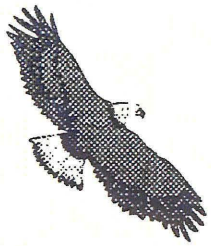
Final Draft Water Needs Assessment



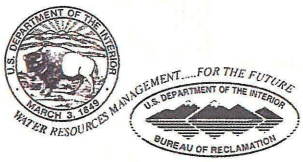
Kickapoo Tribe in Kansas

Prairie Band Potawatomi Nation

Sac and Fox Nation of Missouri

U.S. Department of the Interior
Bureau of Reclamation

Technical Service Center
Denver, Colorado



January 2003

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Denver, Colorado

Adopted by the following
Tribal Council resolutions:

Kickapoo Tribe in Kansas,
No. _____, _____
(date)
Prairie Band Potawatomi Nation,
No. _____, _____
(date)
Sac and Fox Nation of Missouri,
No. _____, _____
(date)

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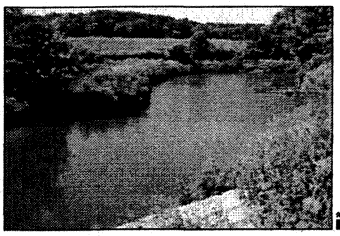

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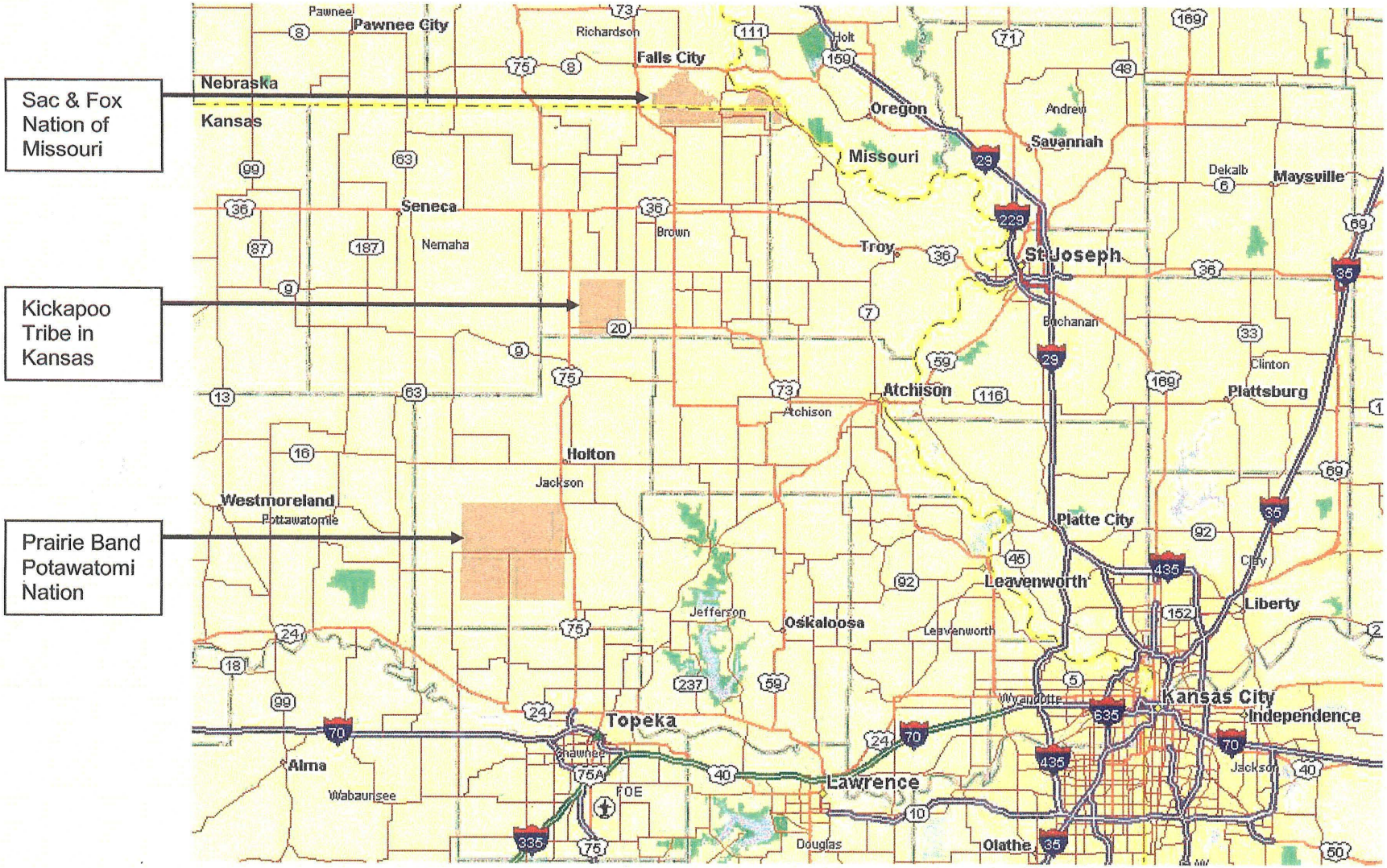
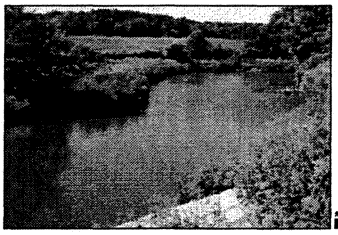


Map courtesy of DeLorme, Inc.



Executive Summary

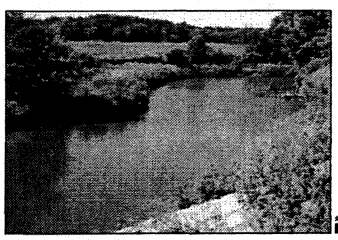
This needs assessment (assessment) was conducted under the authority of the Federal Reclamation Act and prepared for the Kickapoo Tribe in Kansas, Prairie Band Potawatomi Nation, and Sac and Fox Nation of Missouri (Tribe/Nations) under Tribal Council resolutions. Funding was provided mostly from the Native American Affairs Program, but also from the Technical Assistance to States and General Investigations Programs of the Bureau of Reclamation (Reclamation). Technical and other assistance was through Tribal task forces, the Mni Sose Intertribal Water Coalition, rural water districts, local municipalities, the Kansas Water Office, and Kansas and Nebraska departments of environment.

The Tribe/Nations are seeking additional water supplies to augment existing systems that are inadequate to meet water needs for economic development and community/ Tribal infrastructure. Data gathered for this report show a need for increased economic opportunity on the three reservations. Relatively low income and high unemployment exist together with the potential for increased population and growth. In addition, significant droughts for periods up to 2 years are common.

Surface water for the reservations in the study area is limited. Only the Sac and Fox Reservation has access to a surface water source—the Big Nemaha River—with significant annual streamflow. The picture is even less promising for the Potawatomi and Kickapoo Reservations, which have access only to smaller rivers and streams. Major groundwater sources are on the edge of the area evaluated and are not readily accessible by the Tribe/Nations. Wells in the area are generally of low yield.

Specific groundwater and surface water alternatives are analyzed for the Kickapoo Tribe and Prairie Band Potawatomi Nation. Surface water options are analyzed for the Sac and Fox Nation (where groundwater resources are believed to be infeasible). Five multi-Tribal alternatives for water needs to 2040 are offered; Plum Creek Reservoir, Perry Lake, Kansas River/Shawnee Reservoir, Banner Creek, and Hiawatha Wells.

The assessment concludes with findings and recommendations for proposed water supply systems. Finally, it is also noted that the most economical solution for each Tribal entity may not involve a single source for all (i.e., may not be a multi-Tribal water supply project). Among conclusions are that each Tribal Council should review findings and consider the total cost of delivered water in multi-Tribal solutions versus other solutions; that the Tribe/Nations should adopt water conservation and reuse plans; and that evaluation be conducted of the water distribution system serving the Kickapoo Tribe in Kansas (for fire-flow and possible leakage reduction).



CHAPTER I – Purpose of and Need for the Proposal

Background

This water needs assessment (assessment) was conducted under the authority of the Federal Reclamation Act (June 17, 1902, as amended). Funding was provided through the Bureau of Reclamation's (Reclamation) Native American Affairs, Technical Assistance to States, and General Investigation Programs. Technical and other assistance was through Tribal task forces, the Mni Sose the Kansas Water Office, and Kansas and Nebraska Departments of Environment.

The assessment was undertaken as a result of Tribal Council Resolutions of the Kickapoo Tribe in Kansas (Kickapoo), January 11, 2001; the Prairie Band Potawatomi Nation (Potawatomi), March 16, 2001; and the Sac and Fox Nation of Missouri (Sac and Fox), February 7, 2001 (collectively termed the Tribe/Nations). Any municipal, rural, and industrial (MR&I) water obtained as a result of this assessment would not foreclose future water claims of the Tribe/Nations under the Winters Doctrine[1] or other aboriginal, treaty, or American Indian (Indian) Trust Assets rights.

Introduction

The Tribe/Nations are seeking additional water supplies to augment existing systems to meet water needs for economic development and community/Tribal infrastructure. To accommodate these unmet needs, Reclamation, in conjunction with the Tribe/Nations and other cooperators, formulated alternatives for additional water resources. These alternatives were formulated jointly, among all three Tribe/Nations (chapter VI), individually on-reservation (chapter V), and, on a more cursory level, individually with off-reservation sources (attachment D).

[1] Provides that the establishment of an Indian Reservation impliedly reserves the amount of water necessary for the purposes of the reservation. Upheld by the U.S. Supreme Court.

Water Supply Needs

There are major surface water limitations for the reservations in the study area. Only the Sac and Fox reservation has access to a surface water source—the Big Nemaha River—classified as a median mean annual streamflow.[2] However, impoundments would be needed for substantial water development. The picture is even less promising for the Potawatomi and Kickapoo reservations, which have access only to small mean annual streamflow rivers and streams—Soldier Creek and the Delaware River, respectively.

Major groundwater sources—the Kansas River, Delaware River, and Missouri River Valley alluvial aquifer systems—are on the edge of the area evaluated and are not readily accessible by the Tribe/Nations. Wells in the area are generally of low yield.

Data gathered for this report indicate a need for increased economic opportunities on the three reservations. Relatively low income and high unemployment exist together with the potential for increased population growth. The provision of future water supplies, which can support population growth and commercial development, can help meet this need.

This document does not address water rights for the three Tribes. The data presented here were not designed or intended to be used or construed for any estimation, interpretation, or limitation of Tribal water rights.

Scope

The study area included in this study is depicted on the area map and includes the following:

- The Kickapoo Reservation, established in 1854, is in Brown County in northeastern Kansas, about 50 miles from St. Joseph, Missouri, to the east and Topeka, Kansas, to the south. Tribal headquarters are in nearby Horton. Limited surface water is from the Delaware River and tributary creeks.

- The Potawatomi Reservation, established in 1846, is in Jackson County, Kansas, about 25 miles north of Topeka. Tribal headquarters are in nearby Mayetta. Limited surface water is from creeks in the area.

[2] Streamflow is classified as follows: Large mean annual streamflow exceeds 5,000 cubic feet per second (cfs) mean annual streamflow; median mean annual streamflow exceeds 500 cfs; and small mean annual streamflow is less than 50 cfs annually.

- The Sac and Fox reservation, established in 1837, is primarily in extreme northeastern Brown County, Kansas, with a smaller area in adjacent Nebraska. It is located about 8 miles southeast of Falls City, Nebraska. Tribal headquarters are in Reserve, Kansas. Limited surface water is from the Big Nemaha River and tributary creeks.

- Sections of the Highway 75 corridor to facilitate transmission piping.

The general area is characterized by prairie grasslands, wooded areas along rivers and creeks, and cultivated cropland. It is, on the whole, sparsely populated; residents of non-Indian areas tend to be older than the Indian population. The population is increasing on the reservations, while nonreservation populations are declining or increasing very slightly. Per capita income in nonreservation areas is below the State median of $20,506, but on the three reservations it is significantly (about one-third) lower. Casinos and other Tribal enterprises provide income to the reservations. The area has hot summers and cold winters, with average precipitation of about 34 inches occurring mostly between April and September. Significant droughts for periods up to 2 years are common.

Related Projects

- Mni Sose Coalition's study of drought assistance plans.

- Pikatanoi Water System – This proposed system to supply future needs primarily in northeast Kansas is in the study phase, reviewing available water sources, legal issues, existing and future water needs, and the extent and capability of existing systems. Facilities would consist of a treatment plant or multiple plants near high-capacity water supply sources and related structures.

- Banner Creek Water Supply and Recreation Project – This new, multiple use water project centers on a reservoir located on Banner Creek approximately 1 mile southwest of Holton, Kansas. Treated water was initially provided in August 2002. The new water filtration plant at the reservoir has an initial capacity to treat 1.5 million gallons per day (mgd) and could be expanded to treat 2.5 mgd.

- Plum Creek Reservoir – This reservoir near Powhattan, Kansas, has been under study by the Kickapoo Tribe in Kansas to provide a water supply of about 1.5 mgd, but funding issues have not been resolved. The reservoir would provide a water supply, flood mitigation, and recreation.

Tribe/Nations Background

This section presents a brief background on each Tribe and Nation participating in the study.

Kickapoo Tribe in Kansas Community Environmental Profile

Kickapoo Tribal Government.—The United States Government as defined by the United States Constitution has governmental relationships with International, Tribal, and State entities. The Tribal nations have a government-to-government relationship with the United States. The Kickapoo Tribe signed treaties with the United States which are the legal documents that established the Tribal homeland boundaries and recognized Tribal rights as a sovereign government.

The Kickapoo Tribe lived in Wisconsin and Illinois in the days prior to diplomatic relations with the United States Government. The Kickapoo Tribe was originally designated reservation lands in an 1819 treaty in Missouri and was later moved to Kansas with lands recognized in a treaty with the United States signed on March 16, 1854, and amended in 1864 to further reduce land holdings. This includes all rights-of-way, waterways, watercourses and streams running through any part of the reservation and to such others lands as may hereafter be added to the reservation under the law of the United States.

The Kickapoo Tribe operates under a constitution consistent with the Indian Reorganization Act of June 18, 1934, and is governed by the Tribal Council. The Tribal Council consists of a Chairman, Vice-Chairman, Secretary, Treasurer, and three additional Council members, all of whom are elected by the Tribal membership.

The Tribal Council Chairman serves as the administrative head of the Tribe. The Tribal Chairman, Officers, and Council members serve 2-year staggered terms at-large without regard to residence in a particular district of the reservation.

Tribal/Agency Headquarters:	Horton, Kansas
Counties:	Brown, Kansas
Number of enrolled members:	1,539
Reservation population:	(On or near) 783
Labor force:	Not available
Unemployment percentage rate:	Not available
Language:	Kickapoo and English

Tribal History.—The word Kickapoo comes from Kiwigapawa, meaning "he stands about" or "he who moves about, stand now here, now there," according to the *Smithsonian Institution Handbook of American Indians*. It is the name of a Tribe that is closely related to the Sac and Fox Tribe. Both belong to the Algonquin linguistic family and have similar customs and languages.

The Kickapoo Tribe was first encountered by the Catholic Missionary Father Allovez between the Fox and Wisconsin Rivers in southern Wisconsin about 1667. A few years later, they moved south into Illinois, gradually extending their area around the Sangamon River and toward the east along the Vermillion and Wabash Rivers. They played a prominent role in the history of this area up to the end of the War of 1812.

In 1795, the first treaty between the Kickapoo Tribe and the United States was signed at Greenville. Later treaties (1809 and 1819) provided for the cession of all Kickapoo land claims in Illinois, which consisted of about one-half of the State. In exchange, they were promised land on the Osage River in Missouri.

By 1820, most of the Kickapoos had moved to the new Missouri location but not to stay for long. The area had long been the hunting grounds of the Osages, and they protested the intrusion, claiming that the Kickapoos would spread out over the Osage country and would kill the game. In St. Louis in July 1820, the Kickapoos signed an amendment to the 1819 treaty granting them lands in Missouri, and accepted instead a reserve in Kansas. However, not until 1832 did the action to remove the Tribe get seriously underway. On October 24, at Castor Hill, St. Louis County, Missouri, the Tribal leaders signed an agreement to leave Missouri for Kansas. Heading the list of signers were Pa-sha-cha-hah (Jumping Fish) and Kennakuk, the famous Kickapoo prophet.

The new reservation in Kansas consisted of 1,200 square miles located in the present counties of Brown, Atchison, and Jackson. This was reduced to 150,000 acres located at the head of the Delaware River in Brown County in 1854. In 1864, another treaty was signed which further diminished their land holdings to an area measuring 5 miles by 6 miles.

About 1852, a large party of Kickapoos together with some Potawatomi, left Kansas and traveled to Texas and then on to Mexico where they became known as the Mexican-Kickapoo. They were joined by another party of Kickapoo who had become dissatisfied with the reservation life in Kansas. Here, they became a constant source of annoyance to the border settlements, and efforts were made to induce them to return to Kansas. This failed, but in 1873, a number of the Mexican band were induced to move to Oklahoma Indian Territory. Others have since returned, but those that remained in Mexico settled on a reservation granted to them by the Mexican Government in the Santa Rosa Mountains of eastern Chihuahua and western Coahuila.

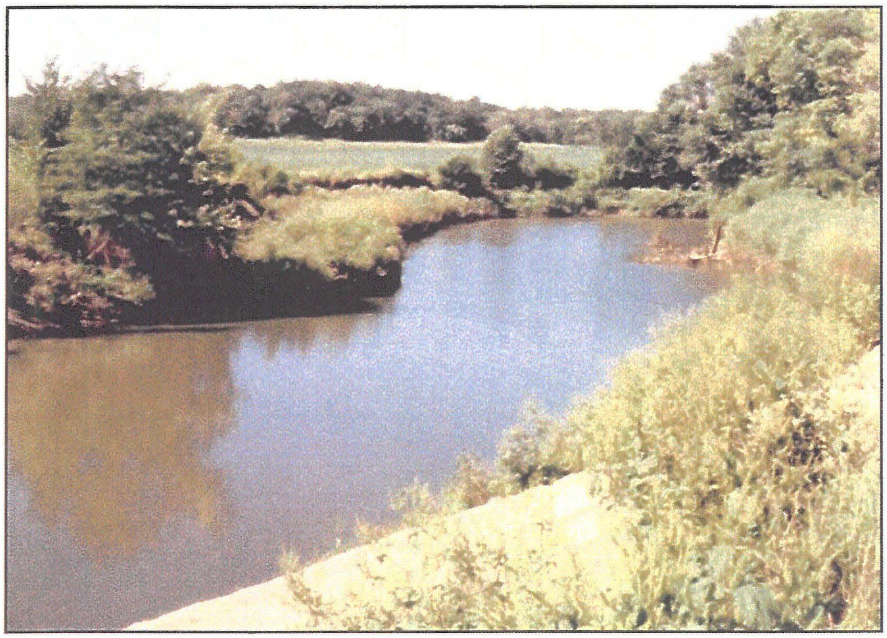
A reservation consisting of 100,000 acres was assigned to the Kickapoos who returned from Mexico. Since then, nearly all of the land located near McCloud, Oklahoma, has been absorbed by non-Indians.

In 1759, the Kickapoo population was estimated to be around 3,000. By 1825, it had declined to 2,200. Today, there are 1,400 Kansas Kickapoos. Approximately 780 of these live in Kansas, with the others scattered throughout the United States.

Environmental Summary.—Terrain: Level farmland and grassland dominate the reservation.

Tribal lands	Acres
Agricultural:	3,051
Grazing:	1,936
Forestry:	221
Other:	2,138
Total	7,346

In 1996, Tribal environmental staff identified solid waste landfill closure, cleanup, and monitoring as the major reservation environmental problem which may be hazardous to the health of reservation residents.



Delaware River as it runs through the Kickapoo Tribe in Kansas reservation.

The Prairie Band Potawatomi Nation

Tribal History

The Prairie Band Potawatomi Nation is a Tribal unit that originated in the Great Lakes area many years ago. During this time, the Tribe was an autonomous and prosperous group living off the bountiful natural resources of the Great Lakes. What they couldn't catch in the lakes or hunt in the forests, they acquired through trade with other Tribes and later with the non-Indians.

After the first contacts with non-Indians in 1641, land became a central issue that intensified with the expansion of the 13 colonies or "13 Fires." Non-Indians wanted the land for mines, timber, and the growing number of towns, cities, and ports.

During this time of advancing settlement, the Potawatomi people held no real concept of land ownership. Their beliefs taught them that land belonged to all living things alike. However, the U.S. Government, in its first treaties with the Indians, established boundaries for Tribal land. In the numerous treaties that followed, known as "cession treaties," the Potawatomi agreed to sell land to the United States Government. Those early concessions soon led to more drastic policies.

The 1830 Removal Act was a governing policy of the U.S. Government. The policy revolved around a dream that the Indian "problem" could be eliminated forever by persuading the eastern Indians to exchange their lands for territory west of the Mississippi. The exchange would leave the area between the Appalachians and the "Father of Waters" free for white exploitation and settlement.

During this forced migration westward, the Potawatomi made temporary stops in Missouri's Platte Country in the mid-1830s and the Council Bluffs area of Iowa in the 1840s. The Tribe controlled up to 5 million acres at both locations. After 1846, the Tribe moved to present-day Kansas, a new region which was once called the "Great American Desert." Although the area lacked the beauty of the Great Lakes, the circumstances of removal left the Tribal people little choice. It amounted to another period of adjustment for the Tribe, just like so many times in the past. At that time, the reservation was 30 square miles, which included part of present-day Topeka.

Even this temporary settlement changed with the passage of the Kansas-Nebraska Act of 1854. Opening this territory to white settlement initiated a stream of immigrating white settlers. The settlers, without even waiting for the land to be officially taken from the Indians by treaty, moved onto Indian lands in what was known as "squatter sovereignty."

Additional white migration to Santa Fe and Oregon areas suddenly made land like the Kansas Territory doubly appealing. In this context, Indians posed a threat to this expansion and were, as a result, victimized by less-than-ethical land deals.

Soon after, railroad interests, religious groups, and politicians got involved in new treaty negotiations. But the Tribe also experienced an internal divide: 1,400 members wanted the land divided into allotments coupled with the promise of eventual citizenship, but a small group of 780 Potawatomi stood firm for communal holdings. This smaller group were neither interested in obtaining citizenship nor rejecting their heritage, and they held firm in their belief that no single person owned the land. This group became what is now the Prairie Band Potawatomi Nation.

Two treaties, one in 1861 and another in 1867, carved the reservation's existing land base of 568,223 acres into portions that accommodated individual interests. The railroad received over 338,000 acres, Jesuit interests 320 acres, Baptist interests 320 acres, and the rest was divided into separate plots. The Jesuits, although failing ultimately to make Kansas a center of Catholic interest, did eventually settle approximately 2,300 acres around St. Mary's Mission.

The Prairie Band Potawatomi Reservation initially constituted 11 square miles in the northeast corner of the original reservation. Here, as elsewhere, the exploitation of the Indian lands became the key to the development of the white man's economy. The total Potawatomi holdings began at 568,223 acres in 1846 and by 1867 had decreased by 87 percent to only 77,357 acres.

With the conclusion of the railroad treaties of the 1860s, the Potawatomi settled upon the 11-square-mile reservation expecting to live in peace. But, as so many times in the past, continued development overlooked the interests of the Tribe.

Despite convincing evidence that earlier attempts at land allotment resulted in exploitation and dispossession of most Indian Tribes, the so-called "friends" of the Indians urged Congress to enact a similar policy nationwide.

"The reservation must go!" became the cry of Eastern reformers determined to fashion Indians in their own image and therefore to proclaim them self-reliant citizens. As a result, in 1887 Congress passed the Dawes Act or the General Allotment Act of 1887. The Government deemed this law a "virtual necessity." They said they could no longer protect Indian lands from further settlement and the demands of the railroads and other enterprises. The basic premise of the General Allotment Act was to give each Indian a private plot of land on which to become an industrious farmer. To hasten assimilation, the law provided for the end of Tribal relationships, such as land held in common. It stipulated that reservations were to

be surrendered and divided into family-sized farms which would be allotted to each Indian. The supreme aim was to substitute white civilization for Tribal culture.

The Potawatomi still persistently refused to recognize their allotments of land or the right of the government to make such a disposition. Persuasion consisted of withholding Federal payments due the Prairie Band and giving double allotments of their land to whites, Indians from other Tribes, and the residing agent's relatives. Furthermore, much of the land allotted to them was too poor to farm, and they received no financial credit and little help of any kind.

Many Indians, including the Potawatomi, were totally unaware of non-Indian economic motivations and customs. They leased or sold their lands to whites for a fraction of its true value. Others were swindled out of their land holdings under the Dawes Act and later legislation designed to accelerate the sale and lease of the Indians' allotments to whites. Conditions on reservations became scandalous. Indians received little or no education and were treated as wards, incapable of self-government or self-determination. In the years following the Dawes Act, the Potawatomi weathered these injustices along with the Great Depression by virtue of their ability to adapt to economic conditions. However, the passage of the Indian Reorganization Act of 1934 was another matter.

The Reorganization Act dealt with Indian self-government, special education for Indians, Indian lands, and a Court of Indian Affairs. The Potawatomi looked favorably on the termination of the allotment policies of the Dawes Act and the return of surplus lands to the Potawatomi because, by this time, the Tribe had lost close to 50,000 acres as a direct result of this law. Indians living on the Potawatomi Reservation, however, greatly opposed self-government. Basically, the Tribe opposed the foreign concept of the formation of a new governing body.

In the history of the Tribe, most decisions were made by the entire Tribe, not a few individuals. Many Tribal members were older people who were suspicious of anything they didn't fully understand.

Another stumbling block for Tribal members was that the Indian Reorganization Act wasn't designed to recognize sovereignty, nor did it encourage it. Most decision-making had to be approved by the Secretary of the Interior or Commissioner of Indian Affairs. Nevertheless, this particular bureaucratic mechanism was installed against the wishes of the Potawatomi and remained a problem for years. A Tribe couldn't embark on any business venture, handle its own trust money, or pass any major change in their government without first seeking Federal approval.

All future dissent of the Tribe can be directly traced to a form of government imposed on the Tribe. A ruling body was never part of the Potawatomi story,

and though changing times dictated this concept, it was never accepted nor were the leaders that became part of the new Tribal body politic.

The issue became almost a moot point in 1947 when a conservative Republican Congress wanted to reduce the expenditures of the Federal Government. Acting Indian Commissioner William Zimmerman was asked to testify on Indian programs, evaluate Tribal conditions and list those Tribes that could immediately succeed without further Federal help. This laid the groundwork for the hectic 1950s and the next commissioner, Dillon Myer, who advocated immediate government withdrawal from the Indian business.

Myer had many people in Congress who shared his sentiments. Hence, this period became known as the Termination Period. This was another assimilation effort on the part of "friends" in Washington—a campaign similar to the allotment policies of the 1800s, but far more serious. Now the entire Indian system was slated for elimination.

In 1954, the House of Representatives drafted a resolution called HR 4985 with the express purpose of withdrawing Federal supervision over five Indian Tribes as soon as possible. This list included the Potawatomi Tribe. Potawatomi strategy to avoid termination included a grass roots campaign. It included signing and sending petitions of protest to the government. Multiple delegations from the Potawatomi Tribe went to Washington D.C. to testify in front of congressional committees and to lobby policymakers. Thankfully, the message of Potawatomi unity came across strong and clear, and Congress withdrew the Potawatomi name from the termination list.

The preceding paragraphs only briefly summarize the Potawatomi story, but it can serve as some background information. Other material goes into more depth on the contributions of individual nation members. Within the last decade, the Nation has experienced a revitalization: the introduction of gaming activities has initiated an improvement in social, educational, and cultural leadership programs. As a result, the Nation is able to provide a wide range of opportunities for employment and business development while contributing to the economic viability of the region. Today, the Prairie Band Potawatomi Nation can once again look optimistically to the future and to the preservation of a valued culture.

Sac and Fox Nation of Missouri

Sac and Fox Nation of Missouri History

Despite the many hardships that they have faced over the years, which included losing the majority of their land and people, the Sac and Fox Nation of Missouri has remained a viable group who are proud of their ancestors and heritage.

The Sac and Fox Nation of Missouri people and their ancestors have been historically located in parts of Canada, Michigan, Wisconsin, Illinois, Iowa, Missouri, Kansas, and Nebraska. The Sac and Fox of Missouri in Kansas and Nebraska (Ne ma ha ha ki) finally settled in the northeast corner of Kansas. There are two other bands: one residing in Oklahoma, which is the Sac and Fox Nation of Oklahoma (Sa Ki wa ki), and the other in Iowa, which is the Sac and Fox Tribe of the Mississippi in Iowa (Meskwaki).

In the year 1836, the Missouri Sauk ceded by treaty their lands in the triangle-shaped region of northwest Missouri for a small reservation in Kansas. The 1836 Platte Purchase left the Missouri Sauk with no choice but to move to once again to a new area. By the late 1850s, the Sacs were forced to adjust to new conditions and a different way of life. They had up until then refused to adopt white ways.

The Missouri Sac and Fox spoke the Algonquian dialect and were culturally related to the Kickapoos and Potawatomis. The Sac and Fox lived in bark houses in small villages. The Sauk social organization consisted of clans—the Bear, Sturgeon, Swan, Thunder, and Wolf. The Sac and Foxes have been portrayed throughout history as being independent and unwilling to change their customs.

In 1837 the Sauk emigrated to their new reservation in Kansas and Nebraska, where they were joined by kinfolk of both bands who had moved into the region earlier to hunt and plant crops. The Sac welcomed the reunion with their people.

Nesourquoit, Sac warrior of the Bear clan, was adamant that his people would not give up their customs and way of life. He would fight hard for his people, but in the end had to give in to circumstances that he fought so long and hard to prevent.

Nesourquoit's village was located at Walnut Grove on the Wolf River, 3 miles northeast of Severance, Kansas. He resented white interference in Tribal affairs and did not listen to whites attempting to make him leave his land.

By the 1830s, Christian missionaries had come to show the Indians the way of Jesus. The Sac and Fox customs have been taught from father to son. Nesourquoit threatened to throw the Presbyterian missionaries off the reservation. Nesourquoit was the main spokesman for approximately 650 Sacs who would not accept any of the teachings of the missionaries.

Nesourquoit fought the ever-increasing threat of alcohol and endeavored to keep whiskey traders off their reservation. He was an example because he himself did not drink.

By the 1850s, the government was attempting to have the band sell part of the land and to accept individual family farms. Nesourquoit insisted that his people had no

intention of selling their reservation; Nesourquoit said, "Where shall we go? We know the whole country. . .and we know not any fit for us to live upon." Despite all of his concerns for the land, it was agreed to sell half of the lands to be able to keep the rest.

Although Nesourquoit, along with other Sauk leaders had signed the treaty, he now refused to abide by its terms and would not move his people to the smaller parcel of the reservation. Nesourquoit encouraged the Sauks to live together in one large village, which would make a more united front against the government. Since Nesourquoit and his people would still not move, annuities were withheld until they complied with the treaty. When the annuities were withheld, the Sac and Fox people used their independent spirit and resourcefulness to survive.

Other noted people of the Sac and Fox include Black Hawk and Keokuk. Black Hawk led his people into the Black Hawk War in 1832. This was the last Indian war east of the Mississippi.

Another Sauk leader, Mokohoko, needs to be recognized for placing the welfare of his people above his own personal interests. Mokohoko, a member of the Sturgeon Clan, had spoken on behalf of the Missouri Sacs before the Commissioner of Indian Affairs. When Keokuk's son Moses Keokuk moved the Mississippi bands to the Indian Territory in 1869, Mokohoko refused to surrender their lands, saying that leaving Kansas "would be like putting our heads in the mouth(s) of the great Bear's to be eaten off."

After 2 years of resisting the government, the Sac and Fox people finally gave in and moved to what was left of the Kansas reservation in November 1856.

They soon regretted the decision.

They were not satisfied with the new location, and the annuities that the government promised were not being paid.

Although these peaceful people eventually surrendered most of their land, they still made a living. By the time individual allotments were given in 1887, many of the more traditional Tribal members had moved to Oklahoma.

The Sac and Fox Nation of Missouri today has 435 Tribal members. These Tribal members reside all over the United States. They are kept informed of the Tribal issues and programs by a newsletter that is printed every 3 months.

Tribal programs that are available to the Tribal members only are:

Elderly assistance – 62 years and older

School allowance – 5 years through 18 years

Higher education – college and vocational-technical

Adult education

Environmental department

Domestic violence program

Indian child welfare – social worker

Eyeglasses, dental, and hearing aid assistance

Community health representative
Blood pressure checks and assistance in transporting to Indian Health

Housing authority

Language program

Burial assistance

Federal dollars and a percentage of the profits of the casino fund the programs above.

The Nation currently has 1,446 acres of land, primarily used for farming. The Sac and Fox Casino on Highway 75 uses some of this land base.

A Tribal Council consisting of five Tribal members governs the Sac and Fox Nation of Missouri. The General Council elects the Tribal Council. The General Council consists of all members of the Nation who are 18 and older. The Nation is governed by a Constitution. The Sac and Fox Nation of Missouri determines, by the Constitution, their own enrollment procedures.

A Tribal museum was opened in April of 1996. The museum presents artifacts of Tribal members and other Native Americans. A research center was recently started within the museum; current resource material includes microfilm, history papers, and photos.

Sac and Fox Nation of Missouri Migration Routes

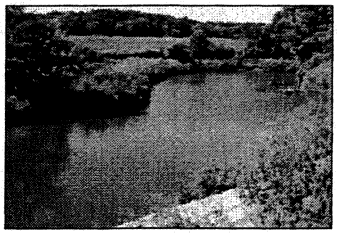
1635 – 1730 Sac and Mesquakie/Fox are separate Tribes found in the St. Lawrence Seaway area in eastern Canada and Great Lakes region in North America. They are known to have migrated to Saginaw Bay in lower Michigan and then further west near Green Bay, Wisconsin.

Mesquakie/Fox and Sac locate to Rock Island, Illinois, on confluence of Rock and Mississippi Rivers.

1804 – 1810	Sac and Fox band under Quashquame's leadership leaves parent Tribe and establishes village near Fort Madison, Iowa.
1811 – 1816	Quashquame's Sac and Fox band are found on Missouri River near the Osage River at a place called Pierced Rock. The Tribe becomes officially named Sac and Fox of the Missouri Tribe in 1815 by United States Government.
1817 – 1824	Sac and Fox of the Missouri migrate across what is now the State of Missouri along the Missouri River and settle in Platte Purchase area in northwest Missouri.
1825 – 1836	Sac and Fox of the Missouri locate in Platte Purchase region that now comprises Atchison, Buchanan, Andrew, Nodaway, Holt, and Platte Counties. The Tribe leaves the area by force in 1836.
1837 – Present	Sac and Fox of the Missouri locate on reservation in what is today southeast Nebraska and northeast Kansas.

Document Organization

In subsequent chapters, this assessment provides information on the social, economic, and demographic characteristics of the area; its water resources and supply systems; and water supply alternatives and recommendations for meeting future water needs.



CHAPTER II – Economic and Social Setting

Population Estimates and Projections for the Study Area

Estimating the current and future population of the three American Indian (Indian) reservations included in this water needs assessment (assessment) is complicated by the disparity in population estimates from various sources of information. Past U.S. Bureau of the Census estimates (U.S. Census) of Indian reservation populations have typically undercounted the number of people on a reservation due primarily to errors in estimating the number of people in each housing unit. On the other hand, the Bureau of Indian Affairs (BIA) estimates of service area population generally overstate the number of people actually on a reservation because the service area can extend well beyond reservation boundaries.

Projecting future population is subject to even more error due to the assumptions that must be made when estimating the components of growth or decline. For example, assuming a relatively high rate of immigration to an Indian reservation will overstate the future population if immigration rates are actually very low. Assumptions about future birth rates, death rates, and longevity will also affect the accuracy of population projections. In addition, several potential sources of population projections exist that can be used to estimate future residential water demands.

Differing sources of population data, as well as future population methods, are presented in attachment A to provide a range of present and future population estimates.

Population Estimates

Kickapoo Reservation.—The 2000 Census estimates 334 non-Indians live in the area, including the Powhattan Township less the population of the Town of Powhattan. Adding this number to the Mni Sose Intertribal Water Rights Coalition (Coalition) Inc., estimates of 783 results in a total of 1,117 people. This estimate of the number of people in the reservation service area accounts for potential undercounting of the number of Indians on the reservation; therefore, this number is judged to be the best estimate available.

Potawatomi Reservation.—The 2000 Census estimates that there are 720 non-Indians on the Potawatomi Reservation. Adding the number of non-Indians to the Coalition estimate of Tribal members on or near the reservation results in a total of 1,625 people.

Sac and Fox Reservation.—The 2000 Census estimates that there are 163 non-Indians on the Sac and Fox Reservation. Adding the Coalition estimate of 55 Tribal members on or near the reservation results in a total of 218 people.

Population Projections

In addition to the population estimates presented above, the Coalition provides total Tribal enrollment data. As of 1996, there were an estimated 1,539 enrolled members in the Kickapoo Tribe, 4,875 enrolled members in the Prairie Band Potawatomi Nation, and 362 enrolled members in the Sac and Fox Nation. These estimates indicate the potential for significant in-migration of Tribal members, assuming housing and other infrastructure are available.

Population Projections for the General Study Area.—All of the trend analysis projections for Brown County show a generally decreasing population trend regardless of the technique used. The Kansas Water Office showed the same trend, only with a slightly lesser decrease. As a result, the Kansas Water Office projections (table II-1) are considered to be a good representation of future population levels for Brown County. However, the Kansas Water Office projections for Jackson County appeared high compared to the trend analysis, which included the most recent 2000 data available. Therefore, modified projections (table II-1) are considered to be the most representative of future growth for Jackson County.

These county-level projections are important to this assessment because they are indicative of the levels of growth or decline in the general area of the three reservations. The county-level projections can be used to help predict future growth on each reservation.

Population Projections for Each Reservation.—The Potawatomi Reservation population is projected to grow at a rate of 17.6 percent every decade, based on modified Reclamation estimates.

