Appendix Q

Review

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Missouri River Bed Degradation Feasibility Study Technical Report, Missouri and Kansas

Section 216 of Public Law 91-611, Flood Control Act of 1970

Agency Technical Review

Review of Draft Technical Report

Prepared for the FRM-PCX by

Craig Evans, ATR Lead
CEMVP-RPEDN-PD-F
June 2017

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AGENCY TECHNICAL REVIEW REPORT

ENCLOSURES

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Subject: Review report for review of the Draft Technical Report for the Missouri River Bed Degradation Feasibility Study, March 2017 through June 2017, Kansas City District.

1. **Scope and Purpose of Review:** The purpose of this review report is to document the agency technical review (ATR) for the subject products. The review was conducted for the Kansas City District. The primary point of contact for the District was Ms. Christina Ostrander, CENWK-PM-PF.

The ATR team (ATRT) was led by Mr. Craig Evans, CEMVP-RPEDN-PD-F. The Flood Risk Management Planning Center of Expertise (FRM-PCX) was the lead center for managing this ATR.

2. **References**

a. This review report was prepared in response to Planning Bulletin 2016-02, 4 March 2016 and EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. The review documents reside online at ProjNet (www.projnet.org). The DR CHECKS Project and Review title is "(400367) Missouri River Bed Degradation Feasibility Study, Technical Report ATR," 3 Mar 2016 to 15 Apr 2016.

b. The review was conducted in accordance with the Review Plan dated February 11, 2013 and approved by the Northwest Division Commander on March 8, 2013. The review plan was updated in February 2017.

3. **Project Description**

The study is authorized by Section 216 of Public Law 91-611, Flood Control Act of 1970. The purpose of the study is to identify and evaluate alternatives to address the impacts of river bed degradation that is occurring on the lower Missouri River, from Rulo, NE to the mouth at St. Louis, MO. The Missouri River Bank Stabilization and Navigation Project (BSNP) is the federal project of interest, both as a causal factor, and as part of the impacted federal infrastructure. The study identified and evaluated alternatives to minimize future impacts of the bed degradation to the federal infrastructure and local public. The study examined the effects of degradation on the long-term stability and sustainability of the BSNP. There are significant flood risk management features, located primarily within the Kansas City Reach and near St. Joseph, MO, that are dependent on the stability of the BSNP and are potentially also impacted by continued bed degradation.

The study did not identify a viable construction project and is being terminated. A "Technical Report" documents the analyses and findings of the study.

4. **Review Team.**

This ATR team included the following disciplines: ATR Lead (including Plan Formulation), Economics (including Risk & Uncertainty), Hydraulic Engineering (three reviewers, including Risk & Uncertainty), Structural Engineering, Geotechnical Engineering, and Cost Engineering. The full ATR team as identified in the original review plan (reference 2b) included the following additional disciplines: Environmental/NEPA, Civil Engineer, Navigation, and Real Estate; these

disciplines were not needed for this review, because the Technical Report did not address those areas of expertise.

ATR Lead (including Plan Formulation)
Craig Evans, CEMVP-RPEDN-PD-F, serves as the Chief of the Plan Formulation Section in St. Paul, MN. He has 30 years of experience with the Corps of Engineers including 12 years in civil design and 18 years in planning and project management. He is a registered Professional Engineer in Minnesota, holds a bachelor's degree in civil engineering and a master's degree in Public Administration, and is a 2005 graduate of the USACE Planning Associates Program. He is a certified ATR reviewer for Plan Formulation. He has led several reconnaissance studies, multi-purpose feasibility studies, watershed studies and developed plans and specifications for construction projects. He has significant experience with plan formulation and report writing for flood risk management, ecosystem restoration and stream bank protection as well as civil engineering review and value engineering.

Economics (including Risk & Uncertainty)
Brian Maestri, CEMVN-RPEDS-PDE-FRC, is a Regional Economist stationed at New Orleans District of the U.S. Army Corps of Engineers since 1985. Mr. Maestri is a certified economic ATR reviewer for flood risk management and a FRM-PCX certified subject matter expert for risk and uncertainty. He is currently a Flood Risk Management Regional Technical Specialist for the Mississippi Valley Division. He was a member of the Interagency Performance Evaluation Task Force (IPET) Interior Flood Control Team in the wake of Hurricane Katrina. He has a Master's and undergraduate degree in Economics from the University of New Orleans (UNO). He has served as an interdisciplinary team member on several large-scale flood risk management studies including the Morganza to the Gulf of Mexico, La. Feasibility and PAC and the Louisiana Coastal Protection and Restoration (LACPR) evaluation. He has participated in six expert elicitation sessions that were conducted for various Corps studies, including development of site-specific depth-damage relationships for structures, contents and vehicles and for emergency costs following a storm event. He served as an Economic Advisor on the National Flood Risk Management Team in 2011 and 2012. He has also served as an instructor for the Corps Flood Risk Management PCC4 training modules held in Jacksonville, Florida (2010), Crystal City, Virginia (2010-11), Dallas, Texas (2012) and New Orleans, Louisiana (2013). He has also taught a module on Coastal Storm Risk Management for the PCC4 classes.

Hydraulic Engineering
Mike Alexander, CESAM-EN-HH, is a Registered Professional Engineer with over 35 years of USACE experience dealing with channel stability, navigation, and training structures design. Mike is a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Mike serves as Lead Hydraulic Engineer in the Hydrologic, Hydraulics, and Coastal Engineering Design Section. He started work with the USACE Laboratories in 1981 at the Waterways Experiment Station's Coastal Engineering Research Center and later working in the Coastal and Hydraulics Laboratory at the Engineering Research and Development Center (ERDC). Mike moved to the USACE Vicksburg District in 2000, where he was involved with developing 2-dimensional modeling and sediment transport expertise and capability. Project experience includes dredging equipment techniques/applications, dredged material production/disposal

evaluations, and wetland restoration with dredged material. Over the last 15 years, work focused on 1-, 2-, and 3-dimensional numerical model studies for navigation and flood control projects, often with sediment transport modeling components. His current work after moving to Mobile District in 2015, is on strategic, quick-turnaround numerical model applications for navigation issues and associated training structure designs. He also presently serves as Acting Chief of the Hydrologic, Hydraulics, and Coastal Engineering Design Section, Water Resources Branch, Engineering Division, at Mobile District.

Hydraulic Engineering

Dr. Paul Boyd, CENWO-ED-HF, is a hydraulic engineer and Regional Technical Specialist for Sedimentation and Alluvial Processes in Omaha District. He is a registered Professional Engineer in Iowa and a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Dr. Boyd has been with the US Army Corps of Engineers since 2002, serving in numerous roles primarily associated with river and reservoir sediment transport and management, including 1-d and 2-d modeling of sediment transport, reservoir flushing modeling, emergent sandbar habitat design, reservoir data collection management, and senior technical review of USACE publications. He is currently working on advancing modeling tools for simulating hydraulic flushing at USACE reservoir projects. In addition, Dr. Boyd is heavily involved in the Missouri River Recovery Program (MRRP) by working on habitat creation projects to protect endangered species. Most recently, he has been tasked as technical lead for reservoir sedimentation training and guidelines development with the Government of Lao PDR as part of the USAID Smart Infrastructure for the Mekong (SIM) River program. In addition, he is currently focused on developing plans for reservoir sustainability to extend the useful life of Federal reservoirs.

Hydraulic Engineering (including Risk and Uncertainty)

Daniel Pridal, CENWO-ED-HF, serves as Chief of the River and Reservoir Engineering Section, Omaha District Hydrologic Engineering Branch. He has 28 years of experience with the Corps of Engineers, serving as Section Chief for the past 9 years and as a regional technical specialist for hydraulic design and analysis for the preceding 6 years. He is a registered Professional Engineer in California and holds a Masters of Science degree in Civil Engineering. Dan is a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28 and he is a FRM-PCX certified subject matter expert for risk and uncertainty. He serves as technical expert and advisor on sedimentation, channel stabilization, and stream restoration activities. He has significant experience in the hydrologic design and analysis of technical projects for flood damage reduction projects, stream restoration, shallow water and emergent sandbar habitat projects for Missouri River recovery, O&M projects for the Missouri River reservoir system and navigation channel.

Structural Engineering

Tim Grundhoffer, CEMVP-EC-D, is a registered engineer with over 25 years of structural engineering experience with flood protection and navigation projects. Tim is a certified ATR reviewer for several structural categories listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. For the last 6 years has served as a structural Regional Technical Specialist (RTS) for MVD. Additionally for the last 5 years has served on dam and levee risk cadres in support of the RMC. He has experience in the analysis and design

of many structural features including: Lock and dams, various pile foundations, flexible pile caps, various retaining structures, sheet pile structures, retaining walls, floodwalls, road and railroad closures, bulkheads, dam control/spillway structures, buildings and building foundations. Additionally, experience includes risk analysis and risk assessments of levee and dam projects. He also assists HQ with updating criteria for reinforced concrete design, I-walls and sign support structures.

Geotechnical Engineering
Neil Schwanz, CEMVP-EC-G, is a registered professional engineer with over 38 years of geotechnical experience. He is currently Chief of Geotechnical Engineering Branch in St. Paul District. Neil is a certified ATR reviewer for several geotechnical categories listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28 and has led and participated on numerous ATR teams nationwide. He has a broad based experience with levee and embankment dam design and with soil structure interaction. He assisted HQ with establishing design criteria for the Greater New Orleans risk reduction system and lead teams in developing analysis and design procedures for SSI based design including the use of advanced analysis techniques. He also assists HQ with developing or revising criteria for levee and floodwall design. Mr. Schwanz assisted on the levee methodology team supporting the BCRA done for the St. Paul, Minnesota, project.

Cost Engineering
James Neubauer is the Cost ATR Coordinator for the Cost MCX, Walla Walla, WA. (Cost ATR for this study was performed separately from the rest of the ATR team and coordinated directly with Kansas City District.)

5. **Charge to Reviewers.**
See Enclosure 1.

6. **Summary.**

a. This review was intended to verify that the Technical Report adequately describes the analyses that were completed and that the analyses support the conclusions presented in the report. The ATR team considered the assumptions and judgments supporting the inputs to the economic model and verified that the H&H modeling results were used appropriately. This included evaluating the trigger points in the economic model that are based on engineering judgment and H&H data. The ATR team also considered the array of alternatives evaluated to ensure that no promising alternatives were overlooked before concluding that no federal action is warranted.

b. Prior reviews.

- An initial targeted review documented in an October 2014 ATR report validated use of the mobile bed hydraulic model in conjunction with an economic spreadsheet model. (See ENCLOSURE 5.)
- The economic spreadsheet model was approved for one-time use on 10 Mar 2015 in accordance with EC 1105-2-412. The study approach includes risk and uncertainty features within the economic model in addition to a sensitivity

analysis/scenario approach for hydraulic and hydrologic inputs. The 18-Feb-15 FRM-PCX review memo for the Economic Model says: "The Kansas City District and review team agreed that it wasn't practical to explicitly incorporate uncertainty around the engineering inputs (river bed and water stage elevations), so the District proposed addressing the uncertainty in engineering inputs through the use of sensitivity and scenario analyses . . . The proposed approach was considered by both the model review and ATR teams and judged to adequately address the review concerns. The sensitivity and scenario analyses were subjected to additional District Quality Control, ATR, and Independent External Peer Review in later phases of the study.

- A targeted review of the hydraulic model calibration to existing conditions was completed in March 2016 and is documented in a report dated September 2016. (See ENCLOSURE 6.)
- A targeted review was conducted to verify that the hydraulic model properly defined future without project (FWOP) conditions and the study approach adequately addressed risk and uncertainty as related to the FWOP conditions. The review was completed in July 2016 and is documented in a report dated September 2016. (See ENCLOSURE 7.)

c. The PDT posted the Technical Report, Appendices A-P and documentation of DQC review in DR CHECKS on 21 March 2017. The economic model spreadsheets and background information were provided to the ATR lead on 7 April 2017. Information on the with-project version of the mobile bed hydraulic model was provided to the hydraulic engineering reviewers on 30 May 2017.

d. The ATR team conducted its review of the Technical Report and economic model documents in March and April 2017. The PDT and ATR Lead held a teleconference on 25 April to discuss issues with the economic spreadsheet models, and final ATR comments were entered into DR CHECKS on 1 May 2017. Revised documents were posted in DR CHECKS on 17 May, and revised economic model files were provided on 18 May. Additional issues were found with the economic spreadsheets, and comments were provided via email on 20 May. The PDT, ATR Lead and Economics reviewer held a teleconference on 23 May to discuss remaining issues. On 30 May the PDT provided revised economic model spreadsheets, revised report documents and the with-project hydraulic models. The hydraulic engineering reviewers validated the final model results and made no comments in DR CHECKS regarding the hydraulic model. All DR CHECKS comments on the Technical Report and economic models were closed on 30 May.

e. The ATR comments were primarily concerned with the following issues:

- Clarifying text in the report that potentially understates impacts to flood heights, flood risk and the environment that may be expected from implementing alternatives.
- Clarifying text to say that O&M costs were not included in the total project cost estimates.

- The report needs to clearly state that a traditional risk and uncertainty analysis was not performed for this study and include the formal approval of the economic model which allowed the use of a scenario approach.
- The sensitivity analysis regarding potential costs to change from river dredging to pit mining as a source of aggregate was originally included in the regional economic analysis section of the report. If additional costs were incurred that raised the price of aggregate, they would be national economic development costs. The final report discusses this sensitivity analysis separate from the regional economic analysis.
- The report demonstrates that aggregate dredging at currently permitted levels is the primary cause of bed degradation, but it does not highlight this conclusion.
- The original report omitted several alternatives that were considered in the early phases of analysis and in the Value Engineering study. The final report includes a more thorough discussion of measures and alternative scales that were considered and screened out.
- The original report lacked detail about the currently permitted levels of dredging and the modified levels used in the final array of alternatives. The final report more clearly defines the different levels of dredging used in the analyses.
- The economic spreadsheet models originally made several simplifying assumptions that differed from the assumptions stated in the report and Appendices. These assumptions affected when various future investments would be made, and therefore affected the modeled average annual damages. The spreadsheet models were revised to match the stated assumptions in the report Appendices.
- The report needs to clearly state that the economic model was approved only for a one-time use in this study, and any future use of the model would require significant updating. Also, the economic model does not include all potential damages; it was not intended to optimize levels of dredging and is not suitable for that purpose.
- The final economic spreadsheet models were reviewed and found to be consistent with stated assumptions. The models incorporate review recommendations made during the model certification process. Risk and uncertainty is adequately addressed through the non-traditional scenario analyses that were described in the report and approved when the economic model was certified for one-time use. Overall, the final economic model works as anticipated, and its use is consistent with the approval granted on 10 March 2015.
- The hydraulic engineering reviewers determined that the structure modifications and the sill alternatives were adequately developed into the hydraulic model geometry, and model simulations effectively show the resulting water level/bed change conditions in the form of reach-averaged solutions. No formal comments were posted in this final review regarding the mobile-bed hydraulic model. The base model was extensively reviewed in earlier targeted reviews.

f. Critical Comments. No critical issues were identified.

g. Unresolved Comments. The PDT responded acceptably to all comments, and the ATR team closed all comments in DR CHECKS.

h. Lessons Learned. The economic spreadsheet models were an integral part of the analysis for this study, and they were very complicated spreadsheets with many interdependent worksheets. The original spreadsheet models provided for ATR were structurally sound and worked as anticipated, although they employed different assumptions than were stated in the report and Appendices. Changes made in response to ATR comments affected certain calculations within the spreadsheets, and normal DQC efforts did not catch the errors that were introduced. It is critical that an extremely thorough DQC be conducted whenever spreadsheet models are used, because it is easy to inadvertently corrupt formulae or overlook references within the model that have been affected by changes. Careful review and testing is needed to ensure that the spreadsheets are producing valid results, especially after major changes are made.

7. DR CHECKS Report. The DR CHECKS report of all comments is attached as Enclosure 2

8. ATR Completion Statement.
Enclosure 3 contains the completion statement.

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Enclosure 1

CHARGE

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US Army Corps of Engineers ®

AGENCY TECHNICAL REVIEW

CHARGE TO THE MISSOURI RIVER BED DEGRADATION FEASIBILITY STUDY PROJECT DELIVERY TEAM & AGENCY TECHNICAL REVIEW TEAM

FOR

TECHNICAL REPORT REVIEW

Missouri River Bed Degradation Feasibility Study, MO & KS
Section 216 of Public Law 91-611, Flood Control Act of 1970

Prepared by: Kansas City District, Degradation PDT
Date: 23 March 2017

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CHARGE TO REVIEWERS

OBJECTIVE

The Missouri River Degradation Feasibility Study did not identify a viable cost-shared construction project and is being terminated. A "Technical Report" which documents the analysis and findings has been assembled, and is provided for review. Much of the work contained in the appendices to the technical report (mobile bed model existing conditions and calibration; mobile bed model future without project with risk & uncertainty; economic model; structural appendix; geotechnical appendix) has previously undergone targeted Agency Technical Review. Reviewers are asked to consider this information, but to focus on how this underlying information is used to develop and analyze alternatives, and clarity of presentation of the results.

The overall purpose of this ATR is to verify that the Technical Report adequately describes the analyses that were completed and that the analyses support the conclusions presented in the report. The ATR team should consider the assumptions and judgments that support the inputs to the economic model and verify that the H&H modeling results were used appropriately. This will include evaluating the trigger points in the economic model that are based on engineering judgment and H&H data. The ATR team should also consider the array of alternatives evaluated to ensure that no promising alternatives have been overlooked before concluding that no federal action is warranted.

EC1165-2-214 defines decision and implementation documents as follows:

Decision Document - For application of the policy contained in this circular, a "decision document" is any product that provides analysis and recommendations for an Agency decision to obtain project authorization to commit Federal funds for project implementation or project modification. They are the basis for approval to spend/receive funds as a result of entering into agreements with other agencies or organizations including those to obtain Congressional authorization.

Implementation Document - For application of the policy contained in this circular, an "implementation document" is defined as a document prepared, generally subsequent to the decision document (e.g. Plans and Specifications), that supports project implementation or project modification in accordance with the decision document and its authorization.

This Technical Report is neither a decision document, nor is it an implementation document. Therefore, while reviewers are expected to be in general compliance with policy, guidance and the "Review Criteria for ATR" set forth in EC 1165-2-214 and copied below for reference, they are also asked to apply appropriate judgment in recognizing the unique nature of the documents provided for review.

h. Review Criteria for ATR. (from EC 1165-2-214)

(1) Products will be reviewed against published guidance, including Engineering Regulations, Engineering Circulars, Engineering Manuals, Engineering Technical Letters, Engineering Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE. Any justified and approved waivers should have been obtained from HQUSACE for any deviations from USACE guidance.

(2) Key considerations include:

(a) The project meets the customer's scope, intent and quality objectives as defined in the PMP.

(b) Formulation and evaluation of alternatives are consistent with applicable regulations and guidance.
(c) Concepts and project costs are valid.
(d) The non- Federal sponsor is aware of its requirements and concurs with the proposed recommendations.
(e) The recommended alternative is feasible and will be safe, functional, constructible, environmentally sustainable, within the Federal interest, and economically justified according to policy.
(f) All relevant engineering and scientific disciplines have been effectively integrated.
(g) Appropriate computer models and methods of analysis were used and basic assumptions are valid and used for the intended purpose.
(h) The source, amount, and level of detail of the data used in the analysis are appropriate for the complexity of the project.
(i) The project complies with accepted practice within USACE.
(j) Content is sufficiently complete for the current phase of the project and provides an adequate basis for future development effort.
(k) Project documentation is appropriate and adequate for the project phase.

(3) Additional considerations for Decision Documents.
(a) Recognizing that the quality of each decision document has a direct and immediate impact on the credibility of the Corps of Engineers and the Department of the Army, ATR on decision documents should address the basic communication aspects of the documents. Quality decision documents allow the public and stakeholders to understand the planning effort and its results, and enable decision makers to reach the same conclusions as the reporting officers (i.e., Quality decision documents are not a simple reporting of PDT findings or a record repository of PDT activities).
(b) The main decision document and appendices should form an integrated and consistent product.
(c) As an initial guide, the ATR team should consider the Project Study Issue Checklist in Exhibit H-2, Appendix H, ER 1105-2-100, which includes many of the more frequent and sensitive policy areas encountered in studies.
(d) Other key considerations include:
- Are the existing and future without-project conditions reasonable and appropriate?
- Are the planning objectives, constraints and assumptions consistent with the without project conditions?
- Do the alternative plans provide a reasonably complete array of solutions, make sense relative to the planning objectives and the without-project conditions, and are they complete, effective, efficient and acceptable?
- Are sufficient alternatives formulated to determine the appropriate combination of measures and a reasonable scale for the selected plan (the National Economic Development (NED), National Ecosystem Restoration (NER) or NED/NER Plan)?
- Are the required plans included, such as nonstructural flood risk management plans?
- Are alternatives safe, functional, constructible, economical, reasonable and sustainable?
- Are calculations and results of analyses essentially correct? There should be documentation in the DQC record on this issue.
- Is the engineering content at a feasibility level-of-detail and is it sufficiently complete to provide an adequate basis for the baseline cost estimate (ER 1110-2-1150)?
- Is the real estate content at a feasibility level-of-detail and is it sufficiently complete to provide an adequate basis for the baseline cost estimate (ER 1110-2-1150)?
- Is the environmental mitigation content at a feasibility level-of-detail and is it sufficiently complete to provide an adequate basis for the baseline cost estimate (ER 1110-2-1150)?

