Missouri River Recovery Program

DRAFT

Missouri River Recovery Management Plan and Environmental Impact Statement

RECREATION ENVIRONMENTAL CONSEQUENCES ANALYSIS TECHNICAL REPORT

December 2016

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Missouri River Recovery Management Plan and Environmental Impact Statement

Recreation
Environmental Consequences Analysis

Technical Report

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Table of Contents

1.0 Introduction 1

1.1 Summary of Alternatives 1

1.2 USACE Planning Accounts 2

1.3 Approach for Evaluating Environmental Consequences of Missouri River Recovery Management Plan 3

2.0 Methodology and Assumptions 5

2.1 Assumptions 5

2.2 Risk and Uncertainty 6

2.3 Evaluation of River and Reservoir Conditions for Recreation 6

2.3.1 Boat Ramp Operability 7

2.3.2 Mid-August Water Elevations 9

2.3.3 Habitat Areas 9

2.4 National Economic Development 9

2.4.1 Identify Plan-Affected Recreation 10

2.4.2 Estimate Changes in Visitation 17

2.4.3 Calculate and Apply the Unit Day Values 20

2.4.4 Recreation Benefits of Visitation (NED Benefits) 27

2.4.5 Estimate Operating, Maintenance, Repair, Replacement and Rehabilitation Costs (NED Losses) 27

2.5 Regional Economic Development 30

3.0 National Economic Development Results 34

3.1 Summary Across Alternatives 34

3.1.1 Upper Three Reservoirs 35

3.1.2 Lower Three Reservoirs 41

3.1.3 Inter-Reservoir River Reaches 42

3.1.4 Lower River 43

3.2 Alternative 1 – No Action 44

3.3 Alternative 2 – USFWS 2003 Biological Opinion Projected Actions 45

3.4 Alternative 3 – Mechanical Construction Only 49

3.5 Alternative 4 – Spring ESH Creating Release 53

3.6 Alternative 5 – Fall ESH Creating Release 57

3.7 Alternative 6 – Pallid Sturgeon Spawning Cue 60

4.0 Regional Economic Development Results 64

5.0 Literature Cited 69

Appendix: Data Sources for Boat Ramps 73

List of Figures

Figure 1. Flow Chart of Inputs Considered in Recreation Evaluation 4

Figure 2. Process to Evaluate the Impacts to Recreation 5

Figure 3. Fort Peck Lake Annual Differences in Visitation NED Benefits under the MRRMP-Draft EIS Alterantives Relative to Alternative 1 38

Figure 4. Lake Sakakwea Annual Differences in Visitation NED Benefits under the MRRMP-Draft EIS Alterantives Relative to Alternative 1 39

Figure 5. Lake Oahe Annual Differences in Visitation NED Benefits under the MRRMP-Draft EIS Alterantives relative to Alternative 1 40

Figure 6. Annual Difference in Recreation NED Benefits Under Alternative 2 Relative to Alternative 1 (2016$) 48

Figure 7. Annual Difference in Recreation NED Benefits under Alternative 2 compared to Alternative 1 in the Upper River 48

Figure 8. Annual Difference in Recreation NED Benefits under Alternative 2 Compared to Alternative 1 in the Lower River 49

Figure 9. Annual Difference in Recreation NED Benefits under Alternative 3 Relative to Alternative 1 in the Upper and Lower River (2016$) 51

Figure 10. Annual Difference in Recreation NED Benefits under Alternative 3 Compared to Alternative 1 in the Upper River (2016$) 52

Figure 11. Annual Difference in Recreation NED Benefits under Alternative 3 Compared to Alternative 1 in the Lower River (2016$) 52

Figure 12. Annual Difference in Recreation NED Benefits under Alternative 4 Relative to Alternative 1 in the Upper and Lower River (2016$) 55

Figure 13. Annual Difference in Recreation NED Benefits under Alternative 4 Compared to Alternative 1 in the Upper River (2016$) 56

Figure 14. Annual Difference in Recreation NED Benefits under Alternative 4 Compared to Alternative 1 in the Lower River (2016$) 56

Figure 15 Annual Difference in Recreation NED Benefits under Alternative 5 Relative to Alternative 1 in the Upper and Lower River (2016$) 59

Figure 16. Annual Difference in Recreation NED Benefits Under Alternative 5 compared to Alternative 1 in the Upper River (2016$) 59

Figure 17. Annual Difference in Recreation NED Benefits Under Alternative 5 compared to Alternative 1 in the Lower River (2016$) 60

Figure 18. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Upper and Lower River (2016$) 62

Figure 19. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Upper River (2016$) 63

Figure 20. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Lower River (2016$) 63

List of Tables

Table 1. River and Reservoir Conditions for Recreation 7

Table 2. Number of Total Boat Ramps in the Recreation Analysis 8

Table 3. Annual Visitation and Distribution of Activities, 2012 11

Table 4. Reservoir 2012 Recreation Visitor Days by Season 12

Table 5. Lower River 2004 Visitation by Type 13

Table 6. Visitation by Season in the River Reaches 14

Table 7. Distribution of Activities in the Inter-Reservoir River Reaches, 2009 15

Table 8. Distribution of Activities in the Lower River, 2004 16

Table 9. Visitation on the River Reaches, Annual Recreation Visitor Days 16

Table 10. Linear Regression Results for the Upper Three Reservoirs 18

Table 11. Unit Day Values for Recreation, Fiscal Year 2016 22

Table 12. Distribution of Specialized and Generalized Recreation Opportunities in the Reservoirs and River Reaches 23

Table 13. Estimates of UDVs for Each Reservoir and River Reach 25

Table 14. Target Acres of Habitat Creation by River Reach 27

Table 15. The Proportion of the Channel Affected by Habitat Creation 27

Table 16. Number of Boat Ramps at each Reservoir 28

Table 17. Study Area Areas 32

Table 18. Residency of Visitors to the Reservoirs 32

Table 19. Non-Local Visitor Activity Distributions 33

Table 20. RECONS Non-Local Visitor Spending by Type of Visitor ($ per party per day, 2016$) 34

Table 21. Summary of Visitation and Recreation NED Benefits for Fort Peck Lake (Thousands of 2016 Dollars) 35

Table 22. Summary of Visitation and Recreation NED Benefits for Lake Sakakawea (Thousands of 2016 Dollars) 36

Table 23. Summary of Visitation and Recreation NED Benefits for Lake Oahe (Thousands of 2016 Dollars) 37

Table 24. Summary of Visitation and Recreation NED Benefits for Lower Three Reservoirs (Thousands of 2016 Dollars) 41

Table 25. Summary of Visitation and Recreation NED Benefits for Inter-Reservoir River Reaches (Thousands of 2016 Dollars) 43

Table 26. Summary of Visitation and Recreation NED Benefits for the Lower River (Thousands of 2016 Dollars) 44

Table 27. Summary of NED Analysis for Alternative 1, 1932-2012 (Thousands of 2016 Dollars) 45

Table 28: Summary of NED Analysis for Alternative 2, 1932-2012 (Thousands of 2016 Dollars) 46

Table 29. Summary of NED Analysis for Alternative 3, 1932-2012 (Thousands of 2016 Dollars) 50

Table 30. Summary of NED Analysis for Alternative 4, 1932-2012 53

Table 31. Summary of NED Analysis for Alternative 5, 1932-2012 (Thousands of 2016 Dollars) 57

Table 32. Summary of NED Analysis for Alternative 6, 1932-2012 61

Table 33. Direct, Indirect, and Induced Employment Benefits from Non-Local Visitor Spending under the MRRMP-Draft EIS Alternatives 66

Table 34. Direct, Indirect, and Induced Labor Income Benefits from Non-Local Visitor Spending under the MRRMP-Draft EIS Alternatives (Thousands of 2016 Dollars) 67

Table 35. Direct, Indirect, and Induced Sales from Non-Local Visitor Spending under the MRRMP-Draft EIS Alternatives (Thousands of 2016 Dollars) 68

1.0 Introduction

The USACE in cooperation with the USFWS are developing a Missouri River Recovery Management Plan and Draft Environmental Impact Statement (MRRMP Draft EIS). The purpose of the MRRMP Draft EIS is to develop a management plan that includes a suite of actions that removes or precludes jeopardy status for the piping plover, the interior least tern, and the pallid sturgeon using USACE authorities.

The purpose of the Recreation Environmental Consequences Analysis Technical Report is to provide supplemental information on the Navigation analysis and results in addition to the information presented in the MRRMP-EIS. Additional details on the National Economic Development (NED) and Regional Economic Development (RED) methodology and results are provided in this report. The Other Social Effects (OSE) impacts are presented in the MRRMP-Draft EIS, Chapter 3, Recreation, Environmental Consequences section. No Environmental Quality (EQ) analysis was undertaken for Recreation.

1.1 Summary of Alternatives

The MRRMP-Draft EIS evaluates the following Management Plan alternatives. Detailed description of the alternatives is provided in the Draft EIS, Chapter 2.

- **Alternative 1 – No Action.** This is the no-action alternative, in which the Missouri River Recovery Program (MRRP) would continue to be implemented as it is currently, including a number of management actions associated with the MRRP and BiOp compliance. Management actions under No Action include creation of early life stage habitat for the pallid sturgeon and emergent sandbar habitat (ESH), as well as a spring plenary pulse. The construction of habitat will be focused in the Garrison and Gavins reaches for ESH (an average rate of 107 acres per year) and between Ponca to the mouth near St. Louis for early life stage habitat (3,999 additional acres constructed).
- **Alternative 2 – USFWS 2003 Biological Opinion Projected Actions.** This alternative represents the USFWS interpretation of the management actions that would be implemented as part of the 2003 Amended BiOp Reasonable and Prudent Alternative (USFWS, 2003). Whereas No Action only includes the continuation of management actions USACE has implemented to date for BiOp compliance, Alternative 2 includes additional iterative actions and expected actions that the USFWS anticipates would ultimately be implemented through adaptive management and as impediments to implementation were removed. Considerably more early life stage habitat (10,758 additional acres constructed) and ESH (an average rate of 3,546 acres per year) would be constructed under Alternative 2 than under Alternative 1. In addition, a spring pallid sturgeon flow release would be implemented every year if specific conditions were met. Alternative 2 would also modify System operations to allow for summer flows that are sufficiently low to provide for early life stage habitat as rearing, refugia, and foraging areas for larval, juvenile, and adult pallid sturgeon.
- **Alternative 3 – Mechanical Construction.** The USACE would only create ESH through mechanical means at an average rate of 391 acres per year across the entire system. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH resulting from system operations. The average annual construction amount includes replacing ESH lost to erosion and vegetative growth, as well as constructing new ESH. An additional 3,380 acres of early life stage habitat for the

pallid sturgeon would be constructed under Alternative 3. There would not be any reoccurring flow releases or pulses implemented under this alternative.

- **Alternative 4 – Spring ESH Creating Release.** The USACE would mechanically construct ESH annually at an average rate of 240 acres per year across the entire system. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH resulting from implementation of an ESH-creating reservoir release in the spring. Alternative 4 would be similar to Alternative 1 (current operations), with the addition of a spring release designed to create ESH for the least tern and piping plover. An additional 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 4.
- **Alternative 5 – Fall ESH Creating Release.** The USACE would mechanically construct ESH annually at an average rate of 309 acres per year across the entire system. This alternative is based on Alternative 1 (current operations), with the addition of a release in the fall designed to create sandbar habitat for the least tern and piping plover. An additional 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 5.
- **Alternative 6 – Pallid Sturgeon Spawning Cue.** The USACE would mechanically construct ESH annually at an average rate of 303 acres per year across the entire system. In addition, the USACE would attempt a spawning cue pulse every three years in March and May. These spawning cue pulses would not be started or would be terminated whenever flood targets are exceeded. An additional 3,380 acres of early life stage habitat for the pallid sturgeon would be constructed under Alternative 6.

1.2 USACE Planning Accounts

Alternative means of achieving species objectives were evaluated including consideration for the effects of each action or alternative on a wide range of human considerations (HC). Human considerations to be evaluated in the MRRMP-DRAFT EIS alternatives are rooted in the economic, social, and cultural values associated with the natural resources of the Missouri River. The HC effects evaluated in the MRRMP Draft EIS are required under the National Environmental Policy Act and its implementing regulations (40 CFR Parts 1500-1508). The 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) also served as the central guiding regulation for the economic and environmental analysis included within the MP-EIS. Further guidance that is specific to USACE is described in Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, which provides the overall direction by which USACE Civil Works projects are formulated, evaluated, and selected for implementation. These guidance documents describe four accounts that were established to facilitate evaluation and display the effects of alternative plans:

- The national economic development (NED) account displays changes in the economic value of the national output of goods and services expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation.
- The regional economic development (RED) account registers changes in the distribution of regional economic activity (i.e. jobs and income).
- The environmental quality (EQ) displays non-monetary effect of significant natural and cultural resources.

- The other social effects (OSE) account registers plan effects from perspective that are relevant to the planning process, but are not reflected in the other three accounts. In a general sense, OSE refers to how the constituents of life that influence personal and group definitions of satisfaction, well-being, and happiness are affected by some condition or proposed intervention.

The accounts framework enables consideration of a range of both monetary and non-monetary values and interests that are expressed as important to stakeholders, while ensuring impacts are not double counted. The USACE planning accounts evaluated for recreation include NED, RED, and OSE.

1.3 Approach for Evaluating Environmental Consequences of Missouri River Recovery Management Plan

The Missouri River and its surrounding floodplain support a wide range of recreational activities. These include both land and water-based activities, such as camping; swimming; floating; boating; sightseeing; picnicking; hiking; fishing; and hunting. The evaluation of the environmental consequences of the MRRMP Draft EIS alternatives to recreational opportunities and experiences requires an understanding of how the physical conditions of the river would change under each of the Management Plan alternatives. The conceptual flow chart shown in Figure 1 demonstrates, in a stepwise manner, how changes in the physical conditions of the Missouri River and its floodplain can impact recreation along the river.

As further described in section 2.3, the recreation analysis assessed how changes in physical river and reservoir conditions under the MRRMP Draft EIS alternatives would affect visitation over the period of record between 1931 and 2012. The estimated changes in visitation for the river reaches and the lower three reservoirs were evaluated based on boat ramp operability. For the upper three reservoirs, multiple regressions were undertaken to identify the best explanatory variables and estimate annual visitation at the reservoirs under the MRRMP Draft EIS alternatives. The results of this analysis served as inputs in the NED, RED, and OSE evaluations. The NED evaluation also examined how changes in river stages and reservoir elevations under the MRRMP-DRAFT EIS alternatives would affect operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs of maintaining access to recreation facilities, and how changes in the prevalence of ESH and early life stage habitat for the pallid sturgeon would affect the quality of recreational experiences along the river. Figure 2 shows the overall approach used to evaluate the environmental consequences to recreation from MRRMP-DRAFT EIS alternatives. The analysis included a series of steps described below, which are further described in section 2.0.

The one-time spawning cue test (Level 2) release that may be implemented under Alternatives 3, 4, and 5 was not included in the hydrologic modeling for these alternatives because of the uncertainty of the hydrologic conditions that would be present if implemented. Hydrologic modeling for Alternative 6 simulates reoccurring implementation (Level 3) of this spawning cue over the wide range of hydrologic conditions in the POR. Therefore, the impacts from the potential implementation of a one-time spawning cue test release would be bound by the range of impacts described for individual releases under Alternative 6.

CHANGES IN: Physical Components of Missouri River Watershed

- River flows and associated stages
- Water surface elevations in reservoirs
- Quality of aquatic and floodplain habitat

Leads To

CHANGES IN: Functionality and Quality of Recreation

- Functionality of boat ramps
- Access to floodplain recreational facilities
- Aesthetics and quality of recreational opportunities, such as picnicking and camping
- Fishing, wildlife, and other recreational opportunities

Leads To

CHANGES IN: Recreation Use, Enjoyment, and Spending

- Recreation visitor days
- Recreation enjoyment value ($/day per visitor) (Unit Day Value)
- Visitor Spending (dollars/day per visitor)
- Cost of extending boat ramps and repairing damage to recreation facilities ($/year)

Leads

CHANGES IN: Beneficial Effects and/or Costs

- National Economic Development (NED) – Recreation Value ($/yr), Operations, Maintenance, Repair, Replacement, and Rehabilitation Costs ($/yr)

Leads

CHANGES IN: Beneficial and/or Adverse Regional Economic Effects

- Regional Economic Development (RED) – changes in total visitor spending by region used to estimate jobs, income, and economic output/sales

Leads

CHANGES IN: Other Social Effects

- Individual and Community Well-Being

Figure 1. Flow Chart of Inputs Considered in Recreation Evaluation

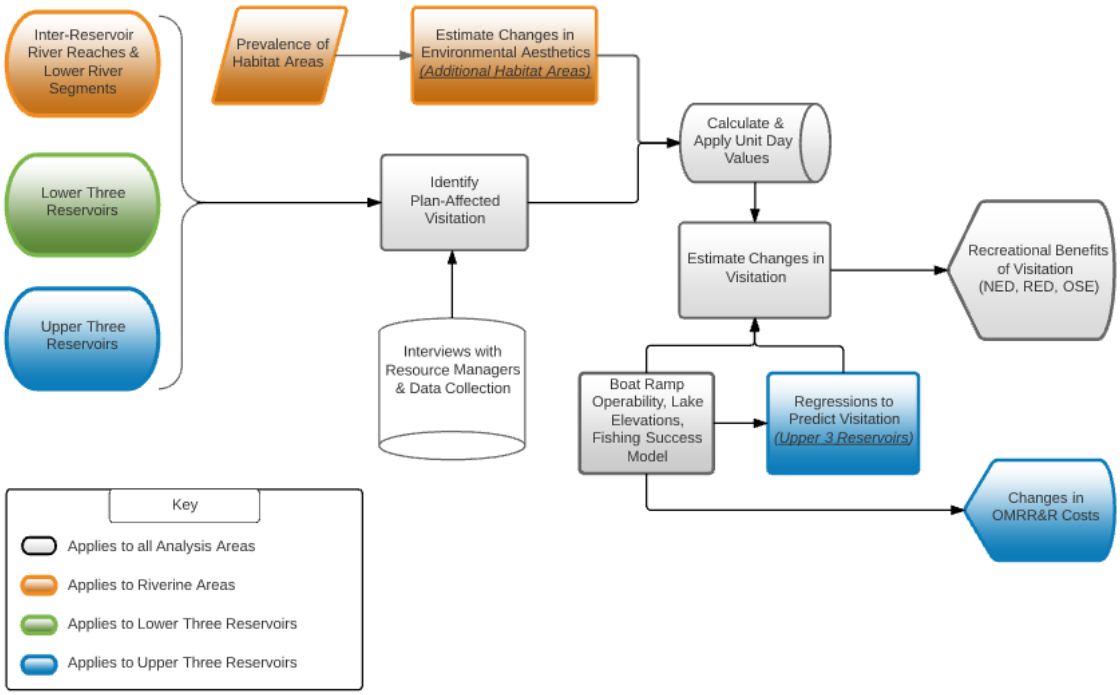

Figure 2. Process to Evaluate the Impacts to Recreation

2.0 Methodology and Assumptions

The methodology includes a summary of assumptions and risk and uncertainty considerations. The initial step in the process, evaluating the relationship between river conditions and recreational opportunities and experiences, is then described, as well as the subsequent steps to assess the NED, RED, and OSE impacts.

2.1 Assumptions

In modeling the environmental consequences to recreation from the MRRMP-Draft EIS alternatives, the project team established a set of assumptions, which are described below.

- The analysis uses data from the HEC-RAS modeling of the river and reservoir system. The analysis assumes that the HEC-RAS models reasonably estimate river flows and reservoir levels over the 82-period of record under each of the Management Plan alternatives as well as Alternative 1 (No Action).
- Repair, replacement, and rehabilitation costs would occur at the upper three reservoirs and are estimated based on capital costs to maintain access to the reservoirs during the drought conditions of the 2000s.
- It is assumed that the information provided by natural resource managers describes the impacts included in the modeling effort; the creation of early life stage habitat would improve the value of the recreational experience but would not induce new visitors to the area.

- Baseline visitation data was used from a number of sources and is assumed to represent accurate visitation to the river and reservoirs.
- Statistical regression models predict annual visitation at the upper three reservoirs based on historic visitation counts between 2002 and 2012.
- It is assumed that the boat ramp operability is an indicator of plan-affected visitation; visitation is assumed to be proportionally impacted depending on the operability of boat ramps in the river reaches, lower three reservoirs, and winter visitation at all reservoirs.
- Recreation in the Oahe Dam to Lake Sharpe river reach is not evaluated because of stable pool elevations at Lake Sharpe and no HEC-RAS modeling in this river reach.
- The RED evaluation focused on visitation at the reservoirs, which attract a large number of “non-local” visitors.

2.2 Risk and Uncertainty

Risk and uncertainty are inherent with any model that is developed and used for water resource planning. Much of the risk and uncertainty with the overall Management Plan is associated with the operation of the Missouri River system and the extent to which flows and reservoir levels will mimic conditions that have occurred over the 82-year period of record. Unforeseen events such as climate change and weather patterns may cause river and reservoir conditions to change in the future and would not be captured by the HEC-RAS models or carried through to the recreation model described is this document. The project team has attempted to address risk and uncertainty in the Management Plan by defining and evaluating a reasonable range of plan alternatives that include an array of management actions within an adaptive management framework for the Missouri River. All of the alternatives were modeled to estimate impacts to recreation along the Missouri River.

A source of uncertainty associated with the recreation analysis is predicting how visitors would react to changes in river and reservoir conditions. The project team has utilized information from interviews with recreation, wildlife, and natural resource management specialists along the river to assess how adverse effects would affect recreation use. It may be possible that prolonged adverse river or reservoir conditions may have long-term impacts to visitation and associated businesses that support visitors, especially in the upper three reservoirs where drought conditions have adverse impacts to recreation.

Some of these river conditions have not occurred in the recent past because considerable degradation and aggradation occurred in 2011; boat ramp operability may experience more adverse effects than what has occurred in the recent past. However, while these operational impacts may be reasonable under current conditions or in the near future, unforeseen conditions may arise that may alter the operational response to adverse conditions.

2.3 Evaluation of River and Reservoir Conditions for Recreation

The purpose of this analysis is to link hydraulic and hydrologic modeling efforts, which simulate river operations of the Missouri River under each of the MRRMP-DRAFT EIS alternatives, with the economic analysis necessary to estimate the consequences to recreation. Specialized software was used to simulate river and reservoir operations for planning studies and decision support developed by the Institute for Water Resources, Hydrologic Engineering Center (HEC). Hydrologic Engineering Center River Analysis System (HEC-RAS) and Reservoir System Simulation (HEC-Res Sim) models were used to provide a profile of river conditions at locations

that approximately corresponded to recreational areas within river reaches and mainstem reservoirs. The analysis used Microsoft Excel® to evaluate potential effects of changes in river flows, river stages, and reservoir elevations on recreation visitation, as well, as recreation impacts associated with habitat creation under the MRRMP-DRAFT EIS alternatives.

Table 1 identifies and describes the physical river and reservoir conditions for recreation in the evaluation of alternatives in the MRRMP-Draft EIS.

Table 1. River and Reservoir Conditions for Recreation

Location	Metric	Description
Reservoirs and River Reaches	Number of days with operable boat ramps	Boat ramps are operable when stages and elevations fall between top and bottom operating elevations for normal boat ramps. Operable boat ramps facilitate access to the reservoirs and river reaches.
Three Upper Reservoirs	Mid-August pool elevation at the upper three reservoirs	Mid-August water elevation is the seven-day average pool elevation of one of the upper three reservoirs with the seven-day average centred on August 15th. Mid-August elevations provide an indication of both recreational access and fishing success; generally, higher mid-August elevations are associated with greater fishing success and access to the recreational resources.
River Reaches (Garrison Dam to Lake Oahe, Randall Dam to Lewis and Clark Lake, Gavins Point Dam to Rulo, and Rulo to the Mouth)	Number of acres of early life stage habitat for the pallid sturgeon and emergent sandbar habitat areas	The anticipated acres of shallow water habitat and emergent sandbar habitat provide a proxy for recreation in terms of potential opportunities for recreational access, and improved recreational experiences (i.e., slower river water velocities, remote experience, more access opportunities, etc.).

2.3.1 Boat Ramp Operability

An Excel®-based model was developed to estimate how often boat ramps would be accessible based on the top and bottom operating elevations of boat ramps relative to the river stages and reservoir pool elevations modeled for different flow regimes under the MRRMP-Draft EIS alternatives. Boat ramp operability can be an indicator for river and reservoir access. When flows or reservoir elevations are above the boat ramp operating elevations, the river or reservoir may be flooding and would not be accessible. Visitation is based in part on the accessibility of boat ramps at the reservoirs, riverine areas between the reservoirs, and the lower river segments below Gavins Point Dam. Similarly, when river stages and reservoir elevations are low and below the operating elevations, access to the river and reservoirs decreases as launches from boat ramps become more difficult. The “operable” condition is defined as the number of total days when the river stages or reservoir elevations are between the top and bottom operating elevation of the boat ramp. At the upper three reservoirs, there are both “normal water” and “low-water” boat ramps. Data on both “normal water” and “low-water” ramps were used in the recreation analysis, however, only “normal water” ramps were used to assess impacts on visitation at the upper three reservoirs.

Boat ramp data, including the river mile for boat ramps, longitude and latitude coordinates, and top and bottom elevations was provided by Kansas City and Omaha District staff in April 2014. Efforts were made to reach out to various state and local government and Corps sources collect additional data on boat ramps. A list of the sources contacted to obtain boat ramp data is provided at the end of this document (See Section 7, Appendix: Data Sources for Boat Ramps).

The number of boat ramps with useable data for each of the reservoirs and river reaches is provided in table 2.