Table II-1.—Population projections for Brown and Jackson Counties

Year	Brown County[1]	Jackson County[2]
2000	10,901	12,643
2010	10,722	13,954
2020	10,542	15,490
2030	10,362	16,598
2040	10,183	17,529

[1] Source: Kansas Water Office and 2000 Census estimates.
[2] Source: Reclamation estimates modified to 2000 Census estimates.

The population of the Kickapoo Reservation was projected to grow by a relatively small rate of 4.5 percent every 10 years. This is based on the change in the population of the reservation from 1980 and 1990 as estimated by the U.S. Census (2000 data was not comparable to previous years, as stated earlier and from the slightly decreasing population for Brown County. Most of the population increase is assumed to be Tribal members moving into the area. The rate of growth could be higher if more housing becomes available.

The population of the Sac and Fox Reservation was projected to remain fairly stable based on the very small change estimated by the U.S. Census from 1990 to 2000 and the small population estimated by both the BIA and the Coalition. The growth rate is estimated at 8.9 percent every 10 years. In addition, the Sac and Fox Reservation is located primarily in Brown County, which has a projected decrease in population.

The estimated current and future population of each Reservation is presented in table II-2.

Table II-2.—Estimated current reservation population and population projections

Reservation	Estimated current population	2010	2020	2030	2040
Kickapoo	1,115	1,160	1,210	1,260	1,310
Potawatomi	1,625	1,935	2,255	2,585	2,935
Sac and Fox	220	240	260	280	300

Economic and Social Setting

Kickapoo Reservation

The economy of the Kickapoo Reservation is based primarily on agricultural production and revenues from the Tribally owned Golden Eagle Casino located on the Kickapoo Reservation. Significant revenues are derived from leasing agricultural lands and from Tribal farm operations. Major crops grown in the area include wheat, corn, soybeans, and milo. The Tribal farm operated by the Kickapoo currently has about 1,200 acres and the Tribe typically leases 500 to 600 acres of pasture. Tribal enrollment is currently 1,611 members.

The largest Tribal enterprise is the Golden Eagle Casino, which opened in 1996 and includes slot machines, table games, a restaurant, and a showroom. The Casino expanded to more than twice its original size in 1998 (from 25,000 square feet to 55,000 square feet). The casino employs 350 to 370 people, 17 to 20 percent of whom (about 75 people) are Kickapoo Tribe members. Another 10 to 20 percent are Indians from other Tribes. It is estimated that about 70 percent of the casino's employees live in the surrounding communities. The casino averages 50,000 to 60,000 visitors each month (720,000 customers each year). The National Indian Gaming Commission (NIGC) estimates that 1998 gaming revenue for the Golden Eagle Casino was $25 million to $50 million.

The Kickapoo Tribe also operates the Kickapoo Truck Plaza, which includes a convenience store and 20 pumps. The truck plaza opened in 1999. The Kickapoo Trading Post is located south of the Golden Eagle Casino on Highway K-20. The Trading Post sells gasoline and also includes a gift shop and convenience store. The Kickapoo Pow-Wow Days attract tourists to the area. Government at all levels provides a significant source of employment and income to the area.

Detailed socioeconomic data from the 2000 Census can be used to help evaluate conditions on the Kickapoo Reservation. Median household income on the Reservation in 1999 was estimated to be $26,515 and per capita income was an estimated $13,212. The percentage of Reservation population below poverty level was 15.7 percent.

According to the 2000 Census, 60.7 percent of all persons on the Reservation 16 years of age or older were in the labor force. Of those considered to be part of the labor force, an estimated 6.1 percent were unemployed. Employment by industry for the Reservation in 1999 indicated that the greatest employment was in health and education services (22.8 percent), services such as food and entertainment (20.3 percent), manufacturing (10.9 percent), public administration (8.7 percent), and

retail trade (8.2 percent). The greatest change in the type of employment on the Reservation occurred with the opening of the Golden Eagle Casino, when employment in the entertainment and recreation services sector grew substantially.

The median age of the Reservation population in 2000 was 37.8 years and there were an estimated 2.51 persons per household. About 17.3 percent of the reservation population was reported to be American Indian in 2000 and 81.9 percent of the Reservation population 25 years of age or older was a high school graduate or higher. Fertility rate data are not yet available for the 2000 Census data. However, the 1990 fertility rate for the Reservation, which is measured as children ever born per 1,000 women, was 550 for women 15 to 24 years of age, 3,154 for women 25 to 34 years of age, and 3,094 for women 35 to 44 years of age.

Potawatomi Reservation

The economy of the Potawatomi Reservation is most influenced by the casino located on the Reservation near Mayetta, Kansas, and by agricultural activities. The single greatest source of economic activity on the reservation is the casino and hotel complex jointly operated by the Prairie Band Potawatomi Nation and Harrah's Entertainment. A temporary casino opened in 1996 and the larger permanent casino opened in 1998. The complex includes a 63,000-square-foot entertainment facility and a 100-room hotel. The casino has slot machines, table games, a bingo hall, a restaurant, and a Nation-run gift shop. A 100-room hotel adjoins the facility.

Employment at the casino varies, depending on the year and season, but there are approximately 900 people employed full-time at the casino. In 1999 there were 1,113 full- and part-time employees at the casino. In 1999, about 62 reservation residents were employed at Harrah's. The average salary at the casino was $24,000, and about 6 percent of those earnings were spent on the reservation. The NIGC estimated Harrah's 1998 gaming revenues to be between $50 million to $100 million.

Approximately 3,000 acres of Tribal land are presently under cultivation, a significant percentage of which is leased to non-Tribal agricultural interests. The primary crops grown in the area include hay and pasture. Other economic activities on the Reservation include a hunting club/preserve, a county-operated landfill, service stations, a nursery, and a bingo hall. The Nation has recently begun to expand its land base; as a result, the amount of land in the reservation owned by non-Indians has decreased from about 80 percent in 1978 to about 40 percent currently.

The Nation also hosts several pow wows and other ceremonies during the year. Government at various levels also provides employment, with the Nation itself employing about 300 people.

The 2000 Census estimated median household income on the Reservation to be $42,232 in 1999 and per capita income was an estimated $15,372. The percentage of reservation population below poverty level was 7.8 percent.

An estimated 70 percent of all persons on the Reservation 16 years of age or older were in the labor force. Of those considered to be part of the labor force, an estimated 3 percent were unemployed. Employment by industry for the reservation in 2000 indicated that the greatest employment was in health and education services (19.7 percent), entertainment and recreation services (13.4 percent), manufacturing (12.6 percent), public administration (11.7 percent), and construction (9.6 percent). Essentially all of the entertainment and recreation services employment is accounted for by the Harrah's Casino.

The median age of the Reservation population in 2000 was 33.3 years and there were an estimated 3.11 persons per household. An estimated 44.7 percent of the reservation population was American Indian in 2000 and 89.2 percent of the reservation population 25 years of age or older was a high school graduate or higher. The 1990 fertility rate for the reservation was 828 for women 15 to 24 years of age, 2,195 for women 25 to 34 years of age, and 2,317 for women 35 to 44 years of age.

Newly constructed Prairie Band Potawatomi Nation Senior Center.

Sac and Fox Reservation

The Sac and Fox Reservation economy depends in large part on agriculture-related activities. Approximately 450 acres of Tribal lands on the Reservation are currently under lease for agricultural use, which provides a significant amount of income to the Reservation. In addition, any land that would be acquired by the Nation in the future would likely be agricultural land which would then be leased back for agricultural production. Sac and Fox Tribal enrollment is currently 429 members

Commercial establishments on or near the reservation include a casino, truck stop, five small establishments and a community building. The Sac and Fox Casino is located in on U.S. 75 highway south of Powhattan, Kansas, and opened in 1997. The casino has slot machines, table games, and a restaurant. Revenues from the Sac and Fox casino provide a significant positive impact on reservation employment and income. The NIGC estimated that gaming revenue for the Sac and Fox Casino was $10 million to $25 million in 1998. As of early 2001 the casino employed a little over 350 people. In addition, Tribal members receive per capita checks, which are funded through casino revenues.

The government sector, including Tribal government activities, also provides a significant source of employment and income to the area. Traditional cultural activities such as beadwork, silverwork, and weaving also provide some income. However, the casino and agricultural activities account for the main portion of the Tribe's economic base.

Based on the 2000 Census data, median household income on the Reservation in 1999 was $31,500 and per capita income was an estimated $13,356. The percentage of Reservation population below poverty level was 7.9 percent.

The 2000 Census indicates that approximately 88.4 percent of all persons on the reservation 16 years of age or older were in the labor force. Of those considered to be part of the labor force, all were considered to be employed as defined in the U.S. Census. Employment by industry for the Reservation in 2000 indicated that the greatest employment was in agriculture (15.8 percent), retail trade (15.8 percent), and public administration (13.2 percent). Other important sectors include the entertainment and recreation services sector, education and health, and transportation and utilities which each account for 7.9 percent of total employment (the casino falls within the entertainment and recreation services sector).

The median age of the reservation population in 2000 was 26.3 years, and there were an estimated 3.07 persons per household. About 48.8 percent of the reservation population was American Indian in 2000 and 85.4 percent of the reservation

population 25 years of age or older was a high school graduate or higher. The 1990 fertility rate for the reservation was zero for women 15 to 24 years of age, 2,250 for women 25 to 34 years of age, and 3,000 for women 35 to 44 years of age.

Home in the Red Earth housing area of the Sac and Fox Nation of Missouri.

Social and Economic Indicators Compared to Brown County, Jackson County, and all of Kansas

The estimates of income, unemployment, educational attainment, and other socio-economic characteristics on each reservation should be compared to other areas in order to better understand conditions on the reservations. Income, employment, age, education, and fertility statistics were obtained for Brown County, Jackson County, and all of Kansas for comparison with each reservation in the study area. The statistics for each area are presented in table II-3. The statistics for each Reservation are repeated for easy comparison. Most of the data presented in table II-3 was obtained from the 2000 U.S. Census.

The data in table II-3 indicate that household and per capita income are lower on the Kickapoo and Sac and Fox Reservations than for the two surrounding counties and all of Kansas. Per capita income is lower on all three reservations than for Jackson

Table II-3.—Comparison of socioeconomic characteristics[1]

	Kickapoo Reservation	Sac and Fox Reservation	Potawatomi Reservation	Brown County	Jackson County	Kansas
Median household income	$26,515	$31,500	$42,232	$31,971	$40,451	$40,624
Per capita income	$13,212	$13,356	$15,372	$15,163	$18,606	$20,506
Population below poverty	15.7%	7.9%	7.8%	12.9%	8.8%	9.9%
Persons at least 16 years old in the labor force	60.7%	88.4%	70.7%	63.5%	67.0%	67.5%
Unemployment rate	6.1%	0%	3.0%	3.7%	2.3%	2.8%
Median age (years)	37.8	26.3	33.3	39.8	37.4	35.2
Household size	2.51	3.07	3.11	2.44	2.63	2.51
American Indian population	17.3%	48.8%	44.7%	9.9%	8.3%	1.8%
High school graduate or higher	81.9%	85.4%	89.2%	84.6%	87.7%	86.0%
Fertility rate: (children every born per 1,000 women)						
15 to 24 years old	550	0	828	418	353	323
25 to 34 years old	3,154	2,250	2,195	2,106	1,840	1,541
35 to 44 years old	3,094	3,000	2,317	2,468	2,291	2,091

County and Kansas as a whole. Median household income on the Potawatomi Reservation is higher than for all of Kansas. The percentage of the population below poverty is much higher on the Kickapoo Reservation than for the two counties and all of Kansas.

The percentage of the population in the labor force varies greatly, depending on the reservation. In decreasing order, comparing each reservation's labor force older than 16 years of age to the State average of 67.5 percent, the Sac and Fox are at 88.4 percent, the Potawatomi at 70 percent, and the Kickapoo at 60.7 percent. A relatively low percentage of people considered to be a part of the labor force on the Kickapoo Reservation compared to the rest of the state may be an indication that there is chronic, long-term unemployment on the Kickapoo Reservation that is not reflected through traditional unemployment rates. The unemployment rate on the Kickapoo and Potawatomi Reservations is higher than for the counties and for all of Kansas.

The demographic data indicate households are somewhat larger and the average age is lower on two of the three reservations than for the two counties and the state as a whole. In addition, the fertility rate (measured as children ever born per 1,000 women) is generally higher than average for the three reservations. The relatively young population and high fertility rates indicate the high potential for future population growth and continued large households. Last, educational attainment on the three reservations is lower than for the State. The lower-than-average high school graduate rate could be a limitation on employment opportunities.

Economic Development and Growth in the Future

Future commercial and industrial water demand depends on the number and types of establishments in the region. Growth in the number of commercial and industrial establishments in an area is difficult to predict because many factors can influence business location decisions. Some of these location factors include availability of adequate transportation links, the size and education level of the labor force, the availability of support industries including financial institutions, the natural resource base, physical factors such as climate, and location incentives provided by state and local governments. Although some of these factors may be known with some certainty and can be used to assess the potential for future business and industry growth (such as transportation links and labor force), others cannot be predicted with any confidence.

Although the exact number of commercial and industrial establishments in the future cannot be predicted with certainty, four different approaches can be used to help evaluate the potential for future growth or decline. These approaches include:

- ❑ Using historical regional business pattern data to develop trends in commercial and industrial activity. Trends can be obtained for total employment by sector, earnings by sector, or value of output by sector. These trends can then be extrapolated to the future based on linear or nonlinear models.

- ❑ Using current and projected growth for various commercial and industrial sectors on a statewide or national level and applying that level of growth to similar local activities.

- ❑ Obtaining future development plans from local land use and development planners and using those plans to establish realistic and desirable economic development goals.

- ❑ Assuming future commercial and industrial development will grow or decline at the same rate as population.

Each approach has disadvantages and advantages. Historical trends may not be realistically projected into the future if there has been unusually high growth in commercial and industrial activity in recent years which cannot be sustained over a long period of time. In addition, current trends can be limited by physical geographical boundaries, which represent limits to potential commercial and industrial activity. Past trends may simply not be applicable into the future.

The application of large regional or national commercial and industrial growth projections to a small area or municipality is a simple procedure but may not represent local conditions accurately. National scale projections are more useful as a guide to better understanding the general effect of the national economy on the local region under consideration. For example, if the national economy is projected to grow significantly in the future, this growth will have a positive impact on local economies.

Economic development plans provided by local planning groups, agencies, and Indian Tribes/Nations, can be used to evaluate potential development in the future. These plans provide insight on the degree and types of development desired by the local community and may provide an upper bound for future growth estimates. In many cases these plans indicate the location of desired growth and the location of future industrial/commercial business parks. In addition, development plans typically provide information on the types of businesses and commercial activities that Indian Tribes/Nations are most interested in pursuing in the future.

Some types of businesses closely follow changes in population over time. Retail trade, services, and some utilities which provide goods and services primarily to the

regional population are significantly influenced by population size. However, the rate of population change in the local region should not be used to project future commercial and industrial activity that is not directly tied to local demand. For example, high-cost or specialized goods and services such as automobile sales and repair, large appliances, and furniture are more likely to be purchased from nonlocal suppliers due to larger potential cost savings, and local population growth projections should not be used to project growth for these types of businesses.

Historical Regional Business Pattern Data

County Business Pattern data for 1977 to 1997 were collected for the total number employees and establishments by sector to evaluate the regional commercial development trends for the study area. The study region was defined as Brown and Jackson Counties. An analysis was then performed to determine if there was a statistically significant trend in employment or number of establishments over the time period for all sectors combined and for individual sectors. The results are summarized in tables II-4 and II-5.

The data in tables II-4 and II-5 indicate that the total number of employees and establishments in the two counties has increased over the 20-year period. There has been statistically significant positive growth for the total number of employees for both counties, an estimated average of 52 employees each year for Brown County and 38 employees for Jackson County. The number of establishments for Jackson County has grown significantly at an average rate of 3.5 establishments per year, while there was not statistically significant growth for Brown County.

Retail employment has increased at a significant rate for both Brown and Jackson Counties from 1977 to 1997, while the number of retail establishments has decreased at a significant rate for Brown County and at a statistically insignificant rate for Jackson County.

Manufacturing employment and the number of manufacturing establishments has not changed significantly from 1977 to 1997 for either county. Employment and the number of establishments for all types of businesses have increased at a significant rate for both counties. Analysis indicates that for the general two-county area there has been significant growth in commercial activity. However, this growth has not occurred in the manufacturing section, the agricultural services sector, or the food-manufacturing sector.

The relative importance of various commercial sectors can also be evaluated by looking at the relative value of output for each sector. Table II-6 shows the value of

Table II-4.—Total number of employees by sector

Category	1977	1981	1984	1989	1993	1997
Brown County						
Agricultural services	0	19	13	29	0	17
Construction	0	110	33	39	0	52
Manufacturing	652	687	552	681	580	859
Transportation, communication, and utilities	206	211	200	99	103	117
Wholesale trade	229	224	181	192	224	218
Retail trade	481	472	435	460	574	642
Finance, insurance, real estate	121	141	144	324	149	148
Services	630	763	801	829	1,054	1,656
Others	0	46	30	23	0	1
Total	2,319	2,673	2,389	2,676	2,684	3,710
Jackson County						
Agricultural services	0	0	0	8	0	0
Construction	220	122	124	146	151	226
Manufacturing	203	0	0	137	191	163
Transportation, communication, and utilities	126	92	97	128	57	73
Wholesale trade	91	140	111	115	108	82
Retail trade	460	405	486	499	516	699
Finance, insurance, real estate	65	72	73	94	125	160
Services	209	252	176	250	443	641
Others	1	0	0	85	0	0
Total	1,375	1,083	1,067	1,462	1,591	2,044

output by sector for Brown and Jackson counties for 1992 and 1997. The data in table II-6 support the same basic conclusion of the employment and number of establishment data that trade and services account for the majority of commercial activity in the area, but that manufacturing also makes a significant contribution to the local economy.

The majority of commercial/business growth in the region is the result of growth in the service, retail, and finance sectors. These types of activities are closely correlated with population growth. Therefore, using projected population growth as an indicator of growth for these sectors is reasonable. Over the last 20 years there has been little if any growth in the agricultural and manufacturing sectors. However, the lack of past commercial/industrial growth outside of the service, retail, and finance sectors does not mean that this type of growth could not occur. In order to account for potential future development, which is not accounted for in the regional data, local development plans and other input are used for the three reservations.

Table II-5.—Number of establishments by sector

Category	1977	1981	1984	1989	1993	1997
Brown County						
Agricultural services	4	5	5	4	3	4
Construction	33	25	23	20	25	18
Manufacturing	16	15	16	13	16	19
Transportation, communication, and utilities	17	19	22	13	22	20
Wholesale trade	32	29	34	28	27	34
Retail trade	81	72	82	63	68	62
Finance, insurance, real estate	23	22	22	25	25	31
Services	77	74	84	90	93	101
Others	2	15	19	14	3	3
Total	285	276	307	270	282	292
Jackson County						
Agricultural services	0	2	3	3	3	4
Construction	31	23	32	28	37	53
Manufacturing	7	9	7	7	9	9
Transportation, communication, and utilities	8	12	12	14	12	16
Wholesale trade	20	21	26	21	19	18
Retail trade	77	62	74	68	62	63
Finance, insurance, real estate	14	13	14	16	23	21
Services	39	35	43	55	71	83
Others	3	11	20	24	1	4
Total	199	188	231	236	237	2

Table II-6.—Value of output by category

	Brown County		Jackson County	
	1997	1992	1997	1992
Category	($ thousands)		($ thousands)	
Manufacturing	75,776	48,000	NA[1]	18,000
Wholesale trade	73,635	66,022	24,952	27,975
Retail trade	67,075	41,157	73,866	51,033
Real estate and related	981	—	—	—
Professional services	4,335	—	1,414	—
Administrative and	1,015	—	705	—
related	8,979	7,167	3,992	3,045
Health care and related	5,416	—	5,754	—
Hotel and food service	3,706	[2]7,561	6,542	[2]5,887
Other services				

[1] Date for this category of output is not available.
[2] Other services includes other categories of services except health care and related.

Additional Considerations

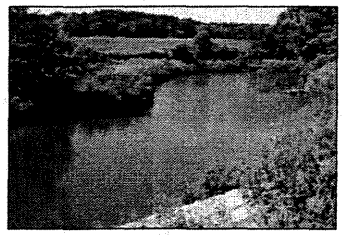
The Kansas Center for Community Development estimates trade "pull factors" by city and county in their Kansas County Profile Report. A "pull factor" (PF) is a measure of how well a community attracts and holds on to business compared to other places. A PF is estimated by dividing community per capita sales tax collections by state per capita sales tax collections at a 1-percent rate. A PF value above 1.00 indicates the community is attracting more business than it is losing. A PF below 1.00 indicates the community is losing more business than it is capturing. Therefore, pull factors are useful for evaluating the relative strength of businesses in a community. PF for Brown and Jackson Counties are shown in table II-7.

Table II-7.—Retail pull factors for Brown and Jackson Counties

County	1985	1990	1995	1999
Brown	.60	.60	.59	.53
Jackson	.48	.57	.59	.61

Both Brown County and Jackson County have PF less than 1.0, indicating the county is losing more business to outside providers than it is capturing from outside demanders. The PF for Brown County is less than 1.0 and it is declining. The PF for Jackson County is less than 1.0 but it has increased over the last 15 years. These PF indicate that most if not all of the future demand for retail sector goods and services will come from within the study area because there are net losses in retail demand for these two counties.

Proposed site for additional housing located west of the Red Earth housing area, Sac and Fox Nation of Missouri.



CHAPTER III – Resource Setting

Climate

Regional climatic records dating back to 1888 indicate that the average long-term annual precipitation is 34.23 inches. Slightly more than 70 percent of the annual precipitation occurs during the growing season between April and September.[1] On average, one year in four will have less than 28 inches of precipitation, and one year in four will have more than 40 inches. The driest year on record was 1988 when only 19.31 inches of precipitation were recorded. The wettest year was 1951 when 62.64 inches of precipitation were recorded. Average free-water evaporation is about 33 inches total between May and October and about 45 inches annually. Droughts of significantly below average precipitation lasting for periods of up to 2 years are common.

Regional Geology

The reservations of the Kickapoo Tribe and the Potawatomi and Sac and Fox Nations (Tribe/Nations) are located on the Dissected Till Plains Section of the Central Lowlands Physiographic Province, Great Plains Region. The soils in the uplands are composed of clay and silty clay loams derived from meltwaters during Pleistocene glaciation. Recently deposited alluvial materials found in the river valleys are composed of silt and clay with lesser quantities of sand and gravel. The surficial materials overlie bedrock composed of shale and limestone of Pennsylvanian and Permian age. Oil well logs indicate the sedimentary bedrock overlying the Pre-Cambrian basement are up to 3,300 feet thick in the area.

Quaternary Age

Alluvial materials, derived from erosion of the surrounding uplands, form the most recent deposits found along the river drainages. These materials range up to 50 feet thick and are principally composed of clay and silt with lesser quantities of sand.

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[1] In this and some other sections, multiple sources are used and are listed in the "References" section at the back of the assessment.

Sand and gravel interbedded with thin layers of clay are also present. According to the 1996 U.S. Geological Survey (USGS) report *Overview of Water Resources in and near Indian Lands in Northeastern Kansas and Southeastern Nebraska* (USGS, 1996), the alluvium yields large quantities of water in the major drainages which tend to be perennial. The smaller drainages have less yield and are influenced by immediate responses to rainfall or snow melt.

Kansas Till and Associated Deposits.—These units are derived from glacial meltwater, ranging up to 150 feet thick. The units are composed of consolidated clay, gravel, and boulders with lesser sand-size materials. The loessal deposits do not allow downward percolation from precipitation, and groundwater recharge from these deposits is negligible. These deposits supply some water to domestic and stock wells where they are in sufficient contact with the water table.

Atchison Formation.—The Atchison grades from sand and silt in the upper section to coarse sand and fine gravel in the lower section. The formation ranges up to 110 feet thick and supplies moderate water yields.

Pre-Kansan Gravel.—This unit is composed primarily of cherty and quartzose gravel. The unit is approximately 12 feet thick and yields moderate supplies of water from a few wells in Jackson County.

Permian Age.—*Council Grove and Admire Groups* – These units are primarily composed of varying thicknesses of limestone and shale. The limestone beds are massive to platy with some shale interbeds. The shales are generally gray to green with red and black units. The upper limestone and shale beds yield little to no water from wells. The lower beds below the Grenola Limestone yield moderate amounts of water to domestic and stock wells in the area.

Pennsylvanian Age.—*Wabaunsee Group* – These units are composed of inter-bedded limestone and shale beds ranging up to 50 feet thick. The limestone is generally gray to brown and fossiliferous. The shale contains varying amounts of coal and sandstone and is bluish-gray to yellow, red and brown. The units of the Wabaunsee Group yield little to no water to wells in Jackson County.

Water Resources - Surface Water, Groundwater, and Water Quality

Major Common Water Sources

Within the geographic limits of this evaluation, there are two basic types of water resources available for water supplies—surface water resources and groundwater resources. All three reservations and the surrounding areas have access to both of these types of resources, although the degree of access varies.

Surface Water.—Principal surface waters in the region of the three Indian reservations include, most notably, the Missouri River, which forms the eastern boundary of the region; the Kansas River, which forms the southern boundary of the region; the Big Nemaha River, which forms the northern boundary of the region, and tributaries to the Kansas River, including Soldier Creek, the Big Blue River, and the Delaware River. These latter tributaries of the Kansas River have two major storage reservoirs, Tuttle Creek Lake and Perry Lake. The Big Blue River forms the western boundary of the region and is tributary to the Kansas River (Trombley, T.J., Wolf, R.J., Jordan, P.R., and Brewer, L.D., 1996).

Within the boundaries of this evaluation, only the Missouri and Kansas Rivers are considered large mean annual streamflow rivers (exceeding 5,000 cfs mean annual streamflow). The Big Nemaha River is considered a medium mean annual stream-flow river (greater than 500 cfs mean annual streamflow). The remaining streams and rivers in the area are considered small mean annual streamflow systems (less than 50 cfs mean annual streamflow). The small mean annual streamflow systems include Soldier Creek, flowing south as it leaves the Potawatomi Reservation, the Delaware River as it leaves the Kickapoo Reservation, and Walnut Creek on the western side of the Sac and Fox Reservation.

The USGS has maintained stream gaging stations on the Missouri River at Rulo, Nebraska, on the Big Blue River near Manhattan, on the Kansas River near Topeka, on the Delaware River near Valley Falls and below Perry Dam, and on Soldier Creek near Soldier. A needs assessment report completed in 1998 for the Kickapoo Tribe presents the streamflow records in monthly form for these stations. A summary of the stream flow statistics for these surface water gaging stations is presented in table III-1.

The regional streams are far less dependable than the Missouri River as water supply sources. Improved management of Tuttle Creek and Perry Reservoirs would improve minimum monthly streamflows. These regional streams are subject to drought conditions which would reduce the yields during droughts.

Table III-1.—Summary of regional streamflow statistics at USGS gaging stations

Station name	Drainage area (square miles)	Period of record (acre-feet)	Average annual flow (acre-feet)	Minimum monthly flow (acre-feet)
Missouri River near Rulo	—	1950 – 92	29,701,000	611,960
Kansas River near Topeka	56,720	1917 – 92	4,003,202	20,192
Big Blue river near Manhattan	9,640	1951 – 92	1,644,232	1,214
Delaware River below Perry Dam	1,117	1969 – 92	482,570	0
Delaware River near Valley Falls	922	1923 – 67	280,785	106
Soldier Creek near Soldier	16	1965 – 98	7,672	6
Big Nemaha River at Falls City, Nebraska	1,339	1944 – present	454,000	240

Variability of streamflow is affected principally by the variability of precipitation, by the amount of groundwater contribution, and by reservoirs on the stream where reservoirs are present. Long-term gaging records indicate that the large mean annual streamflow rivers can have as much as a 22-fold variation in annual streamflows, while the medium and small mean annual streamflow rivers and streams can have as much as a 50-fold variation in annual flows.

Flow variability can also occur on a seasonal basis. Seasonal variations are more pronounced in the small to medium mean annual streamflow rivers and streams. Based on up to 60 years of records, 55 percent of the mean annual streamflow occurs between March and June, while only 17 percent of the mean annual streamflow occurs between November and February. Fifty-nine percent of the smallest 7 consecutive day flows occurs between August and October, while only 6 percent of the smallest 7 consecutive day flows occurs between April and June.

Within the boundaries of this evaluation, only the Sac and Fox Reservation has direct access to a surface water resource that is classified as medium mean annual streamflow—the Big Nemaha River. The Potawatomi and Kickapoo Reservations only have access to small mean annual streamflow rivers and streams—Soldier Creek and the Delaware River, respectively. The surface water resources directly available to the Potawatomi and Kickapoo Reservations are also more susceptible to seasonal and annual variability that would reduce their reliability as water supply sources.

Groundwater.—Within the boundaries of this evaluation, there are five basic types of groundwater resources, all aquifers—deep bedrock, glacial outwash, glacial drift, buried alluvial, and active alluvial aquifers.

Deep Bedrock Aquifer.—The deep bedrock aquifer underlying the portion of eastern Kansas covered by this evaluation is called the Western Interior Plains Aquifer System. This system consists of Cambrian through middle Mississippian massive limestones and dolostones alternating with shales and siltstones. The system is separated into upper and lower units by a dense, impermeable Devonian shale. Both the upper and lower units contain highly mineralized water. The upper unit is presently unused, while the lower unit is extensively used for oilfield brine disposal. Depths to the top of the Western Interior Plains Aquifer System range from 1,500 feet to 3,000 feet.

Glacial Outwash Aquifers.— There are no known or reported deposits of glacial outwash within the area covered by this evaluation. Glacial outwash aquifers are created by meltwaters from the glacier carrying fine- to coarse- grained materials from the glacier and depositing the coarser materials in or on a plain below the glacier. The finer-grained materials are washed or winnowed out of the deposits and are carried further downstream. The result is a unit of fairly coarse, permeable materials that is relatively continuous over a wide area.

Glacial Drift Aquifers.—Virtually the entire area covered by this evaluation is underlain by glacial drift materials, and many of the existing wells within the boundaries of the reservations are developed in lenses of coarser materials within the drift sequence. Wells developed in glacial drift materials may initially have a fairly high yield, but continued usage of the aquifer will generally result in reduced yields. Because of the fine-grained nature of the drift materials surrounding the lenses of coarser materials, recharge to these aquifers is restricted and it is easy for these aquifers to become over-drafted or depleted.

Glacial drift aquifers are created when layers, lenses, or zones of coarser materials are deposited within a generally fine-grained sequence of glacial drift material. The material may be deposited directly by the glacier or by meltwaters issuing from the glacier front. These deposits of coarser materials are generally of limited extent both vertically and horizontally, and are deposited in a random fashion. In general, the thicker the sequence of glacial drift materials, the better the chance of there being deposits of coarser materials within the sequence.

Buried Alluvial Aquifers.—Buried alluvial aquifers consist of alluvial materials within the stream channel that have permeabilities and porosities that are suitable for development. The buried alluvial aquifers are the alluvial channel systems that were in existence prior to glaciation, and were subsequently buried

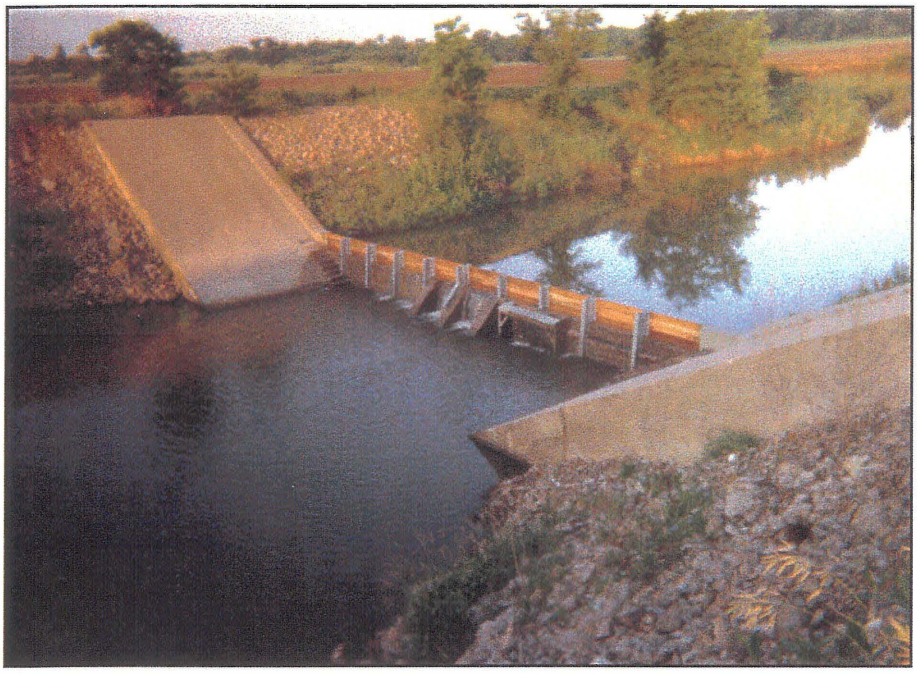
under the glacial drift sequences. Although many of the stream channel systems consisted of mostly fine-grained alluvial materials, most of the channel systems had a coarser layer or zone along the bottom of the stream valley. Buried alluvial aquifers, if and where present, may form an important ground-water resource in areas outside of the existing alluvial systems.

Active Alluvial .—Overlay maps of active stream systems and buried stream channels show that for the most part the current active stream systems parallel, and in most cases are within, the same stream valleys that existed prior to glaciation. The only exception is a major buried stream valley that was oriented west to east through Nemaha, Jackson, and Atchison Counties which is not paralleled by any major present-day stream. The mapped axis of this buried stream valley is several miles south of the current Kickapoo Reservation and essentially coincides with the southern boundary of the 1854 Kickapoo Reservation Treaty boundary. Two major alluvial aquifer systems exist within the boundaries of this evaluation—the Kansas River alluvial aquifer system and the Missouri River Valley alluvial aquifer system. Both systems, as stated previously, are on the edge of the area evaluated, and as such are not readily accessible by the three reservations. These active alluvial aquifers consist of alluvial materials within the active stream channel that have permeabilities and porosities that are suitable for development. Like the buried alluvial aquifers, the active stream channel systems consist of mostly fine-grained alluvial materials, and like the buried stream channel systems they also generally have a coarser layer or zone along the bottom of the stream valley.

The Kansas River alluvial aquifer system is restricted to deposits underlying the flood plain and terraces along the Kansas River. Well yields in the alluvial aquifer are generally 300 to 2,500 gpm. The Missouri River Valley alluvial aquifer is also restricted to deposits underlying the flood plain and terraces of the Missouri River. Well yields in the alluvial aquifer are generally 150 to 3,000 gpm.

Two small-to-medium alluvial aquifer systems are within the area—the Big Nemaha River and the Delaware River systems. The Big Nemaha River borders the northern boundary of the Sac and Fox Reservation, and the Delaware River flows through the Kickapoo Reservation, and, as such, both are accessible to the respective reservations. These alluvial aquifer systems are restricted to the deposits underlying the flood plains and terraces of the rivers. Well yields are generally less than 300 gpm.

Numerous small alluvial aquifer systems exist on all three reservations. These smaller systems are associated with the small streams that are tributary to the Kansas, Missouri, Big Nemaha, and the Delaware Rivers. These smaller systems are very restricted in size and extent. Well yields are generally less than 50 gpm.



The reservoir on the Delaware River located near the water treatment plant, Kickapoo Tribe in Kansas.

Specific Water Sources

Kickapoo Tribe in Kansas.—

Surface Water .—The Kickapoo Tribe currently obtains surface water from the upper Delaware River to meet the water supply needs of the Reservation. However, because of very low flows of the river for some months of some years, the water supply needs are not always met and shortages occur. In the summer drought of 2000, Delaware River flow diminished so significantly that it could not supply the Tribal demand estimated at between 140,000 to 150,000 gpd. The Tribe resorted to pumping water from local ponds as an alternative emergency supply, imposed water use restrictions and rationing, and engaged in hauling water for in-house use. This emergency water supply occurrence highlighted the need for a different or additional water source with a more consistent quantity of available raw water.

Therefore, it is concluded that the current source of raw water supply to the reservation from the Delaware River is not adequate to meet not only the future water needs, but also the current needs of the residents and additional water supplies are needed.

Groundwater .—The Delaware River alluvial aquifer system exists in the area of the Reservation and is accessible for a raw water supply. This alluvial aquifer system is restricted to the deposits underlying the flood plain and terraces of the river. Well yields from the aquifer system are generally less than 300 gpm. Other small aquifer systems and associated with the small streams—Greggs, Plum, and Squaw Creeks—that are tributary to the Delaware River, but the systems are very restricted in size and extent and well yields would generally be expected to be less than 50 gpm.

Site Characterization.—At times there are insufficient Delaware River flows for direct diversion of surface water for use by the Kickapoo Tribe, indicating that additional raw water supplies are needed to meet the needs of the Reservation. Further, past occurrences have revealed the vulnerability of the water quality of the Delaware River. During low river flows, the concentration of contaminants increases and challenges the Kickapoo treatment system.

The amount of information available for review to assess groundwater quality and quantity was found to be limited in the immediate vicinity of the Reservation. The quality of this water is questionable, since some local groundwater contains high levels of salts and sulfates. In terms of quantity, the locations, yields, and saturated thickness of local groundwater aquifers vary greatly. Well yields in Brown County

have been estimated at about 10 percent less than 0.5 gpm, about 60 percent are in the range of 1 to 10 gpm, and about 25 percent in the range of 50 to 100 gpm. Only about 5 percent of the wells yield greater than 100 gpm. By comparison, the wells located in the well field about 3 miles north of the town of Hiawatha and owned by Hiawatha yield as much as 900 gpm (Bayne, Charles K. and Schoewe, Walter, H., 1967).

