochures on the demonstration project have been prepared and distributed to visitors. Monthly progress reports have been distributed to interested parties since 1995. In addition, public comment was solicited on the Draft EIS (DEIS).

5.2.1 <u>PUBLIC MEETING NOTICES</u>

In early October 1997, through published public notices, press releases, and direct mail, the City invited the public and federal, state, and local agencies to participate in the scoping process for the ILWSP. Notices for the public scoping meetings were published in the following newspapers:

- The Ark Valley News
- The Harvey County Independent
- The Times-Sentinel
- The Wichita Eagle

5.2.2 PUBLIC SCOPING MEETING

Three public scoping meetings were held on October 20, 21, and 22, 1997, in Wichita, Cheney, and Halstead, Kansas respectively, to solicit input on the scope of the EIS. A total of 36 individuals attended these meetings. Attendees had the opportunity to view displays about the proposed plan and the framework for the EIS, ask questions about and discuss the plan with knowledgeable representatives from the City and the City's design and environmental consultant, and register their comments and suggestions concerning the proposed plan and the EIS. The public was also invited to submit written comments by mail or fax by November 22, 1997.

5.2.3 DRAFT EIS

Comments received from the public and government agencies as a result of the scoping meetings were used to tailor the content of the EIS so that issues specific to this study and the potentially affected population were addressed. Examples of issues raised by the public and government agencies were water quantity, water quality, water rights, vegetation and wetlands, and impacts on specific threatened, endangered, and state species of special concern (Table 5-1).

Notices of availability of the Draft EIS (DEIS) and public meeting were published in area newspapers. These notices informed the public that the DEIS was available for review, where it could be viewed, and when and where the public meeting was held.

5.2.4 PUBLIC MEETING

Public meetings for the Draft EIS was held shortly after the Draft EIS was made available for review. A public meeting was held in Halstead on April 23, 2002 at the High School. A second public meeting was held in Wichita on April 24, 2002 at City Hall. The purpose of these meetings was to (1) present the conclusions of the DEIS and (2) provide an opportunity for the public to comment. Approximately 30 people attended the two meetings and participated in the process.

5.2.5 FINAL EIS

Comments on the Draft EIS received from the public and the cooperating government agencies were addressed in the Final EIS. Once the Final EIS has been prepared, a Notice of Availability will be published and the Final EIS will be distributed. After 30 days, a Record of Decision will be prepared and issued.

Table 5-1 EIS SECTION NUMBERS FOR SIGNIFICANT ISSUES IDENTIFIED DURING SCOPING

SIGNIFICANT ISSUES	SECTION REFERENCE
ALTERNATIVES	
1) Raise the price of water to encourage conservation.	1.3.4, 2.3.1
2) Reduce demand for water by reducing lawn watering through changes in building codes to specify low-water use grasses and prohibit in-ground sprinkler systems.	1.3.4, 2.3.1
ENVIRONMENTAL CONDITIONS AND IMPACTS	
Water Quantity	
1) Expansion of the local well field could decrease the water table for those with private water wells in northwest Wichita.	2.3.3, 4.4.2.1.2
2) Address affect on streamflow in the North Fork of the Ninnescah River below Cheney Reservoir.	4.4.1.2.3
3) Quantify, through hydrologic analysis, changes in hydrology in the Little Arkansas and Arkansas rivers including: duration of bankfull conditions, duration of out-of-bank flows, increased baseflow from a recharged Equus Beds, and flow duration curve.	4.4.1.2.1, 4.4.1.2.2
4) Estimate the impacts of hydrologic changes in the Little Arkansas, Arkansas, and North Fork of the Ninnescah rivers on bedload transport and channel morphology.	4.4.1.2.1, 4.4.1.2.2, 4.4.1.2.3
5) Establish minimum, seasonally variable, flow releases from Cheney Reservoir.	4.4.1.2.3
6) Estimate changes in Equus Beds groundwater levels under different scenarios of storage, usage, and precipitation patterns.	4.4.2.1.1
7) Describe changes in the hydrology of Cheney Reservoir including storage volumes (total and for the various sub-pools), water level, surface area in terms of average changes and degree of fluctuation.	4.4.1.2.3, 4.4.1.3.4

SIGNIFICANT ISSUES	SECTION REFERENCE
Water Quality	
1) Expansion of well field could disturb a hazardous groundwater site near 57th St. and Broadway	4.4.2.1.2
2) Address impacts on water quality in the North Fork of the Ninnescah River caused by changes in streamflow below Cheney Reservoir.	4.4.1.4.3
3) Address source water protection for the City's investments at Cheney Reservoir and the Equus Beds.	4.4.1.4.4
4) Address the potential intrusion of a plume of highly saline water into the Equus Beds aquifer from the Burrton area.	4.4.2.2.1
5) Address impacts of high atrazine content in Little Arkansas River water.	3.3.1.4, 4.4.1.4.1
6) Address the impact of induced infiltration on the water quality of the Local Well Field caused by increased withdrawal from the Local Well Field.	4.4.2.2.2
7) Expanded use of the Bentley Well Field could induce greater infiltration of high saline waters.	4.4.2.2.3
8) Address impacts on the concentrations of arsenic and other trace elements in ground and surface waters.	4.4.1.4.1
9) Estimate changes in water quality in Cheney Reservoir and North Fork of the Ninnescah River below Cheney Reservoir.	4.4.1.4.3, 4.4.1.4.4
Water Rights	
1) Address the interplay of water rights under the ILWSP, notably conjunctive use opportunities and constraints.	2.3.4, 3.3.3, 4.4.3
2) Describe the contractual relationship between the City and the USBOR relative to water from and the operation and ownership of Cheney Reservoir.	1.3.3.2, 2.3.4
Vegetation and Wetlands	
1) Riparian and wetland vegetation could be adversely impacted by lowering groundwater levels in the Wichita-Valley Center Floodway.	4.7.1, 4.16
2) Estimate impacts on bank stability, riparian wetlands, riparian vegetation, and oxbow lakes associated with the Little Arkansas, Arkansas, and North Fork of the Ninnescah rivers.	4.4.1, 4.4.2, 4.7.1, 4.7.2

SIGNIFICANT ISSUES	SECTION REFERENCE
3) Estimate impacts on wetlands of recharging the Equus Beds including changes in water depth and duration of saturation.	4.7.1
4) Address changes in aquatic vegetation in Cheney Reservoir.	4.4.1.3.4, 4.4.1.4.4
5) Quantify the changes in the amount of area and length of North Fork of the Ninnescah River inundated above Cheney Reservoir and affected vegetation communities as a result of the proposed changes in operation of the reservoir.	4.4.1.3.4, 4.15
6) Potentially affected wetlands should be identified and delineated pursuant to methodology of the U.S. Army Corps of Engineers, Natural Resources Conservation Service, and U.S. Environmental Protection Agency.	2.4, 3.6.1, 4.7.1
Fish and Wildlife	
1) Address impacts to fisheries, riparian wildlife, and their habitats in the Little Arkansas River, the North Fork of the Ninnescah River, and Cheney Reservoir caused by changes in flow or water level fluctuations.	4.4.1.3.4, 4.7.3, 4.7.4
2) Estimate fish mortality caused directly by water withdrawal from the Little Arkansas River and Cheney Reservoir.	4.4.1.3.4, 4.7.3
3) Address impacts to shorebirds, waterfowl, warblers, and woodpeckers caused by changes in operation of Cheney reservoir.	4.4.1.3.4, 4.7.3, 4.7.4
4) Address impacts to fisheries and wildlife management practices including scheduled drawdowns and moist-soil management caused by changes in operation of Cheney reservoir.	4.4.1.3.4, 4.7.3, 4.7.4
Species of Special Concern	
1) Assess impacts to and describe any needed mitigation for federal threatened and endangered species including bald eagle, peregrine falcon, least tern, piping plover, and whopping crane.	4.7.4
2) Address impacts to and describe any needed mitigation for the Arkansas darter, Arkansas River shiner, and speckled chub which occur or have designated critical habitat in North Fork of the Ninnescah River downstream of Cheney Reservoir.	4.7.4.5, 4.8
3) Assess impacts to and describe any needed mitigation for state threatened or endangered species including white-faced ibis and snowy plover.	4.8.3, 4.8.4

SIGNIFICANT ISSUES	SECTION REFERENCE
4) Prepare and submit to U.S. Fish Wildlife Service a Biological Assessment if potential impacts to federally listed and candidate species are identified.	Appendix B
5) Include a plan to enhance, mitigate, or reduce adverse impacts to threatened or endangered species.	4.15, 4.16
Socioeconomics	
1) Address impacts that changes in the operation of Cheney Reservoir could have on recreation at the lake and North Fork of the Ninnescah River including boating, swimming, water skiing, sailing, angling, wildlife appreciation, hiking, horse back riding, camping, hunting, trapping, and shooting.	4.4.1.3.4, 4.14
2) Changes in operation at Cheney Reservoir could affect the original cost allocation of the reservoir project and repayment obligations.	2.3.4, 4.4.1.3.4
3) Address the positioning of Wichita as a major hub of regional water supply as a result of the enhanced water supply developed under the ILWSP.	1.1, 1.2, 1.3
4) How will groundwater mounding in the Equus Beds impact local land owners and water users.	4.4.2.1.1, 4.7.1, 4.16
6) Evaluate potential impacts to Land and Water Conservation Fund properties including state parks, state wildlife areas, county parks, and city parks.	4.4.1.3.4, 4.14
Aesthetics	
1) Address the impacts of changes in Cheney Reservoir operations on aesthetics such as views of exposed dead trees, mudflats, and water clarity.	4.4.1.3.4, 4.13

5.3 AGENCY COORDINATION

5.3.1 SCOPING MEETINGS

Three scoping meetings were held for cooperating government agencies. Table 5-2 contains a list of the agencies and meetings attended. The first meeting was held in Wichita on October 21, 1997. The second meeting was held in Kansas City, Missouri on November 5, 1997, and the third meeting was held in Emporia, Kansas on November 6, 1997. Agency representatives provided initial comments at these meetings and were requested to submit written comments on November 22, 1997.

5.3.2 PROJECT MEETINGS AND OTHER COMMUNICATIONS

Meetings among the City of Wichita, Burns and McDonnell, and cooperating agencies were frequently held to discuss and resolve questions concerning preparation of the EIS and related procedures. Meetings, as a form of inter-agency coordination, were supplemented with frequent telephone calls (person-to-person and conference) and facsimile communications.

5.3.3 FORMAL CONSULTATIONS

During the course of preparing the EIS, state and federal agencies provided necessary data for assessing impacts to sensitive habitats, wildlife, and fisheries, and for planning mitigation. The FWS was consulted, as required by Section 7 of the Endangered Species Act, for their concurrence on the likely impacts to federally listed threatened or endangered species and their recommendations for mitigation. The State Historic Preservation Officer in Kansas was consulted, pursuant to Section 106 of the National Historic Preservation Act of 1966, for concurrence regarding the effect on cultural resources at the sites and potential mitigation.

5.3.4 EIS DOCUMENT REVIEW

The City and cooperating agencies reviewed the chapters of the EIS and supporting documents for technical content, scientific rigor, accuracy, completeness, and consistency. The City's Water and Sewer Department provided final technical and other quality reviews and is responsible for the content of the EIS.

5.3.4.1 Chapters

Each principal chapter of the EIS was subjected to a sequential review and revision process before being incorporated into the Draft EIS. The City made the first review. After their comments were addressed, each chapter

Table 5-2 COOPERATING AND COORDINATING AGENCIES

COOPERATING AGENCIES		MEETINGS ATTENDED
Federal	U.S. Environmental Protection Agency, Region 7	Nov '97, Jul '98
	U.S. Bureau of Reclamation	Oct '97, May '98, Jul '98, Apr '99
	U.S. Geological Survey	Nov '97, May '98, Jul '98, Jul '99, Dec '99
	U.S. Fish and Wildlife Service	Nov '97
State of Kansas	Kansas Water Office	Oct '97
	Kansas Department of Health and Environment	Oct '97
	Kansas Department of Wildlife and Parks	Nov '97
	Kansas Department of Agriculture, Division of Water Resources	Oct '97, Apr '99, Jul '99
	Groundwater Management District No. 2	Oct '97, Jun '98
COORDINATING AGENCIES		
State of Kansas	Kansas Corporation Commission	Oct '97, May '98, Apr '99
	Kansas Conservation Commission	Oct '97
	Sedgwick County Conservation District	Oct '97

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was submitted to FWS and KDWP for review and comment.

5.3.4.2 Supporting Documents

The third-party contractor and other organizations (Table 5-3) performed a number of studies in support of the EIS. The City for technical adequacy independently reviewed these studies.

5.4 EIS PREPARATION TEAM

An interdisciplinary team of qualified federal and state government personnel and consultants were responsible for the preparation of the Wichita Water Supply Study EIS.

5.4.1 FEDERAL LEAD AGENCY

There is no Federal Lead Agency at this time.

5.4.2 THIRD-PARTY CONTRACTOR

Burns and McDonnell, Inc., Kansas City, Missouri, was the third-party consultant which had primary responsibility for preparation of the EIS. The contributors and their roles and expertise are listed in Table 5-4.

5.4.3 OTHER CONTRIBUTORS

Many other individuals contributed information to the EIS as personal communications through the telephone or written contact.

Table 5-3 EIS SUPPORTING DOCUMENTS

Title	Organization	Year
Water Supply Study	Burns & McDonnell	1993
Environmental Assessment for the Equus Beds Groundwater Recharge Demonstration Project	Burns & McDonnell	1994
Annual Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1995
Annual Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1996
Local Well Field Feasibility Study Data Review and Initial Work Plan	Burns & McDonnell	1996
Equus Beds Groundwater Recharge Demonstration Project, Summary of Activities for Calendar Year 1996	Burns & McDonnell	1997
Annual Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1997
Customer and Water Demand Projection Reevaluation	Burns & McDonnell	1997
Quality Assurance Plan for Water Quality Sampling Analysis, Equus Beds Groundwater Recharge Demonstration Project	Burns & McDonnell	1997
State and Federal and Agency Update Meeting, Raw Water Supply Projects, City of Wichita, Kansas	Burns & McDonnell	1997
Local Well Field Expansion Test Well Project, Final Environmental Assessment	Burns & McDonnell	1997
Aquatic Monitoring Report for Little Arkansas River	Burns & McDonnell	1995-97
Annual Aquatic Monitoring Report for the North Fork of the Ninnescah	Burns & McDonnell	1997
Equus Beds Groundwater Recharge Demonstration Project, Summary of Activities for Calendar Year 1997	Burns & McDonnell	1998
Annual Aquatic Monitoring Report for the North Fork of the Ninnescah and the Ninnescah Rivers	Burns & McDonnell	1998
Aquatic Monitoring Report for the North Fork of the Ninnescah and the Ninnescah Rivers	Burns & McDonnell	1997-98
Report on Pipeline Improvements at Key Locations Along City's 48-Inch Well Field Supply Main	Burns & McDonnell	1998
Operation and Testing Manual for the Equus Beds Groundwater recharge Demonstration Project	Burns & McDonnell	1998
Equus Beds Groundwater Recharge Demonstration Project, Summary of Activities for Calendar Year 1998	Burns & McDonnell	1998
Cheney Reservoir Field Study	Burns & McDonnell	1998
Report on Raw Water Delivery With 48-Inch Pipeline Replacement	Burns & McDonnell	1999
Local Well Field Concept Development Study	Burns & McDonnell	1999
Aquatic Monitoring Report for the Little Arkansas River	Burns & McDonnell	2000

Title	Organization	Year
Aquatic Monitoring Report for the North Fork of the Ninnescah and the Ninnescah Rivers	Burns & McDonnell	2000
Concept Design Study of the Equus Beds Aquifer Recharge, Storage and Recovery Project	Burns & McDonnell	2000
Instream Flow Incremental Modeling Report – Little Arkansas River	Burns & McDonnell	2000
Instream Flow Incremental Modeling Report – North Fork of the Ninnescah River	Burns & McDonnell	2001
Atrazine in Source Water Intended for Artificial Groundwater Recharge, South-Central Kansas	US Geological Survey	1998
Changes in Groundwater Levels and Storage in the Wichita Well Field Area, South-Central Kansas	US Geological Survey	1998
Status of Groundwater Levels and Storage in the Wichita Well Field Area, South-Central Kansas	US Geological Survey	1998
Baseline Water Quality and Preliminary Effects of Artificial Recharge on Groundwater, South-Central KS	US Geological Survey	1999

Table 5-4 BURNS & McDONNELL EIS CONTRIBUTORS

Name	Education and Discipline	Years Experience and Expertise	EIS Roles
Robert Sholl	M.S. Botany, B.S. Botany	29, Environmental Impact Analysis	Third Party EIS Oversight, Quality Assurance, Scoping
Fred Pinkney	Ph.D. Plant Ecology and Statistics, M.S. Range Ecology, B.S. Range Science	29, Environmental Impact Analysis, Water Resources Study, NEPA Compliance	Third Party EIS Project Manager, Agency Liaison, Quality Assurance
Justin Meyer	M.A. Ecology and Evolutionary Biology, B.S. Biology	3, NEPA Compliance	NEPA Compliance Specialist
Frank Norman	M.A. Botany, B.S. Systematics and Ecology	13, Wetland Science, Botany	Wetland Impact Analysis and Mitigation
Gene Foster	M.S. Water Resources Engineering, B.S. Civil Engineering	21, Hydrologic Analysis, Facilities Siting, Permitting	Hydrologic Evaluation and Impact Analysis
Cyril Welter	Graduate Studies in Landscape Architecture, M.S. Urban and Regional Planning, B.A. Economics	21, Routing Studies, Socioeconomics, Public Involvement	Socioeconomic, Quality Assurance
Dan Shinn	M.A. Anthropology, B.A. History	11, Cultural Resources, Archeology	Cultural Resources
Hannah Huffman	B.A. Anthropology	2, Archaeology	Cultural Resource
Ryan Boyce	M.A. Geography(Pending), B.A. Environmental Studies	4, GIS, Remote Sensing	GIS, Mapping
Nancy Trobisch	M.A. Education.	15, Technical Writer, Editor	Technical Editor
Kristi Wise	M.S. Wildlife Biology	4, Wildlife Biology, Environmental Science	Biological
Andrew Grammer	M.S. Botany	2, Botany, Wetlands Ecology	Wetlands
David Stous	B.S. Geology M.S. Water Resources	30, Hydrogeology, Geology, Siting, Permitting, Modeling	Hydrogeologist
Jeff Klein	B.S. Civil Engineering M.S. Env. Engineering	15, Water supply planning & Engineering, Agency coordination, Siting, Modeling	Project Engineer
Frank Shorney	B.S. Civil Engineering M.S. Env. Health Engineering	35, Project Management, Water supply planning, Agency coordination	Project Manager
David Vallejo	B.S. Civil Engineering M.S. Env. Engineering	4, Water supply planning & Engineering	Water Supply Engineer
Carla Ballard	B.S. Civil Engineering	7, Environmental Impact Analysis, NEPA Compliance	Assistant EIS Project Manager
Randall Root	B.A. Biology	11, Wetland Permitting, Wetland Design	Wetlands
Mark Latham	M.A. Anthropology	11, Cultural Resources, Archaeology	Cultural Resources

STATE OF KANSAS
DEPARTMENT OF WILDLIFE & PARKS
Operations Office
512 SE 25th Ave.
Pratt, KS 67124-8174
Phone: (620) 672-5911 FAX: (620) 672-6020

3 May 2002

Mr. Jerry Blain, P.E., Water Supply Projects Administrator
Wichita Water & Sewer Department
City Hall, Eighth Floor
455 North Main Street
Wichita, KS 67202-1677

Ref: D5.0400
HV, KM,
RN, SG
Track: 19960558

Dear Mr. Blain:

We reviewed the draft environmental impact statement (EIS) sent by Burns & McDonnell regarding the City of Wichita's Integrated Local Water Supply Plan (ILWSP). The plan includes using ground and surface waters and recharging aquifers to meet the city's project water use needs by 2050. The preferred alternative in the EIS is the 100 MGD.

Of the action alternatives, the 100 MGD alternative appears to have the fewest overall negative effects to terrestrial and aquatic wildlife habitats. Currently, we do not have additional concerns or recommendations to make regarding the draft EIS for the ILWSP. However, we do offer some corrections and clarifications to consider in the final EIS. The Bald Eagle is state-listed as threatened not endangered as stated on page 3-38 under section 3.6.4.3 Bald Eagle. On page 3-41 under section 3.6.4.6 Arkansas Darter, we infer that the state-designated critical habitats mentioned are south of the Arkansas River not the Ash River. On page 3-43 under section 3.6.5.2 Eastern Spotted Skunk, state-designated critical habitats also include all suitable habitats in the Big Slough drainage basin besides the Cowskin Creek drainage basin. And last, on page 4-58 under section 4.8.4 Snowy Plover, the Department has designated critical habitats for the Snowy Plover; however, none of these habitats are within the project area. We are pleased to see that the EIS includes possibilities for biological studies and monitoring to assess potential affects to aquatic and terrestrial wildlife and their habitats.

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If you have any questions, please E-mail me at chrish@wp.state.ks.us or call me at extension 198. Thank you for the opportunity to make these comments.

Sincerely,

Chris Hase

Chris Hase, Aquatic Ecologist
Environmental Services Section

xc: KDWP Reg. 4 F&W Sup., Swan
KDWP Reg. 4 Pub. Lands Sup., Clark
KDWP Reg. 4 Parks Sup., Stark
KBS, Liechti
KDHE, Mueldener
USFWS, Gill
Burns & McDonnell

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Response to comments on the Draft EIS from the State of Kansas, Department of Wildlife and Parks comment letter, May 3, 2002.

1. We concur with your opinion about the 100 MGD alternative and its impacts on terrestrial and aquatic wildlife habitats.

2. The wording in Sections 3.6.4.3, 3.6.4.6, 3.6.5.2, and 4.8.4, respectively, has been changed in the EIS as requested to accurately reflect the status of the species and critical habitat location.

3. Thank you for your comment. We look forward to working with the Kansas Department of Wildlife and Parks and the U.S. Fish and Wildlife Service to further assess the potential environmental impacts of the ILWSP.

KANSAS

STATE

HISTORICAL

SOCIETY

◆

Cultural Resources Division

◆

6425 S.W. 6th Avenue
Topeka, Kansas
66615-1099
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KANSAS HISTORY CENTER

Administration
Center for Historical Research
Cultural Resources
Education / Outreach
Historic Sites
Kansas Museum of History
Library & Archives

HISTORIC SITES

Adair Cabin
Constitution Hall
Cottonwood Ranch
First Territorial Capitol
Fort Hays
Goodnow House
Grinter Place
Hollenberg Station
Kaw Mission
Marais des Cygnes Massacre
Mine Creek Battlefield
Native American Heritage Museum
Pawnee Indian Village
Pawnee Rock
Shawnee Indian Mission

April 23, 2002

Jerry Blain
Water Supply Projects Administrator
Wichita Water and Sewer Department
City Hall, Eighth Floor
455 North Main Street
Wichita, KS 67202-1677

RE: Integrated Local Water Supply Plan
Draft Environmental Impact Statement (EIS), Sedgwick County

Dear Mr. Blain:

Our office has received the Draft EIS concerning the above referenced project. Enclosed you will find an edited copy with our comments. The comments on the Cultural Historical Summary (Section 3) are too numerous to itemize here. Section 4 (pages 65 –67) has a number of statements that need clarification. First, several sites are mentioned but no site numbers are provided. Our office requests that the site numbers be included in the EIS so that our review of the document can be as thorough and accurate as possible. Second, numerous statements by the SHPO are referenced, but no letters are included as an appendix and no correspondence dates are provided. Our office requests that such information be included so that we can assess the report's accuracy.

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If you have any questions or need additional information concerning these comments, please contact Will Banks at (785) 272-8681, ext. 214.

Sincerely,

Ramon Powers
State Historic Preservation Officer

Richard Pankratz

Richard Pankratz, Director
Historic Preservation Office

Response to comments on the Draft EIS from the Kansas State Historical Society comment letter, April 23, 2002.

1. The EIS has been modified to address the comments from the Kansas State Historical Society in Chapter 3, Section 3.9 and Chapter 4, Section 4.12.

2. We have included the site numbers of the recorded sites around Cheney Reservoir, but have eliminated the discussion of the other sites mentioned as within or adjacent to proposed construction areas. These proposed construction areas have been altered or eliminated for the final ILWSP and, therefore, no longer pose threats to known cultural resources in those areas.

3. The Kansas State Historic Preservation Office has not commented on any these sites or this project; therefore, the text in question in Section 3.9 of the EIS has been removed.

Populations and Low-Income Populations" requires each Federal agency to identify and address such potential impacts of its programs, policies, and activities. This process also requires that these parties have had adequate access to participation in project planning.

In accordance with "Final Guidance for Incorporating Environmental Justice concerns in EPA's NEPA Compliance Analyses" (USEPA 1998), this determination is made by reviewing demographic data for the study area, and comparing the percentages of both minority and low-income persons in that population to the percentage present at national levels. Standardized guidelines provide percentages for comparison. The guidelines for determining low-income were identified from the Bureau of the Census, Series P-60 on Income and Poverty. The poverty rate for the nation in 1990 was 13.1 percent. If the percentage of persons below the poverty level equals or exceeds 13.1, the area is then considered to be "low-income".

Minority populations as defined by the Council for Environmental Quality Council include members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin, and Hispanic. For purposes of Environmental Justice analyses, the Council states that a minority population should be identified where either: "a minority population in the affected area exceeds 50 percent, or the minority population in the affected area is meaningfully greater than the minority population percentage in the general population."

Table 3–16 summarizes 1990 census data on minority and low-income populations in the areas that would be impacted by each component of the proposed project. The components include the Equus Beds Well Field and Recharge Basin, the Bentley Reserve Well Field, and both options of the Local Well Fields, in addition to the general project area. Figure 3–15 indicates the locations of the well sites for the Local Well Field Component in relation to the various census tracts that were included in the analysis.

The City of Wichita had a 1990 population of 304,011, of which 11.3 percent were Black, 1.2 percent were American Indian or Alaska Native, 2.6 percent were Asian and Pacific Islander, and 5 percent were Hispanic of all races. These percentages serve as the benchmark for comparison to the study areas. The percentage of persons below the poverty level in Wichita in 1990 was 12.5 percent, 1 percent higher than the state of Kansas, but less than that of the nation.

3.9 CULTURAL RESOURCES

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Where are the References Cited for the Cultural Resources Section?

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of Wyoming. Within the state of Kansas, the Central Great Plains region is divided into a number of smaller physiographic regions based upon differences in landforms. Of these areas, the proposed project cuts through three: the Flint Hills, the Arkansas River Lowland, and the Wellington-McPherson Lowland.

Human occupation of the Central Great Plains can be divided into six broad time periods or stages based upon differences in how people interacted with their environment. Through time, different adaptations produced variations in settlement patterns, cultural materials, and subsistence economics. These time periods, from earliest to latest are: Paleo-Indian, Archaic, Early Ceramic, Middle Ceramic, Late Ceramic, and Historic. Particular artifacts, settlement patterns and house types, as well as the exploitation of different plant and animal species characterize each period. Although each period has been given a name, and is identified by a number of particular characteristics, the periods do not represent isolated cultures; but rather a continuation of cultural development through time. Each period was influenced by those proceeding it as well as the development of new technologies, innovations, and the influx of materials and ideas from neighboring regions.

3.9.1 THE PALEO-INDIAN PERIOD (10,000-6,000 BC)

The start of this period is traditionally marked by a noticeable warming trend toward the end of the Ice Age. People of this period typically traveled together in small bands, hunting now-extinct, large Ice Age animals, and collecting various types of plants and smaller animals. The typical hunting tool was a spear, tipped with a large leaf-shaped chipped-stone projectile point. Groups were highly mobile, and collected berries, seeds, roots, small game, clams, and other locally available plant and animal resources to supplement their diet. This period has been divided into four phases, based primarily upon changes in projectile point forms over time: Pre-Clovis (prior to 10,000 BC); Llano (10,000 - 9,000 BC); Folsom (9,000 - 8,000 BC), and Plano (8,000 - 6,000 BC).

Although human occupation of the Central Great Plains prior to 10,000 years BC is poorly documented and is virtually unknown in Kansas (Brown and Simmons 1987:IX-2), recent work in the state has indicated there may be an as yet unrecorded Pre-Clovis complex in the region. A single site in Marion County, Kansas (14MN12) may contain a Pre-Clovis occupation level, although three dates taken from the site are inconsistent, and therefore not accepted as convincing evidence of human presence during this time period. What additional evidence there is of a Pre-Clovis occupation in the Central Great Plains comes from sites in adjacent states (northeast Colorado, south-central Nebraska, and northwest Missouri). These sites have produced humanly modified stone and bone artifacts in contexts which suggest a Pre-Clovis age, although the evidence remains controversial and is not completely accepted by the professional archaeological community.

The earliest well-documented evidence of human activity in the Central Great Plains is based on several sites attributed to the Llano complex (10,000-9,000 BC). This culture is identified by a distinctive projectile point type with a centrally flaked flute known as "Clovis" found near the remains of large Ice Age animals, particularly the mammoth. The Clovis point is the earliest known projectile point in North America and is identified as a spear point rather than an arrow point. Other artifacts recovered from Llano sites and related to the hunting and butchering of mammoth are cylindrical bone and ivory fore-shafts/projectile points, scrapers, knives, cobble choppers, gravers, bifaces, and hammerstones (Brown and Simmons 1987:IX-4). No sites attributed to the Llano culture have yet been excavated in Kansas. This phase is represented only by isolated surface finds of Clovis projectile points, and no direct association of extinct Ice Age animal remains and Llano artifacts has been documented (Logan 1998:33; O'Brien 1984:28).

The Folsom complex (9,000-8,000 BC) follows Llano, and is also characterized by the presence of a distinctive projectile point in association with extinct Ice Age animal remains. In this case, however, the leaf-shaped "Folsom" point, with an extended central flute, has replaced the Clovis point, and a now-extinct form of bison has replaced mammoth as the primary source of food and raw materials. Surface finds of Folsom projectile points have been recorded throughout Kansas, although they appear to be concentrated in the northeast and southwest corners of the state (Brown and Simmons 1987: figure 9.7). The Twelve-Mile Creek site (14LO2) located in Scott County, west-central Kansas, may represent the only excavated Folsom complex in the state. This site has produced several skeletons of extinct bison in direct association with a leaf-shaped projectile point. The identification of the point as Folsom, however, is uncertain (O'Brien 1984:28)

The next phase of cultural development dates from 8,000-6,000 BC and is called Plano. It is characterized by a wide variety of chipped stone projectile point and knife forms. The most widely hunted animal resources are now-extinct forms of bison, horse, and camel at early sites, and the m... dated to 7... complex c... Indian cul... characteri... point/knife... Kansas a... Meserve/I... Agate Bas... new forms... flaking alc... central flu... types. Th... longer the... region, ra... leaf-shaped forms is present.

You need to mention: Norton Bonebed, DB site, Laird site. These all have paleoindian materials in intact deposits

Due to the scarcity of excavated Plano sites in Kansas, almost all of the information regarding this phase is observed from nearby states. Three Kansas sites which may contain Plano deposits are: the Tim Adrian site (14NT604), a possible Hell Gap quarry site; site (14SG515), a possible Cody complex containing Scottsbluff and Eden points and a Cody knife, located in Sedgwick County near Wichita; and the Sutter site (14JN309), a possible Fredrick complex containing leaf-shaped projectile points with parallel flaking (Brown and Simmons 1987:IX-10&11).

Although the Paleo-Indian period is poorly known in the Central Great Plains and in Kansas, the absence of known sites does not exclude their existence in the state, and within the project area. It has been suggested (Brown and Simmons 1987:IX-11) that the absence of recorded sites may be due to two factors: 1) a lack of intensive surveys in the western two-thirds of the state; and 2) the difficulty of locating Paleo-Indian sites in the eastern two-thirds of the state due to their burial beneath other soil deposits. Although the majority of Paleo-Indian sites are butchering and kill sites of large game, Wheat (1978) has defined four types of human behavior which would result in the formation of different types of sites: 1) mass kill sites; 2) butchering sites; 3) long-term campsites; and 4) short-term campsites. It is possible that all of these forms are present in Kansas.

Mastodon, mammoth and bison remains have been recorded in Harvey and Sedgwick Counties. The presence of Paleo-Indian projectile points and the remains of Ice Age animals hunted by these peoples indicates the potential for Paleo-Indian sites in these areas of Kansas. Brown and Simmons (1987:XX-6) suggest the "probability for bison jump and animal trap sites being present [particularly in western Kansas] is high."

3.9.2 THE ARCHAIC PERIOD (6,000 BC TO AD 1)

The people of the Archaic period practiced a way of life centered on hunting and gathering, with a dependence at least in part on bison as a key component of their diet (Hofman 1996:80). Due to the extinction of Ice Age animals in the late Pleistocene approximately 9,000-8,000 years ago, hunting strategies shifted to smaller game animals including the modern bison, as well as deer and elk, and a greater dependence upon wild plant foods. This change is characterized as a shift from an economy focused on large game, to one based on a wide variety of resources (Logan 1998:34). During this period, hunter-gatherer groups were dependent entirely on the exploitation of wild plant and animal resources. ? Populations became less nomadic and more focused on the seasonal exploitation of resources located in specific areas. Settlements became more permanent, and populations increased. Pit houses appeared in upland hunting-processing camps (bison kill areas), and new food storage and processing technologies developed. Grinding slabs became a common feature of the prehistoric tool kit as seed processing became important. At approximately 5,500 BC, people began to experiment with the manufacture of ceramic objects. The number of chipped-stone tool types increased as tools were manufactured for a variety of specialized uses, and the atlatl, or throwing stick, became common.

No! They were still highly mobile, but just more regional

Evidence of human occupation in Kansas during the Archaic is as difficult to come by as that of the previous period. Few Archaic cultures have been defined for the area, and those that have are based on only a few excavated sites. With the exception of the Flint Hills region, which contains a fairly well known Archaic complex, there are no clearly defined cultures within the project area. Within the Flint Hills region, five cultural complexes/phases have been defined: the Logan Creek complex; Munkers Creek phase; Chelsea phase; El Dorado phase; and Walnut phase.

What about Nebo Hill?

These #'s should be updated or made current.

the Potawatomi, Kickapoo, and other tribes first to reservations and later to Oklahoma. With the granting of state status in 1861 and the end of the Civil War in 1865, Euro-American settlement in the region increased dramatically. In the 1870s, the cattle business boomed, and the "cowboy era" arrived in Kansas along with the railroad. These developments also left their mark in the form of recorded historic sites.

3.9.7 RECORDED SITES AND SPECIFIC SITE TYPES

Recorded Sites. As of 1987, the number of recorded archaeological sites within the counties affected by the alternatives of the proposed project are as follows: Harvey - 54; Reno - 15; and Sedgwick - 45 (Brown and Simmons 1987: figure 6.1). These numbers provide a rough comparison of the density of known sites within the project area as of that date. Although helpful in predicting the possibility of encountering unrecorded sites in some areas, these figures do not indicate the presence or absence of sites in any given location.

A number of specific site types have also been documented within the area crossed by the proposed project, and within the surrounding area utilized by Native American peoples. These are: lithic quarries/collection stations; rock shelters; tipi rings, stone alignments, and earthen construction; human burial areas; and rock art sites.

Lithic Quarries/Collection Stations. Although little systematic excavation of quarry sites has taken place in Kansas, a number of sites have been recorded in the Flint Hills region of the project area. This region is known for the presence of chert or flint outcrops utilized by Native American peoples, and although only one of the recorded sites is close to the project area, there is the potential for locating as yet unrecorded quarry sites in the area. Butler County has four sites located within the region of the project. (Brown and Simmons 1987:XX-2).

Rock shelters. Rock shelters have been recorded primarily in the southeast and north-central half of Kansas. There are no recorded sites within the region of the project area (Brown and Simmons 1987:XX-2). The potential for locating unrecorded sites of this type is dependent upon the presence of rock outcrops of sufficient size to offer protection to Native peoples, and therefore locations suitable for habitation.

Tipi Rings, Stone Alignments, and Earthen Construction. The occurrence of recorded tipi rings, stone alignments, and earthen construction are rare due to extensive cultivation of the Kansas landscape. Prior to Euro-American occupation these features were undoubtedly more common and sites may still occur in more arid or dissected regions less subject to destructive cultivation. Earthen "council circles" attributed to astronomical registers have been recorded in McPherson county at the Paint Creek or Udden site (14MP1), and at the Sharps Creek or Swenson site (14MP301). These two sites are represented by a low central mound 20-30 meters in diameter surrounded by a shallow ditch or a series of oblong depressions. The maximum relief of the features is 44-88 centimeters (Brown and Simmons 1987:XX-6).

the inclusion of a site on the NRHP is in accordance with the Department of the Interior's regulations 36 CFR 60.4. Impacts to cultural resources would be considered significant if the project would damage or destroy any sites eligible for the NRHP.

The water conservation component, redevelopment of the Bentley Well Field, and expansion of the Local Well Field would have no adverse impacts to known cultural resources in the project area.

Ten archaeological sites have been recorded within or adjacent to Cheney Reservoir, of which nine are prehistoric and one is historic. Four of the prehistoric sites have been completely or partially inundated by the reservoir. None of the recorded sites are listed on the National Register of Historic Places (NRHP), considered unevaluated or ineligible for inclusion in the NRHP.

Most of the prehistoric sites are classified as unknown prehistoric. These unknown prehistoric sites are classified as lithic scatters, consisting mostly of flakes and a few discarded tools. At least three of the sites are lithic workshops, where cores of raw chert or quartzite were reduced during the early stages of chipped stone tool production.

Identified prehistoric components were identified at three sites. They include two Middle Ceramic sites and a Plains Woodland site, but all three have been inundated by the reservoir.

The historic site was a surface scatter of a nineteenth century farm site.

Construction of new water pipelines from the reservoir to the City of Wichita would not cross through any known archaeological sites, but may have impact on a known historic and prehistoric trail. The proposed line would cross the Indian trail that leads to the Salt Plains in Oklahoma. The significance of this trail has not been determined and it is not listed in the NRHP.

The Equus Beds ASR component has several options that would require construction of pipelines, wells, holding ponds, overhead transmission lines and access roads in an area of high archaeological site density. The distribution of the sites is primarily limited to terraces along the major streams and tributaries. Typically, sites found more than 0.5 mile from these water resources are historic farmsteads or other Euroamerican sites, dating from the late nineteenth through the twentieth centuries. Due to the age and abundance of these farmsteads, most would not be considered eligible for inclusion in the NRHP.

Under the No-action alternative, agricultural practices would remain the same and no disturbances from construction would occur. Therefore, cultural resources would not be impacte[d] by the No-action alternative.

In summary, the ILWSP project area includes numerous known archaeologica[l] resources and potential for many more. None of the sites known in the area are included in the NRHP, but most are considered unevaluated. Most of the known cultural resources would not be directly or indirectly impacted by this project. Those sites within or adjacent to the proposed construction areas are limited to one prehistoric and three historic sites. Few details are recorded when were these determinations made by the SHPO.

about the prehistoric site, classifying it as unevaluated. All of the historic sites are farmsteads, with two being considered unevaluated and the third as ineligible for inclusion in the NRHP.

These letters from the SHPO, if there are letters, should be included in this document.

4.13 VISUAL RESOURCES

The main elements of visual character are landform, land cover, land use, visual variety, and uniqueness. These elements combine to create a variety of landscapes. Impact to visual character is a function of how the project changes these aspects of the landscape.

Landscape management deals with the visual harmony or disharmony of the components of the landscape, including the topography, vegetation, land use, and any human intrusions. The basic concepts considered are landscape character, visual variety, and deviations from the landscape character (U.S. Department of Agriculture 1973). Impacts on the landscape generally result when human alterations to the topography, vegetation, or land use contrast with the natural character of an area. In general, strong contrast with these components results in visual disharmony, while changes that conform to the existing visual components are less noticeable.

Significant visual impacts would result if any of the alternatives would create visual disharmony. Such disharmony would result from dramatic changes in the visual character of the viewshed, a noticeable reduction in visual variety, or sharply contrasting deviation. Visual impacts would be significant if the disharmony created would be viewed by large numbers of people, alter current points of recognized scenic value, or alter state or federally designated scenic areas.

The construction of additional wells and basins within the existing well fields, pre-sedimentation plant and associated facilities, or new river intake would impact all components of landscape character. Removal of vegetation and loss of cropland would alter the viewshed of some areas. Little of the land in the well field would be converted from crops to wells. The well structures will be enclosed in 21-foot by 33-foot buildings that would rise 9 to 10 ft. above the existing grade elevation (Burns & McDonnell, 2000) and would add vertical contrast to the landscape. The proposed new intake for the Little Arkansas River could contrast with the riparian landscape. The lighting on the pre-sedimentation plant could create a visual contrast at night where none currently exists. The well field, however, would not contribute to light pollution because the wells would not be routinely lighted.

The appearance of a basin will not be incongruous with the appearance of other facilities typically found in agricultural areas, i.e., farm ponds, although the basins would be more rectangular in shape and surrounded by an eight-foot fence and lit at night for security. For the most part, these sites would not be located near any residences. Should it develop that a lighted area need be located near a residence, planners would work with those residents to mitigate any adverse effect.

No areas designated as scenic by state or federal agencies are located in the area, therefore, none would be impacted by this project.

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STATE OF KANSAS

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KANSAS DEPARTMENT OF AGRICULTURE

May; 6, 2002

Mr. Jerry Blain
Wichita Water & Sewer Department
City Hall, Eighth Floor
455 North Main Street
Wichita, KS 67202-1677

RE: DWR A-95 2002.095

Dear Mr. Blain:

This will acknowledge receipt of your letter and attachments dated April 3, 2002 regarding the Integrated Local Water Supply Plan in the City of Wichita, Sedgwick County, Kansas.

If a pipeline and/or cable crosses a stream with a drainage area greater than 50 square miles, a permit is required, except when the installation is by directional boring or attachment to existing bridging structure. Also, if the proposed crossing is above the original channel bottom, the project will require a permit if the drainage area is 240 acres or more, depending on its geographical location. 1

The project may require approval from the local community if it is located in an identified Special Flood Hazard Area (floodplain) and the community participates in the National Flood Insurance Program. The lowest level of the structure may need to be elevated above the base (one percent chance) flood level. If the elevation is accomplished by the placement of fill material in the floodplain, approval of plans for the placement of the fill material may be required from this office. Approval from our office also involves environmental review by other state agencies. 2

If you have questions regarding water structures, please contact Jean Darrah at (785) 296-2855.

Sincerely yours,

Bob Lytle
Environmental Scientist
Technical Services Section

RFL:ssc

pc: Bruce Falk, Water Commissioner, Stafford Field Office

Response to comments on the Draft EIS from the Kansas Department of Agriculture comment letter, May 6, 2002.

1. Thank you for the stream crossing information explaining the conditions under which a permit would be required. Should a stream crossing be anticipated with an ILWSP facility, the City will contact the Kansas Department of Agriculture for advice and direction.

2. Thank you for the information concerning Special Flood Hazard Area designations and National Flood Insurance Program participants. Should the placement of an ILWSP facility effect either program, contact with the local community or the Kansas Department of Agriculture will be made.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
901 N. 5TH STREET
KANSAS CITY, KANSAS 66101

MAY 22 2002

Mr. Jerry Blain, P.E.
Water Supply Projects Administrator
Wichita Water and Sewer Department
City Hall, Eighth Floor
455 Main Street
Wichita, Kansas 67202-1677

Dear Mr. Blain:

Re: Draft Environmental Impact Statement for Integrated Local Water Supply Plan, Wichita, Kansas

Thank you for the opportunity to review this draft Environmental Impact Statement. Typically, the Environmental Protection Agency's reviews are performed under the authority of the National Environmental Policy Act (NEPA), Council on Environmental Quality regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act. However, presently, this project has not been filed with the Council of Environmental Quality, and therefore, procedurally, these comments do not constitute a formal review under NEPA. Since this document is not a 'Draft Environmental Impact Statement" as defined by NEPA, I am unable to give this document a rating. Furthermore, if it is established that this project does require review under NEPA, the prescribed process for filing and comment will have to be followed (see enclosure). We hope the comments listed below serve to improve the document and better inform the public as to the environmental impacts of the project. These comments are not intended to discourage the process that you have chosen to use in preparing this document for the project; on the contrary, we encourage the early involvement of all regulatory agencies as well as the public for better and more informed decision-making. 1

As you have indicated in the document (p. 5-1), it is not clear whether this project is subject to NEPA, but may in fact be -- if there is either: 1) federal money spent on the project, or 2) federal permit requirements, such as a Section 404 permit from the U.S. Army Corps of Engineers. EPA strongly suspects that even without federal money, the project will require a Clean Water Act Section 404 permit, and in such case, would be subject to NEPA. Assuming that is the case, there are several procedural requirements for the proper documentation and filing of Environmental Impact Statements. As one example, upon establishing a federal "lead" agency for the project, an official 'Draft Environmental Impact Statement', which may or may not be identical to this draft dated December 2001, will have to be filed with the Council of 2

Response to comments on the Draft EIS from the U.S. Environmental Protection Agency, Region VII comment letter, May 22, 2002.

1. Your review of the Draft EIS for the ILWSP and comments provided are appreciated. We understand EPA's position relative to providing a rating for the EIS and the potential steps that may have to be followed should the project ultimately require review under the National Environmental Policy Act (NEPA) process.

2. Thank you for the information relative to filing an EIS under the NEPA process. We will endeavor to use the ILWSP EIS to satisfy the NEPA process when and if a lead federal agency is identified.

Environmental Quality, and a public comment period, which follows that document's posting in the federal register, will have to follow that filing. I have spoken to Mr. Fred Pinkney of Burns and McDonnell, the contractor who prepared the Draft, and reviewed this process with him.

Clean Water Act, Section 404

If the final project includes the discharge of dredged or fill material into a Water of the United States, then a permit under Section 404 of the Clean Water Act is likely to be required from the Corps of Engineers. If you have not already contacted the Corps, we would urge you to do so. A person to contact at the Kansas City District, Corps of Engineers, Kansas State Office, El Dorado, Kansas, in the Regulatory Program is David Hobbie. He can be contacted at 316-322-8247. 3

The purpose of the Clean Water Act is "to maintain and restore the chemical, physical, and biological integrity of our nations waters." Just because a stream is already degraded, does not signal that we should not protect it in the terms just mentioned. If we are to ensure that our nation's waters are safe for the general public, we must continue to ensure that streams are not further degraded.

