CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

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

4.2 GENERAL SETTING

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

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

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

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

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

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

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

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

4.3 GEOLOGY

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

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

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

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

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

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

4.3.1 SOILS

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

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

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

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

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

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

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

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

4.3.1.1 Equus Beds Well Field

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

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

4.3.1.2 Local Well Field

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

Table 4-1 Temporary and Permanent Soil Disturbance

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

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

4.3.2 LAND USE

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

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

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

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

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

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

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

4.4 WATER RESOURCES

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

4.4.1 SURFACE WATER

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

4.4.1.1 ILWSP Operations Model

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

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

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

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

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

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

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

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

4.4.1.2 Quantity

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

4.4.1.2.1 Little Arkansas River

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

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

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

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

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

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

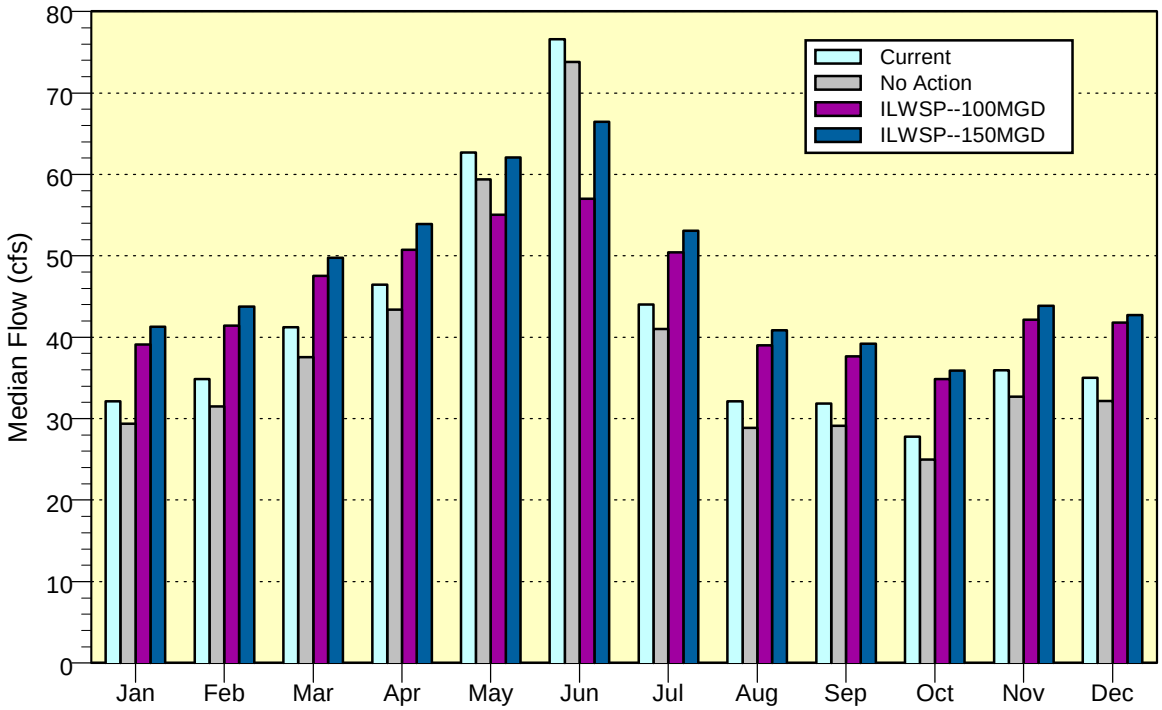
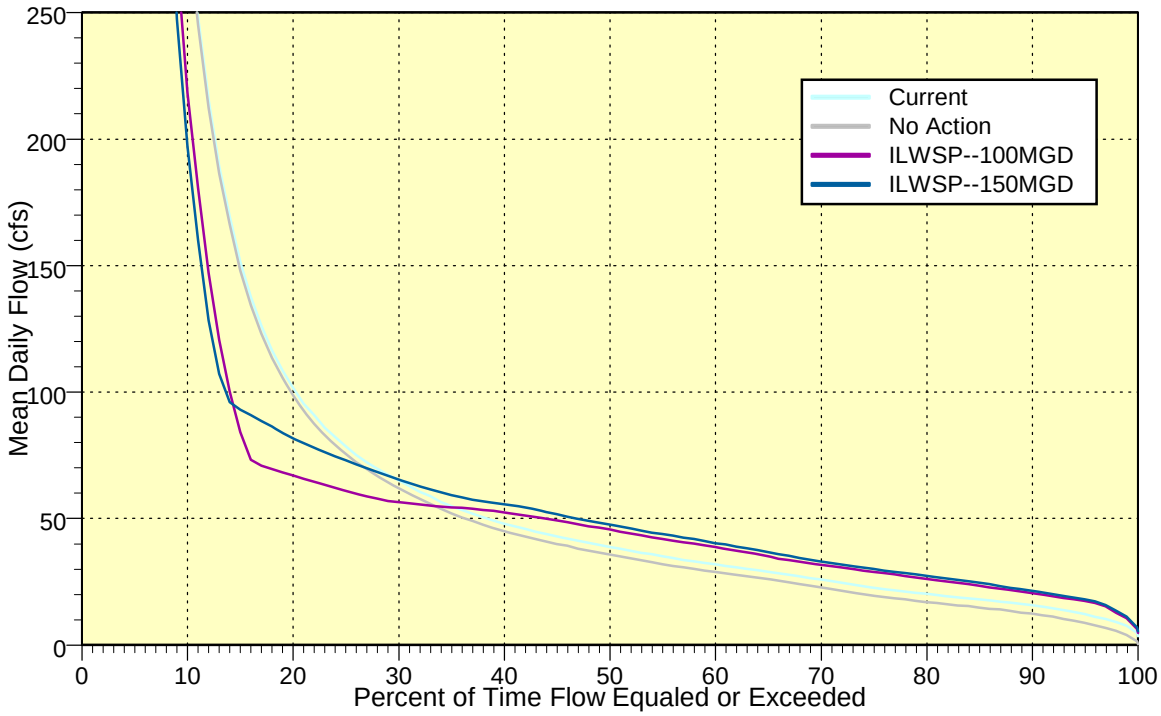


Figure 4-2 Flow Durations, Little Arkansas River at Halstead



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

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

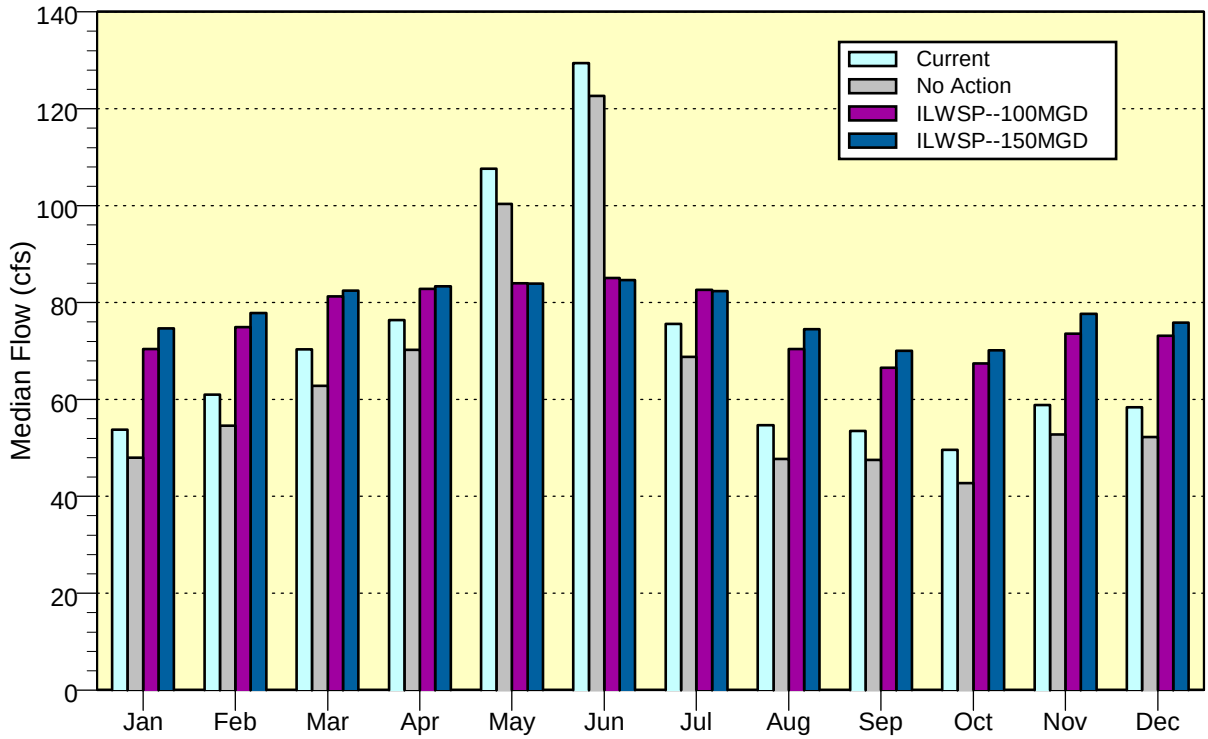
Changes in the flow regime of the Little Arkansas River would be most apparent at medium flow levels, those which occur from about 10 to 40 percent of the time, or roughly in the range of 50 to 200 cfs (see Figure 4–2). In the operations model, it was assumed that the aquifer storage and recovery (ASR)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

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

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

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

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



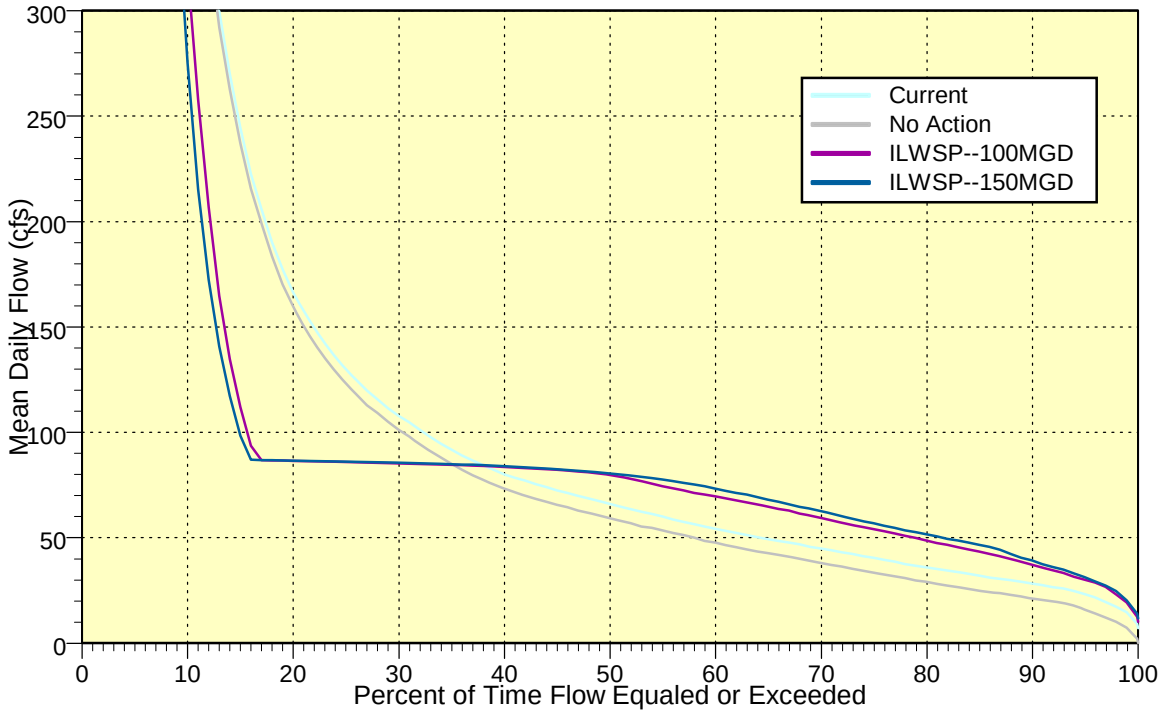
During May and June, the median flow in the river at Valley Center would decrease by 23 to 45 cfs or about 22 to 35 percent respectively. These two months have the highest historic median flow and, therefore, are the months when the recharge system is expected to operate more frequently and at higher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

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

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

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

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

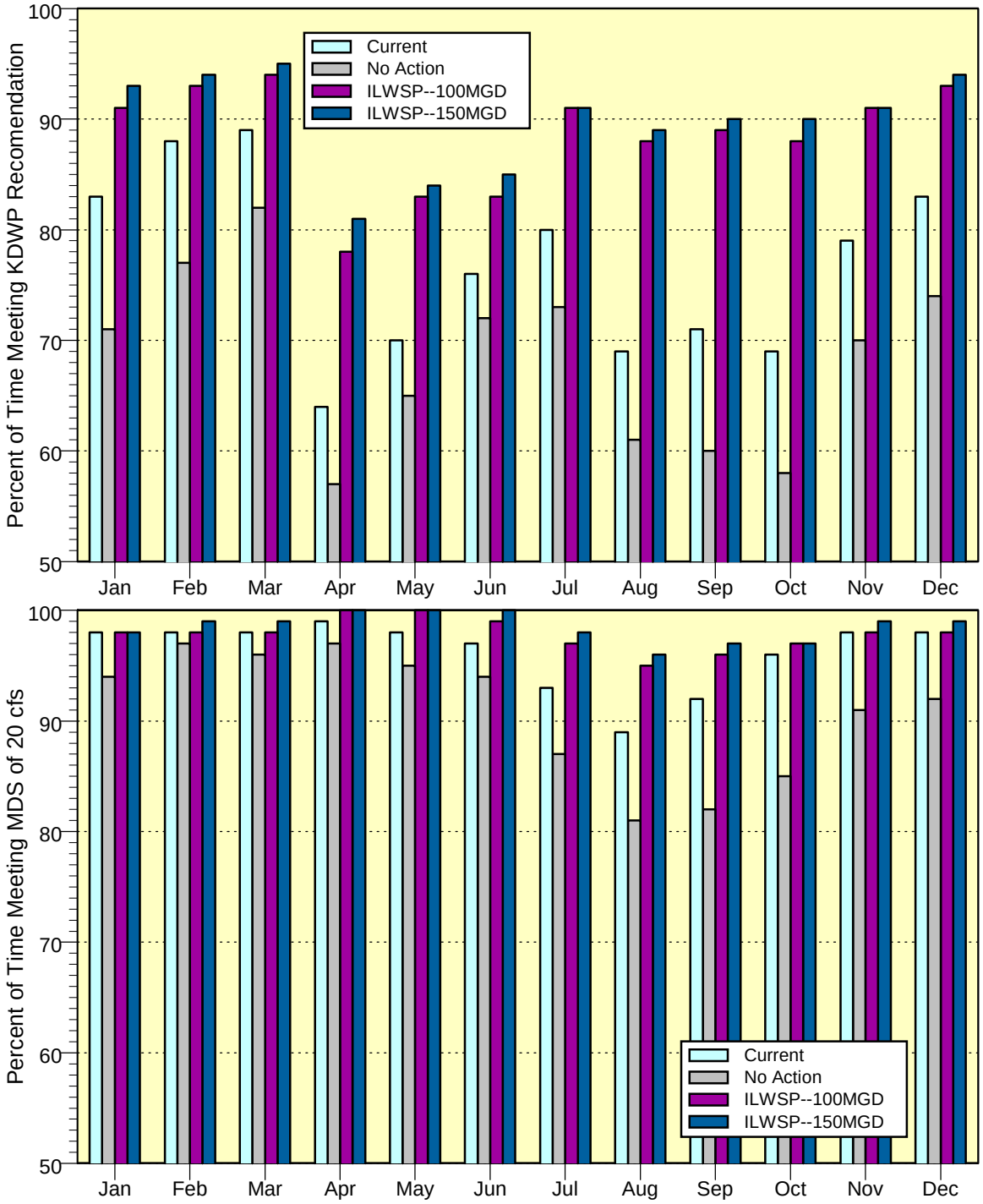


recommended minimums. The lower portion of this figure shows how often each month the flow at Valley Center is at least 20 cfs. The success rate for meeting the MDS is fairly high, generally over 90 percent. However, this graph shows that, compared to current conditions, the success rate will decline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

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

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

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



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

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

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

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

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

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

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

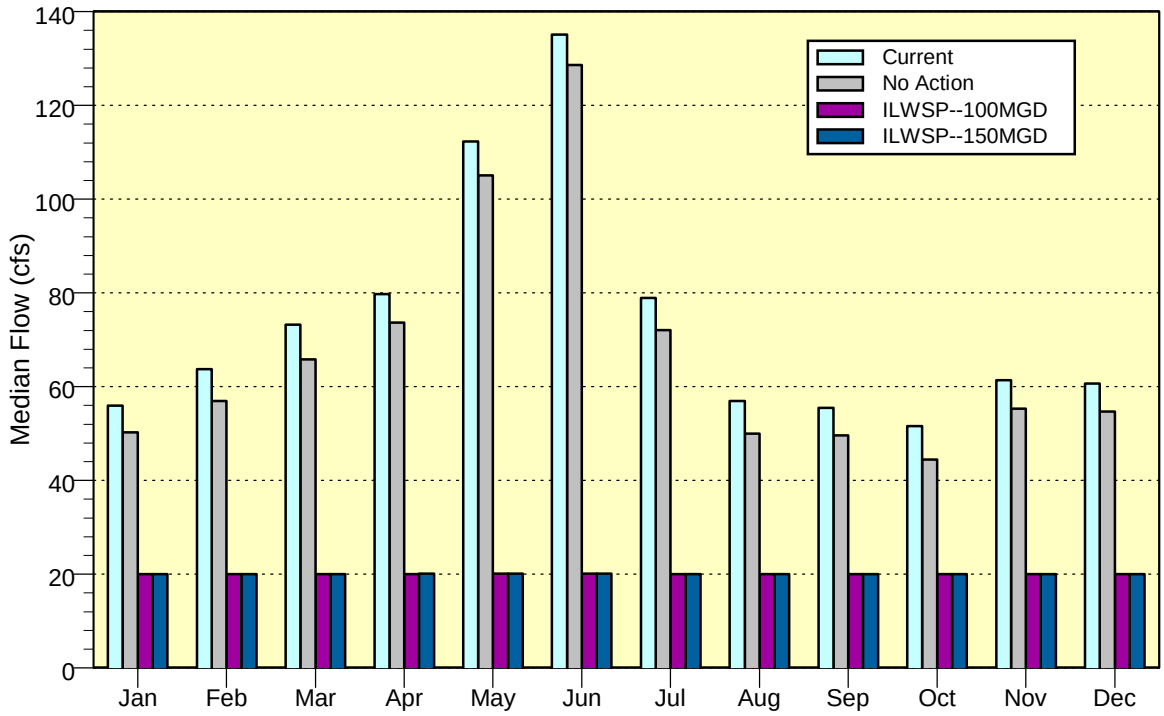
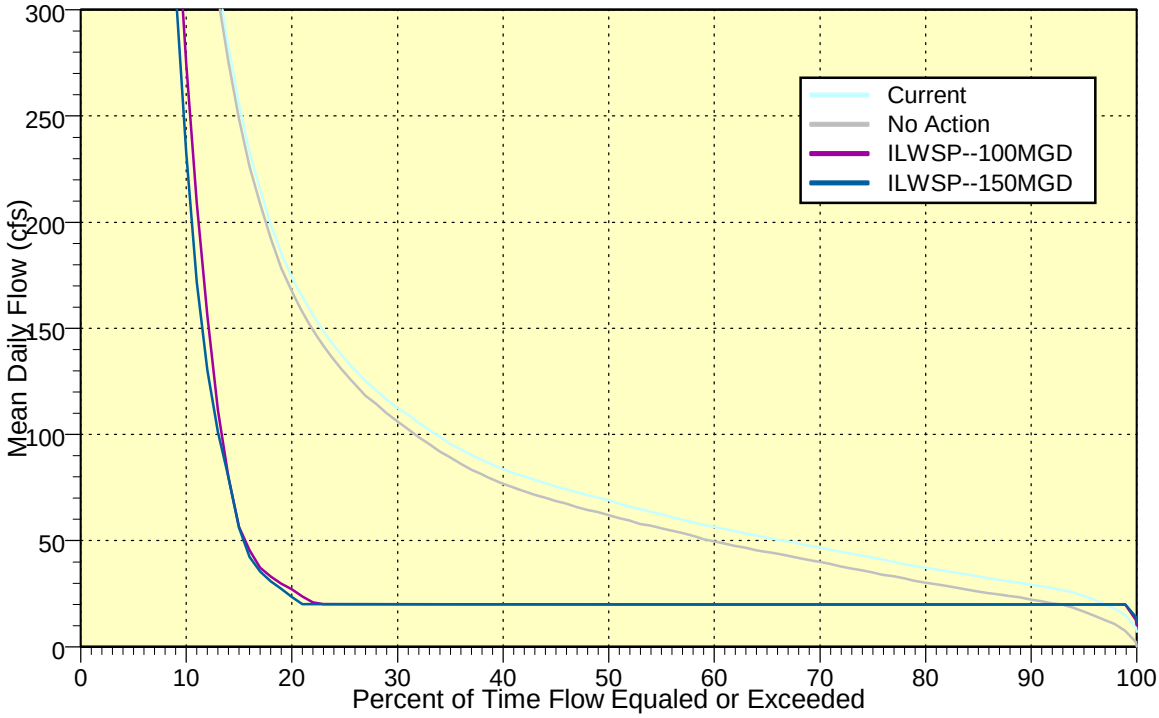


Figure 4–7 Flow Durations, Little Arkansas River at Mouth



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

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

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

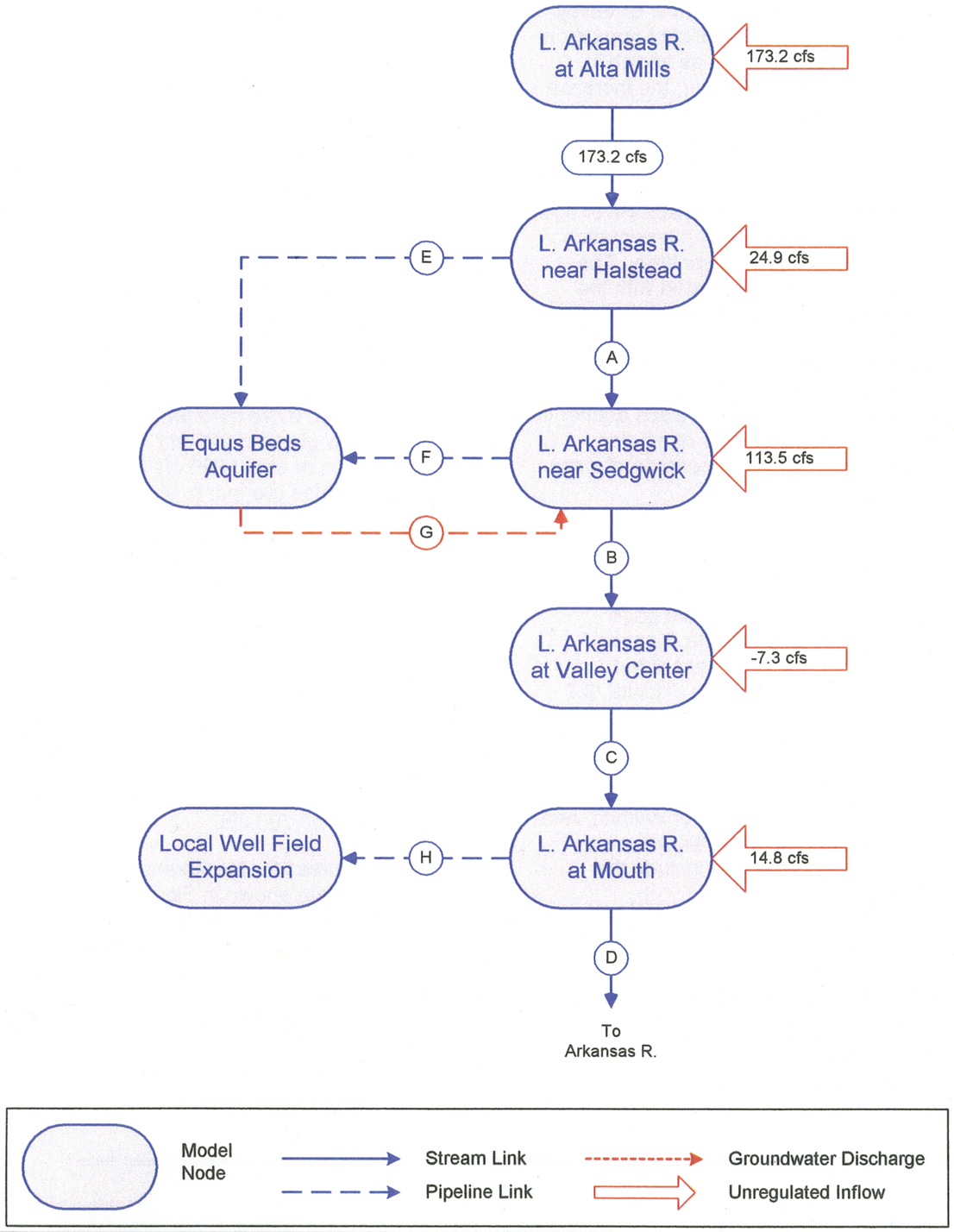
As shown in Figure 4-8, flows in the Little Arkansas River between Sedgwick and its mouth are expected to decline slightly from current conditions under the No-action alternative. These declines in flow, which average close to 7 cfs, occur as a direct result of estimated decreases in groundwater discharge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

