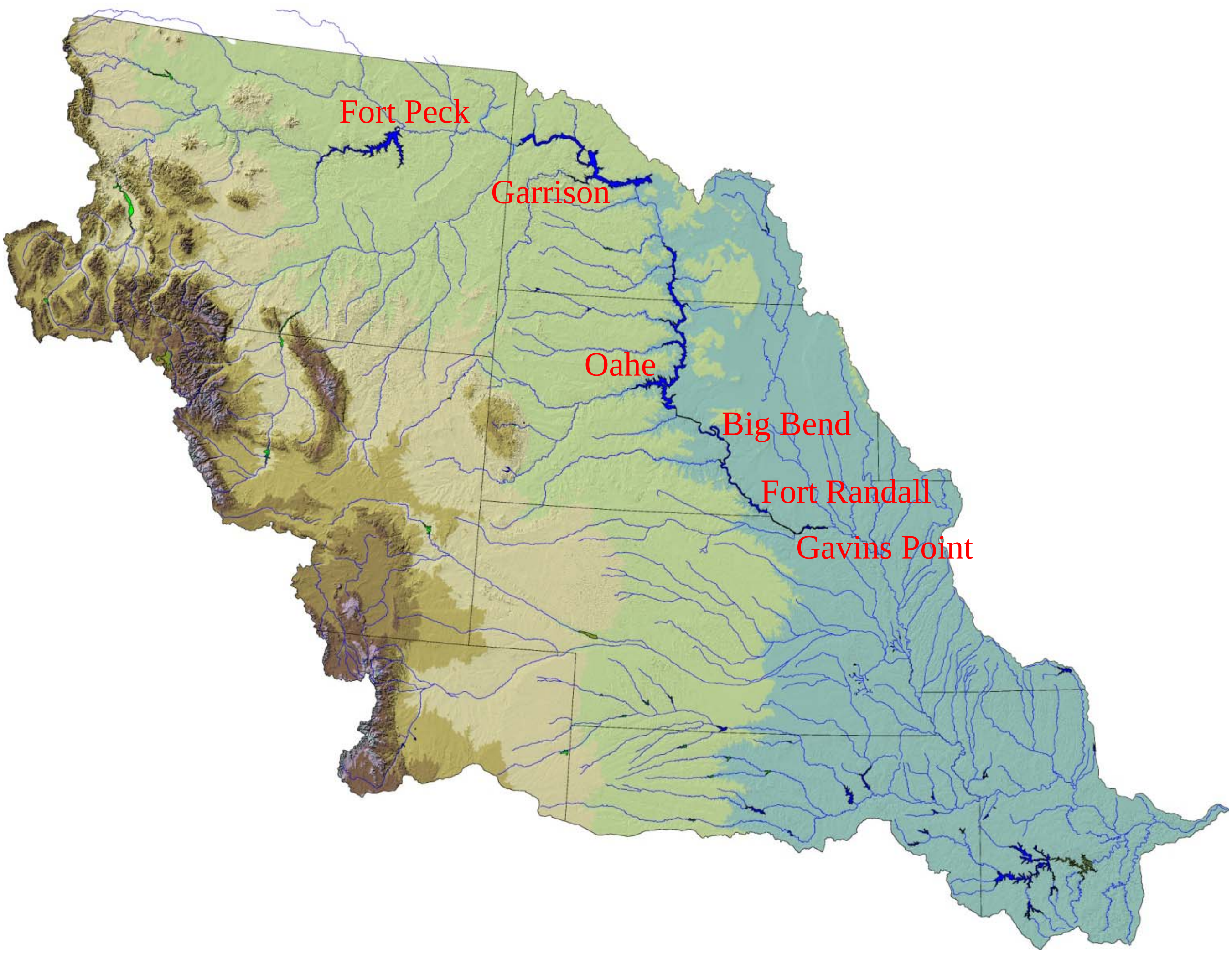
US Army Corps of Engineers ®
Northwestern Division

Missouri River Mainstem Reservoir System

Post 2011 Flood Event Analysis of Missouri River Mainstem Flood Control Storage



U.S. Army Corps of Engineers
Northwestern Division
Missouri River Basin Water Management Division
Omaha, Nebraska

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Post 2011 Flood Event
Analysis of Missouri River
Mainstem Flood Control Storage

Executive Summary

This analysis was initiated as a result of the record 2011 flood event in the Missouri River Basin. The primary purpose was to examine how additional flood control storage may improve flood risk reduction in the future. The analysis also provides a limited investigation at the impacts of providing additional flood control storage on several Congressionally authorized project purposes.

This analysis showed that providing additional flood control storage in the Missouri River Mainstem Reservoir System (System) would enhance flood risk reduction in a repeat of the 2011 flood event. However, due to the tremendous volume of water that must be moved though the System, record releases would be required regardless of the amount of flood control storage provided. If flood control storage were increased by approximately 30 percent, peak release could potentially be reduced from 160,000 cubic feet per second (cfs) to 100,000 cfs. These lower releases would reduce flood risk below the reservoirs, but would not have prevented widespread damages.

The second part of the analysis examined the impact of additional flood control storage on five authorized purposes. Flood control is the only one of these authorized purposes that requires empty space in the reservoirs. This analysis indicates that the other four analyzed purposes, which all require water-in-storage to maximize benefits, would experience negative impacts with additional flood control storage.

<u>Background</u>

Record runoff occurred in the Missouri River basin during 2011 as a result of historic rainfall over portions of the upper basin coupled with heavy plains and mountain snowpack. Runoff in the Missouri River basin above Sioux City, Iowa during the 5-month period of March through July totaled 48.4 million acre-feet (MAF). This runoff volume was more than 20 percent greater than the design storm for the System, which was based on the 1881 March-July runoff of 40.0 MAF, coupled with releases of 100,000 cfs from Fort Randall, during the same 5-month period.

Flood control regulation of the System is centered on the concept of capturing water in the reservoirs during periods of high runoff, typically in the spring and early summer, and evacuating it later in the year at the lowest rate possible over a long period of time to reduce flood damages in the downstream reach. A key objective in this operation is to evacuate all of the flood water stored in the six reservoirs prior to the start of the following runoff season. Flood water is not carried over from year to year because doing so would limit the ability of the System to reduce flood risk in subsequent years. This means that all of the runoff that occurs in the basin in any given year must be released from the reservoirs and must pass through the downstream river reach prior to the start of the next runoff season. Simply put: “what comes in, must go out.” Alternatives that would examine multi-year flood control regulation were beyond the scope of this analysis.

Without the opportunity to carry flood water over from one year to the next, the options available to manage tremendous runoff volumes like that experienced in 2011 are limited. The annual runoff volume for 2011 totaled 61.0 MAF. The sheer magnitude of this volume is difficult to visualize. If the 61 MAF of runoff were spread equally across all 365 days in a year, it would equate to 83,500 cfs of water flowing past Sioux City every minute of every day. Prior to 2011, the record release from Gavins Point, which is located 79 miles upstream of Sioux City, was 70,000 cfs, and typical tributary flows in the reach between Gavins Point and Sioux City would add 3,000 to 5,000 cfs during non-flood periods.

During the winter months, ice restricts channel capacity, making releases of that magnitude infeasible. Therefore, if flows past Sioux City were restricted to 30,000 cfs during the 90 days of winter, the remaining 275 days would require flows past Sioux City of approximately 101,000 cfs to evacuate all of the flood water. This assumes perfect foresight of the flood event and would preclude the lower releases during the fall to inspect and repair any damages associated with the event, as was done in 2011.

Methodology

As a result of this record runoff event, this technical analysis was initiated to determine how additional flood control storage in the System may reduce flood risk for storms greater than the current design storm, including runoff volumes equal to and greater than the 2011 event. This analysis also included a limited investigation of the potential impacts on other authorized purposes if flood control storage was increased.

For this analysis, a two-step process was followed. The first step was to determine the potential effect of additional flood control storage on the 2011 flood releases. The second step evaluated potential economic impacts of alternative flood control scenarios.

Under the first step, a range of scenarios was developed to determine the volume of additional flood control storage necessary to limit Gavins Point peak releases. For the 2011 flood volume, limiting peak releases to 140,000 cfs, 120,000 cfs and 100,000 cfs required 0.9 MAF, 2.6 MAF and 4.6 MAF of additional flood control storage, respectively.

Under the second step, these three flood control storage scenarios were modeled to determine the impact of this additional storage on reservoir levels and releases over the period of record. The Daily Routing Model, which was used in this analysis, simulates the regulation of the System using historic inflows from 1930 through 2011. Since flood control is the only authorized purpose that requires empty space in the reservoirs, increasing the volume of flood control storage impacts the other purposes. The degree of impact varies depending on how the alternative is implemented, and in particular, whether or not the navigation and winter release rule curves are adjusted. Therefore, each storage scenario was modeled twice – the first time with the existing navigation and winter release rule curves, and the second time with rule curves lowered an amount equivalent to the additional flood control volume. For comparison purposes, the “No Action” alternative that has the existing flood control volume of 16.3 MAF was also modeled. Output of this modeling includes reservoir levels and releases and flows at key gaging stations for the 80+ year period of record.

Output from the Daily Routing Model was then used as input to several key economic impact models. These models were used to determine the potential economic effects of changes in the regulation of the reservoir system to authorized purposes. These purposes include flood control, navigation, water supply, hydropower, and recreation.

Limitations of the Current Analysis

This report is not intended to be a complete analysis of impacts and is not intended to be a decision document. It includes a limited investigation of the potential impacts on other authorized purposes for flood risk reduction alternatives. Given the complexity of the System, further studies of economic, environmental, and cultural resource impacts would be required if alternatives to the design regulation are pursued. Additional modeling may also be required to properly assess the coincident flood risk in the lower basin.

This analysis utilizes a portion of the historic hydrologic period-of-record. The analysis does not incorporate future climate change scenarios that might alter the frequency and magnitude of high and low runoff events represented in the historic record. The analysis did not include alternatives that incorporate multi-year flood control regulation or new storage projects.

Economic models that were part of the Missouri River Master Water Control Manual Review and Update Study (Master Manual Study) were used for this report. These models were not updated to 2011 economic conditions for this analysis, however, relative differences between alternatives can still be examined and remain a valid representation of the impacts of changing the regulation of the System utilizing the best available information. The report does not present updated stage/damage relationships at key downstream locations.

Summary of Economic Impacts

The analysis shows that when compared to the No Action alternative, the average annual benefits of the System decrease as the amount of additional flood control storage increases. The reduction in average annual benefits is, for the most part, due to negative impacts to the authorized purposes including navigation, hydropower, water supply and recreation. This loss of economic benefits to other purposes is not offset by an increase in flood control benefits on an average annual basis. The addition of flood control storage has little impact on flood control benefits on an average annual basis, although it can provide significant benefits in a single high runoff year like 2011.

For the period of 1930-2010, there was essentially no change in flood control benefits under all the alternatives modeled. This is because additional flood control storage does not change the volume of runoff that must be passed through the System annually; it simply changes the magnitude and timing of releases. In some cases, the shift in timing of flood evacuation releases can exacerbate flooding and result in an overall reduction in flood benefits. The report contains additional information regarding the 2011 analysis. When 2011 is considered alone, flood control benefits show a 1.5 to 3 percent increase as flood storage increases. With the inclusion of 2011, average annual flood benefits (1930-2011) increase. The percentage change from the No Action alternative, though higher, remains less than one percent.

Navigation benefits diminish as additional flood control storage is added when there is no change to the current navigation rule curves. Lowering the rule curves an amount corresponding to the flood storage change results in the general retention of the navigation benefits. Reductions in navigation benefits range from less than one percent when the rule curves are lowered in the 2.6 and 4.6 MAF scenarios, to more than 22 percent with 4.6 MAF of additional storage without modified rule curves.

In the case of water supply, there is a direct relationship between the flood control storage and the water supply benefits in the reservoirs. Reservoir benefits drop as flood storage increases. Impacts to water supply in the river reaches are not as well defined. Overall benefits are not changed significantly for water supply with the addition of flood control storage.

Overall hydropower benefits generally drop as flood control storage is added. Reductions range from less than one percent for the 0.9 MAF alternative with existing rule curves, to 2.4 percent with the 4.6 MAF alternative with modified rule curves. Modifying the rule curves accentuates the drop in each scenario. In addition, hydropower revenues decline as flood control storage space increases. Capacity at risk and energy-at-risk were also analyzed and showed increased losses as the flood storage increases.

Average annual recreation benefits generally decline as flood storage increases. In general, increasing the amount of flood control storage reduces the recreation benefits for the upper three reservoirs, but has little impact on the lower three reservoirs or the river reaches. The lowering of the rule curves has a varying impact on recreation benefits in the reservoirs and river reaches.

Many of the impacts noted above are a result of a general lowering of the upper three reservoirs, particularly during periods of extended drought. Results of the period-of-record simulation shows that minimum reservoir levels during the most recent drought, which extended from 2000 through 2008, would have been 5.3 to 6.0 feet lower with the alternative with 4.6 MAF of additional flood control storage and modified rule curves.

Conclusions

This analysis showed that increasing the volume of flood control storage in the System would enhance flood risk reduction in a repeat of the 2011 flood event, but would not have prevented record releases from the reservoirs or widespread damages. When analyzed over the 82-year period (1930-2011), despite additional flood control storage, there was no significant increase in average annual flood benefits for any of the alternatives when compared to the No Action alternative. The largest increase in annual flood benefits was less than one percent. When 2011 is considered alone, flood control benefits show a 1.5 to 3 percent increase as flood storage increases. Utilizing the additional flood control storage to reduce flows for long periods in the spring may reduce peak stages during that part of the year, but floods that occur at other times may be aggravated by the higher releases made to evacuate the water stored during that extended low release period.

The lower basin has experienced several years, 2010 being the most recent, when downstream flooding has occurred primarily due to runoff from downstream rainfall events, rather than System releases. Additional flood control storage may reduce flood risks on the lower river during certain runoff events; however, peak downstream flows and maximum stages cannot be reduced in all events. This is due to the difficulty in predicting flood-producing rainfall below the System, including during the late summer and fall evacuation period. The ability to reduce downstream stages depends on the timing of the peak flows and the distance from the control point. Therefore, flood control storage in the System is just a piece of the solution; increasing channel capacity and reducing encroachment in the flood plain are two of many additional methods to effectively reduce flood risk.

Impacts to other authorized purposes were also considered in this analysis. Flood control is the only authorized purpose that requires empty space in the reservoirs, therefore, the other authorized purposes, all of which require water-in-storage to maximum benefits, would experience negative impacts with additional flood control storage.

Post 2011 Flood Event Analysis of Missouri River Mainstem Flood Control Storage

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I. Introduction

A. Background

Record runoff occurred in the Missouri River basin during 2011 as a result of historic rainfall over portions of the upper basin coupled with heavy plains and mountain snowpack. Runoff above Sioux City, Iowa, during the 5-month period of March through July totaled an estimated 48.4 million acre-feet (MAF). This runoff volume was more than 20 percent greater than the design storm for the Missouri River Mainstem Reservoir System (System), which was based on the 1881 runoff of 40.0 MAF during the same 5-month period. The design storm utilized 16.3 MAF of flood control storage with peak releases of 100,000 cubic feet per second (cfs) from Fort Randall Dam for approximately 100 days from late April through July. During the 2011 flood event, System storage crested at 72.8 MAF, just 0.3 MAF below the top of the exclusive flood control zone of 73.1 MAF, utilizing 16.0 MAF of flood control storage with peak releases of 160,000 cfs from Gavins Point Dam. Gavins Point releases remained above 100,000 cfs for 85 days. Runoff for 2011 totaled 61.0 MAF. Surcharge storage was utilized in both Fort Peck and Garrison reservoirs and new record pool levels were set at Fort Peck, Oahe and Fort Randall reservoirs. Record releases were made from all six reservoirs comprising the System.

As a result of this record runoff event, this analysis was initiated to determine how additional flood control storage in the mainstem reservoirs may improve flood risk reduction for storms greater than the current design storm, including runoff volumes equal to and greater than the 2011 event.

B. Limitations of Current Analysis

This report analyzes various alternative regulation scenarios and presents information with regard to providing additional flood control storage in the mainstem reservoirs. The analysis does not consider new storage projects.

This report is not intended to be a complete analysis of impacts and is not intended to be a decision document. It does include a limited investigation of the potential impacts on other authorized purposes for flood risk reduction alternatives. Given the complexity of the mainstem system, further studies of economic, environmental, and cultural resource impacts would be required if alternatives to the design regulation are pursued. Additional modeling may also be required to properly assess the coincident flood risk in the lower basin.

This analysis utilizes a portion of the historic hydrologic period-of-record. The analysis does not incorporate future climate change scenarios that might alter the frequency and magnitude of high and low runoff events represented in the historic record. The analysis did not include alternatives that incorporate multi-year flood control regulation.

Economic models that were part of the Missouri River Master Water Control Manual Review and Update Study (Master Manual Study) were used for this report. These models were not updated to 2011 economic conditions for this study, however, relative differences between alternatives can still be examined and remain a valid representation of the impacts of changing the regulation of the reservoir system utilizing the best available information. The report does not present updated stage/damage relationships at key downstream locations.

II. Technical Analysis

A. Modeling Process

For this analysis, a two-step process was followed. The first step was to determine the potential effect of additional flood control storage on the 2011 flood releases. This first step was followed by a second step that evaluated potential economic impacts of alternative flood control scenarios.

Under the first step, a range of scenarios was developed using the monthly regulation model. This is the same model that is used to generate Annual Operating Plan simulations and monthly forecasts used in real-time regulation. The scenarios varied the flood runoff volume, the amount of flood control storage and the Gavins Point peak release rates. The runoff volumes analyzed included the 2011 runoff volume and a hypothetical annual event 10 percent greater than 2011. The flood control storage was then adjusted in an iterative process to result in specific peak releases from Gavins Point dam. This process resulted in six scenarios which are discussed in more detail later in the report.

Under the step second step, several of the scenarios were then used to generate alternatives that were modeled using the Daily Routing Model (DRM). The DRM simulates the regulation of the System over the period-of-record going back as far as 1898. The DRM was developed to simulate and evaluate alternative System regulation plans for all authorized purposes under a widely varying long-term hydrologic record as part of the Missouri River Master Water Control Manual Review and Update Study (Master Manual Study).

Increasing the volume of flood control storage impacts other authorized purposes. The degree of impact varies depending on whether or not the navigation and winter release rule curves are adjusted. In the case of navigation, the rule curves are used to determine when "full service" to navigation is reduced to "minimum service" and the System storage level at which season lengths are reduced from a full season of 8 months as part of the water conservation measures. To provide a range of results, two DRM alternative runs were made for each of the selected scenarios: the first alternative utilizes the current navigation and winter release rate rule curves, and the second alternative utilizes adjusted rule curves.

For example, one scenario prepared for the fall of 2011 Annual Operating Plan (AOP) public meetings included 4.6 MAF of additional flood control storage for the 2011 flood event, which allowed peak releases from Gavins Point Dam to be limited to 100,000 cfs. If the rule curves were not adjusted in this example, full service navigation flows would rarely be provided during the first half of the navigation season since the target storage on March 1 would be below the level required for full service navigation. Therefore, a second DRM alternative was developed that lowers the rule curves the full amount of the flood control storage increase, which was 4.6

MAF in this example. This analysis will demonstrate a range of potential impacts to reservoir levels and releases for the period of analysis, and consequently to the authorized purposes.

Output from the DRM was used as input to several key economic impact models. These impact models were utilized in the Master Manual Study process, and were used here to determine the potential economic effects to authorized purposes. These purposes include flood control, navigation, water supply, hydropower, and recreation. A brief description of the impact models used can be found in Section II.B. These impact models do not assess the other authorized purposes, but it is acknowledged that there are potential impacts to them.

The U.S. Bureau of Reclamation (USBR) provides estimates of depletions for use in reservoir regulation modeling. Application of depletion data within the DRM input files results in a more accurate comparative analysis as it allows for all historical runoff data to be adjusted to the same level of development in regards to basin conditions. The USBR has provided the Corps depletion estimates from 1930 to present that can be used to comparatively adjust historical runoff data. Therefore, the starting period for the analysis in this report is 1930.

As noted, the DRM was developed during the Master Manual Study, and the model was calibrated using previous runoff events. At that point, the 1997 event was the maximum runoff event, with System releases reaching 70,000 cfs. During the 2011 flood, System releases were as high as 160,000 cfs, far exceeding previous events. The DRM will require modification to more accurately account for the runoff volume and maximum releases experienced in 2011 when executed for a period-of-record analysis. Due to the time constraints involved in this analysis, the DRM was not modified to account for 2011, rather it was used to analyze the 81-year period from 1930-2010. In lieu of running 2011 with the preceding 81-year period, a process was developed to model the 2011 event separately using the DRM. This allowed an analysis to account for the significant flood control impacts in that year and those results were evaluated individually. A more detailed explanation of this separate analysis is provided later in this report.

B. Economic Impact Models

As noted previously, output from the DRM was used as input to several key economic impact models. These impact models were utilized in the Master Manual Study process, and were used here to determine the potential economic effects to authorized purposes. More information on the impact models and the associated benefits computations are presented in this section.

Flood control National Economic Development (NED) benefits are damages prevented by the construction and regulation of the six System dams on the Missouri River. The benefits computed represent the difference between the damages that would have occurred had the dams and reservoirs not been constructed and those with these projects in place.

Missouri River navigation NED benefits represent the cost savings provided by navigation on the Missouri River from Sioux City, Iowa to the mouth versus movement of those commodities by the next least costly mode of transportation, which in the case of down-bound movements is generally rail or truck transport to St. Louis where Mississippi River navigation is used to transport the commodity to the ultimate destination and vice versa for up-bound movements.

Water supply NED benefits are computed based on costs for water supply facilities that depend on the Missouri River or the System reservoirs as a direct source of water. Typically, the costs increase during extended droughts when the reservoir levels drop and the river flows are reduced. Increased costs occur when the users must increase efforts to ensure that the water intakes continue to operate as the water surface drops toward the top of intakes during the droughts. In some cases, the intakes must be modified to ensure that the user has continued access to the water throughout the drought. In the case of powerplants that rely on once-through cooling, the cost for intake modifications are compared to the costs associated with meeting discharge requirements for the waste heat as it is returned to the Missouri River in the form of warmer water. Both the intake limitation and the discharge limitation generally result in reduced power generation. To meet the greater limitation of the two in any given month, replacement energy would need to be purchased from the power grid, which means that additional generating capability must be constructed to provide the capacity needed in the region during power shortfalls. The cost of providing this additional capacity was included in the water supply benefits for the powerplants in the reach downstream from Garrison Dam in North Dakota and along the Lower Missouri River from Gavins Point Dam, the lower most of the six dams, to the mouth of the river. The greater of the two costs (intake versus discharge limitations) is used to compute the benefits for the thermal powerplants.

Hydropower NED benefits are computed for the capacity provided and the energy generated by the hydropower units at the six System dams. The benefits represent the cost savings provided by generating the electricity at the dams versus building additional generating facilities in the basin. These additional facilities would be a mix of base load and peaking powerplants, and the cost for the power from them would be more costly than the hydropower.

Recreation NED benefits are based on the value of the various forms of recreation provided on the Missouri River and the Corps' six System reservoirs. This value is generally based on the amount of money the users are willing to spend to travel to the recreation facilities. Reductions in benefits are computed to reflect increased costs during abnormally high and low reservoir levels. Benefits, therefore, fluctuate as the visitation varies, and the costs increase during extreme events such as extended droughts and very wet years in the upper Missouri River basin.

C. Basic Data and Assumptions

In the first step of the analysis, some basic assumptions were made in the preparation of the initial suite of scenarios developed with the monthly regulation model. As mentioned previously, these scenarios varied the flood runoff volume, the amount of flood control storage and the Gavins Point peak release rates. Although surcharge storage was utilized during the 2011 flood event, the scenarios developed with the monthly regulation model did not allow the utilization of storage space in the surcharge storage zone. The surcharge zone utilizes storage space above the top of the exclusive flood control zone. The dams were not designed to be routinely operated in the surcharge zone. The use of the surcharge zone is reserved for extreme, emergency conditions and therefore was not included as a usable flood control capacity in this analysis. The model does allow utilization of the full flood control storage capacity of Fort Peck, Garrison, and Oahe up to the top of the exclusive flood control zone (the top of the spillway gates in the closed position).

Another important assumption that was used in all of the scenarios was all stored flood water must be evacuated prior to the start of the following runoff season. Scenarios that would consider multi-year flood control operations were beyond the scope of this analysis.

The analysis also assumed that when the reservoirs were lowered to provide more flood control storage, the upper three reservoirs (Fort Peck, Garrison, and Oahe) would be lowered an equal number of feet, rather than an equal amount of storage. In actual practice, the additional flood control storage could be shared equally among the projects based on storage or elevation, or could be optimized resulting in different impacts at each reservoir. Additional analyses would have to be performed to determine the proper combination of storage and elevation variation at each reservoir.

And finally, the regulation and flood control storage of the lower three reservoirs was not adjusted in this analysis. If additional studies are performed, the regulation of Fort Randall, which contains 14 percent of the System's total flood control storage, could be brought into the analysis at that time.

D. Analysis of Scenarios (Monthly Modeling of the 2011 Runoff)

As previously stated, a range of scenarios was developed using the monthly regulation model. These scenarios varied the flood runoff volume, the amount of flood control storage and the Gavins Point peak release rates. The six 6 scenarios are summarized in Table I.

Table I.
Summary of Scenarios Modeled Using the Monthly Regulation Model

	Base of Flood Control Zone (MAF)	Additional Flood Storage (MAF)	Change in upper three from current base (feet)	Runoff (MAF)	Jan-Apr Gavins Point Releases	Gavins Point Peak Release (cfs)
Scenario 0	56.8	-	-	61.2	Similar to 2011	160,000
Scenario 1	55.9	0.9	-1.1	61.2	Similar to 2011	140,000
Scenario 2	54.2	2.6	-3.2	61.2	Similar to 2011	120,000
Scenario 3	52.2	4.6	-5.7	61.2	Similar to 2011	100,000
Scenario 4	52.2	4.6	-5.7	61.2	Historic Peak Monthly Releases	90,000
Scenario 5	56.8	-	-	67.3	Similar to 2011	181,000

Five of the six scenarios developed use the 2011 runoff volume as input to the monthly regulation model. One of the scenarios, Scenario 5, uses a higher runoff of 67.3 MAF. When this analysis was initiated in early January the preliminary 2011 runoff estimate was 61.2 MAF. The final runoff analysis completed in March 2012 estimated the 2011 runoff at 61.0 MAF. In the interest of time, scenarios were not adjusted to account for this small difference in annual runoff.

Scenarios 1, 2 and 3 were developed by varying the flood control storage until peak releases from Gavins Point could be limited to 140,000 cfs, 120,000 cfs and 100,000 cfs, respectively. Actual releases from Gavins Point in 2011 peaked at 160,000 cfs. Scenario 4 is a variation of scenario 3 that has the same flood control storage but uses maximum historic peak monthly releases during the first part of the year. Scenario 5 utilizes a runoff volume that is 10 percent higher than the 2011 runoff, 67.3 MAF, with the current amount of flood control storage. Peak Gavins Point releases under this scenario were 181,000 cfs. It should be noted that all scenarios exceed previous record releases of 70,000 cfs from Gavins Point. Plots of the System storage and Gavins Point releases for each scenario and the actual 2011 data are shown in Figures 1 and 2.

As seen in the plots, adding additional flood control storage allows for a reduction in peak releases. However, since the total runoff volume is the same (scenarios 0 through 4) this extends the time required for complete evacuation of the flood control zone. Higher runoff events than 2011, as noted by scenario 5, would require even higher releases to evacuate the water prior to the next runoff season.

Additional information regarding the regulation of all six reservoirs can be found in the detailed scenario studies at the end of this report. To summarize, Fort Peck's maximum monthly releases ranged from 24,000 cfs in scenarios 3 and 4, to as high as 60,000 cfs in scenario 5. Prior to 2011, the record monthly release from Fort Peck was 35,000 cfs in 1975. Maximum monthly releases at Garrison ranged from 73,000 cfs in scenario 4, to as high as 162,000 cfs in scenario 5. All six scenarios had peak releases from Garrison that exceeded the previous record monthly release of 57,300 cfs in 1997. Oahe's maximum monthly releases ranged from 78,000 cfs in scenario 3, up to 170,800 cfs in scenario 5, with all scenarios exceeding the previous record monthly release of 56,500 cfs in 1997.

As shown in Figure 1, the full flood control storage capacity of all of the reservoirs was not utilized in several of the scenarios. This is due in part to the timing and distribution of the runoff. During the 2011 flood, much of the runoff was in the Fort Peck and Garrison reaches. Thus, when modeling the regulation of these inflows, very high releases would have been required from these reservoirs to move the flood water downstream into Oahe and Fort Randall reservoirs where additional flood control storage was available. Further studies would be needed to optimize the location of additional flood control storage within the System to best operate over a wide range of potential future runoff events.

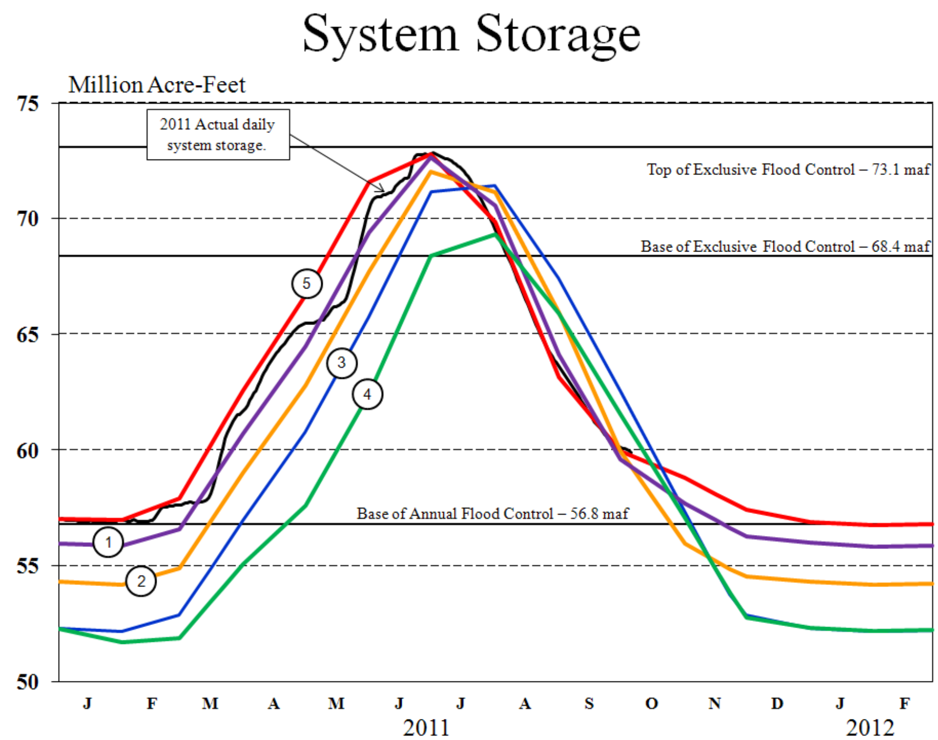

Figure 1. System Storage – 2011 Actual and Scenarios

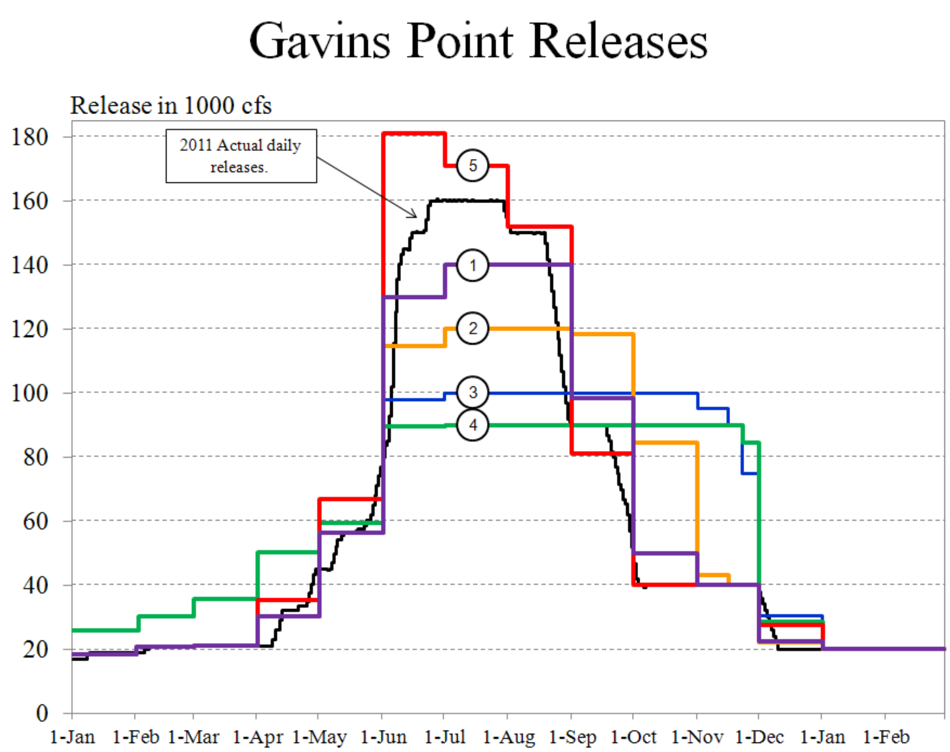

Figure 2. Gavins Point Releases – 2011 Actual and Scenarios

E. Long-Term Analysis of Alternatives Using the Daily Routing Model

Scenarios 1, 2 and 3, which had varying amounts of additional flood control storage, were used to develop six alternatives for the DRM simulation runs. As previously noted, the effects on the other authorized purposes vary depending on the adjustment, if any, to the navigation and winter release rule curves. To provide a range of results, two alternatives runs were developed for DRM simulation for each of the three selected scenarios: the first alternative utilized the current navigation and winter release rate rule curves, and the second alternative utilized adjusted rule curves. For comparison purposes, the existing flood control storage and rule curves were also modeled, so that a total of seven alternatives were modeled with the DRM.

A naming convention utilizing 6 characters was developed for the DRM alternatives. The first two characters, MS, which are common for all alternatives, stand for "Mainstem System." The middle two digits signify the additional amount of flood storage included in that alternative (00 = none, 09 = 0.9 MAF, 26 = 2.6 MAF, and 46 = 4.6 MAF). The last two characters signify whether the existing rule curve is used (RE) or whether a modified curve is used (RM). The MS00RE alternative is also referred to as the "No Action" alternative in this document. The alternatives are summarized in Table II.

Table II.
Summary of Alternatives Modeled with the DRM

	Corresponding Scenario	Additional Flood Storage (MAF)	Rule Curves
MS00RE	Scenario 0	-	Existing
MS09RE	Scenario 1	0.9	Existing
MS09RM	Scenario 1	0.9	Modified
MS26RE	Scenario 2	2.6	Existing
MS26RM	Scenario 2	2.6	Modified
MS46RE	Scenario 3	4.6	Existing
MS46RM	Scenario 3	4.6	Modified

Tables III and IV summarize the navigation service level and season length criteria and the winter release criteria for each of the seven alternatives. The navigation service level is determined based on System storage checks on March 15 and July 1 and utilizes a straight line interpolation between full service and minimum service flow support. The March 15 storage check also includes a navigation preclude storage. If System storage is below the preclude on March 15, navigation support is not provided during that year. The navigation season length is based on the July 1 storage check and ranges from 6 to 8 months. The Gavins Point winter release rate is based on the September 1 System storage check and typically ranges from 12,000 cfs to 17,000 cfs. Both the navigation flow support and winter releases are overridden in high water years for flood water evacuation.

Table III.
Summary of Alternatives Modeled with the DRM
Navigation Service Level and Season Length Criteria

	Base of Flood Control Zone (MAF)	March 15 Full Service (MAF)	March 15 Minimum Service (MAF)	March 15 Preclude (MAF)	July 1 Full Service (MAF)	July 1 Minimum Service (MAF)	Navigation Season Length 8 month/7 month/6 month (MAF)
MS00RE	56.8	54.5	49.0	32.7	57.0	57.0	51.5/46.8-41/36.5
MS09RE	55.9	54.5	49.0	32.8	57.0	57.0	51.5/46.8-41/36.5
MS09RM	55.9	53.6	48.1	31.3	56.1	49.6	50.6/45.9-40.1/35.6
MS26RE	54.2	54.5	49.0	32.8	57.0	57.0	51.5/46.8-41/36.5
MS26RM	54.2	51.9	46.4	31.8	54.4	47.9	48.9/44.2-38.4/33.9
MS46RE	52.2	54.5	49.0	31.4	57.0	57.0	51.5/46.8-41/36.5
MS46RM	52.2	49.9	44.4	31.8	52.4	45.9	46.9/42.2-36.4/31.7

Table IV.
Summary of Alternatives Modeled with the DRM
Winter Release Criteria

	Sept 1 17,000 cfs Winter Release (MAF)	Sept 1 12,000 cfs Winter Release (MAF)
MS00RE	58.0	55.0
MS09RE	58.0	55.0
MS09RM	57.1	54.1
MS26RE	58.0	55.0
MS26RM	55.4	52.4
MS46RE	58.0	55.0
MS46RM	53.4	50.4

III. Comparative Analysis of Alternatives

A. General

Economic and environmental impact models were developed for the Master Manual Study. These models utilize output from the DRM, including reservoir levels and releases over the period-of- record, to determine the impacts of changing the regulation of the mainstem reservoir system on a variety of economic and environmental resources. For this analysis, several key economic impact models were used to determine the potential effects of additional flood control storage to authorized purposes. These purposes include flood control, navigation, water supply, hydropower and recreation.

It is important to note that the economic data contained in the impact models that is used to calculate the National Economic Development (NED) benefits in this analysis has not been updated since the completion of the Master Manual Study. The economic data currently used was last updated between 1998 and 2001. However, relative differences between alternatives can still be examined and remain a valid representation of the impacts of changing the regulation of the reservoir system utilizing the best available information. Recent analysis of impacts models shows that updating the NED benefits for the five models used results in essentially no difference on an average annual basis for net changes and percent differences for all five authorized purposes.

B. Reservoir Effects

Before addressing the economic impacts that were evaluated, some information on general effects of the alternatives is discussed. As previously noted, increasing the volume of flood control storage affects other authorized purposes depending on the volume of additional flood control storage and the use of existing or modified rule curves.

In particular, this discussion focuses on the effects of the various alternatives on reservoir levels during periods of extended drought so that the differences in rule curves can be illustrated. To limit the number of tables and graphs, the data in this section focuses on the most recent drought period, although similar information is available for all years in the modeling period. Figure 3 shows daily System storage from 2000-2010 for all alternatives.

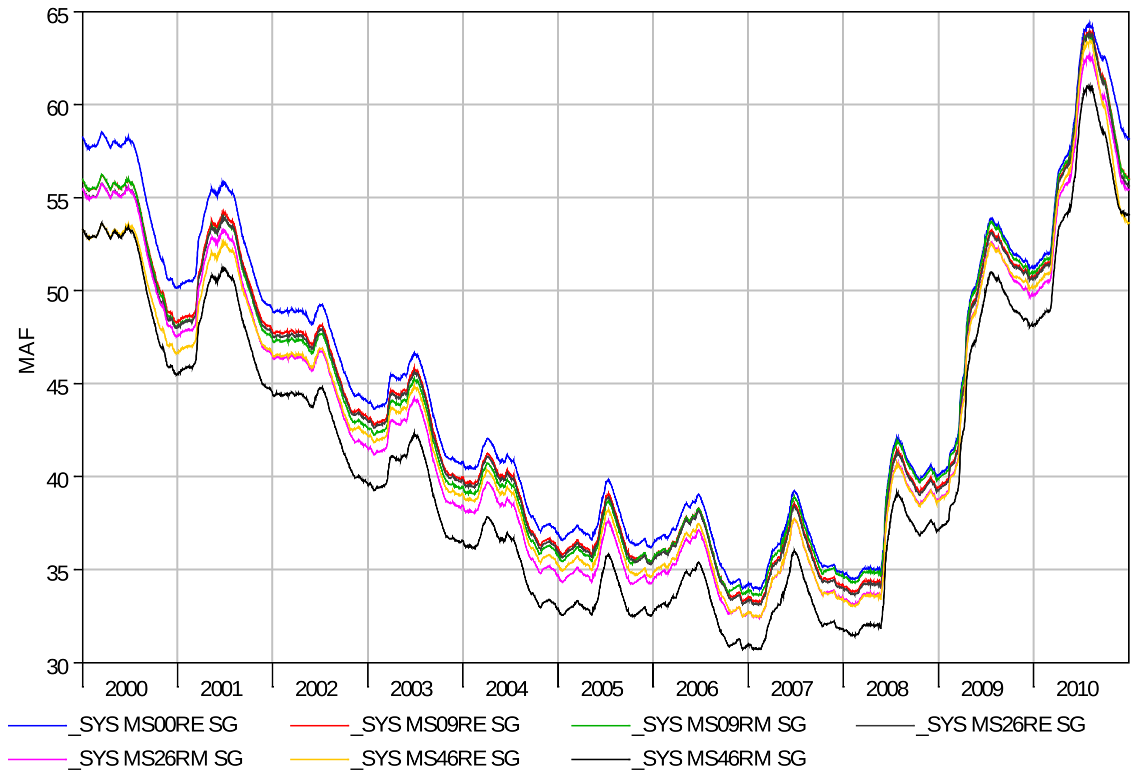

Figure 3. System Storage 2000-2010 – All Alternatives

In this case, the modeled minimum System storage of 34.0 for alternative MS00RE is close to the actual minimum storage of 33.9 MAF in July 2007. However, actual System storage and reservoir elevations will differ from modeled values due to variations in the simulated reservoir regulation, in particular with regard to intra-system regulation and Gavins Point releases for threatened and endangered species. Since the alternatives are consistent with respect to these items, the focus should be on the differences between alternatives and not the actual values.

To illustrate the effect that varying flood control storage and rule curves has on System storage, Figure 4 shows the daily System storage for the two 4.6 MAF alternatives (MR46RE and MR46RM) for the period of 2000-2010 compared to the alternative with no change to flood storage (MS00RE). In 2000, the first year of the most recent drought, the lower starting storage of 52.2 MAF on the 4.6 MAF alternatives can be seen. As the drought progresses the alternative with the existing rule curve (MR46RE) starts to trend toward the No Action alternative (MS00RE). Since there is no change to the rule curve, this alternative quickly begins to conserve water which has the result of reducing impacts on other project purposes such as navigation. The alternative with the modified rule curve conserves water similarly to the existing condition of MS00RE, but since the starting storage is less, this alternative results in much lower System storage later in the drought. The resulting effects on the other authorized purposes are discussed in more detail in later sections.

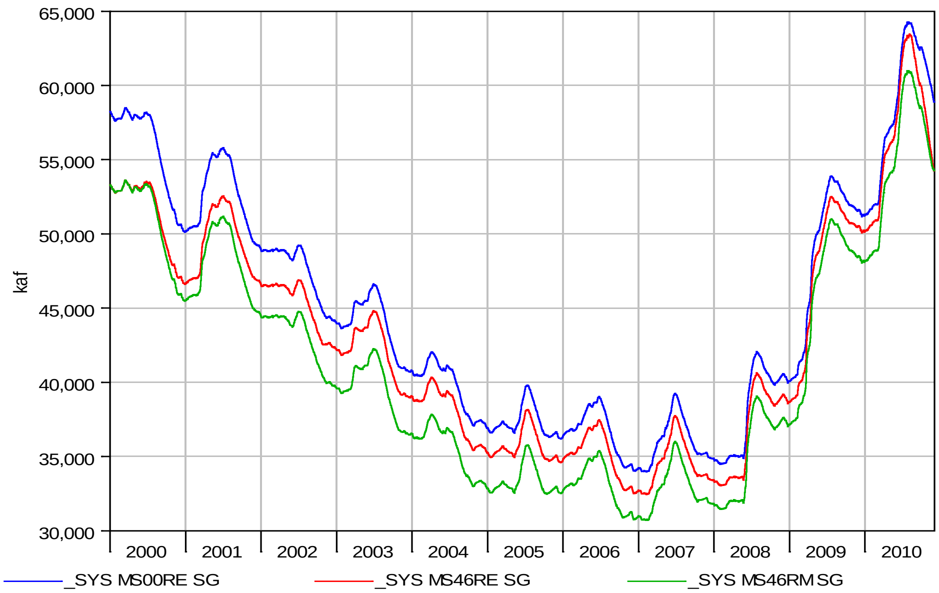

Figure 4. System Storage 2000-2010

End-of-month reservoir elevations for the same period (2000-2010) at Fort Peck, Garrison, and Oahe are plotted for the same three alternatives in Figures 5, 6 and 7.

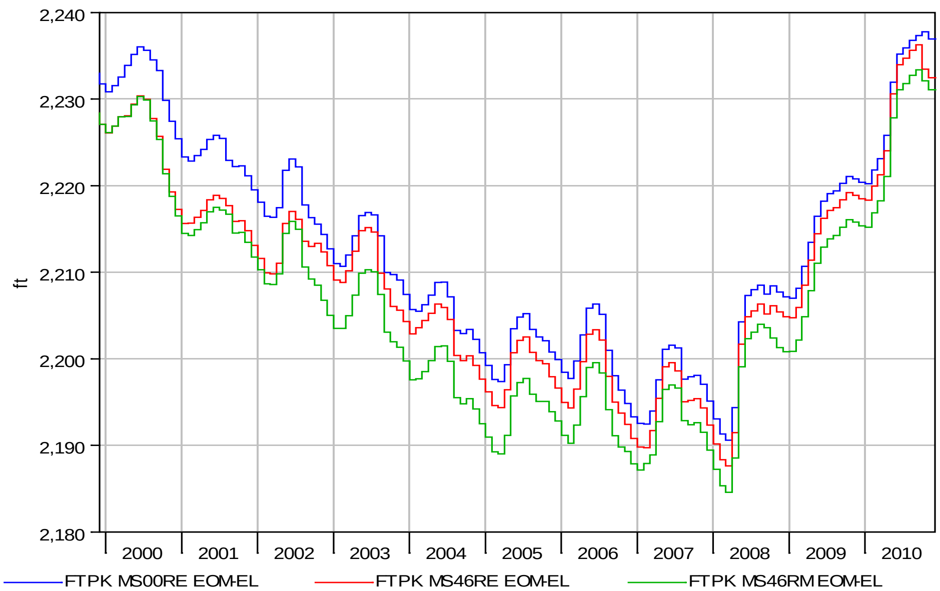

Figure 5. Fort Peck End-of-Month Reservoir Elevation 2000-2010

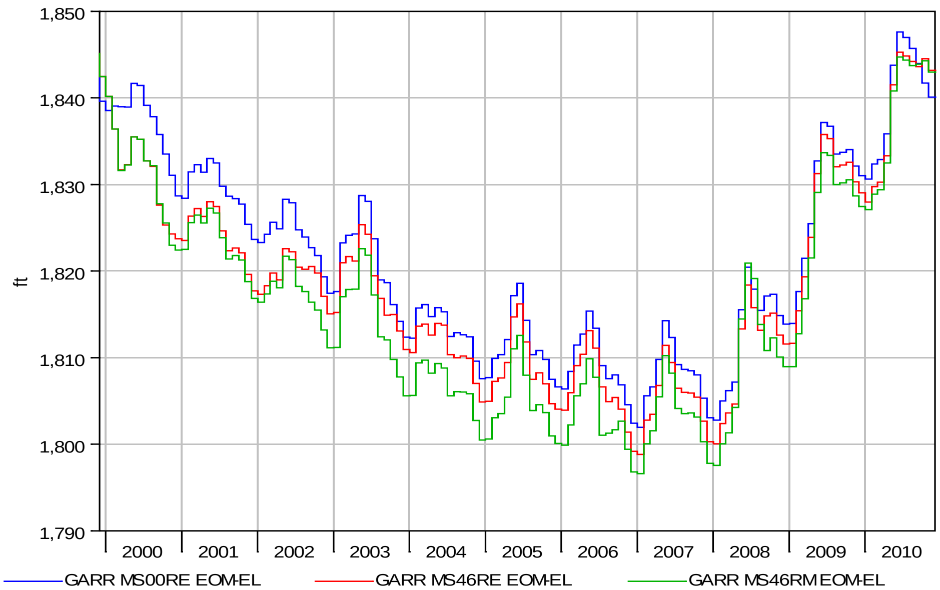

Figure 6. Garrison End-of-Month Reservoir Elevation 2000-2010

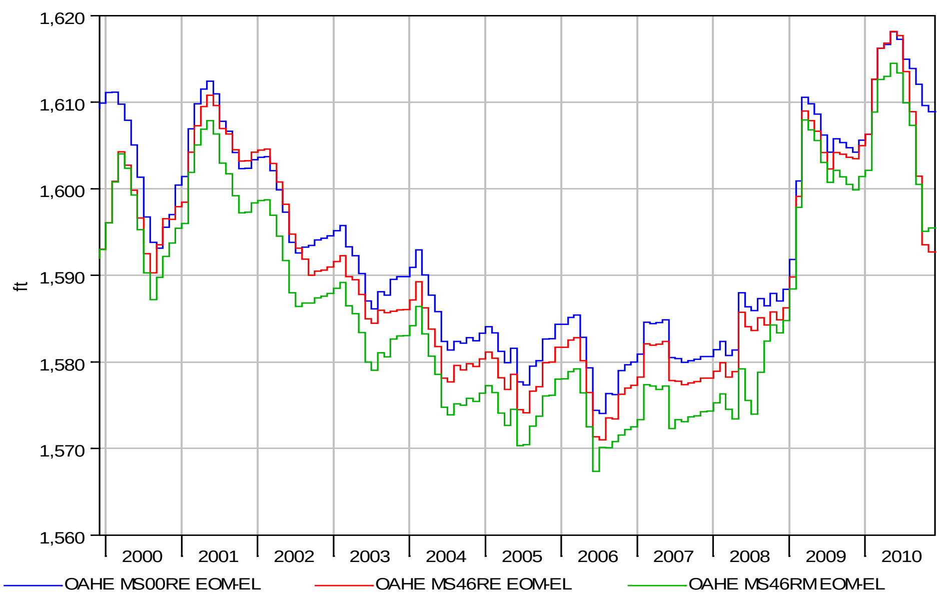

Figure 7. Oahe End-of-Month Reservoir Elevation 2000-2010

Table V shows minimum System storage and reservoir elevations for the most recent drought period (2000-2008) in comparison to the No Action alternative (MS00RE). For example, minimum System storage for MS46RM (4.6 MAF of additional flood control storage with modified rule curves) is 3.3 MAF lower than the No Action alternative. Fort Peck is 6.0 feet lower than the No Action alternative, Garrison is 5.3 feet lower and Oahe is 5.5 feet lower for that same alternative. Similar information can be generated for previous drought periods of 1930-1941, 1954-1961, and 1987-1992.

Table V
Minimum System Storage and Reservoir Elevations 2000-2008
Compared to the No Action Alternative (MS00RE)

	System Storage		Fort Peck Lake		Lake Sakakawea		Lake Oahe	
Alternative	Date	MAF	Date	Level (ft)	Date	Level (ft)	Date	Level (ft)
2000-2008 Drought								
MS00RE	2/8/2007	-	4/15/2008	-	2/22/2007	-	8/18/2006	-
MS09RE	2/8/2007	-0.8	4/15/2008	-0.7	2/22/2007	-1.9	8/18/2006	-1.6
MS09RM	2/8/2007	-0.4	4/15/2008	-0.7	2/22/2007	-1.5	8/18/2006	-1.0
MS26RE	2/8/2007	-0.9	4/15/2008	-1.7	2/22/2007	-2.0	8/18/2006	-1.7
MS26RM	2/8/2007	-1.6	4/15/2008	-2.3	2/22/2007	-2.6	8/18/2006	-3.0
MS46RE	2/8/2007	-1.6	4/15/2008	-3.0	2/22/2007	-3.1	8/18/2006	-3.1
MS46RM	2/15/2007	-3.3	4/15/2008	-6.0	2/22/2007	-5.3	8/18/2006	-5.5

C. Flood Control

Flood control benefits were computed for the river reaches extending from Fort Peck Dam to the mouth of the Missouri River near St. Louis, Missouri, and the four largest reservoirs in the Mainstem Reservoir System. Due to the large difference in actual reservoir releases in 2011 compared to all other modeled years, adjustments in the DRM channel capacity settings were necessary to model that year. As an example, in the DRM the Gavins Point channel capacity is normally set at 65,000 cfs. In high runoff years, evacuation of water is typically accomplished at the lowest release rate possible over a long period of time to minimize risk. The DRM uses the channel capacity settings as part of the evacuation computation, and attempts to set releases at or below these non-damaging channel capacity levels while still allowing for evacuation of the flood control storage by the following runoff year. Raising the channel capacity settings in all years (1930-2010) to levels which account for 2011, would cause the model to unnecessarily use the much higher channel capacity, likely resulting in higher damages in some years. Therefore, 2011 was modeled separately and the results were appended to previous data sets which included 1930-2010. The entire data set from 1930 to 2011was then used in the impacts models. Adding 2011 data to the 1930-2010 data set causes a slight discontinuity in the data, and for this reason, the flood control benefits for both the 1930-2010 and 1930-2011 periods are presented.

Average annual benefits are presented in Figure 8 and Table VI for 1930-2010. For this 81-year period, adding flood control storage to the System results in little change in overall flood control benefits.

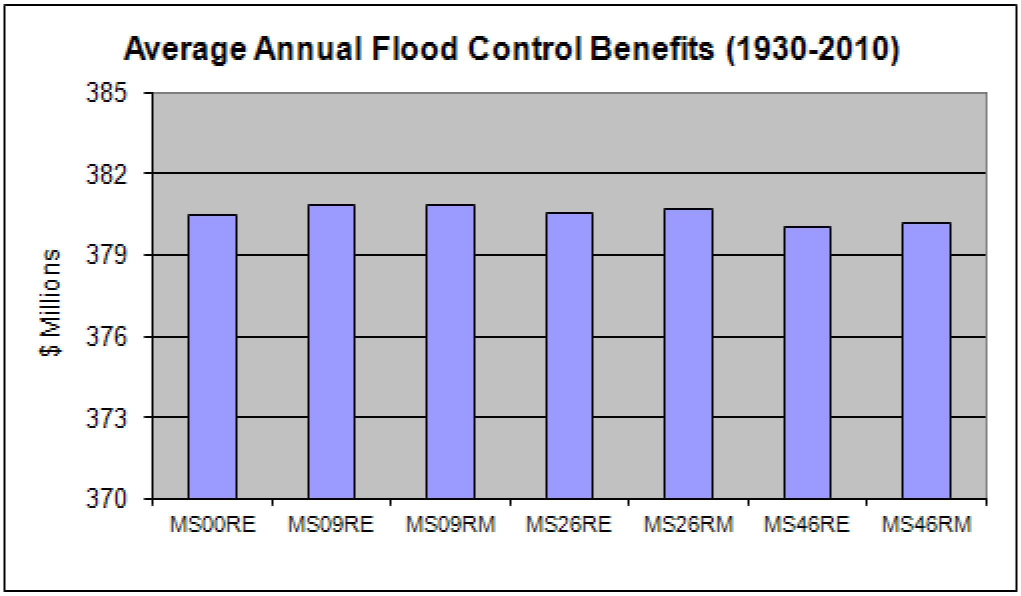

Figure 8. Average Annual Flood Control Benefits (1930-2010)

Table VI. Average Annual Flood Control Benefits ($ Millions) 1930-2010

	Total Benefits	% Change from No Action	Reservoirs	Reach Benefits Upper River	Lower River
MS00RE	380.5	--	-0.5	77.9	303.1
MS09RE	380.9	0.1	-0.3	78.2	303.0
MS09RM	380.9	0.1	-0.3	78.2	303.0
MS26RE	380.5	0.0	-0.3	78.0	302.8
MS26RM	380.7	0.1	-0.3	78.0	303.1
MS46RE	380.0	-0.1	-0.2	77.4	302.9
MS46RM	380.2	-0.1	-0.2	77.4	303.0

The detailed model results indicate that while there were increases in flood control benefits in some years, benefits were reduced in others. For example, the Bismarck reach showed higher benefits in 1997 under all of the increased flood storage alternatives; however that was offset somewhat by a reduction in benefits during the April 1952 flood for some alternatives.

Average annual benefits for the period 1930-2011 are presented in Figure 9 and Table VII. With the addition of 2011 to the data set, the overall benefits increase slightly when additional flood control storage is provided. As shown in the table, when averaged over the 82-year period, the addition of the 2011 event results in an average annual increase in flood control benefits of less than one percent from the No Action alternative.

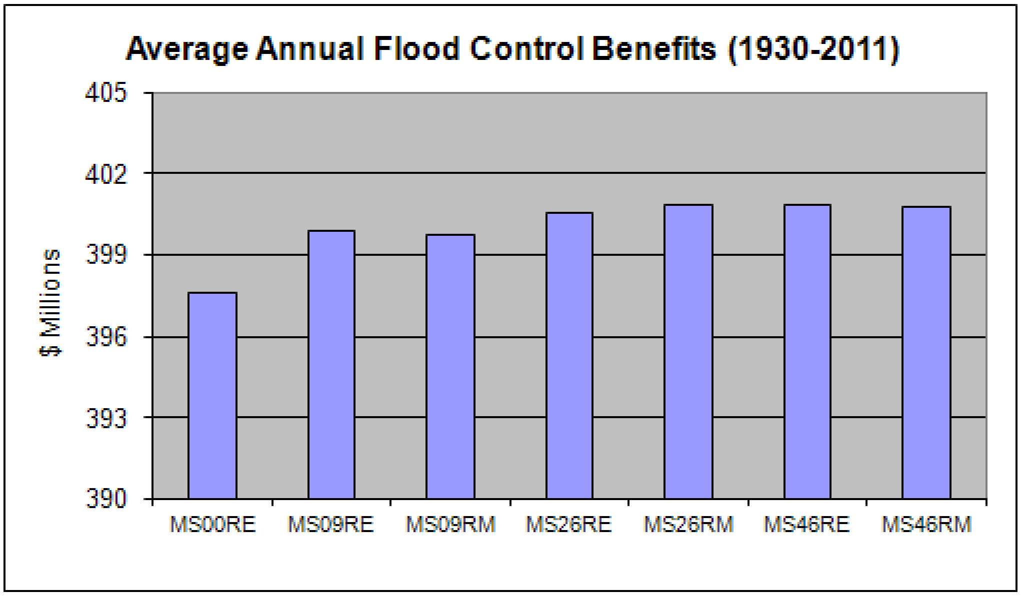

Figure 9. Average Annual Flood Control Benefits (1930-2011)

Table VII. Average Annual Flood Control Benefits ($ Millions) 1930-2011

	Total Benefits	% Change from No Action	Reservoirs	Reach Benefits Upper River	Lower River
MS00RE	397.6	--	-0.6	79.9	318.2
MS09RE	399.9	0.6	-0.4	80.7	319.6
MS09RM	399.8	0.6	-0.4	80.7	319.4
MS26RE	400.6	0.8	-0.4	80.8	320.2
MS26RM	400.8	0.8	-0.3	80.8	320.4
MS46RE	400.8	0.8	-0.3	80.6	320.5
MS46RM	400.8	0.8	-0.2	80.6	320.4

In high runoff years like 2011, the Mainstem System provides tremendous flood control benefits in a single year. The benefits are computed based on the difference between damages that would have occurred had the dams and reservoirs not been constructed and those with the mainstem reservoirs in place. In 2011, actual flows were reduced by as much as 100,000 cfs when compared to the without project flows, resulting in significant benefits even with actual releases of 160,000 cfs. As seen in Tables VI and VII, adding 2011 to the analysis increases the average annual benefits from approximately $380 million when averaged over 81 years, to approximately $398 to $400 million when averaged over 82 years. Preliminary studies show that the 2011 runoff and releases have recurrence intervals of approximately 500 years. Since the recurrence interval is far greater than the period-of-record used in this impact analysis, it's likely that the impact of the 2011 event is overstated and the effect would diminish over a longer period-of-record.

When comparing alternatives solely for their impact on 2011, benefits for alternatives with increased flood control storage are as much as 3 percent higher than the No Action alternative. The percentage change in flood control benefits for 2011 is shown in Table VIII. Actual 2011 flood damages prevented by the System reservoirs, with actual System releases of 160,000 cfs, were $5.4 billion.

Table VIII. Percent Change in 2011 Flood Control Benefits Compared to No Action

	Total Benefits	Reach Benefits		
		Reservoirs	Upper River	Lower River
MS00RE	--	--	--	--
MS09RE	1.62	0.01	0.35	1.26
MS09RM	1.49	0.01	0.35	1.14
MS26RE	2.43	0.01	0.58	1.84
MS26RM	2.47	0.01	0.61	1.86
MS46RE	3.06	0.01	0.94	2.11
MS46RM	2.85	0.01	0.95	1.89

While tremendous damages were sustained during 2011 due to the historic 160,000 cfs releases, many of those damages, such as overtopping and breaching of levees, closure of the interstates, and inundation of areas between reservoirs would have occurred even at the lower release rates shown in the alternatives. This conclusion is based on the dates and corresponding release rates at which actual critical infrastructure was impacted. For example, the full breach of levee L-575 occurred on June 5. Accounting for 5 days travel time from Gavins Point Dam to the location of the breach, indicates that the levee failed when the effective release from Gavins Point Dam was approximately 77,000 cfs. The same type of analysis can be done for the interstate highway closures in western Iowa. Interstates I-29 and I-680 just north of Council Bluffs, Iowa were closed due to flooding on June 9. Accounting for 4 days travel time from Gavins Point Dam to Council Bluffs area, the effective release that resulted in the closure of the interstate was approximately 100,000 cfs. Certainly lower releases would have reduced damages in many locations; however, even with the addition of up to 4.6 MAF of flood control storage, 2011 would have been a historic flood with releases nearly 1.5 times the previous record and catastrophic damages from Montana to Missouri. These examples demonstrate the importance of channel capacity, both between the reservoirs and below the reservoir system, as a critical component of reducing overall flood risk.

Each year's flood water must be evacuated prior to the start of the next runoff season, alternatives with lower peak releases require a longer period of time to evacuate the flood water. As shown on Figure 2, these alternatives must continue the flood water evacuation well into the fall. High releases in the fall would have delayed post-flood recovery efforts including the repairs of critical infrastructure such as the dams, levees and interstate.

Creating additional flood control storage space to store excess runoff during the high inflow months of March through July will allow for lesser releases to be made during those months, however, the stored flood waters will still need to be evacuated. When analyzed over the 82 year period (1930-2011), especially considering evacuation of stored flood waters during the fall, flood control benefits do not significantly increase. While additional flood control storage may have some added benefit on the lower river during certain runoff events, peak downstream flows and maximum stages may not be reduced because of the difficulty in predicting flood-producing rainfall, including during the late summer and fall evacuation period. The ability to reduce downstream stages depends on the timing of the peak flows and the distance from the control point. If it were possible to reduce flows for long periods in the spring by using the additional flood control storage, floods that occur during other parts of the year may be aggravated by the higher releases made to evacuate the water stored during that extended low-release period.

D. Navigation

Water is released from the System to support Missouri River navigation from Sioux City, Iowa to the mouth near St. Louis, Missouri. The navigation service level and season length are determined based on System storage as described by the technical criteria in the Master Manual. Table II (Section II.D.) presents the criteria used when modeling the alternatives with the DRM. The average annual total navigation benefits for each of the alternatives are presented in Figure 10. Additional information can be found in Table IX.

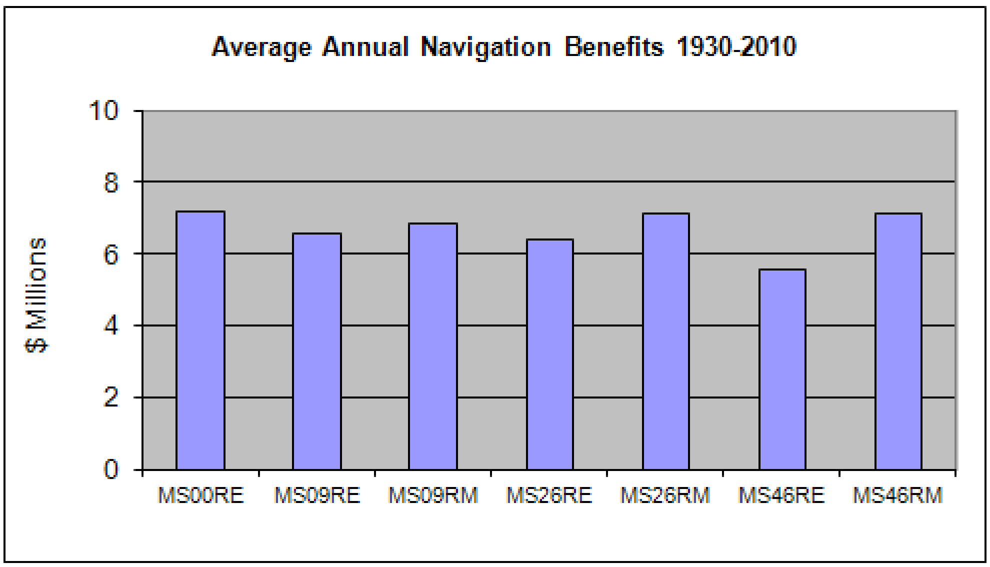

Figure 10. Average Annual Navigation Benefits (1930-2010)

Navigation benefits diminish as additional flood control storage is added when there is no change to the navigation rule curves. In contrast, an equivalent lowering of the rule curves as the amount of flood control storage is increased generally results in the retention of the navigation benefits with only a relatively minor loss of benefits for the addition of 0.9 MAF of flood control storage (Table IX). The losses are substantial if the rule curves are not lowered, ranging from a loss of almost 9 percent to just over 22 percent of the average annual benefits.

Table IX. Average Annual Missouri River Navigation Benefits ($ Millions)

	Total Benefits	% Change from No Action	Reach Benefits			
			Sioux City	Omaha	Nebraska City	Kansas City
MS00RE	7.2	--	0.9	0.7	0.5	5.1
MS09RE	6.6	-8.8	0.8	0.6	0.4	4.7
MS09RM	6.8	-4.7	0.9	0.7	0.4	4.9
MS26RE	6.4	-11.2	0.8	0.6	0.3	4.6
MS26RM	7.2	-0.4	0.9	0.7	0.5	5.0
MS46RE	5.6	-22.2	0.7	0.5	0.2	4.2
MS46RM	7.1	-0.9	0.9	0.7	0.5	5.0

The changes in navigation economic benefits are a reflection of the changes in navigation service levels and season lengths, which are shown in Table X. The table shows the number of years out of the 81-year period that certain navigation criteria are met. For example, for the No Action alternative (MS00RE), 32 years out of 81 years have full service support for navigation at the start of the navigation season based on the March 15 storage check, 16 years have intermediate service, 27 years have minimum service and 6 years have no navigation support,

The most likely factor in the loss of navigation benefits is the loss of navigation service in the early part of the season. Without a change to the rule curves, the number of years having full service drop from 32 out of 81 years without additional flood control storage to 30, 28 and 17 years with the addition of 0.9, 2.6, and 4.6 MAF of flood control storage, respectively. A secondary factor leading to reduced navigation benefits is the loss of extended seasons (8.3-month seasons) with increasing flood control storage. The number of years with extended seasons ranged from 25 of 81 years for the No Action alternative to only 7-10 years in the alternatives with 4.6 MAF of additional flood control storage. Lowering the navigation rule curves reduced the number of extended seasons for each storage scenario and also had the effect of adding some seasons with less than 7 months of navigation service. The alternatives with no lowering of the rule curves did not have navigation season shorter than 7 months.

As noted above, as the volume of flood control storage increases, the impact to navigation is more pronounced unless there is a corresponding shift in the navigation rule curve. To clarify the point, note that MS46RE has 4.6 MAF of additional flood control storage and no shift in the navigation rule curve. The target March 1 storage under this alternative is 52.2 MAF as noted in Table III (Section II.D). The March 15 storage required for full service navigation is currently 54.5 MAF, and thus, the likelihood of starting the navigation season below full service is greatly increased in this alternative. This can be seen in Table X, which indicates full service years for that alternative of 17 compared to 32 under the no-action alternative, nearly a 50 percent drop in the number of full service years to start the navigation season.

Table X. Summary of Navigation Service Level (years) and Season Length (months) Data

Service Level	MS00RE	MS09RE	MS09RM	MS26RE	MS26RM	MS46RE	MS46RM
March 15 Storage Check							
FULL	32	30	34	28	34	17	35
INTER	16	16	14	17	14	27	14
MIN	27	29	27	30	27	31	26
NONE	6	6	6	6	6	6	6
July 1 Storage Check							
FULL	39	36	40	35	40	32	39
INTER	12	14	11	15	11	17	12
MIN	24	25	24	25	24	26	24
NONE	6	6	6	6	6	6	6
Season Length							
July 1 Storage Check							
6.0-6.49	0	0	1	0	1	0	0
6.5-6.99	0	0	4	0	4	0	4
7.0-7.49	21	24	16	24	16	24	16
7.5-7.99	5	2	5	3	5	4	5
8	24	28	34	28	34	37	43
8.33	25	21	15	20	15	10	7

As shown in Table II (Section II.D) the navigation preclude was adjusted on several of the alternatives and ranged from 31.3 MAF to 32.8 MAF. The navigation preclude is currently 31.0 MAF. As a result of the lower starting condition, the higher preclude value is necessary to discontinue service to navigation at an earlier point thereby allowing the model to serve navigation, water supply and other project purposes during the drought of the 1930's.

E. Water Supply

An important benefit of the System is the availability of water at more than 1,600 intake facilities along lake and river reaches from Fort Peck reservoir to St. Louis, Missouri. Economic benefits accrue to the use of water for thermal powerplants, agriculture, public and private drinking water, and other industrial uses of water not served by public systems. Figure 11 presents the average annual water supply benefits of each of the alternatives.

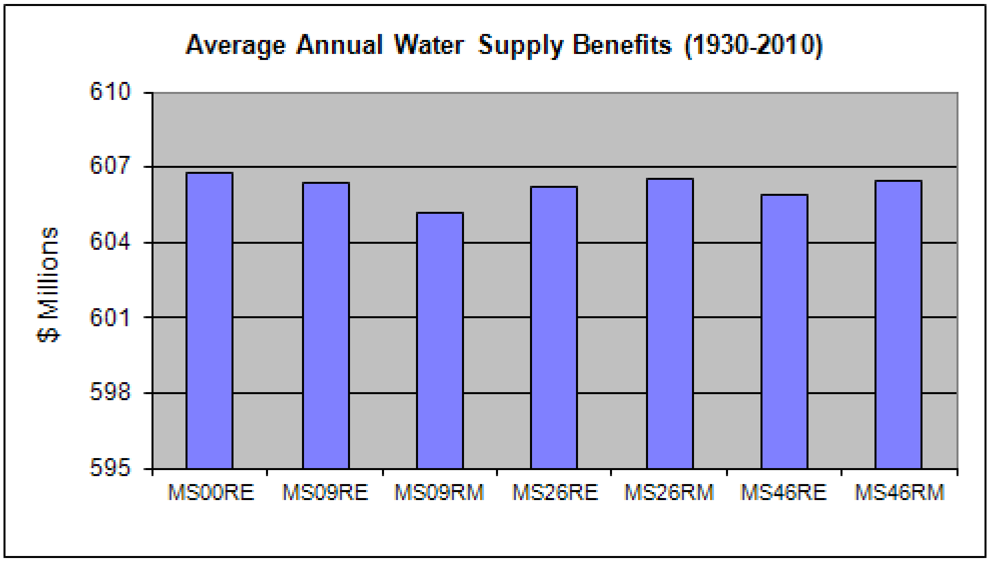

Figure 11. Average Annual Water Supply Benefits (1930-2010)

Table XI presents the benefits in more detail with benefits shown for the reservoirs, the reaches between the reservoirs and the lower river.

Table XI. Average Annual Water Supply Benefits ($ Millions)

	Total Benefits	% Change from No Action	Reservoirs	Reach Benefits Upper River	Lower River
MS00RE	606.8	--	19.8	95.4	491.5
MS09RE	606.4	-0.1	19.7	95.4	491.4
MS09RM	605.2	-0.3	19.6	95.4	490.2
MS26RE	606.2	-0.1	19.7	95.4	491.1
MS26RM	606.5	0.0	19.5	95.4	491.6
MS46RE	605.9	-0.1	19.5	95.3	491.0
MS46RM	606.4	-0.1	19.2	95.3	491.9

In the case of water supply, there is a direct relationship between the flood control storage and the water supply benefits in the reservoirs. Reservoir benefits drop as flood storage increases (a drop in the base of the flood control pool). Lowering the navigation rule curves also has the effect of decreasing benefits. As noted in reservoirs effects section of the report, reservoir levels are generally lower for these other alternatives resulting in reduced water supply benefits in the reservoirs.

F. Hydropower

Economic Modeling Benefits

Hydropower is generated at all of the six dams forming the System. During drought, generation at all six dams is reduced by either lower releases from the dams, as is the case for the three smaller, downstream dams (Big Bend, Fort Randall, and Gavins Point) or by the combination of reduced releases and lower reservoir levels, as is the case at the three larger, upstream dams (Fort Peck, Garrison, and Oahe). Figure 12 presents the hydropower economic benefits in terms of National Economic Development (NED) dollars for 1930-2010.

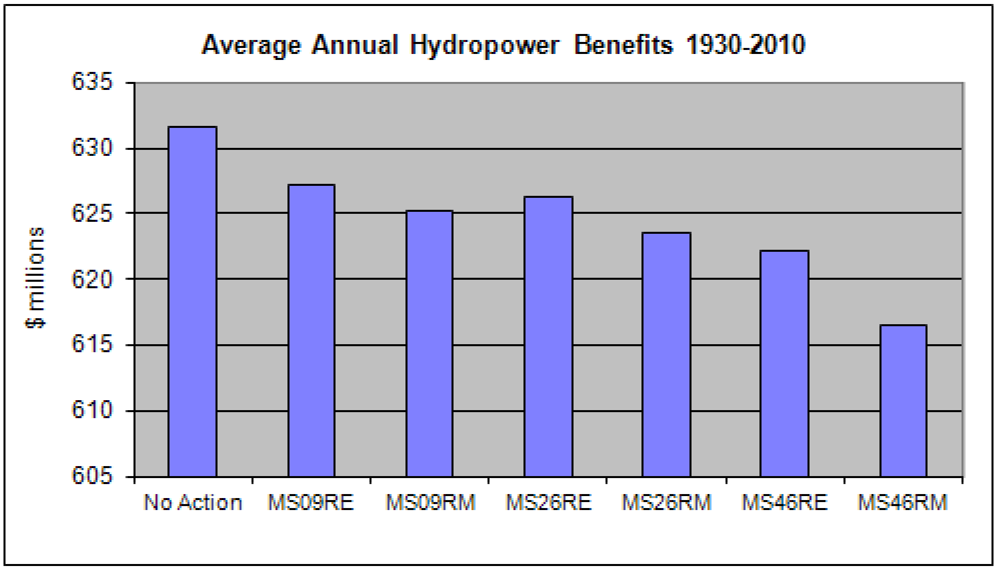

Figure 12. Average Annual Hydropower Benefits (1930-2010)

As shown, the hydropower benefits generally drop as the base of the flood control zone is lowered. Lowering the navigation rule curves accentuates the drop in each scenario.

In addition to the NED benefits analysis for hydropower, three other aspects of hydropower were examined in this analysis. They include hydropower revenues, power at risk and capacity at risk.

Hydropower Revenue

For this and previous studies, Western Area Power Administration has provided a spreadsheet model to the Corps that can be used to compute the energy revenues based on the sales and purchases of energy incurred from June 2009 through May 2010. The average annual energy generation values are provided by the DRM and the resulting average annual energy revenue values are presented in Table XIII. As additional flood control storage space is provided in the System, average annual hydropower energy revenue is expected to decline at the rate of about $0.9 million per MAF of additional flood control storage. Lowering the navigation rule curves had a slight impact on the rate, increasing the loss rate from $0.9 million to $1.0 million per MAF of change.

Table XII. Average Annual Hydropower Marketing Revenues ($ Millions)

	Total Energy Revenue	% Change from No Action	Net Energy Revenue
MS00RE	270.9	--	
MS09RE	269.3	-0.6	-1.5
MS09RM	268.6	-0.8	-2.3
MS26RE	268.6	-0.9	-2.3
MS26RM	268.2	-1.0	-2.6
MS46RE	266.4	-1.6	-4.4
MS46RM	265.7	-1.9	-5.2

Power at Risk and Capacity at Risk

Power at risk reflects the thermal and hydropower generation that is potentially lost due to lower river flows or releases, respectively, and also lost head on the generators for hydropower. When hydropower generation does not meet the firm commitment of the Western Area Power Administration, that agency has to purchase capacity and energy. When river flows are low, the availability of thermal generation as an alternative source to make up the difference is also lost. The capacity-at-risk computations reflect the largest single-day loss of generation in the summer months of June through August. Similarly, the energy-at-risk computations reflect the accumulated loss of energy over the three summer months of June thought August.

For capacity at risk, the average annual capacity at risk was analyzed for the 2000 through 2010 period. Capacity is lost as the base of the flood control zone is lowered. However, capacity is lost at a greater rate when the navigation rule curves are adjusted in conjunction with the lowering of the base of flood control. Capacity is lost at a rate of approximately 9 MW per MAF of lowering only the base of flood control and 17.50 MW per MAF of lowering of both sets of criteria, almost a doubling of the loss of capacity. Similarly, the energy-at-risk loss rates showed rates of approximately 7 million megawatt-hours and 7.9 million megawatt hours per MAF of lowering of the criteria.

G. Recreation

The System reservoirs provide outstanding opportunities for boating, fishing, swimming, camping and other outdoor recreation pursuits. Tourism related to the reservoirs is a major economic factor in all of the states adjoining the river. However, when the reservoirs are drawn down due to extended drought periods, as they were in some recent years, recreation may be adversely affected primarily due to access issues. Most of the recreational impacts of drought are experienced at the upper three large reservoirs – Fort Peck, Garrison and Oahe. The lower three reservoirs are not significantly impacted by drought due to the manner in which they are regulated. Recreation benefits were computed for all reaches of the Missouri River from Fort Peck to the mouth. These benefits are summarized in Figure 13. Table XIII provides more detail for the upper three reservoirs (Fort Peck, Garrison and Oahe), the lower three reservoirs (Big Bend, Fort Randall and Gavins Point), the upper river reaches and the lower river reaches.

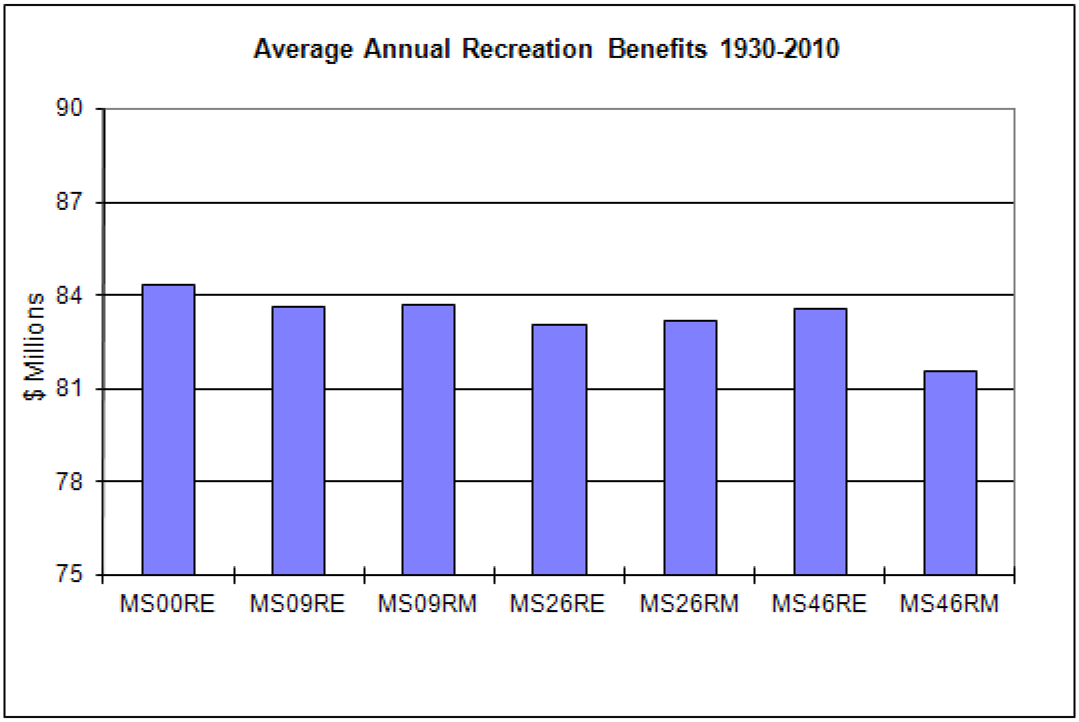

Figure 13. Average Annual Recreation Benefits (1930-2010)

Table XIII. Average Annual Recreation Benefits ($ Millions)

	Total Benefits	% Change from No Action	Reach Benefits Up 3 Res.	Lwr. 3 Res.	Upper River	Lower River
MS00RE	84.3	--	31.2	29.0	4.5	19.6
MS09RE	83.6	-0.8	30.6	29.0	4.5	19.5
MS09RM	83.7	-0.8	30.7	28.8	4.6	19.5
MS26RE	83.0	-1.6	30.0	29.0	4.5	19.5
MS26RM	83.2	-1.4	30.1	29.0	4.6	19.6
MS46RE	83.5	-1.0	30.6	29.0	4.5	19.4
MS46RM	81.6	-3.3	28.5	29.0	4.5	19.5

Increasing the amount of flood control storage reduces the recreation benefits for the upper three reservoirs but has little impact on the lower three reservoirs or either of the river reaches.

IV. Summary of Impacts

By summing the economic impacts for the five economic uses of the Missouri River (not including energy revenues), an estimate can be made of the total National Economic Development impacts of changes to the flood control storage in the Mainstem Reservoir System. The results are presented in Table XIV and Figure 14. As mentioned previously, the economic data contained in the impact models has not been updated since the Mater Manual Study was completed.

Table XIV. Summary of Average Annual Benefits 1930-2010 ($ Millions)

	Flood Control	Navigation	Hydropower	Water Supply	Recreation	Total NED
MS00RE	380.5	7.2	631.7	606.8	84.3	1710.5
MS09RE	380.9	6.6	627.3	606.4	83.6	1704.7
MS09RM	380.9	6.8	625.3	605.2	83.7	1701.8
MS26RE	380.5	6.4	626.3	606.2	83.0	1702.4
MS26RM	380.8	7.2	623.6	606.5	83.2	1701.2
MS46RE	380.0	5.6	622.2	605.9	83.5	1697.2
MS46RM	380.2	7.1	616.5	606.4	81.6	1691.8

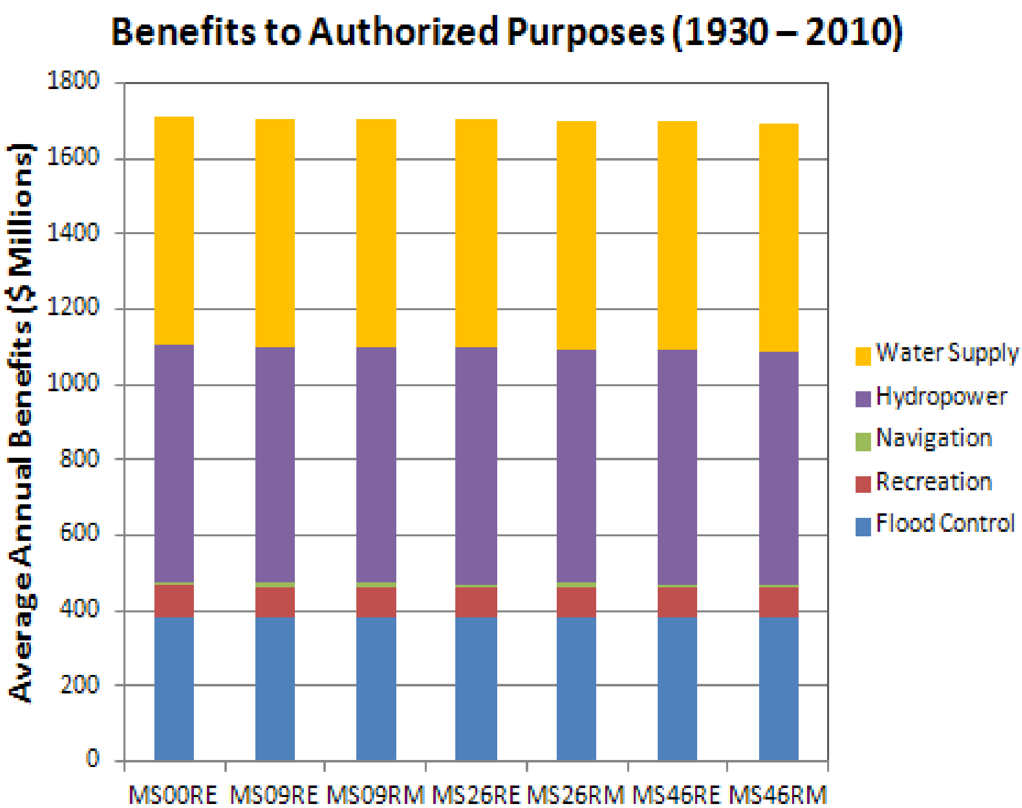

Figure 14. Benefits to Authorized Purposes (1930-2010)

The percent change in the average annual benefits compared to the No Action alternative are shown in Table XV. Values with a percent change greater than one percent are highlighted in the table.

Table XV. Percent Change in Average Annual Benefits Compared to No Action 1930-2010

	Flood Control	Navigation	Hydropower	Water Supply	Recreation	Total NED
MS00RE	-	-	-	-	-	-
MS09RE	0.1	-8.8	-0.7	-0.1	-0.8	-0.3
MS09RM	0.1	-4.7	-1.0	-0.3	-0.8	-0.5
MS26RE	0.0	-11.2	-0.9	-0.1	-1.6	-0.5
MS26RM	0.1	-0.4	-1.3	0.0	-1.4	-0.5
MS46RE	-0.1	-22.2	-1.5	-0.1	-1.0	-0.8
MS46RM	-0.1	-0.9	-2.4	-0.1	-3.3	-1.1

*See section III.C. for discussion of flood control that includes 2011.

V. Conclusions

This technical report presents information on the analysis of various alternative regulation scenarios with a focus of providing additional flood control storage in the System reservoirs. This analysis included a limited investigation of the potential impacts on other authorized purposes if mainstem reservoir flood control storage were increased.

The analysis shows that, when compared to the No Action alternative, the average annual benefits decrease as the amount of additional flood storage increases. The reduction in average annual benefits is, for the most part, due to increased negative impacts to several of the authorized purposes including navigation, hydropower and recreation.

The analysis also indicates that, despite additional flood control storage, there was no significant increase in average annual flood benefits for any of the alternatives when compared to the No Action alternative. Looking specifically at 2011, additional flood control storage would increase the flood benefits as much as 3 percent over the No Action alternative, but storage alone cannot prevent catastrophic damages due to the large volume of runoff that must pass through the System. This is due to the fact that peak releases for all of the alternatives exceed the previous record releases of 70,000 cfs from Gavins Point Dam and are above the damage threshold. Depending on various factors including the timing, distribution and volume of runoff, future flood events similar to that experienced in 2011, or higher, may require future higher releases. Thus, increased channel capacity and reducing encroachment in the flood plain are critical components of reducing overall flood risk in the Missouri River basin, in conjunction with the flood risk reduction provided by the Mainstem Reservoir System. As noted in the Master Manual, the System does not guarantee a flood-free zone in the Missouri River reaches between the System reservoirs and below the System. Downstream flooding will occur in some years even if releases are reduced to minimum levels due to runoff from the large uncontrolled areas downstream from several of the dams. Local inflows from these uncontrolled areas can cause major flooding if significant rainfall occurs.

If a determination is made that additional flood control storage is desired, additional analyses would be required to determine the proper volume of storage and distribution of that flood control storage among the reservoirs. The volume of flood control storage in Fort Randall and its regulation were not examined in this analysis, but could be investigated in the future. In addition, future analyses could examine the potential for multi-year flood control regulation of the System. This analysis focused on the key economic drivers of the system, and did not examine the impacts to cultural resources or the environment including threatened and endangered species. These important resources would need to be considered in future studies as well. In any case, stakeholder involvement would be necessary to improve the analysis, and to balance the associated benefits, impacts and residual flood risks.

VALUES IN 1000 AF EXCEPT AS INDICATED

31DEC10	INI-SUM	2010 31JAN	2011 28FEB
--FORT PECK--			
NAT INFLOW	1011	431	580
DEPLETION	-192	-78	-114
EVAPORATION			
MOD INFLOW	1203	509	694
RELEASE	1109	553	555
STOR CHANGE	94	-44	139
STORAGE	15074	15030	15168
ELEV FTMSL	2235.3	2235.1	2235.8
DISCH KCFS	7.8	9.0	10.0
POWER			
AVE POWER MW		123	137
PEAK POW MW		163	164
ENERGY GWH	183.3	91.6	91.8
--GARRISON--			
NAT INFLOW	756	299	457
DEPLETION	-73	-32	-41
CHAN STOR	-22	-12	-10
EVAPORATION			
REG INFLOW	1916	873	1044
RELEASE	2920	1476	1444
STOR CHANGE	-1003	-603	-400
STORAGE	19409	18806	18406
ELEV FTMSL	1841.6	1839.7	1838.5
DISCH KCFS	17.8	24.0	26.0
POWER			
AVE POWER MW		303	325
PEAK POW MW		476	472
ENERGY GWH	444.1	225.6	218.5
--OAHE--			
NAT INFLOW	438	120	318
DEPLETION	173	80	93
CHAN STOR	-33	-25	-8
EVAPORATION			
REG INFLOW	3151	1490	1661
RELEASE	2258	1234	1024
STOR CHANGE	893	256	637
STORAGE	18059	18315	18952
ELEV FTMSL	1605.0	1605.8	1607.9
DISCH KCFS	24.8	20.1	18.4
POWER			
AVE POWER MW		256	238
PEAK POW MW		699	710
ENERGY GWH	350.3	190.7	159.6
--BIG BEND--			
EVAPORATION			
REG INFLOW	2258	1234	1024
RELEASE	2268	1244	1024
STORAGE	1631	1621	1621
ELEV FTMSL	1420.2	1420.0	1420.0
DISCH KCFS	22.4	20.2	18.4
POWER			
AVE POWER MW		99	88
PEAK POW MW		538	529
ENERGY GWH	133.4	73.9	59.4
--FORT RANDALL--			
NAT INFLOW	303	86	217
DEPLETION	-6	-3	-3
EVAPORATION			
REG INFLOW	2577	1333	1244
RELEASE	1921	1051	870
STOR CHANGE	656	282	374
STORAGE	2468	2750	3124
ELEV FTMSL	1340.5	1344.8	1350.0
DISCH KCFS	22.8	17.1	15.7
POWER			
AVE POWER MW		130	125
PEAK POW MW		319	339
ENERGY GWH	180.7	96.9	83.8
--GAVINS POINT--			
NAT INFLOW	303	67	236
DEPLETION	-1	1	-2
CHAN STOR	13	10	3
EVAPORATION			
REG INFLOW	2238	1128	1111
RELEASE	2287	1138	1150
STOR CHANGE	-49	-10	-39
STORAGE	388	378	339
ELEV FTMSL	1207.8	1207.4	1205.9
DISCH KCFS	25.2	18.5	20.7
POWER			
AVE POWER MW		65	72
PEAK POW MW		117	114
ENERGY GWH	97.2	48.7	48.5
--GAVINS POINT - SIOUX CITY--			
NAT INFLOW	797	273	524
DEPLETION	-26	-12	-14
REGULATED FLOW AT SIOUX CITY			
KAF	3110	1423	1688
KCFS		23.1	30.4
--TOTAL--			
NAT INFLOW	3608	1276	2332
DEPLETION	-125	-44	-81
CHAN STOR	-42	-26	-15
EVAPORATION			
STORAGE	57029	56900	57610
SYSTEM POWER			
AVE POWER MW		978	985
PEAK POW MW		2312	2327
ENERGY GWH	1389.0	727.4	661.6
DAILY GWH		23.5	23.6
	INI-SUM	31JAN	28FEB

DATE OF STUDY 03/29/12 JAN 2012 / ROUTING OF FLOOD 2011 / START JAN 1 / 99001 9901 4 PAGE 2

TIME OF STUDY 16:07:53 / EXISTING CONDITIONS / STUDY NO 0

VALUES IN 1000 AF EXCEPT AS INDICATED

28FEB11		2011												2012			
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB
--FORT PECK--																	
NAT INFLOW	13768	508	237	304	895	2871	4035	2093	538	260	405	207	97	110	428	400	380
DEPLETION	-24	-24	-11	-14	-18	62	462	508	-36	-327	-210	-77	-36	-41	-91	-86	-85
EVAPORATION	479							31	95	115	98	44	21	24	51		
MOD INFLOW	13313	531	248	319	913	2809	3573	1554	479	472	517	240	112	128	468	486	465
RELEASE	13683	220	103	132	422	904	3130	2552	1599	1369	553	298	139	159	676	738	690
STOR CHANGE	-371	311	145	187	491	1905	443	-998	-1120	-897	-37	-58	-27	-31	-208	-252	-225
STORAGE	15168	15479	15625	15811	16302	18207	18650	17652	16532	15635	15598	15540	15514	15483	15275	15023	14797
ELEV FTMSL	2235.8	2237.2	2237.9	2238.7	2240.9	2248.9	2250.7	2246.7	2241.9	2237.9	2237.8	2237.5	2237.4	2237.2	2236.3	2235.1	2234.0
DISCH KCFS	10.0	7.4	7.4	7.4	7.1	14.7	52.6	41.5	26.0	23.0	9.0	10.0	10.0	10.0	11.0	12.0	12.0
POWER																	
AVE POWER MW		102	102	102	99	170	170	170	168	166	124	137	137	137	149	160	159
PEAK POW MW		165	165	166	167	173	171	169	167	164	165	165	165	165	164	163	162
ENERGY GWH	1298.9	36.6	17.1	22.1	70.9	126.5	122.5	126.7	125.3	119.2	92.3	49.5	23.1	26.4	110.9	119.0	110.8
--GARRISON--																	
NAT INFLOW	24809	758	354	455	2748	4414	6467	5560	1374	515	704	194	90	103	393	300	380
DEPLETION	1403	23	11	14	-43	-100	733	1399	-39	-239	8	-87	-41	-46	-58	-77	-55
CHAN STOR	-12	26			3	-72	-349	102	144	29	136	-10		0	-10	-10	
EVAPORATION	547							37	110	131	113	50	23	26	57		
REG INFLOW	36530	981	446	573	3216	5346	8515	6778	3046	2020	1272	518	246	282	1061	1105	1125
RELEASE	37029	655	305	393	893	3117	8128	7852	5602	2583	1586	845	394	451	1254	1476	1496
STOR CHANGE	-499	326	140	180	2324	2228	386	-1074	-2555	-563	-314	-327	-148	-169	-194	-371	-370
STORAGE	18406	18732	18872	19053	21376	23605	23991	22917	20361	19799	19485	19157	19010	18841	18647	18277	17906
ELEV FTMSL	1838.5	1839.5	1839.9	1840.5	1847.3	1853.4	1854.4	1851.6	1844.4	1842.8	1841.8	1840.8	1840.4	1839.8	1839.2	1838.0	1836.8
DISCH KCFS	26.0	22.0	22.0	22.0	15.0	50.7	136.6	127.7	91.1	43.4	25.8	28.4	28.4	28.4	20.4	24.0	26.0
POWER																	
AVE POWER MW		275	277	277	193	503	501	501	499	498	327	359	358	357	256	300	322
PEAK POW MW		475	477	479	501	505	502	500	480	493	484	480	479	477	474	470	466
ENERGY GWH	3321.5	99.1	46.5	59.9	138.9	374.4	360.8	372.7	371.4	358.8	243.5	129.2	60.1	68.5	190.7	222.9	224.0
--OAHE--																	
NAT INFLOW	6846	874	408	524	1617	1259	1009	393	210	67	151	27	13	14	105	75	100
DEPLETION	1419	64	30	38	-17	329	-8	151	232	258	229	7	3	4	45	21	33
CHAN STOR	21	16	0	0	26	-127	-298	31	129	177	69	-10			32	-14	-8
EVAPORATION	537							36	109	130	109	49	22	26	55		
REG INFLOW	41941	1481	683	879	2552	3921	8848	8089	5599	2439	1468	806	381	436	1291	1515	1555
RELEASE	42268	396	183	289	1663	3223	8572	8831	7102	3850	1556	1304	353	505	1472	1597	1372
STOR CHANGE	-327	1085	501	590	890	698	276	-742	-1503	-1411	-89	-498	28	-69	-181	-82	182
STORAGE	18952	20037	20537	21127	22017	22715	22991	22248	20746	19335	19246	18748	18776	18707	18525	18443	18625
ELEV FTMSL	1607.9	1611.2	1612.7	1614.4	1616.9	1618.9	1619.6	1617.6	1613.3	1609.1	1608.8	1607.2	1607.3	1607.1	1606.5	1606.2	1606.8
DISCH KCFS	18.4	13.3	13.2	16.2	27.9	52.4	144.1	143.6	115.5	64.7	25.3	43.8	25.5	31.8	23.9	26.0	23.9
POWER																	
AVE POWER MW		174	174	216	375	697	748	744	735	726	329	563	328	409	308	333	306
PEAK POW MW		727	735	744	757	767	749	739	724	715	715	706	707	706	702	701	704
ENERGY GWH	4359.5	62.7	29.3	46.6	270.2	518.5	538.2	553.8	547.0	522.5	244.7	202.7	55.1	78.5	229.0	247.7	213.1
--BIG BEND--																	
EVAPORATION	103							6	20	25	22	10	5	5	11		
REG INFLOW	42164	396	183	289	1663	3223	8572	8825	7082	3825	1535	1294	349	500	1461	1597	1372
RELEASE	42164	396	183	289	1663	3223	8572	8825	7082	3825	1535	1294	349	500	1461	1597	1372
STORAGE	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621
ELEV FTMSL	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0
DISCH KCFS	18.4	13.3	13.2	16.2	27.9	52.4	144.1	143.5	115.2	64.3	25.0	43.5	25.1	31.5	23.8	26.0	23.9
POWER																	
AVE POWER MW		63	62	74	124	232	295	358	451	304	124	212	125	157	119	127	114
PEAK POW MW		517	509	488	464	464	295	358	451	519	538	538	538	538	538	538	529
ENERGY GWH	1825.7	22.7	10.4	15.9	89.0	172.4	212.4	266.2	335.8	218.8	92.1	76.2	21.0	30.1	88.5	94.6	79.5
--FORT RANDALL--																	
NAT INFLOW	3288	332	155	199	238	305	932	357	288	158	14	9	4	5	97	85	110
DEPLETION	80	1	1	1	4	9	12	18	15	7	1	1	0	1	3	3	3
EVAPORATION	121							9	28	32	24	10	4	5	10		
REG INFLOW	45252	727	337	487	1897	3519	9492	9155	7327	3944	1524	1292	348	500	1546	1679	1479
RELEASE	45253	436	203	261	1701	3519	8147	9652	8085	4642	2324	1162	541	619	1603	1253	1105
STOR CHANGE	-1	291	134	226	196		1345	-497	-758	-698	-800	130	-193	-119	-58	426	374
STORAGE	3124	3415	3549	3775	3971	3971	5316	4819	4061	3363	2563	2693	2500	2381	2323	2749	3123
ELEV FTMSL	1350.0	1353.6	1355.2	1357.8	1360.0	1360.0	1374.0	1369.0	1361.0	1353.0	1342.0	1344.0	1341.0	1339.0	1338.0	1344.8	1350.0
DISCH KCFS	15.7	14.6	14.6	14.6	28.6	57.2	136.9	157.0	131.5	78.0	37.8	39.1	39.0	39.0	26.1	20.4	19.2
POWER																	
AVE POWER MW		121	123	126	248	371	375	375	375	357	297	287	285	277	190	153	153
PEAK POW MW		351	356	365	372	371	375	375	361	344	305	315	301	292	287	319	339
ENERGY GWH	2417.9	43.6	20.7	27.1	178.7	275.7	270.0	279.0	278.9	257.1	220.8	103.5	48.0	53.2	141.6	114.0	106.1
--GAVINS POINT--																	
NAT INFLOW	1999	190	88	114	134	17	301	266	270	159	77	42	19	22	90	90	120
DEPLETION	114	0	0	0	5	19	24	39	10	-5	2	5	2	3	10	1	
CHAN STOR	-12	2	0	0	-27	-55	-153	-38	49	101	74	-2	0	0	24	11	2
EVAPORATION	36							2	6	9	8	3	2	2	4		
REG INFLOW	47090	628	292	375	1803	3462	8271	9838	8388	4898	2466	1193	557	636	1703	1353	1227
RELEASE	47087	625	292	375	1803	3462	8271	9838	8375	4873	2466	1193	557	636	1703	1353	1265
STOR CHANGE	3	3							13	25							-38
STORAGE	339	342	342	342	342	342	342	342	355	380	380	380	380	380	380	380	342
ELEV FTMSL	1205.9	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1206.0
DISCH KCFS	20.7	21.0	21.0	21.0	30.3	56.3	139.0	160.0	136.2	81.9	40.1	40.1	40.1	40.1	27.7	22.0	22.0
POWER																	
AVE POWER MW		72	72	72	102	111	93	89	94	108	116	116	116	116	79	75	74
PEAK POW MW		114	114	114	114	111	93	89	95	110	116	116	116	116	78	78	76
ENERGY GWH	826.9	26.0	12.2	15.6	73.1	82.2	67.0	66.4	70.0	77.9	86.6	41.9	19.6	22.4	58.6	55.8	51.6
--GAVINS POINT - SIOUX CITY--																	
NAT INFLOW	9312	558	260	334	2081	1603	1092	1336	551	252	286	152	71	81	255	200	200
DEPLETION	266	7	3	4	22	36	31	39	36	24	11	6	3	3	13	14	14
REGULATED FLOW AT SIOUX CITY																	
KAF	56133	1176	549	705	3862	5029	9332	11135	8890	5101	2741	1339	625	714	1945	1539	1451
KCFS		39.5	39.5	39.5	64.9	81.8	156.8	181.1	144.6	85.7	44.6	45.0	45.0	45.0	31.6	25.0	25.2
--TOTAL--																	
NAT INFLOW	60022	3220	1502	1931	7713	10469	13836	10005	3231	1411	1637	630	294	336	1368	1150	1290
DEPLETION	3258	71	33	43	-47	355	1254	2154	218	-282	41	-145	-68	-77	-78	-124	-90
CHAN STOR	-2	43	0	0	2	-254	-800	94	322	307	279	-22	0	0	46	-14	-6
EVAPORATION	1824							121	368	442	374	166	77	87	188		
STORAGE	57610	59626	60546	61729	65629	70461	72911	69599	63676	60133	58893	58140	57800	57412	56771	56493	56415
SYSTEM POWER																	
AVE POWER MW		808	810	867	1140	2083	2182	2238	2323	2159	1317	1675	1350	1454	1101	1148	1128
PEAK POW MW		2350	2357	2356	2376	2390	2185	2230	2279	2344	2323	2321	2306	2293	2244	2269	2276
ENERGY GWH	14050.6	290.7	136.1	187.3	820.9	1549.6	1571.0	1664.9	1728.4	1554.3	980.0	603.0	226.8	279.1	819.3	854.0	785.2
DAILY GWH		19.4	19.4	20.8	27.4	50.0	52.4	53.7	55.8	51.8	31.6	40.2	32.4	34.9	26.4	27.5	27.1
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB

VALUES IN 1000 AF EXCEPT AS INDICATED

31DEC10	INI-SUM	31JAN (2010)	28FEB (2011)
--FORT PECK--			
NAT INFLOW	1011	431	580
DEPLETION	-192	-78	-114
EVAPORATION			
MOD INFLOW	1203	509	694
RELEASE	1109	553	555
STOR CHANGE	94	-44	139
STORAGE	14552	14508	14646
ELEV FTMSL	2232.9	2232.7	2233.3
DISCH KCFS	7.8	9.0	10.0
POWER			
AVE POWER MW		122	136
PEAK POW MW		161	162
ENERGY GWH	181.9	90.9	91.1
--GARRISON--			
NAT INFLOW	756	299	457
DEPLETION	-73	-32	-41
CHAN STOR	-22	-12	-10
EVAPORATION			
REG INFLOW	1916	872	1043
RELEASE	2920	1476	1444
STOR CHANGE	-1004	-603	-401
STORAGE	17785	17182	16781
ELEV FTMSL	1836.4	1834.4	1833.0
DISCH KCFS	17.8	24.0	26.0
POWER			
AVE POWER MW		294	314
PEAK POW MW		457	452
ENERGY GWH	429.6	218.4	211.2
--OAHE--			
NAT INFLOW	438	120	318
DEPLETION	173	80	93
CHAN STOR	-33	-25	-8
EVAPORATION			
REG INFLOW	3152	1491	1661
RELEASE	1602	578	1024
STOR CHANGE	1550	913	637
STORAGE	18501	19414	20051
ELEV FTMSL	1606.4	1609.3	1611.3
DISCH KCFS	24.8	9.4	18.4
POWER			
AVE POWER MW		122	242
PEAK POW MW		718	728
ENERGY GWH	253.4	90.9	162.5
--BIG BEND--			
EVAPORATION			
REG INFLOW	1602	578	1024
RELEASE	1612	588	1024
STORAGE	1631	1621	1621
ELEV FTMSL	1420.2	1420.0	1420.0
DISCH KCFS	22.4	9.6	18.4
POWER			
AVE POWER MW		47	88
PEAK POW MW		538	529
ENERGY GWH	94.6	35.1	59.4
--FORT RANDALL--			
NAT INFLOW	303	86	217
DEPLETION	-6	-3	-3
EVAPORATION			
REG INFLOW	1921	677	1244
RELEASE	1921	1051	870
STOR CHANGE		-374	374
STORAGE	3124	2750	3124
ELEV FTMSL	1350.0	1344.8	1350.0
DISCH KCFS	22.8	17.1	15.7
POWER			
AVE POWER MW		136	125
PEAK POW MW		318	339
ENERGY GWH	184.9	101.1	83.8
--GAVINS POINT--			
NAT INFLOW	303	67	236
DEPLETION	-1	1	-2
CHAN STOR	13	10	3
EVAPORATION			
REG INFLOW	2238	1128	1111
RELEASE	2287	1138	1150
STOR CHANGE	-49	-10	-39
STORAGE	388	378	339
ELEV FTMSL	1207.8	1207.4	1205.9
DISCH KCFS	25.2	18.5	20.7
POWER			
AVE POWER MW		65	72
PEAK POW MW		117	114
ENERGY GWH	97.2	48.7	48.5
--GAVINS POINT - SIOUX CITY--			
NAT INFLOW	797	273	524
DEPLETION	-26	-12	-14
REGULATED FLOW AT SIOUX CITY			
KAF	3110	1423	1688
KCFS		23.1	30.4
--TOTAL--			
NAT INFLOW	3608	1276	2332
DEPLETION	-125	-44	-81
CHAN STOR	-42	-26	-15
EVAPORATION			
STORAGE	55981	55852	56562
SYSTEM POWER			
AVE POWER MW		786	977
PEAK POW MW		2309	2323
ENERGY GWH	1241.6	585.1	656.5
DAILY GWH		18.9	23.4
	INI-SUM	31JAN	28FEB

TIME OF STUDY 16:10:11 STARTING POOL: 1.1 FT BLW TOP OF CONS /140K MAX RELEASE STUDY NO 1

VALUES IN 1000 AF EXCEPT AS INDICATED

28FEB11	INI-SUM	15MAR 2011	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC 2012	31JAN	29FEB
--FORT PECK--																	
NAT INFLOW	13768	508	237	304	895	2871	4035	2093	538	260	405	207	97	110	428	400	380
DEPLETION	-24	-24	-11	-14	-18	62	462	508	-36	-327	-210	-77	-36	-41	-91	-86	-85
EVAPORATION	486							31	97	118	100	45	21	24	51		
MOD INFLOW	13306	531	248	319	913	2809	3573	1554	477	469	515	239	112	128	468	486	465
RELEASE	13413	223	104	134	893	922	2321	1845	1660	1211	922	446	208	238	738	799	748
STOR CHANGE	-107	308	144	185	20	1887	1252	-291	-1183	-742	-408	-207	-96	-110	-269	-313	-283
STORAGE	14646	14955	15098	15283	15303	17190	18442	18151	16968	16226	15819	15612	15515	15405	15136	14823	14540
ELEV FTMSL	2233.3	2234.8	2235.5	2236.3	2236.4	2244.7	2249.9	2248.7	2243.8	2240.6	2238.8	2237.8	2237.4	2236.9	2235.6	2234.2	2232.8
DISCH KCFS	10.0	7.5	7.5	7.5	15.0	15.0	39.0	30.0	27.0	20.4	15.0	15.0	15.0	15.0	12.0	13.0	13.0
POWER																	
AVE POWER MW		102	103	103	164	167	170	172	170	167	166	165	165	164	160	163	162
PEAK POW MW		163	163	164	164	170	171	171	168	166	165	165	164	164	163	162	161
ENERGY GWH	1410.2	36.8	17.2	22.2	117.8	124.1	122.1	127.8	126.4	120.6	123.6	59.4	27.7	31.5	119.3	121.1	112.6
--GARRISON--																	
NAT INFLOW	24809	758	354	455	2748	4414	6467	5560	1374	515	704	194	90	103	393	300	380
DEPLETION	1403	23	11	14	-43	-100	733	1399	-39	-239	8	-87	-41	-46	-58	-77	-55
CHAN STOR	-30	25		0	-75		-225	83	28	63	52				30	-10	
EVAPORATION	551							37	112	134	113	50	23	26	56		
REG INFLOW	36238	984	447	575	3608	5436	7830	6051	2988	1895	1557	677	316	362	1162	1166	1183
RELEASE	35246	655	305	357	1190	3074	6248	6210	5534	3132	2152	1041	486	476	1291	1599	1496
STOR CHANGE	992	329	142	218	2418	2362	1582	-159	-2545	-1237	-595	-364	-170	-114	-129	-432	-313
STORAGE	16781	17110	17252	17469	19888	22250	23831	23673	21127	19890	19296	18931	18761	18647	18518	18086	17773
ELEV FTMSL	1833.0	1834.2	1834.6	1835.4	1843.0	1849.8	1854.0	1853.6	1846.6	1843.0	1841.2	1840.1	1839.6	1839.2	1838.8	1837.4	1836.4
DISCH KCFS	26.0	22.0	22.0	20.0	20.0	50.0	105.0	101.0	90.0	52.6	35.0	35.0	35.0	30.0	21.0	26.0	26.0
POWER																	
AVE POWER MW		266	268	245	251	500	501	503	501	499	436	433	431	375	263	323	321
PEAK POW MW		456	458	460	498	503	503	503	498	487	482	478	476	474	473	468	464
ENERGY GWH	3497.5	95.9	45.0	52.8	180.6	372.1	361.0	374.2	372.6	359.1	324.7	155.9	72.4	72.0	195.7	240.4	223.2
--OAHE--																	
NAT INFLOW	6846	874	408	524	1617	1259	1009	393	210	67	151	27	13	14	105	75	100
DEPLETION	1419	64	30	38	-17	329	-8	151	232	258	229	7	3	4	45	21	33
CHAN STOR	35	15	0	7		-103	-188	14	39	142	72			21	37	-20	
EVAPORATION	512							36	107	123	101	45	21	25	53		
REG INFLOW	40197	1480	683	850	2824	3901	7077	6430	5444	2960	2045	1016	474	483	1335	1632	1563
RELEASE	41759	396	183	485	1929	3706	7074	7580	7383	5032	2532	722	353	419	1304	1405	1257
STOR CHANGE	-1562	1084	501	365	896	195	3	-1150	-1939	-2072	-487	294	120	63	31	228	306
STORAGE	20051	21135	21636	22001	22897	23092	23095	21945	20006	17934	17447	17741	17862	17925	17956	18183	18489
ELEV FTMSL	1611.3	1614.5	1615.9	1616.9	1619.3	1619.9	1619.9	1616.7	1611.1	1604.5	1602.9	1603.9	1604.3	1604.5	1604.6	1605.4	1606.4
DISCH KCFS	18.4	13.3	13.2	27.1	32.4	60.3	118.9	123.3	120.1	84.6	41.2	24.3	25.5	26.4	21.2	22.8	21.9
POWER																	
AVE POWER MW		177	177	366	440	770	757	748	726	703	518	306	322	335	270	291	280
PEAK POW MW		744	751	757	769	772	757	740	712	685	684	689	691	692	693	697	702
ENERGY GWH	4435.8	63.8	29.8	79.0	316.7	573.0	545.1	556.4	540.4	506.2	385.0	110.2	54.1	64.3	200.5	216.4	194.7
--BIG BEND--																	
EVAPORATION	103							6	20	25	22	10	5	5	11		
REG INFLOW	41656	396	183	485	1929	3706	7074	7574	7364	5007	2511	712	349	414	1293	1405	1257
RELEASE	41656	396	183	485	1929	3706	7074	7574	7364	5007	2511	712	349	414	1293	1405	1257
STORAGE	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621
ELEV FTMSL	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0
DISCH KCFS	18.4	13.3	13.2	27.1	32.4	60.3	118.9	123.2	119.8	84.1	40.8	23.9	25.1	26.1	21.0	22.8	21.9
POWER																	
AVE POWER MW		63	62	120	131	219	295	359	451	393	195	118	125	131	105	112	105
PEAK POW MW		517	509	464	406	349	295	359	451	510	528	538	538	538	538	538	529
ENERGY GWH	1881.7	22.7	10.4	26.0	94.1	162.8	212.4	267.2	335.6	282.6	144.8	42.3	21.0	25.1	78.5	83.3	72.9
--FORT RANDALL--																	
NAT INFLOW	3288	332	155	199	238	305	932	357	288	158	14	9	4	5	97	85	110
DEPLETION	80	1	1	1	4	9	12	18	15	7	1	1	0	1	3	3	3
EVAPORATION	126							9	28	33	26	11	4	5	10		
REG INFLOW	44739	727	337	683	2163	4002	7994	7904	7609	5125	2497	709	348	414	1377	1487	1364
RELEASE	44739	436	203	261	1701	3519	7594	8401	8367	5653	2906	1141	541	617	1274	1137	990
STOR CHANGE	0	291	134	422	462	483	400	-497	-758	-528	-409	-431	-193	-203	104	350	374
STORAGE	3124	3415	3549	3971	4433	4916	5316	4819	4061	3533	3124	2693	2500	2297	2400	2750	3124
ELEV FTMSL	1350.0	1353.6	1355.2	1360.0	1365.0	1370.0	1374.0	1369.0	1361.0	1355.0	1350.0	1344.0	1341.0	1337.5	1339.3	1344.8	1350.0
DISCH KCFS	15.7	14.6	14.6	14.6	28.6	57.2	127.6	136.6	136.1	95.0	47.3	38.3	39.0	38.9	20.7	18.5	17.2
POWER																	
AVE POWER MW		121	123	127	255	375	375	375	374	358	346	298	285	274	152	140	137
PEAK POW MW		351	356	372	375	375	375	375	361	348	339	314	301	285	294	319	339
ENERGY GWH	2416.5	43.6	20.7	27.4	183.9	279.0	270.0	279.0	278.3	257.5	257.1	107.2	48.0	52.7	112.8	104.2	95.2
--GAVINS POINT--																	
NAT INFLOW	1999	190	88	114	134	17	301	266	270	159	77	42	19	22	90	90	120
DEPLETION	114	0	0	0	5	19	24	39	10	-5	2	5	2	3	10	1	
CHAN STOR	-9	2	0	0	-27	-55	-135	-17	1	78	88	17	-1	0	34	4	2
EVAPORATION	36							2	6	9	8	3	2	2	4		
REG INFLOW	46579	628	292	375	1803	3462	7736	8608	8621	5886	3062	1190	555	635	1383	1230	1112
RELEASE	46576	625	292	375	1803	3462	7736	8608	8608	5861	3062	1190	555	635	1383	1230	1150
STOR CHANGE	3	3							13	25							-38
STORAGE	339	342	342	342	342	342	342	342	355	380	380	380	380	380	380	380	342
ELEV FTMSL	1205.9	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1206.0
DISCH KCFS	20.7	21.0	21.0	21.0	30.3	56.3	130.0	140.0	140.0	98.5	49.8	40.0	40.0	40.0	22.5	20.0	20.0
POWER																	
AVE POWER MW		72	72	72	102	111	95	93	93	104	115	116	116	116	76	70	69
PEAK POW MW		114	114	114	114	111	95	93	94	106	115	116	116	116	78	78	76
ENERGY GWH	817.3	26.0	12.2	15.6	73.1	82.2	68.1	69.1	69.5	74.7	85.9	41.9	19.6	22.4	56.7	52.0	48.3
--GAVINS POINT - SIOUX CITY--																	
NAT INFLOW	9312	558	260	334	2081	1603	1092	1336	551	252	286	152	71	81	255	200	200
DEPLETION	266	7	3	4	22	36	31	39	36	24	11	6	3	3	13	14	14
REGULATED FLOW AT SIOUX CITY																	
KAF	55622	1176	549	705	3862	5029	8797	9905	9123	6089	3337	1336	624	713	1625	1416	1336
KCFS		39.5	39.5	39.5	64.9	81.8	147.8	161.1	148.4	102.3	54.3	44.9	44.9	44.9	26.4	23.0	23.2
--TOTAL--																	
NAT INFLOW	60022	3220	1502	1931	7713	10469	13836	10005	3231	1411	1637	630	294	336	1368	1150	1290
DEPLETION	3258	71	33	43	-47	355	1254	2154	218	-282	41	-145	-68	-77	-78	-124	-90
CHAN STOR	-3	42	0	7	-102	-158	-548	79	68	283	212	17	-1	21	101	-26	2
EVAPORATION	1813							121	370	441	370	164	76	86	185		
STORAGE	56562	58578	59498	60688	64484	69411	72648	70551	64139	59585	57686	56978	56639	56275	56010	55842	55888
SYSTEM POWER																	
AVE POWER MW		802	805	1032	1342	2141	2192	2250	2316	2223	1776	1436	1445	1396	1026	1099	1073
PEAK POW MW		2345	2352	2331	2326	2279	2196	2241	2284	2303	2313	2300	2287	2270	2239	2262	2271
ENERGY GWH	14459.0	288.7	135.2	223.0	966.4	1593.3	1578.6	1673.7	1722.8	1600.7	1321.1	516.9	242.7	268.0	763.5	817.5	746.9
DAILY GWH		19.2	19.3	24.8	32.2	51.4	52.6	54.0	55.6	53.4	42.6	34.5	34.7	33.5	24.6	26.4	25.8
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB

VALUES IN 1000 AF EXCEPT AS INDICATED

31DEC10		2010	2011
	INI-SUM	31JAN	28FEB
--FORT PECK--			
NAT INFLOW	1011	431	580
DEPLETION	-192	-78	-114
EVAPORATION			
MOD INFLOW	1203	509	694
RELEASE	1109	553	555
STOR CHANGE	94	-44	139
STORAGE	14138	14094	14232
ELEV FTMSL	2230.9	2230.6	2231.3
DISCH KCFS	7.8	9.0	10.0
POWER			
AVE POWER MW		121	135
PEAK POW MW		160	160
ENERGY GWH	180.8	90.3	90.5
--GARRISON--			
NAT INFLOW	756	299	457
DEPLETION	-73	-32	-41
CHAN STOR	-22	-12	-10
EVAPORATION			
REG INFLOW	1916	872	1043
RELEASE	2920	1476	1444
STOR CHANGE	-1004	-603	-401
STORAGE	17165	16562	16161
ELEV FTMSL	1834.4	1832.3	1830.9
DISCH KCFS	17.8	24.0	26.0
POWER			
AVE POWER MW		290	310
PEAK POW MW		449	444
ENERGY GWH	423.8	215.5	208.3
--OAHE--			
NAT INFLOW	438	120	318
DEPLETION	173	80	93
CHAN STOR	-33	-25	-8
EVAPORATION			
REG INFLOW	3151	1490	1661
RELEASE	1602	578	1024
STOR CHANGE	1549	912	637
STORAGE	17866	18778	19415
ELEV FTMSL	1604.3	1607.3	1609.3
DISCH KCFS	24.8	9.4	18.4
POWER			
AVE POWER MW		121	239
PEAK POW MW		707	718
ENERGY GWH	250.8	89.9	160.9
--BIG BEND--			
EVAPORATION			
REG INFLOW	1602	578	1024
RELEASE	1612	588	1024
STORAGE	1631	1621	1621
ELEV FTMSL	1420.2	1420.0	1420.0
DISCH KCFS	22.4	9.6	18.4
POWER			
AVE POWER MW		47	88
PEAK POW MW		538	529
ENERGY GWH	94.6	35.1	59.4
--FORT RANDALL--			
NAT INFLOW	303	86	217
DEPLETION	-6	-3	-3
EVAPORATION			
REG INFLOW	1921	677	1244
RELEASE	1921	1051	870
STOR CHANGE		-374	374
STORAGE	3124	2750	3124
ELEV FTMSL	1350.0	1344.8	1350.0
DISCH KCFS	22.8	17.1	15.7
POWER			
AVE POWER MW		136	125
PEAK POW MW		318	339
ENERGY GWH	184.9	101.1	83.8
--GAVINS POINT--			
NAT INFLOW	303	67	236
DEPLETION	-1	1	-2
CHAN STOR	13	10	3
EVAPORATION			
REG INFLOW	2238	1128	1111
RELEASE	2287	1138	1150
STOR CHANGE	-49	-10	-39
STORAGE	388	378	339
ELEV FTMSL	1207.8	1207.4	1205.9
DISCH KCFS	25.2	18.5	20.7
POWER			
AVE POWER MW		65	72
PEAK POW MW		117	114
ENERGY GWH	97.2	48.7	48.5
--GAVINS POINT - SIOUX CITY--			
NAT INFLOW	797	273	524
DEPLETION	-26	-12	-14
REGULATED FLOW AT SIOUX CITY			
KAF	3110	1423	1688
KCFS		23.1	30.4
--TOTAL--			
NAT INFLOW	3608	1276	2332
DEPLETION	-125	-44	-81
CHAN STOR	-42	-27	-15
EVAPORATION			
STORAGE	54312	54182	54892
SYSTEM POWER			
AVE POWER MW		780	969
PEAK POW MW		2289	2303
ENERGY GWH	1232.0	580.6	651.4
DAILY GWH		18.7	23.3
	INI-SUM	31JAN	28FEB

TIME OF STUDY 16:10:58 STARTING POOL: 3.2 FT BLW TOP OF CONS /120K MAX RELEASE STUDY NO 2

VALUES IN 1000 AF EXCEPT AS INDICATED

28FEB11			2011											2012			
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB
--FORT PECK--																	
NAT INFLOW	13768	508	237	304	895	2871	4035	2093	538	260	405	207	97	110	428	400	380
DEPLETION	-24	-24	-11	-14	-18	62	462	508	-36	-327	-210	-77	-36	-41	-91	-86	-85
EVAPORATION	489							31	98	120	102	45	21	23	50		
MOD INFLOW	13303	531	248	319	913	2809	3573	1554	476	467	513	239	112	128	469	486	465
RELEASE	13407	223	104	134	893	922	1904	1660	1414	1263	1230	595	278	317	922	799	748
STOR CHANGE	-105	308	144	185	20	1887	1669	-107	-938	-796	-716	-356	-166	-189	-453	-313	-283
STORAGE	14232	14541	14684	14869	14889	16776	18445	18338	17400	16604	15887	15532	15366	15177	14724	14410	14128
ELEV FTMSL	2231.3	2232.8	2233.5	2234.4	2234.5	2243.0	2249.9	2249.4	2245.6	2242.2	2239.1	2237.5	2236.7	2235.8	2233.7	2232.2	2230.8
DISCH KCFS	10.0	7.5	7.5	7.5	15.0	15.0	32.0	27.0	23.0	21.2	20.0	20.0	20.0	20.0	15.0	13.0	13.0
POWER																	
AVE POWER MW		102	102	102	162	165	170	172	171	169	166	165	164	163	163	161	160
PEAK POW MW		161	162	162	162	169	172	172	170	167	165	164	163	163	162	161	160
ENERGY GWH	1409.0	36.6	17.1	22.1	116.8	123.1	122.0	128.2	127.3	121.4	123.8	59.3	27.5	31.3	120.9	120.1	111.6
--GARRISON--																	
NAT INFLOW	24809	758	354	455	2748	4414	6467	5560	1374	515	704	194	90	103	393	300	380
DEPLETION	1403	23	11	14	-43	-100	733	1399	-39	-239	8	-87	-41	-46	-58	-77	-55
CHAN STOR	-30	26		0	-76		-161	46	37	17	12			0	50	20	
EVAPORATION	537							37	113	132	108	47	22	25	54		
REG INFLOW	36246	984	447	575	3608	5436	7477	5830	2751	1902	1830	828	387	442	1369	1196	1183
RELEASE	35252	655	305	393	1190	3074	5474	5595	5227	4272	2460	1190	555	476	1291	1599	1496
STOR CHANGE	994	329	142	182	2418	2362	2003	235	-2476	-2370	-630	-362	-169	-34	78	-402	-313
STORAGE	16161	16490	16632	16814	19231	21593	23596	23831	21356	18986	18357	17994	17826	17792	17870	17467	17155
ELEV FTMSL	1830.9	1832.0	1832.5	1833.1	1841.0	1847.9	1853.4	1854.0	1847.3	1840.3	1838.3	1837.1	1836.6	1836.5	1836.7	1835.4	1834.3
DISCH KCFS	26.0	22.0	22.0	22.0	20.0	50.0	92.0	91.0	85.0	71.8	40.0	40.0	40.0	30.0	21.0	26.0	26.0
POWER																	
AVE POWER MW		263	264	265	248	499	501	503	501	483	475	469	466	368	259	319	317
PEAK POW MW		448	450	452	481	501	503	504	499	470	471	467	465	464	465	460	456
ENERGY GWH	3523.1	94.5	44.4	57.2	178.4	371.0	360.8	374.5	373.0	347.7	353.2	168.8	78.2	70.7	192.8	237.3	220.3
--OAHE--																	
NAT INFLOW	6846	874	408	524	1617	1259	1009	393	210	67	151	27	13	14	105	75	100
DEPLETION	1419	64	30	38	-17	329	-8	151	232	258	229	7	3	4	45	21	33
CHAN STOR	32	16	0	0	7	-105	-147	3	21	49	128			42	38	-21	
EVAPORATION	511							36	108	126	100	44	21	24	52		
REG INFLOW	40200	1480	683	879	2831	3899	6345	5805	5117	4005	2409	1166	544	505	1337	1632	1563
RELEASE	41760	396	183	485	1929	3706	5727	6839	6718	6068	4248	627	421	480	1272	1406	1257
STOR CHANGE	-1560	1084	501	394	903	193	618	-1034	-1600	-2063	-1839	539	123	25	65	226	306
STORAGE	19415	20500	21000	21394	22297	22490	23108	22074	20474	18411	16571	17110	17234	17259	17324	17550	17856
ELEV FTMSL	1609.3	1612.6	1614.1	1615.2	1617.7	1618.2	1619.9	1617.1	1612.5	1606.1	1599.8	1601.7	1602.2	1602.2	1602.5	1603.2	1604.3
DISCH KCFS	18.4	13.3	13.2	27.1	32.4	60.3	96.2	111.2	109.3	102.0	69.1	21.1	30.3	30.2	20.7	22.9	21.9
POWER																	
AVE POWER MW		175	176	363	436	762	759	752	733	707	681	262	378	378	260	288	276
PEAK POW MW		735	742	748	761	763	763	745	722	689	664	677	680	680	681	685	691
ENERGY GWH	4549.1	63.2	29.5	78.4	314.1	566.8	546.2	559.4	545.6	508.8	506.8	94.5	63.6	72.6	193.3	214.0	192.4
--BIG BEND--																	
EVAPORATION	103							6	20	25	22	10	5	5	11		
REG INFLOW	41657	396	183	485	1929	3706	5727	6833	6698	6043	4227	617	416	475	1261	1406	1257
RELEASE	41657	396	183	485	1929	3706	5727	6833	6698	6043	4227	617	416	475	1261	1406	1257
STORAGE	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621
ELEV FTMSL	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0
DISCH KCFS	18.4	13.3	13.2	27.1	32.4	60.3	96.2	111.1	108.9	101.6	68.7	20.8	30.0	29.9	20.5	22.9	21.9
POWER																	
AVE POWER MW		63	62	120	131	219	340	349	371	439	325	103	149	149	103	112	105
PEAK POW MW		517	509	464	406	349	349	349	371	464	528	538	538	538	538	538	529
ENERGY GWH	1978.0	22.7	10.4	26.0	94.1	162.8	245.0	259.4	276.4	316.0	241.5	37.1	25.1	28.6	76.6	83.4	72.9
--FORT RANDALL--																	
NAT INFLOW	3288	332	155	199	238	305	932	357	288	158	14	9	4	5	97	85	110
DEPLETION	80	1	1	1	4	9	12	18	15	7	1	1	0	1	3	3	3
EVAPORATION	129							9	29	35	27	10	4	5	10		
REG INFLOW	44737	727	337	683	2163	4002	6647	7163	6942	6159	4213	615	415	474	1346	1488	1364
RELEASE	44736	436	203	261	1701	3519	6647	7163	7137	6909	5060	1176	538	617	1242	1138	990
STOR CHANGE	1	291	134	422	462	483	0	0	-195	-750	-847	-561	-123	-143	104	350	374
STORAGE	3124	3415	3549	3971	4433	4916	4916	4916	4721	3971	3124	2563	2440	2297	2401	2751	3125
ELEV FTMSL	1350.0	1353.6	1355.2	1360.0	1365.0	1370.0	1370.0	1370.0	1368.0	1360.0	1350.0	1342.0	1340.0	1337.5	1339.3	1344.8	1350.0
DISCH KCFS	15.7	14.6	14.6	14.6	28.6	57.2	111.7	116.5	116.1	116.1	82.3	39.5	38.8	38.9	20.2	18.5	17.2
POWER																	
AVE POWER MW		121	123	127	255	375	375	375	375	374	350	299	280	273	148	140	137
PEAK POW MW		351	356	372	375	375	375	375	375	361	333	305	297	285	294	319	339
ENERGY GWH	2428.8	43.6	20.7	27.4	183.9	279.0	270.0	279.0	279.0	269.3	260.2	107.7	47.0	52.4	110.0	104.3	95.2
--GAVINS POINT--																	
NAT INFLOW	1999	190	88	114	134	17	301	266	270	159	77	42	19	22	90	90	120
DEPLETION	114	0	0	0	5	19	24	39	10	-5	2	5	2	3	10	1	
CHAN STOR	-9	2	0	0	-27	-55	-104	-9	1	0	63	79	1	0	35	3	2
EVAPORATION	36							2	6	9	8	3	2	2	4		
REG INFLOW	46576	628	292	375	1803	3462	6819	7379	7392	7064	5190	1288	555	635	1353	1230	1112
RELEASE	46573	625	292	375	1803	3462	6819	7379	7379	7039	5190	1288	555	635	1353	1230	1150
STOR CHANGE	3	3							13	25							-38
STORAGE	339	342	342	342	342	342	342	342	355	380	380	380	380	380	380	380	342
ELEV FTMSL	1205.9	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1206.0
DISCH KCFS	20.7	21.0	21.0	21.0	30.3	56.3	114.6	120.0	120.0	118.3	84.4	43.3	40.0	40.0	22.0	20.0	20.0
POWER																	
AVE POWER MW		72	72	72	102	111	97	96	97	99	109	116	116	116	75	70	69
PEAK POW MW		114	114	114	114	111	97	96	97	101	109	116	116	116	78	78	76
ENERGY GWH	814.8	26.0	12.2	15.6	73.1	82.2	69.7	71.6	71.9	71.1	81.5	41.8	19.6	22.4	55.8	52.0	48.3
--GAVINS POINT - SIOUX CITY--																	
NAT INFLOW	9312	558	260	334	2081	1603	1092	1336	551	252	286	152	71	81	255	200	200
DEPLETION	266	7	3	4	22	36	31	39	36	24	11	6	3	3	13	14	14
REGULATED FLOW AT SIOUX CITY																	
KAF	55619	1176	549	705	3862	5029	7880	8676	7894	7267	5465	1434	623	713	1595	1416	1336
KCFS		39.5	39.5	39.5	64.9	81.8	132.4	141.1	128.4	122.1	88.9	48.2	44.9	44.9	25.9	23.0	23.2
--TOTAL--																	
NAT INFLOW	60022	3220	1502	1931	7713	10469	13836	10005	3231	1411	1637	630	294	336	1368	1150	1290
DEPLETION	3258	71	33	43	-47	355	1254	2154	218	-282	41	-145	-68	-77	-78	-124	-90
CHAN STOR	-6	43	0	0	-95	-160	-412	40	59	66	203	79	1	42	123	2	2
EVAPORATION	1805							122	374	446	366	160	74	84	181		
STORAGE	54892	56908	57828	59011	62814	67739	72028	71123	65927	59972	55940	55200	54866	54525	54319	54179	54225
SYSTEM POWER																	
AVE POWER MW		796	799	1049	1334	2130	2241	2247	2249	2270	2106	1414	1553	1448	1007	1090	1064
PEAK POW MW		2326	2333	2313	2300	2268	2259	2240	2234	2252	2271	2267	2259	2247	2218	2241	2251
ENERGY GWH	14702.8	286.6	134.2	226.6	960.5	1584.9	1613.7	1672.1	1673.3	1634.4	1566.9	509.2	261.0	278.1	749.4	811.1	740.7
DAILY GWH		19.1	19.2	25.2	32.0	51.1	53.8	53.9	54.0	54.5	50.5	33.9	37.3	34.8	24.2	26.2	25.5
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB

VALUES IN 1000 AF EXCEPT AS INDICATED

31DEC10 2010 2011

	INI-SUM	31JAN	28FEB
--FORT PECK--			
NAT INFLOW	1011	431	580
DEPLETION	-192	-78	-114
EVAPORATION			
MOD INFLOW	1203	509	694
RELEASE	1109	553	555
STOR CHANGE	94	-44	139
STORAGE	13610	13566	13704
ELEV FTMSL	2228.2	2228.0	2228.7
DISCH KCFS	7.8	9.0	10.0
POWER			
AVE POWER MW		120	134
PEAK POW MW		158	158
ENERGY GWH	179.3	89.6	89.7
--GARRISON--			
NAT INFLOW	756	299	457
DEPLETION	-73	-32	-41
CHAN STOR	-22	-12	-10
EVAPORATION			
REG INFLOW	1915	872	1043
RELEASE	2920	1476	1444
STOR CHANGE	-1004	-604	-401
STORAGE	16429	15825	15425
ELEV FTMSL	1831.8	1829.7	1828.2
DISCH KCFS	17.8	24.0	26.0
POWER			
AVE POWER MW		285	305
PEAK POW MW		439	434
ENERGY GWH	416.7	212.0	204.8
--OAHE--			
NAT INFLOW	438	120	318
DEPLETION	173	80	93
CHAN STOR	-34	-26	-8
EVAPORATION			
REG INFLOW	3150	1490	1661
RELEASE	1602	578	1024
STOR CHANGE	1548	912	637
STORAGE	17112	18024	18660
ELEV FTMSL	1601.7	1604.8	1606.9
DISCH KCFS	24.8	9.4	18.4
POWER			
AVE POWER MW		119	236
PEAK POW MW		694	705
ENERGY GWH	247.5	88.7	158.8
--BIG BEND--			
EVAPORATION			
REG INFLOW	1602	578	1024
RELEASE	1612	588	1024
STORAGE	1631	1621	1621
ELEV FTMSL	1420.2	1420.0	1420.0
DISCH KCFS	22.4	9.6	18.4
POWER			
AVE POWER MW		47	88
PEAK POW MW		538	529
ENERGY GWH	94.6	35.1	59.4
--FORT RANDALL--			
NAT INFLOW	303	86	217
DEPLETION	-6	-3	-3
EVAPORATION			
REG INFLOW	1921	677	1244
RELEASE	1921	1051	870
STOR CHANGE		-374	374
STORAGE	3124	2750	3124
ELEV FTMSL	1350.0	1344.8	1350.0
DISCH KCFS	22.8	17.1	15.7
POWER			
AVE POWER MW		136	125
PEAK POW MW		318	339
ENERGY GWH	184.9	101.1	83.8
--GAVINS POINT--			
NAT INFLOW	303	67	236
DEPLETION	-1	1	-2
CHAN STOR	13	10	3
EVAPORATION			
REG INFLOW	2238	1128	1111
RELEASE	2287	1138	1150
STOR CHANGE	-49	-10	-39
STORAGE	388	378	339
ELEV FTMSL	1207.8	1207.4	1205.9
DISCH KCFS	25.2	18.5	20.7
POWER			
AVE POWER MW		65	72
PEAK POW MW		117	114
ENERGY GWH	97.2	48.7	48.5
--GAVINS POINT - SIOUX CITY--			
NAT INFLOW	797	273	524
DEPLETION	-26	-12	-14
REGULATED FLOW AT SIOUX CITY			
KAF	3110	1423	1688
KCFS		23.1	30.4
--TOTAL--			
NAT INFLOW	3608	1276	2332
DEPLETION	-125	-44	-81
CHAN STOR	-44	-28	-16
EVAPORATION			
STORAGE	52294	52164	52873
SYSTEM POWER			
AVE POWER MW		773	960
PEAK POW MW		2264	2279
ENERGY GWH	1220.1	575.1	645.0
DAILY GWH		18.6	23.0
	INI-SUM	31JAN	28FEB

TIME OF STUDY 16:09:08 STARTING POOL: 5.7 FT BLW TOP OF CONS /100K MAX RELEASE STUDY NO 3

VALUES IN 1000 AF EXCEPT AS INDICATED

28FEB11		2011												2012			
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB
--FORT PECK--																	
NAT INFLOW	13768	508	237	304	895	2871	4035	2093	538	260	405	207	97	110	428	400	380
DEPLETION	-24	-24	-11	-14	-18	62	462	508	-36	-327	-210	-77	-36	-41	-91	-86	-85
EVAPORATION	486							31	98	120	101	44	20	23	49		
MOD INFLOW	13306	531	248	319	913	2809	3573	1554	476	467	514	240	112	129	470	486	465
RELEASE	13391	223	104	134	893	922	1428	1476	1476	1423	1414	655	305	349	922	861	805
STOR CHANGE	-85	308	144	185	20	1887	2145	78	-1000	-956	-900	-415	-193	-221	-452	-375	-340
STORAGE	13704	14013	14156	14341	14361	16248	18393	18471	17471	16515	15615	15200	15007	14787	14334	13960	13619
ELEV FTMSL	2228.7	2230.2	2230.9	2231.8	2231.9	2240.7	2249.7	2250.0	2245.9	2241.8	2237.8	2235.9	2235.0	2234.0	2231.8	2230.0	2228.3
DISCH KCFS	10.0	7.5	7.5	7.5	15.0	15.0	24.0	24.0	24.0	23.9	23.0	22.0	22.0	22.0	15.0	14.0	14.0
POWER																	
AVE POWER MW		101	101	101	160	164	169	173	171	168	165	163	162	162	161	160	158
PEAK POW MW		159	160	161	160	167	173	173	170	167	164	163	162	161	160	159	158
ENERGY GWH	1400.8	36.3	17.0	21.9	115.5	121.7	121.9	128.5	127.5	121.2	123.1	58.8	27.3	31.0	119.9	118.9	110.3
--GARRISON--																	
NAT INFLOW	24809	758	354	455	2748	4414	6467	5560	1374	515	704	194	90	103	393	300	380
DEPLETION	1403	23	11	14	-43	-100	733	1399	-39	-239	8	-87	-41	-46	-58	-77	-55
CHAN STOR	-38	26		0	-77		-86			1	9	10	0	0	70	10	
EVAPORATION	546							37	114	135	112	48	22	25	53		
REG INFLOW	36213	984	447	575	3607	5436	7076	5600	2775	2042	2008	896	414	474	1390	1248	1240
RELEASE	35219	655	305	446	1785	2767	4582	4796	4612	4114	3074	1488	694	793	1537	1845	1726
STOR CHANGE	994	330	142	128	1822	2669	2494	804	-1837	-2071	-1067	-591	-280	-320	-147	-597	-485
STORAGE	15425	15754	15896	16024	17846	20515	23009	23813	21976	19905	18838	18247	17967	17648	17500	16904	16418
ELEV FTMSL	1828.2	1829.4	1829.9	1830.4	1836.6	1844.9	1851.8	1854.0	1849.0	1843.1	1839.8	1837.9	1837.0	1836.0	1835.5	1833.5	1831.8
DISCH KCFS	26.0	22.0	22.0	25.0	30.0	45.0	77.0	78.0	75.0	69.1	50.0	50.0	50.0	50.0	25.0	30.0	30.0
POWER																	
AVE POWER MW		258	260	295	361	479	500	504	503	499	480	471	465	462	306	364	359
PEAK POW MW		439	440	442	465	499	503	504	501	481	474	467	464	460	461	453	447
ENERGY GWH	3726.8	92.9	43.6	63.8	260.2	356.2	360.1	374.6	374.0	359.2	357.2	169.4	78.2	88.7	227.9	270.6	250.1
--OAHE--																	
NAT INFLOW	6846	874	408	524	1617	1259	1009	393	210	67	151	27	13	14	105	75	100
DEPLETION	1419	64	30	38	-17	329	-8	151	232	258	229	7	3	4	45	21	33
CHAN STOR	11	16	0	-11	-19	-52	-111	-3	11	21	73				109	-22	
EVAPORATION	526							36	111	134	108	45	20	23	49		
REG INFLOW	40130	1481	683	921	3401	3645	5487	4999	4489	3809	2961	1463	683	781	1658	1877	1793
RELEASE	41695	396	183	485	1467	3685	5189	5604	5200	5270	5272	2269	1182	1110	1736	1391	1257
STOR CHANGE	-1565	1085	501	436	1934	-40	298	-605	-711	-1460	-2311	-806	-499	-329	-79	485	535
STORAGE	18660	19745	20246	20682	22616	22576	22874	22269	21558	20098	17787	16981	16482	16153	16075	16560	17095
ELEV FTMSL	1606.9	1610.3	1611.9	1613.1	1618.6	1618.5	1619.3	1617.6	1615.7	1611.4	1604.1	1601.3	1599.5	1598.3	1598.0	1599.8	1601.7
DISCH KCFS	18.4	13.3	13.2	27.1	24.6	59.9	87.2	91.1	84.6	88.6	85.7	76.3	85.1	70.0	28.2	22.6	21.9
POWER																	
AVE POWER MW		173	174	359	332	765	760	757	749	732	702	678	663	660	346	279	272
PEAK POW MW		723	731	737	765	764	762	752	744	721	682	670	659	657	658	667	677
ENERGY GWH	4829.2	62.4	29.2	77.5	238.8	568.9	547.0	562.9	557.2	526.9	522.5	244.0	111.4	126.6	257.1	207.3	189.3
--BIG BEND--																	
EVAPORATION	103							6	20	25	22	10	5	5	11		
REG INFLOW	41592	396	183	485	1467	3685	5189	5598	5180	5245	5251	2259	1177	1105	1725	1391	1257
RELEASE	41592	396	183	485	1467	3685	5189	5598	5180	5245	5251	2259	1177	1105	1725	1391	1257
STORAGE	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621
ELEV FTMSL	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0
DISCH KCFS	18.4	13.3	13.2	27.1	24.6	59.9	87.2	91.0	84.2	88.1	85.4	75.9	84.8	69.6	28.1	22.6	21.9
POWER																	
AVE POWER MW		63	62	120	109	241	313	324	338	388	404	368	410	339	140	111	105
PEAK POW MW		517	509	464	464	406	349	349	406	464	528	538	538	538	538	538	529
ENERGY GWH	2141.1	22.7	10.4	26.0	78.6	179.5	225.1	241.4	251.5	279.3	300.5	132.6	68.9	65.1	104.2	82.5	72.9
--FORT RANDALL--																	
NAT INFLOW	3288	332	155	199	238	305	932	357	288	158	14	9	4	5	97	85	110
DEPLETION	80	1	1	1	4	9	12	18	15	7	1	1	0	1	3	3	3
EVAPORATION	127							9	28	34	27	10	4	4	10		
REG INFLOW	44675	727	337	683	1701	3981	6109	5927	5425	5361	5236	2253	1177	1106	1814	1473	1364
RELEASE	44674	436	203	261	1701	3519	5626	5927	5908	5823	6084	2942	1293	1132	1706	1123	990
STOR CHANGE	0	291	134	422		462	483	0	-483	-462	-847	-689	-116	-26	108	350	374
STORAGE	3124	3415	3549	3971	3971	4433	4916	4916	4433	3971	3124	2435	2319	2293	2400	2750	3124
ELEV FTMSL	1350.0	1353.6	1355.2	1360.0	1360.0	1365.0	1370.0	1370.0	1365.0	1360.0	1350.0	1339.9	1337.9	1337.4	1339.3	1344.8	1350.0
DISCH KCFS	15.7	14.6	14.6	14.6	28.6	57.2	94.5	96.4	96.1	97.9	98.9	98.9	93.1	71.4	27.8	18.3	17.2
POWER																	
AVE POWER MW		121	123	127	250	375	375	375	375	372	347	308	281	280	202	138	137
PEAK POW MW		351	356	372	372	375	375	375	375	364	330	284	276	279	294	319	339
ENERGY GWH	2465.4	43.6	20.7	27.4	180.3	279.0	270.0	279.0	279.0	267.9	258.2	110.8	47.2	53.8	150.3	103.0	95.3
--GAVINS POINT--																	
NAT INFLOW	1999	190	88	114	134	17	301	266	270	159	77	42	19	22	90	90	120
DEPLETION	114	0	0	0	5	19	24	39	10	-5	2	5	2	3	10	1	
CHAN STOR	-8	2	0	0	-27	-55	-72	-4	1	-3	-2	0	11	40	81	18	2
EVAPORATION	36							2	6	9	8	3	2	2	4		
REG INFLOW	46515	628	292	375	1803	3462	5831	6149	6162	5976	6149	2975	1319	1190	1863	1230	1112
RELEASE	46512	625	292	375	1803	3462	5831	6149	6149	5951	6149	2975	1319	1190	1863	1230	1150
STOR CHANGE	3	3							13	25							-38
STORAGE	339	342	342	342	342	342	342	342	355	380	380	380	380	380	380	380	342
ELEV FTMSL	1205.9	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1206.0
DISCH KCFS	20.7	21.0	21.0	21.0	30.3	56.3	98.0	100.0	100.0	100.0	100.0	100.0	95.0	75.0	30.3	20.0	20.0
POWER																	
AVE POWER MW		72	72	72	102	111	100	99	100	103	105	105	107	112	78	70	69
PEAK POW MW		114	114	114	114	111	100	99	101	105	105	105	107	112	78	78	76
ENERGY GWH	818.3	26.0	12.2	15.6	73.1	82.2	71.9	73.9	74.6	74.4	78.4	37.9	17.9	21.5	58.4	52.0	48.3
--GAVINS POINT - SIOUX CITY--																	
NAT INFLOW	9312	558	260	334	2081	1603	1092	1336	551	252	286	152	71	81	255	200	200
DEPLETION	266	7	3	4	22	36	31	39	36	24	11	6	3	3	13	14	14
REGULATED FLOW AT SIOUX CITY																	
KAF	55558	1176	549	705	3862	5029	6892	7446	6664	6179	6424	3121	1387	1268	2105	1416	1336
KCFS		39.5	39.5	39.5	64.9	81.8	115.8	121.1	108.4	103.8	104.5	104.9	99.9	79.9	34.2	23.0	23.2
--TOTAL--																	
NAT INFLOW	60022	3220	1502	1931	7713	10469	13836	10005	3231	1411	1637	630	294	336	1368	1150	1290
DEPLETION	3258	71	33	43	-47	355	1254	2154	218	-282	41	-145	-68	-77	-78	-124	-90
CHAN STOR	-34	44	0	-11	-122	-107	-269	-7	11	19	79	6	11	42	265	6	2
EVAPORATION	1825							121	378	458	376	161	73	82	176		
STORAGE	52873	54890	55810	56981	60757	65735	71156	71432	67415	62490	57365	54864	53776	52881	52311	52175	52220
SYSTEM POWER																	
AVE POWER MW		789	792	1075	1315	2134	2217	2232	2236	2262	2204	2093	2089	2014	1234	1121	1101
PEAK POW MW		2303	2311	2290	2341	2322	2261	2253	2296	2301	2284	2227	2206	2207	2189	2215	2226
ENERGY GWH	15381.6	283.9	133.0	232.2	946.5	1587.7	1596.0	1660.3	1663.8	1629.0	1639.8	753.5	350.9	386.7	917.8	834.3	766.2
DAILY GWH		18.9	19.0	25.8	31.5	51.2	53.2	53.6	53.7	54.3	52.9	50.2	50.1	48.3	29.6	26.9	26.4
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB

VALUES IN 1000 AF EXCEPT AS INDICATED

31DEC10	INI-SUM	2010 31JAN	2011 28FEB
--FORT PECK--			
NAT INFLOW	1011	431	580
DEPLETION	-192	-78	-114
EVAPORATION			
MOD INFLOW	1203	509	694
RELEASE	1109	553	555
STOR CHANGE	94	-44	139
STORAGE	13610	13566	13704
ELEV FTMSL	2228.2	2228.0	2228.7
DISCH KCFS	7.8	9.0	10.0
POWER			
AVE POWER MW		120	134
PEAK POW MW		158	158
ENERGY GWH	179.3	89.6	89.7
--GARRISON--			
NAT INFLOW	756	299	457
DEPLETION	-73	-32	-41
CHAN STOR	-22	-12	-10
EVAPORATION			
REG INFLOW	1915	872	1043
RELEASE	2920	1476	1444
STOR CHANGE	-1004	-604	-401
STORAGE	16429	15825	15425
ELEV FTMSL	1831.8	1829.7	1828.2
DISCH KCFS	17.8	24.0	26.0
POWER			
AVE POWER MW		285	305
PEAK POW MW		439	434
ENERGY GWH	416.7	212.0	204.8
--OAHE--			
NAT INFLOW	438	120	318
DEPLETION	173	80	93
CHAN STOR	-34	-26	-8
EVAPORATION			
REG INFLOW	3150	1490	1661
RELEASE	2608	1047	1561
STOR CHANGE	542	442	100
STORAGE	17112	17554	17654
ELEV FTMSL	1601.7	1603.3	1603.6
DISCH KCFS	24.8	17.0	28.1
POWER			
AVE POWER MW		214	354
PEAK POW MW		685	687
ENERGY GWH	397.5	159.5	238.0
--BIG BEND--			
EVAPORATION			
REG INFLOW	2608	1047	1561
RELEASE	2618	1057	1561
STORAGE	1631	1621	1621
ELEV FTMSL	1420.2	1420.0	1420.0
DISCH KCFS	22.4	17.2	28.1
POWER			
AVE POWER MW		85	134
PEAK POW MW		538	528
ENERGY GWH	153.3	62.9	90.3
--FORT RANDALL--			
NAT INFLOW	303	86	217
DEPLETION	-6	-3	-3
EVAPORATION			
REG INFLOW	2927	1146	1781
RELEASE	2927	1520	1407
STOR CHANGE		-374	374
STORAGE	3124	2750	3124
ELEV FTMSL	1350.0	1344.8	1350.0
DISCH KCFS	22.8	24.7	25.3
POWER			
AVE POWER MW		196	200
PEAK POW MW		318	339
ENERGY GWH	280.1	145.5	134.6
--GAVINS POINT--			
NAT INFLOW	303	67	236
DEPLETION	-1	1	-2
CHAN STOR	-5	-4	-1
EVAPORATION			
REG INFLOW	3226	1583	1644
RELEASE	3275	1593	1683
STOR CHANGE	-49	-10	-39
STORAGE	388	378	339
ELEV FTMSL	1207.8	1207.4	1205.9
DISCH KCFS	25.2	25.9	30.3
POWER			
AVE POWER MW		91	103
PEAK POW MW		117	114
ENERGY GWH	136.7	67.7	69.1
--GAVINS POINT - SIOUX CITY--			
NAT INFLOW	797	273	524
DEPLETION	-26	-12	-14
REGULATED FLOW AT SIOUX CITY			
KAF	4098	1878	2221
KCFS		30.5	40.0
--TOTAL--			
NAT INFLOW	3608	1276	2332
DEPLETION	-125	-44	-81
CHAN STOR	-62	-42	-20
EVAPORATION			
STORAGE	52294	51695	51867
SYSTEM POWER			
AVE POWER MW		991	1230
PEAK POW MW		2256	2261
ENERGY GWH	1563.6	737.1	826.5
DAILY GWH		23.8	29.5
	INI-SUM	31JAN	28FEB

