ADAPTIVE MANAGEMENT ON THE PLATTE RIVER

03/04/2014

Platte River Recovery Implementation Program
Adaptive Management Plan (AMP)
2013 "State of the Platte" Report
(updated primarily with 2012 data)

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PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
2013 "State of the Platte"

The Platte River Recovery Implementation Program's ("Program" or "PRRIP") Executive Director's Office (EDO) developed this document for the Governance Committee (GC). It is intended to serve as a synthesis of Program monitoring data, research, analysis, and associated retrospective analyses to provide important information to the GC regarding key scientific and technical uncertainties. These uncertainties form the core structure of the Program's Adaptive Management Plan (AMP) and are directly related to decisions regarding implementation of management actions, assessment of target species' response to those management actions, how best the Program can spend its resources (money, land, water, etc.), and ultimately the success or failure of the Program.

This 2013 report is an annual update to the first State of the Platte Report developed in 2012. A "quick reference" assessment for each of eleven "Big Questions" is provided in Table 1 below, followed by a detailed write-up for each Big Question. Each detailed assessment includes information noting any updates or changes from the 2012 version. This document contains a large number of endnotes as a way to identify key documents or data sets that are important to read and understand when reviewing this report. In general, those endnotes include hyperlinks to information available in the Public Library section of the Program's web site.

The 2012 State of the Platte Report included assessments incorporating Program data from years 2007-2011. The 2013 report primarily incorporates an additional year of data from 2012, though where noted some observations and/or data from 2013 were included to provide context or insight. Significant events like the fall 2013 high flows (due to excessive runoff from precipitation in Colorado) will be addressed in the 2014 report if warranted. Through 2012, the take-home message for each Big Question is:

Implementation – Program Management Actions and Habitat

1) Program monitoring and retrospective analyses indicate that short-duration high flows (SDHF) will likely not build sandbars to a height that is suitable tern and plover nesting habitat with or without sediment balance.
2) Whooping crane roosting habitat suitability increased somewhat from 2009 to 2011, but changes cannot be used to evaluate SDHF because of the confounding effects of a massive phragmites control effort undertaken by the PVWMA. Generally, the emergence and persistence of scour-resistant invasive species like phragmites will necessitate some level of ongoing mechanical intervention in order to maintain the improvements in suitability.
3) Modeling, monitoring, and research indicate that sediment augmentation is necessary to halt continuing channel degradation that negatively impacts target species habitat suitability. However, augmentation alone may not significantly improve habitat suitability.
4) Modeling, monitoring, and analysis indicate that mechanical channel alterations are likely necessary for the creation and maintenance of suitable habitat. However, flow consolidation, which may be necessary to maintain suitable habitat using flow, cannot be implemented in at least half the associated habitat reach.

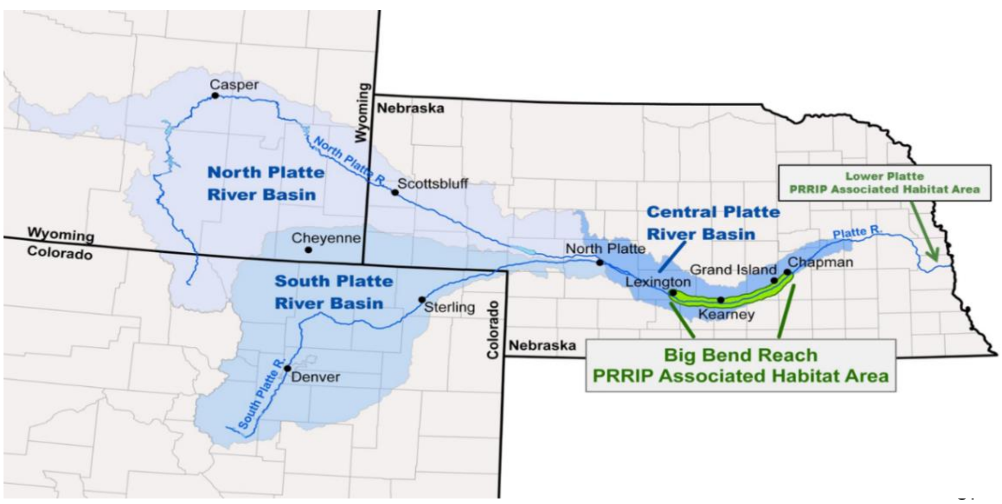
Effectiveness – Habitat and Target Species Response

5) Program monitoring data suggest whooping crane use of the Associated Habitats may be increasing. However, detailed habitat availability assessments are underway but are not yet completed so at this time we are unable to fully assess this Big Question.
6) Program monitoring and data analysis indicate that as habitat increases, tern and plover use and productivity increase. However, this conclusion needs to be further verified as we have observed marginal changes in habitat availability and high variability in the data from 2007-2012.
7) Tern and plover use and productivity have increased at sandpit sites and use has decreased at in-channel sites since 2007. Detailed habitat selection analyses have not yet been completed so at this time we are unable to fully address this Big Question.
8) Forage fish monitoring data, the Program's tern/plover foraging habits study, and Program data analysis reveal that forage abundance (fish and invertebrates) is high at nearly all flow levels on the river during the summer as well as on sandpits so this link does not warrant further investigation as a priority issue.
9) Application of the Program's stage change study tool indicates that central Platte River flow management actions are likely to avoid adverse impacts to pallid sturgeon in the lower Platte River.

Larger Scale Issues – Application of Learning

10) Program implementation is considered a contribution to the recovery of the target species. A clearer picture of the magnitude of that contribution to the overall health of the three target bird species' populations will emerge closer to the end of the First Increment.
11) A list of existing and/or new unanswered questions will be maintained throughout the First Increment to set the stage for evaluation during the Second Increment.

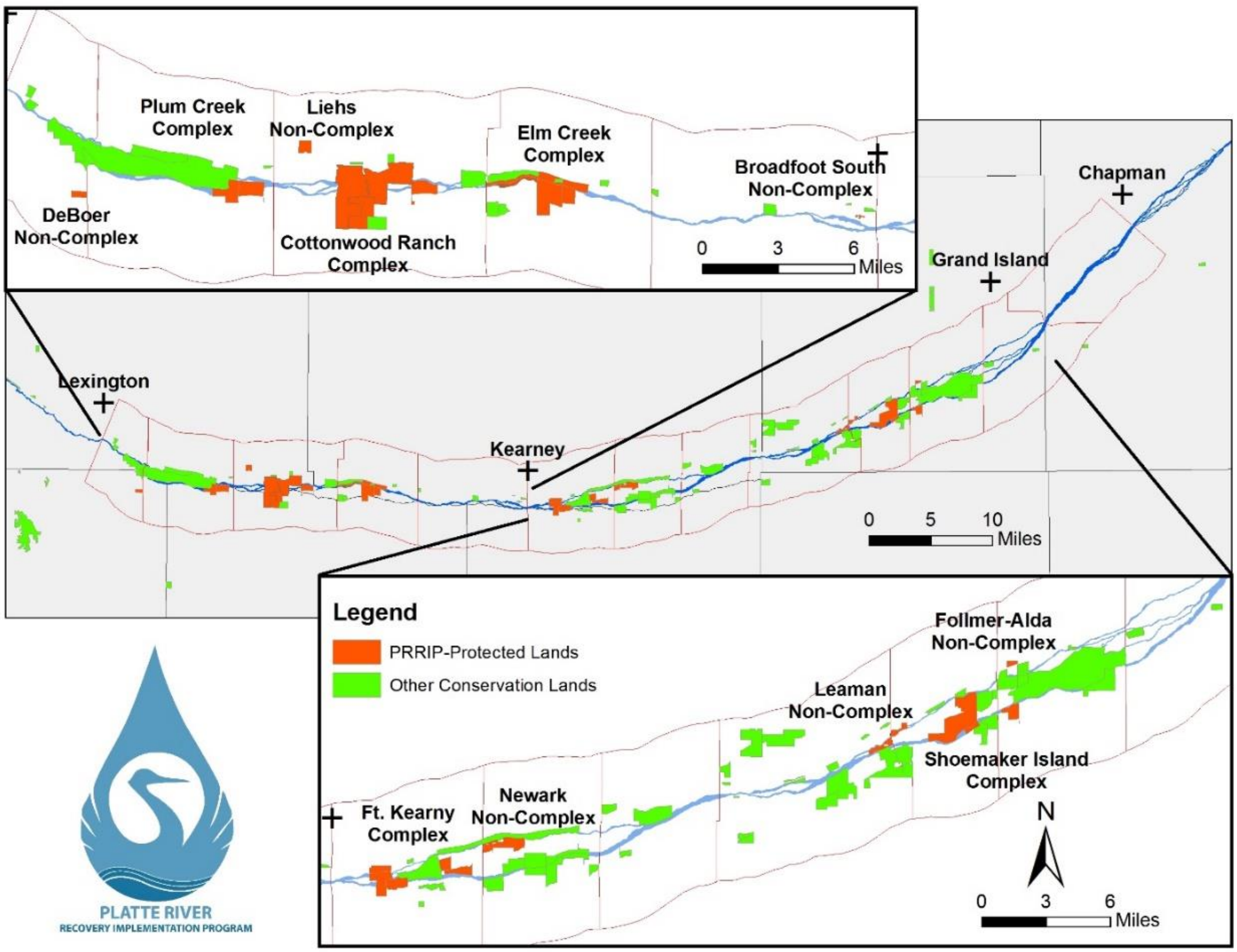
Map depicting Program area, including the Associated Habitat Reaches on the central and lower Platte River.



With the exception of Big Question #6, 2012 data did not lead to changes in the Big Question assessments in 2013. Of the eleven Big Questions, one answer is conclusive (#8), five are trending positive (#3, #4, #6, #9, and #10), one is trending negative (#1), and four remain inconclusive and open to further investigation (#2, #5, #7, and #11). As in 2012, assessment of the Big Questions in 2013 reveals the Program is on track towards meeting the AMP management objectives.

This report was discussed with and reviewed by the Program's Technical Advisory Committee (TAC) and the Program's Independent Scientific Advisory Committee (ISAC) several times during 2013 and early 2014. As noted in **Appendix A**, the ISAC generally agreed with the 2013 Big Question assessments. A subset of feedback from the TAC on the 2013 Big Question assessments is included in **Appendix B**.

The map below details the Program's Associated Habitat Area in the central Platte River, highlighting Program habitat complexes in the western half of the 90-mile reach (top map) and the eastern half (bottom map). Program implementation, data collection, and analysis described in the 2013 assessments of the Big Questions largely center on management actions taken at Program habitat complexes.



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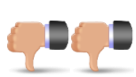
"Quick Reference" Guide

To assist the GC with quickly evaluating the 2013 Big Question assessments, the icons below are used to visually summarize the basic conclusion for each question. Thumbs up or down indicate a trend in the affirmative or negative and may point to the need to re-evaluate management actions based on collected data and analysis. The unknown "character" is used when there is not enough evidence to indicate a trend in either direction and more time is needed to collect appropriate data and conduct analyses. These icons are intended to provide the GC with a quick and visual means to see where the Program stands each year in moving towards resolution of the Program's most significant scientific questions as they relate to management decision-making.

Icon	Trend or Answer Explained by Icon
	• Big Question and underlying hypotheses **answered conclusively** in the **affirmative** • Foundational documents, analysis, and other references on which this assessment is based have undergone peer review through the PRRIP peer review process and/or publication in refereed journals • Governance Committee should consider adjustments to decisions related to PRRIP management actions
	• Affirmative answer or trend, but Big Question and underlying hypotheses **NOT answered conclusively** • Assessment can be based on draft documents and analysis, but peer review and/or publication may be pending • To the extent possible, consider what information is necessary to change this designation
	• Evidence thus far is **inconclusive**; no affirmative or negative answer/trend to Big Question and underlying hypotheses • Assessment can be based on draft documents and analysis, but peer review and/or publication may be pending • To the extent possible, consider what information is necessary to change this designation
	• Negative answer or trend, but Big Question and underlying hypotheses **NOT answered conclusively** • Assessment can be based on draft documents and analysis, but peer review and/or publication may be pending • To the extent possible, consider what information is necessary to change this designation
	• Big Question and underlying hypotheses **answered conclusively** in the **negative** • Foundational documents, analysis, and other references on which this assessment is based have undergone peer review through the PRRIP peer review process and/or publication in refereed journals • Governance Committee should consider adjustments to decisions related to PRRIP management actions

PRRIP Big Questions = What we don't know but want to learn	Broad Hypotheses[1]	Priority Hypotheses[2]	2012 Assessment	2013 Assessment
Implementation – Program Management Actions and Habitat				
1. Will implementation of SDHF[3] produce suitable[4] tern and plover riverine nesting habitat on an annual or near-annual basis?	*PP-1a: 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 will build sandbars to an elevation suitable for least tern and piping plover habitat.*	Flow #1		
2. Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis?	*PP-1b: 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 will increase the average width of the vegetation-free channel.*	Flow #3, Flow #5		
3. Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?	*PP-2: Between Lexington and Chapman, eliminating the sediment imbalance of approximately 400,000 tons annually in eroding reaches will reduce net erosion of the river bed, increase the sustainability of a braided river, contribute to channel widening, shift the river over time to a relatively stable condition, and reduce the potential for degradation in the north channel of Jeffrey Island resulting from headcuts.*	Sediment #1		
4. Are mechanical channel alterations (channel widening and flow consolidation) necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?	*PP-3: Designed mechanical alterations of the channel at select locations can accelerate changes towards braided channel conditions and desired river habitat.*	Mechanical #2		

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[1] From the Final Program Document, Adaptive Management Plan (AMP), Broad Hypotheses, Pages 14-17.
[2] From the Final Program Document, Adaptive Management Plan (AMP), Table 2, Pages 70-78. See **Appendix C** for the specific language of each Priority Hypothesis listed as well as the associated X-Y graph.
[3] Short-Duration High Flows (SDHF) = 5,000-8,000 cfs at Overton for 3 days. This is the only flow-related management action specified in the AMP.
[4] The term "suitable" is defined by the Program either as a function of habitat suitability criteria developed by the Technical Advisory Committee (see **Appendix D**) or Department of Interior (DOI) target habitat criteria in Land Plan Table 1 (see **Appendix E**).

PRRIP Big Questions = What we don't know but want to learn	Broad Hypotheses	Priority Hypotheses	2012 Assessment	2013 Assessment
Effectiveness – Habitat and Target Species Response				
5. Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?	*WC-1: Whooping cranes that use the central Platte River study area during migration seasons prefer habitat complexes (Land Plan Table 1) and use will increase proportionately to an increase in habitat complexes. WC-4: In the central Platte River study area, whooping cranes prefer conditions created by species target flows and annual pulse flows.*	WC1, WC3		
6. Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?	*TP-1: In the CPR study area, terns and plovers prefer/do not prefer riverine habitats as described in Land Plan Table 1 and use will/will not increase proportionately to an increase in habitat complexes.*	T1, P1		
7. Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?	*TP-2: The maintenance of tern & plover populations in the central Platte requires/does not require that sandpits & river continue to function together to provide nesting and foraging habitat. TP-3: Ephemeral river nesting areas are/are not needed for long-term nesting success of tern & plover.*	TP1		
8. Does forage availability limit tern and plover productivity on the central Platte River?	*TP-4: Existing river flows do/do not provide a sufficient forage base throughout the central Platte River study reach for populations of terns and plovers during the nesting season.*	T2, P2		*N/A – question answered in 2012*
9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?	*PS-2: Water related activities above the Loup River do/do not impact pallid sturgeon habitat.*	PS2		
Larger Scale Issues – Application of Learning				
10. How do Program management actions in the central Platte River contribute to least tern, piping plover, and whooping crane recovery?	*S-3: Program management actions will/will not have a detectable effect on target species use of the associated habitats.*	S1b		
11. What uncertainties exist at the end of the First Increment, and how might the Program address those uncertainties?	N/A	N/A		

1 The Program's "Big Questions", associated Broad Hypotheses from the AMP, and associated Priority Hypotheses from the AMP.

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1. Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?

Based upon the SedVeg model and associated assumptions in the FSM management strategy, it is hypothesized that under a balanced sediment budget, a SDHF of 5,000 to 8,000 cfs magnitude for three days (50,000 to 75,000 acre-feet) will build sandbars to an elevation that is suitable for tern and plover nesting.[1]

Analysis Conducted to Date:

The Program developed system and project-scale hydraulic and sediment transport models and collected detailed system and project-scale topographic data following two natural flow events that exceeded SDHF magnitude and duration. The EDO and contractors used these data to analyze sandbar height in relation to peak flow stage and minimum habitat suitability criteria in the portions of the reach that are in sediment deficit (upstream of Gibbon) and sediment balance (downstream of Gibbon).[2]

Thus far, analyses focused on relationships related to SDHF because that flow management action is prioritized in the AMP. Additional monitoring and analysis may be utilized to evaluate alternative flow management actions (i.e. USFWS target flows – pulse flows and species flows) if the GC elects to implement such alternatives.

2013 Update:

No managed high flow events occurred on the central Platte River in 2012. In absence of new data relevant to this Big Question, the 2012 assessment has been retained and reproduced below.

What Does the Science Say?

Program monitoring and research indicates that SDHF will likely not build sandbars to a height that is suitable for tern and plover nesting with or without sediment balance.

The Program's minimum suitable sandbar height criterion for tern and plover nesting is 1.5 feet above a stage of 1,200 cfs.[3] This corresponds to nests having approximately a 45 to 50% probability of being flooded during the nesting season (May-July).[4] During a peak flow event, sandbars grow to some equilibrium height below the flow stage. The maximum stage of an event in combination with equilibrium sandbar height relative to stage, dictate whether or not sandbar heights exceed 1.5 feet above 1,200 cfs. Program modeling, research, and monitoring indicate:

1. Hydraulic modeling and monitoring indicate that stage increase during peak flow events of SDHF magnitude (5,000-8,000 cfs) would be sufficient to produce sandbars meeting the height criterion <u>if</u> sandbars build to the water surface at a discharge of 5,000 cfs or within approximately 0.7' of the water surface at a discharge of 8,000 cfs.[5] (The Final Environmental Impact Statement (FEIS) analysis assumed bars build to the water surface.[6])

2. In 2010, the annual high flow event exceeded SDHF magnitude by 10% (8,800 cfs) and volume by 818% (613 KAF). In 2011, the annual high flow event exceeded SDHF magnitude by 28% (10,200 cfs) and volume by 4,448% (3.34 MAF).[7]

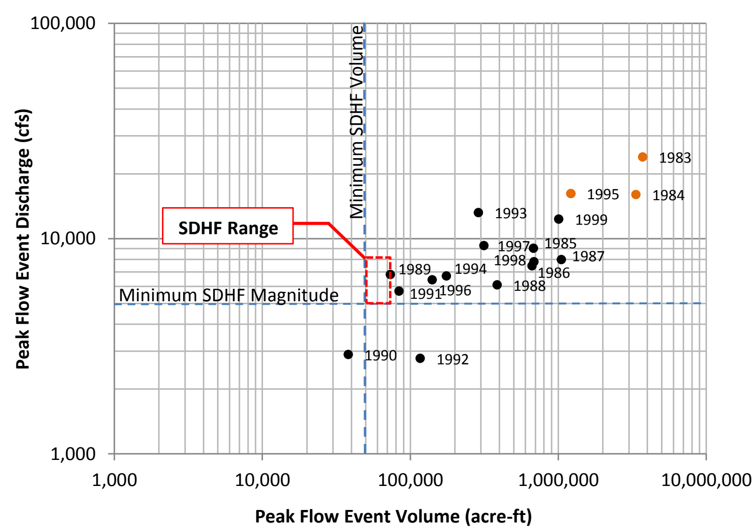
3. Sandbars that formed in the Elm Creek reach during the 2010 and 2011 peak flow events had maximum heights of approximately 1.0’ to 1.6’ below peak flow stage and did not produce appreciable area meeting the minimum height criterion despite the fact that SDHF magnitude and duration was exceeded in both events. At a SDHF discharge of 8,000 cfs, equilibrium bar heights of 1.0’ below peak stage would produce maximum sandbar heights that are 0.3’ below the minimum height criterion. [8]

4. Sandbar heights do not appear to differ significantly in the sediment deficient reach upstream of Gibbon versus the reach in sediment balance downstream of Gibbon, indicating that sediment balance alone does not significantly influence sandbar height.[9]

5. The area of in-channel sandbar habitat meeting minimum suitable habitat criteria has declined from approximately 21 acres in 2008 to five acres in 2011 as constructed nesting islands have been eroded by peak flow events.[10]

The finding that SDHF-magnitude and duration flows do not produce suitable nesting habitat is qualitatively supported by a retrospective analysis of annual peak flow events and tern and plover nesting records. During the period of 1942-2011, annual peak flow event magnitude and volume exceeded SDHF minimums in 41 out of 70 years. In addition, there were seven periods when minimums were exceeded in 2 out of 3 years, including recent periods from 1984-1991 and 1993-1999 (see sidebar figure). *If the FSM management strategy is capable of creating and/or maintaining suitable tern and plover nesting habitat on an annual or near annual basis in areas of sediment balance, regular nesting on natural sandbars should have occurred downstream of Gibbon (area of sediment balance) from 1984-1999.*

Tern and plover nesting records for the period 1984-1999 include 63 nest observations on natural sandbars in the years following consecutive extremely high flow events of 23,900 cfs in 1983 and 16,000 cfs in 1984.[11] All 63 nests were found at five sites. Four of the five sites and all but two of the nests were upstream of Gibbon at locations where infrastructure (J-2 return, bridges, and the Kearney



Annual peak flow events exceeded SDHF minimum discharge and maximum volume in all but two years from 1983 through 1999. During this period, 63 nests were observed on natural sandbars in the years following consecutive extremely high flow events in 1983 and 1984 and a single nest was observed following the high flow event in 1995 (see red points on figure). All but two of the nests were located in the degrading reach upstream of Gibbon at locations where bridges or other infrastructure produced localized depositional zones. If, as hypothesized, SDHF-magnitude flows create and/or maintain suitable nesting habitat in areas of sediment balance, nesting should have occurred on an annual or near/annual basis in the reach downstream of Gibbon during this 16 year period. The lack of nesting downstream of Gibbon is a strong indicator that implementation of the FSM management strategy may not produce suitable tern and plover nesting habitat on an annual or near annual basis.

Canal diversion) produced localized areas of deposition. The only nest observed on a natural sandbar in the latter half of the 1984-1999 period was downstream of the J-2 Return in 1996 following a high flow event of 16,200 cfs the previous year. During the entire period of 1984-1999, 233 nests were observed on man-made/managed islands, 871 nests were observed on managed sandpits, and 144 nests were observed on unmanaged sandpits.

The low number of nest observations on natural sandbars in comparison to other habitat types and lack of nesting downstream of Gibbon are strong indicators that natural variation in peak flows, sediment, and channel characteristics during this period did not produce suitable nesting habitat except in areas with unique hydraulics following very high peak flow events. If the Program is to expect a different result in the future, one or a combination of these factors (flow, sediment, or channel form) must be manipulated outside of the ranges typically experienced during this period.

Governance Committee Decision-making Q&A:

Do these results mean the Program shouldn't attempt to make SDHF releases?

There are other hypothesized benefits of SDHF releases including maintaining wide, unvegetated channels for whooping cranes. The inability of SDHF to produce sandbars defined as nesting habitat by the Program should not necessarily be a reason to abandon the action as what constitutes suitable nesting habitat could be revised. However, results to date necessitate the GC be aware that current flow management priorities (SDHF) are not likely to produce all the hypothesized results and discussion of alternative flow management actions may be warranted.

Do these results mean the Program shouldn't augment sediment?

No. The effects of sediment deficit on braided stream morphology are well documented.[12] Without augmentation, narrowing and incision in the reach upstream of Gibbon will continue. The results only indicate that the sediment deficit is not the reason sandbar heights are not suitable for tern and plover nesting.

What management actions could conceivably produce islands that meet suitable nesting habitat criteria?

Some potential alternative management actions are presented below. They may not be feasible or acceptable, or they may come with potentially negative impacts but are provided as examples of what it would mean to "go beyond" naturally occurring conditions.

- *Increasing frequency of large peak flow events* - Given nesting was observed following very large peak flow events, increasing the frequency of flows exceeding 16,000 cfs in magnitude could increase the frequency of suitable habitat creation.
- *Mechanically over-widen a segment of channel to induce sediment deposition* – This action would induce deposition and potentially encourage development of higher bars.
- *Oversupply the entire reach with medium sand (D_{50} 0.4mm)* – This would produce sediment conditions similar to the lower Platte River. The potential success of this alternative, however, is questionable given the 2011 sandbar height analyses by the USGS in the lower Platte that indicated sandbar heights relative to flow event peak stage were similar to the central Platte.[13]
- *Mechanical approach* – Vegetated sandbars aggrade to heights that are suitable for nesting due to stabilization and sediment trapping by vegetation during natural or augmented annual high flow events. A portion of the sandbars at Program habitat complexes could be selectively allowed to vegetate with non-woody and non-invasive vegetation. Once a sandbar aggrades to a suitable height, it could be mechanically cleared and maintained as nesting habitat until it is eroded by subsequent flow events.

2. Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near annual basis?

A principal metric of whooping crane roosting habitat suitability is unobstructed channel width. Consequently, roosting habitat suitability can be defined as a function of either: 1) the range of unobstructed channel widths at whooping crane use sites, or 2) the range of unobstructed channel widths thought to be necessary to increase whooping crane use. Based upon the SedVeg model and associated assumptions in the FSM management strategy, it is hypothesized that flows of 5,000 to 8,000 cfs magnitude for three days on an annual or near annual basis (SDHF) will increase the average width of the vegetation-free (surrogate for unobstructed) channel [to a suitable width].[14] By extension, SDHF is also hypothesized to be necessary and sufficient to maintain suitable unobstructed widths on an annual or near annual basis.[15]

Analysis Conducted to Date:
The Program has performed a preliminary analysis of unobstructed channel widths at whooping crane riverine roost locations. The Program has also developed system and project-scale hydraulic and sediment transport models and collected detailed system and project-scale topographic and vegetation data following two natural flow events that exceeded SDHF magnitude and duration. The Program also commissioned vegetation scour directed research and is using these data to analyze the relationship between unvegetated and unobstructed channel width and peak flow event magnitude and duration.