The Arkansas River channel has degraded due to changes in the watershed, related to both channel work, as well as development. Downstream communities are experiencing problems due to work in the upstream portions of the Arkansas River watershed. We would have major concerns about additional channelization work to the river due to the adverse impacts associated with channelization. Generally the benefits created by channelization projects are far outweighed by the adverse impacts they create. These types of projects tend to move problems from one area to another, either above, below or within a project area. Stream channelization projects, which straighten and/or shorten river reaches increase the flow velocity within the river. This typically creates or aggravates existing erosion problems and increases flooding downstream. Cumulative 4 losses to the lotic, or free flowing river or stream ecosystem can occur in the following manner:

- Changes in bed substrate and stream length result in changes in habitat (e.g. sand, silt or gravel changed to concrete or other unnaturally occurring substrate, the elimination of riffle and pool areas, destruction of backwater areas, removal of irregular bank boundaries and snags, etc.). Habitat changes can change plant and animal community structures (diversity, which is the number of different species present, as well as population, which is the total number of members within each species). Intermittent or headwater streams, which are the first to be channelized, play an important role the primary production of plant and animal food for downstream areas. These streams can also provide spawning and rearing habitat for forage fish species.
- Typically trees and other vegetation are removed from the banks, which increases the amount of sunlight reaching the water surface (increasing stream temperatures), lowers the amount of dissolved oxygen in the stream and eliminates tree and leaf litter from entering the stream, which serves as food for animals at the bottom of

3. Thank you for providing the information concerning the Clean Water Act, a Section 404 permit, and a point of contact with the U.S. Army Corps of Engineers, Kansas City District.

4. We understand there would be potentially significant impact from channelization of most any river, including the upstream portion of the Arkansas River watershed. However, the ILSWP does not propose any stream channelization as part of the project.

food webs. Vegetation has the natural ability to filter pollutants, such as phosphorous, nitrogen, pesticides, sediment and others before they can enter the adjacent stream, maintaining stream water quality. When water quality is degraded, there is usually an associated change in the diversity of species inhabiting the stream.

- Bank erosion can result in increased turbidity, which can affect less tolerant species, especially smaller fish species. Sediment can effectively smother benthic organisms (aquatic life that lives on or in the stream bed). It can also limit light penetration which can limit microscopic plant production.
- Changes in water amounts and frequency in adjacent areas reduces the ability of areas to recharge (slowly release water to) streams, which is especially important to species during drier times of the year.
- If trees and vegetation are removed along the stream bank, increased amounts of pollutants, such as nitrogen, phosphorous, E-coli bacteria, pesticides, sediment, etc. can enter the stream through non-point source runoff. Such pollutants can impact public health, as well as the health of other aquatic organisms.
- Increased pollutants, such as nitrogen and phosphorous, can increase demand for oxygen by bacteria which can decrease the amount of available oxygen to other aquatic species, such as fish.
- Intermittent and ephemeral streams are valuable in filtering out pollutants due to the direct contact of the flowing water with the stream bed, which ensure the viability of aquatic species, as well as water quality.

When looking at the City of Wichita, one must consider both the Little Arkansas and the Middle Arkansas watersheds, as Wichita is at the downstream end of the first, and the upstream end of the latter. We are concerned about the existing water quality of the area due to urbanization and rapid population increases and their contributions to the downstream watershed, which has some more serious problems. The impacts that may result cumulatively due to many channelization projects within the Arkansas River will continue to add to sediment runoff which is already a serious threat to water quality in the Middle Arkansas - Slate watershed. In addition, according to state 305(b) monitoring data, only 20-50 percent of the waters in this downstream watershed are meeting their intended uses. 5

Under Section 404 of the Clean Water Act, projects must be in compliance with the Guidelines established under Section 404(b)(1). Under this Section dredge and fill activities in waters of the United States are to be evaluated through a sequencing process asking: First, can adverse impacts to the aquatic ecosystem be avoided through the selection of a least environmentally damaging practicable alternative? The placement of fill for a commercial development, such as stated in both project purposes, is not water dependent, and less damaging practical alternatives are presumed to exist. Second, can any unavoidable impacts be minimized through appropriate and practicable measures? Third, can any unavoidable adverse impacts which remain after minimizing measures have been taken, be compensated through appropriate and applicable measures? 6

5. We concur with the concerns expressed by EPA on water quality that may occur with channelization projects and urbanization and rapid population increases. As stated in Response No. 4 above, the ILWSP, as proposed in this EIS, does not include any channelization in either the Arkansas or Little Arkansas rivers or their watersheds.

6. Thank you for the information relative to the Section 404(b)(1) guidelines. The approach described in your comment has been followed in the development of feasible alternatives to be considered in the ILWSP – to avoid impacts first, minimize impacts second, and compensate unavoidable impacts as a last option.

The 404(b)(1) Guidelines, Part 230.10, Restrictions on Discharge, states that no discharge shall be permitted if there is a practicable alternative which would have less impact on the aquatic ecosystem, as long as the alternative does not have other significant adverse environmental consequences. Practicable alternatives include those that (1) do not involve a discharge of dredged or fill material into waters of the United States, or (2) involve discharges of dredged or fill material at other locations in waters of the United States. An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology and logistics, in light of the overall project purposes. Any applicant for a Section 404 permit should be aware that neither increased costs of alternatives nor an unwillingness to pursue practicable alternatives does not necessarily mean that the alternative is impracticable or unavailable.

Potential Project Impacts

One portion of the document that warrants more, or perhaps clearer, study, is that which describes the project's impacts to the Little Arkansas River. The description of the river and the
project's impacts to that river is located in several places in the document. EPA recommends that 7
a water balance discussion of the Little Arkansas River System, which includes clear and detailed discussion of all inputs and outputs (flow, infiltration discharge or recharge, withdrawals for the Project, etc) and their ultimate impact to the Little Arkansas River flow regime. Such a discussion, presumably, would more clearly articulate what will happen to the River as a result of the project, and would answer the questions listed below:

The discussion should discuss how the river flow regime will change over time (as the Equus Beds Aquifer is recharged). Presumably, the current condition of the river will be impacted
by withdrawals for the project. Over time, as the Equus Beds Aquifer is recharged, it will also 8
begin to gain more and more water through induced infiltration, until the Equus Beds are recharged to some equilibrium level and the entire system is at equilibrium. However, it is not clear how long it will take to reach equilibrium, and what status of the river is before equilibrium is reached. A water balance discussion of the Equus Beds would aid in this analysis.

Table 2.7 states that under the 100 MGD Diversion Alternative, "Low flows will increase. Median flows will increase, except during May and June when the flows will decrease." This is, at best, only partially correct. Figure 4-6 lists the flow of the Little Arkansas River at the mouth (and, presumably, in Wichita from the source wells to the mouth) the flow is dramatically reduced (by more than 50%) throughout the year. Presumably, then, Table 2.7 refers to flows in the stretch between Halstead and Wichita. However, it is not clear under what circumstances this would be
correct. The preferred alternative will withdraw up to 100 MGD (approx. 150 cfs) to be used to 9
recharge the Equus Beds Aquifer, and when the water is available, an additional 60 MGD (90 cfs) for city use. (Note that at Valley Center, this amounts to ½ to 2/3 of the mean daily discharge of the river -305 cfs; see Table 3-2). The infiltration rate resulting from higher Equus Bed levels is listed at 'about 10 cubic feet per second (cfs) in every month except May and June." (p. 4-6. Note that if footnote #4 on p. 4-8 is accurate, the infiltration rate above Halstead would be only 4 cfs). This suggests that the river level will be higher only when Equus Beds Recharge withdrawal rates are below 10 cfs (7 MGD).

7. As suggested, an overall water balance for the Little Arkansas River basin has been prepared and presented in Section 4.4.1.2.1 (Figure 4-8) of the EIS. This water balance shows the magnitude of all system inputs and withdrawals for each of the four scenarios under average conditions, providing a clearer picture of the potential impacts to the Little Arkansas River flow regime.

8. It is not possible to give a definitive answer to this question as posed because we cannot predict future climatic conditions. There will be wetter years when significant amounts of water can be diverted for recharge of the Equus Beds aquifer and drier years when aquifer withdrawals will exceed recharge. Correspondingly, the amount of groundwater discharge to the Little Arkansas River during these conditions will also fluctuate as well. The best way to answer this question is in terms of long-term average conditions.

   Using the water supply demands anticipated during the early years of project operation, the net recharge to the Equus Beds aquifer is estimated to average about 17.6 cubic feet per second (cfs) (12,700 acre-feet per year (AFY)) for the 100 MGD option and 21.0 cfs (15,200 AFY) for the 150 MGD option. Net recharge is defined as natural and artificial recharge less water supply and irrigation demands. With an assumed storage deficit of 250,000 acre-feet (AF), the average fill time for the aquifer is 21 years with the 100 MGD recharge capacity option and 17.6 years with the 150 MGD capacity option.

   As discussed in Section 4.4.1.2.1 and shown in the water balance illustrated in Figure 4-8, the average groundwater discharge to the Little Arkansas River is estimated to increase by 14 to 17 cfs from current conditions with implementation of the ILWSP. This increase would occur very gradually over a number of years and would include years with both positive and negative changes in groundwater discharge.

   For example, impacts on the flow (reduction) in the Little Arkansas River may be slightly greater than the average values shown in Figure 4-8 during the early years of project operation. This could result if all of the proposed diversion facilities are constructed and operational at a time when groundwater discharges to the Little Arkansas River still approximate current conditions (that is, they have not yet increased due to aquifer replenishment). These additional impacts though would be relatively small. Conversely, increases in the flow regime of the river could also be slightly greater than shown in Figure 4-8 during the later years of project operation, when aquifer replenishment is nearing equilibrium. Under this condition, even these impacts to the river would also be relatively small.

9. The information presented in Table 2.7, regarding flow increases do apply to the Little Arkansas River upstream of the proposed collector wells for the Local Well Field Expansion. Downstream of these collector wells, flow in the Little Arkansas River would be reduced under most conditions, although not to less than 20 cfs. While these flow reductions in the lower Little Arkansas River are significant, this urban reach of the river is also significantly altered from its natural state.

   The total diversion capacity of the project from the Little Arkansas River would be either 100 MGD (155 cfs) or 150 MGD (232 cfs) depending on the alternative scenario selected. Even

How often will the pumping for the Equus Beds Recharge be active? Judging from Figure 4-4, it appears that there will be no pumping approximately 65% of the time (i.e. to the right of where the "Current" and "ILWSP–100MGD" lines intercept-or between 35% and 100% 0
of the time), at some reduced pumping rate 19% of the time (between 16% and 35% on the graph) and, though the graph doesn't show, presumably at full pumping rate 15% of the time.

Figure 4-4 suggests that with the project, Mean Daily Flow will be 20-30 cfs more than under current conditions, for about 40% of the time (approximately. I am looking at the graph roughly between 45% and 85%). However, as mentioned, induced infiltration will result in an 11
increase of only 10 cfs. The gap between the 'current' line and the 'ILWSP-100MGD" line appears to be larger than it should be.

Thank you for the opportunity to comment on this draft Environmental Impact Statement. If you have any questions, you can contact me at 913-236-9510 or smith.stephenk@epa.gov.

Sincerely,

Stephen K. Smith
NEPA Reviewer
U.S. EPA Region 7

so, average diversions will be only a fraction of the maximum diversion capacity. As shown in Figure 4-8, average diversions for recharge above Valley Center are 38.4 cfs for the 100 MGD alternative and 47.9 cfs for the 150 MGD alternative. Also, due to a corresponding increase in groundwater discharge, the net depletions above Valley Center average only 17.7 and 23.5 cfs, respectively, compared to the No-action alternative. There will be long periods when the diversion system is either shut down or operated at partial capacity because there is insufficient flow in the river. These average depletions amount to less than 8 percent of the average flow in the river, not the half to two-thirds of the flow in the river as stated in the comment.

The statement in Section 4.4.1.2.1 of the EIS referenced in the comment relates to the median, not average or mean, flow in the Little Arkansas River at Halstead, and not to infiltration rate. Therefore, the 40 percent and 60 percent ratio of groundwater discharge above and below Halstead respectively (footnote 4) does not apply as referenced in the comment.

The last sentence of Comment No. 9 suggests that river levels will be higher only when ASR withdrawals are below 10 cfs. However, flows in the Little Arkansas River at Valley Center, for example, are predicted to be higher more than 60 percent of the time with the ILWSP in place (Figure 4-4). Diversions for recharge will exceed the increase in groundwater discharge (refer to Figure 4-8 and the previous paragraph) many times during the life of the ILWSP. The purpose of the project is to provide the City with an enhanced water supply. Therefore, implementation of the ILWSP will cause a net average depletion of approximately 8 percent in the flow of the Little Arkansas River.

10. The interpretation of the flow duration plot at Valley Center (Figure 4-4, Section 4.4.1.2 Water Quantity) presented in this comment (Comment No.10) is not totally correct. Any time the flow in the Little Arkansas River above Sedgwick exceeds 40 cfs, operation of the recharge diversion system may be initiated. The reader is referred to the discussion of the recharge diversions addressed in Section 4.4.2.1.2 of the EIS. The desired information on recharge pumping is shown in Figure 4-30. For the 100-MGD alternative, no recharge diversions would occur about 55 percent of the time; diversions less than 100 MGD would occur about 30 percent of the time while maximum diversions (100 MGD) would occur about 15 percent of the time.

11. Flow duration curves are a plot of the complete universe of mean daily flows, sorted from highest to lowest, against percent of time. Two mean daily flows that have the same duration cannot be directly compared because they occur on different dates. In Figure 4-4, Section 4.4.1.2 Water Quantity, for example, the median, or 50 percent duration, flow for the No-action alternative at Valley Center was 59.2 cfs and occurred on May 13, 1968. The median flow for the 100-MGD alternative was 79.8 cfs and occurred on February 2, 1996. In addition, a number of factors influence the magnitude of these two flows, not just a difference in groundwater discharge. The difference between these two flows, 20.6 cfs, is coincidentally approximately the same as the difference between the average groundwater discharge under these two scenarios (see Figure 4-8, Section 4.4.1.2 Water Quantity).

Office of Federal Activities

EIS Filing System Guidance

ENVIRONMENTAL PROTECTION AGENCY

Filing System Guidance for Implementing 1506.9 and 1506.10 of the CEQ REGULATIONS

published in the FEDERAL REGISTER, March 7, 1989, Part II

PREAMBLE

In 1978, the Council of Environmental Quality (CEQ) and the Environmental Protection Agency (EPA) entered into a Memorandum of Agreement on the allocation of responsibilities of the two agencies for assuring the government-wide implementation of the National Environmental Policy Act of 1969 (NEPA). These responsibilities are consistent with the 1978 CEQ NEPA-Implementing Regulations (40 CFR Parts 1500-1508).

The Memorandum of Agreement transferred to EPA operational duties associated with the administrative aspects of the environmental impact statement (EIS) filing process. The Office of Federal Activities has been designated the official recipient in EPA of all EISs. It should be noted that the operational duties associated with the administrative aspects of the EIS process are totally separate from the substantive EPA reviews performed pursuant to both NEPA and Section 309 of the Clean Air Act.

The purpose of the EPA Filing System paper is to provide guidance to Federal agencies on filing EISs, including draft, final, and supplemental EISs. Information is provided on (1) Where to file; (2) number of copies required; (3) information required in the transmittal letter; (4) steps to follow when a Federal agency is adopting an EIS or when an EIS is being withdrawn, delayed or reopened; (5) review periods; (6) notice of availability in the Federal Register, and, (7) retention of filed EISs.

On August 10, 1988, following consultation with CEQ, EPA sent the draft paper to 26 Federal agencies for comment prior to its submission to the Federal Register for formal publication and implementation. EPA received comment letters from 16 agencies. Although this preamble does not respond to each comment individually all were carefully considered. A synopsis of the comments, other than editorial, and EPA's response follow:

January 2 and January 6.

The last paragraph of this section has been deleted at the request of CEQ. CEQ will remain solely responsible for notification to the public of referral actions due to the process timeframes called for in the current CEQ Regulations.

Section 5--Time Periods

The section heading and opening paragraph have been edited to address many comments requesting clarification of time periods for draft and final EISs. The time period for review and comment on draft EISs shall not be less than 45 "calendar" days. CEQ Regulations do not address a review period for a final EIS. It is a 30 "calendar" day wait period during which no decision may be made to proceed with the proposed action.

Additional information has been added to address the question concerning calculated time periods ending on non-work days. When a calculated time period ends on a non-working day, the assigned time period will be the next working day.

Section 1506.10(b) of the CEQ Regulations allows for an exception to the rules of timing. Language has been included on exceptions relating to cases of an agency decision which is subject to a formal internal appeal. When exceptions are made by an agency, it is important to inform EPA so that it is accurately reflected in the Notice of Availability.

It was requested that the paper cite examples where both extensions and reductions of time periods have been granted by EPA and where CEQ has approved special cases. EPA appreciates the point but has declined to present examples since these are done on a case-by-case basis and each case is considered on its individual merits.

One commenting agency was concerned with having to request reductions and extensions of time periods in writing to EPA. The agency felt this put too much stress on a formal, and possibly time-consuming process. Language has been added indicating EPA will accept these requests by telephone, but agencies should follow up in writing to ensure that EPA can maintain a complete record of the decision-making process.

One commenting agency requested that guidance be provided for filing of non-Federal EISs, i.e., those prepared by state and local governments where Federal statutes specifically identify these governments as the "Federal official for the purposes of NEPA compliance." EPA's position is that EISs prepared by state and local governments for these Federal programs are considered "Federal" EISs by virtue of the fact that they are prepared in response to a Federal statute -- NEPA. Therefore, the same filing procedures apply to the filing of these "non-Federal EISs" as those that apply to filing of Federal EISs.

GENERAL COMMENTS

55978).

The EPA filing system was created to provide an official log and public announcement of EISs received by EPA and to guarantee that the requirements of NEPA and the CEQ Regulations are satisfied. It is a complete and separate filing system from the Environmental Review Process System which fulfills separate requirements under Section 309 of the Clear Air Act for EPA to review and comment on EISs (and other actions) of Federal agencies.

3. Filing an EIS--Draft, Final and Supplemental

Federal agencies are required to prepare EISs in accordance with Section 1502 of the Regulations and to file the EISs with EPA as specified in 1506.9. The EISs must be filed no earlier than they are transmitted to commenting agencies and made available to the public. If an EIS is hand carried to EPA, the person delivering the document must complete a form stating that transmittal to all agencies is being made simultaneously with the filing with EPA. This will assure that the EIS is received by all interested parties by the time the EPA Notice of Availability appears in the Federal Register, and therefore allows for the full minimum review periods prescribed in 1506.10. EPA will acknowledge by a phone call to the sender that it has received an EIS forwarded by means other than hand carried.

If EPA receives a request to file an EIS and transmittal of that EIS is not complete, the EIS will not be filed until assurances have been given that the transmittal process is complete. Similarly, if EPA discovers that a filed EIS has not been transmitted, EPA will retract the EIS from filing and not refile the EIS until the transmittal process is completed. Once the agency has fulfilled the requirements of 1506.9 and has completed the transmittal process, EPA will reestablish the filing date and the minimum time period, and will publish this information in the next Notice of Availability. Requirements for circulation of EISs appear in 1502.19 of the Regulations.

Federal agencies file an EIS by providing EPA with five (5) copies, including appendices. Material which is incorporated into the EIS by reference is not required to be filed with EPA. The agency filing the EIS (usually the lead agency if more than one is involved) should prepare a letter of transmittal to accompany the five copies of the EIS. The letter should identify the name and telephone number of the official responsible for both the distribution and contents of the EIS, should state that the transmittal has been completed; and should be addressed to:

[editor's note: the address and phone number below for filing EISs at EPA have been updated to reflect changes since original publication of this guidance in the *Federal Register*]

US Environmental Protection Agency
Office of Federal Activities
EIS Filing Section
Mail Code 2252-A, Room 7241

also encourages agencies to notify all reviewers and interested parties of the corrected review periods.

4. Notice in the Federal Register

EPA will prepare a weekly report of all EISs filed during the preceding week for publication each Friday under a Notice of Availability in the Federal Register. At the time EPA sends its weekly report for publication in the Federal Register, the report will also be sent to the CEQ. Information included in the report for each EIS is the same as the data entered in EPA's computerized data file. This includes an EIS Accession number (created by EPA), EIS status (draft, final, supplemental), date filed with EPA, the agency or bureau that filed the EIS, the state and county of the action that prompted the EIS, the title of the EIS, the date comments are due and the agency contact. Amended notices may be added to the Notice of Availability to include corrections, changes in time periods of previously filed EISs, withdrawals of EISs by lead agencies, and recision of EISs by EPA. A recision including nullifying the date the EIS was filed can occur, as explained earlier, if, after a filed EIS is published in the Federal Register. EPA is subsequently informed that the EIS has not been made available to commenting agencies and the public by the lead agency.

5. Time Periods

The minimum time periods set forth 1506.10(b),(c), and (d) are calculated from the date EPA publishes the Notice of Availability in the Federal Register. Review periods for draft EISs, draft supplements, and revised draft EISs shall extend 45 calendar days unless the lead agency extends the prescribed period or a reduction of the period has been granted. The wait periods for final EISs and final supplements shall extend for 30 calendar days unless the lead agency extends the period or a reduction or extension in the period has been granted. If a calculated time period would end on a non-working day, the assigned time period will be the next working day (i.e., time periods will not end on weekends or Federal holidays).

It should be noted that 1505.10(b) allows for an exception to the rules of timing. An exception may be made in the case of an agency decision which is subject to a formal internal appeal. Agencies should assure that EPA is informed so that the situation is accurately reflected in the Notice of Availability.

Under 1506.10(d) EPA has the authority to both extend and reduce the time periods on draft and final EISs based on a demonstration of "compelling reasons of national policy." A lead agency request to EPA to reduce time periods or another Federal agency request to formally extend a time period normally takes the form of a letter to the Director, Office of Federal Activities (OFA), EPA outlining the reasons for the request. EPA will accept telephone requests; however, agencies should follow up such requests in writing so that the documentation supporting the decision is complete. A meeting to discuss the consequences for the project and any decision to change time periods may be necessary. For this reason EPA asks that it be made aware of any intent to

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Field Office
315 Houston Street, Suite E
Manhattan, Kansas 66502-6172

May 21, 2002

Mr. Jerry Blain
Water Supply Projects Administrator
Wichita Water & Sewer Department
City Hall, Eighth Floor
455 North Main Street
Wichita, Kansas 67202-1677

Dear Mr. Blain:

This is in response to your letter of April 3, 2002 requesting our review and comments on a Draft Environmental Impact Statement (DEIS) for the Integrated Local Water Supply Plan Wichita, Kansas. My staff has reviewed the subject DEIS and offer the following comments for your consideration. We assume you have also contacted the Department of Wildlife and Parks, Environmental Services for information on their concerns regarding specific state resources.

<u>General Comments</u>

The proposed project is multifaceted with plans to develop a number of local water resources for consumptive use within the greater metropolitan area of Wichita, Kansas. The project is designed to meet a projected consumptive daily demand of 112 million gallons per day and a maximum day demand of 223 million gallons per day (MGD) by 2050. In order to meet the future projected demand the City of Wichita has embarked on a long term plan to develop additional water supply sources and to protect the sources it currently utilizes. The preferred plan involves recharging the aquifer in the Equus Beds Well Field, and Local Well field by capturing water at several places from the Little Arkansas River for aquifer recharge and direct usage, continued use of Cheney Reservoir, and by induced infiltration of water from the Arkansas River near the Bently Reserve Well Field. When fully operational the Little Arkansas River projects will be capable of capturing and diverting all but 20 cfs of the entire rivers flow 78 percent of the time. Given the multiple sources of water and potential for impacts we believe the DEIS is well written and clearly defines the alternatives and resources and does not attempt to obscure the potential for adverse impacts. We appreciate the clarity and candor. 1

Response to comments on the Draft EIS from the U.S. Department of the Interior, Fish and Wildlife Service comment letter, May 21, 2002.

1. We appreciate your opinion concerning the clarity and quality of the EIS.

Major Concerns

The Service is concerned that the minimum desirable stream flow of 20 cfs (7 day average low flow with a 10% chance of occurring in any one year) will take conditions existing during a period of critical stress and establish those conditions as the norm on the lower reach of the Little Arkansas River. We assume that fish can survive under a flat flow of 20 cfs for 7 days but can they survive this low flow condition 78% of the time?

This situation is ameliorated somewhat by the increase in base flow with implementation of the
ASR and by the fact that a major surface water withdrawal resulting in the flat flow of 20 cfs 2
(Local Well Field,) is very near the mouth of the Little Arkansas river, within the developed area of Wichita and just above it's confluence with the Arkansas River. A second consideration is that without the proposed preferred alternative the City will rely more heavily on Cheney Reservoir and the Ninnescah River to meet its projected water supply needs. The North Fork of the Ninnescah River is home to the Arkansas Darter (*Etheostoma cragini*) a federal candidate species. If depletions to the Little Arkansas and Arkansas River under the preferred alternative are not implemented, withdrawals from Cheney Reservoir and the North Fork of the Ninnescah under existing water rights will increase under the No Action Alternative.

Median flows in the Little Arkansas River with the project in place will reduce the median flow of the Arkansas River down stream of their confluence by about 4 %. The Arkansas River upstream and downstream of Wichita is critical habitat for the Federally listed as threatened Arkansas river shiner (*Notropis girardi*). Although the reach of river within Wichita is degraded and generally unsuitable for Arkansas River shiners the excluded section remains important to
recovery efforts because it serves to connect the upper section with the lower section during 3
periods of high flow. Maintenance of this connection is essential to successful egg development and movement of juvenile Arkansas River shiners between the two sections. Depletion of Arkansas River flows by 4% downstream of Wichita is of concern to the Service since this is designated critical habitat for the shiner. There would be no immediate affect to the species however since the habitat is currently unoccupied and peak flows (according to the DEIS) are expected to increase by 18%. To address our concerns and those of the Kansas Department of Wildlife and Parks regarding depletions to flow the City of Wichita is to implement a
monitoring program to determine pre-and post- project impacts to aquatic resources resulting 4
from modification of the normal rate and range of fluctuation of flows in the Little Arkansas River and the Arkansas River. The design and implementation schedule for the study have yet to be developed.

Fish and Wildlife Coordination Act Comments

The Fish and Wildlife Service will review the U.S. Army Corps of Engineers section 404
permit(s) for the proposed project during the final design phase for segments of this project. We 5
fully expect that site specific wetland functional assessments will document the need for wetland mitigation acreage and sites. Our comments on this DEIS therefore do not preclude a separate

2. We concur with the U.S. Fish and Wildlife Service's (FWS) evaluation of the aquatic system with the ILWSP in place and operating. With implementation of either of the ASR system alternatives, low flows are expected to increase in the Little Arkansas River. Without implementation of the proposed preferred alternative and the 100-MGD component of the ILWSP, the City will be forced to rely more heavily on Cheney Reservoir storage to meet its water supply needs. If withdrawals from the Little Arkansas River are not implemented, withdrawals from Cheney Reservoir could subsequently increase, possibly adversely effecting flow in the North Fork of the Ninnescah River below the reservoir and habitat of the Arkansas darter, a federal candidate species.

3. Designation of the Arkansas River upstream and downstream of Wichita as critical habitat for the federally threatened Arkansas River shiner is recognized in the EIS. The importance of minimizing the potential impact of the ILWSP on this reach of river possibly attained through alteration of surface water flows is also recognized.

4. To help determine if the ILWSP will impact the species, the City has committed to developing a Hydrobiological Monitoring Program (HBMP) in cooperation with KDWP and FWS. A HBMP would be designed to evaluate, in part, the pre- and post-project impacts to aquatic resources resulting from modification to the normal rate and range of fluctuation of flows in the Little Arkansas and Arkansas rivers. It would be used to recommend and develop management actions to avoid or minimize adverse impacts and to enhance beneficial impacts.

5. We concur. We fully expect FWS to be asked to participate in the public review of a U.S. Army Corps of Engineers Section 404 permit application for the ILWSP should an individual permit be necessary.

evaluation and report by the Service which may be necessary pursuant to the Fish and Wildlife Coordination Act when the Corps of Engineers issues a Public Notice for a section 404 permit for segments of this project.

Endangerd Species Act Comments

All mention of Critical Habitat in the DEIS and biological assessment is state designated. The
only federal critical habitat in this project area is the mainstem Arkansas River above and below 6
the City of Wichita, for the Arkansas River shiner.

Although the DEIS outlines some information and study needs for threatened and endangered species, further coordination is needed with the Service, since the preferred alternative does have potential for impacts to Federally designated critical habitat. Impacts to the Arkansas River shiner (Federally listed) and the Speckled chub (State listed) are identical. If the 4% reduction in median flow in the Arkansas River within the City of Wichita will result in a measurable
reduction further downstream from the City, where federally-designated critical habitat for the 7
Arkansas River shiner occurs, this action may adversely modify such critical habitat. In this case, the Corps of Engineers or other federal permitting agency should initiate formal consultation with this office pursuant to section 7 of the Endangered Species Act. Through that consultation process, the significance of the adverse modification will be addressed. If on the other hand, the effects of the flow reduction will not be felt downstream from Wichita in the critical habitat reach of the river, consultation will not be necessary. Please advise us which scenario is expected to occur, and all entities may then proceed accordingly.

Summary Comments

The DEIS is generally well done and does not attempt to mask or hide potential problems arising from implementation of the preferred alternative. However, one of the uncertainties encountered in the City's DEIS is the potential for impact to biological resources resulting from alteration of flows within the Little Arkansas and Arkansas Rivers. There are uncertainties and gaps in the information concerning how fish species, in particular, will respond to alterations in the rate and range of fluctuation of flows to the extent that populations may be adversely impacted. A
decrease in the median flow of the Arkansas River by 4% is intuitively "not good" and increase 8
in maximum flow by 18% is intuitively "not bad", if the two are added together is the result good, bad or indifferent? As natural resource managers, we would like to fill the gaps in information, and leave ourselves enough room to remedy adverse impacts should they occur. Adaptive management involves decision making that takes into account these uncertainties and gaps in information, collects data to fill in the gaps, and then modifies the project to eliminate unacceptable adverse impacts. The City of Wichita is, to its credit, apparently committed to such an adaptive management strategy.

6. The information concerning the federal critical habitat for the Arkansas River shiner has been incorporated in the EIS. Thank you for the information.

7. As you are aware, the ILWSP does not have a lead federal agency identified and formal consultation pursuant to Section 7 of the Endangered Species Act has not been initiated. As indicated in the comment, formal consultation with FWS may be entered into at some time in the future in response to request from a federal agency for review of an application for a permit required for implementation of the ILWSP. It may also be needed should the project be projected to adversely impact the designated critical habitat for the Arkansas River shiner downstream of Wichita. Discussions with FWS will be initiated to coordinate the development of the HBMP, and will be used to determine the need to initiate formal consultation. The City of Wichita is committed to working with FWS and KDWP to identify and mitigate potential impacts for the ILWSP.

8. As stated in Response No. 7 above, the City is committed to working with FWS to assess and mitigate environmental impacts resulting from implementation and operation of the ILWSP. The City practices and effectively employs adaptive management on a daily basis, and proposes to continue that process to minimize impacts that could result from the ILWSP.

For technical assistance on matters pertaining to Endangered Species and the Fish and Wildlife Coordination Act, the City of Wichita or the Federal Agency that funds, provides a grant or issues a permit for segments of this project may contact the Field Supervisor, U.S. Fish and Wildlife Service, 315 Houston St., Suite E, Manhattan, Kansas 66502 (785 539-3474 ext; 105).

Sincerely,

William H. Gill

William H. Gill
Field Supervisor

cc: Kansas Department of Wildlife and Parks, Environmental Services, Pratt, KS.

ES, Program Supervisor, South, Denver CO.
ES, Federal Activities, Grady Towns, Denver, CO.

WHG\drc

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United States Department of the Interior
BUREAU OF RECLAMATION
Great Plains Region
OKLAHOMA CITY FIELD OFFICE
4149 Highline Blvd., Suite 200
Oklahoma City, Oklahoma 73108

O/K-KL

MAY 10 2002

Mr. Jerry Blain, P.E.
Water Supply Projects Administrator
Wichita Water & Sewer Department
City Hall, Eighth Floor
455 North Main Street
Wichita, Kansas 67202-1677

Subject: Comments on Draft Environmental Impact Statement (DEIS) For Integrated Local Water Supply Plan, Wichita, Kansas (Your April 3, 2002 Letter)

Dear Mr. Blain:

When multiple Department of the Interior (Department) agencies review a National
Environmental Policy Act (NEPA) document, as is the case here, the Department's policy is to
provide a consolidated response. However, because there is no Federal project at this time, the
Department has recommended that each agency individually provide their comments on this
document directly to the proponent, the City of Wichita. Consequently, the comments contained 1
herein are the Bureau of Reclamation's (Reclamation) general comments on the DEIS and do not
represent a coordinated Department response. If the subject plan becomes a Federal project, it
may be necessary to perform additional studies and alternatives development, which may result
in the need for additional analysis. In that case, a NEPA compliance process and review would
be needed and a coordinated Department response would be conducted.

General Comments

1. There are several sections in the DEIS that state that there would be "extra water <u>available</u>
(underlined for emphasis) in the flood storage pool" under "new operating modifications" as part
of the ILWSP. As discussed with your staff, at best this is a misleading concept, and at worst, it
is not true. Under current operating criteria, the City can deliver municipal water from Cheney
Reservoir regardless of reservoir elevation or current operational pool. The only limiting factors 2
on water delivery are the state water rights permit limits and the maximum physical pipeline and
pumping plant capacities. Under the ILWSP, the amount of "water available" in the flood
control pool would not change. Rather, the new conjunctive use permit and the increased
pumping capacity on the Cheney pipeline have, in fact, increased the City's legal and physical

Response to comments on the Draft EIS from the U.S. Bureau of Reclamation comment letter, May 10, 2002.

1. The City understands the position of the U.S. Department of the Interior and the U.S. Bureau of Reclamation (Reclamation) relative to the ILWSP. Other federal agencies that were asked to review the Draft EIS have expressed similar thoughts in their responses. Your comments are appreciated, however, and serve to improve the overall quality of the EIS for the ILWSP.

2. We understand the concern that Reclamation has with some of the wording in the EIS referring to "extra water available in the flood storage pool" under "new operating modifications". While the explanation that is currently presented in the EIS can be considered to be somewhat misleading, the intent was to make a rather complex subject more understandable to the public. The City concurs that, under the ILWSP, the physical amount of water contained within the flood pool at Cheney Reservoir will not change. However, as stated in the Reclamation comment, the City's new conjunctive use permit and the increased pumping capacity on the Cheney pipeline does increase the City's capability to deliver more water from Cheney Reservoir within a given time period. Changes in Section 2.3.4 Cheney Reservoir Component have been made to clarify the wording in the EIS and more accurately describe the City's current and future operational activities from Cheney Reservoir.

capability to deliver more water from Cheney Reservoir on both a daily and annual basis. However, the amount of water available in the flood control pool has not changed.

2. Although the DEIS discusses new operating modifications for the flood control pool, there is no acknowledgment that the Army Corps of Engineers actually directs the operation of Cheney Reservoir whenever the reservoir is in the flood control pool (elevation 1421.6 - 1429.0). Their 3
decisions as to how floods are routed through Cheney Reservoir have a direct impact on how long the reservoir would remain in the flood pool, which in turn has a direct impact on how long the City would be able to pump at the 80 MGD rate before they would have to revert to the 47 MGD rate. (Also, see General Comment No. 4)

3. If the City were to pump water from Cheney Reservoir at the increased rate of 80 MGD whenever the reservoir was in the flood control pool, in theory less water would flow 4.
downstream as "flood releases". There is no discussion in the DEIS to indicate that this issue was considered and/or evaluated.

4. We have discussed Reclamation's M&I firm yield for Cheney Reservoir on several previous occasions. Although this issue is significantly less critical under the City's new conjunctive use water rights permit than it was under the Cheney Reservoir water rights permit, we believe it is appropriate to revisit the issue since one feature of the ILWSP is related to the firm yield. As previously discussed, Reclamation originally computed and published Cheney Reservoir's firm yield as 52,600 acre-feet per year. This number was based on streamflow data through May 1956 when Reclamation was required to finalize the various planning reports for the Wichita Project and submit them to Congress for project authorization purposes. In the 1957 report that went to Congress, Reclamation stated that as of May 1956, "the critical period has not 5
yet ended and the storage-yield relationship for Cheney Reservoir should be reviewed prior to construction in light of the hydrologic data available at that time." The critical period subsequently ended in 1959. In 1960, Reclamation did, in fact, review the complete critical period data and using that data, recomputed a revised firm yield of 42,900 acre-feet per year. This information is relevant to the new ILWSP since the new operating modifications provide for daily maximum pumping from the conservation pool of 47 MGD (the average daily equivalent of 52,600 acre-feet per year) rather than 38.2 MGD (the average daily equivalent of 42,900 acre-feet per year). In theory, if all the firm yield assumptions are valid and the City were to pump 47 MGD from Cheney Reservoir during a "critical period" (similar to the one that ended in 1959), Cheney Reservoir would run out of water before the critical period ended.

5. It appears 27 water supply sources were initially identified for potential consideration. Eleven of the sources were considered viable. Three water supply plans were developed from 6
these sources. We suggest a brief discussion of criteria of viability be added to the document.

6. Clean Water Act Section 303 (d) List of water quality limited lakes and associated limiting pollutants as compiled by the State of Kansas designates Cheney Reservoir with two specific 7
impairments: 1. eutrophication - biological community impacts, and excessive nutrient/organic loading; and 2. siltation - chronic turbidity that impacts development of trophic state.

3. The City concurs that the operation of the flood control pool at Cheney Reservoir is under the sole direction of the Corps. As stated in the comment and recognized by the City, the Corps makes all decisions about when and how fast to release any water stored in the flood control pool (that is, when the reservoir's pool elevation is between 1421.6 and 1429.0 feet). The Corps is not being requested to change its policy by the City nor would Corps policy need to be modified with implementation of the ILWSP. The proposed operating modifications for Cheney Reservoir as described in Section 2.3.4, Cheney Reservoir Component, of the EIS will only affect how the City schedules water withdrawals from the reservoir. This section has been modified to include some of your suggestions.

   After a flood event has occurred, the amount of water the City would be able to capture from the flood control pool before it is released will depend primarily on how long this water is retained or remains in the flood control pool. The faster this water is evacuated, the less time the City would have to withdraw water from the flood control pool; therefore, the less benefit this water would have to the City from a water supply perspective. While the reservoir's two existing outlets have a combined discharge capacity of 3,600 to 5,900 cfs,[1] it was assumed in the operations model that the flood control pool would be evacuated at a constant rate of 2,000 cfs. This rate is considered to be fairly conservative (that is, high) since it was derived considering the existing downstream channel capacity below Cheney Reservoir, which is reported to be 1,900 cfs.[2] The City assumes that the Corps would be reluctant to release water from Cheney Reservoir at a flow rate that exceeds the downstream channel capacity unless conditions at that specific time warrant more extreme action.

4. The proposed increase in water withdrawal rate from Cheney Reservoir is from 47 to 80 MGD, a difference of about 51 cfs. This increase in withdrawal rate is fairly insignificant when compared to typical reservoir release rates made by the Corps from the flood control pool . However, it is true that the rate of "flood releases" from Cheney Reservoir could be reduced at times with the proposed increased diversions in the ILWSP. Impacts on the frequency, magnitude and duration of releases from Cheney Reservoir with and without the ILWSP in place are discussed in the EIS in Section 4.4.1.2.3. As shown in Figures 4-10 and 4-11, implementation of either one of the ILWSP alternatives will increase downstream releases from Cheney Reservoir slightly when compared to current conditions; downstream releases will be significantly increased with the ILWSP in place when compared to those that would occur with the No-action alternative.

5. As you indicated, the City and Reclamation have discussed the sequence of events that occurred and led up to the Reclamation's current estimate of firm yield of 42,900 acre-feet per year from Cheney Reservoir. This historic information concerning the firm yield

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[1] The uncontrolled morning glory spillway has a discharge capacity of 3,000 cfs at the top of the surcharge pool. When water levels are within the flood control pool (elevation 1,421.6 – 1,429.0 feet), this discharge is estimated to range from zero to about 2,000 cfs. Over these same pool elevations, the river outlet has a discharge capacity that ranges from 3,600 to 3,900 cfs. Therefore, the total discharge capacity from the flood control pool is estimated to range from 3,600 to about 5,900 cfs.

[2] COE. Pertinent Data for Cheney Reservoir. <http://www.usace.army.mil/projects/pertdata/cheney.htm>.

We suggest the EIS address how project implementation may impact existing designated lake impairments.

Specific Comments

ES-4 Cheney Reservoir.

"New operating modifications would allow use of water in the flood storage pool..." Use of Cheney Reservoir water for water supply purposes is already allowed under current operating criteria. 8

"...should the City need more water at a time that extra water (underlined for emphasis) is available in the flood storage pool..." As previously discussed, we do not believe that there is "extra" municipal water in the flood control pool. The City is allowed to pump water from Cheney Reservoir regardless of the reservoir elevation subject to the annual water right's maximum limit.

"When water levels in the flood storage pool drop to a predetermined low level..." It is our understanding from telephone communications with your staff that no such "predetermined low level" exists.

Based on discussions with your staff, it is out understanding that the intent of this paragraph is to state that the City would deliver up to 80 million gallons per day (MGD) from Cheney Reservoir whenever the reservoir is in the flood control pool (elevation 1421.6 - 1429.0) and that they would deliver up to 47 MGD from the reservoir whenever the reservoir was in the conservation pool (elevation 1392.9 - 1421.6). Based on this understanding, we suggest that the paragraph be revised to read as follows: 11

"**Cheney Reservoir.** Use of this existing surface water storage reservoir would be continued in conjunction with the Equus Beds groundwater aquifer. Under new operating criteria, the City would deliver up to 80 MGD from Cheney Reservoir whenever the reservoir was in the flood control pool (elevation 1421.6 - 1429.0) and up to 47 MGD whenever the reservoir was in the conservation pool (elevation 1392.9 - 1421.6)." (Also, see General Comment No. 4)

Section 2.3.4 Cheney Reservoir Component. Most of this section is identical to the ES-4 narrative. We suggest that this section be revised as follows for the same reasons cited in the ES-4 discussion. Delete both paragraphs and replace with the following:

"**Cheney Reservoir Component**. Use of this existing surface water storage reservoir would be continued in conjunction with the Equus Beds groundwater aquifer. Under new operating criteria, the City would deliver up to 80 MGD from Cheney Reservoir whenever the reservoir was in the flood control pool (elevation 1421.6 - 1429.0) and up to 47 MGD whenever the reservoir was in the conservation pool (elevation 1392.9 - 1421.6). The objective is to maximize recharge storage in the aquifer and to maximize use of storage in Cheney Reservoir. Use of these 12 estimates for the Wichita Project completed by Reclamation has been added to Section 3.3.1.1 of the EIS. As also has been discussed, the operations model used in the development of the ILWSP varies the actual daily withdrawal rate from Cheney Reservoir based on a number of factors. The 47-MGD withdrawal rate, which is assumed to apply when the pool elevation in Cheney Reservoir is at or below 1,420 feet, is treated only as a maximum withdrawal rate. During an extended drought, the ILWSP operations model attempts to regulate water withdrawals from both Cheney Reservoir and the Equus Beds aquifer to balance the storage deficits of both municipal water sources while providing for the City's water demands.

6. As suggested, a discussion of the criteria of viability has been added to Section 2.2.1 - Alternatives Selection Process of the EIS and included in Appendix A, Viable Water Resources Criteria.

7. The City recognizes that the State of Kansas has designated Cheney Reservoir as water quality impaired due to eutrophication and siltation under the Clean Water Act, Section 303(d). The City does not believe that the ILWSP will adversely impact Cheney Reservoir, and may ultimately improve the overall water quality of the lake especially when compared to the conditions that may eventually exist with the No-Action alternative. As discussed in Section 4.4.1.4.4 of the EIS, none of the ILWSP alternatives include any physical modifications to the existing watershed above Cheney Reservoir or to wastewater discharges to the reservoir. Therefore, the mass loading of nutrients and organic material, and reservoir siltation should not change from current conditions nor affect the existing water quality as a result of ILWSP implementation. The amount of water available in the reservoir for dilution of these constituents may change with time. As shown in the operations model, water quantity moving through the total system with the ILWSP in place should generally increase, thereby potentially lowering nutrient and organic concentrations and possibly decreasing turbidity that could result with more stable reservoir water levels. Also, the frequency of reservoir releases should increase, providing more opportunity for moving or flushing these constituents through the reservoir. In general, it is expected that the water quality impairments that are currently found in Cheney Reservoir will either not change significantly as a result of project implementation or improve slightly with the ILWSP in place. These neutral to positive water quality impacts with the ILWSP would be much more beneficial and significant if compared to the projected No-Action alternative. Section 4.4.1.4.4 of the EIS has been modified.

8. Comment Nos. 8, 9, 10, and 11 from Reclamation revolve around the Executive Summary in the EIS. The City believes that "new operating modifications" under the ILWSP may be either related to administrative or procedural changes or modifications of facility capacities. The City concurs with Reclamation that Cheney Reservoir is designed to be a municipal water supply and is used in that manner. Part of the total ILWSP development was to increase the capability of the City to transmit up to 80 MG of water daily instead of 47 MGD from Cheney Reservoir to Wichita for treatment and distribution.

9. In Response No. 2 above, "extra water" available in the Cheney Reservoir flood control pool was discussed. The City concurs that water from the reservoir may be transmitted, treated and distributed to satisfy municipal water demands up to the limits set forth in the City's

existing conjunctive water right issued by the State of Kansas. The City also concurs that the physical amount of water contained in the Cheney Reservoir flood control pool has not changed. As stated in Response No. 2 above, Section 2.3.4 and the Executive Summary of the EIS has been modified to reflect these changes.

10. The City agrees that the referenced statement from the Executive Summary is an oversimplification of the proposed operation of the ILWSP. Each of the water supply sources available to the City, including Cheney Reservoir and the Equus Beds Aquifer, will be used conjunctively to satisfy the City's water demands. Under most conditions, none of these sources would be capable of individually supplying all of the water needed by the City. When the flood control pool or the conservation pool in Cheney Reservoir are full or nearly full (pool elevation 1,420 feet or higher), withdrawals from Cheney Reservoir will be given preference over withdrawals from the Equus Beds Aquifer; however, both sources will still be utilized much of the time. During a dry period when it is necessary for the City to rely on stored water to meet its water demands, water will be withdrawn from both Cheney Reservoir and the Equus Beds Aquifer in an attempt to balance the storage deficits of both sources.

