ADDENDUM TO THE ADAPTIVE MANAGEMENT PLAN – FIRST INCREMENT EXTENSION

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
Addendum to the Adaptive Management Plan – First Increment Extension
February 28, 2017

Table of Contents

Introduction

Purpose of Addendum to AMP

The purpose of this Addendum to the Platte River Recovery Implementation Program's Adaptive Management Plan (AMP) is to provide the scientific and technical framework for addressing key uncertainties and providing useful information for Governance Committee (GC) decision-making during the 13-year Extension (2020-2032) of the Program's First Increment. The AMP will continue to be implemented as during the original 13 years of the First Increment with emphasis on evaluating the impacts of flow management actions including short-duration high flows (SDHF) and U.S. Fish and Wildlife Service target flows. As directed in the AMP, this addendum will be updated during the Extension as AM implementation and associated data analysis and synthesis result in improved learning within the Program regarding critical uncertainties. The full AMP is incorporated in this Addendum by reference.

About Adaptive Management

Adaptive management (AM) as described in the AMP is a series of scientifically driven management actions (within policy and resource constraints) that use the monitoring and research results provided by the Integrated Monitoring and Research Plan (IMRP) to test priority hypotheses related to management decisions and actions, and apply the resulting information to improve management (PRRIP, 2006a). Adaptive management works iteratively as illustrated in the "six steps" of adaptive management identified in **Figure 1** (Murray et al., 2011).

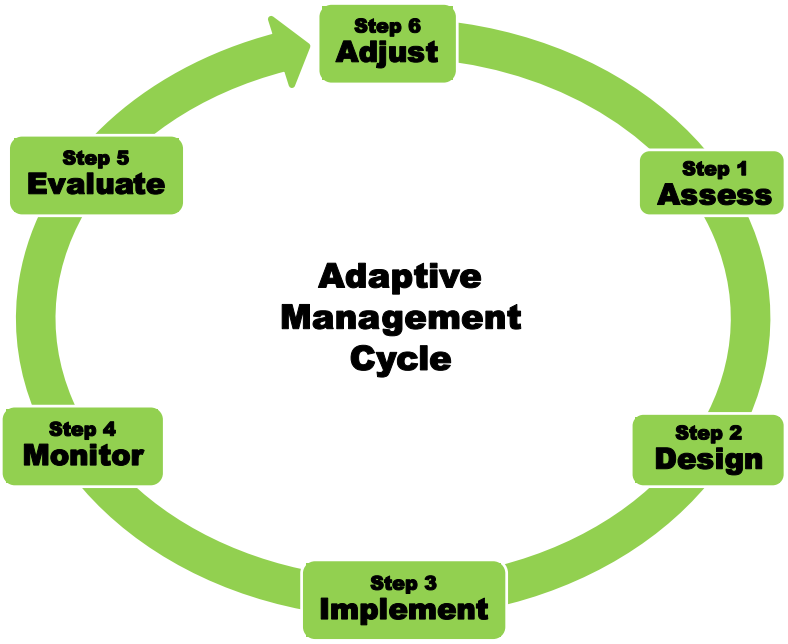


Figure 1. Adaptive management cycle.

In practice, this cycle and Program AM implementation are in alignment with the Department of Interior's Adaptive Management Technical Guide (Williams et al., 2007). As the Program moves forward, it is important for decision-makers to have a common understanding of an AM definition that best fits the purposes and goals of the Program. To that end, the standing definition of AM for the Program is as follows:

> *A rigorous approach for designing and implementing management actions to maximize learning about critical uncertainties that affect decisions, while simultaneously striving to meet multiple management objectives.*

1.0 AM Cycle Step 1 – Assess

This section describes the building blocks of Program AM and provides a roadmap for using science learning to determine how best to implement the AMP and inform Program decision-making.