Table 2. Number of Total Boat Ramps in the Recreation Analysis

Reservoir or River Reach	Number of Boat Ramps
Fort Peck Lake	21
Fort Peck Dam to Lake Sakakawea	7
Lake Sakakawea	87
Garrison Dam to Lake Oahe	8
Lake Oahe	68
Oahe Dam to Lake Sharpe	0
Lake Sharpe	6
Lake Francis Case	21
Randall Dam to Lewis and Clark Lake	1
Lewis and Clark Lake	7
Total Boat Ramps	226

Source: Please see the Appendix of this Report, Data Sources for Boat Ramps

The bottom elevation of the ramp in the data provided from the Corps was assumed to be the bottom engineered elevation of the ramp, or the actual elevation of the bottom of the ramp. Because the boat ramp is not operable when water levels are at the engineered bottom elevation of the ramp, the operable bottom elevation of the ramp needed to be estimated. The approximate draft of a boat using an average boat ramp was estimated to be 3 feet (Peak pers. comm. 2014). Therefore, the bottom engineered elevation of each boat ramp was increased by 3 feet to account for the draft of the average boat and to estimate the bottom operating elevation of the boat ramp. There were some instances where the top and bottom elevations were less than 3 feet apart, which occurred in less than one percent of the boat ramps. In these cases, no elevation was added to the bottom of the boat ramp.

The two seasons for the evaluation were defined as: 1) spring, summer, and fall; and 2) winter. For the geographic locations above Gavins Point Dam, the spring, summer, and fall was defined as between April 1st and November 30th, and the winter season occurs between December 1st and March 31st. In the lower portion of the Missouri River below Gavins Point Dam, the spring, summer, and fall season begins on April 1st and ends on December 30th, while the winter season beings on January 1st and ends on March 31st. The seasons were defined from information obtained from natural resource lake managers and recreation area managers on the lower river. In addition, because much of the visitation data was only available on an annual basis, the spring, summer, and fall season was defined broadly to include most of the peak season visitors.

Some boat ramps were identified as being used in the winter to access frozen reservoirs, primarily for ice fishing. In the winter, when the lake is frozen, boat ramps can be used when the lake falls to the bottom of the engineered elevation of the ramp. In some cases, visitors in the winter can access the lakes through the shore and without the use the boat ramps; however, when lake elevations fall, there are longer distances to travel to the lakes and other

impediments to access (i.e., snow fields, etc.) which can limit access during these conditions. The project team worked with recreation specialists to identify which boat ramps on the reservoirs were used for winter recreation (Longhenry pers. comm. 2015a). The bottom engineered elevations of these normal boat ramps were used to estimate impacts to visitation in the winter season.

The analysis of boat ramp operability used an Excel®-based model to compare the top and bottom operating elevations of 226 boat ramps to the daily stage of the river in the cross section of the river closest to each boat ramp. The model calculated the number of days that river stages at a ramp were within the top and bottom operating elevations during each season.

2.3.2 Mid-August Water Elevations

Mid-August reservoir elevations are an important variable used to predict visitation at the upper three reservoirs (Chipps and Fincel 2015) because they are an indicator of access to the lakes and the quality of fishing opportunities. Reservoir elevations in the upper three reservoirs can vary depending on the natural hydrologic cycles while the reservoirs elevations at the lower three reservoirs remain relatively stable. Generally, with lower lake elevations at the upper three reservoirs, there can be issues with accessing lakes through boat ramps and fishing opportunities are diminished. Conversely, higher reservoir elevations support greater lake access, increasing fishing and of other visitation at the lakes. Research on fishing pressure (also known as angler effort) in Lake Oahe and Lake Sakakawea has shown that in addition to biological variables (such as the abundance of rainbow smelt and walleye), reservoir elevations are also an important variable in predicting angler effort (often measured in angler hours for the summer season). The pool elevations from the H&H data at the upper three reservoirs were used in an Excel®-based model to estimate mid-August water elevations by averaging lake elevations between August 12th and 18th each year over the period of record.

2.3.3 Habitat Areas

The creation of emergent sandbar habitat and early life stage habitat for the pallid sturgeon, through flows or by mechanical means, has the potential to enhance the aesthetics and quality of recreational opportunities, while providing additional opportunities for low density recreation on or around newly created sandbar habitat areas. Changes in the prevalence of ESH and early life stage habitat for the pallid sturgeon in the lower river and Garrison and Randall inter-reservoir river reaches were estimated based on the target number of acres of these habitats to be created by the end of the planning period under the MRRMP-Draft EIS alternatives, as described in Chapter 2.

2.4 National Economic Development

National Economic Development (NED) effects are defined as changes in the net value of the national output of goods and services, expressed in monetary units. NED effects are the direct net benefits (total benefits minus costs) that accrue in the planning area and the rest of the Nation. In the case of recreation, the conceptual basis for the NED impacts analysis is society's willingness to pay for recreation, also known as consumer surplus value. These NED effects are measured using a Unit Day Value (UDV) approach (U.S. Water Resources Council 1983; USACE ER 1105-2-100 Appendix E; USACE Economic Guidance Memorandum (EGM) 06-03), and reflect the maximum amount individuals are willing to pay to engage in recreation activities on the Missouri River, rather than forego them (Walsh 1986). The UDV method of estimating

willingness to pay relies on expert and informed opinion to assign relative values to recreation days based on the quality of recreational opportunities supported by individual recreation areas.

MRRMP-Draft EIS alternatives could affect the functionality and quality of recreation resources, such as availability and accessibility of boat ramps and other recreational facilities, aesthetic resources, and fishing opportunities. The methodology to evaluate the NED impacts to recreation focuses on how changes in reservoir elevations, river stages, and the prevalence of habitat will affect visitation at lakes and river reaches and the value of the recreational experience. The approach summarized below discusses how changes in visitor use and experience will be estimated under the MRRMP-Draft EIS alternatives. In addition, the methodology to assess operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs to maintain access to recreation infrastructure during drought conditions under the MRRMP-Draft EIS alternatives is also described in this section.

Because data and methods are different for the locations across the Missouri River, the following description is focused on four general locations: the upper three main-stem reservoirs, the lower three mainstem reservoirs; the inter-reservoir river reservoirs; and the lower river below Gavins Point Dam. In general, this section includes the following subsections and within each of these subsections the approaches for the locations are described:

- Identify the plan-affected recreation
- Estimate changes in visitation
- Calculate and apply Unit Day Values
- Estimate NED benefits of recreation
- Estimate Operations, Maintenance, Repair, Replacement, and Rehabilitation Costs

2.4.1 Identify Plan-Affected Recreation

This section describes the current visitation for the reservoirs and the river reaches as well as the types of visitors anticipated to be affected by the MRRMP-Draft EIS alternatives.

Reservoirs

There are six mainstem reservoirs on the Missouri River, located in Montana, North Dakota, and South Dakota. The 6 mainstem reservoirs include the three upper reservoirs where the storage volumes and lake elevations vary (Lake Oahe, Lake Sakakawea, and Fort Peck Lake), and three lower reservoirs, where the reservoir elevations remain relatively stable (Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake). Because visitation at the upper three reservoirs can be largely affected by changes in reservoir elevations, the approach to estimate changes in visitation at the upper three reservoirs varies from the approach for the lower three reservoirs, both of which are described in this section.

One of the initial steps in the recreation analysis was to interview Corps lake managers to obtain current visitation data, gain an understanding of the relationship between water elevations and recreational use, and identify the types of visitors likely to be affected by changes in lake elevations. Corps resource managers provided monthly visitation counts from the Operations and Maintenance Business Information Link (OMBIL) database and activity distribution reports (i.e., the types of visitation activities) from the Visitation Estimating and Reporting System (VERS). The most recent year in which visitor counts and activity distributions were both available for recreational sites at each of the six reservoirs was 2012. Visitation and activity distribution percentages at the six reservoirs (excluding downstream and upstream recreation

areas not on the lakes) are shown in table 3. Since activity participation is not mutually exclusive, annual activity distributions reported by VERS include visitors who participate in more than one activity.

Table 3. Annual Visitation and Distribution of Activities, 2012

Activity	Fort Peck Lake	Lake Sakakawea	Lake Oahe	Lake Sharpe	Lake Francis Case	Lewis & Clark Lake
Camping	12.6%	9.2%	3.5%	3.0%	0.4%	4.3%
Picnicking	9.0%	6.2%	1.6%	13.4%	0.3%	3.0%
Boating	24.8%	23.2%	24.7%	11.5%	28.4%	7.3%
Fishing	21.5%	23.7%	37.1%	15.6%	37.4%	9.1%
Hunting	3.8%	2.6%	2.6%	0.3%	0.2%	0.9%
Skiing	1.2%	1.4%	0.5%	0.6%	3.8%	2.1%
Swimming	3.9%	4.6%	3.4%	4.5%	15.9%	9.5%
Sightseeing	12.0%	15.7%	16.1%	40.3%	5.3%	46.4%
Other	11.3%	13.4%	10.6%	10.7%	8.3%	17.4%
Total 2012 Visits	**209,805**	**1,400,243**	**1,490,215**	**774,642**	**160,716**	**1,009,914**

Source: OMBIL (USACE 2012a) and VERS (USACE 2012c) databases. Note that the percentages do not sum to 100% because visitors can participate in more than one activity.

It was necessary to identify the visitation that is likely to be affected by the lake elevation changes under the alternatives. The natural resource managers at the lakes were interviewed and the following grouping of visitors were identified (McMurry pers. comm. 2015; Voehler and Sheffield pers. comm. 2015; Bultsma pers. comm. 2015). The first two categories were identified as plan-affected visitors, or visitors affected by changes in lake elevations.

- *Winter visitation:* all visits between the months of December and March
- *Spring, summer, and fall lake elevation-affected visitation:* angler, boaters, skiers, campers, and some of the sight seers
- *All other spring, summer, and fall visitors*: Off-Highway Vehicles (OHVs), sunbathers, hikers, picnickers, hunters, swimmers, and some sight-seers.

During winter months, reservoir visitors primarily participate in ice fishing as well as other winter activities, including cross-country skiing, sight-seeing, and birding. Although many boat ramps close at the end of November (and re-open or put back in the water in April), several boat ramps continue to provide access to the reservoirs during the winter months (Lepisto and Longhenry pers. comm. 2015; Longhenry pers. comm. 2015a). When lake levels fall below the engineered bottom of these winter boat ramps, access to the lake is difficult because of the relatively longer distance to the lake from the parking area, sometimes as much as a half mile to a mile. In addition, lower lake elevations can cause “river” conditions in the reservoir, which can also affect safety and perceptions of safety on the reservoirs. Boat ramp operability (considering the bottom engineered elevation) was used to evaluate the impacts to winter visitation at all six of the reservoirs.

Popular water-based activities at the reservoirs during the spring, summer, and fall season include fishing, boating, waterskiing, and jet skiing. Typically, these visitors can access the lake directly from boat ramps between April and November, with peak use occurring between the months of June and October. When water elevations drop below the bottom operating elevations of the non-low water boat ramps, anglers, boaters, and skiers have difficulty accessing the water. Low lake elevations during these months can also adversely affect the health of fisheries and lead to reduced fishing opportunities at the upper three reservoirs.

Recreation specialists at the lakes also indicated that low lake elevations could affect shoreline recreation (McMurry pers. comm. 2015; Voehler and Sheffield pers. comm. 2015; Bultsma pers. comm. 2015; Busche pers. comm. 2015). Many visitors during the spring, summer and fall months are attracted to recreation sites on reservoirs because of their scenic quality and easy access to both facilities and water. To capture potential impacts to shoreline users, the analysis assumed that all campers and half of the sight-seers were affected by lake elevations. While some visitors who access the lake by boat may be deterred from visiting when water levels are low; lake visitors who do not require boat access (i.e. some of the sightseers, OHVers, swimmers, picnickers, etc.) are unlikely to be adversely affected by lower lake levels. In fact, some visitors such as swimmers, OHVers, or hunters might benefit when lower lake elevations expose more beach and shoreline areas for outdoor recreation and waterfowl habitat. Swimmers and half of sight-seers are assumed to not be affected by water elevations. Table 4 summarizes the 2012 visitation for the three groups of visitors.

Table 4. Reservoir 2012 Recreation Visitor Days by Season

Reservoir	Winter Recreation Days (Affected by Lake Elevations)	Spring, Summer, and Fall Recreation Visitor Days	
		Affected by Lake Elevation	All Other Recreation Days
Fort Peck Lake	58,540	404,472	135,055
Lake Sakakawea	83,292	954,694	364,723
Lake Oahe	199,617	1,002,648	313,641
Lake Sharpe	111,261	360,218	298,773
Lake Francis Case	8,076	110,715	41,176
Lewis and Clark Lake	105,282	462,993	431,332

Source: Calculated from OMBIL and VERS databases (USACE 2012a; 2012c). Note: The 2012 baseline visitation for the upper three lakes included all spring, summer, and fall recreation visitor days.

For the upper three reservoirs, the potential changes in visitation associated with fluctuating reservoir elevations was evaluated through regression techniques to best explain the changes in visitation. Because all annual spring, summer, and fall visitation was used in the regressions as the dependent variable, the current plan-affected visitation for the upper three reservoirs was assumed to be all spring, summer, and fall visitation (both the two right-hand columns in table 3). For the upper three reservoirs, winter visitation was assumed to be evaluated based on boat ramp operability, as described above.

River Reaches

Visitation along riverine reaches can be affected by high and low river flows and stages. Recreational sites along the riverine segments are administered by private entities and federal,

state, and local agencies. To assess how visitation downstream of the dams and along the river reaches may be affected by flow management under the alternatives, the following six riverine reaches were identified:

- Fort Peck Dam to Lake Sakakawea
- Garrison Dam to Lake Oahe
- Oahe Dam to Lake Sharpe
- Randall Dam to Lewis and Clark Lake
- Gavins Point Dam to Rulo
- Rulo to the Mouth

Current visitation data for Corps recreation areas in the river reaches were obtained from OMBIL, data collected on non-Corp recreation areas, and from the Missouri River Public Use Assessment (Sherriff et al. 2011). Although visitation from OMBIL was available monthly between 2000 and 2012, visitation counts at other non-Corps recreation areas were only available annually for one or two years within that period. Since 2009 visitation was the most widely available year across the data sources, 2009 OMBIL data was used and augmented with visitation data collected by the Corps for the inter-reservoir river reaches.

For the lower river, estimates of annual visitation were obtained from the Missouri River Public Use Assessment (Sheriff et al. 2011) conducted from January 3, 2004 through January 28, 2005. Estimates of visitation from the Public Use Assessment for the river segment between Gavins Point Dam and Rulo, Nebraska were increased based on discussions with the author due to reduced sampling in this section of the river during the 2004 survey (Sheriff pers. comm. 2015). Annual visitation with the adjusted Public Use Assessment estimates represent visitation at public and private sites that specifically access the Missouri River for recreational opportunities. Annual visitation for 2004 at public accesses and private lands from the Public Use Assessment are summarized in table 5.

Table 5. Lower River 2004 Visitation by Type

River Reach	Annual River Visits				
	River Miles (RM)	Public Access	Private Access**	Yacht Clubs	Cruise Operations
Gavins Point Dam to Rulo*	490 to 811	1,052,588	113,946	--	46,360
Rulo, NE to the Mouth	0 to 490	1,146,940	68,934	12,830	--

*Annual visitation to public access areas between Gavin's Point and Rulo, NE was increased by 30% based on personal communication with Steve Sheriff (2015).

**These estimates assume 80% of use of private lands without public access occurs in the upper segment between Gavins Point Dam and Rulo

Interviews with the recreation area managers were conducted to gain an understanding of the types and seasons of river use as well as how river stages and the operability of boat ramps can potentially affect various types of visitation. Recreational use of the river considerably slows during the winter months, while the majority of its use occurred in the spring, summer, and fall seasons. Visitation during the winter months on the inter-reservoir and lower river reaches were assumed to not be affected by boat ramp access and the MRRMP-Draft EIS alternatives.

Because the Public Use Assessment provided annual data, it was necessary to segment the visitation between spring, summer, and fall; and winter. To estimate the winter visitation, the monthly winter OMBIL visitation data (December through March) for the Corps recreation areas as a percentage of total visitation was applied to all visitation in the river reaches below Gavins Point Dam. The proportion of winter visitation relative to annual visits was then applied to total annual visitation for the individual river reaches. Table 6 summarizes the visitation during these seasons.

Table 6. Visitation by Season in the River Reaches

River Reaches	Winter Visits	Spring, Summer, Fall Visits
Fort Peck Dam to Lake Sakakawea Riverine Reach*	21,683	284,783
Fort Randall Dam to Lewis and Clark Lake Riverine Reach*	24,228	170,829
Garrison Dam to Lake Oahe Riverine Reach*	13,036	285,702
Oahe Dam to Lake Sharpe Riverine Reach*	26,505	414,011
Gavins Point Dam to Rulo, NE**	183,121	1,030,415
Rulo, NE to the Mouth**	190,866	1,038,553

*Estimated with 2009 data

** Estimated with 2004 data

Thousands of visitors enjoy recreational activities along the banks of the Missouri River during the spring, summer, and fall months. Pleasure boaters, skiers, and a large portion of hunters and anglers access the river by boat.[1] These visitors launch boats from public and private ramps along the main channel and are directly affected by river stages when they fall above or below the operating elevations of the boat ramps. Visitors accessing the river by boat generally use boat ramps from April through November, with peak use occurring between June and October. When river stages rise above or fall below the operating elevations of boat ramps, boat ramp are inoperable, access becomes limited, hindering visitation during these conditions. Some visitors would not be affected by changes in boat ramp operability, such as campers, picnickers, swimmers, sight-seers, land-based hunters, shore anglers, and other visitors (i.e. OHVs, sunbathing, hikers).

Most water-based visitors (those using motorized boats and paddle craft) on the river prefer a quieter, slower, and safer river. In the river below Gavins Point Dam, lower river flows benefit boaters, paddlecraft visitors, floaters, anglers, and hunters, who are able to view the structures in the river more easily, and habitat features, sandbars, and/or shorelines become more accessible at relatively lower river flows, benefiting visitors during these river conditions. In a Missouri DNR study over four years, from 1984 to 1988, Fleener (1989) evaluated visitation in the lower river. The second year in the 4-year period had river flows that were more representative of average flows, while the other years had higher than average spring, summer, and fall flows. The author states that “an average flow of about 100,000 cfs in year two is ideal

[1] Approximately half of the hunters and anglers use boats to fish and hunt in the inter-reservoir river reaches (USACE 2011). Between Gavins Point and Rulo, approximately 30 percent of angling is done from shore, while the remaining 70 percent is by boat (USACE 2011). Below Rulo, Nebraska, half of the anglers fish by boat, while half fish by shore (Korman pers. comm. 2015; Niswonger pers. comm. 2016).

for most recreational activities in the busy season, April through September," as measured at the Hermann gage (Fleener 1989, page 43). Visitation in the summer of 1985, the second year, was greater than visitation in the other 3 relatively higher-flow years. The river flows in all 4 years would have allowed boat ramps to be operable. Since paddlecraft visitors, floaters, and swimmers don't typically rely on boat ramps for their water access, these visitors are likely to also benefit when from relatively lower river flows.

Visitation was segmented into the following types of visitors. The first category (boat-accessed visitation) was assumed to be directly affected by changes in boat ramp operability. The second category (other water based recreation) would also be affected by changing river flows and stages, and was assessed qualitatively in the analysis. Non-water-based recreation were assumed to not be impacted by changes in rivers flows and stages. Winter visitation would not be affected by the plan because boat ramps are typically not operable in the winter and visitation along with river in the winter does not involve water-based recreation. However, all types of visitors are assumed to affected by the prevalence of habitat in the river channel.

- *Spring, summer, and fall boat-accessed visitation*: for the reaches above Gavins Point Dam, boaters, skiers, and half of the anglers and hunters; for the lower river, boating, waterskiing, jetskiing, cruise operations, waterfowl hunting, and a portion of anglers (70% in Gavins to Rulo and 50% in Rulo to the mouth);
- *Spring, summer, and fall other water-based recreation:* for the reaches above Gavins Point Dam, swimmers; for the lower river, swimmers, floaters, and visitors using paddlecrafts[2];
- *Spring, summer, and fall non-water-based recreation:* campers, picnickers, sight-seers, OHVs, sunbathing, hikers, and some anglers and hunters; and
- *Winter visitation:* all visits between the months of December and March (for the reaches above Gavins Point Dam) and January through March for the reaches below Gavins Point Dam.

For the inter-reservoir river reaches, total visitation for spring, summer, and fall visitation was categorized by the type of activity based on VERS 2009 activity distributions. Types of recreational activities for the river reaches below Gavins Point Dam used information from the Public Use Assessment (Sheriff et al. 2011). Activity distributions for the inter-reservoir river reaches and lower river are summarized in Tables 7 and 8.

Table 7. Distribution of Activities in the Inter-Reservoir River Reaches, 2009

Activity	Fort Peck Dam to Lake Sakakawea	Garrison Dam to Lake Oahe	Oahe Dam to Lake Sharpe	Randall Dam to Lewis & Clark Lake
Camping	18.5%	11.4%	5.3%	5.1%
Picnicking	15.0%	6.5%	2.9%	4.5%
Boating	19.7%	14.2%	20.9%	14.7%

[2] The types of visitors associated with "other water based recreation" are limited to those defined by the data sources available. The Public Use Assessment (Sheriff 2011) has more categories of recreation in the lower river compared to the inter-reservoir reaches, where the USACE VERS database was used.

Fishing	16.7%	19.7%	25.3%	10.3%
Hunting	3.2%	1.6%	0.5%	6.6%
Skiing	0.7%	0.4%	2.8%	0.8%
Swimming	4.1%	3.5%	14.1%	5.0%
Sightseeing	10.7%	24.6%	19.0%	25.9%
Other	11.4%	18.1%	9.1%	27.0%
Total 2009 Visits	**209,692**	**229,641**	**387,187**	**173,975**

Source: OMBIL and VERS databases (USACE 2009a; 2009b); Corps data collection efforts.

Table 8. Distribution of Activities in the Lower River, 2004

Activity	Gavins Point Dam to Rulo, Nebraska	Rulo, Nebraska to the mouth near St. Louis
Boating, Jet Skiing, Waterskiing	19%	10%
Fishing	30%	24%
Waterfowl Hunting	3%	3%
Other Water-based Recreation	3%	1%
Non-Water Based Recreation	53%	63%
Total 2004 Visits	***1,052,588***	***1,146,940***

Source: Sheriff, 2011.
Note: percentages may not sum to 100% due to rounding.

The above activity distributions were then applied to all visitation in the respective river reaches. The total recreational visitor days for various types of visitors are provided in Table 9.

Table 9. Visitation on the River Reaches, Annual Recreation Visitor Days

River Reaches	Total Annual Recreation Days	Winter Recreation Days[c]	Spring, Summer, and Fall Recreational Days		
			Boat-Accessed Recreation Days[d]	Other Water-Based Recreation Days[e]	Non Water-Based Recreation Days
Fort Peck Dam to Lake Sakakawea[a]	307,338	21,683	56,832	28,437	199,514
Fort Randall Dam to Lewis and Clark Lake[a]	195,237	24,228	35,939	13,659	121,231
Garrison Dam to Lake Oahe[a]	298,738	13,036	54,612	77,807	153,283
Oahe Dam to Lake Sharpe[a]	440,516	26,505	132,041	139,893	142,077
Gavins Point Dam to Rulo, NE[b]	1,213,535	183,121**	529,444	135,153	365,818
Rulo, NE to the Mouth[b]	1,229,419	190,866**	323,373	162,132	633,147

[a] Denotes 2009 Visitation

[b] Denotes 2004 Visitation

[c] Sheriff et al. 2011 did not specify winter use. Instead, the average percentage of winter use occurring at Corps recreation areas below Gavins Point Dam were applied to total 2004 visitation to estimate winter visitation.

[d] Boat accessed recreation includes motorized boating, waterskiing, jetskiing, cruise operations, and a portion of hunting and fishing in riverine areas (half of hunting and fishing in inter-reservoir reaches; half of fishing in the Rulo to the mouth reach; 70% of the fishing in the Gavins to Rulo reach; all waterfowl hunting on lower river reaches).

[e] Other water-based recreational days in the inter-reservoir reaches include swimmers and half of anglers.

Once the baseline plan-affected visitation was specified, the next step in the methodology was to assess how the visitation within the reservoirs and river reaches would be affected by management actions under the MRRMP-Draft EIS alternatives.

2.4.2 Estimate Changes in Visitation

This section describes the approach to estimate changes in visitation under the MRRMP-Draft EIS alternatives for the upper three reservoirs, the lower three reservoirs, and the river reaches.

Upper Three Reservoirs

The project team explored the relationships between visitation, boat ramp operability, lake elevations, fishing success, and gas prices in a number of time series regressions for the upper three reservoirs. The Comprehensive R Archive Network (also known as “CRAN R” or “R”) regression program was used to specify linear relationships to explain visitation at the upper three reservoirs. The team used actual total 8-month (spring, summer, and fall) visitation at the recreation areas located on the lake as the dependent variable from 2001 to 2012. Independent variables that were analyzed included the fishing success metric as a dummy variable[3], price of gas (in 2013$), mid-August elevations, total 8-month boat-ramp operability for all boat ramps,

[3] A fishing success metric was used as part of the initial alternatives screening process. The pool elevations at the upper three reservoirs fluctuate more than those of the lower three reservoirs and reservoir elevations can have a large impact on the health of the fishery as well as fishing success for anglers. A rising pool in the spring is important for habitat for spawning and nutrient productivity, both of which improve sport fishing at reservoir. State agencies have fisheries management guidelines on the upper three reservoirs that include recommendations for minimum lake elevation changes and spring reservoir elevation increases to support the fisheries, fish and spawning habitat, and nutrient productivity. Fisheries biologists have indicated that to sustain good to improved fishing in the reservoir in the current summer, the reservoir should rise at least one spring in the current spring and the past two consecutive springs (Longhenry pers. comm. 2015b; Fincel pers. comm. 2014; Fryda pers. comm. 2015).
The fishing success analysis was developed with the H&H data for reservoir elevations. The elevation data from the upper three reservoirs was used to identify in which years, during the spring season, the reservoir rose by at least the specified amount during the season (specified in the fisheries management plans -- North Dakota Game and Fish 2015; Montana Fish Wildlife and Parks 2011), but also did not fall by more than 0.2 feet per day during the season. These successful spring pool rise years were then analyzed further, to identify whether the spring rising reservoir criteria is met at least one time during the current spring and two previous springs prior to a given recreational season. An additional analysis was undertaken to account for decreasing reservoir pool elevations at the onset of a drought, which can concentrate fish in the reservoirs, improving fishing success. When reservoirs are dropping, there are fewer nutrients coming into the reservoirs, lower pool elevations concentrating fish, resulting in higher catch rates for anglers. However, sustained decreases in pool elevations (i.e., drought conditions) over more than two years will result in reduced fishing success. Working with the fisheries biologists, the project team developed criteria to capture both the rising spring pools and the improved fishing success at the initial onset of drought (Longhenry pers. comm. 2015b; Fincel pers. comm. 2015; Fincel pers. comm. 2014).

total boat ramp operability for all non-low water boat ramps (defined by each lake) for the 8-month period, and the average of the monthly mid-point lake elevations for the 8-month period.

