RECLAMATION

Managing Water in the West

Equus Beds Aquifer Storage Recharge and Recovery Project

Equus Beds Division, Wichita Project, Kansas

Final Environmental Impact Statement

U.S. Department of the Interior
Bureau of Reclamation

November 2009

Abbreviations/Acronyms

ASR	Aquifer Recharge (Storage) and Recovery Project
ac-ft	acre-feet
AOP	Advanced Oxidation Process
AHERA	Asbestos Hazard Emergency Response Act
BMP	Best Management Practice
CEQ	Commission on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
CO	carbon monoxide
CO_2	carbon dioxide
CWA	Clean Water Act
dB/A	noise level in weighted decibels
DHHS	U.S. Department of Health and Human Services
DWR	Department of Water Resources (Kansas Department of Agriculture)
EIA	Economic Impact Area
EIS	Environmental Impact Statement
e-mail	computer message
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FPPA	Farmland Protection Policy Act
FWCA	Fish and Wildlife Coordination Act
FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gases
GMD2	Groundwater Monitoring District No. 2
GRP	Gross Regional Product
HBMP	Hydro-Biological Monitoring Plan
HUD	U.S. Department of Housing and Urban Development
ILWSP	Integrated Local Water Supply Plan
IMPLAN	Impact Analysis for Planning Model
IPCC	Intergovernmental Panel on Climate Change
KCC	Kansas Corporation Commission
KDA	Kansas Department of Agriculture
KDHE	Kansas Department of Health and Environment
KGS	Kansas Geological Survey
KWO	Kansas Water Office
KDWP	Kansas Department of Wildlife and Parks
KS	Kansas
KSHS	Kansas State Historical Society
LEEDS	Leadership in Energy and Environmental Design Standards
M&I	municipal and industrial
MDS	Minimum Desirable Streamflow
MGD	million gallons per day
mg/l	milligrams per liter (parts per million)
mg/m^3	milligrams per cubic meter (parts per million)
MOA	Memorandum of Agreement
MSA	Metropolitan Statistical Area
msl	mean (average) sea level
MW	megawatt (1 million watts)
NCLC	National Consumer Law Center
NEPA	National Environmental Protection Act
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO^2	nitrite (nitrogen dioxide)
NO_3	nitrate (nitrogen trioxide)
NO_x	nitrous oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
O&M	operation and maintenance
PAC	Powder Activated Carbon
pH	per hydrion constant (measure of acidity)
PM_{10}	particulate matter less than 10 microns in diameter (refers to air quality)
PM_{25}	particulate matter less than 2.5 microns in diameter (refers to air quality)
ppm	parts per million
PSD	Prevention of Significant Deterioration (refers to air quality)
RCRA	Resource Conservation and Recovery Act
RDA	Rural Development Act (USDA)
RESNET	Reservoir Network (model)
RIA	Regional Impact Analysis
ROD	Record of Decision
RPC	Regional Purchase Coefficient
SCADA	Supervisory Control and Data Acquisition System
SCS	Soil Conservation Service (USDA, now the NRCS)
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Officer
SMCL	Secondary Maximum Contaminant Levels (EPA)
SO_2	sulfur dioxide
TDS	total dissolved solids
TOC	total organic carbon
TSCA	Toxic Substances Control Act
TSS	total suspended solids
$\mu g/cm^3$	micrograms per cubic centimeter
μg/L	micrograms per liter (parts per billion)
μg/ml	micrograms per milliliter (parts per million)
$\mu mhos/cm^3$	electrical conductance in micromhos per cubic centimeter
USACE	U.S. Army Corps of Engineers
USBOC	U.S. Bureau of the Census
USBOL	U.S. Bureau of Labor
USC	U.S. Code
USDA	U.S. Department of Agriculture
USDA-RDA	U.S. Department of Agriculture, Rural Development Act
USDHHS	U.S. Department of Health and Human Services
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USHUD	U.S. Department of Housing and Urban Development
WAM	Water Availability Modeling
WRAPS	Watershed Restoration and Protection Strategy

Aquifer Storage Recharge and Recovery Project

Equus Beds Division, Wichita Project, Kansas
Harvey, Sedgwick, and Reno Counties, Kansas

Final Environmental Impact Statement

Lead Agency
United States Department of the Interior
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office

Abstract

This Environmental Impact Statement (EIS) has been prepared in compliance with the National Environmental Policy Act (NEPA). The Lead Agency is the Department of the Interior, Bureau of Reclamation (Reclamation). The EIS was prepared in cooperation with the following: Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Army Corps of Engineers, Kansas Department of Agriculture, Kansas Department of Health and Environment, Kansas Department of Wildlife and Parks, Kansas Geological Survey, Kansas Water Office, Equus Beds Groundwater Management District No. 2, and the City of Wichita Water and Sewer Department.

The document analyzes potential impacts from the Equus Beds Aquifer Storage Recharge and Recovery Project (ASR). Two alternatives are considered in the EIS. The *Preferred Alternative* would divert a total of 100 MGD of water from the Little Arkansas River during high flows to recharge the Equus Beds Aquifer for later municipal and industrial (M&I) use by the City. The Federal government would fund (cost-share) up to 25% (or $30 million, whichever is less) of the construction costs, of Phases IIb, III and IV of the ASR. The City has already completed Phase I and is working on Phase IIa. No Federal funding was used for these early phases. Since the City would complete the project without the Federal cost-share, the same 100 MGD ASR is also considered as the *No Action Alternative*. There would be no Federal funding in No Action.

After completion, the ASR would become the Equus Beds Division of Reclamation's Wichita Project. Operation, maintenance, replacement, and

liability of the new division would be the responsibility of the City. The ASR would help meet M&I water demands of the City through 2050.

Some impacts to soils, land use, water, air quality, noise, esthetics, wetlands, riparian zones, vegetation, wildlife, and socioeconomics would be expected. Some would be temporary but some would last the duration of the ASR.

Long-term improvements in surface and groundwater quality and availability should result from the ASR. Base flow should increase in both the Arkansas and Little Arkansas rivers, and greater flows should improve aquatic habitat for some endangered or threatened species and species of concern. Aquifer storage should help reduce impacts from evaporation and quality degradation. The ASR should also increase water levels in the aquifer to near-historic levels and help slow saltwater degradation.

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Final Environmental Impact Statement No. **FES 09-29**

Summary

Public Law 109-299 authorizes the Secretary of the Interior to help the City of Wichita, Kansas, complete the *Aquifer Storage Recharge and Recovery Project* (ASR) of the City's *Integrated Local Water Supply Plan* (ILWSP). The purpose of the project is to provide municipal and industrial (M&I) water to the City and surrounding region through the year 2050. The ASR would pump water from the Little Arkansas River basin into the region's Equus Beds Aquifer for storage and later re-use. When completed, the ASR would become the "Equus Beds Division" of the U.S. Bureau of Reclamation's Wichita Project. Reclamation, an agency of the Department of the Interior, provides water to 17 western states, including the State of Kansas.

The Equus Beds aquifer lies under about 900,000 acres in six Kansas counties. The ASR would cover only a small part of this area, however, in northern Sedgwick and southern Harvey counties.

P.L. 109-299 requires Reclamation to use to the extent possible the City's ASR plans, designs, and analyses. Federal funding for the project would be capped at 25% of total costs, or $30 million (indexed to 2003 prices), whichever is less.

Reclamation has responsibility under the National Environmental Policy Act (NEPA) to review, publicly document, and disclose environmental impacts of the ASR before Federal action is taken. This environmental impact statement (EIS) describes the impacts of the project.

Purpose and Need

The City needs water because of population growth and consequent growth in water demands. The City currently has capacity to meet average daily water demands until 2016, while with the ASR, the City would be able to meet demands until 2050. The ASR would provide a safe and reliable M&I water supply by preventing the continuing decline of water levels in the Equus Beds aquifer. About 32% of the City's water comes from the Equus Beds. Use of the aquifer for M&I, rural, and agricultural needs throughout the region over the past 60 years has caused a drop in the water table of up to 50 feet in some locations. It is estimated that the ASR would restore original water levels to the aquifer within 21 years after beginning operation.

The project would also protect water quality in the aquifer. Saltwater encroachment has become a problem because—as freshwater levels drop—saltwater infiltration from the Arkansas River and other sources has become more pronounced. Continuing saltwater encroachment could degrade water quality to the point where water would require much more treatment to make it drinkable. The ASR would help maintain a safe gradient between fresh and saltwater sections, thereby protecting the aquifer from saltwater encroachment.

Proposed Action

The Proposed Action is for Reclamation to help fund the *100 MGD ASR Plan with 60/40 Option*, as described by Burns & McDonnell (2003).

The ASR, as part of the ILWSP, would draw water from the Little Arkansas River, pre-treat it, and recharge the Equus Beds Aquifer in phases. Sixty percent of the water would come from surface water intakes, the rest from diversion wells installed along the river bank. Three recharge basins and 99 recharge recovery wells connected by pipelines would recharge the aquifer. Water would also be pumped directly from the river intakes.

Alternatives

The Preferred Alternative is for Reclamation to provide up to 25% of project costs or $30 million (indexed to 2003) whichever is less to fund and implement the remaining phases of the 100 MGD ASR (60/40). The City, having already completed Phase I and at work on Phase IIa, does not intend to ask for Federal help for this work, but is requesting Federal help for Phases IIb, III, and IV. Total cost of construction for the project would be more than $500 million, including the $27 million already spent during Phase I and $250 million estimated to be spent during Phase II. Operations and maintenance costs would be the responsibility of the City.

Under the No Action Alternative, the City would proceed with construction and operation of the ASR without Federal reimbursement of up to 25% of the total cost of the project, or $30 million, whichever is less. This alternative would have the same facilities built in the same sequence for the same construction and operation and maintenance costs as the Preferred Alternative but without Federal reimbursement. The City would provide 100% of the construction, operation and maintenance costs of the project. The Secretary of the Interior would not enter into a cooperative agreement or other appropriate agreements with the City and no Federal funds would be expended for the Equus Beds Division.

Affected Environment

Reclamation determined some of the environmental concerns to be analyzed in the EIS, and the public, City, and cooperating agencies provided others. By this process, these environmental factors were established:

- Geology
- Soils
- Land Use
- Surface Water Resources
- Surface Water Levels
- Surface Water Quality
- Surface Water Rights
- Groundwater Levels
- Groundwater Quality
- Groundwater Rights
- Air Quality
- Noise
- Esthetics
- Climate Change
- Biological Resources
- Socioeconomics
- Environmental Justice
- Cultural Resources

Environmental Impacts

Analyses have shown that the Preferred and No Action Alternatives would differ only in socioeconomic and environmental justice impacts. Impacts are summarized below and are detailed in Chapter 4.

Geology

Construction of facilities would cause minor changes to surface geology, except in the case of recharge basins, where the removal of topsoils would be permanent.

Soils

About 266 acres would be permanently disturbed by construction of pre-treatment plants and other facilities.

Land Use

About 65 acres of prime farmland would be permanently disturbed by construction of facilities.

Surface Water Resources

Base flows in the Little Arkansas River would increase slightly, but overall flows would be reduced where the Little Arkansas joins the Arkansas River. Discharges from Cheney Reservoir down the North Fork of the Ninnescah River would increase slightly.

Surface Water Levels

Base flows in both the Little Arkansas and Arkansas rivers would increase slightly, while total flows would decrease levels in both rivers. Water levels in Cheney Reservoir and the Ninnescah River system would increase slightly.

Surface Water Quality

Water quality in the Little Arkansas would improve slightly.

Surface Water Rights

There would be no impacts to surface water rights.

Groundwater Levels

Levels in the Equus Beds aquifer would rise.

Groundwater Quality

Rising groundwater levels would help protect the aquifer against saltwater intrusion from the Arkansas River, oilfield brine, and salt mining.

Groundwater Rights

There would be no impacts on groundwater rights.

Air Quality

Construction of facilities would cause localized, short term impacts, while continuing traffic and operation of equipment would cause minor, long term impacts.

Noise

Construction would temporarily disturb local residents and livestock and wildlife.

Esthetics

Construction would temporarily affect the project area, while facilities would have a permanent effect.

Climate Change

Carbon-based fuels would be expended during construction and operation of the project. Storage of water in the Equus Beds aquifer would protect it from losses to evaporation.

Biological Resources

There would be no impacts to critical habitat and no threatened, endangered, or candidate species would be affected. Some small wetlands could be temporarily affected by construction.

Socioeconomics

The net economic benefits of ASR construction within the region would depend upon the relative proportion of local to outside (Federal) funding. Should the government contribute zero dollars, the economic benefit (impact) to the region would be about - $75.6 million. Should all funding come from local sources, household expenditures normally reserved for other goods and services would be needed to pay for the project.

The average Wichita household currently pays about $342 per year in water bills. When this figure is added to the $124.50 in construction and O&M costs estimated for the project, the result is $467. This total is much lower than the EPA's estimated maximum household payment capability for water of $990, but neither of these payment amounts would necessarily protect poor or minority households.

Environmental Justice

EPA's study found 13 postal zip codes in the project area where household incomes averaged less than the study area. When project costs per customer were compared, it was found that No Action Alternative costs (No Federal funding) exceeded the EPA household cost of 2.5% of household income.

Cultural Resources

Should any cultural resource sites be discovered, protection and mitigation, including consultation with the State Historic Preservation Office, would be required before proceeding.

Cumulative Impacts

Impacts from parts of the ILWSP other than ASR, including expansion of the Local Well Field, re-opening of the Burton Reserve Well Field, continuation of the City's water conservation program, and other operations would cumulatively impact the environment. Impacts would be minor, except at the mouth of the Little Arkansas where it empties into the Arkansas River. Flows there would be reduced throughout most of the year to near-base flow. A series of low-head dams pool water in this reach; however, so flow elevations would remain nearly constant.

NEPA Process

Reclamation published a draft EIS on impacts of the ASR project in June 2009. The public and other agencies and organizations were invited to comment on the draft (see Appendix F for the comments and Reclamation's responses). The draft EIS was revised as necessary and, with the comments/responses, constitutes the final EIS.

The EIS found no significant impacts to be expected from the project. No sooner than 30 days after the final EIS, Reclamation will issue a Record of Decision (ROD). The ROD will explain the alternative selected for the ASR Project and means to avoid or minimize effects of implementing the plan.

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Tables

Figures

Chapter 1: Introduction

The "Wichita Project Equus Beds Division Authorization Act of 2005" (Public Law 109-299) authorizes the Secretary of the Interior to help the City of Wichita, Kansas, in funding and implementing the *Aquifer Storage Recharge and Recovery Component* of the City's *Integrated Local Water Supply Plan* (ILWSP). The purpose of the ILWSP is to provide municipal and industrial (M&I) water to the City and surrounding region through the year 2050. The Aquifer Storage Recharge and Recovery Project (ASR) would pump water from the Little Arkansas River into the region's Equus Beds Aquifer for storage and later re-use. When completed, the ASR would become the "Equus Beds Division" of the U.S. Bureau of Reclamation's Wichita Project. Operation, maintenance, replacement, and liability of the new division would be the responsibility of the City.

P.L. 109-299 requires Reclamation to use, to the extent possible, the City's plans, designs, and analyses. The Federal funding cap would be 25% of total costs, or $30 million (indexed to January 2003), whichever is less. The full scale ASR system, costing over $500 million, would recharge the Equus Beds Aquifer with up to 100 million gallons of water per day (MGD).

This environmental impact statement (EIS) is required by the *National Environmental Policy Act* (NEPA). The Federal funding provided through Reclamation is a Federal action subject to NEPA. Alternatives are discussed in Chapter 2. The environment of the affected area is described in Chapter 3, and the impacts of the alternatives analyzed in Chapter 4. A list of agencies and interested groups consulted or coordinated with during the study is provided in Chapter 5.

Purpose and Need

One purpose of the project is to provide a safe and reliable source of drinking water for the City by preventing the continuing decline of water levels in the Equus Beds Aquifer. Federal funding is needed to help implement the ASR and defray costs.

Approximately 32% of the City's water supply comes from the aquifer The Equus Beds also supplies irrigation and livestock water throughout the region. There are approximately 1,650 non-domestic water wells withdrawing about 157,000 acre-feet (51.2 billion gallons) of water per year from the aquifer. Use of the Equus Beds for both municipal and agricultural needs over the last 60 years has exceeded recharge. This has caused a drop in the water table of up to 50 feet in some locations. About 50% of the water used annually goes to agriculture, 34% to cities, 15% to industry and 1% to other users (GMD2 1995).

A **second purpose** of the project is to protect water quality in the aquifer. The decline in the Equus Beds water table has allowed water with higher salt content to seep into the aquifer. Saltwater encroachment has become a problem because as freshwater levels drop, more saltwater infiltrates from the Arkansas River and other sources. This change in "gradient" between fresh and saltwater allows poorer quality water into the aquifer. Continuing saltwater encroachment could degrade water quality to the point where the water would require much more treatment to make it drinkable. In addition, the use of saline water for irrigation would damage crops, reduce soil productivity, and cause more salt to be available for re-infiltration through the soil. The ASR would help maintain a safe gradient between fresh and saltwater sections, protecting the aquifer from saltwater encroachment.

The **ASR is needed** because population and resulting water demands of Wichita and surrounding areas are projected to increase significantly by the year 2050. The City currently has the capacity to meet average daily water demands until 2016 (Burns & McDonnell 2003). With the ASR, the City would have the capacity to meet average daily needs of 112 MGD in 2050. The project would also:

- Store surface water underground to prevent evaporation and reduce other losses
- Reduce the gradient between fresh and saltwater sections within the aquifer to protect water quality
- Capture surface water for storage during periods of high stream flow, and
- Protect stored water from short term, seasonal, annual or long term climate change.

Reclamation has the further purpose to ensure that Federal funds would be spent in such a manner as to protect the environment. Reclamation has the responsibility to review and publicly document the environmental consequences of the project before a Federal action is taken.

Proposed Action

The Proposed Action is for Reclamation to help fund the *100 MGD ASR Plan with 60/40 Option*, as described by Burns & McDonnell (2003).

The ASR, as part of the ILWSP, would draw water from the Little Arkansas River, pre-treat it, and recharge the aquifer in four phases. Sixty percent of the water would come from surface water intakes. The remaining water would come from diversion wells installed along the river bank. Three recharge basins and 99 recharge recovery wells connected by pipelines would recharge the aquifer (see Figure 1-1.) Water would also be pumped directly from two river intakes. The first was constructed near Halstead during Phase I. A second intake is being constructed near Sedgwick, which could be expanded during Phase IV. Water would be piped to a second water treatment plant (Figure 1-1.)

The City, having already completed Phase I and at work on Phase IIa, does not intend to ask for Federal help for this work but is requesting Federal funding for Phases IIb, III, and IV. Total cost of construction for the 100 MGD ASR 60/40 Plan would be more than $500 million, including the $27 million already spent during Phase I and $250 million estimated to be spent during Phase II.

Congress has authorized Federal funding up to 25% of these costs (or up to $30 million, indexed to 2003), whichever is less. Phases I and IIa of the ASR are ineligible for reimbursement, as they are independent of cost-sharing and precede Reclamation's NEPA process for the project.

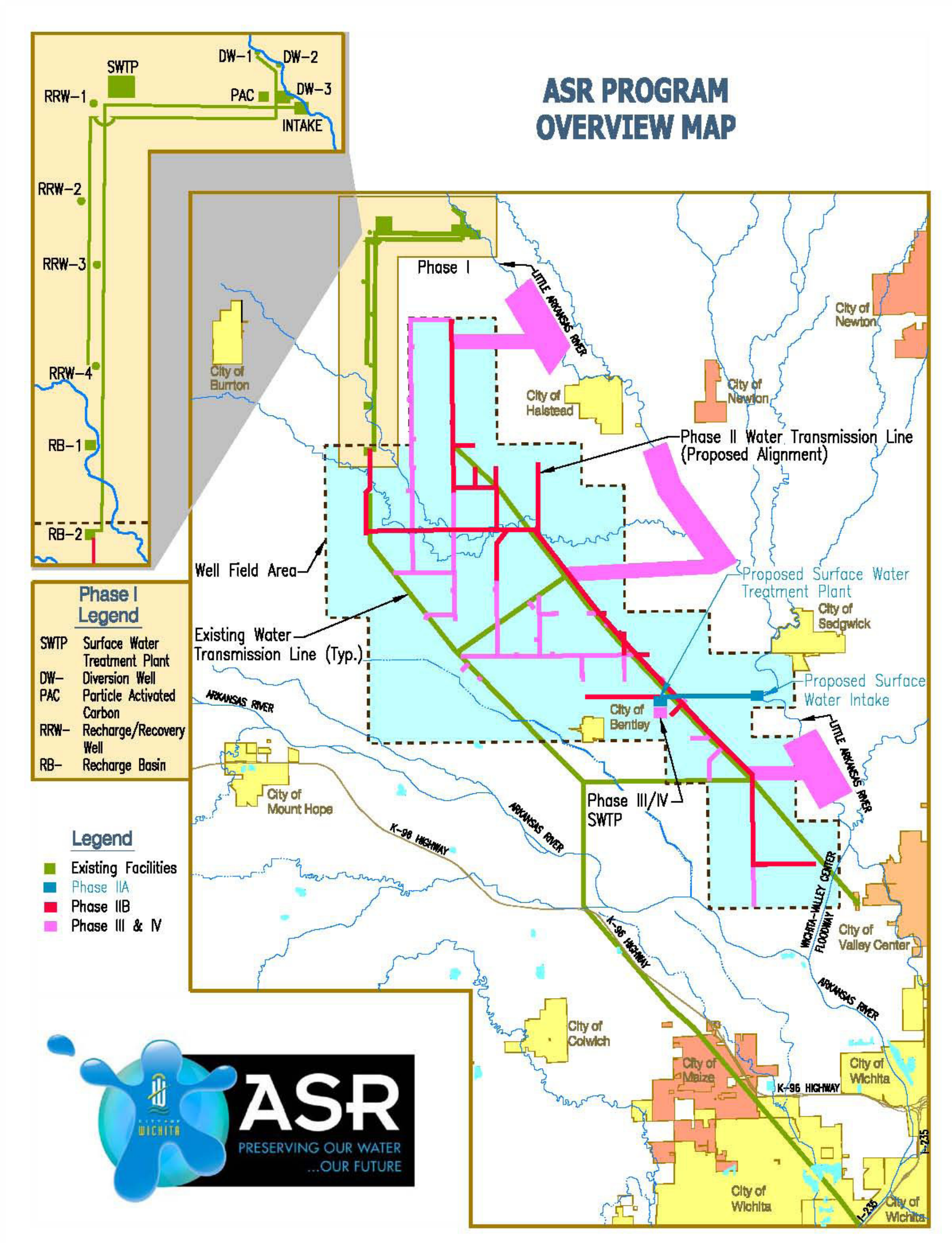

Figure 1-1: Overview of Phases II-IV

Location

The Equus Beds Aquifer lies beneath about 900,000 acres in six Kansas counties. However, the proposed project would cover only a small part of this area. Construction would occur in northern Sedgwick and southern Harvey counties.

The Equus Beds and surrounding, impacted areas are shown in Figure 1-2.

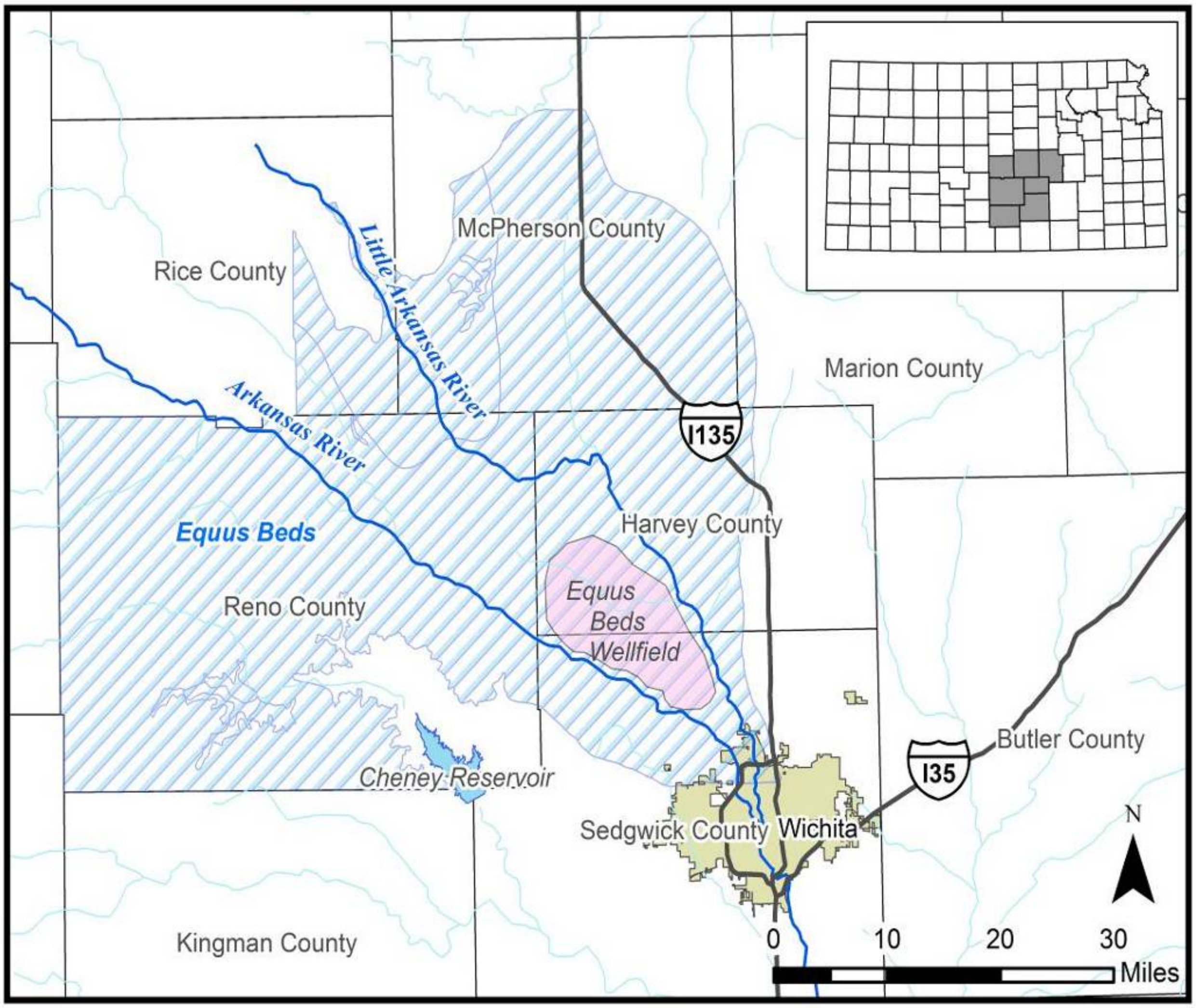

Figure 1-2: Equus Beds Aquifer (blue hatched area) as adapted from USGS

Background

City Water Sources and Facilities

The City and surrounding metropolitan area has many water sources, but only Cheney Reservoir and the Equus Beds have been dependable sources of supply (Burns & McDonnell 2003). The most important water sources and facilities are described below.

Integrated Local Water Supply Plan (ILWSP) – Including ASR

As described above, the City has completed Phase I of the ASR and is at work on Phase IIa. Phase I, at a cost of $27 million, was finished before Reclamation began work on this EIS. (It will not be considered for reimbursement so it is not considered in this report.) The City built a 7 MGD surface water treatment plant, three diversion wells, a 7 MGD river diversion and intake, 4 recharge recovery wells, 2 recharge basins, and 14 miles of overhead power lines, with a computerized *Supervisory Control and Data Acquisition System* (SCADA) system. The City also installed 35 monitoring wells at the request of the Kansas Department of Health and Environment (KDHE). Seven of these monitoring wells are near diversion wells along the Little Arkansas River and 28 are found near recharge recovery sites.

Figure 1-3: Monitoring Well near the River

Phase IIa will consist of a 66-MGD (33-MGD operational) diversion s structure on the river, a 60-MGD surface water intake, 2.5 miles of pipelines, and a 30-MGD surface water treatment plant.

Equus Beds Well Field

Only shallow water wells (predominately hand-dug) were constructed in the Equus Beds before the 1930s. The need for a public water system arose at the population of the City grew. Increasing water demands were met by construction of the Equus Beds Well Field (EBWF, Figures 1-1 and 1-2). Another 30 wells were added during the 1950s, bringing the total to 55.

The EBWF provided approximately 60% of the City's water through 1992. Since that time, the percentage has decreased to about 32%. Surface water from Cheney Reservoir and the Little Arkansas River supply about 68%.

Local Well Field

The Local Well Field (LWF) lies between the Little Arkansas and Arkansas rivers inside the City limits, just above the confluence. It contains 16 wells that pump bank storage water. These wells, constructed in 1949 and 1953, have only been lightly used.

Bentley Reserve Well Field

A drought in the 1950s led to development of a second aquifer along the Arkansas River. The well field lies 22 miles northwest of the City. The City drilled six wells, known as Bentley Reserve Wells, in 1956, but the water was too salty for standard treatment. The reserve well field was abandoned and water rights dismissed soon after the wells were drilled. However, the City recently obtained new water rights for the area (email, D. Ary to C. Webster, March 17, 2009.)

Cheney Reservoir

Cheney Reservoir, a division of Reclamation's Wichita Project, was constructed about 24 miles west of the City on the North Fork of the Ninnescah River during the 1960s. The top of the reservoir conservation pool lies at 1421.6 feet above mean sea level (msl). The impoundment holds approximately 167,074 acre-feet of water at this elevation (Reclamation 1981). Though originally built primarily for flood control and a supplemental water supply, Cheney Reservoir now serves as an important recreational area and as the City's primary water supply.

City Water System

Wichita Water Utilities administers the municipal and industrial (M&I) water supply to residential and commercial customers inside the City and to 23 districts and towns outside the City. The supply consists of water from the Equus Beds Aquifer and the Local Well Fields, as well as from Cheney Reservoir. Water is pumped to the City's water treatment plant and either piped to a pumping station for distribution throughout the region or stored in tanks during periods of low demand.

City Water Supply Study

Burns & McDonnell initiated a study during 1993 to plan for the future by comparing water sources, supplies, and system capacity to projected demands. The process included public meetings, discussions, and reviews with outside agencies. Review of the data indicated that average daily demand by 2050 could more than double to 112 MGD from the present 55.2 MGD. Demand would rise despite the City's stringent conservation program. Maximum daily demand could rise to 223 MGD, up from today's 115.4 MGD. Study results also indicated that water shortages for an average day's supply could occur during dry weather by 2026. Water shortages could also occur for the maximum daily supply.

The study proposed three comprehensive water supply plans, including the ILWSP. The ILWSP (including the ASR) would be completed in four phases (since divided into Phases I, IIa, IIb, III and IV). The primary aim of the ILWSP 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," (Burns & McDonnell 2003, p. 2-12.) Once all phases are completed, the ILWSP would consist of the following components:

- The ASR to transfer Little Arkansas River water into the Equus Beds Aquifer
- Expanded use of water from Cheney Reservoir
- Reuse of the abandoned Bentley Reserve Well Field along the Arkansas River (the saline water would be diluted with fresh water)
- Expansion of the Local Well Field along the Little Arkansas River
- Construction of a new water treatment plant
- Construction of more water pipelines, SCADA system and overhead power lines, and
- Adoption of expanded water conservation measures.

The ASR component is singled out for consideration for Federal funding in this EIS. The funding specified in Public Law 109-299 is to be used solely for Phases IIb, III and IV. Information in the 2003 Burns & McDonnell report has been incorporated in this EIS where appropriate.

Study Participants

Agencies and organizations involved in development of the EIS include:

- U.S. Army Corps of Engineers (USACE)
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Geological Survey (USGS)
- Kansas Department of Agriculture (KDA)
- Kansas Department of Health and Environment
- Kansas Department of Wildlife and Parks (KDWP)

- Kansas Geological Survey (KGS)
- Kansas Water Office (KWO)
- Equus Beds Groundwater Management District No. 2 (EBGMD2), and
- Wichita Water Utilities (WWU).

The EPA and USFWS participated as cooperating agencies in the generation of the report.

Decisions to Be Made

Reclamation

Congress authorized the Department of the Interior (through Reclamation) to enter into a cost share agreement with the City for the Equus Beds ASR Project. A cost share agreement would guide Federal expenditures during Phases IIb – IV. Reclamation would not own or operate the project at any point during design, construction, implementation, or other process.

After publication of the draft EIS in June 2009, Reclamation invited comments about the project from the public and other agencies and organizations. (Comments and Reclamation's responses can be found in Appendix F.) Some revisions to the draft were made based on these comments, and the revised document is published here as the final EIS.

The EIS found no significant impacts to be expected from the project. A Record of Decision (ROD) will be issued to document the alternative selected, explaining Reclamation's rationale for choosing the plan and means to avoid or minimize the effects of implementing it.

City of Wichita

The City implemented the Equus Beds ASR. Phase I of the project has already been completed and Phase IIa is under development. Without Federal assistance, the City could change water rates, continue or expand water conservation and education programs, continue development of both the Bentley Reserve and Local Well Fields, and begin other activities to pay for it. Costs associated with all phases of the ASR would be passed on to water service customers.

Environmental Concerns

The City and Reclamation identified environmental concerns, as noted in this EIS. Concerns were also expressed by citizens participating in public scoping or other informational meetings, or providing information electronically or by mail during the City's original scoping process in

1997 and during Reclamation's scoping process in 2008. Table 1-1 lists collected concerns and indicates geographic areas where they are especially relevant. Pages in this document where the concerns are discussed are provided.

Table 1-1 Environmental Concerns, Geographic Locations, and Pages where Discussed

	Concerns	***Locations***	***Pages***
Groundwater Volume	Expansion of the Local Well Field could lower the water table in private wells	Northwest Wichita	111
	Changes in water storage, use, and precipitation could impact the aquifer	Project Area	111
Groundwater Quality	Expansion of the Local Well Field could disturb a hazardous groundwater site near 57th St. and Broadway	Northwest Wichita	App. C
	Arsenic and other trace metal concentrations could change in groundwater	Project Area	112
	Intrusion rates of highly saline water into the aquifer from the Burrton area could change	Project Area	112
	Greater use of the Bentley Well Field could increase saline water intrusion	Northern Project Area	114
	Greater withdrawals from the Local Well Field could negatively impact ground water quality	Northwest Wichita	114
	Atrazine concentrations in the aquifer could be affected	Project Area	112

Table 1-1 Environmental Concerns, Geographic Locations, and Pages where Discussed

	Concerns	*Locations*	*Pages*
	Pharmaceutical and antibiotic concentrations in the aquifer	Equus Beds Aquifer	
Surface Water Quality	Little is known about pharmaceutical and antibiotic concentrations in the Little Arkansas River	Little Arkansas River	107
River and Reservoir Volume	Storage volumes (total and sub-pool), water levels, surface area, and degree of fluctuation could change in Cheney Reservoir	Cheney Reservoir	103
	Minimum and seasonally variable releases from Cheney Reservoir could change	Cheney Reservoir	103
	Flows of the North Fork Ninnescah River below Cheney Reservoir could change	North Fork of Ninnescah River downstream from reservoir	104
	Duration of bank-full conditions, out-of-bank flows, greater base flow, and flow duration curves could change in the Little Arkansas River	Little Arkansas River	94
	Flows in the Arkansas River downstream of the Little Arkansas could be reduced	Arkansas River	100
Fish and	Fisheries, riparian wildlife,	Major streams in,	121

Table 1-1 Environmental Concerns, Geographic Locations, and Pages where Discussed

	Concerns	*Locations*	*Pages*
Wildlife	birds, and habitat in the Little Arkansas, Arkansas, and North Fork of the Ninnescah rivers and Cheney Reservoir could be affected by changes in flows or water levels	around and below the Project Area	
	Nesting conditions of the Interior least tern, which uses exposed sandbars in the Arkansas River, could be affected	Arkansas River downstream of the Project Area	
Threatened and Endangered Species And Species of Special Concern	Federal and State Threatened and Endangered Species, migratory Species or species of concern could be affected	Project Area and major streams in, around, and below the Project Area	122
Social and Economic Conditions	The nature of the contract Between Reclamation and the City on operation and ownership of Cheney Reservoir could be affected	Project Area	103
	Changes in operations at the reservoir could affect the public	Region	103
	Making Wichita the major hub for regional water supply could affect the public	Region	App. B
	Conjunctive use opportunities and constraints on water rights could be affected	Project Area	App. B
	Land and Water Conservation		

Table 1-1 Environmental Concerns, Geographic Locations, and Pages where Discussed

	Concerns	*Locations*	*Pages*
	Fund properties like state, county, and City parks and wildlife areas could be affected	Project Area	
	City water conservation measures could affect water use	Project Area	
	Costs and expenditures could unfairly impact environmental justice	Project Area	
	Construction in areas with elevated ethnic, minority, or poorer populations could unfairly impact environmental justice	Project Area	
Land Use	Groundwater mounding in the aquifer could affect land owners and water users	Project Area	113
Prime and Unique Farmlands	Prime and Unique Farmlands could be lost to construction	Project Area	93
Air Quality	Construction and system equipment could affect air quality	Project Area	115
Recreation	Public recreation on Cheney Reservoir and in the North Fork of the Ninnescah could be affected	Cheney Reservoir and North Fork of the Ninnescah River	

Table 1-1 Environmental Concerns, Geographic Locations, and Pages where Discussed

	Concerns	*Locations*	*Pages*
Noise	Construction and system equipment could affect air quality	Project Area	
Climate Change	Long term operation and maintenance could impact climate change	Project and surrounding areas	117
Cultural Resources	Construction and excavation could adversely affect historic properties potentially eligible for the National Register of Historic Places	Project area, especially on terraces along Arkansas and Little Arkansas rivers	140
Human Health & Safety	Changing water quality could impact human and community health and safety	Project Area	144

Chapter 2: Alternatives

Development of Alternatives

P.L. 109-299 requires that Reclamation help the City of Wichita fund and implement the Aquifer Storage Recharge and Recovery Project of their Integrated Local Water Supply Plan, using the City's plans, designs, and analyses to the extent possible. The National Environmental Policy Act, on the other hand, requires Reclamation to consider a range of alternatives, including those outside the authority of the agency to implement. Reclamation had to plot a course between these two laws in this EIS.

The Burns & McDonnell study (2003) commissioned by the City produced a number of alternatives. They were examined by the technical team that put this EIS together. Most were dropped during the process (see the "Alternatives Considered But Eliminated" section at the end of this chapter.) Remaining alternatives represent a range in that they: provide for all necessary investments; achieve the purpose of the project and meet the need while minimizing environmental effects to the extent possible; and are acceptable to the public, City, and state.

The City was interested in satisfying a number of needs in order to satisfy its investment in the project. These included:

- Using reliable water sources, considering seasonal availability
- Using water treatable to drinking standards with conventional methods
- Limiting needs for land purchases or easements, for wells and pipelines
- Protecting Equus Bed's water quality
- Utilizing existing infrastructure within the City's water system
- Adopting technology developed in ASR Phase I, and
- Constructing an automated system with ease of maintenance.

In order to develop and evaluate project alternatives, more information on water sources had to be gathered using hydro-geologic field testing and soil boring. Information on water treatment technology, groundwater modeling and systems operation modeling, and for water demands were gathered and organized.

When the information was evaluated, several alternatives were developed for consideration. The City then evaluated economic, social, and environmental impacts of alternatives to provide an M&I water supply. Conceptual designs estimated construction costs, and estimated operation and maintenance costs were analyzed. In addition, regional water sources were evaluated for the following:

- Supply capability, now and in the future
- Water quality
- Legal issues
- Policy and social issues
- Planning horizons, and
- Environmental issues.

In general, it was determined that qualifying water sources must:

(1) Effectively and economically contribute to supplying the City's year 2050 projected average and maximum daily demands
(2) Protect Equus Beds Aquifer water quality, and
(3) Provide raw water treatable to drinking water standards using conventional water treatment processes.

With one exception, sources that would not meet these requirements were eliminated. The City wants to re-open the Bentley Reserve Well Field (Harvey County), despite high salinity of the water. It would be mixed with high quality water from other sources to dilute the salt concentration before treatment.

The City concluded the ASR would best achieve the purposes of meeting water demands and protecting the aquifer from salt water intrusion.

The two alternatives remaining for analysis in this EIS are:

- The 100 MGD 60/40 ASR with Federal funding, and
- The No Action Alternative (60/40 ASR without Federal funding).