- Are comparable cost estimates used for comparing, screening and selecting alternative plans?
- Are analyses for the engineering, economic, environmental, real estate and other disciplines fully described, technically correct, and do they comply with established policy requirements and accepted practices within USACE?
- Is the appropriate plan selected based on the National Objectives and evaluation criteria expressed in Principles and Guidelines and USACE policy? And
- Does the implementation plan have an appropriate division of responsibilities?

i. ATR Comments.

(1) Each review comment should be succinct and enable timely resolution of the concern. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality review comment normally include:

(a) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures;
(b) The basis for the concern – cite the appropriate law, ASA (CW)/USACE policy, guidance or procedure that has not been properly followed;
(c) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability; and
(d) The probable specific action needed to resolve the concern – identify the action(s) that must be taken to resolve the concern.

(2) In some situations, especially addressing incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist. In such situations, the comments generally would defer identifying a probable solution as indicated under dispute resolution below.

(3) ATR comments should generally not include:

(a) Attempts to enforce personal preferences over otherwise acceptable practices, i.e., alternate solutions or analysis methods when the practitioners have already used appropriate methods to develop an adequate solution;
(b) Any other issues that do not add value towards the planning decisions and recommendations, or do not make the recommended plan safe, functional, or more economical.

Enclosure 2

DRCHECKS REPORT OF ALL COMMENTS

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Comment Report: All Comments
Project: Missouri River Bed Degradation Feasibility Study
Review: Technical Report ATR
Displaying 85 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
6897047	Cost Engineering	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Alternatives under ATR)

1. OBSERVATION: Alternatives under ATR study are 4A, 4B, 4C, 5A, 5B, 5C. Cost Alternatives 4A, B and C are all the same cost.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Concur

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897049	Cost Engineering	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Quantity Basis)

2. Quantity basis – CONCERN: Reviewer received quantity basis for Alt5s, lacking Alt 4s. Please provide.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Quantity file has been provided. It should also be noted that the Alternative 4 quantities have changed during the course of the ATR. The design engineer noticed corrections that needed to be made and has revised the quantities.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Provided.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897052 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Quality Control Check)

3. QC – CONCERN: A formal documented QC was not provided. BASIS: ER 1110-2-1302, section 25a requires a documented processes that includes comment and resolution and is performed by a senior cost engineer. SIGNIFICANCE: HIGH. Address QC.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Additional peer review comments/responses have been provided.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Provided.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897055 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

4. Project Properties:

a. General: For escalation index use 1 Oct 2016, same as the TPCS sheet.

b. Cost databases are current for the period of estimate development.

c. Project notes do not seem to reflect the estimates related to subcontract tors and dredging productivity.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Each of these has now been corrected.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Revisions made.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897059 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

5. OBSERVATION: Estimating approach of the Alternative estimates fairly consistent.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Concur

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897060 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

6. Prime and Subcontractors: CONCERN: Prime contractor markups seem reasonable to conservative, but no subcontractors were considered. BASIS: Generally, the Contracting office would require a certain amount of subcontracting, such as small business. SIGNIFICANCE: MODERATE. RESOLUTION: Consider a certain amount such as for clear and grub, possibly hauling.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Added subs for clearing/grubbing & hauling.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897061 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

7. Per Diem – CONCERN: The $92/day rate seems high for contract labor. Generally I would expect to see a certain amount to cover RV site and or 2/hotel room and some meal subsistence. I would expect $45/day more reasonable. BASIS: Experience. SIGNIFICANCE: MODERATE. RESOLUTION: Consider adjustment.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Adjusted to $45/day.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897063 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

8. Alternative level folders: Describe the construction scope/features at each alternative top folder level.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Added.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Provided

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897064 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

9. Alternative 4s: All 3 alternatives are the same cost. Explain the reasoning.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**

All 3 alternatives have the same scope. The reason for 3 different alternatives is that they each refer to different levels of dredging allowed but the construction scope is the same for each.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897068 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: MCACES Estimate)

10. Alternative 5s: Rock size and shape is not clarified in the folder notes but rock size and shape impacts material and productivity costs. Is it cobble, rounded, rip rap? SIGNIFICANCE: UNCLEAR. RESOLUTION: Address in the folder notes.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**

Added notes stating it is quarry run rock with a top size of 36" diameter.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**

Noted.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897077 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

11. OBSERVATION: Generally, I believe the 27% contingency is undervalued.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**

Concur, has increased per the following comments.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Contingencies now at 30%.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897081 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

12. Risk Register: Complete the Concerns columns.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Completed

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897082 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

13. Risk Register – CONCERN: The Impact column has extensive "Crisis" risks which really only belong if the risk is a showstopper. The many Crisis ratings results in unwarranted scrutiny on lesser risks that could be mitigated. Renaming them to Significant or Critical still results in model inclusion. SIGNIFICANCE: HIGH because it brings the model into question and results in lost confidence. RESOLUTION: Reassess the impacts, considering significant of critical impact where more likely.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Corrected

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897083 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

14. Schedule Delays converted to PDT Cost impacts - CONCERN: It is unclear how schedule delays were considered for the cost impacts? Many could impact the PDT, design and/or construction. SIGNIFICANCE: HIGH. RESOLUTION: Ensure PDT schedule impacts are included in the model and contingency output.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**

Several risk items have now been revised to add PDT costs to them to match the corresponding delay in the schedule risk analysis. Additionally, schedule risk analysis results in a contingency duration of approx. 11 years. That contingency duration is factored into the cost risk model in risk PR-7. It accounts for 11 years of escalation (above the OMB projected allowance) due to the schedule delay contingency. The escalation is based on the total project cost so it covers impacts to the PDT, design, & construction costs.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**

Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897086 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

15. CA-1 – CONCERN: Discussions suggest that these alternatives are intended as a MATOC contract. Generally MATOC is less competitive. It is unclear if the MII developed w/ a MATOC contractor as suggested? They are usually not as competitive as open competition. The Alt5's applied the same markups, suggesting they too are intended as MATOC, but that risk discussions suggest otherwise. SIGNIFICANCE: MODERATE. RESOLUTION: Address in the markup applications and folder or Property Notes regarding MATOC for Alt4s and Competitive for Alt5s.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**

Good catch. The latest update in the MII was to assume MATOC for both Alt 4 & Alt 5. The markups used in the MII estimate for both Alt 4 & Alt 5 are consistent for historical MATOC contractors that we've seen. Revised Alt 5 CSRA Risk CA-1 to correct for the contracting switch.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Noted.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897089 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

16. RE-4 and RE-5 – CONCERN: The Discussions suggests contractor impacts and inefficiencies, but the risks were not modeled. SIGNIFICANCE: MODERTAE. RESOLUTION: Assess further and clarify the Discussions.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
RE-4 has been removed based on PDT input as it is seen as having a duplicative impact as PR-3. More discussion to clarify has been added for RE-5.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897097 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

17. CON-1 Construction mods are post contract award, not in design phase. They should be included in the model for both Most Likely and High cases.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Updated

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed, using the uniform distribution in the model.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897100 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

18. CON-6 CONCERN: The Schedule impact is not a risk to Gov't and only in a single construction period. Such delays might result in a construction mod or contractor risk. SIGNIFICANCE: MODERATE. RESOLUTION: Consider a lower risk rating to overall project.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Lowered risk rating

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897102 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

19. Estimate Assumptions - CONCERN: I find little addressing the estimate assumptions related to crews and productivities. SIGNIFICANCE: MODERATE. RESOLUTION: Address both Low and High cases impact potentials.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Added Risk EST-3 to address this concern

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897104 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

20. PED Impacts – CONCERN: Many of the risk Discussions suggest PED impacts, but then apparently rate them as low and do not model the cost impacts. SIGNIFICANCE: MODERATE. RESOLUTION: Address PED or PDT impacts to overall project and schedule risks.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Added cost impacts for PED & PDT delays

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897106 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 4s)

21. PR-7 Project Funding - CONCERN: The model applies a 2% per year potential escalation growth, but OMB does consider a certain escalation forecast. So any further growth would be local escalation above/beyond the OMB projections. And with this type of civil works project, the 2% annual escalation may be overstated. SIGBNIFICANCE: HIGH. RESOLUTION: Assess further.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Good point. Upon review, have lowered to potential of 1% above OMB projections.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897110 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

22. Risk Register – CONCERN: The Impact column has extensive "Crisis" risks which really only belong if the risk is a showstopper. The many Crisis ratings results in unwarranted scrutiny on lesser risks that could be mitigated. Renaming them to Significant or Critical still results in model inclusion. SIGNIFICANCE: HIGH because it brings the model into question and results in lost confidence. RESOLUTION: Reassess the impacts, considering significant of critical where more likely.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Corrected

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897111 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

23. Schedule Delays converted to PDT Cost impacts - CONCERN: It is unclear how schedule delays were considered for the cost impacts? Many could impact the PDT, design and/or construction. SIGNIFICANCE: HIGH. RESOLUTION: Ensure PDT schedule impacts are included in the model and contingency output.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Several risk items have now been revised to add PDT costs to them to match the corresponding delay in the schedule risk analysis. Additionally, schedule risk analysis results in a contingency duration of approx. 12 years. That contingency duration is factored into the cost risk model in risk PR-7. It accounts for 12 years of escalation (above the OMB projected allowance) due to the schedule delay contingency. The escalation is based on the total project cost so it covers impacts to the PDT, design, & construction costs.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897114 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

24. CON-1 Construction mods are post contract award, not in design phase. They should be included in the model for both Most Likely and High cases.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Updated

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed using a uniform distribution in the model.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897117 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

25. TL-1 and TL-2: Cost impacts should be calculated on rock only, at $185M. Other costs should be excluded.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Corrected

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897118 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

26. Risks TL-1, TL-3 and TL-4 - CONCERN: CONCERN: The cost impacts seem overstated. SIGNIFICANCE: HIGH. RESOLUTION: Consider if the risks and quantities are overstated when the 30% waste factors are already included. A 50% addition onto a 30% addition seems overstated, especially for all structures.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Agree, lowered to 25% additional.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Conservative, but accepted.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897120 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

27. Estimate Assumptions - CONCERN: I find little addressing the estimate assumptions related to crews and productivities. SIGNIFICANCE: MODERATE. RESOLUTION: Address both Low and High cases impact potentials.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Added Risk EST-3 to address this concern

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897124 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

28. PED Impacts – CONCERN: Many of the risk Discussions suggest PED impacts, but then apparently rate them as low and do not model the cost impacts. SIGNIFICANCE: MODERATE. RESOLUTION: Address PED or PDT impacts to overall project and schedule risks.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Added cost impacts for PED & PDT delays. The cost impacts have been included in the individual risks where appropriate.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017
Current Comment Status: **Comment Closed**

6897127 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Risk Analyses - Alt 5s)

29. PR-7 Project Funding - CONCERN: The model applies a 2% per year potential escalation growth, but OMB does consider a certain escalation forecast. So any further growth would be local escalation above/beyond the OMB projections. And with this type of civil works project, the 2% annual escalation may be overstated. SIGBNIFICANCE: HIGH. RESOLUTION: Assess further.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Good point. Upon review, have lowered to potential of 1% above OMB projections.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed.

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6897135 Cost Engineering n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: TPCs)

• Why sunk costs in a TPCS? Feasibility study costs are NOT part of TPC.

• Spent cost date would be 1 Oct 2016.

• If MII is a 2016 estimate, TPCS date must also use 1 Sep 2016 CWCCIS.

Submitted By: Jim Neubauer (509-527-7332). Submitted On: Mar 24 2017

1-0 Evaluation **Concurred**
Corrected for each of the points.

Submitted By: Kyle Haake ((816) 389-2220) Submitted On: Mar 29 2017

1-1 Backcheck Recommendation **Close Comment**
Confirmed

Submitted By: Jim Neubauer (509-527-7332) Submitted On: Mar 30 2017

Current Comment Status: **Comment Closed**

6917443 Hydraulics n/a Exec Summary Main Report n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Pg i, para 2: Text states "This approach demonstrated the effectiveness of structural and non-structural measures." Add additional text to clarify text "this approach". Is text referring to the non-structural measures or the study plan to look at both structural and non-structural?
Pg ii, para 1. Text refers to "rock grade control structures". For clarity, suggest something like "installing new rock grade control structures" to distinguish from existing BSNP. Also, suggest adding the text "new" to descriptors for 5A and 5B, para 2 on pg iii. The main report section 9.2.3 could also benefit from a few brief sentences clarifying these are all new structures very different from the existing BSNP.
Pg iii, para 2. Text states "None of the alternatives evaluated would result in bed elevations returning to elevations observed in 1987 by the end of the 50 year period of analysis." Is this specific to only the KC metro area with the worst degradation? What is the relevance of 1987? Fig 18, Appendix C, illustrates predicted aggradation in the KC metro in the future.
Pg iii, para 2. Text "It is likely that grade control structures would result in impacts to fish and wildlife resources and possibly other resource categories." Supporting info for this statement in the main document was not clear. Why would the rock grade control affect fish and wildlife any more than existing BSNP structures?
The Key finding regarding commercial mining impacts is not emphasized in the exec summary.
Pg V, The text states "A detailed assessment of flood heights or flood damages was not undertaken as part of this study. Some of the alternatives have the potential to result in impacts to water quality, fish and wildlife, threatened and endangered species, land use, and cultural resources." The term potential should be replaced with "will likely", also add flood levels to the list of impacts.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

Revised Apr 07 2017.

1-0 Evaluation **Concurred**

Pg i, para 2. Concur. Reworded for clarity.

Pg ii, par 1, Pg iii par 2, and 9.2.3 Concur. Text added to clarify that these are new structures.

Pg iii, para 2. "In Kansas City" added. I have also added a note in 8.1 that 1987 is the earliest digitized survey. It also predates most (but maybe not all) the degradation.

Pg iii, para 2. The environmental implications of grade control were not really described in the report. Accordingly, mention of the likely environmental impacts of grade control has been removed from the executive summary.

Additional emphasis added on the effects of channel mining.

Pg v. Flood heights added.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 10 2017

1-1 Backcheck Recommendation **Open Comment**

Last comment, please further consider the choice of the term potential. Text at the beginning of the paragraph appears contradictory:
Because environmental impacts of alternatives were not evaluated in detail, it is uncertain if any of the alternatives described would result in significant direct, indirect, or cumulative impacts to the environment. Compared to the existing condition, the geomorphology of the river would change for all of the alternatives.
While stating "uncertain" we also state that the geomorphology would change for all alternatives. I think that this paragraph is understating the likely project impact.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

2-0 Evaluation **Concurred**

I have changed "it is uncertain if any of the alternatives described would result in..." to "it is uncertain to what level the alternatives described would result in..."

I retain the word "potential", but change the ordering of sentences in that paragraph which, with the above wording change, I think helps to avoid understating the likely project impact while still staying neutral where we did not do analyses.

Submitted By: John Shelley (816-389-2310) Submitted On: May 22 2017

2-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 22 2017

Current Comment Status: **Comment Closed**

6917444 Hydraulics n/a Main Report n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

General comment. Either add a section on vertical datum to specify what was used for the study (29 or 88) or else add to each individual table / plot (e.g. Fig 7-1).

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

General comment added to 7.1.1 and to table 8-1.

The vertical datum during the calibration time period was NGVD 29 (and comparisons with USGS gage data as in Figure 7-1 were also NGVD 29).

The model was updated with recent bathymetry and dike elevations as the starting geometry for the FWOP and FWP. The updated geometry and future projections were in 88.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 17 2017

1-1 Backcheck Recommendation **Close Comment**
concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6917446 Hydraulics n/a Main Report pg 4
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 1 and 2. Para 1 only discusses one aspect, so it implies that the change in hydraulics is the source for degradation. Suggest refining this to be more of a budget discussion if the sed supply is less than transport, then degradation results. The text includes several sediment budget statements (also pg 47, text and Fig 9-1). However, other components of a traditional sediment budget are not discussed (sediment sources, sinks, etc.) Both Figure 1-2 and 9-1 are on the micro scale. Insert text to state that describe the macro "reach" scale degradation that is more the study focus and that the figure is not representative of all sediment processes, figures are not a comprehensive sediment budget and provided only for illustrative purposes.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**
These paragraphs and figures have been reworked for clarity. The paragraph first introduces the potential sources and sinks, then proceed to the real point, which is that river reaches are interconnected. Figure 1-2 has been updated to emphasize the interconnectedness.

The point of Figure 9-1 and associated paragraphs is to explain how the management measures work. I've changed the caption to "Conceptual sediment budget showing sources and sinks of sediment affected by management measures."

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 10 2017

1-1 Backcheck Recommendation **Open Comment**
Text changes look good. However, Fig 1-2 and 9-1 are different.
In addition, the scale on the figure is quite small, the box covers about the range of 1 cross section, on the order of feet instead of miles. Consider adding a note, something like "For illustrative purposes only. Sediment budgets typically considered on a broad reach scale"

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

2-0 Evaluation **Concurred**
Figure 1-2: I'm not trying to explain what a typical sediment budget is, I'm trying to explain that the reaches of river are inter-connected. I've changed the caption of Figure 1-2 from "Conceptual sediment budget at the small reach scale" to "Inter-connectedness of Missouri River reaches." Hopefully this clarifies the point of the figure and removes the need to for additional caveats.

Figure 9-1: I've revised the figure to be at a higher scale. The point of this figure is to

illustrate how measures work by increasing sediment in, decreasing sediment out (hydraulic) or sediment out (mining), and the scale of alternatives is larger than a single cross section.

Submitted By: John Shelley (816-389-2310) Submitted On: May 22 2017

2-1 Backcheck Recommendation **Close Comment**
concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 22 2017

Current Comment Status: **Comment Closed**

6917448 Hydraulics n/a Main Report pg 19

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Main report pg 19 (Fig 3-3). Also later pg 42, 43. Define the term "detrended" and / or provide a reference to an appendix that includes a definition.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**
Citation added to Appendix C, Section 7.3.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**
concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917449 Hydraulics n/a Main Report pg 20 and 21

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Last and first para. The text is two conflicting points. If maintenance of the structure height is needed for bank stab, then it would seem that the second impact cannot be avoided. Does KC District O&M first repair the dike to the old CRP and then lower the dike? Is this a valid description of actual practice? The main report text in this location does not seem to agree with Append H. Further on in the main report, section 4.1, pg. 26, does a nice job of describing the process. Consider reducing text content at this location and relying more on 4.1.
Main report pg 26, para 1. Suggest using "sediment transport" or "sediment load" instead of "bedload material".

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

These paragraphs have been re-written for clarity. The two modes for degradation are not conflicting, they are operating on different types of structures.

Revetment toes are undermined, which causes rock sloughing.

Dike structures are perched by a degrading water surface, causing less frequent overtopping. This can lead to land accretion, loss of habitat, and loss of flood conveyance.

The Kansas City District has spent money on both of these problems in the recent past, and lowered dikes and reinforced revetments in the same degrading reaches.

Page 26- "bedload material" changed to "sediment transport."

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 10 2017

1-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917450 Hydraulics n/a Main Report pg 34

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Main report, pg 34. Add text to clarify, is the bed elevation change shown derived from an average bed or is it the thalweg?

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

Average bed. Clarification added.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 10 2017

1-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917451 Hydraulics n/a Main Report pg 41

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Main report pg 41, also Appendix K. After reading through text and tables, it is not clear why the existing rock, other than the extra needed on the side slope length, is not sufficient for the revised structure. Is the quantity assuming rock loss due to handling? Is a structure upgrade (increasing size/quantity) planned? Wouldn't the habitat project elevation be allowed or expected to degrade with the river (assuming the control structure is adjusted), the rock crest is at a new and lower

elevation? If the structure footprint (crest width, rock thickness) is increased from the old, then insert additional text to justify why the new structure must be larger than the old to achieve the same performance.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

The appendix has been updated to address these questions.

In summary: The control structure design guidelines have changed, and a chute re-build would have to comply with the current guidelines.

Rock from the existing structure is assumed to be spoiled onsite but not used in the construction of the new grade control structure. This is consistent with Kansas City District dike lowering projects wherein the rock is not re-used in new construction due to the inability to verify rock quality and the difficulty and cost in double handling the rock.