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

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

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

Figure 4-8 Water Balance for Little Arkansas River



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

Notes:

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

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

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

4.4.1.2.2 Arkansas River

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

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

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

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

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

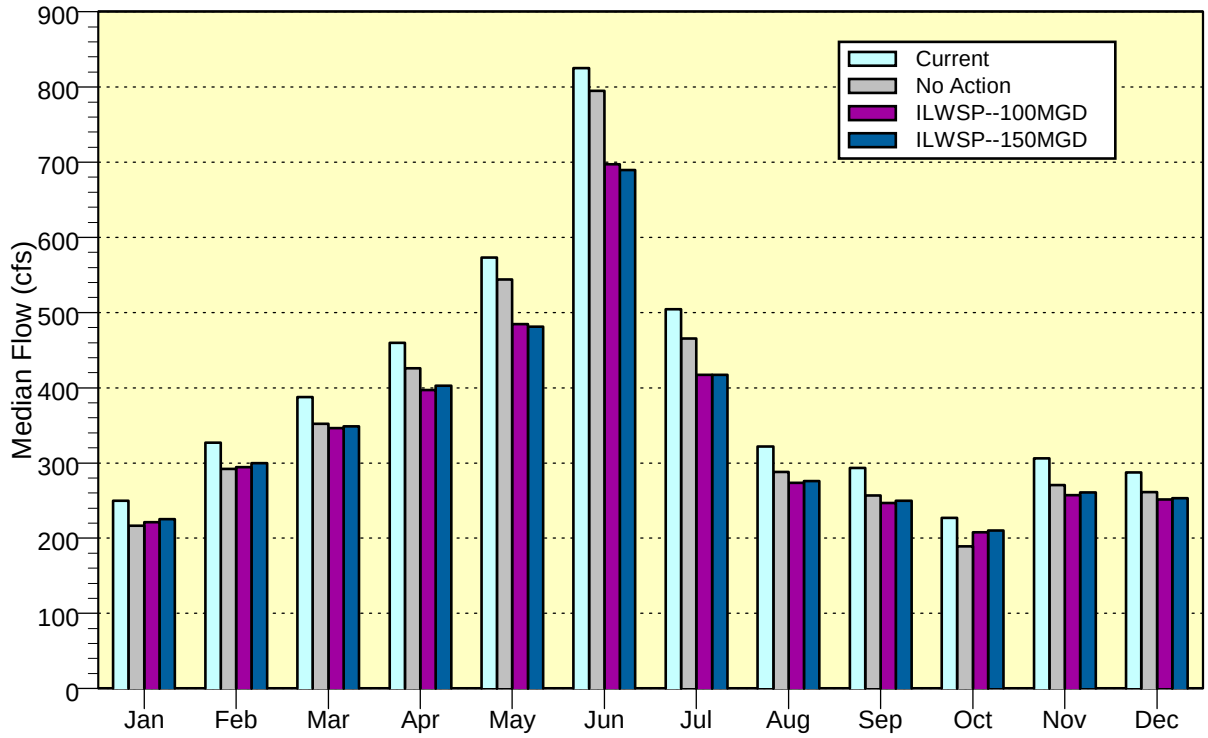
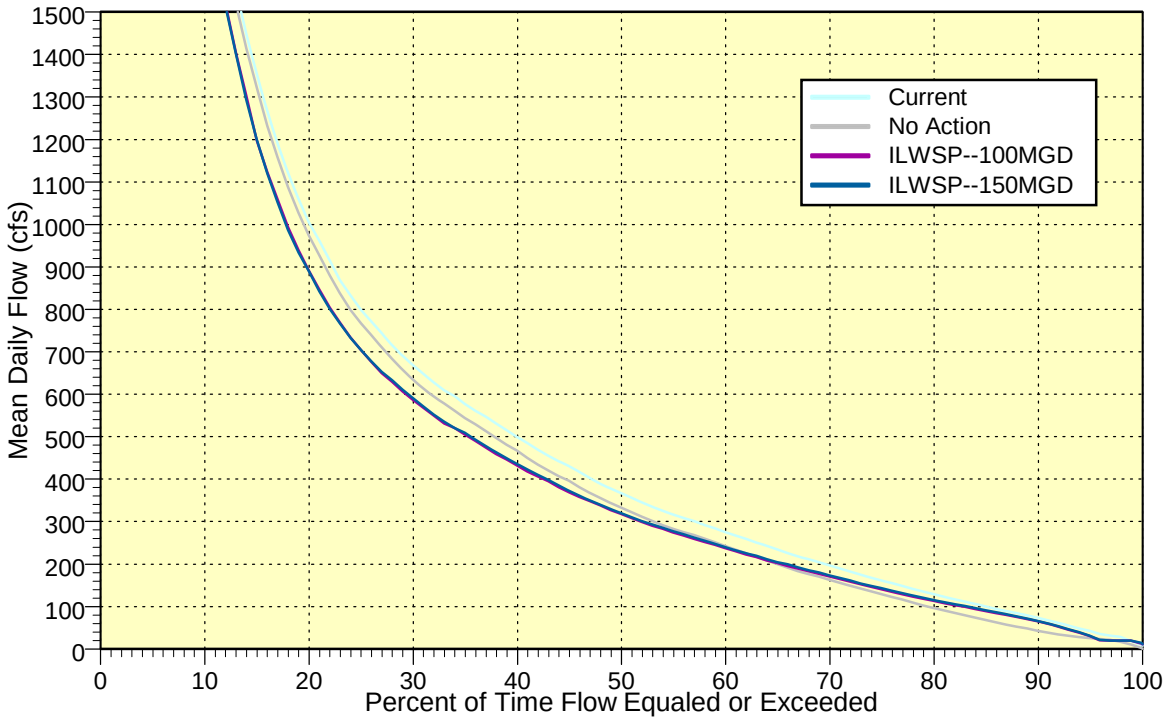


Figure 4–10 Flow Durations, Arkansas River at Wichita



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

4.4.1.2.3 Ninnescah River Basin

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

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

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

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

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

Figure 4-11 Frequency of Discharge from Cheney Dam

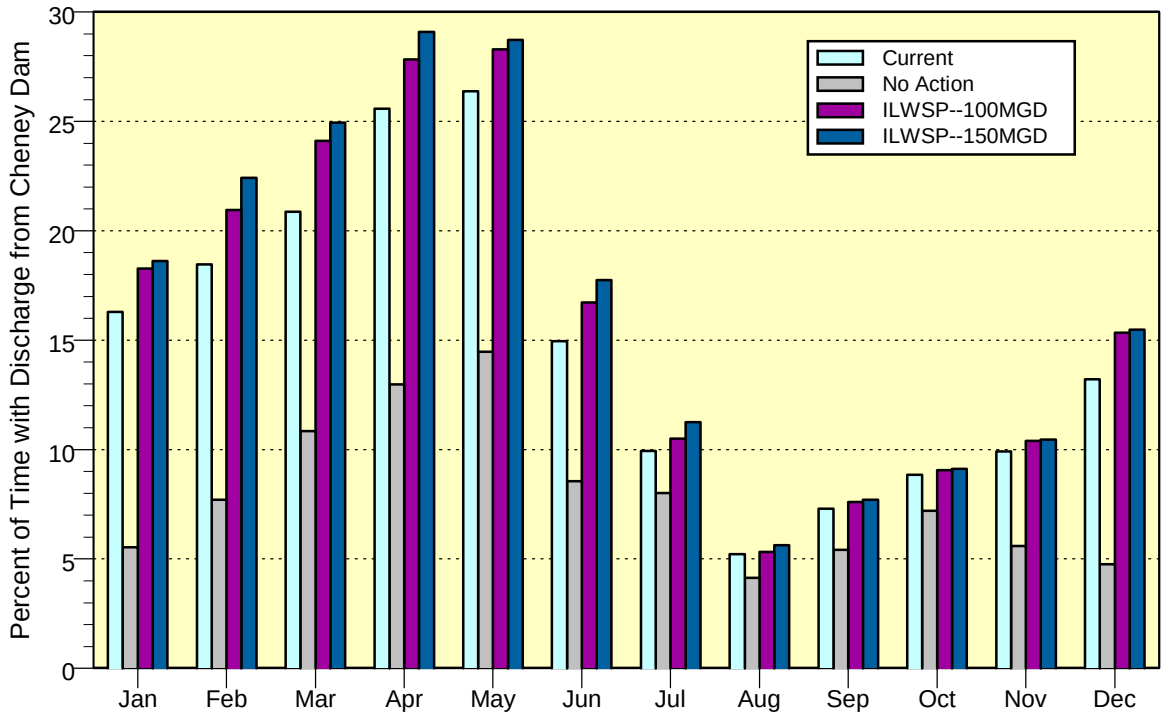
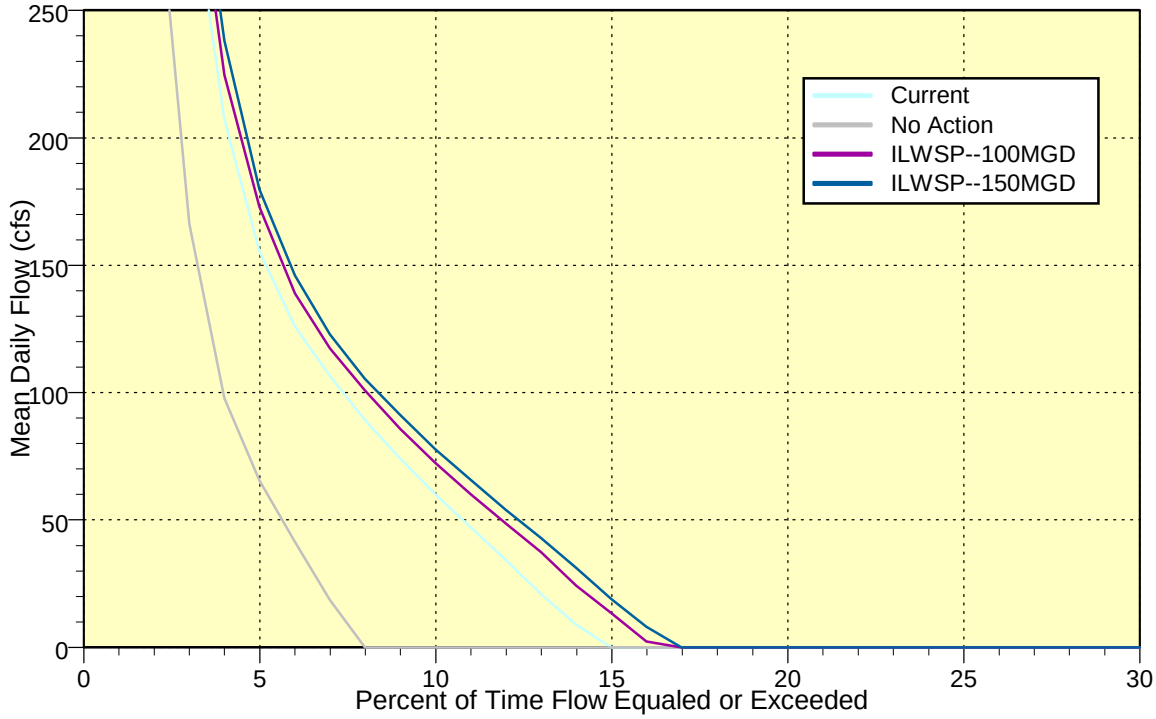


Figure 4–12 Flow Durations, North Fork Ninnescah River below Cheney Dam



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

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

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

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

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

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

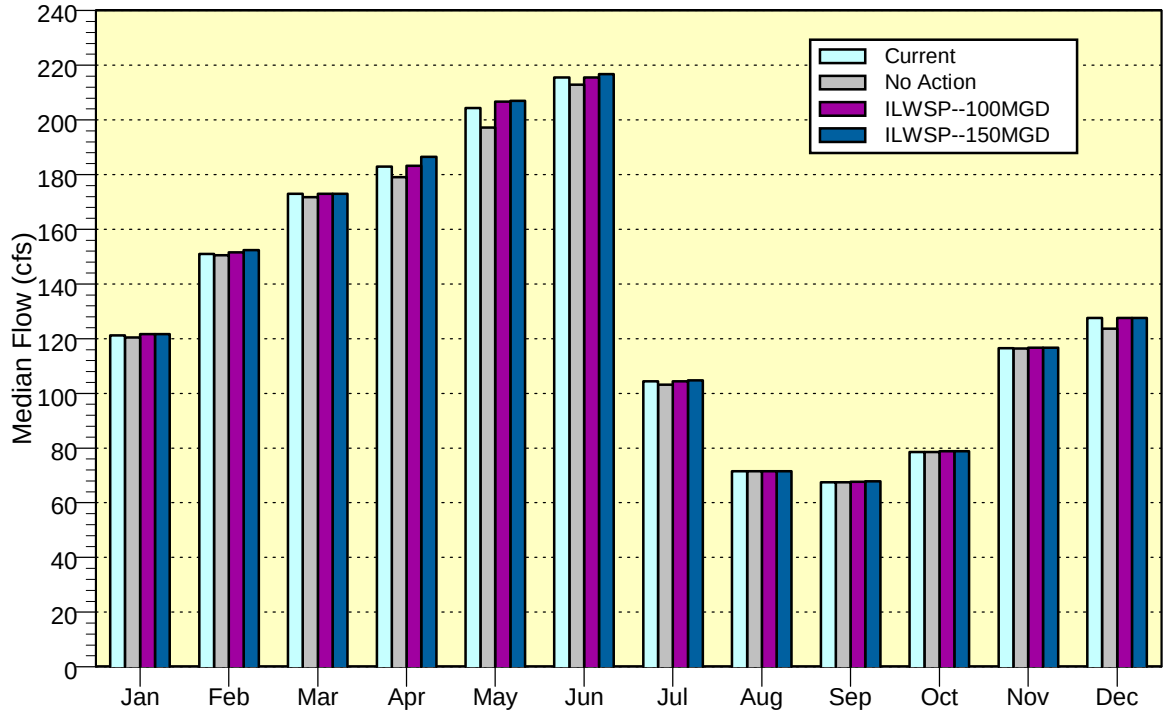


Figure 4–15 shows the percent of time in each month that flows near Peck are equal to or greater than the recommended minimums. The success rate for meeting the MDS varies from about 55 percent in November to about 85 percent in July. What is more relevant however, is that there are almost no differences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

4.4.1.3 Water Surface Elevations and Depths

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

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

4.4.1.3.1 Little Arkansas River

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

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

4.4.1.3.2 Arkansas River

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

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

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

Figure 4-14 Flow Durations, Ninnescah River near Peck

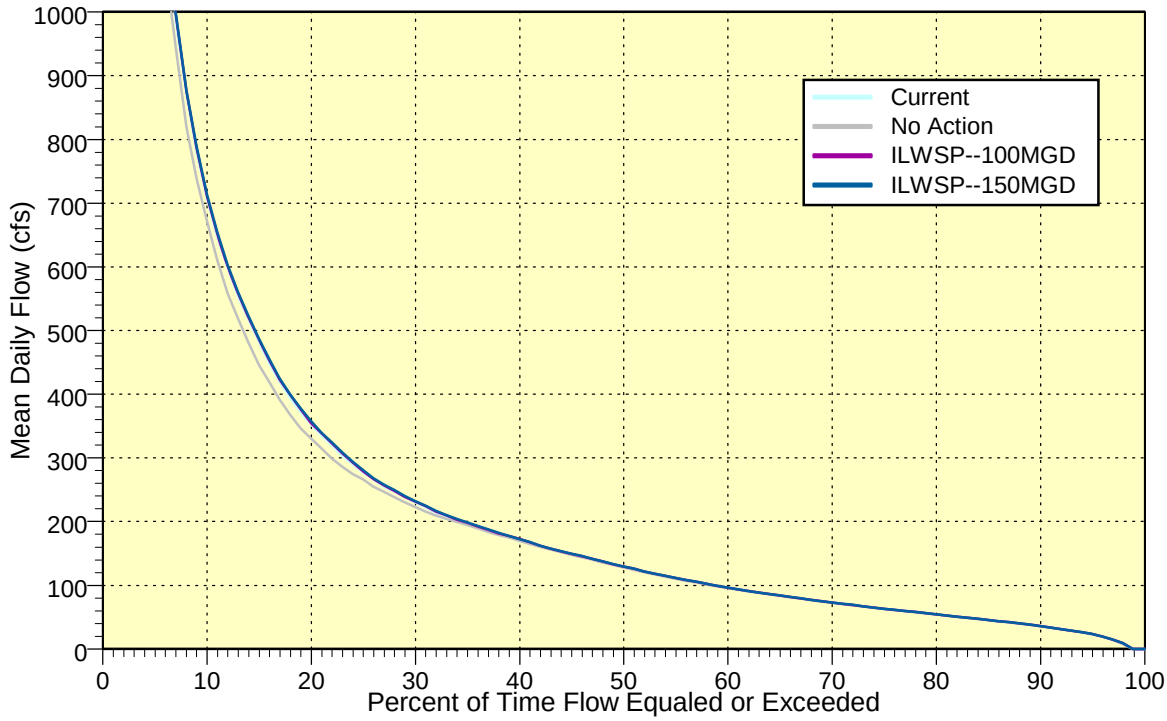


Figure 4-15
Success Rates for Meeting MDS Requirements, Ninnescah River near Peck

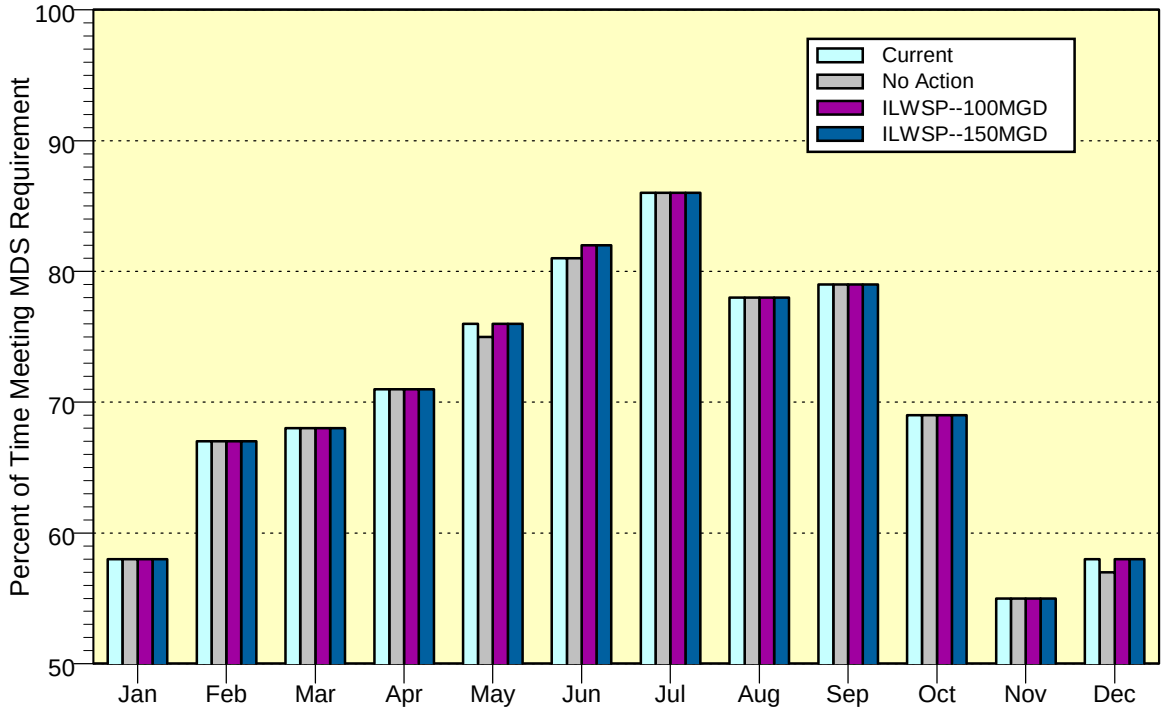


Figure 4–16 Median Water Surface Elevations by Month, Little Arkansas River at Valley Center

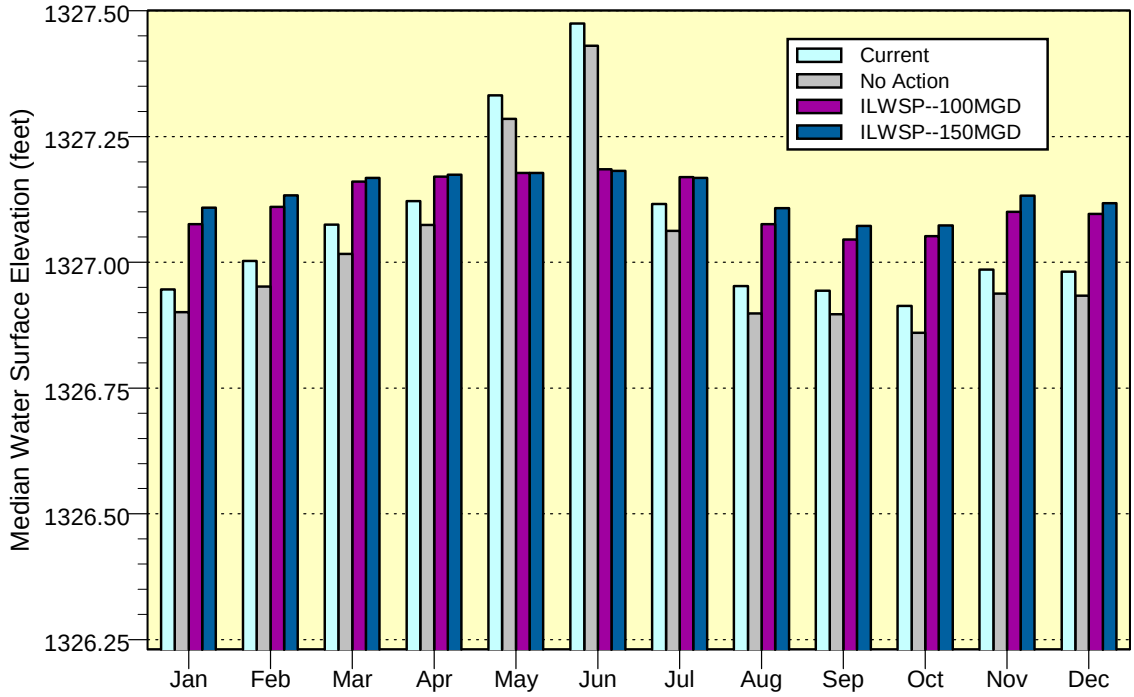
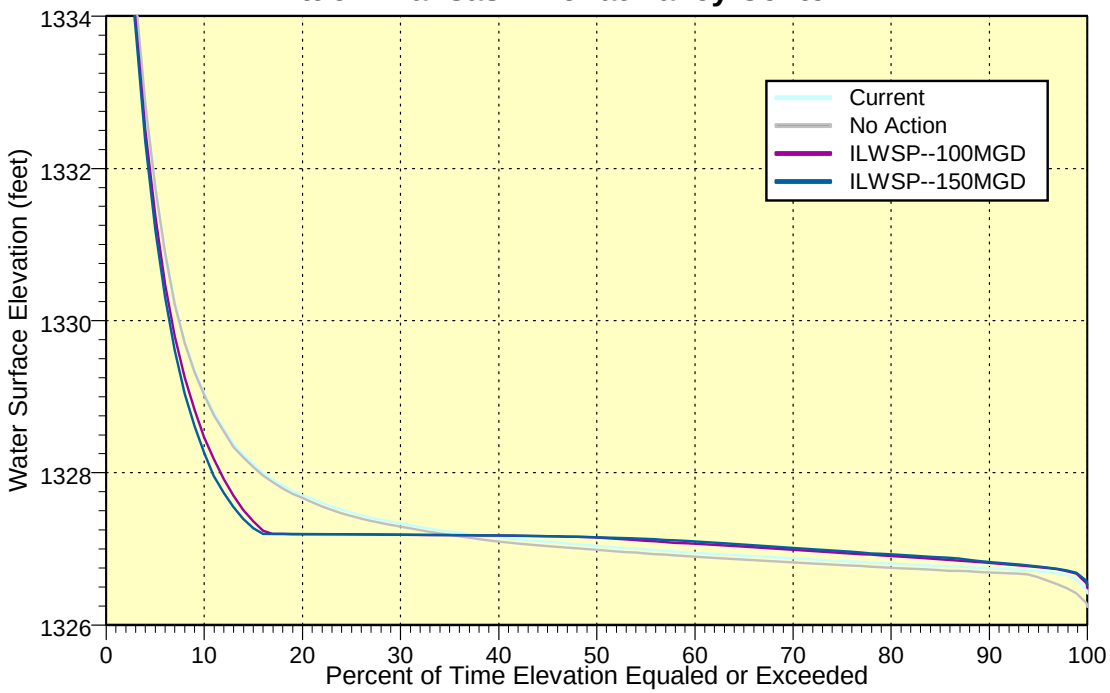