Alternatives

Preferred Alternative: 100 MGD ASR (60/40) with Federal Funding

This is Reclamation and the City's Preferred Alternative. Reclamation would provide up to 25% of project costs or $30 million (indexed to 2003) to help construct facilities and infrastructure to pump 60 MGD of surface

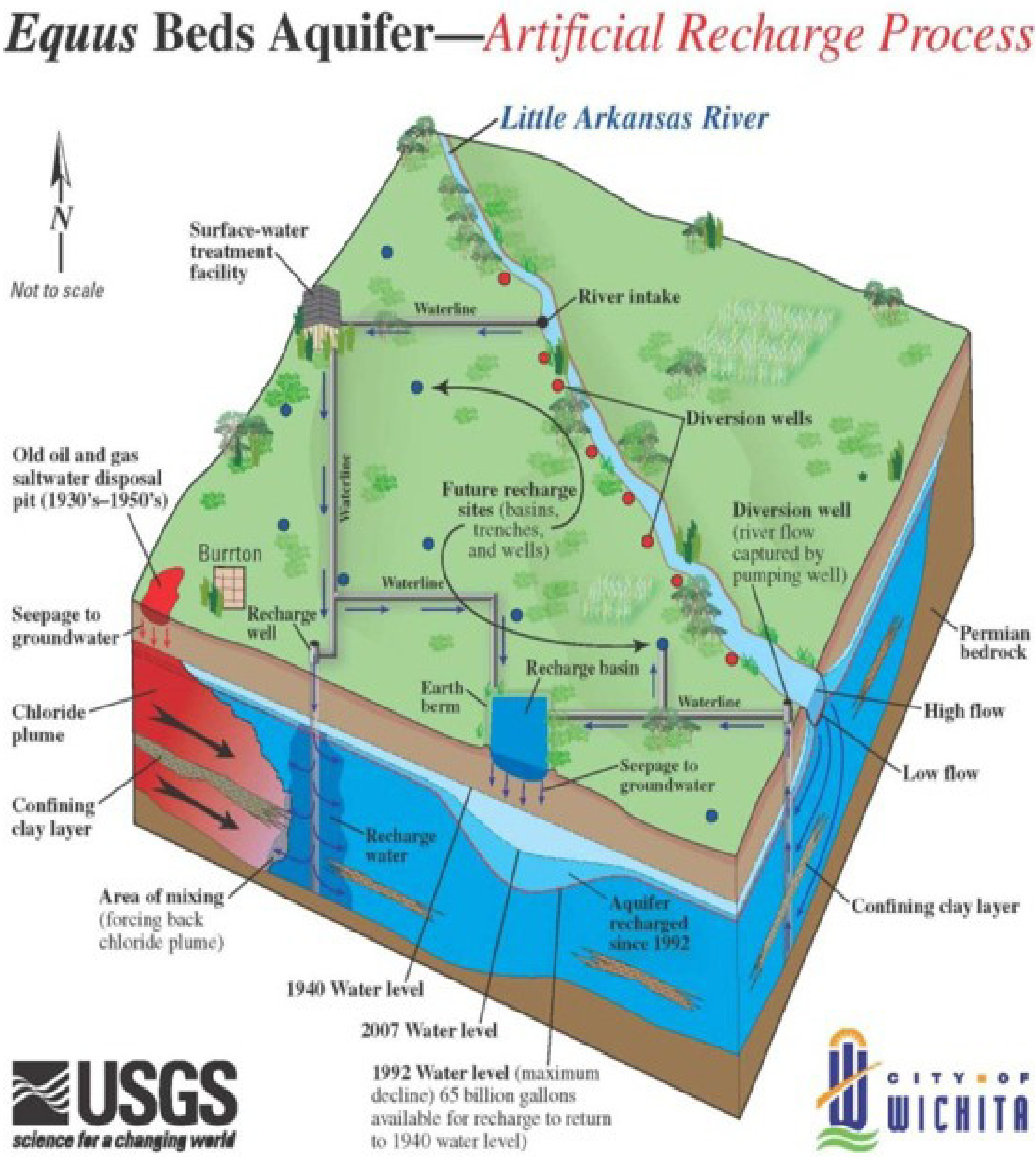

Figure 2-1: Overview of ASR

water and 40 MGD of diverted groundwater from wells along the banks of the Little Arkansas River during *above base flow* conditions (see Figure 2-1 for overview of the process). During primary irrigation months (spring through fall), the Kansas Department of Health and Environment (KDHE) recognizes a base flow of 57 cfs in the Little Arkansas River at Sedgwick and 20 cfs at Halstead. The additional 37 cfs flow between sites is reserved for permitted agricultural diversion. Base flow in the river during winter months would be considered to be 20 cfs throughout.

If necessary, 60 MGD of surface water could be diverted, pre-treated, and conveyed directly to the City's water treatment facility. The City does not intend to pump surface water directly to the treatment plant, although they may choose to do so later. Should this option be pursued, further permitting and environmental analysis may be required. Regardless, Kansas law requires that *minimum base flows* be maintained.

Under Phase IIb-Phase IV of the 100 MGB ASR (60/40) Alternative (those for which Federal reimbursement would be possible), work would continue to complete and implement the project. These phases would increase the City's capacity to recharge and recover water from the aquifer, continue to from saltwater intrusion, and bring groundwater inflows to the Little Arkansas River back to more natural levels.

Phase IIb would see installation of more recharge recovery wells; construction of pipelines from these wells to the new surface water treatment plant and overhead power lines to serve facilities in this and later phases; and a new electrical substation. The SCADA system would also be completed in this phase (Figure 2-2). SCADA requires a radio and antenna at each diversion well and recharge recovery well.

Figure 2-2: Recharge Recovery Well Site with SCADA Tower

Phase III would continue with installation of recharge recovery wells, as well as an unknown number of diversion wells. Pipelines to connect the wells to the rest of the system would be built, and the surface water treatment plant built in an earlier phase might be expanded to 60 MGD if deemed necessary.

Facilities in Phase IV would be similar to those in Phase III, except that the last section of pipeline of pipeline into the City might be rebuilt during this phase. By the end of construction of Phase IV in September 2011, total capacity of the City's water system would be 100 MGD.

Gravel access roads and other facilities required for operation would be constructed immediately next to the wells and pipelines. Wells, roads and facilities would be located in existing rights-of-way, along the edges of agricultural fields, or outside of existing riparian vegetation, to the greatest extent possible.

Table 2.1 describes the facilities to be built in Phases IIb-IV of the Preferred Alternative.

No Action Alternative: 100 MGD ASR (60/40) without Federal Funding

Under this alternative, the City would proceed with construction and operation of the Equus Beds Division without Federal reimbursement of up to 25% of the total cost of the project, or $30 million, whichever is less. This alternative would have the same facilities built in the same sequence for the same construction and operation and maintenance costs as the Preferred Alternative but without Federal reimbursement of part of these costs. The City would provide 100% or the construction and operation costs of the project. The Secretary of the Interior would not enter into a cooperative agreement, or other appropriate agreements, with the City, and no Federal funds would be expended for the Equus Beds Division.

Alternatives Considered but Eliminated

100 MGD ASR (25/75)

Description

As with the City's Preferred Alternative, this alternative would entail creation of a second diversion in the Little Arkansas River near Sedgwick and one at another site. Another 53 diversion wells would be drilled, rather than the 42 needed for the City's Preferred Alternative. This

Table 2-1 Preferred Alternative Facilities

Facility	Description	Total System Capacity (MGD)
	PHASE IIb	
Recharge recovery wells	26 recharge recovery wells would be installed in this phase, 20 from existing sites, 6 at new sites	40
Pipelines	New 12-inch to 72-inch diameter pipelines would be built from the new surface water treatment plant to the recharge recovery wells	
Overhead power lines	40 miles of new power lines would be built to serve facilities of this and future phases	
Substation	A new substation to serve treatment plant and river intake in earlier phases	
Process Control and SCADA	The PC/SCADA communications system would be completed	
	PHASE III	
Diversion wells	An unknown number of diversion wells would be installed along the Little Arkansas	70
Recharge recovery wells	27 existing wells would be re-drilled in Phases III and IV and 38 new wells drilled	
Pipelines	Water pipelines to serve the additional recharge recovery wells would be built	
Surface water treatment plant	Treatment plant built in Phase IIa might be expanded to 60 MGD if necessary	
	PHASE IV	
Diversion wells	An unknown number of diversion wells would be installed along the river	100
Recharge recovery wells	27 existing wells would be re-drilled in Phases III and IV and 38 new wells drilled	
Pipelines	Pipelines to serve the additional recharge recovery wells would be built	
Last section of pipeline into City	The last section of pipeline into the City might be rebuilt during this phase	
Surface water treatment plant	Treatment plant built in Phase IIa might be expanded to 60 MGD if necessary	

alternative would collect 75 MGD of surface water along with 25 MGD of diverted water during above base flow periods for aquifer recharge.

Reason for Elimination

The construction of 11 additional diversion wells and associated infrastructure would not be necessary for the City to meet its goals of: (1) effectively and economically supplying the City's year 2050 projected average and maximum daily demands; (2) protecting Equus Beds water quality; and (3) providing raw water treatable to drinking water standards with existing, conventional water treatment. Constructing more wells and associated infrastructure would force the City to buy additional property, negotiate for easements, cause unnecessary impacts to land owners and the environment, and increase construction and maintenance costs.

100 MGD ASR (0/100)

Description

This alternative would require construction of 70 new diversion wells, rather than those needed for the Preferred. All 100 MGD for aquifer recharge would come from diversion wells.

Reason for Elimination

The 100/0 Option would require the installation of 70 diversion wells along the Little Arkansas River, eliminating the need to divert surface water. The already-completed diversion structure at Sedgwick would be underutilized, if used at all, as 100% of the water would come from bank storage. Drilling and maintaining so many, expensive wells, many on private property, would not be necessary for the City to meet its goals. Constructing extra wells and associated infrastructure would force the City to purchase additional property, negotiate for unnecessary easements, pay extra construction and maintenance costs, and cause more unnecessary impacts to the environment. Many of these environmental impacts would be to the ecologically sensitive riparian zone.

150 MGD ASR (60/90, 75/75 and 100/50 Options)

Description

All three options would have diverted 150 MGD of combined surface and diversion water for aquifer recharge during above base flow conditions. A total of 42, 53, or 70 diversion wells (the same number of wells as for the corresponding 100 MGD options) would be needed, respectively.

Reason for Elimination

Engineering and hydrology studies along, with a demonstration project (Burns and McDonnell 1994), have shown that 100 MGD is enough to supply the City's water needs and protect the Equus Beds Aquifer through 2050. Additional costs of facilities, infrastructure, and the operation and maintenance associated with the 150 MGD ASR system would not be necessary. Constructing extra wells and associated infrastructure also would force the City to purchase more property, negotiate for easements, and cause further impacts to the environment.

The ILWSP without the ASR

Description

Reclamation planning studies for water projects include what is called the *Future without the Project Condition*, the most reasonable prediction of what would happen in the area if no Reclamation action were taken. While this is not a planning report, it was felt important to consider in this EIS an alternative to this effect.

This alternative would result in implementation of the ILWSP without the ASR component. The City would rely solely upon surface water and withdrawals from the aquifer from its current well fields. No surface water would be injected into Equus Beds for storage and protection of water quality. Groundwater levels would continue to fall. Since groundwater rights are greatly over-allocated in the Equus Beds region (J. Blain, Personal Communication, March 24, 2008), the City would have to increase its dependence on non-firm surface water supplies in Cheney Reservoir and the Little Arkansas River. If the City wanted to increase its share of groundwater, it would be required to compete with agriculture for additional water rights.

Reason for Elimination

The City developed the ILWSP to circumvent predicted water shortages and protect its water supply. Implementation of the ILWSP without ASR would not provide additional protection to the Equus Beds by inhibiting saltwater intrusion from the Arkansas River and past oil field and salt mining activities. Water levels in the aquifer would not return to more natural levels and groundwater contributions to base flows in both the Little Arkansas and Arkansas rivers would not be restored. This alternative would not meet the purpose, need, and evaluation criteria for either the Equus Beds water quantity or quality problem.

Conservation Only

Description

This alternative would depend solely on water conservation to meet the project purpose and need. The City has employed an extensive conservation plan since 1991: inverted rate structure; main replacement; automated pumps; meter maintenance; leak detection; low-flow showerheads and faucets; low-flush toilets; lawn-watering restrictions; continuing to encourage industries to reduce water losses to cooling, processing, and irrigation; and, continuing to operate the City's water system to minimize water losses from over pumping and from the treatment facilities.

The conservation program as described will help meet the City's average day water demands until 2016 (Burns and McDonnell 2003).

Reason for Elimination

Even with its stringent water conservation program, the City would be unable to supply the 2050 estimated shortages in average-day demand. In addition, this alternative would not protect the Equus Beds from saltwater intrusion from the Arkansas River and past oil field and salt mining activities. Aquifer water levels would not return to near historic-levels, so groundwater contributions to base flows in both the Arkansas and Little Arkansas rivers would not be restored.

Summary of Impacts

Table 2-2 summarizes impacts of the Preferred Alternative and the No Action Alternative. Since the only difference between the Preferred and No Action alternatives would be a partial source of funding, the only differences resulting would be in socioeconomics, environmental justice, and cumulative impacts.

Table 2-2 Summary of Impacts

	Preferred Alternative (ASR with Federal Funding)	**No Action Alternative** (ASR without Federal Funding)
Geology	Construction would remove topsoil, causing temporary change in surface geology.	Same effects as for the Preferred Alternative.
Soils	Construction of facilities would cause localized, temporary disturbance of 1,700 acres, permanent disturbance of 266 acres.	Same effects as for the Preferred Alternative.
Land Use	Construction would disturb about 65 acres of prime farmland permanently, also with some temporary disturbance.	Same effects as for the Preferred Alternative.
Surface Water Resources	Midpoint flows in the Little Arkansas would increase slightly, as would base flows; significant flow reductions would occur at the confluence with the Arkansas; flow changes in the Arkansas, the Ninnescah system, and in Cheney Reservoir would be minor; discharges from Cheney would increase slightly.	Same effects as for the Preferred Alternative.
Surface Water Levels	Base flows would increase water levels slightly in the Little Arkansas and Arkansas rivers; total flows would decrease water elevations slightly in both	Same effects as for the Preferred Alternative.

Table 2-2 Summary of Impacts		
	Preferred Alternative (ASR with Federal Funding)	**No Action Alternative** (ASR without Federal Funding)
	streams; water levels in Cheney Reservoir and the Ninnescah River system would rise slightly.	
Surface Water Quality	Water quality in the Little Arkansas River would improve slightly; changes in the Arkansas, Ninnescah system, and Cheney Reservoir would be insignificant.	Same effects as for the Preferred Alternative.
Surface Water Rights	Surface water rights would not be affected.	Same effects as for the Preferred Alternative.
Groundwater Levels	Groundwater levels would rise.	Same effects as for the Preferred Alternative.
Groundwater Quality	Rising groundwater levels would help protect the Equus Beds Aquifer against saltwater intrusion from the Arkansas River, oilfield brine, and salt mining.	Same effects as for the Preferred Alternative.
Groundwater Rights	Increasing groundwater storage and quality would help protect groundwater rights	Same effects as for the Preferred Alternative.
Air Quality	Construction would cause	Same effects as for the

Table 2-2 Summary of Impacts

	Preferred Alternative (ASR with Federal Funding)	**No Action Alternative** (ASR without Federal Funding)
	localized, short-term impacts; minor, long-term impacts from continuing transportation and equipment operation.	Preferred Alternative.
Noise	Construction could cause wildlife and livestock to temporarily leave affected areas; increased construction traffic on local roads could temporarily affect residents.	Same effects as for the Preferred Alternative.
Esthetics	Project facilities would permanently affect local rural, agricultural landscape; construction would temporarily affect the area.	Same effects as for the Preferred Alternative.
Climate change	Carbon-based fuels would be expended during construction and operation of the system; storage of surface water underground would provide protection from climate change.	Same effects as for the Preferred Alternative.
Biological Resources	Construction on already-disturbed lands would cause some wildlife species to temporarily leave the affected area, but there would be little further	Same effects as for the Preferred Alternative.

Table 2-2 Summary of Impacts

	Preferred Alternative (ASR with Federal Funding)	**No Action Alternative** (ASR without Federal Funding)
	fragmentation of habitat; should bald eagle nesting be discovered in the project area, all work in the vicinity would cease until after fledging; construction would be routed around wetlands where possible, with wetlands repaired or replaced where impacts were unavoidable.	
Socioeconomics	Federal funding would represent a positive impact on residents of the project area and would result in an overall, positive regional economic benefit.	Implementation of the project without Federal funding would represent a negative impact on residents of the project area and would result in an overall, negative regional economic benefit.
Environmental Justice	Federal funding would help mitigate impacts of increased water bills to low income or minority households; resulting household water bills would be held near or below the EPA recommended payment threshold of 2.5% of total income.	Implementation without Federal funding would cause the entire cost of the cost to be borne by water rate payers; water bills in low income or minority households would exceed the EPA recommended payment threshold of 2.5%.
Cultural Resources	Site protection and mitigation (including consultation with the SHPO) would be required before any site disturbance,	Same effects as for the Preferred Alternative.

Table 2-2 Summary of Impacts		
	Preferred Alternative (ASR with Federal Funding)	**No Action Alternative** (ASR without Federal Funding)
	should any be discovered.	
Cumulative Impacts	Impacts of ASR—combined with those of the remainder of the ILWSP—would result in significant flow reductions at the confluence of the Little Arkansas with the Arkansas River; however, net positive benefits to both surface and groundwater supplies would result; no further loss to wildlife habitat would be expected.	Impacts of ASR, and those of the remainder of the ILWSP, would result in significant flow reductions at the confluence of the Little Arkansas and the Arkansas; however, net positive benefits to both surface and groundwater supplies would result; no further loss to wildlife habitat would be expected; this alternative would result in negative economic impacts to low income or minority households.
Unavoidable Environmental Impacts	About 1,700 acres of land would be temporarily disturbed; about 266 acres would be permanently disturbed, including about 65 acres of prime farmland; localized soil erosion would occur during construction; sedimentation and turbidity in the Little Arkansas River could increase slightly during construction; air quality could decrease slightly during construction; noise levels could increase slightly during and after construction; vehicular access to local residences	About 1,700 acres of land would be temporarily disturbed; about 266 acres would be permanently disturbed, including about 65 acres of prime farmland; localized soil erosion would occur during construction; sedimentation and turbidity in the Little Arkansas River could increase slightly during construction; air quality could decrease slightly during construction; noise levels could increase slightly during and after construction; vehicular access to local residences

Table 2-2 Summary of Impacts		
	Preferred Alternative (ASR with Federal Funding)	**No Action Alternative** (ASR without Federal Funding)
	could temporarily be disrupted; some esthetic impacts would occur; some economic impacts to low income and minority households would occur.	could temporarily be disrupted; some esthetic impacts would occur; significant economic impacts to low income and minority households would occur.
Irreversible and Irretrievable Commitment of Resources	Construction would result in a permanent funding commitment; energy, labor and materials expended would not be available for other uses; Federal funding would be discontinued on completion of the project, resulting in assumption of all O&M costs by the City.	The City would be responsible for the commitment of all resources for construction and operation of ASR; energy, labor and materials expended would not be available for other uses.
Short and Long Term Impacts	Construction would cause short-term impacts to land, water and other resources; system operation would cause long-term impacts; insertion of Federal dollars would result in net positive effects on the local economy and help minimize economic impacts to low income and minority households	Construction would cause short-term impacts to land, water and other resources; system operation would cause long-term impacts; both short and long-term financial hardship could result on low income and minority households

Chapter 3: Affected Environment

Introduction

The geographic area impacted by the Preferred and No Action Alternatives would fall within four Kansas counties – Sedgwick, Harvey, Reno and Kingman. Impacts to Sedgwick and Harvey County would be primarily due to construction and economic impacts to water customers. Smaller impacts would result from changes to the Bentley Reserve and Equus Beds well fields, which are not part of ASR. Potential economic impacts could extend into Reno and Kingman counties, along with possible project-related changes in water use and storage in Cheney Reservoir.

The Equus Beds Aquifer lies beneath parts of Sedgwick, Harvey, Butler, McPherson, Marion and Rice counties. Potential impacts to counties other than Sedgwick and Harvey would be primarily economic or indirect in nature. Construction of the part of the project analyzed in this EIS would be limited to northern Sedgwick and southern Harvey counties.

Setting

The project area includes the City of Wichita and surrounding metropolitan and rural areas in south-central Kansas. The Little Arkansas and Arkansas rivers enter the City from the north and northwest, respectively, joining in downtown Wichita. Cheney Reservoir lies on the North Fork of the Ninnescah River, approximately 24 miles west of the City, while the main stem of the Ninnescah flows to within 15 miles of the City to the southwest. It empties into the Arkansas River approximately 30 miles south of Wichita.

Agriculture and urban development have replaced most of the historic, native mixed-grass prairie. Most local land is used for agriculture, including crop, hay, pasture, and livestock production. Wichita is the largest and most populous metropolitan area in Kansas, with an estimated population of 344,000 (U.S. Bureau of the Census 2003. The Lower Arkansas River basin covers 11,500 square miles in 20 counties and has the second largest population (641,000) of any of the 12 major river basins in Kansas (Kansas Water Office 2008a). That population is expected to swell to 813,000 by 2040.

Local reservoirs, rivers, streams, and nearby areas are used for recreation, including water skiing, hiking, nature watching and other outdoor activities.

Topography

The local topography varies from extremely flat along major rivers and in lowland areas to gently rolling in upland areas. Most of the project area drains to the Arkansas River and its tributaries, including the Little Arkansas, Ninnescah and North Fork of the Ninnescah. Surface elevations range from approximately 1,200 feet above mean sea level (msl) along the river to 1,600 feet above msl in uplands.

Climate

Kansas winters are generally cold, with the most extreme conditions generally occurring December through February. Spring and fall seasons are short and transitional, while summers are hot, humid, and last for approximately six months. The average annual temperature in Wichita is 68.1 degrees Fahrenheit, but both daily and seasonal temperature variations can be severe. Extreme lows and highs range from -10 degrees to 108 degrees Fahrenheit. Severe weather, including extended periods of drought, tornadoes and thunderstorms, are not unusual, especially during spring and summer. Wichita's average annual precipitation is 29.33 inches (Slater and Hall 1996).

Geology

Local physiographic[1] regions include the Flint Hills, High Plains, Arkansas River Lowlands and the Wellington-McPherson Lowlands.

Limestone and shale underlie the Flint Hills, which contain numerous bands of chert and flint deposited in shallow seas 245 to 286 million years ago (KGS 1999).

Streams carried eroded material from the Rocky Mountains to form the High Plains region during the period ranging from approximately 1.6 to 66 million years ago. A mass of eroded sand and rock underlying the plains is known as the Ogallala Formation (KGS 1999). The portion of the formation within the project area is composed primarily of unconsolidated material.

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[1] Landforms are classified according to both their geologic structure and history (physiography.) Different structures and histories result in readily observable, distinct forms

The Arkansas River and Wellington-McPherson lowlands are characteristically similar to the High Plains. They consist of relatively flat plains comprised of alluvial sand, silt, and gravel deposited by streams and rivers. The Arkansas River Lowland was formed approximately 10 million years ago. The Wellington-McPherson Lowland was recently formed, between 1 and 2 million years ago. The Wellington-McPherson alluvium overlies the Hutchinson salt bed, one of the largest salt beds in the world (KGS 1999). The Equus Beds Aquifer is contained within unconsolidated alluvial materials and provides water for Wichita and surrounding communities. It is comprised of saturated sand, silt and gravel deposited during the Pliocene and Pleistocene Ages.

Soils

The USDA, Natural Resources Conservation Service (1999) defines soil as, "a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface and occupies space." Soils are characterized by layers. Layers are distinguishable from each other as a result of additions, losses, transfers, and transformations of energy and matter, or the ability to support rooted plants. A soil association is a group of soils geographically associated in a characteristic repeating pattern, generally consisting of one or more major soils and at least one minor soil. Each soil association has unique soil type(s), relief and drainage (Burns & McDonnell 2003).

Soil associations found in the project area are described below. No construction would be planned outside Sedgwick and Harvey counties.

Sedgwick County

Approximately 82% of Sedgwick County is considered prime farmland comprised of four different soil associations (SCS 1979). Bottomlands adjacent to the Little Arkansas River and North Fork of the Ninnescah River are deep, nearly level and well drained. They consist of the alluvial Elandco-Canadian-Elandco association with a sandy subsurface (Burns & McDonnell 2003). These soils are used primarily for growing cultivated crops.

Shallow to deep, nearly level, moderately-poorly to excessively well-drained soils along the Arkansas River are of the Lesho-Lincoln-Canadian association. They also have a sandy subsurface and are used primarily for crop cultivation.

The Naron-Farnum-Carwile association covers approximately 9% of the county and is also primarily used for plant cultivation. These alluvial soils consist of deep, nearly level, poorly to well-drained soils with a loamy subsurface.

The Goessel-Tabler-Farnum soil association is found south of the town of Sedgwick and covers approximately another 9% of the county. They are deep, nearly level, gently sloping and moderately to well-drained alluvial soils with a clay- to loam-like subsoil. They are also primarily used for crop cultivation.

Harvey County

There are five soil associations found within Harvey County (SCS 1974), where approximately 72% of the land area is described as prime farmland.

The Farnum-Slickspots-Naron association is found in the southwestern part of the county. It consists of deep, nearly level to gently sloping, poorly to well-drained loams and fine sandy loams. These soils are used primarily to grow wheat and sorghum.

About 6% of the county lies within the Little Arkansas River floodplain. It consists of a mixture of deep, nearly level, well-drained silt and silty clay loams known as the Detroit-Hobbs association. The floodplain is used primarily for cultivation of wheat and sorghum.

Deep, nearly level to gently sloping, moderately well- to well-drained silt and silty clay loams form the Crete-Ladysmith association are found west of the Little Arkansas River. This association is found primarily along broad ridges and side slopes. It supports small native grass communities bordering large, cultivated areas.

The Carwile-Pratt association consists of deep, nearly level, poorly-drained, fine sandy loams and deep, well-drained, loamy fine sands. These soils are found on uplands in the western portion of the county. They are used primarily for crop cultivation but also support small areas of native grasses.

The Farnum-Hobbs-Geary association contains deep, nearly level to gently sloping soils. They are well-drained loams and silty loams found on both uplands and floodplains. The association is found primarily along streams in the eastern parts of the county. These soils are also primarily used for crop cultivation.

Reno County

Approximately 67% of the land in Reno County is classified as prime farmland. Most of Cheney Reservoir also lies in this county. Two soil associations are found along the reservoir – the Farnum-Shellabarger and Renfrow-Vernon associations (SCS 1966).

The Farnum-Shellabarger association consists of deep, brown, loamy soils which often overlie sandy/gravelly material on sloping, dissected plains. This association occupies a large area along the southern county boundary and is used primarily for crop cultivation.

Renfrow-Vernon soils consist of both deep and shallow, reddish soils over clayey white shale. The association is found primarily in the southeastern part of the county and consists of about 85% Renfrow -Vernon and 15% minor soils. The primary use is crop cultivation.

Kingman County

A small part of Cheney Reservoir lies in the northeastern corner of Kingman County, within the Shellabarger-Milan-Renfrow association. These gently sloping soils are used primarily for crop cultivation, but some small patches of native grasses remain. There are seven major soil types found in the remainder of the county, intermingled with a wide variety of minor soil types.

Farnum-Shellabarger soils are deep, nearly level to sloping, well drained soils on uplands with loamy subsoil. Nearly all of them are used for crop cultivation.

Albion-Shellabarger soils are deep, nearly level to strongly sloping, upland soils. They have a loamy subsoil. Approximately half of this acreage is used for growing crops, while the remainder is used as rangeland.

Blanket-Clark-Farnum soils are also upland soils that vary in slope and are deep and well-drained, with clayey and loamy subsoil. Like most of the soils in the project vicinity, most of this acreage is used for crop cultivation.

Pratt-Carwile soils are somewhat poorly drained, are found in uplands and have a sandy, loamy and clayey subsoil. Wheat is the main crop grown on these soils, but sorghum and alfalfa are also produced. Large areas in the southern part of the county are used as rangeland.

Quinlan-Nashville soils range from shallow to moderately deep and are found in gently to strongly sloping areas. They are well drained and lie above loamy subsoil. Crops are cultivated in approximately half of this area and the remainder is used primarily as rangeland.

Renfrow-Owens soils are found on uplands and range from shallow to deep. They are well drained with predominantly clayey subsoil. Nearly all this acreage is used for crop cultivation.

Waldeck-Dillwyn-Plevna soils are deep, nearly level, somewhat poorly to poorly drained, with loamy and sandy subsoil. They are found in floodplains and along low terraces near streams. Most of these areas are used for rangeland, as they generally have poor potential for crop cultivation.

Land Use

Irrigation accounted for approximately 71% of all water pumped or diverted within the 11,500 square mile Lower Arkansas River basin during 1997 (KWO 2008). About 92% of that water came from groundwater sources, including the Equus Beds. The combined land area of Sedgwick, Harvey and Reno counties, where project construction and other localized impacts would occur, covers approximately 1.8 million acres. About 1.28 million acres are used for crop cultivation. The primary crops are wheat and corn, but sorghum and alfalfa are also common. Approximately 375,000 acres are used for pasture and livestock production. Important industries in the metropolitan and project areas include crude oil production, petroleum refining, military and private aircraft manufacturing, chemical manufacturing, milling, and grain storage.

The corner of Kingman County next to the project area includes part of Cheney Reservoir and associated Federal property. Cheney Reservoir covers approximately 9,600 surface acres and has about 67 miles of shoreline. Cheney State Park covers approximately 1,913 acres. Another 5,439 acres of land and 4,109 acres of water make up the Cheney Wildlife Management Area.

The Equus Beds Well Field occupies about 200 acres in northern Sedgwick and southern Harvey counties. Most of this area is made up of croplands, warm season pasture, and riparian woodlands. The Local Well Field consists of bank water reclamation wells and distribution lines alongside the Little Arkansas River. The field lies entirely inside the Wichita city limits.

Surface Water Resources

Principal streams in the project area include the Arkansas, Little Arkansas, Ninnescah, and the North Fork of the Ninnescah. Both the Little Arkansas and Ninnescah rivers are tributaries of the Arkansas River, which originates on the eastern slopes of the Rocky Mountains in central Colorado. The Arkansas is impacted by extensive irrigation diversions on its way to Wichita. It often runs dry upstream near Great Bend. Minimum recommended stream flows established for the Arkansas River at Kinsley and Great Bend are only 2 and 3 cfs, respectively (DWR 1-100.17, revised

11/29/94.) The river flows over a predominantly sandy bottom and has a drainage basin covering parts of Colorado, New Mexico, Kansas, Oklahoma, Texas, and Arkansas.

The Little Arkansas River flows through five Kansas counties over a generally clayey bottom. Sand replaces much of the clay before its confluence with the Arkansas in Wichita. There are no large reservoirs on the Little Arkansas, but flows are heavily influenced by irrigation diversions and groundwater withdrawals. Some floodwaters are diverted into the Little Arkansas and Chisholm Creek floodways near Valley Center and Wichita. These flows are discharged to the Arkansas River downstream.

The North Fork of the Ninnescah River flows over a predominantly sandy bottom through five Kansas counties. It joins with the Ninnescah River in Sedgwick County south of Wichita. The North Fork was dammed in 1964 approximately 15 miles upstream from its confluence with the Ninnescah to form Cheney Reservoir. The reservoir is used for water supply by the City and for fish and wildlife conservation, flood control, and recreation. Reclamation computed a "preliminary" firm yield of 52,600 acre feet per year for the reservoir in 1959. That figure was revised in 1960 to 42,900 acre feet. During a year with average precipitation and with the ILWSP in place, the City could operate the reservoir by withdrawing a maximum of 47 MGD (52,600 acre feet per year.) However, if this amount were pumped during a critical period, the reservoir would theoretically run out of water.

Surface Water Quantity

U.S. Geological Survey (USGS) stream flow records from 1922-1966 were used to create a Cheney Reservoir operations model. Stream discharges to the reservoir within the project area come primarily from direct runoff due to precipitation. This results in a highly variable discharge rate, which can change dramatically from day to day, season to season, and year to year. Low flow statistics provide a good indication of *base flow* conditions (groundwater discharge to the stream.) Overall minimum, mean, maximum, 7-day average low flow, and 2, 10, and 100 year flood flow data are provided in Table 3-1.

Table 3-1 Discharges of the Arkansas, Little Arkansas and North Fork of the Ninnecah

Statistic		Mean Daily Discharge (cfs) Arkansas River @ Wichita	Little Arkansas River @ Valley Center	North Fork Ninnescah @ Cheney Dam
Overall Minimum		5	1	0
Overall Maximum		41,100	28,600	47,900
Mean (Average)		986	305	159
Percent of Time Discharge (cfs) Equaled or Exceeded	90%	101	20[b]	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

[a] Statistics based on estimated mean daily discharges, as derived from stream flow records for water years 1923-1996. Flood discharges estimated from analysis of recorded annual instantaneous peak discharges.
[b] Recommended minimum stream flow established in accordance with K.S.A. 82a-703, DWR-1-100.7 (revised 11/29/94).

Use of surface water for M&I supply increased 24% between 1990 and 2000 in northeastern and south-central Kansas. Part of this increase was due to the City's decreasing dependence on the Equus Beds aquifer and increasing dependence on surface water from Cheney Reservoir. As a result, groundwater use from the Equus Beds decreased by 21%. Other municipal water supplies in the Lower Arkansas River Basin continued to come primarily from groundwater sources. Only the Kansas-Lower Republican, Solomon, and Upper Arkansas River Basins used significant amounts of surface water for irrigation (Kenny and Hansen 2004). The state reserves 30 cfs between Halstead and Sedgwick in the Little Arkansas River during spring (high irrigation) months for use by farmers.

Minimum desirable stream flows (MDS) are established by the Kansas Department of Health and Environment (KDHE) for various locations within the Arkansas River basin. These recommendations are listed in Table 3-2. Median monthly flows for the Little Arkansas and Arkansas rivers are found in Table 3-3.[2] Flows in the Arkansas River in Wichita are, on average, roughly three times those in the Little Arkansas, which in turn has about two times the flow of the North Fork of the Ninnescah River.

Table 3-2 Minimum Desirable Stream Flows (cfs) – Little Arkansas River

	Alta Mills	Halstead	Sedgwick	Valley Center
April – September	5[a]	57[b]	20[b]	20[b]
October – March	5[a]	20[b]	20[b]	20[b]

[a] Recommended minimum desirable stream flows (MDS) established in accordance with K.S.A. 82a-703, DWR-1-100.7 (revised 11/29/94)
[b] As required in permit to appropriate water, City of Wichita, File No. 46,578, issued by the Kansas Department of Agriculture, Division of Water Resources, Feb. 23, 2007
[c] The Kansas Department of Wildlife and Parks prefers higher flows during spawning seasons, which typically run from April through June, though specific numeric criteria have not been established (pers. comm., Eric Johnson, KDWP, 5/19/2008)

[2] The median flow in a series of measured flows is the flow measurement where 1/2 the flows are greater and 1/2 the flows are less. This differs from the average flow, which is calculated by dividing the sum of the measurements by the number of measurements

Table 3-3 Median Monthly Flows (cfs)[a]					
Month	Little Arkansas River		Arkansas River		
	Alta Mills	Valley Center	Hutchinson	Wichita	Arkansas City
January	23.3	53.8	124.9	249.9	571.1
February	26.0	61.1	169.4	327.1	645.5
March	31.0	70.4	207.2	387.7	801.0
April	35.0	76.4	216.8	459.7	947.1
May	45.5	107.6	273.5	573.4	1,198.2
June	57.0	129.4	405.1	825.1	1,515.8
July	31.5	75.6	248.4	504.5	959.6
August	22.7	54.7	166.5	321.6	659.7
September	21.6	53.5	150.0	293.2	555.5
October	18.7	49.6	117.6	226.9	520.6
November	26.0	58.8	149.6	306.0	634.2
December	24.5	58.4	142.3	287.8	595.8

[a] Statistics based on flows derived from USGS streamflow records for water years 1923-1996

Surface Water Quality

KDHE includes 2 of the 14 segments of the Little Arkansas River on its list of stream segments with water quality limitations. The project construction area falls inside one of these water quality limited segments. Constituents of concern in the project area include dissolved oxygen, chloride, fluoride, sulfate, total ammonia, chlordane and fecal coliform bacteria (KDHE 2001). River water quality can vary significantly with time and location. A summary of USGS water quality data in, above and below the project area is found in Table 3-4.

Table 3-4 USGS Surface Water Quality Data Ranges (January 1998 – April 2008)				
Stations →	**Little Arkansas River**		**Arkansas River**	
Parameters ↓	07144100 Sedgwick (*project*)	07144200 Valley Center (*downstream*)	07143330 Hutchinson (*upstream*)	07144550 Derby (*downstream*)
Conductance (µmhos/cm^3)	54 – 1480	159 – 1,440	515 – 3751	152 – 4,430
Dissolved Oxygen (mg/l)	3.6 – 15.7 (43 – 127%)[a]	7.5 – 13.9 (89 – 151%)[a]	7.3 – 8.3	8.6 – 13.0 (97 – 118%)[a]
pH (std. units)	6.0 – 8.7	7.0 – 8.5	7.3 – 8.3	7.1 – 8.8
Hardness (mg/l)	16 – 380	130 – 320	*	270[b]
Calcium (mg/l)	4.7-160	38.6 – 101	*	73.9[b]
Magnesium (mg/l)	1 – 23	7.5 – 16.5	*	20.5[b]
Sodium (mg/l)	5.7 – 126	28.0 – 80.4	*	178[b]
Potassium (mg/l)	4.6 – 9.8	5.5 – 7.5	*	7.6[b]
Chloride (mg/l)	<5 – 305	29 – 87	*	236[b, d]
Sulfate (mg/l)	<5 – 80	28 – 67	*	131[b]
E. coli (colonies)	4 – 46,000	13 – 2,600	*	508[b]
Suspended Solids (mg/l)	4 – 1970	9 – 48	*	*
Atrazine (µg/l)	0.07 – 41[c]	*	*	*

[a] ( ) = percent saturation
[b] Only once sample analyzed
[c] Numeric aquatic life criteria for Atrazine in surface water are 170 (acute) & 3 (chronic) µg/ml
[d] EPA recommended secondary drinking water standard for chlorides is 250 mg/l
* Data not collected at this site

The discovery of pharmaceutical and antibiotic contaminants in surface and groundwater around the country has recently attracted scientific and public attention. The cities of McPherson and Newton discharge wastewater into the Little Arkansas River upstream from the proposed project site. Such discharges could potentially result in contamination. The USGS analyzed one water sample from the Little Arkansas River for a broad range of pharmaceuticals in 2003. A low level of caffeine was the only contaminant detected. Other pharmaceutical contaminants, if any, were present at non-detectable levels. Three samples (each) were collected from two Little Arkansas River sites (Sedgwick and Halstead) during 2008 and analyzed for a broad spectrum of antibiotics. None were detected. In addition, no antibiotics were discovered in samples collected from 10 Equus Beds index wells during 2008 (personal communication, A. Ziegler to C. Webster 9/24/08).

Salinity levels are periodically elevated in the Arkansas River. Otherwise, water in the main stem of the Arkansas tends to be moderately hard and acceptable for treatment. Chloride concentrations (representing salinity) can range up to 1,700 mg/l. EPA secondary drinking water standards recommend limiting chloride concentrations to 250 mg/l. Several natural and man-made salinity sources contribute to elevated chloride levels in the Arkansas River basin. These include historic oil field operations, salt mine operations, and naturally occurring buried salts.

Chloride concentrations in the Little Arkansas and North Fork of the Ninnescah rivers are much lower. These higher quality waters discharge to the salty Arkansas River and improve overall surface water quality.

Figure 3-1 ***Cyanobacteria bloom in Cheney Reservoir, 2003 (USGS Photo)***

Cyanobacteria contamination occasionally causes severe taste-and-odor episodes in Cheney Reservoir. The genus, *Anabaena*, is the likely cause (USGS 2008c). Odor and taste problems occur when the bacteria produce the compound geosmin. The USGS monitors environmental variables, such as light, temperature, conductivity, and turbidity to predict cyanobacteria blooms. The City plans to use this data to aid in the management of the reservoir.

Atrazine (herbicide) is applied to local crops during the spring and fall to kill weeds. These applications typically coincide with intense rainfall. Atrazine concentrations in the Little Arkansas often exceed the Kansas chronic aquatic life criterion (3 mg/l) between March and July (Table 3-4). Runoff to the Little Arkansas that is used for Equus Beds recharge may have to be treated to remove atrazine during these months.

Groundwater Resources

The *Kansas Water Plan* (KWO 2008) lists "protecting and enhancing instream flows and stabilizing ground water depletion" as priority issues in the Little Arkansas River Basin. Groundwater is an important source of municipal, industrial, irrigation, domestic, and livestock water. The major water bearing formations in the project area include the Wellington Formation, Ninnescah Shale, Ogallala Formation, Lower Pleistocene Deposits, Illinoisan Terrace Deposits, Wisconsinan Terrace Deposits and Recent Alluvium, and the Equus Beds. The Equus Beds aquifer comprises the eastern-most part of the High Plains Aquifer in Kansas. It underlies approximately 900,000 acres of land in Sedgwick, Harvey, Marion, McPherson, Rice, and Reno counties. It is comprised of sections of the Ogallala Formation, Lower Pleistocene deposits, Illinoisan, and Wisconsinan terrace deposits.

Groundwater Levels

There was little groundwater use in the project area before 1940. The Equus Beds were accessible from shallow, hand-dug wells. The City started developing the aquifer as a water source during the 1940s. Large agricultural tracts were then converted from dry farming to irrigated farmland. Annual water use increased until withdrawals from the aquifer exceeded natural recharge most years. Despite the fact that there tend to be fewer withdrawals and more recharges during wet years, overall declines in groundwater levels since 1940 have exceeded 50 feet in some areas. Figure 3-1 shows water level changes in the Equus Beds recorded between August 1940 and January 2008. As groundwater levels fell, infiltration of salty water from the Arkansas River increased. Contributions of high quality groundwater to the Little Arkansas River decreased at about the same rate. Arkansas River water infiltrated into the aquifer at a rate of less than eight cubic feet per minute (cfm) before 1940. The Equus Beds and river were nearly in equilibrium or at nearly the same elevation (zero-storage deficit) at that time (Myers *et al.* 1996.) The Little

Arkansas River benefited from about 38 cfs recharge from the aquifer during this period of equilibrium.

The current storage deficit in the aquifer is estimated at 200,000 acre-feet. This results in about 26 cfs infiltration (an increase of 18 cfs or 225%) to the aquifer from the Arkansas River, while groundwater recharge to the Little Arkansas River has declined to about 14 cfs (a decrease of approximately 24 cfs or 63%.)

Groundwater Quality

Groundwater quality varies considerably, depending on which geologic formation the water comes from. Water also tends to become more mineralized with depth (Burns & McDonnell 2003). Total dissolved solids (TDS) contents range from about 300 mg/l to 2,700 mg/l in the aquifer. TDS levels below 500 mg/l are usually considered suitable for domestic use, while levels above 1,000 mg/l generally give water an objectionable taste or odor. Although some salt contamination is naturally occurring, fresh water withdrawals may be altering the flow patterns of natural salt. Groundwater development north of the Arkansas River has lowered the water table. Meanwhile, saline water intruding from the river and other sources maintains its natural head. This leads to the potential for saltwater intrusion into the aquifer (Young *et al.* 2001.)