Recent history suggests that river bed degradation rates can greatly exceed rock degradation rates. For the purposes of this analysis, the current elevation of the rock structures is assumed to remain constant. Physically, some level of rock degradation would occur, but this level is likely significantly less than the rate of bed degradation. In addition, the major costs involved are from needing to re-build the entire structure when the rock thickness falls below the minimum thresholds-- a situation that is not offset by the rock degrading.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 17 2017

1-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917555 Hydraulics n/a Main Report Pg. 51 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

pg 51. Section 9.3. Alternative 2 – 4 all describe lowering the BSNP dikes from RM 391 to 449 to 5 ft below CRP. Sections for Alt 2 and 3 state that quantities of material costs and total project costs were not determined. Table 9-1 illustrates the difference between the alts. Additional text is needed to clarify the difference between the alts within the individual text sections within the report. The figures 9-1 through 9-3 show the primary difference, but it is not stated in the text. Rather than individual figures with the location map (which looks the same) that takes up most of the space, consider using a different approach to highlight the difference between alts. Costs are included as total project cost. Do these costs include changes in O&M costs? The rock grade control structures are a very large rock quantity with likely substantial O&M.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

A new figures has been added to better demonstrate the differences among alternatives.

Costs do not include O&M costs. The grade control structures are already not cost effective and not carried forward for analysis. You are correct that the O&M tail on such a large number of additional structures would be substantial-- an additional reason that these structures are not economically viable.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Open Comment**

Section 9.2.3 states that the grade control structures were carried forward for analysis. Costs are provided for each grade control alt within section 9.4.
Can you add a text statement in section 9.4 (either a general upfront or in each of the grade control structure alts) that costs do not include any O&M costs after installation which could be substantial?

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

2-0 Evaluation **Concurred**

Concur. This has been added to 9.4 and also to the captions for Table 10.4, 12.3 and 12.6.

Submitted By: John Shelley (816-389-2310) Submitted On: May 22 2017

2-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 22 2017

Current Comment Status: **Comment Closed**

6917557 Hydraulics n/a Main Report Pg. 58 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Main report, pg 58-60, also pg 80. For the suite of new grade control structure alts, the text discusses how this would fundamentally change the river and that the design was based on the 1973 CRP. It is not clear how grade control structures for this length of river could be implemented without severe negative impacts on flood protection. On page 80, the text describes how the active channel contains a relatively small proportion of flow and a vegetation succession process. However, the assumption of no impact is not supported by any quantitative analysis. Observations on the Missouri River in Omaha District, that include the 10 to 20 ft of temporary main channel degradation during the flood that fill back in on the receding limb, indicate the main channel conveys about 50 - 70% of total flow. It seems very doubtful that the grade control structure alts will not have a substantial, and detrimental, effect on flood levels. Were impacts to flood levels evaluated? Does sediment deposit between the new structures? Can pre- and post-project water surface profiles be compared? Would lower floods cause more frequent and longer levee embankment inundation?

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

The grade control structures are not particularly high.

(Based on earlier, preliminary analysis they have hydraulic control and induce deposition at low flows but are hydraulically drowned out at high flows, such that they would not raise flood heights.)

Cost and the fact that grade control shifts the degradation back towards Kansas City was sufficient to screen out the grade control. Further analyses was not needed or advised for this SMART planning project.

Were grade control carried forward, more rigor would need to be done to see at what flows they affect the water surface.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 10 2017

1-1 Backcheck Recommendation **Open Comment**

Please reconsider adding statements in the document text about grade control structures, sediment deposition, and potential for effect on flood levels. While the alts do not appear feasible, this document will be a reference for decades. Analysis can be deferred due to infeasible as you stated. However, a thorough text discussion of risk to flood levels is warranted.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

2-0 Evaluation **Concurred**

A statement has been added to the explanations in 9.4: "More rigorous analysis of flood effects would be needed were this alternative selected."

Submitted By: John Shelley (816-389-2310) Submitted On: May 22 2017

2-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 22 2017

Current Comment Status: **Comment Closed**

6917574 Hydraulics n/a Main Report Pg. 87 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

pg. 87 section 12, R&U. The main report text should include a reference to USACE guidance on risk and uncertainty analysis and clearly state that a traditional analysis was not performed. Recommend citing the waiver received from the Planning Center of Expertise that R&U was not required for the econ and H&H models and include the waiver as an attachment. Also clarify that a sensitivity analysis, while often a component, is not R&U. Appendix C, pages 21-22, has a lot of info on the method used. Some of this critical information should be cited within the main report. Fig 12-1, terms like less deg and more deg are undefined. Either delete the figure or explain the link from H&H to Econ Analysis and how the more and less deg was used.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

More detail has been added to the main report, including re-describing the "more degradation" and "less degradation" scenarios closer to where they are used. For the actual equations, the reader is directed to Appendix C.

The approval of the one-time use Econ model will be added to the appendix.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 17 2017

1-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917581 Hydraulics n/a Main Report Pg. 93 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Key technical findings 13.1 bed degradation, pg 93. The term "Kansas City reach", used in the bullets, is not defined. Suggest to revise key findings, which are broad, to be more location specific (bullet 3, 4, 6). Consider Appendix C, Fig 18, which has future condition (2065) bed change from -1 to +2.5 from about RM 410 to RM 360. Also Fig 10, 11, 12 App N which illustrates that results from Alt 1, 4, and 5 are nearly the same, that only the dredge scenario has a significant affect. 13.3, last bullet on flood risk. Suggest revising to something like "This report does not quantify changes in flood risk associated with changes in bed elevations or evaluate if any of the alternatives may affect flood risk." 13.6, grade control, bullet 3. Concerned that this understates the impact of grade control structures on navigation.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

Concur. Specific river miles are given and more descriptive language to indicate locations of trends.

Bullet added on lack of analysis for alternatives impact on flood risk.

Additional bullet added explaining that additional impacts on navigation were not quantified.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**

concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917594 Hydraulics n/a Appendix C n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Pg. 5, Sdeg equation, values used in this equation, and the result of 0.57 and 0.56 are not apparent from the text. Pg. 7, inset pt 1. Add text to state that depletion includes water development projects (the mainstem Missouri River and Kansas River dams). Was this flow record compared to the ManPlan study flow record?
Pg 7, inset 2 and 3, clarify that all flow and sediment are at the upstream model boundary near St. Joseph. Are any other inputs to the model (tributary flows, sediment inputs from tribs like the Kansas) including in this sequence?
Fig 12, 1987 and 2009 are nearly the same color.
Pg 18, define de-trended. Pg 23, SQseries, the text states that this is the standard deviation due to uncertainty in daily flows. However, the analysis method is really uncertainty in bed material load. Add text to clarify this is not hydrologic uncertainty as described in EM 1619. The adopted process assumes that historic flows completely describe the flow probability, without any uncertainty.
Pg 22, inset point 3, text states "damages assessed in the Degradation Study are related to low flows or are tied to bed elevations which are largely independent of flow rate". Is this accurate? What portion of the damage is strictly driven by bed elevation, and not water surface elevation? Consider revising or removing the second half of this statement.
The sediment model is developed from historic data. Did the R&U analysis consider that future sediment processes with alts may not be perfectly reproduced within the model (e.g. the future model accuracy is likely different for the suite of actions for No Action, BSNP, and grade control Alts. Different levels of uncertainty would likely be assigned to account for these variations. Suggest adding a text section that discusses this limitation.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

Revised Apr 06 2017.

1-0 Evaluation **Concurred**

Pg 5- Concur. Table 1 added to show the data needed for computing the 0.56 or 0.57.

Pg 7- Language that the regulated data set includes the effect of dams has been added. Additional information on the Missouri River Reservoir System Daily Routing Model can be found in the cited reference. This project did not compare the DRM to the ManPlan hydrologic data set.
Pg 7-"at the St. Joseph gage" added to clarify. No, only flow (and resulting sediment load) at the St. Joseph gage is included in this sequence. Note, however, that the most degradation is projected to occur near St. Joseph, upstream from any major tributaries.
Fig 12- Line color has been changed for 1987. This remains a somewhat hard to read graph, however, due to the large upstream to downstream change in elevation which obscures temporal trends. This is the reason for Figure 13.
Pg 18- Reworded for clarity that this is the departure from the 1987 average slope line.
Pg 23- Extra language added.
Pg 22- The second half is revised. The point is that in a typical flood study, a high flow on a given day = damage on that day, so there is a correlation between damage and flow. The degradation study assesses damages due to the cumulative effects of all the

preceding daily flows and other factors such as commercial dredging which aren't at all tied to flow. This is fundamentally a different type of damage. To answer your second question, toe erosion at revetments and scour at bridge piers are examples of damage tied to the bed rather than the water surface.

The same uncertainty is used for all the alternatives as was computed for the FWOP, a simplification that is more accurate for the alternatives with channel mining restrictions and BSNP changes (Alts 1A, 1B, 1C, 4A, 4B, and 4C) than for the alternatives with grade control (5A, 5B, 5C). This explanation has been added to the report.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**
concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6917599 Hydraulics n/a App H n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The text does not describe the fate of removed rock. Is this available as salvage stone for use on revetment, degraded quality too small for the revetment but useable as aggregate, considered to be waste rock that must be removed for disposal? Depending on the salvage stone fate, is the $22/yd removal cost (pg 7) reflective of all locations?

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**
This was mentioned in the paragraph above Figure 2 and discussed in section 3.2:

"The floating plant usually consists of a trackhoe stationed on a spud barge and a tow boat to move the barge. The removed rock is wasted down the side of the structure."

Wasting of the rock on the side of the dike is one reason given for not needing to reinforce the toe of dikes.

The $22/yd removal is based on actual costs for previous rock lowering and is generally reflective of all locations, given that the rock is wasted down the side of the structure.

Re-using the rock for any new construction is problematic (and is not typically done) given the difficulty in verifying rock quality.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**
concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6917616 Hydraulics n/a App N n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The sediment model has assumptions inherent regarding suspended load and bed load as components of total load. Several of the alts are likely to change transport characteristics (like the widening or grade control) such that a portion of the suspended load becomes bed load. Was this considered in the analysis?
Section 5 on navigation impacts does not address existing and with project condition water surface profiles for a range of flows as a result of grade control structure construction. It seems likely that these structures will have a substantial impact on flood profiles (see previous comment on the main report).
Pg 13, the text is missing that initially only 6 structures (according to the main report) were used, but this results in drops too large.
Pg 13, the text states "Over time, the drop over the most downstream structure increases because the upstream channel is protected while the downstream channel is not." However, consider Fig 9 which shows positive bed change at RM 410 for two dredging alts. Also Fig 10 and 11 do not show downstream degradation for Alt 5. Review this statement. Does the model show upstream sediment storage within the grade control structure reach?
Pg 14, the 1 ft max limit is described with 31 structures. The main report, pg 59, lists 38 structures for alt 5A, 37 for Alt 5b, and 37 for alt 5C. Does the number vary by alternative? What is the basis for the 1 ft max drop assumption? This 1 ft drop would seem to be accompanied by accelerated velocity and redirected flow currents that would be very difficult for tows to successfully navigate. Why is the 1 ft drop assumed to be navigable? Cite supporting studies or modeling results, or revise texts to acknowledge issue which could completely remove project viability.
Figure 12 is very difficult to distinguish the different alts. Text preceding the figure is incomplete on many alt response. It looks like the dredging scenario (A, B, C) is the primary cause of any difference between Alt 1 (future without), 4 (BSNP mods), and 5 (add grade control).

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 06 2017

1-0 Evaluation **Concurred**

Yes, changes in transport characteristics for the alternatives are automatically calculated in the program as a result of different hydraulics.
Specification of a threshold for bed material vs washload in advance is not a need in a HEC-RAS mobile bed model. (You may be thinking of a SIAM model which does require the threshold as a user input.) Dike lowering with channel widening and grade control are included by changing the channel geometry. The model then automatically computes shear stresses and other parameters needed to compute the sediment transport and whether and how much of each grain class deposits. The only inherent assumption made was that silts and clays are not modeled in any of the alternatives.

The grade control structures were designed sufficiently low that they have no hydraulic control at high flows. See previous comment response. There would be additional work to be done in design. However, because economics eliminates the grade control structures anyway, further analysis was not needed.

Pg 13- That 6 structures were modeled is now explained prior to Fig 3 and depicted in Fig 3, as well as that additional structures are needed for navigability.

Pg 13- Additional explanation added. The effect of stabilizing the upstream channel but not the downstream channel can be seen in the graphs with river mile on the x-axis, such as Fig 6 (at currently permitted dredging) and to a lesser extent in Fig 7 (at reduced dredging, which includes 0 dredging in the reach with the grade control structures.)

The paragraph below Fig 2 states "This appendix presents the modeling results for 6 structures, which are sufficient to demonstrate the effectiveness. As explained later in this appendix, between 37 and 38 structures are required to maintain the navigability of the river."

Pg 14- The 31 GCS are required to reduce the drop to 1 ft between the GCS. The additional 6 to 7 additional GCS are required to reduce the drop over the most downstream structure, resulting in 37 to 38 GCS.

Main Report Pg 59- Yes, the number of GCS needed varies based on the level of commercial dredging (channel mining), as shown in Fig 15.
Based on internal discussions, the 1 ft is probably conservative. i.e. less than 1 ft drop may be desirable, which would require more GCS than proposed. As the grade control was already found not cost effective, a closer look at allowable drop which would further increase the cost was not needed. Language to this effect has been added to the appendix.

Additional labels added to Fig 12. The structural alternatives occur so far upstream that their effect is negligible on the most downstream reach.

You are correct. The dredging level is the primary cause of any difference between alternatives shown in Fig 11 or 12.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**
concur.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6918865 Structural n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Appendix J, Structural, Paragraph 3.4.1: It appear the Corps assumption, for some bridges, of the critical elevation at the bottom of seal course seems overly conservative given depths here. Also, how was uncertainty accounted for in the model? Was there a best estimate on critical elevation or was there a high and low estimate?

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Apr 07 2017

1-0 Evaluation **For Information Only**

See Para. 3.5.1 which explains the rationale on how the critical elevations were determined based on assumptions, engineering judgment, input from bridge owners, existing scour analyses, etc. and used for the economics modeling. Please understand, "The actual critical elevations are most likely much lower than indicated by the selected elevations; however, in the absence of a scour action plan, additional information, and time for analysis, there is no quick or easy way to determine those elevations." This was the best estimate we could make. Thanks

Submitted By: Eddie Fernandez (816-389-3247) Submitted On: Apr 11 2017

1-1 Backcheck Recommendation **Close Comment**

Agree this is difficult to estimate. It appears taking a slightly lower critical elevations would not change the results.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6918866 Structural n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Appendix J, Structural, Existing conditions and future without project were discussed but about future with project degradation should be included.

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Apr 07 2017

1-0 Evaluation **Concurred**

Concur with your suggestion. Please see Para. 3.5.3 that essentially states that we've gone as far as we can go based on our scope of work. Unlike typical feasibility reports where future conditions are addressed, this feasibility study has no identified future project. I will add some verbiage to the Appendix that states that more clearly. Thanks

Submitted By: Eddie Fernandez (816-389-3247) Submitted On: May 22 2017

1-1 Backcheck Recommendation **Close Comment**

Changes were not in the submittal. Via email the most current version was forwarded to the Tech Lead.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 24 2017

Current Comment Status: **Comment Closed**

6918867 Structural n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Appendix J, Structural, Page 14: Explain the limited number of bridges in Table 1, many more were identified earlier in the report and Table2. Discuss how other bridges were addressed and present results.

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Apr 07 2017

1-0 Evaluation **For Information Only**

Paragraph 5 on page #5 addresses the reasoning why tributary bridges were not included in this report. Essentially it boils down to cost and time. We believe focusing on the bridges in areas that have exhibited degradation is what needed to be looked at in the analysis. Those bridges are identified in Table #1. Please see the discussion starting with Para. 5 on pg. 5 thru Para. 1 on page 6. Thanks

Submitted By: Eddie Fernandez (816-389-3247) Submitted On: Apr 11 2017

1-1 Backcheck Recommendation **Close Comment**

The evaluation response clarifies the reduced number of bridges used in the study.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6918868 Structural n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Appendix J, Structural, Table 2: define SI&A

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Apr 07 2017

1-0 Evaluation **Concurred**

Concur I made the change in the table.

Submitted By: Eddie Fernandez (816-389-3247) Submitted On: May 22 2017

1-1 Backcheck Recommendation **Close Comment**

Changes were not in the submittal. Via email the most current version was forwarded to the Tech Lead.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 24 2017

Current Comment Status: **Comment Closed**

6919005 Economics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The net benefit analysis using pit-mining operations replacing river dredging operations are included as part of the Regional Economic Development (RED) section of the economic analysis. This may confuse the reviewers in differentiating between national and regional impacts. The benefits and costs using pit-mining operations for the project alternatives are NED (national) values and are not RED (regional) values. The report indicates that the regional impacts will be similar between pit-mining operations dredging operations and river dredging operations.
Basis: ER 1105-2-100. Using different project accounts for national versus regional impacts.
Significance: The NED benefits and costs of the project alternatives are used to calculate the net benefits and BCR. The net benefits for the project alternatives are then used to identify the NED plan. RED impacts can be used by decision makers in making investment decisions, however, the

RED impacts are not included in the BCR or net benefits.
Recommendation: For the economic analysis appendix, include the net benefits analysis for the pit-mining operations for the project alternatives in the NED section of the report. This may be informative to reviewers in that it shows the differences in project costs between pit-mining operations compared to river dredging operations. The RED section of the economic analysis can be used to state that the differences in the regional impacts between pit mining operation and river dredging are similar. This will not confuse the reviewers in the differences between national and regional impacts.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Apr 07 2017

1-0 Evaluation **Concurred**

Concur. Change has been made as requested. The net benefit analysis for the pit mining operations have been moved to the NED section of the report and a sensitivity analysis has been conducted using the pit mining costs.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**

The placement of net benefits analysis for pit mining operations is more appropriate in the NED section rather than being treated as an RED activity. The inclusion of a sensitivity analysis will also provide more relevant information for decision makers.

Submitted By: Brian Maestri (504-862-1915) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6919035 Economics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Table 5 and 11 of the economic analysis shows residual damages are slightly higher than the without project damages with Alternative 4 in place under the base case and more degradation scenarios. Is it expected that this alternative will induce damages under these scenarios? Does the timing of the avoided costs relative to the timing of the project costs lead to overall higher annual residual damages under these scenarios?
Basis: ER 1105-2-100 Address induced damages.
Significance: Alternative 4A with 2015 Permitted Dredging is showing slightly higher damages with modifications to the bank stabilization and navigation project structures.
Recommendation: Address why induced damages are occurring for the implementation of Alternative 4A relative to future without project conditions under the base case and more degradation scenarios, but not for the less degradation scenario.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Apr 07 2017

1-0 Evaluation **Concurred**
Please note that in the final bed degradation models runs and associated economic model runs the anomaly identified in the comment no longer exists.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**
Comment closed with more consistent results being achieved by the model.

Submitted By: Brian Maestri (504-862-1915) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6919037 Economics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The residual damages are higher when dredging is eliminated for Alternative 1C compared to dredging being reduced (Alternative 1B) under the less and more degradation scenarios, but not for the base case scenario. This also occurs in Table 13 for the Pit Mine Costs Sensitivity Analysis for Alternative 1C relative to Alternative 1B. Is this correct?
Basis: ER 1105-2-100 Address induced damages.
Significance: Eliminating dredging (Alternative 1C) relative to reducing dredging (Alternative 1B) should reduce residual damages for Alternative 1C relative to Alternative 1B under the less and more degradation scenarios.
Recommendation: Address why the residual damages go up for Alternative 1C when dredging is eliminated relative to dredging being reduced (Alternative 1B) under the less and more degradation scenarios, but not for the base case scenario. Also, address why residual damages are higher in Table 13 for Alternative 1C relative to Alternative 1B for the Pit Mine Costs Sensitivity Analysis.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Apr 07 2017

1-0 Evaluation **Concurred**
Please note that in the final bed degradation models runs and associated economic model runs the anomaly identified in the comment no longer exists.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**
Comment closed with the model achieving more consistent results.

Submitted By: Brian Maestri (504-862-1915) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6922492 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The executive summary presents a dilemma. Reducing or eliminating Sand and Gravel mining show positive NED benefits, and eliminates much of the no action degradation - but this alternative cannot be implemented under Section 216 Authority.
Basis/Significance: USACE Section 216 Authority shows ongoing and long-term detrimental

effects to a project due to USACE regulatory program actions.
Recommendation: Elevate this issue for a solution.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 10 2017

1-0 Evaluation **Concurred**
Management has been briefed on this issue.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**
OK

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 27 2017
Current Comment Status: **Comment Closed**

6922537 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: The report includes statements on how the Kansas River (tributary to project area) mining was stopped due to substantial impacts to utilities and infrastructure, and how this sand and mining practice is banned in other countries.
BASIS/SIGNIFICANCE: This report is well written and informative, but I see the PDT struggle to present an issue in a difficult political environment.
SOLUTION: As a technical reviewer, based on the information in the report, I can only suggest highlighting (in executive summary)the fact that permits allow removal of 4.3 Million cubic yards per year from the MO River, and that nearly 2 Million cubic yards of this comes from the project reach (St. Joseph to Waverly).

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 10 2017

1-0 Evaluation **Concurred**
Statement added to the executive summary.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
OK

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 27 2017
Current Comment Status: **Comment Closed**

6922593 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concern: Section 7.1 reads a little like an opinion, stating the model cannot test local effects, including a single dredge hole.
BASIS and SIGNIFICANCE: I don't believe we should equate a mobile bed feature like a dredge hole and a static feature like a dike, which is incorporated into the model geometry.