11. Comment Nos. 8, 9, and 10 above in addition to the current Comment No. 11 from Reclamation recommend specific alterations to wording on Page ES-4 of the Executive Summary in the EIS. A revised paragraph was suggested for use; however, as written, the recommended wording does not exactly explain the proposed changes for Cheney Reservoir included in the ILWSP. The City believes that the only real change, when compared to current operational policies, is to allow for an increased maximum withdrawal rate (from 47 to 80 MGD). Using the paragraph provided by Reclamation, the City will include the following wording in the EIS:

    "Cheney Reservoir. Use of this existing surface water reservoir will continue with only administrative or procedural changes or modifications of facility capacities. With the new conjunctive use water right permit and larger capacity water withdrawal facilities at the dam in place, the City would be able to withdraw up to 80 MGD from the reservoir when there is water stored in the flood control pool (between elevations 1,421.6 and 1,429.0 feet). This will allow the City to capture more of the water that would otherwise be released downstream by the Corps, thereby reducing withdrawals from the Equus Beds aquifer. At surface water pool elevations below 1,421.6 feet, the maximum withdrawal rate from the reservoir will revert to its current flow rate of 47 MGD".

12. The wording originally in Section 2.3.4 has been changed as requested to more accurately reflect water withdrawal rates from Cheney Reservoir. The revisions suggested in Section 2.3.4 by Reclamation to maintain consistency with the information presented in the Executive Summary have been used as a starting point, and modified as necessary. The following paragraphs have replaced the referenced section:

"2.3.4 Cheney Reservoir Component
Use of this existing surface water reservoir will continue with only administrative or procedural changes or modifications of facility capacities. With the new conjunctive use water right permit and larger capacity water withdrawal facilities at the dam in place, the City would be able to

withdraw up to 80 MGD from the reservoir when there is water stored in the flood control pool (between elevations 1,421.6 and 1,429.0 feet). At pool elevations below 1,421.6 feet, the maximum withdrawal rate from the reservoir will revert to its current limit of 47 MGD.

These changes in operating criteria will permit the City to capture more of the water in the flood control pool of the reservoir that would otherwise be released downstream by the U.S. Army Corps of Engineers (Corps) as the flood control pool is evacuated. Use of this surface water from Cheney Reservoir when it is available will allow the City to reduce withdrawals from the Equus Beds aquifer, therefore maximizing the amount of aquifer recharge that may be occurring at the time. This additional amount of aquifer recharge water will then be available for use during drier or drought conditions when water levels in Cheney Reservoir are lower and surface water inflow to the reservoir is low. The use of water from these two water sources in a balanced manner will minimize the need for the City to acquire and develop additional water supply sources from outside the local area to meet projected water demands."

waters "as-available" allows the Equus Beds to be recharged for later use during drought conditions and minimizes the need for additional water supply sources from outside the region." (Also, see General Comment No. 4)

Figure 3-2, page 3-7. The surcharge pool data is incorrect; replace with the following data:

elevation - 1,453.4
surface area = approximately* 26,000 acres 13
capacity = 451,347 acre-feet (estimated*)

* Note: there is no official published reservoir data above elevation 1450.0.

Section 3.6.4 Threatened, Endangered, or Candidate Species. Because this analysis spanned several years, we suggest documenting the date of the initial and the most recent update of the TE&C species list provided by the FWS. (Regulations require that Federal action agencies 4 request updates of TE&C species lists every 90 days from the FWS to ensure that appropriate species are analyzed.)

4.4.1.3.4 Cheney Reservoir. Change elevation 1393 to 1392.9 for consistency with other 5 elevation data and change the word "could" to "would" in line 16 of the first paragraph.

Section 4.4.1.4.4 Cheney Reservoir. This section briefly discusses the development scenarios impacts to Cheney Reservoir. General statements are made regarding changes in constituent concentrations being modest and generally positive with implementation of alternatives. We 16 suggest the document address how potential reservoir operational changes may impact nutrient, total dissolved solids and trace element concentrations as a result of the project.

Section 4.7.1 Wetlands. The discussion on wetlands is highly generalized, i.e. if there is sustained pumping there will be impacts, and if there isn't sustained pumping there won't be impacts. The analysis should determine the reasonably foreseeable pumping requirements for each alternative and then determine the impacts to wetlands as a result of the pumping or any 17 other related action that may impact them. Any revised discussion in this section should be coordinated with the discussion in Section 4.7.3 Wildlife, which currently indicates there would be impacts to wetlands if there is drawdown, but again does not attach any specific effects to the alternatives.

Section 4.7.3 Wildlife. There is no discussion of the alternatives' impacts on the 10,000-acre Wildlife Management Area at Cheney Reservoir. Discussion in Section 4.14 Recreational Resources indicates that this wildlife area would potentially be impacted by lower water levels under some of the alternatives. Suggest that the analysis and discussion of the impacts to the 3 Wildlife Management Area be incorporated into this section. It may be useful to obtain any goals and objectives from the agency managing the Wildlife Management Area, and use this information to assess impacts of the alternatives.

13. The data provided by Reclamation for Cheney Reservoir's surcharge pool maximum elevation, approximate surface area, and estimated storage capacity has been reviewed and incorporated as recommended into Figure 3-2, Section 3.3.1.1 of the EIS.

14. The City appreciates Reclamation's concern that additional threatened, endangered, or candidate species of flora and fauna could have been added to the federal list of species during the time the ILWSP has been under consideration and this EIS has been in preparation. Admittedly, reference to all formal and informal correspondence with state and federal agencies has not been included in the EIS. The federal policy for acquiring the most recent information concerning the listing of "TE&C" species is acknowledged. Please also note that the May 21, 2002 letter from the U.S. Fish and Wildlife Service (FWS) did not identify additional species for inclusion in the EIS nor did the May 3, 2002 letter from the Kansas Department of Wildlife and Parks (KDWP). Development of the recommended Hydrobiological Monitoring Program will also provide an opportunity for KDWP and FWS to identify if any additional information is needed to evaluate possible ILWSP impacts to state or federal listed threatened or endangered species. The information received from Reclamation and other agencies referenced in this response have been incorporated as appropriate into the EIS.

15. The Cheney Reservoir conservation pool elevation data presented in Section 4.4.1.3.4 of the EIS has been changed as recommended to maintain consistency. The recommended verb tense change has also been made.

16. Nutrient loading in Cheney Reservoir will continue to vary with the ILWSP in place depending on inflow volumes and season, water storage volume in the reservoir, and agricultural practices used in the upstream watershed. According to City representatives, a Citizens Management Committee is actively working with land owners and local resource and land management agencies in developing a watershed protection program that educates, promotes, and implements a series of best management practices in the North Fork of the Ninnescah watershed above Cheney Reservoir. By developing and implementing this watershed protection program, a positive impact on total suspended solids and nitrogen and phosphorus nutrient levels in Cheney Reservoir is expected. However, no reduction to trace element nor total dissolved solid concentrations is expected. Section 4.4.1.4.4 has been revised to include this information.

17. The City recognizes that the discussions in the EIS relative to wetland impacts are rather generic. Wetland impacts resulting from implementation of the ILWSP, if they are present, would occur as a result of project construction or operation. Wetland impacts due to construction depends on the placement of the project facilities. Several years ago, Reclamation prepared an environmental assessment (EA) and Finding of No Significant Impact (FONSI) for the Equus Beds Aquifer Recharge Demonstration Project. Environmental commitments made in that EA and are still being followed by the City today.

    One of the environmental commitments in the 1995 EA is to avoid and minimize any impacts to wetlands due to the location and construction of project facilities. A process to implement this commitment was established. Project facilities are tentatively located based on geologic and engineering considerations. A field review of the natural resources (wetlands, cultural resources, riparian vegetation, etc.) at these tentative locations is then made . If a specific natural resource will be impacted, the project feature is relocated in the field to an adjacent area that avoids the specific resource, thereby either removing the impact or decreasing the significance of the impact. Since the actual location of project facilities will be developed in phases and determined at a later time, the accurate evaluation of construction-related environmental impacts is difficult to accomplish for alternative comparison purposes.

An estimate of the total amount of land area that would be disturbed during construction and on which land use would be changed is included in the EIS by alternative. As a result, a general comparison of impacts can be made. However, specifically identifying how many acres of wetlands or which cultural resources sites would be impacted during construction disturbance and operations is not possible at this time nor included in the EIS since project facilities have not been located on the ground. Possible operational environmental impacts are further complicated by establishment of the final conditions under which some of the ILWSP components will be "turned on" and the frequency, duration and intensity with which the project will actually be operated.

When the recharge diversion wells or collector wells for the expanded Local Well Field are operating, flows in the Little Arkansas River will be decreased. However, the diversion wells will not operate unless the discharge at Valley Center is above 40 cfs and above 20 cfs at the mouth of the Little Arkansas River. In addition, the baseflow in the Little Arkansas River will increase over time due to recharge of the Equus Beds aquifer. Overall, these flow impacts should not significantly reduce groundwater levels along the river or impact riparian wetlands. However, it is very difficult to accurately predict the location and magnitude of any impacts that may occur to riparian wetlands. This is the reason that the EIS recommends implementation of a biological monitoring plan. General concurrence with this approach and the use of adaptive management is found in the letters from FWS dated May 21, 2002 and KDWP dated May 3, 2002.

As a potential project benefit, increased groundwater levels in the Equus Beds well field area may restore some wetland areas that have been dry in recent decades. Therefore, the net impacts to wetlands due to this project are not expected to be significant and could even be positive.

Revisions to Sections 4.7.1, Wetlands, and 4.7.3, Wildlife, have been made to reflect the above discussion. In addition, discussions in both sections in the EIS are now in agreement as recommended by Reclamation in terms of anticipated wetland impacts.

18. The City concurs that the impacts of proposed alternatives to the Cheney Reservoir Wildlife Management Area were not discussed in detail. In fact, impacts to Cheney Reservoir and the Wildlife Management Area due to implementation of any of the proposed alternatives will be positive compared to the "No-Action" alternative. In addition, KDWP and FWS did not indicate in their comment letters to the DEIS that any impacts to the Wildlife Management Area at Cheney Reservoir would occur or should be discussed in the EIS.

Conversations with KDWP personnel on October 28, 2002 at Cheney Reservoir indicated that no specific goals and objectives have been established for the Wildlife Management

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Section 4.7.4.8 Whooping Crane. The last paragraph of this section states that displaced whooping cranes will move to "less disturbed areas in the vicinity, such as QNWR or CBWA." Suggest citing information that supports this finding and verifies that carrying capacity and/or other environmental aspects are adequate at both QNWR and CBWA for the potentially displaced whooping cranes. 7

Section 4.12 Cultural Resources. It appears that the cultural resource inventory conducted for the EIS is at the Class I level. However, if any Federal agencies become involved in the implementation of the proposed project, an on-the-ground Class III survey/inventory of all areas affected by the project would need to be performed. 20 If the inventory revealed any cultural resources which would be affected by the proposed project, the Federal agency(s) would need to implement a signed Memorandum of Agreement or a signed Programmatic Agreement with the State Historic Preservation Officer (SHPO).

Section 4.14 Recreational Resources. This section is very general and provides limited analysis of the effects of the alternatives on recreation at Cheney Reservoir. There were a number of public comments related to recreation at Cheney Reservoir, which don't appear to be addressed by the analysis presented in this document, such as how changes in operations based on each of the alternatives will impact lake-side facilities, boating, sailing, etc. 21

Suggest that the analysis on Cheney Reservoir recreation be expanded. Consider factors such as anticipated reservoir levels for each of the alternatives in conjunction with season of use, types of use, types of facilities, and related data, to determine the anticipated impacts on the quantity and quality of recreation at the reservoir. If impacts on recreation at Cheney Reservoir are anticipated, suggest considering options for mitigation.

With regard to the first paragraph under "Cheney Reservoir", all releases from the flood control pool are through the controlled "River Outlet Works". The uncontrolled spillway only becomes operational if the reservoir were to rise into the surcharge pool. Based on this information and the comments provided in ES-4, we suggest that the first paragraph on page 4-68 be rewritten as follows:

"**Cheney Reservoir** Should the City's need for more water arise at a time when Cheney Reservoir is operating within the flood control pool, deliveries from the reservoir to the City's water treatment plant could be increased from the conservation pool maximum of 47 MGD to the flood control pool maximum of 80 MGD. This would allow the City to utilize a larger portion the water stored in the flood control pool that would otherwise be released through the river outlet works under the direction of the Army Corps of Engineers." (Also, see General Comment No. 4) 22

The four consecutive paragraphs under Recreational Resources, Cheney Reservoir on pages 4-69 and 4-70 beginning with "Reclamation set the priorities..." and ending with "..from both sources simultaneously, if necessary." have many misstatements and misrepresentations. We suggest that these four paragraphs be replaced with the following two paragraphs: 23

Area. Given the fact that water levels with each of the proposed alternatives will be as high and more stable than without alternative implementation (Section 4.4.1.3.4 Cheney Reservoir) indicates that the overall net impact to the Wildlife Management Area and Cheney Reservoir in general will be positive. Changes in Section 4.14 have been made to reflect these impacts and concepts.

19. Whooping cranes have not been documented using habitats found along the Little Arkansas River or the North Fork of the Ninnescah during annual migration events. The EIS discussion was intended to indicate that if this remote combination of events possibly occurred, it was likely that the cranes would temporarily move to suitable habitat found nearby, such as on the QNWR and the CBWA, while pipelines or wells were installed. QNWR and CBWA personnel confirm that designated critical habitat for the species is found on each area and that sufficient habitat exists at either location to temporarily satisfy any needs additional populations might require. Section 4.7.4.8 has been altered to clarify this concept.

20. Cultural resource surveys of the entire project area have not been completed. Project facilities are proposed to be developed in phases, and cultural resource field inventories are completed, as these facilities are tentatively located on the ground. If a cultural resource property is identified and would be impacted, an attempt to avoid the cultural resource property by relocating the proposed facility is made. This process was first proposed in coordination with the Kansas SHPO and is currently being maintained. Discussions with the SHPO to develop a MOA or MU detailing the requirements pertaining to cultural resources have been initiated for the ILWSP.

21. As a result of this comment and the following two comments, Section 4.14, Recreation Resources, has been revised. A more detailed discussion of the recreational impacts resulting from the public comments received during the scoping process and the alternatives presented in the EIS has been added.

    One of the 42 "highly significant" issues identified and reported during the scoping process (Appendix D) centered on recreation at Cheney Reservoir and the North Fork of the Ninnescah. The comment requested that impacts to recreation due to operational changes at Cheney Reservoir be described relative to boating, swimming, water skiing, sailing, angling, wildlife appreciation, hiking, horse-back riding, camping, hunting, trapping, and shooting.

    To provide an answer to the comment, impacts to recreation resulting from the no-action alternative, current operation, and two proposed alternatives are compared (Section 4.14, Recreation Resources). Hydrologic information used in the assessment is found in Section 4.4.1.3.4, Cheney Reservoir, and helps describe the water level changes that are expected to occur under each alternative.

22. We concur that the wording in the referenced paragraph (second paragraph, Section 4.14, Recreation Resources) is not totally correct. While the suggested revised paragraph provided by Reclamation is certainly an improvement, the City does not believe that it is totally accurate. Therefore, we have taken the liberty of inserting into the EIS using the basic paragraph suggested by Reclamation with one or two modifications. The wording originally

"There are five allocated pools within Cheney Reservoir: surcharge, flood control, conservation, fish and wildlife, and dead (see Figure 3-2). Each pool serves different purposes and is defined by top and bottom elevations that were determined during Reclamation's planning and design process. The surcharge pool (elevation 1429.0 - 1453.4) is designed to temporarily store inflow from the probable maximum flood (PMF) which would result from the worst storm of record. Flood releases from the surcharge pool would be at the direction of Reclamation. The flood control pool (elevation 1421.6 - 1429.0) is designed to temporarily store inflow from lower frequency floods. The size of the flood control pool is based on downstream flood protection benefits that were defined during Reclamation's planning process. Flood releases from the flood control pool would be at the direction of the Army Corps of Engineers. The conservation pool (elevation 1392.9 - 1421.6) is designed to permanently store municipal and industrial (M&I) water for the City of Wichita. M&I releases from the conservation pool are controlled by the City of Wichita. The fish and wildlife pool (elevation 1378.5 - 1392.9) is a minimum pool that was established in the 1960 authorization for the Wichita Project, Public Law 86-787. There are no scheduled releases from this pool. The dead pool (elevation 1368.0 - 1378.5) is the portion of the reservoir which is located below the lowest release structure elevation, i.e. no reservoir can be made below elevation 1378.5. In the last 10 years, Cheney Reservoir has fluctuated between elevation 1416 and 1428. However, most of the time the fluctuation was between elevation 1419 and 1422.

Although there is no minimum pool for recreation, recreation is an authorized secondary purpose of the Wichita Project. Public recreation use of the reservoir in recent years has average around 1 million visitors per year. The initial funding for recreation facilities was $338,000 (1960 price level). Although the water supply is the primary purpose of the Wichita Project, the plan to limit releases from the reservoir to a maximum of 47 MGD when the reservoir at or below elevation 1421.6 will minimize the impact of reservoir operations on public recreation use." (Also, see General Comment No. 4)

Section 4.15 Mitigation Summary. The first mitigation measure states that construction activities "will minimize impacts to wetlands, riparian areas, native grasslands, undisturbed old areas, woodlands, lakes and ponds." Suggest supplementing this with more specific information on how impacts would be minimized. 24

Similarly, the second mitigation measure states, "Electrical transmission facilities will be constructed to reduce the potential for electrocution of birds and other wildlife." Again, suggest supplementing this with information on how the facilities would be constructed to reduce this potential.

Section C.6 RESERVOIR PHYSICAL DATA. There are several misstatements in the first paragraph of this section. "Normal pool" is a Corps of Engineers term and is equivalent to Reclamation's "conservation pool". The spillway at Cheney Reservoir is at the top of the flood control pool (elevation 1429.0) not at the top of the water supply (conservation) pool (elevation 25 1421.6). For consistency with other elevation references in the report, elevation 1,393 should be 1,392.9. The City is not currently limited to withdrawals from the reservoir only when it is between elevations 1,392.9 and 1,421.6. These elevations define the conservation pool, but the included in Section 4.14 of the EIS has been changed as requested to more accurately reflect the conditions that would be expected to occur at Cheney Reservoir with the preferred ILWSP alternative in place.

23. The wording in Section 4.14, Recreational Resources, has been revised as requested to more accurately describe the water storage within Cheney Reservoir. A few modifications to the paragraphs have been made. Recreational resource discussions now included in Sections 3.11.1 and 4.14 of the EIS have been modified to include more recent recreation use data obtained from KDWP (2002) and to clarify the basic recreational impacts that may occur with the different ILWSP alternatives.

24. Additional explanation has been inserted into the first bulleted item in Section 4.15, Mitigation Summary, describing practices to be used to minimize impacts to wetlands or other important ecosystems. These processes are also explained in more detail in Sections 4.7.1 and 4.7.2, Wetlands and Vegetation, respectively. Since phased construction activities will likely disturb more than 5 acres, a NPDES permit would probably be required, including a soil erosion control plan and stormwater pollution prevention plan.

    Additional discussion concerning possible electrocution and collision with electrical distribution facilities due to any of the potential ILWSP alternatives has been added to Section 4.7.3, Wildlife. The item in Section 4.15, Mitigation Summary, to which the comment refers has been revised to be more descriptive and to reference Section 4.7.3 where additional information may be found. Both KDWP and FWS will be contacted during design for advice or recommendations relative to phase conductor spacing and power line construction in general to avoid raptor or other large bird electrocution and collision.

25. The wording originally in Appendix C, Section C.6 of the EIS has been revised to correct the items included in Reclamation's comment to accurately reflect Cheney Reservoir nomenclature and water storage data.

City can withdraw municipal water from the reservoir even when it is in the flood control pool or the surcharge pool. We recommend that this paragraph be rewritten as follows:

"**C.6 RESERVOIR DATA** The ILWS system includes two principal water storage facilities, Cheney Reservoir and the portion of the Equus Beds Aquifer in the City's well field. The relationship between water levels, water surface areas and storage in Cheney Reservoir are listed in Table C-5 and shown graphically in Figure C-3. The fish and wildlife pool at Cheney Reservoir lies between elevations 1378.5 and 1392.9. The water supply storage pool (conservation pool) for the City lies between elevations 1392.9 and 1421.6.

Appendix D. The document did not make a clear connection between how significant issues were used to drive the analysis and what actions may have been proposed to resolve issues. Suggest providing additional information, possibly in a table, that identifies the disposition of each comment or issue (e.g. significant issue, issue is irrelevant to the decision, etc.), and identifies where the comment or issue, if carried forward, is addressed in the document. 7.6

If you have any questions or need any additional information, please contact Mr. Fred Landefeld at (405) 606-2908.

Sincerely,

Donald E. Moomaw

Donald E. Moomaw
Deputy Area Manager

cc: Mr. Fred Pinkney
Burns & McDonnell
9400 Ward Parkway
Kansas City, Missouri 64114-3319

bc: D-108 (Stewart), GP- 4300 (Epperly), TX-Walkoviak

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26. As indicated in the comment, a number of significant issues were identified in the scoping process. A table of the significant issues raised by the public has been developed as recommended, and includes the corresponding section numbers in the EIS where discussions have been added for clarification. This table of significant issues has been added to Appendix D. The table has also been added to Chapter 5, Consultation and Coordination along with additional discussion to Section 5.2.2, Public Scoping Meeting.

the Chamber
Wichita Area Chamber of Commerce

May 22, 2002

Mr. Jerry Blain, P.E.
Wichita Water & Sewer Department
City Hall, Eighth Floor
455 N. Main
Wichita, KS 67202-1677

Dear Jerry:

The Wichita Chamber has regularly received reports and updates on the Integrated Local Water Supply Plan (ILWSP) developed by the City of Wichita. We welcome the opportunity to provide comments for the Environmental Impact Statement for this plan.

Safe, reliable, high quality and multiple sources of water supply are essential as the foundation for the economy and quality of life for the Wichita/Sedgwick County area. The Draft Environmental Impact Statement addresses a five-point strategy. We support this strategy and stand ready to assist in carrying out the strategy.

The Equus Beds, which are being threatened by salt intrusion, provide about half of the current supplies. A critical feature of the ILWSP is the Aquifer Storage and Recovery Project (ASR), which will increase supplies, and provide a hydraulic barrier to mitigate the intrusion and protect the aquifer. The ASR Project will also produce higher base flows in the Little Arkansas River thereby helping the environment in the area of and downstream from the Project. So, this phase of the ILWSP serves three very important purposes. To date, all the engineering studies and the results from the ASR Demonstration Project indicate superior results and prove full-scale project feasibility. We support moving forward with this innovative and environmentally conscious solution.

Multiple sources of supply are critical for the City of Wichita to continue as a regional water supplier and also to provide the foundation for anticipated future growth. Developing local sources to the extent possible while also encouraging conservation is a wise overall management and development strategy. A diversity of supply provides needed backup and protection. To this end, the Bentley Reserve Well Field and the Local Well Field can provide additional supplies during times of need. It will be important, as is pointed out in the Draft Environmental Impact Statement, to use these supplies as supplemental sources due to their relatively lower quality.

The City of Wichita is to be commended for its foresight in developing the integrated strategy and for its ability to manage and carry out that strategy. The City of Wichita is to be commended as well for its interest in and initiatives to protect and enhance the environment as a central part of this overall strategy.

Finally, planning cannot stop with the implementation of this strategy. Developing resources of the magnitude needed for the metropolitan area of Wichita is an extremely long-range proposition. Planning must continue in order to identify the source(s) of supply needed to sustain and improve the quality of life for future generations. Upon implementing the current ILWSP, most if not all local sources will be developed. Therefore, in the distant future, construction of new reservoirs may be required or pipelines from existing reservoirs may be needed. Difficult decisions lie ahead, just as difficult decisions had to be made as the current ILWSP was developed and is now being carried out. We look forward to continuing leadership by the City of Wichita beyond the current ILWSP. 3

Thank you very much.

Sincerely,

Gerald H. Holman

Gerald H. Holman
Senior Vice President

1059

Response to comments on the Draft EIS from the Wichita Area Chamber of Commerce comment letter, May 22, 2002.

1. We concur that maintaining the quality and diversity of a water supply is an integral part of the ILWSP and of a safe and reliable water supply for the City of Wichita. Your support of the ILWSP throughout its development is appreciated.

2. A willingness to think "outside the box" was an important concept during the planning of the ILWSP. As you noted, protection and enhancement of the environment was an important part of the total plan.

3. We concur that the additional water supply sources and plans will ultimately have to be developed and implemented by the City for future generations. Innovative planning will also have to be a part of this future effort.

PUBLIC HEARING
for the City of Wichita's proposed
INTEGRATED LOCAL WATER SUPPLY PLAN

April 23rd & 24th, 2002

COMMENT SHEET

Please write any comments or questions you may have concerning the City of Wichita's Integated Local Water Supply Plan in the space below.

At last someone talks public honesty of the
50s drought. From the outside the acre ft. gain by
the pilot project was not very good. Milford has 1
up front debt but a sure thing. It is Wichita's money
& Wichita's choice. I hope it works out. Because
of drainage & compaction I have been using a deep till
system for several years. I know it helps recharge.
Do not expect me to be perfect. The new TMDL
will be tough enough. The hog issue was a huge 2
problem that did not exist. I am anti-corporate hog.
The end result was the rural-Urban split over a
fairy tale. I know one family who still won't drink
their water 3/4 mile uphill from a few hogs. Safe yield
& 6 in avg. recharge are feel good terms. Mike Withrow said
pump water against the salt plume at Burrton. We now pump 3
it out. The above applies to water in general. It is all related.
I agree doing nothing is a bad option.

Name:

Phone No. (Optional) 772-5607

Address: Wilbur and Lois Kurr
9025 S. Mission Rd.
Sedgwick, KS 67135

☐ Please have someone call me to discuss my question.

If you cannot give us your questions or comments tonight, please mail this form to:
Mr. Jerry Blain P.E., Water Supply Projects Administrator, Wichita Water & Sewer Department, City Hall, Eighth Floor, 455 North Main Street, Wichita, Kansas 67202-1677

Thank you for participating in the EIS process.

Response to comments submitted on the Draft EIS on comment sheets and in letters by individuals at the Public Hearing.

Wilbur and Lois Kurr

1. The City appreciates your candor and your opinion. All of the planning studies completed by the City emphasize and support the economic feasibility of the ILWSP.

2. We concur that deep conservation tillage provides the greatest advantage to your agriculture enterprise. The potential impact of large-scale corporate agricultural enterprises may not be advantageous to the individual operator.

3. As you know, one of the primary goals of the ILWSP is to maintain the good water quality that has been found throughout the years in the Equus Beds aquifer for all users. The City sincerely believes that the selected alternative provides an excellent opportunity for a sustainable water supply for everyone.

NO-TILL AND SOIL RUNOFF?

By Jim Shroyer, Extension Specialist, Crop Production

Results from a three-year tillage study at the East Central Experiment Field near Ottawa provide answers to that question. The study site was ten acre field in a grain sorghum-soybean rotation with 2-5% slopes. Soils were a mixture of Eram-Lebo and some Dennis=Bates complex. The treatments were a combination of: no-till, with fertilizer deep-banded 3-5 inches deep and herbicides broadcast on the surface; and conventional tillage system, which included a chisel-disk-field cultivator, with fertilizer and herbicides incorporated. For grain sorghum 70 lb N, 30lb P_2O_5 and 11 lb K_2O/a were used and atrazine and Dual (metolachlor) were used for weed control. No fertilizer was used for soybeans and Roundup Ultra and Dual were used to control weeds.

Averaged over the three years, 49% of the total rainfall left the field in the no-till system and 29% ran off the field in the conventional tillage system. The researchers explained this difference in runoff was due to the looser and drier soil after each tillage operation in the conventional tillage system. This allowed more water to infiltrate into the soil.

However, there was tree times greater soil loss (sediment) in the water that left the field in the conventional tillage system than with the no-till system.

There were greater concentrations of soluble phosphorus, atrazine, and Dual in the runoff with the surface applications of fertilizer and herbicides in no-till. The greatest losses of soluble phosphorus and herbicides in the runoff occurred early in the season after the first rains.

What's the bottom line?

Plant nutrients and pesticides leave the field in runoff water and attached to soil particles. No-till doesn't necessarily reduce the amount of runoff, as some people think, but it certainly reduces the amount of soil leaving the field. Unfortunately, the common practice of using surface applications of fertilizers and pesticides in a no-till system, instead of incorporating these products into the soil causes them to be lost in the runoff. If these products were incorporated, there would be less chance of them being in the runoff.

POTENTIAL EARLY SEASON SORGHUM

INSECTS

1. **Common concerns-either localized or statewide**

- *Wireworms & other seed attacking insects* – Suspect wireworms and/or others (such as seed corn beetle) as one possibility where poor emergence is being observed.
- *Chinch bugs* – Adults appear to have overwintered in wheat in some south central locations. Higher numbers could occur this year. Adults are already plentiful in some seedling corn fields.
- *Greenbugs* – heavy flights out of wheat from southern areas can coincide with sorghum emergence and result in light to heavy numbers on small sorghum plants. This is serious at times though it has been rare in recent years.
- *Cutworms* – Damage is most likely during the first two weeks following planting. In sorghum infestation is more common during from late May to mid-June.

2. **Occasional pest insects** – not usually anticipated, but damaging during some years.

- *Billbugs* – This is becoming more of a common problem. Injury occurs from emergence up to a month after planting. Suspect it when you have a complaint about loss of stand, leaves of small plants with feeding injury, or complaints about plants dying. A good clue is when you find leaves with a pattern (or rows) of oblong holes. Billbug damage is almost always confined to areas of fields infested with yellow nutsedge.
- *Black Sugarcane Rootstock Weevil* – If you are examining injury to small plants, you may observe some leaves exhibiting a pattern of scattered tiny, round, pinpoint sized holes. This could be feeding by the adult, a miniature black weevil. Look for it in the vicinity of symptomatic plants. The larvae develop later in the summer. By looking at mature plants, you may see the very small, whitish grubs in a blackened cavity near the base of the stalk close to where the braced roots are attached.

...ronomic yield booster: soil tilth

Your plant's life support system

m working with
?uck Shoff
?oley Tractor
?e has a lot
? info on
?his

The Case IH Crop Production Soil Management group has identified four agronomic focus areas: soil tilth; seedbed conditions; plant food availability; and crop residue management. Each can impact yields and each can be enhanced by matching the plant's needs to the appropriate soil management tool. In this first of a four-part series, we look at soil tilth.

When you get right down to it, the soil is what matters most for your crops. It holds them in place and supplies all their needs other than those provided by sunlight and air. Even water must first make its way through soil before the roots can use it. You're not simply tilling your fields; you're preparing a life support system for your plants. The more favorable you make this life support system, the more your plants will reward your efforts with higher yields.

"If you have a good soil environment, you'll grow a good root system," says world champion corn grower Francis Childs. "You'll have a very healthy plant and you're going to have a high yield."

For agricultural crops, a good soil environment:

- Maximizes water/air permeability to reduce ponding, runoff and erosion.
- Allows good early root growth.
- Increases air and water exchange and plant food availability.
- Enables percolation of excess water deep into the soil.
- Enables the roots to go deep to provide moisture needed during dry times.
- Increases yields and your profit potential.

A healthy soil has approximately 50 mineral, soil and organic matter an 50% pore space (air and water). To b most effective, this balance of soil an pore space also has an even distributio of aggregate size and distribution.

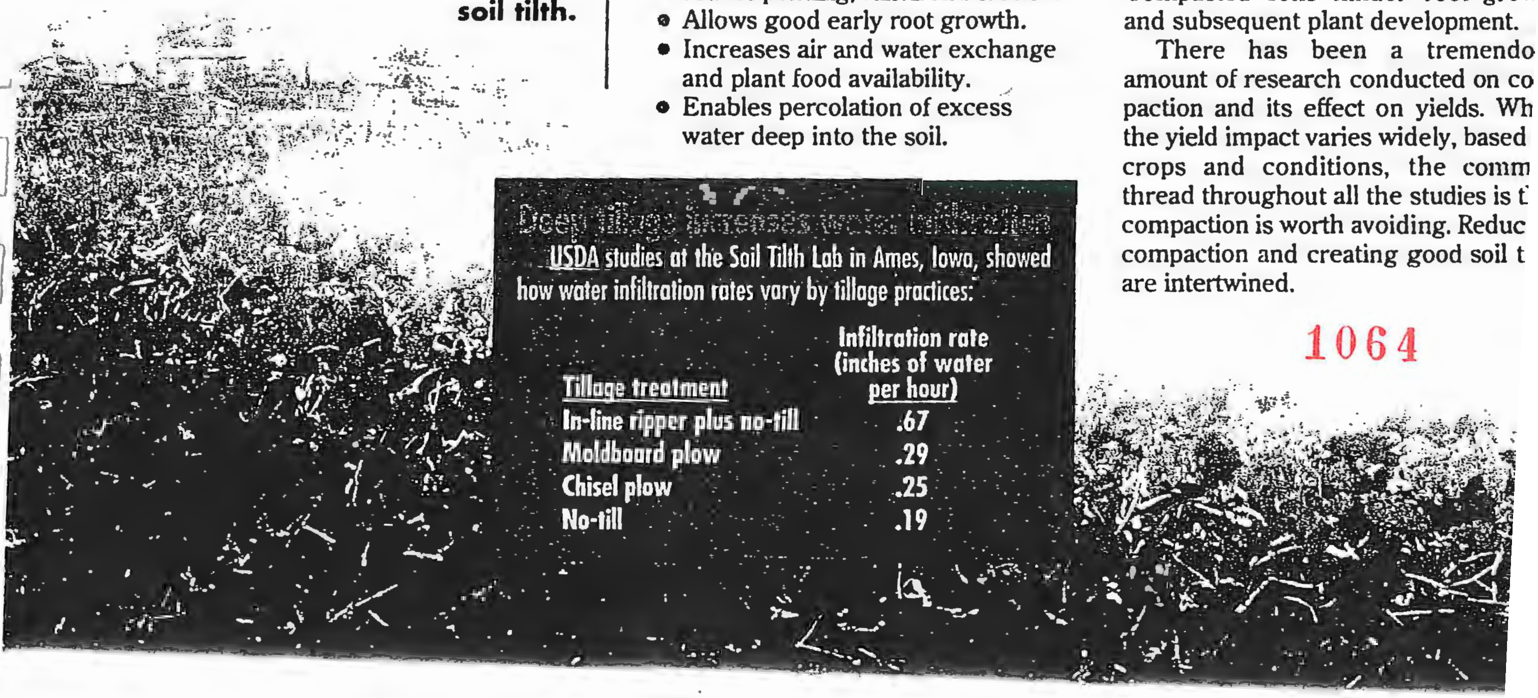
Soil with good tilth — having nea that 50/50 balance of soil and por space — readily absorbs water, lets th excess drain through and allows root to reach moisture reserves.

Creating good soil tilth

Compaction is the enemy of so tilth. It compresses those valuable po spaces which reduces the soil's abili to hold and move water and a Compacted soils hinder root grow and subsequent plant development.

There has been a tremendo amount of research conducted on co paction and its effect on yields. Wh the yield impact varies widely, based crops and conditions, the comm thread throughout all the studies is t compaction is worth avoiding. Reduc compaction and creating good soil t are intertwined.

1064



Deep tillage increases water infiltration

USDA studies at the Soil Tilth Lab in Ames, Iowa, showed how water infiltration rates vary by tillage practices:

Tillage treatment	Infiltration rate (inches of water per hour)
In-line ripper plus no-till	.67
Moldboard plow	.29
Chisel plow	.25
No-till	.19

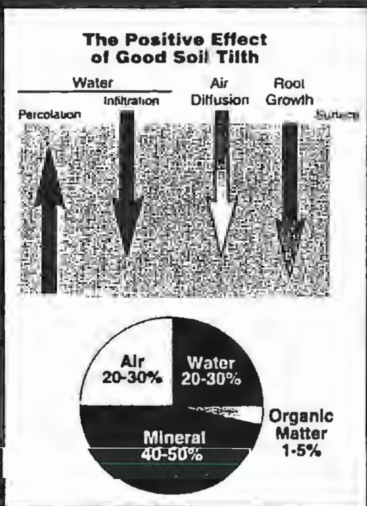
The way you manage field traffic and utilize soil management (tillage) equipment can improve soil tilth even on the tightest soils. "You need to recognize the effects of traffic compaction and know what inputs your plants require from the soil," explains Kent Senf of the Case IH Crop Production Soil Management group. "Then you can choose the most effective tillage inputs to get the changes your plants need."

For example, Senf says, using a Case IH ripper with the patented tiger points can be a very effective method of reducing subsoil compaction and creating a healthy soil environment.

Use deep primary tillage to shatter compaction layers and reorient the shattered soil aggregates. This improves soil tilth and allows greater utilization of water by the plant.

While a moldboard plow provides near total inversion of crop residue which can add valuable organic matter, deep non-inversion tillage with tiger points gives the best water infiltration rates. A study at the Soil Tilth Lab in Ames, Iowa, showed a deep-running in-line ripper provided nearly twice the water infiltration rates provided by the second most effective tool, a moldboard plow.

Use secondary tillage to prepare the type of seedbed your plants need. Thanks to an increasingly broad range of seedbed preparation tools and integrated harrow attachments, you can manage crop residues and soil tilth without compromising the other. Reducing compaction and improving tilth are among the best long-term soil management steps you can take. Water usage, root growth, nutrient utilization ... all these vital plant functions are enhanced when soil tilth is improved. By using the right implements at the right times, you can help make your soils become the best possible life support system for your plants and in turn gain higher returns from your investments in tillage, seed and fertilizer. ■



Good soil tilth ...

- Allows water infiltration and makes it available to the crop.
- Lets air in.
- Allows easy root growth.

Compacted soils ...

- Drain poorly.
- Stay wetter and cooler longer.
- Hinder root growth.

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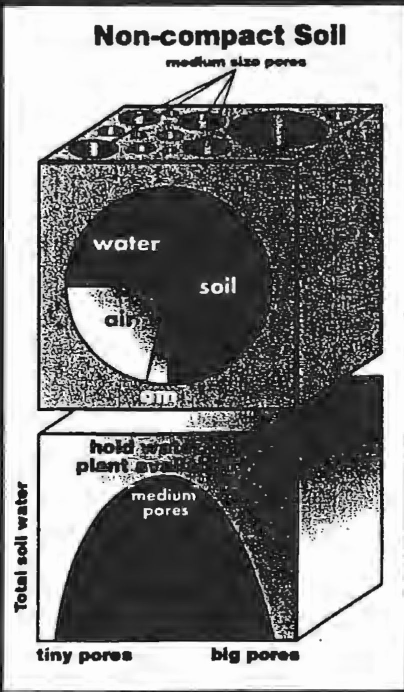

Soil compaction ...

Compaction is the enemy of soil tilth. Here are ways to reduce compaction and improve soil tilth.

Reduce compaction by:

- Keeping heavy equipment off wet soils.
- Adopting controlled traffic patterns.
- Reducing tractor tire pressures to minimum recommended levels.
- Using tracks rather than tires for large tractors and grain wagons, especially if you farm compaction-prone soils.
- Using wider implements (to reduce the number of passes).
- Using compaction-causing implements, such as heavy offset disks, only as needed for specific tillage and residue management needs.
- Carrying the least amount of tractor weight needed for the job (reduce axle loads).
- Varying tillage depths from year to year.

Improve soil tilth by:

- Deep-tilling at least once every three to four years.
- Installing or improving drainage systems (tile or surface) as needed.
- Managing soil residues.
- Maintaining surface residues to reduce erosion; inverting surface residues as needed to build organic content.

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5825 Memphis
Wichita, KS 67220

May 23, 2002

Jerry Blain, P.E.
Water Supply Projects Administrator
Wichita Water and Sewer Department
City Hall, Eighth Floor
455 North Main Street
Wichita, KS 67202-1677

Dear Jerry,

Thank you for the opportunity to review and comment on the Draft Environmental Impact Assessment (DEIS) for the City of Wichita's Integrated Local Water Supply Plan (ILWSP). The City, your department and Groundwater Management District 2 are to be commended for your proactive stance to preserve both the quality and quantity of the City's water supply, especially, the Equus Beds Aquifer. As my comments reflect, I am, however, concerned that the additional water supply will be used in an inefficient manner by increasing the ability of the City to provide water which will encourage the current trend of expansion and development in rural areas, rather than encouraging growth within or continguous to the City. 1

I would like to offer the following comments and reflections regarding the DEIS:

CONSERVATION IMPACTS

- It would seem that much more could be done to conserve water resources within the City 2
- The DEIS states an assumption of a 16% conservation rate but does not define the comparison implied (16% compared to what/when?) 3
- While water rates for industry are apparently the same as for residential users, the industrial user has little seasonal fluctuation and therefore is not subjected to the higher tier costs faced by residential users in summer months 4
- A conservation rate structure (other than rate based) should be available to lo-use residential users. Perhaps the KGE conservation rate could be used as a model 5
- Incentives for retrofitting older homes with lo-flow/lo-flush options should be instituted, particularly in low-income neighborhoods. A tremendous volume of water could be conserved by doing so. The City has offered such incentives to farmers in the Cheney Reservoir program, why not do it for residences? 6

LAND CONVERSION IMPACTS

- The only land conversion impacts considered in the DEIS are those associated with the construction and operation of facilities of the ILWSP. 7
- The DEIS states that " The primary long term effect will be...facilitation of current trend in area population growth which would not be a significant impact"; 8

Response to comments submitted on the Draft EIS in letters by individuals during the public comment period.

Ellie Skokan

1. The City appreciates and concurs with your opinion concerning the need to maintain the quality and quantity of the current water supply and the Equus Beds Aquifer. While we understand your concerns about growth and expansion, much of the water supply developed will be used within the city's current geographic service area. Growth and expansion will also occur as long as the City of Wichita's water supply service policy remains the same.

2. Water conservation efforts being planned and in place with the City are described in Section 2.3.1 of the EIS. While conservation can be enforced through regulations, public education and commitment to daily conservation is equally as important. The City regularly provides advice and information on water conservation through a variety of programs and efforts. The City believes that continuing these conservation programs will increasingly attract public participation. Your concerns are appreciated.

3. The projected water demand in the year 2050 has been reduced by 16 percent due to the implementation of a variety of water conservation practices. Discussions describing these estimated water savings are presented in Section 1.3.4 and numerically shown in Table 1-2. The water conservation reduction was applied to the projected average day demand and the maximum day demand from the year 2000 through 2050 throughout the City's estimated service area. The City believes that 16 percent is a reasonably obtainable goal.

4. Industrial water users generally do require more of a base water volume for use that extends throughout the year and less seasonal fluctuation. Very often this base water use volume used by industry is consistently higher all year, forcing them to stay in a higher tier of costs year-round. If an industry uses water for cooling, similar seasonal increases in water use would occur as it does with residential users in summer months.

5. As you know, no water user experiences an increase in water rate and cost until 110 percent of the winter water consumption rate is exceeded. If low water use residential users do not exceed 110 percent of their winter water consumption rate, no rate or cost increase would occur. The City believes that a "conservation rate structure" is already in place for low water use residential users.

6. An incentive program for fixture replacement and retrofitting older homes may be instituted by the City in the future if the value of water conserved would approach the cost of water treatment and supply. For the last decade, new water fixtures that are available for purchase and as replacement have been low-flow or reduced-flow designed, as required through the Clean Water Act, as amended. While the use of only these fixtures may be difficult to enforce, the City continues to encourage their useprograms similar to the Cheney Reservoir program mentioned in your comment.

7. We concur that the EIS concentrates on land use impacts that result from the actual construction and operation of the proposed ILWSP. Additional land use changes may occur

due to the availability of a dependable water supply and the addition of new customers outside of the City's current service area. These land use issues will continue as growth in the Wichita area and surrounding region continues. Predicting the extent of these changes is more difficult to substantiate due to shifting individual preferences, other available water supplies, and the general economy. These patterns of population increase and urban expansion are anticipated to continue as long as the City continues to accommodate the projected population growth estimated to occur through the year 2050. The EIS recognizes that these patterns are likely to occur (Section 4.20, Cumulative Impacts), but does not attempt to define in detail the impacts that result from these patterns.

8. As background for the ILWSP, the City's objective is to meet the estimated water demand projected to develop through the year 2050. Estimates of the projected water demand were developed using population projections from the U.S. Bureau of Census, City customer data, the U.S. Department of Commerce - Bureau of Economic Analysis, and the Wichita-Sedgwick County Metropolitan Area Planning Department (MAPD). Without the ILWSP in place, the City would limit water delivery to both new customers within the present service area boundary and, as much as possible, new water delivery to customers outside its service area. Even with these conditions, land use changes will occur within and outside the City's current service area. Urban and other growth would continue because the City is required by statute to serve new customers within its service area boundary. Eventually, the City would not be able to maintain system pressure during maximum or peak water use periods. Land use changes will continue to occur outside the City's service area boundary or incorporated area as agriculture is replaced by more urbanized development around the City and other small communities in 3- or 4-county area. This development is anticipated without the City providing a dependable water supply. The economic value of the loss of "$100-165 million from 1,000 to 2,000 acres per year" in agricultural production as indicated in the comment would be more than offset by the increase in land value due to higher density development.

   Wording in the EIS has been reviewed and revised as needed to make sure that any inconsistencies have been corrected.

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that "Subdivision development…would be facilitated"; and, that land use changes "…would not be considered adverse or significant." This is in contradiction to the MAPD Comprehensive Plan Update Vol.2, Issue 2, 4/6/1999 which determined that the loss of farm land due to city expansion in the Current Trends scenario is estimated to be 1000 - 2000 ac per year with a $ 100 - $ 165 million production loss in 30 years. Such expansion will continue if water is available, as shown by the DEIS

- The same Current Trends scenario for City growth will also lead to an estimated $ 52 million additional expenditure for water and sewer facilities over and above that needed for growth limited to in-fill and contiguous development (MAPD, op cit). 9
- The DEIS, itself, states "In the long-term, a significant deterioration in air quality could occur…" in rural areas due to additional air pollution sources from urban expansion 10

LITTLE ARKANSAS ALLUVIUM IMPACTS

- There is no information provided in the document regarding the presence of groundwater users in the area of the Local well field. Any such users with wells within ½ m of the field would be impacted since these wells are projected to be operational 40 % of the time. While it can be presumed that no one is using this water for drinking purposes, it is my understanding that many City residents have wells for watering lawns, gardens, etc. 11
- There does not seem to have been any outreach to the low income and minority community which would be affected by the local well field expansion. The DEIS merely states that such a community exists in the area. I have followed this project closely and recall only a few (2?) meetings in Wichita and none in the affected community. More work should be done on this count to address any Environmental/Social Justice Issues. 12
- I would like further information regarding the impact of replacing groundwater with river water due to pumping in the local well field. The DEIS states this is "…not considered to be a significant project impact." Given, the possible contaminants in the Little Arkansas system, I think the rationale for such a decision should be given. 13

NORTH FORK NINNESCAH/CHENEY RESERVOIR IMPACTS

- The information on negative impacts on recreational users should be more widely disseminated. While agencies have been in the loop, I wonder what effort has been made to include the affected users in the discussion (ex. Ninnescah Yacht Club) 14
- It is unfortunate that this project will not rectify the current situation of little or no flow below Cheney Reservoir. The DEIS estimates that even with some increase in flow volume, the flow will still be less than 75% of the Minimum Desirable Streamflow (MDS) 7 of 12 months of the year. 15

9. Continued growth within the City's current service area is producing demands that exceed the system capacity. In addition, existing City facilities continue to age, requiring increasing maintenance as time passes. Continuation of the current trends, including expansion of the City's service area, will result in additional expenditures for expanding sewage treatment facilities and associated infrastructure. In reality, these needs will occur in the future whether or not the ILWSP is implemented. While these impacts may be considered to be cumulative in nature, they are outside of the scope of the EIS and the ILWSP and do not need to be addressed in the EIS.