Biological and other factors can also heavily influence boating and fishing visitation to the lakes, including biomass of smelt, abundance of sport fish such as walleye, angler effort, catch rates, and others. However, because these variables cannot be estimated for the 82-year period of analysis, the regressions focused only on the independent variables associated with lake elevations for the analysis (boat ramp operability, August lake elevations, average annual summer lake elevations). Based on an approach undertaken by fisheries biologists, regressions were estimated with a number of relevant variables (Chipps and Fincel 2015). To screen through independent variables and choose the best model, the Akaike Information Criteria (AIC) was used. The AIC process uses the statistical information on the goodness of fit and the complexity of the model to estimate the quality of each model in explaining the change in visitation between 2001 and 2012. The best regressions included the mid-August elevations and the price of gas; the regressions are shown for the three reservoirs in the table 10.

Table 10. Linear Regression Results for the Upper Three Reservoirs

Reservoir	Independent Variables	Coefficient	T-Statistics	Significance	Goodness of Fit
Fort Peck Lake	Mid-August Elevation Price of Gas	3,249 55,579	3.20 2.51	0.0109 0.0333	0.61
Lake Sakakawea	1-Year Lag Mid-August Elevation Price of Gas	7,274 -96,208	6.47 -4.57	0.0005 0.0005	0.887
Lake Oahe	1-Year Lag Mid-August Elevation	8,269	3.926	0.0025	0.590

The best regressions were tested for multi-collinearity by calculating their Variable Inflation Factor (VIF). This approach quantifies the degree of multi-collinearity in the regression analyses and provides an index value that measures how much the variance of a regression is impacted due to collinearity. For this analysis, a VIF value of 2 or lower was considered to show that a regression lacked multi-collinearity. All regressions had VIF values below 2.

The relationships identified under these regressions were used with the H&H data and historic price of gas in 2013 dollars to estimate the change in spring, summer, and fall visitation for the upper three reservoirs, using 2012 baseline visitation as described in Section 3.1.1. Mid-August lake elevations, 1-year lagged mid-August elevations, and the price of gas were used to develop a predictive model for each lake based on the regression equations.

Changes in winter visitation (December through March) on the upper three reservoirs were estimated through boat ramp operability, with 2012 as the baseline year. Because the majority of the winter recreation involves ice fishing, accessing the lakes is an important part of the recreational activity. When the lake elevations in the winter fall below the bottom engineered elevation of the non-low water boat ramps, the access is much farther from parking lots and the reservoir can start to become a river condition. The boat ramp operability (number of boat-ramp days operable) for the 4 winter months when elevations fall above the engineered bottom elevation and below the top operational elevation for the specified winter boat ramps was used to estimate how visitation would be affected for the winter visitors; 2012 winter visitation and

boat ramp operability was used as the baseline and the change in visitation was based on a proportional change in winter boat ramp operability.

Lower Three Reservoirs and River Reaches

Since water elevations at the lower three reservoirs remain relatively stable, the correlation between lake elevations and visitation at the lower three reservoirs tends to be much weaker than at the three upstream reservoirs. However, lake elevations can still affect boat ramp operability and access to these lakes. For this reason, regression relationships were not undertaken at the lower three reservoirs, and impacts to spring, summer, and fall lake-affected visitation at Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake were assessed based on changes in the number of days when water elevations fall between the top and bottom operating elevations of the normal water boat ramps. The change in visitation relative to 2012 conditions was based on the proportional change in boat ramp operability under the MRRMP-Draft EIS alternatives for each of the 81 years. Similar to the upper three reservoirs, the winter visitation was also based on boat ramp operability during these months.

For the inter-reservoir river reaches, the change in visitation was based on the proportional change in boat ramp operability under the MRRMP-Draft EIS alternatives for each of the 81 years relative to the boat ramp operability in 2009 as the baseline condition. Baseline visitation in 2009 for the boat-accessed visitation -- boaters, skiers, and some of the hunters and anglers – was used to estimate changes in visitation for the spring, summer, and fall season.

The river reach from Oahe Dam to the headwaters of Lake Sharpe is about 9 miles. Lake Sharpe is the first of the lower three reservoirs that is managed as a flow through reservoir. As a result, Lake Sharpe maintains very constant pool levels. Releases from Oahe Dam are coordinated with releases from Big Bend Dam, Randall Dam, and Gavins Point Dam to maintain storage levels at these lower three reservoirs. The Corps does not have a HEC RAS model to estimate the changes in river stages and flows in this relatively short river segment. Because of the lack of H&H data in this reach and the relatively constant reservoir elevations at Lake Sharpe, which would provide an indication of constant boat ramp operability in the river reach, changes in the visitation in this river reach were not evaluated.

Changes in visitation in the lower river for boat-accessed visitors -- boating, skiing, waterfowl hunting, and some of the anglers – were based on boat ramp operability relative to the 2004 baseline condition for the spring, summer, and fall season. The change in visitation relative to the number of operable boat ramp days was based on the proportional change in boat ramp operability for each of the 81 years under each of the MRRMP-Draft EIS alternatives. Again, winter visitors as well as picnickers, swimmers, sight-seers, and some of the hunters and anglers do not access the river and floodplain through boats and are not anticipated to be adversely affected by the change in boat ramp operability.

As mentioned previously, some water-based visitors on the river reaches prefer relatively lower river flows. However, motorized boat-accessed visitors require river flows and stages that meet the bottom elevation of the boat ramps. Non-motorized boaters, such as those who use paddlecraft, swimmers, floaters, and some of the other non-water-based visitors, may prefer relatively lower river flows. Because no specific threshold could be identified by recreation managers and specialists nor could they specify how visitation changes with lower river flows, the evaluation associated with changes in visitation associated with lower river flows was qualitative in nature, describing the anecdotal evidence. The evaluation was focused on describing how the peak recreation season (May through October) flows would be affected

under the MRRMP-Draft EIS alternatives compared to the no action alternative and a qualitative description of how changes in these conditions would affect these visitors.

Under the MRRMP-Draft EIS alternatives, emergent sandbar habitat (ESH) and early life stage habitat for the pallid sturgeon is anticipated to be created, either through flows or mechanical means, in a number of the river reaches. In addition to supporting native species, these areas are generally viewed as natural features that contribute to topographic diversity and increase scenic values associated with the surrounding viewshed. The prevalence of habitat can benefit visitors, increasing the quality of their recreational experiences. Although there are greater opportunities for low-density dispersed recreation along the river where habitat, especially early life stage habitat, is created, there is not a preponderance of evidence to suggest that the creation of these habitat areas would induce additional visitation to the area (Haller pers. comm. 2016, Kuhlhman pers. comm. 2016, Schneider pers. comm. 2016). While these recreational opportunities may or may not translate to a net increase in visitation, the additional features associated with the habitat are likely to be of higher value to visitors. As a result, the recreation analysis associated with habitat areas is focused on how an increase in the acres of habitat could increase the value of the recreational experience (i.e., the Unit Day Values) through an increase of in the quality of recreational experiences. The approach is further described in Section 3.1.3.

2.4.3 Calculate and Apply the Unit Day Values

Benefits associated with recreational opportunities along the Missouri River can be estimated in terms of willingness to pay, or the NED benefits that accrue to visitors. Total recreation benefits are defined as the sum of the maximum amount individuals are willing to pay to engage in a recreation activity, rather than forego it (Walsh, 1986). Willingness to pay includes entry and use fees actually paid for site use, plus any unpaid value (surplus) enjoyed by visitors. The procedures described in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council 1983) (Principals and Guidelines) and USACE ER 1105-2-100 Appendix E outline three generally accepted methods for measuring recreational benefits: the unit day value (UDV), the travel cost method, and contingent valuation. According to the Principals and Guidelines, considerations in the selection of the evaluation procedure should include the absolute and relative size of the recreation benefit created, displaced, or transferred by the project, and the nature of the recreation activities affected. The Principles and Guidelines (U.S. Water Resources Council 1983, page 68) states:

> *"If either use category specified above involves more than 750,000 annual visits, use either a regional model or site-specific study to evaluate benefits or benefits foregone. If recreation is an important project component relative to other outputs and costs, or if specialized activities (those for which opportunities in general are limited, intensity of use is low, and users' skill, knowledge, and appreciation is great) are affected, the criteria also require greater accuracy in benefit estimates. If both specialized activities and general recreation are affected by the project, the choice between a regional model and a more limited site-specific study is at the discretion of the agency, based on consideration of the relative importance of the specialized activity, the advantages of the respective methods, and cost considerations."*

Preliminary visitation estimates indicate that the largest adverse effects relative to the no action alternative would occur at Lake Oahe. In the worst years, up to 100,000 fewer visitors than the

no action would visit Lake Oahe. At Fort Peck and Lake Sakakawea, up to 84,000 fewer visitors compared to the no action alternative could be experienced under the action alternatives under the worst years in the period of record. During these years, it is anticipated that both specialized activities, such as salmon fishing, as well as general activities would be affected under the action alternatives.

Although a current site specific travel cost or contingent value approach would be a preferred method, a more detailed analysis at this geographic scale would be very costly and time consuming. In addition, during the worst years, at most, 100,000 visitors would be affected at two lakes and 84,000 at the third, with a total adverse effect of less than 300,000 visitors. Since a current regional model was not readily available, the Unit Day Value (UDV) method provided the most practical approach for assessing changes in recreational benefits given time and budgetary constraints.

This section describes the various steps in the process to estimate the UDVs, including an overview of the UDV approach, visitation by the general and specialized categories, and the approach for calculating the UDVs for visitation.

Overview of UDV Approach

The UDV method of estimating average willingness to pay relies on expert or informed opinion and judgment. This method of estimating recreational benefits involves the assignment of relative values to individual sites based on the quality of recreation areas. The USACE Economic Guidance Memorandum (EGM) 06-03 provides guidelines for assigning points on a 100-point scale based on five criteria. Total possible points that can be assigned to each criterion are as follows:

1. the quality of the recreation experience as affected by congestion (0-30 points);
2. availability of substitute areas in terms of travel time (0-18 points);
3. carrying capacity determined by level of facility development (0-14 points);
4. accessibility as affected by road and parking conditions (0-18 points); and
5. environmental quality based on aesthetics (0-20 points)

Recreation managers rate their recreation areas based on the above 5 criteria and each site is identified as a type of site (general recreation, general hunting and fishing, specialized hunting and fishing, and other specialized activities). The most recent point ratings for each recreation area were obtained from the Corps Rec-BEST database and averaged over a 4-year period (2009 to 2012). To obtain a value associated with each reservoir or river reach, the UDV points were specified for all of the recreation areas in each geographic location by type of site and then weighted by visitation.

Point ratings were then converted into a monetary value based on values published in Economic Guidance Memorandum (EGM) 06-03 for each type of recreation (general recreation, general hunting and fishing, specialized hunting and fishing, and other specialized activities). Table 11 provides the points to monetary value conversion from the EGM. The distribution of the visitation to the four different types of values is described in the following section.

Table 11. Unit Day Values for Recreation, Fiscal Year 2016

Point Values	General Recreation Values[1]	General Fishing and Hunting Values[1]	Specialized Fishing and Hunting Values[2]	Specialized Recreation Values other than Fishing and Hunting[2]
0	$3.90	$5.61	$27.33	$15.86
10	$4.64	$6.35	$28.07	$16.84
20	$5.12	$6.83	$28.55	$18.06
30	$5.86	$7.57	$29.29	$19.52
40	$7.32	$8.30	$30.02	$20.74
50	$8.30	$9.03	$32.95	$23.43
60	$9.03	$10.01	$35.87	$25.87
70	$9.52	$10.49	$38.07	$31.24
80	$10.49	$11.23	$41.00	$36.36
90	$11.23	$11.47	$43.93	$41.49
100	$11.71	$11.71	$46.37	$46.37

Source: USACE Economic Guidance Memorandum (EGM) 06-03

[1] General recreation refers to an area with recreation activities that are attractive to the majority of outdoor users. These activities generally require easy access with facilities and amenities that most individuals take advantage of while utilizing a Corps administered Recreation Area.

[2] Specialized recreation refers to an area that supports activities for which opportunities are limited, density of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the user are often involved. These areas are predominately (>75%) used for participating in specialized recreation activities. In the reservoirs, salmon fishing with downriggers is an example of specialized fishing recreation.

General and Specialized Visitation

Hunting and fishing visitation from OMBIL and VERS[4] databases for the activity distributions were used for 2009 (inter-reservoir river reaches) and 2012 (reservoirs). The percentages of fishing and hunting for the lower river were obtained from the Public Use Assessment (Sherriff et al. 2011). The Recreation Technical Appendix of the Missouri River Mainstem Reservoir System Master Water Control Manual (USACE 2006) identified the amount of visitation that falls in each of the five categories identified above based on a 1992 visitor survey. This report was used to allocate the hunting and fishing percentages among specialized and generation hunting and fishing categories. Natural resource managers at each reservoir were interviewed to verify whether the proportions of general to specialized fishing recreation at the reservoirs were still consistent with those reported in the Recreation Appendix of the Master Water Control Manual. While most resource managers agreed with the distributions of specialized and general recreation reported in the Master Water Control Manual, managers at Lake Oahe indicated that recreational opportunities on the lake had likely changed since the 1992 survey and provided updated distributions for general and specialized fishing and hunting (Sheffield and Voeller pers.

[4] The VERS data was obtained by recreation area, and the participation rates were estimated by focusing only on the recreation areas on the lakes; the recreation areas that were located below the dams were assigned to the appropriate river reach.

comm. 2015). The remaining percentage of visitors were allocated to general recreation. Table 12 summarizes the allocation among the general and specialized recreational activities.

Table 12. Distribution of Specialized and Generalized Recreation Opportunities in the Reservoirs and River Reaches

Recreation Category/Location	Percent of Visitation
Fort Peck	
General Recreation	74.8%
General Fishing	18.6%
Specialized Fishing	2.9%
Specialized Hunting	2.5%
General Hunting	1.2%
Fort Peck Dam to Lake Sakakawea	
General Recreation	80.1%
General Fishing	14.2%
Specialized Fishing	2.5%
Specialized Hunting	1.9%
General Hunting	1.3%
Lake Sakakawea	
General Recreation	73.7%
General Fishing	17.3%
Specialized Fishing	6.4%
Specialized Hunting	0.5%
General Hunting	2.1%
Garrison Dam to Lake Oahe	
General Recreation	78.7%
General Fishing	19.7%
Specialized Fishing	0.0%
Specialized Hunting	1.0%
General Hunting	0.6%
Lake Oahe	
General Recreation	60.3%
General Fishing	27.3%
Specialized Fishing	9.8%
Specialized Hunting	0.3%
General Hunting	2.4%
Lake Sharpe	
General Recreation	84.1%
General Fishing	7.9%

Recreation Category/Location	Percent of Visitation
Specialized Fishing	7.7%
Specialized Hunting	0.0%
General Hunting	0.3%
Lake Francis Case	
General Recreation	62.4%
General Fishing	28.1%
Specialized Fishing	9.3%
Specialized Hunting	0.0%
General Hunting	0.1%
Randall Dam to Lewis and Clark Lake	
General Recreation	83.1%
General Fishing	10.3%
Specialized Fishing	0.0%
Specialized Hunting	4.0%
General Hunting	2.6%
Lewis & Clark Lake	
General Recreation	90.0%
General Fishing	8.1%
Specialized Fishing	0.9%
Specialized Hunting	0.0%
General Hunting	0.9%
Gavins Point Dam to Rulo, NE	
General Recreation	79.8%
General Fishing	19.2%
Specialized Fishing	0.0%
Specialized Hunting	0.6%
General Hunting	0.4%

* Calculated based on activity distribution for VERS (2009 and 2012); the distribution of general to specialized opportunities used information from lake managers or from the 1991 Angler Survey from the Master Manual (USACE 2006).

Note: In accordance with Corps guidance, boating is considered to be an activity included in general recreation (USACE 2016).

Estimate UDVs for Non-Habitat-Affected Areas

The UDVs for each reservoir, inter-reservoir river reach, and lower river segment were calculated based on point ratings assigned to Corps-administered recreation areas. Point values between 2009 and 2012 for each recreation area were obtained from the Rec-BEST database and averaged. Average point values for recreation sites were then weighted based on recreation area visitation and aggregated to provide a single point value for each reservoir or

river reach. The UDVs was estimated with the appropriate point value for each location (table 11) and was weighted based on the allocation of activities among general and specialized recreation for each geographic location (table 12). The UDVs for each of the geographic locations are provided in table 13.

Table 13. Estimates of UDVs for Each Reservoir and River Reach

River Reach or Reservoir	UDV (2016$)
Fort Peck Lake	$8.54
Fort Peck Dam to Lake Sakakawea	$7.45
Lake Sakakawea	$9.01
Garrison Dam to Lake Oahe	$6.57
Lake Oahe	$10.83
Lake Sharpe	$11.27
Lake Francis Case	$11.45
Randall Dam to Lewis and Clark Lake	$5.81
Lewis & Clark Lake	$4.91

Because there was no Rec-BEST data for recreation areas in the Rulo to the mouth river reach, the UDV estimate for this river reach was scaled based on the difference between the two values from the Master Manual Recreation Technical Appendix (USACE 2016) for similar river reaches.

Estimate UDVs for Habitat Areas

Emergent sandbars and shallow waters provide critical nesting and foraging habitat for fish and wildlife and add to the natural aesthetics of the Missouri River floodplain. In addition to supporting native species, these areas are generally viewed as natural features that contribute topographic diversity and increase scenic values associated with the surrounding viewshed. The prevalence of these habitat types benefit visitors, increasing the quality of their recreational experiences. Thus, increasing their enjoyment and willingness to pay for a variety of recreational experiences along the river.

To better understand the relationship between various types of habitat and outdoor recreation along the lower river, interviews were conducted with natural resource and recreation area managers who administer sites with habitat or very near habitat areas between Randall Dam and the confluence with the Mississippi River. Across the interviews, natural resource managers agreed that the prevalence of habitat and its features contributed to and enhanced the quality of the recreational experience along the Missouri River. Although some recreation managers have implied that previous mitigation projects (e.g., chutes and backwaters expansion/creation) have attracted additional visitors to local recreation areas, they were not able to quantify the relationship between habitat prevalence and changes in visitation. Most resource managers interviewed were hesitant to speculate on this relationship and were unsure whether new habitat features induced visitation. All recreation managers did however, suggest that new habitat areas (ESH and early life stage habitat for the pallid sturgeon) would support greater opportunities for low-density dispersed recreation along the river. While these opportunities may not translate to a net increase in visitation, these additional opportunities are likely to be of higher value to

visitors. As a result, the recreation analysis associated with habitat areas is focused on how an increase in prevalence of habitat under the MRRMP- Draft EIS alternatives could increase UDVs through an increase in the quality of recreational experiences.

The areas with both early life stage habitat for the pallid sturgeon and ESH provide additional access opportunities as well as greater opportunities for solitude in the river channel. Newly-created ESH and early life stage habitat for the pallid sturgeon within the river reaches would provide additional places to stop and participate in shore-based or in-river activities, including hunting, fishing, picnicking, and other activates.

The creation of additional habitat areas would also enhance the aesthetic quality (i.e., geology, topography, water, vegetation) near these mitigation projects, affecting the ratings of affected river reaches under the “environmental aesthetics” criteria within the UDV guidance. The environmental aesthetics criteria ranges from 1 to 20 points, with a value of 1 indicating a site has low esthetic quality with significant limiting factors and a rating of 20 indicating a site has outstanding esthetic quality, with rare or unique elements and no limiting factors. Based on input from recreation managers at habitat sites, the creation of new habitat would improve aesthetic qualities, but would be unlikely to drastically increase ratings for this criteria. On average, additional habitat creation could increase the value of recreational experiences near mitigation sites by 5 points based on the UDV criteria (Haller pers. comm. 2016).

To estimate relatively higher-valued recreational experiences associated with new habitat areas, current point values for the four river reaches were adjusted to reflect an increase of 5 points (Haller pers. comm. 2016). New point values for these river reaches (Garrison, Randall, Gavins Point Dam to Rulo and Rulo to the mouth) were then converted to a monetary UDV based on values published in the 2016 EGM 06-03. The UDVs for the river reaches where habitat would be created were estimated, as weighted based on the four types of recreation (i.e., general and specialized recreation, hunting, and fishing).

The next step in the process was to estimate the proportion of visitors to which the higher UDV would be applied. The approach focused on estimating the prevalence (i.e., proportion) of target habitat acres in the channel compared to all channel acres in each river reach; the proportion of newly created habitat in the channel was then applied to the visitation in the river reaches to provide an estimate of the visitors that would be affected by the creation of new habitat. Information on anticipated acres of ESH and early life stage habitat for the pallid sturgeon from the alternatives descriptions and the bird modeling results was obtained and is summarized in Table 14.

The project team worked with the USACE modeling specialists to estimate the number of acres within the channel in each of the river reaches. The average top width of the channel for each of the river reaches was provided at normal navigation season while considering the Alternative 1 geometry with current and additional shallow water habitat below Gavins Point Dam. This information was used to estimate the acres of channel in each river reach (some river reaches had multiple segments if they had considerably different top widths). With the acres of habitat in each river reach (table 14), the analysis estimated the proportion of the channel that would have newly created habitat under the MRRMP- Draft EIS alternatives. It was assumed that this proportion of habitat in the channel would affect the same proportion of visitors in the river reach being analyzed. Table 15 summarizes the proportion of visitation anticipated to be affected by the habitat.

Table 14. Target Acres of Habitat Creation by River Reach

River Reach	Alternatives					
	1	2	3	4	5	6
Target Early Life Stage Habitat for the Pallid Sturgeon (Acres)						
Ponca to Rulo, Nebrtaska	1,933	4,483	861	861	861	861
Rulo, NE to the Mouth	2,066	6,275	2,519	2,519	2,519	2,519
Median Available Acres of Emergent Sandbar Habitat						
Garrison Dam to Lake Oahe	294.6	4,375.2	735.4	468.3	603.5	468.5
Randall Dam to Lewis and Clark Lake	54.2	709.6	71.4	91.8	79.7	79.6
Gavins Point Dam to Rulo, Nebraska	147.5	4,658.9	597.3	479.1	479.6	493.5

Note: Target acres to support early life stage requirements were obtained the alternatives descriptions (see Chapter 2 for additional details). Target median acres of emergent sandbar habitat was obtained from the Effects Analysis Reports, available on the MRRP website at www.moriverrecovery.org; median available acres of ESH at the end of the planning period were used in the analysis.

Table 15. The Proportion of the Channel Affected by Habitat Creation

River Reach	Alternatives					
	1	2	3	4	5	6
Garrison to Lake Oahe	1%	21%	4%	2%	3%	2%
Randall Dam to Lewis and Clark Lake	0%	5%	1%	1%	1%	1%
Gavins to Rulo, Nebraska	5%	24%	4%	3%	3%	4%
Rulo, Nebraska to the Mouth	3%	9%	4%	4%	4%	4%

The above proportion of the channel affected by habitat was applied to the annual boat-accessed visitation for each of the river reaches, to which the higher UDV was then applied. In addition, the newly created habitat is anticipated to affect other visitors, including winter and other water- and non-water-based visitors. Therefore, the difference between the higher with-habitat UDVs and the lower non-habitat UDV for each of the river reaches was applied to the remaining proportion of visitors (non-boat-accessed visitors) affected by habitat to estimate the contribution of the habitat to recreation NED benefits.

2.4.4 Recreation Benefits of Visitation (NED Benefits)

The NED benefits of visitation were estimated by applying the appropriate UDV value to the estimated change in the annual spring, summer, and fall, and the winter seasonal visitation. The UDV for the reservoirs is not anticipated to change under the MRRMP- Draft EIS alternatives; the UDV value is based on four years of data (2009-2012) and represents weighted visitation by the type of sites at the reservoirs. As described in the previous section, the higher UDV associated with the prevalence of habitat areas was applied to a proportion of the boat-access visitors as well as all other visitors to estimate the NED effects of visitation in proximity to newly created habitat areas. The UDVs and NED benefits are provided in 2016 dollars.

2.4.5 Estimate Operating, Maintenance, Repair, Replacement and Rehabilitation

Costs (NED Losses)

Persistent drought conditions in the mid-2000s resulted in millions of dollars being invested to maintain and improve lake access at the upper three reservoirs. Funding to facilitate access improvements came from Congressional appropriations as well as federal, state, and local governments. These projects included the construction and extension of numerous boat ramps with relatively low engineered bottom elevations in areas most affected by persistent drought conditions. Table 16 summarizes the number of normal and low water boat ramps at the upper three reservoirs.

Table 16. Number of Boat Ramps at each Reservoir

Reservoir	Low Water Boat Ramps	Normal Water Boat Ramps
Fort Peck Lake	11	10
Lake Sakakawea	39	48
Lake Oahe	18	50

Generally low water boat ramps are brought on-line after the “sister” normal-water boat ramp is no longer operable (i.e., reservoir elevations fall below the operating elevation). Once the low water boat ramp is operable, these ramps are maintained for as long as drought conditions persist. During drought conditions, the simulated reservoir elevations under the MRRMP-DRAFT EIS alternatives at the upper reservoirs show that some of the alternatives would draw down the reservoirs farther than under the no action alternative. As a result, there are possible impacts to capital and operating costs as reservoir elevations fall more frequently and also fall below the bottom elevation of the low water boat ramps. In addition to the costs directly associated with extending or replacing the boat ramp, additional costs may be associated with roads, parking facilities, and toilets to ensure visitors continue to have access to the low water ramps.