- **Goals (1.1)** – Broad statements of desired outcomes that form the direction for the Program and guide the AMP. Program AM should focus on addressing critical uncertainties about how to best achieve these goals.
- **Management Objectives (1.2)** – More specific and measurable statements of outcomes the Program is trying to achieve and that should facilitate evaluation of AM effectiveness.
- **Management Decisions and Critical Uncertainties/Big Questions (1.3)** – Statements of the decisions to be made by the GC and the key scientific and technical uncertainties related to these decisions. "Big Questions" are lay statements of these uncertainties and form the top-line questions to be addressed through implementation of the AMP. What uncertainties are relevant to achieving Program goals and management objectives and selecting management actions for implementation?
- **Conceptual Models (1.4)** – Visual frameworks for representing relationships between the Platte River system, target species, and management actions and for identifying critical pathways to address underlying uncertainties.
- **Hypotheses, Performance Measures, and Benchmarks (1.5)** – Hypotheses (and alternative hypotheses) are specific statements of opinions about critical uncertainties. Performance measures are the metrics to be monitored during hypothesis testing. Benchmarks are targets for the performance measures necessary to draw conclusions regarding hypotheses.
- **Management Actions (1.6)** – Program actions on the ground to test hypotheses and evaluate the responses of the Platte River system and the target species.
- **Spatial and Temporal Bounding (1.7)** – Dimensions in time and space for implementing the AMP and determining the effects of the Program.

1.1 Goals

The foundational purposes, goals, and objectives are detailed in the Final Program Document (PRRIP, 2006b). They are re-stated here to serve as a constant reminder of the "Why?" regarding AM implementation and evaluation.

Purpose
Implement certain aspects of the U.S. Fish and Wildlife Service's (FWS') recovery plans for the target species that relate to their associated habitats by providing for the following:

1) Securing defined benefits for the target species and their associated habitats to assist in their conservation and recovery through a basin wide cooperative approach agreed to by the three states and DOI;
2) Providing ESA compliance for existing and new water related activities in the Platte River basin;
3) Helping prevent the need to list more basin associated species pursuant to the ESA;
4) Mitigating the adverse impacts of new water related activities on (1) the occurrence of FWS target flows (as described in Section III. E.1. a.) and (2) the effectiveness of the Program in reducing shortages to those flows, such mitigation to occur in the manner and to the extent described in Section III.E.3. and in the approved depletions plans; and
5) Establishing and maintaining an organizational structure that will ensure appropriate state and federal

government and stakeholder involvement in the implementation of the Program.

Goal (Fundamental)

Improve and maintain the associated habitats. This goal includes:

1) Improving and maintaining migrational habitat for whooping cranes, and reproductive habitat for least terns and piping plovers;
2) Reducing the likelihood of future listings of other species found in this area; and
3) Testing the assumption that managing flow in the central Platte River also improves the pallid sturgeon's lower Platte River habitat

Elements

1) Increasing streamflows in the central Platte River during relevant time periods through reregulation and water conservation/supply projects;
2) Enhancing, restoring, and protecting habitat lands for the target species; and
3) Accommodating new water related activities in a manner consistent with long-term Program goals.

Long-Term Objectives

1) Provide sufficient water to and through the central Platte River habitat area to meet the general goal set forth in Paragraph II above by reregulation and water conservation/ supply projects, and
2) Perpetually protect, restore where appropriate, and maintain approximately 29,000 acres of suitable habitat primarily in habitat complexes in the central Platte River area located between Lexington and Chapman, Nebraska

First Increment Objectives

1) Reduce shortages to target flows by an average of 130,000 to 150,000 acre-feet per year at Grand Island, through reregulation and water conservation/supply projects, and
2) Protect, restore where appropriate, and maintain at least 10,000 acres of habitat in the central Platte River area between Lexington and Chapman, Nebraska.

As discussed during development of the Extension (as detailed in the Program Document Addendum), the GC determined these broad-scale purposes, goals, and objectives would be retained throughout the Extension and would not be assessed until development of the Second Increment.

1.2 Management Objectives

Management objectives are detailed, measurable descriptions of tangible outcomes the Program is trying to achieve. The Program's current management objectives are specified in the AMP (PRRIP, 2006a):

1) Improve production of Least Tern and Piping Plover from the central Platte River.

- Increase number of fledged tern and plover chicks
  a) Increase nesting pairs (indicator is nesting pairs)
  b) Increase fledge ratios (indicator is chicks successfully produced per unit adult, nest or pair) and reduce chick mortality from causes such as flooding, predation, weather, inadequate forage.
- Reduce adult mortality
  a) Reduce predation (indicator is nesting pairs)

2) Contribute to the survival of Whooping Cranes during migration.

- Increase availability of whooping crane migration habitat along the central Platte River (indicators are the area of suitable roosting habitat, area of suitable foraging habitat, proportion of population, crane use days, etc.).

3) *Avoid adverse impacts from Program actions on Pallid Sturgeon populations.*
   - Indicators have not been identified as more research is needed to determine what potential indicators the Program may affect.