10. The City believes that the statements in Section 4.5 of the EIS are correct. First, impacts to air quality due to ILWSP construction activities would be temporary. Second, impacts to air quality due to the conversion of agricultural land to an urban setting with residential areas, vehicles and industy would be adverse and represent a significant change. As a result, the statements in Section 4.5 have been modified in the EIS to improve clarity.

11. It is projected that the collector wells associated with the Local Well Field expansion will be operated at full capacity approximately 40 percent of the time. Operation of these collector wells could reduce groundwater levels in their immediate vicinity or cone of depression by 10 to 15 feet; these drawdowns will decrease rapidly at larger distances from these wells. Private wells within 0.5 mile of these collector wells could be impacted; however, these impacts should not adversely affect the operation of these private wells unless they are both quite close to a collector well and quite shallow.

12. Environmental justice discussions are presented in Sections 3.8 (Table 3-16) and 4.11 of the EIS. Two low income or minority areas were identified – the City of Sedgwick, Kansas and the area of the Local Well Field in Wichita. The first public scoping meeting for the ILWSP was held at the Minisa Recreation Building at 704 West 13th Street in Wichita. This location was centrally located in the proposed Local Well Field expansion. The general area containing the Local Well Field was identified in the EIS as an area having a larger percentage of minority and low-income population. However, anyone living next to or near the Little Arkansas River (the City of Sedgwick, Kansas) from north of Halstead south to Wichita and the confluence of the Little Arkansas and the Arkansas rivers could potentially be impacted. From an Environmental Justice standpoint, the analysis conducted and included in the EIS found that there would be no disproportionate share of impacts on low income or minority populations in the ILWSP project area.

13. In the ILWSP, installing horizontal collector wells in the alluvium of the Little Arkansas River and the floodway would expand water production from the Local Well Field. The river and floodway alluvium is made up of fine to coarse sand and gravel with only small amounts of silt and clay. As a result, a strong hydraulic connection exists between surface water flowing in the river and the groundwater in the alluvial aquifer. Water naturally migrates back and forth from the river to the aquifer. Because of the constant exchange and mixing of river and ground water, overall water quality tends to be similar. The installation and operation of the new collector wells will not impact this ongoing process.

    As discussed in Sections 3.3.1.4, 3.3.2.3, 4.4.1.4.1, and 4.4.2.2.2 of the EIS, the blending of Little Arkansas River water and nearby alluvial groundwater is not considered to be a significant water quality impact. Water quality in the river and adjacent alluvium is considered good at the present time. If this were not true, the river could not be used as a source of water for recharging the Equus Beds aquifer. It is always possible that the Little Arkansas River could become temporarily contaminated in the future. This contamination would most likely result in an immediate cessation of pumping until water sources such as the Local Well Field or the Equus Beds would not be impacted.

14. The Ninnescah Yacht Club, the City of Cheney, local citizens and the recreating public were provided an opportunity to raise issues at the public scoping and other informational meetings, and to comment on the DEIS at the public hearing. Comments made at various meetings and used to prepare the EIS are described and summarized in Chapter 5 of the EIS.

15. The success rates for meeting the MDS in the Ninnescah River are discussed in Section 4.4.1.2.3. These rates vary from a low of about 55 percent in November to a high of about 85 percent in July. These success rates will remain unchanged or improve slightly with implementation of the ILWSP. The project will tend to increase the frequency and duration of releases from Cheney Reservoir although there will still be significant periods with little or no flow below the dam. However, with no ILWSP, the frequency and duration of releases from the reservoir will be reduced to about half of their current occurrence. Establishing a minimum release from Cheney Reservoir would adversely impact the yield of this water supply reservoir. To meet the City's projected water demands, this reduction in yield would have to be offset by increased yield from other project components or other supply sources, all of which would result in increased environmental or social impacts.

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ARKANSAS AND LITTLE ARKANSAS RIVERS IMPACTS

- Analysis of stream data is based on median monthly flows between 1923 – 1996. While this makes comparison of past and future changes convenient, it ignores the levels of flow which have the greatest impacts on riparian ecosystems – i.e., the high flood stages and the low water drought conditions. I'm not sure what data would be more beneficial for comparisons, but some attention should be given to these extreme data points for an adequate analysis 16
- Are there any users of Arkansas River water below Wichita who would be impacted by the projected decrease in flow? 17
- The Local well field expansion and the ASR are projected to decrease flow in the Little Arkansas below Valley Center (5-40% of the time)and through the City (more than 90% of the time). This in turn will lead to decreased groundwater availability and decreased wetlands. The impacts of these alterations do not seem to have been adequately addressed in the DEIS. 18
- The relationship between decreased streamflows in the Little Arkansas and the concurrent concentration of any contaminants in that system has not been addressed. It is mentioned briefly as an impact on the Arkansas River system, but does not seem to be included in the Little Arkansas analysis. 19
- I do not find any mention of organic pollutants in either river. Only routine water analysis data is presented in the DEIS. I know that atrazine is a recurring problem in the Little Arkansas basin and I believe data collection and analysis regarding atrazine was done by the USGS in conjunction with the City's pilot ASR project. Why is this information not in the DEIS? What is the impact of these contaminants and how will they be addressed? 20
- A critical issue regarding the heavy dependence on Little Arkansas River basin water (in the ASR project) as an additional water source does not seem to be addressed in the DEIS. What is the projection for water availability during periods of prolonged drought, such as the 1930's and 1950's. During these periods, no water will be available for recharge, withdrawals from the Equus Beds will remain limited, and Cheney Reservoir must be maintained at the Fish and Wildlife Pool level. This issue speaks to the importance of a more rigorous conservation plan. 21

BIOLOGICAL ASSESSMENT AND IMPACTS TO THREATENED AND ENDANGERED SPECIES

- The data for the conclusions in this section seem to be minimal. One would expect that a greater database would have been gathered and analyzed before the DEIS was completed (examples include survey of Eagle nesting sites, consideration of the critical habitat for the Arkansas Darter in the area of the Bentley well field, consideration of loss of wetlands on white-faced ibis, etc.). I question the adequacy of doing a hydrobiological assessment <u>after</u> completion of the DEIS, it would seem it should <u>precede</u> such an assessment. While such monitoring during the life of the project will be critical, if no baseline data is gathered now, it will be nearly impossible to assess any future impacts. In addition, once changes have occurred, it is <u>too late</u>, especially for threatened and endangered species. 22

16. The City concurs that the impact of altering high and low flows also need to be considered in the evaluation of a project like the ILWSP. Median monthly flows are used to show how the project could affect stream discharge on a seasonal basis (please see Figure 4-3). However, flow duration curves presented in Figure 4-4 show the frequency of stream discharges over the entire range of flows. Flows presented in Figure 4-4 indicate that extremely low, or drought flows will be enhanced by project development and, during high flows, impacts with the project in place become largely insignificant.

17. Kansas Division of Water Resources' records indicate there are only a small number of water rights downstream of Wichita which divert water from the Arkansas River. This situation is likely due to the relatively poor quality of this water probably due to the high chloride content, which makes it less desirable for irrigation and other uses. The proposed project diversions are of such a small magnitude compared to the typical discharge in the Arkansas River that they should not have a discernible impact to these downstream water users.

18. When the recharge diversion wells upstream of Wichita or the collector wells proposed for the Local Well Field are operating, flows in the Little Arkansas River will be reduced. However, the diversion wells will not operate unless the discharge at Valley Center is above 40 cfs; a MDS of 20 cfs or more in the Little Arkansas River will be maintained at the confluence of the Little Arkansas River with the Arkansas River. Hydrologic model results predict that the baseflow in the Little Arkansas River will increase with time as the Equus Beds aquifer is recharged. Overall, the potential flow impacts resulting from implementation of the ILWSP should not significantly reduce groundwater levels or impact wetlands along the Little Arkansas River. However, it is difficult to predict the specific location and magnitude of impacts that may occur to wetlands due to the variable frequency and duration of the ILWSP when operating. This is the reason why the City recommends implementation of a HBMP in the EIS.

    Increasing groundwater levels in the Equus Beds well field area with time may ultimately restore some wetlands that have been dry in recent decades. This is one reason why discussions in the EIS indicate that the net impact to wetlands due to the ILWSP are not expected to be significant and could even be positive. Again, the proposed HBMP will be designed to assist in quantifying wetland impacts, whether positive or negative.

19. As discussed in Section 4.4.1.4.1 of the EIS, water quality in the Little Arkansas River improves moving downstream. This indicates that the water entering the stream, which is primarily from groundwater discharge, is better quality than the water already in the river. Pollutants currently found in the stream are expected to continue to occur in the future. The concentrations of these pollutants in the stream are not expected to increase with operation of the ILWSP even though water withdrawals will occur. Withdrawals will normally occur during periods of higher flow, when these pollutant concentrations are normally lower. With implementation of the ASR portion of the ILWSP, groundwater discharges to the Little Arkansas River are expected to increase as the aquifer is recharged. With this inflow, water quality in the Little Arkansas River is expected to improve with time.

20. You are correct that organic pollutants do occur periodically in both the Little Arkansas and Arkansas rivers and that a great deal of water quality sampling and analysis was conducted

by the City for the Equus Beds Groundwater Recharge Demonstration Project. A great deal of effort was spent by the City in cooperation with the USGS and EPA assessing the possible impact of organic pollutants in the Little Arkansas River and the water used for aquifer recharge. As you know, there are many factors that influence water quality parameters including stream flow rate, season of the year, rainfall intensity and antecedent moisture conditions. The interaction between these climatic factors and organic compounds is complex and dynamic; accurate predictions of future water quality characteristics are sometimes difficult and always challenging. The water quality sampling and analysis efforts associated with the Demonstration Project extended from 1995 through 1999 and were designed to assure the preservation of water quality in the aquifer system. The primary organic pollutant periodically found in higher flows mainly during the spring months was an herbicide, atrazine. It was determined that chemical treatment would be needed and, where direct surface water diversions were made, turbidity would need to be reduced using a polymer and powdered activated carbon would be used to remove atrazine and other herbicides. Chlorine was added to control biological growth. A brief discussion of this program and findings has been included in Section 4.4.1.4.1 of the EIS.

21. As described in Section 4.4.1.1, ILWSP Operations Model, the historic hydrologic period of record used in the development of the ILWSP is 74 years in length, from 1923 to 1996. This period of record includes both the 1930's and 1950's droughts referenced in your comment. The ILWSP is designed to provide the required amount of water to satisfy the City's projected demands even when the drought of record occurs. The reserves of water stored in Cheney Reservoir and in the Equus Beds aquifer will be decreased during these drought periods. As described in Response No. 2 and 3 above, the estimated water demands projected to occur in 2050 have been reduced by 16 percent due to water conservation. Sufficient quantities of water will be available with the ILWSP in place during drought periods to satisfy the estimated demands projected to occur in 2050 for the City.

22. A Biological Assessment (BA) was prepared in December 2001 that included the list of threatened and endangered species provided by the FWS. This BA was included in the DEIS as Appendix B and describes the impacts the ILWSP is anticipated to have on the species listed in the project area by FWS. The information included in the BA for each species is sufficient to make an assessment of the ILWSP impacts in the project area due to construction and operation activities. Conclusions reached in the BA stated that none of the eight species evaluated would be impacted by the ILWSP; four of the species could be temporarily impacted during construction.

    In addition, the HBMP will be developed in cooperation with KDWP and FWS. The HBMP will help evaluate the pre- and post-project impacts to aquatic and other resources resulting from the modification of the normal rate and range of fluctuation of flows in the Little Arkansas and Arkansas rivers. It could also help identify opportunities to avoid or minimize impacts to federally listed species resulting from ILWSP implementation and operation.

23. The City concurs that sincere efforts to evaluate and minimize impacts may not be successful. However, this is the reason the City has agreed to develop and implement the HBMP in cooperation with the KDWP and FWS. The HBMP will help determine (pre-project/design phase) if water withdrawals cause the flows in the Arkansas and Little

Arkansas rivers to deviate from the normal rate and range of fluctuation. If these fluctuations occur they could cause impacts to a variety of natural resources and species including the speckled chub populations or their habitat.

24. The City concurs that the water rights issued for the Equus Beds aquifer are over-allocated. However, the City does not require that additional quantities of water be allocated or additional water rights issued to the City to implement the ILWSP. Currently, the City is planning to obtain a general ASR water right permit to recover recharged water or water conserved from the ILWSP.

25. Your comments concerning implementation of the ILWSP by the City are appreciated. The City is aware that some questions remain to be answered, and that the objective of the HBMP is to assist in providing some of these answers.

ORIGINAL

PUBLIC HEARING

FOR THE

ENVIRONMENTAL IMPACT STATEMENT
FOR INTEGRATED LOCAL WATER SUPPLY PLAN

APRIL 23, 2002

HALSTEAD, KANSAS

CRS Court Reporting Service
MIDCITY PLACE
115 EAST DOUGLAS
WICHITA, KANSAS 67202
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MR. BLAIN: Thank you you all for coming this evening. My Name is Jerry Blain. I work for the Wichita Water and Sewer Department. I'm the Water Supply Projects Administrator. This evening we're going to talk -- kind of break the meeting into three different pieces, if you will. First we'll talk a little bit about the Draft Environmental Impact Statement that has been created and that process of creating the Draft Environmental Impact Statement, it's not a final statement at this point in time, kind of the things we've been looking at in that -- in the process of that document, and then we will have a comment section period of time for you to give either oral or written or comments -- any oral comments tonight we have a recorder here that will note those down so they become part of the record. You will also have the opportunity to provide written comments on the plan. If you don't do it tonight, you can still send those in. I think we'll leave it open for comments until May 23rd, so if you don't want to say to something this evening, this isn't your last chance to do that. And then when we're done with that, we will essentially -- we'll close the section of talking about the Environmental Impact Statement, the formal part of the meeting and then we'll open it up for questions and answers to give you essentially updates of where we're at on the projects that we're doing as part of the Water Supply Plan and hopefully get you some more information there.

The first part of the meeting is not designed to give a lot of information unfortunately. That's just part of the process we have to go through. It's kind of a real set forum. Dr. Fred Pinkney who is with our engineering firm, Burns & McDonnell, will explain kind of how this is all done. At this point, I'll turn it over to Fred and he can explain more of what we're going to do this evening on the formal part of the meeting.

MR. PINKNEY: Thanks, Jerry. Like Jerry indicated, this is sort of -- the public hearing on Environmental Impact Statement is sort of a formal thing to begin with. What we would like to do is give you a little bit of information about why we're doing what we're doing, describe a little bit about the project in terms of what's in the Environmental Impact Statement, where we are, and then ask for your comments should you have any on the AIS itself.

As Jerry indicated, once everybody has made whatever comments they would like to, make we'll close the session officially and then we'll certainly be available after that to answer comments and questions one-on-one at your -- at your beck and call.

To start, I just want to I guess indicate that there is an overriding environmental documentation in our federal law called the National Environmental Policy Act, and that's the process that we are following at this

After we have heard all the comments that you have then we will close the meeting or adjourn the public hearing officially. The public record will close and then we will talk individually with you about any aspect of the project that we can discuss with the people we have here at the present time, both the City and from Burns & McDonnell.

Now the Draft EIS one of the main sections is what they call -- is what we call the Purpose and Need and the goals of the Integrated Local Water Supply Project for the City of Wichita is to provide a reliable water supply through the year 2050 and basically protect the Equus bed's water quality.

The objective of the plan, as we said, was to meet the 2050 net water needs and this means basically provide approximately an additional 22 million gallons per day of water to meet average day demands, and approximately 28 million gallons per day to meet maximum day demands.

Now when we start looking at alternatives to an EIS, we look at as wide an array as we possibly can, and in this case we looked at 27 different alternatives water sources that could be used either individually or in combination to form a plan. Fourteen of them were what we call conventional types of supplies or sources, and these include things such as water from existing or proposed reservoirs, groundwater aquifers, using river flood flows, or perhaps changing operations in existing water supply systems.

Then we also looked at about 13 what we would term non-conventional water sources, and these would include such things as flood waters in reservoirs and what we would call above average stream flows, treated waste water reuse, remediated groundwater, what is called bank storage water, rain harvesting and water conservation.

Now the alternatives -- these alternatives were screened and eliminated presedimentation plant, transmission pipelines. So each one of the sources may have several components to it.

Now this is an EIS, or Environmental Impact Statement, and so there are rather -- there always are environmental concerns or issues that you deal with in EIS, and in this particular project these were the general list of the most important items that were considered or had to be evaluated: Wetlands, threatened and endangered species, land use, and specifically prime farm land, the fisheries in both the Little Arkansas River and in the Big Ark River, the repairing vegetation that occurred along the Little Ark, and recreation specifically at Cheney. For an example, once again there were many components to each one of these particular disciplines or our environmental issues or concerns and if you look at threatened or endangered species, this is just the list of species that occurred or were evaluated under that particular heading.

The project of the plan -- Integrated Local Water Supply Plan will be developed in phases, and after conferring with the resource agencies including Fish and Wildlife Service and Kansas Department of Wildlife and Parks, Geologic Survey, Environmental Protection Agency and so forth, they really had no real specific mitigation recommendations. Now they may come up and they may have some as a result of this Environmental Impact Statement, but the EIS is designed to do two things: One, satisfy the need to process, and secondly be used to provide supporting information for state and federal permits.

The one thing that was brought up by KDWP was that a hydrobiological monitoring plan should be developed in association with Fish and Wildlife Service and with Kansas Department of Wildlife and Parks to see and to determine what impacts could occur in the future should they occur.

With that, I want to end this presentation and ask that the cards that we filled -- or we asked you to fill out, if you have any comments at this time, we would like for you to make them. If you would prefer to provide written comments, we certainly invite you to do that. You can hand those in to us tonight or you can mail those in to the address that's at the bottom of the page and that's to Jerry Blain at the City. At this time, I would like to open it up for comments for those that may have them. If you do, please raise your hand or come forward.

MS. ARROWSMITH: My name is Kelli Arrowsmith and I live out northwest of Bentley, Kansas. I'm originally from Wichita and my husband and I own a farm out by Bentley and I have several concerns about this project.

Number one is the fact that I just found out about it in the Wichita Eagle and Beacon today reading about it at work. This seems to be a well quiet project that people don't seem to be

Response to comments presented during the April 23, 2002 Public hearing on the Draft EIS.

Ms. Kelli Arrowsmith

1. Since the initial planning stages of the ILWSP began in 1993, the City has pursued an active public involvement program designed to inform the public and governmental agencies about the aquifer recharge, storage and recovery project as it progressed. Public information meetings have been held periodically in the cities of Wichita, Halstead and Sedgwick since that time. In October 1997 using published public notices, press releases, and direct mail, the City announced the initiation of the public involvement process and invited the public to participate. Notices for the public scoping meetings were published in the Ark Valley News, the Harvey County Independent, the Times-Sentinel, and the Wichita Eagle. In addition, tours of the City's ASR Demonstration Project facilities have been conducted and informational brochures have been prepared and distributed to visitors. Annual public information meetings have been held in Halstead since 1993 providing project status updates and answering questions from those attending. In April 2002, the City published public notices, press releases, and direct mail mailings announcing and inviting the public to attend and provide comments at the public hearing for the DEIS. In addition, the USGS has a website on the Equus Beds Recharge Demonstration Project (http://ks.water.usgs.gov/Kansas/equus/).

wanting to talk about very much. However, be that as it may, I have a lot of concerns about this project as I was listening to the speech tonight.

My first concern is the fact that this is not being filed with the EPA. If we're going to be dumping something in the Equus beds and we're not filing it with the EPA, how do we know that we aren't dumping something in the Equus beds that's not poisoning our own wells. I drink the water out of the Equus beds and I think some of the other people in this room do, too. Even though I was born and raised in Wichita, I do have enough common sense to know that I don't want to poison myself. I also don't want to poison the people in Wichita. 2

If you are going to do this, do it correctly. File all your permits, file all your stuff with the EPA. If you cannot file it the EPA then stop what you're doing and do it right. Being as I am from Wichita and I do work in Wichita, 3

2. A copy of the DEIS was provided to EPA for their review and comment. It is federal policy that only EIS's that have another federal agency as the lead agency can be officially filed with EPA and announced in the Federal Register. Although multiple federal agencies were asked by the City to take the lead role, no federal agency has stepped forward and agreed to be the lead federal agency for the ILWSP. However, all of the federal and state agencies that would have been involved with the review and comment process for the DEIS have reviewed the document and provided comments. Please see the discussion in Chapter 5, Consultation and Coordination (Table 5-1), of the EIS for a list of cooperating and coordinating federal and state agencies involved in the preparation and review of the EIS for the ILWSP. Responses to the comments submitted in response to the DEIS review may be found in the EIS at the end of Chapter 5.

3. Your concerns about the importance of efficient and effective watering techniques are recognized. Continuing to question and recommend changes to reduce water usage and loss are important components of the public relations program maintained by the City. Water conservation is an integral component of the ILWSP. Water demands projected to occur through the year 2050 for the City have been reduced by an average of 16 percent due to water conservation.

every morning I drive into Wichita about 5:30 in the morning. Every morning that I drive into Wichita I see exactly the same thing. I see Dillons. I see QuikTrip. I see Wal-Mart. I see all these stores overwatering their grass. I have several types of grass in my yard. I have three-quarter of an acre of buffalo. Buffalo doesn't take any water. It's a nice soft green grass. Once it's established, you do not water it. If Wichita people want water, they need to plant a different grass. I have stopped and complained to McDonald's about watering their parking lot. I have stopped and complained to the City of Wichita about watering their streets. I have gotten my head snapped off. I am tired of watching Wichita water their streets. I am tired of watching QuikTrip water their parking lot, and I am tired of watching the citizens of Wichita water their sidewalks. They're not going to grow. I'm from Wichita and I know this. I'm not real smart but you can't water

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pavement. The City of Wichita is one of the biggest people that actually do this. You can have water conservation to where they tell you not to water. Drive through the Wichita Sedgwick Park and they're watering the park. Last year I took my daughters through the Wichita Sedgwick Park, they're watering the park and they told everyone not to water the grass. I came home, I called the City of Wichita, I said why are you watering the park, we're under water conservation. They said, oh, well, we do it anyway. Why can't Wichita plant buffalo grass. You don't water it. I'll be more than happy, come out to my house, I'll show you three-quarter acre of buffalo. It's a very nice grass. It stands up to wear and tear. Until Wichita themselves are concerned about conservation, I am not interested in handing them any more water. 3

You want to talk about wetlands? Go down to Maize and 21st Street and see the house on the hill. 4

4. Your concerns are noted.

Are any of you aware that Maize and 21st Street used to be Cadillac Lake? I wasn't from this area. I was from Viola. My husband when we were dating used to take me and show me Cadillac Lake. I used to watch people fish there. I used to watch the cranes, I used to watch the storks, I used to watch the wildlife. They filled it in and made it into a shopping center. It was a federal wetlands until Wichita decided they wanted to have a shopping center and people decided they wanted to have a house and they filled it in. Now they tell you that they want to be concerned about a wetland, they want to be concerned about an endangered species. Why weren't they concerned when they filled it in? 4

I don't understand this. But, you know, I do understand something. I was dead broke -- actually I'll tell you something. I do have a couple of degrees. I have a B.A. from Kansas Newman. I paid for my own education by 5

5. Your thoughts about the need for the City to internally enforce water conservation procedures during dry periods or droughts are noted. A combination of enforcement and public education is the approach that has been adopted and instituted by the City to encourage water conservation with its customers.

working 40 to 60 hours a week and going to college full-time. I did it by pennies and nickels. If you save a nickel, you got a nickel. If you save a penny, you got a penny, and if you save a cup of water, you got a cup of water, but you cannot save that cup of water if you're watering the pavement.

We have got to wake up, I understand that. I don't water my grass, I plant Buffalo. I understand Wichita needs more water. I was born and raised there, but I also understand that you cannot keep drawing out of the Equus beds to water Wichita. I also understand that you dump more chemicals on a fescue lawn than most farmers dump on their fields to grow wheat. I also understand that's what causes the algae blooms in the Arkansas River when they want to have the River Fest. We have got to wake up, Wichita. We're already awake. I don't know how to do it. All I can do is stop at McDonald's and say turn your water off. All I can do is call the City of

6. Water conservation now and in the future is an important component of the ILWSP. The City is not taking more water out of the Equus Beds aquifer nor increasing their water right to do so with the ILWSP. By recharging the aquifer through the proposed ASR facilities, the City is trying to maintain the water quality in the aquifer so that future use by both the City and the irrigators is maintained. Encouraging the reasonable use of more environmentally friendly fertilizers, insecticides and pesticides, and agricultural practices will help maintain water quality and quantity being used today. Water conservation is discussed in Section 2.3.1 of the EIS.

Wichita to turn your water off. All I can do is go into QuikTrip and say turn your water off. Can we tell them to turn their water off in any other way? I have no idea. I hope somebody else can come up with an answer.

MR. PINKNEY: Thank you. Do we have any other comments?

MR. DANIELS: My name is Bob Daniels, Valley Center. I just have -- well, I have a lot of questions about this whole project, but let's stick to the urgent one.

Let's say we have a problem with a recharge and we do have contamination. What exactly are we going to do to clean it up? Once we contaminate the Equus beds, what then? Do we have any other options?

About 1982 or '83 we started -- we -- Wichita moved a couple of bulldozers into the little river to clear it out presumably to keep it from flooding or something, but I have to tell you that when I was young, that water was

2

Mr. Bob Daniels

1. The EPA and Kansas Department of Health and Environment (KDHE) will be closely monitoring the construction and operation of the ILWSP. The City, in cooperation with these agencies, will set up the operational criteria that will be followed, including those to provide adequate water quality standards to protect the Equus Beds aquifer. Water quality standards of the recharge water including the monitoring of the source water and its treatment prior to recharge, have been tested and established over the past 5 years. The City, EPA, and KDHE have established plans to be used to prevent contamination to the aquifer; contamination for any length of time would have an adverse impact on the current use of the aquifer by irrigators, local municipalities, and the City. Included in these plans are procedures to be used in the event contaminated water were inadvertently used in recharge, including a specific process for correcting the contamination. A system of "checks and balances" has been specifically established cooperatively by these agencies to prevent such an event from happening. The City considers water quality and the maintenance of the Equus Beds aquifer as a water source for all users. Almost one-third of the cost of the Equus Beds Demonstration Project or about $2 million was spent for water quality sampling, analysis, and the development of the ILWSP operational criteria.

2. The City certainly understands that the Little Arkansas River has changed in the last two decades. Many changes have also occurred in the river's watershed, which no doubt has also affected the river's streambed and banks. Given your observations, your opinion and concerns are understandable. Please be assured that it is not the intent of the City to adversely impact the Little Arkansas River or its ecosystem.

deep. That river bank was healthy. There were a lot of animals there. In fact, I've still got a picture I got a 32-pound catfish there. The water's not that deep now. The river bed, the river bank, it's destroyed. I know that was twenty years ago but you can understand my apprehension in not saying something when Wichita starts to fiddle with that river and the Equus beds. If I live to be a hundred years old, my eyes will never see as robust and healthy river bank as I saw when I was a kid.

I was browsing through your web site -- you have a web site there, do you know?

MR. BLAIN: Yes.

MR. DANIELS: It's very interesting, I like to keep track of it, I have for quite sometime, although it's frequently temporarily out of service or there for awhile it was restricted, I know not why but I'm sure there was a good reason for it. But I noticed in '99 it said that we at Sedgwick experienced what they call 3

3. Streamflow in the Little Arkansas River has generally been consistently higher in the last 3 to 5 years due to the relatively "wet" years that have occurred. As a result, the average base flows in the river have likely been consistently higher. However, the base flow in the river over the last two or more decades has likely been lower, primarily due to the decreasing groundwater levels observed in the Equus Beds aquifer due to increasing groundwater pumpage. With the ILWSP in place and operating, the base flow in the Little Arkansas River is predicted to increase as groundwater is recharged and groundwater levels rise. Please see Appendix C, Section C-7 and Figure C-4 for further discussion and graphic illustration. The City appreciates your concerns.

overflow -- minimum stream flow requirements exceeded 42 feet per second 365 days out of the year. Well, I tell you in August of that year, I was down at the river with my girl, she's six years old, and I jumped across it. It's eight feet, maybe six, eight inches deep. She crossed it and the water was not even over her socks. So I'm a little apprehensive that we were experiencing 42 feet per second flow every day during 1999.

Now I know there's engineers, of course, and I'm sure their gauges are as correct as they can be, but that river today is not nearly as high as it was when I was a lot younger.

So I'd like to leave you with this thought. You really -- when you moved in and cleared the river and those bulldozers came through, that destroyed that river bank and it will take another 50 or 70 years before the amount of sediment and erosion that's polluting that river is healed by natural forces.

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4. The City has many of the same concerns you have expressed in your comments. Please be assured that plans have been developed with input from many of the local stakeholders to address potential issues like contamination and water quality should future conditions warrant. The City intends to continue to provide ILWSP project status information via the existing website and contact with local entities such as Groundwater Management District #2 (GMD2).

If we inadvertently or accidentally pump contaminants into that Equus beds, Lord only knows how long that's going to take to fix. So I hope that somewhere, somehow we have a plan in place as to what's -- what we're going to do when the Equus bed if the Equus bed gets contaminated. Thank you.

MR. PINKNEY: Thank you. Do we have any other comments? In that case what I would like to do is close the meeting, close the record at this point. We will be here. We invite you to come up on stage to talk about the project, ask questions, whatever we can do to try to help explain what your concerns are, what concerns you may have. We'll be here as long as you want to talk and as long as we can help to try to alleviate or explain or offer some sort of other rationale for what you've seen or whatever you believe is going on or what the project may do.

C E R T I F I C A T E

STATE OF KANSAS)
) ss:
SEDGWICK COUNTY)

I, Janelle E. Goddard, a Certified Shorthand Reporter within and for the State of Kansas, do hereby certify that the foregoing is a true and correct transcript of the hearing held at the time and place hereinbefore set forth.

WITNESS my hand and official seal at Wichita, Sedgwick County, Kansas, this 28th day of April, 2002.

Janelle E. Goddard

JANELLE E. GODDARD, C.S.R.
Certified Shorthand Reporter

ORIGINAL

PUBLIC HEARING

FOR THE

ENVIRONMENTAL IMPACT STATEMENT
FOR INTEGRATED LOCAL WATER SUPPLY PLAN

APRIL 24, 2002

WICHITA, KANSAS

Court Reporting Service
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MR. BLAIN: My name is Jerry Blain. I work for the Wichita Water and Sewer Department. I'm the Water Supply Projects Administrator. This evening we're going to talk about the Environmental Impact Statement being created as part of our water supply projects. This is a document -- a draft document at this point in time and we'll be asking for comment from you.

What we'll kind of do is break this evening into three different pieces. First piece, Dr. Fred Pinkney with our consultant, Burns & McDonnell, will explain the purpose for the Environmental Impact Statement and what kinds of things we're looking at. We will then have an opportunity for you all to make comments about the Environmental Impact Statement if you wish to do that at this time. You can do oral comments and we have a reporter here that will record all that information, or you can put it in written form and give it to us, or you can wait until later to send it in to us. We will be receiving comments on the Environmental Impact Statement until May 23rd, so there's an opportunity if you don't want to make comments tonight, you want to make them later you can go that route, too. And then when that is done, we'll close the hearing and the meeting -- I guess the formal part of the meeting, then we'll be able to do question and answer period on the water supply projects, what we're doing, status on the projects and anything you'd like to know about that either as a group or we've got lots of poster boards and stuff and resources here that we can answer questions one-on-one without the group setting if you prefer. So with that, I'm going to turn it over to Dr. Fred Pinkney and he'll explain what we're doing with the Environmental Impact Statement.

MR. PINKNEY: Thank you, Jerry. One of the things I guess I wanted to take a few moments to do is just very, very briefly tell you a little bit about and maybe reiterate a little bit about what

Jerry said about the purpose of the public hearing.

In 1969, Congress passed a piece of legislation called the National Environmental Policy Act and that particular act established a general policy that -- whereby environmental impact statements that were in the federal interests would be reviewed and open to the public in terms of the information they presented, the analysis they presented, basically be a public disclosure document.

Now, part of the public review period that Jerry mentioned that is ongoing at this point until the 23rd is a time for you, the public, to review the document and if you have any questions or comments, make those known. Our goal tonight is to listen to what you have to say about the draft EIS and that's what we're asking you to comment on either now or by May 23rd.

Normally it is a federal requirement that the public hearing be held. In this particular instance and in this -- I guess I should say in this situation with the City of Wichita and the Integrated Local Water Supply Plan, there is no lead federal agency. Now the reason there isn't a lead federal agency is not because they haven't been asked but because they haven't expressed a strong interest in doing so. We have and we are continuing to involve all the federal agencies in this review process. They each have copies of the EIS. They have been involved in the processes all the way up through this point so they know what's going on. They know what the analysis are, what the issues are, what the components of the plan are, but they have not stepped forward, so to speak, and said, okay, we -- for example, the U.S. Army Corps of Engineers will be the lead federal agency for this project. What this does is that it doesn't allow us to file the EIS with the Environmental Protection Agency.

Now two things really

contribute to whether or not an EIS represents a federal action or not. One is whether or not there's any federal money involved, and in this particular instance there is no federal money involved in this project. The second item is that if there is a special permit or a federal permit that will have to be issued for the project to be built or constructed or operated. In this particular case, there will be specific projects -- or specific permits issued by various federal agencies or approvals, but they do not consider them to be of significant magnitude enough for them to be that lead federal agency. It doesn't mean we haven't asked, it doesn't mean we don't continue to ask. They haven't stepped forward.

Now should there be a time when a federal agency says, okay, we'll contribute some money to this project for its construction, then at that point they become the lead federal agency. And if that happens, then what our goal is is to go through the entire NEPA process which is what we're doing with the EIS and preparing it and let them have the opportunity to adopt the existing Environmental Impact Statement rather than go through the entire all the different steps again. So what we're trying to do is save some time and be able to move forward with this project on a more timely basis.

By doing this, the City has assumed quite a proactive stance because, once again, it's not a required thing. It is not required for the City to have done -- prepared an EIS for this project because of those reasons I explained earlier.

As Jerry also mentioned, we do have a court reporter present tonight who is transcribing everything that's being said. It will be entered into a record which will be included in the final Environmental Impact Statement verbatim. What we will present -- or what I will present will give you a very brief overview of what the project is about tonight and then we will ask for any comments that you may have. You do not have to give them tonight, but if you do want to you can give them verbally. They'll be transcribed into the record. You can also provide them in writing. They will appear in the final EIS as you give them to us, or you can send them in later by the 23rd of May is what we would certainly prefer. And again, those letters, comments that you provide at that time will also be included in the final EIS verbatim and we will respond to each comment that you have.

When we do complete the presentation here and ask for the comments, what we ask you to do is state what your name is and perhaps spell it so it can be accurately recorded into the record and then present your comment. We ask you that if you do make a comment, if you can keep it to within -- or less than five minutes at this time, we want to make sure everybody has an opportunity to talk or to have -- present their comments and if we need more time later, we'll come back. Then at that point once everybody's had a chance to make their comments, we will close the record officially and once the record is officially closed then we will be more than willing and more than happy to talk with you one-on-one as a group and try to answer whatever questions you might have specifically at that time about the project.

Now let's talk just briefly about the purpose and need for the project. The Integrated Local Water Supply Plan, the ILWSP acronym up there, is the City's water supply plan. The goals of it were to develop a reliable water supply through the year 2050, approximately a 40 to 45-year planning horizon. And then the second goal is to protect the Equus beds water quality, existing water supply the City uses quite a bit. The objectives of the plan were to meet the 2050 net water needs and these were essentially to provide an extra 22 million gallons per day, MGD, for the average day demand and an additional 28 million gallons per day to satisfy the maximum day demands.

When you look at and try to resolve and satisfy these types of quantities of water needs, you look at a large variety of alternatives initially. You look at all the alternatives that you can come up with that the agencies think that might be viable, that the public thinks that are viable, and you make what we call hopefully a rather complete list of realistic feasible alternatives.

Now they don't all have to fit into those categories initially. You pass these through a rather rigorous screen eliminating those who cannot meet the need and keeping those that can. In this particular instance, we looked at 27 different water supply sources. Fourteen of those were considered to be conventional type sources and these included such things as water from existing reservoirs or proposed reservoirs, from various groundwater aquifers, looking at river flood flows or perhaps changing operations of existing supplies to more efficiently use that water. Thirteen of them were what we considered to be non-conventional and these were things like using flood waters in reservoirs, using the flood water portion, using the above -- what is called above average stream flow, treated wastewater reuse, remediated groundwater, bank storage, and that's an alluvial -- what water is in the alluvium along rivers and streams, rain harvesting, water conservation, so forth.

Now after you screen -- after we screened these alternatives, the ones that were considered to detail were water conservations. Water conservation became a component of all the alternative -- of all plans. It was not excluded under any condition because water conservation from a federal standpoint is considered to be a mandated requirement.

Another -- or other alternatives that were considered in detail the use of them were of course some existing resources, Cheney Reservoir, but perhaps changing the operations a little bit, reactivating the Bentley Reserve Well Field, expanding the local well field here in the City of Wichita. Developing an -- what is called an Aquifer Storage and Recovery project in the Equus beds and basically what this means is you put water into the Equus beds during wet years and you take it out during dry years when you need it. But there is a balance as we'll perhaps describe a little bit later.

There is another alternative that is required from the federal standpoint and an EIS and that's what's called the no-federal action. The no-federal action basically describes if there was nothing done, what would be the future conditions. So it gives you the baseline from which you compare how the other alternatives meet or don't meet the identified need.

The components of the Integrated Local Water Supply Plan ultimately became the water conservation, Cheney Reservoir, the reactivation of the Bentley Reserve Well Field, expansion of the local and the Equus beds ASR, or Aquifer Storage and Recovery plan -- or system. Those all became part of the plan that the City has developed -- is proposing as their preferred alternative.

The Equus beds -- each one of these sources is made up of different components of the more than perhaps one particular facility. For example, the Equus beds aquifer Storage and Recovery system includes a surface water intake, diversion and recovery or recharge wells, presedimentation plant and various transmission pipelines. So they are all made up of usually more than one component to make up -- or to utilize a water source and to make a plan.

Now the EIS looks at the various environmental issues and concerns that were identified both by the public and the regulatory agencies, state and federal. These included such things as the impacts to wetlands, threatened or endangered species, land use and specifically prime farm land, the fisheries both of the existing Cheney Reservoir and the Little Ark and Big Ark Rivers, the reparian vegetation that occurs along each of these streams, and recreation values.

If you once again looked at what would be considered within each group of those issues as environmental issues and concerns, if you just look at threatened or endangered species, for example, this is the list of the species that were considered and looked at in the Environmental Impact Statement as recommendation of Fish and Wildlife Service and the Kansas Department of Wildlife and Parks.

Now I'll just briefly talk about the mitigation that's been proposed. I guess one of the things to really recognize and perhaps remember is that the Integrated Local Water Supply Plan would be developed in phases, and by doing so, if the City needs the next phase then it would consider both the next phase. They will develop one phase at a time, determine how well that functions, does it satisfy the needs, does it meet the needs, do we need the next phase. If you don't need the next phase, you don't build the next phase. The agencies -- the regulatory agencies like the Corps of Engineers, Fish and Wildlife Service, again Kansas Department of Wildlife and Parks had no real specific mitigation requirements. We have been coordinating with them since day one of this effort. There are certain state and federal permits that will be required for the construction of the project. This includes such things as permits from the U.S. Army Corps of Engineers, approvals from Fish and Wildlife Service for threatened and endangered species impacts, and coordination with the State Historic Preservation Office, for example.

What Kansas Department of Wildlife and Parks and Fish and Wildlife have recommended is that we develop what is called a -- or what we would call a hydrobiological monitoring plan in association with those two regulatory agencies to determine what the project impacts possibly could be, and this will be done before -- the plan is in the development stages at this time and would be implemented before the project would begin operation.

This gives you, I hope, a little bit of an overview of what is in the EIS. What we would like to do at this point in time is ask for your comments if you have any. We'd be -- very much like to hear them, like to have them transcribed into the record, and if you do not feel like you are prepared at this time, please don't feel like they won't be considered if you send them in because they certainly will be. Once again, they will appear and will appear in the final Environmental Impact Statement and we would like to know what you're thinking, know what your concerns are.

As soon as we close the record and as soon as you've made all your comments and we close the record then we will be very, very happy and willing to talk with you again one-on-one try to answer whatever questions we can. And I won't say we can resolve all the issues but we can certainly try.

With that in mind, if you have a comment or would like to make a comment if you don't mind signifying, we would like to hear you.

MRS. BECKEL: Well, I'm not for it.

MR. PINKNEY: Would you say your name?

MRS. BECKEL: My name is Dorothy Beckel and I am against it, however, I don't drink the water -- city water because it's bad enough. I pump water and I'm just not -- having it pumped out

Response to comments presented during the April 24, 2002 Public Hearing on the Draft EIS.

Ms. Dorothy Beckel

1. The City understands your feelings about the ILWSP and your concerns about the water quality of the Little Arkansas River. Thank you for participating and providing your comments at the public hearing.

of the river? You know, that river I have seen it real almost dry and I can't see the purpose of doing it because we've lived over there by the river for many years and when the water gets down too low, it does begin to stink. I'm just not for it.

MR. PINKNEY: Thank you. Any other comments?

MR. GRAVES: My name is John Graves. I guess I have more questions probably than comments, and I guess I'll go through them and if you want to address them, fine, or if you want to wait until after the hearing, that's fine.

I've read the executive summary of the EIS and a question I have is can Cheney Reservoir be maintained at or above the conservation pool level given the 60 percent of the city water supply that it represents and the maximum gallons per day that are projected in the plan? I don't know if that's addressed in the detailed portion of the EIS or not. Can you comment on that?

Mr. John Graves

1. As described in Section 4.4.1.3.4, Cheney Reservoir, of the EIS, the No-Action Alternative would increase the stress on Cheney Reservoir with time as the City's water demands continue to increase. Under these conditions, water levels in the reservoir may be 2 to 3 feet lower than experienced today. With either of the proposed ILWSP alternatives, reservoir water levels would be maintained about 0.4 to 0.6 feet higher than found today. Pool levels in Cheney Reservoir will continue to fluctuate as they do now due to changing hydrologic conditions and withdrawal rates. Large fluctuation in water surface elevation can continue to be expected during drought situations. However, implementation of the ILWSP will reduce the magnitude of the water surface elevation fluctuations and the frequency with which they would be expected to occur with normal operations. With the ILWSP in place, median monthly pool level elevations are expected to increase by two to three feet.

MR. PINKNEY: Yes, it is and we can talk more about that after while if that's okay with you.

MR. GRAVES: The second thing is, again I didn't see it in the executive summary, but I would like to know if there's any thought or consideration given to increasing the cost of water usage particularly to, you know, excessive water usage to encourage conservation during the plan. And I know you mentioned in the summary that there are conservation aspects to each component -- or to the components of each plan and certainly something that should be considered.

The third one is I guess I have a question of what the impact is on the vendors and users of Cheney Reservoir. Obviously socioeconomic considerations need to be included. There's quality of life issues as well as economic issues that are represented by the reservoir and the Big Arkansas and Little Arkansas River that should be considered.

2

3

2. As discussed in Sections 1.3.4 and 2.3.1, the City has an inverted water rate structure to promote water conservation in place today. As you know, this type of rate structure is designed to encourage water conservation by providing lower water costs to those customers that use a lower quantity of water. The continued use of this type of rate structure as well as the implementation of other conservation methods will be needed by the City in the future to maintain water use levels in Cheney Reservoir at their desired levels.

3. As discussed in Responses No. 1 and 2 above, increased water demands will impact water levels at Cheney Reservoir without the ILWSP in place. Lake water surface levels would increase with the No-Action alternative, impacting the recreational vendors and users at the reservoir.

   As you know, Reclamation presented a list of needs when they requested authorization and funding for the Wichita Project and Cheney Reservoir from the United States Congress. Recreation was not specifically considered at the time to be a primary project purpose. However, recreation was considered as a secondary purpose and $380,000 were initially awarded for the development of recreation facilities at Cheney Reservoir. Subsequent agreements were implemented between Reclamation, the State of Kansas and KDWP, and the City whereby public recreation facilities were developed.

   With development of the ILWSP, the median water surface elevations at Cheney Reservoir would be 0.4 to 0.6 feet higher than found today. The socioeconomic and quality of life impacts associated with a slightly higher water surface elevation at Cheney Reservoir will be a positive effect for the current vendors and users.

And finally probably a long shot is is it viable or is it a consideration to increase the capacity of Cheney Reservoir somehow either by cleaning up the water that runs into it and/or dredging it to increase the capacity as a part of the water supply plan. There are more questions than comments, I guess.

MR. PINKNEY: And we can try to answer those. Thank you. Any other comments at this time?

At this point I guess I would like to go ahead and officially close the record then.

4. The ILWSP does not propose to increase the capacity of Cheney Reservoir using methods such as dredging. In addition, recent sedimentation studies conducted by Reclamation indicate that Cheney Reservoir is not filling with sediment at the rate originally predicted. Removal of sediment by dredging the reservoir would be very expensive relative to the amount of water storage capacity gained and is not part the City's master water plan. Lastly, the City is currently working closely with landowners in the North Fork of the Ninnescah watershed, Reclamation, and other stakeholders to implement a watershed management plan. The purpose of the watershed management plan is to improve the water quality in the reservoir by altering tillage and fertilizer application techniques to reduce the quantity of incoming total suspended solids and phosphorus loading, the frequency of pesticide and insecticide applications and runoff, and sediment production disturbance without the use of erosion control techniques.

C E R T I F I C A T E

STATE OF KANSAS)
) ss:
SEDGWICK COUNTY)

I, Janelle E. Goddard, a Certified Shorthand Reporter within and for the State of Kansas, do hereby certify that the foregoing is a true and correct transcript of the hearing held at the time and place hereinbefore set forth.

WITNESS my hand and official seal at Wichita, Sedgwick County, Kansas, this 29th day of April, 2002.