Operating and maintenance costs may also be impacted because boat ramps require cleaning and additional maintenance to make them operable after lake elevations have fallen from the previous year. Operations and maintenance activities to ensure access to boat ramps when reservoir elevations are falling generally include cleaning the silt from the ramp, dredging sand around the ramp, and minor repairs. The approach to evaluate the capital and operating and maintenance costs is explained in the following subsections.

Repair, Replacement, and Rehabilitation Costs during Drought Conditions at the Upper Three Reservoirs

To evaluate the repair, replacement, and rehabilitation (RR&R) costs associated with the MRRMP-Draft EIS alternatives, the simulated reservoir elevations were evaluated at the upper three reservoirs for four drought periods:

- 1931 – 1942
- 1955 – 1962
- 1988 – 1993
- 2001 – 2009

During these periods, reservoir elevations for most of the alternatives fell below the bottom operating elevation of low water boat ramps. Reservoir elevations during the drought years were compared alongside bottom operating elevations of each low water boat ramp under the alternatives to evaluate whether, and to what extent, the action alternatives would cause lake elevations during drought periods to fall lower than under the no action. Although drought conditions during the 1930s and early 1940s were shown to have the most significant impacts of the four drought periods identified, lake elevations under all of the alternatives, including the no action alternative, the differences in lake elevations among the alternatives were minimal.

Of the three more recent drought periods, lake elevations under the alternatives were shown to adversely affect low water ramp operability during the simulated drought periods that would occur under conditions similar to the late 1950s and early 1960s; and the 2000's. Adverse impacts during these two time periods were compared to those during the 2000's, revealing that low water ramp operability would be adversely affected for a greater portion of high use summer months in the simulated conditions in the 2000s. The simulated reservoir elevations during the 2000s drought were used to estimate the RR&R costs to extend and replace low water boat ramps and maintain access to recreation infrastructure during drought conditions.

To continue to provide lake access during these extreme low water periods, capital investments would have to be made to extend or replace existing low water boat ramps. Costs associated with building and extending boat ramps can vary widely based on individual project needs. Past projects to construct a new 6 to 9 (vertical) foot boat ramp (including gravel access to the ramp and parking) have cost approximately $50,000, which includes construction materials, labor, associated engineering, project oversight, and permitting (McMurry pers. comm. 2016a). Each foot in excess of 9 feet was projected to cost another $2,000 in materials, engineering, oversight, permitting, and road access. In addition to ramp construction, an estimated $10,000 in major road work and additional parking facilities are also needed when a new boat ramp and access point is constructed. When existing infrastructure exists and is in relatively good repair, boat ramps can be extended at lower costs. It was estimated that the average cost to extend an existing ramp 2 to 4 feet is $23,000 (including costs for engineering, oversight, and permitting), with every foot in addition to the 2 to 4-foot extension costing an additional $2,000 (McMurry pers. comm. 2016a).

Additional RR&R costs for low water ramps and other infrastructure were estimated at each of the three upper reservoirs based on simulated reservoir elevations between 2001 and 2009. Low water ramps were prioritized for replacement and/or extension based on their location and bottom operating elevations. One boat ramp located in a recreation areas was considered a priority ramp for extension and/or replacement. If multiple boat ramps were located in one recreation area, one ramp was considered to be the priority, while the other were not considered for extension and/or replacement. In addition, low water ramps were assumed to be extended and/or replaced if water elevations at the corresponding reservoir fell below the ramp's bottom elevation for the majority of two or more consecutive peak summer seasons.

Based on the elevations of existing boat ramps, it was assumed that some of the ramps most severely affected by drought conditions would not be able to be extended. Instead, these ramps would be replaced. The proportion of ramps extended versus replaced was assumed to be similar across the three upper reservoirs, with one out of every six priority or targeted boat ramps replaced, while the remaining boat ramps would be extended. The lowest point during the drought condition relative to the bottom operating elevation for each low water ramp during the peak summer months (June through September) was used to assess the number of vertical feet needed to extend the boat ramp. The costs obtained from the recreation managers to

extend and/or replace the targeted low water boat ramps, along with additional infrastructure, were used to calculate total RR&R costs at the upper three reservoirs.

Operating and Maintenance Costs to Maintain Access to Boat Ramps

Operating and maintenance costs associated with bringing low water ramps online during low water periods can vary based on the maintenance required to restore operability as reservoir elevations fall. Maintenance to enable low water boat ramp operability can include cleaning the silt from the ramp, dredging sand around the ramp to make the ramp accessible for boats, and minor repairs, etc. On average, it costs approximately $800 per ramp to clean and bring a low water ramp online after the reservoir elevation had fallen from the previous year, although these costs can considerably vary (McMurray pers. comm. 2016b). In addition, normal water boat ramps also require maintenance if the boat ramp remains operable when water levels have dropped from the previous year.

To evaluate how lower surface elevations under the action alternatives may increase O&M costs, an Excel®-based model was developed to evaluate consecutive years when reservoir elevations fall and normal and low water boat ramps remain operable. Boat ramps were considered operable when surface elevations remained between the top and bottom operating elevation of the boat ramp.

Simulated reservoir elevations at the beginning of the summer season, on average between June 25th and July 5th, were obtained and compared to simulated reservoir elevations at the same time in the previous year. If early July surface elevations were three or more feet lower than the average elevation at the beginning of the previous July and the boat ramp was operable, the boat ramps were assumed to require cleaning, de-silting, and other maintenance activities that year to accommodate boat launches. The low water ramps that were assumed to be extended or replaced in the RR&R analysis were assumed to always be operable during the period of record. The $800 was applied to every year that these conditions were met (drop of three feet from previous year and operable boat ramp) for the MRRMP- Draft EIS alternatives to estimate the operating and maintenance costs at the upper three reservoirs.

2.5 Regional Economic Development

The Regional Economic Development (RED) account evaluates how changes under the MRRMP- Draft EIS alternatives would affect regional economic benefits, including labor income, employment, and sales. These effects are typically expressed in monetary values or other numeric units (i.e. number of jobs) and are classified as either a direct or secondary (indirect and induced) effects. Direct effects represent the impacts of the visitor spending and resulting sales that are generated to tourism industries near the recreation areas. Indirect effects represent the impacts caused by the iteration of industries purchasing goods and services to support the directly affected industries. Induced effects represent the economic benefits from all affected workers spending their income in the local or regional economy. Secondary impacts refer to both indirect and induced effects.

RED benefits associated with recreation along the Missouri River stem from visitor spending in gateway communities. Visitors traveling to the Missouri River spend their income in communities where they eat in restaurants, stock up on gas and supplies at local retailers, and stay in overnight accommodations while at their recreation destination. The visitor spending and resulting sales to local businesses provide a measure of the direct effect of outdoor recreation on the regional economy. An economic impact analysis measures the changes in new economic

activity associated with an industry, event, or policy in an existing regional economy (Watson et. al 2007). In the case of recreation on the Missouri River, this type of analysis examines how visitors who reside outside of the local region inject spending into local economies while visiting the area, and how this spending creates multiplier effects in the local economies stimulating additional economic activity.

The RED recreation analysis uses the results from the NED analysis to assess how changes in visitation under the MRRMP- Draft EIS alternatives would affect regional economic conditions. Since results from the NED analysis showed that visitation to Lake Sharpe would be unaffected by actions under the alternatives, there would be no changes in RED impacts for Lake Sharpe under the MRRMP- Draft EIS alternatives and therefore it was not evaluated in the RED analysis. The inter-reservoir river reaches and lower river were also excluded from the RED analysis since these river reaches primarily wind through private lands where public access is limited, and previous reports have indicated that visitation was mostly by residents who live nearby (USACE 2006; USACE 2011; USACE 2001; Sheriff et al. 2011). Although recreation opportunities enjoyed by local residents contribute to personal well-being, spending by residents is generally not included in recreational regional economic analyses because these expenditures would not inject new money or spending into the local economy; spending would occur by local residents regardless of visitation to the recreation area.

Non-local visitation at five of the mainstem reservoirs were used as inputs in an economic impact analysis to estimate how changes in visitor spending will affect jobs and income under the MRRMP- Draft EIS alternatives. The USACE-certified RED model, Regional Economic System (RECONS) was used to estimate the economic impacts. The NED analysis provided estimates of recreation visitor days over the 81-year period of record for each reservoir under each of the MRRMP-Draft EIS alternatives. For consistency with the RECONS, total visitation by various types of visitors needs to be entered into the model. Total recreational visitor days for upper three reservoirs were estimated by combining the spring, summer, and fall visitation with winter visitation. Since visitation at the lower three reservoirs was segmented in the NED analysis to focus on lake-elevation affected visitors, the non-lake affected visitation needed to be added to estimate total lake visitation. Annual recreation visitor days were then converted back to annual visits by adjusting for multi-day camping visits using an estimate of 3.8 recreation days per camping visit, as reported by the OMBIL database (USACE OMBIL 2012a).

The estimates of annual visitation over the 81-year period of record for the plan-affected and non-plan-affected visitation were further analyzed to focus on scenarios for the economic impact analysis. For the 81 years, five scenarios were developed on which to estimate the economic impacts under each of the MRRMP-Draft EIS alternatives: lowest annual visitation; highest annual visitation; annual average visitation; average of the eight years with the lowest visitation difference from no action; and average of the eight years with the highest visitation difference from no action. The total visitation for each of the five scenarios was further segmented for consistency with RECONS.

RECONS model, by default, estimates the economic impacts of visitor spending for three study areas: local, state, and the nation. The local study area is specified by default based on Corps project areas. The local study area usually includes the counties within and surrounding the project boundary, including counties generally within 50 miles of the project area. The state study area includes the state or states in which the local study area is located. After reviewing the local study areas for the five reservoirs, the project team felt that there were a number of counties missing from the local study areas. In addition, the results of the economic impact analysis for the local and state study areas were very similar. Due to these considerations and

consistent with the RED analysis for other resource topics, it was decided that the economic impact analysis should present the state study area results. Although some of the economic impacts may be experienced over the wider state geographic area, the vast majority of the jobs, income, and sales would be supported and generated in the counties surrounding the reservoirs. Table 17 summarizes the state study areas for each of the five reservoirs.

Table 17. Study Area Areas

Reservoir	State Study Area
Fort Peck Lake	Montana
Lake Sakakawea	North Dakota
Lake Oahe	South Dakota
Lake Francis Case	South Dakota
Lewis and Clark Lake	South Dakota

Note: State study areas are defined in the RECONS model.

As described previously, the focus of the economic impact analysis was on visitor spending from non-local visitors. Information was obtained from state sources, recent angler and visitor surveys, and published reports to estimate the percent of local and non-local visitors. Table 18 summarizes recent data on the residency of visitors to the five reservoirs.

Table 18. Residency of Visitors to the Reservoirs

Reservoir	Visitors from Counties Surrounding or Adjacent to Project Area	Non-local Visitors*
Fort Peck Lake	8%	92%
Lake Sakakawea	22%	78%
Lake Oahe	30%	70%
Lake Francis Case	21%	79%
Lewis and Clark Lake	57%	43%

Source: Longhenry pers. comm. 2016; Fryda pers. comm. 2016; USGS 2011; South Dakota Game Fish and Parks 2016.

*Non-local visitors include visitors from counties with population centers greater than 50 miles from the reservoir project area.

Non-local visitation was further segmented into visitor groups consistent with those defined in the RECONS model (table 19). First, day and overnight visits to each reservoir were estimated by applying the day/overnight proportions for each project area from RECONS to the estimates of non-local visitation at the respective reservoir. Day/Boater visits were then estimated by applying boating activity distributions from VERS to counts of non-local day visits at the corresponding reservoir. The remaining day use visits were then allocated to the Day/Non-Boater category. Camping activity distributions from VERS were then applied to overnight visitation counts to specify camping and non-camping overnight visitation at each of the reservoirs. Boating activity distributions from VERS were then applied to camping and overnight (non-camping) visits to identify Camper/Boater and Overnight/Boater visitation. The remaining Camper and Overnight visitation were then allocated to the Non-Boater category.

Table 19. Non-Local Visitor Activity Distributions

Reservoir	Day/Boater	Day/Non-Boater	Overnight/ Boater	Overnight/ Non-Boater	Camper/Boater	Camper/Non-Boater
Fort Peck Lake	21%	64%	3%	9%	1%	2%
Lake Sakakawea	21%	69%	2%	7%	<1%	1%
Lake Oahe	8%	25%	16%	48%	1%	2%
Lake Francis Case	26%	66%	2%	6%	<1%	<1%
Lewis and Clark Lake	6%	85%	1%	7%	<1%	<1%

Source: Estimated with data and information from VERS (USACE 2012c) and RECONS (2012).

Visitor spending profiles for the types of visitors were specified in RECONS; the visitor spending profiles are built into the RECONS database and include spending in ten categories, as shown in table 20. Total spending is then estimated for each type of visitor by multiplying the number of visits times the average spending profile. Although the number of visitors (one person for a day or multiple days) is the input into RECONS, RECONS model then converts the visitors to visitor party-days to estimate visitor spending per party per day.[5]

5 Please see the RECONS User Guide (http://www.iwr.usace.army.mil/Portals/70/docs/missions/RECONS_USER_GUIDE.PDF) and RECONS Methodology Manual (http://www.iwr.usace.army.mil/Portals/70/docs/missions/RECONS_%20MethodologyManual-2.pdf) for additional details on the recreation assumptions and methods.

Table 20. RECONS Non-Local Visitor Spending by Type of Visitor ($ per party per day, 2016$)

Spending Category	Type of Visitor					
	Day Boater	Day/Non-Boater	Camper Boater	Camper Non-Boater	Overnight Boater	Overnight Non-Boater
Motel, Hotel Cabin or B&B	-	-	5.27	2.51	48.98	52.18
Camping Fees	-	-	16.28	25.64	0.20	0.29
Restaurants & Bars	9.27	9.27	17.03	29.33	38.61	45.38
Groceries, Take-out Food/Drinks	7.28	3.80	25.14	18.77	22.80	12.94
Gas & Oil	18.88	6.30	23.04	18.78	28.91	15.47
Other Auto expenses	0.68	0.08	0.86	4.35	0.29	2.10
Other Boat Expenses	18.22	0.44	9.15	0.83	14.23	0.61
Recreation Fees	0.83	2.13	6.50	24.59	15.03	38.77
Sporting Goods	10.05	2.32	3.17	4.71	5.63	2.85
Souvenirs and Other Expenses	10.42	3.11	5.34	13.24	11.55	25.40
Total	**75.62**	**27.45**	**111.79**	**142.75**	**186.24**	**196.00**

Source: RECONS (2012).

The RECONS recreation module then applies these spending profiles to annual visitation counts for each type visitor to estimate visitor expenditures. In RECONS, the visitor expenditures in the ten categories are then mapped to industry sectors in to quantify the direct and secondary (i.e. indirect and induced) effects of visitor spending on regional sales, employment, and labor income. RECONS uses IMPLAN® Pro multipliers and ratios, which is an industry-standard input-output model to estimate the multiplier impacts. Since RECONS and IMPLAN® Pro are linear models and the distribution of visitors to the various types of visitors is the same across alternatives, results from Alternative 1 can be scaled up or down based on the proportional difference in visitation under the other alternatives and scenarios to quantify the RED effects of visitor spending under MRRMP- Draft EIS alternatives and scenarios.

3.0 National Economic Development Results

This section presents the results of the NED analysis. The first section provides the NED impacts across all alternatives, and the following section provide alternative-specific sections.

3.1 Summary Across Alternatives

This section describes the impacts to recreation NED benefits under the MRRMP- Draft EIS alternatives at the upper three reservoirs, lower three reservoirs, the inter-reservoir reaches, and the lower river reaches. The recreation NED tables in this section include total benefits and changes in benefits relative to Alternative 1 over 81-year period of analysis, including visitation, recreation NED benefits and OMRR&R costs; average annual NED benefits and changes in average annual benefits. In addition, the recreation NED tables include two statistics that focus on the differences from Alternative 1: the average of the eight best difference years (highest visitation years compared to Alternative 1); and the average eight worst visitation years (lowest

visitation years compared to Alternative 1). These statistics allow an understanding of the skewness of impacts and magnitude of impacts in these largest difference years.

3.1.1 Upper Three Reservoirs

The recreation visitor days, recreation NED benefits, and OMRR&R costs for Fort Peck Lake, Lake Sakakawea, and Lake Oahe are each summarized respectively in tables 21, 22, and 23. Figures 3, 4, and 5 depict the change in annual recreation NED benefits from changes in visitation relative to Alternative 1 at each of the upper three reservoirs.

Table 21. Summary of Visitation and Recreation NED Benefits for Fort Peck Lake (Thousands of 2016 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days	266,295	262,104	266,560	258,962	265,070	261,769
Change in Average Annual Recreation Visitor Days	NA	- 4,190	265	- 7,332	- 1,225	- 4,526
Percent Change in Average Annual Recreation Visitor Days	NA	-1.6%	0.1%	-2.8%	-0.5%	-1.7%
Total Visitation Benefits	$184,706	$181,776	$184,890	$179,762	$183,847	$181,572
Total Habitat Benefits	NA	NA	NA	NA	NA	NA
OMRR&R Costs (total)	$311	$497	$310	$542	$319	$512
Total NED Benefits	**$184,395**	**$181,279**	**$184,580**	**$179,220**	**$183,528**	**$181,060**
Total NED Change from No Action	NA	-$3,116	$186	-$5,175	-$867	-$3,335
Percent Change from No Action	NA	-1.7%	0.1%	-2.8%	-0.5%	-1.8%
Annual Average NED Benefits	$2,276	$2,238	$2,279	$2,213	$2,266	$2,235
Change in Annual Average NED Benefits	NA	-$38	$2	-$64	-$11	-$41
8 Worst Years Relative to Alternative 1	NA	-$280	-$16	-$277	-$69	-$151
8 Best Years Relative to Alternative 1	NA	$65	$28	$16	$24	$5

Table 22. Summary of Visitation and Recreation NED Benefits for Lake Sakakawea (Thousands of 2016 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Average Annual Recreation Visitor Days	968,923	962,802	970,120	957,028	965,743	961,867
Change in Average Annual Recreation Visitor Days	NA	- 6,121	1,198	- 11,895	- 3,179	- 7,055
Percent Change in Average Annual Recreation Visitor Days	NA	-0.6%	0.1%	-1.2%	-0.3%	-0.7%
Total Visitation Benefits	$706,877	$702,411	$707,750	$698,199	$704,557	$701,729
Total Habitat Benefits	NA	NA	NA	NA	NA	NA
OMRR&R Costs (total)	$1,397	$1,672	$1,430	$1,744	$1,475	$1,636
Total NED Benefits	**$705,480**	**$700,739**	**$706,320**	**$696,454**	**$703,082**	**$700,093**
Total NED Change from No Action	NA	-$4,741	$840	-$9,025	-$2,397	-$5,386
Percent Change from No Action	NA	-0.7%	0.1%	-1.3%	-0.3%	-0.8%
Annual Average NED Benefits	$8,710	$8,651	$8,720	$8,598	$8,680	$8,643
Change in Annual Average NED Benefits	NA	-$59	$10	-$111	-$30	-$66
8 Worst Years Relative to Alternative 1	NA	-$402	-$39	-$443	-$176	-$206
8 Best Years Relative to Alternative 1	NA	$116	$81	$39	$67	$28

Table 23. Summary of Visitation and Recreation NED Benefits for Lake Oahe (Thousands of 2016 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	**2**	**3**	**4**	**5**	**6**
Average Annual Recreation Visitor Days	826,776	811,591	828,424	804,873	825,366	810,289
Change in Average Annual Recreation Visitor Days	NA	-15,185	1,648	-21,903	-1,410	-16,488
Percent Change in Average Annual Recreation Visitor Days	NA	-1.8%	0.2%	-2.6%	-0.2%	-2.0%
Total Visitation Benefits	$725,016	$711,699	$726,461	$705,808	$723,779	$710,557
Total Habitat Benefits	NA	NA	NA	NA	NA	NA
OMRR&R Costs (total)	$1,551	$1,618	$1,495	$1,618	$1,504	$1,632
Total NED Benefits	**$723,465**	**$710,081**	**$724,966**	**$704,190**	**$722,275**	**$708,926**
Total NED Change from No Action	NA	-$13,383	$1,501	-$19,275	-$1,190	-$14,539
Percent Change from No Action	NA	-1.9%	0.2%	-2.7%	-0.2%	-2.0%
Annual Average NED Benefits	$8,932	$8,766	$8,950	$8,694	$8,917	$8,752
Change in Annual Average NED Benefits	NA	-$165	$19	-$238	-$15	-$179
8 Worst Years Relative to Alternative 1	NA	-$864	-$52	-$871	-$131	-$609
8 Best Years Relative to Alternative 1	NA	$309	$98	$86	$107	$42

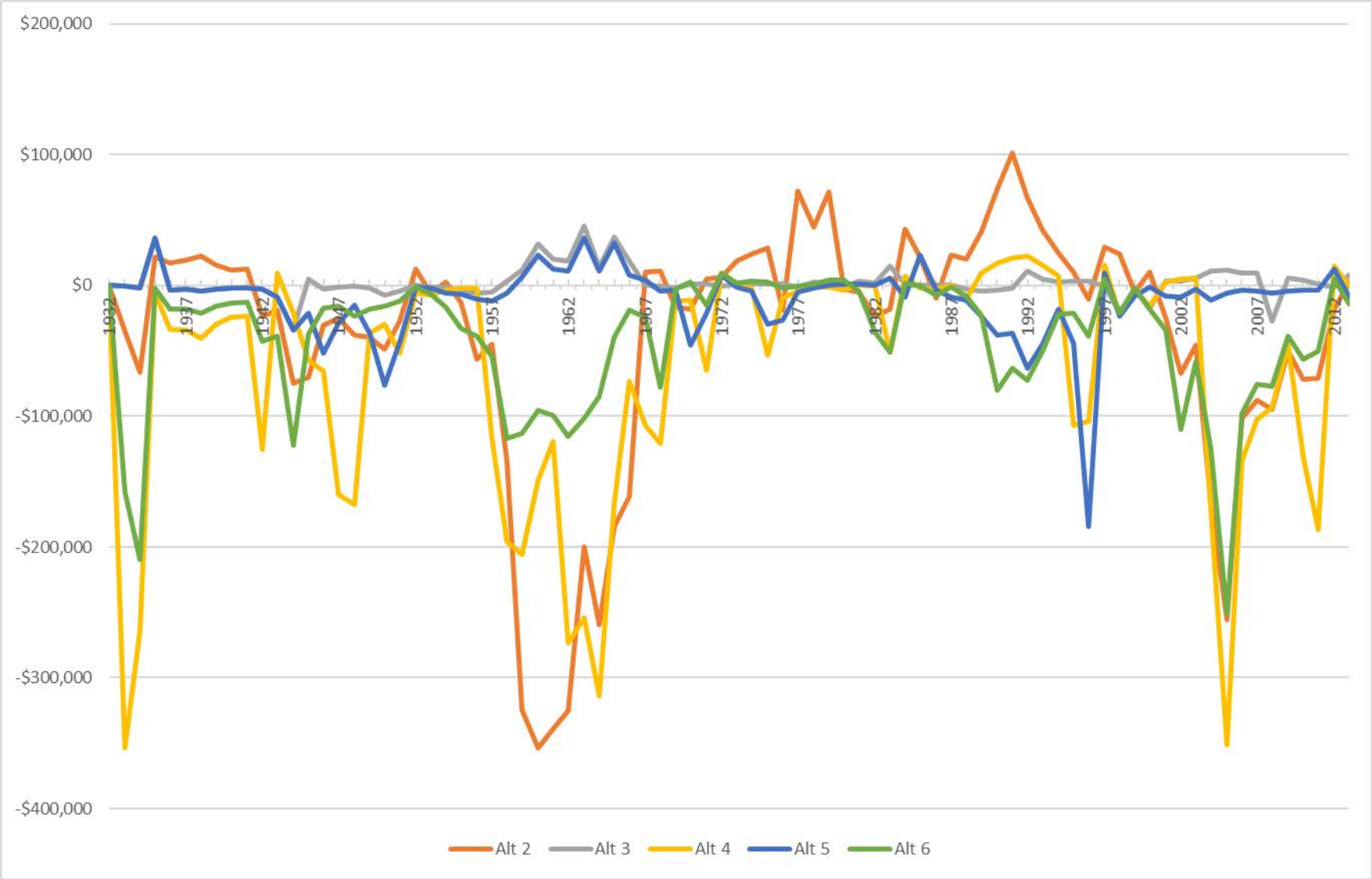

Figure 3. Fort Peck Lake Annual Differences in Visitation NED Benefits under the MRRMP-Draft EIS Alterantives Relative to Alternative 1