Figure 4-17 Water Surface Elevation Durations, Little Arkansas River at Valley Center



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

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

4.4.1.3.3 Ninnescah River

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

4.4.1.3.4 Cheney Reservoir

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

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

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

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

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

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

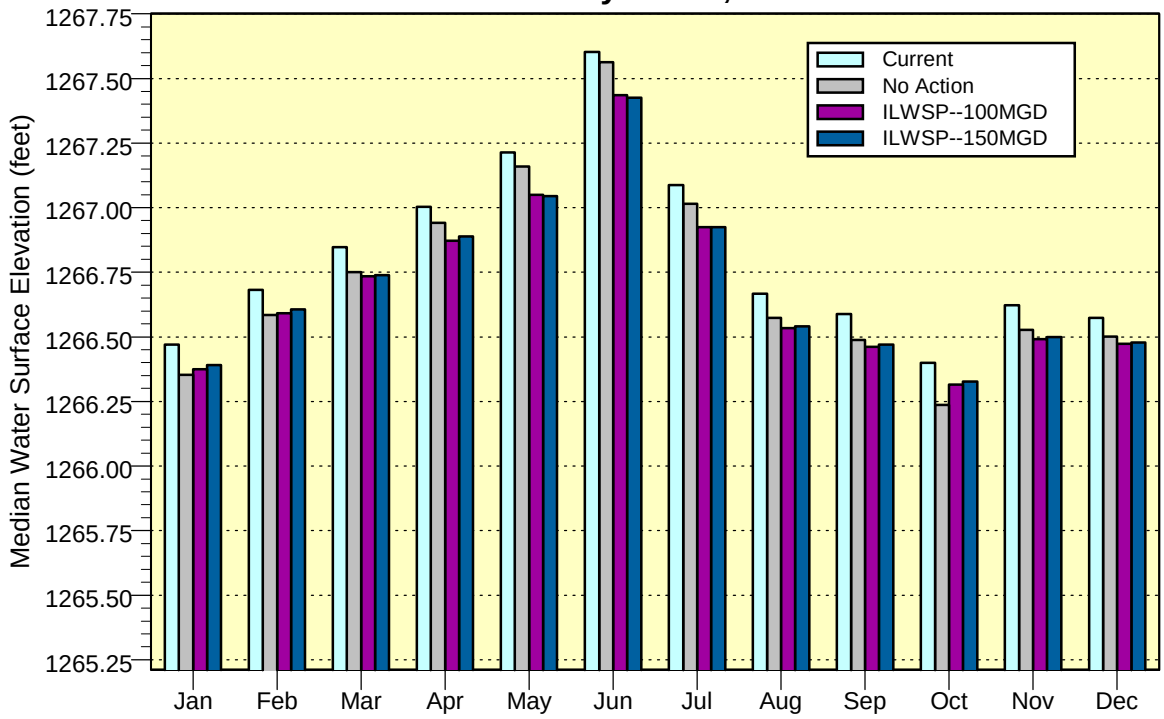
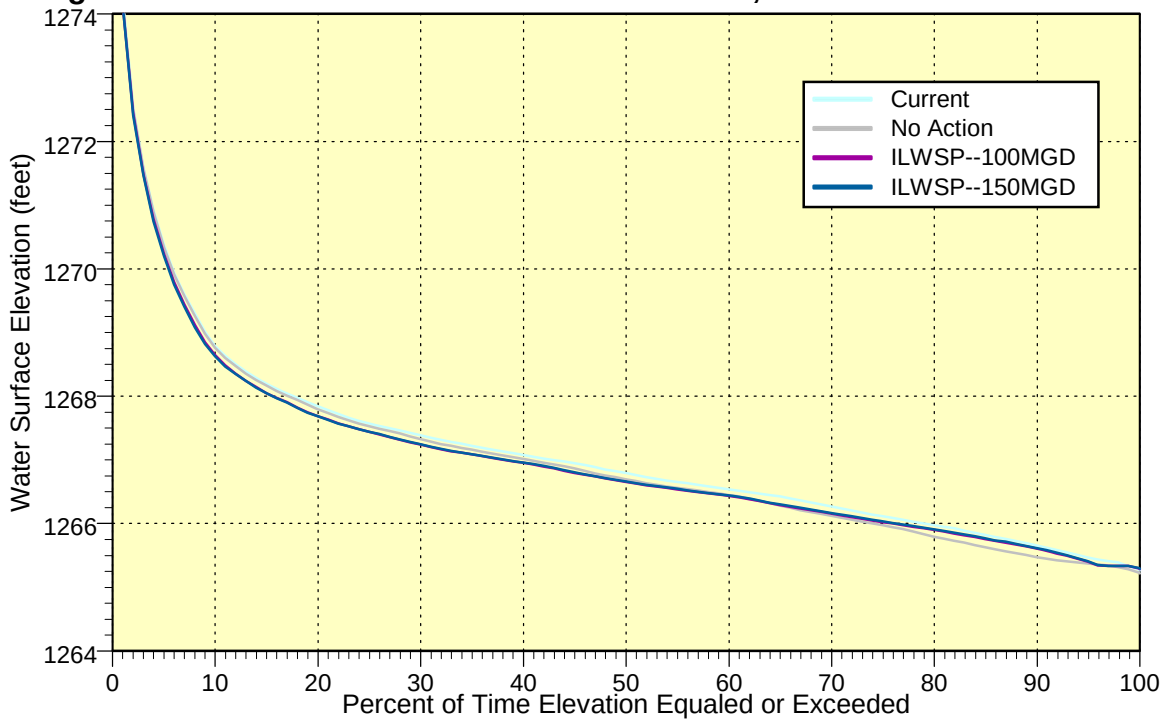


Figure 4-19 Water Surface Elevation Durations, Arkansas River at Wichita



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

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

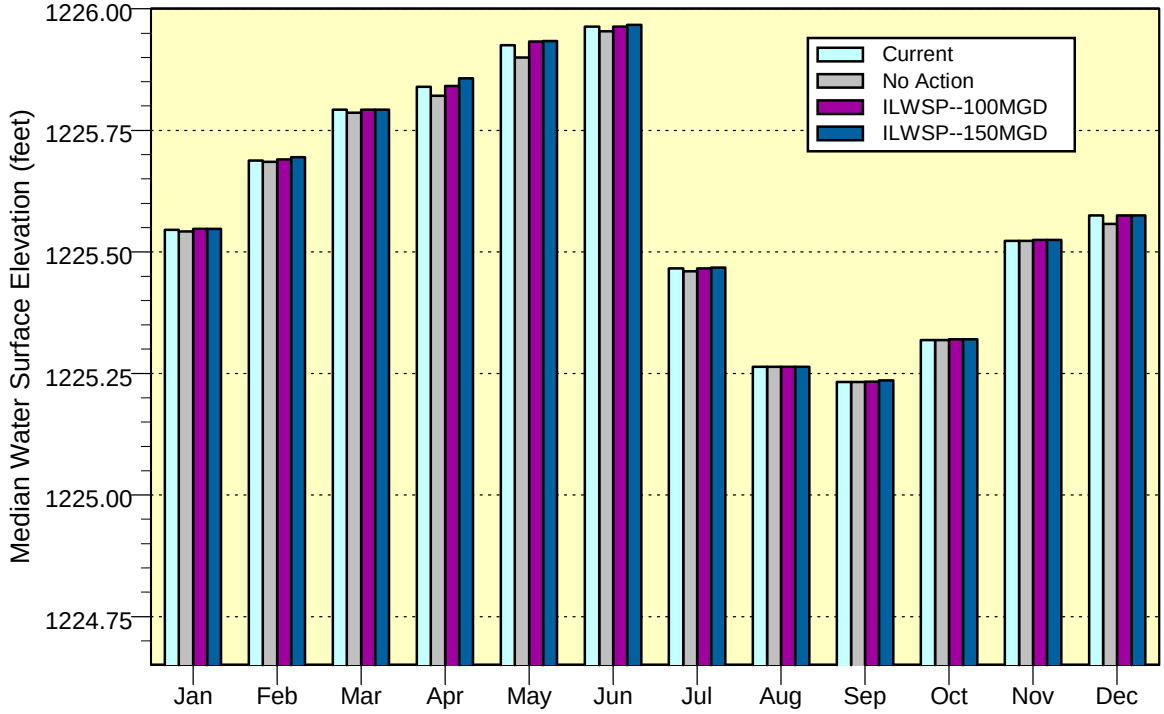


Figure 4–21 Water Surface Elevation Durations, Ninnescah River near Peck

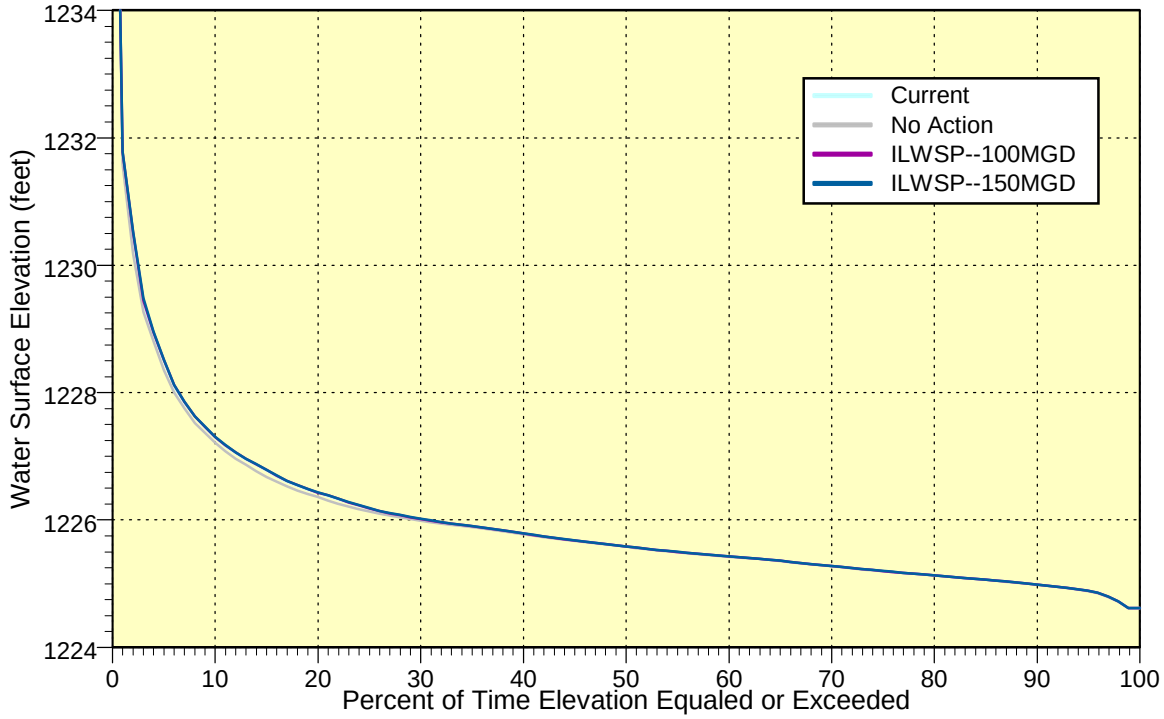


Figure 4-22 Simulated Pool Elevations in Cheney Reservoir

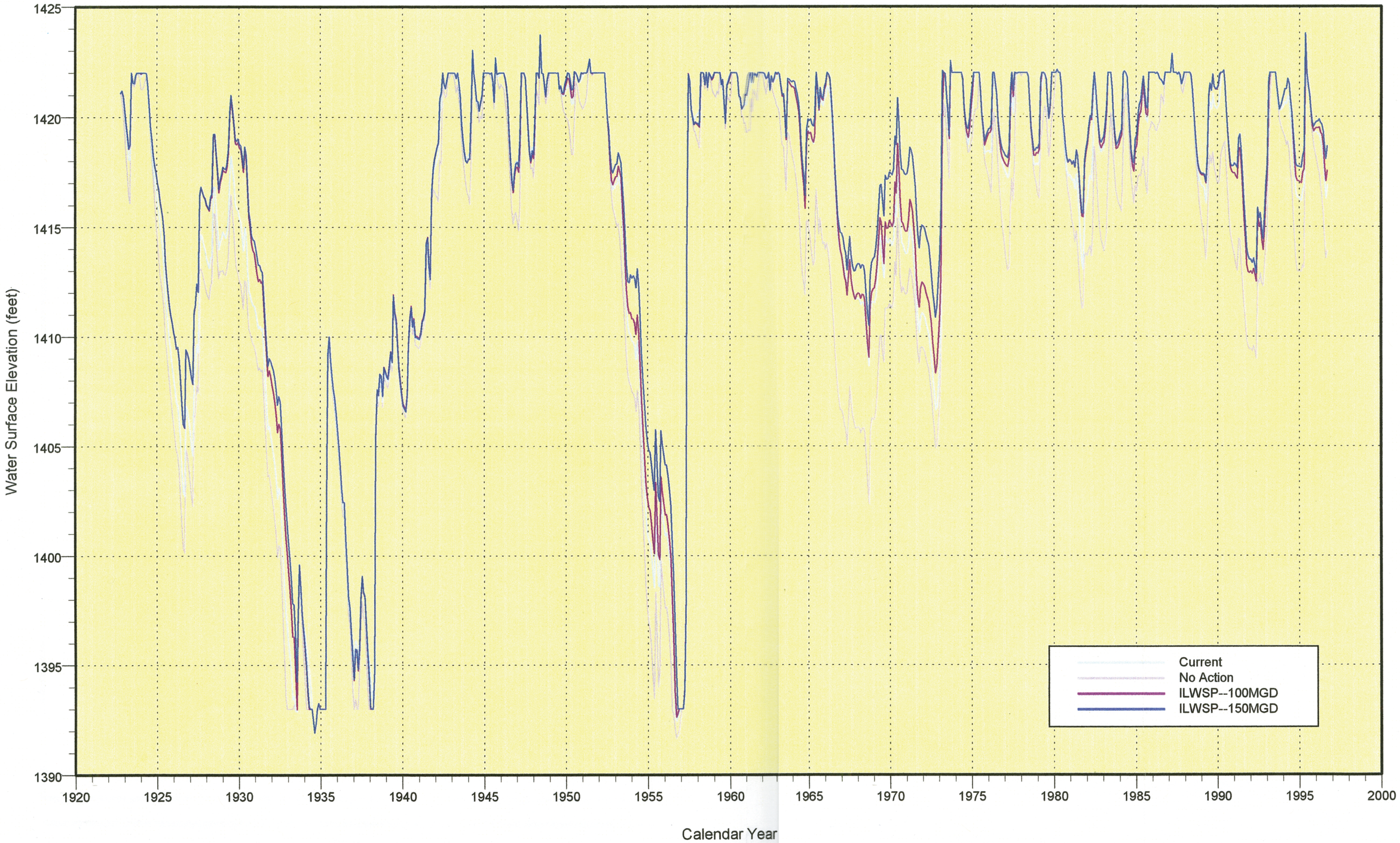


Figure 4–23 Median Water Surface Elevations by Month, Cheney Reservoir

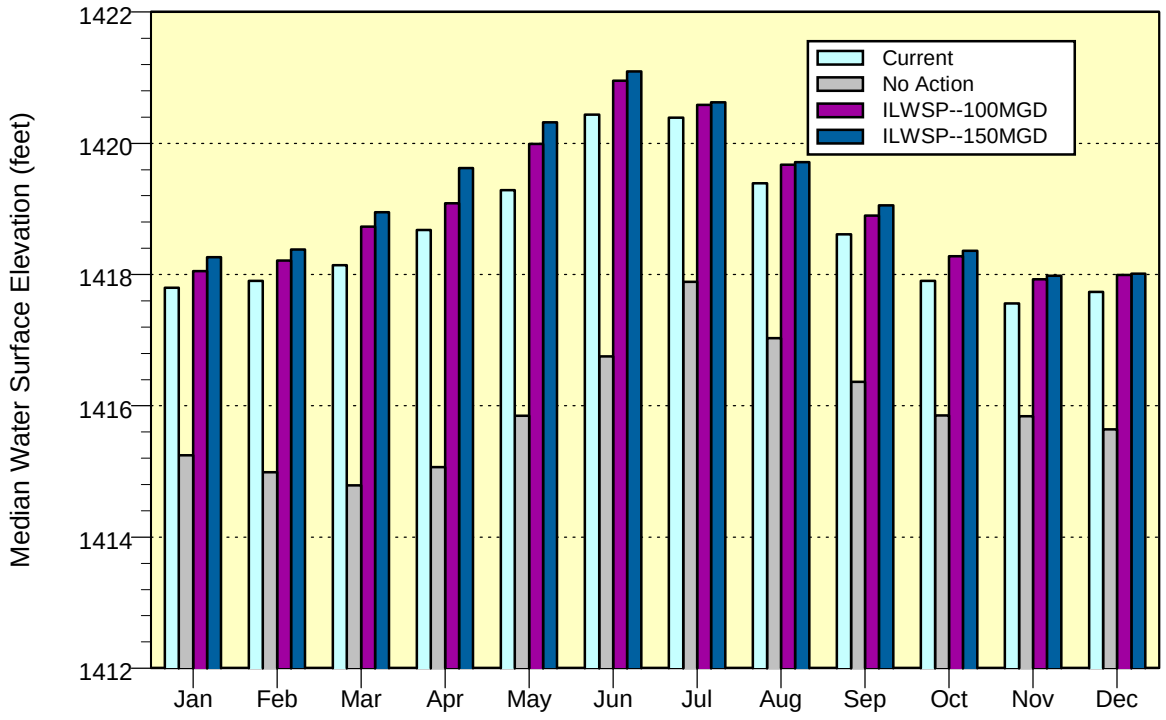
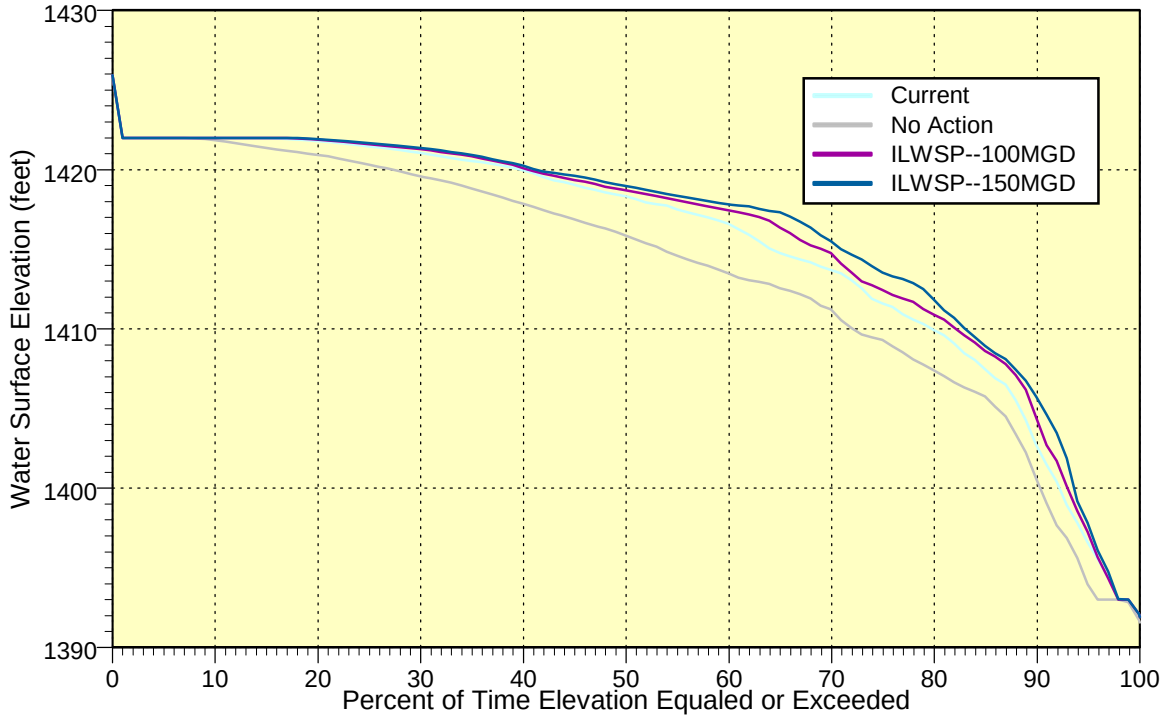


Figure 4–24 Water Surface Elevation Durations, Cheney Reservoir



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

4.4.1.4 Quality

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

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

4.4.1.4.1 Little Arkansas River

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

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

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

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

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

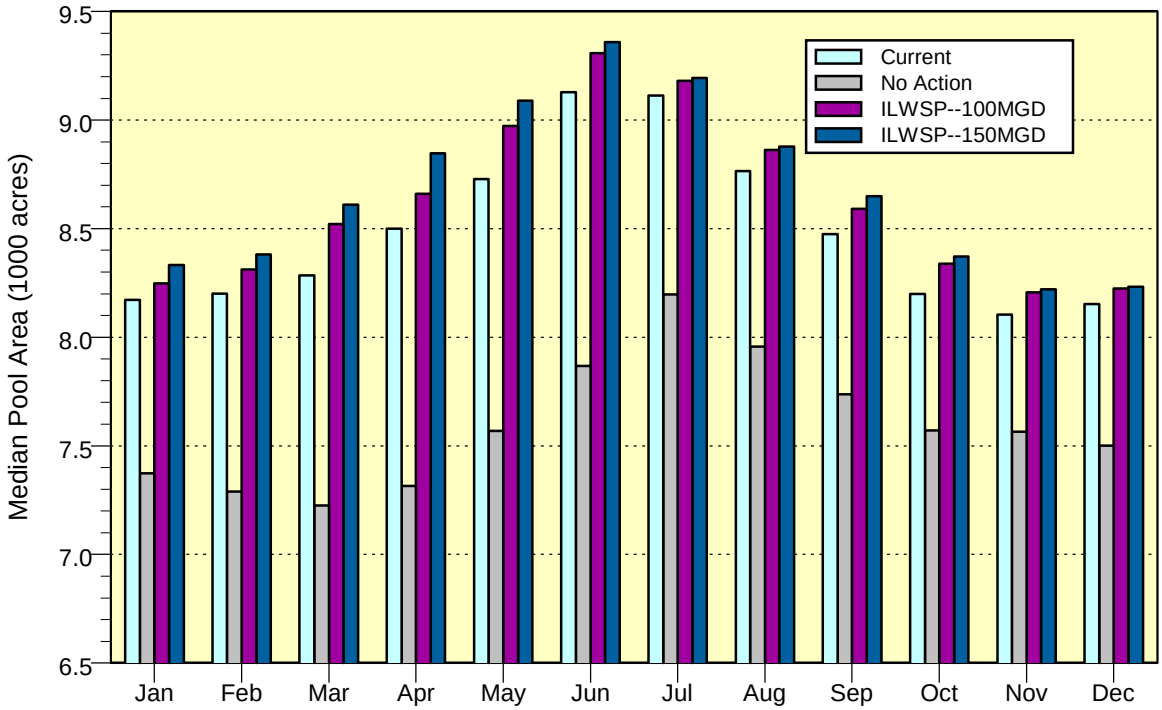
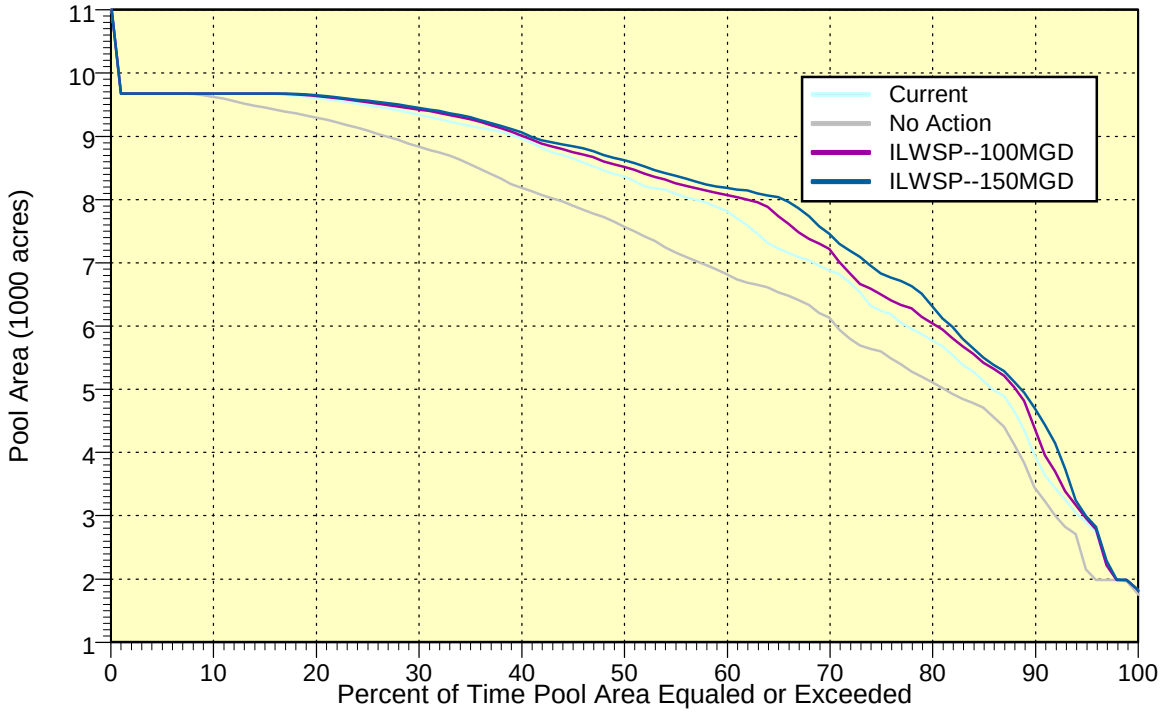


Figure 4–26 Pool Area Durations, Cheney Reservoir



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

Streamflow directly removed from the Little Arkansas River will need to be chemically treated prior to being recharged to the Equus Beds aquifer. Water quality samples taken and analyzed through a cooperative effort by the City and the USGS indicate that turbidity and the herbicide atrazine are the constituents that need to be removed from Little Arkansas River water prior to recharge into the Equus Beds aquifer. The study examined the atrazine concentrations in the Little Arkansas River water near Halstead and Sedgwick, Kansas.