Janelle E. Goddard
JANELLE E. GODDARD, C.S.R.
Certified Shorthand Reporter

C E R T I F I C A T E

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CHAPTER 6

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GLOSSARY

A

Above base flow – the volume of flow in the river, which is generated from rainfall runoff that is above the base river flow as established by the State or local regulatory agencies

Alluvial Water – water within the alluvial soil or earth material which has been deposited by running water, as in a riverbed, flood plain, or delta

Average day demand – total amount of raw water used in a calendar year divided by the number of days in the year

B

Bank storage – is the temporary increase in groundwater levels in the alluvial river bank during periods of high (excess) river flows

Base flow – minimum flow in the river to meet minimum desired streamflow and some surface water rights

C

Contingency allowance – a percent dollar amount added to all costs to account for unknown and unaccounted-for items

D

Diversion facility/surface water intake – transfer of water from a stream by a canal, pipe, well, or other conduit to an aquifer or other source of water, or another watercourse or to the land

Diversion well – transfer of water from a streambank by a well, to an aquifer or other source of water, or another watercourse or to the land

E

Evapotranspiration – water dissipated to the atmosphere by evaporation from water surfaces and moist soil, and by plant transpiration

Eutrophication – overfertilization of a water body due to increases in mineral and organic nutrients, producing an abundance of plant life which uses up oxygen, sometimes creating an environmental hostile to higher forms of marine animal life

F

Firm capacity – (safe peaking ability) available flow with largest unit out of service, in large number of units – 10% out of service for planning purposes

Firm yield – (1) yield of reservoir during most severe drought of record
(2) pumping rate which will not cause incrustation or solidification damage to aquifer

Flood storage – that part of a reservoir's total storage capacity that is allocated for temporary storage of flood waters

G

Groundwater flow – the movement of water through openings in sediment and rock that occurs in the Zone of Saturation

APPENDICES

LIST OF APPENDICES

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APPENDIX B - BIOLOGICAL ASSESSMENT

APPENDIX C - OPERATIONS MODEL DESCRIPTION

APPENDIX D - SCOPING SUMMARY

APPENDIX A - SUPPORTING ALTERNATIVES DATA TABLE

VIABLE WATER RESOURCES CRITERIA

Criteria was developed to screen each water supply alternative for capability, quality, future availability, legal issues, policy and political issues, planning horizons, environmental issues, and cost estimates and economic comparisons. The existence of major deficiencies or fatal flaws with respect to these issues for each alternative was investigated. The occurrence of a fatal flaw eliminated an alternative from further study. The most promising or viable alternatives were carried forward and evaluated in more detail. The following sections describe the criteria used in development of the water supply alternatives.

A. Water Supply Capability

Each potential water source alternative must have the capability to supply all or a part of the projected year 2050 net needs for the average day demand and the maximum day demand. Water supply capability was indicated by the following terms:

- Firm Yield
- Safe Peaking Ability
- Ability to Meet Demands
- Water Rights
- Conjunctive Use
- Peak Nonpotable Use Criteria

The interpretation of several terms varied slightly depending on whether a surface water, groundwater or reclaimed water source was involved.

1. Firm Yield

The firm yield of a surface water reservoir is sometimes considered to be the yield of the reservoir during the most severe drought of record as determined by a reservoir inflow/outflow operational study. Another approach is to consider the firm yield as one with a 2 percent chance of interruption as caused by a drought condition with a one-in-50-year recurrence cycle.

By contrast, the firm yield of a groundwater well is normally considered to be the pumping rate which will not cause incrustation or solidification damage to the aquifer formation (assuming adequate recharge from rainfall or rivers is available). Such yield is normally established by well screen entrance velocities and aquifer characteristics including water chemistry, rate of drawdown, and static groundwater level.

2. Safe Peaking Ability or Firm Capacity

"Safe" peaking ability may be determined by time of use of frequency of use or other conditions. For mechanical components, such as pumps or wells, "safe" peaking ability (or firm capacity) is figured as the available flow with the largest unit considered to be out of service. For systems with a large number of wells, such as the City's 55 wells in the Equus Beds, a larger number of mechanical units is often considered to be out of service at any given time for maintenance or emergency repair. In this case, 10 percent of the units were considered to be out of service for planning purposes when considering "safe" peaking ability or firm yield.

3 Ability to Meet Demands

The ability of a water supply to meet total water demands (either collectively with other sources or as a separate project) would likely impact costs to a significant degree. Maximum use of existing water supply-treatment infrastructure was an important consideration in the development of alternatives for cost savings. Additionally, the ability of a supply(s) to be developed in stages (which allows costs to be delayed until demands increase) was another important consideration.

4. Water Rights

The Kansas Water Office permits annual average day and maximum day withdrawal rates or water rights for water supplies. These rates are typically based on firm yield: therefore, the permitted annual average day withdrawal rate allowed by the State is typically the firm yield. Review of the city's water rights showed the maximum day withdrawal rate at about 2.2 times the average day water right for Cheney Reservoir and the Equus Beds Well Field. This maximum to average day use factor was considered in the evaluation of potential surface and groundwater supply alternatives.

5. Integrated Use

Based on discussions with the State of Kansas, an integrated use permit could be issued to the City, allowing the use of preset quantities of water from groundwater and surface water sources. Such a permit would allow the City to manage the operations of their water supplies to maximize use of excess runoff from surface water sources with accompanying groundwater recovery and storage until needed during drought conditions.

6. Peak Nonpotable use Criteria

Use of treated wastewater effluent, stormwater storage or remediated groundwater in a reclaimed water system could be used to reduce summer peak demands for potable water. Such a system(s) could be used to supply irrigation water to City parks, golf courses, or farmland and to supply nonpotable process water, cooling water, and irrigation water to large industries.

B. Water Quality

The quality of raw water from a water supply alternative and the quality of treated or finished water desired by the City were important variables because the type and cost of water treatment could vary significantly with each alternative. All finished (or drinking) water quality must meet existing and pending regulations of the Safe Drinking Water Act Amendments. Parameters such as chlorides, nitrates, atrazine, pesticides, etc. were important since these constituents require special treatment processes for removal which impact costs. Use of high-chloride groundwater, for example, may require raw water blending or reverse osmosis treatment and product blending to obtain acceptable chloride levels of under 250 mg/L.

Water supply alternatives involving aquifer recharge may need treatment of recharge water to meet requirements by the Kansas Department of Health and Environment (KDHE). KDHE typically looks at each recharge application on a case-by-case basis with the general guideline that the recharge water should not degrade water quality in the aquifer. At this time, KDHE has no minimum water quality standards for aquifer recharge and subsurface storage.

C. Legal Issues

The amended Kansas Water Transfer Act applies to any water supply alternative that transfers more than 2,000 acre-feet of water a distance of more than 35 miles. The purpose of this law is "to determine whether the benefits to the State for approving the transfer outweighs the benefits to the State for not approving the transfer." As such, consideration of this law was important in the evaluation of almost all water supply alternatives for the City.

Transfer applications are evaluated by a "transfer panel", consisting of the Chief Engineer and two other state agency directors. As the act is currently written, many of the alternatives evaluated required obtaining the necessary approval before water could be transferred. An effective water conservation program is also required in order to obtain approval of a water transfer.

D. Policy and Political Issues

Policy issues considered included the City's purchase of water rights from groundwater irrigators and use of City's right of condemnation. Political issues associated with each water supply alternative were considered since any significant opposition could cause long-term delays, substantial cost increases, litigation and the eventual canceling of a project. For example, a concern with the proposed Milford Project was the water needs of Northeast Kansas pitted against those of South-Central Kansas.

E. Future Availability

Future availability of a water supply may be related to the ability of the City to execute the plan given a number of regulatory, social, economic and political constraints. For example, in today's regulatory climate with wetlands issues and emphasis on environmental concerns, entering into a planning phase with the goal of constructing a new reservoir would likely be a very difficult, time-consuming process with no assurance of success. Other factors also considered included continuing development and the need for water by other communities, which could eliminate remaining available water supplies over the next 10 to 50 year period.

F. Planning Horizon

Each water supply alternative, individually or as part of a larger water supply plan, was scheduled for implementation in phases or stages to meet the City's net water needs from year 2000 through year 2050.

G. Environmental Issues

Environmental issues associated with each alternative were evaluated to determine if a possible environmental "deficiency" or "fatal flaw" existed. Typical fatal flaws dealt with the presence of federal endangered species or wetlands or other significant environmental impacts.

Various environmental areas of concern involved the following:

- Relocations (Dwelling, Churches, and
- Biological Resources

Cemeteries
- Land or Right-of-Way Required for Project
- Timber Removal
- Inundation of Rivers and Streams
- Wetlands
- Cultural Resources
  - – Federal Endangered Species
  - – Federal Threatened Species
  - – State Endangered Species
  - – State Rare Species
- State Forests and Natural Area

H. Cost Estimates and Economic Comparisons

Cost estimates for water supply alternatives developed in previous studies by others were reviewed and updated. Cost estimates for new water supply alternatives developed as a result of this study required the conceptual design of facilities for the purpose of determining preliminary sizes and quantities of materials and components. Unit cost data and component cost information from historical projects are used in the estimates. Determination of OMR&E costs required preliminary consideration of how each plan would function in relation to existing water system facilities. All costs were developed for an Engineering News Record (ENR) construction cost index of 5037 for the Kansas City regional area for March 1993.

Project costs estimates and costs per unit of available flow estimates were required for the purpose of comparing each water supply alternative to determine the most economically viable alternative(s). Estimates of cost per unit of available flow were based on the total project cost divided by the total available flow over a 55-year period from 1996 through 2050. This time frame was used for most alternatives and allowed the alternatives to be evaluated on an equal basis. Some alternatives, like Milford, could not be completed in time to be in service in 1996 and were based on 50 years of operation. Potential water supplies with unit costs greater than the Milford Reservoir Alternative were generally considered nonviable from a cost basis.

"Other Costs" included engineering, administration, inspection, geotechnical, survey, environmental and legal work associated with the project. These costs were estimated at 15 percent of the construction cost including the contingency and varied with the size and scope of the project. The contingency of 20 percent on construction costs accounted for unknown and unaccounted-for construction items not typically detailed at the current stage of project development.

SELECTION OF VIABLE ALTERNATIVES

Potential water sources, consisting of conventional and nonconventional alternatives, throughout the regional area in and around Wichita were evaluated. Conventional alternatives included existing and proposed reservoirs, groundwater and surface water flow. Nonconventional alternatives included use of reservoir overflows, excess stream flow, treated wastewater reuse, groundwater bank storage, rain harvesting and water conservation. The 27 water supply alternatives were evaluated according the above criteria, 11 were considered viable. Appendix A contains a table summarizing the water supply alternatives versus the criteria. The most feasible alternatives from the 11 consider viable were used to develop two basic water supply plans capable of meeting the projected water needs of the City's water service area through the year 2050. These two plans are evaluated in this EIS.

Appendix A
Initial Water Supply Alternative Ranking Summary

Alternative	Construction Costs ($million)	Available Flow	Unit Cost ($/MG)	Issues				Advantages	Disadvantages	Rank
				Policy/ Political	Legal	Environmental	Water Quality			
Kanapolis	69	10 MGD firm yield 200,800 MG[1]	344	Water Transfer Act	Must obtain additional water rights		Periodic high chlorides; Questionable	Firm supply	Water quality concerns Difficult to obtain all of the water rights	NS[2]
Milford Reservoir	155	60 MGD firm yield 1,095,000 MG[1]	141	Water Transfer Act Potential conflict with northeast Kansas	Must obtain additional water rights		Moderately hard; Adequate	Single sources; Firm supply ; Regional supply	Political problems Availability under Investigation by State	9
Corbin Reservoir	470	35 MGD firm yield 702,600 MG[1] Max yield of 53 MGD	669		Must obtain additional water rights	Significant impact associated with new reservoir construction	Expected to be adequate	Firm supply; Recreation	Significant environmental Impact	NS
Douglas Reservoir	202	14.2 MGD firm yield 285,100 MG[1]	707		Must obtain additional water rights	Significant impact associated with new reservoir construction	Expected to be poor	Firm supply; Recreation; Flood control	Significant environmental impact Poor water quality	NS
Murdock reservoir	231	35 MGD firm yield 702,600 MG[1] Max yield of 65 MGD	329		Must obtain additional water rights	Significant impact associated with new reservoir construction	High chlorides; Questionable	Firm supply; Recreation	Significant environmental impact Questionable water quality	NS
Equus Beds: Purchase Water Rights	$400/Ac-Ft	As Available	NA		Must obtain additional water rights		Generally good	Low cost; Close to well field; Good water quality	Availability concerns	8
Equus Beds: Burrton SWQUA & IGUCA	26	9.8 MGD firm yield 196,700 MG[1]. 100% use	130		Must obtain additional water rights	Remediate area over time	Very high chlorides	Long-term supply for City; Potential aquifer remediation	Availability concerns Poor water quality	NS
Haysville Groundwater	22	2.85 MGD firm yield 57,200 MG[1]. 100% use	386		Must obtain additional water rights	Remediate area over time	Very high chlorides	Long-term supply for City Potential aquifer remediation	Availability concerns Poor water quality	NS
Reserve Well Field	1 1	10,8 MGD firm yield 216,800 MG[1] 100 % use 10.8 MGD firm yield 27,300 MG[1] Peak use	4.7 37		Must obtain additional water rights		Poor; High Chlorides & hardness; Affects of long-term pumping unknown	Low cost; Firm supply; Supplement Peak demands	Poor water quality High chlorides Additional treatment cost	6
Gilbert-Mosley Remediated Groundwater	1.5	Continuous supply of 3 MGD	25			Conserves water, not conveyed WWTP	Adequate	Low cost; Conserves resources; Firm supply		4
Arkansas River Supply to WTP	21	0 Firm Yield; 155,800 MG[1] as available (avg. 8 MGD)	132	Integrated water use permit required	Must obtain additional water rights		High flows required for acceptable WQ	Close to WTP; Low cost	Poor water quality Low available flows	NS
Little Arkansas River Supply to WTP	21	0 Firm Yield; 880,000 MG[1] as available (avg. 44 MGD)	23	Integrated water use permit required	Must obtain additional water rights		Good	Close to WTP; Low construction cost; High available flows	Poor water quality No firm yield	2
Cheney Reservoir: Operations Modifications	0	Withdrawal up to about 60 MGD	0	Integrated water use permit required	Must obtain additional water rights	Potential impact on reservoir due to water level variations	Adequate	Increased water availability	Recreation impacts Public relations impacts Increased probability shortage	5
Cheney Reservoir: Purchase Flood Storage	0	Estimated 3 MGD yield for 1 ft, 2 MGD for 2 ft, & 1 MGD for 3 ft		Integrated water use permit required	Must obtain additional water rights	Potential impact on reservoir due to water level variations	Adequate	Increased firm yield	Recreation impacts Public relations impacts Extensive relocations	*

Appendix A
Initial Water Supply Alternative Ranking Summary

Alternative	Construction Costs ($million)	Available Flow	Unit Cost ($/MG)	Issues				Advantages	Disadvantages	Rank
				Policy/ Political	Legal	Environmental	Water Quality			
Membrane Filtration Plant	191 34	60 MGD Capacity 10 MGD Capacity	158 168			Brine disposal	Poor; Potable WQ after treatment	Source of the future	Very high operating cost Brine disposal 2% yield of 32 MGD	NS
Cheney Overflow: Pipeline to WTP	53 60	554,400 MG[1] as available (avg. 28 MGD) 695,000 MG[1] as available (avg. 35 MGD)	96 87	Integrated water use permit required	Must obtain additional water rights		Adequate	Uses excess flow; Conserves resources; Allows Equus Beds to recharge	No firm yield	7
Cheney Overflow: Side Storage Reservoir	NA	NA	NA	Integrated water use permit required	Must obtain additional water rights	Significant impact associated with new reservoir construction	Expected to be poor	Uses excess flow; Conserves resources; Recharges Equus Beds	No sites Aesthetic problems Operational problems Multiple pumping req'd	NS
Cheney Overflow: Subsurface Storage	65 / 165**	695,000 MG[1] as available (avg. 34 MGD)	94 / 237**	Account for stored water Integrated water use permit required	Must obtain additional water rights	Potential for Equus Beds groundwater quality degradation	High Chlorides, about 200 mg/l	Uses excess flow; Conserves resources; Recharges Equus Beds	High chlorides No firm yield State may not approve	10
Little Arkansas River: Subsurface Storage	26 / 126**	0 Firm Yield; 574,200 MG[1] as available (avg. 29 MGD)	46 / 219**	Account for stored water Integrated water use permit required	Must obtain additional water rights		Adequate	Conserves resources; Low cost	No firm yield	3A
Treated Wastewater Reuse: Local Irrigation	15	Avg. firm yield of 1.1 MGD for 55 year study period 11,000 MG[1]	1336			Potential impacts	Adequate	Reduces summer peak; Generates revenue; Conserves resources	No public access during irrigation cycle	11
Treated Wastewater Reuse: Subsurface Storage	130 / 230**	Avg. firm yield of 68 MGD for 55 year study period	96 / 169**	Account for stored water Integrated water use permit required	Must obtain additional water rights	Potential to degrade aquifer water quality	High chlorides, 200 mg/l	Firm supply; Conserves resources; Recharges Equus Beds	High construction cost Water quality concerns	NS
Treated Wastewater Reuse: Sell to Irrigators	129	Avg. firm yield of 68 MGD for 55 year study period	95		Must obtain additional water rights	Water is borderline quality for irrigation	Marginal, farmers should initiate a management program for soil	Generates revenue; Obtains water rights; Conserves resources	High construction cost Water quality concerns	NS
Little Arkansas River: Bank Storage	6.2 to 175 11.5 to 164	0 Firm Yield; variable with units installed, range from 7 to 39 MGD	45 to 221 41 to 207	Account for stored water Integrated water use permit required	Must obtain additional water rights	Effects must be evaluated	Good	Phased construction; Use injection wells; Water available for an extended time period	No firm yield Potential impacts on other users	3B*
Rain Harvesting	.6 Unit	Firm Yield of .007 MGD/unit	4117	Account for stored water Integrated water use permit required	Must obtain additional water rights		Good	Good water quality	Low available volume Very high unit cost	NS
Excess Potable Water: Subsurface Storage				Account for stored water Integrated water use permit required	Must obtain additional water rights		Must be monitored; Treat to potable standards	Conserves resources	Insufficient land available for storage Water quality concerns	NS
Low Range Water Conservation	23	279,500 MG[1] with an avg. savings of 15 MGD	77					Other cost savings to be realized; Reduces max day; Conserves resources		1
No Action	0	Reduces year 2050 max day demand 23 MGD	0					Reduces demand, max day net need is 14	Reduces service area Reduces tax base	NS

Notes:

[1]Over a 55 year period form 1996 to 2050

[2]"NS" = not selected

* Requires highly detailed study to confirm viability.

** Includes Equus Beds Well Improvements.

APPENDIX B - BIOLOGICAL ASSESSMENT

BIOLOGICAL ASSESSMENT

for the

INTEGRATED LOCAL WATER SUPPLY PLAN

Submitted to the

CITY OF WICHITA

WATER & SEWER DEPARTMENT

by

BURNS & MCDONNELL ENGINEERING COMPANY, INC.

December 2001

92-195-4-011

Burns & McDonnell

1157

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PART 1 INTRODUCTION

1.1 OVERVIEW

This biological assessment is part of the environmental studies for the Integrated Local Water Supply Plan (ILWSP) proposed for construction by the Water and Sewer Department (Department) of Wichita, Kansas. The assessment describes the federally listed species (threatened, endangered, or candidate for listing) identified by the U.S. Fish and Wildlife Service (FWS) that could be present in the project area, as required under Section 7 of the Endangered Species Act of 1973 (ESA), Public Law 93-205, and subsequent amendments. The biological assessment includes information on each species' status, life history, and the potential for impact by the Department's preferred alternative.

1.2 PURPOSE OF THE BIOLOGICAL ASSESSMENT

Construction of the ILWSP would involve the placement of fill materials in waters of the United States. This action would require a permit from the U.S. Army Corps of Engineers (Corps) pursuant to Section 404 of the Clean Water Act. Issuance of this permit is a federal action that requires compliance with the ESA. This biological assessment is submitted to the FWS in accordance with ESA Section 7. In response, FWS will provide a Biological Opinion on the anticipated project effects and measures necessary to protect or conserve potentially impacted threatened or endangered species.

1.3 PROJECT PURPOSE AND NEED

The purpose of the proposed project is to provide a reliable supply of potable water to the customers of the City of Wichita's water service area (service area) through the year 2050, which requires delivering water to a growing service area population and protection to the Equus Beds Aquifer. In developing the plans for a new supply, the Department used projections of future demands to determine the necessary expansions needed to increase water-pumping capacity. The project is intended to provide a firm or reliable water supply to meet the average and maximum day demand within the service area.

The City of Wichita's water service population is approximately 348,000, of which about 32,000 people are served outside the city limits. To meet its responsibilities, the Department initiated a water supply study in 1993. This study compared projected future water demands with existing raw water delivery capacity and found that water supply shortfalls during extended dry weather periods could begin occurring by 2016 for the average day supply shortfall, and by 2026 for the maximum day supply shortfall. Even with water supply improvements recently completed or currently underway, the projected water needs for the Department for the year 2050 are as follows:

- Average day demand of 112 MGD
- Maximum day demand of 223 MGD.

Implementation of a water supply plan to furnish these projected water needs may require up to 10 years lead time in advance of the projected year of water deficit for completion of planning, permitting, design, construction, start-up and operational activities.

In addition, one of the two principal raw water supply sources for the City of Wichita is the Equus Beds Well Field. Protection of the Equus Beds Well Field water quality is a major concern. With dropping water levels, there is a threat to the Equus Beds' integrity by saltwater intrusion (a naturally occurring feature from the Arkansas river and a by-product of nearby oil field activities) and this, in turn, affects both agriculture and the City of Wichita's drinking water supply. Recharging the underlying aquifer would reduce or prevent water quality degradation and provide a large volume of stored groundwater for future use during drought conditions.

PART 2 ALTERNATIVES

2.1 INTRODUCTION

The City of Wichita established two goals for the new water development project. These goals are

1) to determine water supply plans capable of supplying the year 2050 projected average and maximum daily demand of 112 and 223 MGD, respectively, and
2) to protect the Equus Beds aquifer's water quality.

Alternatives were selected for evaluation based upon engineering feasibility, economics or cost of construction and operation, and water quality impacts.

2.2 IDENTIFICATION OF ALTERNATIVES

In meeting the City's first goal, 27 water supply sources were identified and evaluated. These sources consisted of 14 conventional and 13 non-conventional alternatives, throughout the regional area in and around Wichita. Conventional alternatives included existing and proposed reservoirs, groundwater and surface water flow. Non-conventional alternatives included use of reservoir overflows, excess stream flow, treated wastewater reuse, groundwater bank storage, rain harvesting and water conservation.

Of the 27 water supply sources, only 11 were considered viable for further engineering studies. From the 11 viable water supply sources, 3 water supply plans were developed, the Milford Reservoir Plan, the Integrated Local Water Supply Plan (ILWSP) with a 250 MGD Diversion Option and the ILWSP with a 150 MGD Diversion Option. Both of the ILWSPs used a combination of water supply sources to meet the 2050 water needs.

To meet the second goal of the City, the three alternatives were evaluated as to the capability to protect the aquifer. Under the Milford Reservoir alternative, no protection to the Equus Beds aquifer would be provided and the City would continue to withdraw water from the aquifer. Both of the ILWSP options include a component to recharge the aquifer. Further engineering studies were required to determine the best method for recharge. Therefore, the City completed a 6-year recharge demonstration project (1994-1999).

Refinement of these two ILWSP alternatives resulted from information learned from the demonstration project and various engineering studies. These studies included a re-evaluation of the water demand needs for Wichita, hydrogeologic field tests, soil borings, groundwater modeling, system operation modeling, and surface water treatment investigations. Based on the modifications to the plans, they were renamed ILWSP 150 MGD Diversion and ILWSP 100 MGD Diversion.

2.3 ALTERNATIVES CONSIDERED

The basic strategy of the ILWSPs is to shift the priority of use and primary makeup of the City's raw water supply from groundwater to surface water. This will allow water to be conserved in the aquifer to satisfy both for growing water demands and water needs during extended dry weather conditions. Both ILWSPs contain the same components; however, the Equus Bed recharge component and the Local Well Field component includes several options. The ILWSPs components are:

1. **Water conservation** - rates and public education to influence water demands by all customer classes.
2. **Cheney Reservoir** -greater use of reservoir spillage and flood pool water when available.
3. **Bentley Reserve Well Field** - Redevelopment of an existing site along the Arkansas River for use in meeting short-term peak water demands.
4. **Local Well Field Expansion** to capture "above-base" flow water from the Little Arkansas River and "leakage" water from the upstream, recharged Equus Beds Well Field.
5. **Equus Beds Aquifer** –
   - Capture of "above-base" flow water from the Little Arkansas River to be used for recharge of the Equus Beds Aquifer or direct supply to water treatment facilities in the City.
   - Recovery of stored water in the Equus Beds Aquifer during extended dry weather conditions for conveyance to the city's water treatment plants.

The two ILWSP alternatives are based on an optimized priority of water use on an "as available" basis from several sources to meet demand from storage during dry periods.

The physical features of each of the alternatives are discussed below.

2.3.1 Water Conservation Component

Conservation activities associated with the two water supply plans would involve the following:

- Review and modification of the inverted water rate structure on an annual basis to help achieve and maintain conservation goals.
- Maintenance of watering restrictions (twice per week by address) during drought periods.
- Encouragement of domestic consumers to use flow-restricting faucets and showerheads, reduce toilet tank capacity, and restrict lawn watering or car washing activities.
- Continuation of public awareness and education programs.
- Continuation of leak detection surveys to reduce water distribution system losses.
- Continuation of meter repair and replacement programs to increase the accuracy of water quantity monitoring. All meters would be tested, repaired or replaced on an eight-year cycle.
- Continuation of cooperative efforts with industries to encourage conservation of cooling, process and irrigation water.
- Operation of surface water and groundwater supplies to minimize water losses or yield reductions. Groundwater supplies would be managed to reduce aquifer declines and deterioration due to over-pumping.
- Continuation of operating water treatment facilities to minimize water losses through recycling of water used to clean filters in water treatment processes.

2.3.2 Redevelopment of the Bentley Reserve Component

The Bentley Reserve Well Field is located adjacent to the Arkansas River, south of the town of Bentley and along the right-of-way for the 66-inch Equus Beds well field pipeline. The original wells have been abandoned and the water rights have been terminated. Redevelopment of the abandoned Bentley Reserve Well Field could supply up to 10 MGD of relatively high chloride water to meet peak demands. The high chloride water would be blended with water from other sources to maintain a level less than 200 mg/l to meet short-term peak water demands during dry weather conditions.

2.3.3 Local Well Field Component

The Local Well Field (LWF) lies downstream of the Equus Beds Well Field at the confluence of the Arkansas and Little Arkansas Rivers, near the City's Central Water Treatment Plant. Currently, the LWF is used only during periods of peak demand.

The existing LWF is comprised of 17 wells constructed between 1949 and 1953, plus three redrilled wells constructed in 1997.

The expanded LWF, which incorporates the City's original E & S Well Field, is expected to supply up to 39 percent of the City's raw water needs.

Expansion of the LWF would use "above base flow" water from the Little Arkansas River. In addition, any "leakage water" from the Equus Beds aquifer would also be collected by the new system. Water from both sources would be transferred directly to the Central Water Treatment Plant. New components would include:

- Four horizontal collector wells with pump houses
- Five vertical wells with pumps and motors (underground discharge configuration)
- Collecting pipelines (with easements)

Conceptually the design capacity for the collector wells is 10 MGD during high river stage conditions (2 feet above average flow). On average, approximately 25,000 acre-feet per year would be available, assuming that water can be diverted to the 20 cfs minimum desirable streamflow (MDS) limit. Actual yield would depend on how close to the river the wells can be constructed.

Water rights for the existing wells allow an average day withdrawal rate of 5.4 MGD and a maximum day withdrawal rate of 37.1 MGD. Based on 79 years of historical flow data, approximately 27 MGD would be diverted from the Little Arkansas River about 50 percent of the time and 37 MGD would be diverted about 40 percent of the time. Although the proposed expansion does not provide a firm water supply, it has the potential to divert up to 37 MGD from the Little Arkansas when it is available, saving the stored groundwater for times of low river flow.

Piping for the upper section of the LWF is common for both options and includes connections to three horizontal collector wells. These wells pump the diverted water into a dedicated pipeline routed through the floodway, which connects to an existing 48-inch raw water line for conveyance to the Central Water Treatment Plant.

Two options exist for the Lower Section of the LWF. Option 1 conveys diverted water from the wells south to Vertical Well 5 in the Central Riverside Park area (Figure 2–1). The final section of waterline to the Central Water Treatment Plant is routed through city property and is about 4,000 linear feet longer than the final pipeline section in Option 2.

Option 2 conveys water to Vertical Well 3 near the northern boundary of Oak Park. The final section of waterline connects the lower section of the well field from Vertical Well 3 to the existing 48-inch raw waterline for conveyance to the Central Water Treatment Plant (Figure 2–2).

2.3.4 <u>Cheney Reservoir Component</u>

When available, greater amounts of surface water (from reservoir spillage and flood pool storage) will be used to replace groundwater usage to conserve water in the Equus Beds aquifer. As a component of the ILWSP, use of water in Cheney Reservoir would be continued up to a maximum capacity of 80 MGD. New operating modifications would allow use of waters temporarily stored in the flood pool.

Should the City's need for more water arise at a time that additional water is available in the reservoir's flood storage pool, the capability would exist to pump water to the City's Central Water Treatment Plant. When water levels in the flood storage pool drop to a predetermined low level, the use of Equus Beds aquifer (water from the existing permit or recovered recharge water) would be increased. The objective is to maximize recharge water storage in the aquifer and to maximize use of available water stored in Cheney Reservoir. Use of these waters "as-available" allows the Equus Beds to be recharged for later use during drought conditions and minimizes the need for additional water supply sources from outside the region.

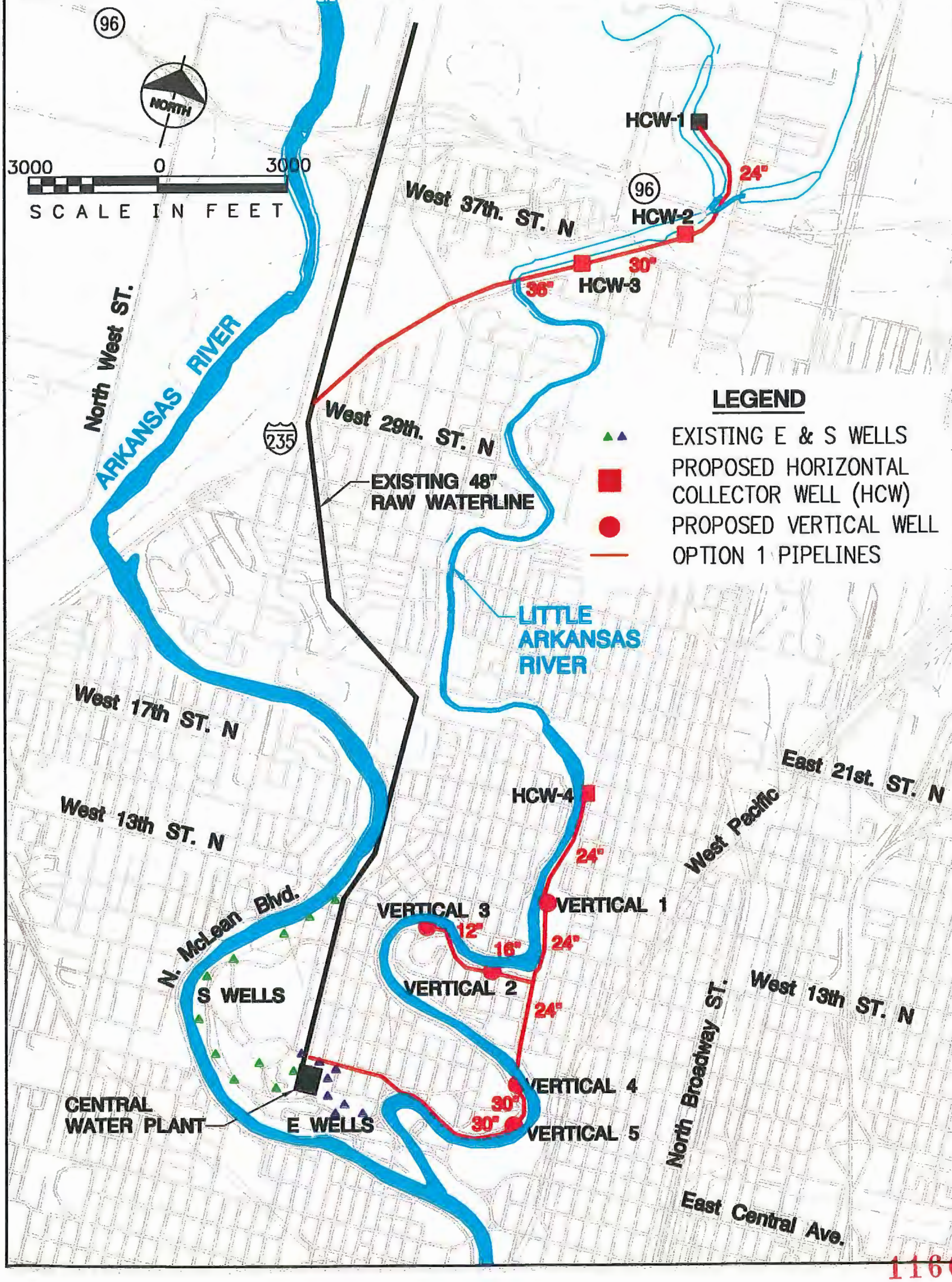
2.3.5 <u>Equus Beds Aquifer Recharge, Storage and Recovery Component (ASR)</u>

Two alternatives were investigated for the Equus Beds Recharge, Storage, and Recovery Project. Alternative 1 includes three options for capturing, pre-treating, and recharging 150 MGD of ground and surface water with an additional option to capture, pre-treat, and transfer 60 MGD of surface water direct to the City's water treatment facilities. Alternative 2 also has three options which would capture, pre-treat, and recharge approximately 100 MGD of ground and surface water with an option to capture, pre-treat, and transfer 60 MGD of surface water directly to the City's water treatment facilities.

2.3.5.1 *Alternative 1 – 150 MGD ASR*

This component consists of three options for capturing 150 MGD of surface water from the Little Arkansas River and groundwater from bank storage adjacent to the river. This includes a surface water intake, induced infiltration wells, and facilities to transfer and recharge the captured water to the Equus Bed aquifer and to recover the stored water. A presedimentation plant is proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment plants. Each of the three options is considered with and without diverting 60 MGD of treated surface water to the City treatment facilities. They are:

Figure 2-1 Piping Option 1 Local Well Field Expansion



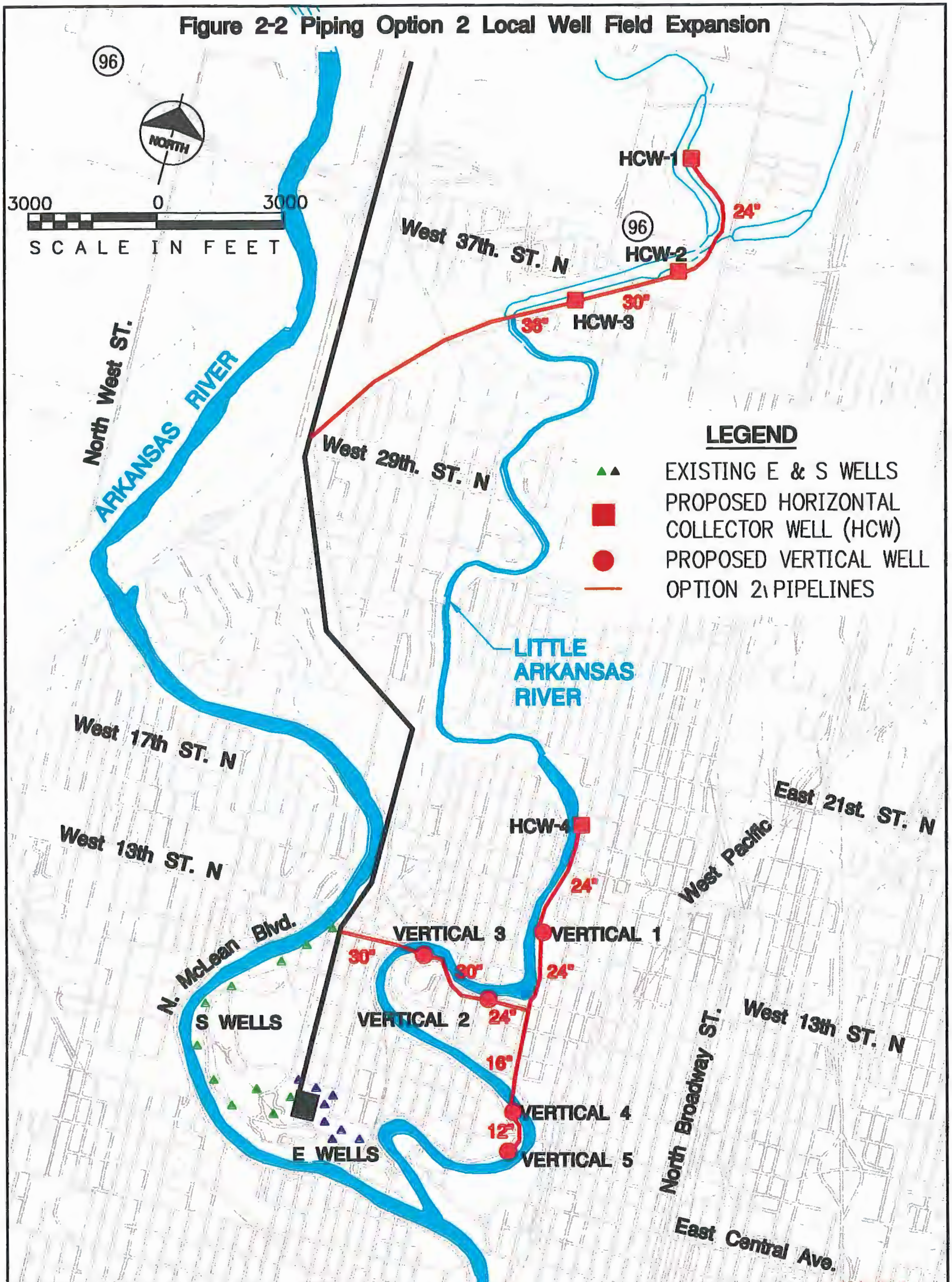


Figure 2-2 Piping Option 2 Local Well Field Expansion
96
NORTH
3000
0
3000
SCALE IN FEET
North West ST.
ARKANSAS RIVER
West 37th. ST. N
West 29th. ST. N
West 17th ST. N
West 13th ST. N
N. McLean Blvd.
HCW-1
24"
96
HCW-2
30"
HCW-3
36"
LEGEND
EXISTING E & S WELLS
PROPOSED HORIZONTAL COLLECTOR WELL (HCW)
PROPOSED VERTICAL WELL
OPTION 2 PIPELINES
LITTLE ARKANSAS RIVER
HCW-4
24"
East 21st. ST. N
West Pacific
VERTICAL 3
VERTICAL 1
30"
30"
24"
VERTICAL 2
24"
16"
S WELLS
VERTICAL 4
12"
VERTICAL 5
E WELLS
North Broadway ST.
West 13th ST. N
East Central Ave.

- **60/90 ASR Option**: Capture of 60 MGD of induced infiltration water for recharge and 90 MGD of surface water for treatment and recharge with an additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facilities.
- **75/75 ASR Option**: Capture of 75 MGD of induced infiltration water for recharge and 75 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facility.
- **100/50 ASR Option**: Capture of 100 MGD of induced infiltration water for recharge and 50 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facilities.

2.3.5.2 *Alternative 2 – 100 MGD ASR*

This component consists of three options for capturing 100 MGD of above base flow water from the Little Arkansas River. This includes a surface water intake, induced infiltration wells, and facilities to transfer and recharge the captured water to the aquifer and to recover the stored water. A presedimentation plant is proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment plants.

Each of the three options are considered with and without capturing and diverting 60 MGD of treated surface water to the City's treatment facilities. Only 100 MGD of above base flow from the Little Arkansas River would be captured without the additional 60 MGD surface water intake. This 100 MGD of captured water would be used for recharge, storage, and recovery in the Equus Beds aquifer.

Options to Alternative 2 for a 100 MGD capture and recharge system include:

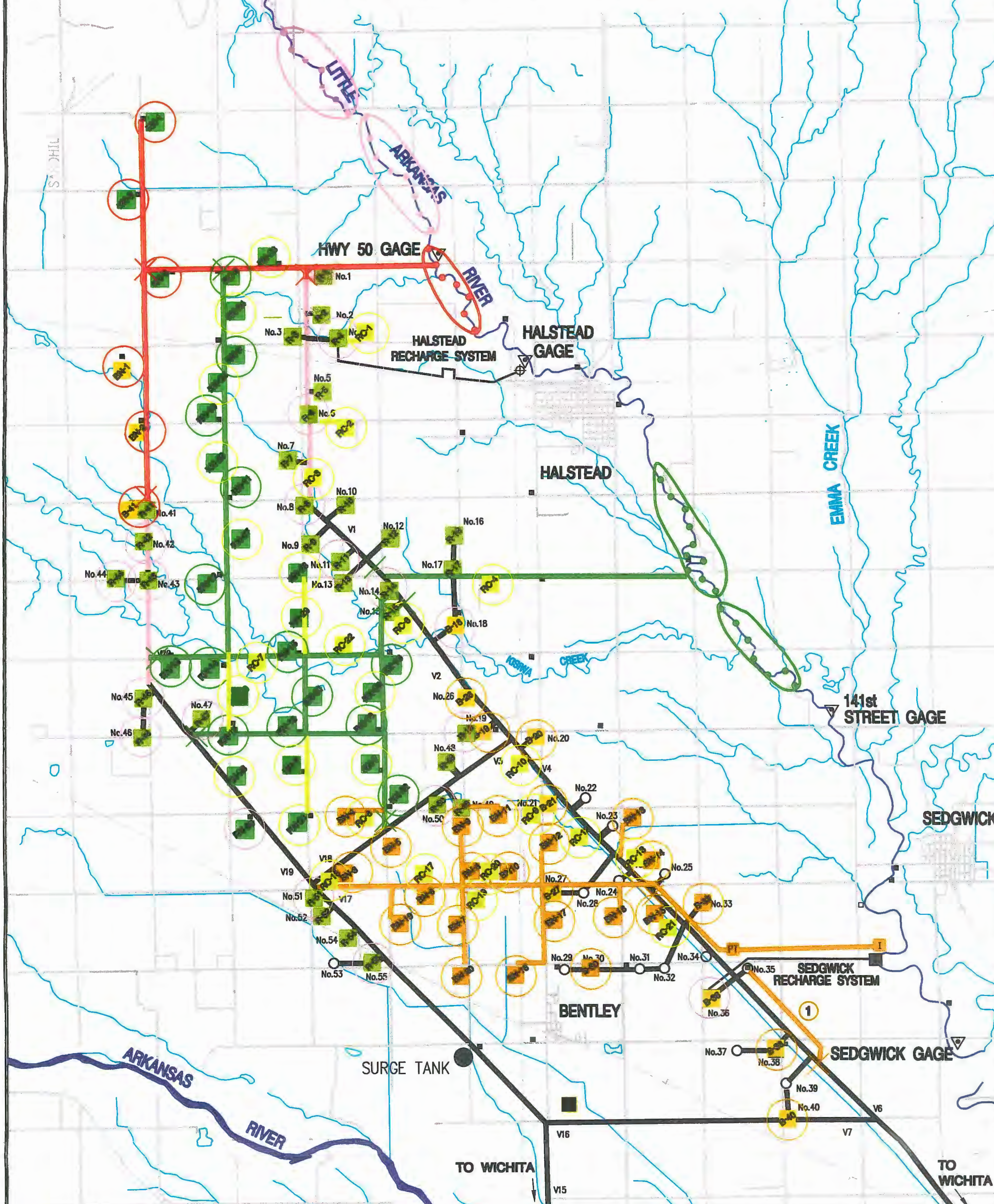
- **60/40 ASR Option**: Capture of 60 MGD of induced infiltration water for recharge and 40 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities.
- **75/25 ASR Option**: Capture of 75 MGD of induced filtration water for recharge and 25 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities.
- **100/0 ASR Option**: Capture of 100 MGD of induced infiltration water for recharge; no surface will be used for recharge. However, there is an additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities. The presedimentation plant in this plan could be located adjacent to the City's Central Water Treatment Plant.

2.3.6 <u>No Federal Action</u>

No federal action means that no federal permits (e.g., Section 404 Dredge and Fill, National Pollution Discharge Elimination System) would be issued, therefore, no new water supply facilities to provide additional drinking water which would require Federal approval could be constructed. If no action is taken, the existing water supply sources would be unable to meet the maximum daily needs for the expected future growth of Wichita. Without additional capacity, the Department would be required to limit new customers to those within the Department's current service area. This action would reduce, but not stop, increases in demand for water because the Department is required by law to supply all customers within its service area. Eventually, the system would be unable to maintain pressure during maximum use periods. Currently, the Department is dependent on the Cheney Reservoir, the Local Well Field and the Equus Bed aquifer to meet average daily demand. Without any additional sources of water and recharge to the Equus Bed aquifer, contamination to the aquifer from salt water would force the Department to limit water use from the source. This contamination would ultimately reduce the City's current water supply. The impact of no-action would be a deterioration of system water pressure with possible repercussions on public health and safety.

2.4 PREFERRED ALTERNATIVE
The City of Wichita's preferred alternative is the Integrated Local Water Supply Plan with 100 MGD ASR with the75/25 ASR Option. The Integrated Local Water Supply Plan would help to preserve the Equus Beds aquifer for use by future generations. Recharging the aquifer would protect the ground water from chloride plumes migrating towards the well field and provide a large volume of stored groundwater for future use, not only by the City of Wichita, but also by local farmland irrigators.