The only physical-chemical properties with regulatory criteria are TDS, pH and laboratory turbidity. During a baseline groundwater quality study of the Equus Beds from 1995-98 (Ziegler 1999), pH ranged from 4.4 to 8.6 standard units. Values below 7.0 are considered acidic, while pH values above 7.0 are considered basic. Some sample values fell outside EPA's (2004) Secondary Drinking Water Standard range for pH of 6.5 (slightly acidic) to 8.5 (slightly basic.)

Increasing salinity is one of the prime water quality issues in the heavily used aquifer. Chlorides from natural and man-made sources have degraded water quality in some areas. The saltier the water, the more difficult and expensive it is to treat to drinking water standards. Naturally occurring salt sources include a variety of deeper geologic formations. Man-made sources include brines from oil fields (primarily the Burrton Oil Field to the northwest) and salt-refining operations (primarily near Hutchinson to the west.) The highest groundwater chloride concentrations occur near the city of Burrton in Harvey County, but the plume in this vicinity is migrating southeast, down the groundwater gradient. Continued expansion of the plume would move saltier water into the project area.

Groundwater chloride levels are also generally higher near the Arkansas River, where salty river water migrates into the aquifer.

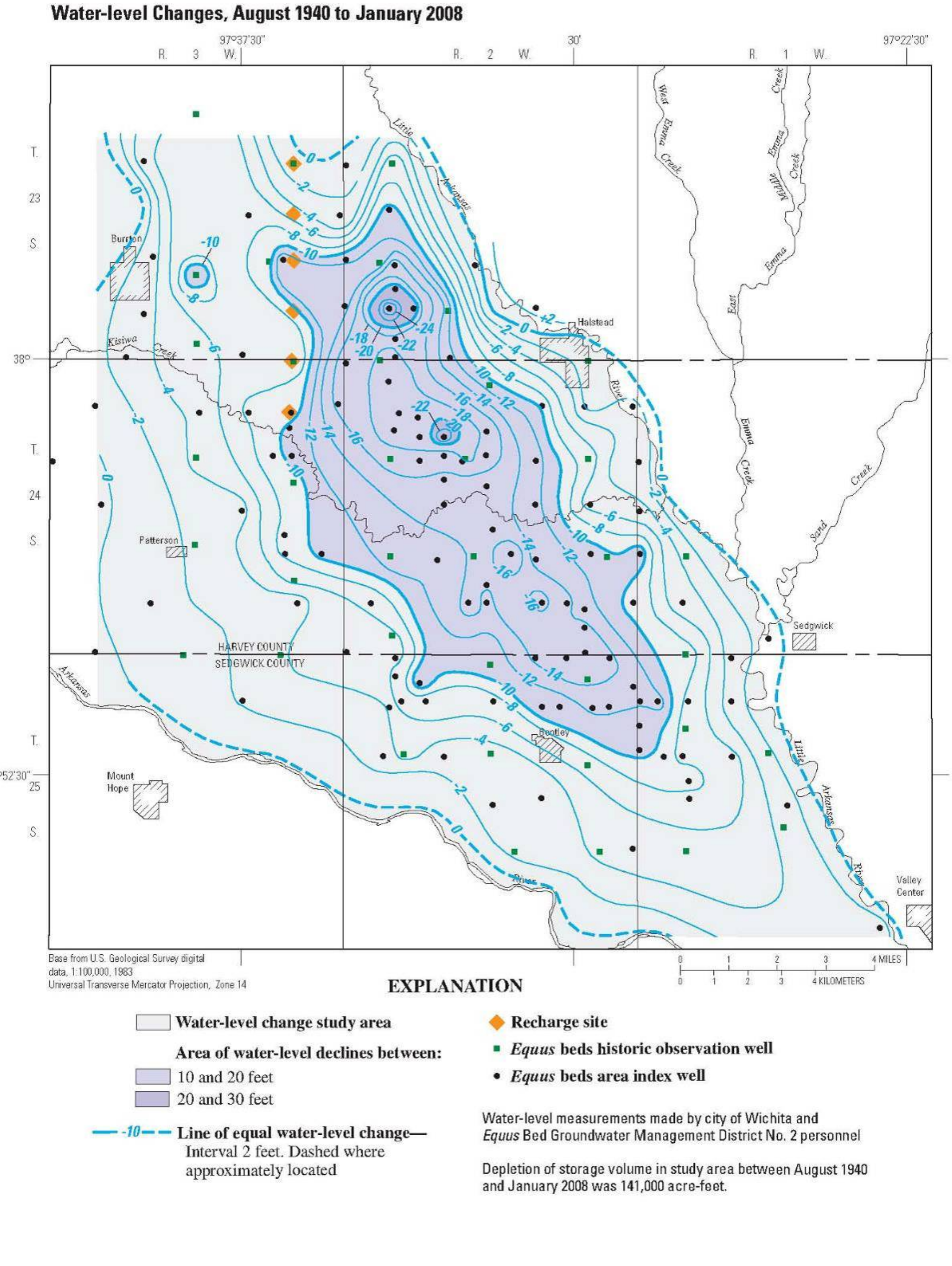

Figure 3-2 Equus Beds Water Storage (Figure courtesy of USGS)

Groundwater Rights

Area groundwater rights are significantly over-allocated. Before 1991, estimated safe groundwater yield from the Equus Beds was 50,240 acre-feet per year, based on recharge estimates of six inches per year. The City's water rights for the Equus Beds Well Field allow the use of 78 MGD (40,000 acre-feet per year.) The USGS subsequently reduced estimated recharge rates by nearly 47% (Hansen 1991) to 3.2 inches per year. The more recent estimate supports an actual annual safe yield of 29,900 acre-feet. Overall, the City has water rights for approximately 99,300 acre-feet per year from combined sources (Equus Beds Well Field, Local Well Field [pulling bank storage water from along the Little Arkansas River] and Cheney Reservoir.) These water rights should be sufficient for the City to meet water demand through 2016. However, over-allocation of water rights highlights threats to the aquifer that cannot be ignored.

Groundwater Management District No. 2 (GMD2) was created by the Kansas Legislature in 1974 to manage the aquifer's falling water table. This resulted in the closure of most areas in the City's well field to development of additional water rights. Despite GMD2 efforts to reverse water rights allocation trends, approximately 120,000 acre-feet per year of water rights had been allocated in the 175 square mile Equus Beds area by 2003.

Air Quality

Air pollution in the agricultural part of the project area consists primarily of dust from unpaved roads and farming activities. There are some emissions from agricultural vehicles and road traffic. Smoke from grassfires or stubble burning occasionally contributes, as does wind-blown dust, but these sources are temporary.

Urban air pollution comes from numerous sources, including motor vehicle traffic, industry, dry cleaners, paint shops, residential fireplaces, and print shops. Natural sources contribute as well (wildfires, wind blown dust, etc.) Prevailing southwest winds generally dilute urban air pollutants in the project area, helping to reduce emission concentrations. The Wichita/Sedgwick County metropolitan area has been designated as "In Attainment" for air toxins and criteria pollutants since 1989 (Wichita Environmental 2008).

Noise

Noise conditions vary from rural to suburban to urban areas. Background noise levels generally increase with increasing population density, activity, and development. The Equus Beds Well Field is located in rural Sedgwick and Harvey counties. The Bentley Reserve Field is located in rural Sedgwick County. The Local Well Field is located alongside the Little Arkansas River inside the Wichita City Limits. Cheney Reservoir is located in rural Reno and Kingman counties. Except for the Local Well Field, the project area lies primarily in rural areas where typical daytime and nighttime sound levels are 35 and 25 decibels (dB/A)[3], respectively (Burns & McDonnell 2003).

Esthetics

The landscape of south-central Kansas outside of the Wichita metropolitan area is composed primarily of nearly flat to rolling croplands and pastures along both uplands and lowlands. Lines or small groves of native trees k

Figure 3-3 Open landscape typical of rural south-central Kansas

known as "hedge rows" or "wind breaks" are fairly common but disappearing. Many hedge rows have been removed to increase the acreage available for crop cultivation. Past climatic conditions and agricultural practices have resulted in riparian zones along streams and

3 dB/A refers to the measurement of noise in "A-weighted" decibels." A-weighted measurements highlight frequencies from 3-6 kHz, to which the human ear is most sensitive

rivers that tend to be relatively narrow. This gives the region an open appearance. Much of the agricultural area is irrigated using center pivot systems and these systems, along with irrigation wells, scattered farm houses, barns, and related structures and equipment dot the landscape.

Biological Resources

Ecoregion

The proposed, extended project area of Harvey, Kingman, Marion, McPherson, Reno, Rice, and Sedgwick counties is located within two EPA Level III ecoregions; the Flint Hills and Central Great Plains (EPA 2008). The Great Bend Sand Prairie, Smoky Hills, and Wellington-McPherson Lowland are encompassed by the Central Great Plains Ecoregion. This ecoregion was once dominated by mixed-grass prairie with scattered low trees and shrubs, but has now been converted primarily to cropland and urban uses.

The Flint Hills is the largest intact tall-grass prairie remaining in the Great Plains. These hills mark the western edge of the tall-grass prairie, characterized by rolling hills composed of shale and cherty limestone, rocky soils, and by wet, humid summers. The rocky surface makes the area difficult to plow. As a result, much of the region remains open, preserving the grasslands while supporting very little cropland agriculture.

The Smoky Hills are an undulating to hilly loess plain with sandstone hills. The region is transitional, with a variable climate and natural vegetation ranging from tall-grass prairie in the east to mixed-grass prairie in the west. Land use consists primarily of cropland and grassland. Dry-land winter wheat is the principal crop.

The Great Bend Sand Prairie is characterized by undulating, rolling sand plains that include windblown dunes. This ecoregion supports native vegetation such as sand prairie bunchgrass. Center-pivot irrigation is more often used than in surrounding regions.

The Wellington-McPherson Lowland consists of flat, lowland topography, which separates it from the Great Bend Sand Prairie Ecoregion. Rich loess and river valley deposits support cropland agriculture comprised primarily of winter wheat and grain sorghum. The area is underlain by shale, gypsum, and salt from ancient Permian seas, and is known for the Hutchinson salt member and the alluvial Equus Beds Aquifer. The McPherson wetlands, located in McPherson County, comprise a small part of this area.

Woody encroachment has occurred in these regions due to poor management and the absence of fire. Oak, cedar, and other woody species are now common where huge expanses of nearly treeless prairie once existed.

Wildlife

Grassland birds, mammals, reptiles and amphibians were common in the area before European settlement. The species composition of the area has varied slightly, but the increasing variety of habitat allows for a greater diversity of species since settlement and urbanization. Common species are described below.

Mammals

Many mammal species are present in Reno, Harvey, Kingman, and Sedgwick counties. All of these species may exist in the project area.

Small mammals include the following species:

- deer mouse (*Peromyscus maniculatus*)
- black-tailed jack rabbit (*Lepus californicus*)
- eastern cottontail rabbit (*Sylvilagus floridanus*)
- blacktail prairie dog (*Cynomys ludovicianus*)
- thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*)
- eastern fox squirrel (*Sciurus niger*)
- marmot (*Marmota monax*)
- muskrat (*Ondatra zibethica*)
- mink (*Mustela vison*).

Larger mammals, often described as predatory, carnivorous, or omnivorous, also reside in the area, including the following species:

- badger (*Taxidea taxus*)
- striped skunk (*Mephitis mephitis*)
- red fox (*Vulpes vulpes*)
- coyote (*Canis latrans*)
- raccoon (*Procyon lotor*)
- opossum (*Didelphis virginiana*).
- beaver (*Castor canadensis*).

Bat species found in the area include the little brown bat (*Myotis lucifigus*), big brown bat (*Eptesicus fuscus*), and red bat (*Lasiurus borealis*).

The two hoofed species in the area are the white-tailed deer (*Odocoileus virgininanus*) and mule deer (*O. hermionus*). The once wide-roaming, American bison (*Bison bison*) has nearly been eliminated from the project area. It now exists only in the Maxwell State Game Preserve in McPherson County.

Birds

Kansas lies along the central flyway, a migratory route for many species of birds. The state is also home to several resident species. Species listed below have been know to, or could occur in the project area.

Shore birds and other waterfowl that exist in or migrate through the area include the:

- great blue heron (*Ardea herodias*)
- snowy egret (*Egretta thula*)
- cattle egret (*Bubulcus ibis*)
- killdeer (*Charadrius vociferous*)
- red-winged blackbird (*Agelaius phoeniceus*)
- mallard (*Anas platyrhynchos*)
- northern shoveler (*Anas clypeata*)
- blue-winged teal (*Anas discors*).

Many birds subsist in grassland habitats, and some also do well in grassland-forest land edge habitats. These include the following species:

- American goldfinch (*Carduelis tristis*)
- American kestrel (*Falco sparverius*)
- northern harrier (*Circus cyaneus*)
- bobwhite quail (*Colinus virginianus*)
- eastern bluebird (*Sialia sialis*)
- dickcissel (*Spiza americana*)
- red-tailed hawk (*Buteo jamaicensis*)
- mourning dove (*Zenaida macroura*)
- eastern kingbird (*Tyrannus tyrannus*)
- northern cardinal (*Cardinalis cardinalis*)
- American robin (*Turdus migratorius*)
- eastern and western meadowlarks (*Sturnella magna* and *S. neglecta*)
- field sparrow (*Spizella pusilla*)
- ring-necked pheasant (*Phasianus colchicus*)
- lark bunting (*Calamospiza melanocorys*)
- horned lark (*Eremophila alpestris*)
- greater prairie-chicken (*Tympanuchus cupido*).

Birds common in forests include a variety of owls, hawks, and thrushes that often hunt in the grasslands. The following species are also found:

- red-headed woodpecker (*Melanerpes erythrocephalus*)
- common flicker (*Colaptes auratus*)

- downy woodpecker (*Picoides pubescens*)
- red-eyed vireo (*Vireo olivaceus*)
- wild turkey (*Meleagris gallopavo*).

Reptiles and Amphibians

Several reptile species occur in or near the project area. These include:

- prairie racerunner (*Cnemidophorus sexlineatus*)
- garter snake (*Thamnophis sirtalis*)
- plains garter snake (*Thamnophis radis*)
- brown snake (*Storeria dekayi*)
- prairie kingsnake (*Lampropeltis calligaster*)
- milk snake (*Lampropeltis triangulum*)
- bull snake (*Pituophis melanoleucus*)
- ringneck snake (*Diadophus punctatus*)
- eastern yellowbelly racer (*Coluber constrictor*)
- northern water snake (*Nerodia sipedon*)
- prairie rattlesnake (*Crotalus viridis*)
- great plains skink (*Eumeces obsoletus*)
- snapping turtle (*Chelydra serpentine*)
- ornate box turtle (*Terrapene ornata*)
- western painted turtle (*Chrysemys picta*)
- spiny softshell turtle (*Apalone spinifera*)
- smooth softshell turtle (*Apalone mutica*).

Amphibians common in the area include:

- 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*)
- bullfrog (*Rana catesbeiana*).

Fish

An aquatic monitoring study was conducted as part of the Equus Beds Groundwater Recharge Demonstration Project, conducted from 1995 through 1997. This study established baseline fisheries data on the Arkansas and Little Arkansas rivers. Data was used to estimate biomass and abundance for fish species, and measure and record the habitat and food available to fish species.

Study results showed that aquatic communities in each river system are typical of sandy bottom streams in Kansas. The macroinvertebrate community is composed of various taxa suited for warm-water streams that have turbid water and shifting sand substrates. Most of the fish are forage species, such as:

- red shiners (*Cyprinella lutrensis*)
- sand shiners (*Notropis ludibundus*).

Game species, such as:

- channel catfish (*Ictalurus punctatus*)
- flathead catfish (*Pylodictis olivaris*)
- green sunfish (*Lepomis cyanellus*).

And rough fish species such as the common carp (*Cyprinus carpio*).

Other common species include:

- river carpsucker (*Carpoides carpio*)
- bluntnose minnow (*Pimephales notatus*)
- suckermouth minnow (*Phenacobius mirabilis*)
- mosquito fish (*Gambusia affinis*).

Fish species more common to the Little Arkansas River are:

- orange-spotted sunfish (*Lepomis humilis*)
- largemouth bass (*Micropterus salmoides*)
- white crappie (*Pomoxis annularis*)
- freshwater drum (*Aplodinotus grunniens*)
- slenderhead darter (*Percina phoxocephala*).

Fish collected less frequently on the Arkansas River system include:

- black buffalo (*Ictiobus niger*)
- emerald shiner (*Notropis atherinoides*)
- yellow bullhead (*Ameiurus natalis*)
- freckled madtom (*Noturus nocturnus*)
- speckled chub (*Extrarius aestivalis*)
- black bullhead (*Ameiurus melas*).

These lists are not all-inclusive and do not represent species missed during sampling.

Threatened, Endangered, or Candidate Species

Six Federally listed threatened or endangered species are identified by the U.S. Fish and Wildlife Service (FWS) for Reno, Kingman, Harvey, Rice, Marion, McPherson, and Sedgwick counties. These species are also considered threatened or endangered by the State of Kansas, as are 12 additional species. Each occurs or occurred in the past in the project area.

Because of their declining populations, any impacts or potential impacts to these species are of concern.

State-Listed

The following species are identified by the Kansas Department of Wildlife and Parks (KDWP) as either threatened or endangered.

American burying beetle (*Nicrophorus americanus*) The American burying beetle is a large beetle listed by the KDWP and FWS as endangered. It is not Federally-listed in any of the project counties.

This species exhibits wide habitat tolerance, though its natural habitat may be mature forests. Soil characteristics are important to the habitat suitability for American burying beetles, because they bury carrion. Extremely xeric[4], saturated, or loose and sandy soils are unsuitable for this practice.

Adults seek out and bury the carcasses of small animals such as mice and young birds. They then move them to suitable substrate, shave them, roll them into a ball, treat them with secretions, and bury them. The American burying beetles lay eggs next to these carcasses so that larvae may feed on the carcass. Adult American burying beetles may also catch and kill other insects.

Populations of American burying beetles are active from April through September. Adults are nocturnal, laying eggs most commonly in June and July. Larvae emerge in July and August (NatureServe 2007).

Arkansas River speckled chub (*Macrhybopsis tetranema*) The Arkansas River speckled chub is a minnow-like fish listed by the KDWP as endangered in the Arkansas River drainage. Critical habitat in the project area includes all of the Arkansas River in Kingman, Reno, Rice, and Sedgwick counties.

This 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. It avoids areas of calm water and silted stream bottoms. The breeding season runs from May to August when water temperatures exceed 70 degrees Fahrenheit. The diet of the Arkansas River speckled chub is not known, but probably consists of larval insects.

Bald eagle (*Haliaeetus leucocephalus*) The bald eagle occurs throughout North America and is listed as threatened by the KDWP. Bald eagle

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[4] Xeric refers to soils typical of dry or desert-like conditions, while saturated refers to soils that are soaked with moisture

populations in the US, except the population in the Sonoran Desert of Arizona, have recovered and are no longer Federally-listed. Eagles remain protected under the Bald Eagle Protection Act (1940) and Migratory Bird Treaty Act (1918).

Habitat requirements are related to the bald eagle's food staple – fish. Bald eagles tend to nest close to large bodies of water including lakes, rivers, reservoirs, and oceans. Nesting typically occurs in large trees or along rocky cliffs. Bald eagles often return to the same nesting area year after year, and will often re-use the same nest. Roosting areas are usually located near water but may be located elsewhere.

Bald eagles will migrate during winter in search of food sources.

Black-footed ferret (*Mustela nigripes*) The black-footed ferret is listed by both the FWS and Kansas as endangered. It is not designated as Federally-endangered in any of the project counties. This ferret is a small, weasel-like mammal, brownish colored above and whitish or yellowish below, with a dark mask around the eyes. Black-footed ferrets breed in March and early April and approximately three young are born in April, May, or June.

Black-footed ferrets are very secretive and rarely observed, except at night. They closely associate with prairie dogs and often use abandoned dens. Their range is limited to open habitat, including grasslands, steppe, and shrub steppe. They are carnivorous, feeding mostly on prairie dogs, but occasionally on ground squirrels, cottontail rabbits, and deer mice.

Captive breeding has helped in the restoration of this dwindling species, though the lack of suitable habitat and prey makes recovery difficult (NatureServe 2007.)

Eastern spotted skunk (*Spilogale putorius*) The eastern spotted skunk is a small mammal listed by KDWP as threatened. Critical habitat is found within Sedgwick County, but is in the Cowskin Creek and Big Slough drainage basins, outside of the project area.

This species prefers riparian habitat and uses fence rows, out buildings, hollow logs, and rock and brush piles as den sites. The eastern spotted skunk breeds in March and April, giving birth to a litter of 2 to 9 young in May or June. This species eats a variety of foods, including berries, carrion, seeds, fruits, birds, bird eggs, and mice. It is almost entirely nocturnal.

Eskimo curlew (*Numenius borealis*) The Eskimo curlew is a shorebird believed to be extinct. It remains on the KDWP endangered list, though the last confirmed sighting in Kansas occurred in 1902. It was once listed as endangered by the FWS, but due to the high likelihood of extinction, is no longer listed.

Flathead chub (*Platygobio gracilis*) The flathead chub is a small fish that only reaches 9 inches long. It has a broad, wedge-shaped head, large mouth, and one small barbel on each side of the mouth. It is light greenish or brown in color on the dorsal side and plain silvery on the sides. This species once occurred in the main stems of the Missouri, Lower Kansas, Republican, Arkansas, and Cimarron rivers. The only recently documented populations in Kansas were found in the extreme upper reaches of the Arkansas River and in the South Fork of the Nemaha River. The flathead chub is still known to occur in out-of-state reaches of the Arkansas and Cimarron rivers, so it may still occur in Kansas during high flow periods. The species occurs from the Rio Grande to the Arctic Circle in small creeks and large rivers that have turbid, fluctuating water levels and unstable sand bottoms. This fish relies on summer floods to successfully spawn.

Flathead chubs feed on a wide variety of food, including aquatic insect larvae, terrestrial insects, berries, seeds, and other small fish.

The primary reason for the decline of flathead chubs is the impoundment of their habitat. Building dams and reservoirs has fragmented their habitat and made it unsuitable for their needs (Rahel and Thel 2004). KDWP lists it as threatened.

Flutedshell mussel (*Lasmigona costata*) The flutedshell mussel is listed by the KDWP as threatened. It is a tan to black, freshwater mussel with indistinct broad green rays. This species is an obligate riverine species that prefers clear water riffles with moderate current, and substrate of medium to small sized gravel. They historically occurred in eastern Kansas (KDWP 2004).

Longnose snake (*Rhinocheilus lecontei*) Longnose snakes are medium-sized snakes, reaching a length of 34 inches in Kansas. They are harmless and easy to recognize. Their upper bodies are yellowish-cream with 18-35 black blotches separated by pink or reddish interspaces. They have round pupils and a long pointed snout.

This species prefers open prairies, sandy regions and rocky areas in rugged canyons. It is a constrictor that feeds on lizards, insects, small mammals, and smaller snakes. Females lay one clutch of 4 to 9 eggs during June, which hatch in August or September (Collins and Collins 2008). The species is listed by KDWP as threatened due to habitat encroachment.

Peregrine falcon (*Falco peregrinus*) The peregrine falcon is listed by KDWP as threatened. It is a bird of prey with pointed wings, a narrow tail, and a quick wing-beat. Adults have slate-blue colored backs, bars and spots below, and a heavy black face pattern that appears as dark sideburns.

Peregrine falcons are uncommon transients and occasional winter residents in Kansas. They are native to both North and South America, living in many different habitat types. They often nest in cliffs, trees, or tall buildings and prey on other birds, small mammals, lizards, fishes, and insects. They nest in May or June and raise a clutch of 3 to 4 young.

Piping plover (*Charadrius melodus*) The piping plover is a shorebird listed by KDWP as threatened. It is also a Federally-listed threatened species, but not listed for any of the project counties. The Great Lakes population of piping plover maintains a far-reaching breeding area in the central portions of Canada and the United States. It exists as far north as Manitoba and Alberta. Piping plovers winter along the Gulf coast and adjacent barrier islands but may rarely be found on sandbars and barren flats within the project area during spring and fall migrations. They feed on invertebrates such as worms, insects, crustaceans, mollusks, beetles, and grasshoppers (USFWS 2008a).

Snowy plover (*Charadrius alexandrinus*) The snowy plover is listed by KDWP as threatened. It can be found along sparsely vegetated salt flats, sandbars, and beaches during spring and fall migrations. This species primarily nests in Kansas at Quivira National Wildlife Refuge, where there is designated critical habitat. It also nests occasionally at Cheyenne Bottoms Wildlife Area and along rivers and streams of southwest and central Kansas. 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 on insects and aquatic invertebrates picked from open flats.

Silver chub (*Macrhybopsis storeriana*) The silver chub is listed by the KDWP as endangered. It is a member of the minnow family and is typically found in deep waters of low gradient streams, rivers and lakes. This species prefers pools with clean sand and fine gravel but will move into riffle areas if necessary to avoid silty areas. Little is known about the spawning habits of the silver chub, but it may spawn in open water in May and June. This fish feeds near the bottom, finding food by sight or taste. Its natural range is mostly east of Kansas and includes the Ohio and Mississippi river basins (KDWP 2005).

Topeka shiner (*Notropis topeka*) The Topeka shiner is a minnow-like fish listed by the KDWP as threatened. The FWS lists it as endangered, though it is not Federally-listed in any of the project counties. 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 during the summer. These fish spawn from late May to July and the young mature in one year. The maximum life span is 2 to 3 years. Their diet consists of insects and zooplankton.

State and Federally-Listed Species that may be found in the Project Area

These species are identified by both the FWS and KDWP as being threatened or endangered and potentially found within the project area.

Arkansas darter (*Etheostoma cragini*) The Arkansas darter is a small, geographically isolated fish found only in southeast Kansas, including parts of the Arkansas River basin. It is presently on the FWS candidate list, but the KDWP lists it as threatened. State-designated critical habitat within the project area lies along the North Fork of the Ninnescah River, starting at the Reno-Stafford County line, and extends to its confluence with the South Fork of the Ninnescah River in Sedgwick County. Additional areas are found along numerous perennial, spring-fed reaches of named and unnamed streams south of the Arkansas River in Reno, Kingman, and Sedgwick counties.

The Arkansas darter prefers small prairie streams, seeps, and springs that are partially overgrown with watercress and other broad-leaved aquatic plants. It is usually found in shallow water with little current, as well as in areas with aquatic vegetation and exposed willow roots for cover. It is most common near the headwaters of small streams. Aquatic insects and other arthropods comprise most of its diet. This species breeds from March to May and lays eggs in sandy substrate.

Arkansas River shiner (*Notropis girardi*) The Arkansas River shiner is a small fish thought to be extinct in Kansas. It is listed by KDWP as endangered and FWS as threatened. There is state-designated critical habitat in the project area, including all of the mainstem of the Arkansas River and portions of the mainstem Ninnescah and South Fork Ninnescah River.

The Arkansas River shiner prefers the protected, leeward side 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 species spawns from June to August when streams approach flood stage. Eggs drift near the surface in the swift current of open channels, develop and hatch within 3 to 4 days. Hatchlings swim to sheltered areas. The Arkansas River shiner feeds facing upstream and captures organisms washed out of shifting sand.

Interior least tern (*Sterna antillarum*) The interior least tern is listed as endangered by both the FWS and KDWP. This designation applies to populations throughout the contiguous United States, except for populations within 50 miles of the Texas Gulf Coast. The most current population data indicates that there are approximately 8,000 individuals (USFWS 2008.)

The interior least tern breeds along large rivers within the interior of the United States during summer months. It migrates south into Mexico, the Caribbean, and northern South America during the winter (Ridgely *et al.*. 2003.) It arrives at breeding sites in April to early June and spends 4 to 5 months breeding, nesting, and brooding. Egg-laying begins in late May in nests constructed on un-vegetated sand or gravel bars within wide river channels, along salt flats, or on artificial habitats such as sand pits. Nests are shallow, inconspicuous depressions scratched out by adults and located in the open. Several nests may be located in the same area. They are susceptible to loss by inundation.

The interior least tern feeds primarily on small fish, but also eats crustaceans, insects, mollusks, and worms. They usually forage near nesting sites. They are considered to be transients and occasional summer visitors in Kansas. However, the species has been known to breed on sandbars in the Arkansas River. There are other breeding populations in Kansas. The species is known to nest at Quivira National Wildlife Refuge in far western Reno County. The refuge has been designated as critical habitat.

Whooping crane (*Grus americana*) The whooping crane is a large bird listed by both KDWP and FWS as endangered. This species once ranged from the Arctic coast to central Mexico, and from Utah to New Jersey, South Carolina, and Florida. Today, a self-sustaining population breeds and nests at Wood Buffalo National Park in Canada and over-winters at Aransas National Wildlife Refuge in Texas. They migrate through the Great Plains between these points, using rivers, lakes, and other water bodies for feeding and resting.

The whooping crane's diet consists of larval insects, frogs, rodents, small birds, berries, plant tubers, crayfish, and waste grains from harvested cropland. They nest in Canada beginning in late April and lay 1 to 3 eggs. Both parents participate in incubation and rearing of the young. Autumn migration begins in mid-September and lasts until mid-November. They roost in riverine habitat on isolated sandbars and in large, palustrine wetlands (dominated by trees, shrubs and emergent plants) while in migration, where they are safer from predators. The total population of whooping cranes reached a low of 240 individuals during the mid-1990s (NatureServe, 2007.)

Whooping cranes commonly roost at Quivira National Wildlife Refuge and Cheyenne Bottoms Wildlife Area while migrating through Kansas. FWS has designated Quivira National Wildlife Refuge, in far western Reno County, as critical habitat for this species.

Vegetation

Vegetation in the project area before European settlement consisted of mixed-grass prairies, wet meadows, emergent wetlands, and some riparian forests. Most of these communities have been converted to cropland, pasture, or shelter belts. Crops are mostly wheat, corn, soybeans, or sorghum (Burns & McDonnell 2003).

Mixed-grass prairies consist of grasses and shrubs of varying heights. Common species include:

- little bluestem (*Schizachyrium scoparium*)
- buffalograss (*Buchloe dactyloides*)
- gamagrass (*Tripsacum dactyloides*)
- big bluestem (*Andropogon gerardii*)
- needlegrasses (*Stipa* spp.).

Mixed-grass prairies were maintained by fire, grazed by large herbivores (including American bison), and the plants had well-established, dense root systems.

Wet meadow communities typically hold a transitional zone between the prairie and lowland areas, and consist of a variety of plant species, such as:

- needlegrasses (*Stipa* spp.)
- prairie cordgrass (*Spartina pectinata*)
- big bluestem (*Andropogon gerardii*)
- switchgrass (*Panicum virgatum*)
- rushes (*Juncus* spp.)
- sedges (*Carex* spp.).

The areas next to rivers and streams in the project area are dominated by thin bands of lowland riparian forest. Species in these forests include:

- cottonwood (*Populus deltoides*)
- willow (*Salix* spp.)
- catalpa (*Catalpa speciusa*)
- hackberry (*Celtis occidentalis*)
- elm (*Ulmus* spp.)

- maple (*Acer* spp.).

Non-Native Invasive Species

Non-native invasive species are plants and animals that are not part of the original flora and fauna of an area. They are considered undesirable for a variety of reasons. The Federal government has been directed by the Federal Noxious Weed Act of 1974 to prevent the spread, introduction, or continued existence of non-native, invasive species. Likewise, Kansas has laws preventing the spread and continued existence of species considered to be a nuisance.

One of the most invasive and destructive animal species is the zebra mussel (*Dreissena polymorpha*), which was discovered in El Dorado Reservoir (Butler County) in 2002. It was discovered in Cheney Reservoir in 2007 (Figures 3-4 and 3-5) and in Marion Reservoir in 2008. The presence of a related and equally undesirable invasive species, the quagga mussel (*Dreissena rostriformis bugensis*), has not yet been documented. White perch and grass carp are also nuisances in Kansas, as are other species which have not been directly identified and targeted by the state or Federal government. Table 3-5 contains a list of state and Federally controlled invasive species.

Figure 3-4   Invasive zebra mussels fouling El Dorado Reservoir, 2003 (USACE photo)

Figure 3-5   Zebra mussels clogging water pipe (USACE photo)

Table 3-5	Non-Native Invasive Species Documented in Project Area
Vegetation	Bull thistle (*Cirsium vulgare*)
	Bur ragweed, bursage (*Ambrosia grayi*)
	Canada thistle (*Cirsium arvense*)
	Field bindweed (*Convolvulus arvensis*)
	Hoary cress (*Lepidium draba*)
	Johnson grass (*Sorghum halepense*)
	Leafy spurge (*Euphorbia esula*)
	Multiflora rose (*Rosa multiflora*)
	Musk thistle (*Carduus nutans*)
	Pignut (*Hoffmannseggia glauca, H. densiflora*)
	Quackgrass (*Elymus repens, Agropyron repens*)
	Russian knapweed (*Acroptilon repens, Centaurea repens*)
	Sericea lespedeza (*Lespedeza cuneata*)
	Kudzu (*Pueraria lobata, P. montana*var. *lobata*)
Animals	White perch (*Morone americana*)
	Common carp (*Cyprinus carpio*)
	Zebra mussel (*Dreissena polymorpha*)

Wetlands

Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, vegetation typically adapted for life in saturated soil conditions. There are a variety of wetland types, including swamps, marshes, bogs, and similar areas. Wetlands are important areas for the support of wildlife and plant diversity. They provide habitat for a wide variety of fish, wildlife, and plants, enhance water quality by filtering pollutants and sediment from runoff, prevent erosion, and store flood waters. For these reasons, wetlands are classified as special aquatic sites. They are afforded protection by the Federal Clean Water Act (CWA). Section 404 of the CWA gives the USACE the authority to regulate such wetlands and other waters. Wetlands are considered jurisdictional. In other words, only a local USACE office may make an official determination on what is considered a wetland.

The project area has dozens of small wetlands of many different types (the larger, McPherson Wetlands are found in McPherson County, well outside of the area where construction impacts would occur.) Small, local wetlands are broadly categorized as riverine, lacustrine, or palustrine habitats. They include freshwater emergent wetlands and freshwater forested/shrub wetlands. Although not considered actual wetlands, small, low-lying areas that collect water during wet periods, known as "vernal pools," occur throughout the area. Vernal pools can be considered to be important breeding or survival habitat for certain species. Most vernal pools in the area lie within or alongside cultivated areas.

Riverine habitats are those existing in and along rivers and streams. Most local riverine habitat consists of slow-flowing perennial streams with a sand and mud substrate. Vegetation consists primarily of submerged aquatic plants. Riverine systems exist within rivers and streams throughout the project area.

Lacustrine systems include wetlands and deep water habitats found in a topographic depression or dammed river. The total area of a lacustrine system is usually more than 20 acres, of which less than 30% is covered with trees, shrubs, persistent emergents, emergent mosses or lichens. This type of wetland generally surrounds lakes and reservoirs, including Cheney Reservoir.

Palustrine habitats are wetlands dominated by trees, shrubs, emergent plants, mosses or lichens, and any other similar water bodies less than 20 acres in size and less than 6.6 feet deep. This wetland type includes natural and man-made ponds and wetland features adjacent or near to riverine and lacustrine systems.

Prime and Unique Farmlands

There has been a substantial and continuing decrease in the amount of open farmland within the project area over the last century. Urbanization has converted many acres of productive farmland to non-agricultural use. Prime and unique farmlands are defined as those that require a relatively small level of cost and effort to produce high-quality food and fiber crops. They are protected from unnecessary and irreversible conversion to non-agricultural use by the Farmland Protection Policy Act (7 USC 4201 *et seq*.) Federal agencies are required to identify the potential effects of government projects on prime and unique farmlands and prevent negative impacts where practical. As described in the "Soils" section of this chapter, a large percentage of the project area is considered to be prime farmland. These prime farmlands are identified by soil type, along with current and former uses.

Visual Resources

Visual character is defined by topography, vegetation, and land use. Each of these attributes contributes to the esthetic quality of an area.

The project area is located on flat to gently rolling ground in a rural setting. Area vegetation consists primarily of row crops and pastures. Scattered across the landscape are center-pivot irrigation systems, wells, and other structures. These include farmhouses, barns, sheds, grain and silage elevators, oilfield batteries and tanks, and oilfield pump jacks.

The Little Arkansas River consists of a braided channel with sand bars, forested islands and numerous bends, enclosed by a riparian zone consisting of trees and shrubs that varies from a few feet to more than 500 feet wide. Riparian zones average less than 300 feet wide and are often much narrower.

Figure 3-6 Little Arkansas above Wichita at a flow of about 58 cfs

Cheney Reservoir lies in a rural setting with scattered houses, trees, campgrounds, and other recreational facilities surrounding it. The communities of Wichita, Sedgwick, Halstead, Bentley, Burrton, Valley Center, and others break up the primarily agricultural/grassland area, but less than 3% of the total area is considered residential. Large buildings and elevated highways dot the landscape in the Wichita vicinity, where much of the area is heavily urbanized.

Wild and Scenic Rivers

Wild and Scenic Rivers are those rivers designated by the National Wild and Scenic Rivers Act (16 USC 1271-1287). They are rivers that are free of dams or other human structures, or that have ecological importance, or that have important recreational values. The act requires that these rivers be considered during planning and development to prevent negative impacts.

None of the rivers in the project area, nor any in Kansas, are designated as Wild and Scenic Rivers.

Socioeconomics

Social and Economic Conditions

Social and economic conditions within the Equus Beds region of influence are indicated by certain factors. These include:

- Existing population(s) and expected changes
- Educational levels and availability
- Income levels
- Values of agricultural and nonagricultural production
- Recreational types and availability
- Local employment.

Each indicator must be placed in context before the magnitude of its impacts can be measured. The economies of Butler, Harvey, Kingman, Marion, McPherson, Reno, Rice, and Sedgwick counties could be directly impacted by an ASR project. Therefore, existing social and economic conditions will be reviewed for these counties.

Wichita is the largest city and center of economic activity in the region. The City is tied closely to aircraft manufacturing, which is the largest economic sector. Additional important sectors include other manufacturing types, health care, petroleum production and refining, government, and agriculture. Wichita State University and smaller colleges, McConnell Air Force Base, and the Kansas Air National Guard also contribute to the economy and impact social and economic conditions.

Each social or economic indicator discussed in this document uses data from various governmental and non-governmental sources. Data sources are identified where needed in the discussion.

Current conditions of economic indicators in the region are described. These indicators include:

- Population
- Education
- Median household and *per capita* income

- Poverty rates
- Home ownership
- Earnings
- Agricultural acreage and value of production
- Labor force and unemployment
- Small area and municipality economies
- Recreation, and
- Other measures of economic activity.

Population

Two population trends have dominated within both Kansas and the project area over the past 40 years. First, rural counties have lost population, sometimes more than 10% per decade. Second, urban counties (including Sedgwick) have gained population at an even greater rate (KWO 2008). The Bureau of the Census estimated a 2007 population of 695,049 for the eight-county economic impact area. This is a 3.4% increase over the 2000 Census of 672,359, and a 14.6% increase over the 1990 Census of 606,717. Most growth since 1990 occurred in Sedgwick County (including Wichita.) Sedgwick County accounted for 81.9%% of total growth in the region. Population throughout the region, outside of Sedgwick County, grew between 1990 and 2000, but declined slightly thereafter. About 24.4% of the population in Kansas' 105 counties lived in the eight-county impact area in 1990. That percentage increased to 25.0% by 2007. Estimated 1990, 2000, and 2007 populations for the impacted region, individual counties, and the State of Kansas are provided in Table 3-6.

Table 3-6 Population of Regional Counties

County	2007 Estimates	2000 Census	1990 Census
Butler	63,045	59,482	50,580
Harvey	33,493	32,869	31,028
Kingman	7,826	8,673	8,292
Marion	12,238	13,361	12,888
McPherson	29,196	29,554	27,268
Reno	63,145	64,790	62,389
Rice	10,080	10,761	10,610
Sedgwick	476,026	452,869	403,662
Total	**695,049**	**672,359**	**606,717**
Kansas	2,775,997	2,688,418	2,477,574

Source: U.S. Bureau of the Census

Population growth (Table 3-7) is projected through 2025 for the economic impact area, based upon the 2000 Census. The most rapid growth is expected in Butler County. Most growth, overall, is anticipated in Sedgwick, Butler, and Harvey Counties. These three counties constitute the Wichita Metropolitan Statistical Area, or MSA, as defined by the

Bureau of the Census. Negative population growth is projected for the more rural Kingman, Marion, McPherson, Reno, and Rice counties.

Table 3-7 Population Projections for Economic Impact Area, 2000-2025

County	**2000 Census**	**2010**	**2015**	**2020**	**2025**	**% Change 2000-2025**
Butler	59,484	74,565	79,925	83,312	86,046	45
Harvey	32,869	34,538	35,338	36,311	37,417	14
Kingman	8,673	8,360	8,249	8,152	8,076	-7
Marion	13,361	13,269	13,051	12,899	12,786	-4
McPherson	29,554	29,573	29,348	29,117	28,863	-2
Reno	64,790	57,877	55,877	54,982	54,455	-16
Rice	10,761	10,241	10,101	10,023	9,942	-8
Sedgwick	452,869	481,730	497,998	515,403	531,939	17
Total	**672,361**	**710,153**	**729,887**	**750,199**	**769,524**	**14**
Kansas	2,688,824	2,818,880	2,880,017	2,936,670	2,988,382	11

Source: U.S. Bureau of the Census, 2000 Census

The most striking population growth reported in the project area between 1990 and 2007 was for Hispanics of all races. Comparisons of total and Hispanic population growth in the eight-county area are presented in Table 3-8. Total growth in the region was 14.6%, while the Hispanic population grew 165.5%, Percentages of Hispanic population residing in the various counties within the project area are provided in Table 3-9.