The State of Kansas has adopted EPA's Maximum Contaminant Level (MCL) of 3 micrograms per liter (μg/l) for atrazine as calculated on an annual mean basis. Annual mean atrazine concentrations in the Little Arkansas River did not exceed the MCL for atrazine and annual mean concentrations ranged between 0.90 and 2.6 μg/l. No other herbicides or pollutants occurred in the Little Arkansas River in concentrations that would have required treatment.

A polymer will be used to remove turbidity from waters directly diverted from the river. In addition, powder activated carbon (PAC) may also be required seasonally to remove atrazine or other herbicides. In general, PAC will only by necessary during a 15- to 40-day period in the May through July period when atrazine concentrations in higher flow runoff events are relatively large. Chorine can also be added to control biological activity prior to recharge into the Equus Beds aquifer.

4.4.1.4.2 Arkansas River

From a water quality perspective, the Arkansas River will experience few changes under the No-action alternative. Above Wichita, the only differences in the flow regime will be increased infiltration losses to the Equus Beds aquifer due to declining aquifer water levels. As discussed above for the Little Arkansas River, withdrawals by infiltration will impact only suspended sediment concentrations. Since the infiltration rate is generally much less than the total discharge in the Arkansas River, these potential changes in suspended sediment concentration will be insignificant.

In Wichita and below, water quality impacts to the Arkansas River will result only from changes in the quantity and quality of water that enters it from the Little Arkansas River. This water will tend to be slightly lower in quantity and have slightly higher concentrations of water quality parameters, resulting in similar changes to the Arkansas River.

The ILWSP includes redevelopment of the Bentley Reserve Well Field. This well field straddles the Arkansas River above Wichita and will withdraw water from the river via induced infiltration. At least partially offsetting these withdrawals will be decreasing infiltration losses to the Equus Beds aquifer. Any water quality impacts above Wichita will be fairly insignificant and similar to those discussed above for the No-action alternative.

The most significant water quality impacts to the Arkansas River will occur in and downstream of Wichita. Water will be diverted from the Little Arkansas River at several places for aquifer recharge and direct usage under the ILWSP. While these diversions will only occur when the

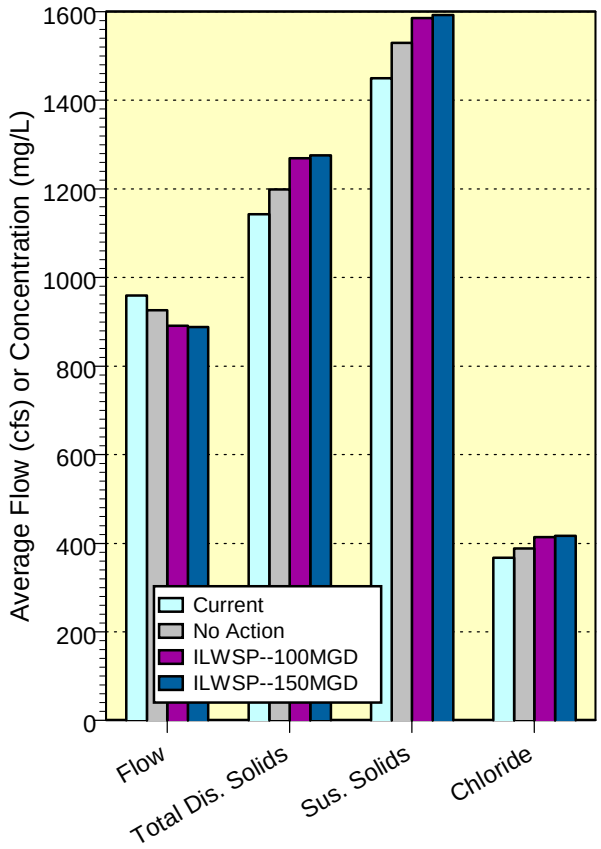
flow in the Little Arkansas River is above baseflow, they will still reduce the quantity of better-quality water that is available for dilution of the Arkansas River.

Using long-term averages for discharge and water quality parameters, a simple mass balance was used to model potential water quality impacts in the Arkansas River at Wichita. The results of this mass balance model are shown in Figure 4–27 for flow, and the concentrations of total dissolved solids, suspended solids and chloride. As compared to the No-action alternative, Figure 4–27 indicates the following changes with implementation of the ILWSP:

- Average flow will decrease by about 4 percent
- Average total dissolved solids concentrations will increase by about 6 percent
- Average suspended sediment concentrations will increase by about 4 percent
- Average chloride concentrations will increase by about 7 percent

On a relative basis, these predicted changes in the water quality of the Arkansas River are not considered very significant.

Figure 4–27
Estimated Water Quality Impacts
Arkansas River at Wichita



4.4.1.4.3 Ninnescah River

Predicted changes in the flow regime of the Ninnescah River and its tributaries are modest under the No-action alternative and with development of either ILWSP alternative. For this reason, any water quality impacts will be similarly modest.

The least attractive alternative, with respect to the North Fork below Cheney Reservoir and the mainstem of the Ninnescah River, is the No-action alternative. As discussed in Section 4.3.1.2.3 above, releases from Cheney Reservoir will decline under the No-action alternative. This will provide somewhat less water for dilution downstream although there do not appear to be major differences in the water quality of North Fork above Cheney Reservoir as compared to points downstream on the mainstem.

Development of the ILWSP will increase the frequency of releases from Cheney

Reservoir, both as compared to current conditions and the No-action alternative. These additional releases are expected to have a neutral or positive impact on water quality.

4.4.1.4.4 Cheney Reservoir

As discussed earlier, the State of Kansas has designated Cheney Reservoir as water quality impaired due to eutrophication and siltation under the Clean Water Act, Section 303(d). None of the proposed development scenarios or alternatives include modifications to the watershed above Cheney Reservoir. Therefore, the mass loading of any water quality constituents to the reservoir due to ILWSP implementation will remain unchanged as well. As shown in the operations model, water quantity moving through the total system with the ILWSP in place should generally increase, thereby potentially lowering nutrient and organic concentrations and possibly decreasing turbidity that could result with more stable reservoir water levels. Also, the frequency of reservoir releases should increase, providing more opportunity for moving or flushing these constituents through the reservoir. Any changes in constituent concentrations will be modest and result only because of changing water levels in the reservoir. Generally, the amount of water stored in Cheney Reservoir, and that available for dilution of incoming constituents, will be least under the No-action alternative and greatest with implementation of the ILWSP. Therefore, water quality impacts in Cheney Reservoir, while modest, are expected to be generally positive with development of the ILWSP.

4.4.2 GROUNDWATER

Groundwater is a very important resource within the ILWSP project area. It is used to supply water for municipal, industrial, agricultural, domestic and live stock uses. Potential impacts to groundwater levels and quality in the project area are discussed in the following paragraphs.

4.4.2.1 Groundwater Levels

Prior to 1940, there was little use made of groundwater within the ILWSP project area except for domestic use and stock watering. Consequently, groundwater levels were near the surface in many areas. Since this time, the City of Wichita, other municipalities, industries and irrigators have extensively developed the existing groundwater supplies. The amount of natural recharge to area aquifers is a direct function of precipitation while groundwater withdrawals are inversely related to precipitation amounts. That is, natural recharge is higher and withdrawals less during wet years. The annual withdrawal of groundwater by the various entities has exceeded the natural recharge to the underlying aquifers in many years so groundwater levels have declined dramatically in some areas. The following sections discuss potential impacts to groundwater sources in the project area.

4.4.2.1.1 Equus Beds Aquifer

The Equus Beds Well Field is, and will continue to be, one of the City’s principal water sources. Without development of the proposed ASR system, the amount of water withdrawn by the City, irrigators and others will generally cause aquifer water levels to decline further in the future and water quality to degrade by increased in-flow from the Arkansas River. Figure 4–28 shows simulated storage deficits in the Equus Beds aquifer for each of the

scenarios.[5] Review of this figure shows that under the No- action alternative, storage deficits are potentially much larger than any of the other alternatives. Maximum storage deficits for current conditions and ILWSP alternatives, which occur during an extreme 1930's-type drought, are nearly equal. However, development of the ASR system will significantly improve the rate that aquifer storage is replenished after a major drought. Storage deficit durations for the Equus Beds aquifer are shown in Figure 4–29. The duration curves in this figure dramatically show the benefits of the ASR component of the proposed ILWSP. Under the No-action alternative, the amount of water stored in the aquifer will be drawn down significantly from current levels resulting in lower water levels and increased poor quality water entering from the Arkansas River. In contrast, development of either ILWSP alternative will help replenish aquifer storage quickly following drought events. Approximately half of the time, aquifer storage can be kept within 100,000 acre-feet of pre-development conditions.

Storage deficits and water levels in the Equus Beds aquifer also impacts the amount of water exchanged between the aquifer and area streams. Figure 4–30 contains duration curves that show how these exchange rates may vary between development alternatives. Infiltration losses from the Arkansas River to the Equus Beds aquifer are represented in Figure 4–30(a). As shown in this figure, infiltration into the Equus Beds is consistently 20 to 30 cfs higher under the No-action alternative than for current conditions, and 20 to 50 cfs higher than either ILWSP alternative. Before extensive development of groundwater resources in the area, the Arkansas River and the Equus Beds were in near equilibrium (that is, infiltration rates were near zero). Due to the elevated chloride content of the Arkansas River, this infiltration is considered undesirable even though it serves as a source of aquifer recharge.

Figure 4–30(b) shows the durations for discharge from the aquifer to the Little Arkansas River. This groundwater discharge is the source of baseflow in the Little Arkansas River and is vital to the maintenance of the river's ecosystem. These groundwater discharges will be the lowest under the No-action alternative, near zero much of the time, and only slightly better under current conditions. With the additional aquifer recharge provided under the ILWSP alternatives, median groundwater discharges will be more than 20 cfs higher.

As shown in Figure 4-28, the amount of water stored in the Equus Beds aquifer will fluctuate significantly over time due to changing climatic conditions, even with implementation of the ILWSP. For this reason, it is not possible to accurately estimate how long it may take to replenish the current storage deficits in aquifer after installation of the ASR system. From the operations model, the average net recharge rates of the Equus Beds aquifer for the 100 MGD and 150 MGD alternatives are 12,700 and 15,200 acre-feet per year, respectively. With a current storage deficit of approximately 250,000 acre-feet, this initial replenishment is expected to take 21 years for the 100 MGD alternative and

[5] Storage deficits are defined as the change in total aquifer storage from pre-development conditions.

Figure 4-28 Simulated Storage Deficits for Equus Beds Aquifer

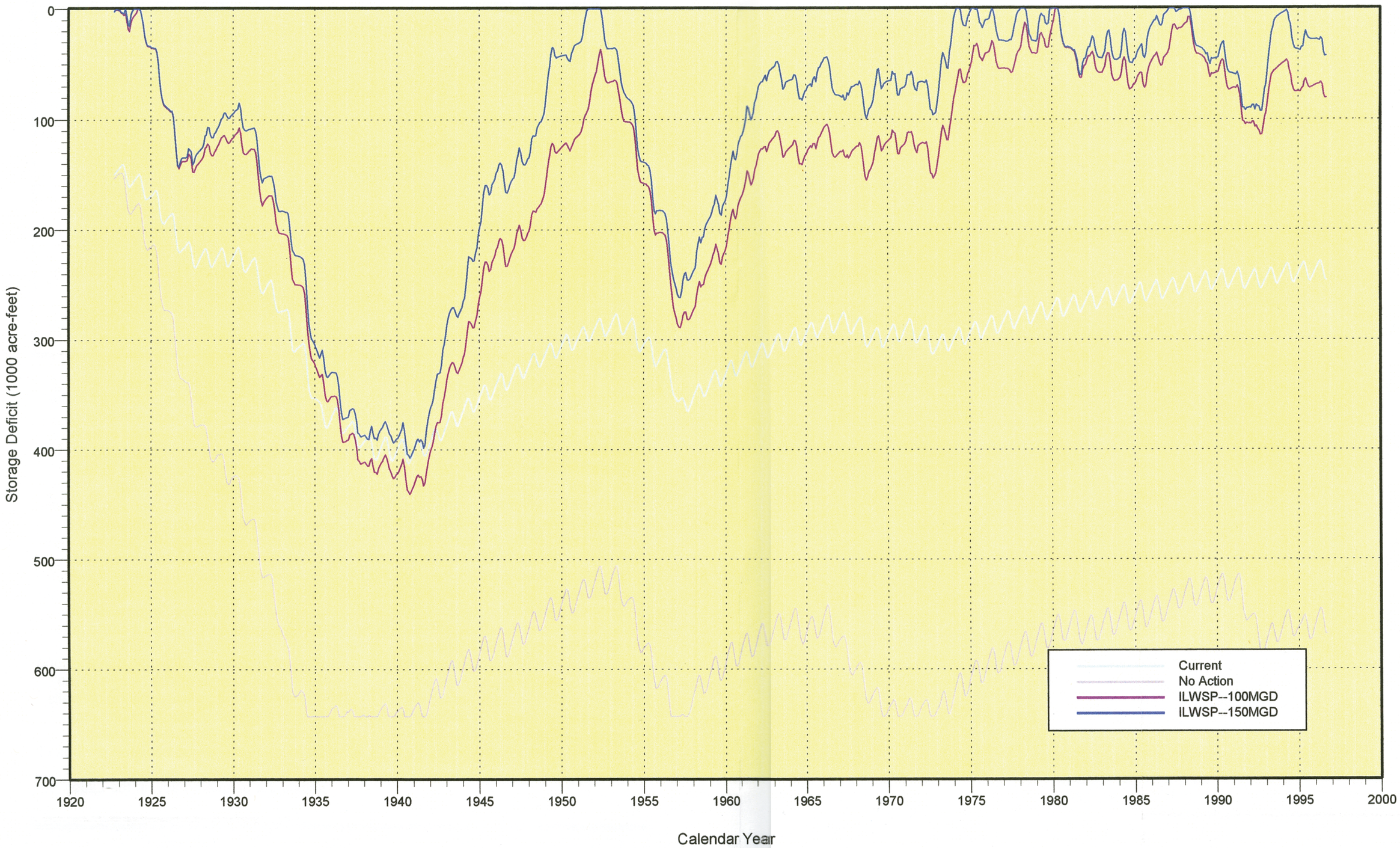
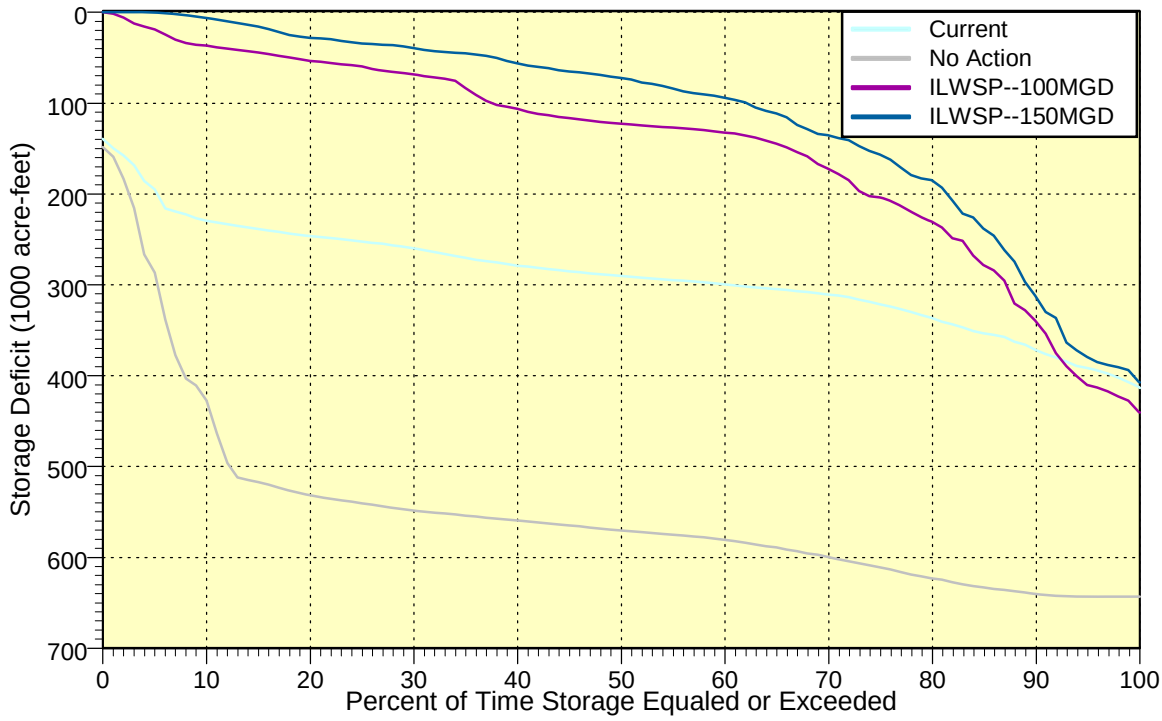


Figure 4–29 Storage Deficit Durations, Equus Beds Aquifer



nearly 18 years for the 150 MGD alternative.

4.4.2.1.2 Little Arkansas River Alluvium

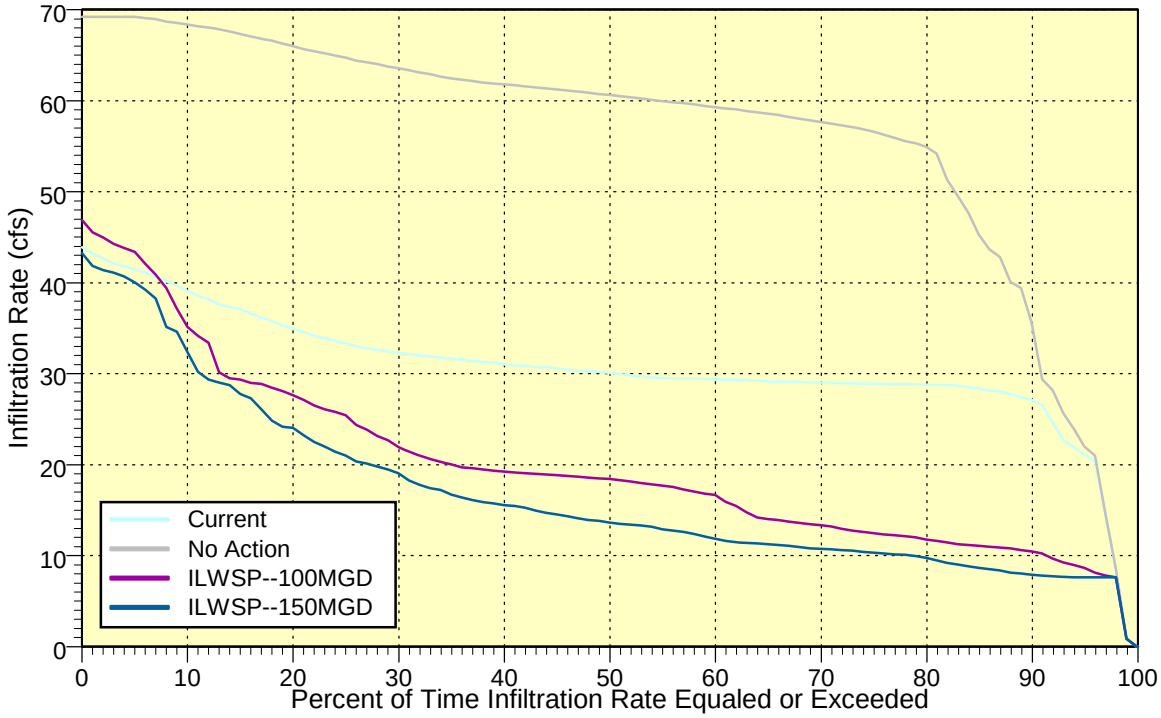
With development of the ILWSP, the water used to recharge the Equus Beds aquifer will be withdrawn from the Little Arkansas River via a series of vertical wells installed along the river. The operation of these wells will depress local groundwater levels and induce infiltration from the river. The drawdown adjacent to an operating well could be 20 to 30 ft. but these drawdowns will dissipate quickly as the distance from the well increases. At distances of a half-mile, drawdowns are likely to be less than one foot. With adjacent wells operating, which are assumed to be installed with quarter-mile spacing, drawdowns may be somewhat larger due to the combined effects from both wells.

The induced infiltration wells will be operated only when the discharge in the Little Arkansas River exceeds 40 cfs. The nominal capacity of each induced infiltration well will be about 1,000 gpm, or about 2.2 cfs. The number of wells operating concurrently will vary depending on the current flow in the Little Arkansas River. Figure 4–31 includes duration curves for aquifer recharge. As shown by these duration curves, the induced infiltration wells will be operated slightly less than half of the time, and that periods with all wells running will total from about 11 to 15 percent of the time.

Review of diversion duration curves alone does not give a complete picture of the operation of the induced infiltration wells because even though diversions may occur about half the time, operating periods are dispersed between periods of inactivity. Figure 4–32 is a graph that shows the simulated flow in the Little

Figure 4-30 Interaction Between Equus Beds Aquifer and Area Streams

(a) Infiltration Losses from Arkansas River to Equus Beds Aquifer



(b) Groundwater Discharge from Equus Beds Aquifer to Little Arkansas River

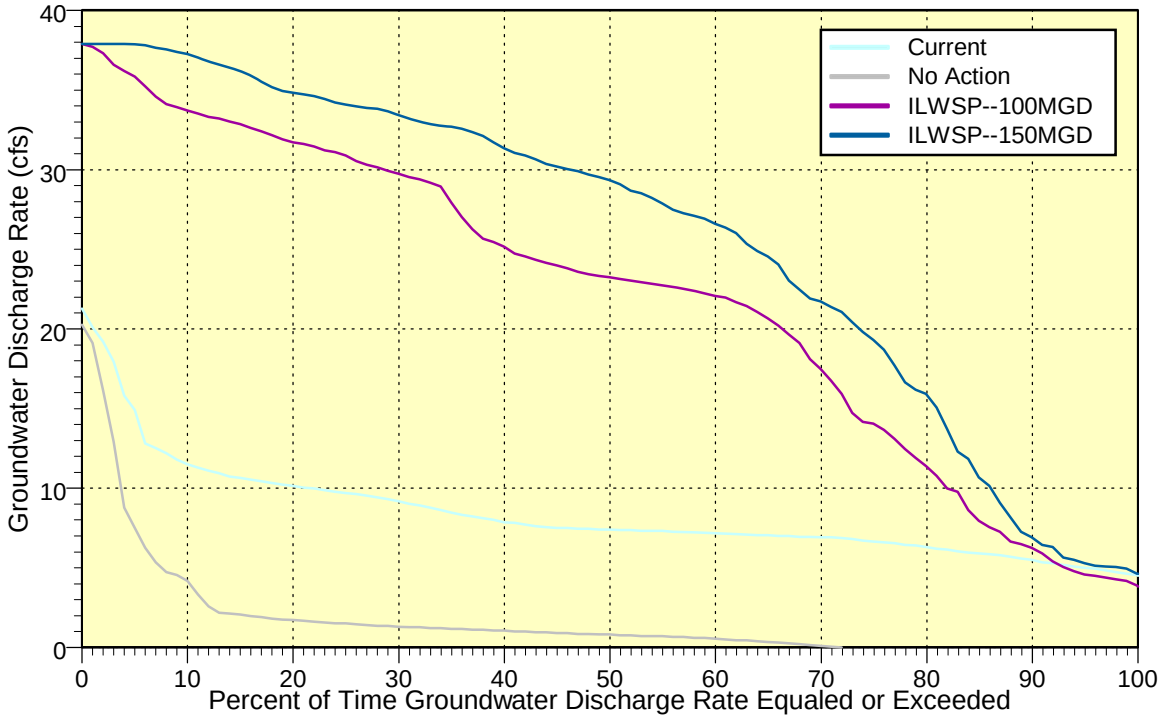
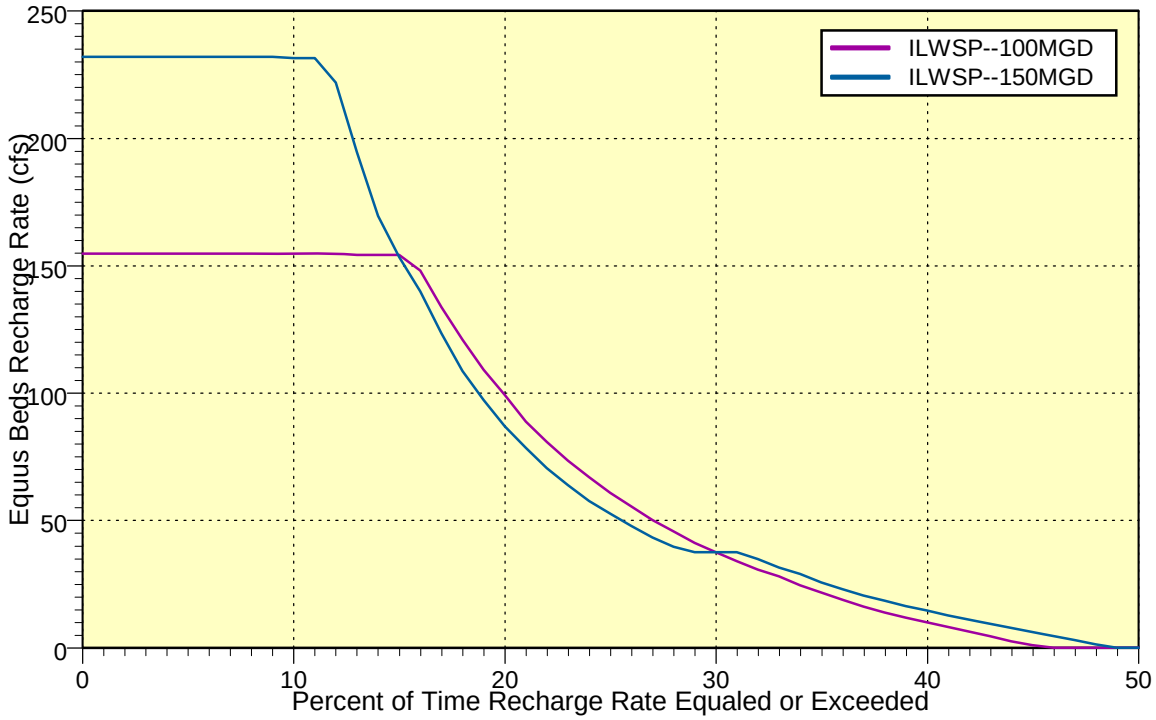


Figure 4–31 Durations of Recharge to Equus Beds Aquifer



Arkansas River at Valley Center for the current and 100 MGD ILWSP alternatives for water year 1992. This is the median water year, as ranked by total annual flow. In this chart, the flow at Valley Center for the ILWSP alternative is superimposed on the flow under current conditions. As a result, the current condition bars are only visible when there are depletions due to operation of the ASR system. Examination of this graph shows there are frequent periods when the system is not operated at all and, when it does operate, it does not usually operate continuously for long periods. In this median flow year, there were two periods when the system operated continuously for about 30 days each, with the remaining operational periods no longer than 5 days.

Groundwater levels in the Little Arkansas River alluvium will also be impacted due to development of the expanded Local Well Field. This development will consist of installation of up to four horizontal collector wells along the river within the Wichita city limits. These collector wells would be operated when the flow in the Little Arkansas River exceeds 20 cfs.

Figure 4–33, which shows the supply durations from these collector wells, indicates that these wells will operate at some capacity almost all of the time and at full capacity about 40 percent of the time.

Drawdowns in the vicinity of these collector wells will depend on a number of factors including the current pumping rate and water surface elevations in the adjacent river. With typical, non-flood flow rates in the Little Arkansas River, drawdowns adjacent to a collector well could be as high as 10 to 15 ft. when pumping at full capacity. At a half-mile from a collector well, these drawdowns

Figure 4-32 Potential Impacts in Median Flow Year for Little Arkansas River at Valley Center

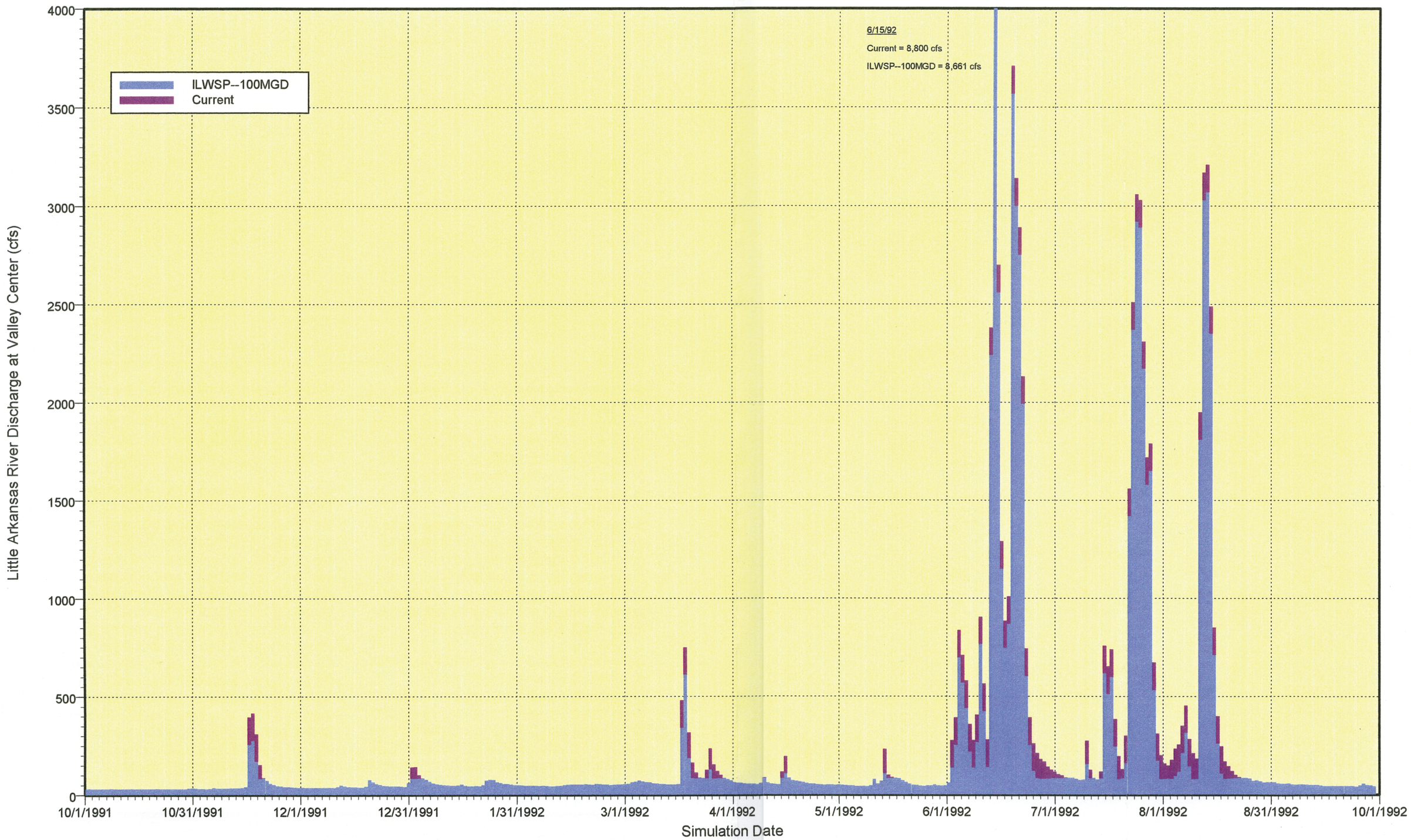
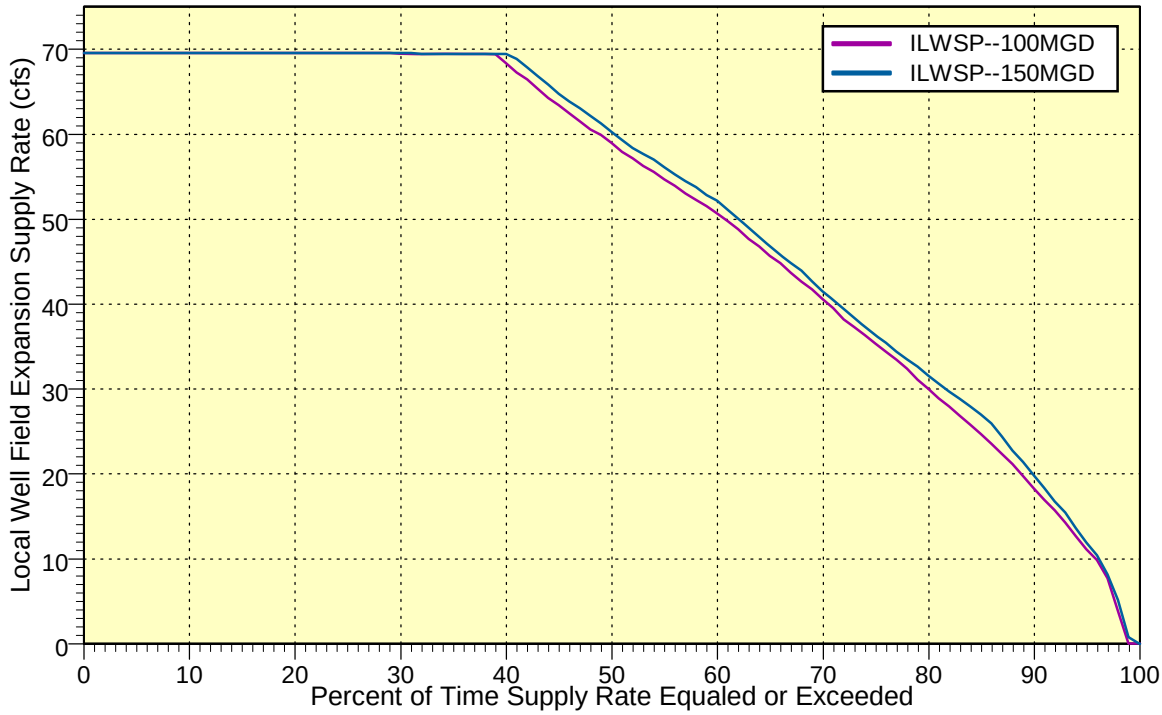


Figure 4–33 Local Well Field Expansion Supply Durations



will have decreased to about one foot. The facilities that would be constructed with the ILWSP and the Local Well Field expansion will be located to avoid impacting existing wells or other City or private facilities that could have an impact to water quality.

Some City residents have private wells that they use for irrigation of lawns and gardens. If there are any private wells in close proximity to a collector well, they could be adversely impacted but these impacts should not be significant unless these wells are quite shallow.

Operation of the induced infiltration wells or collector wells will cause local groundwater level declines that could impact riparian wetlands along the Little Arkansas River. Since these drawdowns will be relatively small and intermittent, it is difficult to predict whether any wetlands will suffer significant impacts.

Under current conditions and the No-action alternative, there will be no additional wells installed in the Little Arkansas River alluvium and, therefore, no localized groundwater impacts.

4.4.2.1.3 Arkansas River Alluvium

The Bentley Reserve Well Field straddles the Arkansas River about 10 miles northwest of Wichita. The ILWSP includes the redevelopment of this well field, which will impact groundwater levels in the Arkansas River alluvium in the immediate vicinity of the well field. Drawdowns adjacent to an operating well may approach 20 to 30 ft. but these drawdowns will decrease rapidly as the distance from the well increases. At a half-mile, drawdowns will likely be less than one foot. Also, the Bentley Reserve Well Field is intended only for peaking use, primarily during the summer months when water demands are normally highest. Therefore, any potential impacts

from the operation of this well field will occur rather infrequently, on an annual basis. For the No-action alternative, this well field will not be redeveloped.

Further downstream, within the City of Wichita, is the City's existing Local Well Field.[6] The City also uses this well field for peaking use. No significant operational changes are expected for Arkansas River alluvial wells in this well field with any of the possible alternatives. As a result, no significant new impacts are anticipated.

4.4.2.2 Quality

The quality of groundwater in the project area varies greatly depending on the geologic formation it is derived from and its depth. Implementation of ILWSP alternatives for this project will primarily impact the aquifers as discussed below.

4.4.2.2.1 Equus Beds Aquifer

The quality of the water in the Equus Beds aquifer is currently quite good but is very vulnerable to future degradation, especially by salinity. There are numerous natural and man-made sources of salinity in the vicinity that could contribute to the aquifer's contamination and resulting degradation.

One source of salinity that could pollute the Equus Beds aquifer is the Arkansas River. Chloride concentrations in the Arkansas River average over 500 mg/L, about eight times the chloride content of the water produced by the City's current water supply wells. Before development of the aquifer for water supply and irrigation, the river and aquifer were nearly in equilibrium; there was little migration of chlorides from the river into the aquifer. Because of the depressed water levels found today in the aquifer, water from the Arkansas River infiltrates into the aquifer at a rate of about 25 cfs (see Figure 3–10). Using this infiltration rate and an average chloride concentration of 500 mg/L is equivalent to dumping about 170 tons of salt into the Equus Beds aquifer every day.

Under the No-action alternative, the infiltration rate and rate of salinity contamination, will increase dramatically. As shown in Figure 4–30(a), the median infiltration rate is expected to double over current conditions. However, with development of either ILWSP alternative, aquifer water levels will rebound and the infiltration rate from the Arkansas River will diminish as compared to current values.

The other potential source of chloride contamination for the Equus Beds aquifer comes from the Burrton area to the northwest. In this area, past oil field development and production have introduced large quantities of brine into the unconsolidated surficial aquifer. It has been estimated that over 90,000 tons of salt were discharged into the aquifer during the oil production period. In the immediate area surrounding Burrton, chloride concentrations over 2,000 mg/L have been discovered. Because of the existing groundwater gradient, these highly saline waters will tend to migrate southeastward into the Equus Beds Well Field area.

4.4.2.2.2 Little Arkansas River

The quality of groundwater adjacent to the Little Arkansas River is expected to closely match that of the adjacent river because of the strong hydraulic

[6] Also known as the Emergency and Sims, or E&S, well fields.

connection between the two sources. At higher river flows, water migrates into the aquifer materials and at low river flows, the process reverses.

With development of the ILWSP, a large number of wells will be installed in the aquifer material to divert water from the Little Arkansas River for recharge of the Equus Beds aquifer. When operating, these wells induce infiltration from the river, mixing river water with in-situ groundwater. With long-term pumping, the river water will replace the groundwater and discharge water quality will approach that of the river. However, since the quality of water in the Little Arkansas River is generally good, this is not considered to be a significant project impact.

Similarly, expansion of the Local Well Field by installation of horizontal collector wells along the Little Arkansas River will have the same water quality impacts as those located further upstream. The water quality in the aquifer will become nearly identical to that of the river.

4.4.2.2.3 Arkansas River Alluvium

In the Arkansas River alluvium, existing groundwater quality is similar to that of the adjacent river, again because of the strong hydraulic connection between the two. Also, the existing groundwater gradient encourages water to infiltrate into the aquifer. As a result, this groundwater tends to have high salinity making it unsuitable for irrigation and most other uses. Under the No-action alternative, the water quality of the alluvial aquifer will continue to decline but at an accelerated pace.

The proposed redevelopment of the Bentley Reserve Well Field will induce additional infiltration of water from the Arkansas River into the alluvial aquifer. This will cause the water quality of the river and the aquifer to become nearly identical in the immediate vicinity of the well field. This is not viewed as a significant adverse impact because the City would be the only entity using this water. The City is able to use this water with high salinity because it will be blended with much larger quantities of better-quality water. Therefore, the dilution effect will keep the chloride content of the water delivered to the City lower than the levels recommended under drinking water standards.

4.4.3 WATER RIGHTS

Impacts to existing and/or potential water right holders may result from the two proposed ILWSP alternatives. Additional water rights will be needed by both alternatives to meet the future water demand. Table 4-2 shows the water rights needed by water source.

Neither ILWSP alternative would make additional water available for appropriators or water users in the Equus Beds aquifer. As discussed in Chapter 3, groundwater development by municipal and agriculture water users is significantly greater than the safe yield of the Equus Beds aquifer. Therefore, most areas in the Equus Beds well field area are closed to applications for new water rights.

An exception may be in the proposed Bentley Reserve Well Field area where poor water quality has limited agricultural use. All or part of the proposed 10-MGD development may be met by development of water available under the safe yield policy.

Additional water rights for the proposed ILWSP, in connection with the Equus Beds aquifer and issued to the City, will

Table 4–2 Additional Required Water Rights

Area	Annual Quantity ac-ft	Maximum Rate of Diversion, MGD
Bentley Reserve Well Field (new water right required)	5,000	10
Expanded Local Well Field (new water right required)	35,000[1]	45
Aquifer Storage & Recovery[3]		
Source water diversion	100,000[2]	100
Storage recovery rights	depends on volume stored[4]	126

Notes:
1. Well Field will only be pumped when "excess" water is available over the minimum desired streamflow of 40 cfs.
2. Diversion will be operated only when river flows are 50 cfs.
3. The Kansas Division of Water Resources and the local groundwater management district are currently developing regulations and permitting requirements.
4. The amount in storage, available for recovery will be reviewed annually and certified by the groundwater management district.

contain criteria to ensure the existing water right holders will not be adversely impacted. These criteria will include adherence to the minimum well spacing standards so that interference drawdown due to pumping will be minimized. Additionally, diversion water rights for the Little Arkansas River will limit operation to periods of above-base flow. The minimum level of operation will include consideration of minimum desired streamflow and existing surface water rights downstream of the ASR diversion area , including the Little Arkansas River and the Arkansas River below Wichita.

Regulations for Aquifer Storage and Recovery projects, such as included in the ILWSP alternatives, are not finalized by Groundwater Management District No. 2. However, it is anticipated that water rights for the recovery of stored water will be evaluated and adjusted annually to determine the amount of water that could be recovered from each individual facility.

Benefits to be gained by current water rights holders due to the recharge element of the ILWSP alternatives include:

- higher groundwater levels which would result in lower power costs to pump water, and
- reduced migration of high-chloride water into the aquifer from the Arkansas River to the southwest and from the Burrton oil field area from the northwest.

As the aquifer is refilled, there will be increased seepage from the aquifer to the Little Arkansas River, increasing base flow. As shown in Figure 4-30(b), the median rate of groundwater discharge to the Little Arkansas River is expected to increase by about 15 cfs or more.

Additionally, there is a potential that Kisiwa Creek may regain surface flow. Changed conditions from pre-development times that may adversely

influence the potential for increased return flows include:

- Channel modification – that may have been made by farming or other "improvements."
- Channel siltation that would raise the base elevation or clog the channel. Because there is currently no flow, sediment buildup is likely.
- Vegetation and phreatophyte growth.

4.5 AIR QUALITY

Criteria pollutants include lead (Pb), particulate matter of 10 microns diameter or smaller (PM_{10}), ozone (O_3), sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon monoxide (CO). Levels for these pollutants have been established to protect human health. Air quality in the counties and major cities in the project area has been classified by the U.S. Environmental Protection Agency (40 CFR 81.328).

The Equus Beds Well Field, Bentley Reserve Well Field and Cheney Reservoir associated with the alternatives are located in rural areas. The expansion of the Local Well Field is located in an urban/suburban area.

In evaluating the significance of project impacts to air quality, Prevention of Significant Deterioration (PSD) increments and significant impact levels were reviewed. Levels have been established for significant increases in certain criteria pollutants over ambient air concentrations (Table 4–3). Under these PSD levels, significant impacts to air quality would occur if these criteria are exceeded because of project activities.

The ILWSP alternatives are not expected to have any long-term impacts on local or regional ambient air quality. If any long-term increases in fugitive dust or engine emissions from operation and maintenance activities would occur, they would be minimal.

Table 4–3 Prevention of Significant Deterioration Increments for Air Pollutants

Pollutant	Averaging period	Significance criteria ($\mu g/m^3$)
SO_2	Annual	20
	24-hour	91
	3-hour	512
PM_{10}	Annual	17
	24-hour	30
NO_x	Annual	25

Source: 42 USC 7473(b)(2)

Construction activities in the immediate vicinity of each water supply alternative would have a temporary effect on local ambient air quality. Increases in dust levels from excavation and vehicle traffic could temporarily increase PM_{10} levels. Diesel engine exhaust from construction equipment could temporarily increase NO_x, CO, and SO_2 levels. The actual decrease in ambient air quality and increase in PM_{10}, NO_x, CO, and SO_2 levels would depend on the particular construction activity being performed, the type and amount of construction equipment being used, the prevailing wind direction and speed, and the soil moisture conditions existing at the time. These pollutants could temporarily exceed PSD levels, thereby resulting in a impact to local ambient air quality.

The No-action alternative would not have any impact on ambient air quality in the project area, because no construction or operational activities would be associated with this alternative.

Several measures would be implemented to reduce or prevent significant impacts to air quality. Dust levels generated during construction would be minimized by spraying water or other approved dust control compounds on haul roads. Disturbed areas would be revegetated as soon as possible. To minimize emissions, all construction vehicles would be maintained in good working conditions. Construction contractors would be required to comply with all local, state, and federal air pollution rules.

4.6 NOISE

Construction and operation activities associated with the ILWSP alternatives could increase noise levels in the surrounding local area. Noise sources during construction would include heavy construction equipment, blasting, and increased vehicular traffic to and from the construction site. Following cessation of construction, most noise would come from operation and maintenance activities. Sensitive noise receptors such as residences, businesses, recreationists, livestock, and wildlife would likely be most impacted.

Most individuals would notice an incremental increase in noise levels. For the purposes of this analysis, the impact would be considered significant if permanent area residences were to experience an increase of 3 dBA or more above ambient noise levels. Construction equipment could cause this level to be exceeded at a residence located within 600 ft. of pipeline, well, or basin construction.

Construction activities would entail the development of vertical recharge/recovery wells on new or existing well sites. The number of wells would vary by alternative selected. A typical construction period for a vertical well would require two weeks continuous activity, followed one week later by an “acceptance test”. The acceptance test would require one to three days of continuous operation. Equipment used for well construction and testing can be considered loud; however, decibel levels vary widely between various types of equipment and their condition and cannot be specified at this point. Should an ASR well and acceptance test be required in an area where residences, business, or recreational activities are nearby, noise mitigation devices, i.e., engine mufflers, etc., may be specified. Once construction is complete, well operation would be virtually noiseless; pump motors used for the wells would be electric submersible or located in buildings (pump houses) constructed for that purpose.

Construction of a horizontal collector well involves the development of a facility about 16 feet to 20 feet in diameter including the cap. The construction period is estimated to be six to nine months. The “acceptance test” would require another three to seven days of continuous operation of a test pump. For horizontal collector wells, a “direct electric feed” device may be used, reducing noise levels considerably. As with the vertical recharge/recovery wells, equipment used to construct the horizontal collector wells would use noise mitigation devices (i.e., engine mufflers, etc.), in areas where residences, business, or recreational activities are nearby.