2013 Update:
No managed high flow events occurred on the central Platte River in 2012. In absence of new data relevant to this Big Question, the 2012 assessment has been retained and reproduced below.

What Does the Science Say?

Whooping crane roosting habitat suitability increased somewhat from 2009 to 2011 but the change cannot be used to evaluate SDHF because of the confounding effects of a massive phragmites control effort undertaken by the PVWMA. Generally, the emergence and persistence of scour-resistant invasive species like phragmites will necessitate some level of ongoing mechanical intervention in order to maintain the improvements in suitability.

The Program's minimum suitable unobstructed channel width criterion for whooping crane roosting is 280 feet, which includes 90% of the whooping crane roost locations during the period of 2001 through spring 2011.[16] The minimum unobstructed width hypothesized by the DOI to be necessary to increase whooping crane use is 750 feet and the targeted width is 1,150 feet.[17] Program research, modeling, and monitoring provide the following indications about the ability of SDHF to create and/or maintain unobstructed channel widths meeting the minimum suitability criterion and/or hypothesized use targets:

1. In 2010, the annual high flow event exceeded SDHF magnitude by 10% (8,800 cfs) and volume by 818% (613 KAF). In 2011, the annual high flow event exceeded SDHF magnitude by 28% (10,200 cfs) and volume by 4,448% (3.34 MAF).[18]

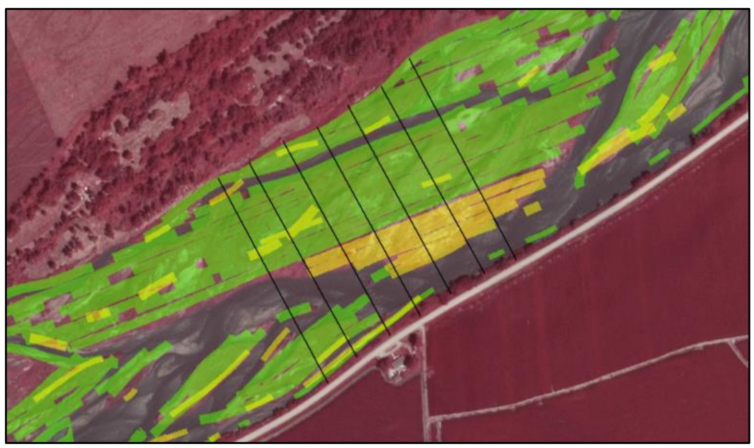
2. A preliminary analysis of system-scale vegetation monitoring data indicates that the average total unvegetated channel width at system-scale monitoring locations increased from 417 feet in 2009 to 721 feet in 2011 (73% increase).[19] During the same period, unobstructed channel width increased from 260 feet to 440 feet (69% increase). In 2011, 80% of monitoring locations exceeded the minimum

unobstructed width suitability criterion of 280 feet, 10% exceeded the minimum targeted width of 750 feet, and the Table 1 width of 1,150 feet was not exceeded at any location.[20]

3. In 2008, the Platte Valley Weed Management Association (PVWMA) undertook a massive invasive species control project focused on eliminating phragmites infestations on the Platte River through aerial application of the non-selective herbicides that kill all vegetation. In the fall of 2008, herbicide was applied to 1,531 acres of channel between Overton and Elm Creek. In the fall of 2009, 3,945 acres were treated between Elm Creek and Chapman. In the fall of 2010, a total of 2,071 acres were treated throughout the Associated Habitat reach extending from Lexington downstream to Chapman.[21] The total sprayed area of 7,547 acres is equivalent to a river treatment corridor approximately 690 feet wide from Lexington to Chapman. The sheer magnitude of the PVWMA control effort will confound the Program's ability to evaluate the relationship between high flow events and increases in unvegetated channel width in 2010 and 2011 (see sidebar figure).

4. Vegetation scour research conducted for the Program indicates that stands of scour-resistant vegetation, including phragmites (> 1 year-old), reed canarygrass (> 1 year-old), and cottonwood trees whose taproots have rooted below the shallow zone of local scour (> 1 year-old), likely cannot be removed through drag and local scour alone, even at the 100-year recurrence interval discharge. Example lateral erosion calculations in the vegetation scour research report indicate that lateral erosion in areas with established phragmites is unlikely but lateral scour of bank and bar edges could be an important mechanism for undercutting, scour and removal of other vegetation and should be studied further.[22]

The combination of natural flow events that significantly exceeded SDHF and the massive PVWMA phragmites control project make it impossible to use 2009-2011 monitoring data to evaluate the ability of SDHF to create and/or maintain suitable whooping crane roosting habitat. However, the rapid colonization of an extremely scour and inundation resistant invasive species like phragmites is a "surprise" that was not envisioned at the time the FSM management strategy was developed. In the absence of a breakthrough in biological control, it appears that some level of ongoing mechanical intervention will be necessary to prevent phragmites from recolonizing the channel.



Summer 2009 aerial photograph of Program Anchor Point 19 showing survey transects (black lines) and area treated with the herbicide Imaziypr in the fall of 2009 (green overlay) and 2010 (yellow overlay) as part of a massive phragmites control project. Imaziypr is a non-selective herbicide that kills all vegetation in the treatment area. The sheer magnitude of the spraying effort makes it impossible to separate increases in unvegetated channel width due to high flow events from increases due to herbicide application.

Given the difficulty in making inferences based on 2009-2011 monitoring data, a retrospective analysis of unvegetated and unobstructed channel widths in 1998 is useful. Imagery flown in 1998 captures channel conditions at the end of a 16 year period when SDHF minimums were exceeded in all but two years, providing an indication of unvegetated channel widths that could be created and/or maintained by SDHF in the absence of an in invasive species like phragmites and reed canarygrass.[23] In 1998, total unvegetated channel width exceeded the minimum target of 750 feet at 40% of monitoring locations but unobstructed width likely only exceeded 750 feet at one location due to the presence of permanently vegetated islands at most Anchor Point locations (see sidebar figure in Big Question 4 summary).[24] The fact that total unvegetated width exceeded 750 feet at 40% of Anchor Point locations is a positive indicator for ability to maintain suitable unvegetated widths with flow *in the absence of phragmites* or other scour-resistant invasive species. However, all but one of those Anchor Points fell short of the minimum unobstructed width target, indicating that almost all of the unvegetated width must be consolidated into a single confined channel to achieve the target.[25]

Governance Committee Decision-making Q&A:

Do these results mean the Program shouldn't attempt to make SDHF releases?

No. SDHF and possibly other flow management actions such as the pulse flow components of target flows should still be implemented to further refine the relationships between flow, channel width, and vegetation scour.

3. Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover and whooping crane habitat?

Based on the SedVeg model and associated assumptions in the FSM management strategy, it is hypothesized that eliminating the existing sediment deficit through sediment augmentation is necessary in addition to SDHF to reduce channel narrowing and incision and contribute to the creation of suitable riverine tern, plover and whooping crane habitat.[26]

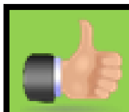
Analysis Conducted to Date:

The Program developed system and project-scale hydraulic and sediment transport models, collected annual system-scale topographic, sediment, and vegetation data in 2009-2011, commissioned a sediment augmentation feasibility study, and developed an implementation design for a two year pilot-scale sediment augmentation project.

2013 Update:

Implementation of pilot-scale sediment augmentation operations began in late 2012 and continued throughout 2013. The results of that implementation effort will be included in the 2014 State of the Platte Report. In the absence of new data, the 2012 assessment has been reproduced below.

What Does the Science Say?



Modeling monitoring and research indicate that sediment augmentation is necessary to halt continuing channel degradation, but augmentation alone may not significantly improve habitat suitability.

During Program development, the DOI estimated the average annual sediment deficit in the associated habitats to be 185,000 tons under existing flow conditions and 225,000 tons once First Increment water objectives are achieved.[27] At that time, stakeholders voiced concerns about uncertainties associated with: 1) the magnitude and extent of the deficit and resulting channel degradation and, 2) the relative importance of vegetation versus sediment supply in restoration and maintenance of channel width.[28] Program modeling, monitoring, and data analysis provide the following insights about the importance of achieving sediment balance in creation and/or maintenance of suitable riverine habitat for Program target species:

1. Updated sediment transport modeling indicates that the average annual sediment deficit in the associated habitat reach is on the order of 152,000 tons with the largest deficits occurring in the reach extending from the J-2 Return downstream to Elm Creek.[29]

2. System-scale topographic monitoring shows results consistent with sediment transport modeling, which predicts that sediment balance is achieved between Kearney and Minden.[30]

3. The upper end of the Associated Habitat reach is degrading in the absence of sediment augmentation. The effects of degradation in the reach from the J-2 Return to the Overton Bridge include up to ten feet of channel incision and significant channel narrowing.[31] This incision and narrowing is migrating slowly downstream and, over time, may impact the four Program habitat complexes that are located in the degradational reach.[32] Elimination of the sediment deficit through sediment augmentation is necessary to halt incision and narrowing that may negatively affect habitat suitability at these locations.

4. Although necessary to halt incision and narrowing, sediment augmentation likely will not result in significant channel widening or shift anastomosed reaches to a braided morphology without mechanical clearing and widening of the channel.[33]

A pilot-scale sediment augmentation management experiment to test augmentation material gradations and methods will begin in September 2012. The pilot-scale experiment is expected to help reduce uncertainties about: 1) the most effective material gradation to offset the deficit; 2) the most cost-efficient method to introduce augmentation material into the channel; and 3) verify that augmentation will not decrease channel capacity. Until full-scale sediment augmentation occurs, it will be difficult to evaluate whether or not the entire deficit can be eliminated through augmentation. It will also be difficult to determine if augmentation only slows/halts channel narrowing and incision or also contributes to channel widening, which is necessary to create and/or maintain suitable habitat for the target bird species.

Governance Committee Decision-making Q&A:

Is sediment augmentation intended to reverse historic channel incision and narrowing in the reaches that have degraded significantly?

No. The objective of sediment augmentation is to offset the deficit and eliminate further degradation. Any attempt to “fill the hole” and raise the channel bed elevation would likely require augmentation of material volumes far in excess of the sediment transport capacity of the river. The benefits or potential impacts of oversupplying the channel with sediment have not been discussed or evaluated at this time.

4. Are mechanical channel alterations (channel widening and flow consolidation) necessary for the creation and/or maintenance of suitable riverine tern, plover and whooping crane habitat?

Based on the SedVeg model and associated assumptions in the FSM management strategy, it is hypothesized that designed mechanical channel alterations like mechanical clearing and leveling of islands, channel widening, vegetation clearing from banks, and consolidation of 85-90% of river flow into one channel are needed to accelerate the creation and or maintenance of suitable riverine habitat.[34]

Analysis Conducted to Date:
The Program developed system and project-scale hydraulic and sediment transport models, collected annual system-scale topographic, sediment, and vegetation data in 2009-2011, and commissioned a flow consolidation pre-feasibility study to investigate the potential to implement a flow consolidation management experiment at the Cottonwood Ranch Complex.

2013 Update:
The investigation of flow consolidation feasibility at Cottonwood Ranch was ongoing during 2012. The results of that investigation will be presented in the 2014 State of the Platte Report. In absence of additional data, the 2012 assessment has been reproduced below.

What Does the Science Say?

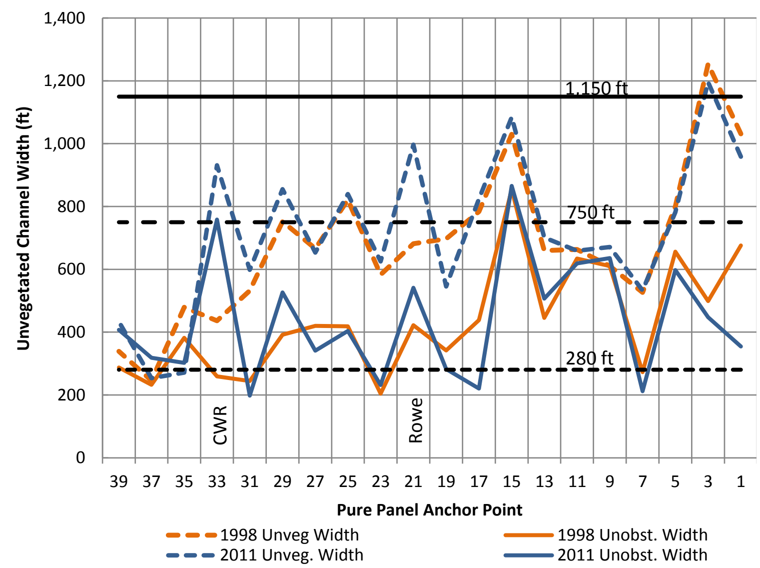
Modeling, monitoring, and analysis indicate that mechanical channel alterations are likely necessary for the creation and maintenance of suitable habitat. However, flow consolidation, which may be necessary to maintain suitable habitat using flow, cannot be implemented in at least half the associated habitat reach.

The central Platte River provides an almost textbook example of the vegetation ratchet effect. During drought periods, vegetation encroaches into the active channel and becomes well established. Subsequent high flow events lack the stream power necessary to remove several-year-old woody vegetation so much of the area that was colonized is permanently stabilized and becomes riparian forest – thus, the one-way ratcheting down of width experienced from the early 1940s through the early 2000s.[35] This effect was the impetus for inclusion of a mechanical component in the FSM management strategy. Mechanical clearing and leveling of islands, channel widening, and flow consolidation are intended to "prepare" a suitable channel that can then be maintained by flow. Program modeling, monitoring, and data analysis provide the following insights about the role of mechanical channel alterations in creating and/or maintaining suitable species habitat.

Mechanical Clearing, Leveling and Channel Widening
As discussed in the Big Question 2 summary, the combination of natural high flow events and massive phragmites control effort resulted in substantial increases in total unvegetated and unobstructed channel widths from 2009 to 2011. On a system scale, these increases have generally returned unvegetated channel widths and configurations to 1998 conditions (see sidebar figure).[36] Two notable exceptions are the Anchor Points located on the Cottonwood Ranch Complex and on Audubon's Rowe Sanctuary where the channel has been intensively managed through island clearing and channel widening (in the case of Cottonwood Ranch).[37] In these areas, both the unvegetated and unobstructed channel widths are significantly greater than they were in 1998. This is a positive indicator for the ability of the Program and/or other organizations to be able to successfully alter the channel mechanically for the purpose of improving habitat suitability.

The overall similarity of channel widths and configurations in 1998 and 2011 on a system scale provides an indication that flows in combination with herbicide application eliminated vegetation that encroached into the active channel during the drought of the 2000s but generally did not widen or reconfigure the overall channel sufficiently to improve on habitat suitability prior to the drought. This supports the contention that mechanical channel consolidation and/or clearing and leveling of permanently vegetated islands is necessary to "prepare" a suitable channel that can then potentially be maintained through SDHF releases.

The channel widening at the Cottonwood Ranch Complex can be attributed to mechanical widening projects implemented by the Nebraska Public Power District (NPPD) and the Program starting in the early 2000s. In addition to channel widening, the Program has conducted mechanical clearing and maintenance activities at every Program habitat complex. As a result of this experience, the Program has developed a good understanding of costs (in terms of both money and time) associated with mechanical channel alterations. This will be useful as the Program begins to evaluate the costs of the FSM and MCM management strategies in relation to their performance.

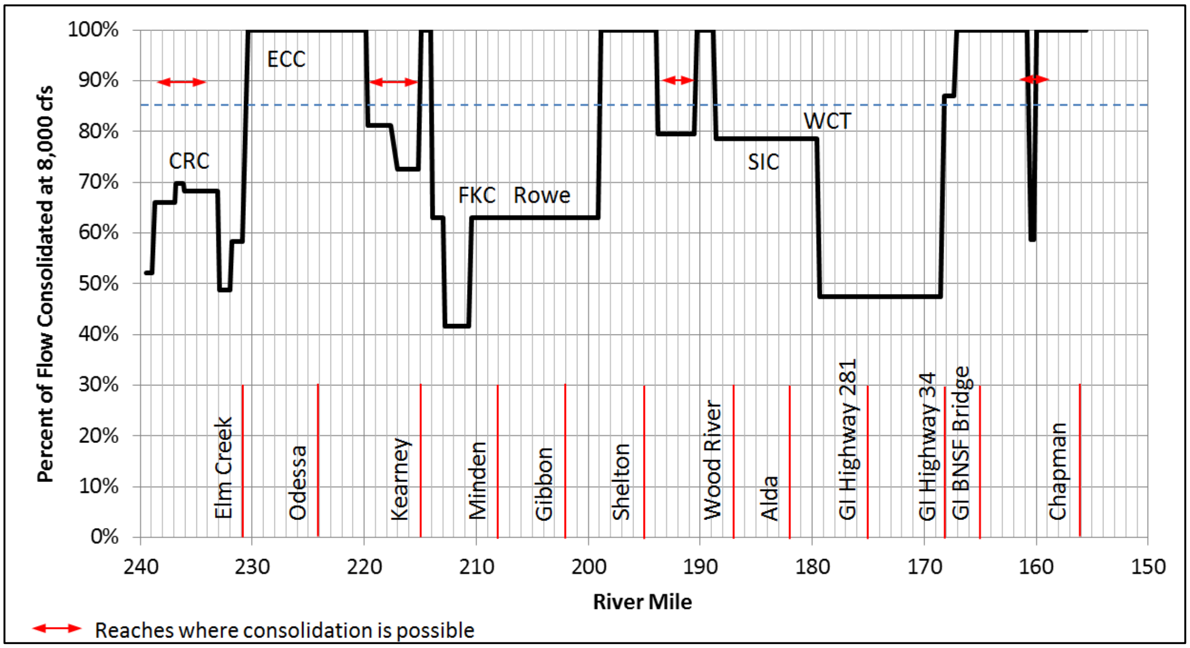


Following the 2011 high flow event, channel widths and configurations in the associated habitat reach are very similar to 1998 conditions except for at locations like Cottonwood Ranch and Rowe Sanctuary where intensive mechanical management actions like island clearing and leveling have increased channel width. This supports the hypothesis that mechanical channel manipulation is necessary to "prepare" a suitable channel that could then potentially be maintained through SDHF releases.

Mechanical Flow Consolidation

The concept of flow consolidation was developed from analysis of unvegetated channel widths in 1998 imagery.[38] At that time, the total unvegetated channel width across much of the associated habitat reach was sufficient to achieve the minimum unobstructed width target of 750 feet but the significant number of flow splits meant that the total width was spread across multiple channels. This resulted in unobstructed width significantly below the target except for reaches where infrastructure or valley confinement consolidated almost all of the flow into a relatively narrow corridor. This observation gave rise to the hypothesis that consolidating 85-90% of flow into a single channel will (at a minimum) accelerate the transition of the river to suitable habitat, and potentially may be necessary to maintain suitable habitat using flow.

Flow consolidation is only a viable management action in reaches where downstream landowners will not be either deprived of flow or subjected to increased flooding risk. There are relatively few reaches in the associated habitats that meet these requirements. The figure on Page 17 presents the existing degree of consolidation in the Associated Habitat reach based on the Program modeling and indicates reaches where consolidation may be feasible. Overall, approximately 33 miles (33%) of the associated habitat reach is consolidated and 17 miles (19%) could potentially be consolidated. *From a FSM performance perspective* *this means that at best, the transition toward suitable habitat in at least half of the associated habitat reach will be very gradual and at worst, some degree of ongoing mechanical intervention will be necessary in 50% of the Associated Habitat reach in order to maintain suitable habitat.* The Cottonwood Ranch Complex is one of the reaches where flow consolidation is potentially feasible and the Program is currently working on the implementation design for a flow consolidation management experiment to evaluate the incremental channel maintenance benefit of consolidation.[39]



This figure presents the percent of flow consolidated in the main channel at 8,000 cfs from Overton downstream to Chapman. Approximately 33% of the associated habitat reach is consolidated and another 19% of the reach could potentially be consolidated (see red arrows). If flow consolidation is necessary to maintain suitable habitat using flow, at least half of the associated habitat reach would require some degree of ongoing mechanical intervention.[40]

Governance Committee Decision-making Q&A:

Is flow consolidation a feasible management action?

At best, it can only be an opportunistic action. Flow is generally consolidated at the Elm Creek Complex and the Shoemaker Island Complex, making them prime locations for evaluating the FSM management strategy. Flow can be consolidated at the Cottonwood Ranch Complex and final design and implementation of that action is now underway. This is likely the only flow consolidation management action that will be recommended during the First Increment.

5. Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?

It is hypothesized that when whooping crane roosting habitat availability increases, the proportion of the whooping crane population using the central Platte River and the length of those stays will increase (i.e., roosting habitat is limiting).[41]

Analysis Conducted to Date:

The Program monitors whooping crane use of the central Platte River during spring and fall migration periods each year and is a core partner in an international whooping crane telemetry tracking project.[42] Program contractors prepare monitoring reports each migration season that, among other things, include raw monitoring numbers, nocturnal roost locations, diurnal use locations, and habitat metrics.[43] Habitat availability during the tern/plover nest initiation period (April-July) and during the spring and fall whooping crane migration periods are calculated each year based on Program-defined suitability criteria using aerial photography, LiDAR imagery, HEC-RAS models, and GIS computing.

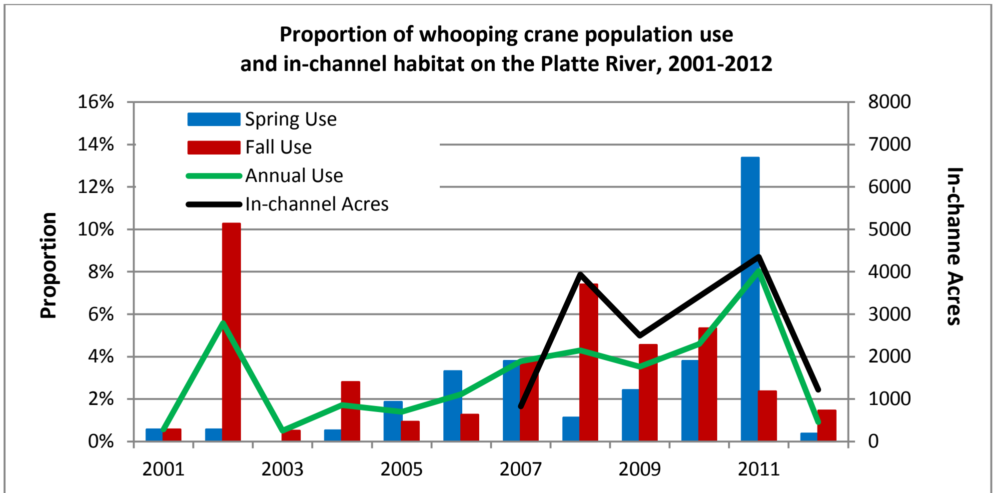
2013 Update:

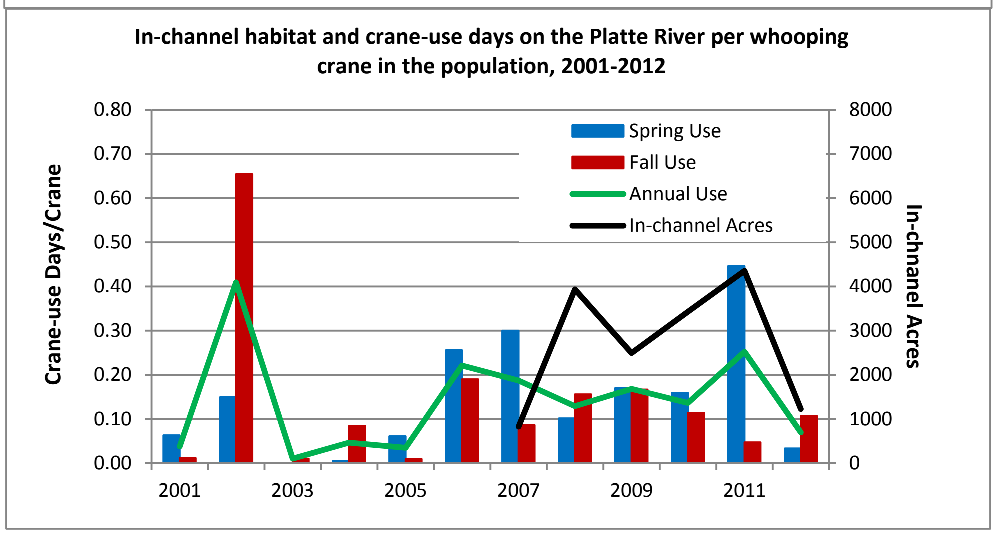
Whooping crane habitat availability assessments for 2007-2012 were completed in late 2013. Habitat availability assessment results and detailed habitat selection analyses will be used to more thoroughly investigate this Big Question in the 2014 State of the Platte Report.

What Does the Science Say?

Program whooping crane monitoring data continue to suggest whooping crane use of the Association Habitats may be increasing[44]. However, detailed habitat selection analyses are underway but are not yet completed so at this time we are unable to fully assess this Big Question.

Program whooping crane monitoring data collected to date (figures below[45]) indicate that the proportion of the whooping crane population observed using the central Platte River and number of days whooping cranes have used the central Platte River on an annual basis (weighted by population size) appear to be increasing annually[46] and may be correlated with availability of Program-defined suitable in-channel habitat. However, use is still being evaluated against habitat availability during each migration season. Detailed whooping crane habitat selection analyses are underway and are expected to be completed in 2014. Once completed, the results of habitat selection analyses will be used to more fully evaluate relationships between whooping crane use and changes in suitable roosting habitat and to re-examine proposed unobstructed channel width targets for whooping cranes.





Program whooping crane monitoring data indicate the proportion of the whooping crane population that utilized the Associated Habitats and crane use days within the Associated Habitats may be increasing and correlated with availability of Program-defined suitable in-channel habitat. Both figures account for changes in the whooping crane population size, 2001-2012.

Governance Committee Decision-making Q&A:

Will be developed once habitat availability assessments and associated analyses are complete in 2014; this assessment will then be updated for the 2014 State of the Platte Report.

6. Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?

It is hypothesized that when in-channel (sandbars) and off-channel (sandpits) nesting habitat availability increase, tern and plover use and productivity will increase (i.e., habitat is limiting).[47]

Analysis Conducted to Date:

The Program monitors tern and plover use of the central Platte River from late April through August each year. This includes both river habitat and off-channel habitat monitoring. EDO staff prepare an annual monitoring report that includes raw monitoring numbers and calculations of important bird-related metrics such as breeding pair (use), nest success, and fledge ratios (productivity).[48] Habitat availability during the tern/plover nest initiation period (April-July) is calculated each year based on Program-defined suitability criteria using aerial photography, LiDAR imagery, HEC-RAS models, and GIS computing.

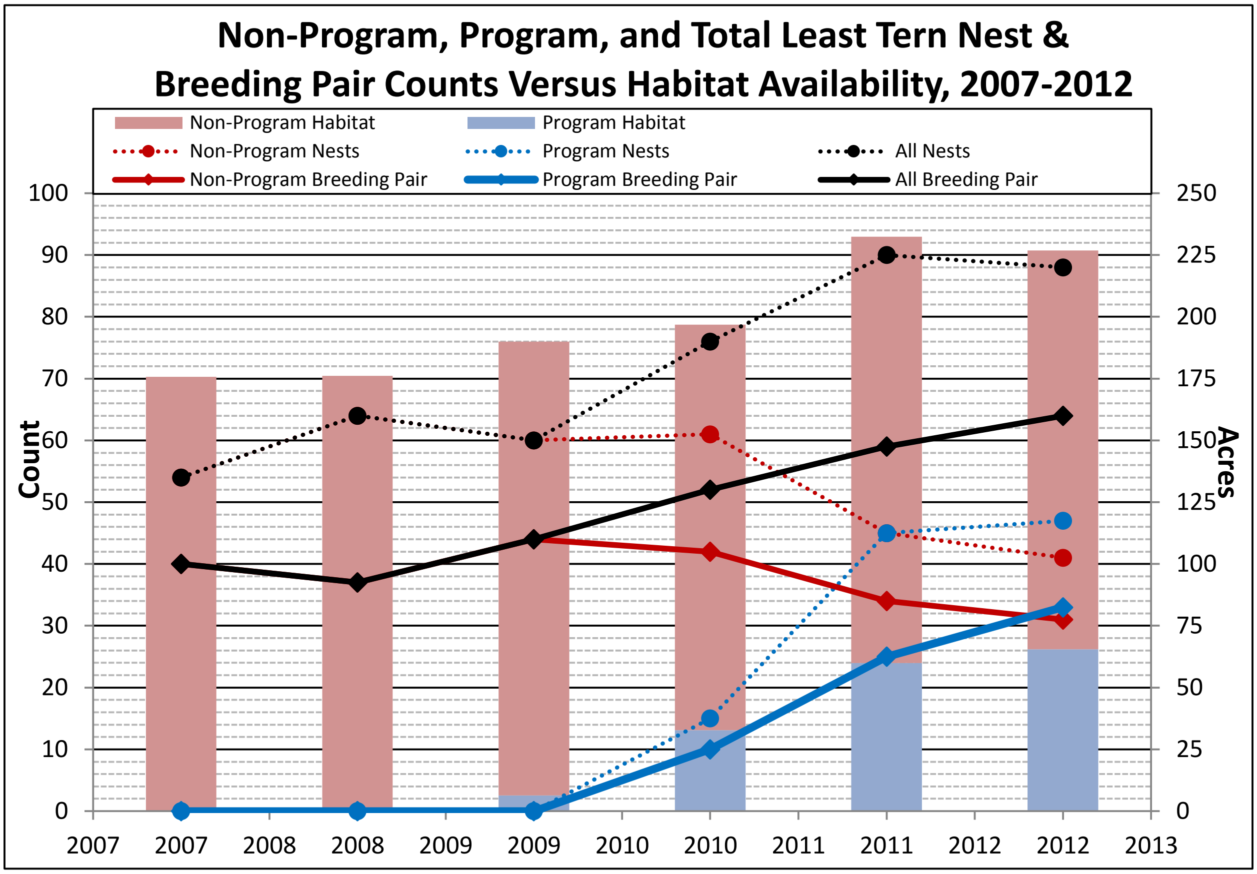
What Does the Science Say?

Program monitoring and data analysis indicate that as habitat increases, tern and plover use and productivity increase. However, this conclusion needs to be further verified as we have observed marginal changes in habitat availability and high variability in the data from 2007-2012.

Program management actions since 2007 resulted in a steady increase in off-channel habitat despite vegetation encroachment and annual loss of suitable nesting habitat at privately owned sandpit sites (table below). Prior to the 2012 nesting season, the Program created or enhanced ~ 66 acres of off-channel, bare-sand nesting habitat which resulted in increased tern and plover nesting at three sites. During this same timeframe, availability of managed in-channel nesting islands decreased due to prolonged natural high-flow events. The Program also created ~ 50 acres of in-channel nesting habitat prior to the 2012 nesting season; however, due to low flows the islands did not conform to Program habitat suitability criteria.

Land Ownership	2007 In-Channel Habitat Acres	2012 In-Channel Habitat Acres	% Change	2007 Off-Channel Habitat Acres	2012 Off-Channel Habitat Acres	% Change
Program	0	0	0%	0	66	NA
Non-Program	0	0	0%	176	161	-9%
TOTAL	**0**	**0**	**0%**	**176**	**227**	**29%**

Program-defined tern and plover nesting habitat acres in the river as sandbars (in-channel) and at sandpits (off-channel) during 2007 and 2012 and the percent increase or decrease in habitat acres from 2007-2012. Habitat numbers are based on habitat availability assessment results and indicate 0 acres of suitable in-channel habitat were available in 2007 and 2012; however, Program entities managed ~ 26 acres of sandbar habitat that didn't conform to Program habitat suitability criteria due to low flows (e.g., <50 foot wide channels surrounding nesting islands). NOTE: "Habitat acres" are different than "Program acres"; all Program acres do not fit Program-defined habitat suitability criteria (for example, only certain acres of a sandpit count as suitable tern and plover nesting habitat based on criteria such as bare-sand area, distance to trees, etc.).


Non-Program, Program, and Total Least Tern Nest & Breeding Pair Counts Versus Habitat Availability, 2007-2012
Non-Program Habitat
Program Habitat
Non-Program Nests
Program Nests
All Nests
Non-Program Breeding Pair
Program Breeding Pair
All Breeding Pair
Count
Acres
0
10
20
30
40
50
60
70
80
90
100
0
25
50
75
100
125
150
175
200
225
250
2007
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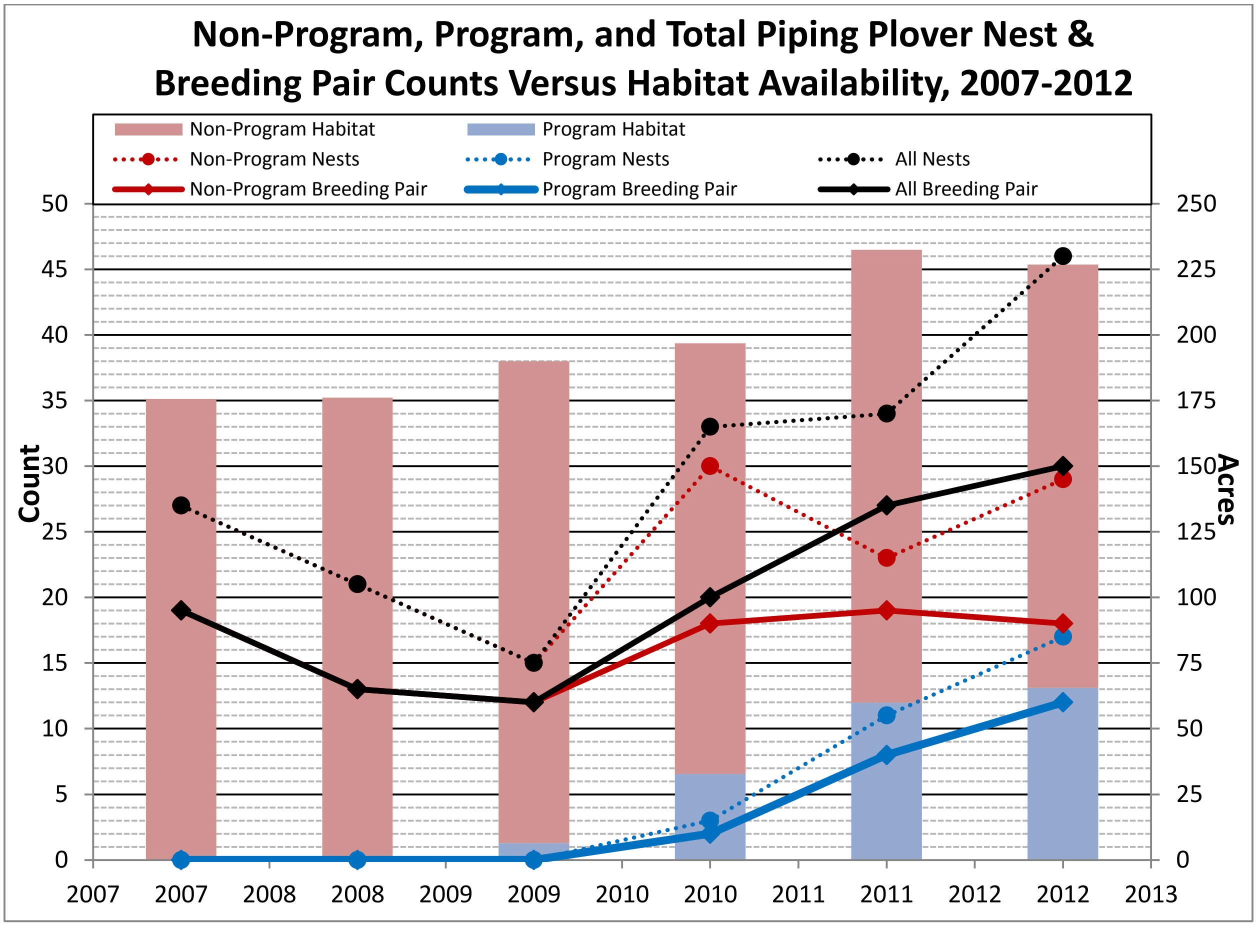
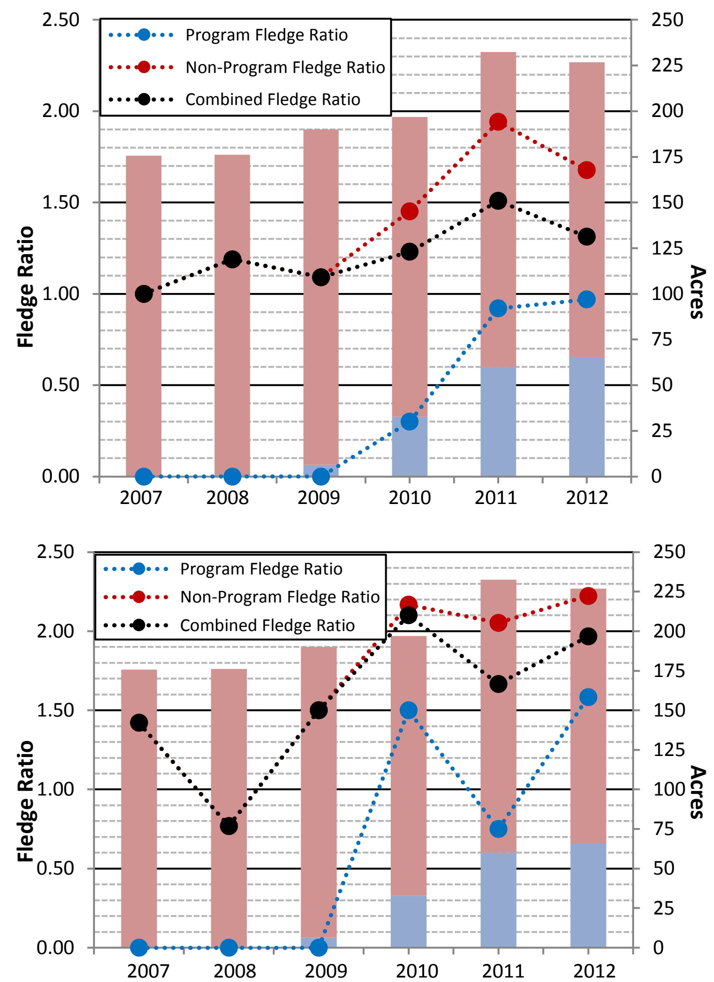


Program monitoring and data analyses indicate that as availability of Program defined suitable habitat increases, tern and plover use and productivity increase (figures above and below). Marginal changes in habitat availability and high year-to-year variability in fledge ratios, however, reduces the certainty of whether or not habitat availability currently limits tern and plover productivity on the central Platte River.



Figures show the relationships between availability of Program-defined suitable nesting habitat owned by the Program (blue bars) and non-Program entities (red bars) and tern (top plot) and plover (bottom plot) Program (blue line), non-Program (red line), and combined (black line) fledge ratios, 2007–2012.

Governance Committee Decision-making Q&A:

Should the Program create and maintain additional off-channel nesting habitat?

Yes. The Program has acquired and maintained approximately 66 acres of suitable tern and plover nesting habitat. Program efforts to create and maintain off-channel tern and plover nesting habitat have been successful and resulted in a net increase in off-channel habitat availability and numbers of tern and plover breeding pair and has also distributed nesting across a wider stretch of river. Fledge ratios on Program properties; however, have been lower than what we have observed on non-Program properties. This is likely a result of the limited amount of predator control that has been implemented to date and we expect fledge ratios will increase as we continue to trap mammalian predators and remove predator perches at nesting areas the Program manages. Despite the Program's efforts and successes, the amount off-channel habitat available for nesting only increased by approximately 50 acres due habitat loss to vegetation encroachment at privately owned sandpits. The Program plans to construct additional in-channel and off-channel nesting habitat on Program properties, and continues to monitor approximately 35 acres of privately-owned, off-channel nesting habitat that is not managed to control vegetation. During the next couple years, the privately-owned habitat will likely become developed or vegetated and unsuitable for terns and plovers which will result in only a slight gain in off-channel habitat during the Program's First Increment.

Should the Program create and maintain additional in-channel nesting habitat?

Yes. Since 2007, the Program created approximately 63 acres of suitable in-channel nesting habitat that, along with other in-channel habitat, was inundated and eroded away by natural high-flow events in 2010 and 2011 or was not moated by water due to low-flow conditions in 2012. Through 2012, there has been a very limited amount of what the Program-defined as suitable in-channel habitat available for nesting. A wider range in habitat availability should be created to confirm the relationships between tern and plover use and habitat availability observed to date. Moving forward, the Program should continue to build in-channel nesting islands to evaluate bird response to habitat availability.

7. Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?

It is hypothesized that ephemeral, in-channel nesting islands (sandbars) are needed for long-term nesting success of terns and plovers on the central Platte and when available, terns and plovers will select sandbars over sandpits for nesting. It is also hypothesized that tern and plover nesting is more successful on in-channel than off-channel habitat which could eliminate the need to maintain off-channel habitat.[49]

Analysis Conducted to Date:
The Program monitors tern and plover use of the central Platte River from late April through August each year. This includes both in-channel and off-channel habitat monitoring. EDO staff prepares an annual monitoring report that includes raw monitoring numbers and calculations of important bird-related metrics such as breeding pairs (use), nest success, and fledge ratios (productivity). Habitat availability during the tern/plover nest initiation period (April-July) is calculated each year based on Program-defined suitability criteria using aerial photography, LiDAR imagery, HEC-RAS models, and GIS computing. EDO staff plan to conduct a rigorous habitat selection analysis that will provide additional insight into answering this Big Question. In addition, the Program conducted a two-year tern and plover foraging habits study[50] (2009-2010) and currently is banding tern and plover adults and chicks to quantify dispersal rates, habitat colonization, and productivity on in-channel and off-channel habitat.

2013 Update:
No successful tern riverine nesting occurred in 2012; however, one plover nest was observed that fledged four chicks. In the absence of new data, this assessment will be updated in the 2014 State of the Platte Report.

What Does the Science Say?

Tern and plover use and productivity continue to increase at sandpit sites[51], but the lack of riverine nesting continues to leave this Big Question open to interpretation.

Detailed tern and plover habitat availability assessments (2007-2012) were completed for the Program in late 2013. In 2014, habitat availability assessment results habitat availability data will be paired with tern and plover use data collected by the Program to evaluate tern and plover selection of Program-defined suitable nesting habitat. Based on Program monitoring data and minimum suitable tern and plover nesting habitat criteria, in-channel habitat and use have declined steadily since 2007 while off-channel habitat availability, use, and productivity[52] have increased.

Though variable, tern and plover productivity numbers (fledge ratios) have increased since 2007 and are at levels believed to result in population growth[53]. Much of the productivity observed to date has been at off-channel sites where productivity is hypothesized to be lower than in-channel sites. We observed higher densities of tern and plover breeding pairs on in-channel nesting habitat; however, we generally observed lower fledge ratios at in-channel sites and observed no tern nests on river islands during 2010-2012 and no plover nests on the river during 2011. Availability of Program-defined suitable in-channel nesting habitat, however, has been low during the first six years of the Program. The decline in sandbar habitat and shortage of sandbar nesting leaves open the question of whether both habitat types are necessary to maintain tern and plover populations on the central Platte River. The Program plans to use habitat assessment results and tern and plover use data to conduct detailed habitat selection analyses and currently is conducting research to quantify dispersal rates, habitat colonization, and productivity on in-channel and off-channel habitat. Results of these studies will allow us to establish better relationships between in-channel and off-channel habitat availability and tern and plover use and productivity and answer this Big Question. Results of these efforts will be available in 2014.

Governance Committee Decision-making Q&A:

Should the Program maintain existing off-channel nesting habitat?

Yes, the Program and its partners acquired and maintain approximately 125 acres of suitable tern and plover nesting habitat. Program efforts to create and maintain off-channel tern and plover nesting habitat have been successful and resulted in a net increase in off-channel habitat availability and numbers of tern and plover breeding pairs and also distributed nesting across a wider stretch of river. Despite these efforts and successes, the amount of off-channel habitat available for nesting only increased by approximately 50 acres due to habitat loss to vegetation encroachment at privately owned sandpits. The Program is currently constructing an additional 35 acres and monitors approximately 80 acres of privately-owned, off-channel nesting habitat that is not managed to control vegetation. During the next couple of years, the privately-owned habitat will likely become developed or vegetated and unsuitable for terns and plovers which will result in only a slight increase in off-channel nesting habitat during the Program's First Increment.

Should the Program create and maintain additional in-channel nesting habitat?

Yes. Prior to 2012, the Program created approximately 13 acres of suitable in-channel nesting habitat that, along with most in-channel habitat created and maintained by Program partners, was inundated and eroded away by natural high-flow events in 2010 and 2011. In 2012, the Program created approximately 50 acres of in-channel nesting islands; however, pre-emergent herbicide failure and drought conditions resulted in no suitable in-channel habitat during the 2012 nesting season. Through 2012, there has been a very limited amount of what the Program-defined as suitable in-channel habitat available for nesting. A wider range in habitat availability should be created to rigorously test the relationships between tern and plover use and habitat availability observed to date. Moving forward, the Program should build islands of various sizes and heights and in channels of various widths to evaluate bird response and ensure Program habitat criteria accurately define habitat conditions used by terns and plovers.

NOTE: Further work is required in 2014 at the technical level of the Program to address the true intent of Priority Hypothesis TP1 and how best to analyze Program data to evaluate the relationship between in-channel and off-channel habitat selection and use by terns and plovers.

8. Does forage availability limit tern and plover productivity on the central Platte River?

It is hypothesized that availability of fish for terns and invertebrates for plovers limits productivity of both species, especially when flows are below 800 cfs during the nesting season (May through August).[54]

Analysis Conducted to Date:

Nebraska Public Power District (NPPD) and Central Nebraska Public Power and Irrigation District (CNPPID) have monitored forage fish abundance on the central Platte since 1999 to comply with Federal Energy Regulatory Commission (FERC) license requirements.[55] The Program and Program contractors provide staff support for this monitoring effort each summer, but this is not a Program monitoring protocol. The EDO analyzed these data in conjunction with U.S. Geological Survey (USGS) flow data in 2008 and again in 2012 to explore relationships between forage fish availability and river flow.[56] The USGS conducted the Program's tern/plover foraging habits study in 2009-2010 providing additional insight on forage availability and foraging habits for both terns and plovers.[57]

2013 Update:

No further work on this Big Question occurred in 2012-2013. In 2014, a manuscript on the relationship between forage availability and tern and plover productivity will be developed by the EDO as a final step in resolving this issue.

What Does the Science Say?

Big Question #8 was answered conclusively in the negative in 2012.

In 2009-2010, invertebrate (plover forage) abundance was higher on sandpit sites than river sites; however, only one river site was sampled. The research also found fish (tern forage) abundance, diversity, and tern foraging success was higher at riverine than sandpit sites.[58] Terns frequently were observed foraging ≥6 miles from their nesting site which indicates terns forage across a wider range of habitat than originally thought. Again, however, in-channel habitat and nesting was fairly minimal so further studies would be needed to confirm these findings.

Despite several years of data collection and the availability of a rather large set of data, we were unable to establish a relationship between discharge and forage fish abundance. Similar to Chadwick and Associates (1992), a vast majority (>80%) of fish captured in open channel areas where least terns forage were deemed suitable forage for least terns.[59] Average forage fish density across all samples, sites and years was 2,438 fish/acre which is similar to what was reported in the Program's Foraging Habits Study.[60] The Foraging Habits Study found abundance, diversity, and tern foraging success was higher at riverine than sandpit sites which would indicate the river likely is an important forage source for least terns. The study also revealed that forage fish abundance at least tern foraging sites and random locations were similar which would indicate forage abundance was high throughout the river channel. We used interior least tern and piping plover habitat classification results for 2009 (low to normal flow year) and 2011 (high flow year) to calculate total wetted channel area within the Program Associated Habitat Area and extrapolated average forage fish densities across the wetted channel areas. We estimated there were 14.8 million potential forage fish available within the active channel area during 2009 and 27.7 million during 2011.[61] The Foraging Habits Study also revealed least terns frequently traveled distances of 6 miles to forage which would make a wide range of habitats and water conditions and hundreds of thousands of forage fish available to least terns while foraging.

Our findings do not easily translate into data useful for assessing priority hypotheses such as T2a and ultimately the relationship between forage fish abundance and least tern productivity. However, with observed least tern productivity numbers[62] and forage fish abundance numbers, there currently is no evidence that abundance of forage fish within the central Platte River limits least tern productivity so long as there is at least some flow in the channel. During years when 0 cfs flows are recorded at gaging stations downstream of NPPD's Kearney Canal Diversion, forage fish populations above the diversion and in other river segments with a consistent supply of water from canal return flows appear to allow the central Platte forage fish populations to rebound quickly once flows return to the river.

The Program collected invertebrate samples at five in-channel and five off-channel sites during the summer of 2012 and preliminary indications are that small and large invertebrates are more abundant on sandbars than sandpit sites; however, final results of this effort will be reported in the Programs 2012 tern and plover monitoring and research report. Contrary to our findings, the Program's Foraging Habits Study found invertebrate (plover forage) abundance was higher on sandpit sites than river sites; however, only one river site was sampled and sampling did not occur within wetted sandbar areas where one would expect to observe plovers foraging. Based on observed plover productivity numbers[63] and a limited amount of invertebrate data, there currently is no evidence that invertebrate abundance within the central Platte River habitats limits plover productivity.

Governance Committee Decision-making Q&A:

Should the Program implement a system-wide forage fish monitoring protocol?

No. While we feel it could be beneficial to continue to monitor forage fish abundance and diversity in the central Platte River as has been done in the past, at this time there is no evidence to warrant implementing a system-wide monitoring protocol. In order to test our assumptions and fully evaluate least tern response to forage fish abundance throughout the Program Associated Habitat Area, additional protocols and a systematic approach, such as sampling at Program anchor points, would be needed. Sampling efforts would also need to be expanded to include the wide range of discharges observed during the May-September time period to provide a larger data set of fish abundance at different river discharges and to capture a broader fish response to discharge related to both fish recruitment and availability as tern forage. Evaluating least tern response to forage fish abundance would also require capturing and weighing least tern chicks on multiple occasions to establish the relationship between growth rates and forage fish abundance. At this time, we do not feel these additional expenses, efforts, and risk of injury to least tern chicks are warranted as it appears forage fish abundance is adequately high to support the central Platte population of least terns.

Should the Program implement a system-scale invertebrate monitoring protocol?

No. While invertebrate data collected to date is limited, at this time there is no evidence to warrant implementing a system-scale invertebrate monitoring protocol on the central Platte River. To test the assumption that invertebrate abundance limits piping plover productivity and fully evaluate plover response to invertebrate densities throughout the Program Associated Habitat Area, a systematic approach and additional protocols would be needed. Evaluating plover response to invertebrate abundance would require sampling at all potential nesting and foraging sites as well as capturing and weighing plover chicks on multiple occasions to establish the relationship between growth rates and invertebrate abundance. At this time, we do not feel these additional expenses, efforts, and risk of injury to plover chicks are warranted given we have observed relatively high productivity that would indicate the forage base at current nesting sites is adequate to support the central Platte population of plovers. Similar to forage fish monitoring, however, we encourage opportunistic sampling to establish baseline invertebrate abundance data at in-channel and off-channel nesting habitats.

9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?

It is hypothesized that Program water management actions, such as diverting excess to target flows for retimed release, will result in a measurable change in stage in the lower Platte River and thus affect pallid sturgeon habitat suitability.[64]

Analysis Conducted to Date:
The Program initiated the Lower Platte River Stage Change Study (IMRP pallid sturgeon activity #3) in 2008 to develop a tool to evaluate the potential effects of Program water management activities (storage projects, re-timing, water conservation, depletions covered by state and federal depletions plans) on stage and how stage changes might affect the physical characteristics of the lower Platte River. Field sampling, 1-D and 2-D modeling, and analysis were completed in 2009. The study was finalized in 2010, peer reviewed in 2011, and the Governance Committee accepted the peer review and the stage change study as complete in June 2012.[65] The Program also completed a pallid sturgeon literature review in 2008.[66]

2013 Update:
No further work on this Big Question occurred in 2012-2013. In 2014, a manuscript focusing on hydraulic parameters and operational aspects related to the Stage Change Study will be developed by the EDO.

What Does the Science Say?

The final peer-reviewed stage change study approved by the Governance Committee is now publicly available and ready for Program use such as evaluating possible operational scenarios for the J-2 reservoir.

The stage change study scale was the lower Platte River from the Elkhorn River confluence to the Missouri River confluence, as defined in the Program document. Intensive fieldwork and modeling were conducted on a smaller study reach from the Highway 50 Bridge to the reclaimed Pedestrian Bridge near Louisville, Nebraska. Data collection and modeling began in September 2008 and concluded in October 2009. Performance measures evaluated during the study are provided in the table below.

Performance Measure	Range of Conditions Evaluated
Water depth and velocity	between 3,700 – 40,000 cfs
% of Program water	reaching Louisville
Changes in habitat classifications (slackwater, flat, riffle, run, isolated pool, plunge)	between 3,700 – 40,000 cfs
Number of days	below 4,000 cfs @ Louisville (Dry Conditions Analysis)
Range of flows	below 4,000 cfs @ Louisville (Dry Conditions Analysis)
Number of consecutive days	below 4,000 cfs @ Louisville (Dry Conditions Analysis)

Given the influence of the Loup and Elkhorn Rivers on lower Platte flows, water management activities in the lower Platte, flow attenuation, and their size and timing, the prediction was Program water management activities would not have a statistically significant impact on lower Platte flows or on the type or availability of pallid sturgeon habitat (as defined only by the study's habitat classifications).[67] Stage change study analysis of historic reach gains and losses showed that not all flow reaching Grand Island is translated downstream to Louisville and that predicted changes in discharge due to Program water management activities is likely within the range of gage uncertainty. 2-D modeling conducted during the study accurately predicted changes in the six habitat classifications over the range of modeled discharges. At the request of Program participants, the study authors conducted a Dry Conditions Analysis as a kind of "worst case scenario" to determine how the stage change study tool might be used to evaluate Program water management activities at a time of excess flow in the central Platte but low flow in the lower Platte.[68] The period of record was analyzed for one period in the spring and one in the fall when flows were above target at Grand Island, the Program could divert some portion of that excess, and flows were simultaneously in the 4,000-6,000 cfs range at Louisville. Assuming habitat connectivity is important for pallid sturgeon and that connectivity declines below 4,000 cfs, this analysis showed that short-term connectivity could be problematic, but only for a range of 2-14 days depending on flow conditions.[69]

The general conclusion of the stage change study is that Program water management will not result in measurable changes on flow in the lower Platte River and thus little change to the amount of habitat available to pallid sturgeon.[70] However, given that short-term connectivity could be problematic under certain, but infrequent hydrological conditions, and assuming the biological significance of habitat connectivity for pallid sturgeon[71] above 4,000 cfs, the study tool could be used by the Program to implement proactive measures (e.g. altering excess-to-target-flow diversion timing or duration) to prevent potential negative impacts on habitat connectivity. Use of the tool for this purpose would be greatly enhanced if additional data were collected and analyzed regarding what defines pallid sturgeon habitat in the lower Platte and how that habitat is being utilized.

Governance Committee Decision-making Q&A:

Does completion of the stage change study mean the Program is "done" with pallid sturgeon?

No. The stage change study is only a technical tool that can now be used by the Program to evaluate the potential impacts of Program water management actions on stage in the lower Platte. Further Program actions for the pallid sturgeon (for example, pallid sturgeon habitat use/selection research[72]) are squarely a policy decision that is at the sole discretion of the Governance Committee. The U.S. Fish and Wildlife Service maintains the GC needs to address, at the policy level, perceived disagreement between the AMP management objective of "avoid adverse impacts from Program actions on pallid sturgeon populations" and the stated Program goal of "testing the assumption that managing flow in the central Platte River also improves the pallid sturgeon's lower Platte River habitat."[73]

Should the stage change study be utilized to evaluate Program water management actions?

Yes. For example, the stage change study can be used to evaluate different operational scenarios for the J-2 re-regulating reservoir now in the planning stages.

10. How do Program management actions in the central Platte River contribute to least tern, piping plover, and whooping crane recovery?

It is hypothesized that restoring land into five habitat complexes of roughly 2,000 acres each and applying Program management actions that influence those complexes will result in positive effects on the target bird species that will help lead to recovery.[74]

Analysis Conducted to Date:
Since 2007, the Program implemented its Land Plan, Water Plan, and Adaptive Management Plan components. The Program is the Reasonable and Prudent Alternative for the U.S. Fish and Wildlife Service's Final Biological Opinion on the Platte River and is being implemented to secure "defined benefits for the target species and their associated habitat to assist in their conservation and recovery".[75] Thus, implementation of Program management actions itself is considered a contribution toward recovery of the target species. Highlights of successful implementation thus far include:

- Acquisition of over 10,000 of the Program's First Increment Land Objective of 10,000 acres. This acreage objective is considered a "floor" so additional acquisition may occur over time.
- Habitat restoration including channel widening, in- and off-channel tern/plover nesting habitat construction and management, vegetation management, and other related activities at five Program habitat complexes.
- Implementation of FSM "Proof of Concept" activities at the Elm Creek and Shoemaker Island Complexes.
- Sediment augmentation pilot-scale management actions at the Plum Creek and Cottonwood Ranch Complexes.
- Flow consolidation management action at the Cottonwood Ranch Complex.

Additionally, the Program is engaging with entities working with the three target bird species in other river systems and locations to develop a strategy for assessing the significance of Program management actions and the resulting bird response on the overall populations of all three species. Activities include:

- Serving as a "Core Partner" in the Whooping Crane Tracking Partnership, a migratory range-wide telemetry study of whooping cranes.
- Serving as a member of the Working Group for development of an Interior Least Tern Metapopulation Model.
- Participating in range-wide meetings on the status of the piping plover.
- Urging development of life-history based Conceptual Ecological Models (CEM) for all three bird species, and contributing to the development of those CEMs.

2013 Update:
As noted in Appendix A, in 2013 the ISAC recommend updating the wording of this Big Question to read "How do Program management actions in the central Platte River ***cumulatively*** *contribute to least tern, piping plover, and whooping crane recovery?" to provide a more direct link to priority hypothesis S-1 in the AMP. This will be addressed in the 2014 State of the Platte Report.*

What Does the Science Say?

> ***Program implementation is considered a contribution to the recovery of the target species. A clearer picture of the magnitude of that contribution to the overall health of the populations of the three target bird species will emerge closer to the end of the First Increment.***

Data collection related to the larger-scale items above is only in the early stages, and any analysis of data such as that collected through the whooping crane telemetry project will produce speculative conclusions. Analyzing data relative to this Big Question will only prove fruitful toward the end of the First Increment, so Program involvement in data collection and developing CEMs for the target bird species will continue until enough data is collected and analysis procedures are specified in a way that will shed more objective light on this question and the associated hypothesis.

Governance Committee Decision-Making Q&A:

What constitutes recovery of the interior least tern, piping plover, and whooping crane?

Addressing this question by developing objective, quantifiable performance measures will continue to be a priority during the First Increment.

What contribution does the central Platte make to overall recovery of the three target bird species?

As above, developing objective, quantifiable performance measures to address this question remains a First Increment priority. However, as per the Final Program Document, implementation of the Program is itself considered a contribution toward recovery of the target species.

11. What uncertainties exist at the end of the First Increment, and how might the Program address those uncertainties?

2013 Update:
No major scientific or technical uncertainties were added to this list as a result of Program implementation and associated data collection and analysis in 2012-2013. Consideration will be given to adding uncertainties to the list in 2014 if necessary.

A list of existing and/or new unanswered questions will be maintained throughout the First Increment to set the stage for evaluation during the Second Increment.

The intent of this Big Question is to serve as "parking lot" for major scientific and technical uncertainties that remain unanswered toward the end of the First Increment. These "unanswered questions" may be Big Questions that still remain unanswered, or secondary uncertainties that were not sequenced as priorities during the First Increment, or they may be new questions revealed during the course of implementation of the AMP during the First Increment. A sample list of existing Priority Hypotheses not intended, at this point, to be addressed during the First Increment is presented in the table below as a placeholder for potential Second Increment uncertainties to be logged as they are identified. This list will continue to change and grow during the course of the First Increment.

Broad Hypotheses & Other Potential Second Increment "Big Questions"	Priority Hypotheses
Implementation – Program Management Actions and Habitat	
PP-4: Higher water surface elevations resulting from raised river bed elevations can generate measurable increases in the elevation, extent, frequency, and/or duration of growing-season high water tables in wet meadows within 3,000 feet of the river.	WM-2, 3, 4, 8a
Effectiveness – Habitat and Target Species Response	
WC-2: Whooping cranes prefer palustrine wetlands to river channel, based on known migratory stopover habitats. Whooping crane use of the central Platte River study area during migration seasons will increase proportionately to an increase in palustrine wetlands.	WC3
PS-3: Non-Program actions (e.g. harvest, stocking, Missouri River conditions) determine the occurrence of pallid sturgeon in the lower Platte River.	PS-11
Larger Scale Issues – Application of Learning	
What uncertainties exist at the end of the Second Increment, and how might the Program address those uncertainties?	N/A

Potential Second Increment "Big Questions", including existing Broad Hypotheses and Priority Hypotheses from the AMP that could serve as the foundation for additional Big Questions in the Second Increment.

Governance Committee Decision-Making Q&A:

In terms of Program science, what don't we know that the GC wants to investigate to inform decision-making?

This question is directed back at the GC to ensure there is open communication between the GC and the technical representatives of the Program. The purpose of this Big Question is to keep a running list of scientific and technical questions the GC needs to have addressed to inform management decision-making.

APPENDIX A

ISAC COMMENTARY ON THE 2013 BIG QUESTION ASSESSMENTS

Independent Science Advisory Committee (ISAC)

2013 Report on the Platte River Recovery Implementation Program (PRRIP)

Islands in Platte River near Elm Creek during high flows, Oct 2, 2013.

Submitted to

PRRIP Governance Committee
c/o Dr. Jerry Kenny, Executive Director,
Platte River Recovery Implementation Program
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October 30, 2013

Introduction

Prior to and during the ISAC meeting in Kearney on October 1-3, 2013, the PRRIP requested written input from the ISAC on the following 7 questions (listed with letters so as not to be confused with the Program's 11 Big Questions):

- **A)** Are the 2013 Big Question assessments logical based on your understanding of Program data and consistent with what you have learned during your involvement with the Program?
- **B)** Based on your understanding of the Flow-Sediment-Mechanical (FSM) management strategy, should Program data, collected during natural high flow events in areas in sediment balance (i.e., below Kearney), be used to provide insight into whether management actions such as Short-Duration High Flows (SDHF) will result in the creation of suitable in-channel tern and plover nesting habitat as defined by the Program?
- **C)** Can the Program still learn important information relevant to decision-making from the results of the FSM "Proof of Concept" experiments at the Elm Creek and Shoemaker Island habitat complexes?
- **D)** Does the technical information provided to the Governance Committee in the 2012 State of the Platte Report and subsequent annual State of the Platte Reports seem useful for making policy decisions on program management actions?
- **E)** Do all reports, documents, or other reference materials need to be published in refereed journals in order to be considered useful for making policy decisions on program management actions?
- **F)** Does the ISAC recommend any improvements to the Program's peer review process?
- **G)** Should the Program pursue publication of PRRIP-related manuscripts in refereed journals either as a special issue compendium or as individual manuscripts? If 'yes', what would be the purpose of publishing?

Our responses to these questions are below.

A) Are the 2013 Big Question assessments logical based on your understanding of Program data and consistent with what you have learned during your involvement with the Program?

Reference Documents – 2012 State of the Platte Report (including Appendix A, ISAC commentary on 2012 Big Question assessments); September 2013 Big Questions table; 2013 Big Questions presentation on 1 October 2013; 2013 Big Questions issues table (in development); 2013 State of the Platte Report (in development).

We begin with some general comments, and then move into specific comments on each of the 11 Big Questions.

- The 2013 State of the Platte Report only has a detailed written response to Big Question 6, which we discuss below together with each of the Big Questions. Our responses also reflect results conveyed in the 2013 Big Questions presentation, and further pondering of our previous comments in 2012.
- The 2013 SPR includes a section on 2013 Assessment Statements, Counterpoints, and Clarifications Table (pg. 12-18). This is a useful format, and when condensed will help the

Program to crystallize differences of opinion on key issues, which is helpful to structure dialogue.

- Over the years, the ISAC has been very impressed with the responsiveness of the Program to our suggestions. As the Program moves towards completion of the 2013 State of the Platte Report we would like to emphasize the importance of ensuring that the Program responds to our recommendations in Appendix A (pages 36-37) of the 2012 State of the Platte Report, either implementing the ISAC's recommendations, providing their rationale for not doing so, or requesting further clarification and discussion.

BQ 1: Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?

Recently there has been some discussion within the Program of the respective roles of SDHF and natural flows. SDHF has been defined in various documents, as listed below with key phrases highlighted:

- Relevant parts of the Adaptive Management Plan (AMP, 2006) include:

  - "Relatively modest management treatments (water during certain periods) will reduce the power of field-scale experiments to detect an effect of the Program over the entire area of interest. Nevertheless, manipulative experiments at the field, meso, and microcosm scale may allow relatively powerful experiments that can detect treatment effects and patterns, and aid in the overall assessment of the Program's effects during and at the end of the First Increment. Also, the design of Program monitoring will take advantage of likely natural events such as large natural pulse flows and similar management of non-Program lands." [AMP, pg. 13]

  - "**Hypothesis PP-1:** Flows of varying magnitude, duration, frequency and rate of change affect the morphology and habitat quality of the river, including:
    • 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 will build sand bars to an elevation suitable for least tern and piping plover habitat;
    • 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 will increase the average width of the vegetation-free channel; "[AMP, pg. 16]

  - "Using the Environmental Account in Lake McConaughy and the Program's ability to deliver 5,000 cfs of Program water at Overton, as well as the flexibility in the CNPPID and NPPD canal and reservoir system operations (assuming mutually acceptable arrangement can be made for the use of that flexibility), short-duration near-bankfull flows will be generated in the habitat reach in the springtime or at other times outside of the main irrigation season. The intent is to achieve these flows, if possible, on an annual or near-annual basis. Testing will begin in the first year of the Program with a pulse flow target of up to 5,000 cfs for three days at Overton." [AMP, pg. 24]

- "Short-duration High Flows: In the context of the Program, these are defined as flows of approximately three to five days duration with magnitudes approaching but not exceeding bankfull channel capacity in the habitat reach. These flows are desired on an annual or near-annual basis to help scour vegetation encroaching on channel habitat areas and to mobilize sand and build ephemeral sandbars to benefit the target species." [pg. 6 of Section 11 of the Water Plan, which formed Attachment 5 of the AMP; pg. 316 of the pdf found here]

- The text under BQ 1 on pg. 11 in the 2012 State of the Platte Report (henceforth abbreviated as **2012 SPR**) was derived from the description of hypothesis PP-1 on pg. 16 of the AMP, and the 2012 SPR uses various lines of evidence to evaluate this hypothesis:

  - "Based upon the SedVeg model and associated assumptions in the FSM management strategy, it is hypothesized that under a balanced sediment budget, a SDHF of 5,000 to 8,000 cfs magnitude for three days (50,000 to 75,000 acre-feet) will build sandbars to an elevation that is suitable for tern and plover nesting." [page 11 (lines 2-5) of 2012 SPR]

- On September 24, 2013, the USFWS issued a 3-page document entitled "FWS Recommendations for PRRIP FSM Implementation" which included the following statements:

  - "The Service believes it is not feasible to address the ability of short-duration high flows (5,000-8,000 cfs) to create and maintain habitat for the target species under existing conditions at the current time. Effort during the remainder of the first increment should instead be focused on the other components of the FSM strategy including (1) increasing channel capacity for flow events (e.g., resolving the North Platte chokepoint); (2) implementing sediment augmentation to reduce the sediment deficit; and (3) using mechanical channel manipulation to widen and clear the channel. Once short duration high flow events can be implemented, it will be possible to analyze and evaluate flow management strategies relative to FSM and increasing the 1.5 year return flow (Q1.5)."

  - "Flow - Flow management (by the PRRIP or the FWS acting as the EA Manager) is currently so limited and constrained that testing the suite of management actions outlined within the AMP is not realistic or achievable. Fotherby (2008) described that the post-Kingsley dam Q1.5 ranged from approximately 3,500 to 6,000 cfs. The PRRIP is currently unable to increase the existing Q1.5. A flow release in 2009 achieved magnitudes ranging from 3,360 to 3,600 cfs while a release in 2013 ranged from 3,690 to 4,070 cfs. Consequently, there is no way to evaluate short duration high flow events and the associated effects given that the PRRIP is unable to release flows within the target range (5,000-8,000 cfs)."

  - "More recently, naturally high peak flow events have also occurred on the Platte River (2008, 2010 and 2011) and have altered ecological conditions to varying degrees based on the magnitude and duration of the peaks and the existing conditions when they occurred. A substantial reduction in vegetation occurred and was visibly noticeable after 2011 high flows. Low flows and drought have also impacted the river since the start of

> the first increment. A substantial increase in vegetation has occurred as a result of these low flow years. Though natural high peak flows provide valuable lessons learned about how flows of different magnitudes affect the river, they are highly unpredictable and cannot be used as a proxy for the effectiveness of short-duration high flows. It is these flows that work in concert with sediment augmentation and mechanical manipulation to restore and maintain habitat for target species. In addition, the short-duration high flows, by augmenting the flow during lower flow years, will over time increase the magnitude of the average annual peak flow. Finally, the peak flows seen during the first six years of the PRRIP are representative of what was observed in the historic hydrograph and we would not expect habitat (quality and quantity) to drastically change without manipulation of flow beyond that observed historically."

ISAC comments on BQ 1 and the USFWS document:

The likelihood of island formation is affected by many factors including channel form, the magnitude, seasonal timing, and duration of flows, and sediment supply. Regarding flows, what matters is what flows actually occur, regardless of whether these flows were naturally generated or from managed releases from reservoirs. The key issue for BQ 1 is whether or not short duration high flows of 5,000 to 8,000 cfs for 3 days, in areas of sediment balance, build sandbars to an elevation that is suitable for tern and plover nesting. The Program does not need to have exactly this magnitude and duration of flows to gain knowledge about their efficacy for habitat creation and maintenance. Flows in excess of SDHF have occurred opportunistically, and where there is sediment balance these events are reasonable tests of SDHF and provide useful information for BQ 1.

The sequence of flows considered under SDHF descriptions is somewhat vague, referring to "annual or near-annual" recurrence. "Near-annual" has been generally considered to mean two out of three years on a running basis. Sequence and timing of flow pulses may be hypothesized to be important as a means to maintain disturbance, and thereby to prevent vegetation encroachment, or as a way to build bars cumulatively over years. Over the six-year period 2008-2013, there have been four years (2008, 2010, 2011, 2013) with opportunistic flows that equaled or exceeded the SDHF criteria, thereby providing useful information on the role of sequence and timing. Moreover, back-to-back high flows in 2010 and 2011 provide a basis for evaluating whether serial high flows are more effective than those separated by one or more years.

Naturally high flows from 2008, 2010 and 2011 provide relevant information for evaluating the effectiveness of SDHF and BQ 1, as do flows in 2013 (i.e., 4,000 cfs SDMF in April 2013; 11,000 cfs in Sept 2013), provided that such evaluations occur in areas of sediment balance. The most compelling evidence for sediment balance are the surveys of river and longitudinal profiles downstream of Gibbon, which do not show aggradation or degradation trends[5]. Mobile boundary modelling (HEC 6T – 1D) provides supportive evidence of sediment balance, indicating that the channel profiles can be maintained with the estimated levels of sediment input and current flows. There will likely be degradation and aggradation on finer spatial and temporal scales within the reaches and years that have overall sediment balance. Sub-zones and sub-periods with aggradation are the areas and times most likely to create island nesting habitat.

[5] endnote 2 in 2012 SPR

We have the following specific comments on the evidence presented for BQ 1 in the 2012 SPR:

- Argument 3 on lines 41-46 on pg. 11 of the 2012 SPO should note that Elm Ck was not in sediment balance in 2010 and 2011, so this evidence is less supportive of the general argument under BQ 1;
- The endnotes should clarify which pieces of evidence have already received peer review, and provide links to those peer reviews (see ISAC answers to Q6)
- We agree with suggestions made by the EDO in presentations that the primary challenge is neither flow nor sediment in the reaches below Gibbon, but rather the wide channel form, which results in less temporal variation in stage than occurs in other rivers where islands are formed and maintained (e.g., in the lower Platte River). In locations where the river channel is relatively wide and well connected with its floodplain, a given increase in discharge produces a smaller increase in stage. Maximum stage sets a limit on the height to which a given flow can build bars. As such, the wide channel and floodplain morphology of the river below Gibbon is not conducive to achieving the stages required to build suitable nesting habitat for tern and plovers. We agree with the statement from Jason Farnsworth of the EDO that:

  > "The Program's minimum suitable height criterion of 1.5' above 1,200 cfs is constant so more discharge is required to increase stage relative to the target in wide channels than in narrow ones. Channels are typically wider in the downstream portion of the Associated Habitat Reach, which decreases the probability of creating suitable habitat at any given discharge."
- It would be helpful to evaluate the importance of channel form for island creation hypothesis by examining the attributes of a range of reaches in the Lower Platte which do or don't build island habitat (i.e., contrasting sites), with the objective of developing a predictive model of the probability of bar formation which could be applied to the Central Platte. This would help to suggest which places along the Central Platte have channel characteristics that make it easier to build in-river, island nesting habitat, and thereby maximize the chances of success.

In conclusion, the information presented in the 2012 SPR for BQ 1 suggests that SDHFs of the indicated magnitude and duration are unlikely to create tern and plover nesting islands in the Central Platte. Based on this evidence, the documents cited in 2012 SPR endnotes 2-13, other written documents we have reviewed, and presentations at ISAC meetings over the last four years, we agree that the one thumb down conclusion for BQ 1 is appropriate at the present time. Given the importance of this information to future flow decisions by the Program, it would be helpful to have the key elements of supportive evidence presented for BQ 1 in the 2012 SPR (including endnotes 2-13) consolidated into either a single technical report, or a set of linked manuscripts, which would be formally peer reviewed (see ISAC answers to questions E and F). We understand that some of the information in the endnotes for BQ 1 has already been peer reviewed, which should be noted in the consolidated document. This is a high priority for the Program. It would be prudent to organize the consolidated information into a form which could also be submitted for later publication in a journal, following the Program's peer review process (e.g., one synthesis paper, other supportive papers and appendices – see ISAC answer to question G).

Going forward, there is likely to be continued learning about BQ 1 to refine the assessment of BQ1. The current sediment augmentation should create more areas with sediment balance or aggradation, depending on levels of natural flows. After the J2 re-regulating reservoir is completed, implementation of SDHF in 2 out of 3 years with adequate sediment augmentation will by definition be the most direct test of “pure SDHF”. However, assessing the effects of “pure SDHF” would be challenging for several reasons. First, it would be difficult or impossible to detect the independent effects of managed SDHF during years with larger natural flows, which could easily swamp effects of managed SDHF. Second, in dryer water years where the signal from managed SDHF would be most easily demarcated, it may be difficult to acquire the volume of water to implement such managed water releases. Third, while having more years of ‘before-data’ without managed SDHF could increase the Program’s ability to detect the complimentary effects of managed SDHF after the J2 re-regulating reservoir is implemented, several challenges will remain in determining the independent benefits of SDHF:

- comparing the effects of [SDHF + natural flows] vs. [natural flows alone] will be very difficult, as there is no control Platte River with only natural flows, or easily defined baseline period for a before-after comparison in areas with sediment balance;
- regressions with flow variables will likely be required rather than before-after comparisons, but a regression approach also has challenges (e.g., effects of flow events are cumulative, not independent; difficult to characterize the appropriate attributes of each flow event as independent variables; difficult to have sufficient post-event data as dependent variables); and
- a year with a natural event of flow magnitude, timing and sediment balance very similar to SDHF would likely have similar outcomes to a year with a managed SDHF release.

In summary, it is appropriate and useful for the Program to evaluate the effects of natural flows at or above the duration and magnitude of SDHF, and to eventually also learn from managed SDHF flows. Not learning from natural flows would vastly extend the length of time needed to more conclusively answer Big Q1.

BQ 2. Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near annual basis?

We note that there are two parts to BQ 2, which are best addressed separately:

BQ 2a) does SDHF *produce* suitable WC riverine roosting habitat on an annual or near annual basis?; and

BQ 2b) does SDHF *maintain* such habitat on an annual or near annual basis?