Figure 2-3 60/90 ASR Option Layout and Implementations



LEGEND

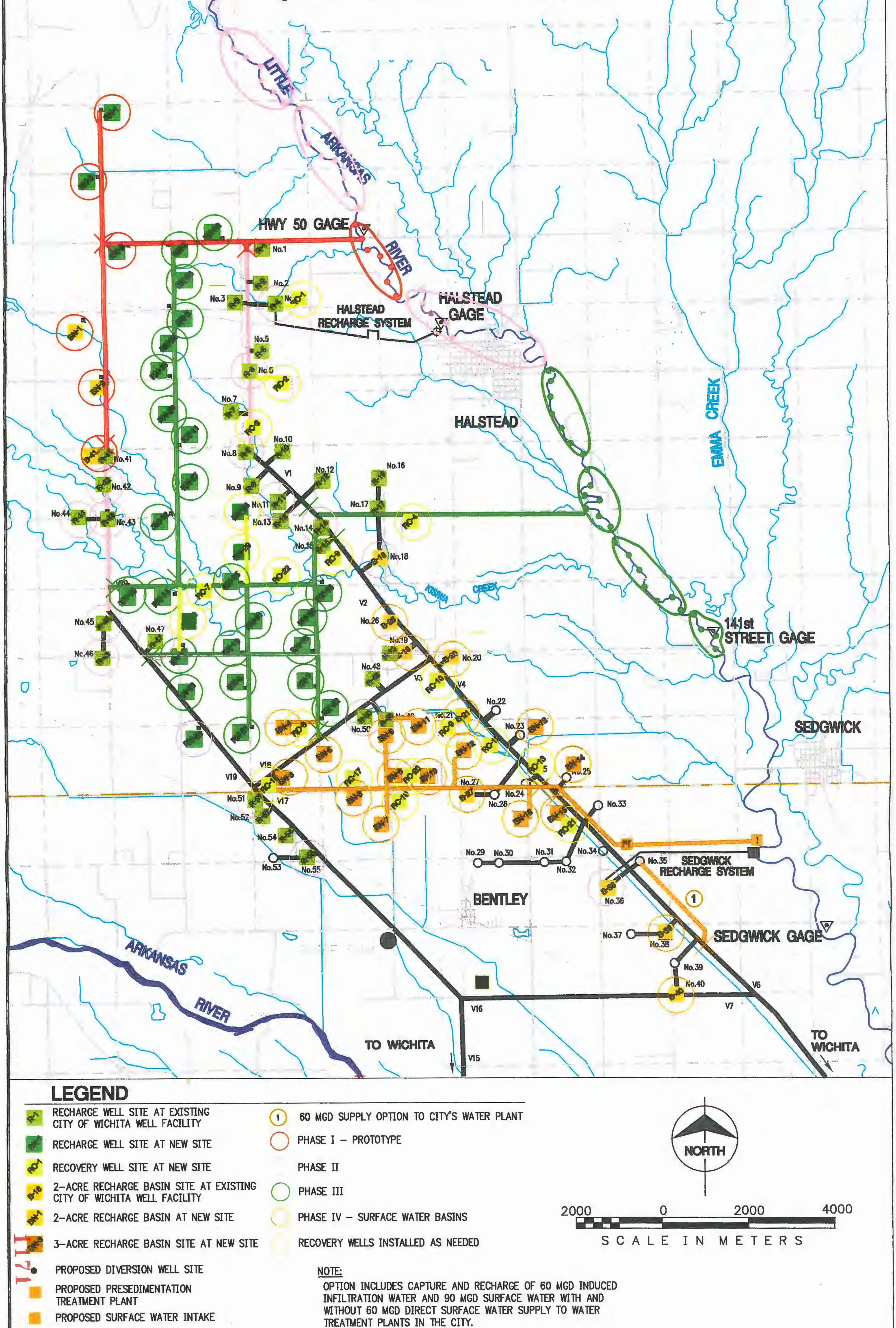
- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000
SCALE IN METERS

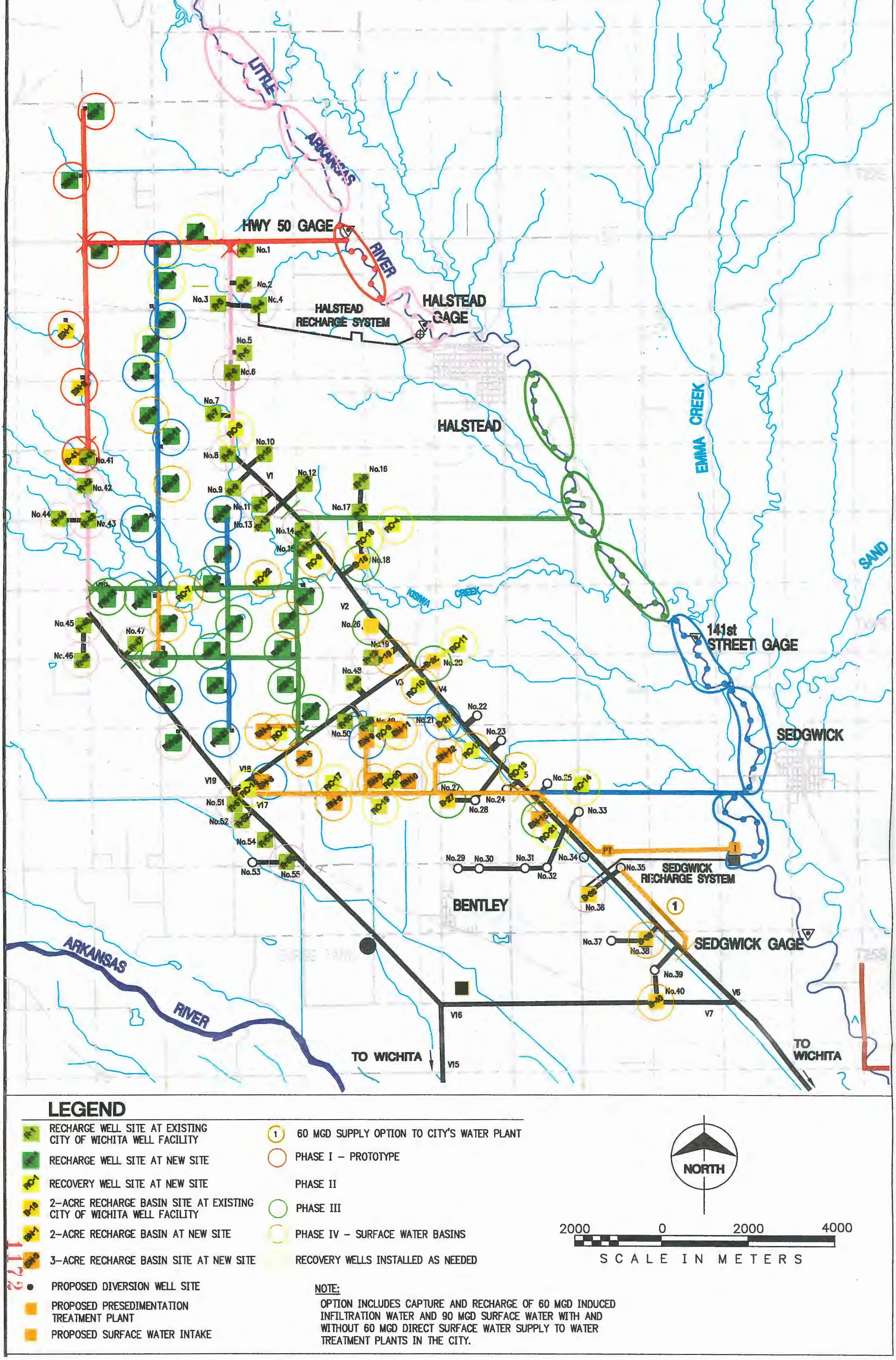
NOTE:
OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

Figure 2-4 75/75 ASR Option Layout and Implementations



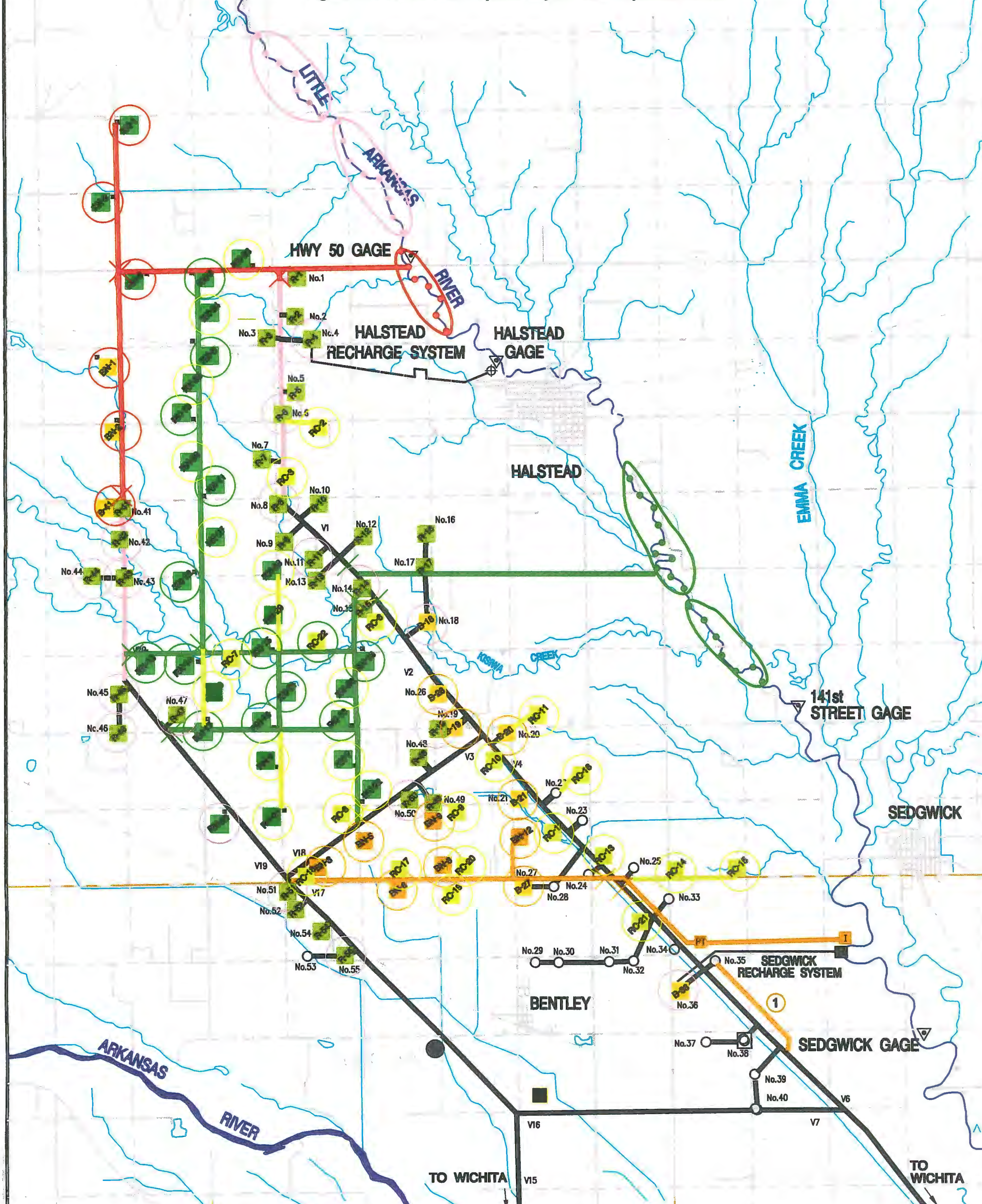
1171

Figure 2-5 100/50 ASR Option Layout and Implementations



1172

Figure 2-6 60/40 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE

- (1) 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

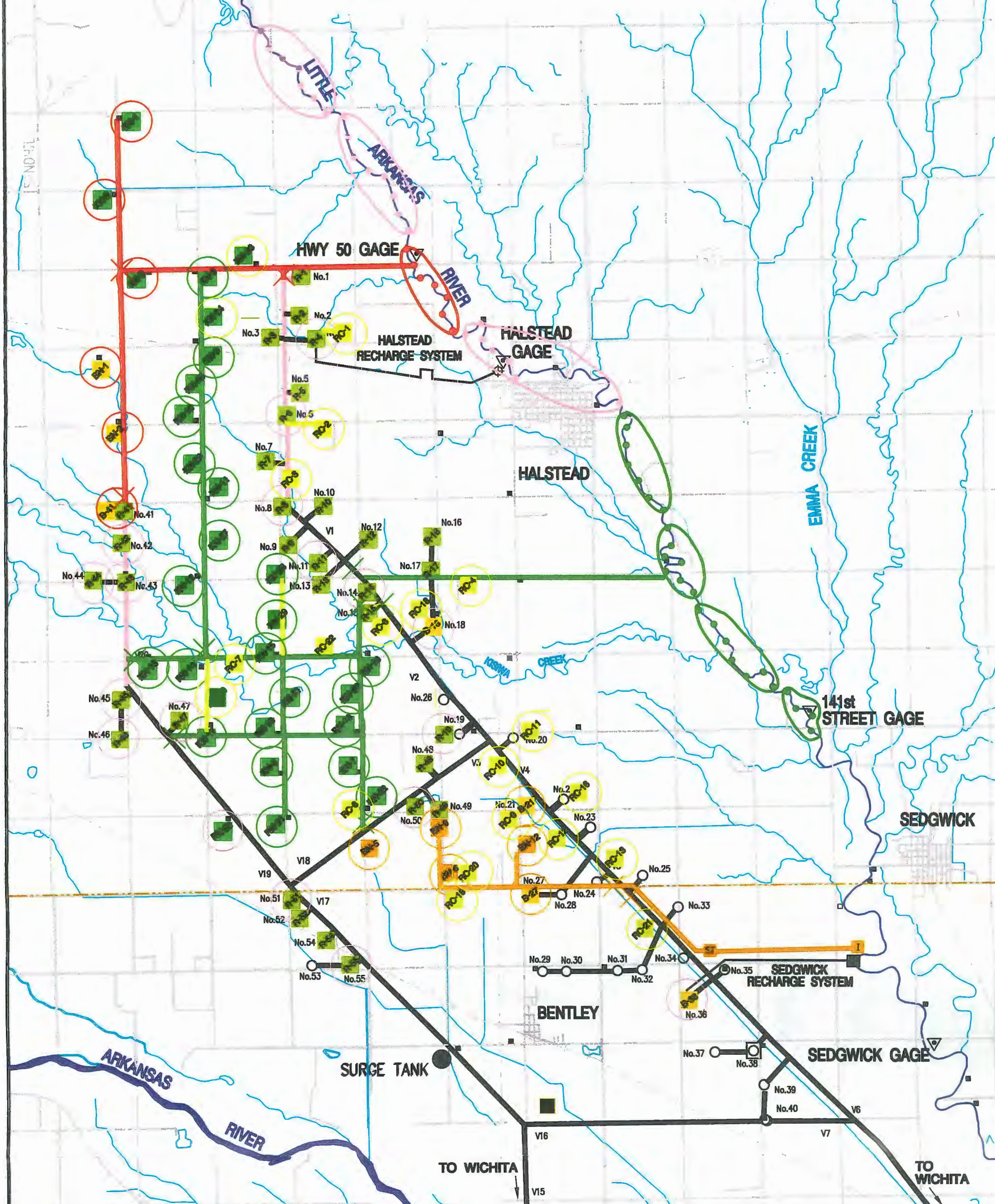
2000 0 2000 4000

SCALE IN METERS

NOTE:
OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

1173

Figure 2-7 75/25 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED SEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE

- (1) 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NOTE:
OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

NORTH

2000 0 2000 4000
SCALE IN METERS

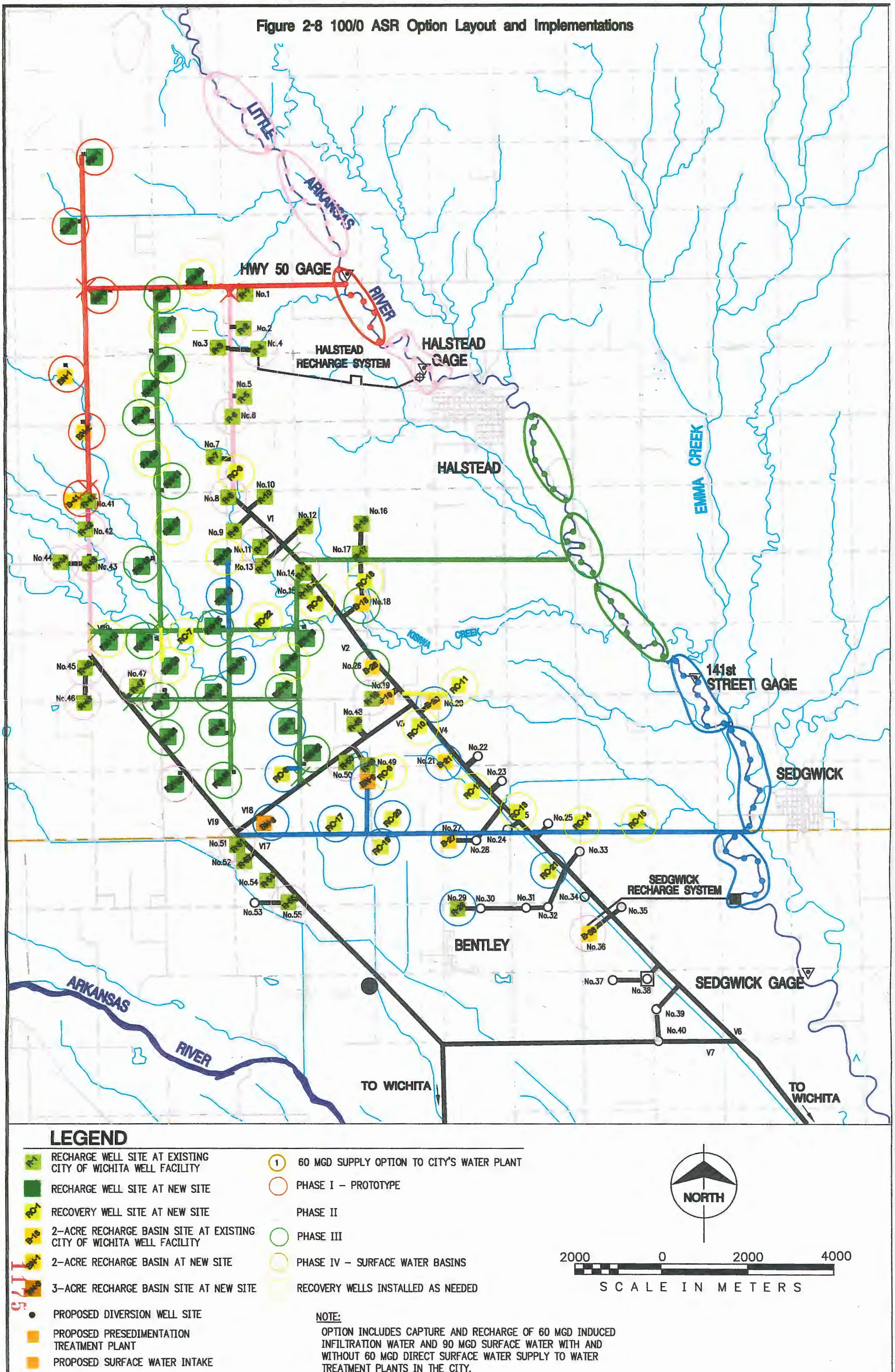


Figure 2-8 100/0 ASR Option Layout and Implementations

PART 3 POTENTIALLY IMPACTED SPECIES

The FWS identified nine federally listed (threatened, endangered, or candidate) species which could be impacted by the proposed project (Table 3–1). Since contacting FWS, the peregrine falcon (*Falco peregrinus*) has been delisted (FWS 1999a) and therefore is not included in the discussion that follows. All of these species occur in other parts of the United States and could exist in the project area. The following discussion provides both general information on each species and more specific information related to each species' usage of the project area.

3.1 BALD EAGLE

The bald eagle (*Haliaeetus leucocephalus*) is a large bird of prey. It occurs throughout North America and once maintained breeding populations in Canada, Alaska, and 45 of the lower 48 states. During the late 1800's and continuing into the 1970's, the population size and breeding range of the species declined considerably. This decline prompted the species to be listed as federally endangered in 1978. Through research, conservation, management, and protection, the species population within the lower 48 states is increasing, as is its breeding range. Improvements in the species status led to it being down-listed to federally threatened in July 1995 (FWS 1995). The bald eagle is currently proposed for delisting from the federal list of endangered and threatened wildlife (FWS 1999b).

3.1.1 General Life History

The bald eagle is approximately three feet in length with a wingspan of 7 to 8 feet (Robbins et al. 1983). Adults are easily distinguished by their large size, white head and tail contrasting with a dark brown to black body. Juveniles are uniformly dark and may resemble the golden eagle (*Aquila chrysaetos*), only smaller in size.

Bald eagles may live as long as 30 years (Grier et al. 1983) with sexual maturity being obtained at 4 to 6 years of age. Mortality of juvenile birds is thought to be high and dependent on winter habitat and the severity of winter weather. After surviving one or two winters, survivorship

Table 3-1 Species of Concern

Common Name	Scientific Name	Federal Status
Bald Eagle	*Haliaeetus leucocephalus*	Threatened
Peregrine Falcon	*Falco peregrinus*	Delisted
Interior Least Tern	*Sterna antillarum athalossos*	Endangered
Piping Plover	*Charadrius melodus circumcintus*	Threatened
Arkansas Darter	**Etheostoma cragini**	Federal Candidate, State Listed Threatened
Arkansas River Shiner	*Notropis girardi*	Threatened
Topeka Shiner	*Notropis topeka*	Endangered
Eskimo Curlew	*Numenius borealis*	Endangered
Whooping Crane	*Grus americana*	Endangered

of immature eagles increases (Sherrod et al. 1977).

Once sexually mature, bald eagles may still not breed for several years. Reproductively active eagles are described as mating for life; however, this is not extensively supported (Grier et al. 1983). Bald eagles tend to use the same area for nesting in successive years and often use the same nest. Reused nests will be repaired and added to each successive year such that nests may reach considerable size, measuring several feet in diameter and depth and weighing several hundred pounds. Bald eagles generally nest in large trees with strong branches. However, where present, rock cliffs may be used.

A minimum of one square mile of essential habitat around a nest is considered necessary to successfully raise young (Grier et al. 1983). Essential habitats are geographical areas, which contain the ecological qualities necessary for survival and recovery of a species. These qualities include space for individual and population growth and normal behavior, food, water, air, light, minerals, cover and shelter, sites for breeding and raising young, and protection from disturbance.

Nesting activities begin in late winter or early spring, depending on the latitude. Nesting occurs earlier in warmer, southern portions of the range and later further north. One, two, or occasionally three eggs are laid. Fledging of chicks occurs approximately four months after eggs are laid.

The bald eagles' primary food source is fish (Grier et al. 1983). Both live and dead fish are utilized (Ehrlich et al. 1988). Because of their reliance on fish, nesting occurs in proximity to large water bodies, including lakes, rivers, and oceans.

While some bald eagles in southern latitudes remain in their nesting areas year-round, the majority of North American bald eagles migrate to coastal or more southerly climates during the winter. Migration depends partly on the severity of the winter, with eagles moving as far south as necessary to find open-water feeding areas. Wintering bald eagles are found throughout the United States but are most abundant in the midwest and west. Each year, thousands of eagles winter in Utah, Colorado, South Dakota, Nebraska, Kansas, Oklahoma, and Missouri. These states account for over 90 percent of the bald eagles recorded during midwinter surveys in the midwest and west and nearly half the eagles counted nationwide.

Suitable wintering areas require an abundant and easily available food supply and cover for protection from the cold and short periods of severe weather. During winter, eagles continue to rely on fish for food but may also feed on waterfowl, scavenge for carrion, or catch small mammals. Thus, wintering eagles may spend considerable time away from water in search of food. At night, bald eagles will select areas offering protection from the wind and severe weather. These areas are often dense stands of trees in areas where the topography affords protection from the elements. Roost sites may be communal, with large numbers of eagles using a single roost site. However, estimates are that only about 50 percent of the eagles in an area will congregate in a communal roost. Additionally, roost sites may be used for many years. Disturbance to a roost may lead to abandonment of the site (Steenhof 1976, Hansen et al. 1981, Keister 1981).

For a variety of reasons, bald eagle populations declined significantly during the 19th and 20th centuries. In the 19th century, population declines were attributed to hunting, trapping, and loss of habitat from human development and intrusion. Population declines continued into the 20th century. During the mid 1900's, reproductive success and survivorship of adults was dramatically reduced by organochlorine insecticides (Grier et al. 1983), including DDE and DDT. Direct poisoning of birds occurred and reproductive failure increased as a result of reduced calcium metabolism resulting in egg shell thinning caused by sub-lethal levels of these chemicals. Additionally, some mortality has been reportedly caused by mercury poisoning from industrial and other wastes and by lead poisoning from ingesting lead shot when feeding on dead or crippled waterfowl (Grier et al. 1983). In some areas of the historic breeding and nesting range, disturbance caused by human development may prevent current and future eagle nesting (Murphy 1965, Retfalvi 1965, Juenemann 1973, Weekes 1974, Grubb1976, Anthony and Isaacs 1989), as well as result in abandonment of wintering areas (Stalmaster and Newman 1978, Russell 1980, Skagen 1980, Knight and Knight 1984, Smith 1988). Lastly, reduction of water quality leading to reduced aquatic productivity resulting from acid rain is under evaluation as a current threat to nesting eagle populations.

3.1.2 Kansas and the Project Area

The bald eagle has become an increasingly more common nester and winter visitor in the State of Kansas. This species has also been increasingly observed in the state, mostly between October and March. These raptors are now seen regularly throughout Kansas, with most winter concentrations occurring in the eastern half of the state in larger reservoirs and rivers. Bald eagle inventories for midwinter have averaged between 800 and 1,000 birds during the 1990's (Collins et al. 1995).

Bald eagle sightings have occurred within the project area. At Cheney Reservoir, approximately five bald eagles have been sited in recent years and these sightings have been of migratory individuals, not of nesting pairs (Ryan Stucky, personal communication).

Eight separate areas in Kansas are currently considered as critical habitat for the bald eagle. One of the eight critical areas falls within the project area; this includes all lands and waters within a corridor along the main stem of the Arkansas River from it's point of entry in Sumner County, at Sec. 1, T30S, R1E, to the Kansas-Oklahoma border in Cowley County. The bald eagle has been recorded in all counties in the project area (Collins et al. 1995).

3.2 INTERIOR LEAST TERN

The interior least tern (*Sterna antillarum athalassos*) is one of three subspecies of New World least terns. The species was first described by Lesson in 1847 (Ridgway 1895, American Ornithologists' Union (AOU) 1957, 1983). However, the first recorded observation of the interior subspecies was noted by the Lewis and Clark expedition in 1804 (Ducey 1985). Originally described as races of the Old World least tern (*Sterna albifrons*), the New World populations are now recognized as a separate species (AOU 1983). Three subspecies are recognized based on breeding distribution: the interior least tern, the eastern or coastal least tern (*Sterna antillarum antillarum*), and the California least tern (*Sterna antillarum browni*) (AOU 1957, 1983). The interior least tern was formally listed as federally endangered on June 27, 1985 (FWS 1985).

The federally endangered status of the interior least tern applies to populations in Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Mississippi River populations in Louisiana and Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, South Dakota, Oklahoma, Tennessee, and those populations over 80 kilometers (50 miles) from the Gulf Coast in Texas (FWS 1990). In addition, the interior subspecies is listed as state endangered in Arkansas, Illinois, Indiana, Iowa, Missouri, Nebraska, Tennessee, Texas, Kansas, Kentucky, New Mexico, Oklahoma, and South Dakota. It is also regarded as endangered in North Dakota; however, it is afforded no legislative protection.

3.2.1 General Life History

The least tern is the smallest member of the subfamily Sterninae, within the family Laridae of the order Charadriiformes. The sexes are nearly identical. Least terns are characterized by a black crown, white forehead, grayish back and dorsal wing surface, snow white underside, and legs varying from orange to yellow. Bill color varies slightly, depending on the sex, but is always black-tipped. Population size of the interior least tern is estimated at 5,000 individuals (FWS 1990).

The least tern is a migratory species, breeding along large rivers within the interior of the United States during the summer months and retreating to more southerly areas during the winter. Historically, breeding habitat included the Mississippi, Red, and Rio Grande rivers and their major tributaries. Breeding and nesting range include the area from Texas north to Montana and from eastern Colorado and New Mexico westward to southern Indiana. Currently, the least tern is still known to nest in all these areas. However, nesting areas are confined primarily to river stretches that are relatively unaltered by human activities.

Least tern wintering areas are largely undetermined but are believed to include the Gulf Coast of Texas and extend southward to Central America and parts of northern South America.

The least tern feeds primarily on small fish, which it plucks from the surface of large rivers or other water bodies. Occasionally, crustaceans, insects, mollusks, and annelids may be taken (Whitman 1988). Foraging areas are usually near nesting sites. However, terns may travel several miles to fish (Talent and Hill 1985).

Least terns return to breeding and nesting areas from late April to early June (Faanes 1983, Hardy 1957, FWS 1987, Wilson 1984, Wycoff 1960, Youngworth 1930). Courtship occurs in the vicinity of the nest site and includes aerial pursuit, ground display, ritual feeding, scraping out a nest, various posturing, calling, and copulation (Ducey 1981, Hardy 1957, Wolk 1974).

Nests are constructed on unvegetated or sparsely vegetated sand or gravel bars within wide river channels, along salt flats, or on artificial habitats such as sand pits (FWS 1990, Dryer and Dryer 1985, Haddon and Knight 1983, Kirsch 1987, 1988, 1989, Larkins 1984, Morris 1980). The nest is a shallow depression in the substrate, scratched out by the adults. It is inconspicuous and located out in the open. Because terns are colonial nesters, several nests may be located in the same area. Nests may be from several feet to several hundred feet apart (Ducey 1988, Anderson 1983, Hardy 1957, Kirsch 1990, Smith and Renken 1990, Stiles 1939). Adult birds do not travel far from their nest colony, however they may re-nest in a totally new colony if their first nest is lost (Lingle 1988). Terns will defend their nest as well as the nests of others within the same colony (FWS 1990).

Least terns begin laying eggs around the end of May. If a nest of eggs or chicks is lost, the pair may nest a second time. The second nesting may occur as late as mid to late July (Lingle 1988). Average clutch size is approximately 2.5 eggs per nest (Lingle 1988). The eggs are generally pale to olive buff with dark purple-brown, chocolate, or blue grey speckles or streaks (Hardy 1957, Whitman 1988) which effectively camouflage the eggs while in the nest. Eggs are incubated by both parents for 17 to 31 days, but generally 20 to 25 days (Faanes 1983, Hardy 1957, Moser 1940, Schwalbach 1988, Cairns 1977). Chicks are precocial, but depend on their parents for food and care until fall migration (Massey 1972). Chicks fledge at approximately 21 days of age (Kirsch 1990). Parents and chicks will remain in the area of nesting colonies until departing for the winter. By early September, terns have usually left the colonies for the southern wintering areas (Bent 1921, Hardy 1957, Stiles 1939).

Sandbar habitats used by least terns for nesting are ephemeral; thus terns are highly susceptible to loss of nests, eggs, or chicks because of high water. Although nesting usually is initiated during high flow periods causing terns to nest on higher areas of sandbars, Lingle (1988) found flooding to be the main cause of nest loss in riverine habitats. In some areas and during abnormally high or late spring flows, artificial habitats such as gravel and sand pits may provide the only suitable nesting habitat in an area (Lingle 1988). While these areas provide suitable nesting habitat, they require adult birds to fly greater distances to forage and may subject nests and chicks to a greater likelihood of loss from predators or human disturbance (Lingle 1988, Lackey 1994).

3.2.2 Kansas and the Project Area

The least tern is an uncommon migrant in the state of Kansas and a local summer resident in the central and western parts of the state. Nesting habitat for the least tern has been lost along southwestern Kansas rivers by the lowering of river flows due to use for irrigation. Lower river flows have reduced or eliminated the scouring process that cleans vegetation from sandbars and riverbanks (Collins et al. 1995).

Breeding areas for the least tern include areas along the flats of the Quivira

National Wildlife Refuge (QNWR) and sandbars along the Cimarron River. The breeding range formerly extended along other rivers in central and western Kansas. The least tern arrives at breeding sites from late April to early June and typically spends 4 to 5 months at the locale. These birds nest in small colonies, creating nests out of small scrapes in the sand. Incubation lasts about 20 days, with chicks fledging about 20 days after hatching (Collins et al. 1995).

Collins et al. (1995) describes the critical habitat designated for Kansas. Habitat falling within the project area includes all wetlands and waters within the QNWR in Reno County. The least tern has been recorded in all counties in the project area.

3.3 PIPING PLOVER

The piping plover is one of six belted plovers found in North America. It was first considered a distinct species in 1824 and was designated *Charadrius melodus*, in reference to its mating call, in 1931 (AOU 1931). Two subspecies of piping plovers are recognized (AOU 1957) even though no consensus currently exists on their distinctness. *Charadrius melodus melodus* is found on the Atlantic Coast and *Charadrius melodus circumcintus* inhabits the Great Lakes and Great Plains regions. For purposes of this biological assessment, only the Great Plains portion of the Great Lakes/Great Plains subspecies is considered, although characteristics of the Atlantic Coast and Great Lakes piping plovers are similar. Piping plover populations have declined dramatically since the early 1900's (FWS 1994a). The causes of the decline have included over-hunting and habitat loss. Although members of the inland population continue to breed throughout the Great Plains region of Canada and the United States, breeding populations of piping plovers have all but disappeared from the Great Lakes region (Haig and Plissmer 1993). These population declines prompted FWS to list the piping plover under the ESA in January 1986. Piping plovers breeding on the Great Lakes were listed as endangered, while those breeding on the Great Plains were listed as threatened. Modeling of piping plover population dynamics, based on a variety of observed and theoretical reproductive and survivorship rates, predicted the extirpation of piping plovers within 44 years (Ryan et al. 1993).

3.3.1 <u>General Life History</u>

Piping plovers winter along the Gulf of Mexico. They occur on the coastal beaches and use beaches, sand flats, and sand dunes. It is unclear whether or not piping plovers return to previous breeding areas. Cairns (1977) found only 15 percent of piping plovers returned to former breeding sites. However, over 90 percent returned to previous breeding sites in Minnesota (Haig and Oring 1988). Return rates for fledglings varied from less than 5 percent in New York to over 20 percent in Minnesota (Wilcox 1959, Wiens 1986). Return rates did not appear to be based on reproductive success (Wiens 1986, Haig and Oring 1988).

Piping plovers arrive on the breeding grounds between mid-April and mid-May (Prindiville- Gaines and Ryan 1988; Haig and Oring 1985; Wiens 1986). Males and females begin courtship, which includes aerial flights, stone tossing, and construction of several nest scrapes (Cairns 1982; Haig 1992). Only one of the nest scrapes is used. It consists of a shallow depression scratched in the sand or gravel and is frequently lined with small pebbles or shells (FWS 1994a). Nests are constructed on bare sand or gravel. During the breeding season, mated pairs establish a territory during courtship and defend that territory until chicks are fledged. Both adults will participate in territory defense. Defended territories generally only include those established around a nest site. Nest sites and foraging areas may be together or separate (Whyte 1985, Cairns 1977, Haig 1992). Piping plovers may nest in small colonies or alone.

Eggs are laid beginning in May. One egg is laid per day for four days. Incubation lasts for 25 to 31 days, with both parents sharing the incubation duties (Wilcox 1959, Cairns 1977, Prindiville 1986, Wiens 1986, Haig and Oring 1988). Eggs hatch from late May to mid-June. Chicks are precocial and able to leave the nest and begin feeding themselves within several hours (FWS 1994a). Males and females share the brooding duties, although females sometimes desert their broods shortly after hatching (Haig 1992). Broods generally remain within the parents' territory but may expand the territory as they mature or if disturbed. Chicks fledge between 21 and 35 days (Haig and Oring 1988, Wilcox 1959). Plovers generally start departing the breeding grounds in mid-July and are gone by the end of August (Wiens 1986). Yearlings generally depart later than the adults.

Piping plovers feed on a variety of invertebrates, which they capture by picking and gleaning. Foraging activity generally occurs within a few inches of either side of the water's edge. Juveniles may initially forage farther away. Food taken includes worms, insects, crustaceans, mollusks, beetles, and grasshoppers (Bent 1929, Lingle 1988).

3.3.2 Kansas and the Project Area

Collins et al. (1995) describes the piping plover as a rare migrant through Kansas. Piping plovers are most likely to be seen between April and May and July through September. The piping plover has been observed in Kansas, mostly in the central part of the state around Cheyenne Bottoms Wildlife Area (CBWA) and QNWR. This bird uses open sandy habitat and saline flats in this area. The piping plover has been greatly reduced because of the loss or modification of beach habitat due to dewatering, channelization, and damming of rivers. This has resulted in the elimination of flooding, which permits growth of vegetation and inhibits the formation of sandbar habitat, areas critical for the piping plover.

There is no record of the piping plover breeding in Kansas (Collins et al. 1995). Currently, no critical habitat has been designated in Kansas. The piping plover has been recorded in the project area in Harvey County (Collins et al. 1995).

3.4 ARKANSAS DARTER

The Arkansas darter (*Etheostoma cragini*) is a federal candidate species and is considered threatened in Kansas. Historically, the sensitive habitat requirements of the Arkansas darter left the species susceptible to population decline due to habitat loss through the damming of rivers and natural drought (Blair 1959). Currently, extensive water use appears to be the greatest cause of habitat depletion. The loss of spring-fed marshes may have caused at least local extirpations and may have forced the species to occupy lower quality habitats (Pigg 1987). Agricultural development has also contributed to the decline in Arkansas darter populations due to increasing water demands and general decline in water quality caused by crop farming and livestock production (Harris and Smith 1985, Pigg et al. 1985, Moss 1981). The construction of reservoirs, especially in headwater areas, also has contributed to the decline in Arkansas darter populations (Robison et al. 1974, Moss 1981, Skeen 1989).

3.4.1 General Life History

Collins et al. (1995) describes the Arkansas darter as having a stout body that is mottled brown. Its head is short and blunt and usually without scales. The snout is shorter than the eye diameter. Breeding males of the Arkansas darter are orange along the entire ventral surface. The dorsal fins have a diffuse orange band, but otherwise the body is plain brown. The Arkansas darter lacks the blue or green pigment that is usually prevalent in males of other darter species. The maximum length for an Arkansas Darter is 2 ¼ inches.

The Arkansas darter is composed of two main groups. The first group, the Great Plains group, is located in the Arkansas River tributaries from southeastern Colorado through south-central Kansas and north-central Oklahoma (Eberle and Stark 1998; Gilbert 1885). This group is generally associated with habitats that are found near spring sources in high plains streams with sandy bottom substrates (Miller 1984). The second group, the Ozark Plateau group, is located in the Spring, Neosho (Grand), and Illinois river drainages of southwestern Missouri, southeastern Kansas, northeastern Oklahoma, and northwestern Arkansas (Eberle and Stark 1998; Meek 1981). This group is associated with rubble and gravel bottom habitats that contain detritus (Miller 1984).

For both of these groups, typical Arkansas darter habitat is located in smaller streams with clear, cool water (< 25°C) near springs or groundwater seeps, usually where broad-leafed aquatic vegetation is abundant (Moss 1981) or exposed willow roots are present for cover (Collins et al. 1995). This habitat is typically located in pools or near-shore areas with little flow and a sand or gravel substrate, often overlain with silt, leaves, or other organic debris. The Arkansas darter feeds by perching above the stream bottom within the aquatic vegetation. Larger adults have been found near undercut banks where terrestrial vegetation extends into flowing water (Taber et al. 1986) and other specimens have been observed in atypical habitats including main stem river reaches with high turbidity, swift current, and little or no vegetation (Matthews and McDaniel 1981).

Moss (1981) observed Arkansas darter reproductive processes in the field. Female Arkansas darters were located in dense vegetation, while the males were located on the edges of the vegetation or in open areas. Spawning occurred in open silty-bottomed areas with eggs deposited in the top 2 cm of ooze. Spawning probably does not occur within the vegetation (Moss 1981). Distler (1972) observed Arkansas darters in an aquarium spawning in gravel away from rock or vegetative cover. Arkansas darters usually spawn from March through May (Cross and Collins 1995).

The Arkansas darter feeds primarily on aquatic insects and other arthropods (Moss 1981, Taber et al. 1986). Snails, fish eggs, and plant materials have also been found to compose a portion of the Arkansas darters diet (Distler 1972, Moss 1981).

3.4.2 Kansas and the Project Area

The Arkansas darter occurs in Kansas in the Arkansas River basin and in streams along the western Ozark Border. This species is endemic to the Arkansas River system and most of the surviving populations are concentrated in small streams south of the "big bend" of the Arkansas River in south-central Kansas. These streams are small, sandy streams that are continuously fed by seepage from the high water table. The species has been able to survive by using other habitats in streams overlying the Ogallala and Great Bend aquifers (Cross and Collins 1995).

Collins et al. (1995) describes critical habitat for the Arkansas darter in Kansas. Critical habitat falling within or near the project area includes the main stem of the North Fork of the Ninnescah River at the Stafford-Reno County line to its confluence with the South Fork of the Ninnescah River in Sedgwick County and numerous perennial spring-fed reaches of named and unnamed streams south of the Arkansas River in Kingman, Reno, and Sedgwick Counties. The Arkansas darter has been recorded in the project area in Sedgwick, Kingman, and Reno Counties.

3.5 ARKANSAS RIVER SHINER

The Arkansas River shiner (*Notropis girardi*) is currently found in the Canadian River in New Mexico, Oklahoma, and Texas and the Cimarron River in Kansas and Oklahoma. Both of these rivers are tributaries to the Arkansas River basin. A non-native introduced population of the Arkansas River shiner occurs in the Pecos River in New Mexico, but is not included in the listing. The populations in the Arkansas River basin are threatened mainly through habitat destruction and modification caused by stream dewatering or depletion due to surface water diversions or groundwater pumping, the construction of impoundments, and water quality degradation. Competition with the Red River shiner (*Notropis bairdi*), a non-indigenous species, has contributed to the reduced distribution and abundance of the Arkansas River shiner in the Cimarron River. Other concerns include incidental capture during commercial bait fishing operations, agriculture and livestock production, drought, and other natural factors (FWS 1998a).

3.5.1 General Life History

Collins et al. (1995) describes the Arkansas River shiner as very small, with a very small head and eyes. The fish is straw colored and has silvery sides with scattered brown flecks on the sides behind the head. The pectoral and dorsal fins are high and have pointed tips. The maximum length for an adult Arkansas River shiner is 3 1/4 inches.

The Arkansas River shiner historically inhabited the main channels of the Arkansas River basin, which are typified by rivers and streams that are wide, shallow, and sandy- bottomed (Gilbert 1980). The Arkansas River shiner was wide spread and abundant throughout the western portion of the Arkansas River basin in Kansas, New Mexico, Oklahoma, and Texas. Although the Arkansas River shiner does not use certain habitats, such as quiet pools, backwaters, and deepwater with mud or stone substrate, it will utilize a broad spectrum of microhabitat features (Cross 1967, Polivka and Matthews 1997). Adult Arkansas River shiners will use habitats based on water depth, sand ridge and mid-channel habitats, dissolved oxygen and current. The juvenile stage of this species is mostly associated with current, conductivity, and backwater and island habitat types (Polivka and Matthews 1997).

The Arkansas River shiner feeds by facing into the stream current and capturing organisms being washed down stream or organisms uncovered by movement of the sand substrate (Cross and Collins 1995). The specific feeding preferences and diets of the Arkansas River shiner have only recently been investigated. A study by Polivka and Matthews (1997) found that sand/sediment and detritus dominate the diet of the Arkansas River shiner. Invertebrates were determined to have been ingested incidentally, with no particular invertebrate type dominating the diet. Polvika and Matthews concluded that the Arkansas River shiner is a generalist. Bonner et al. (1997) also concluded that the Arkansas River shiner was a generalist. They found that the diet of the Arkansas River shiner was composed of detritus, invertebrates, sand and silt. With the exception of the winter season when larval flies were consumed with a greater frequency than other invertebrates, no specific invertebrate taxa dominated the diet.

The Arkansas River shiner spawns from June to August when streams approach the floodstage level. The eggs drift near the surface of the open channel. The eggs develop quickly and the hatchlings swim to sheltered areas within three to four days after the eggs are deposited (Collins et al. 1995). Arkansas River shiner eggs are non-adhesive and drift with the swift current during the high flows. It is believed that the Arkansas River shiner will not spawn unless the conditions are favorable for the survival of the larvae (Moore 1944, Cross 1967).

3.5.2 Kansas and the Project Area

The Arkansas River shiner was listed as threatened on November 23, 1998. Since the 1960's, the Arkansas River shiner has disappeared from the Arkansas River mainstream as well as from most of its original range (Cross and Collins 1995). The species may be extirpated from Kansas (Collins et al. 1995).

The Arkansas River shiner historically inhabited the broad, sandy channels of major streams in the Arkansas River system in southwestern Kansas. This species was most commonly found on the "lee side" of sand ridges that were formed by steady shallow water flow. One of the major causes for the decline in the Arkansas River shiner has been the reduction in stream flows. In addition, competition with other fish species, most specifically non-native species, may also have contributed to the disappearance of the Arkansas River shiner from its former range (Collins et al 1995).

The Arkansas River shiner has been recorded in the project area in Sedgwick and Kingman Counties. Critical habitat in Kansas within the project area includes the main stem of the Arkansas River from its junction with U.S. Route 281 in Barton County to the Kansas-Oklahoma border in

Cowley County, and the main stems of the South Fork Ninnescah River and main stem Ninnescah River from Pratt County Lake to the confluence of the Ninnescah and Arkansas Rivers in Sumner County (Collins et al. 1995). The Arkansas River shiner has been recorded in the project area in Sedgwick and Kingman Counties (Cross et al. 1995).

3.6 TOPEKA SHINER

The Topeka shiner (*Notropis topeka*) presently occurs in small tributary streams in the Kansas and Cottonwood river basins in Kansas; the Missouri, Grand, Lamine, Chariton, and Des Moines river basins in Iowa; the James, Big Sioux and Vermillion river basins in South Dakota; and the Rock and Big Sioux river basins in Minnesota. Topeka shiner populations have been threatened due to habitat destruction, degradation, modification, and fragmentation. The habitat for the Topeka shiner has been altered over time through siltation, poor water quality, impoundments, stream channelization, and stream dewatering (FWS 1998b).

3.6.1 General Life History

Cross and Collins (1995) describe the Topeka shiner as a stout, slightly compressed fish that is nearly as wide as it is high. The dorsal fin is high and acutely pointed, and often reddish. The eye is small and nearly as long as the snout. The tail fin has a small chevron like spot at its base. The Topeka shiner has dusky streaks along its sides and red fins in the summer spawning months. The maximum length for an adult Topeka shiner is 3 inches.

The Topeka shiner typically occurs in small headwater prairie streams with good water quality and cool temperatures. These streams are usually perennial, but some streams can be intermittent during summer months. The Topeka shiner prefers stream substrates composed of clean gravel, cobble, sand and lacking any type of sedimentation (FWS 1998). This species also prefers open water habitats (pools) that maintain stable water levels due to weak springs or water percolation through riffles. The water in these pools is usually clear (Cross and Collins 1995).

The Topeka shiner spawns from late June to August and the young mature in one year. The maximum life span is two or three years (Cross and Collins 1995). There is little information available on the diet of the Topeka shiner, although Cross and Collins (1995) indicate that the diet is composed mainly of midge larvae and other benthic aquatic invertebrates.