4) *Within overall objectives 1-3, provide benefits to non-target listed species and non-listed species of concern and reduce the likelihood of future listing.*
   - Increase availability of habitats for these species (Land Plan "other species of concern") along the central Platte River. Indicators are species occurrence, Land Plan Tables 1 and 2 characteristics.

NEXT STEPS (March 2017-February 2018)

These management objectives are more refined answers to the "Why?" question that should drive implementation of a successful AMP. To that end, further Program discussion is required:

- Considerations for retaining the same management objectives, updating them, and/or developing new management objectives for the Extension
- Program Document says that we will test USFWS target flows during the First Increment; need to consider how that is captured by existing/updated/new management objectives
- First Increment Extension emphasis on doing the science necessary to determine if last 10,000 AF of water is necessary (going from 120,000 AF to 130,000 AF) – again, how is this captured by management objectives
- Define measurable management objectives and identify preliminary flow management and/or protection actions/alternatives
- Identify key indicators for each management objective
- Explore effectives of alternative actions on indicators

1.3 Management Decisions and Critical Uncertainties/Big Questions

NEXT STEPS (March 2017-February 2018)

- Identify decisions GC will make during the Extension – which ones require AM?
- What are the questions of interest to the GC? What questions do the GC have that would be informed by the results of implementing AM?
- Identify key gaps in understanding – what are the critical scientific and technical uncertainties?
- What is the scope of the management problem? What are the Program's obligations?
- **Table 1** identifies the Program's current set of Big Questions. Retain/update/add/subtract as necessary for the set of Big Questions used during the Extension to related to questions the GC wants answered

Table 1. Program's Big Questions.

PRRIP Big Questions	
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?
2.	Will implementation of SDHF produce and/or maintain suitable whooping crane riverine roosting habitat on an annual or near-annual basis?
3.	Is sediment augmentation necessary for the creation and/or maintenance of suitable riverine tern, plover, and whooping crane habitat?
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?
Effectiveness – Habitat and Target Species Response	
5.	Do whooping cranes select suitable riverine roosting habitat in proportions equal to its availability?
6.	Does availability of suitable nesting habitat limit tern and plover use and reproductive success on the central Platte River?
7.	Are both suitable in-channel and off-channel nesting habitats required to maintain central Platte River tern and plover populations?
8.	Does forage availability limit tern and plover productivity on the central Platte River?
9.	Do Program flow management actions in the central Platte River avoid adverse impacts to pallid sturgeon in the lower Platte River?
10.	Do Program management actions in the central Platte River cumulatively lead to detectable changes in the physical environment, habitat, and consequently population responses by least terns and piping plovers in the central Platter River and use of this area by whooping cranes?

- Need to identify and log critical Program decisions. Possible table:

Critical Decisions	Questions GC Members Have	Management Flexibility	Time to Implement	Time to Evaluate and Adjust	Reversibility of Action

- Similarly identify and log critical uncertainties for the Platte River system and the target species, and how they relate to Big Questions. Possible table:

Critical Uncertainties	Relationship to Big Questions/Statement of Broad Hypothesis	Management Implications	What would be compelling evidence to alter management?	How could you test this?	Challenges (spatial/temporal contrast, monitoring precision, etc.)

1.4 Conceptual Models

NEXT STEPS (March 2017-Feburary 2018)

- Current conceptual models in AMP are "management models" and need updated
- Develop Conceptual Ecological Models (CEMs) based on target species life history, riverine processes, etc.
- Develop Conceptual Management Models (CMMs) to provide visual framework for how Program

management could influence important aspects of the CEMs

- Develop simulation models to predict effectiveness of management actions
  - Operations model
  - Physical process model
  - Species response model(s)
- Use models to explore effects of alternative actions

1.5 Hypotheses, Performance Measures, and Benchmarks

NEXT STEPS (March 2017-Febuary 2018)

- Given the results of AMP implementation during the First Increment and the direction of the Extension, develop new hypotheses for testing during the Extension
- Appendix A is a catalog of the status of Priority Hypotheses now identified in the AMP
- Statement of hypothesis, alternative hypothesis, and X-Y graph (if possible); must related to Big Questions/critical uncertainties
- Express key uncertainties and alternative hypotheses of system function
- Assess sensitivity of forecasts (model results) to alternative hypotheses.