SDHFs are hypothesized to produce and maintain suitable riverine roosting habitat for WC by scouring (removing) in channel vegetation that creates vertical obstructions, reduces unobstructed channel width, and reduces an unobstructed view width. These factors are described in Appendix C, 2012 State of the Platte Report (pg. 50-52), Whooping Crane Habitat Suitability Criteria Descriptions.

The ability to remove vegetation depends on the mechanisms and flows described in the work completed for the Program by the USDA-ARS National Sedimentation Laboratory in association with the

University of Tennessee, led by Dr. Natasha Bankhead[6]. This work clearly shows that SDHF flows are not sufficient to remove most vegetation currently present, particularly *Phragmites*. Hence, the conclusion to BQ 2a) is currently one thumb down.

With respect to question BQ 2b), it is still uncertain whether SDHF is sufficient to *maintain* WC roosting habitat after clearing by spraying or mechanical treatment. The effects of flow and spraying are confounded. The ISAC supports the EDO's ongoing analysis of the expansion of channel to determine if it was related to spraying or flow by examining both sprayed and unsprayed areas. This analysis may help to reduce the uncertainty in BQ 2b). For now, the answer to BQ 2b) is inconclusive, meriting the scratchy head.

Since BQ 2 has two components, one of which (a) has evidence suggesting the answer is *unlikely* (one thumb down) and the other (b) has evidence suggesting the answer is *inconclusive* (scratchy head), then an overall answer of *inconclusive* (scratchy head) seems appropriate in the 2012 SPR and preliminary 2013 SPR.

Though originally related to BQ 5, it is appropriate to re-iterate the comment that we made on the 2012 SPR regarding suitability criteria for WC, because it has implications for the criteria applied to BQ 2:

> "A key issue under Big Question 5 is to re-evaluate the target unconfined channel width for whooping cranes, using roosting site data from both the Platte River and all other rivers where such data exist. There is clearly a large difference between the channel widths that whooping cranes use in the Platte and the channel widths that they are believed to require. The ISAC has indicated in earlier reviews that the Program needs to re-evaluate habitat criteria, and this habitat criterion seems like an excellent focus for such a re-evaluation. " [pg. 37 of 2012 SPR]

We recommend the Program evaluate QA/QC'd data (including locally derived data from aerial and ground observations, local data from telemetered whooping cranes and regional observations of telemetered cranes throughout the Central Flyway) to test if channel widths at observed WC roosting sites are consistent with hypothesized suitable width criteria for WC roosting. Plotting out channel widths for all GPS-controlled, telemetered sites with roosting WCs (both local and regional data), as well as other factors which might influence habitat selection, would reveal the attributes of sites being used, and the reasonableness (or not) of current definitions of suitable habitat.

BQ 3. Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover and whooping crane habitat?

The ISAC agrees with the 2012 SPR and preliminary 2013 SPR that it is absolutely necessary to augment sediment (one thumb up). However there are significant unknowns about how far augmented sediments will propagate downstream, the inter-annual variability in the amount of sediment needed given the annual variability in flow, and the challenge of predicting quantitatively just how much sediment is sufficient. Given these uncertainties, one thumb up seems appropriate.

[6] endnote 23 in 2012 SPR

BQ 4. Are mechanical channel alterations (channel widening and flow consolidation) necessary for the creation and/or maintenance of suitable riverine tern, plover and whooping crane habitat?

There are several mechanical actions being used to prepare the channel for FSM, including channel widening, flow consolidation **and** vegetation removal. It makes sense to also include vegetation removal as a mechanical action in the phrasing of BQ 4, since the spraying of *Phragmites* is essential to increase sediment mobility. One thumb up appears to be an appropriate conclusion. Flows are often either too low to remove vegetation, or so high that existing islands are washed away, which implies that mechanical actions will continue to be required for tern and plover island maintenance. Mechanical actions (including spraying) are likely to continue to be required to maintain unobstructed widths for whooping cranes.

Flow consolidation was meant to move the river more towards a braided condition, and to help scour vegetation from islands. The incremental benefit of flow consolidation at Cottonwood Ranch was judged to be negligible, and was not provided with a 404 permit by the US Army Corps of Engineers[7]. In the absence of flow consolidation, mechanical widening and vegetation removal appears to be even more necessary to maintain suitable riverine habitat for terns, plovers and whooping cranes.

BQ 5. Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?

There are three parts to this question which need to be assessed[8]:

1. What habitats do WC select (i.e., what is “suitable habitat”)?
2. Are these habitats increasing over time in the Central Platte?
3. If these habitats are increasing over time in Central Platte, do recorded WC stops in the Central Platte make up an increasing proportion of the overall WC population in North America? [beyond BQ 5, but provides a necessary link to BQ 10]

Answering BQ 5 may take a long time, given the small sample sizes of WC observations on the Central Platte. The ISAC strongly recommends analyzing the existing data on WC (both GPS telemetry at all Central Flyway sites used by cranes for roosting during migration and local data collected by the Program through aerial and ground surveys), continuing the telemetry study of GPS-banded birds, and maintaining the current level of banding. We were concerned to learn that the level of banding is expected to gradually decline in future years. This information is vital to both BQ 5 and also BQ 2 (our response to the latter is above).

The ISAC additionally notes the importance of early assimilation of WC telemetry project data. These data have strong influence on pending decision making in the PRRIP, especially in defining minimum channel distances for habitat assessment and channel maintenance. The WC telemetry data also have important potential to test and validate local habitat-use data. An agreement amongst researchers

[7] EDO memo to ISAC on flow consolidation Sept 24, 2013
[8] Parts 1 and 2 are described on pg. 43 of 2012 SPR, which describes hypotheses WC1 and WC3 from the AMP.

could help to allow early access to these data by the Program without interfering with the rights of primary researchers to be the first to publish in journals.

We understand that habitat availability determinations involve an area 3 miles N and S of the Platte River, from Lexington to Chapman. The Program selects random points within this area and then computes habitat availability for each of these points which are then compared with sites where WC were found. This procedure makes sense. Since WC landing areas are likely affected by the level of moisture / drought in the larger landscape (i.e., what the birds would see as they first approach the Central Platte), it would be worth also including year-specific covariates for this regional habitat attribute (e.g., the area of the rainwater basin, the data that go into the Palmer Drought Index (Palmer 1965), indexed stream flow which would take into account GW withdrawals). Ideally such an analysis would be completed over multiple regions, to test whether interregional variation in moisture within a given year causes WC to shift where they land.

BQ 6. Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?

The ISAC agrees with the Preliminary 2013 SPR that it's reasonable to change the answer to BQ 6 from a scratchy head to one thumb up, based on the Program's recent data analyses. The data analyses presented at the October 2013 ISAC meeting are convincing, and it's worth writing up this work as a manuscript which can be easily be updated with more data over time. The ISAC did some analyses to check on the conclusions to BQ 6. We confirmed that the slope of log(nests) for plovers vs. habitat area has a positive slope for program lands, but no slope for non-Program lands, consistent with the 2013 SPR conclusion. In addition, path analyses (Asher 1983) confirmed that nests are correlated with habitat but not time, which is also consistent with the 2013 SPR conclusion.

Alternative hypotheses, which should also be investigated and confirmed as reasonable or rejected:

- H_{a1}: Tern and plover numbers are going up over time in Central Platte on Program lands due to increases in the overall population of terns and plovers in North America, but not on non-Program lands due to some unspecified differences between Program and non-Program lands.
- H_{a2}: Terns and plovers are attracted to more recently created habitats in preference to older habitats (this hypothesis appears to be contradicted by the high fidelity of banded birds to certain sites, so it might only apply to first time visitors to the Platte).
- H_{a3}: The number of nests is more strongly driven by mortality factors (e.g., predation) than by the area of habitat. Since most OCSW habitat areas are fenced and have predator control, it may be very difficult to disentangle the benefits of predator control and increased habitat area.

BQ 7. Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?

The ISAC's concerns about BQ 7 remain, which were raised in the ISAC's detailed comments on the 2012 SPR provided to the EDO. In summary our concerns are:

- It's not clear what criteria are necessary for a yes/no response to BQ 7. Maintaining the population at the present numbers of nesting adults? Without a clear definition of *maintaining* *tern and plover populations* there is no way to answer this question. How would the Program know if only one or the other nesting habitat were sufficient to 'maintain' this population?

- Does the Program really just want to *maintain* the present populations of both species or does the Program want to increase them?
- What is the Program's measure of the '*population*'? Is it nesting adults, adults + fledglings, or something else?
- The Program would need to have persistent in-channel nesting habitat over a long period of time to be able to assess the relative productivity of in-channel and off-channel nesting habitats. To date it has not been possible to create persistent in-channel nesting habitat other than by mechanical means, and several of those potential nesting islands have washed away in high natural flows. If the tern and plover populations increase in the absence of river nesting (i.e., just off-channel nesting with in-river foraging), then that would provide evidence against BQ7.
- Off-channel nesting habitats require construction and maintenance, but so far it appears that in-channel nesting habitats require at least as much construction and maintenance, and are less durable than off-channel nesting habitats. Off-channel habitat may play an important role by providing nesting habitat during high flow years/seasons when in-channel habitat is inundated.

The ISAC suggests that the BQ 7 should be rewritten in such a manner that it can be feasibly (i.e. quantitatively) answered (eventually) with a thumb up or thumb down response. For example, let's assume that the Program stated that a 5 year running average of 100 nesting pairs of piping plovers was the 'target population' (a hypothetical number). Then it might be possible to build enough off-channel habitats and maintain them free of vegetation to meet this goal, and in- channel bars would not be required for nesting, though in-channel habitat would always be required for foraging.

BQ 8. Does forage availability limit tern and plover productivity on the central Platte River?

The ISAC agrees with the two thumbs down conclusion in the 2012 SPR. We recommend peer review and/or publication of these results.

BQ 9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?

The current conclusion is one thumb up, which is reasonable. The peer-reviewed stage change study confirms that answer to BQ 9 is at least one thumb up. If there are minimal predicted effects on water physical and chemical conditions below the Elkhorn River from Program flow management actions (as determined in the peer-reviewed stage change study), then it is unlikely that sturgeon below the Elkhorn River are exposed to any effects from Program flow management actions, either positively or negatively. If evidence were provided which redefined the area of concern to include areas above Elkhorn River (i.e., from ongoing studies by USGS and the Nebraska Game and Parks Commission), then it would be necessary to repeat the stage change study for areas further upstream. The ISAC recommends publishing the water results of the stage-change study in a journal, and using the tool developed in the stage-change study to examine the effects of the proposed operations of the J2 re-regulating reservoir.

While a one thumb up conclusion is justified, we do not support a conclusion of two-thumbs up at this time. The water part of the peer-reviewed stage change study is robust. However, the connection to sturgeon habitat is less certain because we don't know if the area modeled for sturgeon habitat suitability was sufficient given the true distribution of sturgeon, as discussed above. We recommend that the Program uses the stage-change tool to adjust Program water operations to further minimize downstream effects during low-water conditions, and then re-evaluate the evidence for BQ 9.

BQ 10. How do Program management actions in the central Platte River contribute to least tern, piping plover, and whooping crane recovery?

The ISAC agrees with the 2012 SPR that answering this question will take time. We suggest a minor tweak to BQ 10. Since the answer to BQ 10 in the 2012 SPR implies a consideration of cumulative effects, it might be appropriate to make that more explicit in the question (i.e., "How do Program management actions in the central Platte River **cumulatively** contribute to least tern, piping plover, and whooping crane recovery?"). We note that on page 48 of the 2012 SPR, BQ 10 is linked to hypothesis S-1 in the AMP, which explicitly considers a combination of actions, so our proposed tweak is consistent with the AMP:

> **S-1**: A combination of flow management, sediment management, and land management (i.e., Clear/Level/Pulse) will/will not generate detectable changes in the channel morphology of the Platte River on Program lands, and/or habitats for whooping crane, least tern, piping plover, pallid sturgeon and other species of concern. [pg. 14 of AMP]

It might be more feasible to address the cumulative benefits of all Program actions on smaller spatial scales (e.g., tests of SDHF under BQ 1 and BQ 2 in specific locations assume multiple actions such as flow consolidation and sediment balance).

B) Based on your understanding of the Flow-Sediment-Mechanical (FSM) management strategy, should Program data, collected during natural high flow events in areas in sediment balance (i.e., below Kearney), be used to provide insight into whether management actions such as Short-Duration High Flows (SDHF) will result in the creation of suitable in-channel tern and plover nesting habitat as defined by the Program?
Reference Documents – 2012 State of the Platte Report; FSM packet provided to ISAC for October 2013 meeting; Tern and Plover Habitat Suitability Criteria (see 2012 State of the Platte Report)

Yes! See answers to BQ 1 above under ISAC question A.

C) Can the Program still learn important information relevant to decision-making from the results of the FSM "Proof of Concept" experiments at the Elm Creek and Shoemaker Island habitat complexes?
The ISAC believes that it is still worth learning from natural events in advance of managed SDHF events generated by the J2 re-regulating reservoir, as discussed under ISAC question A – BQ 1. It is worth testing FSM in the parts of the river where it has the maximum chance of success, including Elm Creek and Shoemaker Island. If FSM doesn't work in these locations, then it is unlikely to work elsewhere on Program complexes in the Central Platte. The comparison effort with Lower Platte areas described

above under ISAC Question A – BQ 1 may provide some insights on channel attributes which maximize the probability of island formation.

D) Does the technical information provided to the Governance Committee in the 2012 State of the Platte Report and subsequent annual State of the Platte Reports seem useful for making policy decisions *on program management actions*?
Reference Documents – 2012 State of the Platte Report

Yes! However, please see detailed comments on individual big questions, from both the ISAC 2012 review and this document.

E) Do all reports, documents, or other reference materials need to be published in refereed journals in order to be considered useful for making policy decisions?
Reference Documents –PPRIP Adaptive Management Plan (2006), Appendix A – Peer Review Guidelines including Attachments A-E; PRRIP – ED OFFICE FINAL 02/06/2008, Peer Review Process Flow Chart

No. The primary attribute of PPRIP products for them to be useful in making policy decisions should be the quality of the work informing the decision, not the outlet where they are disseminated. Rigorous independent scientific review (ISR) can help ensure that decisions and policy making reflect the best scientific knowledge available. Meffe et al (1998) identified seven criteria of an ISR to meet this goal:

1. the best available scientific knowledge is brought into the decision- or policymaking process;
2. the influences of bias and special interests are minimized in environmentally relevant decisions or policy making;
3. science is separated clearly from nonscientific issues;
4. decisions or policies are achieved in an open and transparent manner;
5. all relevant information is considered and evaluated;
6. all conclusions drawn are consistent with the available scientific information, and assumptions are made explicit; and
7. the risks associated with different interpretations of data or alternative management decisions are articulated

The ISAC feels that the current PPRIP peer review process meets these criteria. We recommend that the Program consider three nested types of Program documents, and two levels of peer review (for document types 2 and 3, as illustrated in Figure 1):

1. All program documents (green box in Figure 1).
2. Draft documents subject to PRRIP independent peer review (red box in Figure 1). This Program review process should only be applied to the subset of documents which have important implications for management decisions. Programmatic peer review should continue *in parallel* with production of executive summary reports, so that it does not slow down learning and feedback to the GC. The Program's current emphasis on rapid data analysis and evaluation, motivated by the annual AMP reporting sessions, is essential. It's more critical to have peer review of draft final reports as you move from a one thumb to two thumbs conclusion on the big questions, and is less critical for scratchy head or one thumb conclusions.

3. Subsequent publication of a journal version of a subset of the final, peer-reviewed documents (blue box in Figure 1). Manuscripts submitted for publication should be those which:
    a. are appropriate for journal publication (i.e., the paper presents innovative information that significantly advances science/management, or provides insightful information about currently important issues that are of more than regional interest) and
    b. are potentially valuable to other recovery / restoration programs; or
    c. if published would have incremental benefits to the Program in terms of greater "weight" in future decisions, including Biological Opinions.

Some studies that are not decision-critical could be submitted to a journal for publication (with Program approval), without having to go through prior independent peer review by PRRIP (i.e., arrow in Figure 1 from the green box to blue box, bypassing the red box). For studies which the Program would like to ultimately publish, it would be prudent to consider this ultimate objective in how the scope of work is crafted for a given study. The ISAC wishes to emphasize that the internal peer review process in the red box of Figure 1 can be as stringent, or more stringent, and more relevant than the peer review process applied by many journals. Other recent papers emphasize the limitations of the journal peer review process (e.g., Conroy et al. 2006, Bohannon 2013). This point was also raised by OMB (2004):

> "Publication in a refereed scientific journal may mean that adequate peer review has been performed. However, the intensity of peer review is highly variable across journals. There will be cases in which an agency determines that a more rigorous or transparent review process is necessary. For instance, an agency may determine a particular journal review process did not address questions (e.g., the extent of uncertainty inherent in a finding) that the agency determines should be addressed before disseminating that information. As such, prior peer review and publication is not by itself sufficient grounds for determining that no further review is necessary." [page 22 in OMB 2004]

> "Section III(4) requires agencies to provide reviewers with sufficient background information, including access to key studies, data and models, to perform their role as peer reviewers. In this respect, the peer review envisioned in Section III is more rigorous than some forms of journal peer review, where the reviewer is often not provided access to underlying data or models." [page 25 in OMB 2004]

The process outlined here is consistent with that recommended by the National Research Council (2002; pg. 44-45) who suggested that "… increasing 'project magnitude' and 'project risks' warrant an increasing degree of independence of review, with an increased depth and complexity of review, and an increased scope and diversity of the expertise of the reviewers", which is illustrated in Figure 2.

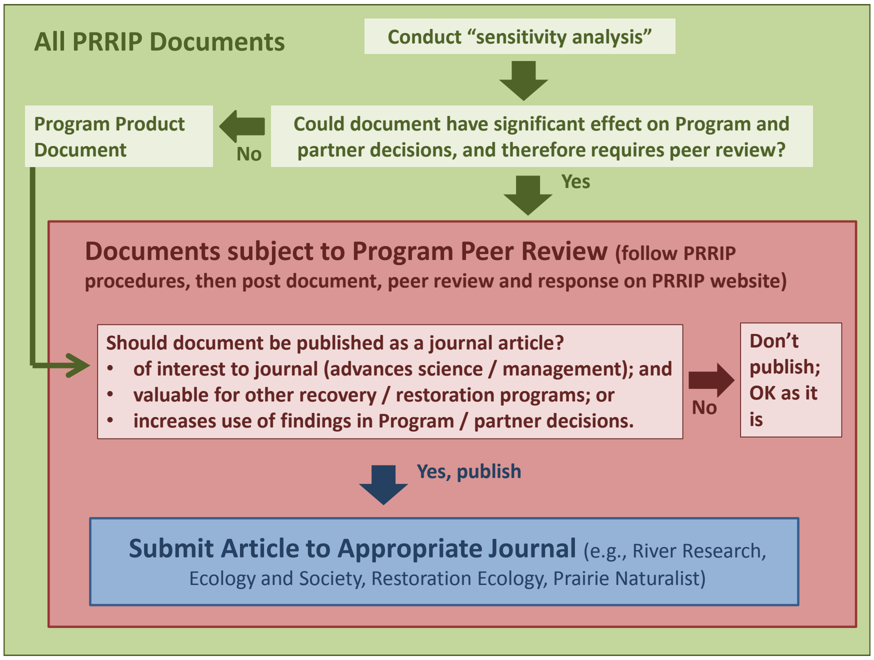

Figure 1. ISAC's recommended framework for thinking about the different types of Program documents, and the criteria for deciding if they warrant Program review or publishing.

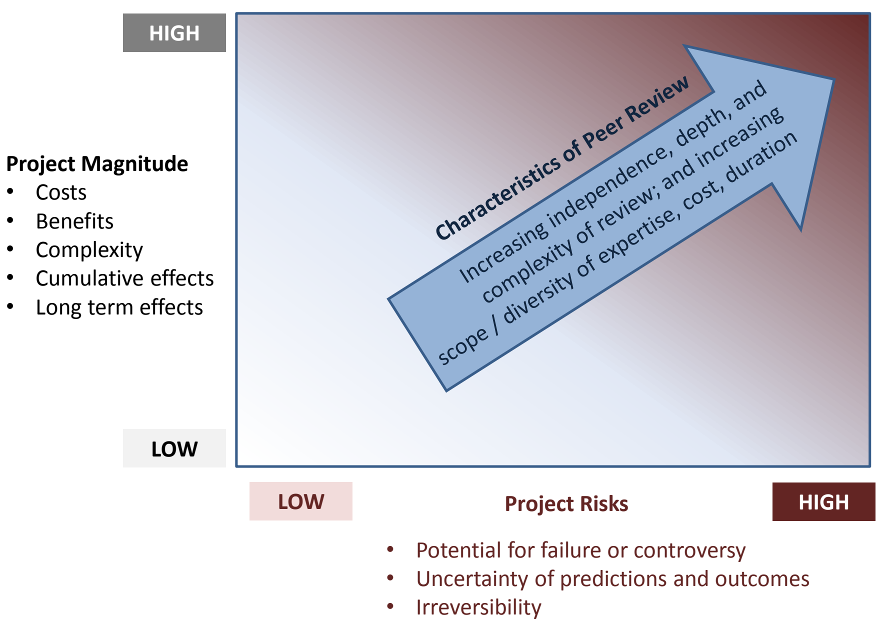

Figure 2. Illustration of how increasing *project magnitude* (y-axis) and *project risks* (x-axis) warrant a higher level of independent peer review (i.e., darker shades further along diagonal arrow) with an increasing degree of independence, depth, and complexity of the peer review, and an increasing scope / diversity of reviewer expertise. In the lower left hand part of the diagram (low project magnitude and risks), independent peer review is likely not required. Adapted from Figure 4.2 on page 45 in NRC (2002).

F) Does the ISAC recommend any improvements to the Program's peer review process?

See above answer to question E. We do not recommend any major improvements to the Program's peer review process, but we do recommend improved documentation of this process. Our evaluation of Program documents indicated that the present peer review process (shown below in Table 1) has improved over what was published in PPRIP Adaptive Management Plan (2006), Appendix A – Peer Review Guidelines including Attachments A-E. Consequently, we recommend that Program 'Scientific Peer- Review Guidelines' be revised to reflect current practices as outlined in Table 1. PRRIP guidelines as shown in Table 1 are consistent with peer review guidelines from OMB (2004) and USFWS (2012). They are also consistent with the recommendations for peer review in Meffe et al. (1998), National Research Council (2002) and Turner (2009). If the Program peer review follows PRRIP guidelines and authors respond thoroughly to peer reviewer comments in the judgment of the EDO (acting like an editor of a journal to assess comments from multiple reviewers), then Program peer review will be adequate.

An effective peer review process occurs when the peer reviewers thoroughly understand the work, and the investigators thoroughly respond to the peer review. We believe that face to face dialogue between peer reviewers and investigators to clarify questions is always beneficial. It increases the reviewers' understanding of the details of what work was done, and minimizes the risk of having peer reviewers misunderstand the scope and consequently recommend approaches that are not relevant to the objectives or have already tried and rejected.

Table 1: Comparison of PRRIP peer-review process with OMB (2004) and USFWS (2012). Source: EDO, based on documents supplied by ISAC.

OMB Final Information Quality Bulletin for Peer Review December 2004	
OMB Peer Review Guidelines Feature	**Present in PRRIP Peer Review Strategy?**
Peer reviewers selected based on expertise, experience, and skills	Yes
Avoid conflicts of interests with peer reviewers	Yes
Reviewers are independent and did not participate in development of work product	Yes
Peer reviewer report includes verbatim copy of comments	Yes
May commission independent entities to manage peer review process and selection of peer reviewers	Yes (Atkins)
Develop clear "charge" or plan of work for peer reviewers	Yes (specific scope of work)

U.S. Fish and Wildlife Service Information Quality Guidelines and Peer Review June 2013	
Service Peer Review Guidelines Feature	**Present in PRRIP Peer Review Strategy?**
List all peer reviewers	Yes
Results of peer review maintained in the public record	Yes
Can utilize management assistance for peer reviews	Yes (use Atkins, which is a firm under contract through 2017 to provide similar services to DOI)
Peer reviewers are external and independent	Yes
Select the best, most qualified peer reviewers with expertise in the subject area	Yes
Can review draft documents	Yes (PRRIP does review draft documents and process allows changes in response to peer review)
Can review final documents (peer review comments evaluated and addressed by Service staff)	Yes (PRRIP does review final documents and process allows comments to be evaluated and addressed)
Utilize standing panel evaluations when necessary	Yes (ISAC)
Keep a running record of peer reviews to be completed or underway; update every six months	Generally (keep an annual record, could do a six-month update)
Responses to peer review comments are included in the official record and made available to the public	Yes

G) Should the Program pursue publication of PRRIP-related manuscripts in refereed journals either as a special issue compendium or as individual manuscripts? If 'yes', what would be the purpose of publishing?

The purposes of publishing were listed under ISAC question E (points 3a, 3b and 3c). We offer three possible approaches to externally peer-reviewed publication for consideration, with a mixture of pros and cons (Table 2):

1. individual articles tailored to the requirements of separate journals, and where appropriate multiple articles in the same journal, for example:
    a. insights on adaptive management could be published in journals like Ecology and Society;
    b. tests of hypotheses related to regulated rivers, published in journals like River Research and Applications;
    c. regionally relevant empirical evidence for deriving habitat suitability criteria in journals like The Prairie Naturalist; and
    d. habitat restoration actions and outcomes relevant to listed species recovery in journals like Restoration Ecology
2. a special issue compendium (e.g., River Research and Applications, Restoration Ecology) ; and
3. a thematic book, such as the series on the Science and Practice of Ecological Restoration, published by Island Press.

Table 2. Pros and cons of three different approaches to publishing Program results.