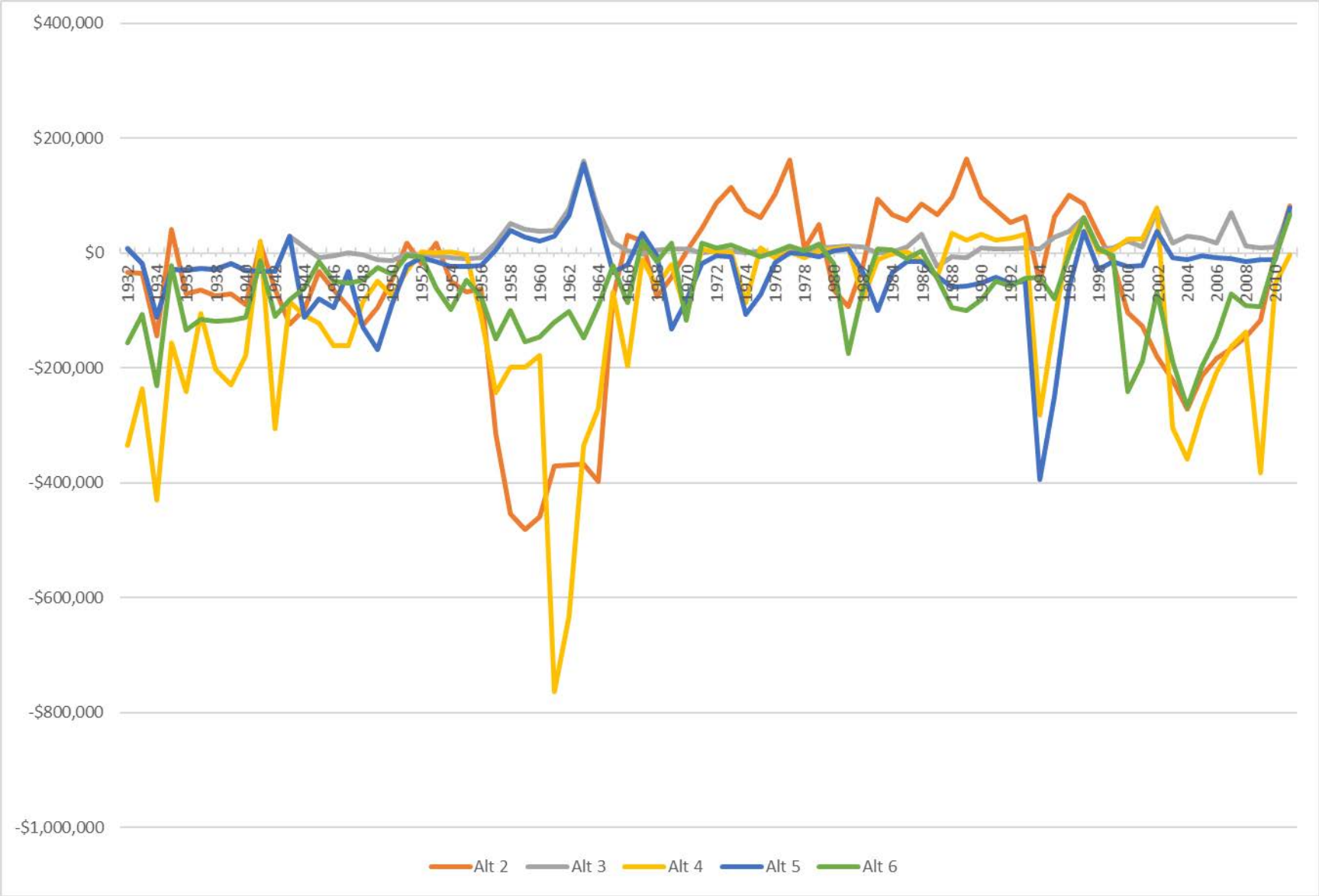

Figure 4. Lake Sakakwea Annual Differences in Visitation NED Benefits under the MRRMP-Draft EIS Alterantives Relative to Alternative 1

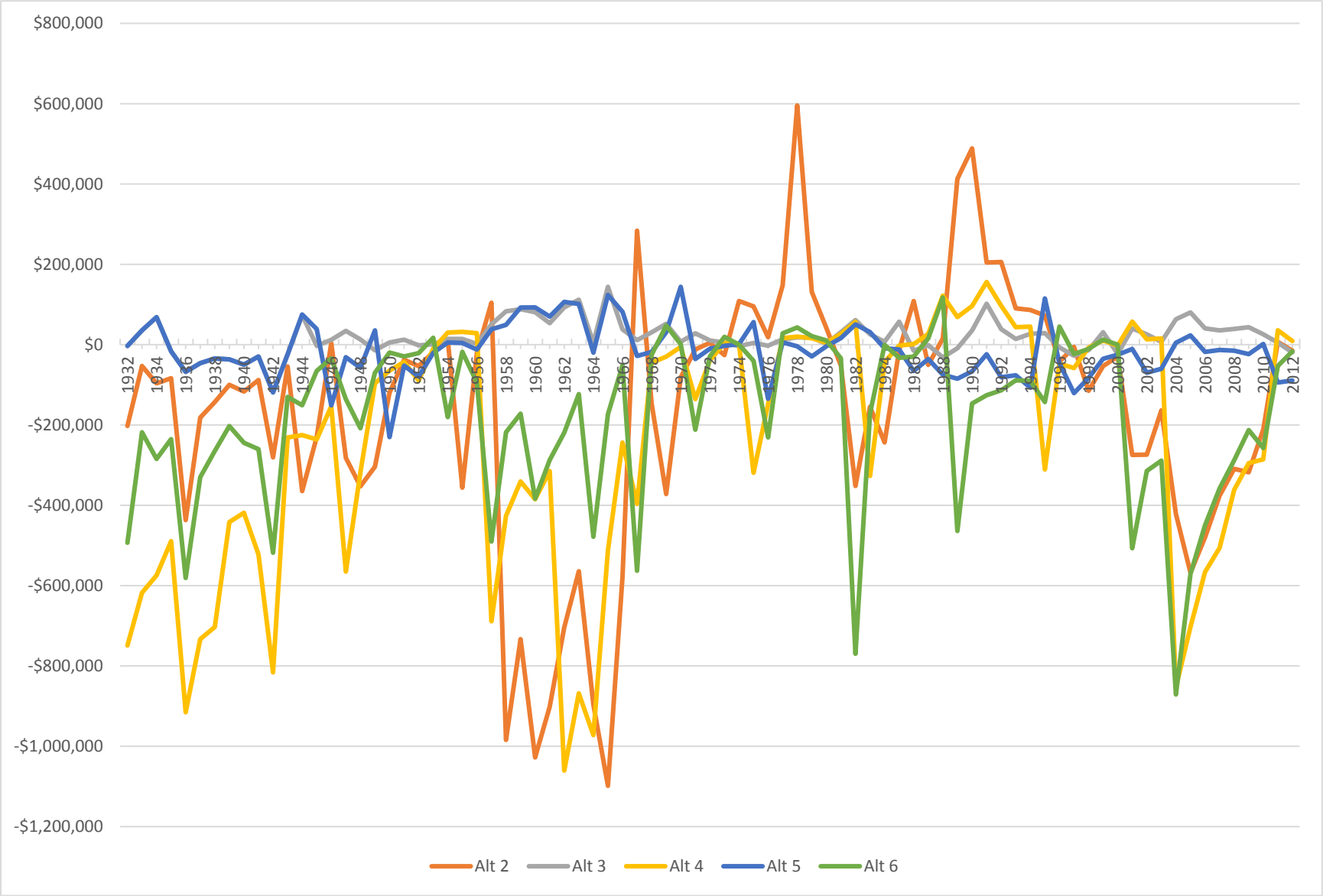

Figure 5. Lake Oahe Annual Differences in Visitation NED Benefits under the MRRMP-Draft EIS Alterantives relative to Alternative 1

Alternatives 2, 4, 5, and 6 would result in adverse impacts to recreational NED benefits. The largest reduction in benefits would occur under Alternative 4, with an average annual reduction of NED benefits of $64,000, $111,000, and $238,000 associated with Fort Peck Lake, Lake Sakakawea, and Lake Oahe, respectively. Relative to Alternatives 2, 4, and 6, Alternative 5 would result in the smallest reduction in NED benefits, while Alternative 3 would result in slight increases in recreation NED benefits.

Relative to recreation NED benefits supported by the mainstem reservoirs under Alternative 1, the NED analysis shows that Lake Oahe would experience the largest adverse impacts under Alternatives 2, 4, and 6. These adverse impacts were shown to be largest in low precipitation years following flow releases and spawning cues, when reservoir elevations would be drawn down more Alternatives 2, 4, and 6 than under Alternative 1 and drier climatic conditions would not be able replenish system storage. Under these conditions, recreation access and fishing opportunities would be reduced with relatively lower reservoir elevations. Some of the largest adverse impacts under Alternatives 2, 4, and 7 would occur under the modeled results during the environmental conditions similar to those experienced in the late 1950s and early 1960s, when simulated reservoir elevations at Lake Oahe and Lake Sakakawea would be 11 feet lower than under Alternative 1, and Fort Peck Lake would be 9 feet lower than under Alternative 1. During the eight worst years relative to Alternative 1 (during these modeled years in late 1950s and early 1960s), average annual recreation NED benefits under Alternatives 2, 4, and 6 were estimated to be $600,000 and $870,000 lower at Lake Oahe; between $200,000 and $450,000 lower at Lake Sakakawea; and between $150,000 and $300,000 lower at Fort Peck Lake relative to Alternative 1.

3.1.2 Lower Three Reservoirs

Table 24 summarizes the recreation NED benefits in the lower three reservoirs. Relative to Alternative 1, the action MRRMP-Draft EIS alternatives would create very little change in NED recreation benefits supported by the lower three mainstem reservoirs. The majority of adverse impacts would occur at Lewis and Clark Lake, while recreation NED benefits associated with Lake Sharpe would be unaffected by management actions under the alternatives. As described in Section 3.1, the RES-SIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, the impacts at Lewis and Clark Lake, which are based on changes in boat ramp-operability, reflect larger adverse impacts than would likely occur.

Recreation NED benefits in the eight worst case years relative to Alternative 1 supported by the lower three reservoirs would decrease from $154,000 (Alternative 6) to $270,000 (Alternative 2). In general, adverse impacts affecting visitation in some years at the lower three reservoirs would be offset by increases in benefits in other years, resulting in negligible impacts to recreation NED benefits over the period of analysis compared to Alternative 1.

Table 24. Summary of Visitation and Recreation NED Benefits for Lower Three Reservoirs (Thousands of 2016 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days[a]	1,167,691	1,168,638	1,165,004	1,168,118	1,166,402	1,169,805
Change in Average Annual Recreation Visitor Days[a]	NA	947	-2,687	427	- 1,288	2,114
Percent Change in Average Annual Recreation Visitor Days[a]	NA	0.1%	-0.2%	0.0%	-0.1%	0.2%
Total Visitation Benefits	$766,761	$766,588	$765,630	$766,835	$766,395	$767,456
Total Habitat Benefits	NA	NA	NA	NA	NA	NA
OMRR&R Costs (total)	NA	NA	NA	NA	NA	NA
Total NED Benefits	**$766,761**	**$766,588**	**$765,630**	**$766,835**	**$766,395**	**$767,456**
Total NED Change from No Action	NA	-$173	-$1,131	$74	-$366	$695
Percent Change from No Action	NA	-0.0%	-0.2%	0.0%	-0.1%	0.1%
Annual Average NED Benefits	$9,466	$9,464	$9,452	$9,467	$9,462	$9,475
Change in Annual Average NED Benefits	NA	-$2	-$14	$1	-$5	$9
8 Worst Years Relative to Alternative 1	NA	-$270	-$185	-$191	-$210	-$154
8 Best Years Relative to Alternative 1	NA	$265	$173	$173	$200	$207

Note: As described in Section 3.1, the RES-SIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] The recreation visitor day estimates include only spring, summer, and fall lake-elevation affected recreation visitor days and do not include all visitation at the reservoirs.

3.1.3 Inter-Reservoir River Reaches

Table 25 summarizes the recreation NED benefits for the inter-reservoir river reaches. Under Alternative 1, the inter-reservoir reaches would support $1.4 million in average annual recreation NED benefits. Alternatives 3 through 6 would result in negligible changes in NED benefits relative to Alternative 1. All alternatives would result in increased in NED benefits compared to Alternative except under Alternative 4, where very small decreases in recreation NED benefits would occur. Alternative 2 would have the greatest increases in recreation NED benefits relative to Alternative 1, an average annual increase of 3.4 percent compared to Alternative 1. Average NED benefits in the 8 worst years relative to Alternative 1 would result in a decrease of recreation NED benefits between $4,000 (Alternative 3) and $35,000 (Alternative 2).

Table 25. Summary of Visitation and Recreation NED Benefits for Inter-Reservoir River Reaches (Thousands of 2016 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days[a]	224,796	224,453	224,871	224,319	224,620	224,848
Change in Average Annual Recreation Visitor Days[a]	NA	-343	75	-476	-176	52
Percent Change in Average Annual Recreation Visitor Days[a]	NA	-0.2%	0.0%	-0.2%	-0.1%	0.0%
Total Visitation Benefits	$115,920	$117,809	$116,149	$115,686	$115,944	$115,994
Total Habitat Benefits (total)	$157	$2,261	$349	$253	$300	$245
OMRR&R Costs (total)	NA	NA	NA	NA	NA	NA
Total NED Benefits	**$116,076**	**$120,070**	**$116,497**	**$115,939**	**$116,244**	**$116,239**
Total NED Change from No Action	NA	$3,993	$421	-$138	$168	$163
Percent Change from No Action	NA	3.4%	0.4%	-0.1%	0.1%	0.1%
Annual Average NED Benefits	$1,433	$1,482	$1,438	$1,431	$1,435	$1,435
Change in Annual Average NED Benefits	NA	$49	$5	-$2	$2	$2
8 Worst Years Relative to Alternative 1	NA	-$35	-$4	-$28	-$16	-$8
8 Best Years Relative to Alternative 1	NA	$17	$11	$9	$13	$9

[a] The recreation visitor day estimates include only spring, summer, and fall boat-accessed recreation visitor days and do not include all visitation at the inter-reservoir river reaches.

3.1.4 Lower River

Table 26 summarizes the recreation NED benefits under the MRRMP- Draft EIS alternative for the lower river, the river reaches below Gavins Point Dam. The annual recreation NED benefits are depicted in graphs under each of the alternatives sections below (Sections 4.2 through 4.7). On annual average, recreation NED benefits supported by the lower river under Alternatives 2 through 6 are higher than those under Alternative 1. Spawning cues and flow releases to create habitat under Alternatives 2, 4, 5, and 6 were generally shown to have temporary beneficial effects on boat ramp operability and visitation in the years when these events occurred. However, there would also be lower river flows relative to those under Alternative 1 during the fall months which would adversely impact boat ramp access and visitation as the reservoir system rebalances from a pulse or release event. In general, adverse impacts experienced in low visitation years are more than offset by benefits in years when there is more access to boat ramps, resulting in small net increase in recreation NED benefits supported by the lower river.

Table 26. Summary of Visitation and Recreation NED Benefits for the Lower River (Thousands of 2016 Dollars)

Visitation or Recreation NED Benefits	Alternative					
	1	2	3	4	5	6
Average Annual Recreation Visitor Days[a]	993,878	1,000,851	995,615	998,637	1,000,016	998,878
Change in Average Annual Recreation Visitor Days[a]	NA	6,973	1,737	4,759	6,138	5,000
Percent Change in Average Annual Recreation Visitor Days[a]	NA	0.7%	0.2%	0.5%	0.6%	0.5%
Total Visitation Benefits	$599,248	$616,549	$599,885	$600,511	$602,380	$600,912
Total Habitat Benefits	$4,527	$17,862	$3,973	$3,804	$3,810	$3,826
OMRR&R Costs (total)	NA	NA	NA	NA	NA	NA
Total NED Benefits	**$603,775**	**$634,411**	**$603,858**	**$604,315**	**$606,190**	**$604,738**
Total NED Change from No Action	NA	$30,636	$83	$540	$2,415	$963
Percent Change from No Action	NA	5.1%	0.0%	0.1%	0.4%	0.2%
Annual Average NED Benefits	$7,454	$7,832	$7,455	$7,461	$7,484	$7,466
Change in Annual Average NED Benefits	NA	$378	$1	$7	$30	$12
8 Worst Years Relative to Alternative 1	NA	-$359	-$60	-$372	-$282	-$312
8 Best Years Relative to Alternative 1	NA	$633	$83	$728	$690	$622

[a] The recreation visitor day estimates include only spring, summer, and fall boat-accessed recreation visitor days and do not include all visitation at the lower river reaches.

In addition to recreation NED impacts associated with boat ramp operability affecting recreation access, the creation of habitat to support the early life stage requirements of the pallid sturgeon under the MRRMP-Draft EIS alternatives would contribute to increases in the abundance and diversity of species, and enhance wildlife-related recreation opportunities along the river. Habitat-related recreation benefits are estimated to range between $3.8 million (Alternative 4) and $17.9 million (Alternative 2) under the MRRMP-Draft EIS alternatives over the 81-year period of analysis, with Alternative 2 supporting four to five times more habitat-related benefits than under the other alternatives. Benefits attributable to habitat creation, however, account for a relatively small portion of total NED benefits under all MRRMP-Draft EIS alternatives, with Alternative 2 accounting for the highest proportion of benefits, approximately 3 percent.

3.2 Alternative 1 – No Action

Under Alternative 1, average annual recreation NED benefits would be $38.2 million, over half of which would be attributable to the upper three reservoirs (Table 27). As modeled, the upper three reservoirs would have the largest variation in recreation NED benefits, ranging from $9.9 million in a severe low-water year to $24.8 million in higher water years. On annual average, the upper three reservoirs would support $19.9 million in recreation NED benefits. The lower three

reservoirs have relatively stable pool levels, and Alternative 1 would result in average annual NED benefits of nearly $9.5 million from these reservoirs.

Table 27. Summary of NED Analysis for Alternative 1, 1932-2012 (Thousands of 2016 Dollars)

Recreation NED Benefits or Costs	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$1,616,598	$766,761	$115,920	$599,248	$3,098,527
Total Habitat Benefits	NA	NA	$157	$4,527	$4,684
OMRR&R Costs (costs)	$3,259	NA	NA	NA	3258.9854
Total NED Benefits	**$1,613,339**	**$766,761**	**$116,076**	**$603,775**	**$3,099,952**
Annual Average Benefits Less Costs	$19,918	$9,466	$1,433	$7,454	$38,271
Maximum Annual Benefits Less Costs	$24,823	$9,835	$1,544	$12,081	$48,283
Minimum Annual Benefits Less Costs	$9,675	$9,033	$1,027	$2,617	$22,352

Note: As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not in the river reaches.

Average annual recreation NED benefits supported by the inter-reservoir river reaches would be $1.4 million, and habitat-related benefits would account for less than one percent of total NED benefit in the inter-reservoir river reaches. Average annual NED benefits in the lower river would be $7.4 million, ranging between $2.6 and $12.1 million in low and high visitation years based on fluctuations in the natural hydrologic cycles that affect accessibility of boat ramps. The prevalence of ESH and SWH would account for less than 1 percent of recreation NED benefits in the lower river. In addition, some visitors prefer lower river flows, such as those using paddle craft or swimming, because lower flows offer additional shoreline and sandbars amenities and/or perceptions of safer conditions. During the spawning cue releases in March and May, there could be some adverse impacts to these visitors who may prefer lower river flows. Peak summer visitation would not be affected under the spawning cue releases. Changes in NED benefits associated with these types of visitors have not been quantified.

The NED evaluation also assessed costs associated with maintaining accessibility of boat ramps and other recreation facilities when the upper three reservoir elevations experience severe low-water conditions for consecutive years. Results from reservoir simulations showed that these OMRR&R costs associated with extending and/or replacing current ramps, providing infrastructure and road access to low boat ramp locations, and maintaining access to boat ramps when reservoir elevations fall in consecutive summers would be approximately $3.3 million under Alternative 1.

Overall, recreation NED benefits supported by the Missouri River under Alternative 1 would be large and long term, providing local residents and non-local visitors with considerable recreational opportunities. The largest decreases in the recreation NED benefits under Alternative 1 would occur on the upper three reservoirs when access to the lakes and fishing

opportunities would be directly affected by lower lake elevations during the natural cycles of drought or relatively drier periods.

3.3 Alternative 2 – USFWS 2003 Biological Opinion Projected Actions

Under Alternative 2, the Missouri River would support on average $38.4 million in recreation NED benefits, increasing $163,000 (0.4%) compared to Alternative 1 (Table 28). The largest variations in recreational benefits would continue to occur at the upper three reservoirs, where management actions under Alternative 2 would cause annual average NED benefits to decrease by 1.3 percent or approximately $262,000 relative to those under Alternative 1. Decreases in average annual NED benefits at the upper three reservoirs are attributable to lower reservoir elevations in modeled years following a spawning cue release during a low precipitation period when it would take longer to replenish system storage. Management actions under Alternative 2 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits at the lower three reservoirs under this alternative since these reservoirs are managed as flow-through reservoirs with relatively stable elevations.

Table 28: Summary of NED Analysis for Alternative 2, 1932-2012 (Thousands of 2016 Dollars)

Recreation NED Benefits or Costs	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$1,595,887	$766,588	$117,809	$616,549	$3,096,833
Total Habitat Benefits	NA	NA	$2,261	$17,862	$20,123
OMRR&R Costs (total)	$3,788	NA	NA	NA	$3,788
Total NED Benefits	**$1,592,099**	**$766,588**	**$120,070**	**$634,411**	**$3,113,168**
Total NED Change from No Action	-$21,240	-$173	$3,993	$30,636	$13,216
Percent Change from No Action	-1.3%	0.0%	3.4%	5.1%	0.4%
Annual Average NED Benefits	$19,656	$9,464	$1,482	$7,832	$38,434
Change in Annual NED Benefits	-$262	-$2	$49	$378	$163
Annual Average 8 Worst Years Relative to Alternative 1	-$1,546	-$270	-$35	-$359	-$2,210
Annual Average of 8 Best Years Relative to Alternative 1	$489	$265	$17	$633	$1,403

Note: As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not in the river reaches.

Extensive habitat creation under Alternative 2 in the Garrison and Randall river reaches would generate long-term recreational benefits and result in higher valued recreational experiences in these river reaches. Under Alternative 2, habitat-related NED benefits in these inter-reservoir

river reaches would increase by approximately $2.1 million compared to Alternative 1 over the period of record. Collectively, management actions under Alternative 2 would increase average annual recreation NED benefits in the inter-reservoir river reaches by approximately $49,000 (3.4%) relative to Alternative 1.

Compared to Alternative 1, average annual NED benefits in the lower river would increase by $378,000, or 5.1 percent, as a result of management actions under Alternative 2. This increase in recreation NED benefits would primarily be driven by a greater prevalence of both ESH and SWH in the lower river, resulting in beneficial impacts to recreation compared to Alternative 1. In addition, visitors who prefer lower river flows in the lower river may experience adverse impacts during spawning cue releases although this alternative would not affect peak summer visitation. The NED benefits for these types of visitors have not been monetized.

OMRR&R costs associated with the upper three reservoirs would be higher under Alternative 2, increasing by $529,000 compared to OMRR&R costs under Alternative 1 because. spawning cue releases under Alternative 2 could reduce lake elevations in the years after release events during periods of relatively low precipitation. As a result, OMRR&R costs associated with low-water recreation infrastructure would increase to maintain reservoir access during these relatively drier periods. OMRR&R costs under Alternative 2 would have small to large adverse impacts relative to Alternative 1 depending on the timing and location of capital investments.

When evaluating impacts associated with each MRRMP-DRAFT EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 6 shows annual NED recreation benefits in the upper (includes both mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 7 and 8 show the difference in recreation NED benefits between Alternatives 1 and 2, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

Annual recreation benefits supported by the upper river were between $900,000 to $2 million lower than those under Alternative 1 in 10 of the 81 simulated years. All 10 of these years, as simulated under Alternatives 1 and 2, occurred under drought conditions like those experienced in the late 1950s to mid-1960s and the 2000s. In these instances, spawning cue releases were initiated (a full release in 1958 and partial releases in 1959, 1963, 1964, and 1965) at the onset of drier environmental conditions, causing reservoir elevations to be lower under Alternative 2 than under Alternative 1 in the years following the spawning cue release. Recreational NED benefits would already be low during these drought periods under Alternative 1, and the adverse impacts of spawning cue releases on lake elevations under Alternative 2 would further reduce reservoir elevations and visitation, resulting in lower recreational NED benefits at the upper reservoirs, relative to those under Alternative 1.

As simulated under the alternatives, Lake Oahe during this period would have the largest decrease in NED benefits, as reservoir elevations were drawn down up to 9 feet lower under Alternative 2 than under Alternative 1 in the early 1960s. These low water elevations would adversely affect recreational access and fishing opportunities at Lake Oahe and would cause recreation NED benefits to decrease by approximately $1 million, or 14 percent, compared to NED benefits under Alternative 1 in the worst case simulated year relative to Alternative 1, 1960.