Possible table:

Hypothesis	Alternative Hypothesis	Relationship to Big Question(s)	Performance Measures	Benchmarks	Time to Detect Response	Feasibility	Cost Estimate	Logical Sequence

1.6 Management Actions

NEXT STEPS (March 2018-February 2019)

- What are the possible management actions/strategies during the Extension?
- Explore potential for management experiments to test hypotheses.
- SDM process – important for Assess, Design, and Adjust steps of AM
- Simulation models and other tools to see what would happen if different management actions/strategies were implemented

1.7 Spatial and Temporal Bounding

NEXT STEPS (March 2018-February 2019)

- Program area remains the same, but does the spatial scale include the lower Platte (pallid sturgeon)?
- Be specific as to time requirements for implementation and expected responses

2.0 AM Cycle Step 2 – Design

NEXT STEPS (March 2018-February 2019)

- Describe experimental design for hypotheses and management actions detailed in Section 1.0
- Design management plan and monitoring program.
  - Consider management options and develop management options/strategies as management experiments.
  - Evaluate management options/strategies and chose one to implement.
  - Design/update monitoring protocols
  - Review data management and analysis procedures.
  - Explicitly state how management actions or objectives could be adjusted
    - Define intensity and degree of response in indicators that will trigger changes in actions or objectives[1]
  - Review system to communicate results and information.

[1] Adjustments should reflect trade-off between costs of acting if preliminary results later prove to be incorrect, and the cost of not acting if they later prove to be correct.

3.0 AM Cycle Step 3 – Implement

NEXT STEPS (March 2018-June 2019)

- Implementation flow chart, project oversight and management, reporting

4.0 AM Cycle Step 4 – Monitor

NEXT STEPS (March 2018-June 2019)

- Discussion of implementation, effectiveness, and validation monitoring to be conducted during Extension; update of IMRP
- Break down by target species/management objectives
- Relationship to Big Questions

5.0 AM Cycle Step 5 – Evaluate

NEXT STEPS (March 2018-June 2019)

- Discussion of data analysis, synthesis, and reporting
- Break down by target species/management objectives
- Relationship to Big Questions
- Role of independent science review (ISAC, peer review, publication)

6.0 AM Cycle Step 6 – Adjust

NEXT STEPS (March 2018-June 2019)

- Describe process for telling the AM "story" to GC
- GC decision-making (SDM or other decision processes)
- When Big Questions and hypotheses are answered, how does the GC decide?

References Cited

Platte River Recovery Implementation Program (PRRIP). 2006a. Adaptive Management Plan. U.S. Department of the Interior, State of Colorado, State of Nebraska, State of Wyoming.

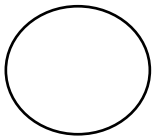
Platte River Recovery Implementation Program (PRRIP). 2006b. Final Program Document. U.S. Department of the Interior, State of Colorado, State of Nebraska, State of Wyoming.

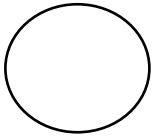
Murray, C., Smith, C., Marmorek, D. 2011. Middle Rio Grande Endangered Species Collaborative Program Adaptive Management Plan Version 1. Prepared by ESSA Technologies Ltd. (Vancouver, BC) and Headwaters Corporation (Kearney, NE) for the Middle Rio Grande Endangered Species Collaborative Program, Albuquerque, NM.

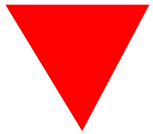
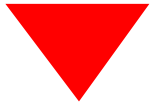
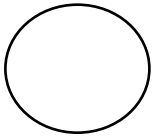
Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2007. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, D.C. 72 pp. Available online: https://www2.usgs.gov/sdc/doc/DOI-%20Adaptive%20ManagementTechGuide.pdf

APPENDIX A: Priority Hypotheses Status Table. Status of AMP priority hypotheses, as identified in Table 2 of the Adaptive Management Plan (PRRIP, 2006a). See color coding key at end of table.

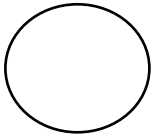
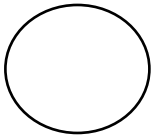
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
System							
S1	The Platte River form can be modified by either mechanical/sediment/flow management (i.e., clear/level/pulse) or mechanical means along with non-Program managed flows (i.e., clear/level/mechanical).		#10	Geomorphology and vegetation monitoring, LiDAR and other aerial imagery, EDO analyses		Collecting the data necessary to answer all S1 hypotheses. To date, *State of the Platte* evaluations focused on BQ #1-#9. The S1 hypotheses and BQ #10 will be addressed in years 2017-2019.	OK with "Notes".
S1a	Program channel habitat restoration actions will result in detectable change to Platte River form and function.	Cannot detect a significant effect on indicators.	#10	Geomorphology and vegetation monitoring, LiDAR and other aerial imagery, EDO analyses		Same as S1.	The term "detectable" as in "measurable" is key, OK with "Notes" for now.
S1b	Program land management actions (i.e., restoration into habitat complexes) will have a detectable effect on target bird species use of the associated habitats.	Cannot detect a significant effect on indicators	#10	Geomorphology and vegetation monitoring, LiDAR and other aerial imagery, bird monitoring, EDO analyses		Same as S1.	There is a significant increase from sandpits on terns and plovers, the hypothesis may need to be broken down into more specific hypotheses.
S1c	Program actions will increase functional wet meadows in habitat complexes during the First Increment.		#10	N/A		Same as S1.	OK with "Notes".