Approach	Pros	Cons
1. Articles published in separate journals	• most rapid publication of 3 options • topic stands alone • can target the journal most relevant to paper's topic • peer review typically the most rigorous of 3 options • program website can link papers together, including overview papers like Smith (2011) • potentially highest Program credibility when published in top-tier journals	• provides readers with the least integrated source of information • requires repetition of background information on Program • longest time to get the full story of Program accomplishments • open-access policies vary among journals, possibly limiting free electronic access by users; • variable editorial consistency among journals
2. Special Issue Compendium	• enables publishing major program actions into a series of integrated articles under a single cover • generally can be made available as open-access (i.e., free download for any user) • introduction can give Program background so subsequent papers can be less repetitious • peer review rigor typically intermediate between separate journals and thematic book • editor can set uniform standard for papers	• requires editor to administer project; • publication delayed by slowest author • relevance of single issue reduced given ease of electronic access of individual papers • some publishable papers might be excluded due to uniform standards for all manuscripts
3. Thematic book	• provides readers with the most carefully integrated source of information covering multiple dimensions and disciplines • page length less limited than options 1) or 2) • editor can set uniform standard for papers.	• requires editor to administer project • peer review typically the least rigorous of 3 options • recommended to delay submission until most program actions are completed and responses evaluated • publication delayed by slowest author; • access limited to those who purchase book

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APPENDIX B

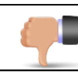
2013 TECHNICAL COMMENT AND RESPONSE TABLE

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
2013 State of the Platte Report

2013 Technical Comment and Response Table

The following table is intended to catalog key technical discussions within the Program that occurred during the development of the 2013 State of the Platte Report to provide the ISAC with an "apples-to-apples" treatment of key technical issues that may require their input, and to provide the GC with a running commentary of technical discussions underlying each Big Question in 2013. Under each Big Question for which there was technical discussion, the 2013 assessment statement is listed first, followed by key Program entity technical comments in *italics*, followed by EDO responses in {curly brackets}.

This comment/response table format was introduced during the development of the 2013 State of the Platte Report after discussion with the ISAC about how to identify and discuss key technical issues. Since the table was introduced during development of the report and after an initial request for TAC input had been made, only one Program entity (Downstream Water Users, or "DWU") provided comments that fit this format. The table below includes only a portion of the DWU comments. It is anticipated that future State of the Platte Reports will have a much more complete comment/response table that includes comments from several Program entities.

BQ#1 – Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?	
2013 Assessment Statement, Comments, & Responses	**Author**
Program monitoring and research indicates that SDHF will likely not build sandbars to a height that is suitable for tern and plover nesting with or without sediment balance.	
Given the results of independent research, the monitoring of naturally occurring flows of similar and greater magnitude and duration, and associated computer modeling of SDHF's, we would argue for a change to two thumbs down. *Based on the above conclusions, empirical data and current knowledge it seems highly unlikely suitable riverine nesting habitat was historically available on an annual or near-annual basis or that flow and sediment management alone in today's environment can achieve that condition.*	DWU[76]
{There are other hypothesized benefits of SDHF releases including maintaining wide, unvegetated channels for whooping cranes. Program-defined suitability criteria for tern/plover nesting habitat could also be revised.} {During the period of 2008-2011, flows exceeding 5,000 cfs occurred in 2 out of three years in the reach downstream of Kearney that is in sediment balance.}	
BQ#2 – Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis?	
2013 Assessment Statement, Comments, & Responses	**Author**
Whooping crane roosting habitat suitability increased somewhat from 2009 to 2011 but the change cannot be used to evaluate SDHF because of the confounding effects of a massive phragmites control effort undertaken by the PVWMA. Generally, the emergence and persistence of scour-resistant invasive species like phragmites will necessitate some level of ongoing mechanical intervention in order to maintain the improvements in suitability.	
The differences in habitat between the species needs to be better defined, obviously as we adjust management what would be good for least terns and piping plovers	DWU

could potentially be bad for whooping cranes. Life history conceptual models that incorporate habitat needs would help with this process.	
{Life history-based conceptual models are now in development by the Missouri River Recovery Program for the tern, plover, and pallid sturgeon. Program staff and participants are part of the review team for these models. The final products may prove useful in this regard.}	
<u>BQ#3</u> – Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?	
2013 Assessment Statement, Comments, & Responses	**Author**
Modeling monitoring and research indicate that sediment augmentation is necessary to halt continuing channel degradation, but augmentation alone may not significantly improve habitat suitability.	
However, with Big Question 1 being a no and Big Question 2 a maybe even in areas of sediment balance, it is difficult to conclude that adding sand creates or maintains habitat (those areas used by the birds).	DWU
{Sediment augmentation activities at this point have only focused on the issue of halting channel degradation.}	
<u>BQ#4</u> – Are mechanical channel alterations (channel widening and flow consolidation) necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?	
2013 Assessment Statement, Comments, & Responses	**Author**
Modeling, monitoring, and analysis indicate that mechanical channel alterations are likely necessary for the creation and maintenance of suitable habitat. However, flow consolidation, which may be necessary to maintain suitable habitat using flow, cannot be implemented in at least half the associated habitat reach.	
The original hypothesis PP-3 (AMP p.17) is a little different and again is geared towards making a braided channel and thus desired habitat. Mechanical actions in this hypothesis were intended to be one time actions, and then the FS portion of FSM would maintain the channel.	DWU
{Discrepancies between Program entities regarding the definition of FSM and what constitutes actual implementation need to be eliminated to ensure future implementation is agreeable to all parties.}	
<u>BQ#5</u> – Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?	
2013 Assessment Statement, Comments, & Responses	**Author**
Program whooping crane monitoring data continue to suggest whooping crane use of the Associated Habitats may be increasing[77]. However, detailed habitat selection analyses are underway but are not yet completed so at this time we are unable to fully assess this Big Question.	
By the end of the first increment will we see a 33% increase in whooping crane use days and/or a 33% increase in the proportion of the population that stops on the Platte?	DWU
{This will be difficult because of the lack of monitoring prior to 1997 and the recent change in population count methodology being utilized at Aransas.}	
The PRRIP should look in to the adequacy of the satellite tracking data to see if whooping cranes truly are evaluating the full suite of resources used in the "available" portion of the resource selection analysis.	DWU
{Telemetry data cannot be used to do this because we need continuous monitoring data and now only get location data every six hours.}	

BQ#6 – Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?	
2013 Assessment Statement, Comments, & Responses	**Author**
Program monitoring and data analysis indicate that as habitat increases, tern and plover use and productivity increase. [78,79] However, this conclusion needs to be further verified as we have observed marginal changes in habitat availability and high variability in the data from 2007-2012.	
We have already shifted some of the in-channel habitat hypothesis by designing and building numerous mechanical islands, some of which we know could not be built with flow. This is one of the areas we need to revisit to accurately reflect where the PRRIP is today. As stated in the Biological Opinion (p. 116) these islands are not created by dynamic ecological process a primary constituent element of piping plover critical habitat. These constructed islands are no different than sandpits in terms of natural verses artificial, so even if the birds use them have we gained anything from a policy standpoint?	DWU
{The intent was to see what combinations of bar heights/sizes that birds would select. So, the islands are not FSM or MCM island. Instead, they are part of a habitat selection experiment.}	

I think in order to truly understand what is going on it will be necessary to figure out of the original 175 acres of defined habitat was actually functioning as habitat and being utilized by the birds. Here is my logic why:
• *Plovers are doing what would be expected in a habitat limited situation as habitat increases, stay steady on existing habitat and increase on new*
    o *However densities are increasing on habitat as whole and densities on Program land are approximately twice what they were on original habitat. Either the Program is building some special stuff.*
• *Terns on the other hand are doing what one would expect in a non-habitat limited situation by a bird that exploits ephemeral habitat. They are moving.*
    o *Again though densities on Program lands are nearly twice what was on original habitat.*
• *Densities of both terns and plovers on Program lands are similar to those we have seen in the past on NPPD managed land, however densities on our lands even though being managed the same are dropping which tends to point more towards the birds are moving and not increasing theory, and that some of the increases are likely due to differences in counting intensity both temporarily and spatially.*
• *Bottom line is though as long as the trend lines for total pairs continues up it is good whatever reason as long as reproductive levels remain above levels necessary for population growth.*
	Jim Jenniges, NPPD

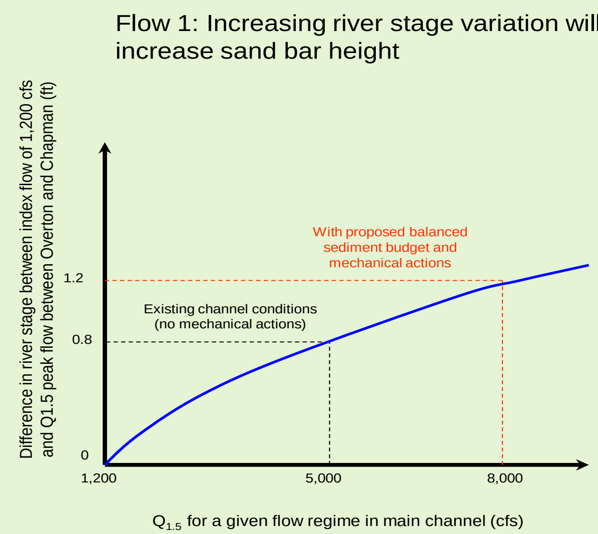
{Breeding pair densities on an individual site basis are similar on Program sites as they are/were on NPPD managed sites. The discrepancy between breeding pair densities on Program and Non-Program properties on a per-acre basis is mostly related to the fact Mark Czaplewski monitors sites that conform to Program minimum habitat criteria and the Program document, but are not designed/shaped like off-channel areas where the birds have historically nested along the central Platte River. The EDO is not sure if this means we need to change our minimum habitat criteria or the way we determine whether or not we monitor a site on a semi-monthly basis or not, but that is why nesting densities appear 'different'. One site that Mark has monitored for quite some	

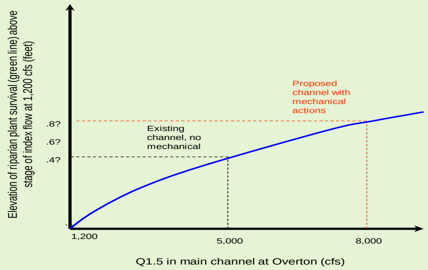
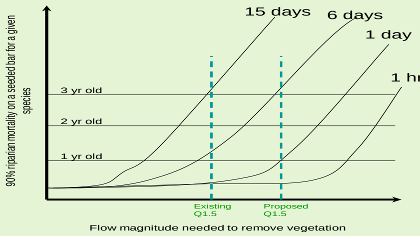
time has recently had some successful tern nests in a ‘shore-line’ type of habitat condition which may be a reason to assess sites the way we currently are.} {The EDO is not sure we can relate the recent shift/increase in tern breeding pair counts to increased monitoring efforts as all sites with active nests have been monitored twice/week since ~2000 and the increase effort has been implemented at all sites (except the Trust and Deweese-Alda sandpits) since 2008. Monitoring results displayed in the figures should be comparable across all sites and years except maybe 2007 when we didn’t do inside monitoring (breeding pair counts actually decreased from 2007 to 2008 though). Though it may not be a good idea at this point to compare current counts to those obtained in 2001-2007, we continue to collect data from outside the colony, as was done in the past, to attempt to develop an appropriate adjustment factor to account for any discrepancies the increased monitoring efforts may have resulted in. Using breeding pair counts (active nest or broods) rather than pair counts (# birds/2) will help account for any differences in counts that the increased monitoring may have resulted in…unless of course we think more nests and/or broods were missed from outside the colony prior to 2008 than recently (no reason to suspect this).} {We agree with your bottom-line statement and did notice it appears a few terns may be ‘shifting’ to the newer Program habitat. However, we don’t believe we’ve observed any of the tern adults that nested and were banded on one site return and nest on another site during subsequent years. We have, however, observed several chicks (mostly plovers to date) nest on non-natal sites which is interesting and makes me wonder if chicks that fledged from Blue Hole in the past just nested at Lexington pit or Johnson pit or if they nested outside the central Platte. We have also seen an increase in breeding pair counts within the associated habitat area so a ‘shift in habitat use’ doesn’t seem to tell the whole story. It appears we are seeing a slight shift in site selection as well as an increase in breeding pair counts the past several years. Time will tell, but it could be possible that we will see an increase in use at NPPD’s historic sites once the birds that fledged from the newer Program sites return to nest for the first time. A few more years of banding data will be very helpful for explaining the shift versus increased use hypothesis.}	
<u>BQ#9</u> – Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?	
2013 Assessment Statement, Comments, & Responses	**Author**
The final stage change study approved by the Governance Committee (including the results of peer review) is now publicly available and ready for Program use such as evaluating possible operational scenarios for the J-2 reservoir.	
The PRRIP could undertake research as directed in Activity 2 on page 45 of the AMP, the only step remaining, but even clear answers to the stated objectives for that activity, would not change the two thumbs down to the big question or Program Goal. There would still not be any way to relate the cause and effect of what we learn back to PRRIP management actions.	DWU
{Further Program action regarding pallid sturgeon in the lower Platte River is at the discretion of the Governance Committee.}	

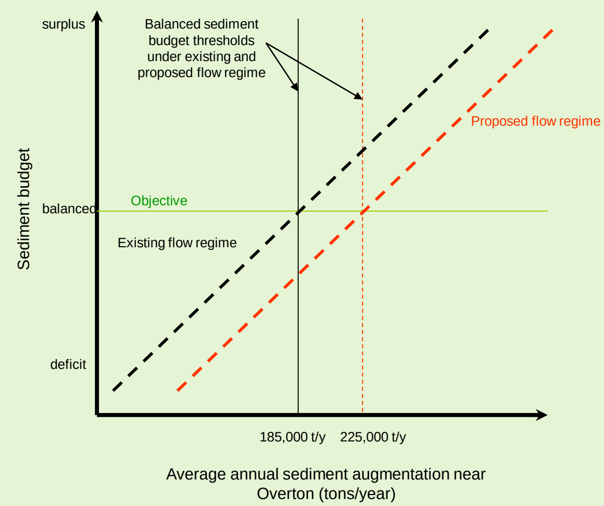
1

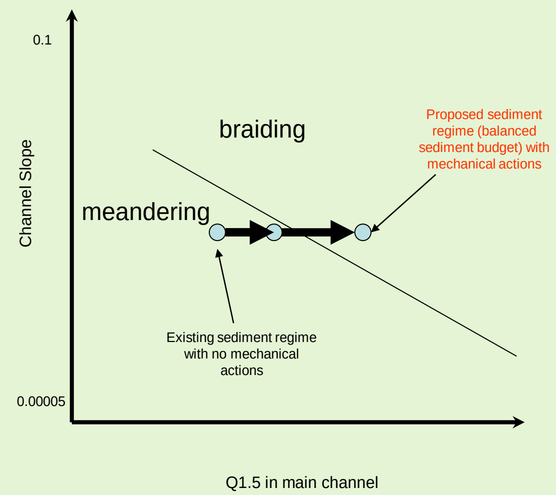
APPENDIX C

TIER 1 PRIORITY HYPOTHESES & ASSOCIATED X-Y GRAPHS

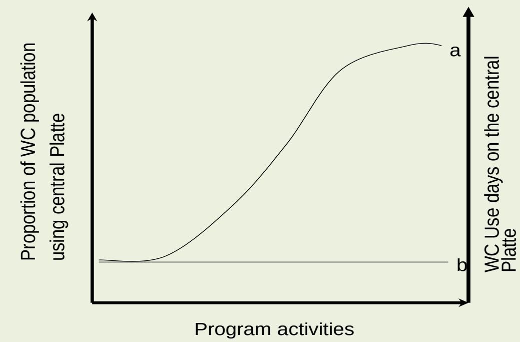
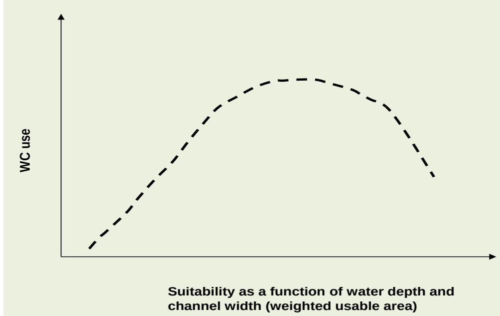
PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
Implementation – Program Management Actions and Habitat			
1. Will implementation of SDHF produce suitable tern and plover riverine nesting habitat on an annual or near-annual basis?	**Flow #1:** ↑ the variation between river stage at peak (indexed by Q1.5 flow @ Overton) and average flows (1,200 cfs index flow), by ↑ the stage of the peak (1.5-yr) flow through Program flows, will ↑ the height of sandbars between Overton and Chapman by 30% to 50% from existing conditions.	Flow magnitudes and channel compilations are insufficient to generate bars high enough to provide habitat for ILT and PP. Bars may become quickly vegetated, making them poor habitat for target species. Bars can be created or maintained by mechanical or other means.	 Increasing the variation between river stage at peak flow (indexed by $Q_{1.5}$ flow at Overton) and average flows (1,200 cfs index flow), by increasing the stage of the peak (1.5-yr) flow through Program flows, will increase the height of sand bars between Overton and Chapman by 30% to 50% from existing conditions, assuming balanced sediment budget.

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
<u>Implementation</u> – Program Management Actions and Habitat			
2. Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis?	**<u>Flow #3</u>**: ↑ 1.5-yr Q with Program flows will ↑ local boundary shear stress and frequency of inundation @ existing green line (elevation at which riparian vegetation can establish). These changes will ↑ riparian plan mortality along margins of channel, raising elevation of green line. Raised green line = more exposed sandbar area and wider unvegetated main channel.	Insufficient Program flows to adequately increase shear stress on banks. Plant mortality can be achieved by other means.	Flow 3: Increased peak (1.5 yr) flow = raised green line (the lowest elevation at which vegetation can establish on river banks and sand bars) = more exposed sand bar area and wider unvegetated main channel.  Increasing the 1.5-yr peak flow regime (indexed by $Q_{1.5}$ flow at Overton) with Program flows will increase the local boundary shear stress and frequency of inundation at the existing green line (elevation at which riparian vegetation can establish). These changes will increase plant mortality along the margins of the channel, raising the elevation of the green line. A raised green line results in more exposed sand bar area and wider unvegetated main channel.
	<u>Flow #5:</u> ↑ magnitude and duration of a 1.5-yr flow will ↑ riparian plan mortality along the margins of the river. There will be different relations (graphs) for different species.	Insufficient Program flows to adequately increase shear stress on banks. Plant mortality can be achieved by other means.	Flow #5: Increased magnitude and duration of flow increases riparian plant mortality  Increasing magnitude and duration will increase riparian plant mortality along the margins of the river. There will be different relations (graphs) for different species.

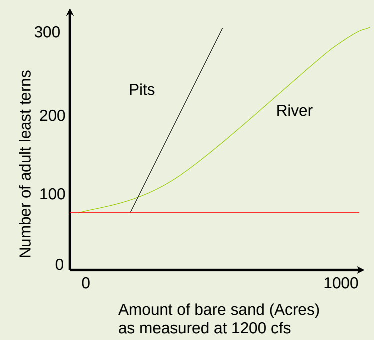
PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
Implementation – Program Management Actions and Habitat			
3. Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?	**Sediment #1**: Average sediment augmentation near Overton of 185,000 tons/yr. under existing flow regime and 225,000 tons/yr. under GC proposed flow regime achieves a sediment balance to Kearney.	Augmentation greater than or less than 225,000 tons/year is needed to balance the sediment budget and increase exposed bar area. There is no sediment imbalance. Exposed bar area or occurrence of braiding will not be affected by increased sediment. Sediment balance is insignificant except in local instances. Satisfactory bar areas can be created and maintained through strictly mechanical actions.	Sediment 1: Sediment augmentation balances the sediment budget.  Sediment augmentation near Overton to 185,000 tons/yr under existing flow regime and 225,000 tons/year under the Governance Committee proposed flow regime achieves a sediment balance to Kearney.

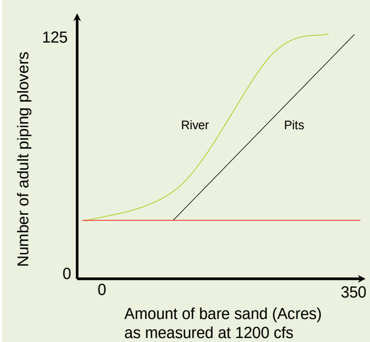
<table>
<tr><th>PRRIP “Big Questions”</th><th>Priority Hypotheses</th><th>Alternative Hypotheses</th><th>X-Y Graphs</th></tr>
<tr><td colspan="4"><u>Implementation</u> – Program Management Actions and Habitat</td></tr>
<tr>
<td>4. Are mechanical channel alterations (channel widening and flow consolidation) necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?</td>
<td><u>Mechanical #2</u>: Increasing the Q1.5 in the main channel by consolidating 85% of the flow, and aided by Program flow and a sediment balance, flows will exceed stream power thresholds that will convert main channel from meander morphology in anastomosed reaches, to braided morphology with an average braiding index > 3.</td>
<td>Higher stream power (higher 1.5 yr. Q and/or more consolidation of side channels) needed to convert channel to braided morphology. Lower stream power will convert channel to braided morphology.</td>
<td>Mechanical (channel manipulation) 2: Stream power determines braided channel morphology (this focuses on channel consolidation rather than increased releases)


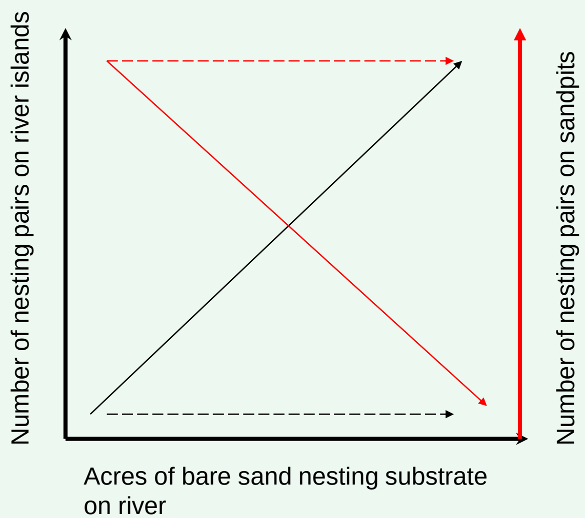
Increasing the Q1.5 in the main channel by consolidating 85% of the flow, and aided by Program flow and a sediment balance, flows will exceed stream power thresholds that will convert the main channel from a meander morphology in anastomosed reaches to a braided morphology with an average braiding index greater than 3.</td>
</tr>
</table>

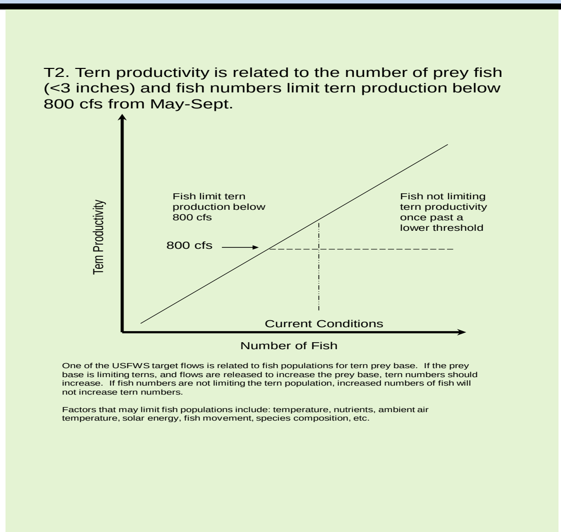
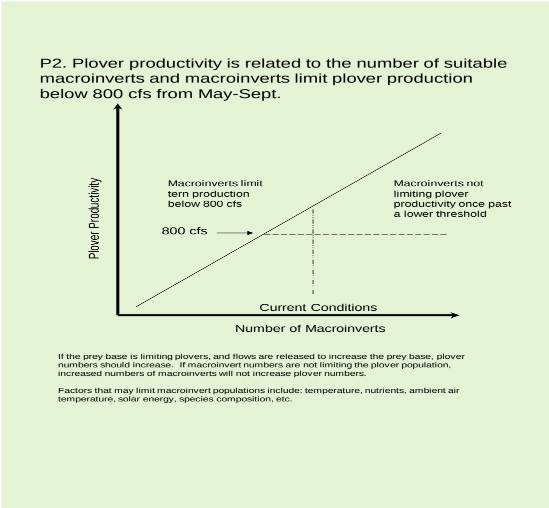
<table>
<tr><th>PRRIP “Big Questions”</th><th>Priority Hypotheses</th><th>Alternative Hypotheses</th><th>X-Y Graphs</th></tr>
<tr><td colspan="4"><u>Effectiveness</u> – Habitat and Target Species Response</td></tr>
<tr><td rowspan="2">5. Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?</td><td><u>WC1</u>: Whooping crane use will increase as function of Program land and water management activities.</td><td>Whooping crane use will not increase as function of Program land and water management activities.</td><td>WC 1. Whooping Crane use will increase as function of Program land and management activities.

a. The amount of whooping crane use days will increase as Program activities increase.
b. Whooping crane use days will not increase with Program activities.
Analysis and consideration will be needed to investigate Program activities and non Program activities (e.g., Trust land management). Analysis could also be done on a bridge segment basis as well as a system basis.</td></tr>
<tr><td><u>WC3</u>: Whooping crane use is related to habitat suitability. The prediction of habitat suitability for whooping crane in channel habitat as a function of water depth (preferred depth?) and channel width (define as wetted width, open width, other?).</td><td>Whooping crane use is not related to habitat suitability. The prediction of habitat suitability for whooping crane in-channel habitat is not a function of water depth (preferred depth?) and channel width (define as wetted width, open width, other?).</td><td>WC 3. Whooping crane use is related to habitat suitability

The prediction of habitat suitability for whooping crane in channel habitat as a function of water depth and unobstructed channel width. FWS Instream flow recommendation for fall and spring whooping crane migration season is 2,400 cfs. Farmer et al. estimates that peak suitability is achieved at 1700 cfs.</td></tr>
</table>

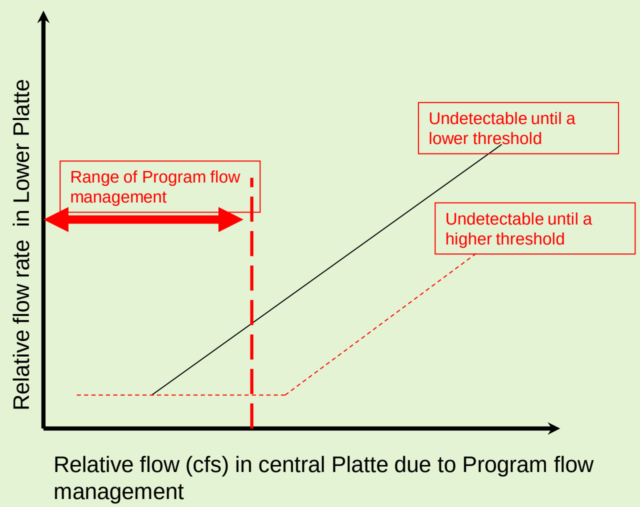
<table>
<tr><th>PRRIP “Big Questions”</th><th>Priority Hypotheses</th><th>Alternative Hypotheses</th><th>X-Y Graphs</th></tr>
<tr><td colspan="4"><u>Effectiveness</u> – Habitat and Target Species Response</td></tr>
<tr><td>6. Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?</td><td><u>T1</u>: Additional bare sand habitat will ↑ number of adult least terns.