Table 3-8 Total & Hispanic Population Growth within the ASR Impact Area

County	**Growth – Total Population**		**Growth – Hispanic Population**	
	1990-2000	1990-2007	1990-2000	1990-2007
Butler	17.6%	24.6%	80.1%	123.9%
Harvey	5.9%	7.8%	62.1%	98.4%
Kingman	4.6%	-5.6%	62.3%	109.1%
Marion	3.7%	-5.0%	117.8%	153.4%
McPherson	8.4%	7.1%	76.3%	137.8%
Reno	3.8%	1.2%	47.7%	62.0%
Rice	1.4%	-5.0%	116.5%	192.8%
Sedgwick	12.2%	17.9%	108.8%	188.7%
Total	**10.8%**	**14.6%**	**97.5%**	**165.5%**

Education

Education is one indicator of the skill level of the labor force. It is a measure of the attractiveness of an area to businesses and industries considering expansion or relocation. Educational attainment in impacted counties, the region, the state, and the United States is provided in Table 3-10.

Table 3-9 Hispanics – Percent of Total Population within the ASR Impact Area

County	1990	2000	2007
Butler	1.47%	2.25%	2.63%
Harvey	5.21%	7.97%	9.58%
Kingman	0.93%	1.44%	2.06%
Marion	0.92%	1.92%	2.44%
McPherson	1.19%	1.94%	2.65%
Reno	3.97%	5.65%	6.36%
Rice	2.63%	5.61%	8.11%
Sedgwick	4.32%	8.04%	10.57%
Total	**3.80%**	**6.78%**	**8.81%**

The percentage of adults 25 years of age or older with at least a high school education in each of the eight counties ranges from 82.7% to 87.3%. The regional average is 85.1%. This compares to 86.0% for the state and 80.4% for the nation.

The percentage of the population with a Bachelor's degree or higher level of education ranges from 17.3% to 25.4% for counties in the region. The regional average is 23.5%. This compares to 25.8% with Bachelor's degrees or higher statewide and 24.4% nationally.

Educational attainment in Wichita and the rest of the region impacted by the project is comparable to state and slightly above national levels. This attainment translates into a skilled workforce. The potential for attracting well paying jobs to the region in the future appears to be good.

Table 3-10 Educational Attainment in Kansas

Percentage of Persons Age 25 and Over – 2000

County	**High School Graduate or Higher**	**Bachelor's Degree or Higher**
Butler	87.3	20.4
Harvey	85.3	23.0
Kingman	84.7	17.8
Marion	84.4	17.9
McPherson	85.9	22.2
Reno	82.7	17.3
Rice	83.4	17.5
Sedgwick	85.1	25.4
Region	85.1	23.5
Kansas	**86.0**	**25.8**
United States	**80.4**	**24.4**

Source: U.S. Bureau of the Census,

2000 Census of Population and Housing

Median Household and Per Capita Income, Poverty Rates, and Home Ownership

Table 3-11 presents median household income, *per capita* income, poverty rate, and home ownership rates for counties potentially impacted by the project. Figures for Kansas and the United States are also provided.

Estimated 2005 median household[5] income in project-impacted counties ranged from $37,176 to $49,091. Estimated 2005 *per capita*[6] income in the same counties ranged from $22,176 to $34,703. Kansas ($32,866) and U.S. ($34,471) *per capita* incomes were near the upper end of this range.

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[5] Household income is the sum of money earned during the calendar year by all household members who are 15 years of age and older

[6] *Per capita* income is the mean income computed for every man, woman, and child in a geographic area. It is derived by dividing the total income of all people 15 years old and over in a geographic area by the total population in that area

Table 3-11 Income, Poverty Rate, and Home Ownership Rate				
County	**2005 Median Household Income[1]**	**2005 *Per Capita* Income[2]**	**2005 Persons Below Poverty[3] Level**	**2000 Home Ownership Rate[4]**
Butler	$49,091	$30,228	9.4%	77.7%
Harvey	$44,032	$29,977	8.2%	71.9%
Kingman	$41,511	$27,137	12.4%	77.8%
Marion	$38,153	$23,336	9.5%	79.9%
McPherson	$46,236	$31,890	9.3%	74.0%
Reno	$39,790	$27,109	13.1%	70.7%
Rice	$37,176	$22,176	13.8%	76.6%
Sedgwick	$43,340	$34,703	13.1%	66.2%
Kansas	**$42,861**	**$32,866**	**11.7%**	**69.2%**
United States	**$46,242**	**$34,471**	**13.3%**	**66.2%**

[1] U.S. Bureau of the Census, Housing and Household Economic Statistics Division
[2] U.S. Bureau of Economic Analysis, Local Area Personal Income,
[3] U.S. Bureau of the Census, Small Area Income and Poverty Estimates
[4] U.S. Bureau of the Census, Census of Population and Housing

There were large differences in both household and *per capita* income among counties in the region. This was especially true for median household income. Higher incomes were more common near the City and along Interstate corridors I-135 and I-35.

There was a large variation in the number of persons below the poverty level[7] in project impacted counties in 2005. The results presented no discernable pattern. Poverty rates were highest in Rice, Sedgwick, Reno, and Kingman counties. Rates in these four counties exceeded the state average, while the Rice county rate exceeded both state and national averages. Poverty rates in Butler, Harvey, Marion, and McPherson counties fell well below state and national averages.

[7] Families and persons are classified as below poverty level if their total family income or unrelated individual income is less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under the age of 18

Home ownership rate is computed by dividing the number of owner-occupied housing units by the number of occupied housing units or households. With the exception of Sedgwick County, home ownership rate in the area is relatively high compared to rates throughout both Kansas and the United States.

Earnings

Major industry groups in the region, based upon total earnings, include construction, manufacturing, wholesale trade, retail trade, health care, and social assistance services, and government and government enterprises. Earning patterns indicate that a wide range of worker skills and education are both needed and available in the area.

The largest segment[8] of earnings is in manufacturing, which accounts for over 30% of estimated total earnings. This is due, in large part, to the presence of aircraft manufacturing. Wichita has a number of aircraft manufacturers and styles itself, "The Aircraft Capitol of the World." Aircraft manufacturers include the Cessna Aircraft Company, Spirit AeroSystems, Hawker Beechcraft, Boeing Integrated Defense Systems, and Bombardier Learjet. These companies generally pay well and employ more than 34,000 people. Other goods manufactured in the Wichita area include HVAC systems, agricultural equipment, and recreation products.

Labor Force and Unemployment

Approximately 67% of the total regional workforce is located in Sedgwick County (Bureau of Labor Statistics 2006). Sedgwick and Butler counties had the highest unemployment rates (4.7%) in 2006. Unemployment rates in the remaining six, project impacted counties ranged from 3.4 to 4.6%. Rates in all counties except Marion, Kingman, and McPherson counties (where unemployment rates were low), approximated state and national averages. Table 3-12 summarizes regional, state and national civilian labor force estimates.

[8] Large segments are defined as sectors that account for 5% or more of total earnings in the area, based upon U.S. Bureau of Labor estimates

Table 3-12 Civilian Labor Force Estimates

County	Labor Force	Employed	Unemployed	Unemployment Rate
Butler	32,110	30,606	1,504	4.7%
Harvey	18,223	17,409	814	4.5%
Kingman	4,333	4,165	168	3.9%
Marion	6,739	6,461	278	4.1%
McPherson	17,842	17,242	600	3.4%
Reno	33,107	31,589	1,518	4.6%
Rice	5,431	5,193	238	4.4%
Sedgwick	245,576	234,097	11,479	4.7%
Total	**363,361**	**346,762**	**16,599**	**4.6%**
Kansas	**1,466,009**	**1,400,172**	**65,837**	**4.5%**
United States	**151,100,848**	**144,113,800**	**6,987,048**	**4.6%**

Source: U.S. Department of Labor, Bureau of Labor Statistics

Agricultural Acreage and Production Value

Agriculture constitutes an important aspect of the regional economy, both in terms of direct income and employment effects on other support and processing industries. The 2002 Census of Agriculture showed that around 9.5% of all Kansas agricultural land lies within the eight-county, project Economic Impact Area (EIA). Farmers in the EIA produce about 8% of the total value of Kansas farm products. Table 3-13 summarizes agricultural data in the impact area and in Kansas. Information includes the number of acres of agricultural land, number of farms, and compares agricultural production within the EIA to production throughout the state.

Table 3-13 Agricultural Acres, Farms, and Product Values					
County	Total Agricultural Land (Acres)	Farm Product Values (millions)	Number of Farms	Average Farm Size (Acres)	Average Product Value (by Farm)
Butler	701,202	$116.42	1,309	536	$88,939
Harvey	351,724	$60.30	832	423	$72,475
Kingman	555,799	$51.79	837	664	$61,879
Marion	588,427	$81.29	996	591	$81,618
McPherson	574,875	$99.43	1,161	495	$85,640
Reno	735,132	$111.67	1,570	468	$71,127
Rice	416,224	$105.79	500	832	$211,575
Sedgwick	533,871	$75.42	1,355	394	$55,664
Total	**4,457,254**	**$702.11**	**8,560**	**521**	**$82,023**
Kansas	**47,227,944**	**$8,746.24**	**64,414**	**733**	**$135,782**
Source: Census of Agriculture 2002					

Recreation

Recreation is an important part of the regional economy. Wichita maintains several museums, 97 public parks, and sporting facilities. Other facilities include amphitheaters, child play areas, basketball courts, playgrounds, picnic areas, fishing ponds, recreation centers, swimming pools, hiking trails, and tennis courts, among others. Popular outdoor activities include hunting, fishing, camping, nature watching, boating, and others. There are fee-based public and private recreational sources in the City and nearby that include professional sports arenas, zoos, amusement parks, paintball facilities, bowling alleys, raceways, golf courses, miniature golf courses, and lakes. In addition, there are three state parks, two major USACE reservoirs (El Dorado and Marion), Cheney Reservoir, and several smaller outdoor recreation areas.

El Dorado State Park

El Dorado State Park is located in Butler County, about 35 miles northeast of Wichita. The dam at El Dorado Reservoir was completed by USACE in June 1981. The lake consists of approximately 8,000 surface acres, with 4,500 acres of nearby park lands and 3,500 acres of wildlife area. KDWP manages reservoir resources, including four primary campgrounds and the largest state park in Kansas.

The lake provides many opportunities for water-oriented activities, such as camping, picnicking, swimming, skiing, fishing, boating, hunting, and nature watching. The state park reported 722,755 visitor days during

2006. This number comprises almost 12% of all visitor days in the Kansas State Park System.

Cheney State Park

Cheney Dam is a Reclamation facility located about 6 miles north of Cheney and 24 miles west of Wichita. The dam lies at the common intersection of the boundaries of Kingman, Reno, and Sedgwick counties. The reservoir lies in all three counties and provides a variety of recreational uses, along with fish and wildlife benefits to south-central Kansas.

Many species of sport fish common in Kansas are caught in Cheney Reservoir. The nearby park provides excellent camping, boating, swimming, and picnicking facilities. The park is administered by KDWP, as are 1,900 acres of nearby land and over 5,400 surface acres of water. In addition, there are over 5,200 acres of land and 4,100 acres of water reserved for conservation and management of migratory birds and other wildlife. There were an estimated 490,837 visits to Cheney State Park during 2006. This represents about 8% of all visitor days recorded that year in the Kansas State Park System.

Marion Reservoir

Marion Dam and Reservoir, completed by USACE in 1968, encompasses 6,200 acres of water surrounded by another 6,000 acres of public lands. The dam lies between the communities of Marion and Hillsboro in Marion County. Four, well-equipped campgrounds and 171 campsites surround the lake. Marion Reservoir supports one of the best walleye fisheries in Kansas. It attracted 78,700 park visits during 2006.

Sand Hills State Park

Sand Hills State Park, located near Hutchinson in Reno County, is a 1,123 acre natural area that has been preserved for its picturesque sand dunes, grasslands, wetlands, and woodlands. Popular activities include hiking, nature watching, and horseback riding. There were an estimated 27,787 visits to the park during 2006.

Maxwell State Game Refuge

This 2,254 acre wildlife refuge and state park located in McPherson County is managed by KDWP. It supports about 50 head of elk and the largest herd of American bison in Kansas (150-200 head.) It also contains a 46 acre fishing lake surrounded by 260 acres of public use area. More than 150 species of birds have been identified along 1.5 miles of hiking trails.

Environmental Justice

An evaluation of environmental justice is mandated by Executive Order 12898 (*Environmental Justice*, February 11, 1994) for Federal actions that affect the environment. "Environmental justice" implies that no group of people, regardless of race, ethnicity, socioeconomic status, or community, bear a disproportionate share of negative impacts of a project. It is evaluated by determining the percentage of impact to one group compared to another. Should the percentage of total impacts on a specific group be greater than the proportion of the total population represented by that group, impacts would be considered to be unfairly distributed.

Demographic data from various sources were used to evaluate environmental justice. The locations of different groups of people in the ASR impact project area were derived from data provided by the Bureau of the Census, individual counties, municipalities, and local school districts. Current conditions were generally estimated using data from the Bureau of the Census.

Evaluating environmental justice concerns requires an understanding of several factors. Among the most important would be, (1) where the project impacts would be likely to occur, and (2) where affected groups would be located. Identifying the location of specific groups can be difficult when nonpermanent residents, such as migrant workers, temporarily use an affected area. Migrant demographic data is limited throughout the nation. Census data do not account for all nonpermanent residents, because some cannot be contacted and others may not want to be found or counted. In addition, difficulty contacting persons residing in sparsely populated, rural areas results in a tendency to undercount local populations. Despite these challenges, Census data are typically the most complete and comparable demographic and economic data available.

Income data for the impacted region and the state are summarized in the previous section in this chapter. Data indicate that median household income is much lower in Rice, Reno, and Marion counties than in many areas of Kansas. Per capita income is lower than average for the same counties, plus Kingman and Harvey counties.

Poverty rates show a different pattern. Both income and poverty rates in Sedgwick County are relatively high, indicating a higher disparity between the wealthiest and poorest individuals. Poverty rates outside of Sedgwick County are relatively low. Any action having a disproportionate, adverse effect on counties or parts of counties listed as having low incomes or high poverty rates could raise environmental justice issues.

Bureau of the Census data are available for race and Hispanic origin (2006). These data are presented in Table 3-14. Distribution of population by race is similar for each of the project area counties, except Sedgwick and Harvey. Blacks and Hispanics make up a relatively high percentage of the total population in the urbanized Wichita area. Hispanics make up a relatively high percentage of the population in Rice and Reno Counties.

Table 3-14 Race and Ethnic Origin – 2006 Percentages

County	White	Black or African American	American Indian	Asian	Pacific Islander	Two or more races	Hispanic or Latino
Butler	95.33	1.53	1.00	0.57	0.03	1.56	2.54
Harvey	95.22	1.86	0.58	0.67	0.04	1.63	9.33
Kingman	96.89	0.33	0.78	0.45	0.16	1.39	2.07
McPherson	96.82	1.07	0.39	0.32	0.07	1.33	2.18
Marion	97.66	0.49	0.67	0.19	0.02	0.98	2.16
Reno	94.27	2.97	0.67	0.80	0.04	1.26	6.40
Rice	96.10	1.36	0.85	0.67	0.04	0.98	7.54
Sedgwick	83.55	9.42	1.08	3.82	0.09	2.05	10.28
Total	**87.34**	**6.99**	**0.97**	**2.79**	**0.08**	**1.84**	**8.54**
Kansas	**89.08**	**5.95**	**0.99**	**2.20**	**0.07**	**1.71**	**8.59**

Sources: U.S. Bureau of the Census 2000; American FactFinder, 2006 Population Estimates, Tables T3 & T4

As noted in Table 3-6, Hispanic population throughout the project area grew by 165.5% from 1990 through 2007. By comparison, the Hispanic population in urbanized Sedgwick County (Wichita) grew 188.7%. Such population increases within a single ethnic group are considered substantial, especially when compared to an overall population growth of 14.6% for the same area over the same time period. Ethnic population changes of this magnitude would need to be addressed during the environmental justice review.

Cultural Resources

The project cuts through three physiographic regions within the Central Great Plains – the Flint Hills, the Arkansas River Lowland, and the Wellington-McPherson Lowland. The history of human occupation within this area can be divided into six broad time periods, or stages, based upon differences in the way people interacted with their environment. These periods, ranging from earliest to latest, include the Paleo-Indian, Archaic, Early Ceramic, Middle Ceramic, Late Ceramic, and Historic. Development within cultures, along with the influx of new ideas and materials from neighboring regions, resulted in adaptations in settlement patterns, cultural materials and subsistence economics. Particular artifacts, house types, and exploitation of different plant and animal species characterized each period.

Paleo-Indian Period (10,000 – 6,000 BC)

This period began near the end of the last Ice Age. People were typically highly mobile and traveled in small bands. They hunted now-extinct, large, Ice Age animals and foraged for berries, seeds, roots, small game, clams, and other locally available plants and animals. The primary hunting tool was a spear tipped with a large, leaf-shaped, chipped-stone projectile point. Archeologists have divided this period into three stages, based primarily upon the shape of the projectile points. The Llano stage ranged from approximately 10,000 – 9,000 BC, the Folsom stage from 9,000 – 8,000 BC, and the Plano stage from approximately 8,000 – 6,000 BC.

The earliest, well-documented evidence of human activity in the Central Great Plains was attributed to the Llano stage (10,000 – 9,000 BC). The culture was identified by a distinctive projectile point with a centrally flaked flute, known as a "Clovis" point. It is the earliest projectile point known in America. It was often found near the remains of mammoth and other large Ice Age mammals. Though Clovis points have been found in Kansas, none closely associated with animal remains have been discovered (Logan 1998). According to Brown and Simmons (1987), other artifacts found that relate to the hunting and butchering of large animals include:

- cylindrical bone and ivory fore-shafts with projectile points
- scrapers
- knives
- cobble choppers
- gravers
- bifaces
- hammerstones.

The Folsom stage (9,000 – 8,000 BC) was characterized by the presence of a different style of projectile point. Archeologists know it as the "Folsom" point. The Folsom point had an extended central flute and was associated with now-extinct bison. The bison replaced the mammoth as the primary source of food and raw materials. Folsom points have been found throughout Kansas, although they appear to be concentrated primarily in the northeast and southwest corners of the state (Brown and Simmons 1987). Leaf-shaped points collected at the Twelve-Mile Creek site (14LO2) in Scott County (west-central Kansas) have not definitively been identified as Folsom. However, site 14L02 produced several skeletons of extinct bison and may represent the only excavated Folsom complex in the state (O'Brien 1984).

The Plano stage (8,000 – 6,000 BC) was characterized by a variety of chipped projectile points and knife forms. Before 7,000 BC, the most widely-hunted animals included now-extinct forms of bison, horse, and camel. Modern bison were associated with sites dated to 7,000 BC and later. A group of Paleo-Indian cultures were represented by various, characteristically chipped stone projectiles and knife forms. Cultures documented in Kansas include the Plainview, Hell Gap, Meserve/Dalton, Milnes and, Midland, Agate Basin, Scottsbluff, and Eden. The newer, leaf-shaped projectile points are variable in design but are characterized by parallel flaking along the tool edges. These, more recent points lack the central flute typical of Clovis and Folsom types.

Six, well-documented Paleo-Indian sites have been excavated in Kansas. They include the Tim Adrian, DB, Norton Bone Bed, Laird, Sutter (scattered around the state), and an unnamed site in Sedgwick County. Excavated Plano sites are scarce in Kansas. Most information comes from nearby states. Site 14SG515, located near Wichita, is a possible Cody complex. It contains Scottsbluff and Eden points, along with a Cody knife (Brown and Simmons 1987). The absence of other known sites in the project area does not preclude their existence. It has been suggested that the absence of known sites may be primarily related to two factors:

- a lack of intensive surveys in the western 2/3 of the state
- difficulty locating sites in the eastern 1/3 of the state, due to their burial beneath other soil deposits (Brown and Simmons 1987).

Wheat (1978) defined four types of human behavior that would result in distinctive archeological sites that may be present in Kansas, including:

- mass kill sites
- butchering sites
- long-term campsites
- short-term campsites.

The presence of projectile points and recorded mastodon, mammoth, and bison remains in Harvey and Sedgwick counties indicates the potential for additional Paleo-Indian sites. The probability is high that additional bison jump and animal trap sites are present, particularly in western Kansas (Brown and Simmons 1987).

Archaic Period (6,000 BC to AD 1)

Many large Ice Age animals went extinct during the Pleistocene, approximately 8,000 to 9,000 years ago. Hunter-gatherer groups learned to depend more upon modern bison, elk and deer as dietary staples (Hofman 1996). Plants became more important in the diet as the economy switched from dependence upon one type of large game, to reliance upon a wide variety of smaller game and other foods (Logan 1998). Human populations remained nomadic, but focused more on seasonal exploitation of resources in certain areas as they became available. Pit houses and new processing-storage technologies appeared in upland hunting and processing camps (bison kill areas.) Seed processing also led to more widespread use of grinding slabs. The manufacture of ceramic objects began around 5,500 BC. Increased numbers and specialized types of chipped-stone tools appeared and the *atlatl*, or throwing stick, became common.

There are a limited number of excavated Archaic sites scattered throughout Kansas. The only clearly defined Archaic site near the project area is found in the Flint Hills. Six cultural complexes or phases have been defined for the Flint Hills. They include the:

- Logan Creek complex
- Munkers Creek phase
- Nebo Hill phase
- Chelsea phase
- El Dorado phase
- Walnut phase.

Early Ceramic Period (AD 1 to 1000)

The Early Ceramic Period, or Plains Woodland, is equivalent to the Woodland stage farther east in the United States. Populations trended toward sedentism.[9] They intensified horticultural activity, expanded regional networks and made ceremonial activities and mortuary practices more elaborate (Griffin 1967). Technological changes became especially important, especially the adoption of bow and arrow weaponry and the widespread use of ceramic pottery for storage and cooking. Ceramics of this stage are typically described as thick, stone-tempered and with cord-marked exteriors (Montet-White 1968; Farnsworth and Asch 1986; Adair 1996).

Expanded use of small, short duration camps next to specific environmental locales suggests increased use of seasonally specialized extraction camps to exploit locally abundant resources (Roper 1979; Emerson and Fortier 1986; Seeman 1986). Several Plains Woodland sites have been recorded (many unofficially) within the Little Arkansas River

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[9] Sedentism refers to a tendency to settle down and spend less time traveling or wandering.

valley inside the project area. Though most of the eight Plains Woodland cultural manifestations found in Kansas are poorly understood, Keith complex sites have been located between the Little Arkansas and Platte rivers (Johnson and Johnson 1998). Ceramics collected at these locations are unique. The vessels are conical in shape and generally have very thick, cord-marked walls. Projectile points ranged in size and shape from large, dart points typically associated with *atlatls*, to small, corner-notched arrow points. Keith complex sites are usually located on ridges and terraces overlooking rivers and streams.

Greenwood and Butler phase sites are found along the eastern edge of the project area. The Butler phase site in El Dorado Reservoir dates to between A.D. 200-800 (Grosser 1970, 1973). Greenwood phase sites are found throughout much of the Flint Hills and Osage Cuestas (Witty 1980). Reviews of cultural materials from these two phases suggest they are connected. They are typically characterized by limestone-tempered, Verdigris[10] type pottery.

Some sites have characteristics typical of both Keith and Greenwood/Butler phases, yet may be unique enough to be considered as distinct cultural manifestations. These sites are typically found on terraces or sand dunes along the Little Arkansas River, or on ridges overlooking small playa lakes. Ceramics are typically sand-tempered, conical, and made from locally available sandy clays. Chipped stone tools include *atlatl* dart points and notched arrow points made from river cobbles and upland quartzite. A few of these tools have been identified as originating in the Flint Hills.

Middle Ceramic Period (AD 1000-1500)

Kansas sites attributed to the Middle Ceramic Period are typically grouped under the Central Plains Tradition or Village Tradition. The Middle Ceramic Period is probably the best understood prehistoric stage in the area. Until recently, some of the studied sites were thought to contain several contemporaneous houses but recent work on the Solomon River phase of north-central Kansas shows that these people lived in broadly scattered homesteads rather than villages (Latham 1996; Blakeslee 1999).

Sites attributed to the Smoky Hill phase are found in the north and northeastern parts of the project area. Smoky Hill people generally resided in semi-rectangular earth lodges on terraces along rivers and streams. These swidden (slash and burn) foragers exploited nearly every edible plant and animal available (Logan 1998; Blakeslee 1999). Ceramics associated with this stage include globular bowls and jars, with exteriors generally cord-marked. They were tempered with sand or grit.

[10] Verdigris refers to a green patina on the pottery resulting from the weathering of copper in the clay

Pratt Complex sites are typically found in the Arkansas River lowlands. These people were likely associated with the Southern Plains Village Tradition (Brosowske and Bevitt 2006). Bluff Creek Complex sites have been found south of the project area, but little is known about this complex.

A few Middle Ceramic sites have been recorded in the project area and it is likely that other sites lie undetected. Recorded sites are most often found along small material scatters on terraces of the Little Arkansas, Saline, Smoky Hill and Solomon rivers and their tributaries.

Late Ceramic Period (AD 1500-1800)

The Late Ceramic Period is often associated with the appearance of Euro-American trade goods. A wide variety of iron, copper, brass, and glass objects and stone gunflints begin to appear. Groups associated with this period include the Wichita, Kansa, Pawnee, and other nations. Prominent village sites of the Great Bend aspect are found along the upper Little Arkansas River in Rice and McPherson counties. Other village concentrations, including wood-framed, grass-covered houses, arbors and subsurface storage pits are found in Marion and Cowley counties. Camp and other special purpose sites have been recorded in the project area. Light to moderate scatter, including chipped stone, pottery, and faunal debris[11] are usually associated with these sites. The preferred Pawnee Nation bison hunting area was located along the northern edge of the project area. Recent work has identified Great Bend aspect hunting camps nearby (Latham 1996). Sites associated with the White Rock phase, a western Oneota component, are also found. White Rock could be associated with either the Kansa or the Otoe.

Euro-American sites started to appear during this period, beginning with Coronado's expedition through the Central Great Plains in 1541. French trappers and explorers arrived around 1740. They left evidence of hunting camps, trails, refuse piles, discarded weapons and armament, etc.

Historic Period (Post-1800)

Euro-American sites did not appear in numbers until after AD 1800. This effectively established the beginning of the Historic Period. The Wichita, Cheyenne, Commanche, Kiowa, Kiowa Apache, and other nations were still in the area. However, most archeological sites attributed to this period are representative of Euro-American settlement. Sites are typically represented by a wide variety of agricultural settlements and implements, bridges and fords, civic sites, artifact scatters, historic trails, cemeteries, and other materials. Sites of historic military forts Ellsworth and Harker are located near the project area, as are a number of historic trails (Santa Fe, Chisholm, etc.) Euro-American settlement increased when Kansas

[11] "Faunal debris" refers to animal remains associated with archeological sites

achieved territorial status in 1854. Potawatomi, Kickapoo, and other Indian nations were moved to reservations and later to Oklahoma. Euro-American settlement increased dramatically following the granting of state status in 1861. Another settlement boom occurred in 1865 at the end of the Civil War. The "cowboy era" arrived during the 1870s, along with the railroad and a booming cattle business.

Recorded Sites and Types of Sites

As of August 8, 2002, there were 59 recorded archeological sites in Harvey County, 32 in Reno County, and 123 in Sedgwick County. Although helpful in determining the likelihood of finding additional sites in the area, these numbers do not provide concrete evidence.

The project area includes a variety of specific site types, including lithic quarries/collection stations, tipi rings, stone alignments, earthen construction, human burial areas, and rock art sites.

Lithic Quarries/Collection Stations

Little systematic excavation of quarry sites has occurred in Kansas. However, several sites have been recorded near the project area in the Flint Hills. Chert or flint outcrops in the Flint Hills were commonly used by native peoples for the manufacture of chipped stone implements. Only one of these sites has been documented on the periphery of the project area, but additional sites are possible. Four quarry sites are found near the project area in Butler County (Brown and Simmons 1987).

Rock Shelters

No rock shelter sites have been reported within the project area. Several sites have been recorded in southeast and north-central Kansas (Brown and Simmons 1987). The potential for locating sites of this type depends on the location of suitable rock outcrops, large enough to be used for shelter.

Tipi Rings, Stone Alignments, and Earthen Construction

` The location of tipi rings, stone alignments, and native inhabitant earthen construction is rare in Kansas. This is probably due to extensive farm cultivation throughout the state. These structures may have been common, before Euro-American settlement. Sites may still occur in arid or other regions less subject to cultivation.

Earthen "council circles" attributed to astronomical registers have been recorded in McPherson County (Paint Creek or Udden site, 14MP1) and at the Sharps Creek or Swenson site (14MP301). These sites consist of low central mounds, 20-30 meters in diameter, surrounded by a shallow ditch or series of oblong depressions. According to Brown and Simmons (1987), maximum relief of the features ranges from 44 to 88 centimeters (17.3 to 34.6 inches.)

Human Burial Areas

Areas set aside for human remains (i.e. mounds and ossuaries) are usually attributed to the Late Archaic and Ceramic periods. A number of these sites have been recorded near the project area and several of these sites have been excavated. Numerous additional instances of fragmentary human bone remains have also been recorded. There is one burial site located near the project area in Reno County (Brown and Simmons 1987). Larger burial sites tend to be associated with large village sites located along the banks of major rivers and tributaries.

Rock Art Sites

Many rock art sites have been recorded in Kansas. Most have been found along the eastern edge of the Smoky Hills region. Smaller numbers of sites have been located in the southeast corner and south-central parts of the state. Site distribution appears to coincide with the distribution of suitable rock outcrops. All recorded sites include petroglyphs (figures pecked into the rock) and one site includes a pictograph (figures painted on the rock.) Nearly all the artwork is considered to be a part of the pan-Plains incised rock art tradition dating from just before European contact. No rock art sites have been recorded within the project area (Brown and Simmons 1987).

Habitation Sites

Cultural deposits at habitation sites are often linked to seasonal occupation and may include subsurface features. Evidence may include organic staining of the soil and/or the presence of a diversity of tool classes. Site size can range from moderate to extensive and may include numerous landforms. Two types of habitation sites may be found within the project area, including:

Residential Base or Village Residential bases or villages served as the hub from which foraging parties originated. Most processing, manufacturing and maintenance activities occurred there. Village archeological sites tend to be large and contain a high density of widely varied tools and other artifacts.

Field Camp Foragers tended to set up temporary operational centers while away from the village. Individual sites have been differentiated according to the nature of the resources collected and the size of the social group supplied. Subsurface features may be present.

Lithic Scatters/Task Specific Sites These short-term occupation sites are generally related to the procurement of a limited number of locally available resources and/or the reduction of raw lithic materials. Subsurface features, structures, and organic staining are not generally found at these small sites. The density and diversity of cultural debris is limited. Artifacts are often restricted to task-specific tools. Lithic scatters often fall below the threshold of visibility, even with excellent survey conditions. Isolated finds may be associated with lithic scatters. These sites are often found in rugged terrain, where only a small area is suitable for habitation, such as on small benches and ridge spurs. Types of sites include preliminary food processing, lithic procurement, and/or reduction, and artifact scatter sites.

Bison Kill Sites These task-specific sites are unique enough to be treated separately. They range in size and are generally associated with favorable terrain for animal impoundments or jumps. Impoundments could be used as naturally occurring traps. They would include steep-walled ravines, draws, or arroyos and other areas where animals could become trapped or bogged down. Jump sites are generally found at the base of steep to moderately steep ravines and canyons where the herd could be driven over the edge. Most recorded kill sites are found buried in sediments. None have been recorded within the project area.

Sacred, Specialized Ceremonial, or Mortuary Sites Cemeteries, cairns, mounds, petroglyph, and pictograph sites are included in this type. They may or may not be spatially separated from habitation sites. Sacred sites are often archeologically difficult to recognize. The *Handbook of American Indian Religious Freedom* indicates that sacred sites include places where:

- ancestors arose from the earth
- the clan received its identity
- ancestors were buried
- people received revelation
- a culture hero left ritual objects for the people
- people made pilgrimages and vision quests
- gods dwelled, or
- animals, plants, minerals, or waters with special powers were found.

Additional types of sacred sites were listed by Sundstrom (1996), which included:

- places frequented by the spirits of one's ancestors
- places where esteemed members of a group died or were buried
- places where ceremonies were held in the past
- places recognized as sacred by other groups.

Archeologists categorize sites as either general or specific. Sites were often associated with springs, round stones (especially in areas at some distance from streams or other water sources), fossil outcrops, or places where rock art or stone effigies were present (Sundstrom 1996).

Chapter 4: Environmental Consequences

The affected area encompasses the communities, land, water, and air-sheds that might be affected by the project. The boundaries of the affected area for each resource extend to where impacts can be reasonably measured and have meaning. Watershed boundaries are used for the analysis of hydrological conditions. For geological, soils, and cultural resources the affected area includes those parts within or in close proximity to the *footprint* impact of the project's construction sites. Human resource impacts are measured within local land divisions, typically counties because of the data sets. For environmental justice issues, zip codes are used to distinguish certain locales of interest. Boundaries for climate change have less meaning, but water basins boundaries add meaning. The term "project area" can be used interchangeably with "affected area" in the discussion in this chapter.

Direct environmental impacts (Phase IIb, III, and IV) would be limited to the immediate areas surrounding the pipeline, Surface Water Treatment Plant (SWTP), recharge basins, the Little Arkansas and Arkansas rivers, and the Equus Beds, Bentley Reserve, and Expanded Local well fields in Harvey and Sedgwick counties. Environmental impacts could include impacts to water levels in Cheney Reservoir in Reno and Kingman counties and possible changes in spillway releases and resulting flows in the North Fork of the Ninnescah River.

Impacts are discussed for the Harvey, Sedgwick, Reno, Marion, and Kingman county region, with an affordability analysis included, for the **Preferred Alternative** (100 MGD ASR [60/40] with Federal funding) and the **No Action Alternative** (100 MGD ASR [60/40] without Federal funding.) Little or no impact to environmental, human, economic, or cultural resources is expected outside of the project area and surrounding counties.

Since the alternatives are identical except for their funding, the impacts would be would be identical also, except the for "Socioeconomics" and "Environmental Justice" sections. A *baseline* was needed to compare impacts of the other sections to; it was decided this baseline would be provided by considering a **No Project Condition**, even though this condition would be impossible to obtain as the ILWSP is in the process of being implemented.

Setting

Construction of a surface water diversion structure and intake, water pre-treatment plant, pipeline, wells, settling basins, access roads, power lines, SCADA, and other infrastructure would cause physical impacts on the landscape. As with the case of many construction projects, many of these impacts would be short-term or intermittent. These include noise and air impacts from machinery, staging areas that are disturbed while stockpiling materials, and active excavation corridors for laying pipelines and cables

The project area covers approximately 150 square miles. Within that area an estimated 266 acres would be physically impacted on a long-term basis, including 65 acres of prime farmland (Table 4-1). Another 1,700 acres would be disturbed on a temporary basis. The project is estimated to be completed over a period of 40 years during which there would periods of intense construction activity.

Geology

Construction could cause localized, permanent changes to geological resources. For example, the removal of topsoils in recharge basins would expose porous sands and conglomerates. Minor, permanent changes could occur to surficial geology due to the construction of roads, overhead power lines, runoff control features, the SWTP, a recharge basin, and other facilities. These minor impacts (either permanent or temporary) would not measurably affect natural geologic processes or project area geology. Overall, geological impacts would not be considered to be of concern.

Mitigation - Geology

No mitigation for impacts to geology is required. Soils and Prime Farmlands Construction of the diversion structure, surface water intake, pipeline, recharge basins, well fields, SWTP, electric power lines, SCADA system, and ancillary structures would result in some soil disturbance. Erosion could occur in areas where bare soil has been left exposed, water temporarily discharged during well tests, and where wheeled or tracked vehicles were operated. Construction traffic could compact some soils and construction would impact some prime farmlands as noted in Table 4-1.

Table 4-1 Projected Impacts to Soils and Prime Farmlands			
Alternative	Temporary (acres)	Permanent (acres)	Prime Farmland (acres)
100 MGD (60/40 Option) with Federal Funding	1,700	266	65
100 MGD 60/40 Option w/o Federal Funding	1,700	266	65

Sedgwick County

Approximately 82% of Sedgwick County is listed as prime farmland (SCS 1979). Wichita and its surrounding metropolitan area cover more than 10% of the county area. The total acreage to be disturbed by the project (Table 4-1) would be less than 0.01% of the total area, and more than 72% of that disturbance would be temporary in nature (trenching, equipment and materials storage, staging, soil stockpiling, temporary erosion control, etc.) Construction in the Equus Beds Well Field (northern Sedgwick and southern Harvey counties) and Local Well Field (Sedgwick County) would temporarily disturb about 900–1200 acres. The access road, and diversion and recharge well heads would permanently impact approximately 200 acres, including 40 acres of prime farmland. Expansion of the Local Well Field would temporarily disturb approximately 17 acres inside the Wichita city limits, and the well heads would permanently disturb another 10 acres.

Harvey County

Approximately 72% of the land area in Harvey County is prime farmland. As with Sedgwick County, only small areas of prime farmland would be disturbed by construction and most impact would be temporary.

Reno County

Approximately 67% of the land in Reno County is prime farmland. Most of Cheney Reservoir also lies in this county. However, actual construction is slated to occur only within Sedgwick and Harvey counties. No direct impact to prime farmlands in Reno County is expected.

Kingman County

A small part of Cheney Reservoir lies in the northeastern corner of Kingman County, but, as with Reno County, no impact to prime farmlands is expected, as no project-related construction is planned for this county.

Permanent, detrimental impacts to soils in the project area are not expected.

Mitigation – Soil Disturbance

Construction would, to the extent practicable, occur along existing rights-of-way and next to, or in place of, pre-existing facilities, minimizing impact to prime farmlands and undisturbed soils. In addition, most disturbances on prime farmland would be for pipeline construction. Soil would be replaced once the pipeline is installed, resulting in only temporary impacts.

Soil loss would be minimized and mitigated by implementation of erosion and sedimentation control plans. Best Management Practices (BMPs) would be used, possibly including silt fences, silt traps, sedimentation basins, and reshaping and reseeding. Water discharged during well-testing would be collected and piped to the nearest waterway to prevent local erosion. Since more than 5 acres of land would be disturbed by construction, a National Pollutant Discharge Elimination System (NPDES) permit would be required. It would be obtained from KDHE and would include a specific plan to prevent and control erosion from storm water runoff and subsequent downstream water quality degradation.

Land Use

The City, with an estimated metropolitan population of 460,000, occupies more than 10% of Sedgwick County and smaller parts of Butler and Harvey counties. A 21% increase in population (60,000 persons) is projected for Sedgwick County, including Wichita, by 2030 (GMD2 1995). This growth, along with related growth of business, industry, and infrastructure, would occur whether or not the project is implemented. Implementation would not dictate whether growth is contiguous and compact, or scattered and of low-density. Though increasing the available water supply would tend to enhance the rate of conversion of agricultural lands into residential and business developments, changes in land use would not generally be considered as substantial or adverse. Restoration of water levels in the aquifer would benefit agricultural irrigators and all other water users.

The combined land area of Sedgwick, Harvey and Reno counties is approximately 1.8 million acres, with approximately 1.28 million acres used for crop cultivation, primarily wheat and corn. Nearly all of that cultivated acreage could be considered prime farmland. Approximately another 375,000 acres are used for pasture and livestock production. The small part of Kingman County within the project area includes part of Cheney Reservoir and nearby lands. Cheney Reservoir covers approximately 9,600 surface acres and has about 67 miles of shoreline. Cheney State Park encompasses approximately 1,913 acres, while another 5,439 acres of land and 4,109 acres of water make up the Cheney Wildlife Management Area.

The Equus Beds Well Field occupies approximately 1,200 acres within Sedgwick and Harvey counties, where most of the land is made up of croplands, warm season pasture and riparian[1] woodlands. The Local Well Field covers only about 10 acres and lies completely inside the Wichita city limits.

Small areas and rights-of-way needed for permanent structures, including the surface water intake, pipeline, recharge basin, SWTP, overhead electric lines, SCADA towers, wells and roadways would cause minor impacts on future land use. Most of the construction would involve pipelines, which would impact land use only temporarily. Approximately 12 miles of the new pipeline would be installed along existing pipeline right-of-way. About 29 acres would be permanently impacted by construction of the SWTP and another 200 acres changed by installation of well heads, roads, and a recharge basin.

Mitigation – Land Use

To the maximum extent practicable, all construction would replace existing structures, occur on already-disturbed land next to existing structures, or along existing roads and rights-of-way. Care would be taken to minimize the foot print whenever construction is required in riparian or other sensitive areas. Roads and rights-of-way would run parallel to or along the edges of, rather than through riparian zones, prime farmland and other sensitive ecosystems whenever possible. For these reasons, no mitigation would be necessary for changes in land use. Approximately 266 acres including about 65 acres of prime farmland would be permanently disturbed. The farmlands disturbed would not be available for crop production. Lands would be physically altered by the project and dedicated to roads, well sites, and recharge basins.

Water Resources

Key concerns about water are related to changes to the levels of water in the Little Arkansas, Arkansas, and Ninnescah rivers, Equus Beds aquifer, and Cheney Reservoir. These changes are in turn related to concerns about water quantities (including water rights) and quality, aquatic resources, wildlife, and other topics addressed in this EIS. To have an understanding how the project would affect water resources a hydrology model was developed and used to estimate the changes. Model results were used in estimating the effects on biological resources.

Modeling Hydrology

The Reservoir Network (RESNET) computer model was used to evaluate potential hydrologic impacts of Wichita's ILWSP (including the ASR.) Modeling required data from all aspects of the ILWSP, as impacts to surface and ground water in the area would not be mutually exclusive. Model details are found in Appendix A, but the following general data sets were used:

[1] *Riparian* – pertaining to the banks of a river or stream, and the plant and animal communities found there

- Historical mean daily stream discharge at selected points within the project area
- Historical monthly reservoir evaporation rates
- Available storage and other physical data for Cheney Reservoir
- Available storage, natural recharge and other parameters for the Equus Beds aquifer
- Wichita's current and projected water demands
- Agricultural irrigation demands in the Equus Beds Well Field area minimum Kansas desirable stream flow requirements
- Supply capability and other operating parameters for all current and potential water supply sources, and
- The preferred allocation order for each water supply source.