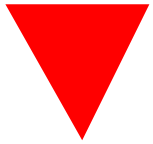
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
S2	Implementing Program land and water management actions (i.e., habitat complexes and clear/level/pulse) will have a detectable effect on other species use of the associated habitats.	Within the overall management objectives for whooping cranes, terns and plovers, and pallids sturgeon, benefits can be provided to non-target listed species and non-listed species of concern thereby reducing the likelihood of future listing and improve overall ecosystem diversity.	N/A	N/A			
Terns and Plovers							
T1	Additional bare sand habitat will increase the number of adult least terns.	Bare sand is not currently limiting number of adults.	#6	PRRIP tern/plover monitoring protocol, EDO analyses, tern/plover habitat synthesis chapters		*2015 State of the Platte* – monitoring and analyses indicate there is a strong positive correlation between Program-defined suitable ***nesting*** habitat and tern and plover breeding pair counts within the AHR.	It may not be necessary to update the X-Y graph but the conclusion should note the increase is due to off-channel sites. Or, at least that an end point for acres of habitat has been determined and the hypothesis is no longer relevant.
T2	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.	#8	Districts' forage fish monitoring protocol, USGS foraging habits study, EDO analyses		Pending publication of manuscript in 2016 will result in conclusive answer for this hypothesis.	OK with "Notes".

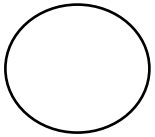
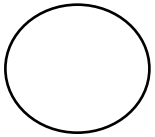
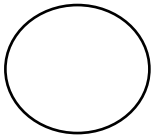
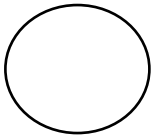
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
T2a	Flow rates influence the number and species diversity in tern prey base (fish).	Tern productivity not affected by fish community species diversity.	N/A	N/A			If the flow rate cannot be tied to productivity per the paper referenced in T2 then this hypothesis can be rejected or the alternative accepted.
P1	Additional bare sand habitat will increase the number of adult piping plovers.	Bare sand is not currently limiting number of adults.	#6	PRRIP tern/plover monitoring protocol, EDO analyses, tern/plover habitat synthesis chapters		*2015 State of the Platte* – monitoring and analyses indicate there is a strong positive correlation between Program-defined suitable ***nesting*** habitat and tern and plover breeding pair counts within the AHR.	See comment under T1.
P2	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.	#8	Districts' forage fish monitoring protocol, USGS foraging habits study, EDO analyses		Tern productivity/flow conclusions generally apply to plovers but need to complete separate analysis and manuscript in 2016-2017.	Since plovers continue to be almost exclusively on sandpits how would we tie flow to chick survival (i.e. production)? It should just be noted that plover do not nest on islands in sufficient numbers to matter.

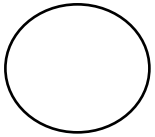
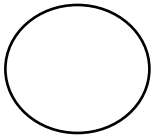
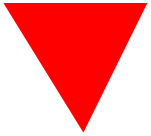
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
TP 1	Interaction of river and sandpit habitat.	LT and PP show no preference for the river over sandpits.	#7	PRRIP tern/plover monitoring protocol, EDO analyses		*2015 State of the Platte* – monitoring and analyses indicate both in-channel and off-channel ***nesting*** habitats are not necessary to maintain the central Platte River population of terns and plovers. However, the river is a valuable source of ***forage*** for both species as forage availability is lower on off-channel habitats.	This was a hypothesis of if birds selected islands over sandpits. The conclusion needs to reflect the hypothesis answered birds do not and all management will be sandpits and a 10-acre moving complex.
TP 2	The central Platte River may act as a source or sink for terns and plovers.	Currently not a sink.	N/A	PRRIP tern/plover monitoring protocol, EDO analyses		Given population growth within the AHR and fledge ratios that exceed all numbers hypothesized to result in population growth, the hypothesis is almost certainly rejected.	The conclusion should be based on the fledge ratio only. Population growth could be due to immigration. Density dependent factors may increase with increased use, this hypothesis should be continually evaluated.
TP 4d	Correlation between river island habitat and flow.		N/A	Tern/plover habitat synthesis chapters		No need to test as sandbars are not suitably high for nesting.	The X-Y graph narrative should note that bars created by anything except the highest flows are inundated at 1,200 cfs or at least are not 1.5 feet above 1,200 cfs. It also raises the question of is 1.5 feet the right number.