The following summarize the site-specific raw water supply conditions on the Kickapoo Reservation in Brown County:

- ❑ Is not located on or near a major alluvial system. Is located near smaller alluvial systems associated with Delaware River and Gregg, Plum, and Squaw Creeks.
- ❑ Has limited surface water resources of essentially only same-year use; limited (same-year use) off-stream storage capability.
- ❑ Does not have surface water availability for substantial water supply development without impoundments.
- ❑ Has primarily agricultural land use, with about 5 percent forest.
- ❑ Has soils along streams and river, which are silty clay loams derived mostly from silty loess or silty alluvium. Has mainly clayey soils away from flood plains derived from weathered shale, clayey glacial till, high-clay content loess, or clayey alluvium.
- ❑ Is underlain by glacial drift sequences. Has no known glacial outwash sequences.
- ❑ Is located above the Western Interior Plains Aquifer System (WIPAS), which is known to be briny and in excess of 2,500 feet below ground surface.
- ❑ Locations, yields, and saturated thickness of minor aquifers vary greatly.
- ❑ Ought to have decreased water demands in the local aquifers since Brown County population trends show an estimated 0.7 percent decrease between 1992 and 1996 (see table II-1 for similar data).
- ❑ Total Brown County water usage served by Brown County Rural Water Districts is shown in table III-2.

Table III-2.—Total Brown County water usage

	1980	2000
Brown County RWD service area (all of Brown County)		
Average daily demand	0.33 mgd	0.29 mgd
Peak daily demand	0.81 mgd	0.70 mgd

Western Interior Plains Aquifer System.—As described in Jorgensen, D.G., Helgesen, J.O., and Imes, J.L. (1993), the WIPAS is a regional aquifer system underlying most of the central mid-west, including most of Kansas. The WIPAS consists mostly of carbonate formations of Cambrian through Mississippian age. In the Kansas area, the WIPAS directly overlays the crystalline basement rocks.

The WIPAS is divided into two parts—an upper aquifer unit and a lower aquifer unit divided by a confining unit consisting of Devonian aged shale. The upper aquifer unit consists of lower Mississippian aged dense, massive limestone and dolostone alternating with thick beds of shale. The lower aquifer unit consists of Silurian through Cambrian aged massive limestones and dolostones with some shale and siltstone.

Yields from the upper aquifer unit are variable and consist of highly mineralized water. The upper aquifer unit is not used as a water supply in the Kansas area. The lower aquifer unit is capable of higher yields than the upper aquifer unit, but it also has highly mineralized waters. The lower aquifer unit has been extensively used by the oil industry for oil-field brine disposal through injection.

The upper aquifer unit varies in thickness from zero to several 100's of feet. The confining unit is up to 300 feet thick in most areas. The lower aquifer unit varies in thickness from zero to 1,200 feet. The elevation of the top of the upper aquifer unit varies between -300 and -1000 feet relative to Mean Sea Level and it generally is dipping to the west except where it is interrupted by faulting such as at the Nemaha Anticline.

Prairie Band Potawatomi Nation.—

Surface Water.—Soldier and Little Soldier Creeks are the two surface water sources located on or close to the Potawatomi Reservation. Water gaging stations on Soldier Creek have measured water flows ranging from 0 to 1900 cfs from 1980 to 1996. Graphs showing Soldier Creek flows at the Soldier USGS gaging station located north of the reservation boundary indicate extremely intermittent flow. Soldier Creek flows are low or intermittent at times and are subject to heavy rains which degrade the water quality; the creek is very questionable as to its ability to

provide sufficient water supplies to the Reservation. To serve as a reliable and safe source of drinking water supply, Soldier Creek would probably require an extremely large diversion dam or infiltration gallery with a water treatment plant.

Potawatomi Tribal staff are currently studying the surface water quality, habitat, and biodiversity of the watersheds located on this reservation. At times, especially during the early spring and summer, soon after herbicides are applied to the agricultural areas, atrazine levels in Soldier Creek rise. The Safe Drinking Water Act (SDWA) maximum contaminant level (MCL) for atrazine is 3 µg/L for a yearly average of at least four samples while levels of 1 µg/L are considered harmful to aquatic life. A map of the surface water sampling stations located in and around the reservation is presented in the Reclamation assessment report (above). Four sites in the Soldier Creek watershed had atrazine levels above 4 µg/L while three sites in the Little Soldier Creek watershed have shown atrazine levels at 1 µg/L. [Zoellner, D., 1996].

Groundwater.—

Quantity.—Water wells drilled on and around reservation lands typically encounter 40 to 50 feet of alluvial and glacial materials. Yields from these wells generally range from 10 to 100 gpm depending on the location. Drilling costs including casing and well development are as high as $125 per foot, depending on size and depth of the well.

Well yields in the alluvium are proportional to the thickness of the alluvial material and range from 300 to 1000 gpm where saturated thickness is from 20 to 40 feet thick. Well yields as high as 500 gpm are locally possible even where saturated thickness is less than 20 feet. Well yields greater than 1,000 gpm are common in areas with more than 40 feet of saturated thickness (USGS, 1996).

The glacial till materials range up to 150 feet thick and are moderately well drained to somewhat excessively drained. Layers of shale and limestone bedrock yield moderate to no quantities of groundwater. The bedrock is highly calcareous and water quality from bedrock wells is hard with lime deposits clogging pipes and conduits.

Quality.—The USGS performed limited groundwater quality sampling on the reservation in 1951 and 1981. The Kansas Department of Health and Environment provided water quality information from water wells drilled in Jackson County in 1980. These findings, presented in table III-3, show that approximately 60 percent of the wells have concentrations of sulfate exceeding the recommended SDWA secondary standard of 250 mg/L. Approximately 30 percent of the wells also

Table III-3.—Groundwater quality (1980 KDOHE wells on the Prairie Band Potawatomi Reservation)

Parameter	MCL	SMCL Recom	2160 Well	2161 Well	2162 Well	PT-416 Well	1736 Well	1737 Well	1738 Well	1364 Well	1241 Well	679 Well	368 Well	31 Well	Mosher Well
Well depth (feet)			ND[1]	ND[1]	ND[1]	35	ND[1]	75	100	120	20.6	168	37	140	ND
Hardness, as $CaCO_3$	–		120	891	624	517	909	1205	1906	1530	534	705	403	442	309
Calcium (mg/L)	–		32	250	171	169	244	361	545	500	158	174	122	126	86
Magnesium (mg/L)	–		9.8	65	48	23.15	73	74	133	68	34	66	24	31	23
Sodium (mg/L)	–	[2]20	68	122	70	24.8	2,436	2,836	4,055	73	13	1,310	28	26	192
Alkalinity, as $CaCO_3$	–		76	276	340	270	337	385	229	222	449	278	325	375	354
Chloride (mg/L)	–	250	60	85	35	4.2	3,920	4,680	8,090	96	11	2,060	25	<5	170
Sulfate (mg/L)	-	250	96	685	358	282	740	907	914	1,250	99	383	81	157	126
Nitrate (mg/L)	10	–	1.1	**13**	3.6	0.05	0.2	0.2	0.2	0.8	3.1	**21**	0.1	0.1	0.1
Fluoride (mg/L)	2	–	1.3	0.8	0.6	0.06	**8**	**5**	**3.4**	0.37	0.43	0.45	0.28	0.38	0.4
Iron (mg/L)	–	0.3	0.08	0.09	0.09	0.01	0.31	0.39	0.19	1.9	0.05	0.19	1.1	0.16	0.13
Manganese (mg/L)	–	0.05	0.01	0.08	0.01	0.01	0.3	0.21	0.05	0.07	0.05	0.12	0.24	0.13	0.06

Notes: (1) Results are in mg/L and are 1980 inorganic data available from the State of Kansas, Department of Health and Environment

(2) **boldtype values** exceed either the mandatory MCL or the secondary recommended levels included in the SDWA.

[1] No data.

[2] Health Advisory Limit.

have chloride and sodium concentrations exceeding the recommended secondary levels specified in the drinking water standards. Fluoride and iron are also a concern in a few of the wells.

In June 2000, Reclamation recommended that the Potawatomi Nation investigate the availability of water from an alluvial saturated aquifer along Big and Little Soldier Creeks. The presence of such an aquifer had been postulated in an earlier USGS report (Trombley, T.J., et al., 1996). Jointly, Reclamation and USGS constructed seven test wells (Talbot, W.R., Reclamation) and conducted pump tests but failed to find the indicated alluvial saturated aquifer and instead found a glacial drift aquifer that contains water of poor quality. Based upon the short-duration aquifer test, the pump test analysis would suggest that this glacial drift aquifer should be able to support a production well with a safe yield of up to 280 gpm without dewatering the aquifer to any significant extent. However, long-term safe yields still need to be determined.

Water quality data were collected in 2000 for seven test wells located on the reservation and the results are presented in table III-4. Some of the wells had concentrations of certain parameters that exceeded SDWA secondary standards, including TDS, sulfate, sodium, and iron. The last well shown in table III-4, 28DACD, is the test well that has an estimated safe yield of 280 gpm. This well would require treatment for removal of dissolved solids and iron.

Site Characterization.—Insufficient river flows and the tribal desire not to construct large surface water impoundments on the reservation make it obvious that a local surface water supply for drinking water is not feasible. Currently, Jackson County Rural Water District No. 3 provides most of the domestic water on the reservation to water users that are connected to the distribution system.

The amount of information available for review to assess groundwater quantity and quality was found to be limited in the immediate vicinity of the reservation. However, since some local groundwater contains high levels of salts and sulfates, and pesticides have been found in surface waters along the creeks, blending these impaired waters with better quality water or treating these impaired waters will be required.

The following summarize the site-specific potential raw water supply conditions on the Potawatomi Reservation in Jackson County:

- ❑ Is not located on or near a major alluvial system: smaller alluvial systems associated with Soldier, Little Soldier, and Big Elm Creeks

Table III-4.—Groundwater quality (2000 Reclamation/USGS test wells on Prairie Band Potawatomi Reservation)

Parameter	MCL	SMCL recommended level	Well locations: 7S 14E 23CDDB	7S 14E 23CCDA	7S 15E 30BBAA	8S 13E 14DDDD	8S 13E 14DDDB	9S 14E 18CCDC	8S 15E 28DACD
Hardness, as $CaCO_3$		–	309	1038	372	391	398	165	967
Calcium	–	–	87.5	336	104	109	111	36.6	244
TDS	–	500	410	**1,590**	454	**517**	**515**	**706**	**1920**
Magnesium	–	–	21.9	48.3	27.2	28.8	29.3	17.8	87
Sodium	–	20	19.3	**30.5**	11.4	22.2	**22.4**	**199**	**222**
Alkalinity, as $CaCO_3$	–	–	286	342	397	348	352	337	309
Chloride	–	250	9.7	6.6	3.3	22.5	22.9	151	227
Sulfate	–	250	45.7	**839**	27.2	79.2	78.6	79.1	**816**
Nitrate	10	–	1.9	0.03	<0.05	1.41	1.39	0.89	<0.01
Fluoride	–	2	0.6	0.6	0.5	0.4	0.4	0.8	0.4
Iron	–	0.3	0.050	0.95	0.37	<0.01	<0.01	<0.01	2.9
Manganese	–	0.05	0.028	0.2	2.05	<0.003	<0.003	<0.003	0.137
Selenium	0.05	0.05	0.003	<0.0024	<0.0024	0.0022	<0.0024	<0.0024	0.0012

Notes: (1) Results are in mg/L and are measured data collected between September through December 2000. (2) **Bold type** values exceed either the mandatory MCL or the secondary recommended levels in the SDWA.

* All water quality criteria in this column are SMCLs (Secondary Maximum Contaminant Levels) except for sodium, for which the value is the Health Advisory Limit (HAL).

- Limited surface water resources exist: essentially only same-year use: limited (same-year use) off-stream storage capability

- Surface water availability for substantial water supply development without impoundments is not promising

- Land use is generally about 60 percent agriculture, 38 percent rangeland, and 2 percent forest

- Kansas-Republican River Basin water usage: 58 percent surface water, 42 percent groundwater: 54 percent irrigation, 30 percent municipal, 3 percent industrial

- Soils along creeks are silty clay loams to silt loams derived from mostly silty loess or silty alluvium: away from stream flood plains, soils are mainly clay derived from shale, clayey glacial till, high-clay content loess, or clayey alluvium

- Is underlain by glacial drift sequences: no known glacial outwash sequences; Western Interior Plains Aquifer System is known to be briny, and in excess of 2500 feet below ground surface

- Minor aquifers classified as type 1 (less than 50 gpm.) and type 2 (50 to 300 gpm.): consist of small stream valley alluvial aquifers, buried sand and gravel in glacial drift, or buried bedrock aquifers: locations, yields, and saturated thickness of minor aquifers vary greatly

- Well yields in Jackson County: about 40 percent are less than 0.5 gpm, about 40 percent are 1 to 10 gpm, about 10 percent are 10 to 100 gpm, 1-2 percent are reported in excess of 100 gpm, and the remainder have unreported yields, according to sources other than the 1996 USGS reports

- Jackson County population trends: estimated 3.8 percent growth between 1992 and 1996

- Total Jackson County water usage served by Jackson and Shawnee Water Districts is shown in table III-5:

Sac and Fox Nation of Missouri.—

Surface Water.—Surface water resources in the area of the Reservation are limited except for the Missouri River. Surface water in the general vicinity of the

Table III-5.—Total Jackson County water usage

	1980	2000
Jackson County RWD service area (northern two-thirds of Jackson County and parts of Jefferson County)		
Average daily demand	0.25 mgd	0.58 mgd
Peak daily demand	0.63 mgd	1.31 mgd
Shawnee WD service area (southern one-third of Jackson County)		
Average daily demand	0.84 mgd	13.07 mgd
Peak daily demand	2.06 mgd	26.59 mgd

Reservation is not used as raw water supplies for domestic uses and the current domestic water supplied to the residents within the town of Reserve is from Brown County RWD No. 1. Richardson County RWD No. 2 in Nebraska supplies treated water to Tribal housing areas outside of the Reserve town limits.

Groundwater.—The source of water being supplied to the Tribal casino is groundwater, principally from a well field located about 3 miles north of the town of Hiawatha. This water is owned and treated by the City of Hiawatha and then sold to Brown County RWD No. 2, who provides it to the Tribe. The quality of the groundwater is considered excellent in this well field and only requires chlorination before delivery to users. The well yields in other parts of Brown County are as indicated above in the groundwater discussion for the Kickapoo Tribe.

Site Characterization.—The water supply for tribal members living in and near the town of Reserve comes from either Brown County RWD No. 1 or Richardson County RWD No. 2. According to the Sac and Fox Nation, service has generally been satisfactory. However, the Nation has infrastructure needs for expanding housing developments, and additional water supply is needed for future expansion of the casino and possibly other commercial developments along the Highway 75 corridor.

The amount of information available for review to assess groundwater quantity and quality was found to be limited in the immediate vicinity of the Reservation, specifically water quality data. The wells located in the well field about 3 miles north of the town of Hiawatha and owned by Hiawatha yield as much as 900 gpm.

The following summarize the site-specific raw water supply conditions on and near the Sac and Fox Reservation in Brown County in Kansas:

- ❑ Is not located on a major alluvial system: medium alluvial system associated with Big Nemaha River in Nebraska and smaller alluvial systems associated with Pony, Walnut, and Roys Creeks.

- ❑ Surface water resources are not limited to same-year use: limited (same-year use) off-stream storage capability.

- ❑ Surface water availability for substantial water supply development without impoundments is not promising.

- ❑ Land use is primarily agriculture, with about 3 percent forest.

- ❑ Soils characteristics are mostly silty clay loams to silt loams derived from silty loess or silty alluvium in low areas and on slopes: upland areas are mainly clay derived from shale, clayey glacial till, high-clay content loess, or clayey alluvium.

- ❑ Glacial or post-glacial eolian sands cover much of area: deposits are usually above water table and are not saturated.

- ❑ Underlain by glacial drift sequences: no known glacial outwash sequences.

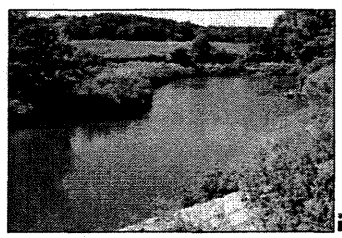
- ❑ Western Interior Plains Aquifer System is known to be briny, and in excess of 2,500 feet below ground surface.

- ❑ Minor aquifers and buried sand and gravel in glacial drift may yield as much as 900 gpm, (wells north of Hiawatha) but less than 500 gpm is more common; locations, yields, and saturated thickness of minor aquifers vary greatly.

- ❑ Well yields in Brown County: about 30 percent are less than 0.5 gpm., about 17 percent are 1 to 10 gpm, and about 28 percent are 50 to 100 gpm; only about 6 percent are greater than 100 gpm. Well yields decrease to the west; there are few, wells in Doniphan County, but of those few, several have yields greater than 100 gpm. and yields for the remaining wells are less than 0.5 gpm.

- ❑ Brown County population trends: estimated 0.7 percent decrease between 1992 and 1996.

- ❑ Brown County water usage is summarized in table III-2.



CHAPTER IV – Water Demands and Ability to Meet Current and Future Needs

General

This section of the report establishes criteria used to evaluate each Tribal water system, describes each system, and identifies the immediate deficiencies found on each system. The scope of this assessment was limited to a review of available data. Physical determinations of the condition of distribution lines or storage tanks either on or off-reservation were beyond the scope of this needs assessment. In addition, because this assessment was conducted at the appraisal level, designs are used for comparison only.

Water Conservation and Reuse

The Bureau of Reclamation (Reclamation) recommends that each Tribe/Nation implement a formal water conservation and reuse program. Conservation lowers operations and maintenance costs. Through education of residents and using water-saving practices, it has been estimated that many communities throughout the U.S. could reduce their water demands between 10 to 20 percent over the next 10 to 20 years. Examples of conservation practices include leak detection and repair of buried distribution lines, meter rehabilitation, retrofit of residences with water-saving devices, water audits for commercial users, and public education programs. Moreover, potable water does not always have to be used for many uses of water. Treated wastewater reuse for irrigation, flushing and certain washing applications can reduce potable water demands in a Tribal conservation program, although these systems would require major infrastructure development.

Population Base

Table IV-1 displays the future population estimates presented in chapter II for the Tribes/Nations based upon demographics. These estimates form the basis of generating future potable water demands for residential land use for the years 2020 and 2040. Population for year 2000 is included for comparison.

Table IV-1.—Population projections used to estimate future water demands

Year	Kickapoo Tribe	Potawatomi Nation	Sac and Fox Nation
2000	1,115	1,625	200
2020	1,210	2,250	260
2040	1,310	2,935	300

Water Demand Criteria

In estimating future water needs, the approach is to adopt a reasonable per capita daily water use rate that includes most commercial/industrial uses (relatively small water users) such as businesses, schools, and others that are tied directly to population growth. For large commercial uses that might be anticipated in future growth scenarios, such as the casino enlargements or other commercial endeavors, the future water demands are estimated separately and added to the daily per capita demand to come up with the total estimated future demand used in this needs assessment. For this needs assessment, for current and future years, **115 gallons per capita per day (gpcd)** is the recommended daily per capita water use rate that meets the residential water demands, including water uses by commercial and industrial concerns such as offices, small businesses, schools, and others that are not large water users. Further, this per capita water use rate is assumed to apply to the three Tribes/Nations.

Reclamation approaches studies of water demand by analyzing water use by sector within the category of municipal and industrial (M&I) uses. In this context, "municipal" refers to residential, commercial, and public uses. In rural and small communities, M&I water use can vary dramatically, depending on the source and quality of the water supply. These factors can strongly influence the price of water and hence the rate of use.

The best method of estimating future water usage is to review historical water usage for a given system, because estimates based on local conditions for a study area are presumed to be more representative than State, regional, or national estimates within a given sector. For this study, water usage rates for each Tribe/Nation were reviewed, were found to vary widely, and are described later in this chapter. To estimate water use under future conditions of expanded population, Reclamation compared average use rates, compiled by sector under similar economic and climatic conditions, to the actual usage rates.

Per capita water use estimates reported by the Kansas Water Office (KWO) for 1999 for Region 7 were evaluated for use as a representative use rate for future conditions on the reservations. Region 7 includes Jackson county and several adjacent counties but not Brown county. In total, Region 7 includes 34 counties from the Nebraska border south to Oklahoma and from the Cloud/Mitchell county boundary east to the Jackson/Jefferson county boundary. Further, regional statistics for water suppliers are separated by size of utility, with water systems serving between 500 and 9,999 people termed medium-sized public water suppliers.

According to the KWO, for medium- sized water suppliers in Region 7, average per capita water use in 1999 was 114 gpcd and from 1995 through 1999 was 115 gpcd. This use rate is based on amounts of water used for residential and commercial sales, free use, and unaccounted-for water (this figure does not include sales to other suppliers, industries, bulk users, or farmsteads using over 200,000 gallons per year). Commercial sales include small commercial developments and businesses within the services sector that can be expected to accompany population growth in a given area. Typical establishments in this category are restaurants, convenience stores, car washes, and laundromats. The free use category is water that is made available to local organizations, such as non-profit institutions and churches, for no charge. Unaccounted-for water includes losses within the distribution system, including tower overflows and line breaks and usually is about 15 percent of the total per capita water use rate.

Several factors can influence the per capita use rate for a particular community over a particular time period. Inexpensive water fees, lack of metering, hot and dry weather, frequent line breaks, expansion or replacement of water mains, tower overflows, or a large amount of water used for treatment or flushing can all contribute to a high rate of use. High water fees, cool rainy weather, a system with few leaks, lack of significant free uses, or minimal need for water treatment can contribute to a low rate of use (Kansas Water Office, 1999 Kansas Municipal Use Report, page 5).

During 1999, per capita water use for medium-sized water supply systems in Region 7 ranged from 70 gpcd to 239 gpcd. At the low end, the water suppliers were noted to have low percentages of unaccounted-for water and higher-than-average water rates. At the high end, systems were noted for large percentages of either metered free or unaccounted-for water. June-September precipitation for Kansas in 1999 was 14.75 inches, slightly more than the long-term State-wide average seasonal rainfall of 13.8 inches.

Per capita use rates were noted to be lower in 1999 than those reported during drier years such as 1994, when summer precipitation averaged 11.54 inches statewide. In a similar vein, per capita use was lower in 1999 relative to use in 1994,

demonstrating the inverse relationship between summer precipitation and water demand when these factors are considered statewide. The highest per capita use rate for medium-sized suppliers in Region 7 was reported to be 127 gpcd in 1991. Average Statewide June-through-September precipitation was 9.05 inches in 1991. The lowest per capita use rate reported for medium-sized suppliers in Region 7 was 110 gpcd is 1993. Average June-September precipitation in 1993 was 22.62 inches. When the very dry and very wet years found in the 1990 through 1994 record are considered, the average per capita use rate for medium-sized water supplier in Region 7 is about 117 gpcd. By comparison, the daily per capita water use rate for JCRWD No. 3 was reported to be 105 gpcd for all water users served by the district for the year 1999.

Water Needs through 2040

Kickapoo Tribe in Kansas.—Recent water use data were obtained from the Kickapoo Tribe. According to the Tribe, average monthly total water use is about 3.9 million gallons per month or about 130,000 gallons per day (gpd), which includes institutional, commercial, and industrial (includes the casino) water use. For the current population estimate of 1,115 (2000 U.S. Census population), this water use is equivalent to about 116 gpcd. Further, according to the Tribe, the average monthly use by the casino is about 14,500 gpd, which is equivalent to about 13 gpcd for the estimated population of 1,115 residents. Therefore, the existing water use (primarily domestic use), excluding the casino, is about 103 gpcd. A 1998 needs assessment for this Tribe (Watson) estimates the average day demand is 149 gpcd, consisting of 135 gpcd for residential purposes and 14 gpcd for institutional, commercial, and industrial uses.

Front view of the Kickapoo Tribe in Kansas water treatment plant.

The current Kickapoo domestic water use rate is considerably higher than that found in other Tribes in the area. This is probably because (1) the Kickapoo water supply and distribution system does not include individual water meters, (2) of the age of the system, and (3) it has been reported that there may be leaks in the system.

It is recommended that the Kickapoo Tribe make system improvements to their existing infrastructure (i.e., installing water meters and repairing existing leaks) and would formalize a conservation and water reuse program, all of which would reduce per capita water use to the planning value of 115 gpcd. The present and estimated future water supply system demands for the Kickapoo Tribe are summarized as follows in table IV-2. Peak demands are defined later in this report.

Table IV-2.—Kickapoo Tribal water demands (current and future)

Period	Population	Use rate (gpcd)[1]	Average daily demand (gpd)	Commercial/casino demand (gpd)[2]	Total demand (gpd)
Current	1,115	115	128,225	14,500	142,725
2020	1,210	115	139,150	218,400	357,550
2040	1,310	115	150,650	218,400	369,050

[1] Includes institutional, commercial, and industrial needs except the casino and other large commercial water users. The M&I per capita use rate of 115 gpcd is reported in 1999 Water Use Report of the Kansas Water Office as the average per capita use rate for medium water utilities in Region 7. This use rate includes water supplied for residential and commercial sales, free use, and unaccounted-for water.

[2] This column represents the needs of large commercial water users. For the current period, the demand is for the existing casino. For future years, the demand reflects increases to local businesses.

Prairie Band Potawatomi Nation.—The Potawatomi Nation obtains most of its water, including water for the casino, from Jackson County Rural Water District (JCRWD) No. 3. Some residents (30 taps that are equivalent to about 100 people) located in the northwest part the reservation obtain their water supply from JCRWD No. 1.

JCRWD No. 3 currently supplies most of the treated water to the residents on the reservation. According to the JCRWD No. 3 (2001 data), reservation residents currently use about 1,707,000 gallons per month (gal/mo) (56,124 gpd or 20,485,000 gal/yr) of water.[1] Table IV-1 indicates that the current total population

[1] This figure does not include the water use by the casino (about 50,250 gpd) or the water use of residents (30 water taps) located in the northwest part of the reservation that are served separately from JCRWD No. 1.

on the reservation is 1,625 people. This total population includes the residents in the northwest part of the reservation and the estimated 10 percent of the population that have private wells as their source of supply.

For planning purposes to determine future water demands, it is assumed that the estimated 163 residents currently on private individual wells would connect to the community water system. The total current water system demands for the community water system to completely serve all 1,625 residents is determined using this population and the use rate of 115 gpcd. This total average daily residential demand for the current population is about 186,875 gpd and the current average daily water demand for the casino is about 50,250 gpd, for a total current demand on the reservation of about 237,125 gpd. The present and estimated future water supply system demands/needs for the Potawatomi Nation are summarized as follows in table IV-3:

Table IV-3.—Potawatomi Nation water needs (current and future)

Period	Population	Use rate (gpcd)[1]	Average daily demand (gpd)	Commercial/casino demand (gpd)[2]	Total demand (gpd)
Current	1,625	115	186,875	50,250	237,125
2020	2,250	115	258,750	94,750	353,500
2040	2,935	115	337,525	94,750	432,275

[1] Includes institutional, commercial, and industrial water supply needs except the casino and other large commercial water users.

[2] This column represents the needs of large commercial water users. For the current period, the demand shown is for the existing casino. For future years, the demand shown reflects increases to local businesses.

Sac and Fox Nation of Missouri.—The Sac and Fox Tribal population is primarily located in and around the town of Reserve, Kansas. The reported actual water use in 1999 for both Tribal and non Tribal residents of the town of Reserve was 84 gpcd (1999 Kansas Municipal Water Use). Treated water for the Red Earth housing area outside of the town of Reserve is supplied by Richardson County RWD No. 2. Based upon the measured water use data (water meters for each tap) for this housing area for the period of August 1, 2000 through July 31, 2001, the average daily water use was 2,773 gpd. This was for 17 occupied houses of the total of 19 in the housing area. The number of Tribal members living in this complex, according to the Nation, is currently 56. Based upon this population and average daily water use, the per capita use is about 50 gpcd. The Sac and Fox casino is located about 40 miles south of the town of Reserve, and currently, the water supply is obtained

from the Hiawatha well field via Brown County RWD No. 2. The average daily measured water use at the casino, for the period of July 2000, through June 2001, was about 19,900 gpd.

The two service areas are located a considerable distance apart, and therefore the water supply needs have divided into the north area around the town of Reserve and the south area near the casino. Table IV-4 summarizes the anticipated water needs for these two areas.

Table IV-4.—Sac and Fox Tribal water needs (current and future)

North area					
Period	Population	Use rate (gpcd)[1]	Average daily demand (gpd)	Commercial/casino demand (gpd)	Total demand (gpd)
Current	150	115	17,250	0	17,250
2020	195	115	22,425	0	22,425
2040	225	115	25,875	0	25,875
South area					
Period	Population	Use rate (gpcd)[1]	Average daily demand (gpd)	Commercial/casino demand (gpd)	Total demand (gpd)
Current	50	115	5,750	19,900	25,650
2020	65	115	7,475	56,470	63,945
2040	75	115	8,625	56,470	65,095

[1] Includes institutional, commercial, and industrial water supply needs except the casino and other large commercial water users.

The column "Commercial/casino demand" represents the needs of large commercial water users. For the current period, the demand shown is for the existing casino. Under the existing contract with BCWD No. 2 (which supplies water to the casino), the casino can use up to 27,400 gpd without improvements to the piping and the execution of a new contract. For future years, the demand shown reflects increases to local businesses.

Current Rural Water Providers

Tables IV-5 and IV-6 list the current rural water districts serving the three Tribes: Brown County Rural Water District No. 1 (BCRWD #1), Brown County Rural Water District No. 2 (BCRWD #2), Jackson County Rural Water District No. 1

Table IV-5.—Water district source waters based on customer

Water district	Currently serves	Water source	Water source location
Jackson Co. RWD #1	Potawatomi (30 taps in NW corner)	Via City of Topeka	Kansas River
Jackson Co. RWD #3	Potawatomi	4 GW wells Banner Creek City of Topeka	Unconfined aquifer Kansas River
Brown Co. RWD #1	Sac and Fox – Yellow Earth/Town of Reserve	GW wells 4 GW wells via City of Hiawatha	Unconfined aquifer –
Brown Co. RWD #2	Sac and Fox – Casino	2 GW wells via City of Hiawatha[1] 4 GW wells via City of Hiawatha	Unconfined aquifer south of Hiawatha Unconfined aquifer north of Hiawatha
Richardson Co., NE RWD #2	Sac and Fox – Red Earth	11 GW wells via City of Falls City	Alluvial water along the Missouri River

[1] Scheduled for decommission and replacement by additional wells north of the city.

Table IV-6.—Water district based on customer

Tribe	Current water source
Potawatomi	Jackson Co. RWD #3 Jackson Co. RWD #1 (3o taps in NW corner)
Kickapoo	Own SW water supply
Sac and Fox	Yellow Earth/Town of Reserve: Brown Co. RWD #1 Red Earth: Richardson Co. RWD #2 Casino: Brown Co. RWD #2

(JCRWD #1), Jackson County Rural Water District No. 3 (JCRWD #3), and Richardson County Rural Water District No. 2 (RCRWD #2). In addition, the City of Holton and JCRWD #3, have formed a wholesale water District, number 18, that utilizes Banner Creek Reservoir. The boundary and major pipelines of each district are shown on figure 1 in attachment B. Brief descriptions of each district's source follow.

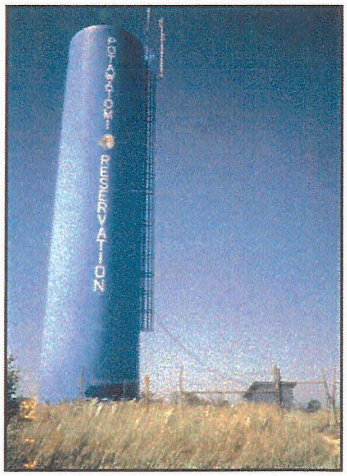
Brown County Rural Water District No. 1 (BCRWD #1).—BCRWD No. 1 has its own raw groundwater supply which comes from district-owned wells in addition to a piping infrastructure for water distribution. The district also buys about 10,000 gpcd (Reynolds) from the town of Hiawatha treated groundwater from the town's wells located about 2 miles north of the town. This water district supplies treated water to the Tribal residents and Tribal headquarters area within the town limits of Reserve.

Brown County Rural Water District No. 2 (BCRWD #2).—BCRWD No. 2 does not have its own raw water supplies but owns and operates the delivery system for water obtained from the town of Hiawatha. The source of water from Hiawatha is groundwater from the Beckwith and Meisenheimer wells, both located south of Hiawatha, as shown on figure 1, and four additional high capacity wells located north of the town, also shown on figure 1. Raw water from these four wells is pumped into a small reservoir for blending before being pumped to the town of Hiawatha or the BCRWD No. 2 and subsequently to domestic users. Figure 1 shows the extent of the piping and distribution systems to the town of Hiawatha and BCRWD No. 2. The well field to the north of Hiawatha is considered to be an excellent source of groundwater, particularly for the well yields. The water quality is generally very good, but sometimes has measurable levels of nitrate near the drinking water standard; however, the nitrate level of blended water from the four northern wells is typically considerably less than the MCL of 10.0 mg/L.

Jackson County Rural Water District No. 1 (JCRWD #1).—JCRWD #1 obtains its raw water supply from the City of Topeka. Water may be available to the Tribes/Nations from Topeka, or from JCRWD #1 through the contract with Topeka.

Jackson County Rural Water District No. 3 (JCRWD #3).—JCRWD #3 obtains its raw water supply from four existing wells in addition to treated surface water (the source being the Kansas River) from the City of Topeka through RWD No. 1. In addition, JCRWD No. 1 obtains treated surface water from the City of Topeka and serves about 30 residential taps in the northwest part of the Potawatomi Reservation. Figure 1 in attachment B shows the location of the four raw water supply wells and the current service area of JCRWD No. 3 as defined by their distribution system. The City of Holton and JCRWD No. 3 formed Public Wholesale Water Supply District No. 18. This district contributed resources to construct Banner Creek Reservoir, which provides an alternative water supply for future needs.

Richardson County Rural Water District No. 2 (RCRWD #2).—RCRWD No. 2 has no raw water supplies of its own but owns and maintains water distribution infrastructure for treated water obtained from Falls City, Nebraska. Falls City has water rights on the Missouri River, which is the raw water source for the city and also for RCRWD No. 2. Falls City has recently completed an expansion and renovation of its water treatment plant near the Missouri River and has additional capacity to meet potential future treated water demands of RCRWD No. 2. Richardson County RWD No. 2 supplies treated water to Sac and Fox members living in Red Earth Tribal housing outside the town of Reserve.



View of the 100,000-gallon water storage tank and wellhouse, Prairie Band Potawatomi Nation.

Water Supply System Evaluation Criteria

For the three Tribal water systems, this report describes existing deficiencies in this chapter, and future needs in chapter V. Reclamation evaluates water systems using the following four evaluation criteria: (1) water quality and treatment, (2) source water supply, (3) storage, and (4) distribution system. Definitions of each criteria and a brief description follow:

(1) *Water quality and treatment* – The ability of each Tribal water system to produce a quality meeting Environmental Protection Agency (EPA) Safe Drinking Water Act (SDWA) primary[2] and secondary[3] Maximum Contaminant Levels (MCLs) for treated water. MCLs are set at levels to insure that the health of the general population is not adversely impacted by ingestion of water. MCLs target the following five broad categories of contaminants: (1) inorganic chemicals, (2) radionuclides, (3) volatile and synthetic organic chemicals (includes pesticides), (4) microbiology and turbidity, and (5) secondary contaminants. Information about each regulated contaminant can be found on EPA's website: <http://www.epa.gov/safewater/standards.html>.

(2) *Source water supply* – The raw water delivered to treatment and storage facilities in sufficient quantity to accommodate system demands under normal and emergency conditions. The average day demand must be met with the largest pump-out of service and the maximum day demand must be met with all pumps in operation.

(3) *Storage* – Sufficient quantities of treated, potable water are stored to accommodate system demands under normal and emergency conditions. The total storage requirement is defined as the summation of volumes needed for equalization and the larger of fire flow or emergency storage. Equalization, Fire Flow and Emergency storage are defined below:

[2] National Primary Drinking Water Regulations (NPDWRs), or primary standards, are legally enforceable standards that apply to public water systems. Primary MCLs apply to constituents that can adversely affect public health.

[3] Under the EPA National Secondary Drinking Water Standards, MCLs are concentrations of constituents above which cosmetic (tooth or skin discoloration) or aesthetic (taste, odor, or color) problems may occur. Secondary MCLs are non-enforceable federal guidelines relating to constituents that do not threaten human health.

- *Equalization for peak day demands* – Volumetric fluctuations in the storage tank due to variances in water consumption throughout the day. The result is approximately 183 gallons of storage required per one gallon per minute of peak day water demand (American Water Works Association, 1989; Manual 32).

- *Fire flow capacity* – Based on the 1997 Uniform Fire Code, treated water storage capacity adequate to provide:

  - Flow of 1,500 gallons per minute (gpm) for 2 hours, or a stored volume of 180,000 gallons for building areas up to 5,900 square feet or

  - Flow of 3,000 gpm for three hours, or a stored volume of 540,000 gallons for a commercial development (e.g., casino).

Distribution System

A successfully designed water distribution system has the ability to convey water to all points in the distribution system with adequate pressure, in a reliable manner. Water distribution lines are sized typically to meet the peak hour flow, which usually is the fireflow rate with enough residual pressure in the line to provide 20 psi at an adjacent fire hydrant. Included in this review is the site topography, which affects the water delivery pressure available from the system's hydraulic grade line. Typical pressure zones provide between 40 to 100 psi to the end users. Pipeline distribution system design prudently calls for looped waterlines where possible so that in the event of a line break, isolation valves can isolate the break and residents can still obtain water from the other end of the looped line.

This needs assessment was limited to only those waterlines within the reservations boundaries and to only non-modeled results of pressure losses.