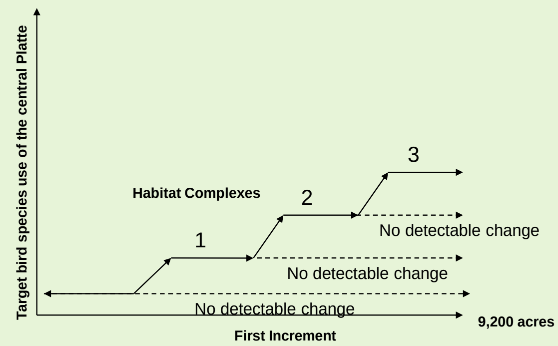
<u>P1</u>: Additional bare sand habitat will ↑ number of adult piping plovers.</td><td>Bare sand is not currently limiting number of adults.</td><td>T1: Additional bare sand habitat will increase the number of adult least terns.

Green line is island densities from central Platte constructed islands using only years when birds were present on islands densities would be approximately half this if we use all years islands were present.
Black line using estimated acres and 96 bird average on 81 acres of sandpits last 4 years
Red line is bare sand not currently limiting so additional acres has no effect.

P1. Additional bare sand habitat will increase the number of adult piping plover.

Green line is island densities from central Platte constructed islands using only years when birds were present on islands densities are approximately half this is we use all years islands were present.
Black line using estimated acres and 30 bird average on 81 acres sandpits last 4 years
Red line bare sand not limiting so additional acres no effect</td></tr>
</table>

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
Effectiveness – Habitat and Target Species Response			
7. Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?	**TP1**: Interaction of river and sandpit habitat.	ILT and PP show no preference for the river over sandpits.	TP 1. There is an Interaction of river and sandpit habitat.  As river habitat increases, additional birds will 1) move into the region, and birds will continue to use the sandpits at current number or 2) move from sandpits to the river. The relationship between use and location (river, sandpit) may indicate a relative preference for nesting location.

PRRIP “Big Questions”	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
<u>Effectiveness</u> – Habitat and Target Species Response			
8. Does forage availability limit tern and plover productivity on the central Platte River?	**<u>T2</u>**: Tern productivity is related to the number of prey fish (<3 inches) and fish numbers limit tern production below 800 cfs from May-Sept.	Prey fish do not limit tern production at 799 cfs or tern production is limited by summer flows of < 50 cfs.	
	<u>P2</u>: Plover productivity is related to the number of suitable macroinverts and macroinverts limit plover production below 800 cfs from May-Sept.	Macroinverts do not limit plover production at 799 cfs or plover production is limited by summer flows of < 50 cfs.	

PRRIP "Big Questions"	Priority Hypotheses	Alternative Hypotheses	X-Y Graphs
Effectiveness – Habitat and Target Species Response			
9. Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?	**PS2**: Program water management will result in measurable changes on flow in the lower Platte River.	Program water management will result in statistically insignificant changes on flow in the lower Platte River.	PS 2: Program water management will result in measurable changes on flow in the lower Platte River.  Program flow management results in measurable change in the lower Platte flows. The probability of detecting flow changes in the lower Platte as a result of Program water management activities (e.g., new depletions plans, summer flow augmentation) is improbable. Program pulse flow management will have the greatest chance of resulting in measurable changes in the lower Platte.

<table>
<tr><th>PRRIP “Big Questions”</th><th>Priority Hypotheses</th><th>Alternative Hypotheses</th><th>X-Y Graphs</th></tr>
<tr><td colspan="4"><u>Larger Scale Issues</u> – Application of Learning</td></tr>
<tr><td>10. Do Program management actions in the central Platte River contribute to least tern, piping plover, and whooping crane recovery?</td><td><u>S1b</u>: Program land management actions (i.e. restoration into habitat complexes) will have a detectable effect on target bird species' use of the associated habitats.</td><td>Cannot detect a significant effect on indicators.</td><td>S1b Program land management actions (i.e., restoration into habitat complexes) will have a detectable effect on target birds species use of the associated habitats


Achieving habitat features on Program lands with characteristic approximating the guidelines in Table of the Land Plan (Habitat Complexes) and the Mgt. Joint Study will be an efficient and biologically effective long-term land conservation and management strategy on the Platte River for the target bird species. Overall habitat complex approach
<u>Distribution</u> – 3 complexes distributed throughout study reach
<u>Location</u> – 6,400 ac above Minden; 2,800 ac below Minden
<u>Channel</u> – 2 miles long; 1,150 ft channels (overall 30% increase in channels >750 ft); maintained by clear/level/pulse approach
<u>Wet Meadows</u> – 640 ac per complex (10% increase in central Platte region)
<u>Buffers</u> – Up to 0.5 miles wide but may be variable
<u>Restoration</u> – At least 50% of land would undergo restoration</td></tr>
<tr><td>11. What uncertainties exist at the end of the Second Increment, and how might the Program address those uncertainties?</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
</table>

1

APPENDIX D

PRRIP HABITAT SUITABILITY CRITERIA

WHOOPING CRANES
&
INTERIOR LEAST TERNS/PIPING PLOVERS

DISCLAIMER: Preliminary Habitat Suitability Criteria were based on an evaluation of Cooperative Agreement and Program whooping crane data collected between 2001 and spring 2011 and generally were set to incorporate 90% of whooping crane observations. These criteria are subject to revision based on Program evaluation of future monitoring and research data.

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
Whooping Crane Habitat Suitability Criteria Descriptions

Terminology for Quantifying Whooping Crane Habitat Availability

- Obstruction – Object ≥1.5 meters above ground level at a reference point or the waterline for wetted areas.
- Unobstructed Channel – Along a line perpendicular to the channel that extends from obstruction to obstruction and passes through a reference point, the unobstructed channel is the area that lies between the vegetation lines of the island or bank that contain the obstructions that lie on the line and on each side of the reference point.
- Disturbance Feature – Road, town, residence, out-building, etc. that may influence whooping crane use of an area. Bridges are an in-channel disturbance feature only.
- Benchmark Flows – To be determined by the Program's Technical Advisory Committee. Year-1 Assessment will be conducted @ 1,700cfs, 2,400cfs, and observed flows.

Whooping Crane In-channel Minimum Habitat Suitability Criteria (Appendix 1)

1. Channel Depth	**≤8 inches**
2. Suitable Channel Area	**≥40% of the channel ≤8 inches or bare sand**
3. Distance to Disturbance Feature	**≥160 feet and ≥1,320 feet (¼ mile) from a bridge**
4. Distance to Obstruction	**≥75 feet**
5. Unobstructed Channel Width	**≥280 feet**
6. Wetted Channel Width	**≥250 feet**
7. Unobstructed View Width	**≥330 feet**

Channel Depth

- *Definition* – Depth of channel from the surface of the water to the bed of the channel at benchmark and observed flows.
- *Criterion* – Channel areas ≤8 inches deep at benchmark and observed flows are habitat if the areas meet all additional in-channel minimum habitat criteria.

Suitable Channel Area

- *Definition* – Proportion of the channel ≤8 inches deep or bare sand.
- *Criterion* – Areas where ≥40% of the channel is ≤8 inches deep or bare sand at benchmark and observed flows are habitat if the areas meet all additional in-channel minimum habitat criteria.

Distance to Disturbance

- *Definition* – Distance from a point in any direction to the nearest disturbance feature.
- *Criterion* – Areas within individual channels that are ≥160 feet from all disturbance features and ≥1,320 feet (¼ mile) from a bridge are habitat if the areas meet all additional in-channel minimum habitat criteria.

Distance to Obstruction

- *Definition* – Distance from a point in any direction to the nearest obstruction (Figure 1).

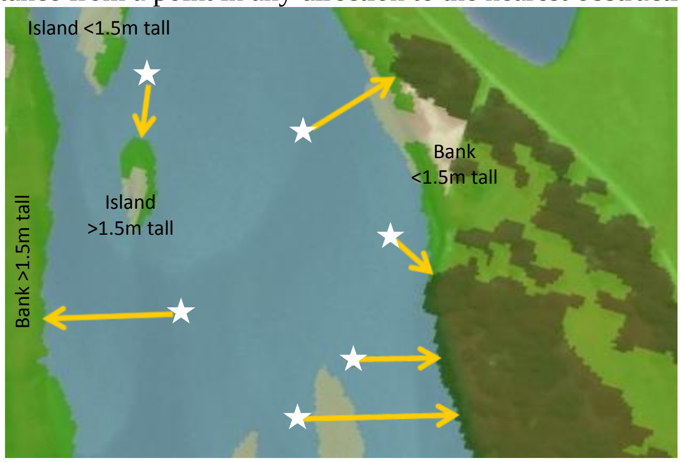


Figure 1. Distance to Obstruction

- *Criterion* – Areas within individual channels that are ≥75 feet from an obstruction are habitat if the areas meet all additional in-channel minimum habitat criteria.

Unobstructed Channel Width

- *Definition* – Measured width of the unobstructed channel at benchmark or observed flows (Figure 2). Unobstructed channel width measurements start and end at the vegetated portion of islands or banks containing the obstruction in either direction from the reference point (i.e., unobstructed channel width does not extend beyond vegetated bank lines). Unobstructed channel width includes bare sand areas and vegetated sandbars that do not contain an obstruction that lies on a line running perpendicular to the channel.

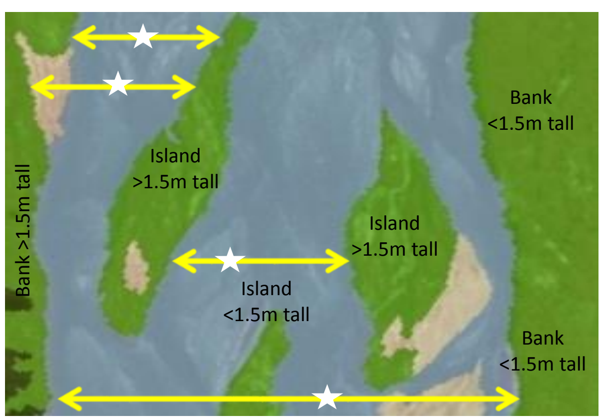


Figure 2. Unobstructed Channel Width

- *Criterion* – Areas with unobstructed channel widths ≥280 feet at benchmark or observed flows are habitat if the areas meet all additional in-channel minimum habitat criteria.

Wetted Channel Width

- *Definition* – Distance within the unobstructed channel that is covered by water at benchmark or observed flows (Figure 3). Wetted channel width measurements exclude bare sand and vegetated sandbar areas within the unobstructed channel.

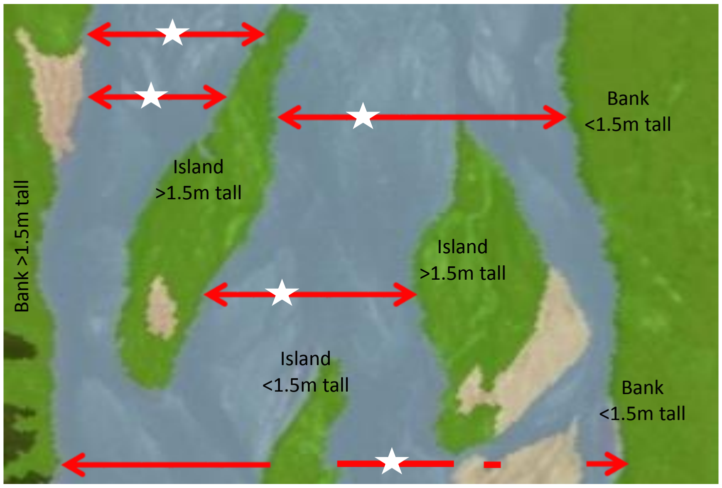


Figure 3. Wetted Channel Width

- *Criterion* – Areas with wetted channel widths ≥250 feet at benchmark or observed flows are habitat if the areas meet all additional in-channel minimum habitat criteria.

Unobstructed View Width

- *Definition* – Along a line perpendicular to the channel that extends from obstruction to obstruction and passes through a reference point, the unobstructed view width is the distance between the obstructions (Figure 4). Unobstructed view width includes all island/bare sand, vegetated sandbars, and banks between the first obstruction on either side of the reference point.

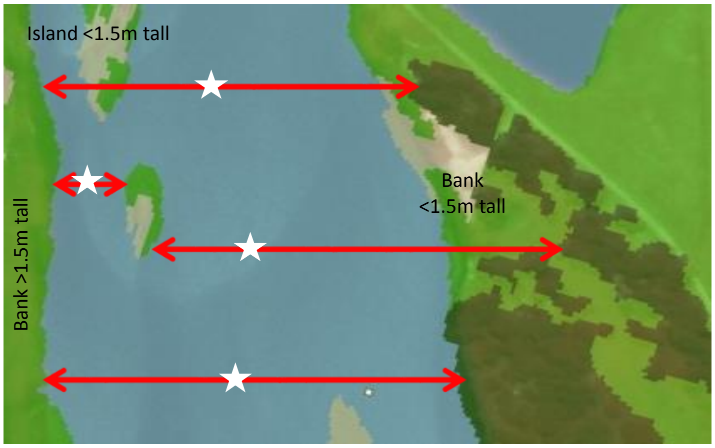


Figure 4. Unobstructed View Width

- *Criterion* – Areas with unobstructed view widths ≥330 feet at benchmark or observed flows are habitat if the areas meet all additional in-channel minimum habitat criteria.

Whooping Crane Off-channel Minimum Habitat Suitability Criteria (Appendix 2)

1. **Area** **≤3.5 miles of main channel or ≤2 miles of side channel**
2. **Landcover Type and Structure**
   - **i. Corn, soybean, alfalfa, wheat, grassland, wet meadow, and palustrine wetland**
     1. Suitable grassland acres determined by visiting a sample of sites
     2. Suitable cropland acres determined by reports of percent of crop fields harvested prior to the migration season
   - **ii. Wet Meadow Criteria**
     1. Wet Meadow Working Group (WMWG) identified potential wet meadow areas
     2. Habitat availability assessment contractor classify all grassland types as grassland
        - i. Identified grasslands that conform to the Program's Wet Meadow Habitat Guidelines (Appendix 3) and meet all Program WC Minimum Habitat Criteria will be classified as whooping crane wet meadow habitat by the habitat availability assessment contractor; however, the WMWG will make the final determination of whooping crane wet meadow areas on a site-by-site basis.
   - **iii. Palustrine Wetland Criteria (Roost Habitat)**
     1. ≥5 acres of water area ≤18 inches deep
     2. ≥25% of the water area ≤12 inches deep
     3. at least 1 water area that is 500 feet × 500 feet
3. **Distance to Obstruction** **≥75 feet**
4. **Unobstructed View Width** **≥330 feet**
5. **Distance to Disturbance Feature** **≥285 feet**

Area

- *Definition* – Program Associated Habitat Area
- *Criterion* – Areas ≤3.5 miles of the main channel or ≤2 miles of side channel or the Platte River are habitat if the areas meet all additional minimum habitat criteria.

Landcover Type and Structure

- *Definition* – Landcover types suitable for whooping crane use
- *Criterion* – Areas of corn, soybean, alfalfa, wheat, grassland, wet meadow, and palustrine wetland are habitat if the areas meet all additional off-channel minimum habitat criteria.
  - *Cropland* – Suitable acres of cropland will be determined by reducing the total acres by the proportion of each crop type reported to have been harvested prior to 1 November each year.
  - *Grasslands* – Suitable acres of grassland will be determined by visiting a sample of grassland sites and reducing the total acres by the proportion of the sample that were of unsuitable structure for whooping crane use.
  - *Wet Meadow* – Wet Meadow areas will be delineated by the Program's Wet Meadow Working Group. Once an area is classified wet meadow habitat, it will remain wet meadow until management activities change the landcover type.
  - *Palustrine Wetland* – ≥5 acres of water area ≤18 inches deep with ≥25% of the water area ≤12 inches deep and at least 1 water area that is 500 feet × 500 feet.

Distance to Obstruction

- *Definition* – Distance from a point in any direction to the nearest obstruction (Figure 5).

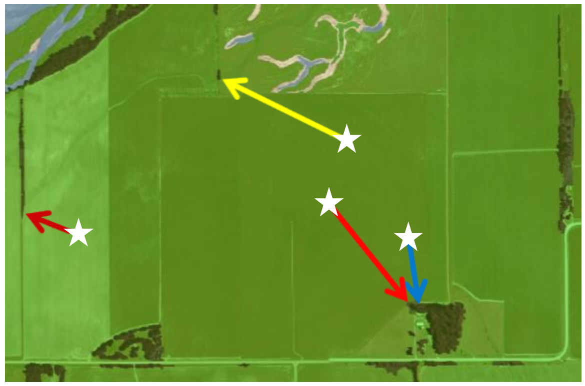


Figure 5. Distance to Obstruction

- *Criterion* – Areas that are ≥75 feet from an obstruction are habitat if the areas meet all additional off-channel minimum habitat criteria.

Unobstructed View Width

- *Definition* – Along a line passing through a reference point in any direction, unobstructed view width is the distance between obstructions (Figure 6). Unobstructed view width includes the area between the first obstruction on each side of the reference point.

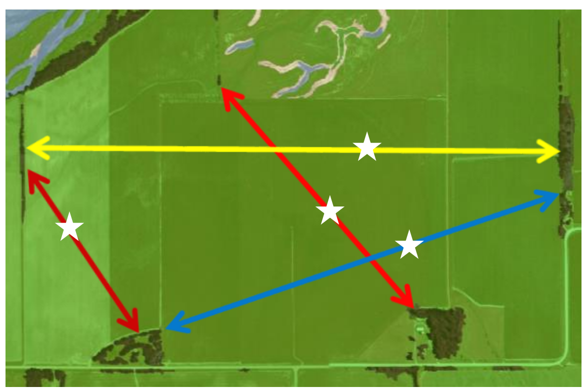


Figure 6. Unobstructed View Width

- *Criterion* – Areas with unobstructed view widths ≥330 feet are habitat if the areas meet all additional off-channel minimum habitat criteria.

Distance to Disturbance Feature

- *Definition* – Distance from a point in any direction to the nearest human disturbance feature (Figure 7).

Figure 7. Distance to Disturbance Feature

Criterion – Areas that are ≥285 feet from a disturbance feature are habitat if the areas meet all additional off-channel minimum habitat criteria.

Appendix 1. Percentiles for in-channel habitat metrics collected at whooping crane roost locations on the central Platte River, 2001 – Spring 2011.

Metric	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Channel Depth (in)	0.5	1.1	1.7	2.2	3.3	3.9	4.3	4.7	5.2	6.1	6.9	6.9	7.1	7.8	8.6	10.1	10.6	12.1	17.0	21.3
Suitable Channel Area	19%	38%	45%	50%	54%	59%	64%	67%	68%	73%	79%	81%	86%	90%	94%	96%	97%	99%	100%	100%
Distance to Obstruction (ft)	46	72	98	118	135	135	138	161	190	197	233	249	292	302	328	394	479	584	630	787
Unobstructed Channel Width (ft)	212	281	350	390	440	467	521	550	591	620	632	683	714	751	751	813	846	891	950	1207
Wetted Channel Width (ft)	208	256	290	328	341	370	402	417	473	493	516	553	571	614	646	652	689	781	868	1310
Unobstructed View Width (ft)	253	331	381	472	530	622	666	722	750	766	810	840	878	920	1031	1092	1175	1175	1237	1537
Flow (cfs)	94	154	175	220	256	342	427	487	582	698	830	965	1074	1161	1183	1480	1720	2568	3670	4240
Sandbar Roost Height (in)	0.1	0.1	0.2	0.3	0.4	0.6	0.8	0.8	1.0	1.0	2.0	2.1	2.4	3.4	3.6	4.2	5.2	6.8	8.2	10.2
Average Distance to Obstruction (ft)	173	215	258	272	290	300	335	376	433	448	490	497	530	554	621	650	791	809	1166	1351
Channel Openness (acres)	3	4	5	7	8	10	13	14	16	17	20	22	27	31	35	37	47	58	126	241
Transect Channel Depth (in)	4.3	4.5	5.1	5.7	5.7	6.0	6.6	7.0	7.4	8.2	8.4	8.7	9.6	10.1	10.6	11.5	12.6	14.8	17.2	25.5

Appendix 2. Percentiles for off-channel habitat metrics collected at whooping crane use locations along the central Platte River, 2001 – spring 2011.

Metric	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Distance to Obstruction (ft)	33	49	82	164	164	197	210	246	322	328	328	328	361	492	656	820	984	1312	1640	4921
Distance to Disturbance (ft)	105	164	328	328	361	492	656	820	935	984	984	1312	1312	1640	1640	2297	2625	2625	3937	5905
Habitat Type	Channel		Sandbar		Corn		Soybean		Alfalfa		Wheat		Grassland		Wet Meadow			Palustrine Wetland		

Appendix 3. Initial guidelines for classifying Program Wet Meadow Habitat (Revised by the WMWG 2-15-12)

Wet Meadow Habitat	Characteristics	When to measure
Location	Within 3.5 miles of main channel or 2 miles of a side channel of the Platte River	During land review process
‘Gold Standard’ acreage	≥40 acres not less than 0.25-mile from potential disturbance or appropriately screened from roads, railroads, occupied dwellings, bridges, etc.	During land review process
Distance from disturbance	Wet meadow habitat areas for whooping cranes will be ≥285 feet from a potential disturbance feature and will conform to the Gold Standard acreage requirements; sites evaluated by WMWG on a case-by-case basis	During land review process
Vegetation composition	Manage for native prairie grasses and herbaceous vegetation; mosaic of wetland (hydrophytic) and upland (non-hydrophytic) plants	Survey after acquisition, after application of management, and annually thereafter
Hydrology	Continuously saturated soils during the WC migration season 2 out of 3 years if possible	Survey after application of management and annually thereafter
Water management	Between February and April, mean monthly groundwater levels are at or above the ground surface in swales 25% to 75% of the time	Survey after application of management and annually thereafter
Topography and soils	Level or low undulating surface with swales and depressions; wetland soils with low salinity in swales and non-wetland soils in uplands	Survey after acquisition and after application of management
Flora and fauna	Supports characteristic aquatic, semi-aquatic, and terrestrial fauna and flora (especially aquatic invertebrates, beetles, insect larvae, and amphibians)	Survey after acquisition, after application of management, and annually thereafter
Whooping crane habitat requirements	Size – 640 contiguous acres or more when possible Unobstructed view area – As far as possible (330 feet = minimum habitat criteria) Low vegetative structure area – As much as possible Water area – As much as possible while maintaining wet meadow flora and fauna	During land review process then evaluate annually

DISCLAIMER: These are draft habitat suitability criteria and are subject to revision based on Program evaluation of monitoring and research data.

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
Tern and Plover Habitat Suitability Criteria Descriptions

Terminology for Quantifying Tern and Plover Habitat Availability

- Bare Sand – River island or sandpit site with <20% vegetative cover. Bare sand areas can be composed of dry sand or gravel substrate and nest furniture may be present.
- Predator Perch – Tree, power line, power pole, etc. ≥10 feet tall that could be used by an avian predator to view the potential nesting area.

Tern and Plover In-channel Minimum Habitat Suitability Criteria

8. **Suitable Nesting Area – ≥1/4-acre sandbar ≥18 inches above river stage @ 1,200cfs.**
9. **Channel width – ≥400 feet**
10. **Water Barrier – ≥50 feet**
11. **Distance to Predator Perch – ≥200 feet**

Suitable Nesting Area

- *Definition* – ≥0.25-contiguous acres of bare sand 18 inches above river stage @ 1,200cfs with ≥1.5 acres of exposed bare sand within a ¼-mile reach of channel.

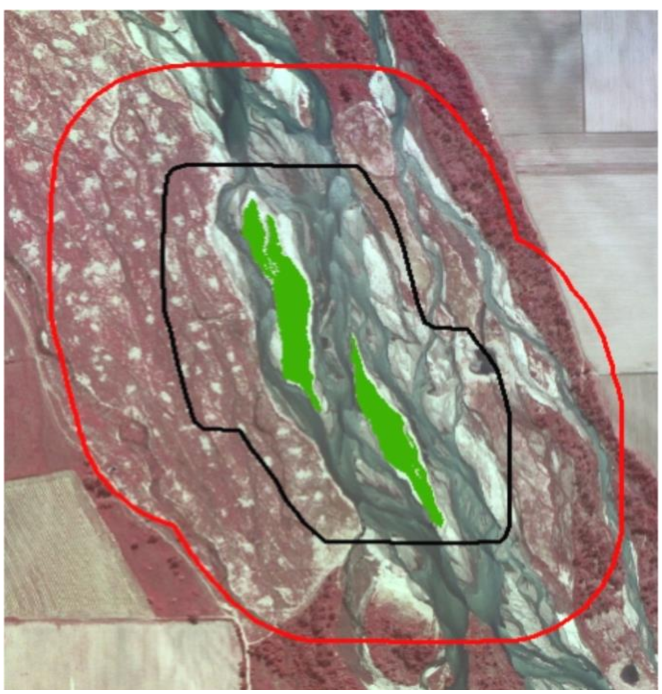


Figure 1. Suitable nesting area (green) with ≥1.5 acres of exposed bare sand within a ¼ mile stretch of channel.

- *Criterion* – all sandbar areas ≥1/4-acre in size and ≥18 inches above river stage @ 1,200cfs are suitable nesting habitat if there is ≥1.5 acres of exposed bare sand within a ¼-mile reach of channel and the areas meet all additional in-channel minimum habitat criteria.

Channel Width

- *Definition* – Along a line perpendicular to the channel extending through the center of a potential nesting island, channel width is the entire open-channel area, including sand, which lies between the vegetation lines of the island or bank on each side of the sandbar.

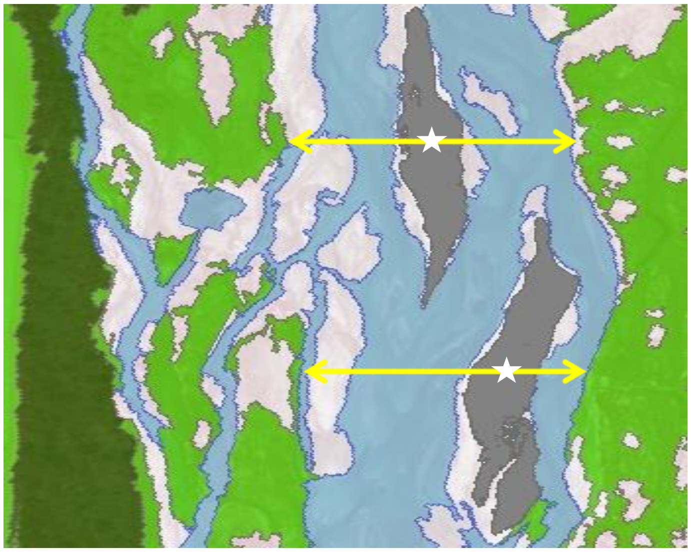


Figure 2. Channel width measured perpendicular to flow from the center of potentially suitable nesting areas.

- *Criterion* – Sandbar areas in channels ≥400 feet wide at 1,200cfs and observed flows are suitable nesting habitat if the areas meet all additional in-channel minimum habitat criteria. Bare-sand areas within channels <400 feet wide contribute to the 1.5 acres of bare sand within a ¼-mile reach of river, but are not suitable nesting habitat.

Distance to Predator Perch

- *Definition* – Distance from the edge of potentially suitable nesting habitat in any direction to the nearest potential predator perch.

Figure 3. 200-foot buffer around predator perches (red area).

Criterion – Sandbar areas ≥200 feet from a predator perch are suitable nesting habitat if the areas meet all additional in-channel minimum habitat criteria. Bare-sand areas <200 feet from a predator perch contribute to the 1.5 acres of bare sand within a ¼-mile reach of river, but are not suitable nesting habitat.

Water Barrier

- *Definition* – Width of individual threads of channel, measured perpendicular to flow, that lie between the bank and potential nesting habitat (Figure 4).

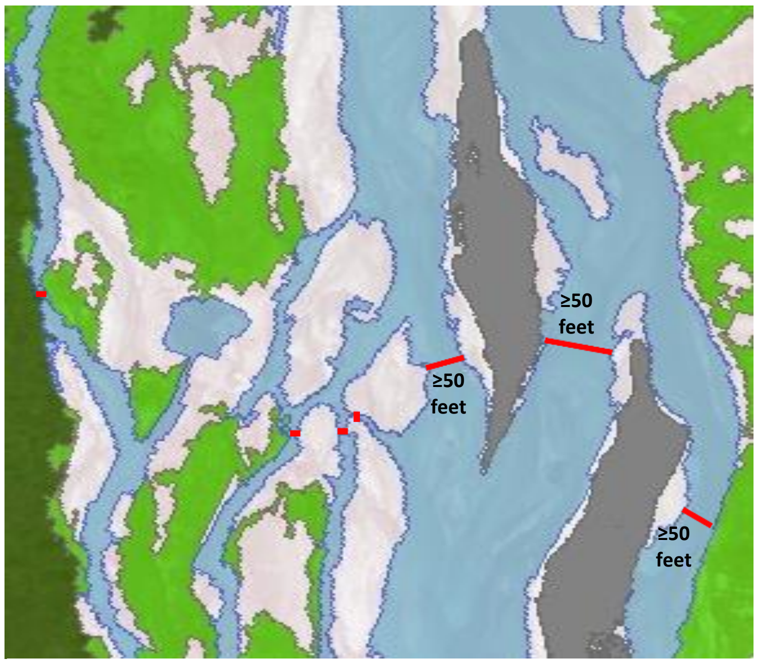


Figure 4. Channel width measured as the shortest distances across water from the edge of potentially suitable nesting areas to the bank lines on each side.

- *Criterion* – Sandbar areas with a ≥50-foot contiguous water barrier between each shoreline and edge of bare sand are suitable nesting habitat if the areas meet all additional in-channel minimum habitat criteria. Bare-sand areas with a water barrier <50 feet contribute to the 1.5 acres of bare sand within a ¼-mile reach of river, but are not suitable nesting habitat.

Tern and Plover Off-channel Minimum Habitat Suitability Criteria

3. **Area – ≤3.5 miles of main channel or ≤2 miles of side channel**
4. **Minimum Habitat Size – ≥1.5 acres of suitable nesting habitat per site; contributing habitat must be ≥0.25 acres in size.**
5. **Distance to Predator Perch – ≥200 feet**
6. **Off-channel sites delineated annually; must contain sand with adjacent water areas**
7. **Suitable Nesting Area – Delineated by monitoring crew annually**

Area

- *Definition* – Program Associated Habitat Area
- *Criterion* – Areas ≤3.5 miles of the main channel or ≤2 miles of side channel of the Platte River are habitat if the areas meet all additional minimum habitat criteria.

Minimum Habitat Size

- *Definition* – Total of ≥1.5 acres of conforming habitat per site
- *Criterion* – ≥¼-acre patches of dry bare sand and/or gravel are suitable nesting habitat if there is ≥1.5 acres of suitable nesting habitat total within a site and the areas meet all additional off-channel minimum habitat criteria.

Distance to Predator Perch

- *Definition* – Distance from potentially suitable nesting habitat in any direction to the nearest potential predator perch.
- *Criterion* – Bare-sand areas ≥200 feet from a predator perch are suitable nesting habitat if the areas meet all additional off-channel minimum habitat criteria.

Water-Sand Criteria

- *Definition* – Off-channel sites will be delineated on an annual basis.
- *Criterion* – Sites with sand and adjacent water areas are suitable nesting habitat if the site meets all additional off-channel minimum habitat criteria.

Suitable Nesting Area

- *Definition* – Delineation of areas within each site that, according to the monitoring crew, are suitable habitat for nesting.
- *Criterion* – Monitoring personnel will hand delineate suitable nesting areas within sites that are monitored to exclude sand and gravel piles and active mining areas that are not conducive to tern and plover nesting. The habitat availability assessment contractor will identify suitable habitat through application of the various filters, document spatial extent and availability of habitat identified via image interpretation, and apply the hand-delineated polygon layer as a final filter to remove unsuitable nesting areas within each site.

APPENDIX E

DEPARTMENT OF INTERIOR TARGET HABITAT CRITERIA

LAND PLAN TABLE 1

Table 1. Target Habitat Complex Guidelines[8]

1. Riverine Habitat	Characteristics
Location	Between Lexington and Chapman, NE
Channel area	Approximately 2 miles long, 1,150 feet wide and includes both sides of the river. "Channel area" represents the portion of the river that conducts flow and is bounded either by stable banks or permanent islands that obstruct view. At low flows, the channel area includes interconnected small channels and exposed sand or gravel bars and non-permanent islands.
Water depth	A range of depths with approximately 40 percent of the channel area less than 0.7-foot deep during whooping crane migration periods.
Wetted width	90 - 100 percent of channel area inundated during migration periods.
Water velocity	Velocity is variable with depth. During whooping crane migration and least tern and piping plover nesting seasons, velocity should be less than 4 mph in shallow areas.
Sandbars and Channel Morphology	Non-permanent sandbars and low, non-permanent islands throughout the channel area, high enough to provide dry sand during the tern/plover nesting season and free of vegetation that inhibits nesting or creates visual obstructions to whooping cranes. Diverse channel morphology providing a variety of submerged sand bars and other macrohabitats, including backwater areas and side channels inundated by discharge.
Proximity to wet meadow forage habitat	Within 2 miles, but contiguous is preferred.
Distance from disturbance	For whooping cranes: In general, not less than 0.5-mile distant or appropriately screened from potential disturbances. Potential disturbances may include roads, railroads, occupied dwellings, bridges or other activities that would disturb whooping cranes from using a site. For least tern/piping plover: Potential disturbances should be evaluated case-by-case. In general, not less than 0.25 mile distant, or appropriately protected from human disturbances.
Unobstructed View	Good visibility upstream, downstream, and across the channel.
Flight Hazards	Overhead lines should be avoided, if possible. Overhead lines within 0.5 mile of complex boundaries should be evaluated during the screening process to determine whether marking would be appropriate.
Security	Sufficient control to avoid human disturbance to target species.

[8]The Parties have agreed to use these habitat complex characteristics as an initial acquisition, restoration and maintenance target. The states and July 1997 Cooperative Agreement Land Committee continue to disagree that these characteristics represent the "best" habitat or necessary habitat for the target species, or that the Program will be able to sustain the characteristics solely with flow management. The states and July 1997 Cooperative Agreement Land Advisory Committee believe that an approach based on acquiring and developing habitat with a range of characteristics is justified.

2. Wet Meadow Habitat	**Characteristics**
Location	Within 2 miles of the above-described channel area.
Size	Approximately 640 contiguous acres or more.
Distance from Disturbance	In general, not less than 0.5-mile distant or appropriately screened from potential disturbance. Potential disturbances may include roads, railroads, occupied dwellings, bridges or other activities that would disturb target species from using a site.
Vegetation Composition	Native prairie grasses and herbaceous vegetation, lacking or mostly lacking sizable trees and shrubs, occurring in a mosaic of wetland (hydrophytic) and upland (non-hydrophytic) plants.
Hydrology	Swales subirrigated by ground water seasonally near the soil surface and by precipitation and surface water, with the root zone of the soil continuously saturated for at least 5 - 12.5% of the growing season. Except immediately following precipitation events, higher areas may remain dry throughout the year.
Topography and Soils	The topography is generally level or low undulating surface, dissected by swales and depressions. Mosaic of wetland soils with low salinity in swales and non-wetland soils occurring in uplands.
Food Sources	Capable of supporting aquatic, semi-aquatic, and terrestrial fauna and flora characteristic of wet meadows; especially aquatic invertebrates, beetles, insect larvae, and amphibians.
3. Buffer	**Characteristics**
	That portion of a complex used to isolate channel areas and wet meadows from potential disturbances. In general, it is up to 0.5 miles wide, but is variable depending on topography, screening, and other factors. Buffer areas may include an extended wet meadow or channel area, upland grassland, pasture, hay land, cropland, palustrine wetland, woodland, managed sandpits, or a combination of these and other compatible land features.

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
2013 State of the Platte Report Endnotes

[1] This is a restatement of the first bullet under broad hypothesis PP-1. See p. 16 of the Adaptive Management Plan.
[2] The USBR estimated that sediment balance is achieved at approximately Gibbon based on repeat channel surveys (Trends of Aggradation and Degradation along the Central Platte River: 1985-2005, pp. 54-56). Program sediment transport modeling predicts that sediment balance is achieved at approximately Minden (1-D Hydraulic and Sediment Transport Model Final Hydraulic Modeling Technical Memorandum, p. 144).
[3] See Appendix D. The criteria are currently based on a combination of professional judgment and historic use data. The Program is intending to perform a habitat selection analysis in 2014 using 2007 through 2013 monitoring data.
[4] This approximation is based on 1-D model stage-discharge relationships and 1947-2008 seasonal peak flow exceedance for the months of May - July.
[5] The conclusion that stage change is generally sufficient is supported by stage-discharge relationships from Program hydraulic modeling. The specific heights (e.g. 0.7') are based on two-dimensional hydraulic modeling performed for the Elm Creek Complex FSM "Proof of Concept" management experiment (final report in development)
[6] See pp. 4-36 and 4-37 of Volume I of the Final Environmental Impact Statement for the Program.
[7] 2010 and 2011 high flow event discharges and volume records from USGS Grand Island gage (USGS 06770500). Analysis assumes a maximum SDHF discharge of 8,000 cfs and volume of 75,000 AF.
[8] 2010 sandbar heights from analysis for Elm Creek Complex FSM "Proof of Concept" management experiment implementation design (see footnote 5). 2011 sandbar heights from management experiment effectiveness monitoring in 2011 (final report in development).
[9] Preliminary determination based on visual inspection of fall 2011 LiDAR imagery. Almost all sandbars in the associated habitat are inundated or at the water surface in the imagery. The flow at the time of acquisition was 2,700 cfs throughout the entire reach. A system-scale analysis of sandbar heights is planned following completion of 2009-2011 system scale geomorphology and vegetation data and will build on hydrologic and stage-discharge metrics from system-scale analyses.
[10] This is based on preliminary results of the 2007-2011 tern and plover habitat availability analysis being conducted for the Program by the Rainwater Basin Joint Venture (see preliminary methods and results document). Final analysis results and report will be delivered in the fall of 2014.
[11] Nest observations based on a 2004 compilation of central Platte River tern and plover nest observations by Gary Lingle. This document (PRRIP DEIS Response Final Report) is the only documents known to categorize nest observations according to habitat type.
http://www.platteriverprogram.org/intranet/NonPublic%20Program%20Library/PRRIP%20DEIS%20Response.pdf
[12] See Big Question 3 summary.
[13] Pilot study results presented by Jason Alexander at the 2011 University of Nebraska-Lincoln Water Center Climate, Water and Ecosystems Conference.
[14] This is a restatement of the second bullet under broad hypothesis PP-1. See p. 16 of the Adaptive Management Plan. Paragraph 2 on pg. 22 of the AMP states that the over-arching hypothesis of the FSM management strategy is that it will generate "detectible changes" in channel morphology and species habitat characteristics. In the following sentence, those changes are identified as achieving the habitat conditions described in Table 1 of the Land Plan, which are hypothesized (WC 3b) to be suitable for the target species. As such, it is reasonable to conclude that the second bullet under broad hypothesis PP-1 infers that FSM will increase unvegetated channel widths to a suitable width.
[15] Otherwise, suitable unobstructed channel widths would already be maintained by the existing peak flow regime. The ability of SDHF to maintain suitable unvegetated channel widths is especially critical during drought periods when natural peak flow events may be completely absent for several years.

[16] See Appendix D. The criteria are currently based on a combination of professional judgment and a habitat selection analysis of 2001-2006 use data. The Program is currently updating the habitat selection analysis to include 2007-2013 data.
[17] See hypothesis WC 3b X-Y graph in Appendix D of the Adaptive Management Plan. The Department of the Interior hypothesizes that increasing unobstructed channel width to a minimum of 750 feet and a target of 1,150 feet is needed to increase the probability of whooping crane roosting.
[18] 2010 and 2011 high flow event discharges and volume records from USGS Grand Island gage (USGS 06770500). Analysis assumes a maximum SDHF discharge of 8,000 cfs and volume of 75,000 AF.
[19] Widths based on a preliminary analysis of 2009-2011 system-scale geomorphology and vegetation monitoring data by EDO. The TAC recommended approval of a system-scale geomorphology and vegetation data analysis protocol in July of 2012. Final analysis of 2009-2013 monitoring data is expected to be completed in 2014.
[20] See bullet three on p. 33 of 2012 State of the Platte Report. The calculations in bullet three are unobstructed width calculations, not unvegetated width calculations (they were mislabeled).
[21] See PVWMA 2008-2011 invasive species control summary.
[22] See pp. i-iii of the draft PRRIP Directed Vegetation Research Study conducted for the Program by the USDA-ARS National Sedimentation Laboratory in association with the University of Tennessee. The draft report was subjected to Program peer review in the spring of 2012 and revisions are expected to be complete by October 2012. In August of 2012, the Program re-engaged the research team to conduct a lateral erosion/scour research project. Both documents are being developed for publication in 2014.
[23] See sidebar figure in Big Question 2 summary for annual peak flow magnitudes and volumes for the period of 1983-1999.
[24] Analysis performed by EDO for executive summary using Program Pure Panel Anchor Point locations and 1998 CIR imagery. Unobstructed width calculated as maximum unvegetated width of any single channel.
[25] See Fotherby, L.M., Valley confinement as a factor of braided river pattern for the Platte River, Geomorphology (2008), doi:10.1016/j.geomorph.2008.08.001 for a discussion of the role of flow consolidation (valley confinement) in the occurrence of braided planform in 1998.
[26] This is a restatement of broad hypothesis PP-2. See p. 17 of the Adaptive Management Plan.
[27] During Program development, the magnitude of the sediment deficit was estimated using several approaches. See pp. 5-55 – 5-57 of Volume I of the Final Environmental Impact Statement for a discussion of the process used to estimate the annual sediment deficit.
[28] See Platte River Channel Dynamics Investigation (which was developed in response to a draft version of the DOI publication titled The Platte River Channel: History and Restoration) and the DOI response to the investigation.
[29] See p. 17 of the Sediment Augmentation Experiment Alternatives Screening Study.
[30] See p. 144 of 1-D Hydraulic and Sediment Transport Model Final Hydraulic Modeling Technical Memorandum.
[31] See p. 8 of Appendix A of the Program's 2009 Geomorphology and Vegetation Monitoring Report for a comparison of the 2009 longitudinal thalweg profiles of the north and south channels at Jeffery Island which demonstrates the degree of channel incision. This reach also exhibits the narrowest channel widths in the associated habitat reach as demonstrated in the Big Question 4 sidebar figure.
[32] See Germanoski, D. and Schumm, S. A., 1993. Changes in Braided River Morphology Resulting from Aggradation and Degradation. J. of Geology, v. 101 for a discussion of the progressive effects of a sediment deficit on the morphology of a braided sand bed river.
[33] See Management of the Platte River for Braided Planform memorandum by Program Special Advisor Dr. Chester Watson for discussion of the role of flow, sediment, and vegetation management in maintenance of a braided planform.
[34] This is a restatement of broad hypothesis PP-3. See p. 17 of the Adaptive Management Plan.
[3]5 See section 4.1 of Tal, M., Gran, K., Murray, B., Paola, C., and Hicks, M., 2004. Riparian Vegetation as a Primary Control on channel Characteristics in Multi-thread Rivers. Riparian Vegetation and Fluvial Geomorphology Water Science and Application 8. American Geophysical Union for a Platte River-specific discussion of the vegetation ratchet effect.
[36] Analysis performed by EDO for executive summary using Program Pure Panel Anchor Point locations and 1998 CIR imagery. Unobstructed width calculated as maximum unvegetated width of any single channel.

[37] Reference Habitat Management Methods for Least Terns, Piping Plovers, and Whooping Cranes for a discussion of the various mechanical management actions that have been taken by a variety of organizations to create and/or maintain target species habitat in the associated habitat reach.
[38] See Fotherby, L.M., Valley confinement as a factor of braided river pattern for the Platte River, Geomorphology (2008), doi:10.1016/j.geomorph.2008.08.001 for a discussion of the role of flow consolidation (valley confinement) in the occurrence of braided planform in 1998.
[39] See Cottonwood Ranch Flow Consolidation Feasibility Study.
[40] Figure acronyms include: CRC – Cottonwood Ranch Complex, ECC – Elm Creek Complex, FCK – Fort Kearny Complex, Rowe – Audubon Rowe Sanctuary, SIC – Shoemaker Island Complex, and WCT – Whooping Crane Trust.
[41] This is a re-statement of Priority Hypotheses WC1 and WC3 in the Adaptive Management Plan. In general, these hypotheses suggest that whooping cranes will select habitat similar to Land Plan Table 1 characteristics (see **Appendix C**) and/or habitat created by Program management actions.
[42] See the Whooping Crane Tracking Partnership Statement of Work for an explanation of the telemetry project and expected outcomes.
[43] See Final Spring 2012 Whooping Crane Monitoring Report for the latest example of a Program whooping crane migration monitoring report. (REPORT WILL BE FINALIZED AND UPLOADED IN FALL 2012).
[44] PRRIP 2013 Final Spring Whooping Crane Monitoring Report.
[45] Summary numbers from Final PRRIP 2012 State of the Platte Report – Technical Details, Whooping Crane Monitoring Summary (Pages 14-23) as provided for the March 2012 AMP Reporting Session.
[46] Regression analyses and statistical tests were performed and indicate some relationships were significant (α=0.05) and others were not; however, results of these analyses are not included in this report because there are so few data points and significance or lack-there-of could easily change based on 1 additional data point (i.e., 2012 data).
[47] This is a restatement of Priority Hypotheses T1 and P1 in the Adaptive Management Plan which suggest that more "bare sand" (i.e. habitat) will result in greater tern and plover use and higher reproductive success.
[48] See Final 2012 PRRIP Interior Least Tern & Piping Plover Monitoring Report.
[49] This is a re-statement of Priority Hypotheses TP1 in the Adaptive Management Plan. This hypothesis is one of the more complex hypotheses in the AMP and may require refinement during the First Increment.
[50] See the final USGS report Foraging Ecology of Least Terns and Piping Plovers Nesting on Central Platte River Sandpits and Sandbars.
[51] PRRIP 2012 Final Tern and Plover Monitoring Report.
[52] See endnote 46.
[53] See endnote 46.
[54] This is a re-statement of Priority Hypotheses T2 and P2 in the Adaptive Management Plan, which suggest that at low flows a lack of forage fish and invertebrates limit tern and plover productivity on the central Platte.
[55] See 2011 Fish Population Studies Report from NPPD for example of monitoring effort and data.
[56] See the PRRIP 2012 Forage Fish Analysis Report.
[57] See the final USGS report Foraging Ecology of Least Terns and Piping Plovers Nesting on Central Platte River Sandpits and Sandbars.
[58] See the final USGS report Foraging Ecology of Least Terns and Piping Plovers Nesting on Central Platte River Sandpits and Sandbars.
[59] See the PRRIP 2012 Forage Fish Analysis Report.
[60] See the final USGS report Foraging Ecology of Least Terns and Piping Plovers Nesting on Central Platte River Sandpits and Sandbars.
[61] See the PRRIP 2012 Forage Fish Analysis Report.
[62] See Final 2011 PRRIP Interior Least Tern & Piping Plover Monitoring Report.
[63] See Final 2011 PRRIP Interior Least Tern & Piping Plover Monitoring Report.
[64] This is a re-statement of Priority Hypothesis PS2 in the Adaptive Management Plan, which suggests that Program water management actions in the central Platte River will result in measurable changes in lower Platte River flow.
[65] See Final PRRIP Stage Change Study for full report of methodology and results.
[66] See Final PRRIP Pallid Sturgeon Literature Review Report. The associated Access database and compendium of PDF publications are available in the non-public section of the Program library on the PRRIP web site.

[67] Table 10, Page 21 of the Final Stage Change Study presents a description of the six habitat classifications used to evaluate the potential impacts of Program management actions in the central Platte on flow in the lower Platte.
[68] The Dry Conditions Analysis was presented in the Final Stage Change Study as Appendix G, "Alternative Analysis of Program Activities" (see Page 167 of the PDF version of Final Stage Change Study).
[69] Table 2, Appendix G (Page 170 of PDF version of Final Stage Change Study).
[70] See "Interpretation and Analysis" section of the Final Stage Change Study, Page 22.
[71] The "Alternative Analysis of Program Activities" evaluated a hydrologic scenario against all six habitat classifications (i.e. longitudinal habitat in the channel and lateral habitat connections between the channel and floodplain) during both the spring (spawning period) and the fall (overwintering and upcoming spawning movements).
[72] Pallid sturgeon item V.K.3.2, Integrated Monitoring and Research Plan (IMRP), Adaptive Management Plan (Page 45).
[73] See Page 1 of the Adaptive Management Plan for the three overall management objectives of the Program, and Page 3 of the Final Program Document for the Program's three sub-goals that comprise the Program's long-term goal to improve and maintain the associated habitats.
[74] This is a re-statement of Priority Hypothesis S1b in the Adaptive Management Plan. In the context of this Big Question, this hypothesis will be used to evaluate tern, plover, and whooping crane use of Program habitat complexes (or habitat identified as "suitable" by the Program) during the course of the First Increment and evaluate that use in terms of its contribution to the broader health of the overall populations of all three target bird species.
[75] See Page 1 of the Final Program Document, Program Purposes.
[76] Downstream Water User (DWU) comments on preliminary 2013 Big Question Assessments.
[77] PRRIP 2013 Final Spring Whooping Crane Monitoring Report.
[78] PRRIP 2012 Final Tern and Plover Monitoring Report.
[79] PRRIP 2007-2012 Tern/Plover Habitat Availability Assessment.