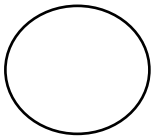
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
TP 5	Use of riverine islands by least terns and piping plovers will increase with active channel width.	Use will not increase with channel width.	#1	Tern/plover habitat synthesis chapters		Hypothesis affirmed in tern/plover synthesis chapter 4.	The hypothesis is supported by data from other rivers in Chapter 4. However, if you are going to base that on data from the Niobrara you would need to examine the need to be 1.5 feet above some flow. NO islands are that high on the Niobrara. This hypothesis is moot given the SDM outcome.
Whooping Cranes							
WC 1	Whooping crane use will increase as function of Program land and water management activities.	Whooping crane use will not increase as function of Program land and water management activities.	N/A	WEST habitat selection report, whooping crane habitat synthesis chapters		Evidence points to accepting this hypothesis. Peer review of key documents is underway and this will change to a conclusive answer in the *2016 State of the Platte*.	OK with "Notes".
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 (preferred depth?) and channel width (define as wetted width, open width, other?).	WC use of areas is not directly linked to FWS habitat suitability values.	#5	WEST habitat selection report, whooping crane habitat synthesis chapters		Evidence points to rejecting this hypothesis. Peer review of key documents is underway and this will change to a conclusive answer in the *2016 State of the Platte*.	OK with "Notes". See Service comments related to this hypothesis on Page 8.

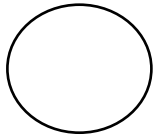
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
WC 4	Whooping crane use of the central Platte River study area will increase proportionally to an increase in wet meadows.	WC do not use wet meadows currently and are unlikely to respond to increases in wet meadow area.	N/A	N/A		Evidence points to rejecting this hypothesis. Peer review of key documents will likely result in a conclusive answer in a future *State of the Platte Report*.	Have there been any whooping crane sightings in restored wet meadows? Were birds on the Johns Tract ever seen out of water? Accept the alternative hypothesis. Service – Restored wet meadow use is certainly not on par with the two pristine wet meadows that have had a lot of repeat use (Mormon Island and Binfield). The Anderson tract, John's tract, and Speidel all have had use in "wet meadow-ish" conditions. They were all either forest or corn and are now grass/wetland. The jury is still out on this one and more time is needed to assess this.
WC 5	Whooping cranes are adversely affected by nocturnal disturbances that lead to flushing (walking or flying) which could lead to potential mortality.	WC are not negatively impacted by nocturnal disturbances.	N/A	N/A			
Pallid Sturgeon							
PS-1	Program flow/sediment management will result in a positive species response by the pallid sturgeon in the lower Platte River.	Program flow/sediment management will result in no increase in species use/occurrence by the plaid sturgeon in the lower Platte River.	N/A	N/A			

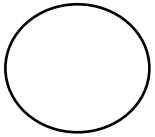
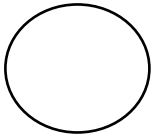
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
PS-2	Program water management will result in measurable changes on flow in the lower Platte River.	Program water management will result in statistically insignificant changes on flow in the lower Platte River.	#9	Stage change study		*2012 State of the Platte* – Stage change study analyses concluded relative change in habitat due to Program water management activities would be small to undetectable and should not provide additional stress to the pallid sturgeon population. Impacts can be avoided through development of operational rules that prohibit Program diversions when lower Platte River discharges fall below 4,000 cfs.	The Service notes inconsistencies with study conclusions and peer reviewer conclusions regarding detection of Program water. Specifically, three peer reviewers answered "yes" in that Program flow can be detected (Guy, Helsel, and Weber). One of the five peer reviewers stated that Program activities cannot be detected (Wilson). One peer reviewer answered "no" because a better evaluation of gaging errors is needed (Gaeuman). The above referenced peer review comments add great uncertainty when it comes to concluding PS-2 with great confidence. The geographic scope of PS-2 is for the "lower Platte River" versus the associated habitat reach, and thus, the Service has concerns about the application of the stage change study for portions of the lower Platte River upstream of the Elkhorn River confluence. Given the above reasons, the Service suggests a yellow color for PS-2.