ACTION: The Mobile Bed Model is a tool for long-term mobile bed effects on the water surface, and a very good one. Suggest removing the dike and dredge hole comparisons. The known quantities of sediment removal from the mobile bed model easily account for the dredge holes.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 10 2017

1-0 Evaluation **Concurred**

Concur.

The statement of the model limitation has been clarified that local 3D effects were not modeled, but such an assessment is not needed in order to make reach-scale conclusions.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 17 2017

1-1 Backcheck Recommendation **Open Comment**

OK. I probably didn't express this quite right. I wanted to make the point that quantitative existing information (surveys/permit volumes) accurately define the effects from sand and gravel mining, and the model accurately defines water level impacts from sand and gravel mining. Higher order model work would only serve to reproduce what we already know and have. I think if we drop in the 3D effects statement, it might be used to delay action until we complete 3D studies!

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 27 2017

2-0 Evaluation **Concurred**

Concur that 3D studies are not required, and that the 1D model, XS data, and locations and amounts of dredging are sufficient to demonstrate the effects of sand and gravel mining.

I have shortened this explanation to:

"This spacing allows testing of reach-scale effects, e.g. the effect on bed change of lowering all dikes over several miles and the reach-averaged effects of commercial mining."

Submitted By: John Shelley (816-389-2310) Submitted On: May 15 2017

2-1 Backcheck Recommendation **Close Comment**

OK, Thanks

Submitted By: Michael Alexander (251-441-6641) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6923322	Geotechnical	n/a	12	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

End of first paragraph. Last sentence indicates the river is now much narrower and deeper, consider including the magnitude of how this has changed to add a level of understanding to this statement.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

Explanation added on river width. Original depth is hard to say and was highly variable.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 21 2017

1-1 Backcheck Recommendation **Close Comment**

Edits added to the report address this comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6923328 Geotechnical n/a 14 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

First paragraph below Fig 2-8. It is stated that 127,168 cy of rock was removed but wasn't rock reshaped rather than removed from the river?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

Language added that the rock was removed from the structure crests. The cited appendix explains the methodology, and you are correct, the rock was typically spoiled on the side of the existing structures, not removed from the river.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**

Edits added to the report address this comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6923347 Geotechnical n/a 21 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 3.3.3, line 5. If it is correct suggest identifying the 2009 levees in Wyandotte Co. as non-federal levees like was done for the federal levees described in follow on sentences.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

Description as a non-federal levee added to report.

Submitted By: John Shelley (816-389-2310) Submitted On: May 01 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6923371 Geotechnical n/a 24 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 3.3.4, last sentence. Bridges were constructed with foundations to bedrock, but nothing is said about the type of foundation or rock. Fig. 3-7 is showing deep foundations but are all bridges founded as such? Shallow foundations on rock could be OK if the rock is durable when exposed from bed degradation but deep foundations may not be OK if lateral support continues to erode between piles. Suggest adding additional description on foundation and bedrock type if that plays a role in this report.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
That last sentence, the one that drew the comment, was intended to make the point that interests up and down the river, including bridge owners, have seen the bottom of the river drop over the years and have gone to extra expense when constructing new / replacement structures to ensure that these structures will be stable no matter what the river bottom elevation ends up being in the future. In other words, they have seen what is happening and are reacting by designing an extra measure of resiliency into their structures.

As for the other bridges within the study area, they are all different. The general approach to the analysis was to determine at what elevation pile caps would be exposed, and then temper that with specifics of the structure, foundation, and information provided by the owners to predict the critical elevation at which $$$$$ would likely be spent. Specific bedrock type was not known for every bridge, but would have been considered in general terms, in cases where it was available, in establishing critical elevations.

Submitted By: Ron Jansen (816-389-3610) Submitted On: Apr 19 2017

1-1 Backcheck Recommendation **Close Comment**
Response provided satisfies this comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6923380 Geotechnical n/a 33 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 7, second to last sentence. Should reference to Section 7.1 be 7.2 instead?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

Concur. Reference has been changed.

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**

Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6924118	Geotechnical	n/a	50	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 9.2.6, line 10. If the BSNP structures are abandoned, why couldn't dredging be used to maintain navigation?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Non-concurred**

Channels that use navigation maintenance dredging to maintain the channel have other features in place for channel stabilization. The BSNP provides both and could not be equivalently replaced by dredging alone. (Let alone it would be cost prohibitive.)

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**

Explanation provided satisfies this comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6924395	Geotechnical	Figure 9-6	61	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The 50:1 downstream slope is quite flat with respect to other fish passage structures that have used 20:1 slopes with strategically placed boulders for fish resting areas. I assume that changing the slope would have negligible effect on this as a positive solution. Is that correct? If so, nothing more needs to be done with this comment.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

Concur. Using 20:1 does not change that grade control does not provide sufficient additional benefit to justify the additional cost.

Also, the gentler slope is also to reduce impacts on navigation (which may be the limiting

factor rather than fish passage).

Submitted By: John Shelley (816-389-2310) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Response satisfies the comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6924414 Geotechnical Table 10-2 72 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Consider including present value benefits (1A - $188M; 1B - $57.6M; 1C - $56.9M) to demonstrate the overall value.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **For Information Only**
Average annual equivalent values are presented because these values are used for comparison of costs and benefits that occur at different times during the planning horizon. Using present values would not facilitate an equal comparison across alternatives that have costs and benefits at different times during the planning horizon.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**
Response satisfies the comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6924421 Geotechnical n/a App A, Chap 2, pg 1 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 2.1. Editorial comment - Change FDRRs to FDRRS.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Change made as suggested.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6924688 Geotechnical n/a App A, Chap 2, pg 4 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para Landside Slope Stability, Flood. This failure mode was not considered significant and was not developed. However, increases in pore-water pressure in the foundation sands can significantly affect slope stability by reducing the effective stress beneath the blanket (i.e. London Canal failures during Katrina). More discussion is needed to support ruling this out (ex. the seepage changes due to bed degradation were found to be minor resulting in negligible PP changes and negligible changes in shear strength, or something similar).

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

A sentence has been added to clarify that foundation seepage did not cause heave at landside toe to impact slope stability:

The foundation seepage pressures at top of levee loading did not heave the landside toe which is critical to slope stability. As a result, landside slope stability during flood events is not considered to be significantly affected by river bed degradation and was not considered in the current study.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**

Following discussion with the Geotechnical Engineer, past flood conditions did not have issues with blanket heave or slope stability. This resolves my comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 22 2017

Current Comment Status: **Comment Closed**

6924708 Geotechnical n/a App A, Chap 2, pg 5 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 2.3.1, line 3. What is the basis for the 1/4 the levee height blanket thickness criteria for using the Taylor Series method?

Line 6. Add a reference citing the log-normal distribution for gradient used in probabilistic analysis.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**

Sentence on line 3 has been revised:

"The probability of failure can be calculated using the Taylor Series method (ETL 1110-2-556) and the underseepage analysis methods outlined in EM 1110-2-1913 Design and Construction of Levees."

Reference to log-normal distribution has been added to line 6:

"The average gradient (i) across the blanket was assumed to be log-normally distributed (ETL 1110-2-556)..."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Changes made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924717 Geotechnical n/a App A, Chap 2, pg 6 n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

EQN 2-2. Cite the reference of this equation.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Reference to equation 2-2 as been added:

"Equation 2-2 (ETL 1110-2-556)

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924750 Geotechnical n/a App A, Chap 2, pg 10 n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 2.5.1, last paragraph on page. Is it truly unlikely that O&M negates this failure mode? Human factors and funding play a significant role in O&M decisions. Is there past experience that can be used to support this argument?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
A sentence on past experience has been added to demonstrate that this failure mode is unlikely to progress to failure due to human factors and funding decisions:

"Based on the 2011 flood event, the North Kansas City levee (station 45+00) and Fairfax-Jersey Creek levee (station 21+27) were repaired immediately after the flood in

accordance with Operation and Maintenance (O&M) requirements of the Bank Stabilization and Navigation Program (BSNP)."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Changes made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924766 Geotechnical n/a App A, Chap 2, pg 12 n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 2.5.2-1, last column. Suggest adding (%) in the column title.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Column has been revised as suggested:

"2013 Baseline Probability of Failure (PoF) – (%)"

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924778 Geotechnical n/a App A, Chap 2, pg 21 n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 2..3-1. The remark for RM 368.60 is that this is critical because of proximity of the levee to the river. The foreshore is shown to be about 80 ft, why is this considered minimal?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Remark has been clarified to also include the fact that failure surface is limited to channel bank:

"Critical because of proximity of levee to river and high PoF. Sloughing limited to channel bank."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924785 Geotechnical n/a App A, Chap 2, pg 22 n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

First sentence refers to degradation of 12 ft. Figure 2-8 in the main report shows 7-8 ft max. Which is correct?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Discrepancy as been addressed:

"... increased incrementally to a maximum of 15 ft; the maximum model predicted degradation is 7-8 ft. Stability performance...

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924797 Geotechnical n/a App A, Chap 2, pg 24 n/a
Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The cost of buying and placing riprap is estimated at $40/ton. I recall the main report is using a higher number. Why wouldn't these be consistent?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
The cost of riprap has been revised to $49/ton (2014) to be consistent.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017
Current Comment Status: **Comment Closed**

6924804 Geotechnical n/a App A, Chap 2, pg 32 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 2.5.7-9. The dot at (12,12) is nearly unnoticeable and needs to be enlarged. Why not plot data as a function or trend rather a few data points?

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Figure has been edited for clarity

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Change made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 19 2017

Current Comment Status: **Comment Closed**

6924806 Geotechnical n/a App A, Chap 2, pg 35 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 2.5.8-1, Note b. Editorial comment - delete "is".

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Footnote has been edited as suggested:

"bForeshore less than 50 ft so repair cost is consists of BSNP and non-federal levee setback."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Discussed with Geotech Engineer about reinserting "is" between "Forshore less" and removing it following "repair cost...". This is non-critical and comment is closed.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 22 2017

Current Comment Status: **Comment Closed**

6924818 Geotechnical n/a App A, Chap 2, pg 36 n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Para 2.5.6. Sorry, another editorial comment (Ron indicated he wanted these) - the references to figures should be 2.6.1 instead of 2-6.1.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Edit has been made as suggested:

"Figure 2-6.1-1: Schematic showing Alternative 4 with both dike and sill lowered to the same elevation and 200 ft landward channel widening"

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Discussed with Geotech Engineer the nomenclature used and remaining minor corrections. These are nomenclature and not critical, comment closed.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 22 2017
Current Comment Status: **Comment Closed**

6924853	Geotechnical	n/a	App A, Chap 2, pg 40	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Table 2.6.4-1. Why do these values differ from 2.3.2-1? How can friction angles be estimated to an accuracy of 0.1 deg? Suggest using values from 2.3.2-1 for consistency.

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Apr 11 2017

1-0 Evaluation **Concurred**
Table 2.6.4-1 applies to design parameters estimated used for future with project condition.

Table 2.3.2-1 applies to mean parameters used for future without projection condition.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2017

1-1 Backcheck Recommendation **Close Comment**
Changes made as noted.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: May 22 2017
Current Comment Status: **Comment Closed**

6954300	Planning - Plan Formulation	Use of numbers in the report	General	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: The majority of the numbers in this report and appendixes present 9 significant figures, which implies far more accuracy than is appropriate. BASIS: General practice. SIGNIFICANCE: Too many significant figures make the report harder to read without adding any real value, and they may mislead readers as to the true accuracy of the analysis. ACTION: All of the numbers in the report that come out of the economic model should be rounded to the nearest $100,000 (or maybe the nearest million). This includes numbers in the text as well as all of the Tables presenting econ model results. Showing more significant figures than that implies greater accuracy than is appropriate, given the model's limitations. For numbers not related to the econ

model, verify that an appropriate number of significant figures is presented.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**

Change made as requested - please not that values are now rounded to the nearest $10,000. Rounding to $100,000 would not display some differences among alternatives.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**

Rounding to 10,000 improves readability significantly. I will defer to the PDT on appropriate number of significant figures.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 24 2017

Current Comment Status: **Comment Closed**

6954301	Planning - Plan Formulation	Section 9.2 Management Measures	Main Report, Page 47	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: The list of management measures does not include all of the concepts that were considered and screened out early in the study. There are more concepts in the VE study, the USFWS PAL, and earlier concepts. This section would be much stronger if it presented the full list of concepts that were considered and explained briefly why they were screened out--usually because they were not effective, I suspect. BASIS: Need for transparency in the planning process. SIGNIFICANCE: showing the full array of concepts considered leaves no doubt as to the thorough thought process the PDT went through and reduces criticism from skeptics. ACTION: Consider providing a more complete list of the concepts that were considered and dismissed early in the study.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**

Agreed, the report may overly summarize key concepts considered. Providing more information regarding the management concepts considered to demonstrate the robust nature of this effort is a good suggestion. The VE study provided valuable information on potential measures to be considered. A summary discussion of the VE study and discussion of measures from the VE proposals that were considered but not adopted is now presented in the report under a new Section of the report - Section 9.3 and references the VE study in Appendix M.

Submitted By: christina ostrander (816-389-3143) Submitted On: May 11 2017

1-1 Backcheck Recommendation **Close Comment**

Changes address the concern.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 24 2017

Current Comment Status: **Comment Closed**

6954304	Planning - Plan Formulation	Section 9.2.1 Modification of the BSNP Structures and Section 9.3 Description of Alternatives	Main Report, Page 48	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: Section 9.2.1 says "The amount that the structures could be lowered would also be considered." Discussion in Section 9.3 of alternatives 2, 3 and 4 only mentions lowering the features to five feet below the construction reference plane. Were any other amounts considered, either more or less than five feet? If not, why not? BASIS: ER 1105-2-100 requires consideration of a full array of different measures. SIGNIFICANCE: skeptics may question if other amounts would have been effective. ACTION: Consider explaining in Section 9.3 any other amounts of lowering that were studied. If only five feet of lowering was studied, explain why five feet was chosen and why more or less lowering would not change the results significantly.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**

Paragraph 9.2.7 has been revised to better describe the process used to develop the BSNP measures as follows: Lowering the elevations of the BSNP dikes and sills increases the effective size of the channel. This would result in slower water velocities and some decrease in sediment transported out of a reach to the downstream reach. Various options exist for modifying these structures to maximize benefits from this measure. These include lowering the elevation of dikes only, lowering the elevations of sills only, and lowering both the elevations of dikes and sills. The amount that the structures could be lowered would also be considered. This measure could be implemented independently or in combination with other measures. Locations where this measure could be implemented could also be evaluated in order to maximize benefits. Multiple variations in BSNP adjustments were evaluated over the course of the study, including deeper and shallower excavations, wider and narrow excavations, and shifted locations of river miles. Excavation depth was limited by the constraint of not lowering the low flow water surface elevation. Excavation width was limited by space constraints and navigation concerns. The river miles of lowering were selected to coincide with the zone of projected location of degradation based on the FWOP. This measure was carried forward for further evaluation.

Submitted By: christina ostrander (816-389-3143) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**

Changes to paragraph 9.2.1 addressed the concern.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6954307	Planning - Plan Formulation	Section 9.3 Description of Alternatives 1A, 1B and 1C, plus remaining alternatives involving reduced dredging	Main Report, Page 52	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: The report does not define the currently authorized levels of dredging that were incorporated in Alternative 1A. The description of the reduced amounts that would continue under Alternative 1B is not clear to this reviewer. Page 66, last sentence says: "As explained in Section 9.2.7, the reduced sand and gravel mining measure includes the complete cessation of commercial sand and gravel mining in the St. Joseph reach, a slight reduction in the Kansas City reach, and a large reduction in the Waverly reach compared to the currently permitted quantities." These details are NOT explained earlier in the report or in Section 9.2.7. All of the remaining alternatives refer to Alts 1A, 1B & 1C. BASIS: Need more info to fully define the alternatives. SIGNIFICANCE: descriptions are incomplete without the info on dredging. ACTION: fully and clearly describe the levels of dredging that were included in the mobile bed model to document these alternatives. The info could be presented in Section 9.2.7 or in Section 9.3 descriptions of Alternatives 1A, 1B and 1C.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**

A discussion defining the dredging measures considered and the rationale for the range of conditions considered is now discussed and are presented in Section 9.2.7. Table 9.1 has been added to show the assumptions.

Submitted By: christina ostrander (816-389-3143) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**

The additional text and table address the concern.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6954308	Planning - Plan Formulation	Section 4	Appendix O --Econ Analysis	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: Based on an April 25, 2017 conversation with the PDT, the trigger point descriptions in Section 4 for the various features in the economic model are not complete and do not accurately describe how the model applies the triggers. For instance, page 9 describes trigger points for the chutes at -3 and -6 feet with different investments to be made at each point. The econ model simplifies this and accrues all of the cost for both trigger points when degradation reaches -3 feet. For BSNP structures, the model assumes that the cost for max degradation condition is incurred when degradation reaches -2; this is not explained in the text. Separate appendices describe assumptions for the BSNP structures, the chutes and levees; the econ model incorporates simplified triggers for some of these features that are not explained in the Appendixes. BASIS: Need consistency between stated assumptions and modeled assumptions. SIGNIFICANCE: lack of consistency affects confidence in the results. ACTION: Explain in Section 3 or 4 of Appendix O how the trigger points are modeled for each type of feature, i.e. BSNP, chutes, levees, and industrial features. (For industrial features, the existing text may be sufficient, since we need to be vague to protect confidential info.) If simplifications are made that are different than what is

presented in the other Appendixes, explain why the model deviates from the stated assumptions. (I do not disagree with the simplifications, per se, but they must be explained so the effects of the inconsistencies can be assessed. Any differences between stated assumptions and modelled assumptions need to be explained in the econ appendix, along with expected impacts of the simplification on the analysis--i.e., "tends to slightly overstate damages," etc.)

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**

Changes have been made to Section 3 as requested.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**

The econ model has been revised to be consistent with the stated assumptions. The Econ Appendix has also been revised to explain the assumptions better and to document the effects of simplifying assumptions. Revisions address the concern. Note that additional DQC was conducted to verify that changes to the econ model spreadsheets were appropriate and that calculations within the model were correct.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6954311	Planning - Plan Formulation	Baseline Conditions	Econ Model--baseline conditions	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: Baseline conditions (year, water surface elevation and/or bed elevation) are not fully documented in the Econ model. The model compares changes in water surface and bed elevation to "critical change" trigger points for each feature in the model. Trigger points for some features were defined in 2013, and the starting point for modeling is 2015. The information in the model is very time-sensitive, and additional bed degradation or changes to infrastructure would affect its accuracy over time. ACTION: Add text to the main report and Appendix O to describe that the model was approved for this "single use" and should not be used in the future unless it has been properly updated to reflect changed conditions. Add text to document the initial elevations or conditions from which the critical changes are measured so there is a baseline to use when updating the model.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**

The recommended text has been added to the introduction of the Economics Appendix and to the Executive Summary of the Main Report discussing single use and the potential need to substantial changes to update the model for future use.

In reference to the potential differences in trigger point between 2013 and 2015 please note that on average, the river in the St. Joseph to Kansas City reach rose 0.3 feet from

2013 to 2014 (the survey year). It is important to note that surveys are typically completed in one year (2014 in this case)and published in another (2015, after QA and final changes). Interviews with infrastructure owners were conducted in July 2013. Those infrastructure owners provided us their best estimation of the critical change that would warrant an action to be taken based on the current river condition and their knowledge of their infrastructure. In 2014 another round of river surveys were completed. Follow-up interviews were conducted in October 2014 with preliminary/draft 2014 survey data that was used in the mobile bed model for bed degradation projections. The infrastructure owners did not provide new or changed data regarding their estimation for critical change (most likely because it was not enough aggradation for them to change). The final QA'd 2014 survey data serves as the baseline of the calibrated model that was used for the technical report. In November 2016, stakeholders were asked to resubmit or update previously provided data regarding their infrastructure; however, no information was received, thus the PDT must rely on the 2013 interview and follow-up meetings in 2014 as the best available information.

If this model is used in the future, new inquiries to the infrastructure owners would be required based on the most recent Missouri River survey data we have. Baseline elevations are not clearly stated in the model due to the sensitivity of the information

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**
Changes in the text address the concern.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6954315	Planning - Plan Formulation	Limited Scope	Econ Model--limited scope	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: The report does not clearly describe the limitations of the economic model due to lack of information about many potentially impacted structures, wells, etc. The PDT appropriately limited the modeling effort to save study cost and time; as a result, the model probably under-estimates total damages. ACTION: Add text to the main report and Appendix O to describe the types of features that are NOT represented in the model and how that affects the magnitude of the damages reported. It would be helpful to also explain why the limited model was deemed sufficient for Federal decision-making in this study and why it should not be used for other economic optimization purposes in the future.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**
The following text has been added to section 3.0:

Note that the economic model is designed to estimate damages and benefits (avoided costs) under various levels of dredging and structural alternatives. The model does not

attempt to identify an optimal level of dredging or economically justify any level of dredging. In addition, the damages identified below are for major types of infrastructure that are projected to be impacted by bed degradation, although not necessarily an exhaustive list of potentially impacted infrastructure. The major infrastructure, which are included in the economic evaluation, were selected because they are presumed to represent the largest component of potential damages and are therefore provide sufficient information to support Federal decision making.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**
Changes to Section 3.0 of the Economics Appendix address the concern.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6954316	Planning - Plan Formulation	Model ignores aggradation	Econ Model--model ignores aggradation	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

CONCERN: The econ model only addresses costs due to bed degradation, and the H&H modeling shows that portions of the bed will rise up to 6 feet under some alternatives. It is possible that costs due to aggradation are needed to accurately reflect future expenditures. ACTION: Verify that costs due to aggradation can be ignored, or modify the econ model to include them.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **Concurred**
Costs due to aggradation are not included in the economic modeling mainly because at the time that the bed degradation model and the economic model were developed, aggradation was not projected to affect critical infrastructure within the Kansas City reach, which was the original focus of the analysis. Later in the modeling and study process model results showed that aggradation is projected to occur in some reaches at the very far out years of the planning horizon. The costs associated with aggradation would inconsequential to the outcome of the analysis due to discounting. Therefore additional study funds and time we not allocated to revising the economic model to include small values that would not affect the evaluation.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**
The explanation in Evaluation 1 addresses the concern. No change in the report is necessary.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6954321	Planning - Plan Formulation	Review of model and inputs	Econ Model--review of model and inputs	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The ATR Economics reviewer confirmed that review recommendations made during the model certification process were incorporated, calculations are correct, and formulas are logically consistent. The ATR lead spot-checked the econ model spreadsheets to ensure that inputs were consistent with stated assumptions and supporting data; several minor issues were found and corrected, resulting in small changes to numerical results but no change in the conclusion that modifications to the BSNP structures are not economically justified at this time. Risk and Uncertainty is adequately addressed with the sensitivity analysis based on a range of bed degradation scenarios. Overall, the economic model works as anticipated, and its use is consistent with the approval granted on 10 March 2015.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 01 2017

1-0 Evaluation **For Information Only**

Concur and thank you.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 15 2017

1-1 Backcheck Recommendation **Close Comment**

Several issues were created in the econ model in the course of addressing earlier comments. Additional DQC was performed during the backchecking phase, and ATR verified that these issues have been resolved. No additional changes are needed in the econ model spreadsheets as of 30-May-2017.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

6996674	Planning - Plan Formulation	n/a	General - Additional changes to closed comments	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Several changes have been made in the main report and appendices related to DR CHECKS comments that were closed during the first round of backchecking. Please document those comments and related changes as a response to this comment.

Submitted By: Craig Evans (651-290-5594). Submitted On: May 30 2017

1-0 Evaluation **Concurred**

6919005 - Revised response. The sensitivity analysis is now included under the Section 12, Risk and Uncertainty under Section 21.1 Land Based Costs Sensitivity Analysis. This is intended an evaluation of sensitivity for NED benefit analysis and is not applicable in the RED discussion of the report.

6919035 - Revised response. The original response to this indicated that the anomaly was not present in the final model runs, however, this was not the case. This is not an anomaly. The implementation of the measures does shift the location (and timing) of the

degradation. Under the appropriate tables in the report the following statement has been added to provide clarity to the reader.
"*Under Alternative 4A, the damages avoided (benefits) are negative because this alternative shifts the degradation toward reaches of the river where higher value impacts occur."

6919037 Revised response. This is essentially due to model noise. The following statement is now included in the report. "* The residual damages, damages avoided, and net benefits in Alternatives 1B and 1C are nominally equivalent. The difference is due to model noise." The basis for this is the following: Alt 1B vice Alt 1C shows up in the More Deg scenario. The reason is that for on key piece of infrastructure which has a critical change of one foot - the change in year 10 is -1.0102 in 1B, but year 10 in 1C has a change of -0.9542. The 1C change in year 11 is -1.0295. So, the cost hits in year 10 for 1B and in year 11 in 1C. The difference between the two alternatives in year 10 is less than .06 of a foot.

Submitted By: christina ostrander (816-389-3143) Submitted On: May 30 2017

1-1 Backcheck Recommendation **Close Comment**
Corrected responses and changes in the text address the original concerns.

Submitted By: Craig Evans (651-290-5594) Submitted On: May 30 2017

Current Comment Status: **Comment Closed**

Enclosure 3

COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW

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COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the Draft Technical Report for the Missouri River Bed Degradation Feasibility Study, for the Kansas City District. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of Planning Bulletin 2016-02, 4 March 2016 and EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy.

The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be effective. DQC review of the mobile bed hydraulic model and final economic spreadsheet models was thorough as indicated by the quality of the models. DQC review of the Technical Report and associated documents was thorough; those comments and responses were provided to the ATR team as DR CHECKS comments. The quality of the documents reviewed was sufficient for this review and indicated that adequate DQC was accomplished.

The review report notes that all comments have been addressed and closed in DR CHECKS.

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Date: 2017.06.05 18:00:35 -05'00'

Craig Evans
ATR Team Leader
CEMVP-RPEDN-PD-F

Date

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Date: 2017.06.06 09:25:59 -05'00'

Christina Ostrander
Project Manager
CENWK-PM-PF

Date

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Date: 2017.06.06 15:08:19 -07'00'

Eric Thaut
Deputy Director, Flood Risk Management
Planning Center of Expertise

Date

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Enclosure 4

CERTIFICATION OF AGENCY TECHNICAL REVIEW

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CERTIFICATION OF AGENCY TECHNICAL REVIEW

Significant concerns and the explanation of their resolution are as follows:

- Text in the report that potentially understated impacts to flood heights, flood risk and the environment that may be expected from implementing alternatives was clarified.
- Text was added to say that O&M costs were not included in the total project cost estimates.
- The report was revised to more clearly state that a traditional risk and uncertainty analysis was not performed for this study and to include the formal approval of the economic model which allowed the use of a scenario approach.
- The sensitivity analysis regarding potential costs to change from river dredging to pit mining as a source of aggregate was originally included in the regional economic analysis section of the report. If additional costs were incurred that raised the price of aggregate, they would be national economic development costs. The final report discusses this sensitivity analysis separate from the regional economic analysis.
- The report demonstrates that aggregate dredging at currently permitted levels is the primary cause of bed degradation, but it does not highlight this conclusion.
- The original report omitted several alternatives that were considered in the early phases of analysis and in the Value Engineering study. The final report includes a more thorough discussion of measures and alternative scales that were considered and screened out.
- The original report lacked detail about the currently permitted levels of dredging and the modified levels used in the final array of alternatives. The final report more clearly defines the different levels of dredging used in the analyses.
- The economic spreadsheet models originally made several simplifying assumptions that differed from the assumptions stated in the report and Appendices. These assumptions affected when various future investments would be made, and therefore affected the modeled average annual damages. The spreadsheet models were revised to match the stated assumptions in the report Appendices.
- The report was revised to more clearly state that the economic model was approved only for a one-time use in this study, and any future use of the model would require significant updating. Also, the economic model does not include all potential damages; it was not intended to optimize levels of dredging and is not suitable for that purpose.
- The final economic spreadsheet models were reviewed and found to be consistent with stated assumptions. The models incorporate review recommendations made during the model certification process. Risk and uncertainty is adequately addressed through the non-traditional scenario analyses that were described in the report and approved when the economic model was certified for one-time use. Overall, the final economic model works as anticipated, and its use is consistent with the approval granted on 10 March 2015.

- The hydraulic engineering reviewers determined that the structure modifications and the sill alternatives were adequately developed into the hydraulic model geometry, and model simulations effectively show the resulting water level/bed change conditions in the form of reach-averaged solutions. No formal comments were posted in this final review regarding the mobile-bed hydraulic model. The base model was extensively reviewed in earlier targeted reviews.

Jennifer L. Switzer
Chief, Planning Branch
Kansas City District

6/6/17
Date

David L. Mathews
Chief, Engineering Division
Kansas City District

6/6/17
Date

Enclosure 5

OCTOBER 2014 TARGETED ATR REPORT:
Preliminary hydraulic and economic models, technical assumptions, and existing and future without project conditions

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Missouri River Bed Degradation Feasibility Study

Targeted Agency Technical Review

Targeted review of preliminary hydraulic and economic models, technical assumptions, and existing and future without project conditions

Prepared for the FRM-PCX by

Craig Evans, ATR Lead
CEMVP-RPEDN-PD-F
October 2014

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TARGETED AGENCY TECHNICAL REVIEW REPORT

ENCLOSURES

Subject: Review report for preliminary hydraulic and economic models, technical assumptions, existing and future without project conditions for the Missouri River Bed Degradation Feasibility Study, December 2013 through September 2014, Kansas City District.

1. **Scope and Purpose of Review:** The purpose of this review report is to document the targeted agency technical review (ATR) for the subject products. The review was conducted for the Kansas City District. The primary point of contact for the District was Ms. Christina Ostrander, CENWK-PM-PF.

The ATR team (ATRT) was lead by Mr. Craig Evans, CEMVP-RPEDN-PD-F. The Flood Risk Management Planning Center of Expertise (FRM-PCX) was the lead center for managing this ATR.

2. **References**

a. This review report was prepared in response to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. The review documents reside online at ProjNet (www.projnet.org), DrChecks Project and Review titles: Missouri River Bed Degradation Feasibility Study, ATR – Existing and FwoP Conditions.

b. The review was conducted in accordance with the Review Plan dated February 11, 2013 and approved by the Northwest Division Commander on March 8, 2013.

3. **Project Description**

The study is authorized by Section 216 of Public Law 91-611, Flood Control Act of 1970. The purpose of the study is to identify and evaluate alternatives to address the impacts of river bed degradation that is occurring on the lower Missouri River, from Rulo, NE to the mouth at St. Louis, MO. The Missouri River Bank Stabilization and Navigation Project (BSNP) is the federal project of interest, both as a causal factor, and as part of the impacted federal infrastructure. The study will identify and evaluate alternatives to minimize or eliminate future impacts of the bed degradation to the federal infrastructure and local public infrastructure. The study will examine the effects of degradation on the long-term stability and sustainability of the BSNP. There are significant flood risk management features, located primarily within the Kansas City Reach and near St. Joseph, MO, that are dependent on the stability of the BSNP and are potentially also impacted by continued bed degradation. Recommendations for structural or operating changes that have potential for minimizing degradation impacts will be considered. In addition, the study will consider approaches to help or maintain or enhance the viability of federally constructed ecosystem projects such as constructed wetlands and shallow water habitat. The study will also inventory and assess measures that protect local and public infrastructures.

4. **Review Team.**

This targeted ATR team included a subset of the disciplines included in the full ATR team as identified in the review plan (reference 2b): ATR Lead (including Plan Formulation), Economics (including Risk & Uncertainty), Hydraulic Engineering, Structural Engineering, and Geotechnical Engineering. Additional disciplines will be added in subsequent review steps.

ATR Lead (including Plan Formulation)

Craig Evans, CEMVP-RPEDN-PD-F, serves as the Chief of the Plan Formulation Sections in St. Paul, MN and St. Louis, MO. He has 27 years of experience with the Corps of Engineers including 12 years in civil design and 15 years in planning and project management. He is a registered Professional Engineer in Minnesota, holds a masters degree in Public Administration, and is a 2005 graduate of the USACE Planning Associates Program. He has led several reconnaissance studies, multi-purpose feasibility studies, watershed studies and construction projects. He has significant experience with plan formulation and report writing for flood risk management, ecosystem restoration and stream bank protection as well as civil engineering review and value engineering.

Economics (including Risk & Uncertainty)

Brian Maestri, CEMVN-RPEDS-PDE-FRC, is a Regional Economist stationed at New Orleans District of the U.S. Army Corps of Engineers since 1985. Mr. Maestri is a certified economic ATR reviewer for flood risk management and a FRM-PCX certified subject matter expert for risk and uncertainty. He is currently a Flood Risk Management Regional Technical Specialist for the Mississippi Valley Division. He was a member of the Interagency Performance Evaluation Task Force (IPET) Interior Flood Control Team in the wake of Hurricane Katrina. He has a Master's and undergraduate degree in Economics from the University of New Orleans (UNO). He has served as an interdisciplinary team member on several large-scale flood risk management studies including the Morganza to the Gulf of Mexico, La. Feasibility and PAC and the Louisiana Coastal Protection and Restoration (LACPR) evaluation. He has participated in six expert elicitation sessions that were conducted for various Corps studies, including development of site-specific depth-damage relationships for structures, contents and vehicles and for emergency costs following a storm event. He served as an Economic Advisor on the National Flood Risk Management Team in 2011 and 2012. He has also served as an instructor for the Corps Flood Risk Management PCC4 training modules held in Jacksonville, Florida (2010), Crystal City, Virginia (2010-11), Dallas, Texas (2012) and New Orleans, Louisiana (2013). He has also taught a module on Coastal Storm Risk Management for the PCC4 classes.

Hydraulic Engineering

Mike Alexander, CEMVK-EC-HH, is a Registered Professional Engineer with over 33 years of USACE experience dealing with channel stability, navigation, and training structures design. Mike is a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Mike serves as a Regional Technical Specialist for Hydraulics and Hydrology within Mississippi Valley Division. He started work with the USACE Laboratories in 1981 at the Waterways Experiment Station's Coastal Engineering Research Center and later working in the Coastal and Hydraulics Laboratory at the Engineering Research and Development Center (ERDC). Mike moved to the USACE Vicksburg District in 2000, where he was involved with developing 2-dimensional modeling and sediment transport expertise and capability. Project experience includes dredging equipment techniques/applications, dredged material production/disposal evaluations, and wetland restoration with dredged material. Over the last 15 years, work focused on 1-, 2-, and 3-dimensional numerical model studies for navigation and flood control projects, often with sediment transport modeling components. His current focus is on strategic, quick-turnaround numerical model applications on the Mississippi, Atchafalaya, and Red Rivers with

the Vicksburg District, which now includes the regional Modeling, Mapping, and Consequences (MMC) program center.

Structural Engineering
Tim Grundhoffer, CEMVP-EC-D, is a registered engineer with over 22 years of structural engineering experience with flood protection and navigation projects. Tim is a certified ATR reviewer for several structural categories listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. For the last 6 years has served as a structural Regional Technical Specialist (RTS) for MVD. Additionally for the last 5 years has served on dam and levee risk cadres in support of the RMC. He has experience in the analysis and design of many structural features including: Lock and dams, various pile foundations, flexible pile caps, various retaining structures, sheet pile structures, retaining walls, floodwalls, road and railroad closures, bulkheads, dam control/spillway structures, buildings and building foundations. Additionally, experience includes risk analysis and risk assessments of levee and dam projects. He also assists HQ with updating criteria for reinforced concrete design, I-walls and sign support structures.

Geotechnical Engineering
Neil Schwanz, CEMVP-EC-G, is a registered professional engineer with over 35 years of geotechnical experience, the last 9 years serving as a geotechnical Regional Technical Specialist for MVD. Neil is a certified ATR reviewer for several geotechnical categories listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. He is currently Chief of Geotechnical Engineering Branch in St. Paul District. He has a broad based experience with levee and embankment dam design and with soil structure interaction. He assisted HQ with establishing design criteria for the Greater New Orleans risk reduction system and lead teams in developing analysis and design procedures for SSI based design including the use of advanced analysis techniques. He also assists HQ with developing or revising criteria for levee and floodwall design. Mr. Schwanz assisted on the levee methodology team supporting the BCRA done for the St. Paul, Minnesota, project. He is a certified reviewer and has led and participated on numerous ATR teams nationwide.

5. **Charge to Reviewers.**
See Enclosure 1.

6. **Summary.**

a. The PDT and ATRT members listed above held a kick-off meeting on 19 Dec 2013. The intent of this targeted review was to verify methods and assumptions and validate the hydraulic and economic models to be used later in the analysis. No single preliminary report was available, so the information to be reviewed was presented in several documents and formats. The PDT posted many of the documents to be reviewed in ProjNet (DrChecks) on 24 Jan 2014. The mobile bed hydraulic model was provided directly to the Hydraulics ATRT member in Jan 2014. Additional review documents were provided in February and March 2014. ATR comments were entered in February and March 2014 and closed in DrChecks by August 2014, with some discussion between the PDT and ATRT to resolve issues.

b. In addition to the targeted ATR, the economic spreadsheet model was also subject to a separate but related review in accordance with EC 1105-2-412, Assuring Quality of Planning Models. In general, the objective of the EC 1105-2-412 model review is to ensure the economic model is theoretically sound, policy compliant, computationally accurate, and based on reasonable assumptions, and the objective of the ATR is to ensure the model is properly applied during execution of the study and the input data and modeling results are reasonable; however, there is a degree of overlap between these two reviews. To maximize efficiency, the targeted ATR and EC 1105-2-412 model review were conducted concurrently and Brian Maestri served as the economics and risk analysis reviewer for both reviews. The kickoff meeting for the model certification review was held on 16 Jan 2014. The discussion below and the enclosed DrChecks comments reflect the targeted ATR effort only. The model review is documented in separate Model Review Report.

c. This targeted ATR focused on the basic assumptions and models the PDT is building to assess the economic impacts and benefits of proposed measures. The intent of the review was to verify early in the study that the PDT's hydraulic and economic models would be valid tools for the study. There were two primary models being developed: 1) a mobile bed hydraulic model to assess river bed degradation, and 2) an Excel spreadsheet economic model to determine the economic costs and benefits associated with various future scenarios. Reviewers also evaluated the geotechnical and structural assumptions that are built into the analyses and affect input data for the economic model.

d. The mobile bed hydraulic model was found to be well-developed and properly applied. No issues were identified that needed further attention. Model development and verification/calibration were found to be comprehensive and among the most accurate for simulated versus field gage data comparison. The review validated the District's quality control review by Mr. Tony Thomas, a consultant and former USACE employee who developed major components of the modeling tools applied in this study. Mr. Alexander included the comment that "sensitive issues with sediment quantities can be developed with confidence."

e. The economic ATR issues centered on how the analyses incorporated risk and uncertainty. The initial economic spreadsheet model did not incorporate risk and uncertainty surrounding the economic and engineering inputs as required by ER 1105-2-101. The hydraulic model also did not include provisions to incorporate risk and uncertainty. The ATR team acknowledged that the nature of this situation does not lend itself to standard probabilistic approaches to risk and uncertainty, particularly within the hydrologic analysis, but felt some uncertainty should be incorporated into the economic modeling. See discussion of these critical comments in Paragraph 6.g below.

f. Geotechnical and Structural comments were focused on specific issues and assumptions that support inputs to the economic model. No major concerns were noted, and additional details were provided to document assumptions and resolve the issues.

g. Critical Comments. Three comments regarding risk and uncertainty in the economic and hydraulic analyses are considered critical issues. The PDT proposed actions that will likely resolve the ATR concerns; the ATR team will verify resolution in the next phase of review.

1) Uncertainty surrounding engineering and economic inputs to the economic model was one critical ATR concern. (See DrCHECKS comment #5521958.) The economic model calculates the benefits of a federal project that would come from delaying or avoiding future investments by federal and non-federal entities. The economic analysis must make assumptions regarding the future timing of investments by others based on the uncertain future progression of bed degradation, critical bed and water surface elevations at each facility, and lead time required to prevent damage. Each affected entity would use its own risk tolerance and required lead time to determine when to act, given a certain level of bed degradation at its facilities. The economic spreadsheet model used point estimates for several engineering and economic inputs that did not reflect uncertainty. The PDT added probability distributions to several parameters in the economic model using "@Risk" modeling. The proposed changes are expected to address the ATR concern about uncertainty related to inputs to the economic model.

2) Uncertainty surrounding future rates of bed degradation was another critical ATR concern. (See DrChecks comments #5598568 and 5598611.) The economic analysis relies on the mobile bed hydraulic model to estimate river bed elevations over a future 50-year period. The hydraulic model results are sensitive to the timing of large flood events, and traditional probabilistic hydrologic methods cannot be applied to this situation. The PDT initially proposed to define the future without project condition using a future scenario that approximated the 1% exceedance probability for bed sediment transport, because they thought it represented a generally accepted risk tolerance of infrastructure owners. The ATR team suggested that a scenario approximating the 50% exceedance probability for bed sediment transport would better represent the most likely future without project condition. The ATR team thought that adjusting the "critical stage" action triggers in the economic model would be a better way to incorporate decision makers' risk tolerance than using the 1% exceedance scenario as the future without project condition. The PDT agreed to use the 50% scenario as the base case for future without project conditions. The PDT will also conduct a sensitivity analysis presenting results based on both the 50% and the 1% bed sediment transport scenarios. The PDT will perform sensitivity analyses around the "critical stage" inputs to the economic model and also incorporate a lead-time adjustment in the model. The proposed changes are expected to address the ATR concern about uncertainty surrounding future bed elevations used in the economic analysis.

h. Unresolved Comments. The PDT responded acceptably to all comments, and the ATR team closed all comments in DrChecks. The results of the proposed changes will be reviewed in the next round of ATR to verify that the identified issues were fully resolved.

i. Lessons Learned. None.

7. DrChecks Report. The DrChecks report of all comments is attached as Enclosure 2

8. ATR Completion Statement.
Enclosure 3 contains the completion statement.

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Enclosure 1

CHARGE

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AGENCY TECHNICAL REVIEW
CHARGE TO PROJECT DELIVERY TEAM AND REVIEWERS

Missouri River Bed Degradation Feasibility Study, MO & KS
Section 216 of Public Law 91-611, Flood Control Act of 1970

Prepared by: Cassidy Garden, P.E.
Date: 16 December 2013

US Army Corps of Engineers ®

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AGENCY TECHNICAL REVIEW
CHARGE TO THE PROJECT DELIVERY TEAM & REVIEWERS

1. General

EC 1165-2-214 "Civil Works Review Policy" establishes procedures to ensure the quality and credibility of Corps documents and work products. The Corps' Planning Centers of Expertise (PCX) are generally responsible for the accomplishment and quality of Agency Technical Review (ATR) for decision documents. Reviews will be assigned to the appropriate Corps PCX based on business programs. A Review Plan (RP) describes the scope of review for the current and/or upcoming phases of work (Feasibility, Preconstruction Engineering and Design, construction, etc.) and is a component of the Quality Management Plan (QMP) in the Project Management Plan (PMP) or Program Management Plan (PgMP). This charge to the Project Delivery Team (PDT) and reviewers is an attachment to the RP and serves as the scope of work for the conduct of the PDT and ATRT for this specific review.

The ATRT is charged with the detailed review of the materials in the submission package, both directly and indirectly related to their field of expertise. The ATRT is to review all documents in the submission package for the intent of verifying overall consistency of the report information among their respective disciplines.

ATR on decision documents should address the basic communication aspects of the submission package. Quality decision documents allow the public and stakeholders to understand the planning effort, process, and its results. The decision document should enable decision makers to reach the same conclusions and recommendations as the PDT.

The ATRT should take into consideration this project is being executed under the SMART Planning Principles
Reference: Engineering Bulleting

2. Project Delivery Team (PDT) Responsibilities

The PDT, as identified in the RP, is comprised of those individuals directly involved in the development of the decision document. The members of this team have the following responsibilities during the ATR process:

a. List of PDT Responsibilities

i. A PDT Lead from the PDT shall be designated for the ATR process. Cassidy Garden, COE Kansas City District will serve as the PDT Lead for this review.

ii. The PDT Lead shall provide the ATRT with contact information for any PDT member as required.

iii. An electronic version of the submission package in Word or searchable Adobe Acrobat format shall be provided at least one business day prior to the start of the comment period.

iv. Other submission documentation and technical products required by the Directory of Expertise (DX) or Mandatory Center of Expertise (MX) representative(s) on the ATRT

may be submitted directly to the DX or MX.

v. The review shall be established in DrChecks to allow access by all PDT and ATRT members. The ATRT Lead shall be assigned the role of review manager and at the discretion of the lead PCX, have the PCX POC assigned access.

vi. The Project Manager (PM) shall provide labor funding by cross charge labor codes to the ATRT as indicated below. See Table in section 3.b.

vii. The PDT is responsible for the ATR kick-off meeting in coordination with the ATR Lead to orient the ATRT no later than the first week of the comment period. Travel funding will be provided for a site visit if a site visit is warranted to understand the problems, opportunities and conditions of the project area.

viii. The PDT will evaluate comments provided by the ATRT in DrChecks. Responses of *Concur* must include a discussion of what action was taken and provide revised text from the submission package if applicable. *Non-Concur* responses shall state the basis for the disagreement or clarification of the concern and suggest actions to negotiate the closure of the comment. PDT members shall coordinate all "Non-Concur" responses with the PDT Lead who will consolidate then discuss these "Non-Concur" responses directly with and the ATRT Lead to attempt to resolve any *Non-Concur* responses prior to submission of evaluation responses.

ix. The PDT Lead shall inform the ATRT Lead when all evaluations have been entered into DrChecks.

x. The PDT Lead may conduct an in progress review to summarize comment evaluations as needed in cases of complex, interrupted, or extended reviews to facilitate the review process.

xi. PDT members shall contact ATRT members or Lead as appropriate to seek clarification of a comment's intent or provide clarification of information in the submission package. These discussions shall occur outside of DrChecks, but a summary of significant discussions should be provided in DrChecks.

xii. The PDT Lead shall coordinate the proposed schedule and time for the relevant milestone such as the CWRB with the ATRT Lead to ensure that the ATRT Lead will be able to participate.

Table 1: PDT Roster

Name	Role	Office Symbol	Phone	Email
Christy Ostrander	PM	CENWK-PM-PF	816-389-3143	Christina.Ostrander@usace.army.mil
Cassidy Garden	Technical Lead/Civil	CENWK-ED-GC	816-389-3851	cassidy.c.garden@usace.army.mil
Pendo Duku	Geotechnical	CENWK-ED-GD	816-389-3831	Pendo.M.Duku@usace.army.mil
LyTreese Lee	Structural	CENWK-ED-DS	816-389-3241	Lytreese.Lee@usace.army.mil
John Shelley	H&H	CENWK-ED-HR	816-389-2310	John.Shelley@usace.army.mil
Kyle Haake	Cost Estimating	CENWK-ED-DC	816-389-2220	Kyle.W.Haake@usace.army.mil
Jen Henggeler	Economics	CENWK-PM-PF	816-389-3778	Jennifer.A.Henggeler@usace.army.mil
Jerry Diamantides	Economics	David Miller Associates	401-861-0084	jdiamantides@dma-us.com
Jesse Granet	Environmental Resource (NEPA)	CENWK-PM-PR	816-389-3470	Jesse.J.Granet@usace.army.mil
TBD	Real Estate	CENWK-RE-C	816-389-	@usace.army.mil

3. Agency Technical Review Team (ATR) Responsibilities

The ATRT is comprised of individuals that have not been involved in the development of the decision document and were chosen based on expertise, experience, and or skills. The members compliment the composition of the PDT. The responsibilities of this team are as follows:

a. List of ATR Responsibilities

i. An ATRT Lead shall be designated for the ATR process. Craig Evans of the St. Paul District will serve as the ATRT Lead for this review.

ii. The ATRT Lead shall provide the PDT Lead with a statement of qualification for each of the reviewers.

iii. The ATRT Lead shall provide organization codes for each team members (see above) and a responsible financial point of contact (CEFMS responsible employee) as needed to the Kansas City District (Christy Ostrander, PM) for creation of cross charge labor codes.

iv. The ATRT shall review the submission package documents to confirm that work was done in accordance with established professional principles, practices, codes, and criteria and for compliance with laws and policy.

v. The ATRT members shall focus on their respective disciplines, but should review other submission package sections to ensure consistency throughout the documents. Reviewers that do not have any significant comments pertaining to their assigned discipline shall provide a comment stating this.

vi. In some situations, especially addressing incomplete or unclear information, comments entered into DrChecks may seek clarification in order to then assess whether further specific concerns may exist. For these instances, the ATRT member will coordinate the

comment with the ATRT Lead prior to submission into DrChecks.

vii. Flagging a comment as "*Critical*" in DrChecks indicates that the concern could have significant impacts on the study schedule or results. The use of the "*Critical*" comment flag should be reserved for those comments that the reviewer feels are of high significance.

viii. Grammatical comments shall not be submitted into Dr Checks. Grammatical comments should be submitted to the ATRT Lead via electronic mail as a Word document in track changes or as a separate Word document that outlines the comments. The ATRT Lead should consolidate and shall provide these grammatical comments to the PDT Lead outside of Dr Checks.

ix. The ATRT shall backcheck PDT evaluations to the review comments and either closes the comment or attempt to resolve any disagreements. Conference calls shall be used to resolve any conflicting comments and responses. A summary of these discussions will be included in backcheck documentation in DrChecks. ATRT members may "agree to disagree" with any comment response and close the comment with a detailed explanation for "*Non-Critical*" comments.

x. ATRT members shall keep the ATRT Lead aware of the status of "*Critical*" *and* unresolved comments. If the ATRT and the PDT are not able to reach agreement on those comments, the Review Management Organization will be engaged to provide direction and facilitate resolution of the comments. If a comment cannot be resolved, then it shall be documented and brought to the attention of the Regional Integration Team as part of the submission package.

xi. The ATRT members shall regularly monitor their respective labor code balances and alert the ATRT Lead to any possible funding shortages. Additional funding requirements by the ATRT will be coordinated through the ATRT and PDT Leads in advance of a negative charge occurring.

Table 2: ATRT Roster

Name	Role	Office Symbol	Phone	Email	Org Code	Amount
Craig Evans	ATRT Lead and Plan Formulation	CEMVP-PD-F	651-290-5594	craig.o.evans@usace.army.mil	B6K2F00	
Brian Maestri	Economics and Risk Analysis	CEMVN-PDE-FRC	504-862-1915	Brian.T.Maestri@usace.army.mil	B2K2222	
Neil Schwanz	Geotechnical	CEMVP-EC-D	651-290-5653	Neil.T.Schwanz@usace.army.mil		
Tim Grundhoffer	Structural	CEMVP-EC-D	651-290-5574	timonthy.m.grundhoffer@usace.army.mil		
Mike Alexander	H&H	CEMVK-EC-HH	601-631-5044	Michael.P.Alexander@usace.army.mil		
TBD	Cost Estimating					
TBD	NEPA					
TBD	Real Estate					

4. Considerations for Review

Products will be reviewed for compliance with guidance, including Engineer Regulations, Engineer Circulars, Engineer Manuals, Engineer Technical Letters, Engineering and Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE.

a. Project Specific Review Considerations

i. The mobile bed model has been reviewed by Tony Thomas, world renowned expert. It is requested the ATR reviewer take into consideration this review. Comments and correspondence will be provided.

ii. The project is being executed under the SMART planning principles. It is asked of the ATRT to take into consideration these principles. Engineering Bulletin provided.

b. Key General Review Considerations

i. Are there any deviations from USACE policy documented in the submission package?

ii. Does the study conform to the intent of the cited study authority?

iii. Is the formulation and evaluation of alternatives consistent with applicable regulations and guidance?

iv. Was the selection of models appropriate for use in evaluations?

v. Was the application of data within those models appropriate?

vi. Was the interpretation of and conclusions drawn from model results reasonable?

vii. What is the status of the certification/approval for use of the planning models used in the study?

viii. Are the sources, amounts, and levels of detail of the data used in the analysis appropriate for the complexity of the project?

ix. Do the main decision document and appendices form an integrated and consistent product?

c. Specific Risk and Uncertainty Review Considerations

i. None

d. For a Draft Report Submittal

i. Has the District provided the draft decision document and the preliminary draft NEPA document in its entirety? Reference ER1105-2-100, Exhibit G-7.

ii. Are both documents and the appendices essentially complete, except for the results of the pending public review?

iii. Does the report address the general evaluation guidelines presented in Exhibit G-1?

iv. Does the report indicate that the sponsor and agency views are preliminary, pending the upcoming public review?

v. Does the report text for public and agency involvement cover the results of the NEPA Scoping Meeting and the results of other coordination and public involvement efforts to date?

vi. Are all supporting analyses complete?

vii. Has the District prepared all of the required components of a Draft Document review as outlined in Exhibit H-5 item 2 (i.e., Project Study Issue Checklist, status of Environmental Compliance, Status of Engineering Activities, Status of Legal Review, Project Schedule, PGMs, Compliance Memorandum(s), and any other pertinent information)?

5. Products for Review

All products are considered draft and pre-decisional and shall not be released outside the Corps of Engineers. It is the intent of the PDT to issue background information as a supplement to the ATR Kick-off presentation which may include but not limited to Reconnaissance Report, Report Synopsis, Decision Management Plan – 1 (DMP-1), Risk Register, Project Review Plan, Draft DMP – 2, updated Synopsis and Risk Register, and peer review documents. Following is a list of products to be reviewed.

a. Hydrology, Hydraulics, & Sedimentation

i. Mobile Bed Model
ii. Mobile Bed Model Documentation
iii. Risk and Uncertainty Documentation

b. Geotechnical

- Existing Conditions Documentation
- Future without Project Conditions
- Future with Project Conditions Analysis (200-foot wide only)

c. Structures

- Existing Conditions Documentation

d. Economics

- Economic model (under review)

6. Schedule

Table 3: ATR Schedule

Activity	Date
Review Begins	06 January 2014
ATR Comments Due	22 January 2014
PDT Responses Due	31 January 2014
Backcheck Complete	14 February 2014
Resolution of Residual Comments (if required)	31 March, 2014

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Enclosure 2

DRCHECKS REPORT OF ALL COMMENTS

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Public / SBU / FOUO

Comment Report: All Comments
Project: Missouri River Bed Degradation Feasibility Study
Review: ATR - Existing and FwoP Conditions
Displaying 29 comments for the criteria specified in this report.

Id	Discipline	DocType	Section/Figure	Page Number	Line Number
5521951	Economics	N/a	n/a	n/a	n/a

Comment Classification: **For Official Use Only (FOUO)**

Please provide a more detailed description on how the project benefits of $8.4 million in Table 4 on page 9 of the Preliminary Economic Analysis were derived for Alternative 1. The basis for concern is that based on the description of the benefits on page 9, the benefits for Alternative 1 would appear to be $5.1 million. Alternative 1 would still be economically justified, but the benefit-to-cost ratio and net benefits would be lower than shown in the preliminary analysis. Recommend providing more detail on the calculation of benefits for Alternative 1.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Feb 12 2014

1-0 Evaluation **Concurred**

The average annual costs are $4.3 million and the AAEQ benefits are $8.4 million, which results in net benefits of $4.1 million. I do not see how $5.1 million was calculated. Nevertheless, all of the these benefit and net benefit calculations were conducted only to show that there are sufficient potential net benefits to continue with plan formulation and associated analyses. Far more detail concerning benefit and net calculations will be provided for the detailed alternatives evaluation. In addition, the spreadsheets used to calculate benefits will be provided with the alternatives evaluation report.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 14 2014

1-1 Backcheck Recommendation **Open Comment**

Attached is the ATR calculation for deriving $5.1 million benefit. Please provide spreadsheet showing detail of benefit calculation provided in the report.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jun 10 2014 (Attachment: ATRCal.xlsx)

1-2 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jul 09 2014

Current Comment Status: **Comment Closed**

5521955	Economics	N/a	n/a	n/a	n/a

Comment Classification: **For Official Use Only (FOUO)**

The preliminary economic analysis shows a project cost of $100 million which annualizes to $4.3 million using a 3.5 percent interest rate and a 50-year period of analysis for Alternatives 1 and 2 in Table 4 on page 9. This calculation doesn't include an estimate of interest during construction being calculated as part of project cost. Is it expected that all $4.3 million of construction would take place in one year? If interest during construction cost is not included in the calculation, then the net benefits and BCR may be overstated for each alternative. Recommend detail be added to report on construction schedule and if the project requires longer than a year to construct, then interest during construction must included in the calculation of annualized project cost.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Feb 12 2014

1-0 Evaluation **Concurred**

At the time that this preliminary economic analysis was conducted, the mobile bed model was not finalized and project costs were rudimentary. The presentation of economic benefits for this preliminary analysis report was meant to show in a very generalized way that there were potentially enough benefits to justify continuing with plan formulation and associated analyses. IDC was not calculated or included as it will be in the more detailed evaluation of alternatives.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 14 2014

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jun 10 2014

Current Comment Status: **Comment Closed**

5521958 Risk Assessment N/a n/a n/a n/a

Comment Classification: **For Official Use Only (FOUO)**

The preliminary economic analysis does not incorporate risk and uncertainty surrounding the economic and engineering inputs which is not in compliance with ER 1105-2-101. Incorporating risk and uncertainty would provide additional information to decision makers surrounding the engineering and economic inputs used in the analysis. Probability distributions rather than point estimates surrounding the engineering and economic inputs would result in probability distributions or risk-based results surrounding the economic results for the evaluation. Recommend model proponents develop an approach for incorporating risk and uncertainty surrounding the engineering and economic inputs to produce results consistent with requirements of ER 1105-2-101.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Feb 12 2014

1-0 Evaluation **Concurred**

The economic model has been modified to include "@Risk" modeling, which calculates project benefits using a distribution instead of a point value for all avoided costs. The revised model has been submitted for review.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 14 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jun 10 2014
Current Comment Status: **Comment Closed**

5521962 Economics N/a n/a n/a n/a

Comment Classification: **For Official Use Only (FOUO)**

The benefit and cost values for the two alternatives shown in the preliminary economic analysis do not seem to be linked to actual figures that are well documented in the rest of the report. Results are shown for two project alternatives in the preliminary economic analysis. Are other project alternatives being investigated in the evaluation? The basis for concern is determining the merits of the inputs for each of these alternatives to the results of the evaluation. Recommend describing future without project conditions and the specific costs that are expected to be incurred from bed degradation and then the impact the alternatives will have on these expected costs or expenditures with the alternatives in place.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Feb 12 2014

1-0 Evaluation **Concurred**
Please note that this preliminary economic analysis was conducted prior to finalization of the mobile bed model and prior to the full definition of alternatives. the preliminary economic analysis was conducted only to show that potential future net benefits may be large enough to justify continuing with the study. The more detailed evaluations of alternatives, which are currently being conducted, include the details requested.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: May 14 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jun 10 2014
Current Comment Status: **Comment Closed**

5536126 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 8, paragraph 2.3.1. Is the underseepage methodology presented similar to or differ from the approach used for the BCRA North Kansas City Unit, Kansas City Flood Protection Project? If it differs from the BCRA approach why wasn't the BCRA approach followed? _____ BASIS FOR THE CONCERN: Calculated probabilities of failure will differ between methodologies followed when applied to the same cross section. Since Pf is being calculated using the same data there should be consistency between reports. _____ SIGNIFICANCE OF THE CONCERN: Minor since underseepage was screened out and not used for assessing the without project conditions. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Align the underseepage methodology with that used

for the BCRA or add a summary statement indicating why this approach was used and how it could affect results (i.e. the approach used is expected to return a conservative higher Pf).(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

Both the BCRA and Degradation study based their underseepage analysis on the methology outlined in ETL 1110-2-556 "Risk Based Analysis in Geotechnical Engineering for Support of Planning Studies." The BCRA study used underseepage analysis results from the feasibility work to inform its process in accessing risk associated with underseepage Potential Failure Modes (PFMs).

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 22 2014

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 24 2014

Current Comment Status: **Comment Closed**

5536127 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 8, paragraph 2.3.2. The threshold for initiating repair was selected at a Pf=0.25 (i.e. 75% probability of satisfactory performance). This seems reasonable for maintenance conditions, and I have no suggestions for another path, but there should be some rationale to support the selected value. _____ BASIS FOR THE CONCERN: This is a criterion used in the report and needs some to be supported in some way, even if it simply engineering judgment. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Add justification for use of Pf=0.25 for initiation of repair.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

The following has been added to the first paragraph of section 2.5.7:

"Bank stabilization repair was triggered when the riverbank slope stability attained a Probability of Failure (PoF) greater than or equal to 25%. The 25% threshold was selected because it corresponds to the failure surface (with Factor of Safety approximately 1.1) halfway on the river bank for the worst baseline condition at River Mile 368.6 (approximately Levee Station 71+00). Since bank sloughing due to degradation occurs progressively, 25% PoF was selected as the trigger point so that repairs could be implemented to ensure that banks are stable and FDRRS are not impacted."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated3.pdf)

1-1 Backcheck Recommendation **Close Comment**
Concur with reasoning.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 24 2014
Current Comment Status: **Comment Closed**

5536128 Geotechnical Feasibility Study n/a n/a n/a
Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 11, Table 2.5.2-1. Comment for information only. The Pf values for 3 of the sections don't agree with values in the figures (Sta 71+00, 1+00, 103+00). _____ BASIS FOR THE CONCERN: The table should agree with the information in the figures. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Update the table according to the figures.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**
PoF values in Table 2.5.2-1 has been updated to match values reported in figures. See attachment.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated.pdf)

1-1 Backcheck Recommendation **Close Comment**
Concur, changes made.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 31 2014
Current Comment Status: **Comment Closed**

5536129 Geotechnical Feasibility Study n/a n/a n/a
Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 21, paragraph 2.5.7. A Pf=0.05 was used as a threshold value for reconstruction. Again, this seems reasonable for maintenance conditions but there should be some rationale to support the selected value. _____ BASIS FOR THE CONCERN: This is a criterion used in the report and needs to be supported in some way, even if it is simply engineering judgment. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: As there is currently no criteria for reliability of structures for maintenance, add justification for use of Pf=0.05 for repair.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

A sentence has been added to end of paragraph two:

"The repair PoF of 5% was selected based on a parametric study of PoF after degradation repair versus cost of repair, see Figure 2.5.7-1. As seen in Figure 2.5.7-1, the repair threshold was selected based on the optimum repair frequency and associated repair cost."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated1.pdf)

1-1 Backcheck Recommendation **Close Comment**

Concur, additional description was added.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 31 2014

Current Comment Status: **Comment Closed**

5536130 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 22, paragraph 2.5.7. In the 2nd to last paragraph the conversion rate of 1.78 tons/cy was used and is very high resulting in overestimating material costs. _____ BASIS FOR THE CONCERN: Because riprap has a very low moisture content the poorly graded Corps riprap is typically around 1.4 tons/cy for s.g. of 2.65. Using a conversion of 1.78 tons/cy will result in overestimating project costs. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Reassess the conversion factor and correct as needed.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

The rate of $40/ton used to estimate the costs reported in the second and third to last paragrapsh includes cost of riprap, transportation, and placement based on experience with BNSP project in Kansas City.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 22 2014

Backcheck not conducted

2-0 Evaluation **For Information Only**

Agree, this significant difference in the conversion factor would have a large cost impact and we reassessed as suggested. Essentially to reassess we started with a verification of the conversion factor, so we backtracked to a curve produced by our Geology Department roughly in 1973. The curve (attached) relates tons required per in-place cubic yard versus specific gravity based on actual field measurements for one or more of our dam projects, essentially for poorly graded riprap. We recognize the sample size was probably small in developing this curve and we don't know how this curve would shift with a well graded riprap or a well graded quarry run stone. However, this curve/conversion factor has been used by NWK for several years and it seems to be fairly accurate. Our cost estimating folks substantiate the conversion factor as they have

seen similar conversion factors used by contractors. In Kansas City District, conversion factors of 1.65 to 1.70 tons / in-place CY for poorly graded riprap and 1.8 to approx 2.0 tons / in-place CY for aggregate are typical. The conversion factor of 1.78 tons / in-place CY was used to be a little on the conservative side and we plan to use a well graded riprap and we thought the appropriate conversion would be somewhere between the poorly graded riprap and aggregate.

Submitted By: Cassidy Garden (816-389-3851) Submitted On: Jul 22 2014
(Attachment: Tons_per_in-place_cubic_yard_curve.pdf)

2-1 Backcheck Recommendation **Close Comment**
Concur, use district specific data.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 25 2014
Current Comment Status: **Comment Closed**

5536131 Geotechnical Feasibility Study n/a n/a n/a
Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 35, Figure 2.6.2-2. Note that this appears to be alternative 7 rather than alternative 6. What is the plan for the rock excavation? Will it be spoiled on site or removed? If removed, have costs been included for this? _____ BASIS FOR THE CONCERN: This may affect cost estimates for alternatives. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Identify the plan for rock removal and verify that it has been included in project costs. [Sidenote: check alternative numbing for the figures and tables.](imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**
Figure 2.6.2-2 caption has been revised:

"Figure 2.6.1-2: Schematic showing Alternative 7 with both dike and sill lowered to same elevation, 200 ft landward channel widening, and channel grade control"

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2014
Backcheck not conducted

2-0 Evaluation **For Information Only**
Currently there are a couple of thoughts with regards to rock disposal. One, reuse on the opposite bank at the revetment or two spoil it on the bank. We have been considering the costs of disposal for both and it is something was are still working through.

Submitted By: Cassidy Garden (816-389-3851) Submitted On: Jul 22 2014

2-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 25 2014

Current Comment Status: **Comment Closed**

5536132 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 36, paragraph 2.6.4. The allowable factor of safety of 1.4 is for conservatively chosen material properties, not for mean material properties. Mean properties are appropriate for probability based analyses but not for comparison with current criteria. _____ BASIS FOR THE CONCERN: Two criteria are applied; criterion for FS and a criterion for Pf. The FS based criterion should be based on conservative material properties which are often the mean minus 1/2 std. deviation. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Verify that FS's reported for comparison with current criteria are based on conservatively selected material properties and if not, correct as needed.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

The stability analysis has been updated using conservative material properties (mean-1/2std) to compare performance with FS criteria. See attachment.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated2.pdf)

1-1 Backcheck Recommendation **Open Comment**

Was a table added for the conservative material properties? If not, a column could be added to Table 2.3.2-1.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 04 2014

2-0 Evaluation **Concurred**

Design parameters has been added to Table 2.6.4-1.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Aug 08 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated8.pdf)

2-1 Backcheck Recommendation **Close Comment**

Concur with table added.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 08 2014

Current Comment Status: **Comment Closed**

5536133 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Appendix A, Chap 2, Page 37, Figure 2.6.4-1. The dike/sill shown is not continuous is it? If not continuous then what is the stability between dikes and does it meets criteria? If it doesn't meet criteria has there been a history of stability problems that need to be addressed? Also, can a different color be used to represent the foundation materials? The dark color covers the location of critical slip surface making it impossible to see how the dike length affects

results? _____ BASIS FOR THE CONCERN: Is the stability between dikes being overlooked which could affect project costs? _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Verify that stability between dikes is satisfactory.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

Dike/Sill is not continous. Stability of the levee reach betweeen the Dikes/Sills has been analyzed. Results are shown in "Table 2.6.4-2."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Apr 18 2014

Backcheck not conducted

2-0 Evaluation **For Information Only**

Since the dikes are built on the inside bends of the river, historically we haven't seen any real issues with bank failure in between the dikes. Of course we get occasional sloughing, but for the most part the bank stays in line. What's happened historically is that accretion occurs in the dike field and along the bank line. If we get a couple years in a row with normal seasonal flow willows and other vegetation begin to establish and the bank becomes "stabilized."

Submitted By: Cassidy Garden (816-389-3851) Submitted On: Jul 22 2014

2-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 25 2014

Current Comment Status: **Comment Closed**

5536134 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Enclosure A.1, Figure 4, Higway Wall Reach. Add discussion of this figure in the report. If the yellow data points represent the current launched stone, then it appears that the significant amounts of 2009 and 2011 stone is no longer in place and was under-designed. Is that correct? _____ BASIS FOR THE CONCERN: Loss of the amount of stone shown is significant. Is this loss only for the Higway reach or is this common to other reaches and will this affect costs. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Add discussion of this section in the report and verify that proper rock design was used and represented in the cost estimate.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**

Section 2.5.7 Paragraph 4 the following sentence has been added to clarify loss of riprap during placement in the Missouri River based on BSNP experience:

"The riprap volume required to repair the levee units was increased by 20% to account for riprap waste attributed to consolidation in underconsolidated riverbed sediment or random displacement by the swift Missouri River current during placement. "

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated4.pdf)

1-1 Backcheck Recommendation **Open Comment**

I agree with the additional discussion added to the report but the comment dealt with describing this figure in the report and summarizing the important aspects to the reader. What do you want the reader to take away from this figure? What I see is that the current survey, marked with little x's, shows that the 2009 and 2011 stone is has been eroded away and what is left is a thin layer denoted by the yellow outline. So where did the 2009/11 stone go? If velocities are so high to move this much stone any new stone must be larger in size. Is that what is intended by this figure?

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 01 2014

2-0 Evaluation **Concurred**

This figure has been removed to avoid causing confusion. Figure was from study on rock placements in the area. Launching of rock at the toe was what led to 2009 rock placement to buttress toe. 2011 rock placement resulted from the 2011 flood. The figure was originally included to develop the existing embankment geometry accounting for all rock placements.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Aug 08 2014 (Attachment: Enclosure_A_1_RD_and_River_Profiles.pdf)

2-1 Backcheck Recommendation **Close Comment**

Concur, figure removed.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 08 2014

Current Comment Status: **Comment Closed**

5536135 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Enclosure A.3, Figure 1. Comment on presentation only, no response required. The predicted degradation figure uses a double negative and the degradation relative to 2011-2062 should be a positive number. _____ BASIS FOR THE CONCERN: _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: A(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **For Information Only**
Figure 1 shows degradation as negative relative to the 2013 riverbed model.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 22 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Jul 25 2014
Current Comment Status: **Comment Closed**

5536136 Geotechnical Feasibility Study n/a n/a n/a
Comment Classification: **Public (Public)**

REVIEW CONCERN: Enclosure A.3, Sta 45+00 1 ft and 12 ft degradation figures. It's hard to believe that with 11 ft of degradation the factor of safety increases from 1.60 to 1.65. The Pf increases by 37 times but why should the mean FS increase? This was also seen in other sections. _____ BASIS FOR THE CONCERN: This relates to correctness of the modeling which serves as the basis for redesign. _____ SIGNIFICANCE OF THE CONCERN: Medium. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Verify correctness and change models if needed. If models are correct, explain why and include in the report. (imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**
Impact of degradation on stability is discussed in section 2.5.6:

"...River degradation affects channel bank and levee stability in two ways. Degradation lowers the water surface, which improves effective stress (and in turn shear strength) in the bank. However, lowering the riverbed all reduces water passive resistance at the toe of the slope. The net effect is usually a decrease in river bank stability."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated5.pdf)

1-1 Backcheck Recommendation **Open Comment**
Concur, but this supports a lower factor of safety rather than the increased factor of safety presented. Perhaps the least factor of safety wasn't found in the model with 12 feet of erosion. If the stability analysis wasn't optimized to find the least FoS then this needs to done, or, if the results are correct then description should be added to say why this differs from the expected results.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 04 2014

2-0 Evaluation **Concurred**
Description in section 2.5.6 has been added discussing the effect of the rock toe on a failure surface that includes the rock mass:

"....However, lowering the riverbed also reduces water passive resistance at the toe of

the slope. Typically the net effect decreases the river bank stability except in the case at Station 45+00 (RM 370.0) where the rock toe configuration increases stability."

Submitted By: Pendo Duku (816-389-3831) Submitted On: Aug 08 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated7.pdf)

2-1 Backcheck Recommendation **Close Comment**
Concur with changes made.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 08 2014
Current Comment Status: **Comment Closed**

5536137 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Enclosure A.3, Sta 60+00 1 ft degradation figure. The reported Pf is based on uncertainty of material parameters but what about the uncertainty in lateral erosion at this location. How does lateral erosion affect Pf? _____ BASIS FOR THE CONCERN: The critical slip surface shown results in a minor maintenance concern, whereas lateral erosion could significantly affect the T-wall which would have a much more significant affect on cost. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Address lateral erosion effects on wall stability.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**
In section 2.5.7 paragraph 3 discusses launching of riprap into degraded riverbed.

"During the analysis, the minimum riprap revetment required to obtain the required stability of the channel slope was determined iteratively. After revetment, degradation was assumed to continue eroding the riverbed and undermining the new riprap. Since degradation causes riprap displacement, the analyses assumed a constant riprap volume balance before and after degradation at each cross section. After degradation, the riprap at the toe launches into the degraded riverbed triggering rolling of the riprap below until the movement stabilizes at the angle of repose (1V:1.5H). When another repair is triggered, the revetment process was repeated. "

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 24 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated6.pdf)

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 04 2014
Current Comment Status: **Comment Closed**

5536138 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Enclosure A.4, Sta 79+00 figure. Here and other figures it's difficult to follow the intent of including these in the report. It appears in this case that the 2008 channel has eroded the riprap dike/sill. Was that the intent? _____ BASIS FOR THE CONCERN: Interpretation of the figure is unclear and it shouldn't be left up to the reader to interpret the intent of the writer. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Suggest including discussion on figures in paragraph 2.6.2 of the Geotech report.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**
Enclosure A.4 has been removed from the report. See attachment.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 22 2014 (Attachment: Enclosure_A_4_Future_with_Project.pdf)

1-1 Backcheck Recommendation **Open Comment**
Where are these figures discussed in the report? If there is no discussion then discussion needs to be added.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 04 2014

2-0 Evaluation **Concurred**
Reference to Enclosure A.4 has been added in section 2.6.4

Submitted By: Pendo Duku (816-389-3831) Submitted On: Aug 08 2014 (Attachment: Chapter_02_Geotechnical_Engineering_Appendix-updated9.pdf)

2-1 Backcheck Recommendation **Close Comment**
Concur. Discussion has been added.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 08 2014

Current Comment Status: **Comment Closed**

5536139 Geotechnical Feasibility Study n/a n/a n/a

Comment Classification: **Public (Public)**

REVIEW CONCERN: Enclosure A.5, 80% RW Efficiency (parallel to levee) figure. With the equal spacing of 500 ft of wells why are 2 wells showing negative heads above the GS? _____ BASIS FOR THE CONCERN: Errors could affect well spacing and cost. _____ SIGNIFICANCE OF THE CONCERN: Minor. _____ ACTION NEEDED TO RESOLVE THE CONCERN: Verify analyses and correct if needed. If analysis is correct add explanation in the report. Have all analyses checked and add checked by initials to computations.(imported from PDF Comment Form)

Submitted By: Neil Schwanz (651-290-5653). Submitted On: Feb 25 2014

1-0 Evaluation **Concurred**
Relief wells analysis has been revised and does not show negative heads. See attachment.

Submitted By: Pendo Duku (816-389-3831) Submitted On: Jul 22 2014 (Attachment: Enclosure_A_5_Future_with_Project_Analysis.pdf)

1-1 Backcheck Recommendation **Close Comment**
Concur, resultant plots have been revised.

Submitted By: Neil Schwanz (651-290-5653) Submitted On: Aug 01 2014
Current Comment Status: **Comment Closed**

5542066	Hydraulics	N/a	n/a	n/a	n/a

Comment Classification: **Public (Public)**

Existing Condition and Feasibility Study Reporting for the subject Degradation Study was included in this Hydraulics and Hydrology discipline ATR for the mobile bed model development and verification. I found the model to be very well done. Dr. Shelley has prepared a quality model, and I enjoyed participating in this level of review.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Feb 28 2014

1-0 Evaluation **Concurred**
Concur. Thank you.

Submitted By: John Shelley (816-389-2310) Submitted On: Jun 10 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (601-631-5044) Submitted On: Jul 31 2014
Current Comment Status: **Comment Closed**

5542070	Hydraulics	N/a	n/a	n/a	n/a

Comment Classification: **Public (Public)**

I found model development and verification/calibration to be comprehensive and among the most accurate for simulated versus field gage data comparison. I could find nothing lacking between the earlier iterations of review between Dr. Shelley and Tony Thomas. I saw certain issues addressed to higher-than-usual standards, notably the model roughness parameters based on discharge and channel bedforms.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Feb 28 2014

1-0 Evaluation **Concurred**
Concur. Thank you.

Submitted By: John Shelley (816-389-2310) Submitted On: Jun 10 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (601-631-5044) Submitted On: Jul 31 2014

2-0 Evaluation **Concurred**
Concur. Thank you.

Submitted By: John Shelley (816-389-2310) Submitted On: Jun 10 2014

Backcheck not conducted

Current Comment Status: **Comment Closed**

5542077 Hydraulics N/a n/a n/a n/a

Comment Classification: **Public (Public)**

This study, more than most, is dependent on simulations that include sediment quantities. I found careful attention given to verifying model simulations to field data. Sensitive issues with sediment quantities can be developed with confidence.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Feb 28 2014

1-0 Evaluation **Concurred**
Concur. Thank you.

Submitted By: John Shelley (816-389-2310) Submitted On: Jun 10 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (601-631-5044) Submitted On: Jul 31 2014

Current Comment Status: **Comment Closed**

5558662 Structural N/a n/a n/a n/a

Comment Classification: **For Official Use Only (FOUO)**

Appendix A, Chapter 3, para. 3.4.5 The paragraph mentions outlet pipes and outfall structures were evaluated in the civil section. No civil sections were found. Additionally, though each outlet would have a small repair cost the number of these structures would be very high. Unless, global levee issues occur first, outlets could be the first flood protection structures to be affect as they are closer the river. Depending on invert elevations, vulnerabilities would include, undermining of outlet structures, scour of impervious blankets, shorten seepage paths etc

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Mar 13 2014

1-0 Evaluation **Concurred**

The outfall structure section was revised based on updated plan for addressing these structures. At this time, it is believed that these structures will not drive the alternative selection, so they are not addressed. See the revised structural appendix attached for exact explanation.

Submitted By: Clint Mason (816-389-3619) Submitted On: Apr 30 2014 (Attachment: Structural_Appendix_revisions_for_ATR_30Apr2014.pdf)

1-1 Backcheck Recommendation **Close Comment**

Adequate updates were included in the attached appendix. Comment closed.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 08 2014

Current Comment Status: **Comment Closed**

5558663	Structural	N/a	n/a	n/a	n/a

Comment Classification: **For Official Use Only (FOUO)**

Appendix A, Chapter 3, para. 3.4.1, Table 1: It is unclear why Table 1 does not include tributary bridges within the focus area. An explanation should be included or expand table to include tributary bridges.

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Mar 13 2014

1-0 Evaluation **Concurred**

An explanation was included. See new section attached to Comment 5558662 for full text. Based on SMART Planning principles, the tributary bridges are not being investigated in-depth at this point in the study.

Submitted By: Clint Mason (816-389-3619) Submitted On: Apr 30 2014

1-1 Backcheck Recommendation **Close Comment**

An explanation and clarification was added to the attached appendix and addresses comment. Comment closed.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 08 2014

Current Comment Status: **Comment Closed**

5558664	Structural	N/a	n/a	n/a	n/a

Comment Classification: **For Official Use Only (FOUO)**

Appendix A, Chapter 3, Table 1: There are four bridges that indicate the "current" bed degradation is well below the identified critical elevation. What is the status of these bridges – have they been repaired, in state of repair etc.

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Mar 13 2014

1-0 Evaluation **Concurred**

Explanation has been added to the sections discussing this issue. Without detailed analysis or owner information, conservative "critical elevation" assumptions were made based on geometry of piers (ie bottom of seal course, etc). Obviously, this does not mean these bridges will fall; however, it does indicate that repairs might be made at any time based on owner judgement. See full explanation attached to Comment 5558662.

Submitted By: Clint Mason (816-389-3619) Submitted On: Apr 30 2014

1-1 Backcheck Recommendation **Close Comment**

An explanation and clarification was added to the attached appendix and addresses comment. Comment closed.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 08 2014

Current Comment Status: **Comment Closed**

5558665	Structural	N/a	n/a	n/a	n/a

Comment Classification: **For Official Use Only (FOUO)**

Appendix A, Chapter 3: The appendix if very general and lacks supporting documentation for critical elevations. Consider including a representative sample to include supporting information (meeting notes, pertinent drawings, pertinent survey info, repair quantities etc). Additionally, it should be stated supporting information for other locations are on file at the district.

Submitted By: Timothy Grundhoffer (651-290-5574). Submitted On: Mar 13 2014

1-0 Evaluation **Concurred**

An example has been added in Section 3.4.1.1. See document attached to Comment 5558662.

Submitted By: Clint Mason (816-389-3619) Submitted On: Apr 30 2014

1-1 Backcheck Recommendation **Close Comment**

Comment closed.

Submitted By: Timothy Grundhoffer (651-290-5574) Submitted On: May 08 2014

Current Comment Status: **Comment Closed**

5598568	Risk Assessment	N/a	n/a	n/a	n/a

Comment Classification: **For Official Use Only (FOUO)**

Concern: The future without project conditions were determined using a series of flows for the 50-year period of analysis based only on the 1 percent probability of exceedance for bed transport and with commercial dredging continuing at the currently permitted levels for the entire 50-year period of analysis. The 50 percent exceedance probability for bed sediment along with various dredging levels was used to develop flows over the 50-year period as a sensitivity analysis. While this scenario is valuable to show how results may vary, a range of exceedance probabilities for sediment transport would need to be investigated by the PDT, unless results are similar for all exceedance probabilities used for flows.

Basis: ER 1105-2-100, Step 6 on Page E-97, computing damages (costs avoided) over a range of probabilities to determine average/expected annual values.
Significance: Flows based on various probability events could have very different outcomes in terms of equivalent values for equivalent annual avoided costs for project alternatives. The Corps decision to invest funds for a proposed flood risk management alternative is usually based on a range of probability events that could occur in any one year to determine an expected value under without and with project conditions.
Recommendation: Demonstrate that avoided costs on an equivalent annual basis will be similar for flow rates over the 50-year period of analysis for the two scenarios using results from the economic model. This demonstration is discussed in Figure 3 of the Sensitivity Analyses Report , however, how the lag in years before receiving critical flows are achieved for the 50 percent probability exceedance relative to the 1 percent exceedance affects equivalent annual expenditures should be quantified using the economic model. One other recommendation is to adjust the "econ model critical stage" to be equal to the actual critical stage minus some stage adjustment since a lower stage below the critical stage would trigger actions by decision makers of public infrastructure to avoid potential catastrophic events. Depending on how fast stages are falling, you could translate time to stage and the stage adjustment would represent the time required to make the expenditures. Linking the scenarios to the critical stage in the economic model as discussed on in Figure 3 page 4 of the Sensitivity Analyses Report may be a good bridge for making decisions.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Apr 11 2014

1-0 Evaluation **Concurred**

The economic model will be run for the 50% exceedance (base case) and for the 1% exceedance (sensitivity analysis), as recommended. Additionally, the "econ model critical stage" will be adjusted to trigger actions in advance of the year the actual critical stage is achieved. This critical stage adjustment will be used as a sensitivity analysis to identify any effects on plan selection. The economic model will also be run by using a "lead time adjustment", which will use the base case critical stage but will have actions taken some number of years (say 3-7) prior to degradation reaching the critical stage. This lead time adjustment will be used as a sensitivity analysis to identify any effects on plan selection.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: Jun 02 2014

1-1 Backcheck Recommendation **Close Comment**

The revised approach will be reviewed when results are available.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jun 10 2014

Current Comment Status: **Comment Closed**

5598611 Risk Assessment N/a n/a n/a n/a

Comment Classification: **For Official Use Only (FOUO)**

Concern: Draft Technical Appendix B, Future Without Project Model Projections, dated 06 Mar 2014, uses a series of flows for the 50-year period of analysis based on the 1 percent probability of exceedance for bed transport and with commercial dredging continuing at the currently permitted levels for the entire 50-year period of analysis. The Draft Sensitivity Analyses Report dated 24 Mar

2014, uses the 50 percent exceedance probability for bed sediment along with various dredging levels to develop flows over the 50-year period as a sensitivity analysis. The reports do not discuss or quantify the uncertainty surrounding the stages produced by the mobile bed transport and other flow models used to produce flows for the two exceedance probability scenarios over the 50-year period of analysis.
Basis: ER 1105-2-101 requires that risk and uncertainty be addressed for important parameters in the evaluation. Distributions have been applied to the expenditures on public infrastructure and critical stage parameters in the economic model; however uncertainty surrounding the flows for the scenarios is not addressed in the Draft Technical Appendix.
Significance: The uncertainty surrounding bed sediment and flow variables based on techniques or models used to produce the analysis will allow for more informed decision-making.
Recommendation: Address uncertainty surrounding the results of models that produce bed sediment and flow levels. If uncertainty cannot be quantified, then qualitatively address the uncertainty surrounding the parameters in the reports.