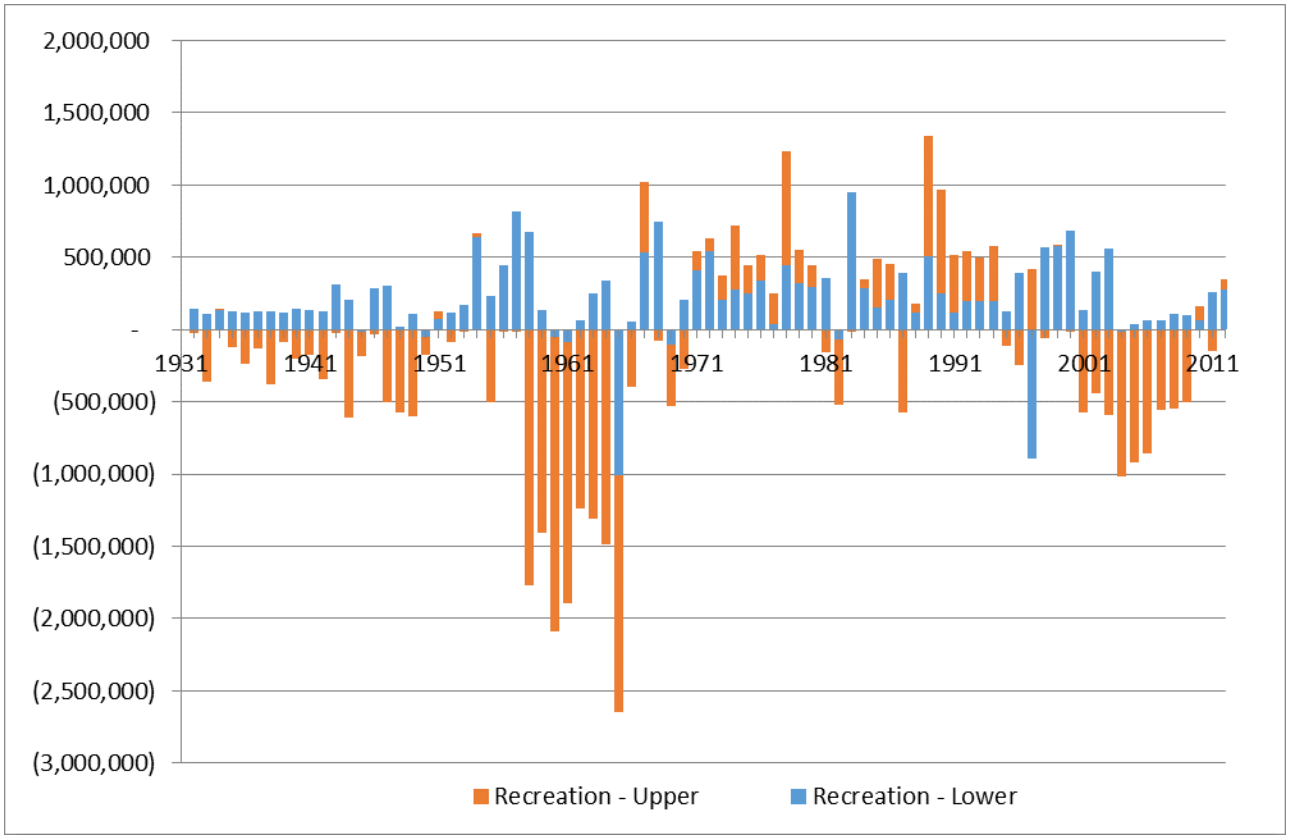

Figure 6. Annual Difference in Recreation NED Benefits Under Alternative 2 Relative to Alternative 1 (2016$)

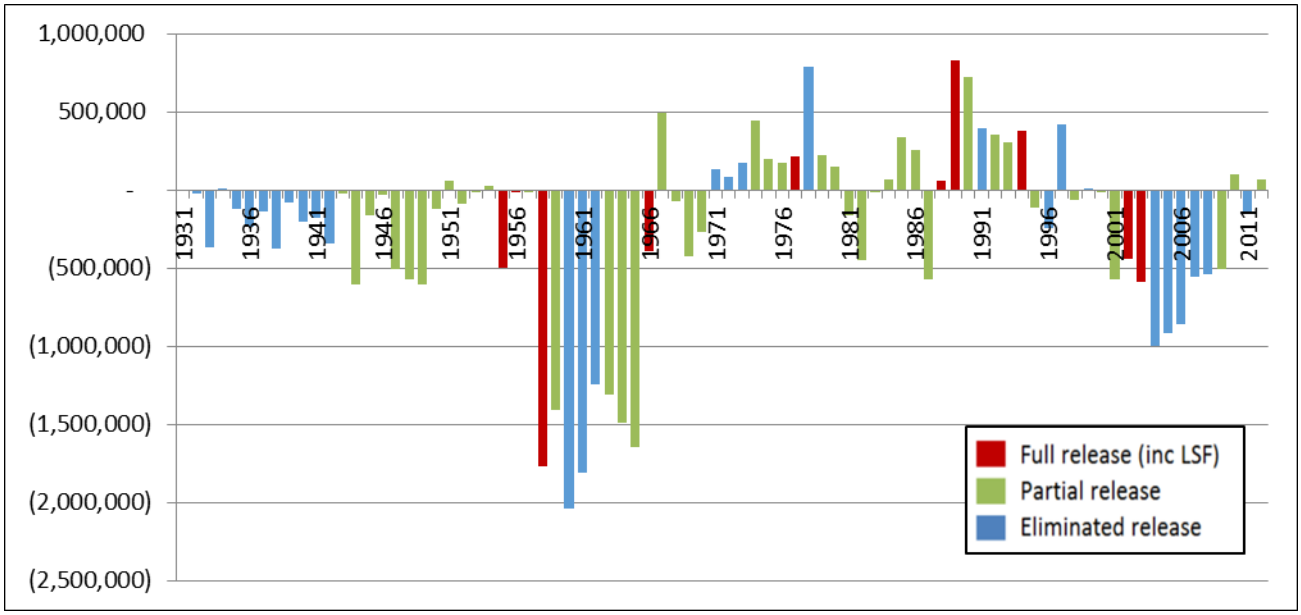

Figure 7. Annual Difference in Recreation NED Benefits under Alternative 2 compared to Alternative 1 in the Upper River

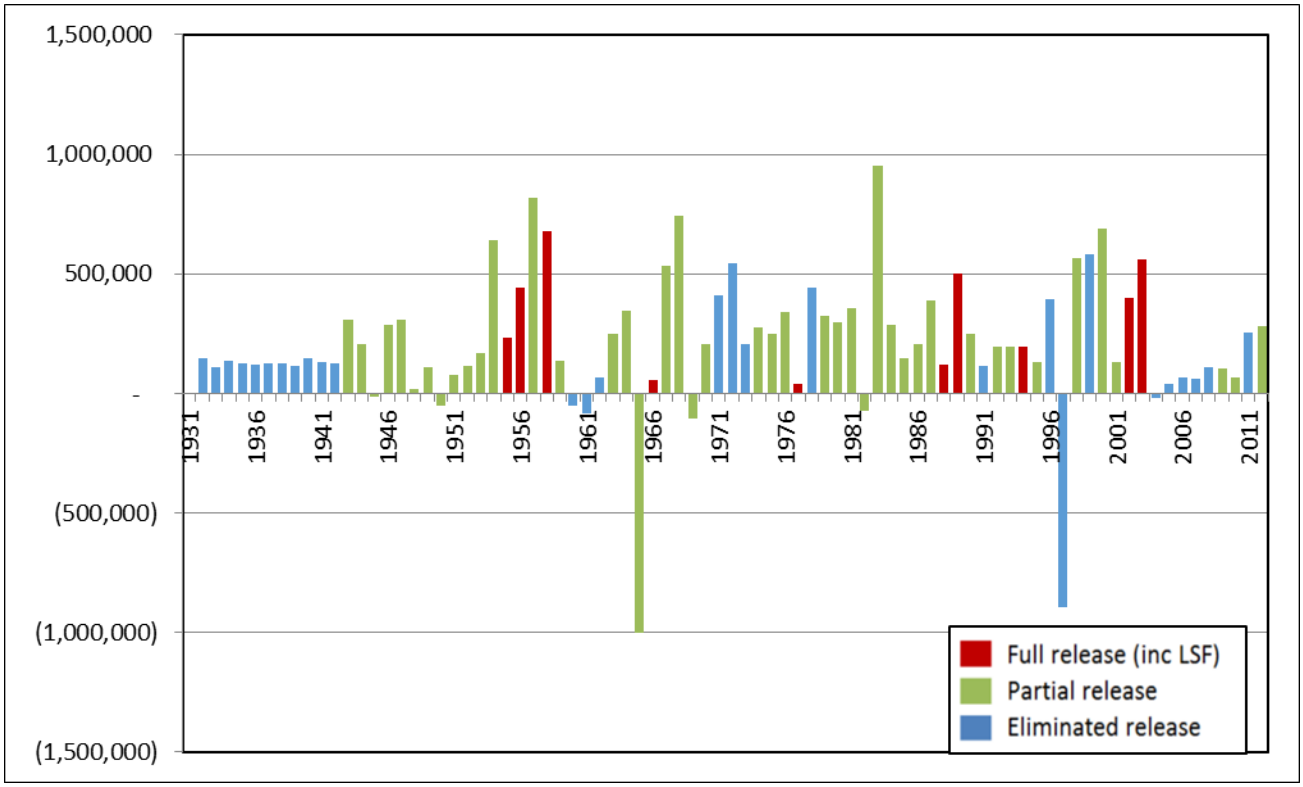

Figure 8. Annual Difference in Recreation NED Benefits under Alternative 2 Compared to Alternative 1 in the Lower River

Simulations of Alternatives 1 and 2 show that annual average NED impacts supported by the lower river under Alternative 2 would be consistently higher than those under Alternative 1. These increases in recreation NED benefits are largely attributable to the creation of SWH below Gavins Point Dam. Recreation benefits associated with the habitat creation in the lower river under Alternative 2 would be $17.9 million over the period of record. Although habitat benefits would still only account for approximately 3 percent of total NED benefits under Alternative 2, habitat-related benefits under this alternative would be nearly 4 times higher than those under Alternative 1, resulting in consistently higher NED benefits under Alternative 2 compared to Alternative 1.

Over the simulated 81-year period of record, there was one year in which recreation NED benefits in the lower river would be approximately $1 million lower under Alternative 2 than under Alternative 1. These adverse impacts to recreation NED benefits as modeled would occur under conditions similar to those in 1965. Partial releases as simulated under Alternative 2 would occur in the late 1950s and early 1960s, which reduced reservoir elevations during these years. Because reservoir elevations were lower in 1965, simulated river stages between August and December in conditions similar to those in 1965 would be up to 3 feet lower under Alternative 2 than those under Alternative 1 in the lower river, reducing boat ramp operability and adversely affecting boat-accessed visitation during these months.

3.4 Alternative 3 – Mechanical Construction Only

Under Alternative 3, average annual NED benefits would be $38.2 million, an increase of $17,000 on annual average compared to Alternative 1 (Table 29). At the upper three reservoirs, there would be slightly higher recreation benefits as a result of small increases in reservoir access and visitation in the absence of the spring plenary pulse under Alternative 1. On annual average, changes in recreation NED benefits in the upper three reservoirs would be negligible, increasing by approximately $31,000 (0.1%) relative to Alternative 1. Management actions under Alternative 3 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits at the lower three reservoirs because these reservoirs have relatively stable elevations.

Table 29. Summary of NED Analysis for Alternative 3, 1932-2012 (Thousands of 2016 Dollars)

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$1,619,101	$765,630	$116,149	$599,885	$3,100,765
Total Habitat Benefits	NA	NA	$349	$3,973	$4,321
OMRR&R Costs (total)	$3,788	NA	NA	NA	$3,788
Total NED Benefits	**$1,615,313**	**$765,630**	**$116,497**	**$603,858**	**$3,101,299**
Total NED Change from No Action	$1,974	-$1,131	$421	$83	$1,347
Percent Change from No Action	0.1%	-0.1%	0.4%	0.0%	0.0%
Annual Average NED Benefits	$19,942	$9,452	$1,438	$7,455	$38,288
Change in Annual Average NED Benefits	$24	-$14	$5	$1	$17
Average 8 Worst Years Relative to Alternative 1	-$107	-$185	-$4	-$60	-$355
Average of 8 Best Years Relative to Alternative 1	$207	$173	$11	$83	$475

Note: As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not in the river reaches.

Relative to Alternative 1, average annual recreation NED benefits in inter-reservoir reaches would increase slightly, driven by the greater prevalence of ESH under Alternative 3. Average annual recreation NED benefits in the lower river would be approximately $7.4 million, a negligible change from Alternative 1. Recreation NED benefits over the period of record associated with habitat creation in the lower river would be negligible compared to Alternative 1, with fewer acres of early life stage habitat and a greater number of acres of ESH. Visitors in the river reaches that prefer lower river flows, such as those using paddle craft or swimming, would have negligible changes under Alternative 3 compared to Alternative 1 due to negligible changes in river flows.

The OMRR&R costs at the upper three reservoirs would be slightly lower under Alternative 3, $3.2 million compared to $3.3 million under Alternative 1 because of relatively higher reservoir elevations during drought conditions because the spring plenary pulse would not occur, with negligible impacts relative to Alternative 1.

Figure 9 shows annual NED recreation benefits in the upper (includes both mainstem reservoirs and inter-reservoir river reaches) and lower river. The difference in recreation NED benefits under Alternatives 1 and 3 are shown in Figures 10 and 11 for the upper river and lower river, respectively. The annual changes in recreation NED benefits show that there would be generally more years with small increases in recreational benefits in the upper river as a result of eliminating the spring plenary pulse under Alternative 3. The elimination of the pulses under Alternative 3 would result in slightly higher lake elevations than under Alternative 1. During the eight best years relative to Alternative 1, average annual recreation NED benefits in the upper three reservoirs would be $207,000 higher under Alternative 3, while the eight worst years relative to Alternative would result in the reduction in average recreation NED benefits of $107,000. Most of the annual increases in recreation NED benefits would occur under conditions similar to those in simulated in the late 1950s and early to 1960s as well as in the drought of the 2000s, when the upper three reservoir elevations would be slightly higher under Alternative 3 compared to Alternative 1.

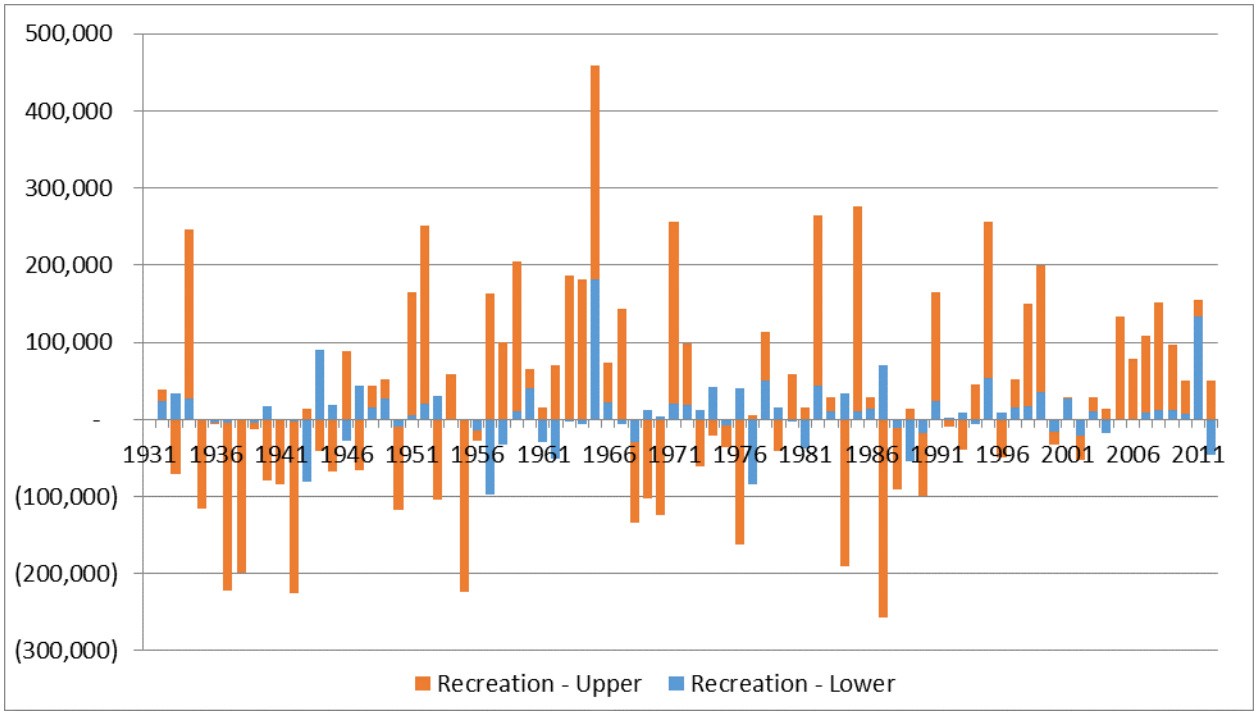

Figure 9. Annual Difference in Recreation NED Benefits under Alternative 3 Relative to Alternative 1 in the Upper and Lower River (2016$)

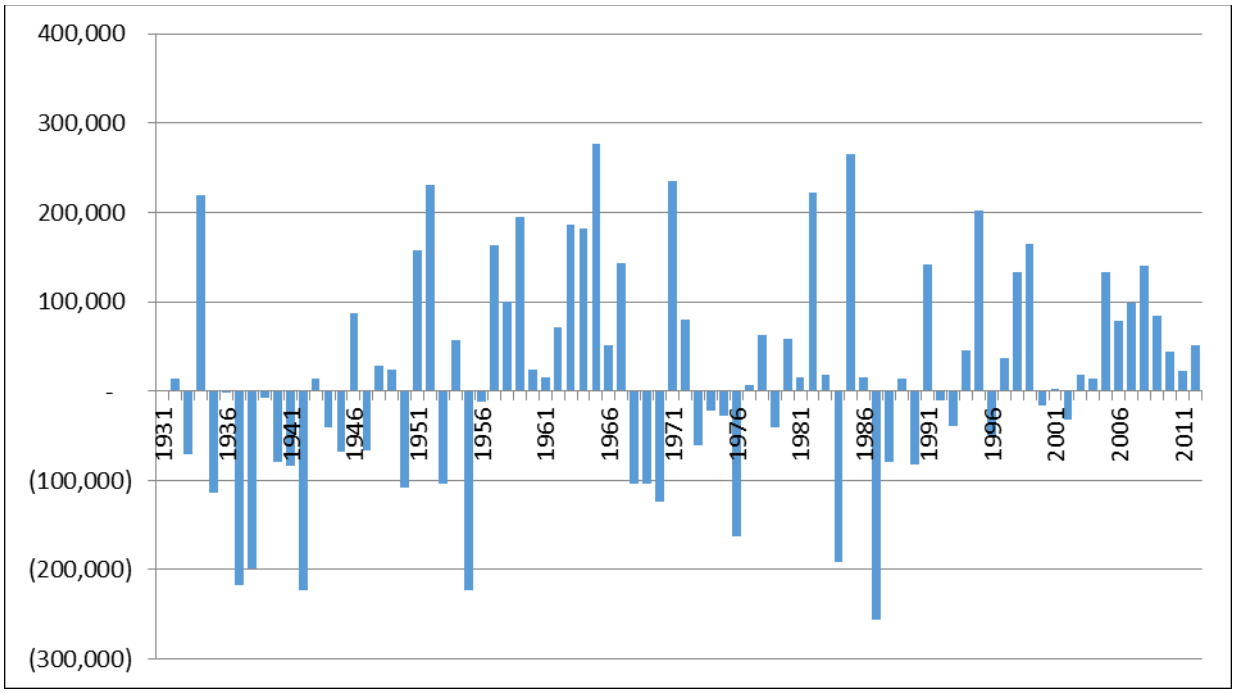

Figure 10. Annual Difference in Recreation NED Benefits under Alternative 3 Compared to Alternative 1 in the Upper River (2016$)

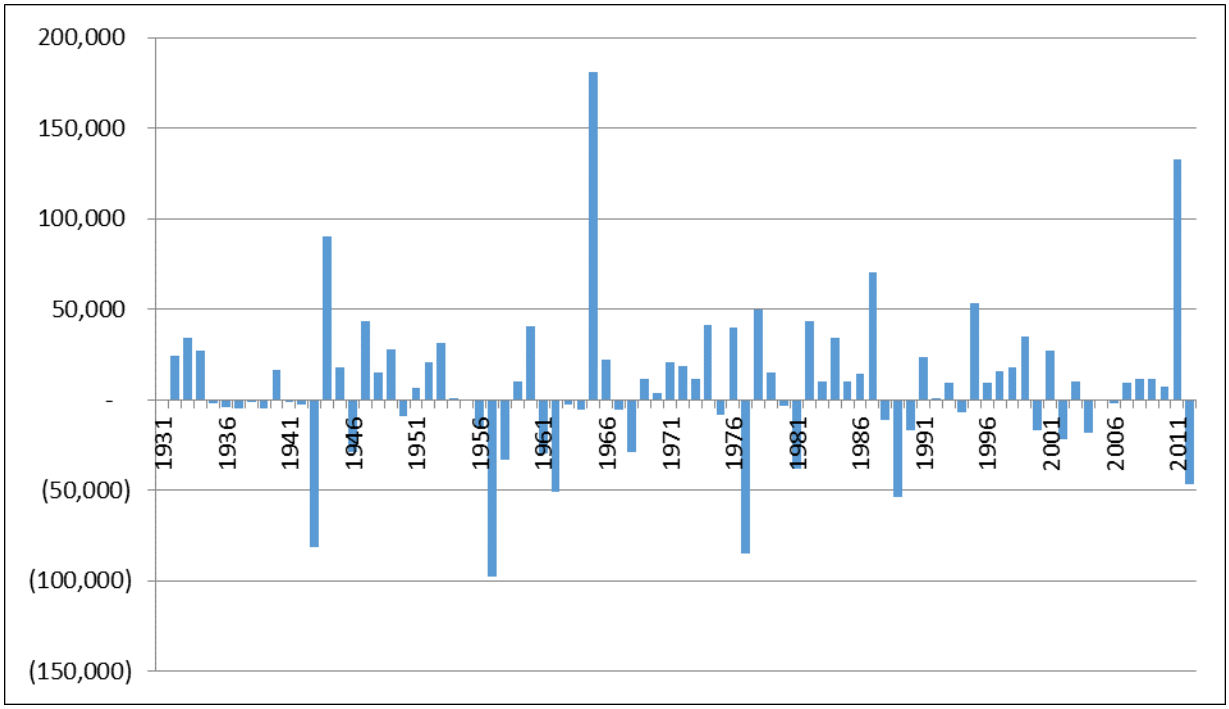

Figure 11. Annual Difference in Recreation NED Benefits under Alternative 3 Compared to Alternative 1 in the Lower River (2016$)

Modeled results under Alternatives 1 and 3 show that annual changes in recreation NED benefits vary in the lower river compared to Alternative 1. There would more years with higher recreation NED benefits under Alternative 3 in the lower river as a result of increased boat ramp operability generally from slightly higher river flows in a greater number of years under Alternative 3. In 2 of the 81 simulated years, recreational NED benefits in the lower river would be more than $100,000 higher than under Alternative 1. These benefits would be realized in years when conditions were similar those to those simulated in 1965 and 2011. As modeled in 1965, river flows would be slightly higher than under Alternative 1, with increased boat ramp operability and visitation. In 2011 (a flooding year), river flows under Alternative 3 were slightly lower for a short period of time, with benefits to boat ramp operability and visitation.

3.5 Alternative 4 – Spring ESH Creating Release

Under Alternative 4, average annual NED benefits would be $37.8 million, a decrease of $407,000 on average compared to Alternative 1 (Table 30). The upper three reservoirs would have the largest variation in NED benefits, with average annual NED benefits decreasing by approximately $413,000, approximately 2.1 percent relative to those under Alternative 1. Decreases in average annual NED recreation benefits supported by the upper three reservoirs would occur in the years following the spring releases when relatively low precipitation or snowmelt conditions would occur and the reservoir elevations as simulated under Alternative 4 are lower than those under Alternative 1. Management actions under Alternative 4 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits in the lower three reservoirs because these reservoirs maintain relatively stable elevations, providing consistent recreational access and opportunities.

Relative to Alternative 1, average annual recreational NED benefits in inter-reservoir reaches would increase slightly. This change, however, would be negligible since river stages and boat ramp operability would not noticeably change. Impacts associated with ESH creation under Alternative 4 would increase total habitat-related benefits over the period of record in the inter-reservoir river reaches by approximately $96,000, but would still account for less than one percent of total recreation NED benefits.

Average annual recreation NED benefits in the lower river would be $7.4 million under Alternative 4, with average NED benefits increasing by $7,000 (0.1%) relative to Alternative 1. Impacts to recreation NED benefits in the lower river would be beneficial and adverse compared to Alternative 1 and would be attributable to changes in boat ramp operability and the creation of ESH and IRC habitat, with negligible changes on average compared to Alternative 1. Habitat-related recreation benefits would account for less than 1 percent of total recreation NED benefits in the lower river and would be slightly lower than those under Alternative 1. In addition, visitors in the lower river that prefer lower river flows, such as those using paddle craft or swimming, would experience some adverse impacts during the spring releases and negligible changes at other times under Alternative 4.

Table 30. Summary of NED Analysis for Alternative 4, 1932-2012

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$1,583,768	$766,835	$115,686	$600,511	$3,066,801
Total Habitat Benefits	NA	NA	$253	$3,810	$4,062
OMRR&R Costs	$3,904	NA	NA	NA	$3,904
Total NED Benefits	***$1,579,864***	***$766,835***	***$115,939***	***$604,320***	***$3,066,959***
Total NED Change from No Action	*-$33,475*	*$74*	*-$138*	*$545*	*-$32,993*
Percent Change from No Action	*-2.1%*	*0.0%*	*-0.1%*	*0.1%*	*-1.1%*
Annual Average NED Benefits	$19,504.49	$9,467.10	$1,431.34	$7,460.75	$37,864
Change in Annual Average NED Benefits	-$413	$1	-$2	$7	-$407
Average 8 Worst Years Relative to Alternative 1	-$1,590	-$191	-$28	-$372	-$2,180
Average of 8 Best Years Relative to Alternative 1	$141	$173	$9	$728	$1,050

Note: As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not in the river reaches.

OMRR&R costs at the upper three reservoirs would be approximately $600,000 higher under Alternative 4 than under Alternative 1 because the spring release would draw down reservoir elevations further than under Alternative 1 during relatively drier periods. As a result, there would be additional capital investments and operating costs needed to extend or replace low water boat ramps, with relatively small to large adverse impacts depending on the timing and location of investments.

When evaluating impacts associated with each MRRMP-Draft EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 12 shows annual NED recreation benefits in the upper (includes both mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 13 and 14 show the difference in recreation NED benefits between Alternatives 1 and 4, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

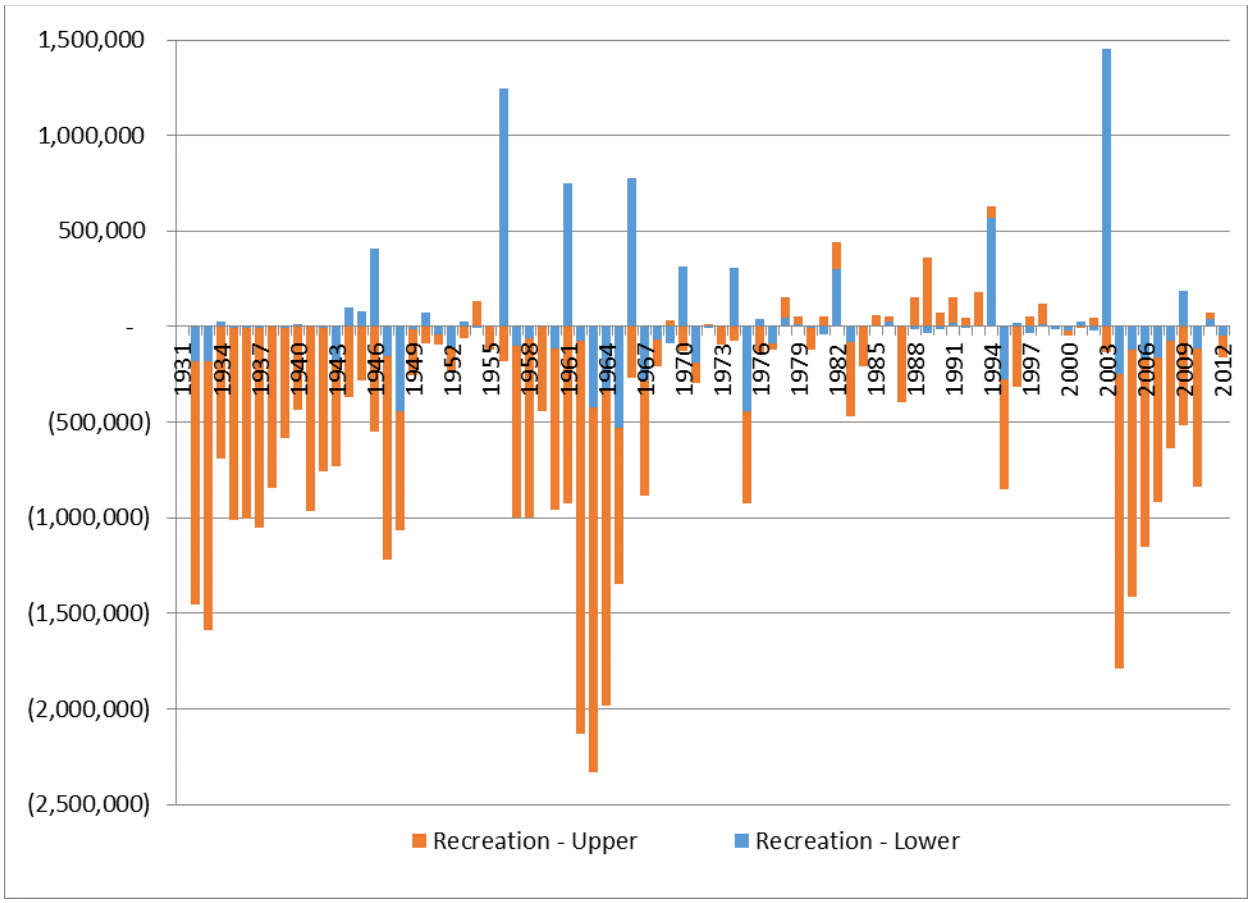

Figure 12. Annual Difference in Recreation NED Benefits under Alternative 4 Relative to Alternative 1 in the Upper and Lower River (2016$)

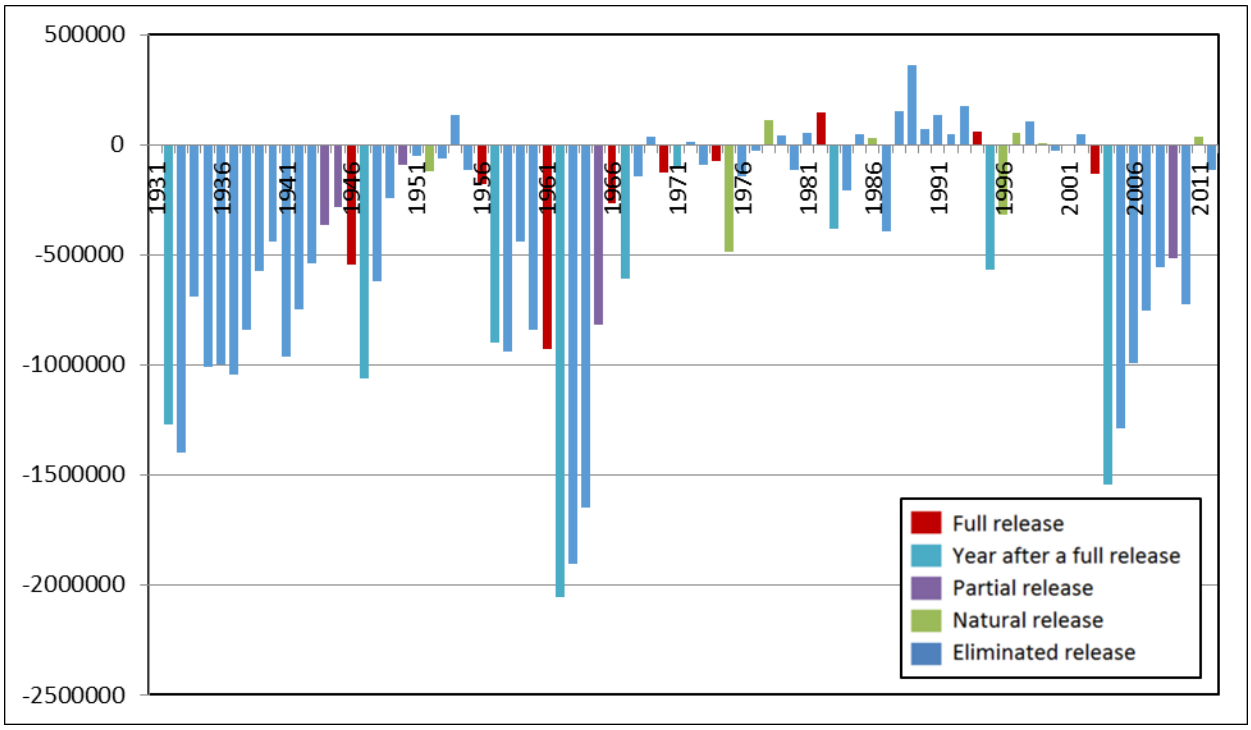

Figure 13. Annual Difference in Recreation NED Benefits under Alternative 4 Compared to Alternative 1 in the Upper River (2016$)

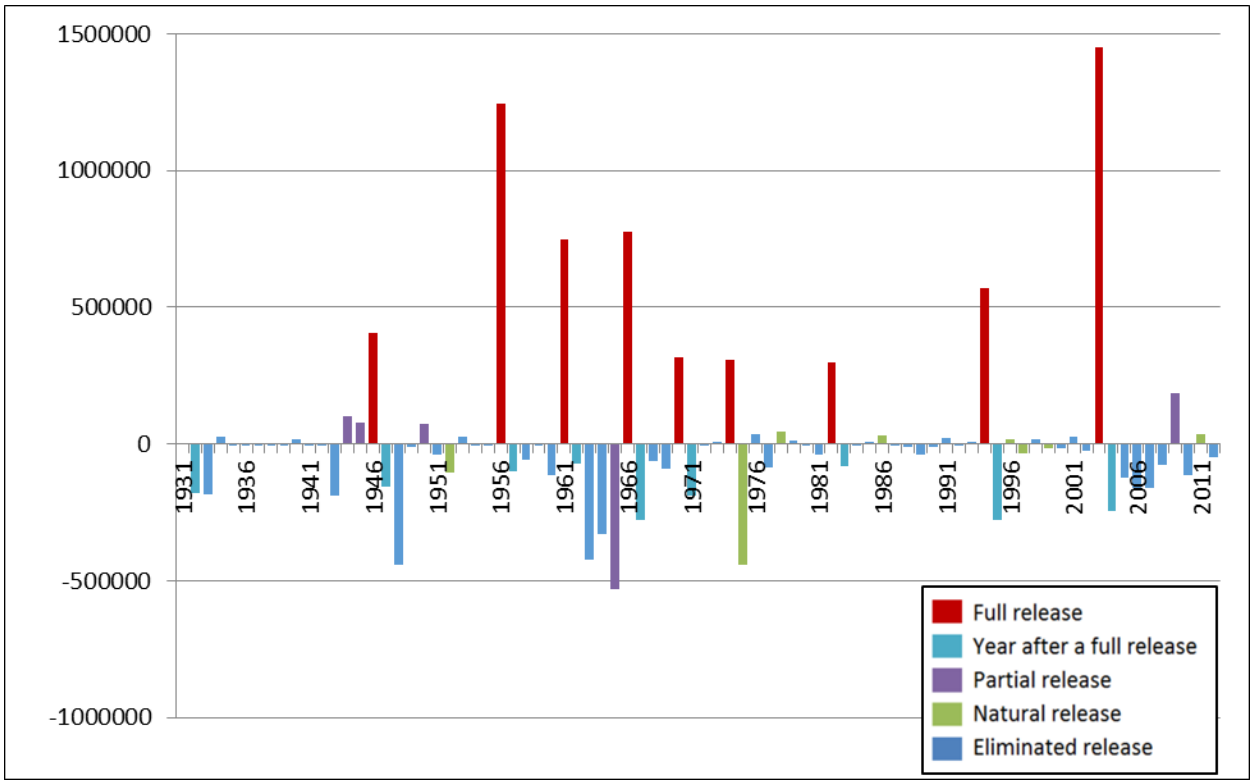

Figure 14. Annual Difference in Recreation NED Benefits under Alternative 4 Compared to Alternative 1 in the Lower River (2016$)

The upper river would support between $1 and $2 million in decreased recreation NED benefits under Alternative 4 in 12 of the 81 simulated years. In the 8 worst years relative to Alternative 1, recreational benefits supported by the upper three reservoirs would decline by approximately $1.6 million on annual average. Simulated spring releases under Alternative 4 would have large adverse impacts in the years following the spring release under drier environmental conditions, like those experienced in the late 1930s and 1940s, the late 1950s to mid-1960s, and the early 2000s. Full releases as simulated in 1931, 1946, 1956, 1961, and 2003 would reduce reservoir elevations and during the subsequent drier or drought conditions, system storage is slow to replenish and reservoir elevations would remain relatively lower than under Alternative 1 for a number of years following the releases. Persistent relatively lower lake elevations cause visitation at the reservoirs to decrease relative to Alternative 1 as boat access to the lakes becomes more limited and fishing opportunities decrease. Lake Oahe would experience the biggest reductions in recreation NED benefits during the early 1960s when the reservoir is drawn down up to 11 feet lower than under Alternative 1. In 1962, reductions in annual recreation NED benefits at Lake Oahe were just over $1 million lower than under Alternative 1.

In the lower river, recreation NED benefits relative to Alternative 1 would be highest in years when a simulated full spring release occurs. These benefits result from higher river stages and improved boat ramp operability compared to under Alternative 1. Under simulated conditions in 2003, recreation benefits in the lower river would be nearly $1.5 million higher than under Alternative 1. In the years following these releases, recreation NED benefits in the lower river decrease relative to those under Alternative 1 from relatively lower river flows in the fall as the system rebalances.

3.6 Alternative 5 – Fall ESH Creating Release

Under Alternative 5, average annual recreation NED benefits would be reduced by $28,000, a decrease of approximately 0.1 percent compared to Alternative 1 (Table 31). In the upper three reservoirs, recreation NED benefits would decrease by nearly $55,000 relative Alternative 1 or 0.3 percent. The upper three reservoirs would be lower than under Alternative 1 in the year following a fall release, with adverse impacts to recreation NED benefits under these conditions. In the eight worst years compared to Alternative 1, there would be a decrease of annual recreation NED benefits of $375,000. Impacts of fall releases under Alternative 5 would result in negligible changes to boat ramp operability, visitation, and recreation NED benefits at the lower three reservoirs because reservoir elevations in these flow-through reservoirs would remain relatively stable.

In the inter-reservoir river reaches, Alternative 5 would result in negligible change in average annual recreation NED benefits of 0.1 percent. Even in the biggest difference years, changes in recreation NED benefits would be very small. Although the creation of ESH in the Garrison and Randall river reaches would generate nearly twice as many recreation NED benefits as under Alternative 1, the habitat benefits would be a very small part of recreation NED benefits in the inter-reservoir river reaches.

Alternative 5 would result in an increase of $30,000 in average annual recreation NED benefits in the lower river, a 0.5 percent increase relative to Alternative 1, with small increases in recreation NED benefits. Benefits under Alternative 5 would occur from higher amount of ESH and fall releases increases recreational access. In addition, visitors in the lower river that prefer lower river flows, such as those using paddle craft or swimming, would experience some adverse impacts during the fall releases and negligible changes at other times under Alternative 5.

Table 31. Summary of NED Analysis for Alternative 5, 1932-2012 (Thousands of 2016 Dollars)

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$1,612,184	$766,395	$115,944	$602,380	$3,096,902
Total Habitat Benefits	NA	NA	$300	$3,810	$4,110
OMRR&R Costs	$3,298	NA	NA	NA	$3,298
Total NED Benefits	***$1,608,885***	***$766,395***	***$116,244***	***$606,190***	***$3,097,714***
Total NED Change from No Action	*-$4,454*	*-$366*	*$168*	*$2,415*	*-$2,237*
Percent Change from No Action	*-0.3%*	*0.0%*	*0.1%*	*0.4%*	*-0.1%*
Annual Average NED Benefits	$19,863	$9,462	$1,435	$7,484	$38,243
Change in Annual Average NED Benefits	-$55	-$5	$2	$30	-$28
Average 8 Worst Years Relative to Alternative 1	-$375	-$210	-$16	-$282	-$884
Average of 8 Best Years Relative to Alternative 1	$198	$200	$13	$690	$1,101

Note: As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not in the river reaches.

The OMRR&R costs at the upper three reservoirs would be relatively the same as those under Alternative 1. There would be slightly lower reservoir elevations in years following a fall release which would increase OMRR&R costs by an estimated $40,000 relative to those under Alternative 1.

When evaluating impacts associated with each MRRMP-Draft EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 15 shows annual NED recreation benefits in the upper (includes both mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 16 and 17 show the difference in recreation NED benefits between Alternatives 1 and 5, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

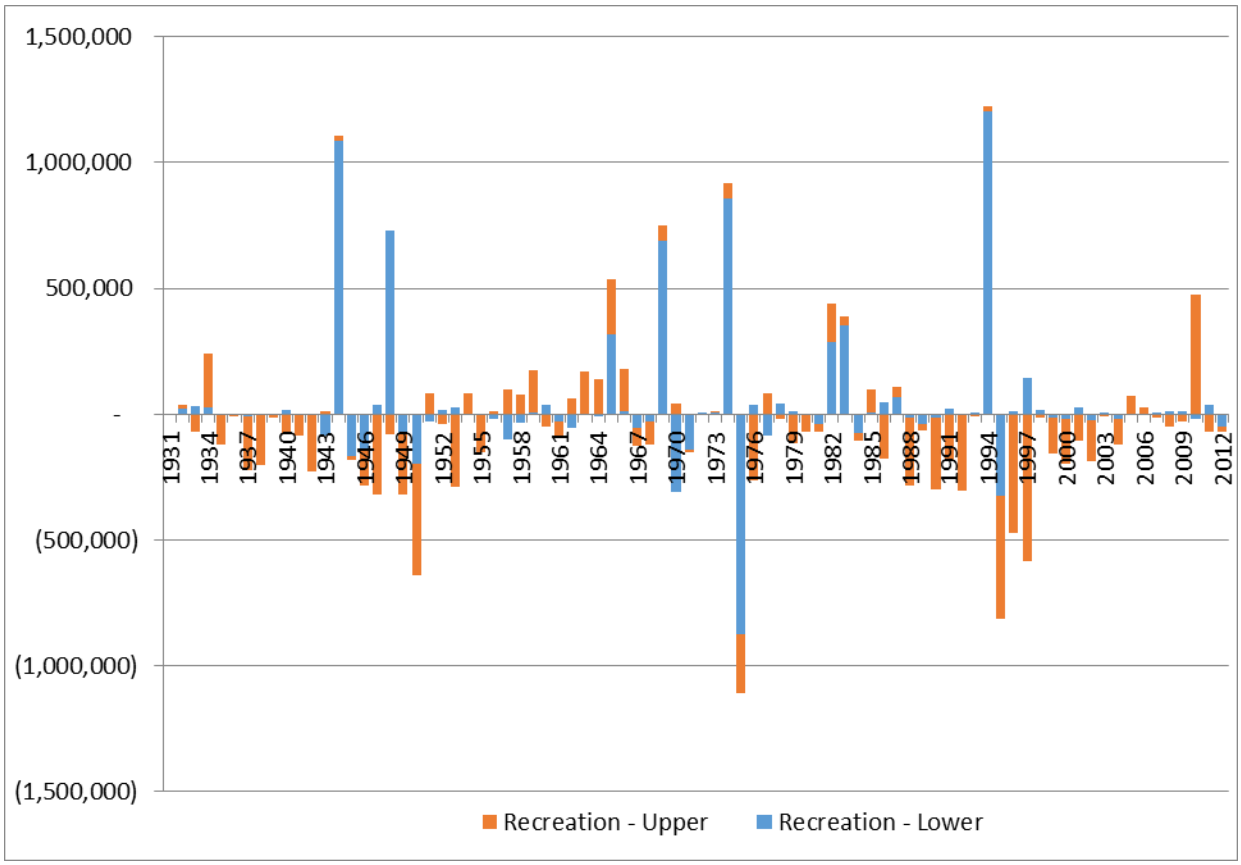

Figure 15 Annual Difference in Recreation NED Benefits under Alternative 5 Relative to Alternative 1 in the Upper and Lower River (2016$)

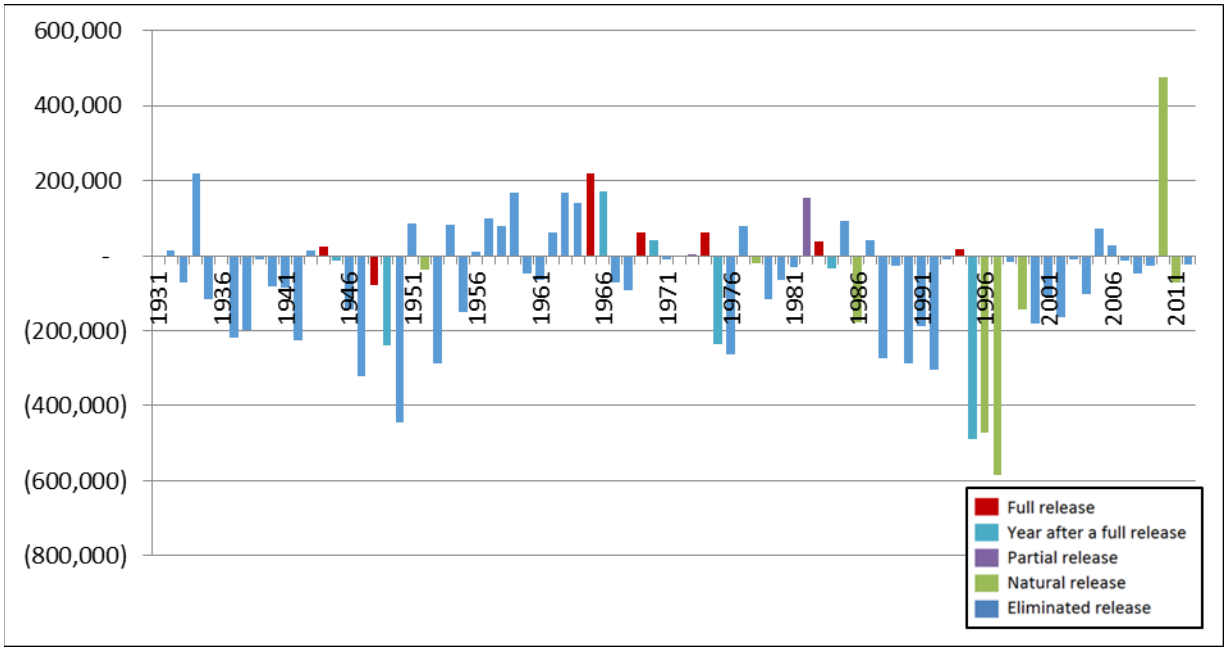

Figure 16. Annual Difference in Recreation NED Benefits Under Alternative 5 compared to Alternative 1 in the Upper River (2016$)

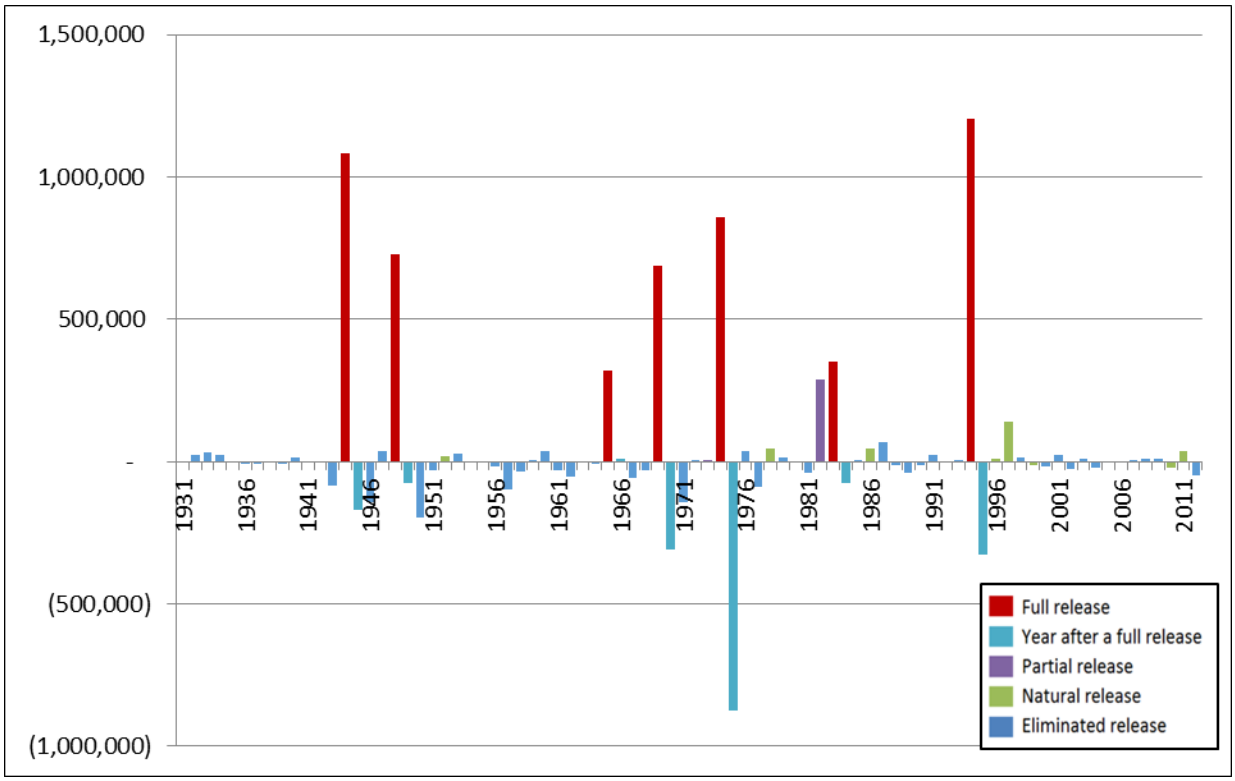

Figure 17. Annual Difference in Recreation NED Benefits Under Alternative 5 compared to Alternative 1 in the Lower River (2016$)

In general, the year after a fall release under Alternative 5 is shown to adversely affect lake elevations and recreation NED benefits in the upper river. Compared to Alternative 1, the worst difference years as simulated under Alternative 5 would occur under conditions similar to those experienced in 1995, 1996, and 1997, after a full release in 1994 when NED benefits in the upper river would be up to $587,000 lower than under Alternative 1. In 1995, as simulated under Alternatives 5 and 1, the reservoir elevations would be up to 5 feet lower than under Alternative 1 during the summer months. Other adverse impacts to recreation NED benefits occur in 1949 and 1975 in the year after a full release and would occur primarily in Lake Sakakawea, Fort Peck Lake, and Lake Oahe.

Annual recreation NED benefits in the lower river show that the recreation benefits are higher during the full fall release when boat ramp operability is improved and visitation is higher under Alternative 5 relative to Alternative 1. These conditions would benefit visitors who use boats to recreate in the fall months during the years when the simulated releases would occur, such as angers and waterfowl hunters. However, as simulated under Alternatives 1 and 5, the year or years following the fall release would reduce recreation NED benefits compared to Alternative 1 from relatively lower river flows in the fall months as reservoirs rebalance. In general, the relatively higher recreation benefits in the release years offset the adverse impacts in the years following the releases in the lower river.

3.7 Alternative 6 – Pallid Sturgeon Spawning Cue

Under Alternative 6, the Missouri River would support on average $38 million in recreation NED benefits, decreasing by $265,000 or 0.7 percent on average compared to Alternative 1 (Table

32). Similar to Alternatives 2 and 4, the adverse impacts under Alternative 6 would be driven by adverse impacts in the upper three reservoirs in the years following a spawning cue release when lake elevations are lower than those under Alternative 1.

Table 32. Summary of NED Analysis for Alternative 6, 1932-2012

Recreation NED Benefits	Upper Three Reservoirs	Lower Three Reservoirs	Inter-Reservoir River Reaches	Lower River	All Locations
Total Visitation Benefits[a]	$1,593,859	$767,456	$115,994	$600,912	$3,078,222
Total Habitat Benefits	NA	NA	$245	$3,826	$4,071
OMRR&R Costs (total)	$3,780	NA	NA	NA	$3,780
Total NED Benefits	**$1,590,079**	**$767,456**	**$116,239**	**$604,738**	**$3,078,513**
Total NED Change from No Action	-$23,260	$695	$163	$963	-$21,439
Percent Change from No Action	-1.4%	0.1%	0.1%	0.2%	-0.7%
Annual Average NED Benefits	$19,631	$9,475	$1,435	$7,466	$38,006
Change in Annual Average Benefits Less Costs	-$287	$9	$2	$12	-$265
Average 8 Worst Years Relative to Alternative 1	-$966	-$154	-$8	-$312	-$1,440
Average of 8 Best Years Relative to Alternative 1	$75	$207	$9	$622	$913

Note: As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

[a] Visitation benefits include all visitors at the upper three reservoirs, lake-elevation affected visitors at the lower three reservoirs, and boat-accessed visitation in the river reaches. Winter visitors are included for the reservoirs but are not in the river reaches.

Management actions under Alternative 6 would result in small increases in recreation access and associated visitation at the lower three reservoirs, inter-reservoir reaches, and lower river, with negligible changes to boat ramp operability, visitation, and recreation NED benefits at these locations because reservoir elevations and river states would remain relatively stable. In the lower river, recreational NED benefits would increase on average by $12,000, a change of 0.2 percent compared to Alternative 1. Some visitors that prefer lower river flows, such as those using paddle craft or swimmers, may be adversely impacted during the spawning cue releases, but would have negligible impacts during at other times under Alternative 6.