Vehicular noise during construction of a horizontal collector well would increase due to two or three trucks delivering concrete to the site each week for five to six weeks, and an estimated 10–15 semi-trucks delivering other items anticipated for each well.

The anticipated construction period for a single recharge basin would be approximately two weeks, but total site development would probably take three to four months. During this period, drilling equipment would be in operation, along with typical heavy construction equipment. Traffic noise should be similar to that for the construction of the horizontal collector well. Once basin and site development is complete, no additional noise impact is anticipated, as basin operation emits no noise. A residential development, near one of the basins located north of the City of Bentley, is currently under consideration for potential expansion. Should temporary construction noise and activity become a concern, planners would work with residents to develop a mitigation plan.

Pipeline construction would typically involve clearing, digging a trench, laying the pipe, filling the trench, and regrading. Noise from this activity is not expected to affect any one point for more than a few days. Most of the area within the well fields would be relatively undisturbed by this type of construction.

Human activity and the noise associated with construction of the wells and associated pipelines have the potential to adversely impact area wildlife. Should increases in ambient noise result in significant redistribution or disturbance to wildlife, noise impacts would be considered significant.

With few exceptions, the areas that would be impacted by construction activities for the proposed water supply alternatives have already been disturbed by agricultural, suburban, or urban development. The use of these areas by wildlife is relatively low. Even so, the noise generated by construction activities may cause some wildlife to temporarily abandon these areas.

After construction, increased noise levels in the vicinity of the well fields would be caused by increased traffic attributable to operation and maintenance. These noise levels, however, would be intermittent and comparable with noise generated by current agricultural activities in the rural areas and local traffic within the urban or suburban areas. Impacts to wildlife due to noise are not expected to be significant.

No construction or operational activities would be associated with the No-action alternative, thus no noise impacts to either human or wildlife populations would occur.

4.7 BIOLOGICAL RESOURCES

Biological resources could be impacted by the proposed water supply alternatives by the construction of water treatment plants, pipelines, and access roads, and by changes in groundwater levels and river flows.

4.7.1 WETLANDS

Wetlands are transitional communities between aquatic and terrestrial systems and are determined by the presence of appropriate soils, plants, and hydrology. Changes to one or more of these criteria have the potential to impact the functions and values of a wetland. In the project area, wetlands are found primarily in lowland areas in the Little Arkansas River floodplain and along the edges of lakes such as Cheney Reservoir and streams. Construction activities and alteration of hydrology caused by lowering groundwater levels may not impact wetlands associated with the Little Arkansas River and its tributaries.

To understand the potential for impacts caused by construction and operation of the proposed project, wetlands were identified using the National Wetland Inventory maps (NWI) near each water supply alternative. The NWI maps were used to determine the extent and type of wetlands that could be impacted by the project. Possible impacts to wetlands by the horizontal collector wells near the Wichita Flood Canal and proposed wells along the Little Arkansas River were evaluated. The impacts were evaluated by comparing the distribution of wetlands on and around the canal and river to existing depth to groundwater and the maximum groundwater level drawdown caused by the proposed pumping scenarios.

Saturated soils within the upper one-foot for an extended duration is essential for the development and maintenance of wetlands. If extended periods of pumping groundwater were to occur in an otherwise stable groundwater table, wetland functions and values may be impacted.

The proposed horizontal collector wells and Equus Beds ASR wells may not draw down the groundwater table, if the pumping period is not sustained. Significant impacts could occur if the source of the wetland's hydrology is not maintained by groundwater.

To assess the connection between groundwater and wetland areas, the depth to groundwater at each site was determined using a groundwater level map prepared from historic monitoring well data. The resulting depth to groundwater is assumed to represent average conditions.

Detailed groundwater modeling has been done for the Equus Beds Well Field and along the Little Arkansas River. The criteria for assessing possible wetland impacts included a qualitative determination of the drawdown and the capture zone in the vicinity of the well field and river. These levels were determined based on the Little Arkansas River flowing at a rate of 20 cfs or greater. The semi-confined nature of the aquifer would tend to reduce the areal extent of the drawdown but increase the depth of the drawdown.

The proposed construction of transmission pipelines and access roads could cross wetlands located in the vicinity of the proposed recharge area north of Wichita. These wetlands, however, would be impacted only temporarily. For transmission pipelines, wetlands were considered to be lost within the 50-foot wide permanent easement and temporarily disturbed within an additional 50-foot wide construction easement. Pipelines within the well fields were considered to temporarily disturb wetlands within a 50-foot wide construction zone. Access roads would be planned to avoid wetlands, if possible. In the event that access roads could not avoid wetlands, the impact would be permanent. The access road width would be approximately 20 ft. Based on spot observations, wetlands were assumed to exist along the banks of all streams and river channels that would be crossed by pipelines, even if no wetlands were shown on the NWI maps.

Wetlands and aquatic beds are afforded an extra measure of protection under the Clean Water Act. Any unavoidable loss to these special aquatic sites would be a significant impact.

The proposed construction of transmission pipelines from the horizontal collector wells and the Equus Beds Well Field to the recharge areas to the north will have temporary wetlands impacts at Kisiwa Creek and the North Branch of Kisiwa Creek. The transmission pipelines will cross the creeks in 17 locations. Approximately 0.50 acre of temporary impacts to emergent wetlands will occur at each of the creek crossings.

Based on City monitoring wells, the average annual groundwater elevation in the areas around the Sedgwick and Harvey county well fields is 1305 feet. The highest groundwater elevations occurred in the winter and spring months. The lowest groundwater elevations occurred in the summer and fall months. Fluctuations in groundwater elevation are caused by changes in Little Arkansas River water levels, by the operation of local irrigation wells and the City's water wells.

Currently, floodway wetlands adjacent to the proposed horizontal collector wells receive surface water and groundwater as sources of hydrology. The floodway wetland hydrology is dynamic, based on a review of local groundwater monitoring well data. Another intermittent source of surface water occurs as run-off from surrounding areas during significant precipitation events. The wetland hydrology can range in depth from 1 foot above ground surface to saturated soils 1 foot below, during normal conditions. The well field, pumping at a rate of 45 MGD (8 MGD per individual collector well) when the water in the floodway is flowing at greater than 20 cfs, may not cause an adverse effect. The steady state groundwater modeling results show decreased groundwater levels within the floodway wetland area. The decrease in groundwater levels would not be visible because of the 20 cfs surface water flow in the floodway and the pumping rates would not be sustained for a sufficient period of time to de-water the floodway wetlands. Groundwater levels would lower if the pumping periods were sustained for long periods of time, especially when flow rates in the floodway are less than 20 cfs. These decreased groundwater levels should not be obtained, because the proposed withdrawal rates will not be sustained for sufficient periods of time to de-water the floodway wetlands. Significantly decreased groundwater levels would occur if the pumping periods in the well fields were sustained for long periods of time, especially during low flow periods.

The City recognizes the discussions of wetland impacts are rather generic. As a result, a generic comparison of impacts can be made. However, specifically identifying how many acres wetlands would be impacted during construction or operation is not possible at this time nor included in this EIS since project facilities have not been located on the ground. Possible operational environmental impacts are further complicated by establishment of the final conditions under which some of the ILWSP components will be "turned on" and the frequency, duration and intensity with which the project will actually be operated.

As a potential project benefit, increased groundwater levels in the Equus Beds Well Field area may restore some wetland areas that have been dry in recent decades. Therefore, the net impacts to wetlands due to this project are not expected to be significant and could be positive.

4.7.2 VEGETATION

Permanent and temporary impacts to vegetation would result from implementation of either of the water supply alternatives. Existing vegetation would be permanently lost or altered at the sites of new wells, basins, pre-sedimentation plant and access road, or the new surface water intake. Construction of pipelines would temporarily and permanently disturb additional areas of existing vegetation.

Vegetation communities at each water supply location were assessed using topographic maps and aerial photos. For transmission pipelines, half of the acres disturbed inside the 100-foot wide construction easement in forested areas were assumed to be permanently altered for maintenance of the right-of-way. Each well was estimated to cause temporary loss of 1.5 acres of vegetation. The significance of the impacts of the proposed water supply alternatives on vegetation communities was determined by evaluating the overall quality of the habitat, regional abundance, importance to wildlife, and permanence of the impact. Significant impacts would occur if the vegetation loss was permanent, of high value to wildlife, and relatively scarce in the surrounding area.

Most of the areas that would be disturbed by the project contain vegetation communities that have already been greatly altered by human activity for agriculture or urban and suburban development.

The Equus Bed Well field ASR facilities for each alternative cover approximately 900 to 1,200 acres of land which is now predominantly used for agriculture (Table 4–4). This type of vegetation community, with its extremely low plant species diversity, has relatively little value to wildlife and is one of the dominant land covers in Harvey and Sedgwick counties. The vegetation at the ASR sites would be converted to buildings and settling ponds. The permanent loss of 266 to 360 acres, depending on which option is chosen, would not significantly impact area vegetation since the lost acreage is characterized in small parcels scattered over a large area. Table 4–4 provides the amount of acreage disturbed and lost for each alternative and option.

Most of the impacts to vegetation from these alternatives are temporary and impact agricultural vegetation. The permanent impacts to existing natural vegetation are relatively small. Overall, no significant impacts to vegetation would occur as a result of the ILWSP alternatives.

If a new water supply is not built, the availability of water for the maintenance of landscaping will decrease. This could spur a decrease in the amount of traditional grass yards and landscaping. Water provided by the City is not used for the irrigation of croplands or the maintenance of natural vegetation. However, local farmers use the Equus Beds aquifer for cropland irrigation during dry periods. The No-action alternative would impact agricultural resources; without recharge to the aquifer, water levels would decrease along with water quality thus making the water unusable and/or unavailable for irrigation. The loss of irrigation on farmland would reduce crop yields and lower property values.

No mitigation is proposed for the impacts to vegetation resources caused by the proposed project.

Table 4-4 Summary of Impact to Vegetation

ILWSP 150 MGD Alternative	60/90 Option		75/75 Option		100/50 Option		Local Well Field Option 1		Local Well Field Option 2	
	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)
Diversion wells and associated access road along the Little Arkansas River	180	124	250	170	330	200	NA	NA	NA	NA
Recharge of induced infiltration water through recharge wells, recharge basins, and associated pipeline	500	39	550	50	650	40	NA	NA	NA	NA
New surface water intake, presedimentation plant, recharge basins, and associated pipeline	160	132	160	110	170	80	NA	NA	NA	NA
Pipeline from presedimentation plant to existing City of Wichita treatment facilities	40	0	30	0	40	0	NA	NA	NA	NA
Projected additional recovery wells	0	50	0	30	0	20	NA	NA	NA	NA
Horizontal collector and vertical wells and associated pipeline	NA	NA	NA	NA	NA	NA	94	5.25	85	5.25
TOTAL	**880**	**345**	**990**	**360**	**1190**	**340**	**94**	**5.25**	**85**	**5.25**

ILWSP 100 MGD Alternative	60/40 Option		75/25 Option		100/0 Option		Local Well Field Option 1		Local Well Field Option 2	
	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)	Temporary (acres)	Permanent (acres)
Diversion wells and associated access road along the Little Arkansas River	180	124	250	170	330	220	NA	NA	NA	NA
Recharge of induced infiltration water through recharge wells, recharge basins, and associated pipeline	500	39	580	50	750	60	NA	NA	NA	NA
New surface water intake, presedimentation plant, recharge basins, and associated pipeline	150	53	180	40	70	10	NA	NA	NA	NA
Pipeline from presedimentation plant to existing City of Wichita treatment facilities	40	0	40	0	0	0	NA	NA	NA	NA
Projected additional recovery wells	0	50	0	30	0	20	NA	NA	NA	NA
Horizontal collector and vertical wells and associated pipeline	NA	NA	NA	NA	NA	NA	94	5.25	85	5.25
TOTAL	**870**	**266**	**1050**	**290**	**1150**	**310**	**94**	**5.25**	**85**	**5.25**

4.7.3 WILDLIFE

In this discussion, wildlife is considered to be the more common species of mammals, birds, reptiles, amphibians, and fish that occur in the project area. The principal impacts of this project on wildlife would be a temporary disturbance during construction and the loss of habitat. Impacts to endangered, threatened, or rare species are discussed in Section 4.7.4.

Impacts on terrestrial wildlife were evaluated based on the quantity, quality, and scarcity of the habitats temporarily disturbed by or lost to construction. Impacts would be significant if high quality, relatively rare wildlife habitat is lost.

The drawdown in the groundwater caused by the well field could de-water some wetlands and displace mammals such as beaver and muskrat; birds such as egrets, herons, killdeer, redwing blackbird, teal, and mallards; amphibians and numerous species of frogs and toads. Wetlands are a relatively rare and valuable habitat for wildlife and their unavoidable loss or alteration would be a significant impact.

As discussed in Section 4.4.1.2.1, withdrawal of water from the Little Arkansas River for recharge would reduce flow; however, these reductions will occur only when the flow in the river exceeds 40 cfs. Compared to the No-action alternative, implementation of the ILWSP will actually increase the median flow in the Little Arkansas River by about 10 cfs in every month except May and June. During May and June, the median flow would decrease from 4 to 18 cfs. These two months have the highest historic median flow and therefore are the months when the recharge system is expected to operate more frequently and at higher diversion rates. Correspondingly, median water levels will also increase most months, by approximately 0.1 foot. In May and June, median water levels will decrease by about 0.15 and 0.25 feet, respectively.

Since there are no minimum release requirements from Cheney Reservoir, the flow in the North Fork of the Ninnescah River below the dam is zero, or near zero, much of the time. However, implementation of the ILWSP will actually increase the frequency of discharges every month as compared to the No-action alternative (see Section 4.3.1.2.3). Therefore, the impacts to fish and aquatic species living in this reach of the North Fork should be positive as well.

The disturbances to wildlife caused by construction of the transmission pipelines would be primarily temporary. Some woodland habitat would be lost for the maintenance of pipeline rights-of-way. These corridors would fragment some existing tracts of woodlands. However, these corridors are probably not wide enough to create barriers to movement for most species of forest dwelling wildlife. The original forests in the project area have been highly fragmented and reduced primarily to locations, such as stream channels, that are too steep for agricultural purposes. These patches are generally of low value to true forest dwelling wildlife because they have a high edge to area ratio. Overall, a pipeline corridor through this type of woodland would not significantly impact terrestrial or aquatic wildlife.

Power lines may adversely impact area wildlife. The greatest potential impact of power lines to wildlife is electrocution of raptors and collision with large migrating

birds such as cranes. Raptors are attracted to power lines and towers because they are suitable perches for hunting, resting, feeding and territorial defense. When electric conductors and ground wires are close enough together, raptors can simultaneously touch them, causing electrocution. Construction of power lines will be such that the spacing between phase conductors is a wide enough distance to prevent phase to phase electrocution.

The City recognizes the discussion of wildlife and impacts to associated habitat are rather generic. As a result, a generic comparison of impacts can be made. However, specifically identifying how many species or acres of associated habitat would be impacted during construction or operation is not possible at this time nor included in this EIS since project facilities have not been located on the ground. Possible operational environmental impacts are further complicated by establishment of the final conditions under which some of the ILWSP components will be "turned on" and the frequency, duration and intensity with which the project will actually be operated.

The No-action alternative would not require any construction activities and would not change existing wildlife habitats. Therefore, the No-action alternative would have no impacts on local wildlife.

4.7.4 THREATENED, ENDANGERED, OR CANDIDATE SPECIES

Nine federally threatened, endangered, or candidate species were identified by the FWS as potentially being impacted by this project. Since contacting FWS, one of these species, the peregrine falcon, has been delisted due to its recovery and is therefore not included in the following discussion.

The remaining eight species either occur or historically occurred near or within the project's study area. Species common to the area but not threatened or endangered will be similarly impacted by the project. However, listed species are of special concern because their declining populations make impacts more critical. Following is a discussion how the alternatives (the ILWSP 100 MGD and 150 MGD) may impact each species.

4.7.4.1 General Impacts

The ILWSP alternatives include several components that could impact the environment in different ways. Drawing additional water from the flood pool of Cheney Reservoir will alter the flow released to the North Fork of the Ninnescah River downstream from the reservoir. However, this river has already been impacted by reservoir flow regulations and the species inhabiting it have adapted. Habitats available in the North Fork of the Ninnescah have been developed and maintained by reservoir flow regulations and alterations. The amount of additional water withdrawn from the reservoir is not expected to be sufficient to significantly impact those species that have adapted to prior alterations.

An In-stream Flow Incremental Modeling (IFIM) study was completed on the Little Arkansas River in 1996, 1997, and 1998 and the North Fork of the Ninnescah in 1997 and 1998 (Burns & McDonnell 1999, 2000). The studies were designed to help identify potential impacts resulting from withdrawal of above-base flows from the river. The optimum discharges for maximum available habitat and the peak-modeled flow fell far below historic

recorded peak flows for all investigated species. The proposed project would result in a maximum removal of approximately 325 cfs from the Little Arkansas River, reducing high flows by approximately 5 percent through surface diversions. These diversions will only occur on an “as available” basis from above-base flows and will be regulated by the Kansas Division of Water Resources to limit the total, annual average and maximum withdrawal. The model indicated that optimum discharges and resulting maximum available habitat for fish species in the Little Arkansas River will still be easily reached even with the planned removal of above-base flow. Thus, the critical threshold for a given fish species in terms of its habitat and presence or absence in the river will not be approached.

If the above-base water from the Little Arkansas River is transferred into the Equus Beds aquifer, the hydrologic character of the overlying surface features such as wetlands could be altered over the long-term. Impacts from recharging the aquifer would likely be more beneficial than detrimental. Overall, there will be a short-term reduction in stream flow during moderate-flow events, but these alternatives have the potential to increase base-flow over several years resulting from the aquifer recharge.

Construction of well fields, pipelines, access roads, and sedimentation structures could result in a loss of available habitat for some species and a temporary disturbance to their normal activities resulting from construction noise and human activity. These facilities will be installed outside the riparian area along the Little Arkansas River and generally within agricultural cropland or pastures.

4.7.4.2 Interior Least Tern

The loss of natural nesting habitat due to river channelization, irrigation, and construction of reservoirs and pools has caused declines in the population of interior least tern and many other shorebirds. The unpredictability of flows released from dams further impacts wetland species. High flow periods may extend into the nesting season and inundate potential shorebird nesting areas, forcing birds to utilize poor quality areas for nesting. Feeding areas may also be dewatered and nests flooded from dam discharges. The storage of flows in reservoirs also allows encroachment of vegetation into areas naturally scoured by river flows and reduces channel width. Sediment loads in reservoirs cause further degradation of the riverbed downstream and reduce available shoreline habitat. In addition, the least tern is sensitive to human disturbance. These birds will not nest in areas with frequent human activity, and increasing recreational use of our nation’s rivers and lakes reduces available nesting areas for the interior least tern.

Interior least terns are generally transients or summer visitants to Kansas and can be found on barren flats and sandbars near large rivers. The QNWR, located 34 miles northwest of Cheney Reservoir and 57 miles northwest of the Little Arkansas River near Sedgwick, has been designated critical habitat for nesting least terns. Both the North Fork of the Ninnescah River and the Little Arkansas River are typical sandy bottom streams, and sandbar habitat can be found scattered along the length of both waterways.

Because of the proximity of QNWR, there is a possibility that least terns may occasionally use portions of either river

during the summer for short periods of time. Neither river is likely large enough or has sufficient sandbar habitat to support nesting least tern colonies, however. No survey for least terns has been completed on either river to document their presence or absence.

Drawdown of the Little Arkansas River and reduced flows through the North Fork of the Ninnescah could reduce the scouring process that cleans vegetation from sandbars and riverbanks, thereby reducing available nesting habitat. However, discharges of only 100 cfs or less may be necessary to inundate sandbars along the North Fork. Peak discharges were estimated by the IFIM to exceed 100 cfs about 73 percent of the time. These conditions are expected to remain unchanged or slightly improve with implementation of the ILWSP. If water is available to recharge the Equus Beds aquifer, wetland areas overlying the aquifer could increase and create additional habitat for a variety of species over the long term. Drawdown during moderate flow conditions may also expose additional habitat found along these sandy-bottomed rivers.

Any terns possibly present in the area along the Little Arkansas River would likely be displaced during construction of intake structures and wells by human activity and construction noise. These impacts, most of which will occur outside the riparian area of the river, would be short-term and temporary.

4.7.4.3 Piping Plover

Threats to the piping plover are similar to those facing the interior least tern. In addition to habitat loss, piping plovers are also subject to high predation rates and nest abandonment.

Like the interior least tern, piping plovers inhabit sand beaches and sandbars of inland rivers and lakes. These birds are most likely to be found at QNWR and CBWA located 73 miles northwest of the project area, though they may also be found along rivers during spring and fall migrations. No critical habitat has been designated in Kansas, and there is no record of piping plovers breeding in Kansas, making impacts of this project on breeding plovers unlikely.

The proximity of the project area to QNWR and CBWA and the presence of some sandbar habitat along both impacted rivers suggest a possibility of transient piping plovers occurring near the project area during their spring or fall migrations. Because of the similarity in habitats for the piping plover and least tern, the impacts to both species are expected to be similar. Flow and discharge reductions are not expected to significantly affect sandbar habitat occurring along the banks of the Little Arkansas and North Fork where piping plovers could be found because frequent flows sufficient to inundate and scour the sandbars will continue to occur annually. Drawdowns could also slightly increase the surface area of available sandbar habitat.

Migrating plovers, if present, could be temporarily displaced by construction noise and human activity near potential feeding areas during the installation of intake structures, wells, access roads, and pipelines. Because of the transitory nature of these stopovers, impacts to the piping plover would be minimal.

4.7.4.4 Bald Eagle

The use of pesticides such as DDT is the major cause of bald eagle population declines. Bald eagle populations have

also suffered from habitat loss, shooting, lead poisoning, and human disturbance.

Eagles require relatively undisturbed areas around lakes, rivers, and reservoirs to feed and nest. Trees such as cottonwoods or sycamores that are at least 50 ft. tall and sturdy enough to support a nest must be available near water. These trees provide a wide field of view for adults and shelter for their chicks. Nests may be very large, ranging up to eight feet in diameter and weighing several hundred pounds. Bald eagles are generally intolerant of human disturbance. Such disturbance has been attributed as the cause of nesting failure and reduced usage of wintering areas (Grier et al. 1983).

Eagles feed on fish in the open water areas created by dam tailwaters, warm water effluents from power plants and other discharges, in power plant cooling ponds, and along rivers and lakes. At night they roost in groups of trees near feeding areas that are protected from harsh weather.

A loss of open water may concentrate migratory waterfowl and increase the potential for avian cholera outbreaks. Expected reservoir levels will not be altered significantly to concentrate waterfowl and would not be expected to increase the incidence of avian cholera. KDWP manages approximately 5,400 acres of water at Cheney Reservoir. Surface withdrawals will alter, to some degree, the characteristics of tailwater flow in the North Fork, potentially altering the supply of fish available for eagles in the area. The relation between the number of eagles that may use the reservoir and associated rivers for feeding and the concentration of fish and waterfowl would not be a limiting factor. If fish and waterfowl were slightly reduced as a result of this project, the reduction would not significantly impact eagle survivability.

Installation of infiltration wells, recharge wells, recovery wells, surface water intake structures, recharge basins, and pipelines to connect all components will occur primarily in agricultural areas outside the riparian area of the rivers. Consequently, no direct impacts to potential roosting sites or nests would be expected. No surveys of construction sites have been completed to document the absence of eagles or potential nesting trees in the area.

It is likely that bald eagles occur in the project area, especially along the Arkansas River and at Cheney Reservoir. All lands and waters within a corridor extending 100 yards landward from the Arkansas River's ordinary high water mark is designated by the State of Kansas as critical habitat for the Bald Eagle. Critical habitat along the Arkansas River, with exception of the Bentley Reserve Wellfield, is approximately four miles from the project area and would not be directly impacted during construction.

During design and layout of the Bentley Reserve Well Field, riparian corridors within 100 yards of the Arkansas River will be avoided. If riparian areas within 100 yards of the Arkansas River cannot be avoided and if any part of the project affects critical habitat for the Bald Eagle, an action permit will be required from the KDWP. Removal of individual trees at least 50 feet tall or 24 inches or more in diameter at breast height, or removal of 10 or more trees greater than 12 inches in diameter at breast height, all within 100 feet of the water’s edge, will also require an action permit from KDWP. An action

permit would include mitigation measures that would be negotiated with KDWP and FWS.

The bald eagle has become an increasingly more common nester and is more commonly seen in Kansas, primarily from October to March. Nesting pairs have recently been documented in the project area. However, because nests are conspicuous, it is not likely there are any nesting eagles that may be impacted. If a nest is located during construction, the FWS will be contacted for avoidance instructions.

4.7.4.5 Arkansas Darter

Due to intensive agricultural demands for the available water supply, natural droughts, construction of reservoirs and the resulting flow regulations, and a specialized habitat, the Arkansas darter is being considered by FWS for protection under the Endangered Species Act (ESA). As a candidate species, it is currently afforded no legal protection under the ESA, but its designation indicates it will likely be listed in the near future. Because this is a long-term project, the Arkansas darter may be legally listed before this project is completed so potential impacts are being considered pro-actively to avoid future complications.

The primary threat to the Arkansas darter is the loss of habitat through groundwater mining for crop irrigation. As water tables drop, the spring-fed habitats essential for this species' survival disappear. River damming, construction of reservoirs, and natural drought have also contributed to this species' decline.

The North Fork has been designated by KDWP as critical habitat for this species. An Arkansas darter was collected during an aquatic survey completed to obtain baseline environmental data for this river in 1997 (Burns & McDonnell 1998). This fish is endemic to the Arkansas River system where it is concentrated in small sandy streams continuously fed by seepage from high water tables. It has also survived by occupying lower quality habitats.

One goal of this project is to recharge the Equus Beds aquifer with above-base flow surface water, which would help protect available habitat for this species by raising the water table and potentially improving overlying streams and wetlands. The removal of surface water from the Little Arkansas River and Cheney Reservoir should have little impact on downstream resources. The IFIM indicated the proposed withdrawals would not reduce flows beyond the critical threshold necessary to maintain fish species. Only during years with excess precipitation will water be removed.

The Arkansas darter and the other fish found within the North Fork waterway have adapted to the irregularity of flows released from Cheney Reservoir. Changes in flows resulting from this project would be insignificant compared to historic alterations following dam construction. Flows into the North Fork have been regulated since 1964.

4.7.4.6 Arkansas River Shiner

The Arkansas River shiner is threatened primarily due to inundation and modification of stream discharge by impoundments, channel desiccation by water diversion and groundwater pumping, stream channelization, degradation in water quality, and the introduction of the non-native Red River shiner (*Notropis bairdi*). Although the Arkansas River shiner evolved in rapidly

fluctuating, harsh environments, channelization of the Arkansas River has permanently altered and eliminated suitable habitat for this species. Inundation following impoundments in the Arkansas River system eliminates spawning habitat, isolates populations, and favors increased abundance of predators.

This species, which may be extirpated from Kansas, was most commonly found on the lee side of sand ridges formed by steady shallow water flow. A reduction in stream flows has severely impacted this habitat. While the proposed project calls for removing additional water for consumptive use, the amount of water to be used is not likely sufficient to significantly impact the already-altered downstream habitats. If this water were not withdrawn, there is the potential that the additional flow during wet years could increase stream flows and improve stream quality for the Arkansas River shiner and other fish. However, the recharging of the Equus Beds aquifer could offset this potential over time.

To address the possible impact of the project to the Arkansas River shiner, the City of Wichita is planning to implement a monitoring program to determine pre- and post-project impacts to aquatic resources resulting from modification to flows in the Little Arkansas and Arkansas rivers.

4.7.4.7 Eskimo Curlew

The primary cause for the Eskimo curlew's decline is loss of significant grassland habitat. It is very rare throughout North America, including Kansas. The last reported sighting in Kansas was in 1902. There is also no record of the curlew breeding in Kansas, nor is there any designated critical habitat that could be affected by the project. Given the extremely rare status of this bird, it is highly unlikely that any Eskimo curlews will be impacted by this project, either directly or indirectly. There is also little grassland habitat available in the project area and most construction of wells and basins will occur in agricultural fields that are not preferred curlew habitat.

4.7.4.8 Whooping Crane

Whooping cranes are endangered primarily due to hunting, specimen collection, human disturbance, conversion of their nesting habitat such as potholes and prairies to agriculture, contaminant spills along their wintering range in Texas, collisions with power transmission lines, and severe weather during migrations that may impede navigation and food availability. In addition, whooping cranes have a delayed sexual maturity and a small clutch size that prevent a rapid population recovery.

These birds may be found in Kansas during their spring and fall migration between their breeding grounds in Canada and their wintering habitat in Texas. Whooping cranes may be found in a variety of habitats during their migration. They typically roost in riverine habitat, on isolated submerged sandbars, and in large palustrine wetlands, such as those found in QNWR and CBWA. They also may be found feeding on waste grains from harvested cropland.

Because of the proximity of the project area to the QNWR and CBWA, it is possible whooping cranes may occasionally be found near the North Fork or the Little Arkansas River during their migrations. Cropland is plentiful in the area as a potential food source. However, both rivers contain only

marginal habitat for this species and there are few other wetlands in the project area, so the likelihood of occurrence is remote.

Whooping cranes are only occasional visitors at the QNWR and CBWA during their migrations, further reducing the likelihood of their presence during ILWSP construction activities. If whooping cranes stop in the project area during their migrations, it is likely that they would stop in the QNWR or CBWA, avoiding any construction in the area. According to QNWR and CBWA management personnel, designated whooping crane critical habitat does occur at these locations and satisfactory quantities of this habitat exists at either location to temporarily satisfy any needs additional whooping crane populations might require.

4.7.4.9 Topeka Shiner

The Topeka shiner has suffered from habitat destruction, degradation, modification and fragmentation resulting from siltation, eutrophication[7], tributary impoundments, and stream channelization and dewatering. Removal of the protective vegetation within a stream's watershed from agricultural and urban development results in accelerated stream sedimentation from soil runoff. The Topeka shiner is an indicator of water quality because it is dependent upon high quality aquatic habitats. It is also threatened from introduced predaceous fishes.

The Topeka shiner typically occurs in small headwater prairie streams that are usually perennial, but may also be intermittent during the summer. In these cases, groundwater seepage must maintain water levels for the fish to survive. It prefers stream substrates, such as sand and clean gravel, like those found within the Little Arkansas River and North Fork. The species is primarily restricted to small streams in the Flint Hills region of Kansas. It is possible that no Topeka shiners occur in the Little Arkansas River or North Fork and thus would not be impacted by the proposed project.

If present, this species, like the Arkansas River shiner and Arkansas darter, could be impacted by the decrease in flows released from Cheney Reservoir and withdrawals from the Little Arkansas River under the No-action alternative. The magnitude of this decrease may become significant enough to seriously affect populations of the Topeka shiner as indicated by the IFIM, especially during dry years. Some riparian vegetation along the banks of the Little Arkansas River may be removed to make way for installation of intake structures. This could result in a slight increase in siltation of the river.

Recharging the Equus Beds aquifer would certainly benefit this species by providing additional groundwater to maintain the intermittent streams in the area upon which this species depends.

4.8 STATE-LISTED SPECIES

The KDWP is responsible for listing protected species in the State of Kansas. Impacts to state-listed species are regulated and may require permits and/or mitigation. Four species, the speckled chub, eastern spotted skunk, white-faced

[7] *Eutrophication* – overfertilization of a water body due to increases in mineral and organic nutrients, producing an abundance of plant life, which uses up oxygen, sometimes creating an environment hostile to higher forms of marine animal life.

ibis, and snowy plover occur within the project area and are listed as state threatened or endangered by KDWP. The impacts to these species are listed below.

4.8.1 Speckled Chub

The southern population of the speckled chub is currently listed as state endangered in the Arkansas River drainage. Critical habitat of the speckled chub in the project area includes all of the Arkansas River in Harvey and Sedgwick counties.

Predicting the direct and indirect impacts the ILWSP might have on the speckled chub and its critical habitats is difficult. To determine possible impacts resulting from withdrawals from the proposed alternatives, median peak monthly flows were analyzed for the Little Arkansas and Arkansas rivers (See Section 4.4.1.2). This analysis considered historical flows of the past 74 years of hydrologic record.

Because the month of June is the spawning season for the speckled chub, the peak flow statistics for this month were of particular interest (KDWP, 2001). Reducing peak flows in the river could alter or reduce the microhabitats of the speckled chub. During the summer spawning season, the speckled chub relies on higher flows to drift and disperse fertilized eggs. There is concern that reducing these higher stream shaping flows could alter and reduce fish and aquatic wildlife habitat.

The minimum, maximum, and median flow conditions in the Arkansas River immediately below the confluence with the Little Arkansas River were developed to estimate changes in flow within the Arkansas River as a result of the proposed ILWSP alternatives. Median flow conditions represent the flow conditions that occur most frequently in the river and were used to estimate impacts to the speckled chub and its critical habitat. The peak flow statistics under maximum flow conditions are presented to estimate the impacts of the alternatives on future shaping of the stream channel.

As shown earlier in Chapter 3, the Kansas Water Office has established the minimum desirable streamflow (MDS) at Valley Center to be 20 cfs. Figure 4–3 shows the median (50 percent) flow at Valley Center is above 20 cfs in all months regardless of the ILWSP alternative considered.

Flows in the Little Arkansas River, a tributary of the Arkansas River, will be maintained at the state designated minimum stream flow of 20 cfs. In 1983, KDWP recommended that higher minimum flow values be maintained, 60 cfs in April, May and June, and 34 cfs otherwise. Figure 4–3 shows that median flows will also exceed KDWP recommendations in all months.

Median flows in the Little Arkansas River with the ILWSP in place will reduce the median flow in the Arkansas River downstream of their confluence by about 4 percent. Statistically, this is considered an insignificant impact; therefore, it is unlikely that reductions in stream flow as a result of the proposed project will impact the speckled chub and its critical habitat.

Statistical analyses indicate the habitat of the speckled chub will likely not adversely be impacted as a result of construction and operation of the proposed ILWSP. Regardless, a hydrobiological monitoring program will be developed to determine if,

following the implementation of surface water withdrawals, flows in the Little Arkansas and Arkansas rivers deviate from the normal rate and range of fluctuation of flows to the extent that water quality, vegetation, and animal populations are adversely impacted. If impacts do occur as a result of the water withdrawals, appropriate mitigation will be recommended to eliminate or mitigate unacceptable adverse impacts.

4.8.2 Eastern Spotted Skunk

The eastern spotted skunk is currently state listed as threatened. Critical habitat that has been designated is located outside the project area, in Sedgwick County's Cowskin Creek basin, west and south of Wichita. Therefore, it is unlikely that implementation of the proposed ILWSP alternative would adversely impact the eastern spotted skunk.

4.8.3 White-faced Ibis.

The white-faced ibis is currently listed as state threatened. Preferred habitat primarily includes permanent wetland areas; however, the ibis will use scattered temporary pools. Designated critical habitat for this species includes the CBWA and QNWR located northwest and west of the project area. This species may, however, inhabit temporary wetlands around streams and rivers in the project area as well as Cheney Reservoir.

Impacts to the white-faced ibis will likely not occur as a result of the proposed ILWSP. To determine if and to what extent impacts occur to water quality, vegetation, and animal populations, a hydrobiological monitoring program is being established. If impacts do occur to critical habitat of the white-faced ibis as a result of the ILWSP water withdrawals, appropriate mitigation will be developed and recommended to eliminate or mitigate unacceptable adverse impacts.

4.8.4 Snowy Plover

The snowy plover is currently listed as state threatened in Kansas, and can be found in sparsely vegetated salt flats, sandbars, and beaches during migration in the spring and fall. Critical habitat for the plover has been identified by the KDWP; however, none of this habitat exists in the ILWSP project area.

4.9 SOCIOECONOMICS

The construction and operation of the ILWSP alternatives would have both positive and negative impacts from a social and economic perspective. The construction phase would take place over approximately 10 years and would create some short-term employment in the area. New long-term employment would consist primarily of personnel for operation and maintenance of the water supply components. The construction of pre-sedimentation basins, ASR wells, surface intake structures and associated facilities would take a small amount of land out of agricultural production in the well fields.

Existing social and economic conditions and trends within the project region were documented and impacts caused by the project were evaluated. Based on existing conditions and trends, project impacts would be significant if changes in the social and economic environment of the area would exceed the ability of the area to absorb the change and result in hardships for a segment of the population, the economy, or public services.

Existing trends in socioeconomic conditions in the project area include steadily increasing population, low

unemployment, and a rapidly expanding housing sector.

4.9.1 POPULATION AND HOUSING

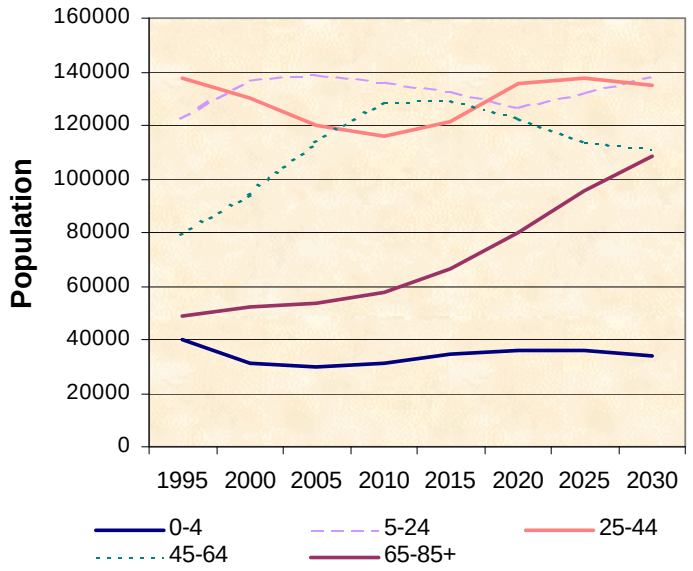
Population. As part of a water supply study for Wichita, Burns and McDonnell developed population projections for the City of Wichita, and the water service area. These projections were based on data collected from the US Census Bureau, Wichita's Water Department customer data, US Department of Commerce – Bureau of Economic Analysis and the Wichita-Sedgwick County Metropolitan Area Planning Department (MAPD) studies and engineering studies by others. Projections included consideration for the availability of land, water, and sewer systems, current and future transportation plans, zoning, area topography, and socioeconomic factors. Figure 4–34 shows the population projections for various age groups in the ROI. Evaluation of the studies indicated the city population is anticipated to increase by 3,000 people per year to the year 2015 and then increase by 2,000 people per year from 2016 to 2050. This results in a city population of 363,000 and 448,000 in 2010 and 2050, respectively.

In addition to the City's residential population, the projected service area also includes existing and anticipated wholesale customers and individually metered customers outside the city limits. The projected growth for the wholesale and individually metered customers outside the city limits are estimated to increase by approximately 20,000 from 2000 to 2050.

Anticipated wholesale customers include additional towns/areas in Sedgwick County not currently served by the City's water system. Connection of these customers to the system would add about 68,000 people to the projected service area by 2050.

The 1995 - 2030 projected population by age class for Sedgwick County is illustrated in Figure 4–34. Sedgwick County is expected to experience large shifts in population between 1995 and 2030. The number of seniors 65 years and over will more than double from 49,000 to 108,200. In 1995, 11 out of 100 county residents were over 65 years of age; by 2030 that will climb to 21 out of every 100 residents. On the other hand, persons between the ages of 25 and 44 will decline by 2 percent and the number of preschoolers will decline by 23 percent. See Appendix A for further information on the population projection by age group in Sedgwick County.

Figure 4-34 Population Projection by Age in Sedgwick County



Source: CEDBR, 1997

Projected areas of growth by the year 2050 around Wichita and Sedgwick County include most of the outer fringes of the current Wichita city limits and the towns of Valley Center, Derby, Haysville, Clearwater, Goodard, Garden Plain, Cheney, and Mt. Hope (Burns & McDonnell, 1997). The growth in these towns will most likely be from commuters who work in Wichita.

The primary long-term effect of the ILWSP alternatives would be the facilitation of the current trend in area population growth, which would not be a significant impact.

Under the No-action alternative, no new water supply sources would be used. The City would no longer supply water to new areas, but water use would continue to grow because the City would still have to supply new customers within its existing service area. Eventually, peak day water shortages would become common and water prices would rise to further discourage use. The current rate of population growth would likely slow as the declining quality of life in the Wichita area began to discourage in-migration and encourage out-migration of families and businesses. Such a change in the quality of life would be a significant adverse impact.

Housing. No increases in housing demands are expected from the temporary and permanent work forces needed for the project because most of the labor would come from local sources.

Construction of new housing is continuing at a rapid pace in the Wichita area, particularly in the northwestern suburbs. The ILWSP alternatives are designed to serve this growing region and allow the City to continue to expand its service area. This expansion would prevent water availability from limiting the growth of housing.

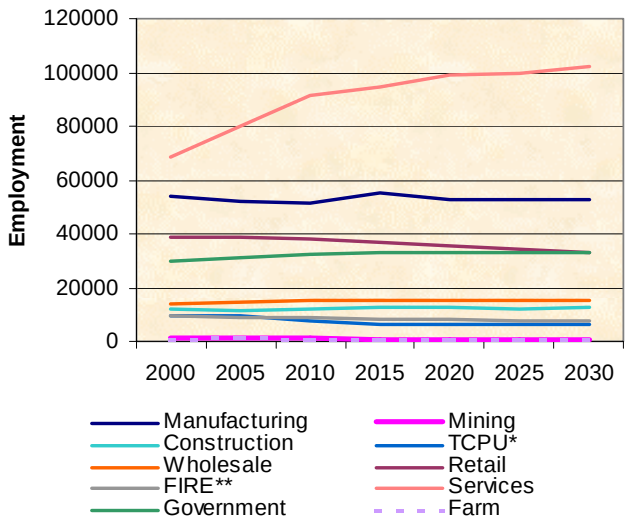
Under the No-action scenario, if new water sources are not developed, the City's short-term solution to limit increasing demand for water would be to stop expanding its service area. This action would stifle housing development in the outlying areas provided these areas could not locate water supplies elsewhere. The reduction in the supply of new homes could force the price of existing homes to increase, which would have a significant negative impact on housing.

4.9.2 ECONOMIC ACTIVITY

Employment. The construction and operation of a new water supply would provide temporary and long-term employment within the study area. Most of the new employment would be in the construction sector of the economy. Demands for construction materials could also stimulate job growth in the manufacturing sector; however, this growth would not necessarily be local because some construction materials would likely be imported from outside the project area (e.g., structural steel, pre-sedimentation plant equipment, pipe). The purchase of materials, fuel, food, and services by construction workers would contribute to local employment and income, particularly in the rural communities of Sedgwick, Halstead, and Bentley near the Equus Bed Well Field. Overall, the project construction would tend to reduce local unemployment.

Limited gains in permanent employment would occur directly as a result of constructing a new pre-sedimentation facility. The work force needed to operate the new water supply would be small relative to the size of the construction work force and the available work force in the Wichita area. Indirectly, the additional water provided by the plant would facilitate the continued expansion of the area economy. This expansion would result in increasing employment and income in most sectors of the local economy.

Figure 4-35 Sedgwick County Employment Forecast by Industry



*Transportation, Communications and Public Utilities
**Finance, Insurance and Real Estate

Overall employment is expected to grow 17.7 percent (264,156) between 1995 and 2030 for Sedgwick County (CEDBR, 1997). The service sector (Figure 4–35) is expected to grow faster than the other sectors from 27.0 percent (1995) to 38.6 percent (2030). Construction and Wholesale Trade is expected to increase the number of employees slightly. Mining, TCPU, Retail Trade, FIRE, and Farm sectors are expected to decrease in the number of employees through 2030 (Figure 4–35). Manufacturing and Government sectors are expected to be fairly level.

Most of the construction labor will be drawn from Sedgwick County and neighboring counties in Kansas. At this time, five peak construction periods are anticipated over the 10-year construction period. The first construction period would be in 2004 and involve the Bentley Reserve Well Field redevelopment. The second construction period would be the later part of 2004 and consist of the ASR Phase I Prototype and LWF Prototype. The third peak construction period is planned for 2006 and be composed of the ASR Phase 2 and the final LWF phase. From 2007-2008 would be the fourth construction period and consist of ASR Phase 3. The final or fifth peak construction period would be during 2010-2011 and include the ASR Phase 4. The number of employees for each of these peak periods has not been determined. Once the project is operational, employment requirements will be primarily for the operation and maintenance of the differing water components. The employment of personnel to conduct operation and maintenance (O&M) would have little to no effect upon the Sedgwick County economy.

No short-term employment or economic benefit would result from implementation of the No-action alternative. Without additional water, however, peak-day water shortages would eventually become common. Water prices would be

raised to discourage use. Businesses could begin to relocate to areas where water is more abundant and less expensive. This could ultimately lead to an increase in unemployment and downward pressure on wages and salaries. This decline in employment and income would be a significant adverse impact.

Agriculture. Farming is an important industry in the area of the Equus Beds Well Field. The Equus Bed Well Field, located in Sedgwick and Harvey counties, is currently used primarily for cropland with small tracts of pasture. Due to the construction of wells and basins, a small amount cropland will be permanently lost for production. Table 4–5 denotes the amount of cropland that will be lost for each Equus Bed ASR option. This loss of crop production would result in the loss of approximately 2250 to 4000 bushels of grain with an estimated value between $7,800 to $13,600. This estimate is based on a calculated average of the crop yield and prices received by farmers from 1991 to 2000 in Sedgwick, Reno, and Harvey counties. Figure 4–36 and 4–37 illustrate the losses by commodity. The loss of crop production for the five top commodities in the three counties represents 0.02 percent of the total crop production. Therefore the impact to crop production is not significant.

Table 4-5 Lost Cropland Acres

Equus Beds ASR Options	Lost Cropland Acres
60/40	74.5
75/25	68.5
100/0	62.5
60/90	109
75/75	97
100/50	97.5

Figure 4-36 Lost Crop Production

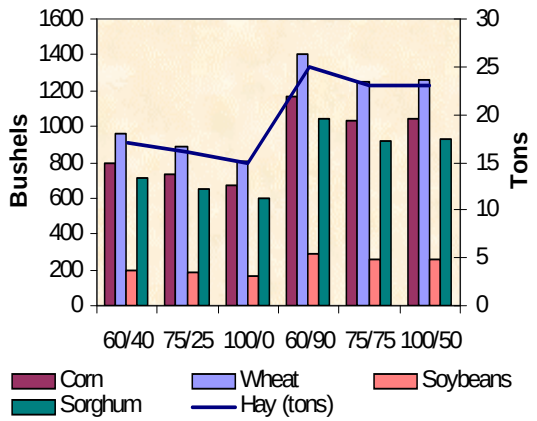
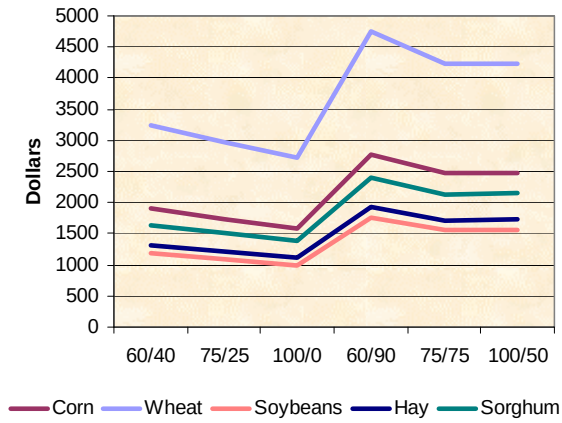


Figure 4-37 Lost Crop Revenue



4.9.3 PUBLIC SERVICES

Transportation. Transportation resources are vital to the metropolitan area functions. Roads and highways provide a convenient means of conducting daily activities. The installation of the transmission pipelines in the Equus Beds Well Field would temporarily block roads, primarily at intersections, and driveways. Construction of the pre-sedimentation basins, wells, etc. would result in a temporary increase in traffic density on

rural roads in northern Sedgwick County and southern Harvey County for the Equus Beds component. Construction of wells and pipelines for the Local Well Field expansion would also result in a temporary increase on city streets in the vicinity of the Local Well Field. Construction of the transmission pipelines would temporarily block roads and driveways. Blockage of any one road or driveway is anticipated to last no more than a few days. These impacts would not be significant.

Under the No-action scenario, no roads, railroads, or driveways would be crossed by the new pipelines. New areas of increased local traffic would not develop. Overall, no disruptions to traffic would occur. If the No-action alternative were to result in a decline of the area population, traffic densities could also decline. These impacts would not be significant. However, if the No-action alternative were to result in a population and economic decline, which reduced tax revenues, public transportation systems and maintenance of the transportation infrastructure could suffer. Any decrease in the safety of the area transportation system caused by a lack of maintenance would be a significant adverse impact.