Individual Tribal Reservations

Kickapoo Tribe

Water Quality and Treatment.—Table IV-7 presents a summary of the maximum observed levels of drinking water contaminants for the water supplied by the Kickapoo water treatment system. Also shown for comparison are the MCLs as

Table IV-7.—Maximum observed levels of drinking water contaminants (Kickapoo Public Water System)

Parameter	Units	Maximum contaminant level	Kickapoo water plant
Primary inorganics			
Antimony	µg/L	6	BDL
Arsenic	µg/L	[1]10	BDL
Barium	µg/L	2000	134.9
Beryllium	µg/L	4	BDL
Cadmium	µg/L	5	BDL
Chromium	µg/L	50	BDL
Copper	**mg/L**	**1.3**	**2.9**
Lead	µg/L	15	BDL
Mercury	µg/L	2	BDL
Nickel	µg/L	100	6.1
Nitrate	mg/L	10	2.9
Selenium	µg/L	50	1.5
Silver	µg/L	50	BDL
Thallium	µg/L	2	BDL
Fluoride	mg/L	4	0.14
All volatile and synthetic organic chemicals			
Carbon tetrachloride	**mg/L**	**0.005**	**0.09**
Chlorobenzene	mg/L	–	ND
2, 4-D	**mg/L**	**0.07**	**0.49**
Dichlorobenzene	mg/L	0.6	0.05
Ethylene dibromide	mg/L	0.00005	ND
Styrene	mg/L	0.1	0.02
Toluene	mg/L	1	0.04
Endothal	µg/L	100	NA
Benzo (a) pyrene	µg/L	0.2	NA

Table IV-7.—Maximum observed levels of drinking water contaminants (Kickapoo Public Water System) (continued)

Parameter	Units	Maximum contaminant level	Kickapoo water plant
Secondary with suggested limit			
Chloride	mg/L	250	17.0
Iron	mg/L	0.3	0.076
All volatile and synthetic organic chemicals (continued)			
Manganese	**mg/L**	**0.05**	**3.2**
Sulfate	mg/L	250	95.1
TDS	mg/L	500	399.7
pH	–	6.5-8.5	7.8
Alkalinity	mg/L	–	290.4
Bicarbonate	mg/L	–	NA
Carbonate	mg/L	–	NA
Spec. conductivity	umhos/cm	–	661.0
Calcium	mg/L	–	95.2
Magnesium	mg/L	–	17.5
Hardness	mg/L	–	310.0
Turbidity	NTU	–	BDL
Sodium	mg/L	–	20.1
Potassium	mg/L	–	3.08
Nitrite	mg/L	–	NA

Source: System values reproduced from "Needs Assessment Kickapoo Rural Water System," Draft, March 31, 1998. MCL values updated to current (September 2002) standards for comparison.
Notes: (1) bold indicates exceeds MCL; (2) ND: Not detected; (3) BDL: Below detection limit; (4) NA: Not available; (5) Radionuclide data was reported as NA. Radionuclide MCLs under review.
[1] Arsenic standard not in effect for small communities until January 2006.

determined by the EPA and as regulated by the Safe Drinking Water Act. As shown, MCLs for three parameters—copper, carbon tetrachloride, and 2,4-D—have been exceeded in the past.

In addition, violations for coliform, fecal coliform, and turbidity, are on file with the EPA for August 23, 2000 (both coliform events) and March 10, 2001, (turbidity). Iron and manganese also appear on plumbing fixture units which indicates their presence in treated water.

The Kickapoo Tribe has their own water supply system utilizing surface water from the Delaware River. The system serves the residential areas, businesses, schools, and casino. The Kickapoo water treatment plant (WTP), shown schematically in figure IV-1, is a lime softening 250,000 gpd plant that has been in service since 1979. The treatment system includes a rapid mixer, lime and alum feed systems, a flocculation and sedimentation basin, rapid sand filters, and disinfection by chlorine gas with contact time in a buried clearwell. Treated water from the plant is pumped to distribution and storage.

Finished treated water storage consists of a 300,000 gallon below-ground concrete clearwell. The pumping facilities at the clearwell consist of two high-service pumps to meet the normal water supply demands of the system users. A third pump is available to meet peak demands during the day. A fourth pump at the clearwell provides water for back-washing the rapid sand filters. Sludge from the water treatment plant unit processes is pumped to holding lagoons located adjacent to the wastewater treatment lagoons. After the solids and chemical sludges settle in the lagoons, the top (clear) portion is discharged into the wastewater lagoons via an outflow pipeline.

In 2002, Reclamation completed an evaluation of the entire water treatment plant. The results of that evaluation indicate that the plant processes are large enough to treat the maximum day flow through year 2010. The capacities of each unit operation are summarized in table IV-8.

Table IV-8.—Kickapoo water treatment plant maximum calculated flow rate for each unit process

Unit process	Design parameter used to calculate flow rate	Limiting unit process maximum flow rate (gpm)
Raw water intake pump	Flow	200 (each pump) 400 (both pumps)
Rapid mix/chemical addition	30-second detention time	288
Coagulation/flocculation	30-minute detention time	263
Clarifier/sedimentation	468 gal/ft^2/day surface loading rate	229
Dual media filters	2 gal/min/ft^2 filtration rate	234 (both units operating)
Clearwell	120-minute contact time	2,500
Distribution system service pump	Flow	150 (each pump) 300 (both pumps)

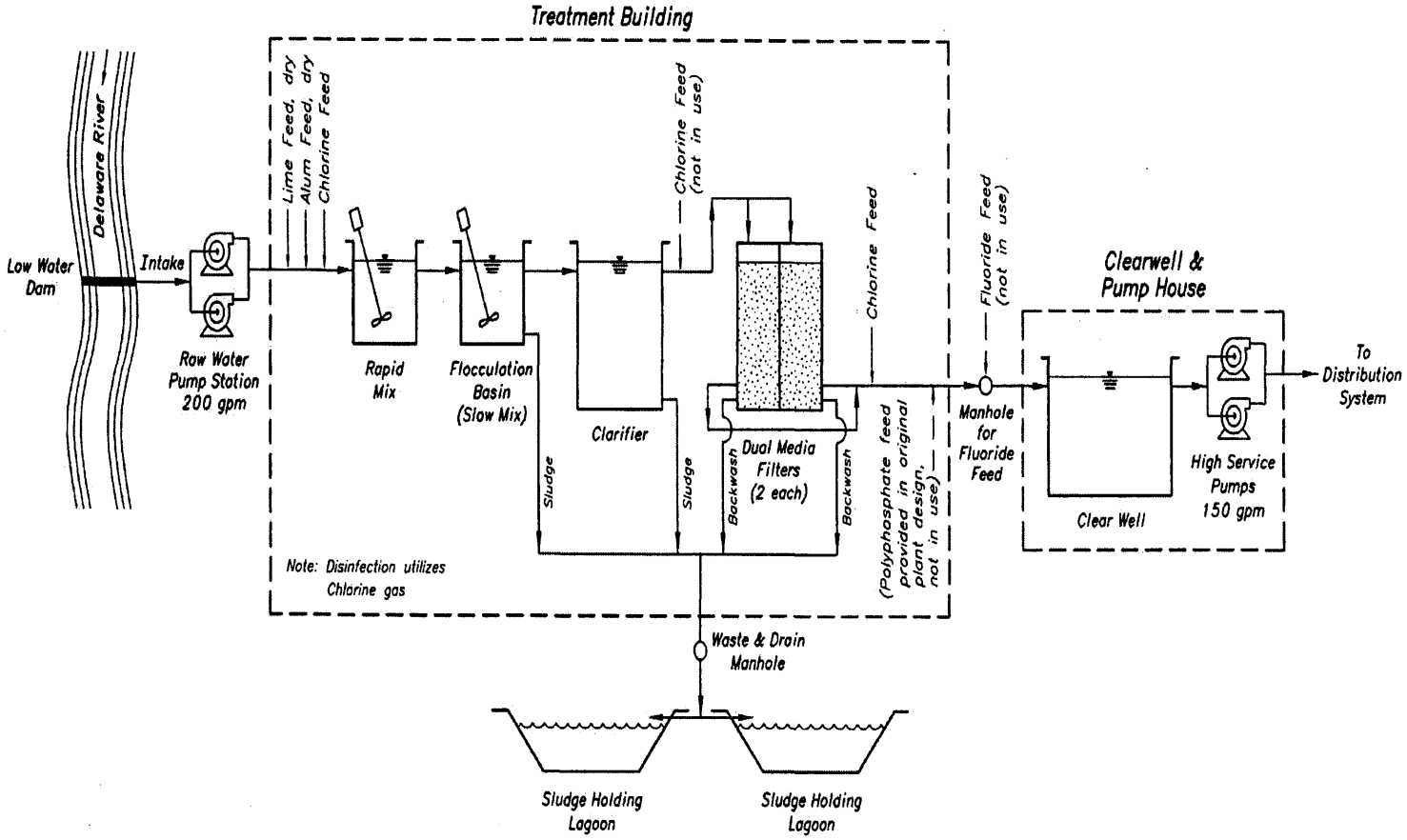


Figure IV-1.—Water treatment plant process schematic (Kickapoo Nation in Kansas).

In addition, the following summarizes the existing capacity of other pumps in the plant:

- Third service pump capacity – 600 gpm at 245 feet of head (1 pump for emergency use)
- Backwash pump capacity – 900 gpm at 40 feet of head (1 pump)

Based on the above findings, the operating procedures at the plant need attention or the safety and reliability of the produced water will be at risk. The Kickapoo Tribe must maintain the raw and high service pumps so that both pumps operate. In addition, based on average day flow projections shown in table IV-2, this plant will be overloaded around 2010 from a capacity standpoint due to the clarifier. Elevated copper levels noted in table III-7 may be from plumbing connections and not indicative of plant performance. If organics continue to be found above MCLs, the addition of carbon in the treatment process is recommended.

Source Water Supply.—The Kickapoo Tribe operates their own public water supply system which is located within the reservation boundaries. The source of raw water for the Reservation is surface water from the Delaware River and the diversion point is located upstream and to the north of Perry Lake. The diversion structure consists of a concrete overflow weir built by Bushman Construction and the water treatment plant was built by BRB Construction. A pumping station, piping, and valving are located adjacent to the dam above the 100-year flood level. The Delaware River is relatively deeply incised at the location of the diversion works. The diversion structure is capable of storing limited quantities of raw surface water through the use of stop logs. However, the storage capacity is very limited with the surface water stored within the deeply incised river channel.

Storage.—The existing storage within the distribution system includes two elevated water storage tanks (70,000 and 221,000 gallons) totaling 291,000 gallons of storage. It is assumed the 300,000-gallon plant clearwell will need replacement. Table IV-9 outlines the requirements of stored water for years 2020 and 2040 based on the growth projections found in this report. Subtracting the current available storage from the total needed storage yields the amount of storage required prior to the year shown.

As shown, there currently exits a shortage of about 286,000 gallons. For year 2020, additional storage required (assuming the 286,000-gallon current deficit is provided) would be about 588,000 gallons, and for year 2040 an additional 40,000 gallons above the 2020 need would be required. It is assumed that the types of tanks to be

Table IV-9.—Water storage requirements for Kickapoo Tribe for 2000, 2020, and 2040

Year	Maximum day flow (gpd)[1]	Equalization storage (gal)	Fire flow storage (gal)	Emergency storage (gal)	Total storage (gal)	Current storage (gal)	Additional capacity required (gal)
2000	285,450	36,276	540,000	428,175	576,276	291,000	285,276
2020	715,100	90,877	540,000	1,072,650	1,163,527	291,000	872,527
2040	738,100	93,800	540,000	1,107,150	1,200,950	291,000	909,950

[1] Maximum day flow is assumed twice the average day flow.

installed would be similar to the existing tanks. If the tanks could be placed to match the elevation of the tank on Highway 20, then adequate water delivery pressure, between 30 to 100 psi, will be available.

Distribution System.—The distribution system consists of the buried network of piping that transports the water from the source to and from the storage tanks, and to the users. The current distribution system, as previously described, was not designed for fire service. Therefore, many of the lines are not looped and would not provide reliable pressure for future peak flows or current and future fire demands. It is recommended that the Tribe develop and adopt a master plan for the systematic replacement of pipelines so that, eventually, fire protection is afforded to all parts of the reservation and a looped distribution line, such as the 8-inch diameter pipeline shown on figure 7, is installed. Combination air release and vacuum relief valves, gate valves, and blow-off or drain valves will be required, respectively, at high points (to allow trapped air to be vented), and to isolate sections of the pipeline (for maintenance), and at low points to flush or drain the pipeline system, respectively.

Figure 1 (attachment B) is a site plan of the existing service area and includes the treated water distribution system. The distribution system consists of 2- through 8-inch polyvinyl chloride (PVC) pipelines. Water service is provided to approximately 173 homes, Tribal businesses including the casino, trading post, and tire shop, and Tribal buildings including the health center, Headstart, offices and senior citizens building. The Indian Health Service (IHS) conducted a preliminary computer-modeled hydraulic analysis of the water distribution system in 1994. No specific flow or pressure problems were identified at that time.

In addition to the water supplied by the Tribal water treatment plant, there is an interconnection with the water supply system for the City of Horton which would provide treated water during an emergency. But this interconnection has been, for all practical purposes, abandoned, as the Tribe used no water from the City of Horton during the critical water supply shortage that occurred during the summer of 2000.

With regard to the existing water supply system for the Kickapoo Tribe, the following are items of concern or items that should be considered for system improvements that have been previously identified:

- ❑ Raw water diversion works on the Delaware River is in need of additional protection from erosion. The facilities are losing supporting foundation material due to erosion processes.

- ❑ The levels of trihalomethanes (THMs) are slightly higher than the maximum contaminant level (MCL) regulated by the Federal Drinking Water Standards. Based upon a Tribal treatment evaluation performed in 1996, the THMs in the water system were found to range from 0.05 to 0.15 milligrams per liter (mg/L) as compared with the MCL of 0.08 mg/L. However, the safe drinking water criteria apply to community water systems serving populations of 10,000 or more, and therefore, technically, the MCL for THMs would not be enforced for the Kickapoo water system since the service population is less than 10,000.[4]

- ❑ Repair of existing leaks in the water distribution system which result in the loss of large quantities of treated water.

- ❑ Installation of water meters at each residential water tap and the collection of water user fees will result in reduced average daily water use.

- ❑ Hydraulic analysis of the distribution system has not been performed since the construction of the Tribe's casino. Peak demand and fire flows with adequate pressures are a concern. Reclamation recommends that the water distribution system be analyzed using a computer model.

Water System Performance.—Based upon the current water use data, it has been concluded that the current demands are excessive, about double what would be reasonably expected for their water supply system. Therefore, the first order of need is to make improvements to the existing water distribution system. The per capita water use rates for the Potawatomi and Sac and Fox Nations (excluding the water used by the casinos) are 43 gpcd and 50 gpcd, respectively, as compared to 103 gpcd for the Kickapoo Tribe. According to the Tribe, the main reasons for their increased demand contributing to the excessive demand, are (1) significant leaks in the distribution system, and (2) the lack of water meters in place for each of the water

[4] Bruce Savage, August 1996, *Kickapoo Nation in Kansas Water Treatment Plant, Trihalomethane Treatment Study*, Oklahoma Area Indian Health Service, Guthrie District, Guthrie, Oklahoma.

taps in the system. Therefore, the improvements that should be made to the existing distribution system consist mainly of locating and repairing pipeline leaks and the installation of water meters for each residential and commercial water tap in the system. Water user fees may also be collected to provide a revenue to cover operation and maintenance costs.

There currently exists a shortage of about 286,000 gallons in treated water storage. For year 2020, additional storage required would be about 588,000 gallons, and for 2040 an additional 40,000 gallons above the 2020 need would be required.

A review of the water distribution system on the reservation reveals many small lines and many others that are unlooped. Fire protection or reliable drinking water is questioned. The size of the surface water impoundment on the Delaware River for the water treatment plant has been found inadequate over recent years. Also, the water supply is not adequate during drought years.

Potawatomi Nation

Water Quality and Treatment .—The Prairie Band Potawatomi Nation receives treated water from Jackson County Rural Water District (JCRWD) No. 3. The origin of JCRWD No. 3's water is primarily surface water—the Kansas River from Topeka. Topeka, through a cost arrangement, transfers this water to JCRWD No. 1, which in turn, by similar contract, transfers the water to JCRWD No. 3. Also, some JCRWD No. 3 water is groundwater pumped from three wells located about 2 miles north of Holton and an additional well located about 7 miles northeast of Holton. The water quality of the groundwater from these wells is generally good, but has relatively high total dissolved solids (TDS), about 358 to 395 mg/L (as compared with the recommended "secondary" level of 500 mg/L) and high hardness, 245 to 290 mg/L. Table IV-10 includes results from sampling these JCRWD wells from July 2000.

JCRWD No 3 receives treated water from the Banner Creek Reservoir water supply and treatment system. The Banner Creek Reservoir and dam was initially proposed as a flood control project to be located on Banner Creek, southwest of the town of Holton. Over the years the project evolved into a multiple-use reservoir, providing flood control, recreation, and water supply for residential, commercial, industrial, and agricultural uses. The town of Holton and the JCRWD No. 3 are cooperative partners in the domestic water supply aspects of the project, which includes a new water treatment (surface water filtration) plant. The new water filtration plant located directly below the dam has a capacity to treat 1.5 mgd and could be expanded to treat 2.5 mgd.

Table IV-10.—Water quality data for water supply wells JCRWD No. 3 (for water samples collected in July 2000)

Parameter	Well #1, #2, #13	Well #4
Alkalinity as $CaCO_3$	262	290
Aluminum	0.0132	0.0132
Antimony	<0.001	<0.001
Arsenic	<0.001	0.0027
Barium	0.140	0.1746
Beryllium	<0.001	<0.001
Cadmium	<0.001	<0.001
Calcium	77	92
Chloride	18.9	24.6
Chromium	0.0073	0.0054
Copper	0.0047	0.0929
Corrosivity, Langlier Index	0.131	0.077
Fluoride	0.21	0.24
Iron	<0.01	0.123
Lead	<0.001	<0.001
Magnesium	12.95	14.46
Manganese	<0.001	0.4328
Mercury	<0.0005	<0.0005
Nickel	0.0028	0.0032
Nitrate (N)	2.36	<0.01
PH	7.43	7.25
Potassium	0.867	2.05
Selenium	0.0068	<0.001
Silica	25.5	27.8
Silver	<0.001	<0.001
Sodium	26.9	22.19
Specific conductivity, us/cm	626.	676.
Sulfate	27.85	34.42
Thallium	<0.001	<0.001
Total dissolved solids (TDS)	358.	395
Total hardness	245.	290.
Total phosphorus (P)	0.05	1.02
Turbidity	0.26	0.84
Zinc	0.017	0.028

Note: All parameter concentrations are in mg/L except corrosivity and conductivity; no detects for VOCs or SOCs.

Concerning groundwater quality within the reservation, tables III-3 and III-4 present results of groundwater quality from well samples collected in 1980 by Kansas Department of Health and Environment (KDOHE) and in July 2000 by Reclamation/ USGS (Talbot). Chloride and sulfate, which were found to exceed the MCL in 1980 in most wells, were found in only one or two wells. Most trace elements are significantly below mandatory drinking water limits; however, iron and manganese levels are high in several wells.

Source Water Supply.—Two 6-inch-diameter water mains deliver water from the eastern boundary of the reservation, across Highway 75 at roads 126 and 175, to two booster pump stations. Only the southern booster pump station currently operates, delivering water at a rate of 100 gpm. A third water supply main, from JCRWD No. 3 at road K at the north reservation boundary, delivers water to the reservation and also fills an off-site elevated standpipe owned by JCRWD No. 3. In addition, a 12-inch water main delivers water from the north to the north booster station.

Storage.—Storage on the reservation consists of the main elevated storage tank, 100,000 gallons, located on 158th Street between roads L and M, and a 75,000-gallon elevated tank located at the casino. As previously mentioned, a third water supply main from JCRWD No. 3 at road K at the north reservation boundary delivers water to the service area and also fills an off-site elevated standpipe owned by others. The elevation of the main tank ranges from a low of 1315 feet to a high of 1338 feet mean sea level (MSL) at the overflow point. The ground elevation at the tank is approximately 1250 feet MSL.

Table IV-11 outlines the requirements of stored water for 2020 and 2040 based on the growth projections found in this report. Subtracting the current available storage from the total needed storage yields the amount of storage required to be built.

Table IV-11.—Water storage requirements for the Potawatomi Nation for 2000, 2020, and 2040

Year	Maximum day flow (gpd)	Equalization storage (gal)	Fire flow storage (gal)	Emergency storage (gal)	Total storage (gal)	Current storage (gal)	Additional capacity required (gal)
2000	474,250	60,269	540,000	711,375	771,644	175,000	596,644
2020	707,000	89,848	540,000	1,060,500	1,150,348	175,000	975,348
2040	864,550	109,870	540,000	1,296,825	1,406,695	175,000	1,231,695

Currently, about 600,000 gallons are needed to meet the water storage criteria established herein. For 2020, additional storage required would be 379,000 gallons, assuming the current 600,000 deficit is provided. For 2040, an additional 257,000 gallons above the 2020 need would be required. It is assumed that the types of tanks to be installed for 2020 and 2040 would be similar to the existing tanks. If the tanks could be placed to match the elevation of the tank on 158th Street, then adequate water delivery pressure, between 30 to 100 psi, will be available.

Distribution System.—A review of the topography of the 11-square-mile reservation concludes that one pressure zone is needed to serve the entire reservation and all users are located between elevations 1100 and 1260 MSL. The water is distributed within the reservation by PVC lines that range from 2- to 6-inch diameter, as shown in figure 1, attachment B. The hydraulic grade line from JCRWD #3 is approximately 1,320 feet.

The system has not been designed for adequate fire protection because many of the water lines are small in diameter and the headloss for a fireflow rate would be too great, resulting in inadequate pressure. In addition, there are many unlooped waterlines, so a mainbreak or a fireflow rate could not be assisted from flow from another direction.

The pipeline size to the casino is 6 inches, but it has a 2-inch flow-restrictive valve that can limit the flow to the casino to 51 gpm (73,440 gpd).

Water System Performance.—The limited service from Jackson County RWD # 1 is acceptable. There are no known immediate deficiencies in the Potawatomi service as received from JCRWD #3, except for the fact that the water distribution lines have not been sized properly for fire protection and peak use periods, and currently about 600,000 gallons are needed to meet the water storage criteria established herein. Treated water received from JCRWD #3 is excellent, and the new water treatment plant at Banner Creek Reservoir could provide safe, reliable drinking water to the Potawatomi. In addition, water production from JCRWD #3 seems to be adequate to accommodate Potawatomi's future demands.

Sac and Fox

The Sac and Fox Nation obtains treated water from Brown County Rural Water District No. 1 (BCRWD No. 1) for Tribal members and the Tribal offices within the town of Reserve. The water supplied to Tribal members at the Red Earth housing

area outside the town limits comes from Richardson County RWD No. 2. The water supplied to the casino, located about 40 miles to the south of Reserve along Highway 75, comes from Brown County RWD No. 2 (BCRWD No. 2).

Water Quality and Treatment.—There have been no MCL water quality violations in the water supplied to the water users in and near the Sac and Fox Reservation. The groundwater, supplied to the Nation by the BCRWD No. 2, who purchases it from Hiawatha from their well field located north of Hiawatha, is excellent quality and the only treatment needed is chlorination. Hiawatha treats the water from the wells before delivery to BCRWD No. 2

Table IV-12 presents a summary of water quality parameters for the wells owned by the city of Hiawatha. It should be pointed out that currently Hiawatha is developing two additional wells in the well field north of the city and the wells will replace the south Beckwith and Meisenheimer wells that have shown elevated nitrate levels in the past.

Source Water Supply.—The Sac and Fox Nation north area obtains the required water supply from two local rural water districts. The Nation has two housing areas, the Yellow Earth housing area in the town of Reserve, which is outside the reservation boundaries but on Tribal trust land, and the Red Earth housing area at the Kansas/Nebraska state line. The Yellow Earth housing area, including the Tribal headquarters and the town of Reserve, receives domestic water from Brown County RWD No. 1. The Red Earth housing area obtains its water supply from Richardson County RWD No. 2. Richardson County No. 2 obtains its water from the Falls City NE. Currently all water supply needs are being met by these rural water districts. Conversations by Tribal representatives and Reclamation with these two water districts confirm that each has the ability to continue to supply the residential water needs at present and into the future in the vicinity of the town of Reserve.

The Sac and Fox casino is located a considerable distance from the Tribal headquarters and main housing areas. The current water supply for the casino is supplied by Brown County RWD No. 2 and appears adequate at the present time. The capacity of the water line to the casino on Highway 75 south of the Reservation has been reported to be somewhat inadequate to meet the current water demands. However, the ability of the well field to supply water to meet the future water needs at the casino is more than adequate, according to the city of Hiawatha.[5] The

[5] Personal communication – city of Hiawatha, Carl Slaugh, July 10, 2002.

Table IV-12.—Water quality data for water supply wells – city of Hiawatha
(for water samples collected in June 2000)

Parameter	Reservoir[1]	Beckwith Well	Meisenheimer Well
Alkalinity as $CACO_3$	207	245	248
Aluminum	0.0125	0.0077	0.0113
Antimony	<0.001	<0.001	<0.001
Arsenic	<0.001	<0.001	<0.001
Barium	0.1882	0.2186	0.3507
Beryllium	<0.001	<0.001	<0.001
Cadmium	<0.001	<0.001	<0.001
Calcium	70	71	76
Chloride	8.2	7.25	8.99
Chromium	0.0052	0.0047	0.0066
Copper	0.0206	0.0055	0.0026
Corrosivity, Langlier Index	0.031	0.113	0.071
Fluoride	0.32	0.34	0.32
Iron	0.027	0.015	0.017
Lead	<0.001	<0.001	<0.001
Magnesium	12.49	18.37	18.11
Manganese	<0.001	<0.001	<0.001
Mercury	<0.0005	<0.0005	<0.0005
Nickel	0.0024	0.0022	0.0025
Nitrate (N)	7.96	9.43	**11.28**
PH	7.47	7.48	7.40
Potassium	0.831	0.743	0.765
Selenium	0.0018	0.002	0.0021
Silica	26.6	31.4	30.8
Silver	<0.001	<0.001	<0.001
Sodium	16.8	28.54	26.83
Specific conductivity, µs/cm	511	594	623
Sulfate	16.76	25.53	21.16
Thallium	<0.001	<0.001	<0.001

Table IV-12.—Water quality data for water supply wells – city of Hiawatha (for water samples collected in June 2000) (continued)

Parameter	Reservoir[1]	Beckwith Well	Meisenheimer Well
Total dissolved solids (TDS)	312	372	382
Total hardness	227	252	265
Total phosphorus (P)	0.05	0.04	0.04
Turbidity	<0.05	<0.05	0.07
Zinc	0.029	0.017	0.023

Notes: (1) All parameter concentrations are in mg/L except for corrosivity and conductivity; (2) No detects for VOCs or SOCs; (30 **Bold face type** indicates exceeds MCL Federal limit.
[1] Water from 4 wells in north well field blended in reservoir - located north of Hiawatha.

groundwater aquifer is reported to be excellent as to water availability and water quality (good compared to the water quality of groundwater in other areas of the northeastern part of Kansas).

An abandoned, unused water line along Highway 75 was constructed by Jackson RWD No. 3, to supply treated water to a truck farm owned by the Tribe. The pipeline is very small (1.5-inch diameter) and extends for over 4 miles from the truck farm to the district's water supply; it would have very limited capacity when considering other possible uses.

Future water needs due to possible expansion of the casino and attendant facilities can be met by contracting for additional water from Brown County RWD No. 2, which has indicated that it would be willing to supply additional water, as needed, for the Sac and Fox south area.

Storage.—Tables IV-13, IV-14, and IV-15, outline the requirements of stored water for years 2000, 2020, and 2040 for the north, south, and total reservation, respectively, based on the growth projections found in this report. Subtracting the current available storage from the total needed storage yields the amount of storage required to be built.

Currently, about 730,900 gallons (184,400 gallons for the north area and 546,500 gallons for the south area) are needed to meet the water storage criteria established herein. For 2020, additional storage required would be 11,000 gallons (561,953 minus 550,903 gallons) if 2000 storage is added prior to the time 2020 facilities are constructed. For 2040, an additional 1,169 gallons would be required assuming the 11,000-gallon deficit is provided in year 2020. Based on these tank

Table IV-13.—Water storage requirements for Sac and Fox Nation – north for 2000, 2020, and 2040

Year	Maximum day flow (gpd)	Equalization storage (gal)	Fire flow storage (gal)	Emergency storage (gal)	Total storage (gal)	Current storage (gal)	Additional capacity required (gal)
2000	34,500	4,384	180,000	51,750	184,384	0	184,384
2020	44,850	5,700	180,000	67,275	185,700	0	185,700
2040	51,750	6,577	180,000	77,625	186,577	0	186,577

Table IV-14.—Water storage requirements for Sac and Fox Nation – south for 2000, 2020, and 2040

Year	Maximum day flow (gpd)	Equalization storage (gal)	Fire flow storage (gal)	Emergency storage (gal)	Total storage (gal)	Current storage (gal)	Additional capacity required (gal)
2000	51,300	6,519	540,000	76,950	546,519	0	546,519
2020	127,890	16,253	540,000	191,835	556,253	0	556,253
2040	130,190	16,545	540,000	195,285	556,545	0	556,545

Table IV-15.—Water storage requirements for Sac and Fox Nation – total north and south for 2000, 2020, and 2040

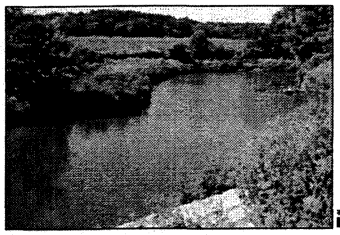
Year	Maximum day flow (gpd)	Equalization storage (gal)	Fire flow storage (gal)	Emergency storage (gal)	Total storage (gal)	Current storage (gal)	Additional capacity required (gal)
2000	858,000	10,903	540,000	128,700	550,903	0	550,903
2020	172,740	21,953	540,000	259,110	561,953	0	561,953
2040	181,940	23,122	540,000	272,910	563,122	0	563,122

sizes, and the small difference in added storage associated between years, the Sac and Fox Nation is urged to obtain the entire additional required storage, 551,000 gallons, as soon as possible. It is assumed that the types of tanks to be installed for the years 2020 and 2040 would be similar to the existing tanks.

Distribution System.—One drawing (dated August 1976) obtained from RCRWD #2 shows the Sac and Fox waterlines in Nebraska. These waterlines were copied onto figure 1, existing service area, of this report. As-built drawings of the Kansas portion of the Sac and Fox north area and the casino were not available.

Water System Performance.—The Sac and Fox Nation has indicated their general satisfaction with the existing water supply in the town of Reserve and in the Red Earth housing area. However, they have expressed a desire for self-sufficiency and the need for additional infrastructure to serve additional housing in the Red Earth area planned for the future. The two rural water districts that serve the town of Reserve (Brown County RWD No. 1) and the Red Earth housing area (Richardson County RWD No. 2) are willing and would be able to supply treated water to meet future growth of the Sac and Fox Nation. Currently, about 730,900 gallons are needed to meet the water storage criteria established herein. For 2020, additional storage required would be 11,000 gallons if 2000 storage is added prior to the time 2020 facilities are constructed. For 2040, an additional 1,169 gallons would be required.

Approaching the Red Earth housing area of the Sac and Fox Nation of Missouri.



CHAPTER V – Tribe/Nations-Specific On-Reservation Water Supply Alternatives

General

This section of the report assesses the available water sources within each reservation boundary to meet 2040 water demands. Groundwater and surface water resources were described previously on regional and specific bases in chapter III. The lack of on-reservation-specific quantitative groundwater (i.e., long-term well yields) and surface water data precludes making appraisal-level construction cost estimates for groundwater development at all three reservations.

Table V-1 summarizes from chapter IV each Tribe/Nation's 2040 water demand in acre-feet per year and in million gallons per day (MGD).

Table V-1.—Year 2040 yearly and average day water demands

Demand	Acre-feet per year	MGD
Potawatomi	485	0.43
Kickapoo Tribe	414	0.37
Sac and Fox South Area	73	0.07
Sac and Fox North Area	29	0.03
Total all Tribe/Nations	**1,001**	**0.90**

Kickapoo Tribe in Kansas

Groundwater

As discussed in chapter III, groundwater resources around the Kickapoo reservation may be developed along the Delaware River alluvium. Yield may be between 50 and 300 gallons per minute (gpm) but no specific pump yields within the reservation have been determined.

Surface Water

The Delaware River has been studied by the US Department of Agriculture and appears to have sufficient flow to satisfy the Kickapoo water demands. (USDA-SCS Kansas report, *Watershed Plan and Environmental Impact Statement,* January 1994). The existing Delaware River impoundment has proven to be insufficient in size to retain the required volume for current water demands for the Kickapoo Tribe and will need to be expanded.

An option to using the Delaware River for an on-site water supply to meet 2040 demands is to construct a surface water reservoir at the Plum Creek dam site (see figure VI-3).

Prairie Band Potawatomi Nation

Groundwater

From the results of short-term pump tests performed on several exploratory wells along Big Elm Creek in October 2001, Reclamation concludes that an aquifer along Big Elm Creek in the southeast corner of the reservation may support a yield of around 280 gpm (403,200 gpd) without dewatering the aquifer. Additional long-term pumping of test wells would be necessary to verify the long-term yields of proposed raw water supply wells along Big Elm Creek.

Initial water quality sampling results of groundwater from a test well along Big Elm Creek, is presented in the last column of preceding table III-4. Although the water does not exceed any Federal SDWA primary contaminant regulations, it does exceed several secondary standards. The water quality data indicates that the groundwater is very high in TDS, hardness, sodium, sulfates, and iron. Assuming the water quality from this well is indicative of the water quality of the aquifer, the water quality of the pumped water would be considered poor. Hence, treatment is recommended to reduce the secondary contaminants and for pathogen removal/ inactivation.

Based on the above, developing groundwater within the Potawatomi Reservation is problematic from both a quantitative and qualitative aspect. Reclamation and the USGS were unsuccessful at locating test wells with high yields along Big Soldier Creek and historic water quality problems, as previously described, would warrant complex water treatment processes which would be costly both for construction as well as for operation and maintenance (Reclamation, October 2001).

If pursued, the following options would be necessary to develop a groundwater supply and treatment and distribution system on the Potawatomi reservation. This list is not all-inclusive and is not in priority order.

(1) Institute a more comprehensive exploration program to find groundwater with better quality.

(2) Design and construct necessary pumping facilities and piping to transport raw water from the wells to the new water treatment facilities and then to the existing water distribution system.

(3) Design and construct water treatment facilities at the sites of the groundwater supply wells along Big Elm Creek and/or other sites if exploratory test wells find higher yields.

(4) Add storage and distribution piping as indicated in chapter IV.

(5) Acquire the water distribution system components from Jackson County RWD No. 3, including all existing distribution piping, water storage tanks, pumps, and associated equipment (attachment B).

Surface Water

The volume of flow in Big Soldier Creek appears to be inadequate to meet the Potawatomi Nation's water demands. Big Soldier Creek has also had water quality problems with Atrazine, a synthetic organic chemical used in herbicides. For these reasons, developing a surface water source on the Potawatomi Reservation appears infeasible.

Sac and Fox Nation of Missouri

Groundwater

There are no known groundwater resources within the Sac and Fox area, based on available data.

Surface Water

Along the northern border of the Sac and Fox Reservation is the Big Nemaha River. As shown in table III-1, the average annual stream flow is 454,000 acre-feet. The water quality of the Big Nemaha River appears to be generally acceptable, assuming

standard surface water treatment. Based upon past USGS existing water quality data, at station 6815000, iron and manganese are parameters that exceed primary or secondary drinking water standards and need to be addressed by treatment.

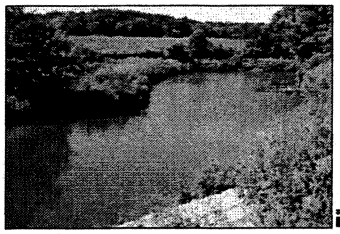
For the Sac and Fox Nation to pursue obtaining water from the Big Nemaha River, the following would be required. This list is not intended to be inclusive nor is it in priority order.

(1) Install a proposed river diversion located in the southeast corner of Section 26, Township 1 North, Range 17 East and on the Sac and Fox Reservation.

(2) Install a surface water filtration treatment plant near the point of diversion, about 1 mile north and 2 miles east of the Red Earth housing area.

(3) Since the Red Earth area is presently being served by Richardson County RWD No. 2, the existing water distribution infrastructure would have to be purchased from the district or new distribution piping installed. Similarly, facilities currently serving the Yellow Earth subdivision, the town of Reserve, and the casino all would have to be purchased if the Tribe wants their own water supply system.

(4) Construct and operate the water storage facilities identified in chapter IV.



CHAPTER VI – Multi-Tribal Water Supply Alternatives

General

This chapter describes five multi-Tribal (MT) water supply alternatives that can furnish more raw or treated water than either of the year 2020 or year 2040 annual water demands of the Kickapoo Tribe in Kansas, Prairie Band Potawatomi Nation, and Sac and Fox Nation of Missouri (south area) (Tribe/Nations). The total estimated residential, commercial, and industrial demands for 2040 for the Tribe/Nations, as defined in chapter IV, are summarized below in table VI-1. Also shown in table VI-1 are known estimated yields from each alternative.

Table VI-1.—2040 yearly and average day water demands and current available water

2040 demands		
Demand	Acre-feet per year	MGD
Kickapoo	414	0.37
Potawatomi	485	0.43
Sac and Fox (south area)	73	0.07
Sac and Fox (north area)	29	0.03
Total all Tribe/Nations	**1,001**	**0.90**
Current available water		
Water supply alternative	Acre-feet per year	MGD
Plum Creek (projected)[1]	1,792	1.60
Perry Lake[2]	84,000	75.00
Kansas River/Shawnee Reservoir[3]	>1,001	>0.9
Banner Creek[4]	>1,001	>0.9
Hiawatha Well[5]	>1,001	>0.9

[1] Obtained from *Watershed Plan and Environmental Impact Statement, Upper Delaware and Tributaries Watershed in Atchison, Brown, Jackson, and Nemaha Counties, Kansas*, page 30, January 1994 – NRCS.

[2] Obtained from the State of Kansas Water Office.

[3] Water is available via verbal contact with the U.S. Army Corps of Engineers.

[4] The treatment plant can provide 1.5 MGD, expandable to 2.5 MGD. Sufficient water is available via verbal contact with Jackson Co. RWD #3.

[5] Adequate water appears to be available based on verbal contact with the City of Hiawatha. Currently at 70 percent capacity at highest demand day per year. Currently researching new water sources.

The five multi-Tribal alternatives are listed below and are described in this chapter, after general descriptions of water treatment and pumping plant features common to each alternative.

- MT1: Plum Creek Reservoir
- MT2: Perry Lake
- MT3: Kansas River / Shawnee Reservoir
- MT4: Banner Creek
- MT5: Hiawatha Wells

Only MT5 will provide water to all Tribes. MT4 excludes Sac and Fox north due to the long distance involved.

A detailed list of layouts of water sources, water treatment plants and pipe alignments follow in tables VI-2 and VI-3 and are illustrated in figure 2, attachment B.

Although a source needs to provide the average annual demand shown in table VI-1, the delivery system (pumping stations and treatment plants) is designed to pump the maximum day demand (twice the average day demand).

Facilities that serve more than one Tribe/Nation, such as a pipeline, water treatment plant, or pump station, are, for the purpose of this report, defined as shared facilities. The cost of a shared facility is assumed for this report, to be proportional to each Tribe/Nation based on the demands by each Tribe. To clarify, the respective maximum daily design flows for the Kickapoo, Potawatomi and Sac and Fox south are 513 gpm, 600 gpm, and 90 gpm, respectively. Costs for all three would be apportioned 42.6 percent to Kickapoo, 49.9 percent to Potawatomi, and 7.5 percent to the Sac and Fox based on these flows. These flows total 1,203 gpm, which is also 1.7 mgd or 1,940 acre-feet per year.

For MT1 through 4, the water treatment plant, a shared facility, is described below and is sized for the maximum day water demand from all three Tribes of 1.7 mgd. Shared pump stations are assumed for each alternative to pump raw water from its source to the water treatment plant. Pump stations which pump treated water from the plant to each Tribe may or may not be shared.

Water Treatment

Surface Water Treatment Rule Requirements.—Since the water sources for all the treatment plants are tributaries of the Missouri River, water quality for the Missouri River in the area under study is provided in table VI-4.

TableVI-2.—Multi-Tribal alternatives source waters, treatment facilities, and end points

Alternative	Tribe/Nation	Color[1]	Source	Treatment	Destination
MT1 Proposed Plum Creek Reservoir	Potawatomi Kickapoo Sac and Fox (casino only)	Magenta	Proposed Plum Creek Reservoir	Proposed joint Tribal Plum Creek WTP	North Booster Station Distribution System Connection Sac and Fox casino
MT2 Perry Lake	Potawatomi Kickapoo Sac and Fox (casino only)	Blue	Perry Lake	Proposed south Cedar Creek WTP	North Booster Station Distribution System Connection Sac and Fox casino
MT3 Kansas River	Potawatomi Kickapoo Sac and Fox (casino only)	Yellow	Kansas River/Shawnee River	Proposed south Cedar Creek WTP	North Booster Station Distribution System Connection Sac and Fox casino
MT4 Banner Creek	Potawatomi Kickapoo Sac and Fox (casino only)	Green	Jackson County RWD #3/City of Holton Banner Creek Reservoir	Banner Creek WTP	North Booster Station Distribution System Connection Sac and Fox casino
MT5 Hiawatha Wells	Potawatomi Kickapoo Sac and Fox (casino only)	Salmon	Hiawatha wells	Chlorination by City of Hiawatha	North Booster Station Distribution System Connection Sac and Fox casino
	Sac and Fox (Red Earth)			Proposed chlorination facility	Red Earth subdivision

[1] Supply alternative color code for site plan maps of supply alternative layouts, figure 5.

Table VI-3.—Multi-Tribal alternatives pipe segment specifics

Alternative	Tribe	Color[1]	Source	Destination	Treatment
MT1 Proposed Plum Creek Reservoir	Potawatomi, Sac and Fox (casino only)	Magenta	Proposed Plum Creek Reservoir	Sac and Fox casino	Proposed joint Tribal Plum Creek WTP
	Potawatomi	Magenta	Sac and Fox casino	North Booster Station	
	Kickapoo	Magenta	Proposed Plum Creek Reservoir	Distribution connection	
MT2 Perry Lake	Potawatomi, Kickapoo, Sac and Fox (casino only)	Blue	Perry Lake	Proposed South Cedar WTP	Proposed South Cedar Creek WTP
	Potawatomi	Blue	Proposed South Cedar WTP	North Booster Station	
	Kickapoo, Sac and Fox (casino only)	Blue	Proposed South Cedar WTP	K-20/I-75 Intersection	
	Kickapoo	Blue	K-20/I-75 intersection	Distribution connection	
	Sac and Fox (casino only)	Blue	K-20/I-75 intersection	Sac and Fox casino	
MT3 Kansas River	Potawatomi, Kickapoo, Sac and Fox (casino only)	Yellow	Shawnee Reservoir/Kansas River	Proposed South Cedar WTP	Proposed South Cedar Creek WTP
	Potawatomi	Yellow	Proposed South Cedar WTP	North Booster Station	
	Kickapoo, Sac and Fox (casino only)	Yellow	Proposed South Cedar WTP	K-20/I-75 Intersection	
	Kickapoo	Yellow	K-20/I-75 intersection	Distribution connection	
	Sac and Fox (casino only)	Yellow	K-20/I-75 intersection	Sac and Fox casino	

Table VI-3.—Multi-Tribal alternatives pipe segment specifics (continued)

Alternative	Tribe/Nation	Color[1]	Source	Destination	Treatment
MT4 Banner Creek	Potawatomi, Kickapoo, Sac and Fox (casino only)	Green	Banner Creek Reservoir	K-16/I-75	Banner Creek WTP
	Potawatomi	Green	K-16/I-75 intersection	North booster station	
	Kickapoo, Sac and Fox (casino only)	Green	K-16/I-75 intersection	K-20/I-75 intersection	
	Kickapoo	Green	K-20/I-75 intersection	Distribution connection	
	Sac and Fox (casino only)	Green	K-20/I-75 intersection	Sac and Fox casino	
MT5 Hiawatha Wells	Potawatomi, Kickapoo, Sac and Fox (casino only)	Salmon	Brown Co. 2 distribution connection	Kickapoo distribution connection	Chlorination by City of Hiawatha
	Potawatomi, Sac and Fox (casino only)	Salmon	Kickapoo distribution connection	I-75	
	Potawatomi	Salmon	I-75, 2 miles north of K-20	North booster station	
	Sac and Fox (casino only)	Salmon	I-75, 2 miles north of K-20	Sac and Fox casino	
	Sac and Fox (Red Earth)	Salmon	Hiawatha north wells	Red Earth	Proposed chlorination facility

Table VI-4.—Design water quality for the Missouri River

Parameter	Concentration[1]	Secondary[2] MCL
pH	8.24	
Total organic carbon, TOC (mg/L)	15.3	
Total dissolved solids, TDS (mg/L)	455	500
Sulfates, SO_4 (mg/L)	153	250
Chlorides (mg/L)	18	250

[1] Average data from Missouri River USGS station 6818000, St. Joseph, Missouri.

[2] Secondary standards or MCLs are established by EPA for control of aesthetic qualities relating to public acceptance and includes contaminants that may affect taste, color, odor, and appearance.

The treatment systems used to provide drinking water to the various Tribe/Nations must comply with the Surface Water Treatment Rule (SWTR). The SWTR was published in the Federal Register on June 29, 1989, and is promulgated by the Environmental Protection Agency (EPA) as a National Primary Drinking Water Regulation for public water systems using surface water sources or ground water under the direct influence of surface water. The filtration and disinfection requirements under this rule protect consumers against the potential adverse effects of exposure to *Giardia lambia*, *Cryptosporidium*, viruses, Legionella, and heterotrophic bacteria by requiring the inactivation of 99.9 percent (3 log) for Giardia cysts and 99.99 percent (4 log) for viruses. The inactivation of potential pathogens, as required by the SWTR, is accomplished by the use of EPA-approved technologies for filtration and disinfection methods. Newly adopted regulations to address the risk of disinfection by-products (DBPs) include: Disinfectants - Disinfection Byproducts Rule (D-DBP Rule) and the Interim Enhanced Surface Water Treatment Rule, which requires continual monitoring of filtered water turbidity and routine DBPs monitoring in the distribution system.

The D-DBP Rule is divided into two stages. Stage 1 of the Rule will be required for all community water systems and includes an MCL of 80 micrograms per liter (µg/L) for Total Trihalomethanes (TTHMs), 60 µg/L for five haloacetic acids (HAA5), 10 µg/L for bromate and 1.0 µg/L for chlorite. Stage 1 will also require a reduction of total organic carbon (TOC) by the treatment plant. Based on the TOC and alkalinity data provided in table 1 the potable water treatment plants will require a 25 percent reduction in TOC.

The relatively high concentrations of total organic carbons (TOC) in surface and subsurface diversions, as shown in accompanying tables, in combination with long detention time required to convey the treated water to some of the delivery points, indicate a potential for the production of DBPs that may exceed current and future regulatory limits at the treated water service points or within the domestic water storage and distributions systems used to distribute the water to consumers.

Proposed Treatment System.—The proposed treatment system consists of direct filtration using ultrafiltration followed by ultraviolet and chloramination disinfection to provide multiple treatment barriers for removal of TOC, *Giardia*, *Cryptosporidium* and viruses. The use of chloramines to provide a disinfection residual during the conveyance of treated water from the treatment plant to the service areas will not only provide a treated water that is not conducive to the formation of disinfection by-products but also provide an additional disinfection barrier. Figures VI-1 and VI-2 show the process flow diagram of the proposed processes and the floor plan for a 1.7 million gallon per day (MGD) ultrafiltration treatment plant.

The hollow fiber ultrafiltration treatment system physically removes suspended particles greater than 0.1 micron in diameter by having a nominal and absolute pore size of .035 and 0.1 micron, respectively. Particles found in the water that exceed this size range are easily filtered. They include Giardia (5-15 microns in size), Cryptosporidium (4-6 microns in size), large viruses and large organic molecules. The continuous hollow fiber ultrafiltration system manufactured by US Filter(CMF-S) or Zenon (ZeeWeed) are bundles or cassettes of tubular membranes that filter water through microscopic holes. Designed for large-scale systems, the pre-engineered cassettes are submerged into open top concrete or steel tanks. The proposed ZeeWeed 1000 system consists of a series of parallel concrete tanks, or trains, in which cassettes are immersed in modules consisting of three active cassettes and space for an additional cassette. Each cassette can produce a flow of 0.58 MGD or 403 gallons per minute (gpm). In these systems feed water enters each tank from the bottom and flows upward though the cassettes. During the filtration cycle, a vacuum is applied to each hollow fiber to draw water into the tube leaving the flocculated and suspended solids greater than 0.1 micron on the outside of the tube. Untreated water is added to maintain a constant level in each concrete tank.

Recovery Rate and Reuse of Wastewater.—The recovery of treated water is estimated to be 95 percent of the raw inflow, assuming 5 percent of the inflow is used for membrane cleaning and discharged as wastewater with a small amount of solids in it. Options for the treatment and disposal of this wastewater include discharge to ponds followed by use for irrigation, discharge to ponds followed by treatment by the system, or discharge back to the source water.

Description of Membrane Cleaning Techniques.—At the end of a filtration cycle, which is characterized by plugging enough holes in the hollow fiber with filtered material to increase suction pressure, a backwash is performed. During backwash, the membranes are simultaneously aerated and back pulsed with treated water to dislodge solids from the outside of each fiber. The water, which includes

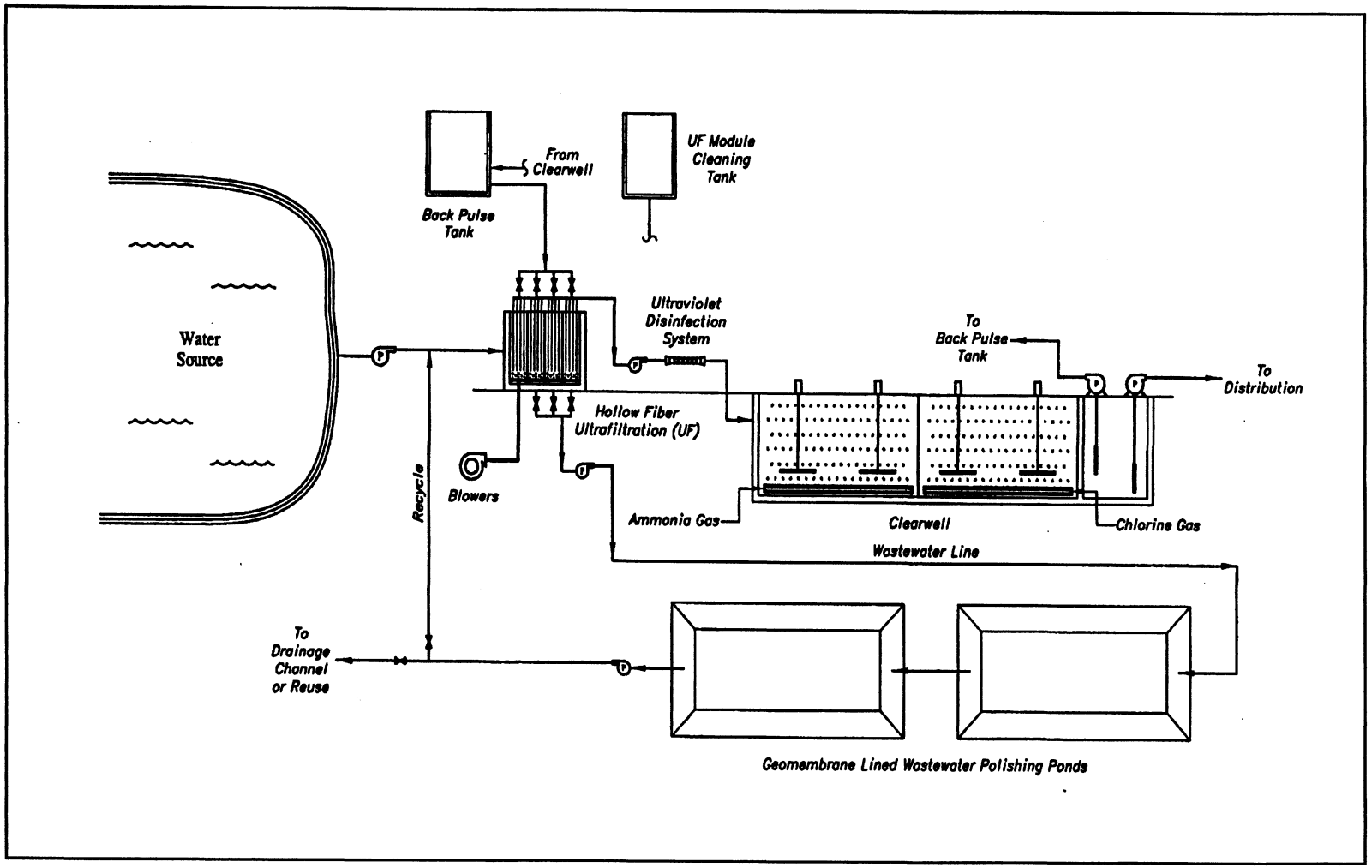


Figure VI-1.—Process flow diagram for all multi-Tribal alternatives (Plum Creek, Kansas River/Shawnee Reservoir, Perry Lake, and Banner Creek water treatment plants).

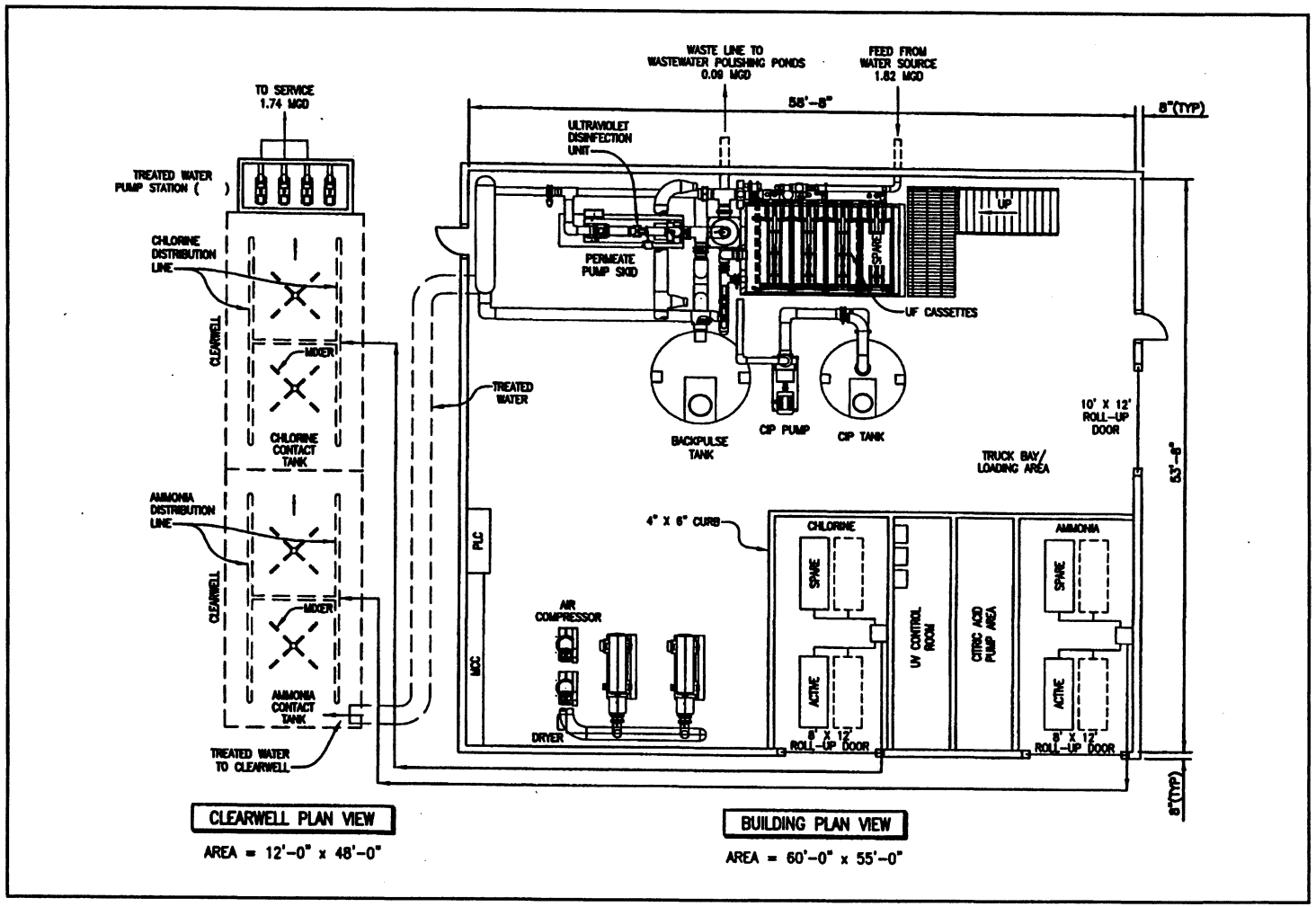


Figure VI-2.—Typical water treatment plant—1.74 MGD—for all multi-Tribal alternatives (Plum Creek, Kansas River/Shawnee Reservoir, Perry Lake, and Banner Creek water treatment plants).

the backwashed solids, is routed into the backwash trough and out to the backwash water polishing ponds. The time for backwash varies from 15 minutes to 1 hour. The number of filtration cycles a day is directly related to the amount and type of contaminants or floc particles in the water.

Recovery cleaning is performed as required, typically every 2-6 months, at which time the fibers are back pulsed with a cleaning solution followed by in-situ soaking for several hours. After cleaning, the tanks are emptied and the cleaning solution is pumped to a storage tank for future use.

Log Credits .—According to information provided by ZENON, the enhanced coagulation and ultrafiltration treatment process is expected to provide a 6 log reduction in *Giardia* and *Cryptosporidium* and 2 log reduction in viruses in the source water thus meeting all the SWTR removal requirements for for *Giardia* and *Cryptosporidium* reduction and half of the requirements for virus reduction.

Ultraviolet Disinfection Units.—Disinfection after ultrafiltration is accomplished by state of the art flow through ultraviolet (UV) disinfection units which are located on the filtered water discharge line from each ultrafiltration treatment train. Each unit consists of a stainless steel chamber containing eight UV lamps, an automatic cleaning system, UV monitoring system and control cabinet. Each unit will provide a minimum UV dose of 40 mJ/cm2 to the filtered water before being routed to the clear well.

Log Credits .—According to the information provided by Aqionics, the proposed UV units will add an additional 3 log (99.9 percent) reduction of Giardia and Cryptosporidium and an additional 4 log (99.99 percent) reduction in viruses to the water following the ultrafiltration process. Based on this information, the unit processes of ultrafiltration and UV disinfection will provide a reduction of 9 log for Giardia and Cryptosporidium and 6 log for viruses; this reduction far exceeds the SDWA requirements.

Disinfection.—The preferred disinfection technique is free chlorine. If dissolved organics remain in the treated water, chloramination will be required to reduce the formation of THM. Chloramination requires the mixing of filtered and disinfected water with ammonia gas followed by chlorine gas in the clearwell will provide a chloramine residual prior to being pumped by the service water pump plant into the treated water mains leading to the service areas. This form of residual is

being used to reduce the development of disinfection by-products that would be generated by extended contact times in the conveyance and storage facilities if a free chlorine residual was used. Other benefits of a chloramine residual include prevention of taste and odor problems and the fact that the chloramine residual will last longer in the treated water transmission line and storage system thus eliminating the number of re-chloramination stations.

Detention times and dosage rates for a chloramination system can only be determined by laboratory and field testing. In this study, an estimated chloramine dosage of 1.00 ppm was used. This consists of a 0.5 ppm demand and 0.5 ppm residual. The ratio of 3 parts chlorine to 1 part ammonia was used to size the ammonia and chlorine gas storage area and cost estimate. A detention time of 30 minutes was used to size the clearwell where mixing will occur.

Not having the disinfection power as a free chlorine residual, chloramination will still provide additional disinfection log credit based on the contact time from the plant to the withdrawal point by individual communities. The water treatment attachment provides an estimate of the contact times and additional log credit removals that occur during conveyance of the treated water.

Treatment Plant Building Requirements..—The treatment building for the multi-Tribal treatment plants will be approximately the same size, with a first-floor surface area of approximately 3,300 square feet and a second floor mezzanine that is approximately 55 feet wide and 60 feet long. The proposed floor plan of each treatment plant is shown on the attached drawings. The Tribal treatment plants will be of the same configuration, but smaller. The proposed building will be a pre-engineered, prefabricated structure with metal siding and suitable insulation and ventilation to meet the building code requirements of the State of Kansas. The building will house the 10-foot-tall flocculation basins, 10-foot-tall concrete tanks containing the ultrafiltration modules for each train, UV units, vacuum pumps and internal piping. The second floor mezzanine will contain the control room for the filters and UV units, air blowers used for module cleaning, and the motor control center. The chlorine storage room and ammonia storage room are included in the main building but have outside entrances and separate HVAC systems to eliminate the risk to the operators if leakage occurs in any of the cylinders.

Clearwell.—The below-grade clearwell will provide a detention time of 30 minutes and will include injection manifolds, baffles and mixers to properly mix ammonia and chlorine with treated water. After disinfection, treated water will be pumped by the service pumping station into the distribution system.

Pumping Stations

Raw Water Diversion Pumping Stations.—Diversion pumps will be required to pump untreated water from each source to the influent header of the water treatment plant. Each pump station will have 3 pumps each rated at half the influent rate for each plant. Two pumps will be needed to meet peak day demands with the third pump as a spare. Table VI-5 provides an appraisal-level description for each raw water pump station.

Table VI-5.—Diversion pump stations for multi-Tribal options

Location	Flow (gpm)	Maximum TDH (feet)[1]
Plum Creek to WTP	1,203	40
Perry Lake Alternative		
Perry Lake to pump station	1,203	300
Pump station to WTP	1,203	300
Kansas River/Shawnee Reservoir Alternative		
Reservoir to pump station	1,203	295
Pump station to WTP	1,203	290
Banner Creek Reservoir to WTP	1,203	40

Note: Power Source 460 VAC - 3 phase.

[1] TDH, total dynamic head, rounded to nearest multiple of 5 feet. Three hundred feet is assumed maximum design TDH.

Treated Water Pumping Stations.—A treated water pumping station will be located at each water treatment plant and will pump treated/disinfected water to service. The pumping station will be composed of three submersible turbine pumps. Each pump will be rated at one-half plant capacity. Two pumps will be required to meet demands, with a third pump as a spare. Table VI-6 provides the sub-appraisal level description of each main treated water pump station.

Multi-Tribal Alternatives

The following description and cost of the MT1 alternative does not include the construction of a dam on Plum Creek. Raw water diversion pump stations, although not listed below for each alternative, are included in the cost estimates.

Table VI-6.—Treated water pump stations multi-Tribal alternatives

Location	Flow (gpm)	Maximum TDH (feet)[1]
Plum Creek Alternative		
WTP to distribution connection	513	95
WTP to casino	690	175
Casino junction to north booster	600	275
Perry Lake Alternative		
WTP to north booster	600	65
WTP to distribution connection	603/513	255
I-75 to casino	90	75
Kansas River/Shawnee Reservoir Alternative		
WTP to north booster	600	65
WTP to distribution connection	603/513	255
I-75 to casino	90	145
Banner Creek Reservoir Alternative		
WTP to I-75	1,203	140
I-75 to north booster	600	210
I-75 to distribution connection	603/513	205
I-75 to casino	90	75
Hiawatha Wells Alternative		
Distribution connection to casino	691	150
Casino to north booster	600	165
Hiawatha wells to Red Earth	36	45

Notes: Power Source 460 VAC - 3 phase.
[1] TDH, total dynamic head, rounded to nearest multiple of 5 feet. Three hundred feet is assumed maximum design TDH.

Plum Creek Reservoir

This alternative consists of the implementation and construction of a dam to provide a multi-purpose reservoir on Plum Creek, a tributary to the Delaware River. The Plum Creek dam and reservoir project was one of 20 flood-retarding dams with a multipurpose structure proposed by the Soil Conservation Service (SCS) in a Watershed Plan and Environmental Impact Statement (January, 1994). Table VI-7 contains selected data for this multi-purpose structure taken from the Watershed Plan.

The Plum Creek dam would be located on the Kickapoo Reservation (sec. 2, 3, 10, 11, 14, and 15 T4S R15E), and about 50 percent of the land inundated by the reservoir would be on the reservation (figure VI-3). About 90 percent of the drainage

Table VI-7.—Structural data for Plum Creek upper Delaware and tributaries watershed, Kansas, from SCS

Item	Unit	Plum Creek Dam
Total drainage area	Square miles	16.54
Elevation top of dam	Feet	1,092.6
Maximum height of dam	Feet	53.9
Total capacity	Acre-feet	10,572
Sediment	Acre-feet	1,287
Flood water	Acre-feet	3,572
Water supply[1]	Acre-feet	5,713
Beneficial use surface area	Acres	475

[1] The water supply storage volume within the proposed Plum Creek Reservoir (MP21-14) is 5,713 acre-feet; based upon an hydrologic study for various estimated continuous yields, it was determined that the safe yield with a surety of 98 percent is 1.6 mgd or about 1792 acre-feet per year ("Watershed Plan and Environmental Impact Statement, Upper Delaware and Tributaries Watershed in Atchison, Brown, Jackson, and Nemaha Counties, Kansas," page 30, January 1994). Additional structural data is presented in Table 3 of the Watershed Plan and EIS, page 63.

area above the dam is outside the 1862 Reservation Boundary. SCS expressed concerns relative to the quality of the water that would be captured by the reservoir. Nitrates and phosphates from irrigation runoff, fecal material from livestock, and pesticide runoff from irrigated lands, all existing problems in Perry Lake reservoir, may presumably be in Plum Creek since it intercepts waters that would normally have gone to Perry Reservoir.

A water treatment plant could be located by the dam, sized to meet year 2040 water demands for the Tribe/Nations. This plant would provide filtered and chlorinated water to all end users. The operation and maintenance of the plant is assumed to be a joint effort of the three Tribe/Nations.

Common among the Tribe/Nations.—

- ❑ Arrangement by the Tribe/Nations for construction of Plum Creek dam and reservoir.
- ❑ Raw water supply pump station sized for 1.7 MGD is needed.

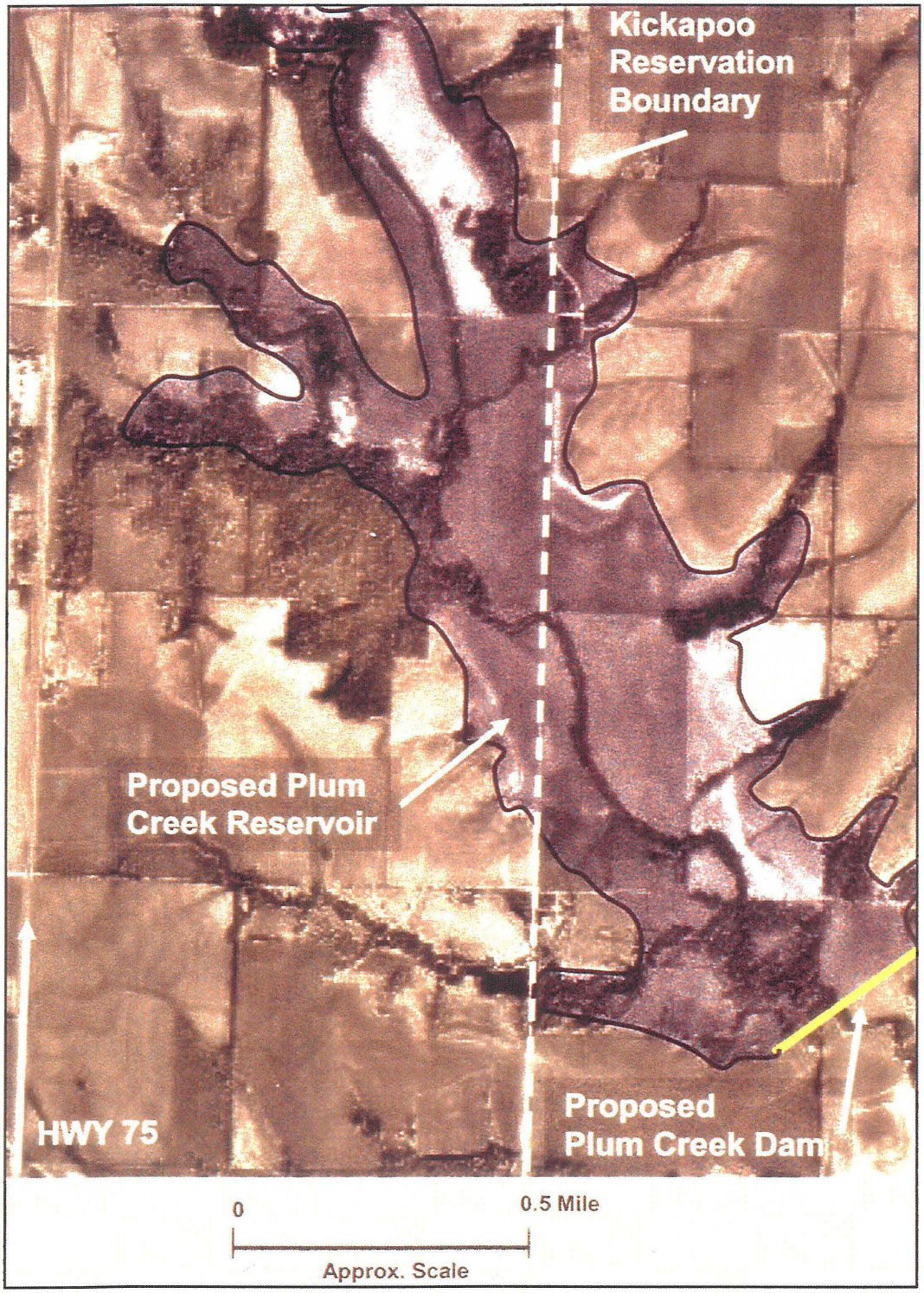


Figure VI-3.—Plum Creek Reservoir aerial view.
(Notes: (1) Prepared by Reclamation from data supplied by Terraserver [Microsoft®], USGS, and SCS; (2) Reservoir boundaries are approximate).

- ❑ Construction and operation of a 1.7 mgd new water treatment plant, previously described in chapter 5 and located at the Plum Creek dam. This plant is assumed to be jointly operated by the Tribe/Nations.

The following are additional required infrastructure each Tribe/Nation will need to operate their own water supply and distribution system for 2040 when converting to the Plum Creek Reservoir Alternative:

Potawatomi.—

- ❑ A shared treated water pump station sized for 690 gpm for Potawatomi and Sac and Fox.
- ❑ Approximately 2 miles of shared (with the Sac and Fox) water supply pipeline and an additional 24 miles of water supply pipeline from the water treatment plant at the Plum Creek dam to the north booster station on the Tribal reservation.
- ❑ A 600-gpm treated water pump station.
- ❑ Construction of 1.23 million gallons of storage tank capacity.
- ❑ Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Jackson County RWD No. 1 or Jackson County RWD No. 3.

Kickapoo.—

- ❑ A 513 gpm treated water pump station.
- ❑ Approximately 3 miles of treated water supply pipeline from the water treatment plant at the Plum Creek dam to existing distribution system connection point.
- ❑ Construction of 0.91 million gallons of storage tank capacity.

Sac and Fox (South).—

- A treated water pump station sized at 690 gpm and shared with the Potawatomi.
- Approximately 2 miles of shared (with the Potawatomi) water supply pipeline from the water treatment plant at the Plum Creek dam to the casino.
- Construction of 0.6 million gallons of storage tank capacity.
- Acquisition of existing distribution piping and appurtenances currently owned by Richardson County RWD No. 2.

Perry Lake

This alternative assumes the Tribe/Nations obtain water rights for 972 acre-feet per year of raw water from Perry Lake.

Common among the Tribe/Nations.—

- Raw water supply pump station, sized at 1203 gpm (1.7 mgd), and 23 miles of pipeline from Perry Lake to a proposed water treatment plant located near Highway 75 by the Potawatomi Reservation at South Cedar Creek.
- Construction and operation of the 1.7-mgd new water treatment plant (described in chapter V) located at South Cedar Creek. This plant is assumed to be jointly operated by the Tribe/Nations.

The following are additional infrastructure requirements each Tribe/Nation will need to operate their own water supply and distribution system for year 2040 when converting to the Perry Lake alternative:

Potawatomi.—

- A 600-gpm treated water pump station.
- Approximately 1 mile of treated water supply pipeline from the proposed South Cedar Creek Water Treatment Plant to the north booster station on the reservation.

- Construction of 1.23 million gallons of storage tank capacity.

- Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Jackson County RWD No. 1 or Jackson County RWD No. 3.

Kickapoo.—

- A finished water pump station sized at 603 gpm directs flow northward for the Kickapoo Tribe and Sac and Fox (south) Nation from the South Cedar Creek water treatment plan. This pump station is assumed to be operated and shared by the Kickapoo and Sac and Fox.

- Approximately 21 miles of shared (with the Sac and Fox) water supply pipeline from the South Cedar Creek Water Treatment Plant to the storage near the intersection of K-20 and Highway 75.

- Approximately 5 miles of treated water supply pipeline from K-20 and Highway 75 to a water distribution system connection point within the Kickapoo Reservation.

- Construction of 0.91 million gallons of storage tank capacity.

Sac and Fox (South).—

- A shared treated water pump station sized at 603 gpm directs flow northward for the Sac and Fox (southern development) and Kickapoo. This pump station is assumed to be operated and shared by the Sac and Fox Nation and Kickapoo Tribe.

- Approximately 21 miles of shared (with the Kickapoo) water supply pipeline from the South Cedar Creek Water Treatment Plant to the distribution system connection to the intersection of K-20 and Highway 75.

- Approximately 2.25 miles of treated water supply pipeline from the intersection of K-20 and Highway 75 to the Sac and Fox's southern development.

- Construction of 0.6 million gallons of storage tank capacity.

- Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Brown County RWD No. 2.

Kansas River/Shawnee Reservoir

This alternative assumes the three Tribes arrange for the acquisition of 972 acre feet per year of raw water from Kansas River (or possibly Shawnee Reservoir). Costs are based on withdrawing water directly from the Kansas River at a point directly below Highway 75.

Common among the Tribe/Nations.—

- Raw water supply pump station sized at 1.7 mgd, and approximately 22 miles of raw water supply pipeline from the Kansas River to a proposed water treatment plant at South Cedar Creek on Highway 75.

- Construction and operation of the 1.7-mgd new water treatment plant, described in chapter V and located at South Cedar Creek. This plant is assumed to be jointly operated by the Tribe/Nations.

The following are additional required infrastructure each Tribe/Nation will need to operate their own water supply and distribution system for 2040 when converting to the Kansas River alternative.

Potawatomi.—

- A 600-gpm treated water pump station.

- Approximately 1 mile of treated water supply pipeline from the proposed South Cedar Creek Water Treatment Plant to the north booster station on the reservation.

- Construction of 1.23 million gallons of storage tank capacity

- Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Jackson County RWD No. 1 or Jackson County RWD No. 3.

Kickapoo.—

- A treated water pump station sized at 603 gpm directs flow northward for the Kickapoo Tribe and Sac and Fox (south) Nation from the South Cedar Creek water treatment plant. This pump station is assumed to be operated and shared by the Kickapoo Tribe and Sac and Fox Nation.

- Approximately 21 miles of shared (with the Sac and Fox) water supply pipeline from the South Cedar Creek Water Treatment Plant to the distribution system connection to the intersection of K-20 and Highway 75.

- Approximately 5 miles of treated water supply pipeline from K-20 and Highway 75 to the distribution system connection within the Kickapoo Reservation.

- Construction of 0.91 million gallons of storage tank capacity.

Sac and Fox (South).—

- A treated water pump station, sized at 603 gpm, directs flow northward for the Sac and Fox southern development and Kickapoo. This pump station is assumed to be operated and shared by the Sac and Fox and Kickapoo.

- Approximately 21 miles of shared (with the Kickapoo) water supply pipeline from the South Cedar Creek Water Treatment Plant to the distribution system connection to the intersection of K-20 and Highway 75.

- A 90 gpm treated water pump station.

- Approximately 2.25 miles of treated water supply pipeline from the intersection of K-20 and Highway 75 to the Sac and Fox's southern development.

- Construction of 0.6 million gallons of storage tank capacity.

- Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Brown County RWD No. 2.

Banner Creek Reservoir

This alternative assumes that the Tribe/Nations arrange for the acquisition of 972 acre-feet per year of water from Banner Creek Reservoir.

Common among the Tribe/Nations.—

- Construction and operation of a 1.7 mgd water treatment plant located at Banner Creek Reservoir. This plant is assumed to be jointly operated by the three Tribal entities.
- A 1,203 treated water pump station.
- Approximately 1 mile of treated water supply pipeline from the proposed Banner Creek Water Treatment Plant to the intersection of K-16 and Highway 75.

The following presents the infrastructure needs for each Tribe for the Banner Creek Reservoir alternative.

Potawatomi.—

- A 600-gpm treated water pump station located at the intersection of K-16 and Highway 75.
- Approximately 8 miles of treated water supply pipeline from the intersection of K-16 and Highway 75 to the north booster station on the reservation.
- Construction of 1.23 million gallons of storage tank capacity.
- Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Jackson County RWD No. 1 or Jackson County RWD No. 3.

Kickapoo.—

- A treated water pump station, sized at 603 gpm, directs flow northward for the Kickapoo and Sac and Fox (south) from the intersection of K-16 and

Highway 75 to storage near the Kickapoo and Sac and Fox Reservations. This pump station is assumed to be operated and shared by the Kickapoo Tribe and Sac and Fox Nation.

- Approximately 14.25 miles of shared (with the Sac and Fox) water supply pipeline from the intersection of K-16 and Hwy. 75 to the intersection of K-20 and Highway 75.

- Approximately 5 miles of treated water supply pipeline from K-20 and Highway 75 to the distribution system connection within the Kickapoo Reservation.

- Construction of 0.91 million gallons of storage tank capacity.

Sac and Fox (South).—

- A treated water pump station, sized at 603 gpm, directs flow northward for the Kickapoo and Sac and Fox (south) from the intersection of K-16 and Highway 75 to storage near the Sac and Fox and Kickapoo Reservations. This pump station is assumed to be operated and shared by the Sac and Fox Nation and Kickapoo Tribe.

- Approximately 14.25 miles of shared (with the Kickapoo) water supply pipeline from the intersection of K-16 and Highway 75 to the intersection of K-20 and Highway 75.

- Approximately 2.25 miles of treated water supply pipeline from the intersection of K-20 and Highway 75 to the Sac and Fox's southern development.

- Construction of 0.6 million gallons of storage tank capacity

Hiawatha Wells

This alternative assumes that the Tribe/Nations arrange for the acquisition of 972 acre-feet of water per year from Brown Co. RWD No. 2 and 29 acre-feet of water per year from the City of Hiawatha.

The source for water for all areas south of the Hiawatha wells was chosen to be the distribution system connection for Brown Co. RWD No. 2 near their water tank. This saves the 14 miles of water pipeline that would be needed to connect directly to the Hiawatha wells or the 10 miles of pipeline to connect to the city center. The water tank should provide sufficient head to convey water to the distribution system connection on the Kickapoo Reservation. Brown Co. RWD No. 2 is also likely to have a higher priority over water allocation, which would be significant during periods of water shortage.

The source of water for all areas north of the Hiawatha wells (the Sac and Fox Reservation) was chosen to be the Hiawatha well field. The city of Hiawatha treats its water 2 miles south of the well field. It was determined that it would be less costly to chlorinate the water at the well field than to install 2 miles of additional pipe to the Hiawatha chlorination facility.

Common among the Tribe/Nations.—

- ❑ Approximately 7 miles of pipeline constructed from the Brown Co. RWD No. 2 distribution system connection point to the distribution system connection point on the Kickapoo reservation.

- ❑ Construction of a 1.7 mgd advanced water treatment plant for nitrate and organic chemical removal (assumes source water quality degrades over time to exceeding drinking water standards and that the city of Hiawatha treats the water before distributing to Brown Co. RWD No. 2).

The following are additional required infrastructure each Tribe/Nation will need to operate their own water supply and distribution system for year 2040 when converting to the Hiawatha Well Alternative:

Potawatomi.—

- ❑ A shared treated water pump station sized for 690 gpm for the Potawatomi and Sac and Fox (south) Nations..

- ❑ Approximately 3 miles of shared (with the Sac and Fox) water supply pipeline and an additional 24 miles of water supply pipeline from the junction point 2 miles north of K-20 on Highway 75 to the north booster station on the Tribal reservation.

- A 600-gpm treated water pump station.
- Construction of 1.23 million gallons of storage tank capacity.
- Acquisition of existing distribution piping and appurtenances within the reservation boundary and currently owned by Jackson County RWD No. 1 or Jackson County RWD No. 3.

Kickapoo.—

- Construction of 0.91 million gallons of storage tank capacity.

Sac and Fox (South).—

- A treated water pump station sized at 690 gpm and shared with the Potawatomi.
- Approximately 3 miles of shared (with the Potawatomi) water supply pipeline and an additional 0.25 mile of water supply pipeline from the junction point 2 miles north of Highway K-20 on Highway 75 to the casino.
- Construction of 0.6 million gallons of storage tank capacity.

Sac and Fox (North).—

- Construction and operation of a 0.05 mgd (36 gpm) chlorination facility at the Hiawatha well field.
- A 36-gpm treated water pump station.
- Approximately 7.5 miles of water supply pipeline from the Hiawatha well field to the Red Earth subdivision.
- Construction of 0.2 million gallons of storage tank capacity.
- Acquisition of existing distribution piping and appurtenances currently owned by Richardson County RWD No. 2.

- Potential construction of a 0.05 mgd (36 gpm) treatment plant for nitrate and organic chemical removal if source water quality degrades over time to exceed drinking water standards. However, it is likely that the city of Hiawatha will treat the water if there are any problems in the future. This treated water could be accessed by extending the feed water pipeline 2 miles further south.

Construction Costs of Multi-Tribal Water Supply Alternatives

General

Cost estimates (at appraisal or sub-appraisal level, depending on the amount of information available) are provided for major system components. At this level of study, these estimates are adequate to determine that a workable system could be developed, are accurate to ±40 percent, and are useful only for general planning purposes.

Therefore, they were not and should not be applied on a per capita or individual household basis. Underlying assumptions used to formulate the estimates would have to be further refined to obtain greater accuracy.

An allowance of 5 percent and 15 percent of the estimated costs was included for contractor mobilization and unlisted items, respectively. A 25 percent contingency has been added for unforeseen changes in work scope that occur, and a 30 percent noncontract cost has been added. Noncontract costs include design data collection, design, contract administration, and construction management costs.

Specific Cost Assumptions and Component Costs

***Water Treatment*.**—Estimated capital cost for each water treatment plant for each multi-Tribal system is $1.2 million dollars. Costs include the major components of each plant: a prefabricated building, UF filter cleaning system, process tanks, UV disinfection, clearwell, and chloramination treatment system.

Pump Stations.—Table VI-8 provides an appraisal level description and cost for each raw water pump station. Pump stations costs include the costs for buildings and all equipment inside of the building including pumps, motors, and electrical equipment.

Table VI-8.—Diversion pump stations multi-Tribal options

Location	Flow (gpm)	Maximum TDH (feet)[1]	Estimated cost[2] ($)
Plum Creek to WTP	1,203	40	87,000
Perry Lake Alternative			
Perry Lake to pump station	1,203	300	645,000
Pumpstation to WTP	1,203	300	645,000
Kansas River/Shawnee Reservoir Alternative			
Reservoir to pump station	1,203	295	637,000
Pump station to WTP	1,203	290	629,000
Banner Creek Reservoir to WTP	1,203	40	87,000

Note: Power Source 460 VAC -3 phase.

[1] TDH, total dynamic head, rounded to nearest multiple of 5 feet.

[2] Costs rounded to nearest $1,000.

Table VI-9 provides the appraisal-level description and cost of each of the main treated water pump stations. Pump stations costs include the costs for buildings and all equipment inside of the building, including pumps, motors and electrical equipment.

Pipelines.—Costs for pipeline construction were calculated using data from the 2002 Cost Estimating Guides for Kansas Heavy Construction available at <www.get-a-quote.com>. Component costs are as follows:

- Pipe cover depth assumed to be 4 feet; trench width is pipe diameter plus 9 inches on both sides of the pipe, and 6 inches of sand bedding.
- Trenching 4 feet to 6 feet deep with a 1.5 cubic yard hydraulic excavator, excavated material piled on bank using a 1.5 CY hydraulic tractor excavator and small tools in medium soil.
- Backfill sand bedding in trenches, without compaction, using a 1.5 CY front-end crawler loader or small front end loader.
- Compaction in 6-inch (15 centimeters) layers using a compactor rammer with 13- by 11-inch shoe and small tools and air tamp by hand.

Table VI-9.—Treated water pump stations multi-Tribal alternatives

Location	Flow (gpm)	Maximum TDS (feet)[1]	Estimated cost[2]
Plum Creek Alternative			
WTP to distribution connection	513	95	86,000
WTP to casino	690	175	212,000
Casino junction to north booster	600	275	295,000
Perry Lake Alternative			
WTP to north booster	600	65	67,000
WTP to distribution connection	603/513	255	265,000
Highway 75 to casino	90	75	30,000
Kansas River/Shawnee Reservoir Alternative			
WTP to north booster	600	65	67,000
WTP to distribution connection	603/513	255	266,000
Highway 75 to casino	90	145	30,000
Banner Creek Reservoir Alternative			
WTP to I-75	1,203	140	301,000
Highway 75 to north booster	600	210	227,000
Highway 75 to distribution connection	603/513	205	208,000
Highway 75 to casino	90	75	30,000
Hiawatha Wells Alternative			
Distribution connection to casino	691	150	183,000
Casino to north booster	600	165	176,000
Hiawatha wells to Red Earth	36	45	30,000

Notes: Power Source 460 VAC - 3 phase.

[1] TDS, total dynamic head, rounded to nearest multiple of 5 feet.

[2] Costs rounded to nearest $1,000. Minimum pump station cost is $30,000.

- Ductile iron pipe — Mechanical joint ductile iron pipe, no fittings included, using a 20-ton hydraulic crane with 70-foot boom and small tools.
- 40 percent of total added for contractor overhead and profit.

Subappraisal Level Construction Cost Estimates

The subappraisal level construction cost estimates for the five multi-Tribal water supply options are presented below (table VI-10).

Table VI-10.—Summary of total construction cost by alternative

Joint Tribal alternatives	MT1 Plum Creek Reservoir	MT2 Perry Lake	MT3 Kansas River/ Shawnee Reservoir	MT4 Banner Creek Reservoir	MT5 Hiawatha Wells
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment	1,178,739	1,178,739	1,178,739	1,178,739	3,427,504
Pumping plants	679,846	1,652,491	1,629,191	766,512	388,998
Pipelines	3,856,889	7,650,518	7,326,170	4,397,685	5,988,295
Storage	3,425,000	3,425,000	3,425,000	3,425,000	3,425,000
Mobilization	457,024	695,337	677,955	488,397	661,490
Unlisted items	1,371,071	2,086,012	2,033,865	1,465,190	1,984,470
Contract cost[1]	**10,968,569**	**16,688,097**	**16,270,920**	**11,721,523**	**15,875,757**
Contingencies	2,742,142	4,172,024	4,067,730	2,930,381	3,968,939
Field cost[2]	**13,710,711**	**20,860,121**	**20,338,650**	**14,651,904**	**19,844,696**
Noncontract cost	4,113,213	6,258,036	6,101,595	4,395,571	5,953,409
Construction cost	**17,823,924**	**27,118,157**	**26,440,245**	**19,047,475**	**25,798,105**

[1] Subtotal of items above.
[2] Subtotal of contract cost plus contingencies.

Tables VI-11 through VI-15 present the total construction costs for each of the five water supply alternatives, respectively, and the individual Tribal cost shares in percent, based on all assumptions previously stated.

Table VI-11.—Approximate costs by Tribe/Nation for **MT1 Plum Creek Reservoir Alternative**

MT1 Plum Creek Reservoir	Total project	Potawatomi share (67%)	Kickapoo share (23%)	Sac and Fox share (10%)
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment	1,178,739	588,191	502,143	88,405
Pumping plants	679,846	522,984	122,759	34,103
Pipelines	3,856,889	3,521,953	305,661	29,275
Storage	3,425,000	1,537,825	1,137,100	750,075
Mobilization	457,024	308,548	103,383	45,093
Unlisted items	1,371,071	925,643	310,149	135,279
Contract cost[1]	**10,968,569**	**7,405,144**	**2,481,195**	**1,082,230**
Contingencies	2,742,142	1,851,286	620,299	270,558
Field cost[2]	**13,710,711**	**9,256,430**	**3,101,494**	**1,352,788**
Noncontract cost	4,113,213	2,776,929	930,448	405,836
Construction cost	**17,823,924**	**12,033,359**	**4,031,942**	**1,758,624**

Note: Dam and reservoir construction is not included.

[1] Subtotal of items above.

[2] Subtotal of contract cost plus contingencies.

Table VI-12.—Approximate costs by Tribe/Nation for **MT2 Perry Lake Alternative**

MT2 Perry Lake	Total project	Potawatomi share (35%)	Kickapoo share (51%)	Sac and Fox share (14%)
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment	1,178,739	588,191	502,143	88,405
Pumping plants	1,652,491	710,679	775,233	166,578
Pipelines	7,650,518	2,070,292	4,683,332	896,895
Storage	3,425,000	1,537,825	1,137,100	750,075
Mobilization	695,337	245,349	354,890	95098
Unlisted items	2,086,012	736,048	1,064,671	285,293
Contract cost[1]	**16,688,097**	**5,888,384**	**8,517,369**	**2,282,344**
Contingencies	4,172,024	1,472,096	2,129,342	570,586
Field cost[2]	**20,860,121**	**7,360,480**	**10,646,711**	**2,852,930**
Noncontract cost	6,258,036	2,208,144	3,194,013	855,879
Construction cost	**27,118,157**	**9,568,624**	**13,840,724**	**3,708,809**

[1] Subtotal of items above.

[2] Subtotal of contract cost plus contingencies.

Table VI-13.—Approximate costs by Tribe/Nation for **MT3 Kansas River/ Shawnee Reservoir Alternative**

MT3 Kansas River/ Shawnee Reservoir	Total project	Potawatomi share (35%)	Kickapoo share (52%)	Sac and Fox share (13%)
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment	1,178,739	588,191	502,143	88,405
Pumping plants	1,629,191	699,053	765,308	164,831
Pipelines	7,326,170	1,985,112	4,610,503	730,556
Storage	3,425,000	1,537,825	1,137,100	750,075
Mobilization	677,955	240,509	350,753	86,693
Unlisted items	2,033,865	721,527	1,052,258	260,080
Contract cost	**16,270,920**	**5,772,217**	**8,418,065**	**2,080,640**
Contingencies	4,067,730	1,443,054	2,104,516	520,160
Field cost	**20,338,650**	**7,215,271**	**10,522,581**	**2,600,800**
Noncontract cost	6,101,595	2,164,581	3,156,774	780,240
Construction cost	**26,440,245**	**9,379,852**	**13,679,355**	**3,381,040**

[1] Subtotal of items above.
[2] Subtotal of contract cost plus contingencies.

Table VI-14.—Approximate costs by Tribe/Nation for **MT4 Banner Creek Reservoir Alternative**

MT4 Banner Creek Reservoir	Total project	Potawatomi share (38%)	Kickapoo share (47%)	Sac and Fox share (15%)
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment	1,178,739	588,191	502,143	88,405
Pumping plants	766,512	377,196	305,465	83,852
Pipelines	4,397,685	1,166,670	2,684,748	546,266
Storage	3,425,000	1,537,825	1,137,100	750,075
Mobilization	488,397	183,494	231,473	73,430
Unlisted items	1,465,190	550,482	694,418	220,290
Contract cost[1]	**11,721,523**	**4,403,858**	**5,555,347**	**1,762,318**
Contingencies	2,930,381	1,100,965	1,388,837	440,580
Field cost[2]	**14,651,904**	**5,504,823**	**6,944,184**	**2,202,898**
Noncontract cost	4,395,571	1,651,447	2,083,255	660,869
Construction cost	**19,047,475**	**7,156,270**	**9,027,439**	**2,863,767**

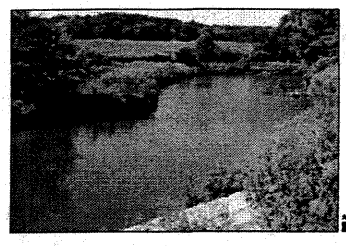
[1] Subtotal of items above.
[2] Subtotal of contract cost plus contingencies.

Table VI-15.—Approximate costs by Tribe/Nation for **MT5 Hiawatha Wells Alternative**

MT5 Hiawatha Wells	Total project	Potawatomi share (63%)	Kickapoo share (22%)	Sac and Fox share (15%)
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment (south)	3,152,032	1,572,864	1,342,766	236,402
Water treatment (north)	275,472			275,472
Pumping plants	388,998	335,254	0	53,744
Pipelines	5,988,295	4,868,105	409,317	710,873
Storage	3,425,000	1,537,825	1,137,100	750,075
Mobilization	661,490	415,702	144,459	101,328
Unlisted items	1,984,470	1,247,107	433,377	303,985
Contract cost[1]	15,875,757	9,976,857	3,467,019	2,431,879
Contingencies	3,968,939	2,494,214	866,755	607,970
Field cost[2]	**19,844,696**	**12,471,071**	**4,333,774**	**3,039,849**
Noncontract cost	5,953,409	3,741,321	1,300,132	911,955
Construction cost	**25,798,105**	**16,212,392**	**5,633,906**	**3,951,804**

[1] Subtotal of items above.

[2] Subtotal of contract cost plus contingencies.



CHAPTER VII – Conclusions and Recommendations

This joint Tribal water needs assessment was performed for the purpose of examining multi-Tribal water supply options available to the three Tribe/Nations. A brief assessment of the capability of each reservation to meet current and future water demands is presented. Only existing data, personal communications, and information collected during a cursory field tour were used to support this work, which together with all assumptions made herein, generated the following conclusions:

Multi-Tribal

- Multi-Tribal alternative water supply solutions include Plum Creek Reservoir, Perry Lake, the Shawnee reservoir/Kansas river, Banner Creek Reservoir, and the City of Hiawatha well field. Construction costs for these alternatives range from $17.8 M dollars to $27.1 M dollars +/- 40 percent.

- The Plum Creek Reservoir alternative, at $17.8 M dollars, is the least costly alternative while the Perry Lake alternative, at $27.1M dollars had the highest construction costs.

- High cost estimates for all five multi-Tribal water supply options reflect long lengths of water transmission lines. The most economical solution for each Tribe may not involve a single water source serving all the Tribe/Nations.

- None of the Reservation communities have a formalized water conservation plan. It has been demonstrated that 10 to 20 percent water savings can accrue from a properly conceived and implemented water conservation program.

- If criteria used to assess water quality are predicated on compliance with the Surface Water Treatment Rule of the Clean Water Act, the four surface water alternative solutions would include a water treatment plant using filtration and disinfection.

Kickapoo Tribe in Kansas

- The current source of water supply, the Delaware River, and the existing river impoundment, are unreliable and undersized, respectively, to provide adequate water supplies for current water demands.
- The least costly multi-Tribal option of water supply for this Tribe is the Plum Creek Reservoir at $4.03 M dollars +/- 40 percent.
- The current water treatment plant has sufficient capacity to meet the maximum day water demands of the Tribe to 2010. However, operational procedures paid to some of the water treatment plant equipment, the routine operation and maintenance (O&M) procedures, and the resources available to the O&M staff, all the subject of an earlier Reclamation report, were found to require increased attention to lower costs and provide efficient and reliable safe drinking water. This recommendation is heightened by the fact that in drought years the stream water quality degrades and the likelihood of further violation of the SDWA increases.
- Storage of potable water is currently inadequate by 285,000 gallons. This deficit increases to an additional 625,000 gallons by 2040.
- Either the per capita water use is excessive or the water distribution system has a high amount of leakage. A leakage detection and pipe replacement program is recommended.
- The ability of the water distribution system for firefighting is inconclusive.

Prairie Band Potawatomi Nation

- The least costly multi-Tribal option of water supply for this Nation is the Banner Creek Reservoir at $7.2 M dollars +/- 40 percent.
- Surface and groundwater resources within the reservation appear inadequate in terms of quantity and quality to meet current and future water demands.
- Storage of potable water is currently inadequate by 597,000 gallons. This deficit increases to an additional 635,000 gallons by 2040.
- The water distribution system is inadequately sized for firefighting.

Sac and Fox Nation of Missouri

- The Sac and Fox Nation of Missouri borders the Big Nemaha River, and therefore may pursue development for its own water supply from that source.
- The least costly multi-Tribal option of water supply for this Nation's southern development is the Plum Creek Reservoir at $1.7 M dollars +/- 40 percent.
- For the Sac and Fox north area, storage of potable water is currently inadequate by about 184,384 gallons. This deficit increases by an additional 2,200 gallons by 2040. The small increase in storage needs from today to 2040 is proportional to the population increase over the same time period.
- For the Sac and Fox south area, storage of potable water is currently inadequate by 546,519 gallons. This deficit increases by an additional 10,000 gallons by 2040.
- Since the incremental storage requirement between current and year 2040 is small, the initial expansion is recommended to be sized for the year 2040 storage need.

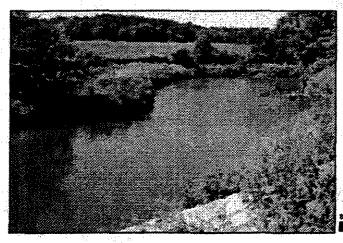
Recommendations

Each Tribal Council should review the findings and conclusions noted in this report. Consideration should be given to the total cost of delivered water for the multi-Tribal solutions identified, versus other non-multi-Tribal solutions.

The Kickapoo Tribe in Kansas, the Prairie Band Potawatomi Nation, and the Sac and Fox Nation of Missouri should all adopt water conservation and reuse plans to reduce potable water demands.

The water distribution system serving the Kickapoo Tribe in Kansas is recommended to be evaluated for its capability to deliver fire flow and to quantify and possibly reduce leakage.

Collaboration with the State of Kansas is recommended since some of the water supply alternatives of this report may also be sources of raw water for other communities in the region.



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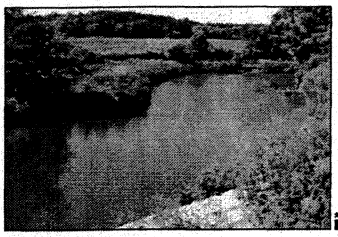
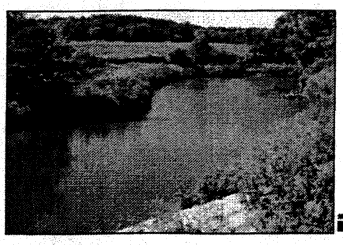


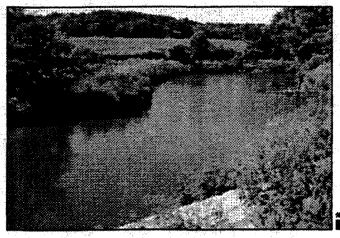
ATTACHMENTS

A	Social and Economic Technical Data
B	Site Plans
C	Pipe Flow and Size Calculations
D	Off-Reservation Water Source Options



ATTACHMENT A

Social and Economic Technical Data



ATTACHMENT A – Social and Economic Technical Data

Population Estimates for the Three Indian Reservations

Accurate population projections are difficult to obtain for Indian reservations due to difficulties in counting all residents, different definitions used to estimate population size, and other factors. As a first step, population estimates were obtained from U.S. Census data. U.S. Census population estimates for each of the three reservations included in this assessment are presented in table A-1.

Table A-1.—Census estimates of reservation population

Reservation	1980	1990	2000
Kickapoo	461	478	[1]783
Potawatomi	985	1,082	1,238
Sac and Fox	114	209	217

[1] This estimate is not the 2000 U.S. Census estimate for the Kickapoo Reservation, but is instead the estimate for the Powhattan Township, Brown County, Kansas, minus the population of the town of Powhattan, which lies outside the reservation as defined in previous U.S. Census estimates. The published 2000 U.S. Census estimate for the Kickapoo Reservation is 4,419 people, which is not comparable to previous U.S. Census estimates.

Additional population data were obtained from the Bureau of Indian Affairs (BIA) and the Mni Sose Intertribal Water Rights Coalition (Coalition), Inc. The BIA estimates represent 1995 Service area Indian resident service populations, and the Coalition data represent Tribal members living on reservations in 1996. These data are presented in table A-2.

The estimates presented in table A-2 may not be representative of reservation populations for two primary reasons. First, table A-2 represents only the Indian population. Second, the population numbers represent people who live on or near the reservation or are within an area that depends on each respective reservation for services. As a result, the estimates in table A-2 will tend to overestimate the Indian population on the reservation. However, the Coalition estimates of people on or near the reservation may be a better indicator of water supply demands as they relate to the reservation.

Table A-2.—BIA and Mni Sose Intertribal Water Rights Coalition estimates of Tribal member population on reservations

Reservation	BIA estimates of Indian service population on the reservation	Mni Sose Intertribal Water Rights Coalition estimates of Tribal members on the reservation
Kickapoo	822	783
Prairie Band Potawatomi	1,702	905
Sac and Fox	200	55

One possible method for trying to obtain representative estimates of the current population of the three reservations included in this assessment is to add the U.S. Census estimates of non-Indian reservation population to estimates of Indian populations in or near reservations.

Estimated Current Population of Each Reservation

Current population estimates from which base level water demands can be estimated are presented below in table A-3 (each estimate is rounded to the nearest five people). The BIA service area populations were not used as the basis for estimating current population because the service area population could not encompass an area that is much larger than the reservation. The Coalition estimates appear to include an area that is closer to the reservation.

Table A-3.—Estimated current reservation population

Reservation	Estimated current population
Kickapoo	1,115
Potawatomi	1,625
Sac and Fox	220

Population Projections

Kansas Water Office Projections.—Population projections are not available for the three Indian Reservations included in this needs assessment. However, population projections are available by county, municipality, and water service provider from the Kansas Water Office. Until recently, official Kansas population projections were provided by the Kansas Division of the Budget. The Kansas

Division of the Budget now depends on the Kansas Water Office for projections. The Kansas Water Office estimates of future population appear to be based on projections of the number of future water connections, which can then be translated into population estimates. Assumptions are made about the number of people associated with each connection now and in the future.

A paper presented at the 1999 U.S. Census Bureau Population Estimates Methods Conference indicated that data sources include: 1980 and 1990 Decennial Census counts, U.S. Census Bureau interim population estimates, time series data of active residential water service connections from public water suppliers, and on-site interviews with local government officials and other groups. In addition, all public water suppliers in Kansas were contacted for input on perceived changes in population, water use, and water demand in local communities and rural areas. The projections are based on a linear regression (fitting a straight line to the data) and are subject to the constraint that no city or county population could decline by more than 10.0 percent per decade. Population projections for Brown and Jackson Counties are shown below along with the 2000 Census count. Kansas Water Office population projections for Brown County and Jackson County are presented in table A-4.

Table A-4.—Kansas Water Office population projections and 2000 U.S. Census estimates

Year	Brown County	Jackson County
2000 U.S. Census	10,274	12,657
2000	10,901	13,161
2010	10,722	14,793
2020	10,542	16,426
2030	10,362	18,058
2040	10,183	19,691

Using the number of connections to public water suppliers as an explanatory variable to predict population growth can potentially lead to an over-estimation of population if a significant number of households are switching from individual water supplies (for example individual groundwater wells) to public systems. This will tend to overstate growth in the number of people in the area where the public system is located. In addition, the assumptions used for the number of people per connection can have a large impact on population estimates. Lastly, it is not unusual for local water suppliers and utility personnel to indicate that they are expecting high levels of growth based on very localized anecdotal evidence or hopes for the future. As a result, using data from on-site interviews could also skew projections higher than

would otherwise be expected. Comparing the Kansas Water Office Projections with the 2000 Census estimates indicates the Kansas Water Office overestimated population for both Brown and Jackson Counties.

Other Possible Projection Techniques.—In previous work for the Prairie Band Potawatomi (U.S. Department of the Interior, Bureau of Reclamation [Reclamation], June 2000), a simplified cohort-component model was developed to project future population for Jackson County (a cohort represents a group of individuals having a specific factor [for example age] in common). The cohort-component method involves separating the population under consideration into cohorts, looking at the demographic components of each cohort, and projecting the population of each cohort into the future in discrete intervals. The demographic components included birth rates, death rates, and migration rates. The projections from this work for Jackson County are shown in table A-5.

Table A-5.—Population projections for Jackson County from the 2000 Reclamation report

Year	Jackson County total
2000	11,750
2010	12,050
2020	12,520
2030	12,970
2040	13,310

Based on 2000 Census data, it is clear that this technique under-estimated Jackson County population for the year 2000. The most likely source of error is in the assumption for immigration rates. As a follow-up, the net in-migration rate can be changed so the year 2000 projection matches the 2000 Census estimate. This can then be used to project out to 2040. The results using this adjustment are shown in table A-6.

Population growth patterns can also be projected into the future based on trends from the past. Although trend analysis is simplistic and does not account for changes that may occur in basic demographic relationships, the technique can be used in situations where there is a well defined and stable history of growth or decline. The trend analysis technique can also be used as a basis for assessing population projections based on other techniques. Census population estimates for Brown and Jackson Counties from 1950 to 2000 are shown in table A-7.

Table A-6.—Population projections based on the cohort-component model with modified immigration assumptions to match 2000 U.S. Census estimates

Year	Jackson County total
2000	12,643
2010	13,954
2020	15,490
2030	16,598
2040	17,529

Table A-7.—Brown County and Jackson County, Kansas, U.S. Census estimates

Year	Brown County total	Jackson County total
1950	14,651	11,098
1960	13,229	10,309
1970	11,685	10,342
1980	11,955	11,644
1990	11,128	11,525
2000	10,724	12,657

Using the data presented in table A-7, two different sets of trend analysis estimates were derived. One set used 10-year incremental data from 1950 to 2000 and the second used annual data from 1970 to 2000. The time period from 1950 to 1970 showed a substantial decrease in population which may not be applicable to the current condition. Therefore, only the models using 1970 to 2000 data are presented here. Two different functional forms were used, a linear model which simply assumes a straight line and a semi-log form which represents a curved path of change over time. The trend analysis results are presented in table A-8.

The county population can also be divided into separate urban and rural components. Additional regressions were run on the urban and rural populations separately. These results are shown in table A-9.

Population Projections for the General Study Area.—All of the trend analysis projections for Brown County show a generally decreasing population trend regardless of the technique used. The Kansas Water Office showed the same trend,

Table A-8.—Ordinary least square population projections based on 1970 to 2000 annual data

Year	Brown County linear estimate	Jackson County linear estimate	Brown County semi-log estimate	Jackson County semi-log estimate
2000	10,724 (U.S. Census)	12,657 (U.S. Census)	10,724	12,657
2010	10,486	12,661	10,512	12,724
2020	10,139	13,155	10,196	13,288
2030	9,793	13,649	9,889	13,877
2040	9,446	14,142	9,592	14,493

Table A-9.—Ordinary least square regression estimate using 1970 to 2000 data and separate data for urban and rural populations

Year	Brown County total	Jackson County total	Brown County rural	Brown County urban	Jackson County rural	Jackson County urban
Linear						
2010	10,445	13,248	3,536	6,909	3,420	9,828
2020	10,074	13,931	3,541	6,533	3,514	10,417
2030	9,703	14,614	3,547	6,157	3,608	11,005
2040	9,332	15,296	3,552	5,781	3,702	11,594
Semi-log						
2010	10,485	13,377	3,536	6,949	3,426	9,951
2020	10,165	14,216	3,542	6,623	3,528	10,687
2030	9,860	15,111	3,548	6,311	3,633	11,478
2040	9,569	16,069	3,555	6,015	3,742	12,327

only with a slightly lesser decrease. As a result, the Kansas Water Office projections (table A-10) are considered to be a good representation of future population levels for Brown County.

Kansas Water Office projections for Jackson County appeared high compared to the trend analysis, which included the most recent 2000 data available. Therefore, the modified cohort-component based projections (table A-6) are considered to be the most representative of future growth for Jackson County.

These county-level projections are important to this assessment because they are indicative of the levels of growth or decline in the general area of the three reservations. The county-level projections can be used to help predict future growth on each reservation.

Population Projections for Each Reservation.—The Potawatomi Reservation population projection technique from the 2000 Bureau of Reclamation report is used, except the projections were modified to match the estimated current reservation population. This is the same technique as was used to modify population projections for all of Jackson County.

The population of the Kickapoo Reservation was projected to grow by a relatively small rate of 4 percent every 10 years. This is based on the change in the population of the reservation from 1980 and 1990 as estimated by the U.S. Census (2000 data were not comparable to previous years, as stated earlier) and from the slightly decreasing population for Brown County. Most of the population increase is assumed to be Tribal members moving into the area. The rate of growth could be higher if more housing becomes available.

The population of the Sac and Fox Reservation was projected to remain fairly stable based on the very small change estimated by the U.S. Census from 1990 to 2000 and the small population estimated by both the BIA and the Coalition. In addition, the Sac and Fox Reservation is located primarily in Brown County, which has a projected decrease in population.

The estimated current and future population of each Reservation is presented in table A-10.

Table A-10.—Estimated current reservation population and population projections

Reservation	Estimated current population	2010	2020	2030	2040
Kickapoo	1,115	1,160	1,210	1,260	1,310
Potawatomi	1,625	1,935	2,255	2,585	2,935
Sac and Fox	220	240	260	280	300

Economic Development and Growth

The R-squared statistic presented in table A-11 can be interpreted as the percentage of the variation in employment and number of establishments explained by the model. An R-squared of 1.0 would mean that model explains all of the variation in employment and number of establishments while an R-squared of 0.0 indicates the model explains none of the variation. The estimated coefficient indicates the annual

change in employment and number of establishments predicted by the model and the t-statistic is a measure of statistical significance for the estimated coefficient. Higher t-statistics indicate greater levels of statistical significance

Table A-11.—Regression results for employment and total number of establishments for all sectors

Model attribute	Brown County employment	Jackson County employment	Number of Brown County establishments	Number of Jackson County establishments
Constant	2,175.02	1,022.51	284.94	188.21
R-squared	0.62	0.63	0.0004	0.82
Coefficient	52.32	38.26	0.0363	3.58
t-statistic	[1]2.57	[1]2.63	0.04	[1]4.31

[1] Indicates statistical significance at the 95 percent level of confidence.

The results presented in table A-11 indicate that there has been overall positive growth in employment and the number of commercial establishments in the larger region that includes the study area. However, table A-11 does not address which sectors have contributed most to this growth. A regression trend analysis was performed for the retail, services, finance, and manufacturing sectors separately to determine which individual sectors have shown significant rates of growth. The results are presented in table A-12.

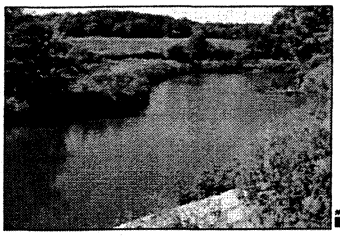
The regression results in table A-12 indicate a consistent increase in services and finance, except for employment in the finance sector for Jackson County. Retail employment has increased at a significant rate for both Brown and Jackson Counties from 1977 to 1997, while the number of retail establishments has decreased at a significant rate for Brown County and at a statistically insignificant rate for Jackson County.

Manufacturing employment and the number of manufacturing establishments has not changed significantly from 1977 to 1997 for either county. Employment and the number of establishments for all types of businesses have increased at a significant positive rate for both counties. Analysis indicates that for the general two-county area there has been significant growth in commercial activity. However, this growth has not occurred in the manufacturing sector, the agricultural services sector, or the food-manufacturing sector.

Table A-12.—Results of statistical analysis of county business trends from 1977 to 1997

Model attribute	Brown County employment	Jackson County employment	Number of Brown County establishments	Number of Jackson County establishments
Retail				
Constant	421.37	392.67	81.32	73.69
R squared	0.61	0.68	0.64	0.41
Coefficient	8.24	10.91	-0.92	-0.556
t-statistic	[1]2.48	[1]2.90	[1]-2.70	-1.68
Services				
Constant	490.86	109.18	72.48	28.04
R squared	0.77	0.73	0.92	0.91
Coefficient	42.89	20.25	1.29	2.43
t-statistic	[1]3.63	[1]3.27	[1]6.84	[1]6.49
Finance				
Constant	144.35	47.38	20.61	11.63
R squared	0.06	0.90	0.70	0.76
Coefficient	2.48	4.69	0.37	0.48
t-statistic	0.51	[1]5.89	[1]3.03	[1]3.53
Manufacturing				
Constant	599.94	72.47	14.70	7.20
R squared	0.195	0.106	0.166	0.26
Coefficient	6.328	3.987	0.105	0.074
t-statistic	0.985	0.688	0.892	1.179

[1] Indicates statistical significance at the 95 percent level of confidence.



ATTACHMENT B

Site Plans

Figure 1 Existing Service Area

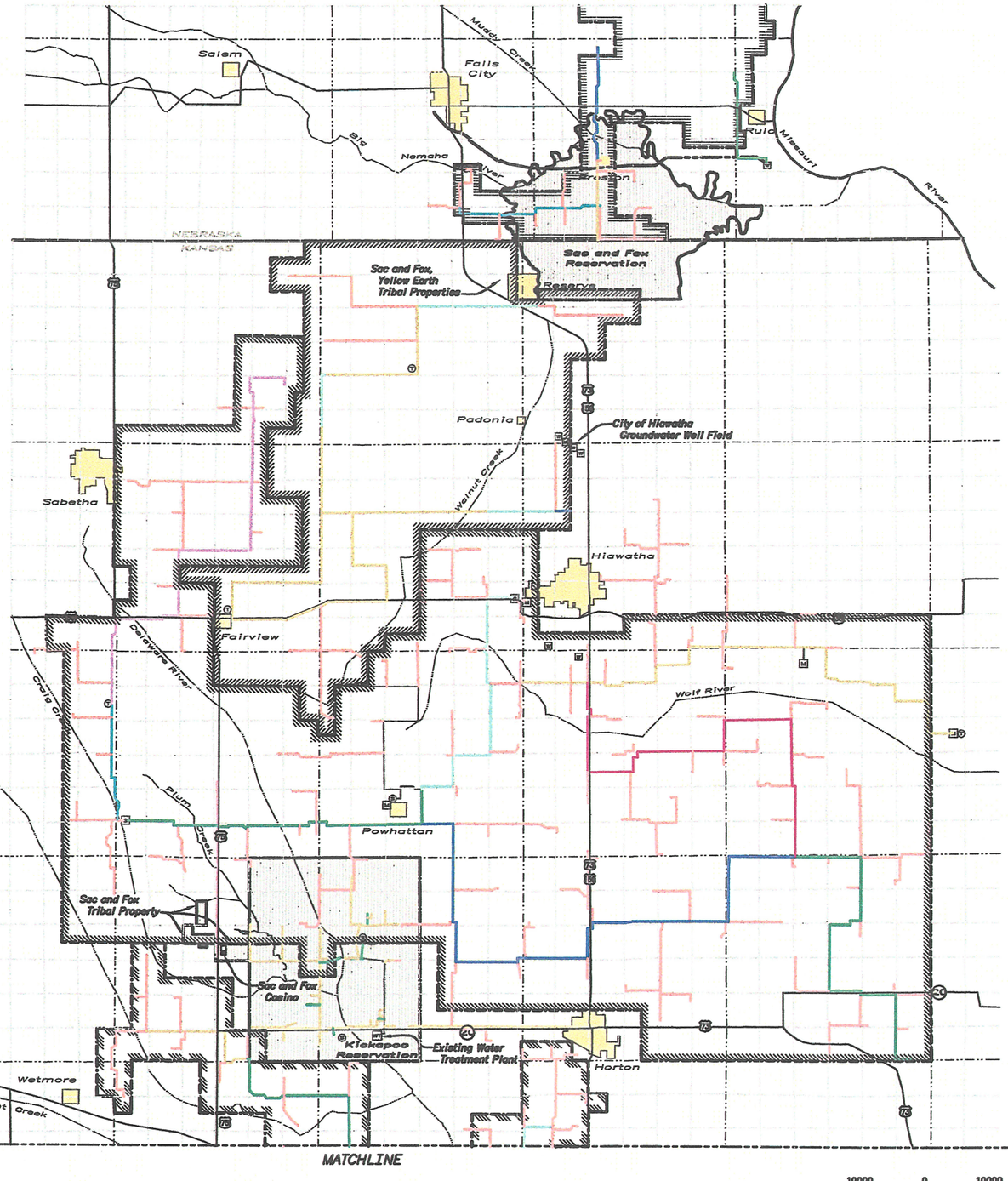
Figure 2 Multi Tribal Water Supply Alternatives

Figure 3 Kickapoo Tribe Water Supply Alternatives

Figure 4 Prairie Band of the Potawatomi Tribe Water Supply Alternatives

Figure 5 Sac and Fox Nation of Missouri Water Supply Alternatives

FIGURE 1



LEGEND

- WT — Water Treatment Plant
- M — Meter
- W — Well
- B — Booster
- T — Tank
- S — Stand Pipe
- 2" and below
- 3" pipe
- 3.5" pipe
- 4" pipe
- 5" pipe
- 6" pipe
- 8" pipe
- 10" pipe
- 12" pipe
- Reservation
- Rural Water District Richardson County, NE No.2
- Rural Water District Brown County, KS No.1
- Rural Water District Brown County, KS No.2
- Rural Water District Jackson County, KS No.1
- Rural Water District Jackson County, KS No.2
- Rural Water District Jackson County, KS No.3

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AUGUST 23, 2002

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KANSAS AND NEBRASKA

EXISTING SERVICE AREA

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA
DRAWN J. AXIELL/R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH GROUP

CADD SYSTEM AutoCAD Rel. 15.0 DENVER, COLORADO
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FIGURE 1

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FIGURE 1

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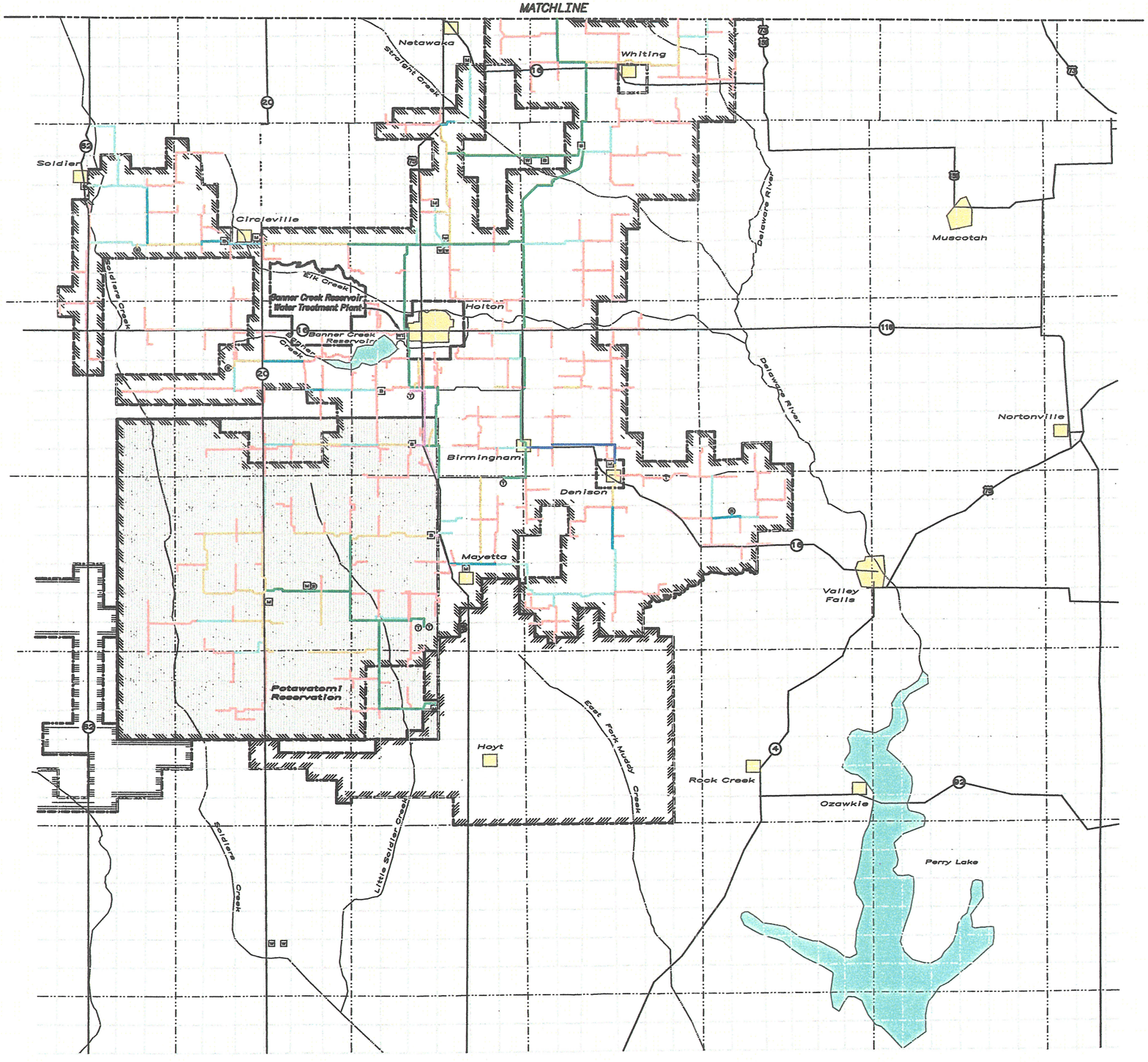

LEGEND

- WT Water Treatment Plant
- M Meter
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- T Tank
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- 2" and below
- 3" pipe
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- Rural Water District Brown County, KS No.1
- Rural Water District Brown County, KS No.2
- Rural Water District Jackson County, KS No.1
- Rural Water District Jackson County, KS No.2
- Rural Water District Jackson County, KS No.3

PRELIMINARY

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UNITED STATES
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BUREAU OF RECLAMATION

KANSAS AND NEBRASKA

EXISTING SERVICE AREA

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA

DRAWN J. AXTELL/R.D. RODRIGUEZ TECH. APPR.

APPROVED

WATER TREATMENT ENGINEERING AND RESEARCH GROUP

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DENVER, COLORADO	JUNE 28, 2002	FIGURE 1

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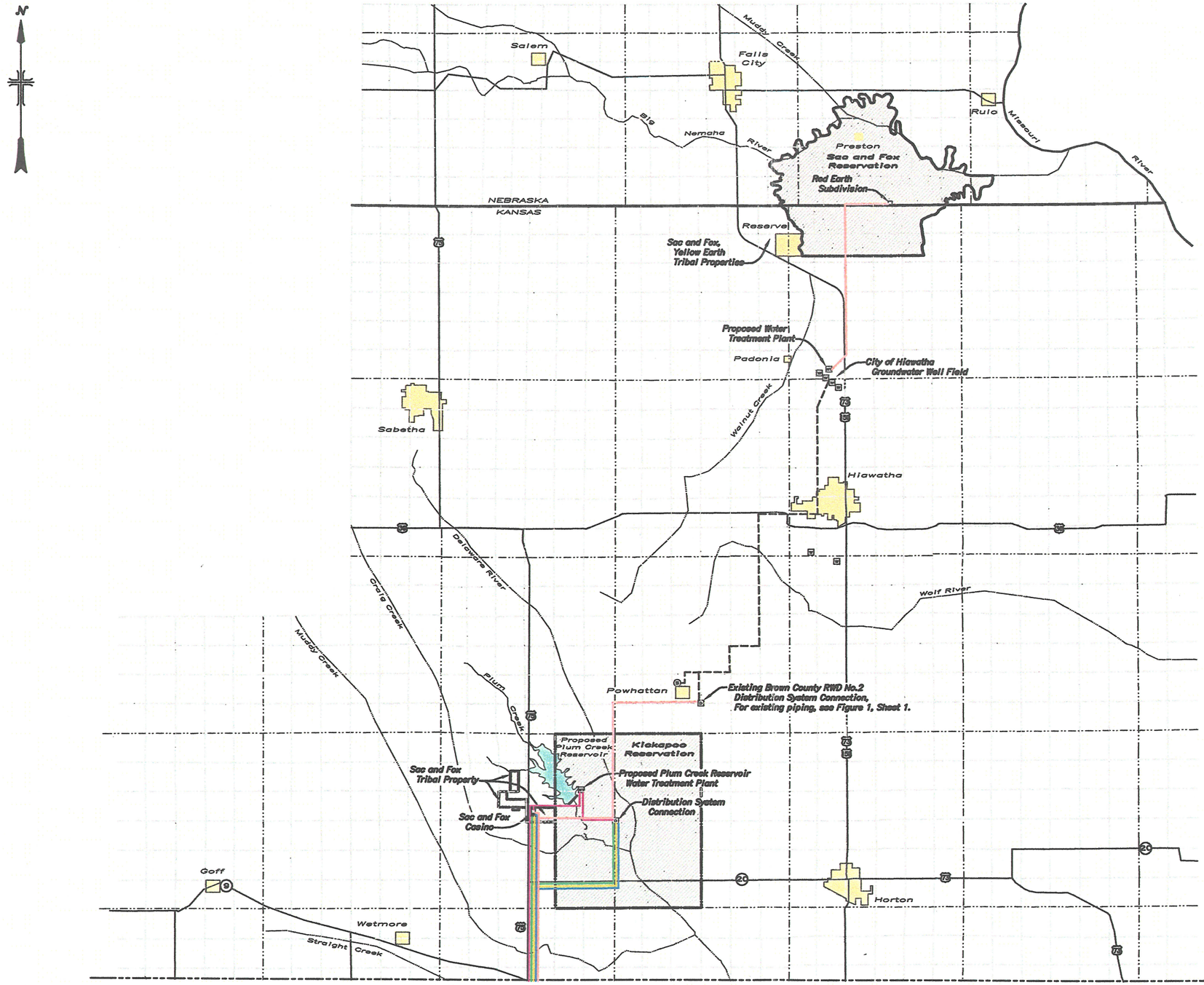
FIGURE 2



LEGEND

- WT — Water Treatment Plant
- W — Well — Groundwater
- D — Distribution System
- S — Storage Tank

Alternative MT1
- Potawatomi — Proposed Plum Creek Reservoir to North Booster Station.
- Kickapoo — Proposed Plum Creek Reservoir to Distribution System Connection.
- Sac & Fox — Proposed Plum Creek Reservoir to Sac & Fox Casino.

Alternative MT2
- Potawatomi — Perry Lake to North Booster Station
- Kickapoo — Perry Lake to Distribution System Connection.
- Sac & Fox — Perry Lake to Sac & Fox Casino.

Alternative MT3
- Potawatomi — Kansas River/Shawnee Reservoir to North Booster Station.
- Kickapoo — Kansas River/Shawnee Reservoir to Distribution System Connection.
- Sac & Fox — Kansas River/Shawnee Reservoir to Sac & Fox Casino.

Alternative MT4
- Potawatomi — Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to North Booster Station
- Kickapoo — Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to Distribution System Connection.
- Sac & Fox — Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to Sac & Fox Casino.

Alternative MT5
- Potawatomi — Brown County RWD No.2 Distribution System Connection to North Booster Station.
- Kickapoo — Brown County RWD No.2 Distribution System Connection to Distribution System Connection.
- Sac & Fox — City of Hiawatha Groundwater Wells to Red Earth Subdivision.
- — Brown County RWD No.2 Distribution System Connection to Sac & Fox Casino.

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DEPARTMENT OF THE INTERIOR
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KANSAS AND NEBRASKA

MULTI TRIBAL WATER SUPPLY ALTERNATIVES

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA

DRAWN R.D. RODRIGUEZ TECH. APPR.

APPROVED

WATER TREATMENT ENGINEERING AND RESEARCH GROUP

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AUGUST 28, 2002

SHEET 1 OF 2

FIGURE 2

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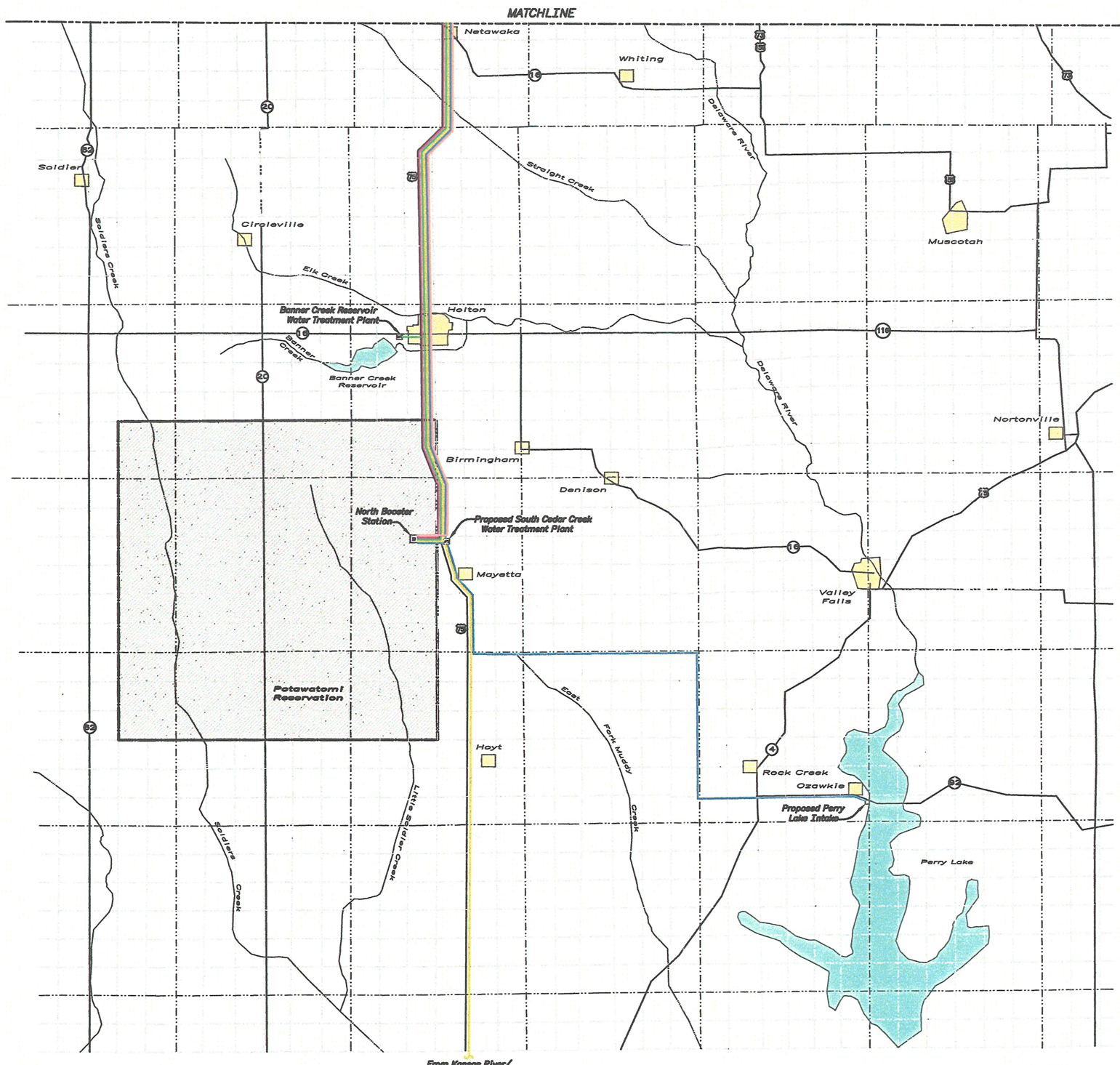
FIGURE 2



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Kickapoo — Kansas River/Shawnee Reservoir to Distribution System Connection.
Sac & Fox — Kansas River/Shawnee Reservoir to Sac & Fox Casino.

Alternative MT4
Potawatomi — Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to North Booster Station
Kickapoo — Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to Distribution System Connection.
Sac & Fox — Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to Sac & Fox Casino.

Alternative MT5
Potawatomi — Brown County RWD No.2 Distribution System Connection to North Booster Station.
Kickapoo — Brown County RWD No.2 Distribution System Connection to Distribution System Connection.
Sac & Fox — City of Hiawatha Groundwater Wells to Red Earth Subdivision.
— Brown County RWD No.2 Distribution System Connection to Sac & Fox Casino.

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KANSAS AND NEBRASKA

MULTI TRIBAL WATER SUPPLY ALTERNATIVES

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH GROUP

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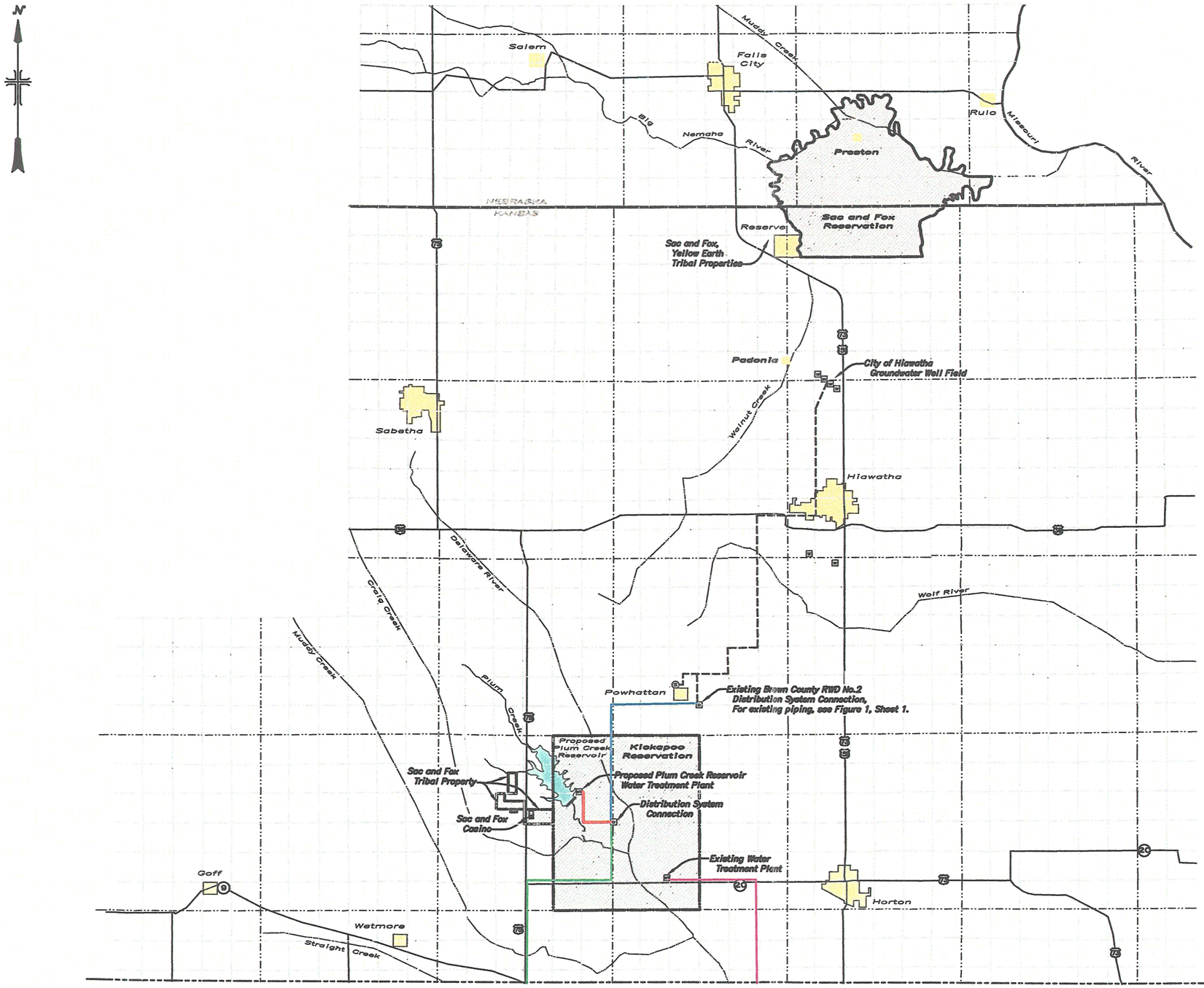
FIGURE 3



LEGEND

- WT — Water Treatment Plant
- W — Well — Groundwater
- D — Distribution System
- S — Storage Tank
- (Not Shown) — Alternative 1 — Existing conditions
- Alternative 2.1 — From Brown County RWD No.2 Distribution Connection System to Kickapoo Distribution Connection System.
- Alternative 2.2 — From Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to Kickapoo Distribution System Connection.
- Alternative 3 — From proposed Plum Creek Reservoir to Kickapoo Distribution System Connection.
- (Not Shown) — Alternative 4 — Pikitanoi Project.
- Alternative 5 — From Perry Lake Intake to existing WTP.
- Existing — Pipeline from City of Hiawatha groundwater wells to Brown County RWD No.2 Distribution System Connection.

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KANSAS

KICKAPOO TRIBE WATER SUPPLY ALTERNATIVES

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

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FIGURE 3

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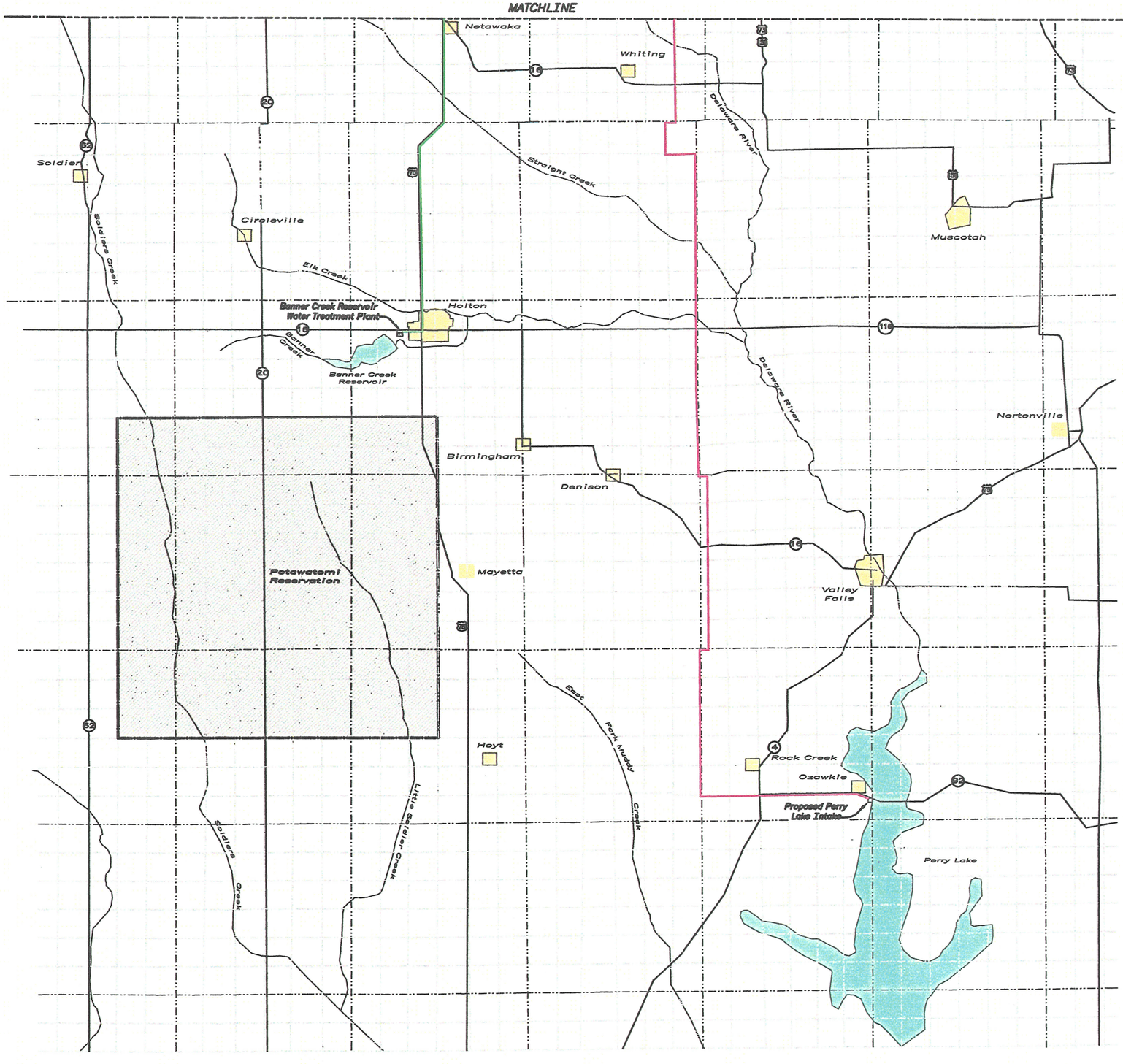
FIGURE 3

MATCHLINE



LEGEND

- WT — Water Treatment Plant
- W — Well – Groundwater
- D — Distribution System
- S — Storage Tank
- (Not Shown) — Alternative 1 – Existing conditions
- Alternative 2.1 – From Brown County RWD No. Distribution Connection Sys to Kickapoo Distribution Connection System.
- Alternative 2.2 – From Jackson County RWD No.3, City of Holton, Banner Creek Reservoir to Kickapoo Distribution System Connec
- Alternative 3 – From proposed Plum Creek Reservoir to Kickapoo Distribution System Connecti
- (Not Shown) — Alternative 4 – Pikitanoi Project.
- Alternative 5 – From Perry Lake Intake to existing WTP.
- Existing – Pipeline from City of Hiawatha groundwater wells to Brown Count RWD No.2 Distribution System Connection.

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

JULY 2, 2002

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KANSAS

KICKAPOO TRIBE
WATER SUPPLY ALTERNATIVES
JOINT TRIBAL NEEDS ASSESSMENT
SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH GROUP

CADD SYSTEM AutoCAD Rel. 15.0 DENVER, COLORADO
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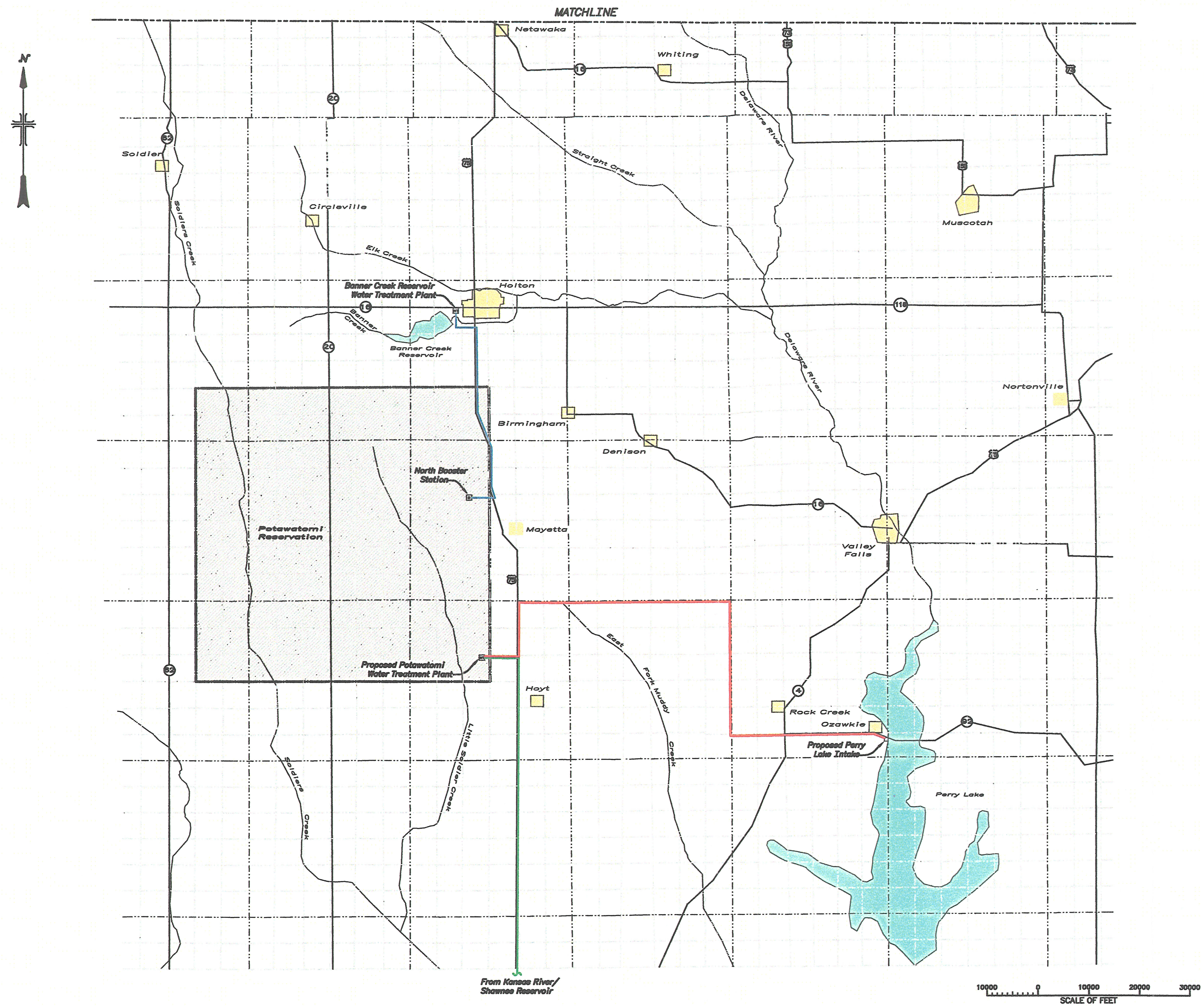
DATE AND TIME PLOTTED OCTOBER 15, 2002 13:0
JUNE 28, 2002
SHEET 2 OF 2
FIGURE 3

FIGURE 4



LEGEND

- WT Water Treatment Plant
- B Booster Station
- (Not Shown) Alternative 1 – Existing conditions
- Alternative 2 – From Jackson County RWD No.3 Banner Creek Reservoir to North Booster Station.
- Alternative 3 – From Perry Lake Intake to proposed Potawatomi WTP.
- (Not Shown) Alternative 4 – Pikitanoi Project.
- Alternative 5 – From Kansas River/Shawnee Reservoir to proposed Potawatomi WTP.

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

JULY 2, 2002

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KANSAS

PRAIRIE BAND OF THE POTAWATOMI TRIBE WATER SUPPLY ALTERNATIVES

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH GROUP

CADD SYSTEM AutoCAD Rel. 15.0	CADD FILENAME FIGURE4.DWG	DATE AND TIME PLOTTED OCTOBER 15, 2002 13:02
DENVER, COLORADO	JUNE 28, 2002	FIGURE 4

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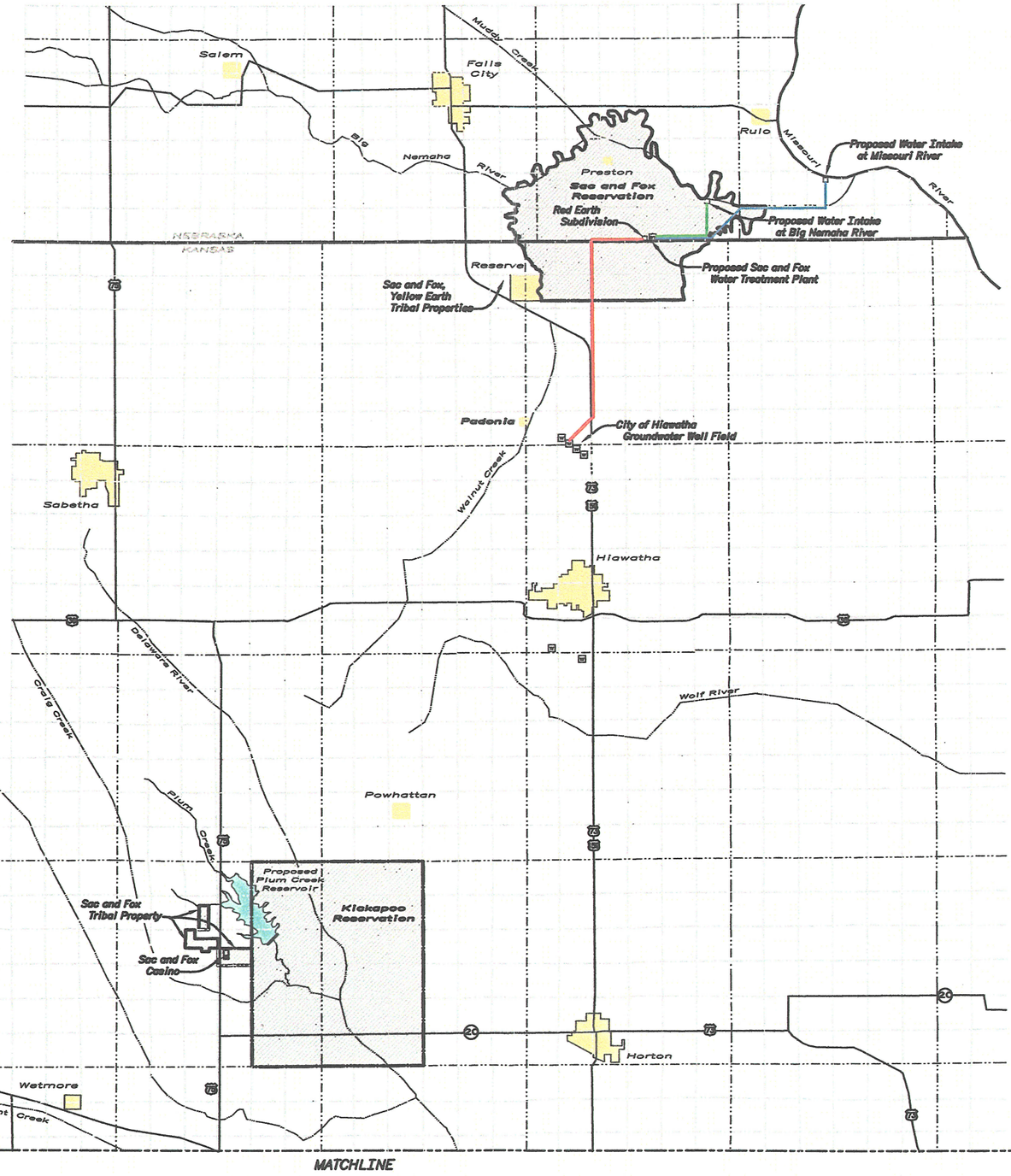
FIGURE 5



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SCALE OF FEET

LEGEND

- WT — Water Treatment Plant
- W — Well – Groundwater
- (Not Shown) — Alternative 1 – Existing conditions
- Alternative 2 – From Big Nemaha River Intake to proposed Sac and Fox WTP.
- Alternative 3 – From City of Hiawatha groundwater wells to Red Earth subdivision.
- Alternative 4 – From Missouri River Intake to proposed Sac and Fox WTP.

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

JULY 2, 2002

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
KANSAS AND NEBRASKA

SAC AND FOX NATION OF MISSOURI WATER SUPPLY ALTERNATIVES

JOINT TRIBAL NEEDS ASSESSMENT

SITE PLAN

DESIGNED S. DUNDORF CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED WATER TREATMENT ENGINEERING AND RESEARCH GROUP

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
AutoCAD Rel. 15.0 DENVER, COLORADO	FIGURE5.DWG JUNE 28, 2002	OCTOBER 15, 2002 13:03

FIGURE 5

RODRIGUEZ
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ATTACHMENT C

Pipe Flow and Size Calculations

1: Individual Tribal Alternatives - Pipe Flow and Size Calculations

2000 Population Flow Calculations			Average Daily Demand					Max Daily Demand [2]		
	Tribe	Population	capita per day [1] (gpcd)	Commercial / Casino (gpd)	Total (gpd)	Total (gpm)	Total (cfs)	Total (gpd)	Total (gpm)	Total (cfs)
	Potawatomi Nation	1,625	115	50,250	237,125	164.7	0.367	474,250	329.3	0.734
	Kickapoo Tribe	1,115	115	14,500	142,725	99.1	0.221	285,450	198.2	0.442
	Sac and Fox Nation (North)	150	115	0	17,250	12.0	0.027	34,500	24.0	0.053
	Sac and Fox Nation (South)	50	115	19,900	25,650	17.8	0.040	51,300	35.6	0.079
2020 Population Flow Calculations			**Average Daily Demand**					**Max Daily Demand [2]**		
	Tribe	**Population**	**capita per day [1] (gpcd)**	**Commercial / Casino (gpd)**	**Total (gpd)**	**Total (gpm)**	**Total (cfs)**	**Total (gpd)**	**Total (gpm)**	**Total (cfs)**
	Potawatomi Nation	2,250	115	94,750	353,500	245.5	0.547	707,000	491.0	1.094
	Kickapoo Tribe	1,210	115	218,400	357,550	248.3	0.553	715,100	496.6	1.106
	Sac and Fox Nation (North)	195	115	0	22,425	15.6	0.035	44,850	31.1	0.069
	Sac and Fox Nation (South)	65	115	56,470	63,945	44.4	0.099	127,890	88.8	0.198
2040 Population Flow Calculations			**Average Daily Demand**					**Max Daily Demand [2]**		
	Tribe	**Population**	**capita per day [1] (gpcd)**	**Commercial / Casino (gpd)**	**Total (gpd)**	**Total (gpm)**	**Total (cfs)**	**Total (gpd)**	**Total (gpm)**	**Total (cfs)**
	Potawatomi Nation	2,935	115	94,750	432,275	300.2	0.669	864,550	600.4	1.338
	Kickapoo Tribe	1,310	115	218,400	369,050	256.3	0.571	738,100	512.6	1.142
	Sac and Fox Nation (North)	225	115	0	25,875	18.0	0.040	51,750	35.9	0.080
	Sac and Fox Nation (South)	75	115	56,470	65,095	45.2	0.101	130,190	90.4	0.201

Notes

1 = includes residential water demands including uses by commercial and industrial concerns that are not large water users, on average day of average month.

2 = 2 x average daily demand

2: Individual Tribal Alternatives - Pipe Summary

Tribe	Alternative	Color [1]	Source	Destination	Pipeline Length (miles)	Pipe Size (in.)
Potawatomi	1	-	GW wells on reservation, combined with any of the other alternatives	-		
	2	Blue	Jackson County RWD # 3 Banner Creek Reservoir	North Booster Station	8.50	8
	3	Red	Perry Lake	Proposed Potawatomi WTP	22.25	12
	4	-	Pikitanoi Project	-		
	5	Green	Shawnee Reservoir / Kansas River	Proposed Potawatomi WTP	16.00	12
Kickapoo	1	-	Existing water supply on the reservation, combined with any of the other alternatives	-		
	2.1	Blue	Brown County RWD #2/City of Hiawatha – GW wells	Distribution System Connection	7.00	8
	2.2	Green	Jackson County RWD #3/City of Holton – Banner Creek Reservoir	Distribution System Connection	21.00	10
	3	Red	Proposed Plum Creek Reservoir	Distribution System Connection	2.75	6
	4	-	Pikitanoi Project	-		
	5	Magenta	Perry Lake	Existing WTP	41.00	6
Sac & Fox	1	-	Brown County RWD #1	Yellow Earth / Town of Reserve		
		-	Richardson County, NE RWD #2	Red Earth		
		-	Brown County RWD #3	Sac & Fox Casino		
	2	Green	Big Nemaha	Proposed Sac & Fox WTP	2.75	4
	3	Red	City of Hiawatha – GW wells	Red Earth	7.50	4
	4	Blue	Missouri River	Proposed Sac & Fox WTP	5.75	4

Notes

1 = Supply alternative color code for Site Plan maps of supply alternative layouts

.3: Individual Tribal Alternatives - Pipe Length, Elevation, Highway and Stream Crossings

Tribe	Alternative	Color [1]	Source	Destination	Pipeline Length (mi.)	Source Elev. (m.)	Destination Elev. (m.)	High Point (m.)	Low Point (m.)	Source Elev. (ft.)	Destination Elev. (ft.)	High Point (ft.)	Low Point (ft.)	Source / Destination Elev Dif. (ft.)	High / Low Pt. Elev Dif. (ft.)	# of Stream Crossings	# of Hwy. Crossings
Potawatomi	1	-	GW wells on reservation, combined with any of the other alternatives	-													
	2	Blue	Jackson County RWD # 3 Banner Creek Reservoir	North Booster Station	8.50	320	350	360	305	1050	1148	1181	1001	-98	180	4	0
	3	Red	Perry Lake	Proposed Potawatomi WTP	22.25	272	340	360	272	892	1115	1181	892	-223	289	8	2
	4	-	Pikitanoi Project	-													
	5	Green	Shawnee Reservoir / Kansas River	Proposed Potawatomi WTP	16.00	265	355	330	265	869	1165	1083	869	-295	213	6	1
Kickapoo	1	-	Existing water supply on the reservation, combined with any of the other alternatives	-													
	2.1	Blue	Brown County RWD #2/City of Hiawatha – GW wells	Distribution System Connection	7.00	-	300	365	300	1050	984	1198	984	66	213	13	2
	2.2	Green	Jackson County RWD #3/City of Holton – Banner Creek Reservoir	Distribution System Connection	21.00	320	330	355	310	1050	1083	1165	1017	-33	148	9	2
	3	Red	Proposed Plum Creek Reservoir	Distribution System Connection	2.75	320	330	330	310	1050	1083	1083	1017	-33	66	4	0
	4	-	Pikitanoi Project	-													
	5	Magenta	Perry Lake	Existing WTP	41.00	272	300	355	272	892	984	1165	892	-92	272	25	4
Sac & Fox	1	-	Brown County RWD #1	Yellow Earth / Town of Reserve													
		-	Richardson County, NE RWD #2	Red Earth													
		-	Brown County RWD #3	Sac & Fox Casino													
	2	Green	Big Nemaha	Proposed Sac & Fox WTP	2.75	260	290	290	260	853	951	951	853	-98	98	1	0
	3	Red	City of Hiawatha – GW wells	Red Earth - Distribution System	7.50	-	290	335	290	1050	951	1099	951	99	148	4	1
	4	Blue	Missouri River	Proposed Sac & Fox WTP	5.75	250	290	290	250	1051	951	951	820	100	131	3	0

Notes

1 = Supply alternative color code for Site Plan maps of supply alternative layouts

4: Multi-Tribal Alternatives - Pipe Sizing Calculations

Tribe	Tribe	Color [1]	Source	Destination	Max Daily Demand [2]		Pipe Velocity (fps) for Specific Pipe Size						Pipe Choosen (in.) [3]	Pipe Length (miles)
					Total (gpm)	Total (cfs)	3 inch Pipe	4 inch Pipe	6 inch Pipe	8 inch Pipe	10 inch Pipe	12 inch Pipe		
MT1 Plum Creek Reservoir	Potawatomi, Sac & Fox (Casino Only)	Magenta	Proposed Plum Creek Reservoir	Sac & Fox Casino	691	1.539	31.4	17.6	7.8	4.4	2.8	2.0	8	2.00
	Potawatomi	Magenta	Sac & Fox Casino	North Booster Station	600	1.338	27.3	15.3	6.8	3.8	2.5	1.7	10	24.25
	Kickapoo	Magenta	Proposed Plum Creek Reservoir	Distribution Connection	513	1.142	23.3	13.1	5.8	3.3	2.1	1.5	8	2.75
MT2 Perry Lake	Potawatomi, Kickappo, Sac & Fox (Casino only)	Blue	Perry Lake	Proposed South Cedar WTP	1203	2.681	54.6	30.7	13.7	7.7	4.9	3.4	12	23.00
	Potawatomi	Blue	Proposed South Cedar WTP	North Booster Station	600	1.338	27.3	15.3	6.8	3.8	2.5	1.7	8	1.00
	Kickappo, Sac & Fox (Casino only)	Blue	Proposed South Cedar WTP	K-20/I-75 Int.	603	1.343	27.4	15.4	6.8	3.8	2.5	1.7	10	21.00
	Kickapoo	Blue	K-20/I-75 Int.	Distribution Connection	513	1.142	23.3	13.1	5.8	3.3	2.1	1.5	8	5.00
	Sac & Fox (Casino only)	Blue	K-20/I-75 Int.	Sac & Fox Casino	90	0.201	4.1	2.3	1.0	0.6	0.4	0.3	3	2.25
MT3 Res.	Potawatomi, Kickappo, Sac & Fox (Casino only)	Yellow	Shawnee Reservoir / Kansas River	Proposed South Cedar WTP	1203	2.681	54.6	30.7	13.7	7.7	4.9	3.4	12	22.00
	Potawatomi	Blue	Proposed South Cedar WTP	North Booster Station	600	1.338	27.3	15.3	6.8	3.8	2.5	1.7	8	1.00
	Kickappo, Sac & Fox (Casino only)	Yellow	Proposed South Cedar WTP	K-20/I-75 Int.	603	1.343	27.4	15.4	6.8	3.8	2.5	1.7	10	21.00
	Kickapoo	Yellow	K-20/I-75 Int.	Distribution Connection	513	1.142	23.3	13.1	5.8	3.3	2.1	1.5	8	5.00
	Sac & Fox (Casino only)	Yellow	K-20/I-75 Int.	Sac & Fox Casino	90	0.201	4.1	2.3	1.0	0.6	0.4	0.3	3	0.25
MT4 Banner Creek Reservoir	Potawatomi, Kickappo, Sac & Fox (Casino only)	Green	Banner Creek Reservoir	K-16/I-75 Int.	1203	2.681	54.6	30.7	13.7	7.7	4.9	3.4	10	1.00
	Potawatomi	Green	K-16/I-75 Int.	North Booster Station	600	1.338	27.3	15.3	6.8	3.8	2.5	1.7	10	8.00
	Kickappo, Sac & Fox (Casino only)	Green	K-16/I-75 Int.	K-20/I-75 Int.	603	1.343	27.4	15.4	6.8	3.8	2.5	1.7	12	14.25
	Kickapoo	Green	K-20/I-75 Int.	Distribution Connection	513	1.142	23.3	13.1	5.8	3.3	2.1	1.5	8	5.00
	Sac & Fox (Casino only)	Green	K-20/I-75 Int.	Sac & Fox Casino	90	0.201	4.1	2.3	1.0	0.6	0.4	0.3	3	2.25

Notes

1 = Supply alternative color code for Site Plan maps of supply alternative layouts

2 = 2 x average daily demand

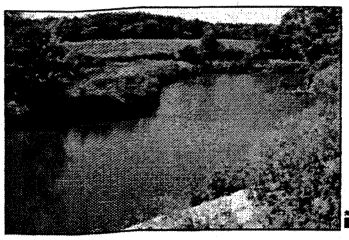
3 = based on maximum velocity of 5 ft./sec. or head loss if pipe length exceeds 8 miles

5: Multi-Tribal Alternatives - Pipe Length, Elevation, Highway and Stream Crossings

Alternative	Tribe	Color [1]	Source	Destination	Pipeline Length (miles)	Source Elev. (m.)	Destination Elev. (m.)	High Point (m.)	Low Point (m.)	Source Elev. (ft.)	Destination Elev. (ft.)	High Point (ft.)	Low Point (ft.)	Source / Destination Elev Dif. (ft.)	High / Low Pt. Elev Dif. (ft.)	# of Stream Crossings	# of Hwy. Crossings
MT1	Potawatomi, Sac & Fox (Casino Only)	Magenta	Proposed Plum Creek Reservoir	Sac & Fox Casino	2.00	320	350	350	320	1050	1148	1148	1050	-98	98	1	0
Plum Creek Reservoir	Potawatomi	Magenta	Sac & Fox Casino	North Booster Station	24.25	350	360	360	310	1148	1181	1181	1017	-33	164	19	4
	Kickapoo	Magenta	Proposed Plum Creek Reservoir	Distribution Connection	2.75	320	330	330	310	1050	1083	1083	1017	-33	66	4	0
MT2	Potawatomi, Kickappo, Sac & Fox (Casino only)	Blue	Perry Lake	Proposed South Cedar Creek WTP	23.00	272	345	375	272	892	1132	1230	892	-240	338	10	2
Perry Lake	Potawatomi	Blue	Proposed South Cedar WTP	North Booster Station	1.00	350	360	360	350	1148	1181	1181	1148	-33	33	0	1
	Kickappo, Sac & Fox (Casino only)	Blue	Proposed South Cedar WTP	K-20/I-75 Int.	21.00	350	345	365	305	1148	1132	1198	1001	16	197	14	3
	Kickapoo	Blue	K-20/I-75 Int.	Distribution Connection	5.00	345	330	350	310	1132	1083	1148	1017	49	131	4	0
	Sac & Fox (Casino only)	Blue	K-20/I-75 Int.	Sac & Fox Casino	2.25	345	350	350	345	1132	1148	1148	1132	-16	16	1	0
MT3	Potawatomi, Kickappo, Sac & Fox (Casino only)	Yellow	Shawnee Reservoir / Kansas River	Proposed South Cedar Creek WTP	22.00	265	305	375	265	869	1001	1230	869	-131	361	9	1
Kansas River / Shawnee Res.	Potawatomi	Blue	Proposed South Cedar Creek WTP	North Booster Station	1.00	350	360	360	350	1148	1181	1181	1148	-33	33	0	1
	Kickappo, Sac & Fox (Casino only)	Yellow	Proposed South Cedar Creek WTP	K-20/I-75 Int.	21.00	350	345	365	305	1148	1132	1198	1001	16	197	14	3
	Kickapoo	Yellow	K-20/I-75 Int.	Distribution Connection	5.00	345	330	350	310	1132	1083	1148	1017	49	131	4	0
	Sac & Fox (Casino only)	Yellow	K-20/I-75 Int.	Sac & Fox Casino	0.25	345	350	350	345	1132	1148	1148	1132	-16	16	1	0
MT4	Potawatomi, Kickappo, Sac & Fox (Casino only)	Green	Banner Creek Reservoir	K-16/I-75 Int.	1.00	310	320	320	310	1017	1050	1050	1017	-33	33	0	0
Banner Creek Reservoir	Potawatomi	Green	K-16/I-75 Int.	North Booster Station	8.00	320	350	360	305	1050	1148	1181	1001	-98	180	4	0
	Kickappo, Sac & Fox (Casino only)	Green	K-16/I-75 Int.	K-20/I-75 Int.	14.25	320	345	350	310	1050	1132	1148	1017	-82	131	9	4
	Kickapoo	Green	K-20/I-75 Int.	Distribution Connection	5.00	345	330	350	310	1132	1083	1148	1017	49	131	4	0
	Sac & Fox (Casino only)	Green	K-20/I-75 Int.	Sac & Fox Casino	2.25	345	350	350	345	1132	1148	1148	1132	-16	16	1	0

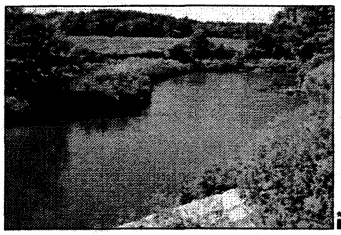
Notes:

1 = Supply alternative color code for Site Plan maps of supply alternative layouts



ATTACHMENT D

Off-Reservation Water Source Options



ATTACHMENT D – Off-Reservation Water Source Options

Kickapoo

General

Five Kickapoo Tribe-specific water supply alternatives were identified as viable options for satisfying the Tribe's water needs through 2040. They are the following and are described in detail below:

(1) Existing water supply on the Reservation, combined with any of the other alternatives

(2) Brown County RWD No. 2/city of Hiawatha – GW wells

(3) Banner Creek Reservoir via Jackson Co. RWD No. 3/city of Holton

(4) Proposed Plum Creek Reservoir

(5) Pikitanoi Project

(6) Perry Lake

The Tribe is particularly committed to the Pikitanoi Project for the long term and, according to the Tribe, the most pressing water supply needs are at the present time and into the near future (probably 5 to10 years into the future). Therefore, the Tribe is most interested in water supply alternatives that will meet their needs for the next 10 years or so, at which time Pikitanoi might become a reality.

Alternative 1: Existing Water Supply on the Reservation Combined with Any of the Other Alternatives.—This alternative assumes that the near-future water supply needs (for the next 5 to 10 years) would be met by the use of the existing surface water supply on the reservation and the acquisition of additional treated water through one of the other alternatives. The augmented treated water would likely be obtained from either Brown County RWD No. 2 or Jackson County RWD No. 3. According to the managers of Brown County RWD No. 2 and Jackson County RWD No. 3, this is a feasible option, as the districts would be willing to

supply the additional treated water as needed by the Tribe to meet their future water supply demands. Both Brown County RWD No. 2 and Jackson County RWD No. 3 have existing piping within a reasonable distance from the reservation and it is assumed that existing piping would be used to supply additional water to the reservation to the extent of the deficit.

(1) Construction of a treated water supply pipeline from a nearby water source identified in one of the other alternatives to the distribution system connection on the reservation.

(2) Add storage and distribution piping, as indicated in chapter IV.

Alternative 2: Brown County RWD No. 2 / City of Hiawatha -GW Wells.—This alternative consists of the acquisition of sufficient treated water from Brown Co. RWD No. 2 via the City of Hiawatha groundwater wells or directly from the city of Hiawatha to meet 2040 demands. Brown Co. RWD No. 2 has sufficient nearby infrastructure to supply the needed water. Brown Co. RWD No. 2 currently taps into the City of Hiawatha's water system at a tap in the city center. There is also the possibility of obtaining water directly from the City of Hiawatha. The city water commission would have to approve this agreement, but at this point it appears to be a reasonable possibility from the city administrator's standpoint. The only foreseeable problem would occur in the event that water supplies became limited, Brown Co. RWD No. 2 may have a higher priority level for receiving water. The city of Hiawatha is currently at 70 percent of their capacity and they are investigating new well field locations for future water supplies if needed.

The following would be necessary to develop the complete water supply, treatment and distribution system (also see attachment b).

(1) [Water via Brown Co. RWD No. 2] Construction of a treated water supply pipeline from the Brown Co. RWD No. 2 distribution system connection point to the distribution system connection on the reservation.

(2) [Water directly via city of Hiawatha] Construction of a treated water supply pipeline from the city of Hiawatha connection point in the city center to the distribution system connection on the reservation.

(3) Add storage and distribution piping.

Alternative 3: Banner Creek Reservoir via Jackson Co. RWD #3 / City of Holton.—This alternative assumes that the future water supply needs would be met

by the acquisition of additional treated water from Banner Creek Reservoir via Jackson County RWD No. 3/city of Holton. The town of Holton and Jackson County RWD No. 3 are cooperators in the Banner Creek water supply project and will share the water from the new treatment plant. The new water treatment plant near the reservoir is designed to produce 1.5 MGD of treated water and is expandable to 2.5 MGD. It is been indicated that treated water from this project will be available in mid-2002 with completion of the water treatment plant. If the available infra-structure from Jackson Co. RWD No. 3 has sufficient capacity, the water feed line into the reservation could be significantly shortened.

The following would be necessary to develop the complete water supply, treatment and distribution system (also see attachment b):

(1) Construct a new water supply pipeline from the Banner Creek Reservoir treatment plant to the north booster station in conjunction with Jackson Co. RWD No. 3 and the city of Holton.

(2) Add storage and distribution piping, as indicated in chapter II.

Alternative 4: Plum Creek Multi-Purpose Reservoir.—This alternative consists of the implementation and construction of a multi-purpose reservoir on Plum Creek which is a tributary to the Delaware River on the Kickapoo Reservation. The proposed Plum Creek dam and reservoir project was one of 20 flood water-retarding dams and one multipurpose structure (Plum Creek dam) that were included in a Watershed Plan and Environmental Impact Statement (January, 1994) prepared by the Soil Conservation Service. The following table shows selected data for this multipurpose structure taken from the Watershed Plan.

The Plum Creek dam would be located on the Kickapoo Reservation and about 50 percent of the land inundated by the reservoir would be on the reservation. About 90 percent of the drainage area above the dam is outside the 1862 Reservation Boundary. There are some concerns about the quality of the water that would be captured by the reservoir (mainly nitrates and phosphates from irrigation runoff, fecal material from livestock, and pesticide runoff from irrigated lands), all of which are existing problems in Perry Lake reservoir and would presumably be a problem in Plum Creek as well since Plum Creek would be intercepting waters that would normally have gone to Perry Reservoir.

A new water treatment plant would be located by the dam, sized to meet 2040 treated water demands. This plant would provide filtered and disinfected water to all end users. The following would be necessary to develop the complete water supply, treatment and distribution system (also see attachment b):

Structural data for Plum Creek upper Delaware and tributaries watershed, Kansas

Item	Unit	Plum Creek Dam
Total drainage area	square miles	16.54
Elevation top of dam	feet	1,092.6
Maximum height of dam	feet	53.9
Total capacity	acre-feet	10,572
Sediment	acre-feet	1,287
Flood water	acre-feet	3,572
Water supply[1]	acre-feet	5,713
Beneficial use surface area	acres	475

[1] The water supply storage volume within the proposed Plum Creek Reservoir (MP21-14) is 5,713 acre-feet. Based upon an hydrologic study for various estimated continuous yields, it was determined that the safe yield with a surety of 98 percent is 1.6 MGD or about 1792 acre-feet/year ("Watershed Plan and Environmental Impact Statement, Upper Delaware and Tributaries Watershed in Atchison, Brown, Jackson, and Nemaha Counties, Kansas", page 30, January 1994). Additional structural data is presented in table 3 of the Watershed Plan and EIS, page 63.

(1) Construction and operation of a new water treatment plant at the Plum Creek dam.

(2) Construction of a treated water supply pipeline from the water treatment plant at the Plum Creek dam to the distribution system connection.

(3) Construction of additional distribution piping and storage tanks as needed (see chapter IV).

Alternative 5: Pikitanoi Project.—The implementation of the Pikitanoi project will probably not occur for at least 10 to 15 years. This alternative assumes that the water supply needs of the reservation in the years 2020 and 2040 would be met by the Pikitanoi project if and when it becomes a reality. In addition, it is assumed that the interim water supply needs for the reservation would continue to be met through the use of water supplied by Jackson County RWD No. 3 until Pikitanoi is completed. However, assuming Pikitanoi becomes a reality, treated water for reservation needs could still ultimately come from Jackson County RWD No. 3 as the district is a participant and a supporter of the long-term project and they are the current owners of the distribution piping system that serves the Tribe on the reservation.

Alternative 6: Perry Lake.—Perry Lake is owned by the State of Kansas and would provide sufficient water through 2040. There are no known water quality problems with this source, and treatment would only be required for pathogen removal/inactivation. The following would be necessary to develop the complete water supply, treatment and distribution system:

(1) Possible modification or replacement of the existing water treatment plant on the reservation.

(2) Construction of a raw water intake structure, pumping facilities and pipeline to transport raw water from Perry Lake to the treatment plant and to the existing water distribution system.

(3) Add storage and distribution piping, as indicated in chapter IV.

Construction Costs to Meet Year 2040 Demands

This section provides water supply and treatment system conceptual design plans that illustrate the type of facility upgrades needed to implement the 2040 projected service demands. Cost estimates (at appraisal or sub-appraisal level, depending on the amount of information available) are provided for major system components. At this level of study, these estimates are accurate to ±40 percent and are useful for only general planning purposes. Therefore, they were not and should not be applied on a per capita or individual household basis. The design is only adequate to determine that a workable system could be developed. Underlying assumptions used to formulate the estimates would have to be further refined to obtain greater accuracy.

An allowance of about 5 percent and 15 percent of the estimated costs was included for contractor mobilization and unlisted items respectively, a 25 percent contingency was added, and a 30 percent noncontract cost added. The noncontract cost includes design data collection, design, contract administration, or construction management costs.

Costs for pipeline construction were calculated using data from the 2002 Cost Estimating Guides for Kansas Heavy Construction available at <www.get-a-quote.com>. Component costs are as follows:

(1) Pipe cover depth assumed to be 4 feet, trench width is pipe diameter plus 9 inches on both sides of the pipe, and 6 inches of sand bedding.

(2) Trenching 4 feet to 6 feet deep with a 1.5 cubic yard hydraulic excavator, excavated material piled on bank, using a 1.5 cubic yard hydraulic tractor excavator and small tools in medium soil.

(3) Backfill sand bedding in trenches, without compaction, using a 1.5 cubic yard front-end crawler loader or small front-end loader.

(4) Compaction in 6-inch (15-centimeter) layers using a compactor rammer with 13- by 11-inch shoe and small tools and air tamp by hand.

(5) Ductile iron pipe — Mechanical joint ductile iron pipe, no fittings included, using a 20-ton hydraulic crane with 70-foot boom and small tools.

(6) 40 percent of total added for contractor overhead and profit.

Kickapoo Tribal alternatives	Alternative 2 Brown County RWD #2	Alternative 3 Banner Creek Jackson County RWD #3	Alternative 4 Plum Creek Reservoir	Alternative 6 Perry Lake
Item	Cost ($)	Cost ($)	Cost ($)	Cost ($)
Water treatment	788,000	788,000	788,000	788,000
Pumping plants	277,651	249,010	255,018	366,928
Pipelines	778,045	2,882,785	240,100	7,002,231
Storage	1,137,100	1,137,100	1,137,100	1,137,100
Mobilization	149,040	252,845	121,011	464,713
Unlisted items	447,119	758,534	363,033	1,394,139
Contract cost (subtotal of items above)	3,576,955	6,068,274	2,904,262	11,153,111
Contingencies	894,239	1,517,069	726,066	2,788,278
Field cost (subtotal of contract cost plus contingencies)	4,471,194	7,585,343	3,630,328	13,941,389
Noncontract cost	1,341,358	2,275,603	1,089,098	4,182,417
Construction cost	5,812,552	9,860,946	4,719,426	18,123,806

Prairie Band Potawatomi

General

Three viable Potawatomi-specific water supply options were identified which could satisfy the Tribe's water needs through 2040 and pipeline alignment information. They are the following and are described in detail below:

(1) Banner Creek Reservoir via Jackson Co. RWD No. 3/city of Holton
(2) Perry Lake
(3) Shawnee Reservoir/Kansas River

The Nation may also develop some water from within its boundary and supplement the difference from that needed with any of the above-listed options. In addition, since the regional Pikitanoi project may be implemented, it cannot be omitted from a list of options, but is not included further in this study.

Alternative 1: Banner Creek Reservoir via Jackson Co. RWD No. 3/City of Holton.—This alternative assumes that the future water supply needs would be met by the acquisition of additional treated water from the existing rural water supply districts, most notably Jackson County RWD No. 3. The district manager of Jackson County RWD No. 3 has indicated that this is a feasible option and the district would be willing to supply the additional treated water as needed by the Potawatomi to meet future water supply demands. The additional water supply needs on the reservation would probably come from the new Banner Creek Water Supply and Recreation project located just west of Holton. The new surface water treatment plant near the reservoir is designed to produce 1.5 mgd of treated water and is expandable to 2.5 MGD. The town of Holton and Jackson County RWD No. 3 are cooperators in the Banner Creek water supply project and will share the treated water from the plant.

The following would be necessary to develop the complete water supply, treatment and distribution system (also see attachment b).

(1) Construct a new water supply pipeline from the Banner Creek Reservoir treatment plant to the north booster station independently or in conjunction with Jackson Co. RWD No. 3.

(2) Add storage and distribution piping, as indicated in chapter IV.

Alternative 2: Perry Lake.—Perry Lake is owned by the State of Kansas and would provide sufficient water through the year 2040. There are no known water quality problems with this source, and treatment would only be required for pathogen removal/inactivation. The following would be necessary to develop the complete water supply, treatment and distribution system:

(1) Construction and operation of a new water treatment plant in the SE corner of the reservation.

(2) Acquisition of the water distribution system components from Jackson Co. RWD No. 3 and Jackson Co. RWD No. 1, including all existing distribution piping, water storage tanks, pumps, and associated equipment.

(3) Addition of storage and distribution piping, as indicated in chapter IV.

(4) Construction of a raw water intake structure, pumping facilities and pipeline to transport raw water from Perry Lake to the new water treatment plant and to the existing water distribution system.

Alternative 3: Kansas River/ Shawnee Reservoir.— This alternative consists of the acquisition of sufficient raw water from the Kansas River or Shawnee Reservoir near Topeka, to meet 2040 demands. There are no known water quality problems with these sources, and treatment would only be required for pathogen removal/inactivation. The following would be necessary to develop the complete water supply, treatment and distribution system (also see attachment b).

(1) Construction and operation of a new water treatment plant in the southeast corner of the reservation.

(2) Acquisition of the water distribution system components from the Jackson Co. RWD No. 3 and Jackson Co. RWD No. 1, including all existing distribution piping, water storage tanks, pumps, and associated equipment.

(3) Addition of storage and distribution piping, as indicated in chapter IV, intertribal report.

(4) Construction of a raw water intake structure, pumping facilities and pipeline to transport raw water from the Kansas River or Shawnee Reservoir to the new water treatment plant and to the existing water distribution system become a reality.

Construction Costs to Meet 2040 Demands

This section provides water supply and treatment system conceptual design plans that illustrate the type of facility upgrades needed to implement to meet 2040 projected service demands. Cost estimates (at appraisal or sub-appraisal level, depending on the amount of information available) are provided for major system components. At this level of study, these estimates are accurate to 40 percent and are useful for only general planning purposes; therefore, they were not and should not be applied on a per capita or individual household basis. The design is only adequate to determine that a workable system could be developed. Underlying assumptions used to formulate the estimates would have to be further refined to obtain greater accuracy.

An allowance of about 5 percent and 15 percent of the estimated costs was included for contractor mobilization and unlisted items respectively, a 25 percent contingency was added, and a 30 percent noncontract cost added. The noncontract cost includes design data collection, design, contract administration, or construction management costs.

Costs for pipeline construction were calculated using data from the 2002 Cost Estimating Guides for Kansas Heavy Construction available at <www.get-a-quote.com> Component costs are as follows:

(1) Pipe cover depth assumed to be 4 feet, trench width is pipe diameter plus 9 inches on both sides of the pipe, and 6 inches of sand bedding.

(2) Trenching 4 feet to 6 feet deep with a 1.5 cubic yard hydraulic excavator, excavated material piled on bank, using a 1.5 cubic yard hydraulic tractor excavator and small tools in medium soil.

(3) Backfill sand bedding in trenches, without compaction, using a 1.5 cubic yard front-end crawler loader or small front end loader.

(4) Compaction in 6-inch (15 centimeters) layers using a compactor rammer with 13- by 11-inch shoe and small tools and air tamp by hand.

(5) Ductile iron pipe — Mechanical joint ductile iron pipe, no fittings included, using a 20-ton hydraulic crane with 70-foot boom and small tools.

(6) 40 percent of total added for contractor overhead and profit.

Potawatomi alternatives	Alternative 1 Banner Creek Jackson County RWD #3	Alternative 2 Perry Lake	Alternative 3 Kansas River/ Shawnee Reservoir
Item	Cost ($)	Cost ($)	Cost ($)
Water treatment	788,000	788,000	788,000
Pumping plants	409,109	409,546	389,739
Pipelines	944,769	3,799,991	2,732,578
Storage	1,537,825	1,537,825	1,537,825
Mobilization	183,985	326,768	272,407
Unlisted items	551,955	980,304	817,221
Contract cost (subtotal of items above)	4,415,643	7,842,434	6,537,770
Contingencies	1,103,911	1,960,609	1,634,443
Field cost (subtotal of contract cost plus contingencies)	5,519,554	9,803,043	8,172,213
Noncontract cost	1,655,866	2,940,913	2,451,664
Construction cost	7,175,420	12,743,956	10,623,877

Sac and Fox Nation

General

Alternative 1: Water Supplied by Existing Rural Water Supply Districts.—

Yellow Earth/Town of Reserve.—Brown County RWD No.1 currently serves the Tribal members in the Yellow Earth housing area in the town of Reserve. They are willing to supply additional treated water as needed by the Tribe to meet future water supply demands. It should be noted that Brown County RWD No.1 has an agreement with the city of Hiawatha to obtain additional water for use by those served by the district during periods when their existing raw water supply wells, located north of the town of Fairview, cannot supply all of the needed water.

Red Earth.—Richardson Co. RWD No. 2 currently serves the Red Earth housing area and the rest of the reservation in Nebraska. The district currently obtains water from GW wells from Falls City with sufficient water to meet planned increased needs to year 2040. They are willing to supply this water to the reservation and with minimal infrastructure changes needed. There are currently no water quality problems with the treated water from Falls City.

Sac and Fox Casino.—Brown Co. RWD No. 2 currently serves the casino and other commercial development in the area near the casino along Highway 75. The existing water lines are currently at capacity. Delivering additional water would require the construction of additional or higher-capacity pipelines. Brown Co. RWD No. 2 is willing to supply additional water, but the details on the pipelines would have to be addressed.

Alternative 2: Big Nemaha River Surface Water Alternative.—This alternative consists of the acquisition of sufficient raw water from the Big Nemaha River to meet year 2040 demands. The water would be drawn from the Big Nemaha River on the eastern edge of the reservation. The river along the eastern edge of the reservation is prone to flooding, so water intake and pipeline facilities would need to be designed with this in mind. The water quality of the Big Nemaha River appears to be generally acceptable assuming standard surface water treatment. Existing water quality data shows that there are no primary drinking water standard problems and only iron and manganese are parameters that exceed secondary standards. The water is primarily subject to surface water flow from farmland in southeast Nebraska and would need to be treated.

(1) Construction and operation of a new surface water treatment plant at Red Earth.

(2) Acquisition of the water distribution system components from Richardson Co. RWD No. 2 including all existing distribution piping, pumps, and associated equipment.

(3) Construction of a flood-resistant raw water intake structure or groundwater wells, pumping facilities and pipeline to transport raw water from the Big Nemaha River to the treatment plant and to the existing water distribution system.

(4) Addition of storage and distribution piping.

Alternative 3: City of Hiawatha Groundwater Wells (for Red Earth).— This alternative consists of the acquisition of sufficient raw water from the City of Hiawatha groundwater to meet 2040 demands. The system would be its own system except for the raw water supply, which it is assumed would come from the City of Hiawatha's well field located approximately 4 miles north of the town. The city water commission would have to approve this agreement of selling directly to the Tribe, but at this point it appears to be a reasonable possibility from the city administrator's standpoint. The only foreseeable problem would be that in the event water supplies became limited, the RWDs may have a higher priority level for receiving water. The city of Hiawatha is currently at 70 percent of capacity and is investigating new well field locations for future water supplies if needed.

The City of Hiawatha treats its water 2 miles south of the well field. It was determined that it would be less costly to chlorinate the water at the well field to install 2 miles of additional pipe to the Hiawatha chlorination facility. Additional water treatment may be needed if source water quality degrades in the future.

The following would be necessary to develop the complete water supply, treatment and distribution system:

(1) Construction and operation of a 0.05 mgd (36 gpm) chlorination facility at the Hiawatha well field.

(2) Construction of a raw water supply pipeline (7.5 miles) from the City of Hiawatha GW wells to the Red Earth development, and construction of a new treatment facility (disinfection only).

(3) Acquisition of the water distribution system components from Richardson Co. RWD No. 2, including all existing distribution piping, pumps, and associated equipment.

(4) Addition of storage and distribution piping.

Alternative 4: Missouri River (for Red Earth).—The Missouri River is relatively close to the Red Earth development and would be capable of satisfying the future water needs. Water quality data obtained further downstream from Kansas City, Kansas, do not show any significant water quality problems. The lead and arsenic concentrations were around the maximum contaminant levels, but were well below these limits after conventional treatment. There is the option of drawing directly out of the Missouri River or through groundwater wells next to the river using river bank filtration. The plain between the reservation and the Kansas River is prone to flooding, so water intake and pipeline facilities would need to be designed with this in mind.

The following would be necessary to develop the complete water supply, treatment and distribution system:

(1) Construction and operation of a new surface water treatment plant at Red Earth.

(2) Acquisition of the water distribution system components from Richardson Co. RWD No. 2 including all existing distribution piping, pumps, and associated equipment.

(3) Construction of a flood-resistant raw water intake structure or groundwater wells, pumping facilities and pipeline to transport raw water from the Missouri River to the treatment plant and to the existing water distribution system.

(4) Addition of storage and distribution piping.

Construction Costs to Meet 2040 Demands

This section provides water supply and treatment system conceptual design plans that illustrate the type of facility upgrades needed to implement to meet 2040 projected service demands. Cost estimates (at appraisal or sub-appraisal level, depending on the amount of information available) are provided for major system components. At this level of study, these estimates are accurate to ±40 percent and are useful only for general planning purposes. Therefore, they were not and should not be applied on a per capita or individual household basis. The design is only adequate to determine that a workable system could be developed. Underlying assumptions used to formulate the estimates would have to be further refined to obtain greater accuracy.

An allowance of about 5 percent and 15 percent of the estimated costs was included for contractor mobilization and unlisted items, respectively; a 25 percent contingency was added, and a 30 percent noncontract cost added. The noncontract cost includes design data collection, design, contract administration, or construction management costs.

Costs for pipeline construction were calculated using data from the 2002 Cost Estimating Guides for Kansas Heavy Construction available at <www.get-a-quote.com>. Component costs are as follows:

(1) Pipe cover depth assumed to be 4 feet, trench width is pipe diameter plus 9 inches on both sides of the pipe, and 6 inches of sand bedding.

(2) Trenching 4 feet to 6 feet deep with a 1.5 cubic yard hydraulic excavator, excavated material piled on bank, using a 1.5 cubic yard hydraulic tractor excavator and small tools in medium soil.

(3) Backfill sand bedding in trenches, without compaction, using a 1.5 cubic yard front-end crawler loader or small front end loader.

(4) Compaction in 6-inch (15-centimeter) layers using a compactor rammer with 13- by 11-inch shoe and small tools and air tamp by hand.

(5) Ductile iron pipe — Mechanical joint ductile iron pipe, no fittings included, using a 20-ton hydraulic crane with 70-foot boom and small tools.

(6) 40 percent of total added for contractor overhead and profit.

Sac and Fox Tribal alternatives	Alternative 2 Big Nemaha	Alternative 3 City of Hiawatha	Alternative 4 Missouri River
Item	Cost ($)	Cost[1] ($)	Cost ($)
Water treatment	394,000	275,472	394,000
Pumping plants	30,000	30,000	30,000
Pipelines	211,148	575,857	441,490
Storage	750,075	750,075	750,075
Mobilization	69,261	87,497	80,778
Unlisted items	207,783	262,490	242,335
Contract cost (subtotal of items above)	1,662,267	2,099,919	1,938,678
Contingencies	415,567	524,980	484,670
Field cost (subtotal of contract cost plus contingencies)	2,077,834	2,624,899	2,423,348
Noncontract cost	623,350	787,470	727,004
Construction cost	2,701,184	3,412,369	3,150,352

[1] Treatment cost assumes full treatment of water, not chlorination only.