OMRR&R costs would be higher under Alternatives 6, $3.8 million compared to $3.3 million under Alternative 1. The upper three reservoir elevations would be relatively lower during conditions similar to those simulated in the 2000s drought under Alternative 6, with small to large adverse impacts depending on the timing and location of needed investments.

When evaluating impacts associated with each MRRMP-Draft EIS alternative, it is useful to analyze annual impacts to better understand under what conditions beneficial or adverse impacts would occur. Figure 18 shows annual NED recreation benefits in the upper (includes

both mainstem reservoirs and inter-reservoir river reaches) and lower river. Figures 19 and 20 show the difference in recreation NED benefits between Alternatives 1 and 6, which are plotted and color-coded based on the type of release occurring each year, for the upper river and lower river, respectively.

In the upper river, modeled results under Alternative 6 show that there would be reductions in recreation NED benefits compared to Alternative 1 during the relatively drier periods of the 1930s, the late 1950s to early 1960s, and the 2000s. The full spawning cue releases in 1931, 1956, 2000, and 2003 decrease the upper reservoirs elevations in the years that follow the release and the reservoirs remain lower than under Alternative 1 due to the relatively drier conditions, causing adverse impacts to visitation and recreation NED benefits. In 7 of the 81 years, recreation benefits in the upper river (the reservoirs and the inter-reservoir reaches) are between $700,000 and $1.3 million lower than those under Alternative 1; these 7 years occur in the drought and low water years of the 2000s, early to mid-1960s, and 1982 when the upper three reservoirs would be drawn down lower under Alternative 6 than under the Alternative 1. In the worst case year in Lake Oahe as simulated in 2004, reductions in NED benefits would be approximately $870,000 lower than under Alternative 1.

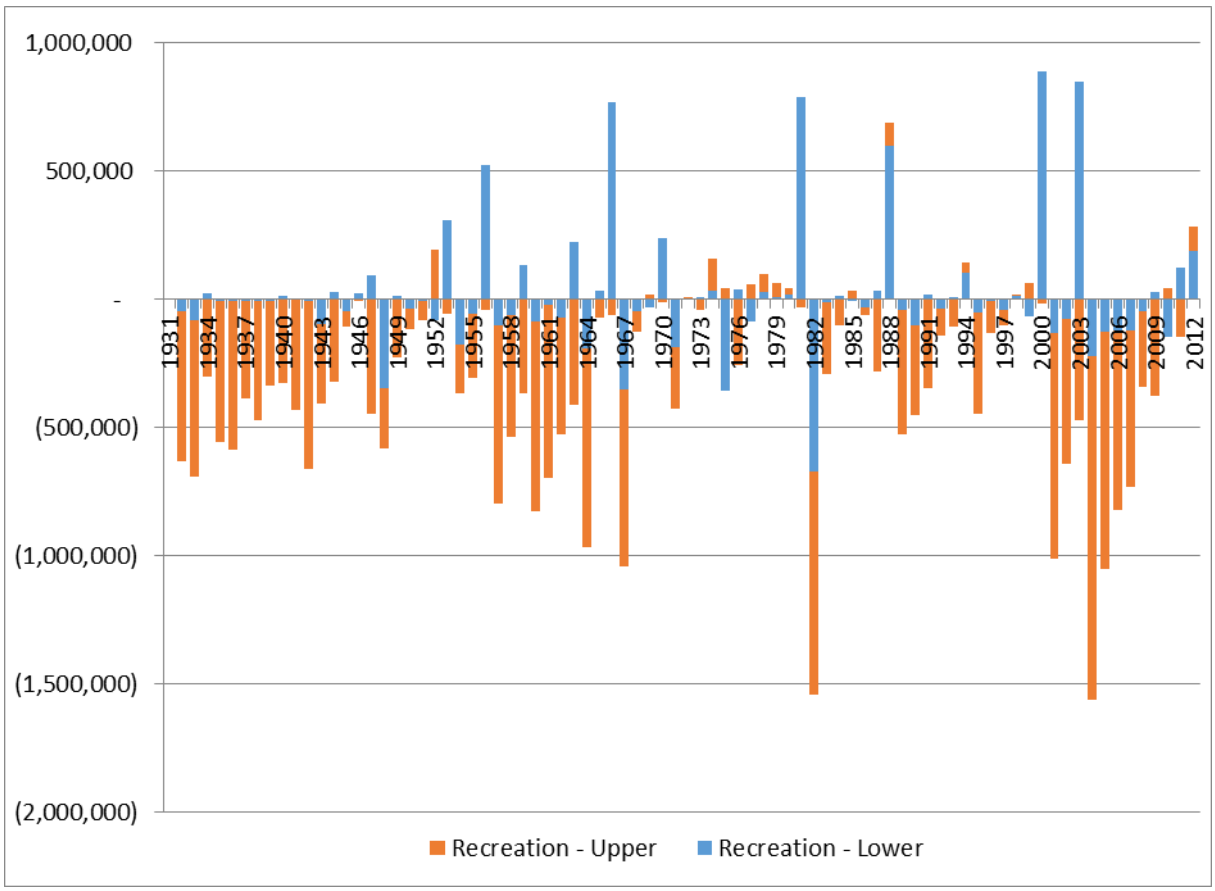

Figure 18. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Upper and Lower River (2016$)

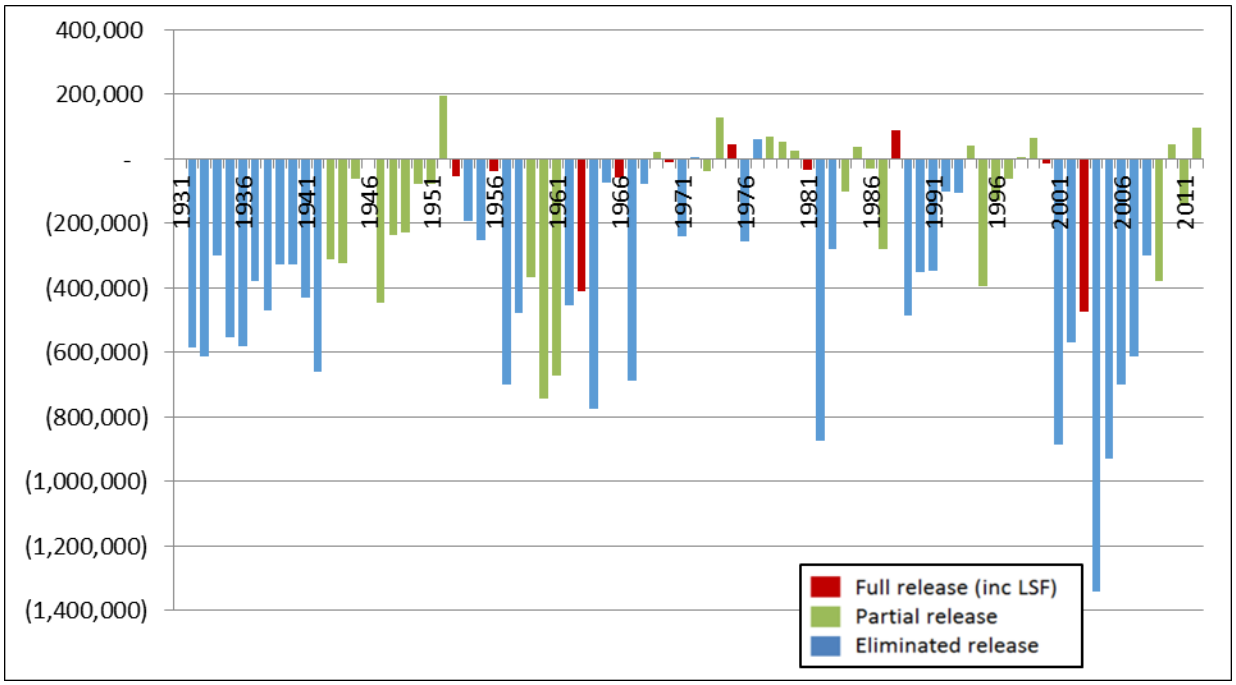

Figure 19. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Upper River (2016$)

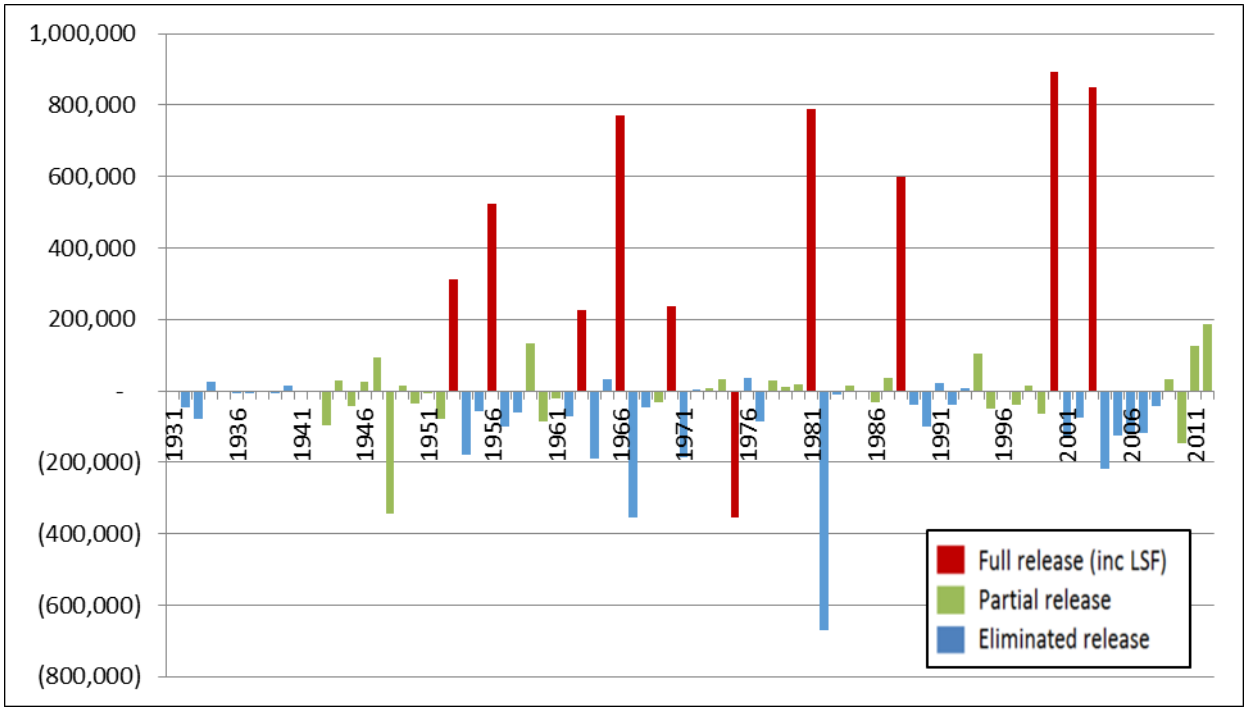

Figure 20. Annual Difference in Recreation NED Benefits under Alternative 6 Relative to Alternative 1 in the Lower River (2016$)

In the lower river, the annual impacts vary with higher benefits relative to Alternative 1 during spawning cue releases and adverse impacts in the years following the releases. The changes in recreation NED benefits under Alternative 6 relative to Alternative 1 are attributable to changes in boat ramp operability with generally higher operability during the spawning cue release and lower operability when river stages fall further than under Alternative 1 in the fall months when the reservoir system must rebalance under Alternative 6. The highest benefit year as simulated in 2000 in the lower river compared to Alternative 1 would result in $890,000 higher recreation NED benefits, while the lowest benefit year as simulated in 1982 would result in a decrease of $669,000 compared to Alternative 1. Across the period of analysis, there would be a 0.2 percent increase in recreation NED benefits on average in the lower river.

4.0 Regional Economic Development Results

This section provides results from the RED analysis. The economic impact analysis was analyzed at state and local levels (i.e. counties adjacent to and surrounding each of the lakes) for each of the five reservoirs. In general, economic benefits tend to be greater in larger geographic areas because larger economies capture additional economic activity. However, local and state economic impact results from the visitor spending under the MRRMP-Draft EIS alternatives for each reservoir project were very similar in magnitude, indicating that changes in economic activity stimulated by visitor spending are mostly concentrated in local communities surrounding each reservoir. This section summarizes the economic benefits at the state level for each of the reservoirs (see table 17 for the state study areas for each reservoir). However, most of the economic benefits are likely to be generated from and supported by the communities surrounding the reservoirs.

The employment and income estimates include industries and businesses directly benefitting from non-local visitor spending (i.e. those who provide goods and services to non-local visitors), as well as secondary jobs and income in industries that support recreation and tourism-related businesses (indirect impact) and jobs and income supported by local workers spending their income in the local economy (induced impact). The employment estimates include both full-time and part-time jobs.

Recreation RED benefits are presented for the following scenarios: the lowest visitation year; the highest visitation year; annual average visitation over the 81-year period; the average difference during the 8 worst years (lowest visitation years) relative to Alternative 1; and the average difference during the 8 best years (highest visitation years) relative to Alternative 1.

Under Alternative 1, non-local visitor spending at the five mainstem reservoirs would support between 62 (Lake Francis Case) and 550 (Lake Oahe) jobs, and between $1.3 million (Lake Francis Case) and $12.5 million (Lake Oahe) in labor income on annual average across the period of record. The degree to which recreation at the reservoirs contributes to regional employment and income at each reservoir is based on the number of non-local visitors and the types of recreational activities in which visitor participate. Lake Francis Case has the fewest number of visitors of all of the six reservoirs.

Tables 33, 34, and 35 summarize employment, labor income, and sales, respectively, supported by non-local visitor spending under the MRRMP-Draft EIS alternatives for each lake. Under Alternative 1, reservoir elevations can affect visitation, which in turn can affect the amount of visitor spending in local economies. As a result, there can be substantial variations in employment and income benefits over the period of record, with Lake Oahe supporting between 229 and 704 jobs and $5.2 million and $16.0 million in labor income depending on visitation at the lake. Lake elevations are the main driver of changes in visitation at the upper three reservoirs, with drought and relatively drier climactic and hydrologic conditions adversely affecting recreation access and fishing opportunities at the lakes.

In general, Alternatives 2, 4, and 6 would have the greatest adverse impacts to jobs, income, and sales relative to Alternative 1. Lake Oahe would be most affected with from 10 to 14 fewer average annual jobs, while Fort Peck Lake and Lake Sakakwea would have from 2 to 4 fewer jobs on average relative to Alternative 1. Alternatives 2, 4, and 6 would reduce reservoir elevations further than under Alternative 1 in the years following a spring release or spawning cue pulse during relatively drier conditions. Under these simulated conditions, Alternative 1 would already be resulting in adverse impacts to regional economic conditions because drought or drier conditions would reduce recreational access and visitation. Alternatives 2, 4, and 6 would exacerbate these impacts, drawing reservoirs elevations down further. During the worst eight difference years relative to Alternative 1 when these conditions would occur, Alternatives 2 and 4 would reduce annual jobs by 53 and $1.2 million in labor income at Lake Oahe. Lake Sakakwea and Fort Peck Lake would experience from 13 to 16 fewer jobs under Alternatives 2 and 4 in the eight worst years relative to Alternative 1. During these conditions, Alternative 6 would have fewer adverse impacts than Alternatives 2 and 4, with Lake Oahe, Lake Sakakawea, and Fort Peck Lake supporting a reduction in annual jobs of 37, 7, and 7, respectively, under Alternative 6 during the eight worst difference years relative to Alternative 1. There are a number of modeled years under Alternatives 2, 4, and 6 when lake elevations would be higher than under Alternative 1, resulting in small increases in RED benefits compared to Alternative 1. However, when comparing the eight worst and best years at the upper three reservoirs, the adverse annual impacts under the eight worst years are considerably worse than the small increases in benefits during the eight best years.

Alternative 3 would have very small benefits to jobs and income at the upper three reservoirs because of slight increases in reservoir elevations relative to Alternative 1. On average, there would be negligible change in jobs and income at Fort Peck Lake and Lake Sakakwea, and an increase of 1 job and $25,000 in labor income at Lake Oahe. When comparing the eight worst and best years at the upper three reservoirs under Alternative 3 compared to Alternative 1, the reductions in annual impacts under the eight worst difference years would be the same as the increases in benefits during the eight best difference years at Fort Peck Lake. At Lake Sakakwea and Lake Oahe, there would be greater increases in annual jobs in the best difference years than decreases in jobs in the worst difference years relative to Alternative 1. Lake Oahe would have the largest increases in jobs and income -- 6 more annual jobs and an increase $136,000 labor income -- during the 8 best difference years under Alternative 3 compared to Alternative 1.

Alternative 5 would reduce average annual jobs by 1 and average labor income between $10,000 and $22,000 per year at each of the upper three reservoirs. During the 8 worst years relative to Alternative 1, usually in the years following simulated fall releases, there would be a reduction in average annual jobs of 3, 6, and 8 at Fort Peck Lake, Lake Sakakawea, and Lake Oahe, respectively.

Table 33. Direct, Indirect, and Induced Employment Benefits from Non-Local Visitor Spending under the MRRMP-Draft EIS Alternatives

Reservoir	Alternative					
	1	2	3	4	5	6
Fort Peck Lake						
Lowest Visitation Year	9	10	9	7	9	8
Highest Visitation Year	182	181	182	183	182	182
Annual Average	108	106	108	105	107	106
Change in Annual Average	-	-2	0	-3	-1	-2
8 Worst Years Relative to Alt 1	-	-13	-1	-13	-3	-7
8 Best Years Relative to Alt 1	-	3	1	1	1	0
Lake Sakakawea						
Lowest Visitation Year	189	185	186	174	186	181
Highest Visitation Year	394	397	396	396	395	396
Annual Average	316	314	316	312	315	314
Change in Annual Average	-	-2	0	-4	-1	-2
8 Worst Years Relative to Alt 1	-	-14	-1	-16	-6	-7
8 Best Years Relative to Alt 1	-	4	3	2	2	1
Lake Oahe						
Lowest Visitation Year	229	203	225	173	225	194
Highest Visitation Year	704	704	703	705	699	703
Annual Average	549	539	550	535	548	538
Change in Annual Average	-	-10	1	-14	-1	-11
8 Worst Years Relative to Alt 1	-	-53	-3	-53	-8	-37
8 Best Years Relative to Alt 1	-	19	6	5	7	3
Lake Francis Case						
Lowest Visitation Year	28	28	25	27	31	26
Highest Visitation Year	68	68	68	67	69	68
Annual Average	62	61	62	62	62	62
Change in Annual Average	-	-1	0	0	0	0
8 Worst Years Relative to Alt 1	-	-5	-1	-2	-1	-1
8 Best Years Relative to Alt 1	-	1	1	2	2	1
Lewis and Clark Lake[a]						
Lowest Visitation Year	181	180	183	183	183	182
Highest Visitation Year	234	254	239	241	241	236
Annual Average	200	201	199	200	200	201
Change in Annual Average	-	1	-1	0	0	1
8 Worst Years Relative to Alt 1	-	-19	-14	-14	-18	-13
8 Best Years Relative to Alt 1	-	20	14	13	16	15

Note: Estimated with the USACE RECONS model.

[a] As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

Table 34. Direct, Indirect, and Induced Labor Income Benefits from Non-Local Visitor Spending under the MRRMP-Draft EIS Alternatives (Thousands of 2016 Dollars)

Reservoir	Alternative					
	1	2	3	4	5	6
Fort Peck Lake						
Lowest Visitation Year	$167	$41	$163	$133	$163	$150
Highest Visitation Year	$3,488	$749	$3,487	$3,504	$3,499	$3,495
Annual Average	$2,068	$439	$2,070	$2,011	$2,058	$2,033
Change in Annual Average	-	-$1,629	$2	-$57	-$10	-$35
8 Worst Years Relative to Alt 1	-	-$54	-$14	-$13	-$63	-$135
8 Best Years Relative to Alt 1	-	$13	$25	$1	$21	$6
Lake Sakakawea						
Lowest Visitation Year	$3,593	$3,511	$3,532	$3,315	$3,532	$3,451
Highest Visitation Year	$7,493	$7,554	$7,535	$7,536	$7,519	$7,538
Annual Average	$6,009	$5,971	$6,016	$5,935	$5,989	$5,965
Change in Annual Average	-	-$38	$7	-$74	-$20	-$44
8 Worst Years Relative to Alt 1	-	-$274	-$27	-$302	-$120	-$140
8 Best Years Relative to Alt 1	-	$83	$56	$30	$47	$21
Lake Oahe						
Lowest Visitation Year	$5,213	$4,605	$5,118	$3,937	$5,118	$4,404
Highest Visitation Year	$16,014	$15,994	$15,987	$16,028	$15,889	$27,031
Annual Average	$12,488	$12,258	$12,513	$12,157	$12,466	$12,239
Change in Annual Average	-	-$230	$25	-$331	-$22	-$249
8 Worst Years Relative to Alt 1	-	-$1,206	-$73	-$1,214	-$183	-$849
8 Best Years Relative to Alt 1	-	$432	$136	$123	$149	$61
Lake Francis Case						
Lowest Visitation Year	$582	$582	$525	$553	$639	$548
Highest Visitation Year	$1,414	$1,418	$1,410	$1,401	$1,435	$5,064
Annual Average	$1,285	$1,272	$1,284	$1,282	$1,288	$1,281
Change in Annual Average	-	-$13	-$1	-$3	$3	-$4
8 Worst Years Relative to Alt 1	-	-$105	-$25	-$45	-$19	-$31
8 Best Years Relative to Alt 1	-	$23	$14	$47	$49	$19
Lewis and Clark Lake[a]						
Lowest Visitation Year	$3,887	$3,862	$3,911	$3,929	$3,916	$3,909
Highest Visitation Year	$5,024	$5,449	$5,124	$5,170	$5,163	$5,064
Annual Average	$4,292	$4,305	$4,274	$4,296	$4,279	$4,306
Change in Annual Average	-	$13	-$18	$4	-$13	$14
8 Worst Years Relative to Alt 1	-	-$399	-$302	-$296	-$382	-$277
8 Best Years Relative to Alt 1	-	$424	$292	$268	$335	$327

Note: Estimated with the USACE RECONS model.

[a] As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

Table 35. Direct, Indirect, and Induced Sales from Non-Local Visitor Spending under the MRRMP-Draft EIS Alternatives (Thousands of 2016 Dollars)

Reservoir	Alternative					
	1	2	3	4	5	6
Fort Peck Lake						
Lowest Visitation Year	$529	$600	$518	$421	$518	$475
Highest Visitation Year	$11,048	$11,048	$11,045	$11,100	$11,084	$11,070
Annual Average	$6,550	$6,447	$6,556	$6,370	$6,520	$6,439
Change in Annual Average	-	-$103	$6	-$180	-$30	-$111
8 Worst Years Relative to Alt 1	-	-$801	-$45	-$789	-$199	-$429
8 Best Years Relative to Alt 1	-	$193	$193	$54	$68	$20
Lake Sakakawea						
Lowest Visitation Year	$11,265	$11,008	$11,074	$10,392	$11,074	$10,819
Highest Visitation Year	$23,491	$23,685	$23,625	$23,627	$23,575	$23,632
Annual Average	$18,839	$18,720	$18,862	$18,608	$18,777	$18,702
Change in Annual Average						
8 Worst Years Relative to Alt 1	-	-$860	-$84	-$947	-$377	-$438
8 Best Years Relative to Alt 1	-	$259	$177	$94	$147	$67
Lake Oahe						
Lowest Visitation Year	$17,040	$15,052	$16,729	$12,870	$16,729	$14,395
Highest Visitation Year	$52,347	$52,282	$52,256	$52,392	$51,937	$52,276
Annual Average	$40,819	$40,070	$40,901	$24,311	$40,750	$40,005
Change in Annual Average						
8 Worst Years Relative to Alt 1	-	-$3,943	-$239	-$3,968	-$599	-$2,774
8 Best Years Relative to Alt 1	-	$1,412	$443	$402	$486	$198
Lake Francis Case						
Lowest Visitation Year	$1,802	$1,803	$1,627	$1,714	$1,979	$1,697
Highest Visitation Year	$4,377	$4,389	$4,366	$4,336	$4,444	$4,371
Annual Average	$3,978	$3,940	$3,975	$3,971	$3,988	$3,968
Change in Annual Average						
8 Worst Years Relative to Alt 1	-	-$324	-$77	-$140	-$58	-$94
8 Best Years Relative to Alt 1	-	$72	$42	$144	$153	$60
Lewis and Clark Lake[a]						
Lowest Visitation Year	$12,549	$12,467	$12,625	$12,684	$12,644	$12,620
Highest Visitation Year	$16,220	$17,592	$16,541	$16,691	$16,670	$16,348
Annual Average	$13,857	$13,898	$13,798	$13,869	$13,813	$13,903
Change in Annual Average						
8 Worst Years Relative to Alt 1	-	-$1,288	-$975	-$956	-$1,233	-$896
8 Best Years Relative to Alt 1	-	$1,370	$943	$866	$1,080	$1,056

Note: Estimated with the USACE RECONS model.

[a] As described in Section 3.1, the RESSIM modeling results indicate that lake elevations at Lewis and Clark Lake would fluctuate more than would occur during the real-time management of these reservoirs. Therefore, these impacts, which are based on boat ramp-operability, reflect larger adverse impacts than would likely occur.

Lake Francis Case and Lewis and Clark Lake would have minimal changes in visitation, non-local visitor spending, and regional economic impacts under Alternatives 2 through 6 compared to Alternative 1. Most of the years when there would be adverse impacts to visitation would be offset by higher reservoir elevations benefiting regional economic benefits. Though modeled results for Lewis and Clark Lake show variations in employment and income relative to Alternative 1, on average there would be negligible changes in jobs and income (the best difference years offset the worst difference years from Alternative 1). In addition, the relatively stable reservoir elevations maintained at this reservoir suggest that the modeled results may be fluctuating (and causing impacts to recreation access and visitation) more than would occur during the real-time management of this reservoir.

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Appendix: Data Sources for Boat Ramps

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