

7.9 WATER SUPPLY

An important benefit of the Mainstem Reservoir System is the availability of water at more than 1,600 intake facilities along lake and river reaches, from Fort Peck Lake to St. Louis. In this section, the estimated level of economic benefit, as it relates to water supply that could result from the alternative operating strategies, is compared to the estimated economic benefit if the CWCP were continued. Economic benefits are provided through the use of water for powerplants (other than hydroelectric), agriculture, drinking water, and other industrial uses of water. These benefits are described in greater detail in *Economic Studies—Water Supply Economics* (Corps, 1994g).

The major effects of the different operating strategies are the added costs that would be incurred to maintain water supplies during drought conditions. The main concern of most intake-facility owners is adequate access to water rather than an inadequate quantity of water. Drought conditions may require use of more expensive alternative water sources (e.g., wells) because intakes are above the water surface, may result in added mitigation costs to maintain water quality, or may cause temporary shutdowns (e.g., during toxic algae blooms) or increased maintenance and operation costs (e.g., increased pumping costs). To avoid “double counting” benefits that may be related to water quality or water supply, these effects have been combined.

Economic benefits in this section are measured in terms of millions of dollars generated at intake facilities. The economic benefits were estimated using the Daily Routing Model (DRM) and the Economic Impacts Model (EIM). The DRM is a hydrologic model (Corps, 1998b) that estimates water surface elevation and flow at 23 river reaches using the alternative operation strategies and the historic runoff levels between 1898 and 1997. The EIM (Corps, 1994r) uses the output from the DRM and economic value functions to estimate the economic benefit. The estimated economic benefits are used for comparative purposes only and may not represent actual economic returns under the different alternatives. The models were designed expressly for comparing the effects of changing the CWCP and not to provide economic forecasts.

Table 7.9-1 and Figure 7.9-1 present the average annual water supply benefits for the CWCP, the MCP, and the four GP options. Table 7.9-1 also includes data for individual lakes and river reaches. The CWCP provides \$610.08 million in benefits

along the entire Mainstem Reservoir System. This total benefit is distributed among the lake subtotal (3.0 percent), the Upper River (16.0 percent), and the Lower River (81.0 percent). Over the entire 100-year period of analysis from 1897 to 1997, total average annual benefits from water supply systems in the river system vary only slightly among the alternatives (less than 0.4 percent difference from highest to lowest).

Figure 7.9-1 shows that there are three separate groupings of total average water supply benefits of all of the alternatives analyzed in this chapter. The CWCP and the MCP are closely grouped between \$610.08 and \$610.44 million, a difference of \$0.36 million. The two GP options with a flat summer low flow, the GP1528 option (the potential starting point for the GP options) and the GP2028 option, are more closely grouped between \$611.06 and 610.95 million, a difference of \$0.11 million. The two GP options with a split summer release, the GP2021 and GP1521 options, are more closely aligned between \$608.49 and \$608.58 million, a difference of only \$0.09 million. This figure also shows the values for the submitted alternatives discussed in Chapter 5 to provide perspective as to how the GP options perform relative to the Chapter 5 submitted alternatives. The GP1528 and GP2021 options provide water supply benefits that are closest to the MLDDA, BIOP, and FWS30 alternatives. Also, the MCP and MRBA alternative have similar benefits. These corresponding alternatives have the same summer flows.

The MCP is similar to the CWCP except that increased water conservation (retention of water in the lakes) will occur under drought conditions. Similar to the other alternatives, the average annual water supply benefits are not substantially different than the CWCP. Average annual water supply benefits under the MCP (\$610.44 million) are about \$0.36 million (0.1 percent) more than under the CWCP for the entire Mainstem Reservoir System. Under the MCP, the average annual water supply benefits increase in the lake subtotal by \$0.32 million (1.6 percent) and in the Upper River by \$1.89 million (2.0 percent). Compared to the CWCP, the MCP decreases water supply benefits in the Lower River by \$1.86 million, or 0.4 percent.

The GP options differ from the MCP by adding a spring rise and summer low-flow measures at Gavins Point Dam. The potential starting point for the GP options, the GP1528 option, includes a 15-kcfs spring rise and a 28.5-kcfs flat release during summer. These measures result in a \$0.62 million (0.1 percent) increase in total average annual water

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Table 7.9-1. Average annual water supply benefits (\$millions).

Lake/Reach	CWCP	MCP	GP1528	GP2021	GP1521	GP2028
Fort Peck Lake	0.57	0.58	0.57	0.57	0.57	0.56
Lake Sakakawea	6.28	6.61	6.73	6.54	6.54	6.73
Lake Oahe	5.97	5.96	6.06	6.05	6.07	6.03
Lake Sharpe	4.74	4.74	4.74	4.74	4.74	4.74
Lake Francis Case	2.34	2.32	2.34	2.38	2.38	2.34
Lewis and Clark Lake	0.65	0.65	0.66	0.66	0.66	0.66
Lake Subtotal	20.55	20.87	21.09	20.93	20.95	21.06
Fort Peck	1.39	1.39	1.46	1.47	1.47	1.46
Garrison	92.37	94.25	94.25	94.25	94.25	94.25
Fort Randall	0.01	0.01	0.01	0.01	0.01	0.01
Upper River Subtotal	93.77	95.66	95.72	95.73	95.74	95.72
Gavins Point	1.53	1.53	1.53	1.53	1.53	1.53
Sioux City	32.15	32.14	32.12	32.14	32.14	32.12
Omaha	198.76	197.68	197.81	196.21	196.25	197.74
Nebraska City	145.44	144.89	145.12	144.28	144.29	145.11
St. Joseph	24.26	24.25	24.24	24.24	24.24	24.24
Kansas City	49.18	49.03	49.04	49.04	49.05	49.03
Boonville	0.64	0.64	0.64	0.64	0.64	0.64
Hermann	43.81	43.76	43.76	43.76	43.76	43.76
Lower River Subtotal	495.77	493.91	494.26	491.83	491.89	494.17
Total	610.08	610.44	611.06	608.49	608.58	610.95

supply benefits over the MCP. Compared to the MCP, the GP1528 option increases water supply benefits in the lake subtotal by \$0.22 million (1.1 percent), the Upper River by \$0.06 million (0.1 percent), and the Lower River by \$0.35 million (0.1 percent).

The GP2021 option includes a 20-kcfs rise during the spring that is similar to the GP2028 option. During the summer period, the GP2021 option includes a provision for low summer flows (the 25/21 flow option) similar to the GP1521 option. From July 15 to August 15, 21 kcfs will be released from Gavins Point Dam, and during the periods June 21 to July 15 and August 15 to August 31, flow releases will be set to 25 kcfs. Under the GP2021 option, average annual benefits are \$608.49 million, \$2.57 million (0.4 percent) less than under the GP1528 option. Compared to the potential starting point for the GP options, the GP2021 option decreases water supply benefits in the lake subtotal by \$0.16 million (0.8 percent) and in the Lower River by \$2.43 million (0.5 percent), but increases the water supply benefit in the Upper River by \$0.01 million, or less than 0.1 percent.

The GP1521 option has a 15-kcfs rise during the spring, and includes a provision for low summer flows of 21 kcfs from July 15 to August 15. During

the periods June 21 to July 15 and August 15 to August 31, Gavins Point Dam releases will be set to 25 kcfs. Total average annual water supply benefits under the GP1521 option (\$608.58 million) are about \$2.48 million (0.4 percent) less than the GP1528 option. As with the GP2021 option, the variable summer low-flow measures under the GP1521 option result in a water supply benefit decrease in the lake subtotal and Lower River and an increase in the Upper River. Compared to the GP1528 option, the GP1521 option provides \$0.14 million (0.7 percent) less benefit in the lake subtotal and \$2.37 million (0.5 percent) less benefit in the Lower River, but increases the water supply benefit by \$0.02 million, or less than 0.1 percent in the Upper River.

The GP2028 option includes a 20-kcfs rise during the spring and a flat 28.5-kcfs summer release. Under the GP2028 option, total average annual water supply benefits will be \$610.95 million, about \$0.11 million (less than 0.1 percent) less than the GP1528 option. Compared to the GP1528 option, the GP2028 option decreases water supply benefits in the lake subtotal by \$0.03 million (0.1 percent) and the Lower River by \$0.09 million, or less than 0.1 percent. The GP2028 option does not change the water supply benefit from the GP1528 option in the Upper River.

The annual values of total water supply benefits for the CWCP, the MCP, and the four GP options are shown on Figures 7.9-2 through 7.9-4. All of the alternatives discussed in this chapter tend to respond similarly to changes made during the 100-year period of analysis. The average water supply benefits show a dramatic decrease during the early 1930s and 1960s and a lesser decrease during the early 1990s. These dips occur on a 30-year cycle when major water supply capital improvements are assumed to be made to all facilities.

7.9.1 Water Supply for Tribal Reservations

Native Americans own approximately 302 water supply intakes and intake facilities along the Mainstem Reservoir System. Table 7.9.1-1 presents the average annual water supply benefits of the alternatives for 10 Tribal Reservations during the full period from 1898 to 1997. Under the CWCP, total water supply benefits provided are \$5.37 million. Each of the alternatives provides an increase in the total average annual benefits to the Tribes relative to the CWCP; however, the level of increase to individual Tribes is dependent upon the location of the Reservation within the river system and how that section of the river will be operated under the alternatives.

Depending upon the alternative, many Tribes in the Lower River are expected to have no increase in water supply benefits, but those in the Upper River reaches will be provided the bulk of the increase in water supply benefits. None of the Tribes is expected to have a decrease in water supply

benefits. Note that values less than \$5,000 (\$0.005 million) are not represented in Table 7.9.1-1.

The CWCP provides \$0.21 million of water supply benefits to the Fort Peck Reservation. Each of the four GP options increases the water supply benefits to this Reservation by 14.3 percent. The MCP does not result in a change in water supply benefits when compared to the CWCP.

Fort Berthold Reservation has 79 water supply intakes and intake facilities identified along Lake Sakakawea, on Reservation land. Under the CWCP, average annual benefits total \$1.75 million. Within Fort Berthold Reservation, the GP1528 and GP2028 options provide the greatest increase in average annual water supply benefits (8.6 percent) and the MCP provides the second largest benefit increase (6.3 percent). Both the GP2021 and GP1521 options increase the water supply benefit within this Reservation by only 1.1 percent.

Standing Rock Reservation has 14 water supply intakes along Lake Oahe on Reservation land. Under the CWCP, average annual benefits total \$0.67 million. Each of the four GP options provides the same amount of benefit increase within this Reservation (10.4 percent over the CWCP), while the MCP provides a 9.0 percent increase over the CWCP in water supply benefit.

Nine water supply intakes have been identified along Lake Oahe on Cheyenne River Reservation. Under the CWCP, average annual benefits to this Reservation total \$0.08 million. None of the four GP options result in a change in water supply

Table 7.9.1-1. Average annual water supply benefits (\$millions) to Tribes.

Reservation	CWCP	MCP	GP1528	GP2021	GP1521	GP2028
Fort Peck	0.21	0.21	0.24	0.24	0.24	0.24
Fort Berthold	1.75	1.86	1.90	1.77	1.77	1.90
Standing Rock	0.67	0.73	0.74	0.74	0.74	0.74
Cheyenne River	0.08	0.09	0.08	0.08	0.08	0.08
Lower Brule	0.54	0.54	0.54	0.54	0.54	0.54
Crow Creek	1.98	1.99	1.99	1.99	1.99	1.99
Yankton	0.00	0.00	0.00	0.00	0.00	0.00
Santee	0.11	0.11	0.11	0.11	0.11	0.11
Winnebago	0.01	0.01	0.01	0.01	0.01	0.01
Omaha	0.02	0.02	0.02	0.02	0.02	0.02
Total	5.37	5.56	5.63	5.50	5.50	5.63

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benefits to this Reservation; however, the MCP provides a 12.5 percent average annual water supply benefit increase over the CWCP.

Lower Brule Reservation has 22 water supply intakes identified along Lake Sharpe on Reservation land. Under the CWCP, average annual benefits for these intakes total \$0.54 million. Compared to the CWCP, the MCP and the four GP options provide the same water supply benefits. The operation of Lake Sharpe does not vary under any of the alternatives.

There are 55 water supply intakes serving Crow Creek Reservation from Lake Sharpe and Lake Francis Case. Under the CWCP, average annual benefits to these intakes total \$1.98 million. The MCP and the four GP options slightly increase the average annual water supply benefits to this Reservation by the same amount (increase of 0.5 percent).

Four irrigation intakes pulling water from Lake Francis Case are located on Yankton Reservation.

The alternatives analyzed in this chapter do not result in a change in water supply benefits when compared to the CWCP. Santee Reservation has seven water supply intakes located on Lewis and Clark Lake. As with Yankton Reservation, none of the alternatives analyzed in this chapter results in a change in water supply benefits when compared to the CWCP.

Of the 49 water supply intakes located on the Missouri River in the Sioux City reach, there is one irrigation intake on Winnebago Reservation and two irrigation intakes on Omaha Reservation. For Winnebago and Omaha Reservation irrigation intakes, there is no change in water supply benefits from the CWCP under the MCP or the four GP options.

None of the nine water supply intakes located on the St. Joseph reach of the Missouri River is on Iowa Reservation or Sac and Fox Reservation.

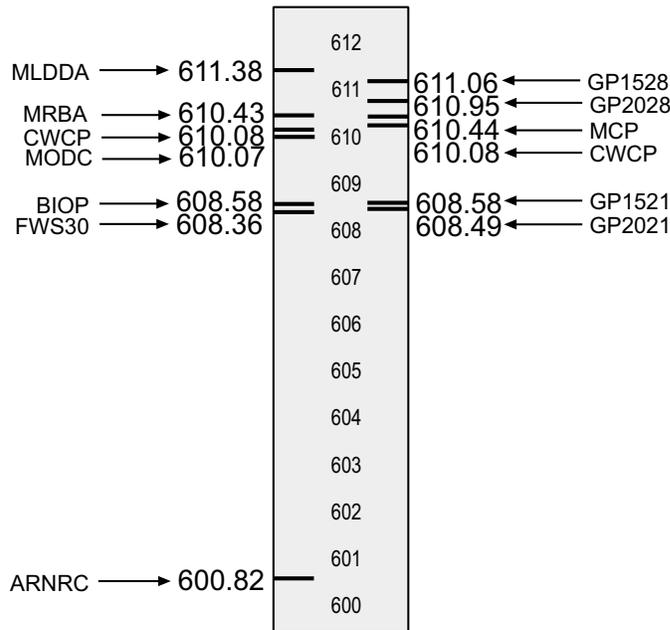


Figure 7.9-1. Average annual water supply benefits for submitted alternatives and the alternatives (\$millions).

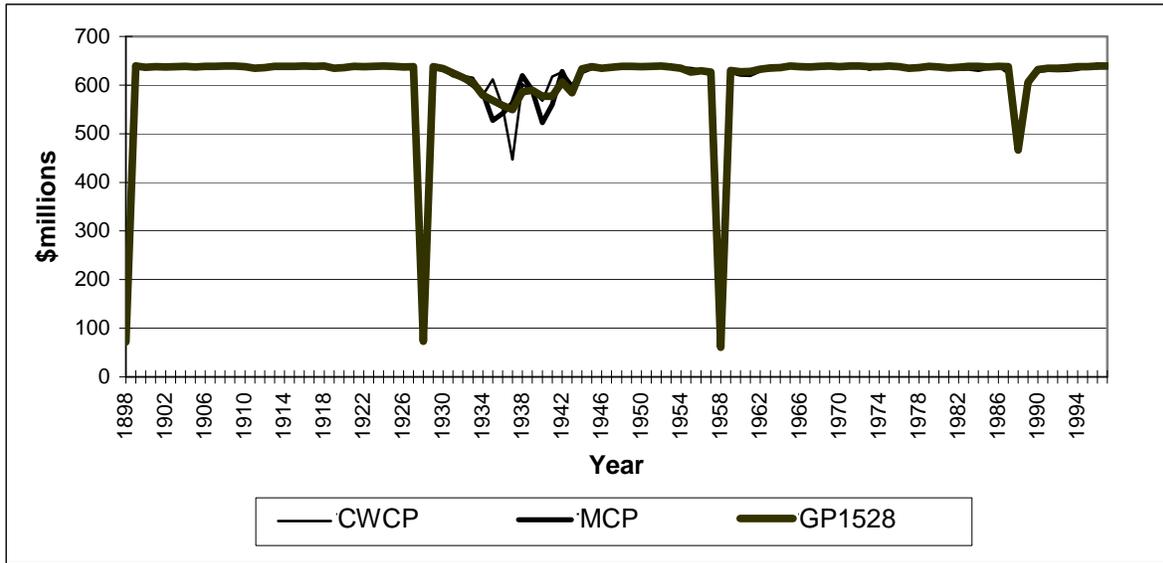


Figure 7.9-2. Average annual water supply benefits for CWCP, MCP, and GP1528.



Figure 7.9-3. Average annual water supply benefits for GP1528 and GP2021.

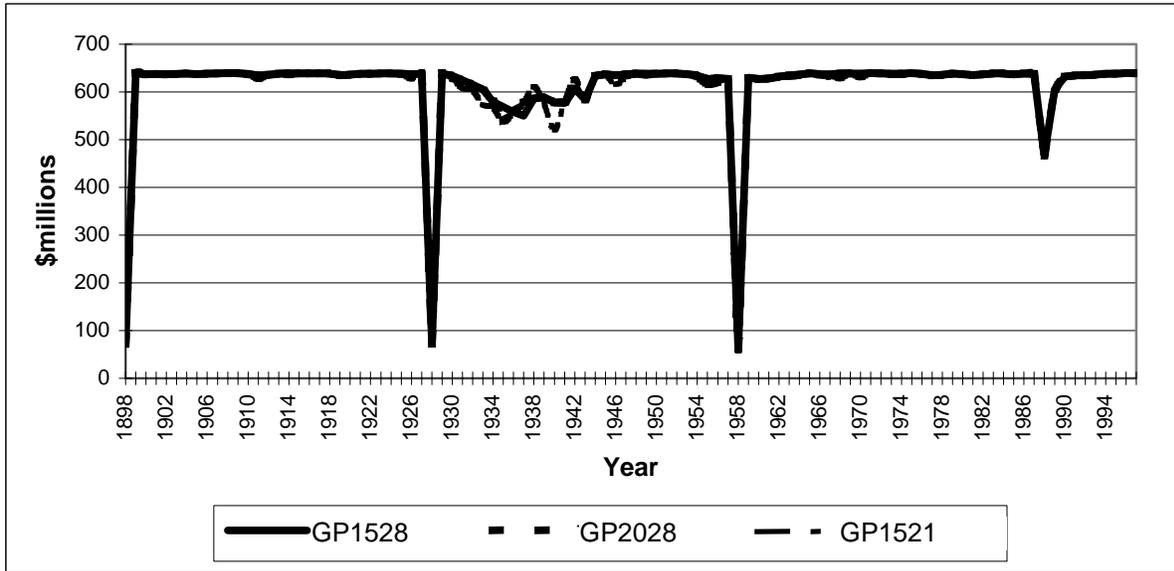


Figure 7.9-4. Average annual water supply benefits for GP1528, GP2028, and GP1521.