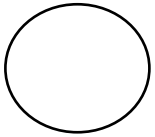
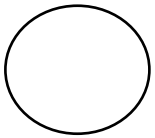
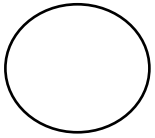
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
PS-4	Flows in the lower Platte will affect pallid sturgeon habitat suitability.	Flows in the lower Platte River will have no effect on pallid sturgeon habitat suitability.	N/A	N/A			
PS-5	Pallid sturgeon habitat suitability is maximized between water temperatures of X and Y in the lower Platte River.	Pallid sturgeon use is independent of river water temperature.	N/A	N/A			
PS-6	Increasing flow in the lower Platte will affect pallid sturgeon habitat availability.	Increasing flow in the lower Platte River will have no effect on pallid sturgeon habitat availability.	N/A	N/A			
PS-7	Increasing habitat availability in the lower Platte will increase pallid sturgeon use.	Pallid sturgeon use is independent of lower Platte River habitat availability.	N/A	N/A			

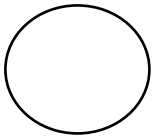
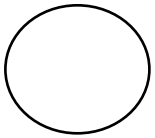
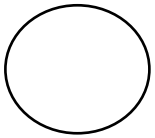
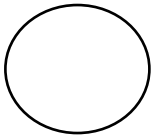
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
PS-9	Increasing Program flow releases will decrease water temperatures in the lower Platte River.	River water temperature is independent of flow rate in the lower Platte River Increases in program flow releases will increase water temperatures on the lower Platte River.	N/A	N/A			
PS-11	Non-Program actions (e.g. harvest, stocking, Missouri River conditions) determine the occurrence of pallid sturgeon in the lower Platte River.	Program actions will affect the rate of occurrence of pallid sturgeon in the lower Platte River such that use is disproportionate to external factors (e.g., stocking, harvest, local conditions) relative to local population.	N/A	N/A			
Physical Processes – Flow							
Flow #1	Increasing the variation between river stage at peak (indexed by Q1.5 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.	Flow magnitudes and channel compilations are insufficient to generate bars high enough to provide habitat for LT and PP. Bars may quickly vegetate making them poor habitat for target species. Bars can be created/maintained by mechanical/other means.	#1	Geomorphology and vegetation monitoring, tern/plover monitoring, tern/plover habitat synthesis chapters		*2014 State of the Platte* – Full SDHF magnitude of 8,000 cfs is not sufficient to create sandbars exceeding the PRRIP's minimum height suitability criterion. Sandbars created by SDHF releases will be inundated during the nesting season in most years.	The hypothesis and alternate hypothesis are not quite the same. Agree with the note on accepting the alternative hypothesis but not sure we can reject the original hypothesis of increasing bar height by 30-50%.

X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
Flow #3	Increasing 1.5-yr Q with Program flows will increase local boundary shear stress and frequency of inundation at existing green line (elevation at which riparian vegetation can establish). These changes will increase riparian plant 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.	#2	Directed scour research, whooping crane habitat synthesis chapters		Evidence points to rejecting this hypothesis. Peer review and publication of key documents is underway and this will change to a conclusive answer in the *2016 State of the Platte*.	Should this change to red with Natasha's publication?
Flow #4	Annual riparian seedling mortality greater than 90% is required to prevent riparian encroachment on exposed bars, thereby increasing (maintaining at least 10 acres/mile) exposed bars between Overton and Grand Island that are usable as LT and PP habitat.	Riparian seedling mortality greater than 90% is needed to increase exposed bar area. Other factors drive exposed bar area instead of seedling mortality. Plant mortality can be achieved by other means.	N/A	N/A			Should this change to red with Natasha's publication?
Flow #5	Increasing magnitude and duration of a 1.5-yr flow will increase riparian plant mortality along the margins of the river. There will be different relations (graphs) for different species.	Insufficient Program flows to maintain required flow durations. Plant mortality can be achieved by other means.	#2	Directed scour research, whooping crane habitat synthesis chapters		Evidence points to rejecting this hypothesis. Peer review and publication of key documents is underway and this will change to a conclusive answer in the *2016 State of the Platte*.	Should this change to red with Natasha's publication?