Law Enforcement. Law enforcement is crucial to public safety and presenting positive public images of an area. Adequate law enforcement is necessary to maintain law and order. Some additional police patrol of the water supply alternative facilities could be required. The existing police force for Sedgwick, Harvey, and Butler counties would be able to accommodate the additional patrols and police services associated with project construction and operation. However, additional police may be necessary to accommodate the continued growth in northwestern Wichita, which would occur with an increase in the water supply. The impact on law enforcement would not be significant because the project would not change current trends in the need for police services.

Initially, the No-action alternative would have no impact on law enforcement. In the long-term, limited water supplies could ultimately limit local tax revenues, which could have a significant adverse affect on public services such as law enforcement.

Health Care. Health care resources provide vital needs for a large and growing metropolitan area. Adequate bed space in hospitals is important for maintaining the growing needs of an area. No impacts to hospitals and other health care facilities from the new water supply would occur assuming the supply of facilities would keep pace with the currently projected increases in the area population. The No-action alternative would have no impact on health care. In the long-term, limited water supplies could limit local tax revenues, which could have a significant adverse affect on public health care services.

Public Schools. Public schools would be affected by the changes in population, which would continue if a new water supply is built. Impacts to public schools would be similar to health care facilities. No impacts from the ILWSP alternatives would occur, provided the supply of classrooms increases in accordance with currently projected increases in population. Initially, the No-action alternative would have no impact on public schools, however long-term, limited water supplies could limit local tax

revenues which could have a significant adverse affect on public education.

4.10 WATER RATES

Future water rates for the City of Wichita are expected to increase at the same rate as in the past three years, approximately 5 to 6 percent annually. This increase will result due to increases in cost for maintenance of the current system and the additional costs associated with the ILWSP alternative.

4.11 ENVIRONMENTAL JUSTICE

A review of the minority and low-income data for the proposed project area presented in Table 3–15 identified two low-income or minority areas with potential to be impacted by the project. All other areas analyzed did not contain an identifiable minority nor did they have a percentage of persons below the poverty level that was higher than the standard being used for comparison.

The City of Sedgwick is located east of the intake wells that would be installed on the Little Arkansas River. Sedgwick's 1990 population was 1,438, of which 97.5 percent of the population was white with no identifiable minority group present. However, the percent of persons below the poverty level for Sedgwick was 14.1, which is 1 percent higher than that for the nation in 1990.

The second low-income and minority area with potential to be impacted is that falling within the Local Well Field component of the proposed project. There are two options being considered for the Local Well Field, however both options fall within the same census tracts included in this analysis. The census tracts that were included for the analysis of the Local Well Field component were Tracts 3, 14, 81, 82, and 83 (Figure 3–14). All of these tracts are located along the Little Arkansas River and Wichita -Valley Center Floodway. The total population for these five census tracts in 1990 was 23,832. The percentage of Hispanics of all races in this population was 2,747, which is 11.5 percent of the total population. The City of Wichita had a Hispanic population of 15,250 in 1990, 5 percent of the total population. The Hispanic population in the area of the Local Well Field component is two times that of the City of Wichita, representing a "meaningfully greater" percentage of that minority group. In addition, the percentage of persons below the poverty level in this area is 14 percent, which is higher than the standard of 13.1 percent representing an identifiable "low-income" community.

The potential negative impacts to the two communities identified would be temporary and mainly due to construction activities within the areas. Impacts related to the intake wells near Sedgwick would include construction activities that would produce dust and diesel engine exhaust, temporarily decreasing air quality, and increasing noise. Well construction periods are expected to last about three weeks, two weeks for basins, with basin site development taking up to four months. The Sedgwick Recharge System enlargement would take two and one-half years to complete.

The impacts related to the Local Well Field component of the project would include activities due to the installation of vertical and horizontal collector wells. Installation would require a three-week construction period for vertical wells and 6 to 9 months for horizontal wells. Also, with Option One of the Local Well Field expansion project, a 30-inch pipeline would be routed along West River Blvd.,

then along Murdock to tie into an existing pipeline close to the water plant. Under Option Two, a 30-inch pipeline would tie to the existing pipeline near 13th and Amidon or Perry. With either Option, a four-day construction period (two days pipeline installation and two days asphalt repair) would be required.

There is potential for the benefits of the proposed project to outweigh the negative impacts in the two identified communities. For instance, the construction and operation of a new water supply would provide temporary and long-term employment within the study area. The construction period for the entire project is projected to last ten years. Most of the construction work force would be drawn from Sedgwick County and neighboring areas, which would provide potential job opportunities to residents of the communities. The most important benefit of the project would be a reliable water supply for residents of these communities. The project would provide a reliable supply of potable water to the customers of the City of Wichita water service area through the year 2050, which would be a significant benefit to the residents of the communities discussed previously. In addition, mitigation measures would minimize the negative impacts experienced by the communities.

The location of the Local Well Field component that is impacting the two identified communities is limited by the physical constraints of the project. The intake wells must be located along the Little Arkansas River and close to the pre-sedimentation plant in order to divert water from the river and facilitate transport of the water. By locating the intake wells close to the pre-sedimentation plant, the length of new pipeline and construction disturbance for the project is minimized. Therefore the location options for this component are severely limited and it would not be feasible to locate the Local Well Field in any other community.

Residents of the communities have been given adequate access to participate in project planning through a public involvement plan that includes public meetings, informational handouts, publication of public meeting notices, and media releases and briefings. The details of the activities included in the public involvement plan are discussed in Chapter 5.

Under the No-action alternative, new water supply sources would not be used. The City would no longer supply water to new areas, but water use would continue to grow because the City would still have to supply new customers within its existing service area. Eventually, peak day water shortages would become common and water prices would rise to further discourage use. Such a change in the quality of life would be a significant adverse impact to these communities.

4.12 CULTURAL RESOURCES

The water supply alternatives could destroy culturally significant or historically important sites through the construction of new wells, basins, surface water intake structure, pre-sedimentation plant and pipelines.

Existing information was reviewed to determine if any known cultural resources were present within portions of the ILWSP alternatives. Research was conducted to determine if any known sites were located in and/or near the various water supply components. The Kansas State Historic Preservation Office (SHPO) was also contacted for their input

and concerns regarding these alternatives. All of the sites were evaluated for their potential for listing on the National Register of Historic Places (NRHP). The criteria used to determine the inclusion of a site on the NRHP is in accordance with the Department of the Interior's regulations 36 CFR 60.4. Impacts to cultural resources would be considered significant if the project would damage or destroy any sites eligible for the NRHP.

All cultural resource inventories in the project area to date have been in response to development of the Equus Beds Groundwater Recharge Demonstration Project, construction of various testing and monitoring facilities, and location of Phase I ASR Project facilities, the first phase of the ILWSP. Each of these inventories have been evaluated through record and literature reviews and field surveys of proposed facility locations. Reports detailing each of these surveys have been filed with the Kansas State Historic Preservation Officer. Letters of concurrence have been received from the SHPO and are on file.

To date, the Equus Beds Demonstration Project has been the only portion of the ILWSP that has used federal funds for facility development and operation. NEPA compliance for this portion of the ILWSP was provided through the 1995 EA completed by Reclamation. Additional cultural resource surveys of areas where project facilities will be located will be completed as the proposed locations become known. If required, a Memorandum of Agreement or Programmatic Agreement with the SHPO will be developed. At the present time, the SHPO has declined to participate in the development of a MOA or PA because of the absence of federal agency involvement. The water conservation component, redevelopment of the Bentley Well Field, and expansion of the Local Well Field would have no adverse impacts to known cultural resources in the project area. These alternative water sources either do not disturb any cultural resource properties or are located in areas that are currently urbanized or have been disturbed by past construction activities.

Ten archaeological sites have been recorded with the Kansas State Historical Society as of August 8, 2002 within or adjacent to Cheney Reservoir. Current investigations, being conducted by the Anthropology Department at Wichita State University, of the shoreline around Cheney Reservoir have not been reported to date, but should be consulted for and Section 106 issues in the reservoir area after December 2002, the project completion date. Of the ten known sites in the reservoir area, nine are prehistoric (14RN301, 14RN302, 14KM301, 14RN103, 14RN105, 14RN102, 14RN104, 14RN503, 14RN501) and two are historic (14RN101 and 14RN502). Four of the prehistoric sites have been completely or partially inundated by the reservoir. None of the recorded sites are listed on the National Register of Historic Places (NRHP) or considered for inclusion in the NRHP.

Most of the prehistoric sites are classified as unknown prehistoric. These unknown prehistoric sites are classified as lithic scatters, consisting mostly of flakes and a few discarded tools. At least three of the sites are lithic workshops, where cores of raw chert or quartzite were reduced during the early stages of chipped stone tool production.

Identified prehistoric components were identified at three sites. They include two Middle Ceramic sites and a Plains Woodland site, but all three have been inundated by the reservoir.

The historic sites were surface scatters of nineteenth century farmsteads.

No construction activities will occur from Cheney Reservoir to the City of Wichita with the ILWSP. The Equus Beds ASR component has several possible options or phases that would require construction of pipelines, wells, holding ponds, overhead transmission lines and access roads in an area of high archaeological site density. The distribution of the sites is primarily limited to terraces along the major streams and tributaries. Typically, sites found more than 0.5 mile from these water resources are historic farmsteads or other Euroamerican sites, dating from the late nineteenth through the twentieth centuries. Under the No-action alternative, agricultural practices would remain the same and no disturbances from construction would occur. Therefore, cultural resources would not be impacted by the No-action alternative.

In summary, the ILWSP project area includes numerous known archaeological resources and potential for many more. None of the sites known in the area are included in the NRHP, but most are considered unevaluated. All of the known cultural resources would not be directly or indirectly impacted by this project.

4.13 VISUAL RESOURCES

The main elements of visual character are landform, land cover, land use, visual variety, and uniqueness. These elements combine to create a variety of landscapes. Impact to visual character is a function of how the project changes these aspects of the landscape.

Landscape management deals with the visual harmony or disharmony of the components of the landscape, including the topography, vegetation, land use, and any human intrusions. The basic concepts considered are landscape character, visual variety, and deviations from the landscape character (U.S. Department of Agriculture 1973). Impacts on the landscape generally result when human alterations to the topography, vegetation, or land use contrast with the natural character of an area. In general, strong contrast with these components results in visual disharmony, while changes that conform to the existing visual components are less noticeable.

Significant visual impacts would result if any of the alternatives would create visual disharmony. Such disharmony would result from dramatic changes in the visual character of the viewshed, a noticeable reduction in visual variety, or sharply contrasting deviation. Visual impacts would be significant if the disharmony created would be viewed by large numbers of people, alter current points of recognized scenic value, or alter state or federally designated scenic areas.

The construction of additional wells and basins within the existing well fields, pre-sedimentation plant and associated facilities, or new river intake would impact all components of landscape character. Removal of vegetation and loss of cropland would alter the viewshed of some areas. Little of the land in the well field would be converted from crops to wells. The well structures will be enclosed in 21-foot by 33-foot buildings that would rise 9 to 10 ft. above the existing grade elevation (Burns &

McDonnell, 2000) and would add vertical contrast to the landscape. The proposed new intake for the Little Arkansas River could contrast with the riparian landscape. The lighting on the pre-sedimentation plant could create a visual contrast at night where none currently exists. The well field, however, would not contribute to light pollution because the wells would not be routinely lighted.

The appearance of a basin will not be incongruous with the appearance of other facilities typically found in agricultural areas, i.e., farm ponds, although the basins would be more rectangular in shape and surrounded by an eight-foot fence and lit at night for security. For the most part, these sites would not be located near any residences. Should it develop that a lighted area need be located near a residence, planners would work with those residents to mitigate any adverse effect.

No areas designated as scenic by state or federal agencies are located in the area, therefore, none would be impacted by this project.

Overall, the only significant impact to the visual character of the area would be the addition of an industrial component to an agricultural landscape. Overall, significant adverse impacts to the visual character of the area would be local.

The No-action alternative would not change the landscape or visual character or create large deviations from surrounding landscape character. Therefore, it would have no significant impact on the aesthetics of the area.

Visual impacts caused by the pre-sedimentation plant would be mitigated by adding berms and vegetation around the building and treatment ponds to screen the structures from view, breaking up the strong rectangular and geometric visual elements, and return a natural aspect to the landscape. Painting the structures earthtone colors would mitigate the visual impact of the well structures. Lighting on the outside of the pre-sedimentation plant would be kept to the minimum necessary to provide adequate safety and security.

4.14 RECREATIONAL RESOURCES

Impact to recreational resources will primarily occur at Cheney Reservoir. No recreational impacts are expected to occur in the Equus Beds Well Field, or result from the expansion of the Local Well Field or the Bentley Reserve Well Field. The following discussion will be primarily concerned with the anticipated impacts to Cheney Reservoir.

Cheney Reservoir. The City has the capability to pump up to 80 MGD of water from Cheney Reservoir to the City's water treatment plant. Should this need for additional water arise at a time when Cheney Reservoir is operating in the flood control pool, the City would be able to withdraw up to 80 MGD for delivery to the City's water treatment plant, thereby decreasing the total amount of water that would normally be released downstream to the North Fork through the river outlet works under the direction of the Corps. Use of flood water as a water supply could be continued up to a maximum capacity of 80 MGD. When water levels in the flood control pool are evacuated, the City could decrease withdrawals from Cheney Reservoir and increase withdrawals from the Equus Beds. Any impacts to recreational facilities at Cheney Reservoir would be slowed, since water from several of the City's sources would be used simultaneously.

As would be expected, diversion of water from the flood pool will have some impacts on water levels at Cheney Reservoir. However, as stated in Section 4.4.1.3.4, the development of either ILWSP alternative would increase the median water levels from 0.4 to 0.6 feet compared to current conditions (Figure 4-22). Therefore under normal operating scenarios, day-to-day recreational activities at Cheney Reservoir would not be impacted by the implementation of either of the ILWSP alternatives.

Should drought conditions occur, rather than being forced to pump the reservoir to lower levels, the City would instead be able to use water from the recharged Equus Beds aquifer, reducing demand on the reservoir. Therefore, demands on the reservoir during a drought would be less severe than they would have been without the ILWSP in place.

Recreation was considered to be a secondary project purpose at Cheney Reservoir; the initial funding allocated by Congress totaled $338,000 at a 1960 price level. Water supply is the primary purpose for Cheney Reservoir and the Wichita Project. The ILWSP is designed to limit withdrawals from the reservoir to a maximum of 47 MGD when the reservoir water surface elevation is at or below 1,421.6 ft. (the top of the conservation pool). Maintenance of this condition would minimize the impact to public recreation use.

Since the primary purpose of Cheney Reservoir is to supply water to the City, large water level fluctuations can be expected during a drought situation regardless of which alternative is selected. Figure 4-22 contains graphs showing simulated pool elevations verses time for all four alternatives. These graphs show that water stored in the conservation pool, the water level associated with day-to-day recreation activities, would be fully used during a major drought. Using the historic period of record employed in the operations model, under the proposed operation scenarios, severe drawdowns would have occurred during the droughts of the 1930's, mid-1950's, and even the late 1960's. Under severe drought conditions such as these, regardless of the alternative evaluated, recreation would be significantly impacted.

Impacts to Cheney Reservoir and the Wildlife Management Area due to implementation of any of the proposed alternatives will be positive compared to the No-action alternative. Given the fact that water levels with each of the proposed alternatives will be as high and more stable than without alternative implementation indicates that the overall net impact to the Wildlife Management Area and Cheney Reservoir in general will be positive.

Water levels would also be impacted under the No-action alternative. If neither of the ILWSP alternatives are implemented, the No-action alternative would result in a shrinking conservation pool with exposed mud flats, changing the hydrology of riparian wetlands, and reducing the utility of recreation facilities, such as boat docks and ramps (Figures 4-22, 23, 24 and 25).

4.15 MITIGATION SUMMARY

Many of the mitigation activities proposed for use with the ILWSP are a result of the environmental commitments included and made by the City in Reclamation’s 1995 EA and FONSI for the Equus Beds Groundwater Recharge Demonstration Project. Since several of the potential

environmental impacts are difficult to accurately and concisely describe prior to ILWSP implementation, the City has committed to the development of a Hydrobiological Monitoring Program in cooperation with the FWS, KDWP, and others. As a result, the following is a summary of the mitigation proposed for implementation:

- Construction activities will avoid or minimize impacts to wetlands, riparian areas, native grasslands, undisturbed old areas, woodlands, lakes and ponds by completing field surveys to relocate project facilities prior to initiating final design and land acquisition activities.
- Electrical transmission facilities will be constructed to reduce the potential for the electrocution of birds and other wildlife by using KDWP and FWS recommended designs and construction techniques.
- Where feasible, stream crossings will be bored under rather than trenched.
- A hydrobiological monitoring program will be developed to help understand if and how the impacts associated with the construction and operational activities for the proposed ILWSP will affect aquatic and terrestrial wildlife and their associated habitats.
- Best management practices such as silt fences, silt traps, sedimentation basins, reshaping, and reseeding would be used where appropriate to control soil erosion during construction. Because the construction activities for any of the ILWSP alternatives would disturb one acre or greater, a National Pollution Discharge Elimination System permit would be required for construction. A City of Wichita Land Disturbance Permit may also be required for lands within the city limits.
- Dust levels generated during construction would be minimized by spraying water or other approved dust control compounds on haul or access roads.
- All construction vehicles would be maintained in good working condition and construction contractors would be required to comply with all local, state, and federal air pollution rules.
- Visual impacts caused by the pre-sedimentation plant would be mitigated by adding berms and vegetation around the building and treatment ponds to screen the structures from view, breaking up the strong rectangular and geometric visual elements, and return a natural aspect to the landscape.
- Painting the structures earthtone colors would mitigate the visual impact of project facilities and structures.
- Lighting on the outside of the pre-sedimentation plant would be kept to the minimum necessary to provide adequate public safety and security.

4.16 HYDROBIOLOGICAL MONITORING PROGRAM

The Hydrobiological Monitoring Program (HBMP) will be a comprehensive environmental monitoring program that would be developed in coordination with KDWP and FWS to provide for the integrated sampling of hydrobiological parameters in the project area. The HBMP would specify the schedule for the preparation and dissemination of data reports, the posting of those reports, and the review of data generated from the HBMP to make any necessary

adjustments to the sampling program and/or the data analysis and reporting procedures.

The HBMP would also define a process by which adverse impacts could be evaluated and described. This process would also develop management actions that could be implemented in response to detected hydrobiological changes to avoid or minimize adverse environmental impacts resulting from the surface water withdrawals.

The goal of the HBMP is to determine if, following the construction of project facilities and initiation of operations (i.e., surface water withdrawals), flows in the Little Arkansas and Arkansas rivers deviate from the baseline rate and range of fluctuation to the extent that water quality, vegetation, and animal populations are adversely impacted. In addition, the HBMP would contain an established monitoring schedule to determine baseline conditions prior to permitted withdrawals for streamflow rates, selected water quality parameters, and biological variables within the identified study area. The appropriate agencies that have in the past or are currently collecting data in the local area would be contacted and coordinated with to avoid duplication of effort and to facilitate the most efficient use of available resources.

In conclusion, the objectives of the HBMP are to:

- Document existing conditions in the potentially affected water bodies.
- Enable the detection of changed conditions in the potentially affected water bodies.
- If changes are detected, determine if these changed conditions are attributable to reductions in stream flow.
- Provide a scientifically defensible means to evaluate whether the surface water withdrawals are causing or significantly contributing to the detected changed conditions.
- Determine whether the detected changed conditions constitute, or could result in, unacceptable adverse impacts.
- Recommend appropriate management actions or operational changes designed to eliminate or mitigate unacceptable adverse impacts, if they occur or are expected to occur.

4.17 UNAVOIDABLE ADVERSE IMPACTS

The construction and operation of recharge/recovery wells, recharge basins and associated pre-sedimentation plant would have unavoidable adverse impacts that could not be completely mitigated. These impacts are listed in the following sections.

4.17.1 ILWSP 150 MGD ALTERNATIVE

Unavoidable adverse impacts associated with the 150 MGD ILWSP alternative are as follows:

- The agricultural use of 1190 acres, including 79.5 acres of prime farmland, would be lost for the life of the project.
- Sedimentation and turbidity in the Little Arkansas River would temporarily increase during transmission pipeline and access road construction.

- Construction would temporarily decrease air quality and temporarily increase noise and soil erosion in the immediate project area.
- 109 acres of row crops, hay fields, and pasture would be lost for the life of the project.
- Wildlife would be displaced at the pre-sedimentation plant site for the life of the project.
- Vehicular access to residences and businesses would be temporarily disrupted during pipeline construction.
- Industrial visual elements would be added to a rural landscape for the life of the project.

4.17.2 ILSWP 100 MGD ALTERNATIVE

Implementation of the 100 MGD ILWSP alternative would have the following adverse environmental impacts:

- The agricultural use of 310 acres, including 65 acres of prime farmland, would be lost for the life of the project.
- Sedimentation and turbidity in the Little Arkansas River would temporarily increase during transmission and access road construction.
- Construction would temporarily decrease air quality and temporarily increase noise and soil erosion in the immediate project area.
- 74.5 acres of row crops, hay fields, and pasture would be lost for the life of the project.
- Wildlife would be displaced at the pre-sedimentation plant site for the life of the project.
- Vehicular access to residences and businesses would be temporarily disrupted during pipeline construction.
- Industrial visual elements would be added to a rural landscape for the life of the project.

4.17.3 NO ACTION

With the No-action alternative, the following adverse impacts would be expected to occur:

- Flows in the Little Arkansas River would decline an average of 6 to 7 cfs as the Equus Beds aquifer is further depleted and groundwater discharges are reduced.
- Releases from Cheney Reservoir would decrease in frequency to about 8 percent of the time or about half as often as under current conditions.
- The amount of water stored in the Equus Beds aquifer will be drawn down significantly from current levels and remain depressed with little hope of recovery.
- Infiltration rate and rate of salinity contamination in the Equus Beds aquifer will increase dramatically.

4.18 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The water supply alternatives identified in this EIS would have varying degrees of effect on the use of resources and productivity. The short-term is defined as the period of project construction through the time when the success of the mitigation measures can be ascertained. The short-term is estimated to be 5 to 10 years. The long-term would be the remainder of the life of the project.

Short-term resource commitments include the manpower, energy, and construction equipment required for the duration of construction activities. Some soil, vegetation, wetland, and stream resources would be temporarily disturbed for the construction of pipelines. This disturbance would represent soil loss through erosion, vegetation removal, a decrease in soil moisture, and the displacement of wildlife through loss of habitat. Suitable habitat adjacent to the project site would be temporarily lost to those wildlife species that are intolerant of construction. Short-term gains in productivity would include a temporary economic stimulation in nearby towns and in the construction industry.

Long-term commitments of resources would include the conversion of project area lands from agricultural uses to project purposes. Undisturbed land converted to project uses would result in a long-term loss of wildlife habitat. Current habitat resource utilization patterns would be modified by the presence of the pre-sedimentation plant and access roads. The dependable, long-term water supply for customers of the City of Wichita, provided by the proposed water supply alternatives would allow for long-term gains in productivity in the form of continued growth in the area population, economy, and residential, commercial, and infrastructure development.

4.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction and operation would result in the permanent commitment to the project of building materials and supplies, such as borrow material, steel, and concrete. Energy expended on the project would not be available for other uses. Petroleum-based products, including gasoline, diesel fuel, and lubricants would be consumed during construction. Operation and maintenance of the project facilities would also require the long-term commitment of energy resources for moving water and for chemical resources for treating water. The project would result in a commitment of manpower. Considerable efforts and funds have already been expended on planning and design of the project.

4.20 CUMULATIVE IMPACTS

Cumulative impacts are those effects on resources from the proposed action or alternative added to the effects on those same resources from the past, present, and reasonably foreseeable actions of others.

4.20.1 IMPACTS FROM PAST AND PRESENT ACTIONS

Since settlement of Arkansas River watershed by Euro-Americans, flows in the Arkansas River have been altered by damming and depleted by withdrawals, primarily for irrigation. Although many of these changes have been individually insignificant, the cumulative impacts have raised concerns for fish and wildlife, which depend on the river for their existence.

Urbanization, suburbanization, and agricultural activities have reduced the amount of wetlands in the project area relative to pre-settlement times. Residential and business development is probably continuing this trend.

4.20.2 IMPACTS FROM OTHER FUTURE ACTIONS

Suburban development is expected to continue around Wichita, Kansas. This development would be facilitated by the

construction of the proposed water supply project.

4.20.3 SIGNIFICANCE OF CUMULATIVE IMPACTS

The quantity of wetlands has been declining on a national scale and changes in the flow of the Little Arkansas, Arkansas, and the North Fork of the Ninnescah Rivers have been occurring since settlement of the area by Euro-Americans. With mitigation, the ILWSP alternatives would not contribute to the on-going, cumulative destruction of wetlands and the aquatic habitat of the previously mentioned rivers.