3.6.2 Kansas and the Project Area

The Topeka shiner was once wide-spread throughout the State of Kansas. The species is now restricted to small streams in the Flint Hills (both Kansas and Neosho drainages), as well as a few streams elsewhere, such as Willow Creek in Wallace County, Cherry Creek in Cheyenne County, and single streams in Jefferson and Johnson counties. Most of the remaining populations of the Topeka shiner are in Kansas and formerly occurred in at least twelve counties in central and western Kansas, but has not been found recently. The Topeka shiner has been recorded within the project area in Sedgwick and Harvey counties (Cross and Collins 1995). No critical habitat has been designated for the Topeka shiner.

3.7 ESKIMO CURLEW

Historically, around 150 years ago, the Eskimo curlew (*Numenius borealis)* may have been the second most abundant shorebird, to the lesser golden-plover (*Pluvialis dominica*), among nearly 50 shorebirds in North America. Since the beginning of this century, the Eskimo curlew has been an endangered species. Since 1916, sightings of the species have been of 25 birds or less at a time, usually only 1 or 2 birds. The Eskimo curlew once occurred in the "millions" (Gollop et al. 1986).

Eskimo curlew observations have been reported in 25 of the years from 1945 to 1986. All of these observations have been made in North America, except for a 1963 specimen in Barbados and a sighting in Guatemala in 1977. Of these observations, usually one or two birds have been sighted and never more than six at a time, with the exception of 23 in Texas in 1981 (Gollop et al. 1986).

The Migratory Bird Treaty of 1916, between Canada and the United States, protected Eskimo curlews throughout the year in North America. The species has also come under protection elsewhere through the Convention between the United States and Mexico Protection of Migratory Birds and Game Animals in 1936, the Convention on Natural Protection and Wildlife Preservation in the Western Hemisphere in 1940, and the Convention on the International Trade in Endangered Species of Wild Fauna and Flora in 1974 (Gollop et al. 1986). The Anderson River Migratory Bird Sanctuary, established in 1961, also protects a portion of the Eskimo curlew's breeding range. In 1980, the Eskimo curlew was listed as an endangered species in Canada (Fraser 1980). This species was designated as endangered in the United States in 1967 (50 CFR 17.11).

3.7.1 General Life History

The life history information available relies heavily on the accounts documented by hunters and, to a smaller extent, collectors. Eskimo curlew nests have only been found in the Northwest Territories in Canada and North America and might possibly have also bred in Alaska, eastern Siberia, and some of the Canadian Arctic Islands (Gollop et al. 1986). The species has been recorded outside the breeding season in Uruguay, Argentina, Chile, and on passage in Central America. The Eskimo curlew migrates south through the North American prairies to over-winter in the pampas and grasslands in Argentina. (Texas Parks and Wildlife Department 1997).

A majority of the information on breeding comes from a collector named MacFarlane during the late 1800's and early 1900's (Gollop et al. 1986). The Eskimo curlew was noted to breed in the "barren grounds" area, near the Arctic Ocean in North America, and avoided wooded tracts. In general, the curlew utilizes open tundra and tidal marsh areas. Of the curlew nests MacFarlane observed, most contained four eggs or four young. Nests were simple holes in the ground lined with decaying leaves and various grasses. It is uncertain which sex incubates the clutch. However, both sexes incubate clutches in two species closely related to Eskimo curlew, the little curlew (*Numenius minutus*) and the whimbrel (*Numenius phaeopus*) (Labutin et al. 1982 and Skeel 1978).

The incubation period of the Eskimo curlew is probably about two weeks and most likely peaks in the last week of June and the first two weeks of July. The Eskimo curlew was examined by MacFarlane on the breeding grounds near Fort Anderson between 27 May 1865 and 2 August 1865. Sightings have been made in recent years from as early as 18 May 1964 and as late as 15 August 1982.

Eskimo curlews used a variety of habitats through breeding, migration, and over-wintering. All habitats are open, and when open habitats such as mud flats and sandbars are not available, then headlands and hills within a few kilometers of the seas are preferred. Old fields, closely grazed pastures, and broad dry or marshy pampas are also utilized. Burned-over prairies and marshes have been noted as attractive habitats for migrating curlews, as well as plowed wheat and corn fields (Gollop et al. 1986).

In coastal habitats, a curlew's diet consists of snails, worms and other invertebrates. Nearby upland areas in these coastal regions contained the crowberry or curlew-berry (*Empetrum nigrum*), which also composes a large portion of the curlew's diet. In the curlew's southern range, the diet is composed mainly of insects. Grasshoppers and crickets are important food items along the Atlantic coast of the United States. Curlews also eat beetles, moths, ants, spiders, seeds, and other berries, grubs, and freshwater insects (Gollop et al. 1986).

Curlews will often nest in the company of other shore birds, such as the lesser golden-plover. Curlews will also occasionally be found migrating in the company of lesser golden-plovers and whimbrels. Flock sizes historically varied from three to thousands of curlews, with 30 to 50 individuals being the average flock size (Gollop et al. 1986).

The main reason for the decline of the Eskimo curlew was unrestricted hunting between 1870 and 1890. Curlews were easy to hunt due to the species' abundance and tame nature and were killed by the thousands. The curlew was valued as a food and sport item and at one time the demand for curlew meat was large and wide spread as it was considered a desirable food item.

The Eskimo curlew began to decline noticeably between 1885 and 1890 and has been declining ever since. This species is now quite rare, difficult to locate, and little is known about it (Gollop et al. 1986). The Eskimo curlew did not recover after non-game bird hunting ceased in the United States with the passage of the Migratory Bird Treaty Act. The lack of recovery of the curlew population might be attributable to the conversion of native grasslands to cropland both in South American wintering areas and along migration routes through tall grass prairies in North America. Currently, no approved recovery plan is in place for the Eskimo curlew.

3.7.2 <u>Kansas and the Project Area</u>

The Eskimo curlew was once an abundant migrant throughout Kansas, but is now on the verge of extinction. However, recorded sightings in North and South America are numerous enough to extend the possibility of a breeding population still existing. There are five known counties from which curlew specimens have been taken: Russell, Ellis, Lyon, Woodson, and Douglas. The species may also have occurred in Dickinson and Riley counties.

None of these counties are in the project area. The Eskimo curlew has historically been seen from April 13 through June 15 to September 5 and 28 (Thompson and Ely 1989). There is no record of the Eskimo curlew breeding in Kansas. No critical habitat has been designated in Kansas for this species. The last reported sighting was in1902 (Collins et al. 1995).

3.8 WHOOPING CRANE

The whooping crane (*Grus americana*) is perhaps the best known endangered species in North America. It is also a symbol of international efforts to protect and restore endangered wildlife. The annual travels of this endangered species are well documented.

In the mid-1800's, the principal breeding range extended from central Illinois northwestward through northern Iowa, western Minnesota, northeastern North Dakota, southern Manitoba and Saskatchewan, into central Alberta. A non-migratory breeding population occurred along the coast of Louisiana until the mid-1940's. The whooping crane disappeared from the heart of its breeding range in the north-central United States by the 1890's. Historically, the whooping crane wintered along the coast of the Gulf of Mexico from Florida to central Mexico. There were two important migration routes, one between Louisiana and Manitoba and the other from Texas and the Rio Grande delta region to the Canadian provinces (Allen 1952, FWS 1994b).

Although widely distributed, the whooping crane was never common. According to one estimate, the total population in the mid 1800's may have been 1,300 to 1,400 (Allen 1952).

The species declined dramatically as human settlement and development spread westward. By 1942, only 16 birds remained in the migratory population. The remnant Louisiana non-migratory population was reduced from 13 to six birds following a hurricane in 1940 and the last individual was taken into captivity in 1950 (FWS 1994b).

As a result of an enormous conservation effort since 1940, the whooping crane population has slowly increased. Although numbers have fluctuated from year to year, by March 1990 the Aransas/Wood Buffalo population had climbed to 146. In March 1993, this population numbered 136. In 1993, 45 pairs nested, an all-time high. In 1985, an experimental flock of 33 migrated from Idaho to New Mexico. Only eight individuals remained in this flock in 1993 and there has been no reproduction. In late 1993, a third wild flock in Florida consisted of 10 captive-reared birds remaining from experimental releases. In May 1993, 112 whooping cranes were held in captivity (FWS 1994b).

The current breeding distribution of wild whooping cranes is restricted to a small area in the northern part of Wood Buffalo National Park near Fort Smith, Northwest Territories. The population is migratory and winters in and around the Aransas National Wildlife Refuge (NWR) on the coast of the Gulf of Mexico in Texas.

3.8.1 <u>General Life History</u>

The whooping crane is the tallest North American bird. The males approach five feet when standing erect and average 16 pounds. Females average 14 pounds. The whooping crane is snowy white with black wingtips (visible only when the wings are extended) and has a wingspan that may reach eight feet. The neck is long, the bill is long, dark and pointed, and the legs are long, thin and black. There is a patch of reddish-black bristly feathers on the top and back of the head. Black feathers on the side of the head below the yellow eye look like a long, dark moustache. The whooping crane is the only large white bird with black wingtips that flies with its neck straight out in front, the legs trailing far behind. It also is the only one that walks or stands on long thin legs and does not swim.

Plumage of the juvenile whooping crane is a rusty or cinnamon brown color. At about four months of age, white feathers begin to appear on the neck and back. Young in their first fall migration usually have a brown head and neck and a mixture of brown and white on the body. The plumage is predominantly white by the following spring (FWS 1994b).

3.8.2 Habits

Birds arrive on the wintering grounds located on Aransas NWR or in its vicinity between late October and mid-November. Occasionally, stragglers may not arrive until late December. Non-breeders and unsuccessful breeders usually initiate and complete the fall migration sooner than family groups (FWS 1994b).

As spring approaches, dancing, calling and flying increase in frequency, indicative of pre-migratory restlessness (Allen 1952, Blankinship 1976). Family groups and pairs are usually among the first to depart the wintering grounds. First departure dates usually are between March 25 and April 15, with the last birds usually leaving by May 1 (FWS 1994b).

Occasionally, one to four birds have remained at the Aransas NWR throughout the summer. Some of those birds were ill or crippled or mates of crippled birds. Parents and the young of the previous year separate upon departure from Aransas NWR while enroute to the breeding grounds or soon after arrival on the breeding grounds (FWS 1994b).

The 2,400-mile migration route generally cuts across northeastern Alberta and southwestern Saskatchewan, through northeastern Montana, the western half of North Dakota, central South Dakota, Nebraska and Oklahoma and east-central Texas (FWS 1994b).

The primary migration route through Nebraska is a narrow swath approximately 140 miles wide. Migration may take two to six weeks. Whooping cranes migrate in the daytime and make regular stops for the night to feed and rest. Some stopovers last only one night, others up to four weeks. Whooping cranes migrate as individuals, pairs, family groups or small flocks of up to 11 birds (FWS 1994b).

Whooping cranes may live up to 24 years in the wild. Captive birds can live 35 to 40 years. A 29-year-old captive male was still reproductively active in 1993 (FWS 1994b).

3.8.3 Reproduction

Whooping cranes mate for life but will accept a new mate if one of the pair dies (Blankinship 1976, Stehn 1992). Birds reach sexual maturity in three to five years. Courtship displays, involving dancing, begin in early spring on the wintering grounds. On the nesting ground, adults carry out an elaborate courtship display, bobbing, weaving, jumping and calling with their mates (FWS 1994b).

Breeding pairs show considerable fidelity to their breeding territories, returning to the same nesting area each year. Individual nests are often used for three or four years. Whooping cranes may re-nest if their first clutch is destroyed or lost before mid-incubation (Erickson and Derrickson 1981, Derrickson and Carpenter 1981, Kuyt 1981). Although they usually nest annually, breeding pairs will occasionally skip a nesting season, particularly when nesting habitat conditions are unsuitable (FWS 1994b).

Nests are large mounds of dried bulrushes about four feet wide with the flat-topped central mound up to five inches above the water. Usually two eggs are laid, occasionally one or three. Eggs are light brown or olive-buff overlaid with dark, purplish-brown blotches. Each egg is about four inches long, about two-and-a-half inches wide and weighs about seven ounces (Bent 1926, Allen 1952, Stephenson and Smart 1972, and FWS 1994b).

Both adults are involved in incubating the eggs for 29 to 31 days. The eggs hatch in late April to mid May. The eggs in each nest hatch at different times, and the second egg or chick often is pushed out of the nest or starves to death. Young birds are able to fly 80 to 90 days after hatching.

3.8.4 Habitat

The current nesting area in Wood Buffalo National Park lies near the headwaters of the Little Buffalo, Klewi, Sass and Nyarling rivers. The area is interspersed with potholes and is poorly drained. Wetlands vary considerably in size, shape and depth, and most have soft marl bottoms (FWS 1994b).

Approximately 22,500 acres of salt flats and marshes on Aransas NWR and adjacent areas comprise the principal wintering grounds. Interior portions of the refuge that are periodically used by foraging whooping cranes are gently rolling and sandy grasslands with swells and ponds (FWS 1994b).

Although a variety of habitats are used during migration, a wetland is always used for night roosting and frequently for foraging. While migrating, whooping cranes roost standing in the shallow water of marshes, flooded crop fields, artificial ponds, reservoirs and rivers. Wetlands surrounded by tall trees or other visual obstructions, or marked with dense vegetation are not used. The birds select sites with wide, open panoramas. Sites must also be isolated from human disturbances. The preference for isolation and the birds' rarity result in relatively few confirmed sightings during migration each year.

Although the whooping crane is considered an omnivorous feeder, it subsists primarily on an aquatic animal diet (Walkinshaw 1973). In summer they eat snails, minnows, frogs, larval insects and leeches. If given the opportunity, they may also take small rodents such as voles, lemmings or shrews. During migration, cranes eat aquatic animals, plant tubers, roots and waste grain in crop fields. Wintering whooping cranes eat crabs, clams, crayfish and small fish in the tidal marshes and sandflats and acorns and wild fruits in the uplands (FWS 1994b).

3.8.5 Limiting Factors

Reasons for the initial decline in the whooping crane population include habitat loss from draining and clearing wetlands and human disturbance in breeding areas and along the migration routes. Conversion of wetlands and prairie to hay and grain production made much of the original habitat unsuitable for whooping cranes. Mere human presence interfered with the continued use of prairies and wetlands by breeding and migrating whooping cranes. Birds were once shot for their feathers and as meat for the table (FWS 1994b).

Most deaths, other than those of chicks, occur during migration and in the summer. Deaths from April through November are three times greater than deaths on the wintering grounds. Whooping cranes are exposed to a variety of hazards such as collision with obstructions, predators, disease and illegal shooting. Snow and hail storms, low temperatures and drought can present navigational handicaps or reduce food availability. Collision with powerlines is the primary known cause of death for whooping cranes, accounting for the death or serious injury of at least 19 whooping cranes since 1956. The frequent stopovers necessary during migration become increasingly perilous as more land is developed for agriculture, industry or habitation, and fewer suitable resting sites remain (FWS 1994b).

The only self-sustaining wild population of whooping cranes is vulnerable to destruction through a chemical contaminant spill on the wintering grounds. Barge traffic on the Gulf International Waterway, primarily transporting petrochemical products, is among the heaviest on any waterway in the world. Hurricanes could place the birds at risk from high winds. Drought decreases the availability and abundance of the natural food supply (FWS 1994b).

Several natural factors limit whooping cranes numbers. Although they have a long life span, sexual maturity is delayed for at least three years. A pair produces only two eggs and raises but one chick. The low number of breeding pairs further limits the number of young that can be produced. Since the current northern breeding ground has an ice-free season of only four months, there is rarely time for a second clutch of eggs if the first clutch fails. Under those conditions, even a healthy population will grow very slowly (FWS 1994b).

3.8.6 Management and Outlook

The whooping crane is protected internationally in Canada, the United States and Mexico under the Migratory Bird Treaty Act. The species is classified and protected as endangered in Canada and the United States (FWS 1994b).

Wintering habitat in the Aransas NWR and the last breeding area in the Wood Buffalo National Park are managed to protect the whooping crane. Canada and the United States work closely on all management actions affecting the winter or summer habitat of the whooping crane.

Since 1954, when the whooping crane breeding area was first located, there have been annual surveys to determine the number and location of breeding pairs and nonbreeding birds. Surveys of wintering birds also are conducted annually in and around Aransas NWR. Surveys on the wintering grounds monitor the birds' arrival at the refuge in fall and departure in spring. The number of birds in the population also is determined. Public sightings along the migration route provide state and federal wildlife agencies the opportunity to locate and protect habitat and to limit human disturbance that might be harmful (FWS 1994b).

In 1967, efforts were initiated to develop a captive flock of whooping cranes. A captive flock saves the species from extinction should it be extirpated from the wild and can be used to bolster the wild population through captive propagation and release of captive-produced stock. There are now two breeding populations of whooping cranes in captivity, one at the Patuxent Wildlife Research Center in Maryland and one at the International Crane Foundation in Wisconsin. Construction of a third facility is underway at the Calgary Zoo in Alberta (FWS 1994b).

Since the whooping cranes use only one breeding area and one wintering area, there is a high potential for the loss of this species in the wild. The goal of the U.S. Whooping Crane Recovery Plan is to establish two wild populations of at least 25 breeding pairs in addition to the existing population so that the species can be down-listed from endangered to threatened status (FWS 1994b).

Efforts to establish an additional wild population began in 1975 when whooping crane eggs from Wood Buffalo National Park were placed in the nests of sandhill cranes at Grays Lake National Wildlife Refuge in Idaho. After hatching, the chicks were adopted and raised by the foster parents. The young whooping cranes then migrated with their adoptive parents and wintered in New Mexico. Initial results were promising, but the whooping cranes failed to form pair bonds, and breeding never occurred (FWS 1994b).

The next attempt to establish an additional population was made in January 1993, when the first group of 14 whooping cranes hatched in captivity was released in Kissimmee Prairie, Florida. The objective is to establish a non-migratory, self-sustaining population there. Studies also are underway to determine the feasibility of establishing other migratory populations in Wisconsin and Canada (FWS 1994b).

The outlook for the survival of the whooping crane is considerably brighter than it was in 1950. The population has slowly increased, but complete protection and intensive management will have to continue if desirable population levels of whooping cranes are to be attained and maintained. Preventing further human encroachment that would threaten nesting and wintering habitat is vital. Protection of suitable migratory stop-over habitat and reducing mortality, particularly along the migration route, are critical. Positive public support remains an essential ingredient in the efforts to restore the whooping crane.

3.8.7 Kansas and the Project Area

The whooping crane is a rare spring and fall migrant through the state of Kansas. The species usually spends one night in the state and then moves on. Central Kansas appears to be the principle flyway, with the CBWA and QNWR as primary stopover locations. Critical habitat for the whooping crane in the project area includes all portions of QNWR falling within Reno County (Collins et al. 1995).

The species has been recorded from February 10 through April 28 in the spring and from October 5 to November 16 in the fall. In Kansas, the whooping crane mainly utilizes marsh habitat, and has occasionally been sighted near farm ponds (Thompson and Ely 1989). The whooping crane has been recorded within the project area in Kingman and Reno Counties.

PART 4 POTENTIAL IMPACTS OF THE PREFERRED ALTERNATIVE

The preferred alternative for the proposed water supply project is the 100 MGD Diversion Option and could impact the existing environment in the project area in several ways. The use of additional water from Cheney Reservoir may affect the amount of total discharge to the North Fork of the Ninnescah River and could result in the alteration of stream flow during high flow periods. The use of surface water from the Little Arkansas River may reduce flow in that river during specific periods. However, recharging the Equus Beds aquifer would benefit groundwater resources and spring-fed streams, and would ultimately increase base flow in the Little Arkansas River. Construction of the well field, pipelines, and water treatment plant could temporarily disturb wildlife in the immediate area and permanently change some land use.

From 1996-1998, Burns & McDonnell conducted an In-Stream Flow Incremental Methodology (IFIM) study on the North Fork of the Ninnescah and Little Arkansas rivers to assess the potential beneficial and adverse impacts of Wichita's ILWSP. The IFIM incorporates data on stream velocity and water depth, water surface elevation, and physical habitat to determine discharge and useable habitat for fish species. Discussions in this Part describe the likely extent to which the federally threatened, endangered, or candidate species presented in Part 3 of this Biological Assessment and might be impacted by construction and operation of the proposed project. Results of the IFIM are addressed where applicable to the species.

4.1 BALD EAGLE

The use of pesticides and DDT are the major causes for bald eagle population declines. Bald eagle populations have also suffered from habitat loss, shooting, lead poisoning, and human disturbance.

Eagles require relatively undisturbed areas around lakes, rivers, and reservoirs to feed and nest. Trees such as cottonwoods or sycamores that are at least 50 feet tall and sturdy enough to support a nest must be available near water. These trees provide a wide field of view for adults and shelter for their chicks. Nests may be very large, ranging up to eight feet in diameter and weighing several hundred pounds. Bald eagles are generally intolerant of human disturbance. Such disturbance has been attributed as the cause of nesting failure and reduced usage of wintering areas (Grier et al. 1983).

Eagles feed on fish in the open water areas created by dam tailwaters, warm water effluents from power plants and other discharges, in power plant cooling ponds, and along rivers and lakes. At night they roost in groups of trees near feeding areas that are protected from harsh weather.

The bald eagle has become an increasingly more common nester and is more commonly seen in Kansas, primarily from October to March (Collins et al. 1995). Bald eagles likely occur in the project area, especially along the Arkansas River and at Cheney Reservoir. However, no nesting pairs have been documented recently in these areas. Because nests are conspicuous, it is not likely there are any nesting eagles that may be impacted. If a nest is located during construction, the FWS will be immediately contacted for avoidance instructions.

A loss of open water may concentrate migratory waterfowl and increase the potential for avian cholera outbreaks. Expected reservoir levels will not be altered significantly to concentrate waterfowl and increase the incidence of avian cholera. Surface withdrawals will alter, to some degree, the characteristics of tailwater flow in the North Fork, potentially altering the supply of fish available for eagles in the area. The relation between the number of eagles that may use the reservoir and associated rivers for feeding and the concentration of fish and waterfowl is not a limiting factor. If fish and waterfowl populations were slightly reduced as a result of this project, the reduction would not significantly impact eagle survivability. However, results of the IFIM showed that implementation of the ILWSP is not expected to impact peak discharges in any significant way. Therefore, there will be no effect on the available habitat that has historically been available for all the life stages of fish species since Cheney Reservoir was constructed (Burns & McDonnell 2001), and the fish available as a prey base for bald eagles should not be impacted.

Installation of infiltration wells, recharge wells, recovery wells, surface water intake structures, recharge basins, and pipelines to connect all components will occur primarily in agricultural areas outside the riparian communities associated with the rivers. Consequently, no direct impacts to potential roosting sites or nests are expected. No surveys of construction sites have been completed to document the absence of eagles or potential nesting trees in the area.

If eagles are present in the area during construction, there may be some indirect, short-term disturbances resulting from construction noise and human activity. Critical habitat along the Arkansas River is approximately 4 miles from the project area; as a result, no critical habitat will be directly impacted during construction.

4.2 INTERIOR LEAST TERN

The loss of natural nesting habitat due to river channelization, irrigation, and construction of reservoirs and pools has caused declines in populations of the interior least tern and many other shorebirds. The unpredictability of flows released from dams further impacts wetland dependent species. High flow periods may extend into the nesting season and inundate potential shorebird nesting areas, forcing birds to utilize poor quality areas for nesting. Feeding areas may also be dewatered and nests flooded from dam discharges. The storage of flows in reservoirs also allows encroachment of vegetation into areas naturally scoured by river flows and reduces channel width. Sediment loads retained in reservoirs cause further degradation of the riverbed and reduce available shoreline habitat. In addition, the least tern is sensitive to human disturbance. These birds will not nest in areas with frequent human activity; increasing recreational use of our nation's rivers and lakes reduces available nesting areas for the interior least tern (FWS

1990).

Interior least terns are generally transients or summer visitants to Kansas and can be found on barren flats and sandbars near large rivers. The QNWR, located 34 miles northwest of Cheney Reservoir and 57 miles northwest of the Little Arkansas River near Sedgwick, has been designated critical habitat for nesting least terns (Collins et al. 1995). Both the North Fork of the Ninnescah River and the Little Arkansas River are typical sandy bottom streams found in Kansas, and sandbar habitat can be found scattered along the length of both waterways.

Because of the proximity of QNWR, there is a possibility that least terns may occasionally use portions of either river during the summer for short periods of time. However, neither river is likely large enough or has sufficient sandbar habitat to support nesting least tern colonies. No survey for least terns has been completed on either river to document the presence or absence of terns.

Drawdown of flows in the Little Arkansas River and reduced flows through the North Fork of the Ninnescah could reduce the scouring process that cleans vegetation from sandbars and riverbanks, thereby reducing available nesting habitat. However, IFIM studies indicated that discharges of only 100 cfs or less may be necessary to inundate sandbars along the North Fork (Burns & McDonnell 2001). Peak discharges were estimated by the IFIM to exceed 100 cfs about 73 percent of the time. These conditions are expected to remain unchanged or slightly improve with implementation of the ILWSP. If water is available to recharge the Equus Beds Aquifer, wetland areas overlying the aquifer could increase in coverage with time and create additional habitat for a variety of species over the long term. Drawdown may also expose additional habitat found along these sandy-bottomed rivers.

Any terns possibly present in the area along the Little Arkansas River will likely be displaced during construction of intake structures and wells by human activity and construction noise. These impacts, most of which will occur outside the riparian area of the river, will be short-term and temporary.

4.3 PIPING PLOVER

Threats to the piping plover are similar to those facing the interior least tern. In addition to habitat loss, piping plovers are also subject to high predation rates and nest abandonment (FWS 1988).

Like the interior least tern, piping plovers inhabit sand beaches and sandbars of inland rivers and lakes. These birds are most likely to be found at QNWR and CBWA located 34 to 57 miles northwest of the project area, though they may also be found along rivers during spring and fall migrations. No critical habitat has been designated in Kansas, and there is no record of piping plovers breeding in Kansas, making impacts of the ILWSP project on breeding plovers unlikely (Collins et al. 1995).

The proximity of the project area to QNWR and CBWA and the presence of some sandbar habitat along both rivers suggest a possibility of transient piping plovers occurring near the project area during their spring or fall migrations.

Because of the similarity in habitats for the piping plover and least tern, the impacts to both species are expected to be similar. Flow and discharge reductions are not expected to significantly affect sandbar habitat occurring along the banks of the Little Arkansas and North Fork rivers where piping plovers could be found; flows sufficient to inundate and scour the sandbars will continue to occur nearly annually. Drawdowns could also slightly increase the surface area of available sandbar habitat.

Migrating plovers, if present, could be temporarily displaced by construction noise and human activity near potential feeding areas during the installation of intake structures, wells, access roads, and pipeline. Because of the transitory nature of these stopovers, impacts to the piping plover would be minimal.

4.4 ARKANSAS DARTER

Due to intensive agricultural demands for the available water supply, natural droughts, construction of reservoirs and the resulting flow regulations, and a specialized habitat, the Arkansas darter is being considered by FWS for protection under ESA (FWS 2000). As a candidate species, it is currently afforded no legal protection under the ESA, but its designation indicates it will likely be listed in the near future. Because this is a long-term project, the Arkansas darter may be legally listed before this project is completed, so potential impacts are being considered pro-actively to avoid future complications.

The primary threat to the Arkansas darter is the loss of habitat through groundwater mining for crop irrigation. As water tables drop, the spring-fed habitats essential for this species' survival disappear. River damming, construction of reservoirs, and natural drought have also contributed to this species' decline.

The North Fork of the Ninnescah River has been designated by KDWP as critical habitat for this species (Collins et al. 1995). An Arkansas darter was collected during an aquatic survey completed to obtain baseline environmental data for this river in 1997 (Burns & McDonnell 1998). This fish is endemic to the Arkansas River system where it is concentrated in small sandy streams continuously fed by seepage from high water tables. It has also survived by occupying lower quality habitats.

One goal of this project is to recharge the Equus Beds Well Field with above-base flow surface water, which would help protect available habitat for this species by increasing the water table and potentially improving base flows in overlying streams and increasing the extent of wetlands. The removal of surface water from the Little Arkansas River and Cheney Reservoir should have little impact on downstream resources. The IFIM indicated the proposed withdrawals would not reduce flows beyond the critical threshold necessary to maintain fish species (Burns & McDonnell 2001, Burns & McDonnell 2000). Even at maximum depletion of 250 cfs on the Little Arkansas River, optimum discharges and resulting maximum available habitat will still be easily reached (Burns & McDonnell 2000). Therefore, the reduction in available discharge will not affect available habitat that has historically been present for all life stages of the fish species studied in the Little Arkansas and North Fork of the Ninnescah rivers. Based on the outcome of IFIM modeling for the indicator fish species, it is believed that the reduction of discharge during peak flow periods will also not greatly impact the other fish species for all life stages found in the Little Arkansas or the North Fork of the Ninnescah rivers.

The Arkansas darter and the other fish found within the North Fork waterway have adapted to the irregularity of flows released from Cheney Reservoir. Changes in flows resulting from this project would be insignificant compared to historic alterations following dam construction. Flows into the North Fork have been regulated since 1964.

4.5 ARKANSAS RIVER SHINER

The Arkansas River shiner is threatened primarily due to inundation and modification of stream discharge by impoundments, channel desiccation by water diversion and groundwater pumping, stream channelization, degradation in water quality, and the introduction of the non-native Red River shiner (*Notropis bairdi*). Although the Arkansas River shiner evolved in rapidly fluctuating, harsh environments, channelization of the Arkansas River has permanently altered and eliminated suitable habitat for this species. Inundation following impoundments in the Arkansas River system eliminate spawning habitat, isolate populations, and favor increased abundance of predators (FWS 1998a).

This species, which may be extirpated from Kansas, was most commonly found on the lee side of sand ridges formed by steady shallow water flow. A reduction in stream flows has severely impacted this habitat. While the proposed project calls for removing additional water for consumptive use, the amount of water to be used is not likely sufficient to significantly impact the already-altered downstream habitats. If this water were not withdrawn, there is the potential that the additional flow during wet years could increase stream flows and improve stream quality for the Arkansas River shiner and other fish. However, the recharging of the Equus Beds Well Field could offset this potential over time since base flow in the river is projected to increase with time.

4.6 TOPEKA SHINER

The Topeka shiner has suffered from habitat destruction, degradation, modification and fragmentation resulting from siltation, eutrophication, tributary impoundments, and stream channelization and dewatering. Removal of the protective vegetation within a stream's watershed from agricultural and urban development results in accelerated stream sedimentation from soil runoff. The Topeka shiner is an indicator of water quality because it is dependent upon high quality aquatic habitats. It is also threatened from introduced predaceous fishes (FWS 1998b).

The Topeka shiner typically occurs in small headwater prairie streams that are usually perennial, but may also be intermittent during the summer. In these cases, groundwater seepage must maintain water levels for the fish to survive. It prefers stream substrates, such as sand and clean gravel, like those found within the Little Arkansas and North Fork of the Ninnescah rivers. The species is primarily restricted to small streams in the Flint Hills region of Kansas (Collins et al. 1995). It is possible that no Topeka shiners occur in the Little Arkansas or North Fork of the Ninnescah rivers and thus would not be impacted by the proposed project.

If present, this species, like the Arkansas River shiner and Arkansas darter, could be impacted by an alteration in flows released from Cheney Reservoir and withdrawals from the Little Arkansas River. Again, the magnitude of this change is not significant enough to seriously affect populations of the Topeka shiner as indicated by the IFIM (Burns & McDonnell 2001, Burns & McDonnell 2000). Some riparian vegetation along the banks of the Little Arkansas may be removed to make way for installation of project facilities or impacted by removal of alluvial bank storage water. This could result in a slight increase in siltation of the river.

Recharging the Equus Beds aquifer would certainly benefit this species by providing additional groundwater to increase the base flow and maintain the intermittent streams and Little Arkansas River in the area upon which this species depends.

4.7 ESKIMO CURLEW

The primary cause for the Eskimo curlew's decline is loss of significant grassland habitat. It is very rare throughout North America, including Kansas. The last reported sighting in Kansas was in 1902. There is also no record of the curlew breeding in Kansas, nor is there any designated critical habitat that could be affected by the project (Collins et al. 1995).

Given the extremely rare status of this bird, it is highly unlikely that any Eskimo curlews will be impacted by this project, either directly or indirectly. There is also little grassland habitat available in the project area, and most construction of wells and basins will occur in agricultural fields that are not preferred curlew habitat.

4.8 WHOOPING CRANE

Whooping cranes are endangered primarily due to hunting, specimen collection, human disturbance, conversion of their nesting habitat such as potholes and prairies to agriculture, contaminant spills along their wintering range in Texas, collisions with power transmission lines, and severe weather during migrations that may impede navigation and food availability. In addition, whooping cranes have a delayed sexual maturity and a small clutch size that prevent a rapid population recovery (FWS 1994b, Campbell 1995).

These birds may be found in Kansas during their spring and fall migration between their breeding grounds in Canada and their wintering habitat in Texas (Collins et al. 1995). Whooping cranes may be found in a variety of habitats during their migration. They typically roost in riverine habitat, on isolated submerged sandbars, and in large palustrine wetlands, such as those found in the QNWR and the CBWA. They also may be found feeding on waste grains from harvested cropland.

Because of the proximity of the project area to the QNWR and CBWA, it is possible whooping cranes may occasionally be found near the North Fork of the Ninnescah River or the Little Arkansas River during their migrations. Cropland is plentiful in the area as a potential food source. However, both rivers contain only marginal habitat for this species and there are few other wetlands in the project area; the likelihood of occurrence is remote.

Because the cranes are only occasional visitors during their migrations further reduces the likelihood of their presence during construction. If whooping cranes do occur in the construction area and construction is timed to coincide with their migration, the only probable disturbance would be a displacement from the construction area to a less disturbed area in the vicinity, such as the QNWR or CBWA. This displacement would be temporary and would likely be to equal or superior quality habitat.

PART 5 CONCLUSIONS

Nine species were identified by FWS as endangered, threatened, or candidate for listing that may potentially occur in the project area. One of these species, the peregrine falcon, has been delisted due to its recovery. The Arkansas River shiner may be extirpated from Kansas and likely no longer occurs in the project area. Also, the Topeka shiner may no longer occur in the project area. The Eskimo curlew is extremely rare, last sighted in Kansas in 1902, and has a high probability of no longer occurring in the project area. Therefore, impacts to these species are not expected due to implementation of the ILWSP. The primary source of disturbance to any of the species present in the project area will be temporary displacement due to construction activities (Table 5-1). No long-term adverse impacts to any of the species discussed are anticipated. The results of the IFIM show that implementation of the ILWSP will not affect available fish habitat and will not change the frequency of flows needed to scour and maintain sandbar habitat, which is important to the least tern and the piping plover. Recharging of the Equus Beds aquifer will improve groundwater resources, benefit spring-fed and intermittent streams, and wetlands, and increase base flow in the Little Arkansas River. This has the potential for long-term benefits to the habitats occupied by the fish species discussed in this Biological Assessment. As fish habitat and the scouring process will not be affected by the proposed project, there should be no adverse impacts to sensitive fish species due to the implementation of the 100 MGD Diversion Alternative of the ILWSP.

Table 5-1 Summary of Impacts to Threatened or Endangered Species

Common Name	Impacts	Potential to Adversely Affect
Bald Eagle	Possible temporary displacement due to construction activities	May (Temporary)
Interior Least Tern	Possible temporary displacement due to construction activities	May (Temporary)
Piping Plover	Possible temporary displacement due to construction activities	May (Temporary)
Arkansas Darter	None expected	Not likely
Arkansas River Shiner	None, not present	Not likely
Topeka Shiner	Not anticipated	Not likely
Eskimo Curlew	None, not present	Not likely
Whooping Crane	Possible temporary displacement due to construction activities	May (Temporary)

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APPENDIX C - OPERATIONS MODEL DESCRIPTION

APPENDIX C

OPERATIONS MODEL DESCRIPTION

C.1 INTRODUCTION

This appendix describes a computer model of the City's proposed Integrated Local Water Supply (ILWS) system that has been developed to simulate system operation under various scenarios. The primary purpose of the operations model is to aid in the evaluation of concept design alternatives for the Equus Beds ASR Project by testing the reliability and impacts of the proposed system under various simulated conditions using historical streamflow.

C.2 HISTORIC STREAM DISCHARGE

The operations model for the ILWS system requires estimates of historic stream discharge at several locations in the project vicinity. In the United States, stream discharge data are collected primarily by the U.S. Geological Survey (USGS). Although the USGS maintains a network of stream gaging stations located throughout the country, it does not operate gaging stations at all points of interest for this study. Therefore, it was necessary to derive some of the stream discharge data used in the operations model from those data that are available. This section describes the stream discharge data that are available and procedures used to estimate discharge at other locations.

The USGS gaging stations used in the development of the operations model are listed in Chapter 3, Table 3-1, along with other pertinent data on these gages. The locations of these gages are shown on Figure 3-2. The period of record for each of these gages is also listed in Table 3-1. The recorded mean daily discharge data available at each of these gages were obtained from the National Water Information System (NWIS-W) via the Internet (USGS, 1999).

In this analysis, the recorded discharge data retrieved from the USGS are treated as natural discharge data. Natural discharge is the discharge that would have occurred in a stream without any man-made influences, such as construction of a reservoir or withdrawals for water supply or irrigation. This assumption is generally considered valid for all gages listed in Table 3-1, except those on the mainstem of the Arkansas River and the lower Ninnescah River. Numerous reservoirs and diversions in the Arkansas River basin exist upstream of Wichita, but the mainstem of the Arkansas River is not the primary focus of this study. Also, the primary human influence on the lower Ninnescah River is Cheney Reservoir. Therefore, the extensive effort required to naturalize the discharge data for these streams is not considered justified.

Several of the stream gages listed in Table 3-1 were adopted as system nodes in the operations model. Several additional nodes at critical locations were also added. For those system nodes located on streams, it is desirable to have as long a period of streamflow record as possible. This allows the operations model to demonstrate the operation of the ILWS system through multiple drought cycles.

Only two stream gages are available in the project vicinity that have long, continuous records. These are the Little Arkansas River gage at Valley Center, Kansas (Valley Center gage) and the

Arkansas River gage at Arkansas City, Kansas (Arkansas City gage). These two gages have been in continuous operation since June 1922 and October 1921, respectively. Because of the records available at these two gages, a 74-year simulation period — water years 1923 to 1996 (10/1/1922-9/30/1996) — is used in the operations model. Historic streamflow at the other system nodes is estimated by combining the records of two or more gages and/or by statistical methods. The synthesis of the historic streamflow records at each stream node is discussed in the following section.

C.3 DERIVATION OF STREAMFLOW ESTIMATES

The discharge record at each stream node is derived using the following procedure.

- Where and when available, actual recorded discharge data at the target location are used.
- For locations or time periods not covered by actual recorded data, use data recorded at another representative stream gage to estimate discharge at the target location. Preferably, this stream gage should be located on the same stream.
- If there are overlapping discharge records at the target location and at the source gage, use regression analyses to develop an adjustment ratio for the two gages. If there is no overlap, use a simple drainage area ratio instead.

The specific source(s), and derivation when applicable, of the stream discharge data used in the operations model is described in Table C-1, along with the source(s) and means used to estimate these discharge data.

The operations model requires estimates of the unregulated inflow at each system node. Unregulated inflow is the incremental runoff at a node that occurs between the node and any upstream nodes. Only the system nodes listed in Table C-1 have unregulated inflow. None of the other system nodes have unregulated inflow. For the nodes listed in Table C-1, their unregulated daily inflow was calculated, using the discharge estimates described above, by subtracting any flow at upstream nodes. For example, the unregulated inflow at Node 100 (Ninnescah River near Peck) is calculated by subtracting out the estimated flow at Node 90 (Cheney Reservoir inflow) for each day in the 74-year simulation period. Due to inaccuracies in these discharge estimation procedures, the incremental discharge at some nodes is negative on some days, although generally small in magnitude. The operations model treats negative inflow as a flow depletion.

Over the simulation period for the operations model, there have been periods of extreme drought and flood. The variability of streamflow in the project vicinity is illustrated in Figure 3-4. Review of this figure shows that there have been two serious drought periods during the simulation period, one occurred in the 1930's and the other in the mid-1950's. During these drought years, the discharge in area streams was typically about 10 percent of the average. In contrast, during 1993 discharge was several times the average.

Table C-1 Stream Discharge Estimates

Model Node No.	Node Name	Source Gage No.	Applicable Time Period	Adjustments		
				Drainage Area Ratio	Regres-sion Coef.	R^2
10	Arkansas River near Hutchinson, KS	07143400	10/22–09/34	0.992	---	---
		07144300	10/34-09/59	---	0.536	0.959
		07143330	10/59–09/96	---	---	---
20	Arkansas River near Maize, KS	07143400	10/22–09/34	0.998	---	---
		07144300	10/34–02/87	---	0.789	0.971
		07143375	03/87–09/96	---	---	---
30	Little Arkansas River at Alta Mills, KS	07144200	10/22–06/73	---	1.022	0.993
		07143665	07/73–09/96	---	---	---
40	Little Arkansas River at Halstead			see Note	---	---
50	Little Arkansas River near Sedgwick, KS	07144200	10/22–09/93	---	1.112	0.995
		07144100	10/93–09/96	---	---	---
60	Little Arkansas River at Valley Center, KS	07144200	10/22–09/96	---	---	---
70	Little Arkansas River at Mouth	07144200	10/22–09/96	1.049	---	---
80	Arkansas River at Wichita, KS	07146500	10/22–09/34	---	0.593	0.970
		07144300	10/34–09/96	---	---	---
90	NF Ninnescah River at Cheney Reservoir	07146500	10/22–09/50	0.018	---	---
		07144800	10/50–09/64	0.969	---	---
		07146500	10/64–09/65	0.018	---	---
		07144780	10/65–09/96	1.207	---	---
100	Ninnescah River near Peck, KS	07146500	10/22–03/38	---	4.803	0.958
		07145500	04/38–09/96	---	---	---
110	Arkansas River at Arkansas City, KS	07146500	10/22–09/96	---	---	---

Note: Calculated using average of unit daily runoffs at Alta Mills and Sedgwick times contributing drainage area at Halstead of 757 square miles.

C.4 RESERVOIR EVAPORATION

The ILWS system includes two principal water storage facilities. These are Cheney Reservoir and the Equus Beds Aquifer. Since water stored in Cheney Reservoir is exposed to the atmosphere, evaporation from this reservoir can represent a significant water loss. Evaporative losses from the Equus Beds aquifer are assumed to be negligible.

The City has collected pan evaporation data at Cheney Reservoir since September 1965, just after the reservoir was placed in service. There are no evaporation data available at the reservoir prior to this time, but there are other sources of evaporation data from the general vicinity. These data are used with Burns & McDonnell's ETCALC evaporation model to estimate evaporation rates at Cheney Reservoir prior to September 1965. This analysis is described in detail by Burns & McDonnell (1997).

Gross evaporation rates are a function of meteorological conditions, such as temperature, cloud cover, and wind, which vary seasonally. These conditions do not however vary significantly from year to year, so annual gross evaporation rates vary only within a fairly narrow range. However, net evaporation rates can vary significantly from month to month and year to year. Net evaporation is the difference between the amount of water that may evaporate from a water surface and that which is replaced by direct precipitation. Since precipitation rates can vary significantly, net evaporation rates will also. Table C-2 presents statistics on monthly gross and net evaporation rates at Cheney Reservoir. Figure C-1 shows the variability in annual gross and net evaporation rates.

C.5 WATER DEMAND

The City's projected raw water supply demands are listed in Table C-3. Included in this table are average daily and maximum daily demands. For the operations model, it is necessary to estimate the system water demand for each day of the year. Daily water demands were estimated using the total demand data (Table C-3) and the daily demand distribution shown in Figure C-2.

Table C-2 Summary of Cheney Reservoir Evaporation Rates

Month	Gross Evaporation (inches)			Net Evaporation (inches)		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Jan	1.16	0.65	1.69	0.57	-3.53	1.62
Feb	1.30	0.81	1.87	0.62	-0.79	1.87
Mar	1.96	1.37	2.54	0.57	-4.25	2.33
Apr	2.70	1.99	3.28	0.85	-6.34	3.02
May	3.46	2.93	4.42	0.63	-4.82	3.73
Jun	4.59	3.90	5.43	1.55	-3.08	4.79
Jul	5.72	4.78	7.06	3.34	-4.58	6.74
Aug	5.46	4.56	6.71	3.27	-0.71	6.69
Sep	3.93	3.29	4.82	1.65	-3.60	4.41
Oct	2.92	2.17	3.69	1.30	-1.70	3.45
Nov	1.73	1.39	2.08	0.64	-2.36	2.03
Dec	1.25	0.63	1.60	0.46	-1.94	1.29
Annual	36.19	34.24	39.90	15.46	1.39	27.42

Figure C-1 Annual Reservoir Evaporation at Cheney Reservoir

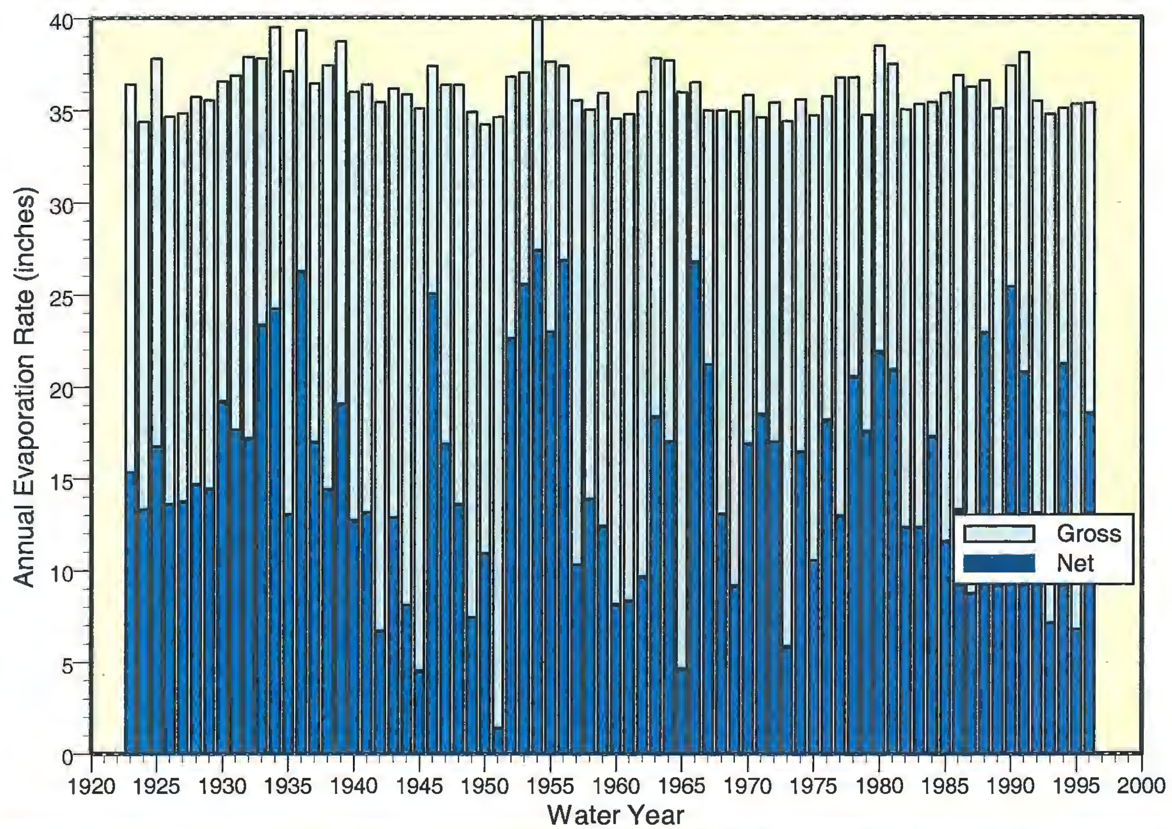

Table C-3
City of Wichita
Projected Water Demands

Year	Daily Raw Water Demand (MGD)	
	Average	Maximum
2000	70.4	140.3
2010	84.6	168.6
2020	92.8	184.9
2030	99.4	198.1
2040	105.7	210.6
2050	111.6	222.4

The daily distribution shown in Figure C-2 is based on actual 1991 water usage data for the City. To represent the potential impacts of water conservation programs, the daily demand distribution was segregated into zones based on percentages of the total annual water demand. The colored bands in Figure C-2 represent these demand zones. For example, the top 5 percent of the total annual water demand (95-100 percent by volume) occurs when daily demands exceed approximately 124 percent of the average day demand. Stated differently, limiting peak daily demands to 124 percent of the average day demand would decrease annual demand volumes by 5 percent and the maximum day by 38 percent. This limitation is consistent with a conservation program that limits lawn watering. The specific demand zone boundaries are listed in Table C-4.

Figure C-2 Daily Demand Distribution

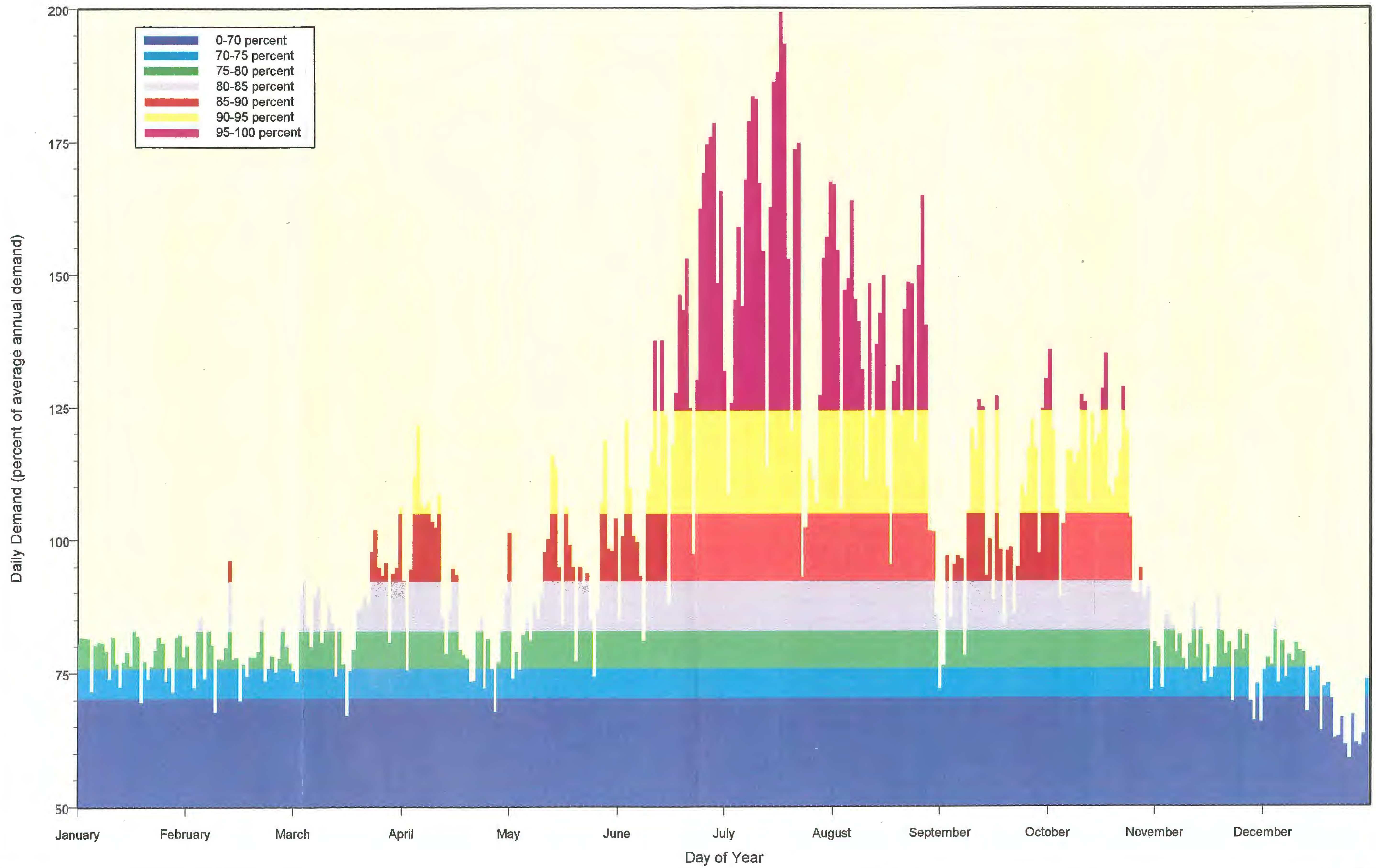

Table C-4 Demand Zones

Demand Zone (% of Annual)	Range in Daily Demand (% of avg. day)
0– 70	0- 70.3
70- 75	70.3- 75.8
75- 80	75.8- 82.8
80- 85	82.8– 92.2
85- 90	92.2-104.9
90- 95	104.9-124.3
95-100	124.3–199.3

Operations model scenarios were run with and without additional conservation.

C.6 RESERVOIR PHYSICAL DATA

The two water storage facilities included in the ILWSP system are Cheney Reservoir and the portion of the Equus Beds aquifer in the City's well field. The relationship between water levels, water surface areas and storage in Cheney Reservoir are listed in Table C-5 and shown graphically in Figure C-3. The top of the designated fish and wildlife pool at Cheney Reservoir is at elevation 1,392.9 feet while the top of the conservation pool is at elevation 1421.6 feet. These two elevations represent the limits of the conservation (water supply storage) pool at Cheney Reservoir. That is, the City can store water in the reservoir up to elevation 1,421.6 feet and withdraw water from the reservoir, when needed, down to elevation 1,392.9 feet.

Data on water levels in the Equus Beds and corresponding storage are presented in Table C-6. Also listed in this table are estimates of the infiltration gain rates from the Arkansas River and seepage loss rates to the Little Arkansas River. Both of these rates are dependent on the storage contents of the aquifer. A graphical representation of these data is shown in Figure C-4.

As stated above, the storage deficits listed in Table C-6 are relative to the amount of water contained in the Equus Beds aquifer in the City's well field area under pre-development conditions. As a result of well development and pumping by the City and irrigators, the water stored in the aquifer had declined by about 200,000 acre-feet by 1993. One of the goals of the ILWS Plan is to limit periods when the aquifer storage deficit exceeds 200,000 acre-feet.

C.7 OPERATIONS MODEL ARCHITECTURE

The operations model for the ILWS system was developed using Burns & McDonnell's Reservoir Network (RESNET) simulation model (Foster, 1989). This computer model represents the stream/reservoir system being simulated as a circulating network. This network representation allows the RESNET model to efficiently determine an optimum solution in each daily time step using network optimization techniques. This architecture makes it possible for RESNET to simulate systems of virtually unlimited complexity.

A schematic of the operations model for the ILWS system is shown in Figure C-5. In the ILWS system, water can be supplied to the City's water treatment plant(s) — Node 200 in model schematic — from a number of sources. These sources and their supply limits are shown in Figure C-6. Further discussion of these supply sources is provided below.

Cheney Reservoir: The City's original water right for Cheney Reservoir allowed for a withdrawal up to 47 MGD. This

Table C-5 Cheney Reservoir, Elevation-Area-Storage Data

Elevation (feet)	Surface Area (acres)	Storage (acre-feet)	Elevation (feet)	Surface Area (acres	Storage (acre-feet)
1,370	14	13	1,420	8,976	152,222
1,380	445	1,545	1,430	12,835	260,557
1,390	1,504	10,241	1,440	17,466	411,058
1,400	3,291	33,761	1,450	23,387	616,350
1,410	5,785	78,897	---	---	---

Figure C-3 Cheney Reservoir Elevation-Area-Storage

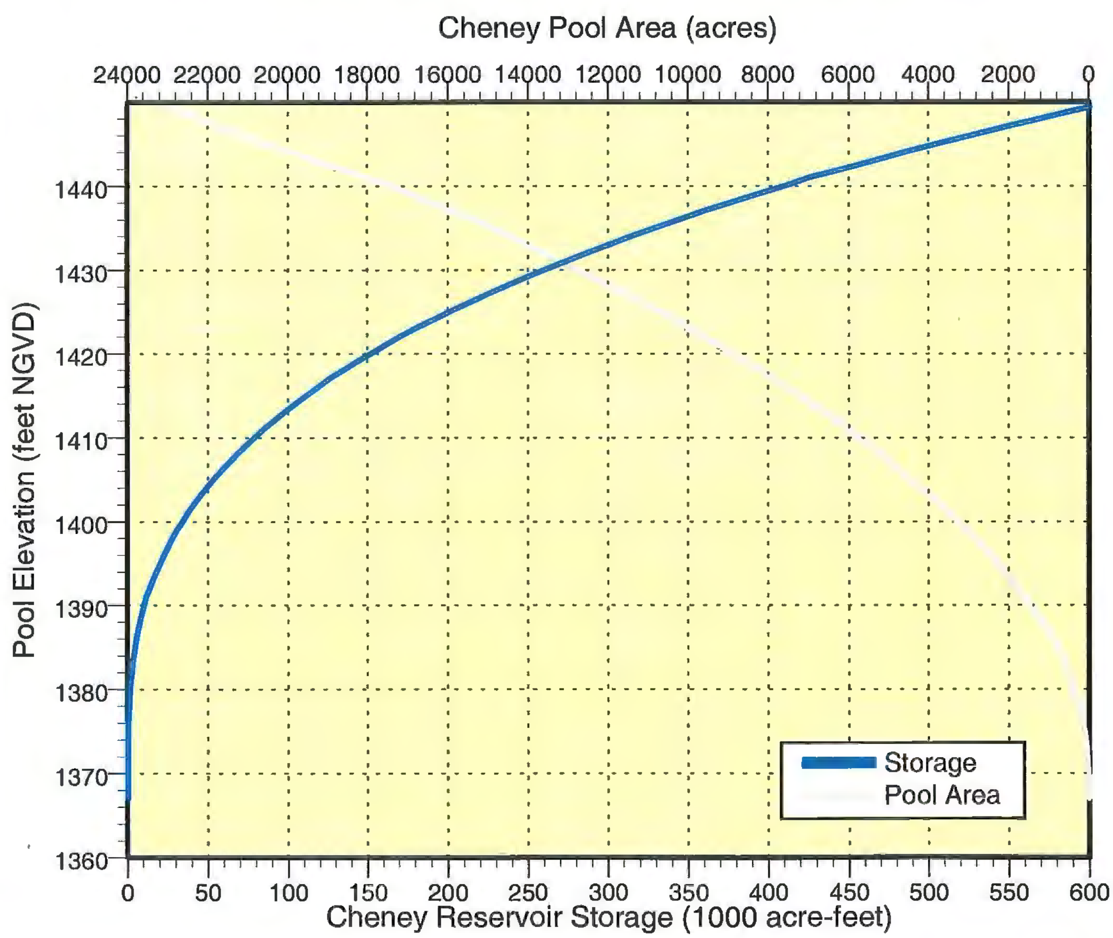

Table C-6 Equus Beds Elevation-Storage-Gain-Loss Data

Elevation (feet)	Storage Deficit (acre-feet)	Gain from Arkansas River (cfs)	Loss to Little Arkansas River (cfs)
1,342	647,233	138.2	-2.0
1,360	429,067	90.5	8.2
1,366	356,345	74.5	11.6
1,370	307,864	63.9	13.9
1,375	248,468	57.3	19.8
1,380	196,696	50.2	29.2
1,385	140,879	40.3	41.9
1,390	79,804	29.1	56.3
1,395	14,697	17.7	72.0
1,396	0	15.1	75.2

Figure C-4 Equus Beds Elevation-Storage

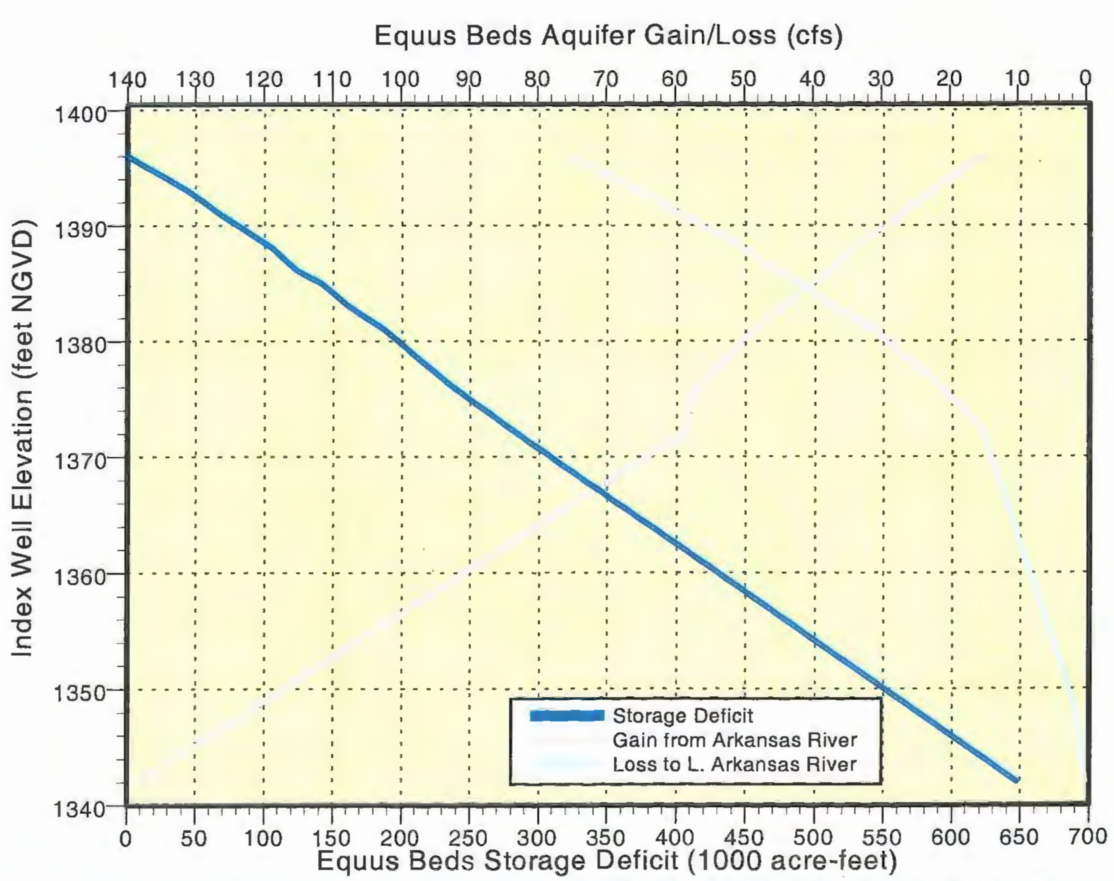

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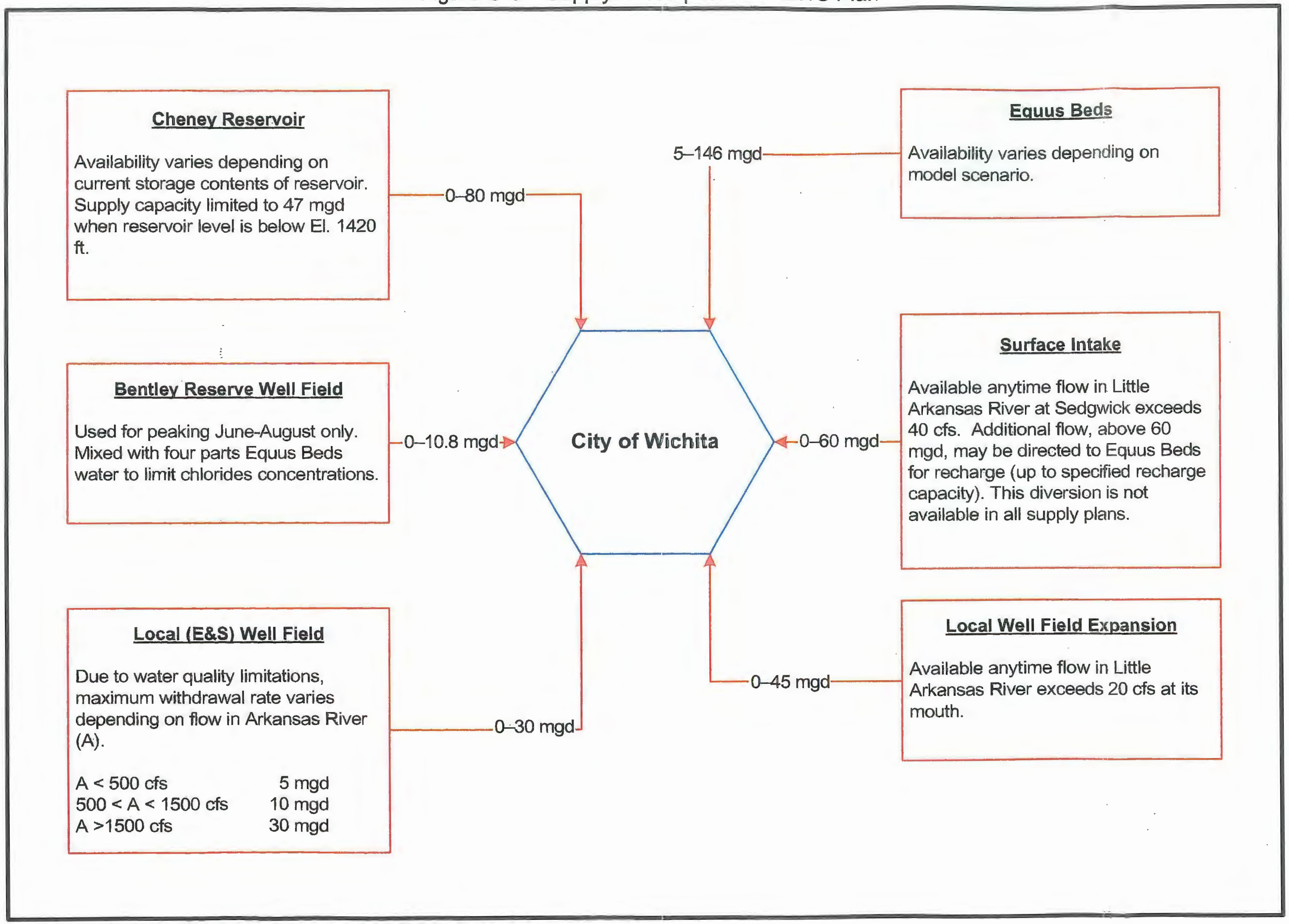
Figure C-6 Supply Assumptions for ILWS Plan



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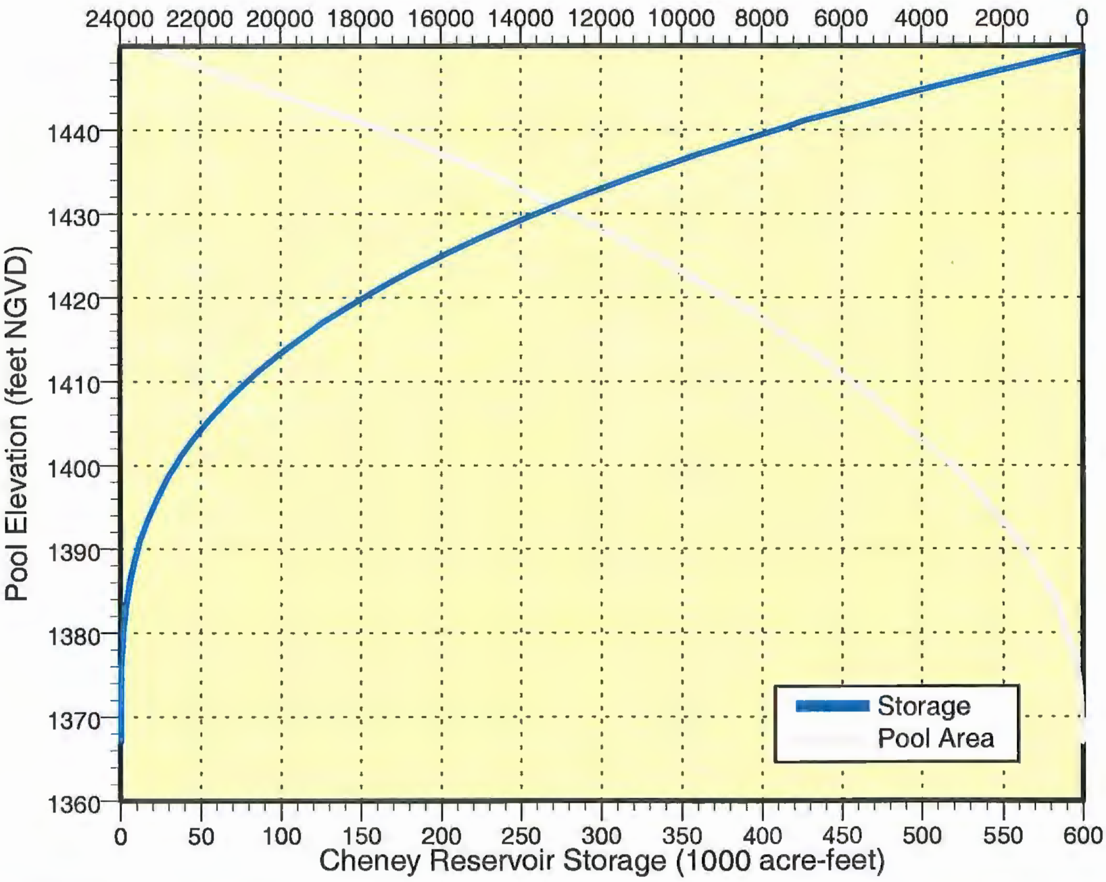

- The recharge account is credited with any water delivered to the aquifer for recharge and any infiltration gains from the Arkansas River. Aquifer leakage amounts to the Little Arkansas River are debited from the recharge account.

- When the City withdraws water from the aquifer, these volumes are subtracted from the recharge account until such time as it is exhausted. As long as the City has recharge credits, they can pump from the aquifer at a rate up to 146 MGD.

- Once all recharge credits are exhausted, the City can continue withdrawing water under its base water right of 40,000 acre-feet per year. The maximum allowable pumping rate under this water right is approximately 78 MGD.

The natural aquifer recharge is estimated to average about 3.2 inches per year, or a total of 18,800 acre-feet per year. Although the actual natural recharge will vary with the amount of precipitation, in the operations model it is assumed to remain constant each year and be distributed evenly across each day of the year.

Irrigators in the Equus Beds Well Field area are assumed to withdraw an average of 26,500 acre-feet per year from the aquifer. As with natural recharge, these withdrawals are assumed to remain constant each year. The volume of water withdrawn each year for irrigation is assumed to be evenly distributed from mid-May through mid-September.

Bentley Reserve Well Field: Because of water quality limitations, the Bentley Reserve Well Field would be used only during times of peak water demand, assumed to be June–August. This well field will has a maximum withdrawal rate of 10.8 MGD. In order to mitigate the high chlorides concentration in the water from this well field, the operations model will mix this water with three parts Equus Beds water.

Surface Intake: When the flow in the Little Arkansas River exceeds 40 cfs, the surface intake may withdraw water from the river up to a maximum of 60 MGD. This water could be delivered to the Equus Beds well field for recharge or delivered directly to the water treatment plant for immediate use. This last option, direct delivery from the surface intake to the water treatment plant, was not included in any of the alternatives investigated for the EIS.

Local (E&S) Well Field: Because of its location near the Arkansas River, hydrogeologic studies have shown there is a strong hydraulic connection between the river and the Local Well Field aquifer. Therefore, the quality of the water available from this source closely matches that of the river. It has been shown that the water quality of the Arkansas River improves at higher flow rates so the maximum pumping capacity of the Local Well Field is tied to flow rates in the river as shown in Figure C-6.

Local Well Field Expansion: The collector wells associated with the Local Well Field Expansion will be installed adjacent to the Little Arkansas River so pumping these wells will induce infiltration from the river. These collector wells will have a maximum capacity of 45 MGD, but can only be operated when the flow in the Little Arkansas River exceeds 20 cfs at its mouth.

C.8 REFERENCES

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USGS. 1999. National Water Information System (NWIS-W). http://water.usgs.gov.

APPENDIX D - SCOPING SUMMARY

LOCAL INTEGRATED WATER SUPPLY PLAN
for the City of Wichita

SCOPING SUMMARY
for the
ENVIRONMENTAL IMPACT STATEMENT

BACKGROUND

The City of Wichita Water and Sewer Department provides potable water to approximately 350,000 people. The sources of this water are Cheney Reservoir, the Equus Beds Well Field, and the Local Well Field. From these sources, the City has an average delivery capacity of 78 million gallons per day (mgd) and a maximum delivery capacity of 160 mgd. In 1991, a water shortfall was projected for the City by the year 1996. Responding immediately, the City completed improvements to existing surface water and groundwater supply sources and modified operations to optimize use and conserve water resources. These actions delayed the projected shortfall to the year 2016. By 2050, average and maximum daily demands are projected to be 112 and 223 mgd, respectively, assuming a 16 percent reduction in demand can be obtained through conservation. To meet these demands, the City proposes to develop an additional average and maximum daily delivery capacity of approximately 40 mgd and 100 mgd, respectively.

Historically, the City's mix of water sources has been heavily dependent on groundwater, particularly from the Equus Beds. During the last 60 years, withdrawal of water from the Equus Beds for agricultural, industrial, municipal, and domestic use has exceeded recharge. As a result, the water table as dropped about 40 feet from its historic static level and saltwater contamination from adjacent formations is moving into the aquifer. Therefore, another goal of any new water development project is to reduce the City's dependence on groundwater and thereby allow for the replenishment of the Equus Beds aquifer and protection of it's water quality.

Previous studies identified 27 alternatives to meet the City's future water supply needs. After consideration of factors such as potential supply, cost, public policy, legal issues, environmental impacts, and water quality; one alternative was selected as the most feasible. This alternative, the Integrated Local Water Supply Plan (ILWSP), specifies the development and enhancement of multiple, local sources of water. Actions to be taken include increasing the capacity of the existing local well field; redeveloping the Bentley Reserve well field; increasing the amount of water taken from Cheney Reservoir; and diverting high flows in the Little Arkansas River on an as-available basis. The capacity of the local well fields would be expanded by placing additional wells along the Little Arkansas River and the Wichita-Valley Center floodway. The Bentley Reserve Well Field would be redeveloped. This well field is located about 22 miles north of Wichita along the Arkansas River and was abandoned because of high chloride content. Water from this well field would be blended with low chloride content water to create an increased quantity of water of acceptable quantity. Construction of additional pumping capacity would allow the City to make full use of its water right in Cheney Reservoir. Surface water and induced infiltration would be extracted from the Little Arkansas River during periods of above base river flow such that occur in the spring or after storm events. Because this water would not necessarily be needed when it is available, it would be treated as necessary, then stored in the Equus Beds aquifer in the vicinity of the City's existing water wells.

With all sources combined, this alternative would provide an additional 40 mgd of average-day capacity and 100 mgd of maximum-day capacity and could meet demand through the year 2050. Because of the greater use of surface water, the plan would also provide for recharge of the Equus Beds. Water in the Equus Beds would then be available during extended dry periods when surface water is limited. The availability of water from multiple sources under local control should minimize the chances for water shortages.

An integral part of the water supply plan is water conservation. In order to meet projections, the plan requires a 16 percent reduction in water use rates attributable to conservation. This will be accomplished by the use of water-efficient plumbing fixtures, a full-scale plumbing fixture retrofit program, and implementation of an inclined block rate structure which rewards those who use less water with lower rates.

SCOPING PROCESS

The National Environmental Policy Act (NEPA) requires a process of environmental analysis, consultation, and disclosure be followed when actions to be taken by the federal government, such as construction, funding, or permitting, could produce environmental impacts. The process is intended to identify the significant potential impacts to the human and natural environment and provide an opportunity for interested individuals, organizations, and government agencies to participate in the analysis. For actions with a high probability of significant adverse environmental impact, the centerpiece of NEPA analysis is the environmental document, an Environmental Assessment or an Environmental Impact Statement. The primary mechanism for public participation under NEPA is the scoping process. The purpose of the scoping process is to identify the significant environmental issues that require study, sort out insignificant issues, and thereby focus the scope of the environmental document.

Normally, the federal government agency with the most involvement in a particular project would lead the NEPA process. In the case of the ILWSP, no federal agency has as of yet stepped forward to take the lead. This does not preclude the possibility that a federal agency may invoke and lead the NEPA process for this project in the future. The City, in conjunction with Groundwater Management District No. 2, therefore, has determined that it is in the best interest of the public to proceed with an environmental analysis according to NEPA guidelines despite the lack at this time of a federal lead agency.

Over the past five years, while the City has developed the ILWSP and implemented an Equus Beds Groundwater Recharge demonstration project, the public and government agencies have been kept informed through public meetings, tours, press releases, monthly and annual progress reports, project reports, and formal agency consultations. In early October 1997, through published and broadcast public notices, press releases, and direct mail, the City invited the public and federal, state, and local agencies to participate in the scoping process for the ILWSP's environmental document.

Three public meetings were held on October 20, 21, and 22, 1997 in Wichita, Cheney, and Halstead, Kansas, respectively, to solicit input on the scope of the Environmental document. A total of 36 individuals attended these meetings. Attendees had the opportunity to view displays about the proposed plan and the framework for the environmental document, ask questions about and discuss the plan with knowledgeable representatives from the City and the City's design and environmental consultant, and register their comments and suggestions concerning the proposed plan and the environmental document. The public was also invited to submit written comments by mail or fax by November 22, 1997.

Three similar meetings were held for cooperating government agencies. The first was held in Wichita on October 21, 1997 and was attended by representatives of the U.S. Bureau of Reclamation (USBOR), the Kansas Corporation Commission, the Kansas Department of Agriculture-Division of Water Resources, the Kansas Department of Health and Environment (KDHE), the Kansas Water Office, Groundwater Management District No. 2, and the Sedgwick County Conservation District. The second meeting was held in Kansas City, Missouri on November 5, 1997 and was attended by the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey, and KDHE. The third meeting was held in Emporia, Kansas on November 6, 1997 and was attended by the U.S. Fish and Wildlife Service (USFWS) and the Kansas Department of Wildlife and Parks. Agency representatives provided initial comments at these meetings and were requested to submit written comments by November 22, 1997.

SUMMARY OF COMMENTS

The following summary is organized along the lines of the NEPA process and the environmental document. The first section contains comments on public participation and the environmental document process. Subsequent comments are grouped into categories that correspond to major sections of the environmental document: purpose and need, alternatives, current environmental conditions and impacts, and mitigation. The last section of the summary contains comments beyond the scope of the environmental document.

Based on public and agency comments received, 66 issues were identified. Of these, 42 were considered highly significant and will be discussed in detail in the environmental document, 16 were considered less significant and will be briefly discussed in the environmental document, and 8 were considered beyond the scope of the environmental document. Highly significant issues are identified with a ★. Table D-1 identifies the section numbers in the EIS that relate to the significant issues listed below.

PUBLIC AND AGENCY PARTICIPATION AND THE ENVIRONMENTAL DOCUMENT

1) Create a public repository for project information so that the public will know where to go to get more information.
2) Create a Citizens Advisory Panel to interact with the City on this important issue.

3) Maintain close coordination with USBOR during the plan formulation process especially in regards to changes in the operation of Cheney Reservoir.
4) Consider the appropriateness of doing an Environmental Assessment instead of an Environmental Impact Statement as the environmental document.
5) Include in the environmental document a description of informal and formal consultation with the USFWS.

PURPOSE AND NEED

No comments.

ALTERNATIVES

1) ★Raise the price of water to encourage conservation.
2) ★Reduce demand for water by reducing lawn watering through changes in building codes to specify low-water use grasses and prohibit in-ground sprinkler systems.
3) Recharge Equus Beds with low-head dams on the Little Arkansas River.
4) Foster the wise use of water by creating an office and regulatory structure to penalize people for the miss-use of water.
5) The City should sponsor research into the development of techniques to recover water from sources that are currently considered unfeasible.
6) Make a commitment to developing use for gray water to reduce the use of treated water.
7) Conserve groundwater resources by regulating, through permitting, private water wells on private property.

ENVIRONMENTAL CONDITIONS AND IMPACTS

Geology and Soils

1) Address impacts of groundwater removal or recharge on land subsidence and well collapse

Water Quantity

1) ★Expansion of the local well field could decrease the water table for those with private water wells in north-west Wichita.
2) ★Address effect on streamflow in the North Fork Ninnescah River (NFNR) below Cheney Reservoir.
3) ★Quantify, through hydrologic analysis, changes in hydrology in the Little Arkansas and Arkansas rivers including: duration of bankful conditions, duration of out-of-bank flows, increased baseflow from a recharged Equus Beds, and flow duration curve.

4) ★Estimate the impacts of hydrologic changes in the Little Arkansas, Arkansas, and North Fork Ninnescah rivers on bedload transport and channel morphology.
5) ★Establish minimum, seasonally variable, flow releases from Cheney Reservoir.
6) ★Estimate changes in Equus Beds groundwater levels under different scenarios of storage, usage, and precipitation patterns.
7) ★Describe changes in the hydrology of Cheney Reservoir including storage volumes (total and for the various sub-pools), water level, surface area in terms of average changes and degree of fluctuation.

Water Quality
1) ★Expansion of well field could disturb a hazardous groundwater site near 57th St. and Broadway
2) ★Address impacts on water quality in the NFNR caused by changes in streamflow below Cheney Reservoir.
3) ★Address source water protection for the City's investments at Cheney Reservoir and the Equus Beds.
4) ★Address the potential intrusion of a plume of highly saline water into the Equus Beds aquifer from the Burrton area.
5) ★Address impacts of high atrazine content in Little Arkansas River water.
6) ★Address the impact of induced infiltration on the water quality of the Local Well Field caused by increased withdrawal from the Local Well Field.
7) ★Expanded use of the Bentley Well Field could induce greater infiltration of high saline waters.
8) ★Address impacts on the concentrations of arsenic and other trace elements in ground and surface waters.
9) Manage groundwater quality in the Equus Beds by not exceeding maximum drawdown target level and by the establishment of a more detailed groundwater sampling network between the Equus beds and the Burrton and Nikkel groundwater contamination sites; groundwater sample analysis should be expanded to include organic constituents.
10) ★Estimate changes in water quality in Cheney Reservoir and NFNR below Cheney Reservoir.
11) Expand riparian areas to improve surface water quality in agricultural areas.

Water Rights
1) ★Address the interplay of water rights under the ILWSP, notably conjunctive use opportunities and constraints.
2) ★Describe the contractual relationship between the City and the USBOR relative to water from and the operation and ownership of Cheney Reservoir.
3) It is not necessary to address the issue of a water rights banking system for the Equus Beds.

Vegetation and Wetlands
1) ★Riparian and wetland vegetation could be adversely impacted by lowering groundwater levels in the Wichita-Valley Center Floodway.
2) ★Estimate impacts on bank stability, riparian wetlands, riparian vegetation, and oxbow lakes associated with the Little Arkansas, Arkansas, and North Fork Ninnescah rivers.
3) ★Estimate impacts on wetlands of recharging the Equus Beds including changes in water depth

and duration of saturation.

4) ★Address changes in aquatic vegetation in Cheney Reservoir.
5) ★Quantify the changes in the amount of area and length of NFNR inundated above Cheney Reservoir and affected vegetation communities as a result of the proposed changes in operation of the reservoir.
6) ★Potentially affected wetlands should be identified and delineated pursuant to methodology of the Corps of Engineers, Natural Resources Conservation Service, and EPA.

Fish and Wildlife

1) ★Address impacts to fisheries, riparian wildlife, and their habitats in the Little Arkansas River, the North Fork Ninniscah River, and Cheney Reservoir caused by changes in flow or water level fluctuations.
2) ★Estimate fish mortality caused directly by water withdrawal from the Little Arkansas River and Cheney Reservoir.
3) ★Address impacts to shorebirds, waterfowl, warblers, and woodpeckers caused by changes in operation of Cheney reservoir.
3) ★Address impacts to fisheries and wildlife management practices including scheduled drawdowns and moist-soil management caused by changes in operation of Cheney reservoir.
4) Assess impacts of changes in Cheney Reservoir operation on white bass runs up the NFNR.

Species of Special Concern

1) ★Assess impacts to and describe any needed mitigation for federal threatened and endangered species including bald eagle, peregrine falcon, least tern, piping plover, and whopping crane.
2) ★Address impacts to and describe any needed mitigation for the Arkansas darter, Arkansas River shiner, and speckled chub which occur or have designated critical habitat in NFNR downstream of Cheney Reservoir.
3) ★Assess impacts to and describe any needed mitigation for state threatened or endangered species including white-faced ibis and snowy plover.
4) ★Prepare and submit to USFWS a Biological Assessment if potential impacts to federally listed and candidates species are identified.
5) Include a description of USFWS's Biological Opinion on threatened or endangered species, if applicable.
6) ★Include a plan to enhance, mitigate, or reduce adverse impacts to threatened or endangered species.

Socioeconomics

1) ★Address impacts that changes in the operation of Cheney Reservoir could have on recreation at the lake and NFNR including boating, swimming, water skiing, sailing, angling, wildlife appreciation, hiking, horse back riding, camping, hunting, trapping, and shooting.
2) ★Changes in operation at Cheney Reservoir could affect the original cost allocation of the reservoir project and repayment obligations.
3) ★Address the positioning of Wichita as a major hub of regional water supply as a result of the enhanced water supply developed under the ILWSP.
4) ★How will groundwater mounding in the Equus Beds impact local land owners and water users.

5) ★Address the physical and economic impacts of changes in operation of Cheney reservoir on lake-side facilities and infrastructure such as recreation related structures and sales.
6) ★Evaluate potential impacts to Land and Water Conservation Fund properties including state parks, state wildlife areas, county parks, and city parks.

Aesthetics

1) ★Address the impacts of changes in Cheney Reservoir operations on aesthetics such as views of exposed dead trees, mudflats, and water clarity.

BEYOND THE SCOPE OF THE ENVIRONMENTAL DOCUMENT

1) Reduce the demand for water by practicing active reproduction control on a certain disadvantaged segment of the population of Wichita.
2) Government attitude that water is a commodity does not foster a commitment to conservation.
3) Water should not be a commodity used for bartering to secure annexation.
4) Government and community leaders need to accept the "reality of limits" and that the availability of water can set limits on economic and residential growth.
5) Area governments need to provide incentives, positive and negative, that encourage the protection of surface and ground water quality through measures such as erosion control, proper yard chemical application, and plugging abandoned water wells.
6) Remain vigilant for invasion by zebra mussels.
7) Evaluate the selling of millions of gallons of water to Pepsi for bottled water.
8) Promote legislation that guarantees irrigation farmers will not be penalized for conserving water by having their vested water rights or allotment reduced if they do not use it all.

FUTURE PUBLIC INVOLVEMENT

The draft Environmental document is tentatively scheduled to be completed and available for public comment in late 1999. It is possible that public meetings will be held at that time to present the findings. If you have any questions about the scoping or NEPA process, please contact:

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Kansas City, MO 64114
Phone 816-833-3304 Fax 816-333-3690

Table D-1 EIS Section Numbers for Significant Issues Identified During Scoping

SIGNIFICANT ISSUES	SECTION REFERENCE
ALTERNATIVES	
1) Raise the price of water to encourage conservation.	1.3.4, 2.3.1
2) Reduce demand for water by reducing lawn watering through changes in building codes to specify low-water use grasses and prohibit in-ground sprinkler systems.	1.3.4, 2.3.1
ENVIRONMENTAL CONDITIONS AND IMPACTS	
Water Quantity	
1) Expansion of the local well field could decrease the water table for those with private water wells in northwest Wichita.	2.3.3, 4.4.2.1.2
2) Address effect on streamflow in the North Fork Ninnescah River (NFNR) below Cheney Reservoir.	4.4.1.2.3
3) Quantify, through hydrologic analysis, changes in hydrology in the Little Arkansas and Arkansas rivers including: duration of bankfull conditions, duration of out-of-bank flows, increased baseflow from a recharged Equus Beds, and flow duration curve.	4.4.1.2.1, 4.4.1.2.2
4) Estimate the impacts of hydrologic changes in the Little Arkansas, Arkansas, and North Fork Ninnescah rivers on bedload transport and channel morphology.	4.4.1.2.1, 4.4.1.2.2, 4.4.1.2.3
5) Establish minimum, seasonally variable, flow releases from Cheney Reservoir.	4.4.1.2.3
6) Estimate changes in Equus Beds groundwater levels under different scenarios of storage, usage, and precipitation patterns.	4.4.2.1.1
7) Describe changes in the hydrology of Cheney Reservoir including storage volumes (total and for the various sub-pools), water level, surface area in terms of average changes and degree of fluctuation.	4.4.1.2.3, 4.4.1.3.4
Water Quality	
1) Expansion of well field could disturb a hazardous groundwater site near 57th St. and Broadway	4.4.2.1.2
2) Address impacts on water quality in the NFNR caused by changes in streamflow below Cheney Reservoir.	4.4.1.4.3
3) Address source water protection for the City□s investments at Cheney Reservoir and the Equus Beds.	4.4.1.4.4
4) Address the potential intrusion of a plume of highly saline water into the Equus Beds aquifer from the Burrton area.	4.4.2.2.1
5) Address impacts of high atrazine content in Little Arkansas River water.	3.3.1.4, 4.4.1.4.1
6) Address the impact of induced infiltration on the water quality of the Local Well Field caused by increased withdrawal from the Local Well Field.	4.4.2.2.2
7) Expanded use of the Bentley Well Field could induce greater infiltration of high saline waters.	4.4.2.2.3
8) Address impacts on the concentrations of arsenic and other trace elements in ground and surface waters.	4.4.1.4.1
9) Estimate changes in water quality in Cheney Reservoir and NFNR below Cheney Reservoir.	4.4.1.4.3, 4.4.1.4.4
Water Rights	
1) Address the interplay of water rights under the ILWSP, notably conjunctive use opportunities and constraints.	2.3.4, 3.3.3, 4.4.3
2) Describe the contractual relationship between the City and the USBOR relative to water from and the operation and ownership of Cheney Reservoir.	1.3.3.2, 2.3.4

Vegetation and Wetlands	
1) Riparian and wetland vegetation could be adversely impacted by lowering groundwater levels in the Wichita-Valley Center Floodway.	4.7.1, 4.16
2) Estimate impacts on bank stability, riparian wetlands, riparian vegetation, and oxbow lakes associated with the Little Arkansas, Arkansas, and North Fork Ninnescah rivers.	4.4.1, 4.4.2, 4.7.1, 4.7.2
3) Estimate impacts on wetlands of recharging the Equus Beds including changes in water depth and duration of saturation.	4.7.1
4) Address changes in aquatic vegetation in Cheney Reservoir.	4.4.1.3.4, 4.4.1.4.4
5) Quantify the changes in the amount of area and length of NFNR inundated above Cheney Reservoir and affected vegetation communities as a result of the proposed changes in operation of the reservoir.	4.4.1.3.4, 4.15
6) Potentially affected wetlands should be identified and delineated pursuant to methodology of the Corps of Engineers, Natural Resources Conservation Service, and EPA.	2.4, 3.6.1, 4.7.1
Fish and Wildlife	
1) Address impacts to fisheries, riparian wildlife, and their habitats in the Little Arkansas River, the North Fork Ninnescah River, and Cheney Reservoir caused by changes in flow or water level fluctuations.	4.4.1.3.4, 4.7.3, 4.7.4
2) Estimate fish mortality caused directly by water withdrawal from the Little Arkansas River and Cheney Reservoir.	4.4.1.3.4, 4.7.3
3) Address impacts to shorebirds, waterfowl, warblers, and woodpeckers caused by changes in operation of Cheney reservoir.	4.4.1.3.4, 4.7.3, 4.7.4
4) Address impacts to fisheries and wildlife management practices including scheduled drawdowns and moist-soil management caused by changes in operation of Cheney reservoir.	4.4.1.3.4, 4.7.3, 4.7.4
Species of Special Concern	
1) Assess impacts to and describe any needed mitigation for federal threatened and endangered species including bald eagle, peregrine falcon, least tern, piping plover, and whopping crane.	4.7.4
2) Address impacts to and describe any needed mitigation for the Arkansas darter, Arkansas River shiner, and speckled chub which occur or have designated critical habitat in NFNR downstream of Cheney Reservoir.	4.7.4.5, 4.8
3) Assess impacts to and describe any needed mitigation for state threatened or endangered species including white-faced ibis and snowy plover.	4.8.3, 4.8.4
4) Prepare and submit to USFWS a Biological Assessment if potential impacts to federally listed and candidate species are identified.	Appendix B
5) Include a plan to enhance, mitigate, or reduce adverse impacts to threatened or endangered species.	4.15, 4.16
Socioeconomics	
1) Address impacts that changes in the operation of Cheney Reservoir could have on recreation at the lake and NFNR including boating, swimming, water skiing, sailing, angling, wildlife appreciation, hiking, horse back riding, camping, hunting, trapping, and shooting.	4.4.1.3.4, 4.14
2) Changes in operation at Cheney Reservoir could affect the original cost allocation of the reservoir project and repayment obligations.	2.3.4, 4.4.1.3.4
3) Address the positioning of Wichita as a major hub of regional water supply as a result of the enhanced water supply developed under the ILWSP.	1.1, 1.2, 1.3
4) How will groundwater mounding in the Equus Beds impact local land owners and water users.	4.4.2.1.1, 4.7.1, 4.16

6) Evaluate potential impacts to Land and Water Conservation Fund properties including state parks, state wildlife areas, county parks, and city parks.	4.4.1.3.4, 4.14
Aesthetics	
1) Address the impacts of changes in Cheney Reservoir operations on aesthetics such as views of exposed dead trees, mudflats, and water clarity.	4.4.1.3.4, 4.13