RESNET then performed a daily simulation of reservoirs and streams as a circulating network. Impacts to ground waters were simulated. A daily water balance was calculated for ILWSP over an 85-year period (for water years 1923 – 2007.)

Three alternatives were modeled, based on date, water demand, and comparison of a project compared to no project, as follows:

- **Current** – This alternative used year 2000 average-day demand data to simulate current City water requirements, based on ASR construction through Phase I
- **No Project** – Same as "Current," except average-day raw-water demands were projected through the year 2050
- **ILWSP 100** – This alternative projected average-day demands and included development of the following components, projected through the year 2050, including:

    - The capture of 60 MGD of induced filtration surface water and 40 MGD of direct diversion surface water from the Little Arkansas River (ASR)
    - Redevelopment of the Bentley Reserve Well Field, and
    - Expansion of the Local Well Field.

The model considered both municipal and agricultural demands on the aquifer.[2] RESNET simulated aquifer operations in the same way it would a surface water reservoir. A USGS MODFLOW groundwater flow model was used to create a table used by RESNET to relate aquifer elevation, aquifer storage deficit, and aquifer gains and losses to the Arkansas and Little Arkansas rivers. Table 4-2 lists total gains and losses for the Equus Beds as a function of water table level. The table is a product of simulated stream flux derived from the groundwater flow model and a review of the distribution of recent baseflow gains

[2] Details on the development of water demands can be found in section 1.5 of Appendix A

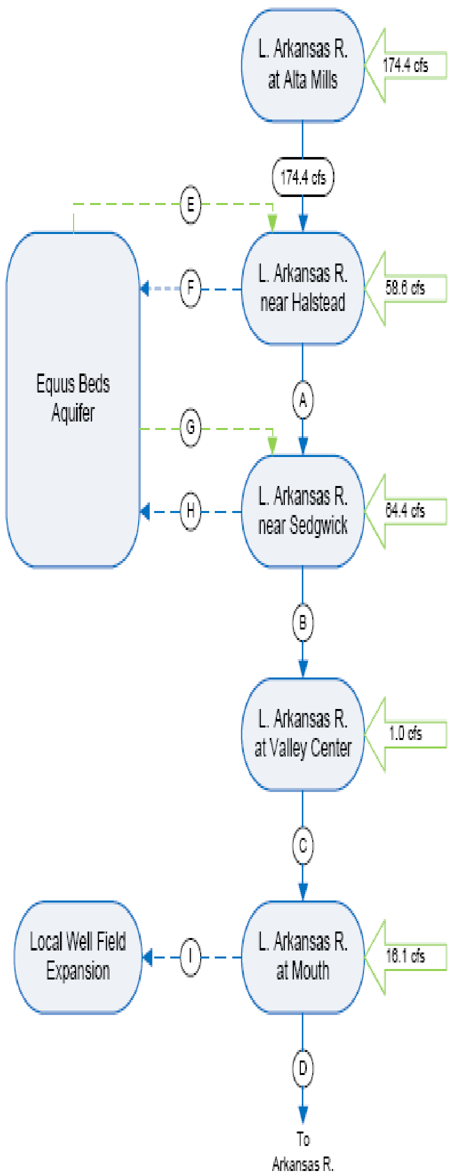
in the Arkansas and Little Arkansas rivers next to the project area. The final two columns in Table 4-2 show the resulting distribution of aquifer losses. Results indicate that the aquifer contributes water to both rivers once elevations reach 1,389 feet (storage deficit of 63,500 acre-feet.) Aquifer gains and losses were simulated to the Arkansas River near Maize, Little Arkansas River near Halstead, and the Little Arkansas River near Sedgwick.

Table 4-2 Equus Beds Storage Deficit Gains-Loss Data

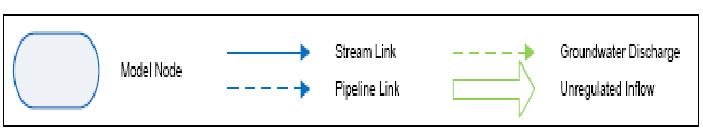
Index Well 886 Elevation (ft. NGVD[3])	Storage Deficit (acre-ft.)	Net Equus Beds Loss Rates (cfs)	
		To Arkansas River	To Little Arkansas River
1,342	429,700	-116.6	6.6
1,360	289,400	-72.8	10.8
1,366	242,700	-58.3	12.3
1,370	211,500	-50.5	12.5
1,375	172,600	-38.7	13.7
1,380	133,600	-24.1	15.1
1,385	94,700	-11.1	17.1
1,389	63,500	0.6	19.4
1,390	55,700	4.1	20.0
1,395	16,800	20.6	23.4
1,396	9,000	24.8	24.2
1,402	0	41.8	28.2

[3] NGVD = National Geodetic Vertical Datum

Water Balance for Little Arkansas River



Schematic Location	Description	Average Flow for Alternative (cfs)		
		Current	No Project	ILWSP
A	Flow in Little Arkansas River below Halstead	238.5	236.8	222.9
B	Flow in Little Arkansas River below Sedgwick	310.9	306.7	278.1
C	Flow in Little Arkansas River below Valley Center	311.9	307.7	279.2
D	Flow in Little Arkansas River at Mouth	328.0	323.8	258.1
E	Groundwater discharge from Equus Beds to Little Arkansas River above Halstead	5.4	3.7	6.0
F	Recharge to Equus Beds from diversion wells along Little Arkansas River	0.0	0.0	16.3
G	Groundwater discharge from Equus Beds to Little Arkansas River between Halstead and Sedgwick	8.0	5.5	9.1
H	Total recharge from Little Arkansas River to Equus Beds through diversion wells between Halstead and Sedgwick and surface intake near Sedgwick	0.0	0.0	18.2
I	Diversions from Little Arkansas River to Local Well Field expansion	0.0	0.0	39.2



Notes:

- Current alternative assumes no project with approximate current water demands (70.4 million gallons per day [MGD] average).
- No-project alternative is same as Current except with projected year 2050 demands (111.6 MGD average).
- ILWSP alternative assumed year 2050 water demands with 100-MGD diversion system from Little Arkansas River for recharge of Equus Beds aquifer.
- All stated values are average flows, in cubic feet per second, over the entire 85-year simulation period (10/1/1922-9/30/2007).
- Flows may not balance exactly because of rounding.

Figure 4-1 Water Balance for the Little Arkansas River

Surface Water Resources

Principal streams in the project area include the Arkansas, Little Arkansas, Ninnescah and the North Fork of the Ninnescah rivers. Both the Little Arkansas and Ninnescah are tributaries of the Arkansas River. Cheney Reservoir lies on the North Fork of the Ninnescah and stores water for the support of fish and wildlife, recreation, and drinking water supply.

Zebra mussels (*Dreissena polymorpha*), originally thought to originate in the Black or Caspian seas of Europe, are confirmed invaders of Cheney Reservoir (Jeffrey Tompkins, pers. comm. 5/30/2008) as well as El Dorado and Marion reservoirs. These fingernail-sized, rapidly reproducing mollusks have created serious, economically devastating problems in water supply systems around the country by clogging up intakes, filters, pumps, etc. There are no known effective predators of this species in America, and no known means of extermination. This leaves expensive chemical application along with labor-intensive manual removal of infestations in water systems as the only, temporary treatment options. The presence of this species could impact the City's future reliance on public water supplies from the reservoir.

Cyanobacteria (*Anabaena*) blooms occasionally cause severe taste and odor problems in Cheney Reservoir. The USGS monitors environmental variables, such as light, temperature, conductivity, and turbidity to predict blooms, which can impact use of reservoir water for drinking water.

Minimum desirable stream flows (MDS) established by the Kansas Department of Health and Environment (KDHE) for locations within on the Little Arkansas River are found in Table 3-2. Minimum allowable flows were established primarily for the purpose of protecting irrigation water rights, but also to protect vegetation, fish and wildlife. The Kansas Department of Wildlife and Parks (KDWP) prefers higher flows, especially during spawning seasons, to protect aquatic life (60 cfs from May through June, 34 cfs during the remaining months.) No minimum desirable stream flow standards have been formally established for the protection of spawning aquatic species (Eric Johnson, personal communication, May 19, 2008). Impacts to "Surface Water Resources" are specified below under "Surface Water Levels" and "Surface Water Quality."

Surface Water Levels

Impacts to water surface elevations and flow depths would closely mirror changes in flow. Therefore, flow and elevation are considered together in this section.

Little Arkansas River

Halstead

The project should result in approximately 3 cfs increase in median flow at Halstead for ten months each year by 2050. However, median flows from May through June (typically high flow months) should decrease up to 12 cfs. Should the project not be completed, median flows would be expected to range from about 26 cfs in October to a high of 90 cfs in June. This compares to

Figure 4-2 Little Arkansas River near Halstead

28-78 cfs with the project. Average daily flows at Halstead (in Harvey County) above 1,000 cfs would still occur approximately 4% of the time, and average daily flows above 300 cfs would occur about 10% of the time, in comparison to 11% without the project. Changes in the flow regime due to diversion would be more apparent during flows between 80 and 200 cfs (Figure 4-3.)

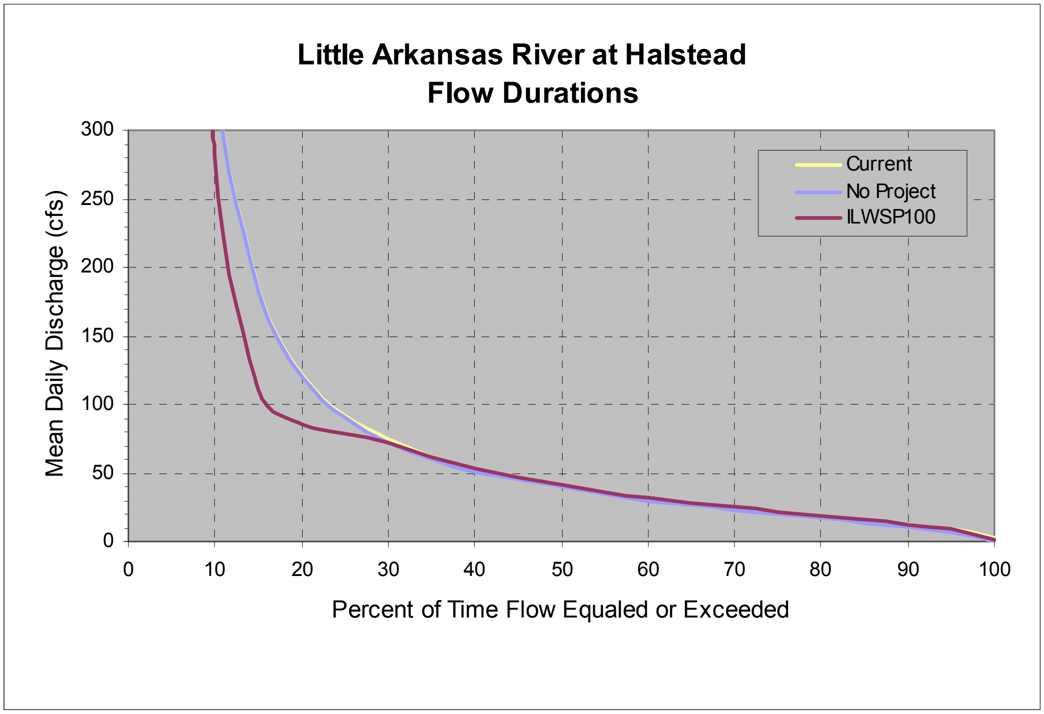


Figure 4-3 Flow durations for the Little Arkansas River at Halstead

Sedgwick

Median flows at Sedgwick should increase about 2-6 cfs from July through April, but decrease by 15-35 cfs during May and June. Monthly median flows for these two months are currently about 94 and 117 cfs, respectively. Based on these results, median monthly flows would continue to exceed the lower limit recommendations from KDHE and KDWP. Greater median flows during low-flow periods should benefit both riparian and aquatic habitat, including vegetation, fish, and wildlife. The predicted increase would be due to additional groundwater recharge of the stream resulting from rising aquifer levels. Water would be diverted from the river more frequently and at higher rates during May and June when flows are typically the highest. Changes in the flow regime due to diversion would be more apparent during flows between 80 and 300 cfs (Figure 4-4.)

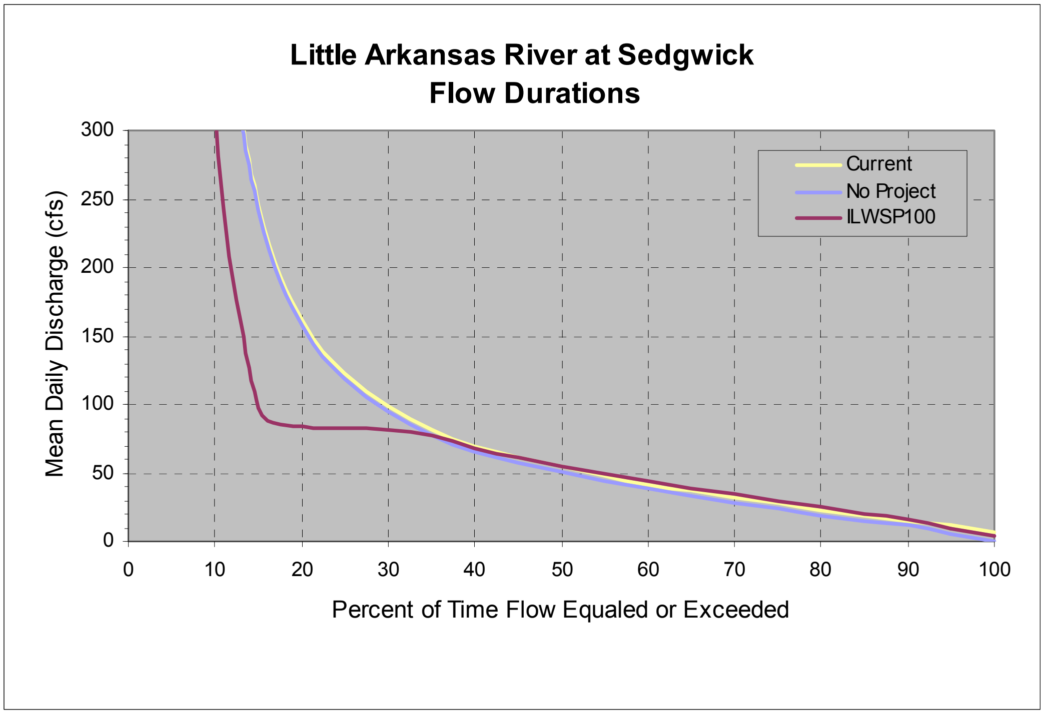


Figure 4-4 Flow durations for the Little Arkansas River at Sedgwick

Table 4-3 Number of Days per Year when Base Flows were exceeded (2005 Permit Requirements)*

	Year										
Little Arkansas River @	1995	1996	1997	1998	1999	2000	2001	2001	2003	2004	2005
Halstead	114	130	270	199	349	228	168	99	151	151	144
Sedgwick	210	180	318	301	365	290	226	143	218	258	239

* *Based on USGS recorded flows*

Valley Center

The project should result in median flow increases of 6-7 cfs at Valley Center (in Sedgwick County) during all months except May and June. Flows would decrease by about 16-36 cfs during this two-month period. Average daily flows over 1,000 cfs would still occur approximately 5% of the time, and average daily flows above 300 cfs would continue approximately 10% of the time. Since these larger, high energy flows would change little and high energy flows have the most influence on stream morphology,[4] load transport,[5] and often on aquatic species reproduction, impacts to these natural processes should be minimal. Kansas established a year-round MDS of 20 cfs at this location. All simulated median monthly flows with the project would exceed the MDS (Figure 4-5). Project implementation would increase the probability of stream flows exceeding the Kansas MDS (78-92%), as compared to conditions without the project (68-92%.) The KDWP has no official, current MDS recommendations for protection of habitat but has indicated in the past that it would prefer minimum flow values at this site of 60 cfs in April, May, and June, when many species reproduce. The agency recommends minimum flows of 34 cfs for the remaining months. Again, project implementation should result in greater frequency in meeting KDWP flow recommendations (56-77% with project compared to 51-74% without project.)

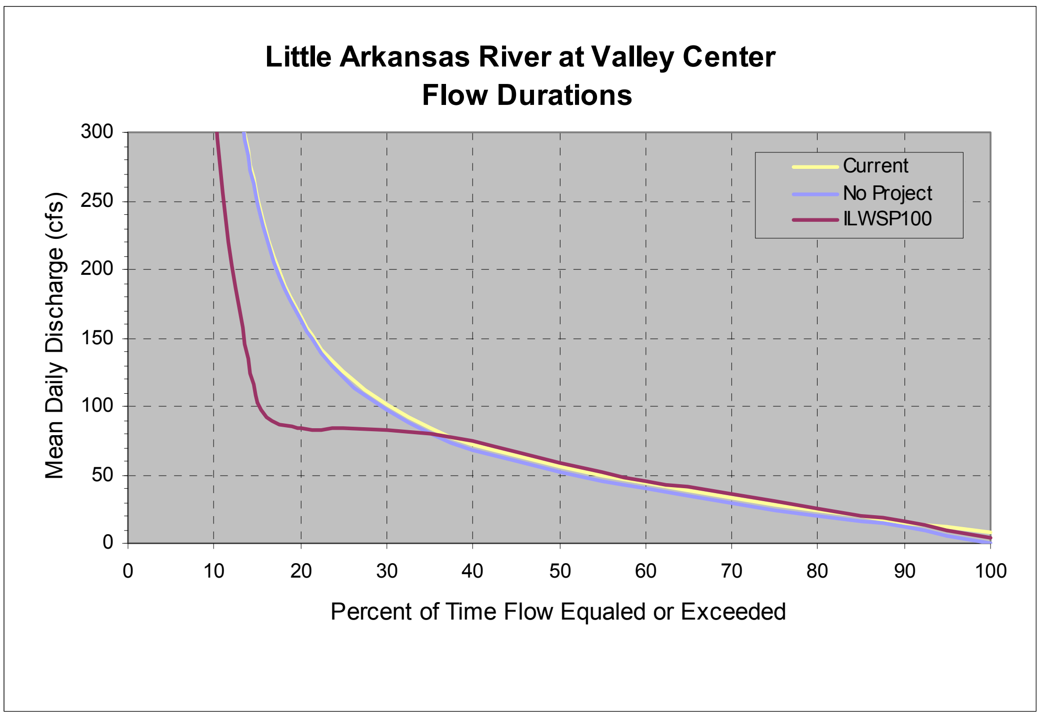


Figure 4-5 Flow durations for the Little Arkansas River at Valley Center

Project-related increases in *base flow* in the Little Arkansas at Valley Center should eventually raise flow elevations in the river about 0.05 feet during most months. Slight declines in elevation from April through June would be likely (as stated above) when diversions would be highest. These greater diversions for aquifer recharge could lower water levels by as much as 0.2 feet about 25% of the time. Data on the number of days per year (1995-2005) when base flow was exceeded are provided in Table 4-3. Modeled monthly base flow summaries are charted in Appendix A.

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4 Stream morphology is the field of science dealing with changes of stream form and cross-section due to sedimentation and erosion processes

5 High energy flows can pick up and carry much more sediment, debris and other particles than lower energy flows

No diversions would occur during low flows and changes to flow during moderate periods would impact aquatic ecosystems less than changes during high or low "outlier" flows. Negative impacts resulting from surface diversions would be partially offset by the benefits of increased *base flow*. Changes in the flow regime due to diversion would be more apparent during flows between 80 and 300 cfs (Figure 4-5.)

Little Arkansas at Mouth

The most pronounced flow changes would occur just upstream of the confluence of the Little Arkansas with the Arkansas River in Wichita. The Expanded Local Well Field (not part of the project) could divert up to 45 MGD (70 cfs) from the Little Arkansas River in this area. Again, no diversions would occur when river flows fall below 20 cfs, the MDS established by KDHE. However, pumping from

Figure 4-6 Little Arkansas flows into the Arkansas River at Wichita

the Expanded Local Well Field and from upstream would typically cause monthly, median flows at the mouth to drop to about 20 cfs. Water would be diverted from collector (infiltration) wells approximately 90% of the time, or for all flows above the MDS. Median monthly flows currently range from about 17-106 cfs. Simulated daily flow durations indicate that discharge to the Arkansas River from this location would decrease markedly about 80% of the time. The Expanded Local Well Field lies between the Arkansas and Little Arkansas rivers, near their confluence in an urban, extensively developed area. Natural habitat within the City has been reduced by floodway diversions, low-head dams, bulkheads, and other channel modifications. Most of the river banks through downtown have been rip-rapped, built upon, or otherwise modified by man

(Figure 4-6.) There is a low-head dam at the mouth of the Little Arkansas, a second dam about 500 meters upstream, and additional dams constructed upstream from there. As a result, water flows from pool to pool and water elevation in this short stream segment would be maintained, despite the drop in average flow. Likewise, periodic high and flood flows would not be expected to decrease in frequency. These flows would effectively maintain the scour and build effects needed to maintain sandbars and other riverine habitat. As a result, changes resulting from the project should not cumulatively impact natural habitats.

During periods of maximum diversion, flows and water levels would drop, but the amount of drop would be limited by the MDS (Figure 4-7.) Project facilities would continue to be developed through the year 2050 (Phase IV), which would assure incremental change in streamflow. Extended implementation would also result in incremental increases in *base flow* as the aquifer level increases. The rate at which the Equus Beds is recharged would depend on climatic conditions and the rate at which construction is completed.

Mitigation – Little Arkansas River, Surface Water Levels
Regaining the natural operating balance between the aquifer and the Little Arkansas River is one of the primary objectives of the project. Overall median flows would decrease, as more water would be diverted from the river when flows reach or exceed moderate levels. However, *base flows* would be protected and likely increased. Significant flow reductions would occur only in the short, pooled reach near the mouth of the stream, primarily during periods of moderate flow. Low-head dams and other modifications to both stream and banks have resulted in an urban, rather than a natural environment near the confluence. Additional mitigation for any changes in water surface level or flow is not necessary in this locale.

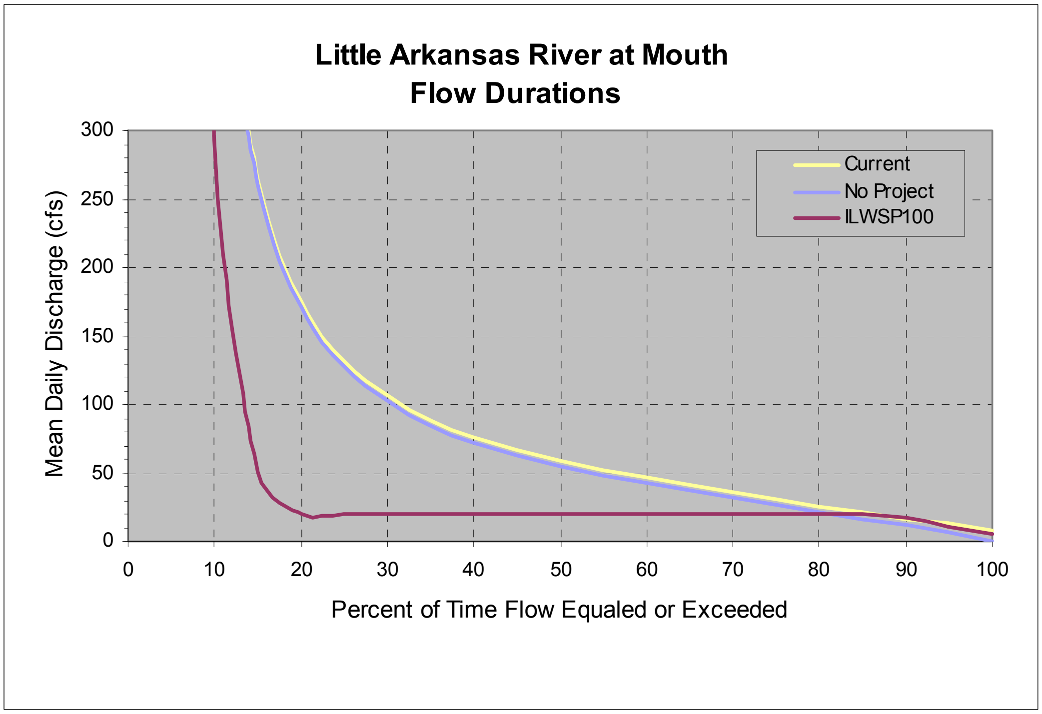

Figure 4-7 Flow durations for the Little Arkansas River at the mouth

Arkansas River

Wichita

The nearest USGS gauging station in the Arkansas River downstream from the Little Arkansas and the project area is approximately 3.7 miles below the confluence with the Little Arkansas. Flows at this site are influenced by groundwater discharges to the Little Arkansas and by withdrawals from both the Arkansas River upstream and from the Little Arkansas. These discharges and diversions include:

- Induced infiltration from the Arkansas River resulting from redevelopment of the Bentley Reserve Well Field
- Induced infiltration from the Little Arkansas River resulting from operation of the expanded Local Well Field
- Diversions from the Little Arkansas for recharge of the Equus Beds aquifer (the Aquifer Storage and Recharge Phases of the ILWSP)
- Changes in the amount of groundwater discharge from the Equus Beds to the Little Arkansas and Arkansas rivers
- Upstream irrigation and water rights withdrawals from the Little Arkansas and Arkansas rivers.

Figure 4-8 Arkansas River downstream from confluence with Little Arkansas

Median monthly flows below the confluence with the Little Arkansas River currently range from about 206 to 765 cfs. During these typically higher flows, impacts from diversions upstream or in the Little Arkansas would be largely buffered. The net or overall effect would be reduced. Simulated flow duration curves indicate that during low flow periods, project flows would be slightly higher than those predicted without the project. Conversely, the project would result in slightly reduced flows during higher flow periods. Overall, water surface elevations with the project would be expected to vary less than 0.1 feet from those without the project (Figure 4-9.) Modeled monthly base flow summaries are charted Appendix A. Flows in the Arkansas River near the mouth of the Little Arkansas should be minor, as the Little Arkansas contributes only a small part of the total river flow. Impacts to sediment load transport and channel morphology would also be considered minor, as these processes occur primarily during high and flood flows. The percent of time that flows exceed 1500 cfs should drop slightly, from about 14% to 13%, with the project.

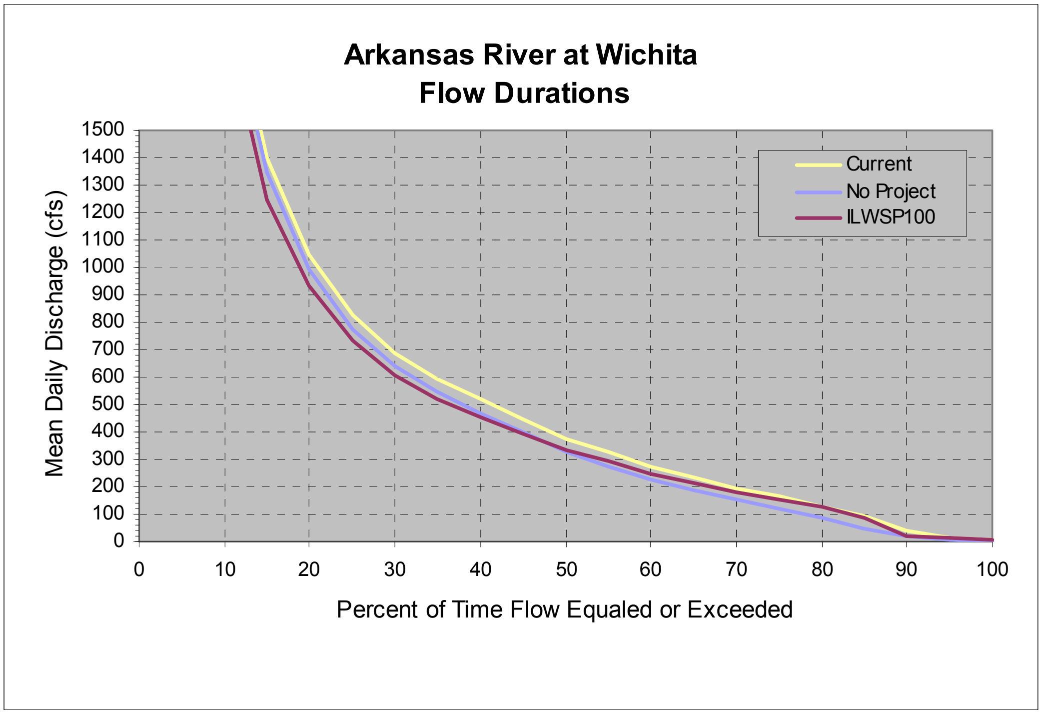

Figure 4-9   Flow durations for the Arkansas River at Wichita

Arkansas City

The USGS station on the Arkansas River at Arkansas City lies about 24 miles downstream from the confluence with the Ninnescah, near the Kansas-Oklahoma state line. Discharge at this site would reflect net downstream impacts from the ILWSP (including the project) as it lies below both the confluence of the Arkansas with the Little Arkansas and with the Ninnescah. Due to distance downstream and relatively small predicted changes to overall flow, no adverse impacts on water resources are expected. Simulated median monthly flows suggest that peak flows in June could be 36 cfs less with the project than without it. That would be equal to about a 2% reduction in median flow. Annual median flows would drop by only about 1.2 cfs or about 0.15% (Figure 4-10).

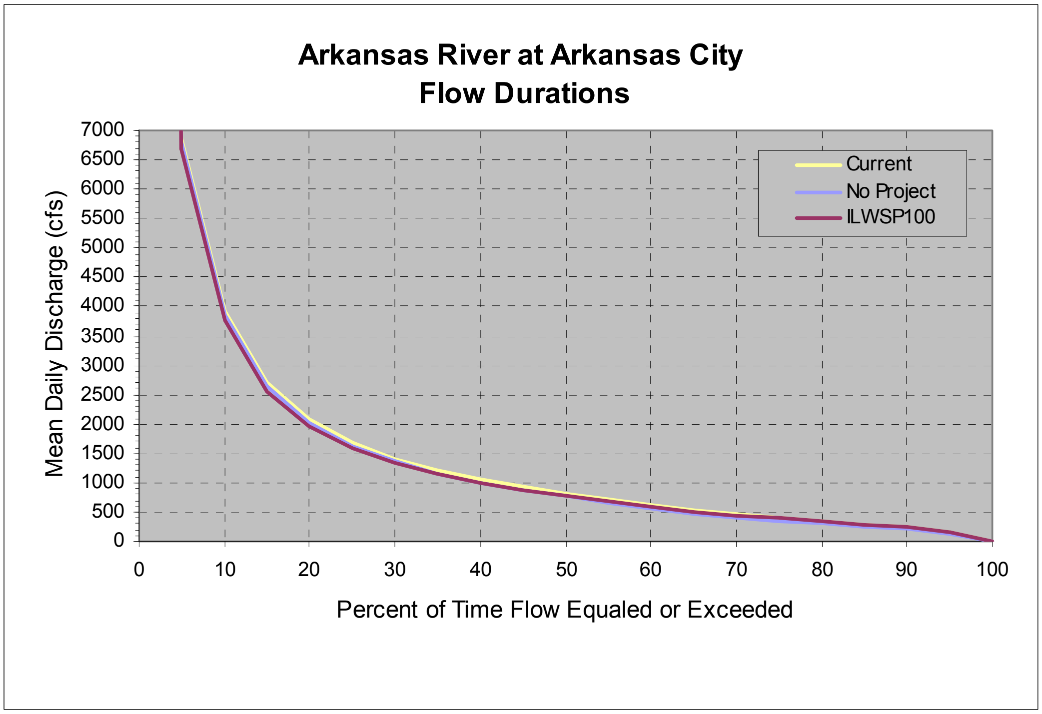

Figure 4-10 Simulated flow durations on the Arkansas River at Arkansas City

Mitigation – Arkansas River, Surface Water Levels
Changes in flow in the Arkansas River downstream from the project area considered to be inconsequential. As a result, net impacts to the river and ecosystem should be insignificant. No mitigation is necessary.

Cheney Reservoir

The project should result in more City reliance upon water from the Equus Beds and less dependence upon water from Cheney Reservoir. Increased use of the Local and Bentley Reserve Well fields (through the ILWSP) would also reduce the City's reliance on the reservoir. RESNET modeling predicts that increased use of Equus Beds water would result in a 1.5 to 3 foot overall increase in pool elevation at Cheney (Figure 4-11.) Should the project not be completed, municipal demands on Cheney during drought periods could deplete the usable water supply.

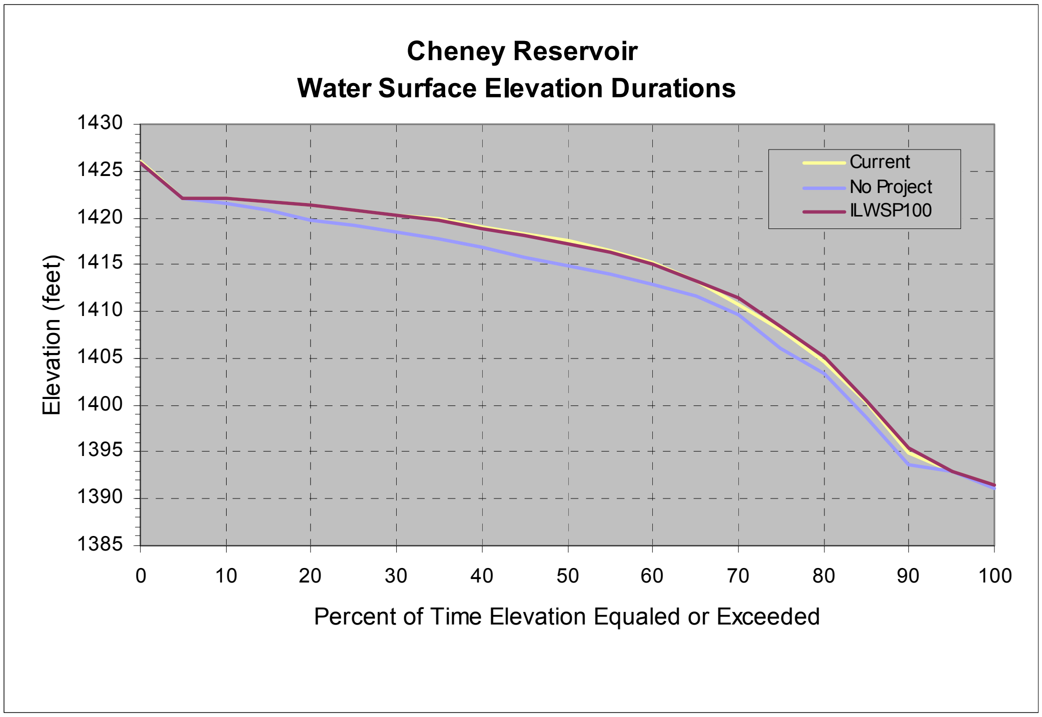

Figure 4-11 Surface water elevations for Cheney Reservoir

Mitigation – Cheney Reservoir, Surface Water Levels
No mitigation should be necessary.

North Fork of the Ninnescah River

There are no minimum release requirements for Cheney Reservoir. Releases generally occur only after significant runoff events and when the conservation pool is full (elevation 1421.6 feet.). Releases and spills from the reservoir into the North Fork would likely decrease without the project, as Wichita would be forced to take more water from conservation storage. The project should result in lower municipal demand on the reservoir, and thus higher average water levels. This could result in an increase in the number and volume of water releases from the dam (Figures 4-11 and 4-12), resulting in similarly modest, higher average flows in the river. Higher water levels should benefit water rights holders, and both aquatic and riparian communities downstream.

Mitigation – North Fork of the Ninnescah River, Surface Water Levels
No mitigation is necessary.

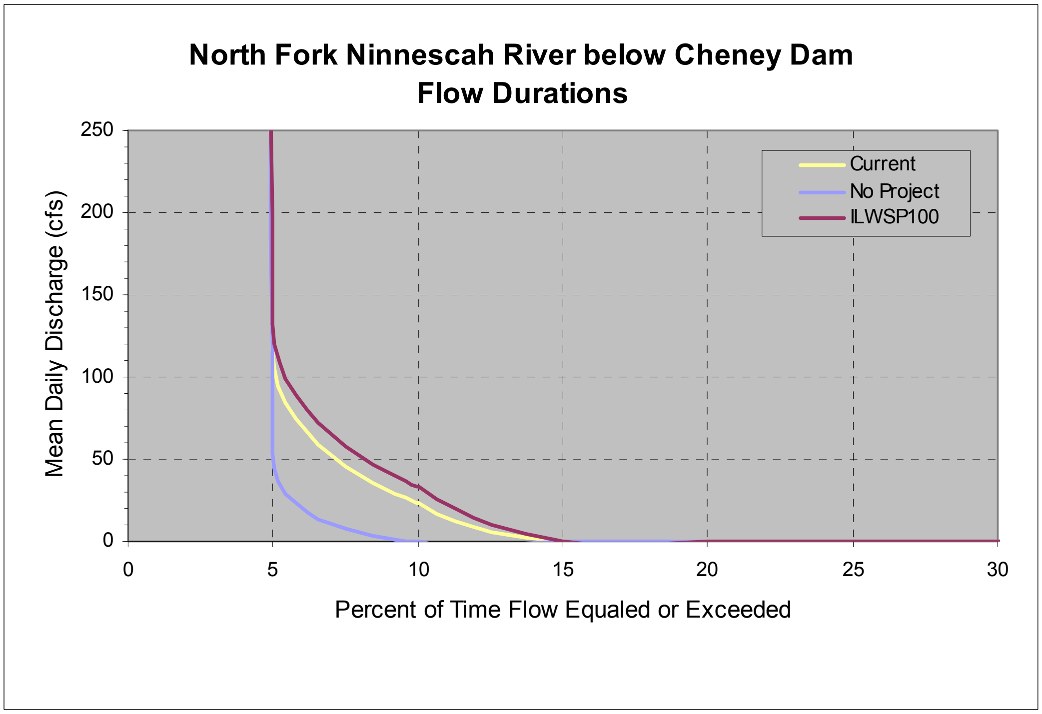

Figure 4-12 Flow durations for North Fork Ninnescah below Cheney Dam

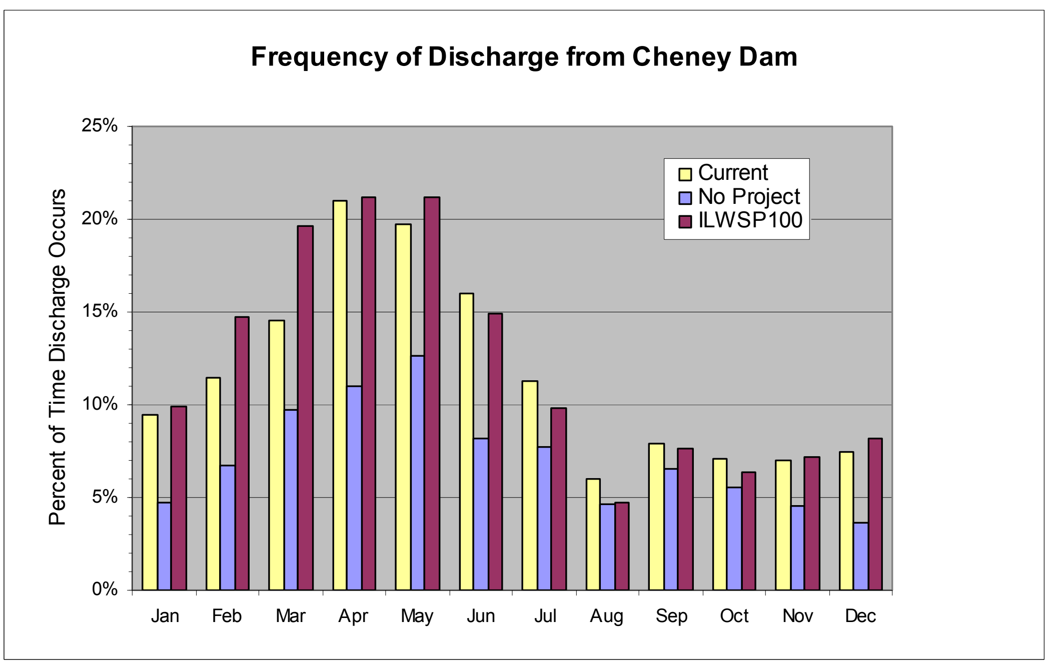

Figure 4-13 Discharge frequency from Cheney Dam

Ninnescah River near Peck

Simulated project impacts to the Ninnescah River below its confluence with the North Fork would be insignificant compared to total stream discharge. Spills from Cheney Reservoir make up only a tiny part of total streamflow. The project could result in overall flow increases of about 9 cfs in comparison to no project (Figure 4-14)

The established MDSs at this location based on month are:

- 100 cfs from November through May
- 70 cfs in June
- 30 cfs from July through September, and
- 50 cfs in October.

The percentage of time that MDS values could be met would vary slightly, whether or not the project is implemented.

Mitigation – Ninnescah River near Peck, Surface Water Levels
No mitigation is necessary.

