**TO:** GOVERNANCE COMMITTEE

**FROM:** WATER ACTION PLAN SCORING SUBCOMMITTEE

**SUBJECT:** CNPPID REREGULATING RESERVOIR SCORING RECOMMENDATION

**DATE:** MAY 12, 2010

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The Governance Committee (GC) formed an ad-hoc Scoring Subcommittee to advance discussions[1] raised at the December 2009 GC meeting, related to scoring analyses for proposed Water Action Plan (WAP) projects. The Subcommittee utilized the Central Nebraska Public Power and Irrigation District (CNPPID) Reregulating Reservoir preliminary-feasibility findings to provide a case study, illustrating the criteria and methodologies that may be used to score this particular WAP project, and to identify remaining scoring issues that may need further consideration with other WAP projects. The Executive Director's (ED) Office provided technical support toward this effort, working with members of the Subcommittee. This memorandum provides a summary of the findings and Subcommittee recommendations.

## Background

The Water Advisory Committee's (WAC) preferred alternative from the pre-feasibility study[2] is referred to as the *J-2 Alternative 2 Areas 1 and 2*, with a total storage capacity of 14,320 acre-feet. The project water supply would originate from excesses to Nebraska instream flows and Program target flows that are already diverted into CNPPID's system, and would otherwise be returned to the Platte River. Given the source of the water supply and the proximity of the project to the associated habitat, the pre-feasibility yield analyses were completed on a daily basis, which raised certain questions related to the hydrologic analyses in quantifying excesses and shortages to target flows[3]. The scoring case study utilized the pre-feasibility project configuration, size, and location to investigate the ***sensitivity*** of the project yield to these questions, and additional issues identified by the Subcommittee.

The Subcommittee developed an encompassing list of criteria and methodologies that are likely to impact all WAP project yield analyses, shown below in **Table 1**, and then narrowed the list to criteria that are most likely to affect the CNPPID Reregulating project. The ED Office completed multiple spreadsheet[4] sensitivity analyses to bracket the yield that would result through applying various alternatives, which were documented and reviewed in detail by the Subcommittee.

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[1] One of the questions raised at the December 2009 GC meeting was related to the various sets of Program target flows described in the Program Document Attachment 5, Section 11 Water Plan Reference Materials.

[2] Completed by Olsson Associates, February 2010.

[3] Given that one of the primary goals of the pre-feasibility investigation was to screen various design alternatives against one another, it was not critical that all of these questions be resolved for the pre-feasibility hydrologic analyses, as long as the assumptions were consistently applied across the different alternatives.

[4] While the OPStudy Fortran model that was developed in support of the Program EIS was not directly utilized for this exercise, the model input and output data were applied and the model documentation was referenced in attempt to be consistent where possible, and to document differences as identified.

**Table 1. Scoring Components**

| Component | Alternatives | Alternative(s) Used for Case-Study Scoring |
|---|---|---|
| Analysis Tool | • OPStudy model<br>• Individual/combined project modeling using other tools (e.g. Excel)<br>• WMC Loss Model for routing | • Excel daily flow spreadsheet<br>• Data from the WMC Loss Model for routing |
| Analysis Period | • 1947-1994<br>• Extended period to include recent years<br>• Truncated period (e.g. 1975-1994 used for the Reconnaissance-Level WAP) | • 1947-1994 |
| Time-Step | • Monthly<br>• Daily | • Daily |
| Hydrology | • Unadjusted historical gage data<br>• Adjusted Present Conditions data with or without Three States Projects | • EIS OPStudy model data (*Adjusted Present Conditions With Three States Projects*)<br>• Unadjusted Phelps Canal data<br>• ED Office estimates to remove EA flows |
| Calculating Excesses and Shortages to Target Flows | • Applying Appendix A-5 "cfs" (column 4), Appendix A-5 Weighted Monthly "Average cfs" (column 8), or Appendix E Fixed Daily target flow values<br>• Calculating excesses and shortages at Grand Island or Overton gage | • Comparison of applying Appendix A-5 and Appendix E target flow values<br>• Comparison of various combinations of Overton and Grand Island gage data |
| Routing | • No routing<br>• Routing yield to/through the associated habitat | • Comparison of no routing and routing to Grand Island gage |
| Scoring Adjustments | • Bonus score for *new* v. retimed water<br>• Bonus score for ability to augment short duration high flows (SDHF)<br>• Bonus score for ability to provide other benefits (e.g. hydrocycling mitigation)<br>• Bonus score for daily operations if a monthly model is used<br>• Discounting score for percent of associated habitat benefited | • No 'bonuses' were incorporated into score<br>• Possibility of bonus score for SDHF augmentation considered |

## Results

Using daily spreadsheet analyses of hydrologic data from the OPStudy model, the scoring sensitivity analyses showed a range of project yields relative to Program target flows **between 35,836 and 42,480 acre-feet**. This compares to a normal-year yield of 47,480 acre-feet at Overton[5] estimated in the pre-feasibility analysis. Through these sensitivity analyses, the Subcommittee found that yield from this project is most sensitive to the reservoir storage capacity, as well as the inlet and outlet design. This is because the volume of excess flows far exceeds the volume that can be reregulated with the current project storage capacity. The flexibility of daily operations and proximity to the associated habitat also contribute to the ability

[5] For the pre-feasibility study, both excesses and shortages were calculated at Overton. This assumption was made based, in part, on the project's proximity to Overton, anticipating that a real-time operational plan may eventually be developed utilizing the Overton gage. See section *B. Calculating Excesses and Shortages to Target Flows – Grand Island versus Overton* below for more information.

of this project to yield similar volumes regardless of the various criteria and methodologies identified.

**Recommendations**

Through various analyses and considerations, the Scoring Subcommittee recommends the following methodology[6] be utilized in CNPPID Reregulating Reservoir project scoring and could be the basis for scoring future projects recognizing that adjustments may be required when evaluating future projects:

- Utilize 1947-1994 adjusted Three State hydrology[7] developed in support of the Program EIS, disaggregated into daily data by previous OPStudy modeling efforts.
- Apply target flows from the Water Plan Reference Materials[8] Appendix A-5, column 4
- Calculate excesses and shortages at Grand Island, utilizing the WMC Loss model to route project yields to Grand Island

The scoring methodology should remain the same for this WAP project unless the project concept changes considerably through further feasibility study and final design.

Based on this case study, and assuming no substantial change in the size or operational aspects of this project, the Subcommittee recommends that this project be assigned a preliminary score of **40,000 acre-feet**, and that the GC further considers whether the score needs to be updated once the feasibility findings become available. The Subcommittee believes the process used to develop this recommendation, using multiple sensitivity analyses to explore effects of multiple variables, is similar to the process of scoring the initial Three State projects. The Subcommittee anticipates that additional analyses will likely be needed for other types of WAP projects, and that most will benefit from sensitivity analyses to provide context to the potential ranges of yields likely to result from planning and operational considerations. The Subcommittee recommends the GC consider these issues as they arise.

Through discussions, the Subcommittee also identified several issues that the GC may want to refer to the WAC for further investigation, to provide additional context for scoring projects. These include:

- Effects of operation of the Wood River flood way on the Platte River flows at Grand Island as recorded by this gage
- Potential for using a 2- or 3-day running average to analyze excesses and shortages at

[6] Spreadsheet analyses are sufficient, at least until effects of multiple projects need to be compared.

[7] Hydrology without “pulse flows” (terminology of the OPStudy Model; these are equivalent to “short-duration high flows”) should be used and sensitivity analyses similar to those conducted for this case study should be performed to investigate effects of reregulating Environmental Account (EA) flows. There may be times when the Program will want to reregulate EA flows, depending on the project. There are likely certain efficiencies in having the ability to reregulate some of the EA water in J-2 Reregulating Reservoir, due to its proximity to the habitat.

[8] The various target flows provided in the Water Plan Reference Materials provide flexibility in scoring and operating WAP projects; different sets of target flows may be appropriate for different purposes and with different projects. That said, scoring should always reflect the Program’s interest in coordinating all Program water projects to achieve common instream-flow objectives.

Grand Island

- Questions related to the OPStudy adjusted Three State hydrology, including Julesburg flows and other issues identified by the ED Office and documented in the case study supporting documents

Enclosures:
Scoring Subcommittee Conference Call Minutes – April 22, 2010
Scoring Subcommittee Conference Call Minutes – March 4, 2010
Water Action Plan Project Scoring Case Study: CNPPID Reregulating Reservoir

# PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
## Scoring Subcommittee Conference Call
## FINAL Minutes

**April 22, 2010**

## Attendance

Subcommittee Members
John Lawson – Scoring Subcommittee Chair, Bureau of Reclamation
Beorn Courtney – ED Office/Headwaters Corp
Alan Berryman – Northern Colorado WCD
Jon Altenhofen – Northern Colorado WCD
Mike Besson – Wyoming Water Development Commission
Brian Barels – Nebraska Public Power District
Mike Drain – Central Nebraska Public Power and Irrigation District
Jennifer Schellpeper – Nebraska Department of Natural Resources
Don Anderson – Bureau of Reclamation

Other Attendees
Laura Belanger – ED Office/Headwaters Corp
Brock Merrill – Bureau of Reclamation
Greg Wingfield – US Fish and Wildlife Service
Jim Schneider – Nebraska Department of Natural Resources

## Introduction

Lawson went through a roll call. He noted that the only comments received since the last meeting were provided by Mike Drain. Lawson reminded the subcommittee that he would like to have a recommendation for the Governance Committee (GC) to consider at their June 8 meeting regarding scoring this particular J-2 Reregulating Reservoir project. He said that this won't necessarily be the same methodology used for other projects, which would likely require additional discussion.

**The draft minutes for the March 4, 2010 Subcommittee call were approved with no changes.**

## Review of Recent Analyses

Courtney went through the additional analyses that the ED Office has completed since the last Scoring Subcommittee (Subcommittee) call. Additional information was added to Table 4 to show how much excess flow (or excesses) was available at Grand Island versus in CNPPID's system and to the project. This information demonstrates that there are a large amount of excess flows available for reregulation and the size of the reservoir is the major driver of the project score. The ED Office also created Attachment D to describe the OPStudy adjusted hydrology dataset being used.

Courtney said that additional analyses were completed to evaluate the impacts of using Appendix A-5 column 8 (weighted monthly average flows) as compared to column 4 from this same appendix. These results were added to Table 3. She noted that there is little difference in yields between Appendix E and Appendix A-5 column 4. The difference in yields between Appendix A-5 columns 4 and 8 was larger.

Courtney noted that during the last call, there were questions about the dataset being used. In March, the Subcommittee agreed that pulse flows (OPStudy terminology) shouldn't be included in the dataset used for scoring purposes. Pulse flows as used in this document are short duration high flows (i.e not annual pulse flows or peak flows). Since that time, the ED Office located OPStudy output *without* pulse flows. This dataset was used in developing the additional results presented in Table 2. The Subcommittee then discussed how OPStudy disaggregates monthly data to daily. Courtney noted that pulse flows occurred only on specific days within a month and are not disaggregated evenly over the entire month. The Subcommittee has also asked how much EA water was being reregulated. Courtney noted that OPStudy output doesn't identify EA water in the daily output. As a result, the ED Office had to disaggregate monthly EA output as described in Attachment A to the main scoring document. Table 2 includes two analyses completed removing EA water in different ways. In one analysis (Table 2 row 4), all EA water was removed from Grand Island (so not considered when evaluating if excesses or shortages existed) and the project supply (J-2 Return flows). In the other analysis (Table 2 row 3), EA water was left in the Grand Island flows to calculate excesses and shortages, but any EA water in the J-2 Return project supply was removed so could not be stored. Anderson asked why the results in Table 2 in Rows 3 and 4 are so different if EA water was removed from the J-2 Return project supply in both cases. **The ED Office will investigate the differences and provide additional information to the Subcommittee.** Drain noted that the analysis completed in Rows 2 and 4 bracket the Row 3 results. Wingfield noted that we now know the relative significance of taking out pulse flows and EA flows based upon Table 2 and that this is very helpful in considering the implications of retimed EA flows for scoring.

## <u>Discussion</u>

Lawson said that ultimately the Fish and Wildlife Service (FWS) needs to agree with whatever the Subcommittee proposes. This is an effort to provide information that FWS can be comfortable with. Lawson noted that he'd like to use Drain's comments as a means to discuss the various topics. Drain reviewed his key points. He recommends that pulse flows shouldn't be included in the dataset used for scoring, noting that the analyses completed shows this doesn't impact the score much. Regarding EA flows, he thinks that there may be times when the Program will want to reregulate EA flows depending on the project. What the ED Office has done in Table 2 provides a sensitivity analysis, rather than a final score. Drain believes that the score should be between Rows 2 and 4 in this table, or approximately 40,000 acre-feet. Lawson noted that there are probably certain efficiencies in having the ability to reregulate some of the EA water in a J-2 Reregulating Reservoir due to its proximity to the habitat. Drain also noted that the difference in using EA flows or not isn't large enough to spend too much time on.

Regarding target flows, Drain noted that certain projects will operate in different ways, so different targets may be appropriate for different projects. For example, Tamarack I can't be operated daily so shouldn't use the changing daily targets. He noted that the differences in yields developed using Appendix E versus Appendix A-5 column 4 are small.

Regarding the location used to calculate target flows, Drain thinks that either using just Grand Island or just Overton to calculate excesses and shortages makes the most sense. Drain noted that in actual operations, the EA Manager may change the location that he's focused on depending on the specific situation. Drain said that results are very similar for both Grand Island and Overton. He doesn't think it matters much but we should use the same location for excess and shortage calculations.

Drain noted that there are some concerns about the dataset such as if Tamarack I flows were included. There seems to be something strange going on at Julesburg. Drain thinks we should move on, as this probably doesn't impact the score much, though **the ED Office should continue to investigate the dataset**.

Drain also recommended that the Subcommittee pick a round number for a score and not haggle over of few hundred acre-feet (AF) of score.

Lawson then asked the group for their thoughts on Drain's proposal. Besson believes it is reasonable and thanked Drain for his efforts. Wingfield noted that he knows this can be evaluated numerous ways and he's comfortable that at some point this will be a negotiated number. This is consistent with how the three state projects were evaluated. Wingfield said that he is comfortable with Grand Island being the gage that is used. Wingfield also thinks it makes sense for some EA flows to be reregulated by this particular WAP project. He noted that the final score would be decided at a later date once final design information is available, particularly since the analysis is so sensitive to the reservoir capacity.

Wingfield also said that the score would be impacted if the hydrology was extended beyond the OPStudy model period (1947 – 1994) to present. One reason is that completion of the Wood River flood way a few years ago now results in additional flows being returned to the river above Grand Island. This needs to be considered in scoring future projects, as it can impact Grand Island gaging records. Drain noted that the Program needs to be paying attention to any changes occurring in the vicinity of gages.

Lawson said that the Subcommittee needs to have thorough documentation regarding the process, what was considered, and what was determined to score this particular project. This documentation will then serve as a starting point for scoring other projects in the future. Lawson told the Subcommittee that if they can decide on a methodology today, he would like a document describing what was completed and where the group ended up. He recommended using Drain's memo as a good starting point.

Lawson asked Wingfield to clarify that when a final score was determined for the initial three state projects, the group agreed that the score was 80,000 AF and this won't change. There will be a monitoring program to see how well we achieved our goal but the score won't be changed. Wingfield clarified this and said that his earlier comment that "a final score would be decided at a later date" simply meant that if the design changes as the J-2 Reregulating Reservoir project moves ahead, that the draft project score will need to be adjusted prior to being accepted as an official project score. Drain confirmed that the data in the Scoring Subcommittee memo is based on a preliminary project design and this will change as the project moves through feasibility and final design.

Regarding the location used to calculate excesses and shortages, Anderson thought that it makes sense to use one gage for both calculations and also that it makes sense to use Grand Island. Anderson thought that by focusing solely on Grand Island, because of travel time, there could be days with excess flows at Grand Island but not at Overton. He noted that he understands that this analysis is for scoring and not real-time operations, but he does think there needs to be some correlation between scoring and operations. He proposed that rather than scoring against daily flows, a rolling two or three day running average could be used to evaluate excess flows and shortages. Drain noted that we are assuming that if we're within one day, then we're probably good enough. Anderson noted that it may well be that enough analysis has been completed and that the Subcommittee is close enough with the analyses already done to be able to come to a negotiated score.

Barels suggested that some of the outstanding data questions and final design details can continue to be worked on, but at the same time the Subcommittee can draft a proposal for the GC regarding the methodology for scoring this project. He noted that ultimately, the Subcommittee will have to figure out how to score all WAP projects and that with this current project, the group is changing, to some degree, the methodology laid out in the Program Document. This makes sense because we have more information and know more now. Barels said this all needs to be well documented so it can referred to in the future. Lawson noted that for this project, we will frame the proposed scoring methodology and get it to the GC. The Subcommittee can then describe additional analysis that should be considered by the Water Advisory Committee (WAC), such as looking into what's going on regarding Tamarack I in the model and Anderson's proposal to use a two or three day running averages for analysis. Wingfield noted that if the group is identifying issues to discuss with the WAC, he'd like to include changes to flows at the Grand Island gage as a result of the Wood River flood way return.

Lawson confirmed with the Subcommittee that at this point, it has a proposal regarding how to score this project. Anderson also noted that his two or three day rolling average idea is more of a policy approach that this group should consider, regardless of whether the project design changes. Courtney asked for clarification on how this analysis would work and Anderson said that the daily flow data would be averaged over two or three days, and the daily target flow compared to the rolling average. Drain then said that he thought you might also want to average the target flow, especially if it's changing. Drain noted that that once we decide how to do the analysis, it could be done fairly quickly but deciding exactly how to do it would take some time. Anderson suggested that it may not be something to bring to the WAC and that perhaps the best way to do this would be for FWS to discuss it with the ED Office. Wingfield doesn't think this is critical and if the ED Office were to complete additional analyses, it would be similar to how the other analyses were completed in the memo, as another sensitivity analysis. It was left that this issue was something the WAC could consider evaluating in the future, as noted earlier.

Lawson asked Wingfield if he thinks we need to do additional analysis at this point. Wingfield said no, if the Subcommittee is ready to go forward and say here's the methodology, then he's okay with that. Lawson said if the Subcommittee can agree that further analysis regarding methodology isn't needed now, then a proposal can be brought to the GC. Separate from this, the WAC can look at other questions to add general knowledge and context. Drain noted that to the extent that projects are considered on a daily basis, in the future the Subcommittee could consider if there is a better mechanism to take travel time of more than a day to Grand Island into consideration.

**Lawson said the he will work with the ED Office to put a draft GC recommendation together that will be sent out to the group.** Barels noted that one of the items that stimulated the formation of the Subcommittee was whether or not Appendix E or A-5 needed to be modified. He said that the group has learned that scoring can vary, depending on the project, but for this analysis Appendix A-5 column 4 will be used. He suggested that the GC proposal highlight that this can vary depending on the project.

Altenhofen said that he agreed with Drain's memo and the proposal to use Grand Island to calculate excesses and shortages using target flows from Appendix A-5 column 4. He also thought it makes sense to consider EA water at Grand Island when calculating excess flows and shortages but perhaps not storing these in the Reregulating Reservoir. Altenhofen asked about Olsson's next round of project design analysis. Courtney explained that the draft scope proposes that the ED Office continues to update, as necessary, the types of analyses that have been completed for this case study once the next level of CNPPID Reregulating Reservoir feasibility is completed. Olsson will run their models for design regarding reservoir capacity, specific gate sizes, numbers of gates, outflow capacities, etc. Olsson will also likely use historical hydrology and a longer period for their design analysis. Scoring is outside of Olsson's scope and experience. Courtney noted that Olsson will design the reservoir for a combination of uses, including short duration high flows, target flows, and potentially hydrocycling mitigation. Olsson will provide revised capacities to the ED Office, which will then rerun the analyses and update the project score, if necessary.

Lawson agreed that if the reservoir size changes the analysis will need to rerun. Courtney confirmed this and said that the ED Office can redo all of the tables in the case study memo or just specific analyses identified by the Subcommittee. Drain suggested that only the key analysis the Subcommittee has identified will need to be updated. He also said that once the revised design information is available, the Subcommittee could also consider if the design is similar enough that existing results could be used.

The group thanked the ED Office for the work they've done on this and for major contributions from various Subcommittee members. **Lawson will develop a schedule regarding how to get a proposal to the GC for their June 8 meeting.**

# PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
## Scoring Subcommittee Conference Call
## FINAL Minutes

**March 4, 2010**

## Attendance

Subcommittee Members
John Lawson – Scoring Subcommittee Chair, Bureau of Reclamation
Beorn Courtney – ED Office/Headwaters Corp
Don Anderson – Bureau of Reclamation
Alan Berryman – Northern Colorado WCD
Jon Altenhofen – Northern Colorado WCD
Mike Purcell – Wyoming Water Development Commission
Mike Besson – Wyoming Water Development Commission
Brian Barels – Nebraska Public Power District
Mike Drain – Central Nebraska Public Power and Irrigation District
Jennifer Schellpeper – Nebraska Department of Natural Resources

Other Attendees
Jerry Kenny – Executive Director, Headwaters Corp
Laura Belanger – ED Office/Headwaters Corp
Greg Wingfield – US Fish and Wildlife Service
Brock Merrill – Bureau of Reclamation
Jim Schneider – Nebraska Department of Natural Resources

## Introduction

Courtney reminded the group that per Lawson's direction, the purpose of the case study is to run to ground some of the scoring issues relevant to the CNPPID reregulating reservoir project. It also focuses on issues Anderson could provide unique input, given that his time is limited on this project. Table 1 in the case study memo outlines major scoring issues that have been identified over time and also notes which were addressed in this case study. The case study showed some of the sensitivities of these decisions by presenting a range of scores rather than picking a score. **The following two corrections to Table 1 will be made: (1) the Analysis Period component will be updated to reflect that an extended period could be run as an alternative to the historical 1947-1994 scoring period, and (2) the Hydrology component will be corrected to include an unadjusted and adjusted alternative.**

## Discussion

The reregulating reservoir prefeasibility study used daily historical gage data for three representative year types. The case study used OpStudy model output for a continuous daily simulation of 1947-1994. Don Anderson provided the OpStudy model output hydrology, which was based on "adjusted" OPStudy output for Present Conditions (as of mid-1990's) with full implementation of the initial three State projects. Anderson explained that OPStudy is a monthly timestep model. Late in the EIS process there was a need for daily data (for sediment modeling). Monthly data was disaggregated to daily using the historical daily distribution for that particular month. Berryman asked if in using the OpStudy adjusted hydrology, did we avoid mixing the water already counted toward the three State projects? The OpStudy dataset used for this analysis did include effects of operating the three State projects and the pulse flow releases, and that water was not 'colored' differently so there may have been some double accounting.

The group discussed the Appendix A-5 and E target flows. Table 2, which used Grand Island to calculate excess flows and shortages, shows there is 0.32% difference on average and 0.81% difference in wet years. The bottom line is there's a very small difference in the score – roughly 140 acre-feet on average over the 1947 – 1994 period used in this case study. The issue is that there is a discrepancy between the two appendices in wet years in May and June as described in footnote 3 on page 3 of the case study memo. Altenhofen noted that Tamarack I was scored against Appendix E and Nebraska's Depletions Plan refers to Appendix E. There was discussion regarding the various appendices and when they can/should be used according to the Water Plan Reference Materials (WPRM), which appears to provide some flexibility. Barels referred to page 10 of the WPRM that describes operation of approved Water Plan projects. It provides flexibility and says that the applicable target flows may be expressed in terms of weighted-monthly averages, fixed daily values, or flexible daily values.

The subcommittee will need to decide which appendices will be used for what purposes. Lawson noted that the group needs to come to a conclusion for the scoring of Water Action Plan projects, but not today. Any discussions regarding Tamarack I and Nebraska's Depletions Plan is not under the scope of this subcommittee and is referred to the Water Advisory Committee for discussion and recommendations to the Governance Committee as needed. The subcommittee also needs to decide if a daily spreadsheet can be used for scoring rather than using the monthly OPStudy model. There was some discussion regarding how the initial three State projects were scored and if we do something different, is that a problem? The subcommittee generally supported using the 1947 – 1994 adjusted hydrology as has been used in the past. Drain noted that even when OPStudy was used there were issues with the monthly timestep. The score was increased when there was some benefit to a project being operated on a daily basis. Courtney noted that the ED Office does not currently have the ability to use OPStudy and also was using assumptions from the prefeasibility level project analysis, which was performed on a daily basis. From the pre-feasibility study, we learned that in many cases there are excesses and shortages in the same month so using a monthly model hides this. OPStudy considers a month to either have shortages or excesses, but not both.

Lawson then moved on to Table 3 which used varying gages to evaluate excess flows and shortages. This is something that will have to be resolved, likely through the Fish and Wildlife Service. Anderson explained that all of the scoring is relative to target flows in the Platte River. When there are flows above the target flows (excess flows) water can be stored and retimed.

When flows are below the target flows, there is a shortages and water can be released/retimed to decrease, or reduce, the shortage. OPStudy modeling used the Grand Island gage, using monthly average flows, to determine if there were excesses or shortages in a particular month. The reality is that the FWS wants to protect and improve flows throughout the habitat reach. This raises the question, particularly on a daily basis versus monthly average, if you have different flow conditions at the upper end of the reach and Grand Island, do you need to pay attention only to Grand Island or also Overton (towards the upper end of the reach). The selection of the gage does have a substantial impact on the score as shown in Table 3 in the scoring case study memo. Anderson noted that this needs to be resolved and the FWS needs to determine what they are comfortable with regarding the gage to use to determine excesses and shortages. Drain pointed out that we are assuming that we need to have a rigid set of rules but he believes the Program Document allows for flexibility in the way the individual projects are evaluated. It's ultimately the FWS's decision but the rest of the group can have input. Drain noted that the original score was not exactly what came out of OPStudy. There were some adjustments made for various projects based on other information.

Lawson asked what if the target flow was 1,200 cfs and there is 600 cfs at Overton and 1300 cfs at Grand Island. Courtney explained how Table 3 works; that if Grand Island is to determine excess flows and shortages, 100 cfs of excess flow could be diverted into storage (if there is water in CNPPID's system and capacity to store it). When use the minimum of Grand Island and Overton, there needs to be an excess at both gages, so in this case there are no excesses at Overton so no water could be stored. The same is true for the remaining cases in the table because they use Overton to determine if there are excess flows. In the last case, when Overton is used to determine excesses and shortages, there is a shortage at Overton so if water was available, there could be a release to reduce the shortage. Anderson pointed the group to footnote 4 in the scoring memo which documented the FWS concerns about improving flows throughout the entire reach and Wingfield concurred. The group agreed that scoring is – and should be – separate from real time operations. If both gages had been used in OPStudy, scores would have been lower. The scoring subcommittee ultimately needs to make a recommendation to the FWS. Drain said that the Program Document allows flexibility and the subcommittee can look at ranges of options for projects as they come forward and make a recommendation to the FWS. The Environmental Account (EA) Manager can also choose to operate projects differently from the exact assumptions used for scoring.

Purcell then asked if any EA water resulting from the initial three State projects was being more efficiently reregulated by this project; does this analysis show the benefit of having storage lower in the system? Drain and Anderson confirmed that any EA water that ends up at the habitat would be in the OPStudy data. If EA water arrived during a period of excesses, some EA water could potentially be reregulated. Altenhofen noted that ideally we would run OPStudy with the SDHF turned off as documented in the scoring memo. Courtney noted that the ED Office spent a long time discussing this with Anderson and pointed to Figure A-1 in Attachment A of the scoring case study memo. Looking at all of the excesses that were available in CNPPID's system and that could have been sent down the Phelps Canal for this particular project, there were a lot of additional excesses available as compared to what was actually scored. For this particular project, the score didn't seem particularly sensitive to this. Purcell noted that double accounting may be appropriate, assuming it's not a large volume, if this reregulating reservoir allows the Program to better optimize use of water. Lawson and Purcell noted that the group may chose to score a project one way, but then asked how will that get used in combination with the three State projects and other projects? Anderson pointed out this is why a model like OPStudy is important because as you begin getting more projects operating, you can model project interactions. Drain said that it may be possible to include additional projects in the daily spreadsheets analysis.

The 80,000 AF score for the initial three State projects used Grand Island to determine excess flows and shortages. The group tended to think that Grand Island is what should be used for scoring as was done with the three State projects. Purcell asked what the assumptions were for the initial three State projects. Courtney responded that we didn't color or track that water so we don't know if we're storing any of this as excess flows. The capacity of these reservoirs is small enough, that if that did happen, we could likely leave that water in the river and grab other excesses on subsequent days. If any EA water was double counted, it could likely have been replaced with other excess water in this particular case. **The ED Office will add information regarding total volumes of excess flows available and how much was stored to Table 3.** Wingfield noted that if EA water stored as excess flows was a significant percentage of what was stored then the group should be concerned but for this particular project, the FWS isn't concerned. Courtney noted that Table A-1 in the scoring memo Attachment A showing Olsson's (the consultant that completed the prefeasibility study) normal year result, which was based on different hydrology and assumptions, was very similar to the average case study score. The reservoir capacity appears to have a larger impact on the score for this project than the dataset used. This may become important for other projects.

Belanger noted that OPStudy did not model the Phelps County Canal. As a result historical, filled data (as described in the scoring memo Attachment A) was used. Drain and Belanger discussed these data and agreed that for this case study they are appropriate.

Altenhofen requested that the daily modeling files be provided to him. Belanger noted the files are large so will need to be posted to an ftp site. **Subcommittee members who would like these files should email her at belangerl@headwaterscorp.com. The ED Office will post the files to Altenhofen's ftp site and will also post them at the Program's ftp site if anyone else is interested.**

## Bonus Scoring and Short Duration High Flows

Short Duration High Flow (SDHF) scoring and assumptions were briefly discussed. Courtney noted that it is assumed that the supply for a SDHF can be either EA water routed down and staged immediately prior to an event or excess flows if available. Anderson said that up to now the FWS hasn't considered giving a bonus score for SDHF and that they are concerned that if EA water is being used, the water is being double counted. Belanger noted that if you only use excess flows for SDHFs you don't score any higher than if you are using a reregulating reservoir solely to meet target flows. The reservoir is more efficient for target flows because water is not held for long periods of time.

**Conclusions**

Lawson asked the group if it thinks its purpose is only trying to determine how to score this project or is it also thinking about how other projects will be scored in the future? He noted that it may be difficult if the group tries to think about other projects for which specific details are not known. Lawson also said that it seems that this project should be scored on target flow operations and nothing else. The group needs to make a recommendation regarding this project and if it thinks that recommendation conflicts with anything in the Program Document, it will need to address this.

At the subcommittee's request, **the ED Office will run the daily model using the weighted-monthly average target flow values (last column) in Appendix A-5 using the Grand Island gage to determine excesses and shortages. Results will be added to Table 2 of the scoring memo.** This will help address the guidance provided in the WPRM regarding when to apply which appendices.

At the subcommittee's request, **the ED Office will document, using information that can be pulled from the EIS and OPStudy documentation, regarding how the adjusted present condition and three State hydrology that was used to develop the 80,000 acre-foot score for the initial three State projects was developed. The ED Office will also look at available OPStudy output data (possibly requesting additional output data from Anderson or with assistance from Drain) for the adjusted dataset to try to determine when EA releases were made, and compare this to when excesses were stored to estimate the volume of excesses potentially stored under the current case study analysis.**

**Lawson asked that each subcommittee member provide him with input regarding how they think this project should be scored.** He noted that he is not looking for why certain things won't work but rather what they think will work. **The goal is for this subcommittee to have a recommendation to take to the June 8 GC meeting.** Lawson reiterated that right now, the subcommittee is thinking that the score be based on target flows at Grand Island.

# WATER ACTION PLAN PROJECT SCORING CASE STUDY: CNPPID Reregulating Reservoir

## I. EXECUTIVE SUMMARY

The Platte River Recovery Implementation Program (Program) Scoring Subcommittee was formed by the Governance Committee (GC) to advance discussions regarding scoring analyses for proposed Water Action Plan (WAP) projects. The Subcommittee Chair, John Lawson, asked the Program Executive Director's Office (ED Office) to utilize the Central Nebraska Public Power and Irrigation District (CNPPID) Reregulating Reservoir pre-feasibility findings to provide a case-study illustrating the criteria and methodologies (see Table 1) that may be used to "score" that particular WAP project, and to highlight remaining unresolved scoring issues. Potential topics that may be relevant for scoring other WAP projects could be identified, but did not have to be evaluated at this time if they were not directly relevant to the reregulating reservoir WAP project. Don Anderson, formerly with the U.S. Fish and Wildlife Service (Service), provided input to this exercise.

This case study utilizes physical parameters from the Water Advisory Committee's preferred CNPPID Reregulating Reservoir pre-feasibility alternative, *J-2 Alternative 2 Areas 1 and 2* with a total storage capacity of 14,320 acre-feet. Using this project configuration, size, and location, **our analysis results in a project score of between 35,836 and 42,480 acre-feet**[1] (see Table 4), depending upon the specific criteria applied to determine the occurrence of excesses or shortages to target flows on a daily basis and <u>not including</u> any scoring adjustment for 'bonus' score (see discussion below). The case study evaluated the options and results for:

- Hydrology – With or Without Environmental Account (EA) Flows;
- Calculating Excesses and Shortages to Target Flows – Applying Appendix A-5 or Appendix E target flows;
- Calculating Excesses and Shortages to Target Flows – Calculating at Grand Island or Overton gage; and
- Potential Scoring Adjustments for Short Duration High Flow (SDHF) Augmentation and other topics.

The scoring methodology and policy issues outlined in this document need to be resolved before a final project score can be assigned. These decisions may also influence feasibility analyses.

## II. INTRODUCTION

A project score toward reducing shortages to target flows was estimated by comparing the potential project yield to target flows at a certain location. This approach creates several potential alternatives with respect to the criteria applied and the data utilized in the analysis.

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[1] This is a preliminary range based upon the assumptions specified for Table 4. This range may change, depending on the data and assumptions presented in this memo and ultimately selected by the Scoring Subcommittee.

**Table 1** provides a list of components that may potentially affect a project score, alternatives to analyzing each component, and the approach applied for this case study analysis. The results for this project are expressed as a range of possible scores, because certain components affecting the score for this (or any) WAP project ultimately depend upon Service and Program policy decisions that have not yet been clarified. It should also be noted that additional scoring issues were not addressed here that may need to be addressed in the future for other WAP projects.

**Table 1. Scoring Components**

| Component | Alternatives | Alternative(s) Used for Case-Study Scoring |
|---|---|---|
| Analysis Tool | • OPStudy model<br>• Individual/combined project modeling using other tools (e.g. Excel)<br>• WMC Loss Model for routing | • Excel daily flow spreadsheet<br>• Data from the WMC Loss Model for routing |
| Analysis Period | • 1947-1994<br>• Extended period to include recent years<br>• Truncated period (e.g. 1975-1994 used for the Reconnaissance-Level WAP) | • 1947-1994 |
| Time-Step | • Monthly<br>• Daily | • Daily |
| Hydrology | • Unadjusted historical gage data<br>• Adjusted Present Conditions data with or without Three States Projects | • EIS OPStudy model data (*Adjusted Present Conditions With Three States Projects*)<br>• Unadjusted Phelps Canal data<br>• ED Office estimates to remove EA flows |
| Calculating Excesses and Shortages to Target Flows | • Applying Appendix A-5 "cfs" (column 4), Appendix A-5 Weighted Monthly "Average cfs" (column 8), or Appendix E Fixed Daily target flow values<br>• Calculating excesses and shortages at Grand Island or Overton gage | • Comparison of applying Appendix A-5 and Appendix E target flow values<br>• Comparison of various combinations of Overton and Grand Island gage data |
| Routing | • No routing<br>• Routing yield to/through the associated habitat | • Comparison of no routing and routing to Grand Island gage |
| Scoring Adjustments | • Bonus score for *new* v. retimed water<br>• Bonus score for ability to augment short duration high flows (SDHF)<br>• Bonus score for ability to provide other benefits (e.g. hydrocycling mitigation)<br>• Bonus score for daily operations if a monthly model is used<br>• Discounting score for percent of associated habitat benefited | • No 'bonuses' were incorporated into score<br>• Possibility of bonus score for SDHF augmentation considered |

## III. PROJECT DESCRIPTION AND PRELIMINARY SCORING RESULTS

This case study utilizes physical parameters from the Water Advisory Committee's preferred pre-feasibility alternative, *J-2 Alternative 2 Areas 1 and 2* with a total storage capacity of 14,320 acre-feet. Using this project configuration, size, and location, **our analysis results in a project score of between 35,836 and 42,480 acre-feet**[2] (see **Table 4**). This compares to a normal-year yield of 47,480 acre-feet at Overton[3] estimated in the pre-feasibility analysis. That figure was not necessarily intended to translate directly into a WAP project score; its purpose was to compare yields between alternatives being evaluated at the pre-feasibility level.[4]

Key differences between this scoring exercise and the pre-feasibility study include:

- Continuous daily hydrologic simulation over 48 years using OPStudy hydrology (pre-feasibility study used a representative normal, wet, and dry year)
- Comparison between applying Appendices A-5 and E from the Water Plan Reference Materials (including different target flows from Appendix A-5) to calculate shortages to target flows (pre-feasibility study used column 4 from Appendix A-5)
- Comparison between using Grand Island or Overton gage data to calculate excesses and shortages to target flows (pre-feasibility study used Overton)

## IV. ALTERNATIVES EVALUATED FOR EFFECT ON SCORE

As noted above, the score determined for this project ranged from 35,836 to 42,480 acre-feet, depending upon the specific criteria applied to determine the occurrence of excesses or shortages to target flows on a daily basis and not including any scoring adjustment for 'bonus' score. The following sections describe the options and results for:

- Hydrology – With or Without EA Flows;
- Calculating Excesses and Shortages to Target Flows – Applying Appendix A-5 or Appendix E target flows;
- Calculating Excesses and Shortages to Target Flows – Calculating at Grand Island or Overton gage; and
- Other Possible Scoring Adjustments.

[2] See footnote 1.
[3] For the pre-feasibility study, both excesses and shortages were calculated at Overton. This assumption was made based, in part, on the project's proximity to Overton, anticipating that a real-time operational plan may eventually be developed utilizing the Overton gage. See section *IV.B. Calculating Excesses and Shortages to Target Flows – Grand Island versus Overton* below for more information.
[4] Also, note that project sponsors may wish to reserve a portion of this yield; per the Reconnaissance-Level Water Action Plan, Nebraska indicated it may reserve 2,500 to 4,000 acre-feet of reregulating reservoir project yield to offset depletions.

## IV.A. Hydrology – With and Without EA Flows

The majority of the results provided in this case study were generated using daily OPStudy EIS model run output data (*Adjusted Present Conditions With Three States Projects*) provided to the ED Office, which included pulse and EA flows (see **Attachment D** for background information regarding the OPStudy model hydrology). This was the only data readily available when the ED Office performed the initial case study analyses. Upon reviewing the results, the Scoring Subcommittee and the ED Office agreed that ideally pulse flows would not have been included. The ED Office has since identified additional OPStudy model run output data. Rather than rerun all case study scenarios, one simulation was completed *without pulse flows* by applying target flows from Appendix A-5 column 4, and using the Grand Island gage to calculate daily excesses and shortages, to determine the general impact. Results presented in row 2 of **Table 2** show that removing pulse flows had a small impact on excess flows and project yield (approximately a 1% decrease in average annual reductions in shortages to target flows). We recommend that data without pulse flows be used in future project scoring.

The Scoring Subcommittee also requested that the ED Office attempt to gain a better understanding of the extent to which the case study analyses may have reregulated EA flows in the CNPPID reregulating reservoir, and how this may have impacted the project yield[5]. The ED Office used the OPStudy model run output data (without pulse flows) from Grand Island and the J-2 Return to "remove" EA flows from the hydrology data, as described in **Attachment A**[6]. This adjusted data was then utilized in the reregulating reservoir case study analysis, applying target flows from Appendix A-5 column 4, and using the Grand Island gage to calculate daily excesses and shortages. Results are presented in rows 3 and 4 of **Table 2**. Row 3 includes EA flows when determining excesses and shortages at Grand Island, but removes EA flows from the amount of water that can stored in the CNPPID reregulating reservoir. Row 4 is similar to row 3 except that EA flows were not included when determining excesses and shortages at Grand Island. There are limitations with both analyses, as further described in Attachment A; however the ED Office found the approach used to develop row 3 results more representative of the intent for projects to be incrementally scored toward a total 130,000 to 150,000 AFY. As compared to the simulation with only pulse flows removed (row 2), removing the pulse *and* EA flows (row 4) has the largest effect on the project yield, with a decreased average annual reduction to shortages by approximately 7%. This shows that under this scenario, on average, less than 3,000 acre-feet per year of the reregulated flows may have been EA water.

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[5] The *Adjusted Present Conditions With Three States Projects* OPStudy dataset includes Lake McConaughy EA releases that served to reduce shortages to target flows and were counted toward the initial Program score. These releases were included in the data used throughout this case study to determine excesses and shortages. To the extent that EA flows were reregulated in the CNPPID reregulating reservoir, there is potential that the score was "double counted".

[6] The adjustments were made to estimate the yield if no EA water is reregulated. The ED Office analyses to remove EA flows should be considered preliminary as there are several data issues outlined in Attachment A which may impact EA flow adjustments. The ED Office anticipates any related modifications to the OPStudy hydrology will likely have a minimal impact on the results presented in Table 2.

**Table 2: Average Annual Yield Comparison with Various Pulse and EA Flow Hydrology [1]**

| Row | Grand Island and J-2 Return Hydrology | Average from 1947-1994 Period (acre-feet) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Excesses at Grand Island | Excesses in CNPPID's System | Excesses Available for Phelps County Canal | Excesses Stored | Reservoir Releases | Reductions to Shortages [2] |
| **1** | With Pulse, With EA Flows | 405,734 | 216,676 | 169,791 | 47,758 | 47,621 | 42,181 |
| **2** | Without Pulse, With EA Flows | 393,441 | 207,788 | 163,300 | 47,303 | 47,138 | 41,556 |
| **3** | Without Pulse, Without EA Flows in J-2 Return but With EA flows at Grand Island | 393,441 | 206,014 | 162,156 | 46,982 | 46,820 | 41,295 |
| **4** | Without Pulse, Without EA Flows | 374,459 | 193,070 | 150,422 | 43,596 | 43,459 | 38,670 |

[1] All scenarios in Table 2 were developed by applying target flows from Appendix A-5 column 4, and using the Grand Island gage data from the OPStudy *Adjusted Present Conditions With Three States Projects* dataset (which include pulse and EA flows) to calculate daily excesses and shortages.
[2] Differences between Reservoir Releases and Reductions to Shortages reflect routing effects (transit loss).

## IV.B. Calculating Excesses and Shortages to Target Flows – Applying Appendix A-5 or Appendix E

The Subcommittee has discussed the various target flows described in the Water Plan Reference Materials, and how they may be applicable for different purposes (e.g. scoring, depletions plans, etc.). **Table 3** compares the difference in the average annual yield resulting from the use of target flows from Appendix A-5 versus Appendix E. Two sets of target flows from Appendix A-5 were evaluated: "cfs" from column 4 (targets may vary within a month) and Weighted Monthly "Average cfs" from column 8 (targets are constant within a month). Appendix A-5 "cfs" daily targets are the same as the Fixed Daily targets presented in Appendix E with the exception of variations that occur in May and June of wet years[7]. Due to the weighting effect, the Weighted Monthly target flow values in Appendix A-5 column 8 differ more substantially from Appendix A-5 column 4 and the Fixed Daily targets in Appendix E in many months and across all year types. A table including the various target flow alternatives from Appendices A-5 and E is provided in Attachment A.

Table 3 (row 5) shows that there is little difference (less than 0.5% on average) in reduction to shortages between using Appendix A-5 column 4 and Appendix E Fixed Daily target flows.

[7] Appendix A-5 has a target of 4,900 cfs from May 20 through May 26 and 3,400 cfs from May 27 through June 20. Appendix E has a target of 3,700 from May 20 through June 20.

This is not surprising as the targets are the same except in May and June of wet years. However, there is a larger difference (up to 10% on average) in reduction to shortages between using Appendix A-5 column 4 and column 8 (row 4). Using the targets from Appendix A-5 column 8 would reduce the case study average annual yield by approximately 4,000 acre-feet as compared to using the Appendix A-5 column 4 or Appendix E target flow values.

*Note that Appendix A-5, column 4 was used to develop the rest of the results presented in this document.*

**Table 3: Average Annual Yield Comparison with Various Daily Target Flows [1]**

| Row | Daily Target Flows Used | Average from 1947-1994 Period (acre-feet) | | Average of Wet Years Only[2] (acre-feet) | |
|---|---|---|---|---|---|
| | | Reservoir Releases | Reductions to Shortages[3] | Reservoir Releases | Reductions to Shortages[3] |
| 1 | Appendix A-5 (column 4) | 47,621 | 42,181 | 52,823 | 49,722 |
| 2 | Appendix A-5 Weighted Monthly (column 8) | 42,956 | 37,976 | NA | NA |
| 3 | Appendix E Fixed Daily | 47,481 | 42,046 | 52,405 | 49,317 |
| 4 | Percent Difference Row 1 & 2 | 9.8% | 10.0% | NA | NA |
| 5 | Percent Difference Row 1 & 3 | 0.29% | 0.32% | 0.79% | 0.81% |

[1] All scenarios in Table 3 were developed by applying the specified target flows and using the Grand Island gage data from the OPStudy *Adjusted Present Conditions With Three States Projects* dataset (which include pulse and EA flows) to calculate daily excesses and shortages.
[2] The average of wet years only was provided to show the difference between Appendix A-5 column 4 and Appendix E, given that the only difference between these sets of target flows occur in May and June of wet years only.
[3] Differences between Reservoir Releases and Reductions to Shortages reflect routing effects (transit loss).

## IV.C. Calculating Excesses and Shortages to Target Flows – Grand Island or Overton

The location at which the target flows are applied and the specific stream gage data affects the case study analysis in terms of determining (a) whether there is an "excess" or "shortage" based on gage data at that location and subsequently (b) whether the reregulating reservoir is in a storage or release mode[8]. **Table 4** presents annual releases and calculated reductions in

[8] For the EIS analysis, all OpStudy simulations considered flows at the Grand Island gage (only) for project simulations and Program scoring. However, the Service wants to improve flow conditions throughout the entire habitat reach, not just at Grand Island. Also, real-time WAP project diversion/release decisions will need to take into account the lag in flow travel time to the Grand Island gage, regardless of the project location.

**Table 4: Average Yields Using Varying Gage Locations to Calculate Excess Flows and Shortages to Target Flows[1]**

| Row | Gage Location Used | | Average Annual (acre-feet) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Excess Flows | Shortages | Excess Flows at Gage Specified | Excess Flows in CNPPID's System[5] | Excess Flows Available to Phelps Canal[6] | Excess Flows Stored in J-2 Rereg Reservoir | Reservoir Releases | Reductions to Shortages |
| **1** | Grand Island | Grand Island | 405,734 | 216,676 | 169,791 | 47,758 | 47,621 | 42,181* |
| **2** | Minimum of Grand Island and Overton[2] | Grand Island | 321,792 | 181,098 | 143,065 | 40,628 | 40,623 | 35,836* |
| **3** | Overton[3] | Grand Island | 404,827 | 222,435 | 175,118 | 43,154 | 43,148 | 37,614* |
| **4** | Overton[4] | Overton | 404,827 | 229,882 | 181,745 | 42,492 | 42,480 | 42,480** |

[1] All scenarios in Table 4 were developed by applying target flows from Appendix A-5 column 4 and using gage data from the OPStudy *Adjusted Present Conditions With Three States Projects* output dataset (which include pulse and EA flows) to calculate daily excesses and shortages.

[2] Excess flows were calculated at Overton and Grand Island. The minimum of the two could be stored (excesses must be available at both locations).

[3] Using Overton to calculate excess flows and Grand Island to calculate shortages leads to days with excesses at Overton and shortages at Grand Island. As to not increase Grand Island shortages on such days, only excess flows at Overton that were greater than shortages at Grand Island could be stored. For example, if there were excess flows of 300 cfs at Overton but a 200 cfs shortage at Grand Island on the same day, only 100 cfs could be stored. This is a rough analysis and if there is interest in using both gages, assumptions for determining when excess flows can be stored should be further evaluated.

[4] It is anticipated that if Overton is used to calculate both excess flows and shortages to target flows, then the project score would be based on the yield at Overton and additional routing to Grand Island would not apply to the score.

[5] Excess flows in CNPPID's system were calculated as the minimum of J-2 Return flows and excess flows at the gage specified.

[6] Excess Flows Available to Phelps Canal were calculated as the minimum of remaining canal capacity (maximum capacity of 1,000 cfs assumed) and Excess Flows in CNPPID's System.

* Reductions to Shortages at Grand Island

** Reductions to Shortages at Overton. Because Overton was used to calculate shortages, no transit loss is applied and reservoir releases equal reductions to shortages at Overton.

shortages to target flows based on different combinations of daily flow data from the Grand Island and Overton gages. Average annual reductions in shortages to target flows range from just under 36,000 acre-feet to nearly 42,500 acre-feet. When only the Grand Island gage is used to calculate both excess flows and shortages to target flows, average annual reductions in shortages to target flows are 42,181 acre-feet after transit losses are applied. Using only the Overton gage to calculate excess flows and shortages resulted in a similar yield of 42,480 acre-feet, although this figure would decrease if routed to Grand Island. Using a combination of the two gages resulted in lower yields and project "scores".

## IV.D. Scoring Adjustments

Another purpose of this exercise was to evaluate the potential for adjustments to score that recognize flow benefits provided by a project that are in addition to reducing shortages to target flows. To date, only the ability of a project to reduce shortages to target flows is recognized by the Service and in the Program Agreement as a valid basis for Program "score" relative to the 130,000 to 150,000 acre-foot water objective.

### IV.D.1 SDHF Augmentation

An important WAP project benefit may be the enhanced ability to augment SDHFs. For this project, the pre-feasibility study had an objective of augmenting a SDHF with 2,000 cfs (to achieve a total Program and non-Program water flow of 5,000 cfs to 8,000 cfs) for three days (resulting in an augmentation volume of 11,901 acre-feet), with water supply being provided by either excesses to target flows or Environmental Account (EA) water that is routed through the CNPPID system and "staged" in the reregulating reservoir. The pre-feasibility study results showed that the SDHF goal of 5,000 to 8,000 cfs can be achieved in all SDHF years, and the same three-day volume of augmented flow (11,901 acre-feet) would be provided by this reservoir for each SDHF.

While the evaluated reservoir will have the ability to augment SDHFs, it will not be used for this purpose every year. After considering various possible approaches, we conclude that the most straightforward method of assigning a "bonus score" to reflect SDHF-augmentation capability (if any bonus at all is ultimately determined to be appropriate by the Service and by the Program) would be to apply a direct weighting factor to a base figure consisting of the total acre-feet of augmented SDHF flow that the project can supply for three days. Using this case-study as an example, that "base figure" is 11,901 acre-feet. Depending upon the logic applied to weighting that figure, a bonus of 20.8% (2,479 acre-feet) to 100% of that base could be considered as a supplemental score.[9] This range of potential scores was based upon the following examples:

[9] For example, a bonus score might be weighted on the basis of the increased frequency with which SDHFs of suitable magnitude and duration could be achieved as a direct result of the project or were assumed to occur in EIS OPStudy modeling. On the other hand, the Service is concerned that EA water that already counts toward Program score could be inappropriately "double counted" by virtue of simply being re-positioned to more effectively augment SDHFs.

- A bonus score of **11,901 acre-feet –** scaled to the theoretical maximum contribution to SDHFs the project could provide annually (11,901 acre-feet = 2,000 cfs over three days);
- A bonus score of 11,901 * (30/48 years) = **7,438 acre-feet –** scaled to the number of years the Program EIS[10] modeled SDHF-augmentation releases; or
- A bonus score of 11,901 * (10/48 years) = **2,479 acre-feet –** scaled to the number of years OPStudy modeled some amount of Program flow augmentation would be necessary to achieve a minimum SDHF of 6,000 cfs at Overton.[11]
- Some other arbitrary scaling of the 11,901 acre-foot base figure.

IV.D.2 "New" Water and Hydrocycling Attenuation

Additional "bonus score" considerations that have been suggested by Program stakeholders include possible bonuses for:

- Providing new/additional (as opposed to re-timed) water to meet central Platte flow targets; and/or
- Mitigating the effects of hydrocycling by attenuating the amplitude of hydrocycling "waves" downstream.

The Service does not expect to recognize any additional WAP project bonus score for providing either of these benefits. It is our understanding that the Service welcomes projects that attenuate the negative effects of hydrocycling operations on flows and habitat in the central Platte. To date the potential impacts of hydrocycling on Platte target species have been addressed in the context of CNPPID's FERC licensing and mitigation of these impacts has not been considered a responsibility of the Program. Thus a corresponding bonus score will not be recognized for Program purposes.

A substantial portion of the WAP score in the Program EIS analysis was assumed to be derived from "new" water (e.g., water recovered through conservation and/or re-allocated from other uses to instream flow). Though to our knowledge, no specified quantity of new Program water supply was ever explicitly mandated in Program documents, in the Service's opinion a certain portion of new water is implicit in the mix of WAP projects proposed, and was factored into the EIS analysis of Program benefits versus impacts. Thus, to achieve adequate habitat benefits, it is already assumed the Program will implement a similar mix of "new" and re-timed water to reduce shortages to targets. The water supply for this case study is retimed water (or EA water

[10] EIS Table 5-WR-27.—Program Achievement of Target Flows and Short-Duration Bankfull Flows, Platte River Recovery.
Implementation Program Final Environmental Impact Statement, April 2006. The difference in years with pulse releases between the Governance Committee and Present Condition alternatives.
[11] Overton SDHF OPStudy results were not presented in the Program EIS. This information was provided by Don Anderson and 6,000 cfs is identified as a possible scoring threshold because Murphy et al. (2004) proposed that the program generate short-duration near-bankful flows to increase the annual peak discharges equaled or exceeded (on average) in two of three years to 6,000 to 8,000 cfs (measured at Grand Island).

to augment a SDHF), therefore the potential of scoring adjustments for providing "new" water was not considered. However it is our understanding that the Service will not consider a bonus score for "new" water, to the extent such water sources were already anticipated in the Reconnaissance-Level Water Action Plan.

IV.D.3 Mean Daily versus Mean Monthly Target Flows

The Service does consider the ability of a project to reduce shortages to target flows on a mean daily (as opposed to mean monthly) basis to be an appropriate metric for determining score. That daily criterion was applied in this case study. Utilizing a daily spreadsheet analysis found that many months have both days of excess flows and days of shortages. Monthly analysis only allows for months to have excesses *or* shortages, but not both, which eliminates potential opportunities to store and make releases to reduce shortages to target flows. This is worth emphasizing, as our understanding is that the EIS scoring estimate for the reconnaissance-level version of this project evaluated shortages and excesses to target flows on a *mean monthly* basis, and then (somewhat arbitrarily) doubled that score to reflect the added benefit of having daily control over the timing of returns. By explicitly incorporating a daily analysis into the project scoring exercise, as was done for this case study, there is no need to further "adjust" the score for this purpose.

IV.D.4 Portion of Habitat Reach Benefited

The Service's position is that some reduction of score will be necessary in cases where the entire habitat reach (or at least the Overton-to-Duncan portion of that reach) does not benefit from the flow improvements. As the project evaluated for this exercise would return all of its flow *upstream* of the Overton gage, such a score reduction was unnecessary. However, our understanding is that the Service's policy is that any future WAP project providing some or all of its flow benefits only at some distance downstream of Overton will be subject to a corresponding score reduction.

## V. CONCLUSIONS

Evaluating only the ability of this project to reduce shortages to target flows results in a potential project score between 35,836 and 42,480 acre-feet[12] (Table 4). Combining a potential SDHF bonus with this range of scores results in a total potential project score of between 38,315 acre-feet (low end of range = 35,836 target flow operations + 2,479 SDHF augmentation) and 54,381 acre-feet (high end of range = 42,480 target flow operations + 11,901 SDHF augmentation).

Before a final score can be assigned, the following remaining scoring methodology and policy issues will need to be resolved:

- Excess Flows and Shortages to Target Flows
    - Scoring Subcommittee recommendation for scoring; and

[12] See footnote 1.

    - Service policy decision regarding acceptable gage(s) and methods to use for determining excess flow availability and shortages.
- SDHF Bonus Score
    - Scoring subcommittee recommendation for scoring; and
    - Service policy decision regarding SDHF bonus score (if any).
- GC decision regarding the use of Appendix A-5 versus Appendix E and, if A-5, which set of target flows from that appendix should be used (column 4 or column 8).

For this initial case study, most of the analyses were completed by applying the Appendix A-5 column 4 target flows and using the OPStudy *Adjusted Present Conditions With Three States Projects* output dataset (which include pulse and EA flows) to calculate daily excesses and shortages, because this was the dataset readily available at the time. Since the initial simulations were completed, data *without pulse flow* impacts and *without EA* water was located, making it possible to provide the additional sensitivity analyses in Section IV.A of this document. The ED Office can easily update other sections of this document to consider different combinations of applying selected target flows with selected hydrology, as recommended by the Scoring Subcommittee. However, at this time we have limited the combinations to those shown to help bracket the various options. If other data issues arise as additional WAP projects are scored in the future, it is important to remember that currently only Don Anderson and Duane Stroup (with the Bureau of Reclamation in California) have experience running the OPStudy model.

## VI. ATTACHMENTS

Several attachments are included to provide additional technical detail.

Attachment A – Case Study Assumptions and Rationale **-** provides a detailed description of assumptions used in this scoring case study for:

- Reservoir Design;
- Analysis Tool and Hydrology;
- Target Flow Operations Modeling;
- Target Flow Operations Scoring Analysis;
- SDHF Qualitative Evaluation; and
- SDHF Scoring Analysis.

In addition, illustrative case study results are included in Attachment A, as well as a description of data developed for this scoring exercise.

Attachment B – Location of Case Study Reservoir Location **-** shows the reservoir footprint and location (see Areas 1 and 2).

Attachment C – Conceptual Diagram: SDHF Flows and System Component Contributions **-** includes a conceptual diagram illustrating assumptions in how system components contribute to a SDHF.

Attachment D – OPStudy "Adjusted" Hydrology Background – provides background information regarding the OPStudy hydrology used for the case study analyses.

**TO:** SCORING SUBCOMMITTEE

**FROM:** ED OFFICE

**SUBJECT:** FOLLOW-UP TO APRIL 22, 2010 SCORING CALL QUESTION REGARDING EA FLOW SENSITIVITY

**DATE:** APRIL 30, 2010

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On the April 22, 2010 Scoring Subcommittee conference call, there was a question related to information in Table 2 (Rows 3 and 4) of the Scoring Case Study memo that shows the sensitivity analysis related to including Environmental Account (EA) flows in the J-2 Reregulating Reservoir yield analyses. We reviewed the analysis and believe the information as shown in Table 2 is correct, and are providing the information in this memorandum as follow-up.

There are a couple of things that happen differently in the analysis for Row 3 versus 4. The largest difference is that when EA flows are considered in the excess/shortage calculations at Grand Island (Row 3), there are times when the presence of EA water change the period from one of shortage to one of excess. For example, on 5/1/1947:

- The target flow for this day was 2,400 cfs
- Grand Island flows with EA water (Row 3 scenario) = 2,672 cfs
- Grand Island flows without EA water (Row 4 scenario) = 1,892 cfs

So when EA flows were *not* considered, it was a period of shortage. When EA flows were considered, there was an excess of 272 cfs, all of which was captured in the reregulating reservoir. The total J-2 return flows **did not change** between the two scenarios – they were 1,027 cfs in both cases. However, in the Row 3 case, they could be colored as excess flow and stored in the reregulating reservoir whereas in the Row 4 case, they were not colored as excess flow and therefore were not stored.

The other difference of note between the analysis for Row 3 and Row 4 is that *not* including EA flows at Grand Island (Row 4 scenario) results in more days of shortage, providing additional opportunities to make releases. Then, reservoir capacity becomes available due to the release, which allows additional excess flows to be stored. But overall, considering EA flows at Grand Island (Row 3 scenario) results in higher excess flows at Grand Island and more flows being stored. This is shown in Table 1 below, which compares the average annual total excess flows at Grand Island, shortages at Grand Island, and excess flows stored in the J-2 Reregulating Reservoir.

**Table 1: Average Annual Totals Comparison**

| Average Annual Total (acre-feet) | Without EA Flows in J-2 Return but With EA Flows at Grand Island (Row 3 Scenario) | Without EA Flows in J-2 Return or Grand Island (Row 4 Scenario) |
|---|---|---|
| Excess Flows at Grand Island | 393,441 | 374,459 |
| Shortages at Grand Island | 316,329 | 368,734 |
| Excess Flows Stored in J-2 Reservoir | 46,982 | 43,596 |

It is important to note that flow at the J-2 Return is not equal to flow at Grand Island. Some of the J-2 Return flow can be lost in the Overton to Grand Island reach and some may be diverted by the Kearney Canal. There can also be additional water at Grand Island that came down the river or that was gained below the J-2 Return.

# Attachment A
# CNPPID Reregulating Reservoir Scoring Case Study Assumptions

## Introduction

This attachment was developed with input from Don Anderson, formerly with the U.S. Fish and Wildlife Service (Service). It identifies the assumptions used in the Central Nebraska Public Power and Irrigation District (CNPPID) reregulating reservoir project scoring case study for the following:

- Reservoir Design;
- Analysis Tool and Hydrology;
- Target Flow Operations Modeling;
- Target Flow Operations Scoring Analysis;
- Short Duration High Flow (SDHF) Qualitative Evaluation; and
- SDHF Scoring Analysis.

In addition, illustrative case study results are included when they help explain the potential impacts of selected assumptions. This document concludes with a description of data developed for this scoring exercise (EA adjusted OPStudy daily data, filled Phelps County Canal data and monthly loss values by year type from the WMC Loss Model).

## Assumptions and Rationale

The following section describes the assumptions used in the case study analyses, supported by explanatory information to describe the rationale in developing the assumptions.

<u>Reservoir Design</u>

- Case Study Alternative: J-2 Alternative 2, Areas 1 and 2 Combination
- Reservoir Design: Priority is to provide 2,000 cubic feet per second (cfs) of SDHF augmentation flows for three days
- Storage Capacity: 14,320 acre-feet
- Inlet Capacity: 1,000 cfs[1]
- Outlet Capacity: 2,000 cfs
- Water Supply: Excess to target flows ("excess flows" or "excesses") in the J-2 Return that can be routed using remaining Phelps County Canal capacity for target flows, augmented with Lake McConaughy Environmental Account (EA) water for SDHF releases
- Supply Structure: Phelps County Canal to reservoir inlet

[1] The reservoir inlet capacity is limited by Phelps County Canal capacity. The design capacity for the impacted section of the Phelps County Canal is 1,400 cfs but CNPPID has stated that the current safe capacity is 1,000 cfs. Potential for making improvements to this section of the canal to increase it to the design capacity may be investigated in the next phase of project feasibility.

The CNPPID reregulating reservoir project is being used for the case study for several reasons. It will most likely be the first WAP project to advance past pre-feasibility. It can be operated for target flows and to augment SDHF. Due to its location and water supply (excess flows already routed through the CNPPID system that would have been returned to the river through the J-2 Return), it may be operated on a daily basis to store excess flows when available and release them to reduce shortages to target flows within the same month. The J-2 Alternative 2, Areas 1 & 2 combination is being used because it rose to the top as a preferred alternative in the pre-feasibility study due to target flow yields, SDHF augmentation, and project costs. **Attachment B** shows the reservoir location and footprint (see Areas 1 and 2).

Analysis Tool and Hydrology

- Time-step: Daily[2]
- Analysis Tool: Excel daily flows spreadsheet
- Analysis Period: Calendar years 1947 – 1994
- Input Data:
  - Daily OPStudy[3] *Adjusted Present Conditions with Three States Projects* output data for J-2 Return and the Platte River at Grand Island
    - With pulse flows[4] and with EA (this dataset was utilized in all case study scenarios except where noted)
    - Without pulse flows and with EA
    - Without pulse flows and without EA
      - EA water removed from J-2 Return Flows (reservoir supply) but present in Grand Island flows which were used to calculated excesses and shortages
      - EA water removed from J-2 Return Flows and Grand Island flows
  - Historical Phelps County Canal gage data
    - Data for 1947 through 1969 filled with historical daily averages
    - Historical data for all years 1947 - 1994

The benefits of daily operations were considered in this case study. Utilizing a daily spreadsheet analysis found that many months have both days of excess flows and days of shortages. Monthly analysis only allows for months to have excesses or shortages, but not both, which eliminates

[2] When determining WAP project 'score', the Service has agreed to consider the ability of the project to offset shortages to target flows on a mean daily, and not just monthly, basis. Offsets to target flow shortages that occur on a strictly sub-daily basis will not be recognized for Program scoring purposes.

[3] OPStudy is a monthly model with a post-processing subroutine that can disaggregate monthly results to daily values. The daily pattern of river flow within a month can be highly variable, so mean-monthly flow rates cannot be used to accurately compute certain effects. The subroutine uses the historical daily flows and the difference in average monthly flows in cfs to simulate the daily flows that would result with the analyzed alternative.

[4] The OPStudy modeling referred to "pulse flows" rather than "short duration high flows" and OPStudy model output datasets include data labels that reference "pulse flows". This terminology has been used throughout this document when referring to specific OPStudy model results.

potential opportunities to store and make releases to reduce shortages to target flows. The EIS Team doubled the mean-monthly-based OPStudy score for the CNPPID Reregulating Reservoir in the Reconnaissance Level WAP in recognition of the value of daily analysis for this project.

OpStudy *Adjusted Present Conditions With Three States Projects* data for the 1947 – 1994 period was used for case-study scoring hydrology because it provides a consistent set of data with what was originally used in the Program Environmental Impact Statement (EIS) and Biological Opinion (BO). The "Adjusted" dataset was adjusted to reflect 1990's water-development conditions ("Present Conditions") and full implementation of Tamarack I, the Pathfinder Modification account, and the Environmental Account ("Three States Projects"). Daily data and analysis are being used to capture the effects of storing excesses and releasing for shortages in the same month. This was not possible with earlier monthly OPStudy modeling.

It should be noted that while reviewing and adjusting OPStudy output, the ED Office noticed that Tamarack I appears to have only impacted Julesburg flows in the last two months of 1994 (the last year in the 48 year simulation period). This is being further investigated. If contributions from Tamarack I were not included in the OPStudy model run, there may be times when the current case study analyses show the J-2 Reregulating Reservoir meeting a shortage that would have already been met by Tamarack I. In this case, J-2 Reregulating Reservoir water would likely be held in storage for a longer period but still released to meet a shortage at a later date; this may shift the timing of the releases but have a minimal impact on the project score (the difference being related to seepage and evaporation losses due to holding water in storage for a longer period of time). If Tamarack I were to be included in the current case study analyses, there would be times when Tamarack I return flows did not historically get 'counted' toward the initial three state projects score because return flows did not occur during a period of shortage. These Tamarack I return flows occurring during periods of excess could be reregulated by the J-2 Reregulating Reservoir, increasing the overall efficiency. The ED Office is contacting Don Anderson for further assistance in evaluating the OPStudy model run data to assess the potential effects of Tamarack I on this case study.

For this initial case study, most of the analyses were completed by applying the Appendix A-5 column 4 target flows and using the OPStudy *Adjusted Present Conditions With Three States Projects* output dataset (which include pulse and EA flows) to calculate daily excesses and shortages, because this was the dataset readily available at the time the analyses were completed. Since the initial simulations were completed, data *without pulse flow*[5] impacts were located. Rather than rerunning all of the case study scenarios, one scenario using the Grand Island gage to calculate excesses and shortages was rerun to determine the impact on the average yield. The ED Office can easily update other scenarios to consider different combinations of applying selected target flows with selected hydrology, as recommended by the Scoring Subcommittee.

[5] The OPStudy model solves for pulse flows iteratively and output for many locations was provided with and without the impacts of pulse flows.

The Scoring Subcommittee also requested that the ED Office evaluate if EA flows impacted the project yield and if some of these flows may have been reregulated in the CNPPID reregulating reservoir if they arrived at the associated habitat during a time of excess. The ED Office evaluated two different alternatives for adjusting OPStudy output (*without pulse flows*) to remove EA flows[6]. For both alternatives, EA flows were removed from the J-2 Return output which is the supply to the CNPPID reregulating reservoir. In one scenario, EA flows were also removed from Grand Island flows, which are used to calculate excess flows and shortages to targets flows, and in the other scenario EA flows were not removed from Grand Island flows. The process used to remove EA flows is described in more detail below in the "Pulse Flow and EA Flow Adjustments" section.

Short Duration High Flow (SDHF) scoring analysis was completed separately (as described below in the "SDHF Assumptions" section) to provide flexibility in making releases based on more recent pre-feasibility analysis results.

The Phelps County Canal was not modeled in OPStudy but, because the reservoirs are supplied via the canal, remaining canal capacity data is needed to determine potential inflows. Daily historical data, described in more detail in the "Phelps County Canal Data" section below, filled for the 1947 – 1969 period were used for most scenarios presented in the scoring case study document. The exception was one scenario that was run using historical data for the entire 1947 – 1994 period that was located after the other simulations had been completed.

Target Flow Operations Modeling Assumptions

- Daily Target Flows: Column 4 of Appendix A-5 and Appendix E of the Water Plan Reference Materials. Appendix A-5 was use for this case study with the exception of one scenario which used Appendix E, to compare results for the two appendices. Column 4 ("cfs") was used for most Appendix A-5 scenarios, with the exception of one scenario which used column 8 (Weighted Monthly "Average cfs") to compare results using the two target flow columns.
- Excesses and Shortages Gage: Several options for evaluating excess flows and shortages were evaluated:
  - Excess flows and shortages evaluated at Grand Island;
  - Excess flows evaluated at both Grand Island and Overton and set as the minimum of these. Shortages evaluated at Grand Island;
  - Excess flows evaluated at Overton and shortages evaluated at Grand Island; and
  - Excess flows and shortages evaluated at Overton.

[6] The OPStudy hydrology without EA flows developed for this analysis should be considered preliminary as there are several issues, summarized below in the "Pulse Flow and EA Flow Adjustments" section, regarding the data that could impact EA flow adjustments. However, the ED Office believes any additional modifications to the OPStudy hydrology will likely have a minimal impact on the OPStudy hydrology with EA flows removed.

- Excess Flows and Instream Flows: Excess flows calculated as those flows in excess of the maximum of daily Program target flows and the Nebraska Game and Parks Commission (NGPC) and Central Platte NRD instream flows[7].
- Shortages: Shortages were calculated as the difference between gage flows and Daily Program Target Flows
- Routing: Reservoir releases for target flow operations are routed from Overton to Grand Island by applying average percent losses which vary by month and year type from WMC Loss Model (described in additional detail below). No transit losses or gains from Overton to Grand Island are estimated when calculating the volume of excess flows that can be stored. When Overton was used to calculate shortages, releases were not routed.
- Time Lag: No time lag between Overton and Grand Island for purposes of determining real-time excesses and shortages to targets
- Reservoir Loss: No reservoir loss is applied

At the December 2009 meeting, the Governance Committee (GC) discussed whether daily targets flows for Appendix E or Appendix A-5 (column 4) in the Water Plan Reference Materials should be used for daily WAP Project scoring. The Scoring Subcommittee was formed to address scoring issues and bring a recommendation back to the GC. The GC meeting minutes state that the WAC is correct in using Appendix A-5 to score projects at this point. As a result, Appendix A-5 (column 4) was used for this case study with the exception of one scenario which used Appendix E, to compare results for the two appendices. The Scoring Subcommittee also asked if the use of column 8 from Appendix A-5, which lists Weighted Monthly average flow targets, might be appropriate. For comparison purposes, one scenario was developed using the average daily flow targets from this column. Appendix A-5 column 4 daily flows targets may change during the month while the weighted monthly targets in column 8 are constant within a given month. **Table A-1** lists the various target flows used in this case study.

Several variations for evaluating excess flows and shortages were used (as described above) to compare options being considered by the Service as well as assumptions used in the pre-feasibility study for the CNPPID reregulating reservoir project. Evaluating excess flows and shortages at Grand Island reflects earlier OPStudy analyses. However, Overton is located closer to the top of the habitat reach, and the Service's intention is to protect flows through the entire reach. Overton was also used to evaluate this project in the Reconnaissance-Level WAP and in the pre-feasibility analysis to develop yields for the CNPPID reregulating reservoir project, due to its close proximity to the project.

Excess flows are calculated as those flows in excess of the maximum of Program target flows and the Nebraska Game and Parks Commission (NGPC) and Central Platte NRD instream flow rights (minimum instream flows). In average and wet years, Program target flows are always

[7] Nebraska DNR, Total Platte River Instream Flow Needs For Purposes of Water Administration. 2nd Revised edition, November 7, 2007 (utilizing the Grand Island gage quantities)

**Table A-1: Appendix E and Appendix A-5 Target Flows from the Water Plan Reference Materials**

| Appendix E Fixed Daily Targets | | | | Appendix A-5: Column 4 ("cfs") | | | | Appendix A-5: Column 8 (Weighted Monthly "Average cfs") | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Target Flow Period | Hydrologic Condition: Wet | Normal | Dry | Target Flow Period | Hydrologic Condition: Wet | Normal | Dry | Target Flow Period | Hydrologic Condition: Wet | Normal | Dry |
| Jan 1 – Jan 31 | 1,000 | 1,000 | 600 | Jan 1 – Jan 31 | 1,000 | 1,000 | 600 | Jan | 1,000 | 1,000 | 600 |
| Feb 1 – Feb 14 | 1,800 | 1,800 | 1,200 | Feb 1 – Feb 14 | 1,800 | 1,800 | 1,200 | Feb | 2,575 | 2,575 | 1,725 |
| Feb 15 – Mar 15 | 3,350 | 3,350 | 2,250 | Feb 15 – Mar 15 | 3,350 | 3,350 | 2,250 | Mar | 2,724 | 2,724 | 1,853 |
| Mar 16 – Mar 22 | 1,800 | 1,800 | 1,200 | Mar 16 – Mar 22 | 1,800 | 1,800 | 1,200 | Apr | 2,400 | 2,400 | 1,700 |
| Mar 23 – May 10 | 2,400 | 2,400 | 1,700 | Mar 23 – May 10 | 2,400 | 2,400 | 1,700 | May | 2,777 | 2,439 | 1,090 |
| May 11 – May 19 | 1,200 | 1,200 | 800 | May 11 – May 19 | 1,200 | 1,200 | 800 | Jun | 2,667 | 2,667 | 800 |
| May 20 – Jun 20 | 3,700 | 3,400 | 800 | May 20 - May 26 | 4,900 | 3,400 | 800 | Jul | 1,200 | 1,200 | 800 |
| | | | | May 27 – June 20 | 3,400 | 3,400 | 800 | Aug | 1,200 | 1,200 | 800 |
| Jun 21 – Sep 15 | 1,200 | 1,200 | 800 | June 21 – Sept 15 | 1,200 | 1,200 | 800 | Sep | 1,100 | 1,100 | 700 |
| Sep 16 – Sep 30 | 1,000 | 1,000 | 600 | Sept 16 – Sept 30 | 1,000 | 1,000 | 600 | Oct | 2,400 | 1,800 | 1,300 |
| Oct 1 – Nov 15 | 2,400 | 1,800 | 1,300 | Oct 1 – Nov 15 | 2,400 | 1,800 | 1,300 | Nov | 1,700 | 1,400 | 950 |
| Nov 16 – Dec 31 | 1,000 | 1,000 | 600 | Nov 16 – Dec 31 | 1,000 | 1,000 | 600 | Dec | 1,000 | 1,000 | 600 |

Shading highlights that Appendix E Fixed Daily targets and the Appendix A-5 column 4 targets are identical except in the months of May and June in wet years.

higher than the minimum instream flows. In dry years, there are periods when minimum instream flows are higher than Program target flows. Only Program target flows are considered when evaluating shortages. No transit losses or gains from Overton to Grand Island were estimated in this case study when calculating the volume of excess flows that could be stored.

**Figure A-1** shows the total annual excess flows available in CNNPID's system (using Grand Island to calculate excesses and shortages), constrained by remaining Phelps County Canal capacity, and stored in the reregulating reservoir (constrained by reservoir capacity). This figure demonstrates that excess flows in CNPPID's system potentially available to divert down the Phelps County Canal far exceed the reregulating reservoir's capacity. This suggests that while assumptions used to calculate excess flows may impact the total volume of excess flows available, specific reservoir design characteristics have the most significant impact on the project score. This is supported by **Table A-2**, which evaluated reservoir yields for other, non-preferred alternatives from the pre-feasibility analysis. The average yields developed for this case study are similar to the normal year yields estimated in the pre-feasibility study. Yields also increase or decrease based upon reservoir capacity.

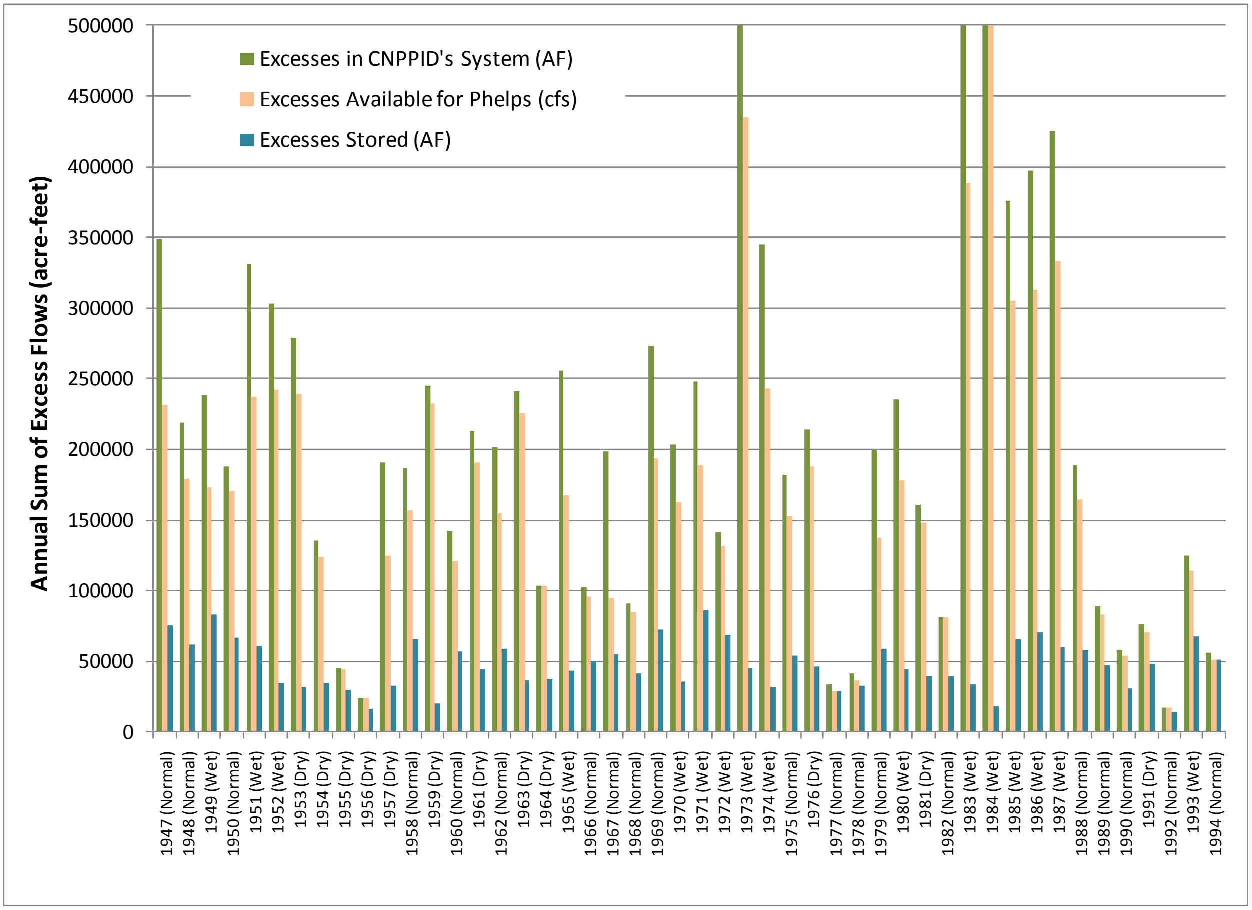



**Figure A-1: J-2 Alt 2, Areas 1 & 2 Combination Alternative Annual Excess Flow Totals Using the Grand Island Gage to Calculate Excesses and Shortages**

**Table A-2: Pre-feasibility Study Normal Year Yields Compared to Scoring Case Study Yields for Various Pre-feasibility Alternatives (using the Grand Island Gage to Calculate Excess Flows and Shortages to Target Flows)**

| | | Olsson Pre-feasibility | Scoring Case Study Analysis | |
|---|---|---|---|---|
| Alternative[1] | Maximum Storage Capacity (acre-feet) | Normal Year (1975) Yield at Overton[2] (acre-feet) | Average 1947 - 1994 Releases at Overton (acre-feet) | Average 1947 - 1994 Yield at Grand Island (acre-feet) |
| J-2 Alt 2, Areas 1 & 2 | 14,320 | 47,480 | 47,621 | 42,181 |
| J-2 Alt 1 | 3,380 | 14,660 | 18,108 | 16,077 |
| J-2 Alt 2 Area 4 | 6,137 | 24,268 | 27,523 | 24,438 |

[1] J-2 Alt 2, Areas 1 & 2 is the preferred alternative discussed throughout most of this document. J-2 Alt 1 is an in-channel alternative below the J-2 Return consisting of four dams. J-2 Alt 2 Area 4 is a reservoir located northwest of the J-2 Return and south of the river.
[2] Olsson's Pre-feasibility analysis used the Overton gage to calculate both excess flows and shortages to target flows. As a result, yields were calculated at Overton with no transit losses assumed between the reservoirs and Overton. However, as described in the Case Study memorandum, if Overton is used to calculate both excess flows and shortages to target flows, then the project score would be based on the yield at Overton and additional routing to Grand Island would not apply the score.

Transit losses (developed using data from the WMC Loss Model, described below in the "Routing from Overton to Grand Island" section) were applied to route water released from the reservoir to Grand Island. By definition, during daily analyses, flows at Grand Island either exceed (excesses) or fall short (shortages) of target flows, with perhaps an occasional day when flows exactly match the target flows. Return flows from the J-2 Return frequently constitute a significant portion of river flows below this point. An analysis by the ED Office found that for the 17,532 days in the simulation period, there were only 25 days when there were excess flows at Grand Island but no flows being returned to the river through CNPPID's J-2 Return. Additionally in dry years, there may be periods[8] when there are neither excess flows nor shortages due to minimum instream flows that are higher than Program target flows. An example of this is on 6/9/1981 where the Program target was 800 cfs, the minimum instream flow was 1,000 cfs and the flow at Grand Island was 976 cfs. Only flows in excess of the maximum of minimum instream flows and Program target flows are considered excesses, so in this case flows are less than 1,000 cfs so there are no excesses. However, there isn't a shortage either because the flows are above the Program target. An ED Office analysis found that for the simulation period, there were only 129 days where this pattern occurred, without either a shortage or excess at Grand Island.

**Figure A-2** shows annual releases and reductions in shortages to target flows for the case study reservoir using the Grand Island gage to calculate both excess flows and shortages to target flows. On average, 47,621 acre-feet of retimed excess flows were released on an annual basis.

[8] In dry years, instream flows are higher than Program target flows by 200 cfs from June 1 through July 31 and October 12 through November 10th and by 50 cfs from October 1 through October 10.

After routing this water to Grand Island, average annual reductions to shortages to target flows were 42,181 acre-feet. **Figure A-2** is shown to demonstrate annual variability in project yields.

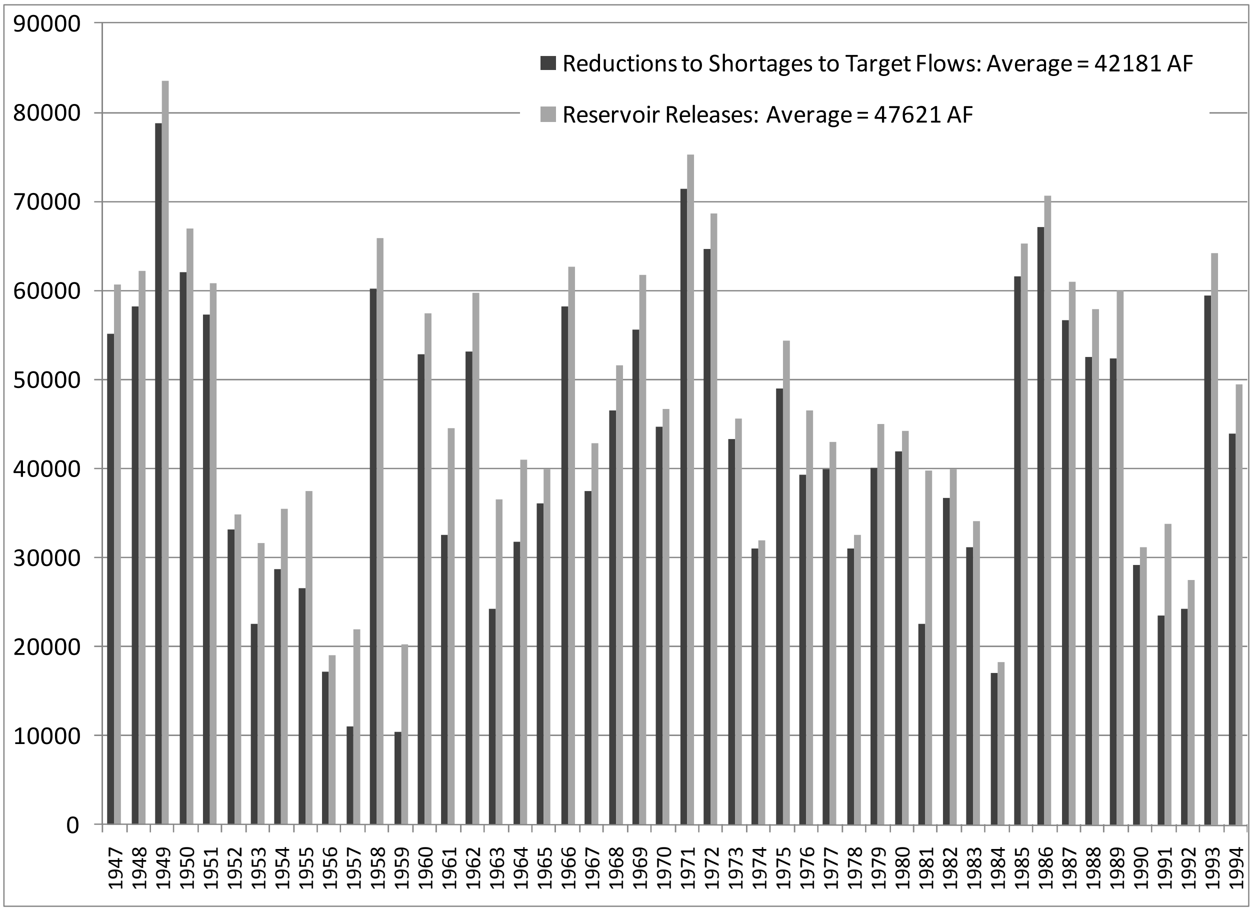



**Figure A-2: Annual Reregulating Reservoir Releases (in the vicinity of Overton) and Reductions in Shortages to Target Flows (routed to Grand Island) Using the Grand Island Gage to Calculate Excesses and Shortages for the J-2 Alt 2, Areas 1 & 2 Alternative**

Throughout the year, excess flows in CNPPID's system are available to be stored and then released as soon as periods of excess stop and shortages begin. The project score is based on reductions to shortages. This analysis applies no losses to water in storage, which is the equivalent to topping off the reservoir to replace any losses throughout a period of excess until shortages begin. **Figure A-3** uses an example year to demonstrate how the reservoir frequently fills (in this year note that the reservoir started the year full with carryover storage from the previous year), and then remains full (while excess flows continue to be available) until a period of shortages. Most of the time, when the reservoir is "maintained" full in this analysis because evaporation and seepage losses are not assessed, losses could have been replaced with additional excess flows, ensuring the reservoir full when shortages begin. Additionally, the case study assumed that the reservoir filled as early as possible in the winter and then was maintained full until the first period of shortages (typically in early spring). Actual operations likely wouldn't maintain the reservoir full all winter. If the reservoir does not fill completely, such as in July/August and September/October of this year, it is because it fills for several days (in this case: 14 days in July/August and 4 days in September/October) and then immediately begins releasing when shortages start. In this case, water is in storage only for a very short period, so evaporation and seepage would be minimal.

Additionally, the J-2 Alternative 2 Areas 1 and 2 are located adjacent to the south channel of the Platte River. As a result, at least a portion of reservoir seepage may accrue to the river, though this only counts as a "score" when it accrues during a period of shortage to target flows. This analysis did not attempt to score reservoir seepage.

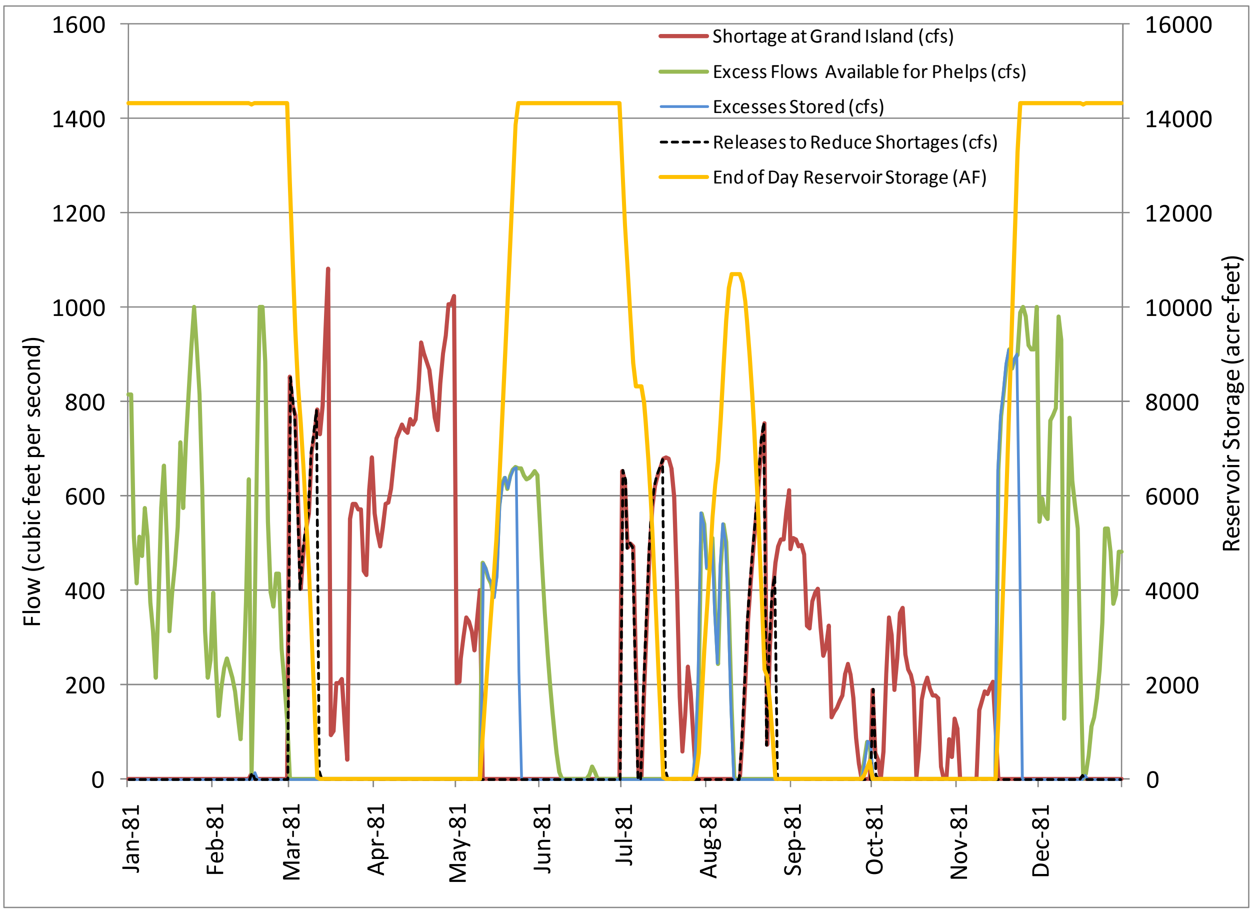



**Figure A-3: Dry Year 1981 Results Illustrating the Availability of Excess Flows and Reservoir Storing and Releasing Using the Grand Island Gage to Calculate Excesses and Shortages for the J-2 Alt 2, Areas 1 & 2 Alternative**

While reservoir losses were not considered for this case study and may not have a large impact on the project score, losses will need to be evaluated for this project at some time prior to applying a final score to determine any new depletions that must be offset. The timing of reservoir seepage to the reservoir may also be further evaluated to estimate water returning to the river during periods of shortages.

Target Flow Operations Scoring Analysis Assumptions

- Target Flow Operations: Score is based on modeled reservoir releases during periods of shortages, routed to Grand Island. The exception of this is the case when Overton was used to calculate shortages. No routing occurred for this scenario.
- Nebraska and Project Sponsor Portion of Yield: The yield estimates provided do not account for water that may be reserved towards Nebraska's Depletions Plan or by any other project sponsor. Per the Reconnaissance-Level Water Action Plan, Nebraska may wish to reserve 2,500 to 4,000 acre-feet of reregulating reservoir project yield to offset depletions.
- Scoring Exercise: Scoring is a separate exercise from the project feasibility analyses[9].

Target flow operations are scored based on the volume of water released from reservoir storage to reduce shortages to target flows and then routed to Grand Island in all cases except when Overton was used to calculate shortages. When Overton is used, no routing losses were applied to the project score. The daily analysis is performed over the 1947-1994 period, using assumptions documented above. The average annual acre-feet reduction in shortages to target flows is counted toward the project "score".

SDHF Qualitative Evaluation Assumptions

- SDHF Analysis: Was not modeled but was evaluated qualitatively
- SDHF Goal: 5,000 – 8,000 cfs for three[10] days
- SDHF without Reregulating Reservoir: at least 4,700 cfs for three days in most years
- Reservoir SDHF Augmentation: 2,000 cfs for three days
- Total SDHF Flow at Overton with reservoir: at least 6,700 cfs for three days in most years
- SDHF: Evaluated at Overton
- Water Supply: Lake McConaughy EA water routed and staged immediately before a SDHF event or excess flows if available during the filling period
- Analysis Period: Nine days (six days to fill and three days to release) during the non-irrigation season
- Routing: No routing necessary for SDHF releases

[9] Scoring should use adjusted hydrology for the 1947-1994 period but feasibility studies may use more recent hydrology and other assumptions to more precisely evaluate design and operational impacts.

[10] Water Plan Reference Materials refer to SDHF goal of 5,000 – 8,000 cfs (total flow including non-Program water) for 3 to 5 days. For this case study and project feasibility, a 3 day goal is being used. However, with lower reservoir augmentation flows over five days (1,444 cfs for 5 days versus 2,000 cfs for 3 days) the 5,000 – 8,000 goal may still be met. In both cases, the total reservoir SDHF augmentation volume does not exceed the reservoir capacity of 14,320 acre-feet.

- Reservoir Loss: No reservoir loss applied

Information gained during the 2009 Flow Routing Test and pre-feasibility analysis has resulted in the assumption that 4,700 cfs can be provided for three days at Overton for SDHF events without the use of a reregulating reservoir in all but the driest of years. This assumes that the Program can utilize NPPD's and CNPPID's systems at or close to capacity to route water for a SDHF and that the safe-conveyance capacity of the North Platte choke point is restored to at least 3,000 cfs.

**Attachment C** illustrates the contributions of the various Central Platte system components towards a SDHF. This also assumes that peak flows from the various system components are correctly timed to arrive at Overton, and that losses and attenuation downstream of CNPPID's headgates will be no greater than illustrated in Attachment C. The addition of a reregulating reservoir capable of providing 2,000 cfs of augmentation flow results in SDHF flows of 6,700 cfs for three days. The Adaptive Management Plan refers to *"Flows of 5,000 to 8,000 cfs magnitude in the habitat reach for a duration of three days at Overton on an annual or near-annual basis"*. Because the SDHF goal of 5,000 – 8,000 cfs can be met in all SDHF years with the J-2 Alternative 2 Areas 1 & 2 combination, inter-annual variability is evaluated qualitatively rather than modeled. Timing a SDHF event to coincide with a precipitation event would increase the peak flows but would not impact the augmentation volume provided by the reregulating reservoir.

SDHF supply is assumed to be EA water routed down and stored in the reregulating reservoir prior to the event and excess flows if available during the filling period. Excess flows could also potentially be stored over the winter, but EA water may be necessary to top off the reservoir prior to an SDHF. Based upon the pre-feasibility study and this analysis, reservoirs are able to capture and release excess flows throughout the year for target flow operations so SDHFs are not anticipated to result in additional overall project yield.

The reservoir outlet is located below the J-2 Return and above Overton so no routing is necessary. The J-2 Alternative 2 Areas 1 and 2 reservoirs are located adjacent to the south channel of the Platte River. Any reservoir seepage is assumed to accrue to the river. For SDHF events, water will be stored over a period of six days and then released in the three following days. Reservoir evaporation will likely be minimal during the short SDHF period and is not considered in this scoring case study.

SDHF Scoring Analysis Assumptions

- SDHF Augmentation: The Service has not yet determined what, if any, bonus score would be provided for project SDHF-augmentation capacity. If a bonus score is provided, it is proposed the score be calculated proportionally to the project's ability to augment SDHFs for three days at Overton.

The reservoir must be designed around SDHFs to provide the desired volume and release rates. The Service has committed to exploring, through this case study, the potential to award some amount of “bonus” score for a project that provides the capability of augmenting SDHFs. *However*, as of today, the Service has not determined whether such a bonus score should be recognized, or how such a bonus score should be calculated. The Service indicates this is because providing this kind of “bonus score” would represent a major Program scoring policy shift, and the Service considers the burden of proof to be on the Program to first demonstrate that such a policy shift is necessary and justified (for example, because it is clear that achieving both the target flow and the SDHF goals is not feasible within the available budget). Also, the Service is concerned about double-counting yields if EA water is used to fill the reservoir for SDHF purposes. This case-study is considered an ideal opportunity to propose possible SDHF “bonus scoring” alternatives for future consideration by the Service, if and when such bonus scoring is deemed appropriate. After considering various alternatives, the Service proposes that any such bonus be calculated in direct proportion to the ability of the project to augment SDHFs for three days at the Overton stream gage.

## Scoring Case Study Data Development

Pulse Flow and EA Flow Adjustments

All analyses, with the exception of one, developed for the scoring case study used OPStudy output data *with pulse flows*. As a result, some pulse flow water could have been captured in the CNPPID reregulating reservoir, which is not the intent of the pulse/SDHF release. After those analyses were completed, daily OPStudy output data *without pulse flows*[11] were located and a sensitivity analysis was completed. Results presented in the case study document show that reregulating pulse flows had a minimal effect on the overall project yield. We recommend that data *without pulse flows* be used in future project scoring.

All of the initial case study analyses performed with the *Adjusted Present Conditions With Three States Projects* OPStudy daily output data included the impacts of EA releases. To investigate the extent to which the initial case study analyses may have reregulated EA flows in the CNPPID reregulating reservoir, the ED Office used available OPStudy output to “adjust” the data to develop a daily dataset with EA flows removed at Grand Island (to determine excesses and shortages to target flows) and within the J-2 Return flows (to determine excess flows that could be stored in the CNPPID reregulating reservoir). There were two challenges with this: (1) while the OPStudy model reported monthly EA flows at many locations, it did not report the monthly EA flows separately at the J-2 Return; and (2) the OPStudy post-processing that disaggregated monthly model output into daily data did not report the EA flows at any location. EA flows were included in the total reported daily flows (note that the post-processor did report daily data with and without pulse flows at a given location).

[11] The OPStudy model solves for pulse flows iteratively and output for many locations is provided with and without the impacts of pulse flows.

To address the first issue, where monthly EA flows at Grand Island were available from the OPStudy model output but EA flows in the J-2 Return were not, the EA portion of the monthly J-2 Return flows were estimated by the ED Office as the difference between monthly EA flows at Overton and at Cozad. This was based on an assumption that the difference in flow was related to EA water that was routed through CNPPID's system and was returned to the river via the J-2 Return.

To address the second issue, the ED Office disaggregated monthly EA flow volumes into daily EA flow rates. According to the OPStudy Technical Documentation and Users Guide (Platte River EIS Office, 2006): *The OPSTUDY model calculates daily flows from monthly values. The daily flows are assumed to have the same pattern as the historic daily flows, but are adjusted up or down based on the monthly volumes*. To disaggregate monthly EA flow volumes into daily EA flow rates at the J-2 Return and at Grand Island, the ED Office applied a similar method as follows:

- Using daily OPStudy output, sum daily gage flows to get total monthly flow;
- For each day determine the percentage daily flow was of the total monthly flow;
- Multiply that percentage by the total EA flow at that location for that month; and
- Subtract that value (daily portion of the total monthly EA) from the daily flow, not allowing flows to go to zero.

While the ED Office methodology is not identical to the way monthly output data was disaggregated into daily data in the OPStudy model, it is generally consistent the OPStudy methodology.

Analyses included the project yields for the following alternatives:

- EA flows removed from Grand Island and J-2 Return flows; and
- EA flows left in Grand Island flows but removed from J-2 Return flows.

In our attempt to replicate this method, we found that OPStudy monthly output data did not always match the OPStudy model daily output data (if the daily data were summed to monthly). This issue was isolated to locations below the J-2 Return, including Overton and Grand Island and we believe it may be related to specific model adjustments made to represent flows moving through the CNPPID system however we were not able to exactly replicate the adjustment.
To avoid flows going negative, there were a few months (in one month at Grand Island and in four months in the J-2 Return) over the analysis period when the full EA flow volume was not removed in the adjustment process. Over the entire 48 year modeling period, out of 3,473,000 acre-feet of EA water at Grand Island, 15.4 acre-feet were not removed from Grand Island flows to avoid negative flows (this occurred in September 1972). This issue was more significant when dealing with J-2 Return flows. Out of 1,479,700 acre-feet of EA water in the J-2 Return, 5,788 acre-feet were not removed (this occurred over four months: May 1995, May 1956, June 1956, and September 1960). This will likely have a minimal, if any, impact on results and is the impact of existing differences in available OPStudy output.

Phelps County Canal Data

According to Cory Steinke with CNPPID, Phelps County Canal operations haven't changed much during the 1947 through 1994 period. The exception to this is that in the first few years of the canal's operations it was used only in the fall after irrigation season, to fill the subsoil profile for the following year. After this initial period CNPPID began using the canal during the irrigation season. Historical Phelps County Canal diversion data that was available when the scenarios in the initial case study analyses were completed was missing 1948, part of 1949, and 1950 through 1969. Historical data for 1970 through 1994 were available and were used, unadjusted, for these years. For the 1947 through 1969 period, the ED Office developed daily average Phelps County Canal diversions using 1970 through 2004 data (1947 and partial 1948 data were replaced with filled data because these early operations were not representative of later operations). Because the canal is used to route excess flows to the reregulating reservoir, higher diversions leave less remaining capacity available to route excess flows to fill the project reservoir. The 1970 through 2004 period was selected to be conservative because diversions were slightly higher than for the 1970 through 1994 period. The period was ended in 2004 for developing the daily averages because CNPPID began allocations in 2005, which decreased diversions. The daily average diversions were then applied to the entire 1947 – 1969 period as shown in **Figure A-4**. In considering if Phelps County Canal historical gage needs to be adjusted to reflect the *Adjusted Present Conditions with Three States Projects* dataset, CNNPID indicated that Phelps County Canal operations will not change as a result of full implementation of the initial three state projects or for "Present Conditions".

After all the scoring scenarios were performed, CNPPID located the complete historical dataset (note that the 1970 historical data was slightly different through April of that year than in the first dataset provided) . Historical Phelps County Canal diversions for the 1947 – 1994 period are also show in **Figure A-4**. Historical diversions were lower than the filled dataset for the first several years of the simulation period and then generally higher than the filled data from 1955 through 1969.

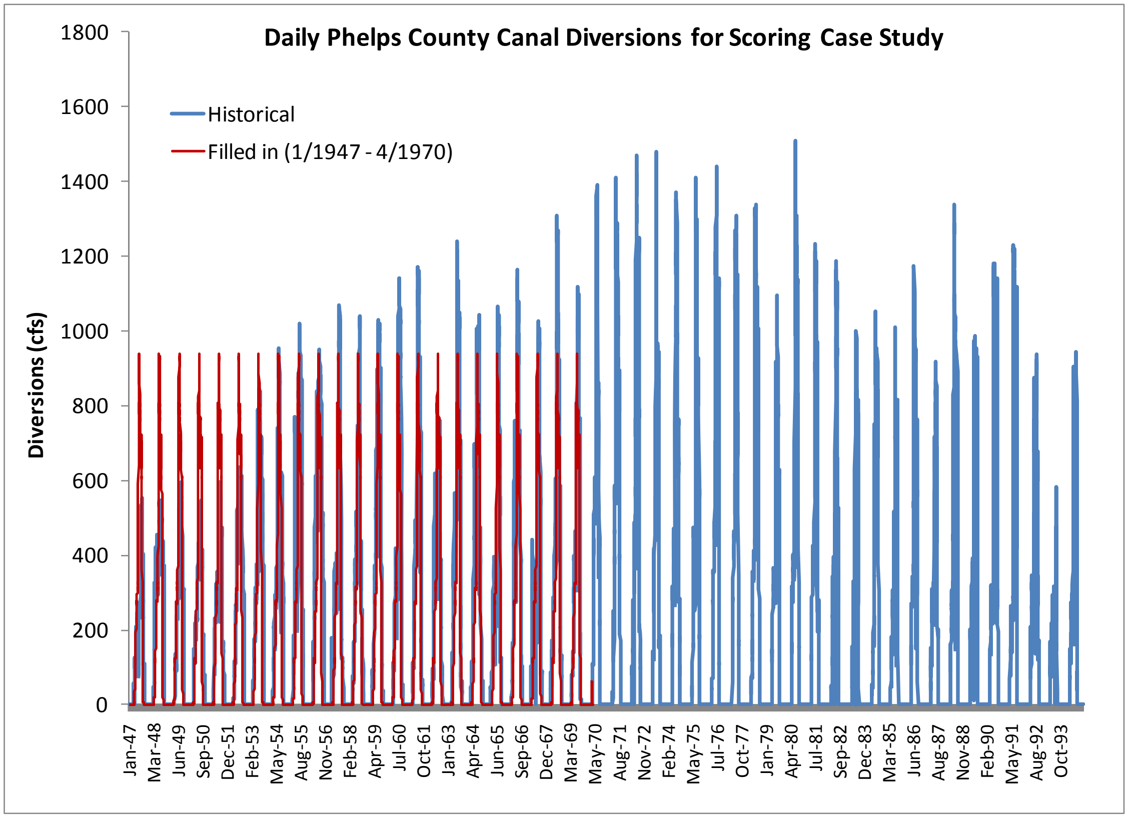



**Figure A-4: Daily Phelps County Canal Diversions (filled and historical data)**

To evaluate the impacts of using this dataset (unadjusted) as compared to the filled data for the years 1947 – 1969, the ED Office reran the scenario applying column 4 of Appendix A-5 target flows and using Grand Island to calculate excesses and shortages and (without pulse flows and with EA flows). The results are provided in **Table A-3**. Using the historical rather than filled Phelps dataset had a minimal impact on average annual project yield, increasing it by around 300 AF. Based upon these results, using the filled Phelps County Canal data appears sufficient for this scoring exercise, and slightly conservative as it tended to slightly decrease the remaining capacity available to route excess flows to the J-2 reregulating reservoir. We recommend that historical Phelps County Canal data be used for the entire 1947 – 1994 period for future project scoring.

**Table A-3: Impact of Using Historical versus Filled Phelps County Canal Data**

| Phelps Data Used | Average from 1947-1994 Period (acre-feet) | | | | | |
|---|---|---|---|---|---|---|
| | Excesses at Grand Island | Excesses in CNPPID's System | Excesses Available for Phelps County Canal | Excesses Stored | Reservoir Releases | Reductions to Shortages[1] |
| **Historical with 1947 - 1969 Filled with Daily Averages** | 405,734 | 216,676 | 169,791 | 47,758 | 47,621 | 42,181 |
| **Historical for Entire Period** | 405,734 | 216,676 | 173,803 | 48,161 | 48,024 | 42,497 |

[1] Differences between Reservoir Releases and Reductions to Shortages reflect routing effects (transit loss).

Routing from Overton to Grand Island

The WMC Loss Model estimates the percent loss per mile for each month for water years 1975 – 2006 for 19 reaches. The ED Office routed 100 cfs from the Overton to Odessa and Odessa to Grand Island reaches to develop loss percentages which were then averaged by month and year type as shown in **A-4**. These losses were applied to daily reregulating reservoir releases to route the water to Grand Island during periods of shortage. This analysis assumed that releases were protected from diversions.

**Table A-4: Average Percent Loss from Overton to Grand Island by Month and Year Type**

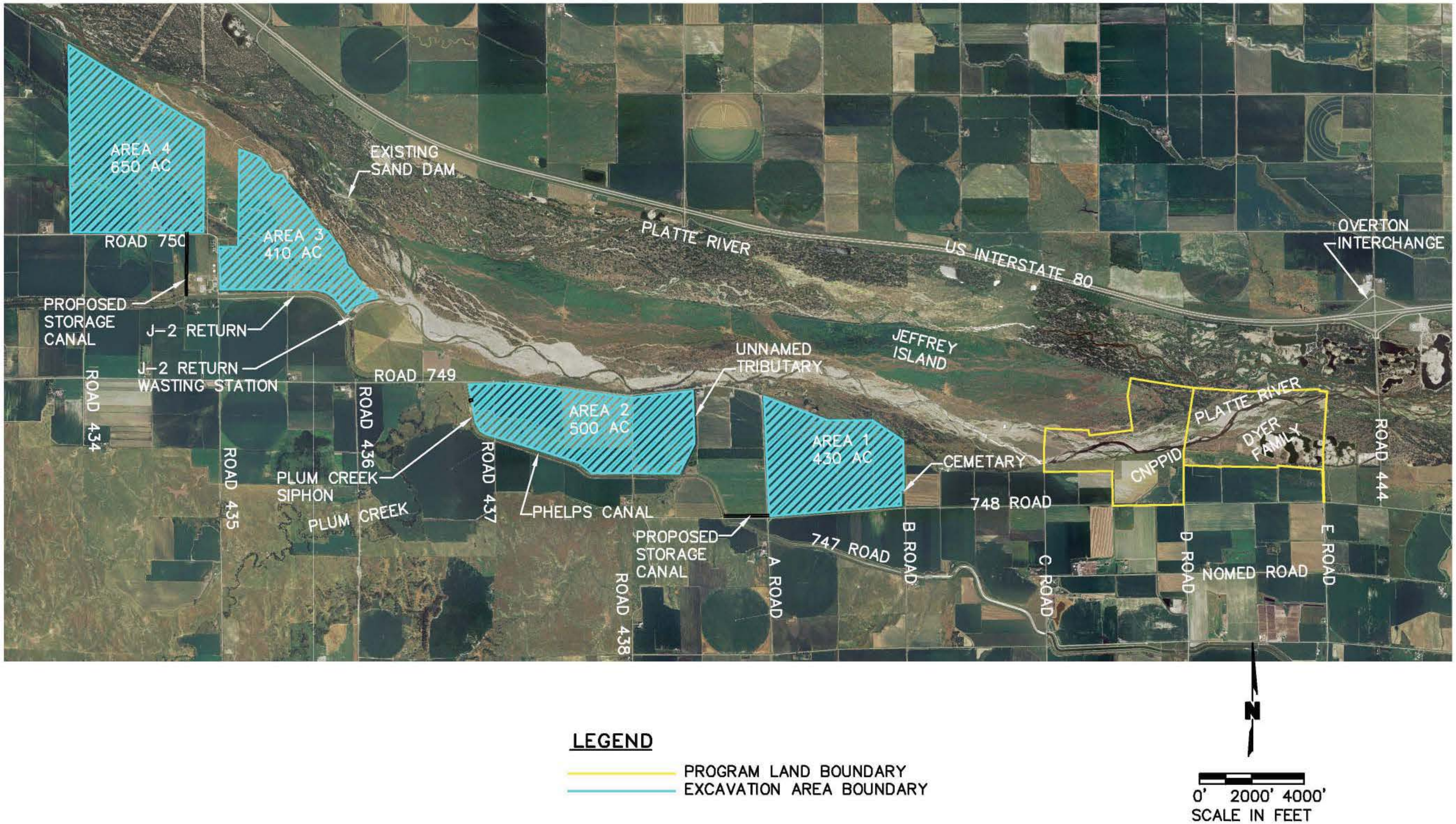
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wet** | 11% | 8% | 2% | 4% | 3% | 4% | 4% | 12% | 16% | 9% | 8% | 8% |
| **Normal** | 11% | 7% | 3% | 3% | 5% | 7% | 21% | 23% | 26% | 16% | 13% | 12% |
| **Dry** | 15% | 9% | 5% | 5% | 6% | 32% | 59% | 73% | 64% | 46% | 26% | 15% |

## References

Platte River EIS Office, 2006. Central Platte River Model (OPSTUDY8) Technical Documentation and Users Guide, Platte River EIS Office, Lakewood, Colorado, February 2006

# Attachment B

# CNPPID Reregulating Reservoir Scoring Case Study
# Reservoir Location (see Areas 1 and 2)




**LEGEND**

PROGRAM LAND BOUNDARY
EXCAVATION AREA BOUNDARY

| PROJECT: 09-1466 | J-2 RETURN ALTERNATIVE 2 | OLSSON ASSOCIATES | PROPOSED EXCAVATION | FIGURE |
|---|---|---|---|---|
| DRAWN BY: CRL | GOSPER AND PHELPS COUNTY, NEBRASKA | | | 2.1 |
| DATE: 10.8.09 | | | | |

DWG: F:\Projects\009-1466\Alternative 2\009-1466_StageStorageCover.dwg USER: cluttrell
DATE: Dec 10, 2009 9:55am XREFS: 09_1466_Pbase J2_TOPO 009-1466_SectionTownship 09_1466_LowResolutionAerials TitleBlock

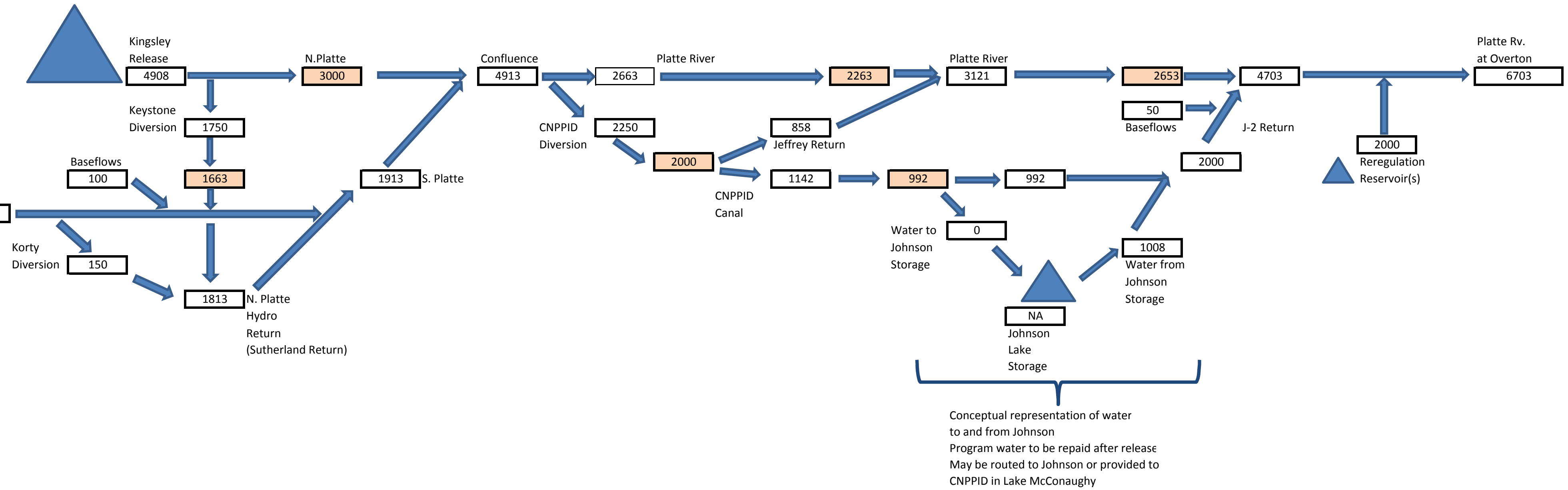
# Attachment C

# CNPPID Reregulating Reservoir Scoring Case Study
# Conceptual Diagram: SDHF Flows and
# System Component Contributions

| | | |
|---|---|---|
| CNPPID Percent Loss per Reach | 5% | |
| Mainstem Percent Loss per Reach | 15% | |
| Loss to Jeffrey Reservoir | 250 | cfs |
| Loss Jeffrey to Johnson | 150 | cfs |
| N. Platte Choke Pt Capacity = | 3000 | cfs |
| Kingsley Diversion Capacity = | 1750 | cfs |
| S. Platte Flows = | 150 | cfs (typical) |
| Sutherland Return Capacity = | 1900 | cfs |
| CNPPID Diversion Capacity = | 2250 | cfs |
| Jeffrey Return Capacity = | 1250 | cfs |
| Water to Johnson Storage = | 0 | cfs (6,000 af/3 days) |
| Johnson Release Max = | 1008 | cfs |
| J-2 Hydro Capacity = | 2000 | cfs |
| Reregulation Res. Release = | 2000 | cfs |
| No Phelps Canal diversions off of J-2 Return | | |

[shaded box] = Loss Applied to get this flow

## CONCEPTUAL DIAGRAM - PEAK SHORT DURATION HIGH FLOW EVENT FLOWS



# Attachment D
# OPStudy "Adjusted" Hydrology Background

## Case Study Hydrology

OPStudy *Adjusted Present Conditions With Three States Projects* data[1] for the 1947 – 1994 period was used for the CNPPID Reregulating Reservoir scoring case study because it provides a consistent set of data with what was originally used in the Platte River Recovery Implementation Program (Program) Environmental Impact Statement (EIS) and Biological Opinion (BO). The "Adjusted" dataset reflects 1990's water-development conditions ("Present Conditions") and full implementation of Tamarack I, the Pathfinder Modification account, and the Environmental Account ("Three States Projects").

The following information provides background on the development of this dataset and is primarily taken from the Program EIS and the OPStudy Technical Documentation, with minor modifications by the Program Executive Director's Office (ED Office).

## EIS Modeling

Multiple models were used to support the Program EIS. Output data from the North Platte River EIS Model the South Platte River EIS Model provided input data for the Central Platte OPStudy Model for EIS alternative analyses.

<u>North Platte River EIS Model (NPREIS)</u>
The NPREIS model is a monthly water balance model developed to simulate the operation of US Bureau of Reclamation projects on the North Platte River. The monthly NPREIS model output flows at Lewellen, Nebraska are provided as input to the Central Platte River OPStudy model.

<u>South Platte River EIS Model (SPREIS)</u>
The SPREIS model was designed to estimate South Platte River flows at Julesburg, Colorado under current conditions and with various EIS alternatives superimposed upon current conditions, for the EIS. The monthly SPREIS model output flows at Julesburg are provided as input to the Central Platte River OPStudy model.

<u>Central Platte River Model (OPStudy)</u>
The Central Platte River OPStudy model representation of the system begins near the lower end of the South Platte river (near Julesburg, Colorado) and the North Platte River above Lake McConaughy (near Lewellen, Nebraska), and continues through central Nebraska to Duncan,

[1] The pulse flow (or SDHF) option was turned on in the *Adjusted Present Conditions With Three States Projects* OPStudy model run which generated the daily data being used for this case study. However, because the model iteratively solves, output for many gage locations is provided "with" and "without" the pulse flows. It is anticipated that OPStudy output without pulse flows will be used for water project scoring.

Nebraska. The NPREIS model and SPREIS model were run independently to provide monthly input data to OPStudy.

**Adjusted Present Condition Modeling Hydrology**

In the EIS, an *Adjusted Present Condition* or "Reference Condition" was defined for purposes of comparing results of various model runs against a standardized baseline. The "Present Condition" scenario is intended to reflect the "current" level of water storage and diversion facilities, water demands, and operating criteria on the Central Platte River system, applied as if those same conditions had existed throughout the 1947 - 1994 modeling period. For example, although the Gerald Gentleman power generation facility was not completed until the 1980's, the *Present Condition* scenario accounts for water in the river system as if this facility had existed throughout the 48-year model period. In addition, the *Present Condition* scenario assumes that the NPPD and CNPPID facilities on the river system are relicensed on the same terms as their past licenses.

The OPStudy model documentation describes that ideally, July 1, 1997 is considered the baseline date" for *Present Condition*. However, because many river system facilities and operations are implemented gradually over a long period of time, it may be more realistic to think of the "baseline date" as being the general time frame of the mid- to late-1990s. Changes that occurred below Lake McConaughy during the 1947-1994 modeling period that are included as "Present Condition" features in the Central Platte River OPStudy model are described in the EIS hydrologic analysis. The following provides a general overview of some of the "adjustments" to present conditions that were made in each of the EIS models.

<u>North Platte River EIS Model (NPREIS)</u>
The following changes to the North Platte River are included in the NPREIS model, to reflect construction of new facilities and changes in operation of existing facilities within the 1947 - 1994 period:

- Construction of Glendo Reservoir
- Construction of Alcova Reservoir
- Construction of Gray Reef Reservoir
- Construction of Kortes Reservoir
- Construction of Gray Rocks Reservoir
- Construction of Fremont Canyon Power Plant
- Construction of Glendo Reservoir minimum flow bypass
- Excess to Ownership operations (varied historically)
- Increasing Kendrick and Glendo irrigation use

If an item has been included in the NPREIS model, it is operated as if it had existed for the entire period of record. For example, construction of Glendo Reservoir was not completed until 1958, but the reservoir is included in the NPREIS model for the entire period of record. Other items are not as easy to visualize because they involve changes in the physical environment that have occurred over time (i.e., irrigation demand changes or adjusted river gains or inflows) or changes in how existing facilities are operated (i.e., Excess to Ownership operations).

South Platte River EIS Model (SPREIS)
Development of the SPREIS model relied upon three existing point flow studies of the South Platte River. Point flow studies are mass-balance analyses performed on specific river segments defined by stream gages at their upper and lower ends. These point flow studies were used to initially configure the SPREIS model to represent the historical operation of the South Platte River mainstem over the 1947 – 1994 period. This historical representation was then modified to account for current conditions with respect to major trends that occurred over the modeled period: growth in transbasin imports; growth in municipal water use along the Front Range, and associated changes in water rights and water use patterns; increased use of alluvial wells; and development of recharge projects.

Central Platte River Model (OPStudy)
All of the changes in the North Platte River above Lake McConaughy and in the South Platte River above Julesburg are reflected in the modified Lewellen and Julesburg inflow data sets that are used for the Central Platte River OPStudy model. The following changes to the Central Platte River are included in the OPStudy model, to reflect construction of new facilities and changes in operation of existing facilities within the 1947 – 1994 period:

- Construction of Gerald Gentleman Station
- Maximum/minimum canal diversion requirements
- Sutherland Reservoir operation changes
- FERC elevation limits
- Irrigation demand changes
- Construction of Elwood Reservoir (old fill pattern)
- Construction of Kingsley Hydro
- Adjusted river gains (addressed, not necessarily agreed upon)
- Howel-Bunger valve operations
- Korty diversion operations
- Present condition Julesburg flows
- CNPPID and NPPD contract changes

If an item has been included in the OPStudy model, it is operated as if it had existed for the entire period of record. For example, construction of the Howel-Bunger valve was not completed until the 1980's, but the operation is included in the OPStudy model for the entire period of record. Other items are not as easy to visualize because they involve changes in the physical environment that have occurred over time (i.e., irrigation demand changes or adjusted river gains or inflows) or changes in how existing facilities are operated (i.e., CNPPID and NPPD contract changes).

## Three States Projects Modeling Hydrology

The EIS modeling of the initial "Three States Projects" was based on data that was previously adjusted for the "Present Conditions". The following briefly describes how the model input data for each of the initial three projects were developed.

Colorado: Tamarack I

The Tamarack Plan involves the use of wells and other water facilities in Colorado to reregulate excess flows in Colorado in a manner that is consistent with the flow-related goals of the Program. The Tamarack project was modeled using SDFView[2], which determines the rate of return for the water pumped from the South Platte River. Because the Tamarack project only removes water from the river when flows at Grand Island are in excess of Program instream flow targets, SDFView requires the flows at Grand Island. Therefore, OPStudy is first operated with all features *except* Tamarack being simulated. This provides the flows at Grand Island that are necessary for the operation of SDFView. Augmented flows to the South Platte River at Julesburg resulting from Tamarack are included in South Platte River at Julesburg flows which are input to the OPStudy model. OPStudy is then reoperated with the Tamarack project being simulated. Tamarack EA water at Julesburg was not exchanged for EA water at Lake McConaughy in the *Three States Projects* OPStudy run, though the model has this capability.

Wyoming: Pathfinder Modification

The Pathfinder Modification Project includes a 34,000 acre-feet increase in capacity for an environmental account operated for the benefit of endangered species and habitat in central Nebraska. Contributions to the Lake McConaughy EA account from the state of Wyoming are included in Lewellen flows from the NPREIS model which are input into the OPStudy model.

Nebraska: Lake McConaughy Environmental Account

An environmental account (EA) was established in Lake McConaughy, Nebraska. Water contributed to the EA, regardless of its source, loses any separate identity upon entering Lake McConaughy or other approved storage facility, and simply becomes part of the EA. Water is allocated to the EA on the first of October of each year. The allocation is based upon the combined total of the reservoir level as of the beginning of October and the expected inflows from that date through April 30 of the following year. Contributions to the account from CNPPID and NPPD are based on 10% of the "storable natural inflows" to Lake McConaughy from October through April, up to a 100 thousand acre-feet annual limit, and a 200 thousand acre-feet total limit.

[2] *OPStudy Technical Documentation:* SDF View is a software product of the Integrated Decision Support Group at Colorado State University. SDF View uses the "SDF method" developed by the U.S. Geological Survey to quantify the rate, volume, and timing of depletive/accretive effects of pumping from or recharging to wells in unconfined alluvial river aquifers, such as those in the Tamarack project area.

## References

Central Platte River Model (OPSTUDY8) Technical Documentation and Users Guide, Platte River EIS Office, Lakewood, Colorado, February 2006.

Platte River Recovery Implementation Program Final EIS. US Department of the Interior. April 2006. Volume 3 - Water Resources and Water Quality CD.