TIME OF STUDY 16:13:02 STARTING POOL: 5.7 FT BLW TOP OF CONS / JAN-MAY HIST PEAK MON RELEASE STUDY NO 4

VALUES IN 1000 AF EXCEPT AS INDICATED

28FEB11			2011											2012			
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB
--FORT PECK--																	
NAT INFLOW	13768	508	237	304	895	2871	4035	2093	538	260	405	207	97	110	428	400	380
DEPLETION	-24	-24	-11	-14	-18	62	462	508	-36	-327	-210	-77	-36	-41	-91	-86	-85
EVAPORATION	486							31	98	120	101	44	20	23	49		
MOD INFLOW	13306	531	248	319	913	2809	3573	1554	476	467	514	240	112	129	470	486	465
RELEASE	13388	223	104	134	893	922	1428	1476	1476	1420	1414	655	305	349	922	861	805
STOR CHANGE	-82	308	144	185	20	1887	2145	78	-1000	-954	-900	-415	-193	-221	-452	-375	-340
STORAGE	13704	14013	14156	14341	14361	16248	18393	18471	17471	16517	15617	15203	15010	14789	14337	13962	13622
ELEV FTMSL	2228.7	2230.2	2230.9	2231.8	2231.9	2240.7	2249.7	2250.0	2245.9	2241.9	2237.8	2235.9	2235.0	2234.0	2231.8	2230.0	2228.3
DISCH KCFS	10.0	7.5	7.5	7.5	15.0	15.0	24.0	24.0	24.0	23.9	23.0	22.0	22.0	22.0	15.0	14.0	14.0
POWER																	
AVE POWER MW		101	101	101	160	164	169	173	171	168	165	163	162	162	161	160	158
PEAK POW MW		159	160	161	160	167	173	173	170	167	164	163	162	161	160	159	158
ENERGY GWH	1400.9	36.3	17.0	21.9	115.5	121.7	121.9	128.5	127.5	121.2	123.1	58.8	27.3	31.0	119.9	118.9	110.3
--GARRISON--																	
NAT INFLOW	24809	758	354	455	2748	4414	6467	5560	1374	515	704	194	90	103	393	300	380
DEPLETION	1403	23	11	14	-43	-100	733	1399	-39	-239	8	-87	-41	-46	-58	-77	-55
CHAN STOR	-39	26		0	-77		-87			1	8	10	0	0	70	10	
EVAPORATION	546							36	114	136	112	48	22	25	53		
REG INFLOW	36209	984	447	575	3607	5436	7075	5600	2775	2040	2007	896	414	474	1390	1248	1240
RELEASE	35213	655	305	446	2083	3074	4284	4489	4489	4230	3074	1488	694	793	1537	1845	1726
STOR CHANGE	996	330	142	128	1524	2362	2791	1112	-1714	-2190	-1067	-591	-280	-320	-147	-597	-485
STORAGE	15425	15754	15896	16024	17548	19910	22701	23813	22099	19908	18841	18250	17970	17650	17503	16906	16421
ELEV FTMSL	1828.2	1829.4	1829.9	1830.4	1835.6	1843.1	1851.0	1854.0	1849.4	1843.1	1839.8	1838.0	1837.0	1836.0	1835.5	1833.5	1831.8
DISCH KCFS	26.0	22.0	22.0	25.0	35.0	50.0	72.0	73.0	73.0	71.1	50.0	50.0	50.0	50.0	25.0	30.0	30.0
POWER																	
AVE POWER MW		258	260	295	412	472	499	504	503	499	480	471	466	462	306	364	359
PEAK POW MW		439	440	442	462	492	502	505	501	480	474	467	464	460	461	453	447
ENERGY GWH	3758.0	92.9	43.6	63.8	296.5	351.5	359.6	374.6	374.1	359.2	357.2	169.4	78.2	88.7	227.9	270.6	250.1
--OAHE--																	
NAT INFLOW	6846	874	408	524	1617	1259	1009	393	210	67	151	27	13	14	105	75	100
DEPLETION	1419	64	30	38	-17	329	-8	151	232	258	229	7	3	4	45	21	33
CHAN STOR	-2	17	0	-12	-40	-58	-83	-4		7	83				110	-22	
EVAPORATION	506							34	105	127	104	44	20	23	49		
REG INFLOW	40132	1481	683	920	3677	3947	5218	4693	4361	3919	2976	1463	683	781	1658	1877	1793
RELEASE	40688	840	385	745	2667	3568	4178	4986	5067	5044	4686	2211	1007	1050	1601	1395	1257
STOR CHANGE	-556	641	298	175	1010	379	1040	-293	-705	-1125	-1711	-748	-323	-268	57	481	535
STORAGE	17654	18295	18593	18768	19778	20157	21197	20904	20199	19074	17363	16615	16292	16024	16081	16562	17098
ELEV FTMSL	1603.6	1605.7	1606.7	1607.3	1610.5	1611.6	1614.6	1613.8	1611.7	1608.3	1602.6	1600.0	1598.8	1597.8	1598.1	1599.8	1601.7
DISCH KCFS	28.1	28.2	27.7	41.8	44.8	58.0	70.2	81.1	82.4	84.8	76.2	74.3	72.5	66.2	26.0	22.7	21.9
POWER																	
AVE POWER MW		358	355	534	578	725	734	737	729	714	692	671	661	658	318	279	272
PEAK POW MW		699	704	707	723	729	742	735	724	705	677	664	658	655	658	667	677
ENERGY GWH	5022.2	129.0	59.6	115.4	416.5	539.3	528.6	548.5	542.6	514.4	515.1	241.5	111.1	126.3	237.0	207.9	189.3
--BIG BEND--																	
EVAPORATION	103							6	20	25	22	10	5	5	11		
REG INFLOW	40585	840	385	745	2667	3568	4178	4980	5047	5019	4664	2202	1002	1045	1590	1395	1257
RELEASE	40585	840	385	745	2667	3568	4178	4980	5047	5019	4664	2202	1002	1045	1590	1395	1257
STORAGE	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621
ELEV FTMSL	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0
DISCH KCFS	28.1	28.2	27.7	41.8	44.8	58.0	70.2	81.0	82.1	84.4	75.9	74.0	72.2	65.8	25.9	22.7	21.9
POWER																	
AVE POWER MW		134	130	185	198	248	299	345	350	366	359	353	348	321	129	111	105
PEAK POW MW		517	509	464	464	440	440	440	440	452	523	538	538	538	538	538	528
ENERGY GWH	2199.5	48.1	21.8	39.9	142.7	184.3	215.6	256.8	260.2	263.4	267.5	127.2	58.5	61.7	96.2	82.8	72.9
--FORT RANDALL--																	
NAT INFLOW	3288	332	155	199	238	305	932	357	288	158	14	9	4	5	97	85	110
DEPLETION	80	1	1	1	4	9	12	18	15	7	1	1	0	1	3	3	3
EVAPORATION	127							9	27	34	28	11	5	5	10		
REG INFLOW	43670	1171	539	944	2901	3864	5098	5310	5293	5136	4650	2199	1001	1044	1678	1477	1364
RELEASE	43666	880	405	522	2901	3682	5098	5310	5293	5228	5469	2645	1234	1310	1571	1127	990
STOR CHANGE	4	291	134	422	0	182		0	0	-92	-819	-446	-233	-266	107	350	374
STORAGE	3124	3415	3549	3971	3971	4153	4153	4153	4153	4061	3242	2796	2563	2297	2404	2754	3128
ELEV FTMSL	1350.0	1353.6	1355.2	1360.0	1360.0	1362.0	1362.0	1362.0	1362.0	1361.0	1351.5	1345.5	1342.0	1337.5	1339.4	1344.9	1350.1
DISCH KCFS	25.3	29.6	29.2	29.2	48.8	59.9	85.7	86.4	86.1	87.9	88.9	88.9	88.9	82.6	25.5	18.3	17.2
POWER																	
AVE POWER MW		242	244	251	372	373	372	372	372	370	353	326	304	287	186	139	137
PEAK POW MW		351	356	372	372	375	372	372	372	369	337	312	296	276	294	319	339
ENERGY GWH	2640.5	87.2	41.0	54.2	267.8	277.8	268.2	277.0	277.1	266.7	262.5	117.4	51.1	55.2	138.7	103.4	95.3
--GAVINS POINT--																	
NAT INFLOW	1999	190	88	114	134	17	301	266	270	159	77	42	19	22	90	90	120
DEPLETION	114	0	0	0	5	19	24	39	10	-5	2	5	2	3	10	1	
CHAN STOR	11	-8	1	0	-37	-21	-49	-1	1	-3	-2	0	0	12	106	13	2
EVAPORATION	36							2	6	9	8	3	2	2	4		
REG INFLOW	45526	1062	495	636	2993	3659	5326	5534	5547	5380	5534	2678	1250	1339	1752	1230	1112
RELEASE	45523	1059	495	636	2993	3659	5326	5534	5534	5355	5534	2678	1250	1339	1752	1230	1150
STOR CHANGE	3	3							13	25							-38
STORAGE	339	342	342	342	342	342	342	342	355	380	380	380	380	380	380	380	342
ELEV FTMSL	1205.9	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1206.0
DISCH KCFS	30.3	35.6	35.6	35.6	50.3	59.5	89.5	90.0	90.0	90.0	90.0	90.0	90.0	84.4	28.5	20.0	20.0
POWER																	
AVE POWER MW		113	113	113	112	110	102	102	103	106	108	108	108	109	79	70	69
PEAK POW MW		114	114	114	112	110	102	102	104	108	108	108	108	109	78	78	76
ENERGY GWH	865.8	40.7	19.0	24.4	80.5	81.7	73.5	75.8	76.6	76.3	80.3	38.9	18.1	21.0	58.5	52.0	48.3
--GAVINS POINT - SIOUX CITY--																	
NAT INFLOW	9312	558	260	334	2081	1603	1092	1336	551	252	286	152	71	81	255	200	200
DEPLETION	266	7	3	4	22	36	31	39	36	24	11	6	3	3	13	14	14
REGULATED FLOW AT SIOUX CITY																	
KAF	54569	1610	752	966	5052	5226	6387	6831	6049	5583	5809	2824	1318	1417	1994	1416	1336
KCFS		54.1	54.1	54.1	84.9	85.0	107.3	111.1	98.4	93.8	94.5	94.9	94.9	89.3	32.4	23.0	23.2
--TOTAL--																	
NAT INFLOW	60022	3220	1502	1931	7713	10469	13836	10005	3231	1411	1637	630	294	336	1368	1150	1290
DEPLETION	3258	71	33	43	-47	355	1254	2154	218	-282	41	-145	-68	-77	-78	-124	-90
CHAN STOR	-25	34	1	-12	-154	-79	-220	-5	1	5	89	10	0	11	290	1	2
EVAPORATION	1805							118	371	451	373	161	73	82	176		
STORAGE	51867	53440	54157	55067	57622	62431	68407	69303	65897	61561	57064	54865	53835	52761	52326	52186	52231
SYSTEM POWER																	
AVE POWER MW		1206	1203	1480	1833	2092	2177	2233	2229	2224	2158	2092	2050	1999	1180	1123	1101
PEAK POW MW		2279	2284	2259	2293	2313	2331	2327	2311	2281	2284	2252	2226	2200	2190	2215	2226
ENERGY GWH	15886.9	434.3	202.1	319.6	1319.4	1556.3	1567.4	1661.2	1658.1	1601.2	1605.7	753.3	344.4	383.8	878.1	835.6	766.2
DAILY GWH		29.0	28.9	35.5	44.0	50.2	52.2	53.6	53.5	53.4	51.8	50.2	49.2	48.0	28.3	27.0	26.4
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB

VALUES IN 1000 AF EXCEPT AS INDICATED

31DEC10	2010		2011
	INI-SUM	31JAN	28FEB
--FORT PECK--			
NAT INFLOW	1112	474	638
DEPLETION	-192	-78	-114
EVAPORATION			
MOD INFLOW	1304	552	752
RELEASE	1109	553	555
STOR CHANGE	195	-1	197
STORAGE	15074	15073	15269
ELEV FTMSL	2235.3	2235.3	2236.3
DISCH KCFS	7.8	9.0	10.0
POWER			
AVE POWER MW		123	137
PEAK POW MW		163	164
ENERGY GWH	183.5	91.6	91.9
--GARRISON--			
NAT INFLOW	832	329	503
DEPLETION	-73	-32	-41
CHAN STOR	-22	-12	-10
EVAPORATION			
REG INFLOW	1992	903	1090
RELEASE	2920	1476	1444
STOR CHANGE	-927	-573	-354
STORAGE	19409	18836	18482
ELEV FTMSL	1841.6	1839.8	1838.7
DISCH KCFS	17.8	24.0	26.0
POWER			
AVE POWER MW		303	325
PEAK POW MW		477	473
ENERGY GWH	444.3	225.6	218.7
--OAHE--			
NAT INFLOW	482	132	350
DEPLETION	173	80	93
CHAN STOR	-33	-25	-8
EVAPORATION			
REG INFLOW	3195	1502	1693
RELEASE	2195	1218	977
STOR CHANGE	1000	285	716
STORAGE	18059	18344	19059
ELEV FTMSL	1605.0	1605.9	1608.2
DISCH KCFS	24.8	19.8	17.6
POWER			
AVE POWER MW		253	227
PEAK POW MW		699	712
ENERGY GWH	340.9	188.3	152.6
--BIG BEND--			
EVAPORATION			
REG INFLOW	2195	1218	977
RELEASE	2205	1228	977
STORAGE	1631	1621	1621
ELEV FTMSL	1420.2	1420.0	1420.0
DISCH KCFS	22.4	20.0	17.6
POWER			
AVE POWER MW		98	84
PEAK POW MW		538	529
ENERGY GWH	129.7	73.0	56.7
--FORT RANDALL--			
NAT INFLOW	334	95	239
DEPLETION	-6	-3	-3
EVAPORATION			
REG INFLOW	2545	1326	1219
RELEASE	1889	1044	845
STOR CHANGE	656	282	374
STORAGE	2468	2750	3124
ELEV FTMSL	1340.5	1344.8	1350.0
DISCH KCFS	22.8	17.0	15.2
POWER			
AVE POWER MW		129	121
PEAK POW MW		319	339
ENERGY GWH	177.7	96.3	81.4
--GAVINS POINT--			
NAT INFLOW	334	74	260
DEPLETION	-1	1	-2
CHAN STOR	14	11	3
EVAPORATION			
REG INFLOW	2238	1128	1111
RELEASE	2287	1138	1150
STOR CHANGE	-49	-10	-39
STORAGE	388	378	339
ELEV FTMSL	1207.8	1207.4	1205.9
DISCH KCFS	25.2	18.5	20.7
POWER			
AVE POWER MW		65	72
PEAK POW MW		117	114
ENERGY GWH	97.2	48.7	48.5
--GAVINS POINT - SIOUX CITY--			
NAT INFLOW	876	300	576
DEPLETION	-26	-12	-14
REGULATED FLOW AT SIOUX CITY			
KAF	3189	1450	1740
KCFS		23.6	31.3
--TOTAL--			
NAT INFLOW	3970	1404	2566
DEPLETION	-125	-44	-81
CHAN STOR	-41	-26	-15
EVAPORATION			
STORAGE	57029	57001	57894
SYSTEM POWER			
AVE POWER MW		972	967
PEAK POW MW		2313	2330
ENERGY GWH	1373.3	723.5	649.8
DAILY GWH		23.3	23.2
	INI-SUM	31JAN	28FEB

VALUES IN 1000 AF EXCEPT AS INDICATED

28FEB11		2011												2012			
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB
--FORT PECK--																	
NAT INFLOW	15068	559	261	335	985	3158	4439	2302	592	286	446	228	106	121	471	400	380
DEPLETION	-24	-24	-11	-14	-18	62	462	508	-36	-327	-210	-77	-36	-41	-91	-86	-85
EVAPORATION	474							31	93	113	98	44	21	23	51		
MOD INFLOW	14618	582	272	349	1003	3096	3977	1763	535	500	558	260	122	139	511	486	465
RELEASE	15110	223	104	134	446	1599	3570	2767	2152	800	615	298	139	159	676	738	690
STOR CHANGE	-492	359	167	215	557	1497	407	-1004	-1618	-300	-57	-37	-17	-20	-165	-252	-225
STORAGE	15269	15628	15796	16011	16568	18065	18472	17468	15850	15550	15493	15456	15439	15419	15254	15002	14777
ELEV FTMSL	2236.3	2237.9	2238.7	2239.6	2242.1	2248.4	2250.0	2245.9	2238.9	2237.5	2237.3	2237.1	2237.0	2236.9	2236.2	2235.0	2233.9
DISCH KCFS	10.0	7.5	7.5	7.5	7.5	26.0	60.0	45.0	35.0	13.4	10.0	10.0	10.0	10.0	11.0	12.0	12.0
POWER																	
AVE POWER MW		103	104	104	104	169	169	169	166	165	137	137	137	137	149	160	159
PEAK POW MW		165	166	166	168	171	170	168	164	165	165	165	164	164	164	163	162
ENERGY GWH	1310.0	37.2	17.4	22.4	75.1	125.9	121.7	126.1	123.7	118.9	102.2	49.4	23.1	26.3	110.9	119.0	110.7
--GARRISON--																	
NAT INFLOW	27222	834	389	500	3023	4855	7114	6116	1511	567	774	213	99	114	432	300	380
DEPLETION	1403	23	11	14	-43	-100	733	1399	-39	-239	8	-87	-41	-46	-58	-77	-55
CHAN STOR	-15	25		0	0	-174	-313	138	92	204	33			0	-10	-10	
EVAPORATION	556							37	113	135	114	51	23	27	57		
REG INFLOW	40359	1059	482	620	3512	6379	9639	7585	3681	1675	1301	547	255	292	1099	1105	1125
RELEASE	40741	655	305	393	893	4489	9640	7852	5602	3325	1722	833	389	444	1230	1476	1496
STOR CHANGE	-382	404	177	228	2620	1891	-1	-267	-1920	-1650	-421	-286	-133	-152	-130	-371	-370
STORAGE	18482	18886	19063	19291	21910	23801	23800	23533	21613	19963	19542	19256	19123	18970	18840	18469	18099
ELEV FTMSL	1838.7	1840.0	1840.5	1841.2	1848.8	1853.9	1853.9	1853.2	1848.0	1843.2	1842.0	1841.1	1840.7	1840.2	1839.8	1838.7	1837.5
DISCH KCFS	26.0	22.0	22.0	22.0	15.0	73.0	162.0	127.7	91.1	55.9	28.0	28.0	28.0	28.0	20.0	24.0	26.0
POWER																	
AVE POWER MW		276	278	278	194	503	500	501	501	499	356	354	354	353	252	301	323
PEAK POW MW		477	479	482	503	505	500	501	499	487	485	481	480	478	477	472	468
ENERGY GWH	3340.2	99.3	46.6	60.1	139.8	374.0	359.9	373.0	372.8	359.4	264.5	127.5	59.4	67.7	187.7	223.7	224.8
--OAHE--																	
NAT INFLOW	7514	962	449	577	1779	1385	1110	432	231	74	166	30	14	16	116	75	100
DEPLETION	1419	64	30	38	-17	329	-8	151	232	258	229	7	3	4	45	21	33
CHAN STOR	30	16	0	0	25	-204	-307	117	130	136	110			0	32	-16	-8
EVAPORATION	529							36	106	126	109	49	22	26	55		
REG INFLOW	46338	1568	724	931	2714	5341	10451	8214	5624	3151	1660	807	377	431	1277	1514	1555
RELEASE	46574	343	158	257	1934	4805	10166	9278	8029	3731	1544	1296	350	501	1453	1471	1257
STOR CHANGE	-236	1225	566	674	780	536	285	-1064	-2405	-580	116	-489	27	-70	-176	43	297
STORAGE	19059	20284	20850	21524	22304	22839	23124	22060	19655	19075	19191	18702	18729	18659	18483	18526	18823
ELEV FTMSL	1608.2	1612.0	1613.6	1615.6	1617.7	1619.2	1620.0	1617.1	1610.1	1608.3	1608.6	1607.1	1607.2	1606.9	1606.4	1606.5	1607.5
DISCH KCFS	17.6	11.5	11.4	14.4	32.5	78.1	170.8	150.9	130.6	62.7	25.1	43.5	25.2	31.6	23.6	23.9	21.9
POWER																	
AVE POWER MW		152	152	193	438	760	743	742	722	716	325	559	324	405	304	307	281
PEAK POW MW		731	740	750	761	764	745	735	703	711	714	706	706	705	702	703	708
ENERGY GWH	4367.7	54.5	25.5	41.8	315.3	565.3	534.9	552.2	537.1	515.3	242.1	201.3	54.5	77.8	225.9	228.3	195.9
--BIG BEND--																	
EVAPORATION	103							6	20	25	22	10	5	5	11		
REG INFLOW	46471	343	158	257	1934	4805	10166	9272	8009	3707	1522	1286	345	496	1442	1471	1257
RELEASE	46471	343	158	257	1934	4805	10166	9272	8009	3707	1522	1286	345	496	1442	1471	1257
STORAGE	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621	1621
ELEV FTMSL	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0	1420.0
DISCH KCFS	17.6	11.5	11.4	14.4	32.5	78.1	170.8	150.8	130.3	62.3	24.8	43.2	24.9	31.2	23.5	23.9	21.9
POWER																	
AVE POWER MW		55	53	66	144	283	295	357	450	295	123	210	124	156	117	117	105
PEAK POW MW		517	509	488	464	349	295	357	450	519	538	538	538	538	538	538	529
ENERGY GWH	1848.0	19.7	9.0	14.2	103.6	210.9	212.4	265.8	335.2	212.1	91.3	75.7	20.8	29.9	87.4	87.2	72.9
--FORT RANDALL--																	
NAT INFLOW	3599	365	170	219	262	336	1025	393	317	174	15	10	5	5	107	85	110
DEPLETION	80	1	1	1	4	9	12	18	15	7	1	1	0	1	3	3	3
EVAPORATION	121							9	28	32	24	10	4	5	10		
REG INFLOW	49869	707	328	476	2192	5132	11179	9638	8283	3841	1513	1285	345	496	1537	1553	1364
RELEASE	49870	416	194	250	1996	4186	10677	10238	9041	4539	2313	1155	538	615	1594	1127	990
STOR CHANGE	-1	291	134	226	196	946	502	-600	-758	-698	-800	130	-193	-119	-58	426	374
STORAGE	3124	3415	3549	3775	3971	4917	5419	4819	4061	3363	2563	2693	2500	2381	2323	2749	3123
ELEV FTMSL	1350.0	1353.6	1355.2	1357.8	1360.0	1370.0	1375.0	1369.0	1361.0	1353.0	1342.0	1344.0	1341.0	1339.0	1338.0	1344.8	1350.0
DISCH KCFS	15.2	14.0	14.0	14.0	33.5	68.1	179.4	166.5	147.0	76.3	37.6	38.8	38.7	38.8	25.9	18.3	17.2
POWER																	
AVE POWER MW		116	118	120	290	375	375	375	372	357	295	287	285	276	189	138	137
PEAK POW MW		351	356	365	372	375	375	375	359	344	305	315	301	292	287	319	339
ENERGY GWH	2421.3	41.7	19.9	26.0	209.1	279.0	270.0	279.0	277.0	257.3	219.8	103.2	47.8	53.0	140.8	102.7	95.2
--GAVINS POINT--																	
NAT INFLOW	2178	209	97	125	147	19	331	293	297	175	85	46	21	24	99	90	120
DEPLETION	114	0	0	0	5	19	24	39	10	-5	2	5	2	3	10	1	
CHAN STOR	-9	2	0	0	-38	-66	-214	25	37	134	72	-2	0	0	24	14	2
EVAPORATION	36							2	6	9	8	3	2	2	4		
REG INFLOW	51889	628	292	375	2100	4120	10770	10515	9359	4845	2460	1190	555	635	1703	1230	1112
RELEASE	51886	625	292	375	2100	4120	10770	10515	9346	4820	2460	1190	555	635	1703	1230	1150
STOR CHANGE	3	3							13	25							-38
STORAGE	339	342	342	342	342	342	342	342	355	380	380	380	380	380	380	380	342
ELEV FTMSL	1205.9	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.0	1206.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1207.5	1206.0
DISCH KCFS	20.7	21.0	21.0	21.0	35.3	67.0	181.0	171.0	152.0	81.0	40.0	40.0	40.0	40.0	27.7	20.0	20.0
POWER																	
AVE POWER MW		72	72	72	113	108	84	87	91	108	116	116	116	116	79	70	69
PEAK POW MW		114	114	114	114	108	84	87	92	110	116	116	116	116	78	78	76
ENERGY GWH	816.0	26.0	12.2	15.6	81.0	80.4	60.5	65.0	68.0	78.0	86.7	41.9	19.6	22.4	58.6	52.0	48.3
--GAVINS POINT - SIOUX CITY--																	
NAT INFLOW	10203	613	286	368	2289	1763	1201	1470	606	277	315	167	78	89	281	200	200
DEPLETION	266	7	3	4	22	36	31	39	36	24	11	6	3	3	13	14	14
REGULATED FLOW AT SIOUX CITY																	
KAF	61823	1231	575	739	4367	5847	11940	11946	9916	5073	2764	1351	631	721	1971	1416	1336
KCFS		41.4	41.4	41.4	73.4	95.1	200.7	194.3	161.3	85.3	44.9	45.4	45.4	45.4	32.1	23.0	23.2
--TOTAL--																	
NAT INFLOW	65784	3542	1652	2124	8485	11516	15220	11006	3554	1553	1801	693	323	369	1506	1150	1290
DEPLETION	3258	71	33	43	-47	355	1254	2154	218	-282	41	-145	-68	-77	-78	-124	-90
CHAN STOR	7	43	0	0	-12	-444	-833	280	259	474	215	-2	0	0	46	-12	-6
EVAPORATION	1819							121	367	439	373	166	77	87	188		
STORAGE	57894	60176	61221	62563	66716	71586	72778	69843	63155	59952	58790	58108	57792	57431	56901	56748	56785
SYSTEM POWER																	
AVE POWER MW		773	777	834	1283	2198	2166	2233	2303	2140	1353	1664	1340	1443	1090	1092	1075
PEAK POW MW		2356	2364	2365	2382	2272	2168	2223	2267	2336	2323	2321	2306	2294	2246	2273	2282
ENERGY GWH	14103.2	278.4	130.5	180.0	923.8	1635.4	1559.4	1661.1	1713.7	1541.1	1006.7	599.0	225.1	277.1	811.2	812.8	747.9
DAILY GWH		18.6	18.6	20.0	30.8	52.8	52.0	53.6	55.3	51.4	32.5	39.9	32.2	34.6	26.2	26.2	25.8
	INI-SUM	15MAR	22MAR	31MAR	30APR	31MAY	30JUN	31JUL	31AUG	30SEP	31OCT	15NOV	22NOV	30NOV	31DEC	31JAN	29FEB