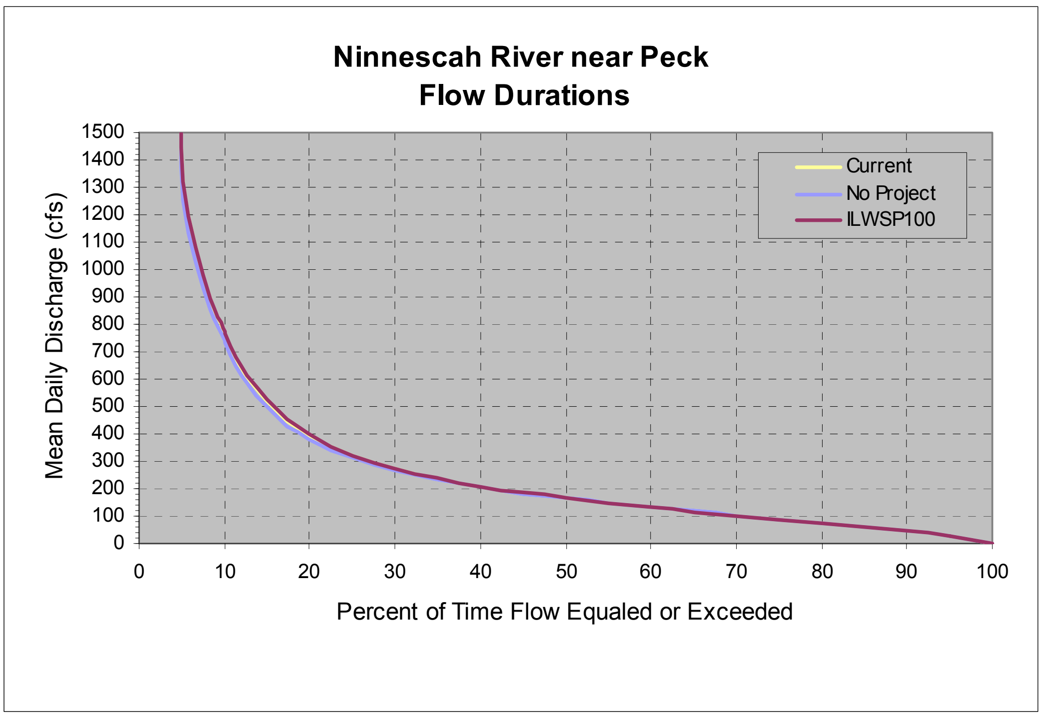

Figure 4-14 Flow durations in the Ninnescah River near Peck

Surface Water Quality

A variety of factors influence water quality in and around the project area, including season, amount of sunlight or shade, flow rate, water depth, precipitation, temperature, aquatic/riparian community health, and agricultural, industrial and domestic activities. Given these factors, surface water quality can vary considerably with both time and location. The project would impact some of these contributing factors, water depth and flow rate, for example, but this impact should be minimal. In addition, eventual higher quality groundwater discharges contributing to *base flow* should improve water quality in the Little Arkansas, which discharges to the Arkansas River.

Little Arkansas River

KDHE includes Little Arkansas River segments 1 (headwaters[6]) and 14 (upstream of the confluence with the Arkansas in Wichita) on its list of streams with water quality impairments. The constituents of concern for segment 14 (project area) include chlordane, dissolved oxygen, oxygen demand, nutrients, and sediments (KDHE 2001). Atrazine levels in water may be elevated during the spring and summer when most herbicides are applied. Identification of seasonal trends is important because high stream flows have a substantial effect on chemical loads (Christensen *et al*. 2000). Chemical concentrations are often reduced during periods of high flow, which are generally more common during certain months.

In general, the Little Arkansas is a "gaining" stream within the project area, as indicated by higher water levels in the surrounding aquifer than in the stream (Myers *et al.* 1996; Aucott *et al*. 1998). Gaining streams are partially replenished from groundwater sources. A relatively large amount of local annual precipitation (approximately 20%) recharges the Equus Beds aquifer and moves down gradient. Percolation through sands and soils removes some contaminants, resulting in higher quality water in the aquifer than on the surface. Groundwater not intercepted by pumping ultimately discharges to the Little Arkansas and lower reaches of the Arkansas River. The single exception along the Little Arkansas is near Halstead, where a small dam causes higher surface water elevations upstream than in the aquifer, resulting in a reverse flow (the stream recharges the aquifer.)

The quality of water in the aquifer can often exceed that of the river. Seasonal environmental fluctuations, changes in human or livestock activities, flow rates and groundwater levels can directly impact surface waters. Therefore, surface water quality can be beneficially impacted by groundwater discharges. Injecting pre-treated water into the aquifer, or allowing it to infiltrate through sands from recharge basins should increase aquifer storage. It should also raise water table levels, limit salt water intrusion, and help enhance water quality. In addition, pre-treating water to reduce atrazine has been shown to effectively reduce concentrations to near-baseline levels (Ziegler et al. 1999). Simply diverting water through a diversion well located next to the stream removed about 75% of the atrazine, probably through sorption to aquifer sediment (Schmidt *et al.* 2007). This filtration process also removed or reduced the concentration of other potential contaminants (that is*,* chlorides, suspended solids, bacteria, etc.) Some suspended solids filter out as water flows through the stream bottom to bank storage wells. These solids tend to re-suspend in the stream during high flows,

[6] Headwaters refer to waters located near the origin or beginning of a stream

which temporarily increases suspended solids concentrations in the water column. Suspended sediments are scoured from the bottom during high flow events anyway, so little additional impact would be expected.

The overall effect would be increased gain of higher quality water in the Little Arkansas from Equus Beds discharges. Provided that polluting influences remain the same, long-term improvements in Little Arkansas River water quality would be expected.

Mitigation – Little Arkansas River, Water Quality
The project is intended to improve long-term water quality in the Little Arkansas River. No mitigation is necessary.

Arkansas River

Water quality impacts to the Arkansas River should result primarily from changes in the quantity and quality of water received from the Little Arkansas. While diversions from the Little Arkansas would occur only when flows are above *base flow*, these diversions would nevertheless reduce the quantity of better quality water available for dilution of the salty Arkansas River. This impact would be somewhat reduced once the aquifer elevation exceeds 1389 ft. Flow simulations indicate that the Equus Beds would then start contributing to *base flow* in the Arkansas as well as the Little Arkansas. Water entering the stream from the aquifer would be of generally higher quality, but of insufficient quantity to substantially improve mainstem water quality.

Long-term impacts to the Arkansas River downstream of the confluence with the Little Arkansas should result in an overall average decrease in flow of about 2%. Improvements in the quality of Little Arkansas discharges and to Arkansas River recharge from a rising aquifer should partially mitigate this minor reduction in flow. Total dissolved solids (TDS), total suspended sediment (TSS), and chloride concentrations would likely increase slightly in the mainstem. Such increases would be expected to be insignificant.

Mitigation – Arkansas River, Water Quality
Predicted changes in water quality in the Arkansas River are less discernable in comparison to the water quality improvements expected in the Equus Beds and Little Arkansas River. No changes in designated stream uses would result, as salinity of the Arkansas River is periodically too high for use as an irrigation or drinking water source. No mitigation is necessary.

Cheney Reservoir

Cheney Reservoir lies on the North Fork of the Ninnescah River, which is outside the immediate project area. No direct impact on reservoir water quality would be expected. As aquifer levels rise and groundwater quality improves, more drinking water should be diverted from the Equus Beds aquifer and less from the reservoir, resulting in higher reservoir water levels (provided there are no significant changes in local climate or other surface water uses.) Rising water levels would be expected to have neutral to positive effects on water quality.

Mitigation – Cheney Reservoir, Water Quality
Water quality impacts of higher water levels in Cheney Reservoir are not known at this time, but should not cause any degradation of water quality. Mitigation is not necessary.

North Fork of the Ninnescah River

Increased releases from Cheney Reservoir due to the project should provide a net, positive benefit to water quality in the North Fork of the Ninnescah River and to nearby riparian zones. Increased flows should increase dissolved oxygen levels for support of fish and wildlife and provide additional water to water rights holders.

Mitigation – North Fork of the Ninnescah River, Water Quality
No mitigation is necessary.

Surface Water Rights

Little Arkansas River

The City would not divert water from the Little Arkansas River unless flow exceeds MDS requirements (20 cfs during winter (non-irrigation season and 57 cfs (irrigation season) at Halstead. Trigger rights at the Sedgwick river intake have not yet been determined by the KDWR.) No additional water rights would be needed. There should be no impact to existing water rights.

Mitigation – Little Arkansas River, Surface Water Rights
No mitigation is necessary.

Arkansas River

Flows in the Arkansas River downstream from the confluence with the Little Arkansas would decrease slightly with the project, especially during periods of moderate to high flow. The KDA lists only 1 water rights permit (industrial) within the City on the Arkansas below the confluence with the Little Arkansas. State records indicate that this diversion is not currently active (KGS 2008). The next diversion point is located more than 11 miles downstream, near the city of Derby.

Mitigation – Arkansas River, Surface Water Rights
The modest decrease in flow during high energy river flows, when plenty of water is available, would not impact existing surface water rights. No mitigation is necessary.

Cheney Reservoir

The project should make more water available for withdrawal from the Equus Beds. This should ultimately result in less reliance by the City upon waters diverted from Cheney Reservoir. Reservoir water rights holders would benefit.

Mitigation – Surface Water Rights in Cheney Reservoir
No mitigation is necessary.

North Fork of the Ninnescah River

The project would mean decreased City dependence upon water diverted from Cheney Reservoir. As a result, more water should be available for release from Cheney Dam, benefiting downstream water rights holders.

Mitigation – North Fork of the Ninnescah River, Surface Water Rights
No mitigation is necessary.

Groundwater Resources

The Equus Beds is an important source of municipal, industrial, irrigation, domestic and livestock water. There are 1,620 non-domestic wells withdrawing an average of 157,000 acre-feet (51.2 billion gallons) of water from the aquifer each year. Industrial use comprises approximately 15% of the total, while irrigation takes another 50% and municipalities use 34%. All other uses account for about 1% (GMD2 1995). The Kansas legislature created GMD2 in 1972 to manage and protect the heavily used aquifer. Once representatives were selected and the district boundaries approved in 1974, management of the Equus Beds was based on two fundamental principles: 1) the Aquifer Safe-Yield Principle, which limits withdrawals to annual recharge, and 2) the Groundwater Quality Principle, which seeks to maintain naturally occurring water quality.

Groundwater Levels

The City, irrigators, and others would continue to rely on the Equus Beds as a prime water source, with or without the project. Should the project not be developed, water levels in the aquifer would continue to drop and water quality would degrade as more high-chloride Arkansas River water seeps into the aquifer.

In general, the project would increase the volume of water stored within the Equus Beds. Increasing storage would result in a corresponding increase in aquifer elevation. The rate at which the Equus Beds could be recharged after a drought would improve dramatically. Due to changing climatic conditions, it is not possible to accurately estimate the time needed to replenish current storage deficits; however, the 100 MGD ASR (60/40) Preferred and No Action Alternatives should result in an estimated net recharge rate of 12,700 acre-feet/year (Burns &McDonnell 2003.) With a current deficit of 250,000 acre-feet, initial replenishment should take an estimated 21 years, given the current information on precipitation, temperature, and water use. Once the aquifer were replenished, modeling suggests that water storage could be maintained within 100,000 acre-feet of pre-aquifer development conditions.

The USGS studied groundwater level impacts at artificial recharge sites near Halstead and Sedgwick during 1997-98 (Ziegler *et al.* 1999). River levels near Halstead were nearly always higher than water levels in the adjacent aquifer, due to a downstream, low-head dam. This indicated that, contrary to other segments of the Little Arkansas, the segment running through Halstead tends to recharge the aquifer. In addition, approximately 307 million gallons of water were artificially recharged through a well at the Halstead site. Water levels in shallow monitoring wells showed little or no change, while water levels in deep wells rose during extended periods of artificial recharge. Water levels receded once artificial recharge stopped, most likely due to distribution of locally recharged water throughout a wider area within the aquifer. Regardless, these notable changes in water level in the deep wells verified that artificial recharge rates were sufficient to benefit the aquifer.

Only approximately 37 million gallons of water were artificially recharged at the Sedgwick site. The entire recharge was done through recharge basins rather than through recharge recovery wells. All four monitoring wells showed increases in water levels while recharge was occurring, but when recharge ceased, water levels dropped within two months.

The volume of water recharged at either site during the study was inadequate to accurately predict long-term water level impacts. The spread of recharge waters throughout the aquifer over time and distance (moving away from the recharge point) likely limited the ability to monitor long-term effects over such a short time period. However, RESNET modeling indicates that raising the water table would increase hydraulic gradients from the aquifer to the Little Arkansas River. This would result in an increase in river *base flows*. Raising the water table would also result in a general reduction of hydraulic gradients from the Arkansas River to the aquifer, resulting in decreased infiltration of river water with higher chloride concentrations. RESNET predicts an overall, potential decrease of about 50 cfs by 2050, should the project be fully implemented. In addition, once aquifer levels reach 1389 feet, the aquifer could begin recharging the Arkansas, though volumes would be too small to impact water quality in the river. Discharge from the aquifer to the smaller Little Arkansas would be expected to increase by 4 cfs or greater.

Mitigation – Groundwater Levels
One of the primary purposes of the project is to increase water levels in the aquifer to more natural levels. This should help protect against saltwater intrusion and increase groundwater gains to both the Little Arkansas and Arkansas rivers. More ground water would become available for agricultural, municipal and industrial use. No mitigation for rising groundwater levels is necessary.

Groundwater Quality

Water quality in the aquifer varies considerably, depending upon which geologic formation the water comes from. Water tends to become more mineralized with depth (Burns & McDonnell 2003). Total dissolved solids (TDS) content ranges from 300 mg/l to 2,700 mg/l. Oil field brine (saltwater) contamination has made some groundwater unsuitable for use in parts of western Harvey County. This water quality degradation is attributable, in part, to historic poor management of brines from salt-mining and oilfield production prior to enactment of laws and regulations designed to prevent mismanagement of waste. Chloride concentrations in contaminated areas range from 500 mg/l to 8,000 mg/l. Before saltwater contamination, chloride concentrations were less than 150 mg/l (GMD2 1995). The EPA Secondary Maximum Contaminant Level (SMCL) is 250 mg/l.

The project should provide some water quality relief in both shallow and deeper areas. This would be accomplished by:

1) injecting relatively high quality water from the Little Arkansas River during high flows
2) reducing the hydraulic gradient between the Arkansas River and the aquifer, thereby reducing infiltration rates of high chloride water, and
3) inserting freshwater between salty and higher quality water areas.

Salinity increase in the aquifer is undesirable and is a key water management issue. Adding freshwater is expected to dilute high chloride waters and help impede the rate of water quality degradation by changing the hydraulic gradient.

The USGS collected more than 4,000 water samples from the Little Arkansas River, diverted source water, and monitoring wells near the recharge areas between 1995 and 2000. Researchers found four possible contaminants to be of concern (COCs.) COCs, are defined as contaminants with concentrations greater than 20% of drinking water standards (Ziegler *et al*. 2001). COCs in the Equus Beds include chloride, arsenic, total coliform bacteria, and atrazine. Data indicate that mixing shallow groundwater near the stream with surface water dilutes overall concentrations of atrazine. Powder Activated Carbon (PAC) could be used to remove additional amounts during primary herbicide application season (May through June.) The City would monitor atrazine levels to ensure that water is treated for the contaminant when necessary.

The USGS used chloride as a tracer during artificial recharge studies from 1995 through 2004. Researchers noted that Total Organic Carbon (TOC) concentrations from shallow monitoring wells alongside the Little Arkansas River near Halstead were diluted by 20% compared to water collected directly from the river. Diverting stream water through a diversion well at Halstead removed approximately 75% of the atrazine and diluted other chemical concentrations as well (Schmidt *et al.* 2007). Clay, organic matter, and other particles in the soil

appeared to filter out many constituents. These results demonstrated potentially effective bank water collection and filtration which could enhance water quality protection of the alluvial aquifer.
Schmidt, *et al.* (2007) examined the geochemical effects of induced stream-water recharge on the Equus Beds during a pilot demonstration project from April 1995 through May 2002. The authors concluded that water level declines in the aquifer may accelerate migration of saltwater from the Burrton oil field and the Arkansas River. Data indicated that water levels and chemistry in the shallow part of the aquifer next to the Little Arkansas River were constantly recharged. As a result, groundwater chemistry was similar to that of the Little Arkansas River. Data suggest that artificial recharge from the Little Arkansas during high flow would not only augment the City's underground water supply, it would replenish the aquifer with fresh rather than saltwater (Appendix A).

Water samples from the Halstead recharge site showed physicochemical impacts from artificial recharge. Chloride concentrations (median concentration of 60 mg/l) in diverted source water at the Halstead site were lower than in samples of fresh water. The USGS attributes this to the fact that diversion water was collected during high flow periods when chloride concentrations were lower. Chloride concentrations in shallow monitoring wells approximated chloride concentrations in recharge water shortly after recharge. Once recharge ceased, chloride levels rebounded to greater than pre-recharge concentrations.

The quality of pre-treated surface water diverted at the Sedgwick site was also improved over the quality of raw river water (Ziegler *et al.* 1999). Diverted surface water was treated before pumping into recharge basins (no recharge recovery wells were used at Sedgwick) and most physical properties – like turbidity and suspended solids – improved substantially. A polymer was used to remove turbidity before recharge. Concentrations of constituents like dissolved solids, bacteria, and organic compounds were lower in treated recharge water than in the river. Median chloride concentration in the treated diversion water was 62 mg/l, well below EPA's SMCL.

Given these findings, USGS researchers point out that the volume and period of artificial recharge (especially at the Sedgwick site) have been inadequate to determine long-term water quality impacts. About 744 million gallons of water had been artificially recharged at Halstead by January 2001. Approximately 136 million gallons had been recharged near Sedgwick. Artificial recharge during the Equus Beds Groundwater Demonstration project was equivalent to less than 3% of the water pumped for municipal use (USGS 2008). Some increases in chloride and atrazine concentrations in well water were noted during the trial, though concentrations remained considerably less than standards established by the EPA.

Mitigation – Groundwater Quality
One of the intended purposes of the project is to protect and enhance groundwater quality. Water quality monitoring would continue and mitigation measures; that

is, additional treatment to reduce atrazine, turbidity, chloride or bacteria levels (chlorination followed by dechlorination) would be instituted, as needed.

Groundwater Rights

Area groundwater rights are significantly over-allocated in relation to groundwater recharge values. Prior to 1990, estimated safe groundwater yield per year was 50,240 acre-feet, based on recharge estimates of 6 inches/year. The USGS subsequently revised estimated recharge rates to 3.2 inches/year (Hansen 1991). The more recent estimate supports an actual safe yield of 29,900 acre-feet/year. The City's water rights for the Equus Beds Well Field alone allow use of 40,000 acre-feet (78 MGD) per year.

Groundwater Management District No. 2 was created in 1974 to manage the aquifer's falling water table. This resulted in the closure of most areas in the City's well field to development of additional water rights. Regardless, a total of approximately 120,000 acre-feet/year of water rights had already been allocated in the 175 square mile Equus Beds area by 2003. Should the project be implemented, the amount of water in storage and available for recovery would be reviewed and certified annually by GMD2. The City has obtained additional water rights for withdrawals from the Bentley Reserve and Expanded Local well fields (Table 4-4). However, poor water quality in the Bentley Reserve Well Field already limits agricultural use.

Table 4-4 Projected Water Recovery and Diversion Rates

Area	Annual Quantity (ac-ft)	Max. Diversion Rate (MGD)
Bentley Reserve Well Field	5,000	10
Expanded Local Well Field	35,000	45
Source Water Diversion (Surface)	100,000	100
Storage Recovery Rights	Depends upon volume stored	126

The project would benefit current water rights holders in two ways: 1) higher groundwater levels would reduce pumping costs, and 2) reduced migration of high chloride water from the Arkansas River and the Burrton oil field would help protect groundwater quality.

Mitigation – Groundwater Rights

The project would help protect existing groundwater rights by increasing water storage and improving water quality in the Equus Beds. The KDWR and GMD2 are developing regulations and permitting requirements to ensure that existing water rights would not be negatively impacted. No further mitigation would be necessary.

Air Quality

The Wichita/Sedgwick County area has been designated as "In Attainment" for air toxins and criteria pollutants since 1989 (USEPA 2008). Air pollutant criteria are provided in Table 4-4. The project would add only minor sources of air pollutants and contaminants. Well-head pumps and other equipment would be electrically powered, placing additional modest demands on electric utilities. Backup generators would be used only when utilities fail. As a result, neither the "Prevention of Significant Deterioration" (PSD) increments nor significant impact levels for criteria pollutants would be exceeded in the long-term. Fugitive dust (PM_{10}) from excavations or vehicle traffic over dirt roads could exceed PSD levels during construction. Likewise, short-term emissions from construction equipment could increase NO_X (nitrogen dioxide produced by high temperature combustion), CO (carbon monoxide) and SO_2 levels. Actual increases would depend upon the type and amount of construction equipment being used, but pollutants would only result in short-term impacts to ambient air quality.

Table 4-5 Air Pollutant Criteria

Pollutant	Averaging Period	Significance Criteria (μg/m³)	Secondary[a] Criteria
SO_2[b]	Annual	20	
	24-hour	91	
	3-hour	512	1300 μg/m³
PM_{10}[c]	Annual	17	
	24-hour	30	150 μg/m³
$PM_{2.5}$[d]	Annual		15 μg/m³
	24-hour		35 μg/m³
NO_2[e]	Annual	25	0.053 ppm[f]

Source: www.epa.gov/air/criteria.html

[a] Secondary criteria were established by the EPA to protect public welfare
[b] Sulfur dioxide
[c] Particulate matter less than 10 micrometers in diameter
[d] Particulate matter less than 2.5 micrometers in diameter
[e] Nitrogen dioxide
[f] ppm = parts per million by volume

Mitigation – Air Quality

No mitigation is necessary.

Noise

Background noise levels generally decrease with decreasing population density. The Equus Beds Well Field, Bentley Reserve Well Field and most proposed pumping, pipeline, pre-treatment and recharge facilities would be located in sparsely populated areas of rural Sedgwick and Harvey counties. The Local Well Field is located inside the Wichita city limits, but within a fenced area on City property.

Noise-generating project facilities would be widely dispersed and the operation would not produce a sufficient increase in noise level to impact the public. Most pumps would either be electric submersibles or operate inside enclosed buildings. No facilities would be scheduled for construction within several hundred feet of existing residences or other public structures. On completion of construction, increased operational or maintenance traffic would be intermittent and generate noise comparable to that generated by existing agricultural activities.

Noise during construction would result from construction of wells, increased traffic to and from construction sites and operation of construction equipment. No blasting would occur. If an estimated 3 dB/A increase in noise resulted during construction, the incremental increase could impact a residence or occupied area situated within 600 feet. Should construction noise become a concern, planners could work with residents to develop a mitigation plan. If well construction should occur too near a residence or other occupied structure or populated area, noise mitigation devises, like special mufflers, etc., could be required. Wildlife, livestock, and other sensitive noise receptors could be temporarily impacted as well.

Mitigation – Noise
If necessary, communication with local residents during construction could be important to mitigate possible noise impacts. Wildlife and livestock would likely temporarily vacate heavy construction areas. No further noise mitigation is necessary.

Esthetics

A rural, open, level to rolling agricultural area with scattered trees and farmhouses is typical outside of metropolitan areas in south-central Kansas. The project would not require installation of huge facilities that would block the horizon or interfere with the overall view. Scattered grain elevators, outbuildings, and farm equipment would likely be more intrusive to the passing observer than project facilities. The pre-treatment facility, surface water intake, well-heads and overhead power lines would perhaps contribute the most to change in the observable landscape. Most of the facilities would be constructed underground.

Recharge basins would be located on City property inside locked fences and landscaping would make them as unobtrusive as possible.

Construction and well-drilling equipment would temporarily impact local esthetics. All wastes and by-products generated during construction would be properly handled and disposed. All ground disturbances not specifically resulting in the construction of above-ground facilities would be repaired, reseeded, replanted, or returned to original condition and use. Horizontal drilling would be used to install stream pipeline crossings underground.

Mitigation – Esthetics
No further mitigation is necessary.

Climate Change

U.S. Department of the Interior, Secretarial Order 3226 (2001), *Evaluating Climate Change Impacts in Management Planning*, states that, "Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for scientific research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department's purview. Departmental activities covered by this Order include, but are not limited to, programmatic and long-term environmental reviews undertaken by the Department…".

Weather, something that changes every day or week, but when averaged over a long period of years, is called climate. The World Meteorological Organization and the United Nations Environment Program established the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC predicts that the earth's climate is changing due to atmospheric buildup of greenhouse gases (GHG). These gases include carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (IPCC 2007). Uncertainty exists about exactly how the earth's climate will respond to enhanced concentrations of GHG. However, observations indicate that detectable climatic changes will occur. Most models predict increases in overall temperature and changes in rainfall, evaporation, groundwater recharge rates, soil moisture, and runoff patterns. Based on this information, it is likely that historic and future (that is, year 2050) hydroclimatic[7] conditions in the proposed project area will differ.

Council on Environmental Quality (CEQ) 1997 draft guidance on climate change requires Federal agencies to determine whether and to what extent (1) their actions may affect climate change, and (2) climate change may affect their actions. The CEQ asserts that the first question is perhaps better answered at the

[7] Hydroclimatic refers to conditions of precipitation, flood, drought, evaporation, evapotranspiration, and related water-cycle phenomena

Federal program level. Project-level (local) emissions are likely to be of such insignificance that predicting impacts to climate may not be possible. This approach recognizes that individual projects such as the City's proposed ASR may increase GHG by only marginal amounts, compared to emissions emitted by the state, county, City, or even the utility providing power to the project.

Westar Energy supplies electricity to about 664,000 customers. It is the largest electrical utility in Kansas and would provide electricity for ASR. Demand for electricity in the state increases approximately 1.5% annually (Westar Energy 2007) and peak demand is expected to increase from 4,836 MW[8] in 2007 to 5,648 MW in 2018. ASR would be responsible for only a tiny fraction of this increase. The magnitude of CO_2 emissions generated by ASR would pale in comparison to those generated by the City, county, state, country, or utility. This point illustrates the need to focus on Federal actions at the program level, not the project level, in order to disclose meaningful information about the impacts of Federal actions on climate change.

Kansas does not currently regulate CO_2 emissions. Westar signed an agreement with the State of Kansas during February 2008 to voluntarily reduce its carbon emissions. The company proposes to complete its first round of carbon measurements by early 2009. As a result, figures comparing ASR carbon emissions to those produced by Westar as a whole are not yet available.

Westar proposes to increase its percentage of natural gas electrical generation from 6% in 2007 to about 10% or 11% by 2017 (Westar Energy 2007). Some methane recycled from decomposing landfills is used in its natural gas plants. Gas fired plants generate only about 40% as much CO_2 as coal plants (Westar Energy 2007). In addition, the company reports that efficiency at its Wolf Creek nuclear power plant has increased from about 74% in 1985 to 91% today. This has allowed Westar to increase peak generating capacity to 1,200 MW from the original 1,150 MW while keeping the generation of nuclear waste at a constant level. Nuclear energy generates almost no GHG. Westar has requested a 20 year permit extension (until 2045) for its Wolf Creek operations.

Westar also plans to invest in wind energy and expects to operate three wind farms in Kansas by the end of this year, generating nearly 300MW of emission-free energy. In addition, Westar recently agreed to abide by Leadership in Energy and Environmental Design Standards (LEEDS). Referred to as "Green Building Rating," LEEDS requires state-of-the-art, energy-efficient and environmentally-sound construction. Westar attempts to increase both operational and environmental efficiency as demand increases.

The second question posed by CEQ is difficult to answer. It requires an evaluation of the potential impacts of climate change on the project. To do this, global information must be downscaled to a water basin or local scale. Although

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[8] MW refers to 1 megawatt of energy, which equals 1 million watts

climatic change may be considered to be reasonably foreseeable, especially at the continental or global level, there is no widely-accepted methodology for transforming variations in global temperature or precipitation into incremental, quantifiable changes. Global climatic changes could lead to a variety of impacts on a local scale. Precipitation could increase on one side of a county and decrease on the other. Average temperatures could go down over one time period, and up during the next.

Current climate modeling focuses on *global* hydroclimatic changes. Changes recorded across large areas would be easier to average over time. This could lead to significant differences between global, continental, regional, and local conditions over a specified time period. As an example, overall precipitation could decrease significantly for Sedgwick County by 2050. On the other hand, there would likely be "wet" years, where annual precipitation greatly exceeds the average. The range of change from global influences could mask observation of impacts from small actions. The project's actions can not be differentiated for these reasons.

Numerous "downscaling" techniques have emerged to reconcile global climate change data with local data (Giorgi *et al.*. 1994; Semenov and Barrow 1997; Conway and Jones 1998; Prudhomme *et al.*. 2002; Wurbs *et al.*. 2005). Although few downscaling attempts have been made in Kansas, some insight can be gained from conclusions drawn by University of Kansas scientists (Feddema *et al.* 2008) and from studies conducted in Texas. Spatial downscaling was used to evaluate the impacts of climate change on Water Availability Modeling (WAM) estimates for the Brazos River Basin (Wurbs *et al.* 2005). The study concluded that using Global Circulation Models to predict local climatic changes does not necessarily result in accurate predictions. Muttiah and Wurbs (2002) conducted a similar study on the San Jacinto River Basin. They concluded that their downscaling methods provided only a general framework for evaluating impacts of climate change on water resources management. They also concluded that several different, alternative models could be used to make climate impact predictions. Different models could produce different results.

Feddema *et al.* (2008) provided the most comprehensive projections for climate change in Kansas. They based their projections upon a variety of models and evidence that the level of atmospheric GHG has grown significantly over the past 200 years. Their projections are based on IPCC A1B (middle-of-the-road) GHG emissions levels. Most of the increase in levels can be attributed to fossil fuel burning. According to the authors, about 40% of burned carbon ends up in the atmosphere, while the rest is absorbed by the ocean and land surfaces. As a result, atmospheric carbon dioxide concentrations have risen by 1/3 compared to pre-industrial conditions. Methane levels rose about 300% during the same period. Temperature records show an average increase in global temperature of 1˚ F over the past century. Most of this change has occurred over the past 20 years. Some Kansas farmers are now delaying winter wheat planting by as much as three weeks, compared to 30 years ago. Feddema and his associates conclude that global climate change will lead to stronger, but less frequent, local convective systems (for example thunderstorms) in the mid-latitudes (including Kansas.) This would result in longer dry periods between storms. Less frequent, higher intensity rainfall would likely mean more runoff, more intense floods, and less water storage in soil during dry periods.

The authors suggest that the number of "growing degree days"[9] will increase over the next several decades. This should enhance crop maturation and productivity. However, this prediction comes with a caveat. Increasing the number of "growing degree days" would mean an increase in a crop's need for water, which is estimated as potential evapotranspiration. Model projections show a significant increase in both temperature and evapotranspiration in Kansas' future. As a result, simulations of water deficit, or irrigation water need within the state are projected to increase by 2-8 inches by 2050, depending on location. Soil moisture levels are concurrently projected to decrease, especially during summer months, which would negatively impact river flows, reservoir supplies, and groundwater recharge (Feddema *et al.* 2008). These same authors project that average climate values for south-central Kansas (including the project area) would change between 2000 and 2050, as follows:

- temperature would increase about 4˚ F
- potential evapotranspiration would increase about 5" per year, and
- precipitation levels would remain relatively stable.

The following consequences would likely result:

- there would be a seasonal redistribution of precipitation.
- precipitation events would likely be more severe
- there would be longer dry spells between precipitation events, and
- moisture deficits (the difference between potential and actual evapotranspiration) would increase.

Based on these results, Feddema and associates project that water demand will exceed water supply in south-central Kansas by 2050.

No single downscaling technique has gained wide acceptance among scientists, so the authors based their results on a variety of models, including the:

- Community Climate System Model (CCSM), National Center for Atmospheric Research
- Canadian Climate Center model, and the
- U.K. Hadley Center model.

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9 Increasing average annual temperatures should result in more days each year when warm conditions stimulate plant (crop) growth

Models more suitable to downscaling global-scale climate results into local-scale hydrologic variables are being and will continue to be developed. Reclamation funded one such study during 2008 and more are being planned. Better predictions of future climate change at the basin and local level are needed in order to accurately revise input data sets for the RESNET model used to evaluate impacts of water projects like ASR.

Though accurate, quantitative evaluation of climate change for the small project area may not be possible at this time, conclusions drawn by Feddema and associates highlight general trends. As a result, protecting water supplies in the project area is of high concern. Storing surface waters underground may make them less susceptible to changes in long or short-term hydroclimatic conditions. Raising the water level in the aquifer to near historical levels, as intended, would result in higher base flows in both the Little Arkansas and Arkansas rivers. Increased base flows would help offset projected impacts to river levels caused by climate change.

Mitigation – Climate Change

To the extent practicable, environmentally friendly and energy efficient procedures and equipment would be used both during construction and operational phases of the project. Diversion of surface water, which would be exposed to climatic change, for storage underground should help protect it.

Biological Resources

Wildlife

Most impacts to wildlife would be temporary, occurring only during short periods of intense construction. Increased human and mechanical activity would cause some species to temporarily vacate. Small areas would be permanently altered to construct a recharge basin, SWTP, service roads, power lines, fence enclosures, and install well-heads, pumps, and other small structures. Most permanent construction would occur underground. Native and introduced vegetation are either interspersed between large cultivated fields or residential areas or line the banks of streams (riparian zones) or croplands (hedge rows.) There would be little further fragmentation of the environment.

Mitigation – Wildlife

To the extent practicable, environmentally friendly procedures and equipment would be used both during construction and operational phases. Most construction would occur along existing rights-of-way or on land already cleared for agriculture. Care would be taken to avoid riparian zones, hedge rows, and other areas needed by wildlife whenever possible. No other mitigation is needed.

Endangered, Threatened, and Candidate Species

Several Federal or State-listed species (such as the piping plover, snowy plover, interior least tern, and whooping crane) migrate through or around the project area. Most of these species would be present only during early spring and late fall months, when ASR would operate at reduced capacity. A few species (like the interior least tern) occasionally breed on isolated sandbars in the Arkansas River and endangered, migrating whooping cranes may occasionally rest there as well. Recent development in downtown Wichita has created some suitable habitat for nesting of the least tern in the Arkansas River. However, there is no designated critical habitat in the project area. Construction would occur along the Little Arkansas rather than the mainstem. Project completion would lead to only slight impact to Arkansas River flow. There would be no measurable impact on the Arkansas River or to its sandbars due to periodic construction. Mostly seasonal, high and flood flows would continue to scour river bottoms and maintain sandbars. Mammal and reptile species could move out of the way during construction and re-inhabit most areas once construction is complete.

Though no longer listed, the bald eagle is protected by the Migratory Bird Treaty Act (MBTA) and Bald Eagle Protection Act (BEPA). BEPA does not allow disturbance of nesting sites.

There are no known endangered, threatened, or candidate aquatic species in the Little Arkansas River. The Arkansas River shiner has historically inhabited the main channels of wide, shallow, sandy bottomed rivers in the Arkansas River basin, but there are no known populations in the project area.

Mitigation – Endangered, Threatened, and Candidate Species

To the extent practicable, environmentally friendly procedures and equipment would be used both during construction and operational phases. Should bald eagle nesting be discovered anywhere in the project area, all construction in the immediate vicinity would cease until after fledging. No other mitigation is needed.

Non-Native Species

Most project construction would occur on already disturbed land. Standardized construction methodology designed to limit the transfer or introduction of non-native species would be used. Certified weed-free seed would be used to re-establish vegetation where removed or damaged. Several introduced plant and animal species exist in Kansas. Zebra mussels are found in Cheney, Marion, and El Dorado reservoirs. None of these reservoirs are located within or hydraulically connected to the construction area. Salt cedar, purple loosestrife, and several other introduced plant species are also present, but redistribution of non-native species into new habitats through construction would not be likely.

Mitigation – Non-Native Species

No additional mitigation is necessary.

Critical Habitat

There is no federally designated critical habitat in the project area. There is state-designated critical habitat in the North Fork Ninnescah for the Arkansas River speckled chub and some habitat designated for other species along the Arkansas River. Conditions would not be expected to change enough to have a measurable impact on habitats in these stream reaches.

Mitigation – Critical Habitat

No mitigation for impacts to critical habitat is needed.

Wetlands

Wetlands in or near the project area are small and scattered. The City has taken steps to protect existing wetlands by locating pipelines within roadways, when necessary.

Mitigation – Wetlands

Construction would be routed around wetlands to the maximum extent practicable. Where practical options are unavailable to avoid impacts, wetlands repair and or replacement would become necessary. No other mitigation is needed.

Socioeconomics

Two possible funding alternatives were investigated for this project (Phases IIb, III, and IV.) The first (the Preferred Alternative) would involve Federal funding of up to 25% of the project cost (Federal-local cost sharing.) The second (the No Action Alternative) would require the City to fund 100% of the project. The City has already completed Phase I and is working on Phase IIa without Federal funds. City officials have stated their decision to complete the project, with or without Federal dollars. Therefore, investigating the socioeconomic impacts of both alternatives is imperative. Consumer affordability, regional economic impacts, and environmental justice issues were evaluated for each alternative. Results along with the analytical details and discussions of the economic analyses are found in Appendices B and C.

Water supply projects that reduce the potential for current and/or future water shortages generally benefit a local economy. Water availability can influence commercial output levels, production costs, the number and types of businesses locating in an area, and even labor availability. Should some funding for the project come from sources outside the project region, these funds would positively influence regional economic activity. Outside funding would reduce the amount of local funds needed to build the project and lessen the adverse impact of project costs on household spending by reducing the percentage of consumer income required to "pay the water bill."

Regional economic impacts from construction and operation of water supply facilities stem from capital, labor, energy, and other expenditures. Such spending generally leads to both long and short-term, positive changes in local output, and increased employment. However, if a project is totally self-financed, the net difference in regional economic impacts could be negative. Affordability or financial feasibility refers to the ability of households, businesses, and other water users to pay project costs.

The project could be considered "financially feasible" if local water users have the resources to pay all construction and operating costs. Monthly user fees, retirement of debt incurred during project construction, tax assessments, or other funding methods could be used to pay for the project. The project would be large and costly (the entire ILWSP would cost more than $500 million.) If costs are greater than the community's ability to pay, imposing all costs on consumers would result in financial hardship. Clearly, distributing costs (that is, through government cost-sharing) could make the project more affordable for area consumers.

Economic and other impacts from a project like ASR are not necessarily evenly spread throughout a community. Lower income families could end up paying a higher, or unaffordable, percentage of household income for project benefits. Construction could impact one neighborhood or group more than another as a result of the pipeline layout, location of treatment plants, or the location of other project features. For that reason, environmental justice becomes a concern. The intent of environmental justice is to assure that no group of people bear a disproportionate share of negative impacts.

Methods

The socioeconomic analysis for the project includes a regional impact analysis (RIA) and an affordability analysis. The RIA requires economic modeling using IMPLAN to capture the spin-off effects of project expenditures. These impacts include one-time impacts from initial construction expenditures and recurring impacts from annual operation.

The affordability analysis is based on a household budgeting approach. Water bills (as a percentage of household income) in the project area are compared to water bills paid in others parts of Kansas. Environmental justice is addressed by comparing the potential increase in water bills (with project completion) to income in different sub-areas of the region.

IMPLAN

Regional impacts of projected expenditures for ASR construction, operation, and maintenance were analyzed using the *Impact Analysis for Planning Model* (IMPLAN). IMPLAN uses the Department of Commerce national input-output model to estimate flows of commodities used and produced by industry. Social accounts[10] are converted into input/output accounts. Multipliers[11] are applied for each industry in the area. The model considers percentages of expenditures in each category that either remain in or flow out of the region. This requires the use of estimated changes in expenditures for goods and services.[12]

Regional impact analysis (RIA) measures changes in the distribution of regional economic activity as a result of an alternative. In this case, the alternative is construction of the ASR, and the region includes the Wichita metropolitan area and surrounding counties. For the purposes of this analysis, economically impacted counties would be assumed to include Butler, Harvey, Kingman, Marion, McPherson, Reno, Rice, and Sedgwick.

Flows of money into, out of, or through the selected counties would have both social and economic impacts. The size of the impact area is both expanded and limited by the outward flow of goods, services, and payments. Economic impacts within the region would include:

- Changes in industry output
- Value added
- Employee compensation, and
- Employment.

Industry output is a measure of the value of total industry production. It is directly comparable to Gross Regional Product (GRP). Value added represents payments made to workers, interest payments, profits, and indirect business taxes. Employee compensation refers to wages and benefits paid to workers. Employment is measured as the combination of full and part-time jobs.

IMPLAN considers the following types of facilities associated with water projects:

- Intake facilities
- Wells
- Water lines
- Buildings, and
- Instrumentation.

Activities associated with these facilities (and therefore considered in IMPLAN) include:

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[10] Social Accounts track monetary flows between industries and institutions

[11] Multipliers represent the effect of a dollar spent in a region as it moves from one individual to another. A dollar spent by one individual becomes income for another, who then spends a portion of that dollar in the region, which becomes someone else's income

[12] Goods and services values used in the model cover project construction, operation, maintenance and repair activities

- Water treatment
- Facility repair
- Pumping, and
- Storage.

Estimated costs for each activity are sorted into the following categories:

- Materials
- Equipment
- Fuel, and
- Labor.

Affordability Analysis

Several acts and laws are intended to protect water resources and assure clean public water supplies. These include:

- The Safe Drinking Water Act (SDWA)
- The Clean Water Act (CWA)
- The Toxic Substances Control Act (TSCA)
- The Asbestos Hazard Emergency Response Act (AHERA)
- The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and
- The Resource Conservation and Recovery Act (RCRA).

However, from the public point of view, assuring the affordability of a water supply could be as important as protecting the source itself. The EPA includes "affordability determination" on its list of guidelines for assessing the legal compliance of water supply projects. The use of Federal grants or credit assistance requires an affordability assessment. This assessment requires knowledge of financial responsibility, establishment of penalties and fines, and setting of standards.

"Ability to pay" can be defined as the maximum amount households can pay for water, considering both incoming and outgoing dollars (income and household expenses.) There is no universally accepted method for measuring payment capability or affordability for domestic water supplies. The most common technique has involved calculating the cost of water as a percentage of median household income. Total annual user charges are divided by median annual income and compared to a predetermined threshold value of water utility affordability. This threshold is determined by analyzing household income information, payments for water service, and payments for other goods and services. Affordability criteria are often used with other measures to describe general socioeconomic conditions, including poverty and unemployment rates.

The EPA (1980) looked at the consumer cost for complying with Federal drinking water regulations. Agency economists concluded that annual household water service costs ranging from 1.5% to 2.5%[13] of median annual income raised questions about affordability. Rates over 2.5% of median household income were labeled "unaffordable." The EPA published a follow-up affordability study in 1993. The agency then revised its estimated unable-to-afford threshold to 2.0%.[14] Finally, it was decided that, on average, any increase in annual household user charge greater than 1.0% of median income would require additional financial resources to make it affordable. Study results indicated that a 25% increase in consumer water rates would, in many cases, cause financial hardship. As a result, 1996 SDWA amendments authorized small, public water systems to use less extensive (therefore less expensive) water treatment technology – if the most effective technology was not considered to be "affordable."

The EPA then defined the total affordability level for combined water supply and wastewater treatment as 4% of median household income. This figure was later amended to 4.5%, to allow 2.5% for drinking water supply and 2.0% for wastewater treatment. This 4.5% threshold does *not* apply to each and every household, however. The threshold does not recognize differences in income distribution. Some households can afford to pay more, while others can only afford to pay less.

Confusing the issue even further, the Department of Housing and Urban Development (HUD) established an affordability threshold for water and sewer payments, respectively, of 1.3% and 1.4% (total of 2.7%) of annual median income (EPA 2006). An independent study by the National Consumer Law Center (NCLC 1991) supported an affordability threshold for combined water and sewer bills of 2.0%. The United States Department of Agriculture, Rural Development Act (USDA-RDA) set grant eligibility at 0.5% of median annual income, if annual income in the region is less than 80% of the state median. In other words, any project resulting in a water bill cost increase of less than 0.5% of median household income would not be eligible for Federal funding. Should median household income in a project area fall between 80% and 100% of the state median, the eligible cost-increase threshold would be 1.0%.

None of the thresholds discussed above necessarily represent a maximum payment per household that can be made for water supplies. Accounting for all household expenses in every household would be extremely difficult. Affordability thresholds are based on a variety of factors, some of which can only be estimated. These factors include:

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[13] These rates correspond to average water bill rate increases of 100% (questionable affordability) to 200% (considered unaffordable)

[14] The EPA affordability threshold is not a true measure of *affordability*. It is, instead, a measure of fee increases considered acceptable by lending institutions

- Current water rates
- Current household income
- Costs of alternate water supplies, and
- Other financial considerations.

It is apparent that different Federal agencies use different affordability thresholds for determining the economic impacts of water supply projects. In order to simplify this analysis, meet NEPA requirements for keeping documents concise and to the point, and come up with a single, planning threshold, the commonly used EPA threshold (2.5%) was selected for use in this investigation.

Finally, using simple cost to income ratio to determine affordability within individual households ignores other important factors. The ratio would apply to "average" households only.

According to Piper and Martin (1999), a study assessing the financial and economic feasibility of rural water system improvements could provide a relatively simple framework for estimating the average ability of water users to pay for improvements. The method adequately accounts for differences in household income and expenses. Affordability analysis assumes that the highest observed water payments made within a region represent an upper limit in the ability to pay. The process involves five steps:

(1) Evaluating water cost data for users *outside* the impact area
(2) Gathering household income, housing cost, tax payment, utility cost, insurance payment, and other household expense data *outside* the study area, but *within* the same region
(3) Calculating residual household income (income less payments for housing, taxes, utilities other than water, etc.)
(4) Calculating the cost paid for water per $1,000 of residual income by users *outside* the area but *within* the same region, and
(5) Applying *ability-to-pay* factors[15] to the residual income of households *within* the study area.

Measurable variations in household income, household expenses, and other costs of living must be accounted for. In regions with lower housing costs but equivalent median incomes, the percentage of income available for water payments would be greater.

Higher income households would be expected to use more water and have higher water bills than lower income households. Since water is a necessity, poorer families would be expected to spend a greater part of their household income on it. Therefore, estimating the variation in the percentage of total income spent by

[15] *Ability-to-pay* factors compare dollars spent on water service to dollars remaining once other household bills have been paid

households making different levels of income would better represent average household ability to pay for water supplies.

Household Payment Capability within the Region

Data from the report, *Kansas Municipal Water Use 2006* (Kansas Water Office 2008) were used to estimate water use and cost in Kansas, both inside and outside the Equus Beds project area. Average housing costs for individual municipalities were derived from the 2000 Census. Percentage of households owning a home (1) with a mortgage, (2) without a mortgage, and (3) households with renters, were calculated along with average costs for each category of home. This information was used to derive a weighted,[16] average housing cost. Average household expenditures were calculated, based upon U.S. Department of Health and Human Services (DHHS 2008) data. The DHHS estimated average health costs in Kansas to be about $4,089 annually. Average annual costs for food were estimated to be $5,366. Average transportation ($8,166) and insurance costs ($3,630) for the Midwest region were obtained from the *2000 Consumer Expenditure Survey* (U.S. Bureau of the Census 2008).

Median household income data for each municipality was also gathered from the 2000 Census. The estimated representative household expenditures discussed above were subtracted from median annual household income to estimate residual (leftover) income for all municipalities inside and outside the study region. Water cost was then divided by residual income to estimate payment capability factors. These factors were then separated into a mean factor, a median factor, the factor that separated the highest 10% of municipalities from the other 90%, and the factor that separated the highest 25% from the other 75%.

Table 4-6 Payment Capability Factors[17]

Measure[18]	Kansas	Kansas outside study area	Study Area
Average	.05118	.05983	.04032
Median	.04015	.04212	.03079
Highest 10%	.13088	.13596	.05604
Highest 25%	.05530	.07062	.04367

For comparison purposes, different categories of payment capability factors are provided in Table 4-6. Payment capability factors are used to indicate the amount of variation in water bills as a percentage of income, both within the study area and throughout Kansas. Payment capability factors estimated for households outside the study area are applied to estimate total payment capability. Outside-of-area factors are used primarily for two reasons. First, these factors

[16] The weighted housing cost is based on the percentage of households that fit a certain category and the housing cost for that category. The percentage of housing fitting a category is multiplied by the cost for that category, then the result for all categories are summed to derive a weighted housing cost for each municipality

[17] "Payment capability factors" are used to estimate the percent of residual household income needed to pay the water bill

[18] Payment capabilities are calculated for households with average and median incomes, as well as for poorer households, where greater percentages of residual (leftover) income are needed to pay the water bill (top 10% and 25% refer to households with the highest water bills compared to residual income)

represent a wide range of actual payments made under a variety of economic conditions. Therefore, it is likely that the high end of this range would be closer to the maximum amount households *can* pay for water within the smaller study (sub) area. Second, comparing study area factors to data collected only from within that same area would imply that the highest *current* household water bill is the most that can be afforded. For this reason, outside comparison is required.

Results indicate that the highest 10% payment capability throughout Kansas is about 13.1%; the highest 10% for Kansas municipalities and rural water suppliers outside the study area is 13.6%; and the highest 10% for municipalities and rural water suppliers within the study area is 5.6%. The higher payment capability factors calculated outside the study area support the use of these factors to estimate payment capability. The top 10% factor is used to represent the maximum amount of residual income that can be spent on water, because that represents a payment near the observed maximum. This factor is used to account for potential outlying municipalities with unusual circumstances. Therefore, the payment capability factor used to estimate payment capability throughout the study area is 13.6% of residual household income.

The factors presented in Table 4-6 can be converted to percentages of median household income and compared to the EPA threshold of 2.5% of median household income. This would be done to evaluate consistency between the two measures. The top 10% factor of 13.6% of residual income (outside the study area) is the equivalent of about 2.6% of median family income. This figure exceeds the EPA threshold of 2.5%, but is fairly consistent.

Payment capability within the Equus Beds study area was estimated by applying the top 10% factor of 13.6% to residual income data for Wichita. The City is the dominant municipality in the study region and represents most payment capability. The residual annual household income within Wichita was estimated to be $7,275. Applying the top 10% factor (13.6%) resulted in a payment capability of $990 per connection per year ($83 per month.) Residential and commercial customers were combined to calculate payment affordability.

Total payment capability over a 50 year period (2000 – 2050) was used to evaluate project affordability. There were an estimated 110,000 residential and 12,000 commercial water customers in Wichita during 2000 (Burns and McDonnell 2003). Totals are projected to increase to 164,200 residential and 15,000 commercial customers by 2050.

Total construction cost for the project was estimated at $236.52 million. The annual equivalent construction cost ($12.71 billion) was estimated using the current water plan formulation rate of 4.875 percent[19] over a 50 year period.

[19] The plan formulation rate is used to discount future benefits and computing costs, or otherwise convert benefits and costs to a common time basis. The basis for the rate is the average yield during the preceding fiscal year on United States interest-bearing, marketable securities. At the time the computation was made, terms of 15 years or

Annual operation and maintenance (O&M) costs were estimated to be $5.82 million. Assuming that all project costs (construction and O&M) would be paid by consumers, annual costs over the 50 year period would be $18.53 million. Dividing this total by the number of expected customers in 2050 would result in an annual cost per customer of $103.50. Average cost per customer over the entire 50 year period would be $124.50.

The average Wichita household currently pays about $342 per year in water bills (Kansas Water Office 2008). When costs associated with project construction, operation, and maintenance are added together ($124.50 + $342.00), the average annual cost per household comes to about $467. This total is much lower than the total estimated maximum payment capability of $990. These results indicate that construction, operation and maintenance costs could be paid by water users. In other words, the *average* household would find the project to be affordable.

Regional Economic Impacts

In most cases, calculating increases in commercial activity attributable to expanded or improved water supplies is very difficult. However, changes in water rates could either negatively or positively impact the composition of goods and services. One such impact would be on the numbers and types of businesses locating in an area. This could lead to increased commercial activity. However, estimating increases in commercial activity associated with water improvement projects is difficult. Costs of building, operating, and maintaining the proposed project have to be known before general, regional economic impacts can be calculated. Total expenditures would lead to a change in final demand[20] for goods and services throughout the project area. Construction costs would represent a one-time infusion of funds, while project O&M would result in benefits to the local economy over a longer term.

Project construction cost estimates were obtained from R.W. Beck, Inc. (Personal communication 6/13/08) and broken down into the following three categories.

- materials
- labor and
- equipment.

Breaking costs down was necessary to improve the accuracy of impact estimates. However. two questions had to be answered before any accurate estimate of overall impact could be made. First, would all or only part of the money originate inside the region? Second, if all funding originated inside the region, but the project did not continue to completion, would those funds flow outside the region?

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more remained to maturity. However, the rate cannot be raised or lowered more than one-quarter of 1 percent for any year

[20] Estimated change in final demand for goods and services within the project area would be equal to the change in local spending directly attributable to the project

Money coming from any source, whether inside or outside the area, would impact the regional economy. Spending that originates inside the area, however, would result primarily in a redistribution of income and output, rather than an increase in regional economic activity.

Regional Purchase Coefficients (RPCs[21]) were used in this analysis to address sources of funding. The ASR could generate net positive regional economic benefits, regardless of whether or not the source of funds comes from within. However, calculating that benefit would be difficult, as the analysis would require specific data on consumer spending patterns that generally do not exist. For the purposes of this evaluation, funds coming from outside the region that would be used to pay for project related costs would be assumed to be spent within the region.

Project-related labor costs were treated as household expenditures. To further simplify the evaluation, it was assumed that all labor costs would be translated into household income. Equipment costs were split into fuel and non-fuel categories. Fuel costs went into the model as direct fuel expenditures, while non-fuel equipment costs were sorted by equipment type. Estimated project construction costs are provided in Table 4-7.

Table 4-7 Construction Costs by Category Used to Estimate Regional Impacts

Construction Feature	Total Cost	Materials Cost	Labor Cost	Equipment (Non-Fuel)	Equipment (Fuel)
Recharge/Recovery Wells at Existing Sites					
Recharge/Recovery Well	$3,109,000	$1,119,882	$552,239	$949,796	$487,083
Control Building	$1,536,000	$926,417	$551,906	$32,827	$24,850
Piping & Valving	$995,000	$696,500	$248,750	$35,048	$14,702
Monitor Wells (1 shallow & 1 deep)	$124,000	$41,100	$19,991	$39426	$23,482
SCADA	$311,000	$248,037	$62,963	$0	$0
Electrical & Instrumentation	$1,710,000	$1,561,864	$108,686	$19,409	$20,040
Site Work, Access & Fence	$622,000	$450,511	$83,839	$53,703	$33,947
Subtotal	**$8,407,000**	**$5,044,312**	**$1,628,374**	**$1,130,209**	**$604,105**
Recharge/Recovery Wells at New Sites					
Recharge Well	$1,473,000	$530,584	$261,643	$450,000	$230,773
Control Building	$727,000	$438,480	$261,221	$15,537	$11,762
Piping & Valving	$515,000	$360,500	$128,750	$18,140	$7,610
Monitor Wells (1 shallow & 1 deep)	$59,000	$19,556	$9,512	$18,759	$11,173
SCADA	$147,000	$117,239	$29,761	$0	$0
Electrical & Instrumentation	$810,000	$739,831	$51,483	$6,346	$12,340
Land	$91,000	$65,911	$12,266	$7,857	$4,966
Site Work, Access & Fence	$368,000	$0	$0	$0	$0

[21] RPCs are ratios provided within the MPLAN model that represent trade flows and the portion of regional demands purchased from local producers

Subtotal	**$4,190,000**	**$2,272,100**	**$754,635**	**$516,640**	**$278,624**
Waterlines					
12" DIP	$489,000	$234,958	$157,282	$62,962	$33,797
16" DIP	$966,000	$506,481	$289,200	$109,570	$60,749
20" DIP	$491,000	$258,677	$147,981	$53,846	$30,495
24" DIP	$1,562,000	$908,549	$417,391	$150,220	$85,840
30" DIP	$1,023,000	$698,413	$194,800	$91,502	$38,286
36" DIP	$7,822,000	$5,252,988	$1,505,749	$750,579	$312,684
42" DIP	$2,139,000	$1,432,504	$416,315	$205,040	$85,141
48" DIP	$3,007,000	$1,987,709	$599,134	$297,117	$123,039
66" PCCP	$33,857,000	$25,393,341	$4,950,675	$2,480,456	$1,032,528
Subtotal	**$51,356,000**	**$36,673,620**	**$8,678,528**	**$4,201,293**	**$1,802,559**
Computer & Radio Systems					
Power Lines	$4,909,000	$3,681,750	$981,800	$75,764	$169,686
Transmission Lines	$6,620,000	$4,288,543	$1,544,428	$492,438	$294,590
Service Drop	$119,000	$106,856	$9,143	$1,502	$1,499
Subtotal	**$6,739,000**	**$4,395,399**	**$1,553,572**	**$493,940**	**$296,089**
Surface Water Treatment (Membrane – 30 MGD)	$59,600,000	$41,720,000	$11,920,000	$3,874,000	$2,086,000
Sedgwick Surface Water Intake (60 MGD)	$4,935,000	$3,454,500	$987,000	$320,775	$172,725
Substation	$4,908,000	$3,435,600	$981,600	$319,020	$171,780
Standpipe	$505,000	$353,500	$101,000	$32,825	$17,675
Raw Project Cost	**$145,549,000**	**$101,287,000**	**$27,656,000**	**$10,992,000**	**$5,614,000**
Contingency @ 30%	**$43,664,700**	**$30,386,100**	**$8,296,900**	**$3,297,700**	**$1,684,000**
Admin, Legal, Planning	**$47,303,400**	**$21,002,700**	**$26,300,700**	**$0**	**$0**
TOTAL COSTS	$236,517,100	$152,675,800	$62,253,600	$14,289,700	$7,298,000

Data from Burns & McDonnell (2000, 2003) were used to estimate regional impacts from annual operation and maintenance. O&M costs were divided into material, labor, equipment, fuel, and power costs. Estimates were based on results calculated for a regional water supply project in South Dakota, Iowa, and Minnesota (Reclamation 1993). Cost percentages applied to each category of O&M are provided in Table 4-8. Actual O&M cost estimates are presented in Table 4-9.

Table 4-8 Percentage of Costs Attributed to Each O&M Category

Activity	Material	Labor	Power	Equipment	Fuel
Treatment	17.5%	32.5%	38.0%	9.0%	3.0%
Wells	26.0%	26.0%	0	35.0%	3.0%
Waterlines	63.0%	26.0%	0	11.0%	0

Table 4-9 O&M Costs by Category Used to Estimate Regional Impacts

Construction Feature	Total	Materials	Labor	Equipment (Non-Fuel)	Equipment (Fuel)	Power
Capture Flow from Little Arkansas River						
Surface Water Intake	$147,200	$38,400	$53,150	$51,250	$4,400	$0
Recharge-water Treatment	$2,300,000	$404,800	$747,500	$209,300	$69,000	$869,400
Equus Beds Aquifer Recharge						
Recharge (vertical wells)	$290,950	$75,900	$105,000	$101,300	$8,750	$0
Recharge (recovery wells)	$539,350	$140,750	$194,650	$187,750	$16,200	$0
Surface Water Recharge	$263,350	$68,700	$95,050	$91,700	$7,900	$0
Waterlines	$17,250	$10,850	$4,500	$1,900	$0	$0
Powerlines	$11,500	$7,250	$3,000	$1,250	$0	$0
SCADA	$79,350	$49,950	$20,700	$8,700	$0	$0
Expansion of Local Well Field						
Horizontal Collector Wells	$46,000	$12,000	$16,600	$16,000	$1,400	$0
Vertical Wells	$14,950	$3,900	$5,400	$5,200	$450	$0
Waterlines & Powerlines	$2,300	$1,450	$600	$250	$0	$0
Development of Bentley Well Field						
Vertical Wells	$26,000	$6,800	$9,400	$9,050	$750	$0
Raw Water Treatment & Delivery Improvements						
Pipeline	$6,900	$1,800	$2,500	$2,400	$200	$0
Treatment Plant (Phase I)	$747,500	$130,800	$244,800	$67,300	$22,400	$282,200
Treatment Plant (Phase II)	$1,322,500	$231,450	$433,100	$119,000	$39,700	$499,250
TOTAL COSTS	$5,815,100	$1,184,800	$1,935,950	$872,350	$171,150	$1,650,850

Construction of a water supply project (ASR) should generate positive regional economic impacts. However, the net economic effect would depend upon the relative proportions of local and outside (in this case, Federal) funding. Should all funding come from within the region, local (including household) expenditures normally reserved for other goods and services would be used to pay for the project. Should different demand sectors within the region have different rates of leakage,[22] a resultant change in final demand would produce changes in both income and economic output.

Estimated construction-related economic impacts, based on 100% funding from outside sources (Federal funding), are presented in Table 4-10. Direct economic benefits to the local region would be limited to periods of construction.

[22] Leakages of money from within to outside the region occur as a result of spending on goods and services produced outside

Table 4-10 Regional Economic Benefits – 100% Outside Funding

Expenditure Category	Cost of Feature (millions)	Impact Category: Value Added (millions)	Employee Compensation (millions)	Employment (total)	Output (millions)
Recharge/Recovery wells	$4.582	$1.796	$0.861	27.5	$5.963
Control Building	$2.263	$1.744	$1.045	32.1	$3.585
Piping & Valving	$1.510	$0.621	$0.316	8.8	$2.126
Monitor Wells	$0.183	$0.050	$0.023	0.8	$0.218
SCADA	$0.458	$0.107	$0.064	1.6	$0.556
Electrical & Instruments	$2.520	$0.409	$0.266	6.7	$2.895
Site Work, Access & Fence	$0.990	$0.256	$0.123	3.9	$1.169
Land	$0.091	$0.047	$0.011	0.6	$0.115
Waterlines	$51.356	$7.664	$3.753	112.2	$21.004
Computer, Radio Systems	$4.909	$0.897	$0.456	13.2	$5.671
Powerlines	$6.739	$1.472	$0.750	22.0	$7.975
Surface Water Treatment	$59.600	$26.987	$15.171	462.8	$80.550
Water Intake	$4.935	$1.484	$0.734	21.4	$6.172
Substation	$4.908	$3.713	$2.287	71.9	$7.624
Standpipe	$0.505	$0.123	$0.063	1.8	$0.604
Admin, Planning, Legal & Management	$47.303	$22.004	$12.512	338.7	$62.961
Contingency	$43.665	$20.812	$11.531	337.8	$62.756
TOTAL	$236.52	$90.186	$49.966	1,463.8	$271.994

For the purposes of this analysis, predicted regional economic impacts were compared for various cost share scenarios, including zero share (no Federal funding), 30%, 50%, and 70% cost share, and project construction using 100% Federal funding. Results are presented in Table 4-11.

Table 4-11 Regional Economic Impact Based on Percent of Federal Funding (Construction)

Portion of Federal Funding	Impact Category: Value Added (millions)	Employee Compensation (millions)	Employment (total)	Output (millions)
0% Federal Funding	-$75.6	-$33.2	-901	-$110.5
30% Federal Cost Share	-$25.9	-$8.2	-192	+$4.2
50% Federal Cost Share	+$7.3	+$8.4	+281	+$80.7
70% Federal Cost Share	+$40.5	+$25.0	+754	+$157.2
100% Federal Funding	+$90.2	+$50.0	+1,464	+$271.9

Results indicate that a 50% Federal cost share would be necessary before the project could generate net positive economic benefits for the region. Compared to 50% Federal funding, paying for the project locally would cost the region about 900 jobs and more than $110 million in reduced economic output.
O&M expenditures were analyzed using a similar approach. Unlike construction spending, O&M spending would impact the area economy throughout the operating existence of the project. Results are presented in Table 4-12.

Table 4-12 Regional Economic Impact Based on Percent of Federal Funding (Operation & Maintenance)

Portion of Federal Funding	Impact Category			
	Value Added (thousands)	Employee Compensation (thousands)	Employment (total)	Output (thousands)
0% Federal Funding	-$2,229.4	-$1,143.1	-53.4	-$4,084.6
50% Federal Cost Share	-$1,114.7	-$571.6	-26.7	-$2,047.3
100% Federal Funding	+$2,233.3	+$869.1	+21.9	+$6930.8

Mitigation – Socioeconomics
Both impact and affordability analyses indicate that the project without Federal cost sharing as proposed in the No Action Alternative would result in negative regional economic impacts. Providing Federal funding equal to 50% of total project construction, operation and maintenance costs would result in positive regional impacts. The Reclamation Preferred Action (25% Federal funding) would largely alleviate negative impacts. In addition, it would make ASR more "affordable." Outside funding would result in an overall, positive regional economic benefit.

Environmental Justice

Evaluating environmental justice requires both an understanding of where project impacts are or would be likely to occur, and where potentially affected groups are located. Demographics from the U.S. Bureau of the Census, counties, municipalities, and local school districts were used to identify and locate potentially affected groups.

The primary environmental justice issue associated with the project would be is the effect of increased water payments on low income or minority households. Income, race, and ethnic data were collected from the U.S. Bureau of the Census by zip code within the metropolitan area. There were 13 zip codes with median household incomes less than the median for the entire study area, and at least one category of minority population greater than the average (see Table 4-13). Area codes 67210, 67214, and 67219 had environmental justice issues of particular concern. Average water cost per customer, both with and without the project completion, were compared to median household incomes within these zip codes. Results were then compared to the affordability thresholds. Water costs per consumer were calculated for each of the 17 zip codes where median income was less than the regional average, or percentage of minority population was greater than the average. These results were calculated by dividing water cost by household income. They are provided in Table 4-13.

Environmental justice is evaluated in this document based on the comparison of physical and economic impacts among groups. The primary environmental justice issue associated with ASR is the effect of increased water payments on low income or minority households. Income, race and ethnic data for the City were collected from the U.S. Bureau of the Census by zip code. There were 13 zip codes with median household incomes less than the median for the entire study area, and at least one category of minority population greater than the average (see Table 4-13). Area codes 67210, 67214, and 67219 had environmental justice issues of particular concern. Average water cost per customer, both with and without the project, were compared to median household incomes within these zip codes. Results were then compared to the established EPA threshold (2.5%) and the threshold established during the regional payment capability analysis (3.46%). Water costs per consumer were calculated for each of the 17 zip codes where median income was less than the regional average, or percentage of minority population was greater than the average. These results were calculated by dividing water cost by household income. They are provided in Table 4-13.

Table 4-13 Household Income, Race & Ethnicity within Wichita

Zip Code	Median Household Income	Black	American Indian	Hispanic
67037	$60,066	0.75%	0.53%	2.33%
67038	*$36,719	0.44%	**6.65%	1.92%
67050	$51,328	0.17%	0.28%	2.00%
67060	$48,463	0.45%	0.90%	2.49%
67101	$52,000	0.82%	0.66%	2.33%
67108	$46,464	0.70%	0.30%	0.30%
67202	*$17,384	**19.62%	0.85%	6.50%
67203	*$34,345	5.60%	**1.34%	**16.84%
67204	*$41,181	3.13%	**1.26%	**21.93%
67205	$75,070	0.43%	**1.28%	3.01%
67206	$64,258	4.14%	0.55%	1.17%
67207	$43,251	**11.02%	0.89%	5.28%
67208	*$34,291	**29.80%	1.01%	3.77%
67209	$56,033	1.83%	0.79%	4.54%

Table 4-13 Household Income, Race & Ethnicity within Wichita

Zip Code	Median Household Income	Black	American Indian	Hispanic
67210	*$36,657	**10.86%	**1.47%	**18.46%
67211	*$29,794	7.96%	**1.52%	**12.51%
67212	$52,022	2.38%	0.88%	5.04%
67213	*$28,541	6.20%	**2.29%	**12.15%
67214	*$21,119	**54.98%	**1.32%	**17.85%
67215	$59,028	1.02%	1.07%	2.92%
67216	*$36,691	7.93%	**1.53%	8.02%
67217	*$39,874	4.72%	**1.45%	6.71%
67218	*$32,153	**10.25%	0.99%	**11.28%
67219	*$34,594	**30.43%	**1.38%	**9.29%
67220	$50,972	**25.92%	0.76%	3.52%
67226	$67,206	6.35%	0.11%	3.51%
67230	$93,593	2.76%	**1.61%	1.82%
67235	$80,472	1.58%	0%	4.90%
Area Average	**$43,459**	**10.12%**	**1.16%**	**8.78%**
Kansas Average	**$40,628**	**5.60%**	**0.92%**	**6.93%**

* = Median household income is less than for entire study area
** = percentage of minority population is greater than for the entire study area

Data in Table 4-14 indicate that current average household water payment income percentages fall below both affordability thresholds, except for zip code 67202. Federal cost sharing equal to 26% would help keep average household water payments under the EPA threshold.

Additional environmental justice concerns could include potential neighborhood impacts associated with construction and operation of facilities. Any adverse impacts related to changes in the physical environment in neighborhoods that have a high percentage of low income or minority households would need to be addressed under environmental justice.

Reclamation and EPA staff conducted a project site visit in August 2008 to evaluate environmental justice concerns. There appeared to be no environmental justice issues related to the location of water treatment plants, recharge recovery wells, recharge basins, pipelines, power lines, or other ASR facilities. EPA investigators expressed some concern related to potential negative impacts of decreased streamflow in the Little Arkansas River downstream. Concern was based on possible subsistence activities of a growing Hispanic population located downstream from the project area. It was decided that, as long as there is no adverse impact on streamflow, there should be no adverse environmental justice impacts.

Table 4-14 Water Cost per Consumer as a Percentage of Household Income, Present versus Future Condition, if ASR Costs are Paid entirely from Local Funds*		
	Current Household Income Percentage	**Predicted Household Income Percentage**
Zip Code	@ $341.82 per Customer	@ $467.00 Per Customer
67038	0.93%	1.27%
67202	1.97%	**2.69%
67203	1.00%	1.36%
67204	0.83%	1.13%
67205	0.46%	0.62%
67207	0.79%	1.08%
67208	1.00%	1.36%
67210	0.93%	1.27%
67211	1.15%	1.57%
67213	1.20%	1.64%
67214	1.62%	2.21%***
67216	0.93%	1.27%
67217	0.86%	1.17%
67218	1.06%	1.45%
67219	0.99%	1.35%
67220	0.67%	0.92%
67230	0.37%	0.50%

* Income percentages are for each of the 17 zip codes where either the average income is less than the area average, or the minority population is greater than the area average
** Exceeds EPA payment threshold of 2.5%
*** Approaches EPA payment threshold of 2.5%

Mitigation – Environmental Justice
Providing Federal funding for approximately 25% of the ASR would largely mitigate predicted impacts to low income or minority households. Resulting increases in average household water bills would be held below, or near the EPA recommended payment threshold of 2.5%, for all areas in the region. Hydrology data indicate that base flows would go up slightly in the Little Arkansas River downstream from the project site, though seasonal flows could drop slightly. Flows at the junction of the Little Arkansas with the Arkansas River would drop with the project. This area is located well below the EPA's geographic area of concern. Negative impacts to possible subsistence fishing would be unlikely. No mitigation should be necessary.

Cultural Resources

The affected area for cultural resources is in northern Sedgwick and southern Harvey counties. Neither county has been intensively inventoried for cultural resources. Even so, Sedgwick County has 145 recorded archeological sites, while Harvey County has 65. Most of these sites are prehistoric, though some are historic sites. Sedgwick County has 87 sites listed in the *National Register of Historic Places (NRHP).* Harvey County has 21 sites in the NRHP. All but one of the known NRHP sites in the two counties are located in urban areas and none lie within the project area.

Parts of the project area were inventoried by the City before Phase I of the ILWSP. No potential NRHP sites were impacted during that construction. However, pipelines would be buried in some terraces along the Arkansas and Little Arkansas rivers during later construction phases. There is a high probability of discovery of more archeological sites along these terraces.

Once project excavation and construction locations are defined and mapped, the City must comply with the Antiquities Code of Kansas (74-5403) as well as to the requirements of the National Historic Preservation Act (NHPA). A qualified archeologist must survey all proposed construction areas before any ground disturbance. Any discovered historic properties would be inventoried and appropriate steps taken to protect all sites potentially eligible for listing on the NRHP.

The City must consult with the Kansas State Historic Preservation Office (SHPO) on ground-disturbing activities likely to produce archeological sites before proceeding. Copies of any/all permits and/or concurrence letters from the SHPO must be provided to Reclamation.

Mitigation – Cultural Resources
Should potential historic properties be discovered that may be impacted by the project, design changes or mitigation would become necessary. Site protection would be required before any ground disturbance. Preferred protection measures would involve redesign to avoid the sites altogether. Should mitigation become necessary, appropriate measures would be determined beforehand in consultation with the SHPO.

Cumulative Impacts Summary

Regulations implementing both NEPA and ESA require the consideration of cumulative effects. NEPA requires that cumulative effects analysis consider the incremental impact of the proposed action, when added to other past, present, and reasonably foreseeable future actions, whether or not those actions are Federal. ESA requires analysis of impacts from non-Federal actions only. In this instance, the City already completed Phase I and started construction on Phase IIa before seeking Federal funds. Impacts from the entire ASR project are discussed in this document, including already completed parts of the project. Federal actions that have already undergone FWS consultation or that have already been completed are considered to be part of the environmental baseline. The environmental impacts of prior ASR activities were discussed in the City's environmental document (Burns & McDonnell 2003) but are also reviewed here. This ensures that the environmental impacts of the cost-shared part of the project (Phases IIb, III and IV) are considered within the context of the entire project.

Water Resources

Flows in the Arkansas River basin have been altered by dams and depletions due to withdrawals since post-1800 Euro-American settlement. Several low-head dams currently exist on the Little Arkansas. Withdrawals have been primarily for irrigation. Municipal and industrial water needs have been on an increasing trend. Population and industrial growth in the region have resulted in increased water quality concerns. Both overall flow and water quality have been reduced, resulting in elevated fish and wildlife, water quality and water quantity concerns. Certain segments of the Little Arkansas River are currently listed by the State as water quality impacted.

Ground and surface waters have been depleted for municipal, industrial, and agricultural use and increased use of agricultural chemicals (that is, atrazine and others) have resulted in threats to water quality. There is no measurable indication showing the future trend of impacts on water quality, but projected growth in the Wichita metropolitan area and potential future climate change could compound problems.

Overuse of surface water has resulted in increased use of groundwater as the other source for irrigation, municipal and industrial supply, recreation, and other activities. This has resulted in drops in the aquifer level of up to 40 feet since the 1930s. Equus Beds Groundwater Management District No. 2 was created to manage groundwater use in the region for this reason. The district has limited allocation of water resources to present levels, so no new irrigation permits are being issued. The City has also reduced its reliance on water from the Equus Beds in favor of increased use of surface water from Cheney Reservoir. These actions have resulted in some rebound in groundwater levels. The purpose of

ASR is to further increase groundwater levels by injecting water collected from the Little Arkansas River during periods of high flow. The intent would be to restore groundwater levels to near-historic levels. Beneficial impacts to both ground and surface water quantity and quality would be expected.

ASR is just one part of the City's ILWSP. As a result of the ILWSP, withdrawals from Cheney Reservoir during normal and wet weather periods would continue to increase. Most of these withdrawals would occur during periods when reservoir storage is nominal or above. This could result in slightly lower, overall reservoir levels, especially during periods of high precipitation (that is, spring months). It could also result in slightly lower discharge rates to the North Fork of the Ninnescah River downstream during the same periods.

The Bentley Reserve Well Field would also be reactivated. Its high-chloride water would be blended with low-chloride water from other sources to provide water of acceptable quality. Use of Wichita's Local Well Field near the confluence of the Arkansas and Little Arkansas rivers would be expanded. Water produced here comes from bank storage areas and aquifers located alongside both rivers. Using water from the Arkansas River sometimes results in elevated chloride levels in the aquifer. Lower-quality water from the Arkansas could be blended to produce a final product with higher quality water.

The City has included in its ILWSP an effort for public conservation, protection and water-use education. These programs, while not expected to solve the key issues for water management, should contribute to an overall positive impact on ground and surface water resources and conditions.

Oil and salt production within the Arkansas River basin have impacted water quality in both the river and aquifer. Regulatory changes and improvements in production technology over the last century have helped reduce surface and ground water impacts from oilfield brines and mining. Contaminants remaining in the environment will pose a future challenge. In combination with the project, these programs should reduce impacts that contribute to ground water quality problems. Monitoring will provide a better view on how the conservation and mitigation measures are working.

Biological Resources

Urbanization, suburbanization, and advances in agricultural and livestock production have impacted the distribution and quality of riparian areas, wetlands, and vernal pools. Riparian areas along area streams have diminished to narrow belts alongside the stream. Most wetlands and vernal pools have been filled or otherwise converted into settlement or agricultural production areas.

The project in conjunction with other Federal and non-Federal actions would not contribute to further destruction of habitat, including habitat considered critical to propagation and protection of threatened or endangered species. No measurable impacts to critical habitat, threatened, endangered, or candidate species would be expected. Improvements to ground and surface water quality, quantity, and habitat should result. The intent of the project is to improve and protect both ground and surface water resources.

Mitigation: Cumulative Impacts
No mitigation for cumulative impacts is necessary.

Unavoidable Environmental Impacts

Preferred Alternative: 100 MGD ASR (60/40) with Federal Funding

- Approximately 1,700 acres of land would be temporarily disturbed
- Approximately 266 acres of land (including about 65 acres of prime farmland) would be permanently disturbed (altered and dedicated to the project)
- Localized soil erosion would temporarily increase in construction areas
- Sedimentation and turbidity in the Little Arkansas River would increase during transmission, access road, surface water intake, and other construction
- Air quality would decrease in local areas during construction
- Noise levels would increase in local areas during construction. Some minor noise level increases would be expected in areas of operating equipment
- Vehicular access to residences and businesses would be temporarily disrupted during construction
- Some industrial visual impact on the rural landscape would result for the life of the project.

No Action Alternative: 100 MGD ASR (60/40) without Federal Funding

- Approximately 1,700 acres of land would be temporarily disturbed
- Approximately 266 acres of land (including about 65 acres of prime farmland) would be permanently disturbed (altered and dedicated to the project)
- Localized soil erosion would temporarily increase in construction areas
- Sedimentation and turbidity in the Little Arkansas River would increase during transmission, access road, surface water intake, and other construction
- Air quality would decrease in local areas during construction
- Noise levels would increase in local areas during construction. Some minor noise level increases would be expected in areas of operating equipment
- Wildlife would be displaced during expansion of the Phase II SWTP
- Vehicular access to residences and businesses would be temporarily disrupted during construction
- Some industrial visual impact on the rural landscape would result for the life of the project.

Irreversible and Irretrievable Commitment of Resources

Construction and operation would result in a permanent funding commitment. Funding would be for conducting impact analysis, paying for manpower, purchasing building materials and supplies, and construction. Materials would include borrow material, steel, concrete, piping, radio and computer equipment, transmission equipment, and other items. Energy expended on the project would not be available for other uses. Petroleum-based products, such as gasoline, diesel fuel, lubricants, and plastics would be consumed during construction.

Expenditure of Federal resources would be discontinued upon completion of the cost-sharing. The City would assume all O&M costs.

Short Term Uses/Long Term Productivity

Short term negative impacts can be counterbalanced by long term positive impacts. The short term negative impacts to soils, water quality, air quality, noise, and visual aspects of the project would be offset by the long term beneficial impact of the City having an assured M&I water supply through the year 2050. Farmers and others using water from the aquifer would also benefit.

Human Health and Safety

Water quality analysis indicates no resulting project-related health hazards to the public. Regulated toxins (COCs) are under the limits established for human health. Filtering river water through sandy banks or water treatment plants would reduce existing contaminant levels. Underground water storage would help protect water quality, limit evaporation, and conserve it in the face of possible climate change. In addition, aquifer storage would help protect the City's water supply from potential biological problems like the cyanobacteria blooms increasingly impacting Cheney Reservoir. Localized increases in noise or air pollution would also be insignificant.

There are no resultant, unusual hazards to public safety. Public hazards commonly associated with construction projects would be managed through standard safety practices.

Chapter 5: Consultation and Coordination

Public Involvement

NEPA requires Federal agencies to involve the public when taking actions such as construction, funding, or permitting. Public involvement provides an opportunity for interested individuals, officials, and organizations to participate in the EIS process.

This chapter documents Reclamation's consultation and coordination activities during preparation of this EIS. Public involvement is described, including the public scoping and review processes.

Scoping Notice

"Scoping" before and during the EIS process is designed to help determine issues and alternatives to be analyzed.

Reclamation announced its intention to prepare in a Notice of Intent (NOI) published in the *Federal Register* on Friday, February 29, 2008. An information release (*Equus Beds Aquifer Recharge and Recovery Project, Environmental Impact Scoping Document*) announcing the NOI was mailed to approximately 156 parties. Recipients included Federal, Tribal, State, and local officials, agency representatives, public interest groups, conservation organizations, legal organizations, chambers of commerce, news media, and other interested parties.

Almost no public comment resulted from the scoping notice or information release. One local mayor asked if the proposed alternative would be equivalent to ASR as originally proposed by Burns and McDonnell in 2003. The Sierra Club expressed concerns about protecting the aquifer from increased concentrations of atrazine, arsenic, and pharmaceuticals. Other concerns from the Sierra Club included impacts of the project on growth in the Wichita area and requests to address concerns already raised during development of the City's 2003 document by Burns and McDonnell.

Public Scoping Meetings

The City has been holding public information and scoping meetings on its ILWSP since 1997. Members of the public, government agencies, other organizations, and individuals have also been kept informed through tours, press releases, monthly and annual progress reports, project reports, public education projects, and formal agency consultations.

Three public scoping meetings concerning ILWSP were held during 1997 (October 20, 21, and 22) in Wichita, Cheney, and Halstead. The City announced these meetings to the public in the following local publications:

- The Ark Valley News
- The Harvey County Independent
- The Times-Sentinel, and
- The Wichita Eagle.

A total of 36 people attended the three meetings. All were asked to listen, view displays, and provide input. The public was also asked to submit written comments by mail or fax.

Three similar meetings were held for cooperating and interested government agencies in 1997 (October 21, November 5, and November 6). Representatives from Reclamation, EPA, USGS, FWS, KDWP, the Kansas Corporation Commission, the Kansas Department of Agriculture Division of Water Resources, KDHE, KWO, GMD2, and the Sedgwick County Conservation District attended. All were asked to listen, view displays, and provide input. They were also asked to submit written comments by mail or fax.

Issues raised included water quantity, water quality, water rights, vegetation, wetlands, and impacts on specific Federal and state threatened, endangered, or species of concern. Local farmers expressed concerns that the project would negatively impact their ability to irrigate. These concerns and comments were used to tailor the environmental analysis.

Since publication of the Burns and McDonnell report in 2003, a total of nine public information meetings, along with poster displays, have been held in Sedgwick, Harvey, and Reno counties. A total of 335 people attended at least one of these events. Reclamation participated in the most recent one, conducted in Halstead on May 14, 2008. The USGS and several Kansas agencies (including KDHE, KDA, KCC, and KWO) provided displays. No comments or questions were received. In addition, informational materials have been provided to local libraries, chambers of commerce, and city councils. The City reports no substantive public comments on the project since publication of the 2003 report.

Public Hearings

Public hearings were held in 2004 by the Kansas Department of Agriculture Department of Water Resources (50 attendees) and GMD2 (70 attendees.) No concerns were expressed.

Figure 5-1 Public Involvement Meeting at Halstead High School, May 14, 2008.

Website

A public involvement website, (www.usbr.gov/gp/otao/equus), was created and announced to the public. The announcement occurred simultaneously with the release of the information pamphlet (*Equus Beds Aquifer Recharge and Recovery Project, Environmental Impact Scoping Document.)* The site provided project information and additional contact information.

Draft EIS

The draft EIS was distributed either in hard copy or CD to people, agencies, and others interested in the project (see "Distribution List" below). The draft was also loaded on Reclamation's website at www.usbr.gov/gp/otao/equus/deis_equus_be... .

Three government agencies (EPA, FWS, and KDWP) and the Sierra Club commented. Responses to these comments can be found in Appendix F.

Cooperating Agencies

As the lead agency responsible for the preparation of this EIS, Reclamation invited 11 outside agencies with relevant expertise or jurisdiction to participate in the NEPA process. Officials from three agencies signed memoranda of agreement (MOAs), signifying the agency's intent to participate as a cooperating partner. Those agencies included the:

- Kansas Water Office,
- U.S. Environmental Protection Agency, and the
- U.S. Fish and Wildlife Service.

Officials from the remaining nine agencies notified Reclamation that their agencies chose to participate on a consulting basis only. These agencies included the:

- City of Wichita
- Kansas Department of Agriculture
- Kansas Department of Health and Environment
- Kansas Department of Wildlife and Parks
- Kansas Water Office
- Groundwater Management District No. 2
- Natural Resource Conservation Commission
- U.S. Army Corps of Engineers, and the
- U.S. Geological Survey.

Both the Kansas Historical Society and Wichita State University provided information and assistance as needed.

List of Preparers

Table 5-1 Bureau of Reclamation ASR EIS Technical Team

Name	Experience/Expertise	Title	Contribution
Collins Balcombe	B.A. Zoology, M.S. Wildlife & Fisheries, 5 years NEPA/ESA experience	Special Projects Director	Writing, editing, & technical review
Bob Blasing	B.S. Anthropology & Geography, M.S. Anthropology, 23 years archeology experience	Archeologist	Cultural resources, writing, editing, data interpretation & technical review

Table 5-1 Bureau of Reclamation ASR EIS Technical Team			
Name	**Experience/Expertise**	**Title**	**Contribution**
Ben Claggett	B.S. Mechanical Engineering, 5 years project management experience	Equus Beds Federal Funding Program Manager	Program development & oversight
Robert G. Harris	B.A. English, M.A. English, 30 years technical writing & instruction experience	Technical Writer	Editing
Ashley Ladd	B.S. Wildlife Management & Research, 2 years NEPA/ESA experience	Natural Resource Specialist	ESA, FWCA, writing, editing, data verification & technical review
Vernon LaFontaine	B.S. Range & Wildlife Habitat Management, 29 years experience in wildlife management, ecosystem planning & environmental analysis	Natural Resource Specialist	Technical review, editing, & data verification
Roger Otstot	B.A. Economics, M.A. Agricultural Economics, 12 years economics experience	Economist	Socioeconomics, writing, editing, & data verification
Mark Phillips	B.S. Geology, 29 years experience in geohydrologic studies/modeling, river system studies/modeling, water conservation & GIS	Geologist	Hydrology, data interpretation & verification, & technical review
Steven Piper	B.S. Economics, M.S. Agricultural & Natural Resource Economics, Ph.D. Environmental Economics,	Economist	Socioeconomics, writing, editing, & data verification

Table 5-1 Bureau of Reclamation ASR EIS Technical Team

Name	Experience/Expertise	Title	Contribution
	23 years economic analysis, including natural resource, regional impact, & water supply experience		
Charles F. Webster	B.S. Biology, M.S. Marine Biology, 29 years environmental analysis, 18 years NEPA/ESA, & 7 years environmental teaching experience, 37 peer-reviewed environmental publications	ASR EIS Team Leader, Environmental Protection Specialist	ASR EIS project coordination, writing, editing, data interpretation, & technical review

Table 5-2 Environmental Protection Agency ASR EIS Technical Team

Name	Experience/Expertise	Title	Contribution
Debbie M. Bishop	B.S. Social Science & Environmental Science, M.P.A. Urban Administration & Planning, 8 years Environmental Justice experience	Environmental Protection Specialist	Environmental Justice, writing & editing
Kristina Kasper	Environmental Justice & GIS	Environmental Justice Intern	Environmental Justice, GIS/mapping & writing
Althea Moses	B.S. Civil Engineering	Environmental Justice Program Manager	Environmental Justice, editing & consultation

Table 5-3 City of Wichita ASR EIS Technical Team (including contractors)

Name	Experience/Expertise	Title	Contribution
Deb Ary (Wichita)	Project Management	Superintendent of Production and Pumping, Project Manager	Project Management
Jerry Blain (Wichita)	Project Management	Former Superintendent of Production and Pumping, Project Manager	Project Management
Gene Foster (Burns & McDonnell)	Hydrology & modeling	Hydrology Modeler	Hydrology
Pat Higgins (Burns & McDonnell)	Geology, hydrology & modeling	Geohydrologist	Hydrology
Tom Jacobs (R.W. Beck)	Program Management Team	Program Manger	Project Management
Jeff Klein (Burns & McDonnell)	Project Management	Project Engineer	Project Management
Lynn Moore (Professional Engineering Consultants)	Program Management Team	Program Manager	Project Management
Mike Schomaker (Professional	Program Management Team	Program Manager	Project Management

Table 5-3 City of Wichita ASR EIS Technical Team (including contractors)			
Name	**Experience/Expertise**	**Title**	**Contribution**
Engineering Consultants)			
Dave Stous (Burns & McDonnell)	Geology & Hydrology	Geohydrologist	Hydrology
David Warren (Wichita)	Project Management	Director of Water Utilities	Project Director

Environmental Compliance

Environmental Protection Agency Consultation

EPA, Region 7, agreed to serve as a cooperating agency in the production of this EIS. Final signatures on the MOA between Reclamation (lead agency) and EPA were obtained on August 21, 2008. EPA and Reclamation conducted a joint, project site visit on August 18, 2008. The purpose of the visit was to 1) familiarize EPA personnel with the project area, and 2) investigate potential project impacts on Environmental Justice. EPA investigators were particularly concerned about a rapidly growing Hispanic population downstream from the project site. Information collected during the site visit adequately answered questions about potential impacts to families depending upon subsistence fishing.

EPA Environmental Justice specialists provided input and completed an independent Environmental Justice investigation. Their final report is included as (Appendix C.)

Clean Water Act (Section 404)

Section 404 of CWA is administered by the U.S. Army Corps of Engineers (USACE), with oversight from the Environmental Protection Agency (EPA). Section 404 regulates the placement of dredged or fill materials into water bodies, including wetlands. An individual, Section 404 permit would be required for any action on the Little Arkansas River or in wetlands that caused more than minimal adverse impacts. The City is constructing a surface water intake on the Little Arkansas River during Phase IIa. It is a 66 MGD structure; however, it will only be operated at 33 MGD until the addition of more pumps during Phase III or IV.

Endangered Species Act (ESA)

ESA requires consultation with the U.S. Fish and Wildlife Service for actions that may affect Federally-listed threatened or endangered plant, fish or wildlife species. Should the biological assessment for the project conclude that there are no effects to threatened or endangered species, or critical habitat, the action could be implemented without consultation. Should it be determined that the Proposed Action may affect threatened or endangered species, formal consultation would be required.

Farmland Protection Policy Act (FPPA)

The U.S. Natural Resources Conservation Service (NRCS) is responsible for this Act. The lead Federal agency is required to consult with NRCS to ensure that impacts to prime or unique farmlands are considered.

Fish and Wildlife Coordination Act (FWCA)

FWCA, as amended in 1964, requires Federal agencies to consider the effect of any water-related project on fish and wildlife resources. The Federal agency is required to consult with the USFWS to ensure that any project-related losses of fish and wildlife resources are mitigated. Consultations with state fish and wildlife agencies would also be required.

National Historic Preservation Act (NHPA)

NHPA establishes the protection of historic properties as national policy. It requires cooperation with states, tribes, local governments, and the general public. Historic properties are those buildings, structures, sites, objects, and districts, or properties of traditional religious and cultural importance to Native Americans, determined to be eligible for inclusion in the National Register of Historic Places (NRHP). Section 106 requires Federal agencies to provide the Advisory Council on Historic Preservation the opportunity to comment. Consultations are also required with the State Historic Preservation Office (SHPO), affected tribes, and the general public.

Distribution List

Federal Agencies/Contacts

Army Corps of Engineers, Kansas City District
Army Corps of Engineers, Tulsa District
Environmental Protection Agency, Region 7
Fish & Wildlife Service, Kansas Ecological Services
Natural Resources Conservation Service
U.S. House of Representatives – Kansas 1st District
U.S. House of Representatives – Kansas 4th District
U.S. Senators (2)

State Agencies/Contacts

Kansas Advisory Council for Environmental Education
Kansas Association of Conservation Districts
Kansas Biological Survey
Kansas Corporation Commission
Kansas Department of Agriculture –Division of Water Resources
Kansas Department of Health & Environment
Kansas Department of Wildlife & Parks
Kansas Geological Survey
Kansas House of Representatives – District 74
Kansas House of Representatives – District 80
Kansas House of Representatives – District 83
Kansas House of Representatives – District 84
Kansas House of Representatives – District 85
Kansas House of Representatives – District 86
Kansas House of Representatives – District 87
Kansas House of Representatives – District 88
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Kansas House of Representatives – District 93
Kansas House of Representatives – District 94
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Kansas House of Representatives – District 98
Kansas House of Representatives – District 99
Kansas House of Representatives – District 100
Kansas House of Representatives – District 101
Kansas House of Representatives – District 102
Kansas House of Representatives – District 103
Kansas Natural Resource Council
Kansas Senate District 25
Kansas Senate District 26
Kansas Senate District 27
Kansas Senate District 28
Kansas Senate District 29
Kansas Senate District 30
Kansas Senate District 31
Kansas Senate District 34
Kansas State Historical Society
Kansas State University, Office of Extension Forestry
Kansas Water Office

City/County Governments

City of Andale
City of Burrton
City of Cheney
City of Colwich
City of Derby
City of Garden Plain
City of Goddard
City of Halstead
City of Haven
City of Hutchinson
City of Maize
City of Mt. Hope
City of Newton
City of Sedgwick
City of Valley Center
City of Wichita
Harvey County Commission
Reno County Commission
Sedgwick County Commissioner – 1st District
Sedgwick County Commissioner – 2nd District
Sedgwick County Commissioner – 3rd District
Sedgwick County Commissioner – 4th District
Sedgwick County Commissioner – 5th District
Wichita Water Utilities

Organizations/Businesses

American Fisheries Society, Kansas Chapter
Equus Beds Groundwater Management District No. 2
National Audubon Society
Ninnescah Yacht Club
Sedgwick County Conservation District
Sierra Club, Southwind Group
The Nature Conservancy
Wichita Area Chamber of Commerce
Wichita State University, Center for Economic Development
Wildlife Society, Kansas Chapter

Libraries

Wichita Public Library
Halstead Public Library
Hutchinson Public Library
Newton Public Library
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Comments on the DEIS with Responses (Appendix F)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Ecological Services Field Office
2609 Anderson Avenue
Manhattan, Kansas 66502

August 13, 2009

Equus Beds ASR Project DEIS
Bureau of Reclamation
Oklahoma-Texas Area Office
5924 NW 2nd Street, Suite 200
Oklahoma City, OK 73127-6514

RE: DEIS Equus Beds ASR FWS Tracking # 2009-FA-0698

Dear Mr. Webster:

This is in response to your letter of July 10, 2009 requesting our review of a Draft Environmental Impact Statement (DEIS) for the Equus Beds ASR. My staff has reviewed the subject DEIS and offer the following comments for your consideration.

Fish and Wildlife Coordination Act Comments

The Service recommends that the 20 cfs minimum desirable stream flow (MDS) be used as a threshold, rather than a target, for withdrawal from the Little Arkansas River. Operations should avoid to the extent possible, reducing flow to the MDS for prolonged periods of time because continuous flow maintained at the minimum is not desirable.

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. If site- specific wetland functional assessments document the need for wetland mitigation acreage and sites, a separate evaluation and report by the Service 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.

Invasive Species Comments

Invasive species have been identified as a major factor in the decline of native flora and fauna and impact aquatic resources. Executive order 13112 Section 2 (3) directs Federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere and to ensure that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. Tools to perform Hazard Analysis and Critical Control Points (HACCP) planning for invasive species control are available at http://haccp-nrm.org/. HACCP planning focuses attention on critical control points where non-target species can be removed. Documenting risks and methods used to remove non target species gives managers a strategic method to make consistent decisions based on identified risks. Planning builds a logical framework of information to weigh risks for species spread against management benefits.
The project area has known populations of zebra mussels (*Dreissena polymorpha*). We strongly encourage the inclusion of best management practices for the prevention of invasive species in

all project plans. At the minimum the following should be required as a Best Management Practice (BMP):

> All equipment brought on site will be thoroughly washed to remove dirt, seeds, and plant parts. Any equipment that has been in any body of water within the past 30 days will be thoroughly cleaned with hot water greater 140° F (typically the temperature found at commercial truck washes) and dried for a minimum of five days before being used at this project site. In addition, before transporting equipment from the project site all visible mud, plants and fish/animals will be removed, all water will be eliminated, and the equipment will be thoroughly cleaned. Anything that came in contact with water will be cleaned and dried following the above procedure.

Other invasive species in Kansas include the Eurasian watermilfoil (*Myriophyllum spicatum*), purple loosestrife (*Lythrum salicaria*), Johnson grass (*Sorghum halepense*), sericea lespedeza (*Lespedeza cuneata*), salt cedar (*Tamarix spp.*), and reed canary grass (*Phalaris arundinacea*). Additional information on aquatic invasive species in Kansas can be found on KDWP's website http://www.kdwp.state.ks.us/news/fishing/aquatic_nuisance_species. Human actions are the primary means of invasive species introductions. Prevention of introductions is the first and most cost-effective option for dealing with invasive species.

Endangered Species Act Comments

We previously concurred with the determination that the ASR, as proposed, would not likely adversely affect the Arkansas River Shiner *(Notropis girardi)*, the interior least tern *(Sterna antillarum)* or the whooping crane *(Grus Americana)*.

Summary Comments

The DEIS is well done and clearly discloses the potential impacts of the preferred alternative. However, one of the uncertainties encountered in the DEIS is the potential for impacts to stream flows and biological resources within the Little Arkansas and Arkansas Rivers resulting from climate change. There are major uncertainties and gaps regarding how aquatic communities will respond to further depletions in streamflow that are projected by the year 2050. We encourage you as the project progresses, to closely monitor the changes in streamflows within the project area and adjust project operations if needed to protect aquatic resources in the future.

Thank you for this opportunity to comment on the DEIS. If we can be of any further assistance, please call Ms. Michele McNulty, of my staff, at 785-539-3474 ext. 106.

Sincerely,

Michael J. LeValley
Field Supervisor

cc: KDWP, Pratt, KS, (Environmental Services)
COE, Kansas State Regulatory Office, El Dorado, KS
USFWS, R6RO, Tim Modde, Lakewood, CO

Responses to USFWS Comments and Concerns

Fish and Wildlife Coordination Act

Comment:
The Service recommends that the 20 cfs minimum desirable stream flow (MDS) be used as a threshold, rather than a target, for withdrawal from the Little Arkansas River. Operations should avoid, to the extent possible, reducing flow to the MDS for prolonged periods of time because continuous flow maintained at the minimum is not desirable.

Response:
In response to public concerns, the City of Wichita (email D. Ary to C. Webster 9/10/09) decided to maintain flow at the Valley Center Gauge (downstream from the project) at 30 cfs whenever pumping occurs. Thus, the City does not intend to use 20 cfs as the ASR trigger point, but rather as a threshold. Base flow (20 cfs) in the Little Arkansas would be expected to increase slightly by 2050, even during low flow seasons, due to increased stream recharge from recovering water levels in the Equus Beds. Median flow increases of 3 cfs would be expected upstream at Halstead 10 months out of the year. Flow decreases up to 12 cfs would be expected from May through June (typically high flow months), but median flows should range from 28-78 cfs throughout the year. Similar changes in flow would occur downstream at Sedgwick and Valley Center (ranging from 2-7 cfs increases about 10 months out of the year to decreases of 15-36 cfs during high flow months.) Flows would decrease about 80% of the time above the confluence with the Arkansas River, but low head dams would help maintain water levels in this highly modified urban environment (EIS p. 94-99.)

Comment:
If site-specific wetland functional assessments document the need for wetland mitigation acreage and sites, a separate evaluation and report by the Service may be necessary … when the Corps of Engineers issues a Public Notice for a section 404 permit.

Response:
The Service notified the Army Corps of Engineers, Kansas State Regulatory Office in El Dorado, KS of these comments by sending them a copy. Should the City need to apply for any additional 404 permit as part of this project, it would be required to document any potential impacts to wetlands and notify Reclamation, the Service, and ACE in writing. Mitigation would likely become necessary.

Invasive Species

Comment:
We strongly recommend the inclusion of best management practices for the prevention of invasive species in all project plans.

Response:

Recommendations as provided by the Service in their comment letter would be required during construction, as provided below:

At a minimum, the following would be required:

> "All equipment brought on site would be thoroughly washed to remove dirt, seeds, and plant parts. Any equipment that has been in any body of water within the past 30 days would be thoroughly cleaned with hot water greater [than] 140˚ F (typically the temperature found at truck washes) and dried for a minimum of five days before being used at this project site. In addition, before transporting equipment from the project site all visible mud, plants, and fish/animals would be removed, all water would be eliminated, and the equipment would be thoroughly cleaned. Anything that came in contact with water would be cleaned and dried following the above procedure."

BMPs for management of invasive species (Hazard Analysis and Critical Control Points or HACCP) are available at http://haccp-nrm.org/. The City would be required to complete and abide by a HACCP Plan and maintain a copy in the project file. The purpose would be to prevent the movement of invasive species into or out of the construction area.

Endangered Species Act

Comment:
USFWS concurred with conclusions in the DEIS that ASR would not likely adversely affect the Arkansas River Shiner (Notropis girardi), the interior least tern (Sterna antillarum), or the whooping crane (Grus americana).

Response:
This comment confirms the analytical findings of the EIS for federally-listed threatened and endangered species.

Summary

Comment:
…one of the uncertainties encountered…is the potential for impacts to stream flows and biological resources within the Little Arkansas and Arkansas Rivers resulting from climate change. There are major uncertainties and gaps regarding how aquatic communities will respond to further depletions in stream flow that are projected by 2050. We encourage you…to closely monitor the changes in stream flows…and adjust project operations if needed to protect aquatic resources in the future.

Response:
ASR would operate only under high flow conditions, typically occurring from May through June. Flows under low-flow conditions should not be significantly impacted by ASR. The City indicates that it intends to use adaptive management techniques. Current intentions are to maintain flows of 30 cfs at the downstream, Valley Center gauge when

pumping, which is 10 cfs above current base flow (email from D. Ary to C. Webster 9/10/09). The City currently has a Hydro-Biological Monitoring Plan (HBMP) in place and plans to continue the plan as necessary.

Increasing aquifer elevations due to ASR recharge would contribute to slightly higher base flows over time. This should provide some protection to the stream during low-flow conditions as well as droughts possibly related to climate change. Stream water quality should also improve with increasing recharge from the Equus Beds, which would benefit aquatic communities (EIS p. 108).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 7
901 NORTH 5TH STREET
KANSAS CITY, KANSAS 66101

0 2 SEP 2009

Charles F. Webster
Equus Beds ASR Project DEIS
U.S. Bureau of Reclamation
Oklahoma-Texas Area Office
5924 NW 2nd Street, Suite 200
Oklahoma City, OK 73127

Dear Mr. Webster:

RE: Review of Draft Environmental Impact Statement for Equus Beds ASR Project, Sedgwick & Harvey Counties, Kansas, DEIS No. DES 09-27

The U.S. Environmental Protection Agency has reviewed the Environmental Impact Statement for Equus Beds ASR Project, Sedgwick & Harvey Counties, Kansas. Our review is provided pursuant to the National Environmental Policy Act 42 U.S.C. 4231, Council on Environmental Quality regulations 40 C.F.R. Parts 1500-1508, and Section 309 of the Clean Air Act. The DEIS was assigned the Council on Environmental Quality number 20090241.

Based on our overall review and the level of our comments, the EPA has rated the DEIS for this project LO (Lack of Objections). A copy of EPA's rating descriptions is provided as an enclosure to this letter.

Overall, the DSEIS adequately identifies potential environmental and human health impacts. Though the environmental impacts included in the DEIS were overall minimal, the following comments focus on minimization and mitigation of these impacts and provide additional information related to the project:

Rock Shelters

On page 87, there is one discrepancy regarding Rock Shelters in the project area. The second paragraph under the heading Recorded Sites and Types of Sites states that "the project area includes a variety of specific site types, including…rock shelters…" However, in the description paragraph under the Rock Shelters heading, it is stated that "No rock shelters sites have been reported within the project area." EPA recommends that the statements are amended in the FEIS to reflect the correct information.

Construction Impacts

Though mentioned briefly in the Air Quality section on page 115, there were not clearly defined mitigation measures regarding construction. While most mitigation procedures related to construction are fairly standard, you may want to include a brief but more detailed explanation of said procedures.

As you mentioned, though the completed project should have no direct or cumulative impact on air quality, construction activities may have the potential to impact the proximate air quality for the short term duration of said activities. EPA has the following recommendations regarding the construction period of the project:

- Use ultra low sulfur fuel (< 15 ppm) in all diesel engines
- Use add-on controls such as catalysts and particulate traps where suitable
- Minimize engine idling (e.g., 5-10 minutes/hour
- Use equipment that runs on clean, alternative fuels as much as possible
- Use updated construction equipment that was either manufactured after 1996 or retrofit to meet the 1996 emissions standards
- Prohibit engine tampering and require continuing adherence to manufacturers' recommendations
- Maintain engines in top running condition tuned to manufacturers' specifications
- Phase project construction to minimize exposed surface areas
- Reduce speeds to 10 and 15 mpg in construction zones
- Conduct unannounced site inspections to ensure compliance
- Locate haul truck routes and staging areas away from sensitive population centers

Wetlands

In the Biological Resources section of the DEIS, Wetlands are addressed on page 123. It is stated that construction would be routed around wetlands to the maximum extent practicable and where these options are unavailable or inadequate to avoid impacts, the repair and/or replacement of wetlands would be necessary and that no other mitigation is needed. However, this description does not indicate whether any of the wetlands that could be potentially impacted are jurisdictional, or protected under the Clean Water Act Section 404.

In the event that there are jurisdictional wetlands impacted by the proposed action, we recommend that any mitigation should occur in the same HUC 8 or smaller watershed as the location of the project impacts. If changes occur in the project purpose, need, alternatives, or impacts between now and the time of issuance on Public Notice by the Corps of Engineers, EPA's 404 program reserves the ability to comment further on this project. Information may be generated through the 404 public interest review process that was not documented during the EIS process and should be considered in the final decision. This could include changes in regulation or processes, advances in the knowledge of the resources to be impacted, discovery of populations of threatened or endangered species, new best management practices, and/or improvement in stream or wetland restoration science.

Geology & Groundwater

Comments stemming from consultation with our WWPD/Drinking Water Division include the following. It is stated in the second paragraph on page 44 that "The only physical properties with regulatory criteria are TDS, pH and laboratory turbidity." Though a minor point, it might be technically safer to say "physical-chemical properties" instead of just "physical," as it can be argued that pH, for instance, is a chemical property because it is defined as the negative logarithm of the hydrogen-ion activity in water. It can also be argued too that, apart from conductivity being a function of Total Dissolved Solids (TDS), TDS itself is not necessarily a "physical property" because TDS results from chemical and biochemical interactions between groundwater and geological materials through which it flows, and to a lesser extent from contributions from the atmosphere and surface-water bodies. As a result, groundwater contains a wide variety of dissolved inorganic chemical constituents in various concentrations.

The phrase "regulatory criteria" is vague. EPA recommends clarification of what "regulatory criteria" is referenced and make sure it is appropriate and relevant. There are national surface Water Quality Criteria which have been established under the authority of the Clean Water Act (CWA) for a number of contaminants, and there are also national criteria (or drinking water standards) for a number of contaminants in the form of Maximum Contaminant Levels (MCLs) that have been established under the authority of the Safe Drinking Water Act (SDWA) which apply to public water systems.

Also in paragraph two on page 44, as a matter of syntax, EPA suggests a minor modification of the following sentence, as follows: "Some sample values fell outside of EPA's (2004) Secondary Drinking Water Standard **range for pH** of 6.5 (slightly acidic) to 8.5 (slightly basic)."

In the final paragraph on page 110, EPA suggests clarification that water quality degradation from brines is attributable, in part, to "historic poor management" of brines from salt-mining and oil field production, prior to enactment of laws and regulations designed to prevent future such mismanagement of brine waste.

In regards to the last paragraph on page 112, in addition to, or in an effort to reduce the need for PAC to remove additional amounts of atrazine during primary herbicide application season, EPA would also like to include a recommendation that the City of Wichita link up with NRCS and/or the Cooperative Extension Service to promote Best Management Practices (BMPs) by area growers to prevent improper and/or injudicious use of atrazine and nitrates in the project area.

Thank you for the opportunity to provide our comments regarding this project. If you have any questions, please contact me at 913-551-7565, or via email at tucker.amber@epa.gov, or you may contact Joe Cothern, NEPA Team Leader, at 913-551-7148 or via email at cothern.joe@epa.gov.

Sincerely,

Amber Tucker

Amber Tucker
NEPA Reviewer
Environmental Services Division

Enclosure

Responses to EPA Comments and Concerns

Rock Shelters

Comment:
There is one discrepancy regarding rock shelters. The heading "Recorded Sites and Types of Sites" states that rock shelters are found in the project area (page 87). Later in the document, it is stated that "No rock shelters have been reported within the project area."

Response:
To clarify, no rock shelters have been reported in the project area. The erroneous statement on page 87 indicating that rock shelters have been found has been corrected.

Construction Impacts

Comment:
There were no clearly defined mitigation measures regarding construction. EPA recommends the following mitigation measures be taken during the period of construction:

- *Use ultra-low sulfur fuel (<15 ppm) in all diesel engines*
- *Use add-on controls such as catalysts and particulate traps where suitable*
- *Minimize engine idling (e.g., 5-10 minutes/hour)*
- *Use equipment that runs on clean, alternative fuels as much as possible*
- *Use updated construction equipment that was either manufactured after 1996 or retrofit to meet the 1996 emissions standards*
- *Prohibit engine tampering and require continuing adherence to manufacturers' recommendations*
- *Maintain engines in top running condition tuned to manufacturers' specs*
- *Phase project construction to minimize exposed surface areas*
- *Reduce speeds to 10 and 15 mph in construction zones*
- *Conduct unannounced site inspections to ensure compliance*
- *Locate haul truck routes and staging areas away from sensitive population centers*

Response:
EPA recommendations for construction activities would be included in the EIS for the City to implement and administrate accordingly. Reclamation would conduct quarterly construction inspections and would verify compliance with environmental requirements during these inspections. Updated construction equipment (constructed or retrofitted to meet 1996 emissions standards) would be used to the maximum extent practical.

Wetlands

Comment:
In the event that jurisdictional wetlands (protected under Section 404 of the Clean Water Act) are impacted, EPA recommends that any mitigation should occur in the same HUC 8 or smaller watershed as the location of the project impacts. In the event changes occur in the project purpose, need, alternatives, or impacts…EPA's 404 program reserves the right to comment further on this project. Information may be generated through the 404 public interest review process that was not documented during the EIS process and should be considered in the final decision. This could include changes in regulation or processes, advances in the knowledge of the resources to be impacted, discovery of populations of threatened or endangered species, new best management practices, and/or improvement in stream or wetland restoration science.

Response:
ASR construction should not impact any jurisdictional wetlands, because no jurisdictional sites have been documented in the construction area. The nearest known jurisdictional wetlands are located in the McPherson lowlands north of the project. However, should jurisdictional wetlands be discovered in the construction area, mitigation requirements would apply. Where changes occur, proper notification would be provided to ACE and EPA.

Geology and Groundwater

Comment:
It is stated…on page 44 that, "the only physical properties with regulatory criteria are TDS, pH and laboratory turbidity." It might be technically safer to say "physical-chemical" properties…

Response:
"Physical" properties referred to on page 44 has been changed to read "physical-chemical" properties.

Comment:
The phrase "regulatory criteria" is vague. EPA recommends clarification of what is referenced and make sure it is appropriate and relevant. There are national surface water quality criteria…and there are also national criteria (or drinking water standards)…in the form of Maximum Contaminant Levels (MCLs)…which apply to public water systems.

Response:
Where used, the term "regulatory criteria" refers to national surface water quality criteria. Drinking water standards are referred to individually as "Maximum Contaminant Levels" where appropriate.

Comment:
…on page 44, EPA suggests a minor modification of the following sentence, as follows: "Some sample values fell outside of EPA's (2004) Secondary Drinking Water Standard [range for pH] of 6.5 (slightly acidic) to 8.5 (slightly basic).

Response:
The words "range for pH" have been inserted in the sentence as recommended.

Comment:
In the final paragraph on page 110, EPA suggests clarification that water quality degradation from brines is attributable, in part, to "historic poor management" of brines from salt-mining and oil field production, prior to enactment of laws and regulations designed to prevent future such mismanagement of brine waste.

Response:
The referenced comment will be included in the document on p. 112, as appropriate.

Comment:
In regards to the last paragraph on page 112…in an effort to reduce the need for PAC to remove additional amounts of atrazine…EPA would also like to include a recommendation that the City of Wichita link up with NRCS and/or the Cooperative Extension Service to promote Best Management Practices (BMPs) by area growers to prevent improper and/or injudicious use of atrazine and nitrates in the project area.

Response:
The City would use the ozone/hydrogen peroxide Advanced Oxidation Process (AOP) process to remove Atrazine at the SWTP. In addition, the City contributes to and supports the Kansas Watershed Restoration and Protection Strategy (WRAPS) annually to help protect and restore Kansas watersheds. The City has indicated its intent to link up with NRCS and/or the Cooperative Extension Service to promote BMPs in the judicious application of atrazine and nitrates in the project area.

SIERRA CLUB
FOUNDED 1892

Southwind Group

September 9, 2009

Equus Beds ASR Project DEIS
Bureau of Reclamation
Oklahoma-Texas Area Office
5924 NW 2nd St, Suite 200
Oklahoma City, OK 73127

RE: Equus Beds Aquifer Storage Recharge and Recovery Project (ASR) Draft Environmental Impact Statement (DEIS)

Thank you for the opportunity to provide comments on the DEIS. As noted in our previous communications, we have followed this project since its inception and have provided comments previously on behalf of the 800-plus Sierra Club members in south-central Kansas on the Integrated Local Water Supply Plan (ILWSP) and the City of Wichita's (City) EIS. Additionally we participated in the scoping process for the City's EIS and the current DEIS. We also sponsored a tour of the Phase I facility for our members in 2007. We continue to support this project, but have continuing concerns relating to:

- Plans for removal of atrazine from the river water for Phase II are not adequately addressed in either the City's EIS or the DEIS. It is our understanding that an advanced oxidation process (ozone and hydrogen peroxide) will be utilized for Phase II but it is not discussed in the DEIS.
- There are no additional plans for water conservation, beyond the current rate structure and emergency provision, to assist in providing an adequate supply of drinking water to the City. Additional measures such as low-flow fixtures could

be subsidized providing a low cost source of additional water and lessening the socio-economic and environmental justice impacts noted in the DEIS. While the goal of the ILWSP is to provide sufficient water for 2050, how will we continue to meet later demands if no additional conservation is required?

- No consideration is given to land use and air quality impacts other than those at the project site. Additional water supplies will inevitably lead to urban expansion causing impacts in the broader area.
- Little consideration is given to the presence of pharmaceuticals in the River water. While current methodologies might not permit detection of these chemicals, the likelihood of their presence and their potential impacts should be included in the DEIS.
- The expansion of the local well-field in the area of the junction of the Little Arkansas and Arkansas Rivers would seem to have greater potential impacts than discussed in the EIS. These potential impacts should include not only stream flows but neighboring residential wells and the municipal wells of Bel Aire and the Chisholm Creek Utility Authority located within one mile of the expanded local well-field.

In addition, we have concerns relating to two ASR issues not addressed in the DEIS:

- First, we understand that the City plans to seek an NPDES permit for Phase II of the ASR which would allow them to return sediment, removed with river water, to the Little Arkansas River. Sediment levels are at their highest during periods of peak flow which is when water will be removed from the river. Removing water and returning sediment would seem to increase the sediment load during this time of already heavy loads. In our view, this activity would add to the river's current impaired status due to sediment. While the City is undertaking a Watershed Restoration and Protection Strategy on its rivers, this sediment loading upstream appears to be in opposition to that effort. This should be addressed in the current DEIS.
- Secondly, the City has now completed redevelopment of its Bentley well-field, which lies between the Equus Beds and the Arkansas River. We understand that the groundwater at this site has high salt content of River origin. Wouldn't the use of this well-field increase the potential to move additional high salt content water from the Arkansas River to the Equus Beds and be counterproductive to ASR goals? The ASR is intended to increase the levels of groundwater in the Equus Beds with the side benefit of preventing the further migration of salt plumes into the Equus Beds from areas bordering the Arkansas River and from the old Burrton well-field. Pumping groundwater from the Bentley well-field would seem to negate any effects raising groundwater levels would have on preventing migration of the Arkansas River salt plume into the Equus Beds in that area. This issue should also be addressed in the DEIS.

Again, we appreciate the opportunity to provide comment and are hopeful that funding will be provided for this project. This will be particularly important to lessen the socio-economic and environmental justice impacts of the project as noted in the DEIS. We look forward to working with the City and the Bureau of Reclamation as this project moves forward.

Sincerely,

Ellie Skokan
Conservation Chair
5825 Memphis
Wichita, KS 67220
ellie_skokan@yahoo.com
316 744-0033

Responses to Sierra Club Comments and Concerns

Comment:
Plans for removal of atrazine from the river water for Phase II are not adequately addressed… It is our understanding that an advanced oxidation process (ozone and hydrogen peroxide) will be utilized but it is not discussed in the DEIS.

Response:
Pilot studies (Hughes and Thompson 2009) have demonstrated that advanced oxidation using ozone and hydrogen peroxide (AOP) effectively destroys the Atrazine molecule. The SWTP AOP process would be operated at design conditions (15 mg/l ozone and 22.3 mg/l hydrogen peroxide) at all times. AOP reduces the concentration of Atrazine to levels lower than the public drinking water standard.

Comment:
There are no additional plans for water conservation, beyond the current rate structure and emergency provision, to assist in providing an adequate supply of drinking water to the City. Additional measures such as low-flow fixtures could be subsidized providing a low cost source of additional water and lessening the socio-economic and environmental justice impacts noted in the DEIS. While the goal of the ILWSP is to provide sufficient water for 2050, how will we continue to meet later demands if no additional conservation is required?

Response:
The City is revising its water conservation plan at the present time. Existing conservation practices have resulted in a slower growth of water use than population growth. The City adopted requirements of the 1992 Energy Conservation Act recommending the use of low flush toilets (1.6 gallons per flush or gpf), low flow urinals (1 gpf), and low flow

showerheads and faucets (2.5 gallons per minute or gpm). The City also plans to (email D. Ary to C. Webster 3/16/09):

1) Continue its public education program and strive to make its message constant, consistent, and pervasive.
2) Require adoption and enforcement of City-approved water conservation plans that are at least as comprehensive as Wichita's for all new, renewed, or amended wholesale water contracts.
3) Continue its aggressive leak detection surveys and repairs program.
4) Continue its aggressive meter repair and replacement program.
5) Require applicants for Industrial Revenue Bonds to write and implement a Water Management Plan.
6) Initiate a pilot irrigation system retrofit program that specifically targets systems 10 years and older and provides cost sharing for adding rain sensors, drip irrigation, clocks and matched precipitation/pressure compensating sprinkler heads. The program would require 80% water distribution uniformity after the retrofit is completed and have an education component on the growth habits of turf grass and the benefits of deficit irrigation.
7) Review and modify the rate structure on an annual basis to help achieve and maintain conservation goals.
8) Adopt standardized construction and landscape specifications throughout the City so that City projects are built to be water conservative.
9) Set an example for the public by adopting municipal procedures that require water conservation and management plans.
10) Implement and administer the Kansas Water Office Long-Term Water Use Efficiency Practices for Water Utilities.

Comment:
No consideration is given to land use and air quality impacts other than those at the project site. Additional water supplies will inevitably lead to urban expansion causing impacts in the broader area.

Response:
It is recognized that population growth impacts both land use and air quality. Urban counties in Kansas (including Sedgwick) continue to grow in population, while rural counties tend to lose up to 10% of their population per decade (KWO 2008). The 8-county project area, including Wichita, grew about 3.4% between 2000 and 2007. This statewide shift in population from rural to urban areas is projected to continue, regardless of how water is obtained.

ASR has been designed to respond to expected urban growth. Without ASR, withdrawals from the Equus Beds would continue, along with increased withdrawals from Cheney Reservoir and other surface water sources EIS p. 103, 142, Appendix A.) This would result in lower water levels in Cheney Reservoir, the Little Arkansas River, the North Fork of the Ninnescah, and possibly in the mainstems of the Arkansas and Ninnescah rivers. The net effect is that Equus Beds recharge to the Little Arkansas would continue to decline along with continuing water level declines in the aquifer. Saltwater intrusion would increase. The relationship between ASR and population growth is not apparent, but the EIS did consider future and cumulative effects on natural resources of the area. Effects may be undesirable for some resources and for others the effects should be beneficial.

Comment:
Little consideration is given to the presence of pharmaceuticals in the river water. While current methodologies might not permit detection of these chemicals, the likelihood of their presence and their potential impacts should be included.

Response:
This issue was brought up during scoping and an effort was made to look into it (EIS p. 41-42.) It was not considered to be a key issue, as no substantial contamination sources are known in the project area, based on the sample data available. The Little Arkansas River watershed is composed primarily of agricultural and rural lands. Only about 3% of the watershed is urbanized and most pharmaceutical contamination would come from populated areas. The remaining 97% is composed of agricultural (95%), wooded (1%), and aquatic (1%) areas. There are no significant, suspected sources of pharmaceuticals within several miles of the project area (Newton is located more than 20 miles upstream.) Only the small towns of Halstead and Sedgwick are located within the ASR project area.

Comment:
First, we understand that the City plans to…return sediment, removed with river water, to the Little Arkansas River. Sediment levels are at their highest during periods of peak flow which is when water will be removed from the river. Removing water and returning sediment would seem to increase the sediment load during this time of already heavy loads. In our view, this activity would add to the river's current impaired status due to sediment.

Response:
The City's outfall component is part of a pre-existing project and is independent of Federal funding. It is therefore not discussed in this EIS, except in the context of cumulative impact. Information provided by the City (email A. Cole to C. Webster 8/19/09) describes the design, which includes treatment to minimize environmental impacts. The WTP and intake would utilize a solids line to return sediment to the Little Arkansas River during high flows. High flow events tend to suspend bottom sediments, thus minimizing the overall effect of solids return. Suspended materials would be rapidly carried downstream and drop out of the water column as flows recede. Solids would be separated from surface water using a circular clarifier process at the intake. Detention time in the clarifier would be about 1 hour to allow the solids to settle and the raw water would then be piped to the WTP and pumped through membranes to remove the remaining solids. Spent membranes would be disposed of offsite as a solid waste when necessary. No chemicals would be added to the solids discharged to the river.

Comment:
The expansion of the local well-field in the area of the junction of the Little Arkansas and Arkansas rivers would seem to have greater potential than discussed… potential impacts should include not only stream flows but neighboring residential wells and the municipal wells of Bel Aire and the Chisholm Creek Utility Authority located within 1 mile of the expanded local well-field.

Response:
All water withdrawn from planned new wells in the expanded local well field would be taken from bank storage wells only. Wells would be drilled down to bank-storage levels only and screened above the Equus Beds. No additional water would be withdrawn from the aquifer, so there would be no expected change in impact to neighboring wells.

Comment:
…the City has now completed redevelopment of its Bentley Well Field, which lies between the Equus Beds and the Arkansas River…the groundwater at this site has high salt content of river origin. Wouldn't use of this well-field increase the potential to move additional high salt content water from the Arkansas River to the Equus beds and be counterproductive to ASR Goals? …Pumping groundwater from the Bentley Well Field would seem to negate any effects raising groundwater levels would have on preventing migration of the Arkansas River salt plume into the Equus Beds in that area.

Response:
Increased pumping in the Bentley Well Field (which is not a component of the ASR) would lower the local water table and increase the amount of Arkansas River water reaching the field. In the long term, however, the relative rise in the Equus Beds water table resulting from ASR should impede movement of Bentley Well Field water into the project area.

KANSAS

DEPARTMENT OF WILDLIFE AND PARKS

Mark Parkinson, Governor
J. Michael Hayden, Secretary
www.kdwp.state.ks.us

September 11, 2009

Equus Beds ASR Project DEIS
Bureau of Reclamation
Oklahoma –Texas Area Office
5924 NW. 2nd Street, STE. 200
Oklahoma City, OK 73127

Ref: D5.0400
Harvey
Track: 20080149-4

RE: Comments and Concerns Regarding the DEIS Equus Beds Wichita ASR Project

Dear Mr. Webster:

This letter is in response to your July 10, 2009 letter requesting our department to review and provide comments on the Draft Environmental Impact Statement of the Wichita Equus Beds ASR Project

Based on the assumption that no changes will occur in the original design of the project, we will likely concur with the DEIS findings and conclude that this project will have minimal impacts to the natural resources that are of concern for our department.

However, due to a May 7, 2009 Wastewater Discharge Permit Notice reviewed by our department, the Wichita Water Utilities' Production and Pumping Division propose to dispose high solids (sludge) slurry back into the Little Arkansas River from outfall 002A1. It is our understanding that this project was not part of the original design and was not included in the DEIS evaluation.

At this time we are unsure about the status of the slurry disposal with respect to the DEIS. We request that this matter be addressed and clarified with respect to the DEIS. Once addressed, we will provide our final comments and concurrence.

If you have any questions or concerns, please contact me at (620)-672-0798 or ericj@wp.state.ks.us.

Sincerely,

cc: LeValley, USFWS
Dillingham, KDHE
edillingham@kdheks.gov
Ary, City of Wichita
DAry@wichita.gov

Eric R. Johnson, Ecologist
Environmental Services Section

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Responses to KDWP Comments and Concerns

Comment:
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