X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
Physical Processes – Sediment							
Sediment #1	Average sediment augmentation at Overton of 185,000 tons/yr. under existing flow regime and 225,000 tons/yr. under Governance Committee 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.	#3	Sediment transport modeling, results of sediment augmentation Proof of Concept experimental implementation		Augmentation of sediment in the south channel is necessary to slow incision and narrowing and prevent degradation from progressing downstream past the Overton bridge. It will be challenging to measure the effectiveness of augmentation given that the desired beneficial effect is slowing and ultimately halting of a long-term trend.	Is the issue with measuring natural variability? Does the hypothesis need to change?
Sediment #2	A balanced sediment budget (sediment augmentation of 225,000 tons/year near Overton under proposed Governance Committee flows) when implemented with mechanical actions (channel consolidation & widening) in anastomosed reaches will promote braided channel morphology with an average braiding index in the main channel of greater than 3.	Flows and sediment augmentation are insufficient to achieve desired braiding index.	N/A	N/A			

X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
Sediment #3	Increasing the average braiding index of the main channel by achieving a balanced sediment budget, increases the active unvegetated width of the main channel at an index flow of 2,000 cfs (at Overton).	Width will not change with increasing braiding index.	N/A	N/A			
Sediment #4	Increasing the average braiding index to greater than 3 for the main channel in the sediment deficient reach near Overton will increase and maintain exposed bar area greater than 1.5 acres in the reach between Overton and Kearney at an index flow of 1,200 cfs (at Overton).	There is no relationship between braiding index and area of exposed bars. Exposed bars may be created (maintained) through mechanical means without need to change braiding index.	N/A	N/A			
Physical Processes – Mechanical							
Mechanical #2	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.	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.	#4	Directed scour research, whooping crane habitat synthesis chapters		Evidence points to affirming this hypothesis. Peer review and publication of key documents is underway and this will change to a conclusive answer in the *2016 State of the Platte*.	Where have we consolidated flow?

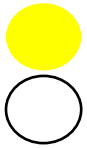
X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
Mechanical #3	Reducing the number of channels in a transect to 3 or less under balanced sediment budget will convert anastomosed reaches of the Platte River between Overton and Chapman to a braided channel morphology. With proposed flow regime, should occur with greater number of channels.	Reducing the number of channels in a transect to 1 or 2 is necessary to achieve an average braiding index in the main channel of greater than 3.	N/A	N/A			
Mechanical #4	Increasing the average braiding index to greater than 3 in the main channel by channel manipulation will promote in the Platte River at the mechanically changed sites a total main channel wetted width exceeding 500 to 750 ft at an index flow of 1,700 cfs (at Overton).	A braiding index greater than 4 is needed to achieve a width greater than 500 ft. There is no relation between braiding index and channel width.	N/A	N/A			
Mechanical #5	Increasing the average braiding index to greater than 3 for the main channel by mechanical channel manipulation, will increase and maintain exposed bar area greater than 1.5 acres at mechanical changed sites at an index flow of 1,200 cfs (at Overton).	Mechanically consolidating flows will have no effect on areal extent of bars.	N/A	N/A			

X-Y Graph Number	Description of hypothesis	Description of alternative/competing hypotheses	Link to PRRIP Big Questions	Data Source(s)	Hypothesis Test Results [i]	Notes	Comments from TAC/AMWG
Wet Meadows							
WM-2	Wet meadows producing the optimum productivity and diversity of macro-invertebrates potentially consumed by WC exhibit certain characteristic combinations of soils, hydrology, size and location. Mormon Island and adjacent to Rowe Sanctuary have some of best existing combinations	There are too many possible combinations of site characteristics to allow for a meaningful characterization of "desirable" conditions.	N/A	N/A			
WM-3	Shallow surface water and groundwater in March and April support high productivity and diversity of macroinvertebrates as potential food sources to WC in wet meadows.		N/A	N/A			
WM-4	A predominance of organic-rich soils supports the productivity and diversity of macro-invertebrates as potential WC food sources in bottomland grasslands.	Wet meadows and their soils are too complex and variable to allow this individual factor to be effectively assessed.	N/A	N/A			
WM-8a	As the spring depth to groundwater increases, surface soils stay frozen longer. Where groundwater is closer to the surface soils thaw sooner.		N/A	N/A			

[i] Hypothesis Test Results are indicated as one of the following categories:

Hypothesis answered conclusively – affirmed.

Hypothesis answered conclusively – rejected.



Hypothesis not yet answered – ongoing implementation, analysis, and synthesis.

Not currently being addressed through implementation of the AMP.

APPENDIX B: