5.12 NAVIGATION

Navigation is served on the Lower River from Sioux City to St. Louis. Changes in several of the criteria making up the set of submitted alternatives affect navigation in differing ways. The drought conservation criteria change how navigation service would be affected during droughts in terms of level of service (flow support) and in minimum season lengths. The changes in Gavins Point releases for endangered species affect how navigation would be served in the non-drought periods. Three of the submitted alternatives would eliminate service to navigation for 2 months or longer in the June through August timeframe. This section of Chapter 5 describes the changes in navigation benefits that occur for these changes to the CWCP.

Navigation benefits are computed based on the cost reduction the navigation industry provides to the Nation. Alternative modes of transportation can move the commodities that the industry moves on the Missouri River; however, these other modes of transportation would move these commodities at a higher cost. The navigation benefits are computed by taking the difference in cost between the next highest costs and the costs of moving the various commodities by barge on the Missouri River from their various origins to the destinations for the commodities moved in 1994. This analysis derived the value per ton of each commodity moved that year that was provided by the navigators on the Missouri River. The details of how these unit values were determined and the breakdown of the annual tonnage moved among the commodities are detailed in the Navigation Economics (Revised) technical report (Corps 1998c). This technical report also discusses how the operation and maintenance costs were deducted from the cost savings benefits to arrive at the navigation benefits presented in this section of Chapter 5. This chapter describes the impacts of submitted alternatives compared to the current water control plan (CWCP).

The average annual navigation benefits for the Missouri River under the CWCP and the submitted alternatives are listed in Table 5.12-1 and displayed in Figure 5.12-1. Table 5.12-1 shows the total benefits for the system and the breakdown of those benefits by river reach. The CWCP total annual economic benefits outperform all of the submitted alternatives with an average annual benefit of $6.97 million. The bulk of the navigation benefits occur in the Kansas City reach, which extends from Kansas City to the mouth ($4.51 million).

Figure 5.12-1 also shows that the CWCP economically outperforms all of the submitted alternatives, which cluster into three basic groupings. The highest benefits cluster includes the CWCP and the MODC, MRBA, and MLDDA alternatives with benefits ranging from a high of $6.97 million for the CWCP to $6.68 million for the MLDDA alternative. The next cluster includes the high level of benefits for the three alternatives with summer releases from Gavins Point Dam that do not serve navigation during the summer. These are the BIOP, ARNRC, and FWS30 alternatives, and the benefits ranges from a high of $4.78 million to a low of $4.62 million, a difference of only $0.16 million. The final cluster consists of the benefits of the same three alternatives but with the assumption that only sand and gravel operations and the placement of waterway materials continue in the future for Missouri River navigation. The benefits range from $0.99 million to $0.94 million, a difference of only $0.05 million. The actual benefits for these three alternatives may lie in between the low and high values presented in the table and figure. The submitted alternatives are discussed individually below.

Table 5.12-1. Average annual navigation benefits ($millions).

Alternative	Total	Sioux City	Omaha	Nebraska City	Kansas City
CWCP	**6.97**	0.46	1.12	0.88	4.51
MLDDA	**6.68**	0.43	1.08	0.84	4.33
ARNRC*	**4.61**	0.48	0.70	0.65	2.77
ARNRC **	**0.94**	0.07	0.00	0.13	0.73
MRBA	**6.89**	0.49	1.11	0.93	4.36
MODC	**6.91**	0.49	1.11	0.94	4.36
BIOP*	**4.78**	0.48	0.73	0.66	2.91
BIOP**	**0.99**	0.08	0.00	0.14	0.78
FWS30*	**4.52**	0.45	0.69	0.61	2.77
FWS30**	**0.97**	0.08	0.00	0.14	0.76

* Includes benefits if navigation continues before and after the split season.
** Includes remaining sand/rock benefits if navigation is essentially extinguished; excludes O&M cost adjustments.

Briefly summarized, the MLDDA alternative is based on the CWCP and primarily focuses on increasing flood control storage compared to the CWCP by increasing in the amount of flood control storage in the system of dams. To accomplish this, the MLDDA alternative includes an additional 2 MAF of flood control storage (base of flood control at 55.1 instead of the 57.1 MAF level of CWCP). The MLDDA alternative also has a higher nonnavigation summer service level of 18 kcfs instead of the 9 kcfs of the CWCP, and this would increase the number of nonnavigation years for the MLDDA alternative to 3 years instead of 1 year for the CWCP. The MLDDA benefits are very similar to the CWCP, with an average annual benefit of $6.68 million. The MLDDA changes in operation would reduce total annual benefits to navigation by 4.2 percent compared to the CWCP (Table 5.12-1). By reach these reductions average from 3.6 to 6.5 percent, with the principal loss of absolute benefits ($0.18 million) occurring in the Kansas City reach. The MLDDA average annual benefits place it in the cluster of submitted alternatives highest in benefits compared to the CWCP (Figure 5.12-1).

The ARNRC alternative recommends a series of flow adjustments that "…mimic the timing, magnitude, duration, and variability of the river's natural annual hydrograph…." The ARNRC alternative has a 15 kcfs spring rise over releases required to serve navigation in the May through June timeframe. This rise is followed by releases of 18 kcfs from Gavins Point Dam in the July and August period. As discussed above, two potential outcomes were considered for the alternatives that had releases from Gavins Point Dam in the summer that would be too low to serve navigation. The higher values assume that navigation would occur before and after the navigation "split". The lower values assume that the only navigation remaining on the river would be sand and gravel mining of the riverbed and the placement of waterway materials. In reality, the actual value may lie somewhere in between these two values as flows on the river would be high enough in some years that some tow company may move into a portion of the Lower River to move some commodities in and/or out of the river. The navigation benefits, therefore, for the ARNRC alternative range from $4.61 million per year down to $0.94 million per year. These values represent a 33.9 to 86.5 percent reduction in the navigation benefits under the ARNRC alternative.

The MRBA alternative includes higher drought conservation measures than the CWCP, but slightly less than the ARNRC alternative. The MRBA alternative would reduce total annual benefits by only 1.1 percent compared to the CWCP with an average annual benefit of $6.89 million. By reach these changes would range from a 6.5 percent increase in the Sioux City reach to a 3.3 percent reduction in the Kansas City reach.

The MODC alternative follows MRDA exactly except evacuations of water from the flood control zones of the system are delayed until mid-September to accommodate environmental needs of the endangered pallid sturgeon. The MODC alternative would reduce total annual benefits by only 0.9 percent compared to the CWCP with an average annual benefit of $6.91 million. By reach these changes would range from a 6.8 percent increase in the Nebraska City reach to a 3.3 percent reduction in the Kansas City reach.

The BIOP alternative is the one prescribed in the Biological Opinion. It has a Gavins Point Dam 17.5 kcfs spring rise followed by a 25/21 summer low flow. The 25 kcfs release extends from June 21 to July 15 and is followed by a 21 kcfs release from 16 July to 15 August. The Gavins release then goes back up to 25 kcfs until 1 September when the release goes back on navigation targets for the remainder of the navigation season. The BIOP alternative also has the same conservation measures as the MRBA alternative. The BIOP alternative has two sets of benefits; the first outcome would reduce total annual benefits by 31.4 percent compared to the CWCP with an average annual benefit of $4.78 million. By reach these reductions would average from 4.3 to 35.5 percent. The second outcome would reduce total annual benefits by 85.8 percent compared to the CWCP with an average annual benefit of $0.99 million. By reach these reductions would average from 82.6 to 100.0 percent.

The FWS30 alternative reflects characteristics similar to the BIOP alternative with the same release durations as the BIOP but reflecting a higher spring rise to 30 kcfs in comparison to the initial spring rise of 17.5 kcfs under BIOP. In evaluating the benefits of the FWS30 alternative, two outcomes for navigation benefit response are presented. The FWS30 alternative would have an average annual benefit of $4.52 million if one assumes navigation will continue before and after the low-flow split. By reach these reductions would average from 2.2 to 38.6 percent compared to the CWCP. The lower FWS30 alternative benefits would represent the lower limit of benefits reducing total annual benefits assuming only sand and gravel mining survive. These benefits are 86.1

percent lower when compared to those of the CWCP with an average annual benefit of $0.97 million. By reach these reductions would average from 82.6 to 100.0 percent.

Table 5.12-2 summarizes navigation service level and season length expressed in years for the CWCP and each of the six submitted alternatives. Operation of the Mainstem Reservoir System for navigation includes two checkpoints for determining navigation service level and season length: the March 15 check and the July 1 check. Navigation service levels can range from full service to minimum service, a difference of 6 kcfs and 1-foot of draft (9 versus 8 feet). In the 1930 to 1941 drought, there were years of no service. Under the CWCP, navigation season length can range from 5.5 to 8.33 months. The submitted alternatives provide differing season lengths.

Review of Table 5.12-2 indicates that the submitted alternatives provide changes in service level and season length that can be viewed as either positive changes or negative changes. The MLDDA alternative would provide similar service to the CWCP. This alternative would have 91 8-month or 8.33-month seasons; however, it would have 3 nonnavigation years versus only 1 for the CWCP. All of the other alternatives would have 5 nonnavigation years, all in the 1930 to 1941 drought. The ARNRC, BIOP, and FWS30 alternatives would have season lengths that can never be considered to be 8 months long. The low summer flows under all three alternatives would be too low to provide even minimum navigation service in most years. Because of the unpredictability of having adequate water to navigate, these alternatives would not take advantage of high runoff years that may provide adequate flows on the Lower River to navigate from April 1 through December 15, an 8.33-month season. The ARNRC alternative navigation season can end as early as October 1 because its season length in extended droughts would decrease gradually as the drought progresses. The other two alternatives, however, are based on two storage levels, one for each of the two checkpoint dates. This type of reduction is referred as having a navigation trigger storage level for each checkpoint.

The BIOP and FWS30 alternatives would have navigation seasons that end no earlier than November 25 at the mouth. The trade-off is that there is generally no navigation service from about June 29 (June 18 at Sioux City) through September 14 at the mouth. The low flow would end on September 1 and it takes about 3 days to increase the releases from Gavins Point Dam enough to have full service water in the river plus another 11 days for that water to get to the mouth of the river. This means that the navigation season lengths are generally about 5.5 months long, whether in droughts or normal runoff periods.

Table 5.12-2. Summary of navigation service level and season length data (years).

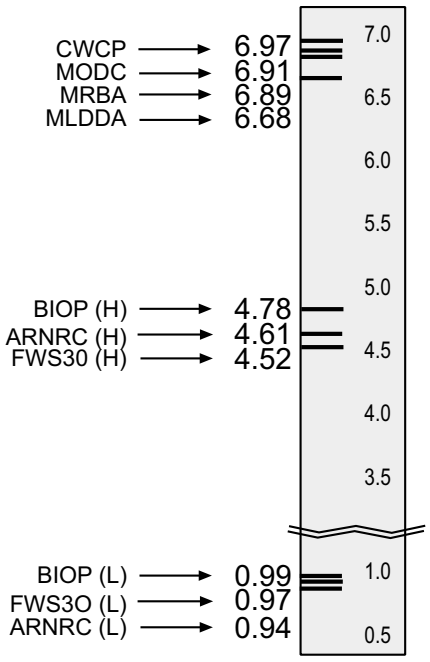
		CWCP	MLDDA	ARNRC	MRBA	MODC	BIOP	FWS30
Service Level								
March Check	Full	56	53	60	63	63	67	68
	Partial	24	26	22	25	26	20	17
	Minimum	19	18	13	7	6	8	10
	No Service	1	3	5	5	5	5	5
July Check	Full	59	54	64	60	63	64	66
	Partial	16	22	12	27	25	22	18
	Minimum	24	21	19	8	7	9	11
	No Service	1	3	5	5	5	5	5
Season Length								
	5.5 to < 6 Months	5	3	95	0	0	95	95
	6.0 to < 6.5 Months	2	0	0	0	0	0	0
	6.5 to < 7.0 Months	1	1	0	0	0	0	0
	7.0 to < 7.5 Months	0	1	0	35	32	0	0
	7.5 to < 8 Months	0	1	0	0	0	0	0
	8 Months	45	53	0	10	14	0	0
	8.33 Months	46	38	0	50	49	0	0

Finally, the MRBA and MODC alternatives would have season lengths that range from 7.1 months long in multi-year droughts to 8.33 months in the higher runoff years. From a service level standpoint, the MRBA and MODC alternatives would also have the benefit of going to minimum service in the fewest number of years. They would only go to minimum service in extremely low runoff years when system storage does not experience a gain between the two checkpoints. The drawback is that these two alternatives would have fewer 8- or 8.33-month seasons than the CWCP, 60 and 63 years, respectively, versus the 91 years for the CWCP.

Annual benefits for the 100-year history of the river for the CWCP and the submitted alternatives are shown in Figures 5.12-2 to 5.12-4. The MLDDA alternative's annual values closely track the CWCP with decreased benefits seen primarily during the 1930 to 1941 drought when 3 nonnavigation years occurred, compared to 1 nonnavigation year for the CWCP. The ARNRC alternative has two sets of values on this figure that represent the range of annual values under the two assumptions (navigation continues before and after the split for the high value and does not for the low value). The higher values mimic the patterns seen in the CWCP and the MLDDA alternative values, although offering average benefit levels approximately 31.0 percent less than either the CWCP or the MLDDA alternative. There is also a greater reduction during the 1930 to 1941 drought when 5 nonnavigation years occur compared to the 1 nonnavigation year of the CWCP. In contrast, the lower values show a relatively constant value of about $1 million with a drop to zero during part of the 1930 to 1941 drought.

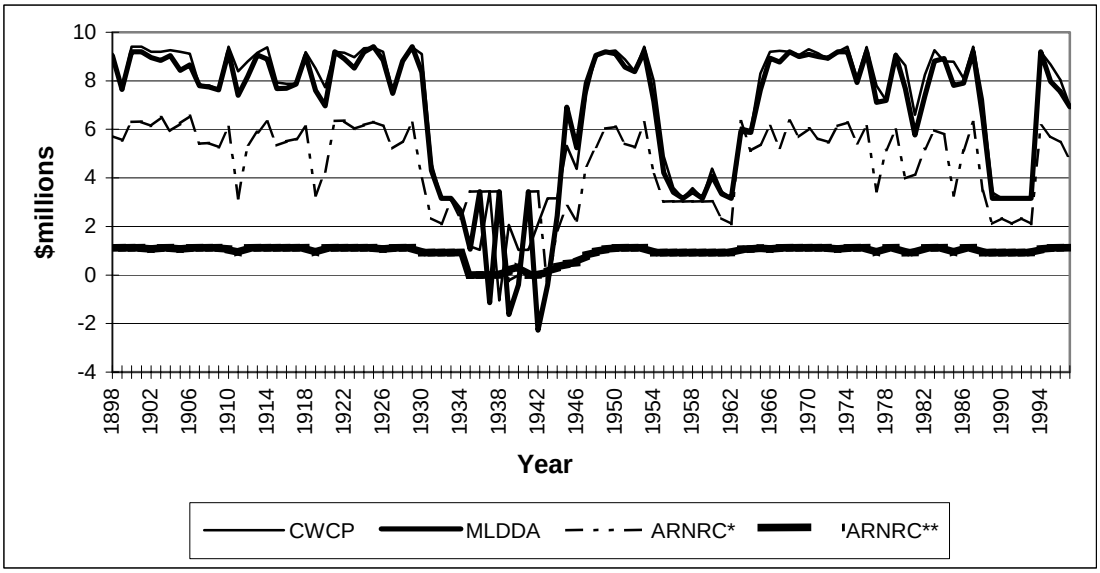
Figure 5.12-3 shows the annual values for navigation under the CWCP, MRBA, and MODC alternatives. The greatest differences between the MRBA and MODC alternatives compared to the CWCP occur during droughts, whether for a short duration or the longer duration of the three major droughts due to their higher drought conservation measures. Both the MRBA and the MODC alternatives would incur 5 nonnavigation years compared to 1 nonnavigation year for the CWCP during the 1930 to 1941 drought.

Figure 5.12-4 shows the annual values for navigation under the MRBA, BIOP, and FWS30 alternatives. As discussed above, the MRBA alternative includes additional conservation benefits compared to the CWCP and is the base plan to which the Gavins Point Dam releases in the BIOP and FWS30 alternatives were added. Again, the BIOP and FWS30 alternatives show two sets of reduced annual benefits compared to their base plan, in this case the MRBA alternative. For the higher values, average annual benefit reductions of 30.6 and 34.4 percent are observed in the BIOP and FWS30 alternatives, respectively, due to the split navigation season. All three alternatives respond similarly in the 1930 to 1941 drought. The lower BIOP and FWS30 annual values respond very similarly over the 100-year period with 85.6 and 85.9 percent reductions in average annual values compared to the MRBA alternative. These reductions reflect the almost complete loss of navigation on the river with only sand and gravel operations and the placement of waterway materials benefits accruing.



(H) Includes benefits if navigation continues before and after the split season.
(L) Includes remaining sand/rock benefits if navigation is essentially extinguished.

Figure 5.12-1. Average annual navigation benefits for the submitted alternatives ($millions).



*Includes benefits if navigation continues before and after the split season.
**Includes remaining sand/rock benefits if navigation is essentially extinguished.

Figure 5.12-2. Average annual navigation benefits for alternatives CWCP, MLDDA, and ARNRC.

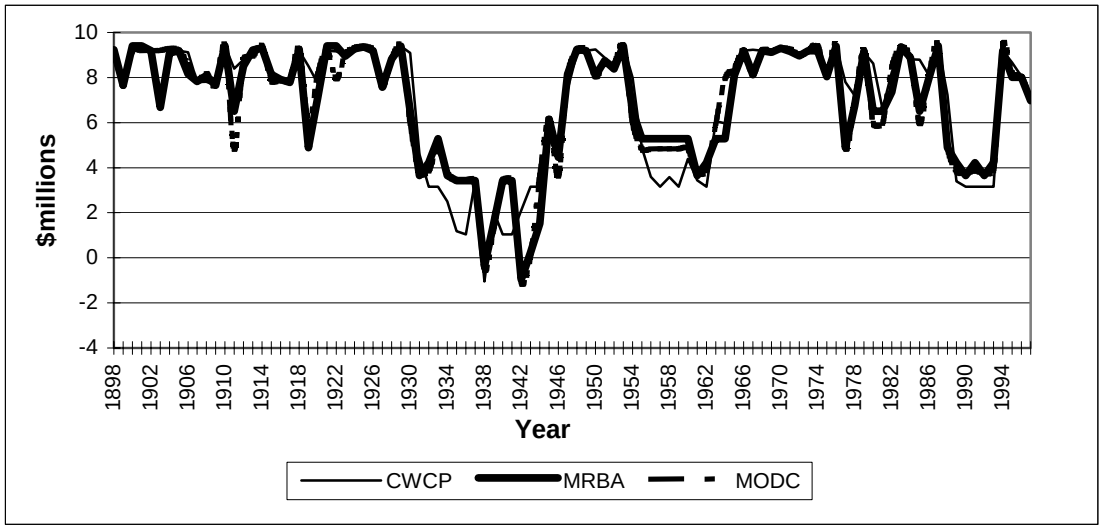
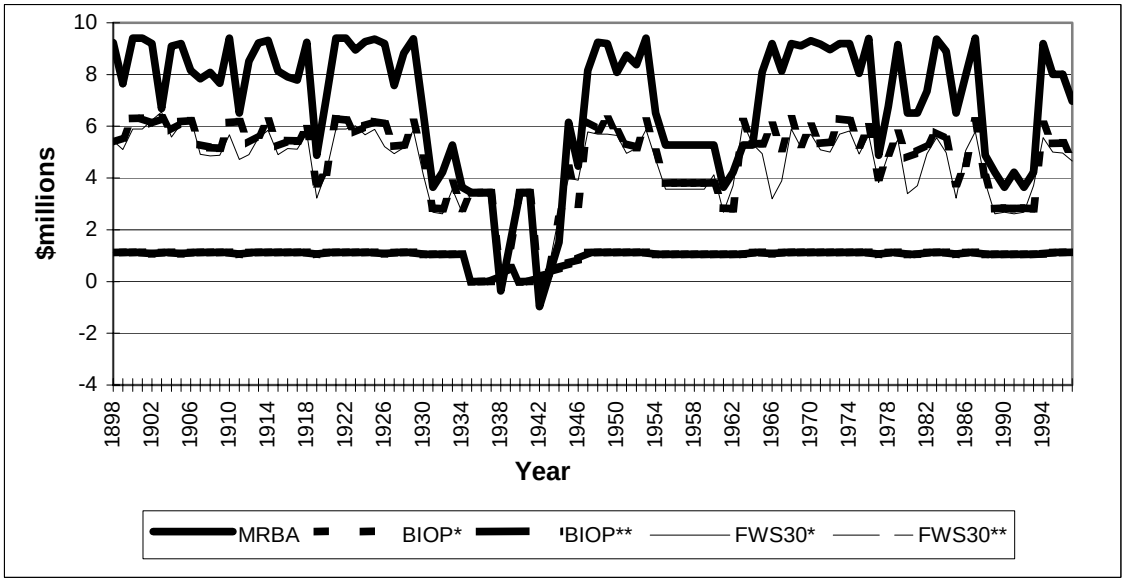


Figure 5.12-3. Average annual navigation benefits for alternatives CWCP, MRBA and MODC.



*Includes benefits if navigation continues before and after the split season.
**Includes remaining sand/rock benefits if navigation is essentially extinguished.

Figure 5.12-4. Average annual navigation benefits for alternatives MRBA, BIOP, and FWS30.