Submitted By: Brian Maestri (504-862-1915). Submitted On: Apr 11 2014

1-0 Evaluation **Concurred**

Please see response to Comment ID 5598568. Based on multiple conference calls with the review and modeling teams uncertainty concerning bed sediment and flow levels will be addressed in the economics model by altering "critical stages" in the economic model to see how alternative critical stages affect plan selection. In addition, the year in which an action is taken in response to perceptions of future bed sediment and flow stages will be altered to show the way that alternative lead times might affect plan selection.

Submitted By: Jerry Diamantides (401 861 0084) Submitted On: Jun 02 2014

1-1 Backcheck Recommendation **Close Comment**

Revised approach will be reviewed when results are available.

Submitted By: Brian Maestri (504-862-1915) Submitted On: Jun 10 2014

Current Comment Status: **Comment Closed**

5612572 Hydraulics N/a n/a n/a n/a

Comment Classification: **Public (Public)**

For the subject MO River Bed Degradation Feasibility Study, documents reviewed included the 1) Model Calibration Report, 2) the Future Without Project Appendix, 3) the Future with Project Appendix, and 4) the Sensitivity Appendix.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Apr 22 2014

1-0 Evaluation **Concurred**

Correct. Those are the documents sent to ATR.

Submitted By: John Shelley (816-389-2310) Submitted On: Jun 10 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (601-631-5044) Submitted On: Jul 31 2014
Current Comment Status: **Comment Closed**

5612623	Hydraulics	N/a	n/a	n/a	n/a

Comment Classification: **Public (Public)**

I found no issues of concern with the FWOP and FWP appendices. The hydraulic model was properly applied to the alternatives as presented in the FWOP and FWP appendices.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Apr 22 2014

1-0 Evaluation **Concurred**
Concur.

FYI- These appendices will be updated with another iteration of model runs for new alternatives for the next round of ATR.

Submitted By: John Shelley (816-389-2310) Submitted On: Jun 10 2014

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (601-631-5044) Submitted On: Jul 31 2014
Current Comment Status: **Comment Closed**

Enclosure 3

COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW

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COMPLETION OF AGENCY TECHNICAL REVIEW

The Targeted Agency Technical Review (ATR) has been completed for the preliminary hydraulic and economic models, technical assumptions, existing and future without project conditions for the Missouri River Bed Degradation Feasibility Study, for the Kansas City District. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy.

The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be effective. DQC review of the mobile bed hydraulic model was extensive and conducted by a nationally recognized expert in sediment modeling; those comments and responses were recorded in DrChecks and provided to the ATR team. Additional DQC comments and responses on documents related to the hydraulic model and sensitivity reports were provided to the ATR team in writing. Although there were no written DQC comments for some documents, communication with the PDT's project manager indicated that all of the documents to be reviewed had undergone DQC before they were provided to the ATR team. The quality of the documents reviewed was sufficient for this review and indicated that adequate DQC was accomplished.

The review report notes that all comments have been addressed and closed in DrChecks. The proposed changes are expected to resolve all issues raised by the ATR team. Resolution will be verified in subsequent reviews when model results are available.

2014.10.24 (Original)

Craig Evans Date
ATR Team Leader
CEMVP-RPEDN-PD-F

Christina Ostrander Date
Project Manager
CENWK-PM-PF

Enclosure 6

SEPTEMBER 2016 TARGETED ATR REPORT:
Hydraulic model calibration and existing conditions

Missouri River Bed Degradation Feasibility Study

Targeted Agency Technical Review

Targeted review of hydraulic model calibration and existing conditions

Prepared for the FRM-PCX by

Craig Evans, ATR Lead
CEMVP-RPEDN-PD-F
September 2016

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TABLE OF CONTENTS

TARGETED AGENCY TECHNICAL REVIEW REPORT

ENCLOSURES

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Subject: Review report for targeted review of hydraulic model calibration and existing conditions for the Missouri River Bed Degradation Feasibility Study, November 2014 through July 2016, Kansas City District.

1. **Scope and Purpose of Review:** The purpose of this review report is to document the targeted agency technical review (ATR) for the subject products. The review was conducted for the Kansas City District. The primary point of contact for the District was Ms. Christina Ostrander, CENWK-PM-PF.

The ATR team (ATRT) was led by Mr. Craig Evans, CEMVP-RPEDN-PD-F. The Flood Risk Management Planning Center of Expertise (FRM-PCX) was the lead center for managing this ATR.

2. **References**

a. This review report was prepared in response to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. The review documents reside online at ProjNet (www.projnet.org). The DrChecks Project title is "(400367) Missouri River Bed Degradation Feasibility Study." The targeted review was conducted in steps and used the following DrChecks review titles:

- 14 Nov 2014 to 19 Dec 2014: Targeted ATR – Mobile Bed Model (5 comments, no evaluation)
- 06 May 2015 to 31 May 2015: Mobile Bed Model-Targeted Rvw (No comments)
- 26 Jan 2016 to 26 Feb 2016: Mobile Bed Model EC and Calibration Rvw (8 comments, all closed)

b. The review was conducted in accordance with the Review Plan dated February 11, 2013 and approved by the Northwest Division Commander on March 8, 2013.

3. **Project Description**

The study is authorized by Section 216 of Public Law 91-611, Flood Control Act of 1970. The purpose of the study is to identify and evaluate alternatives to address the impacts of river bed degradation that is occurring on the lower Missouri River, from Rulo, NE to the mouth at St. Louis, MO. The Missouri River Bank Stabilization and Navigation Project (BSNP) is the federal project of interest, both as a causal factor, and as part of the impacted federal infrastructure. The study will identify and evaluate alternatives to minimize or eliminate future impacts of the bed degradation to the federal infrastructure and local public infrastructure. The study will examine the effects of degradation on the long-term stability and sustainability of the BSNP. There are significant flood risk management features, located primarily within the Kansas City Reach and near St. Joseph, MO, that are dependent on the stability of the BSNP and are potentially also impacted by continued bed degradation. Recommendations for structural or operating changes that have potential for minimizing degradation impacts will be considered. In addition, the study will consider approaches to help or maintain or enhance the viability of federally constructed

ecosystem projects such as constructed wetlands and shallow water habitat. The study will also inventory and assess measures that protect local and public infrastructures.

4. **Review Team.**
This targeted ATR team included a subset of the disciplines included in the full ATR team as identified in the review plan (reference 2b): ATR Lead (including Plan Formulation) and Hydraulic Engineering. Additional disciplines will be added in subsequent review steps.

ATR Lead (including Plan Formulation)
Craig Evans, CEMVP-RPEDN-PD-F, serves as the Chief of the Plan Formulation Section in St. Paul, MN. He has 29 years of experience with the Corps of Engineers including 12 years in civil design and 17 years in planning and project management. He is a registered Professional Engineer in Minnesota, holds a masters degree in Public Administration, and is a 2005 graduate of the USACE Planning Associates Program. He has led several reconnaissance studies, multi-purpose feasibility studies, watershed studies and construction projects. He has significant experience with plan formulation and report writing for flood risk management, ecosystem restoration and stream bank protection as well as civil engineering review and value engineering.

Hydraulic Engineering
Mike Alexander, CESAM-EN-HH, is a Registered Professional Engineer with over 35 years of USACE experience dealing with channel stability, navigation, and training structures design. Mike is a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Mike serves as Lead Hydraulic Engineer in the Hydrologic, Hydraulics, and Coastal Engineering Design Section. He started work with the USACE Laboratories in 1981 at the Waterways Experiment Station's Coastal Engineering Research Center and later working in the Coastal and Hydraulics Laboratory at the Engineering Research and Development Center (ERDC). Mike moved to the USACE Vicksburg District in 2000, where he was involved with developing 2-dimensional modeling and sediment transport expertise and capability. Project experience includes dredging equipment techniques/applications, dredged material production/disposal evaluations, and wetland restoration with dredged material. Over the last 15 years, work focused on 1-, 2-, and 3-dimensional numerical model studies for navigation and flood control projects, often with sediment transport modeling components. His current work after moving to Mobile District in 2015, is on strategic, quick-turnaround numerical model applications for navigation issues and associated training structure designs. He also presently serves as Acting Chief of the Hydrologic, Hydraulics, and Coastal Engineering Design Section, Water Resources Branch, Engineering Division, at Mobile District.

Hydraulic Engineering
Dr. Paul Boyd, CENWO-ED-HF, is a hydraulic engineer and Regional Technical Specialist for Sedimentation and Alluvial Processes in Omaha District. He is a registered Professional Engineer in Iowa and a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Dr. Boyd has been with the US Army Corps of Engineers since 2002, serving in numerous roles primarily associated with river and reservoir sediment transport and management, including 1-d and 2-d modeling of sediment transport, reservoir flushing modeling, emergent sandbar habitat

design, reservoir data collection management, and senior technical review of USACE publications. He is currently working on advancing modeling tools for simulating hydraulic flushing at USACE reservoir projects. In addition, Dr. Boyd is heavily involved in the Missouri River Recovery Program (MRRP) by working on habitat creation projects to protect endangered species. Most recently, he has been tasked as technical lead for reservoir sedimentation training and guidelines development with the Government of Lao PDR as part of the USAID Smart Infrastructure for the Mekong (SIM) River program. In addition, he is currently focused on developing plans for reservoir sustainability to extend the useful life of Federal reservoirs.

5. **Charge to Reviewers.**
See Enclosure 1. Note that the Charge dated December 2015 defines three separate targeted review efforts:

- 1. Mobile Bed Model calibration, associated model documentation, and DQC documentation (documented in this report)
- 2. Projection Mobile Bed Model, future without project projections, future with project projections, risk & uncertainty, and sensitivity analysis documentations (documented in a separate report dated September 2016)
- 3. Targeted plan formulation review will be the subsequent round of full ATR and will focus on the plan formulation (review not conducted as of September 2016)

Only the Mobile Bed Model calibration review is documented in this report.

6. **Summary.**

a. This targeted review of the updated mobile bed hydraulic model calibration was intended to verify that the model was properly calibrated to reflect existing conditions as the basis for developing the future without project conditions. An initial targeted review documented in an October 2014 ATR report validated use of the mobile bed hydraulic model in conjunction with an economic spreadsheet model. After the initial targeted ATR, changes were made in the mobile bed hydraulic model to address the ATR comments, stakeholder comments, survey monument errors, and software bugs. These changes occurred while this ATR effort was underway, so the ATR was extended from November 2014 through March 2016, as the model evolved.

b. The PDT posted the documents to be reviewed in DrChecks in November 2014. The hydraulic model files were provided via the AMRDEC website. The ATR team entered comments into DrChecks in December 2014. The PDT reviewed the comments but never formally evaluated them in DrChecks because anticipated changes from stakeholder review comments would necessitate additional ATR. The PDT made changes to the model based on the ATR comments and stakeholder comments, and the ATR was extended to review the updated model.

c. A review was set up in DrChecks to be conducted in May 2015. However, that review did not occur because the PDT discovered that some of the benchmarks used for cross section surveys were incorrect. In June 2015, the PDT and HEC found a bug in the RAS mobile bed

model software that needed to be fixed. The PDT discovered another bug in the software in December 2015 that needed to be fixed.

d. The PDT provided an updated calibration report, DQC documentation, model runs and software files in January 2016. The ATR team completed its review in March 2016, and evaluation and backchecking occurred in April 2016. One comment was added in July 2016 to document that DQC documentation was provided and considered in the ATR. The December 2014 ATR comments were largely overcome by subsequent events; the PDT addressed the concerns in the course of finalizing the model and calibration report. In the end, all of the issues raised by the ATR team were adequately addressed even though the December 2014 comments were not officially evaluated or closed in DrChecks.

e. The ATR team found that the mobile bed hydraulic model was adequately calibrated and appropriate for the analysis to be conducted. The model properly incorporated dredging. No issues were identified that needed further attention.

f. Critical Comments. No critical issues were identified.

g. Unresolved Comments. The PDT responded acceptably to all comments, and the ATR team closed all comments in DrChecks.

h. Lessons Learned. None.

7. DrChecks Report. The DrChecks report of all comments is attached as Enclosure 2

8. ATR Completion Statement.
Enclosure 3 contains the completion statement.

Enclosure 1

CHARGE

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AGENCY TECHNICAL REVIEW

CHARGE TO THE MISSOURI RIVER BED DEGRADATION FEASIBILITY STUDY PROJECT DELIVERY TEAM & AGENCY TECHNICAL REVIEW TEAM FOR CALIBRATION MODEL REVIEW, TARGETED H&H REVIEW, AND TARGETED PLAN FORMULATION REVIEW

Missouri River Bed Degradation Feasibility Study, MO & KS
Section 216 of Public Law 91-611, Flood Control Act of 1970

Prepared by: Kansas City District, Degradation PDT
Date: 17 November 2014
Version 7 Updated: 13 April 2015
Version 8 Updated 21 Dec 2015

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AGENCY TECHNICAL REVIEW
CHARGE TO THE MISSOURI RIVER BED DEGRADATION FEASIBILITY STUDY PROJECT DELIVERY TEAM & AGENCY TECHNICAL REVIEW TEAM

1. General

Engineering Circular (EC) 1165-2-214 "Civil Works Review" provides procedures to ensure the quality and credibility of U.S. Army Corps of Engineers (Corps) work products for the nation. Technical, scientific, and engineering information used to support recommendations in decision documents must undergo a rigorous review process. A review plan is developed at the start of each study or project to describe the scope of review that will be needed in accordance with the EC 1165-2-214. As documented in the Missouri River Bed Degradation Feasibility Study Review Plan, Agency Technical Review (ATR) is one of the required levels of review for this study. ATR reviews must be conducted by professionals outside the home district with appropriate technical expertise. The purpose of this document is to provide a charge, or direction, to the Agency Technical Review Team (ATRT) and the Kansas City District Project Development Team (PDT) to conduct an Agency Technical Review of work products for the Missouri River Bed Degradation Feasibility Study. This charge will be included as an attachment to the projects review plan.

2. Project Delivery Team (PDT) Responsibilities

The PDT is comprised of individuals directly involved in the development of the Missouri River Bed Degradation Integrated Feasibility Study and Environmental Impacts Statement.

2.1 PDT Team Members

Name	Role	Office Symbol	Phone	Email
Christy Ostrander	Project Manager	CENWK-PM-PF	816-389-3143	Christina.Ostrander@usace.army.mil
Ron Jansen	Technical Lead/Civil	CENWK-ED-GC	816-389-3610	ronaldgjansen@usace.army.mil
Pendo Duku	Geotechnical	CENWK-ED-GD	816-389-3831	Pendo.M.Duku@usace.army.mil
Eddie Fernandez	Structural	CENWK-ED-DS	816-389-3237	Eduardo.H.Fernandez@usace.army.mil
John Shelley	H&H	CENWK-ED-HR	816-389-2310	John.Shelley@usace.army.mil
Kyle Haake	Cost Estimating	CENWK-ED-DC	816-389-2220	Kyle.W.Haake@usace.army.mil
Jen Henggeler	Economics	CENWK-PM-PF	816-389-3778	Jennifer.A.Henggeler@usace.army.mil
Jerry Diamantides	Economics	David Miller Associates	401-861-0084	jdiamantides@dma-us.com
Jesse Granet	Environmental Resources (NEPA)	CENWK-PM-PR	816-389-3470	Jesse.J.Granet@usace.army.mil

John Nicol	Real Estate	CENWK-RE-C	816-389-3755	John.M.Nicol@usace.army.mil

2.2 Specific PDT Responsibilities

1. A PDT Lead shall be designated for the ATR process. Ron Jansen, COE Kansas City District will serve as the PDT Lead.

2. The PDT Lead shall facilitate communications between the PDT and ATRT.

3. An electronic version of items to be reviewed in either Microsoft Word or a searchable Adobe Acrobat shall be provided at least one business day prior to the start of the review.

4. DrChecks shall be used to by the PDT to evaluate all substantive comments provided by the ATRT. Responses of "Concur" must include a description of what action was taken to resolve the review comment. Revised documentation will be provided if requested. "Non-Concur" responses shall state the basis for the disagreement or clarification of the concern and suggest actions to negotiate the closure of the comment. PDT members shall coordinate all "Non-Concur" responses with the PDT Lead who will consolidate and discuss "Non-Concur" responses directly with and the ATRT Lead for resolution.

5. The Project Manager shall provide labor funding by cross charge labor codes to the ATR Lead for the ATRT members.

6. The PDT Lead is responsible for organizing an ATR kick-off meeting in coordination with the ATR Lead before or during the first week of the review period.

7. The PDT Lead may conduct an in progress review to summarize comment evaluations as needed in cases of complex, interrupted, or extended reviews to facilitate the review process.

8. PDT members shall contact ATRT members or Lead as appropriate to seek clarification of a comment's intent or provide clarification of information in the submission package. These discussions may occur outside of DrChecks, but a summary of significant discussions should be provided in DrChecks.

9. The PM shall coordinate the proposed schedule and time for the relevant HQ Vertical Team milestones to ensure that the ATRT Lead will be able to participate.

3. Agency Technical Review Team (ATRT) Responsibilities

The ATRT is comprised of individuals from outside the Kansas City District who have not been involved in the day-to-day production of the project/product. They have been selected based on

expertise, experience, and/or skills. The ATRT should note that this project is being executed under the SMART Planning Principles. Reference: Planning Bulletin No. PB 2013-03-reissue, dated 14 March 2014, Subject: SMART Planning Milestones.

3.1 ATR Team Members

Name	Role	Office Symbol	Phone	Email	District	Org Code
Craig Evans	ATRT Lead and Plan Formulation	CEMVP -PD-F	651-290-5594	craig.o.evans@usace.army.mil	CEMVP	B6K2F00
Brian Maestri	Economics and Risk Analysis	CEMVN -PDE-FRC	504-862-1915	Brian.T.Maestri@usace.army.mil	CEMVN	B2K2222
Neil Schwanz	Geotechnical	CEMVP -EC-D	651-290-5653	Neil.T.Schwanz@usace.army.mil	CEMVP	B6L1DGG
Tim Grundhoffer	Structural	CEMVP -EC-D	651-290-5574	Timothy.M.Grundhoffer@usace.army.mil	CEMVP	B6L1DSM
Mike Alexander	H&H	CESAM-EN-HH	251-441-6641	Michael.P.Alexander@usace.army.mil	CESAM	K5L0ED0
Paul Boyd	H&H	CENWO -ED-HF	402-995-2350	Paul.M.Boyd@usace.army.mil	CENWO	G6L0HS0
Dan Pridal	Risk & Uncertainty w H&H	CENWO -ED-HF	402-995-2336	Daniel.b.pridal@usace.army.mil	CENWO	G6L0HS0
TBD	Cost Estimating	TBD	TBD	TBD	TBD	TBD
Kip Runyon	NEPA	CEMVP -PD-P	314-331-8396	Kip.r.runyon@usace.army.mil	CEMVP	B6K2P00
Rodney Peterson	Real Estate	CEMVR -RE	651-290-5397	Rodney.r.peterson@usace.army.mil	CEMVR	B5N0540

3.2 Specific ATRT Responsibilities

1. An ATRT Lead shall be designated for the ATR process. Craig Evans of the St. Paul District will serve as the ATRT Lead.

2. The ATRT Lead shall provide the PDT Lead with a statement of qualification for each of the reviewers.

3. The ATRT Lead shall provide organization codes for each team member and a responsible financial point of contact (CEFMS responsible employee) as needed to the Kansas City District (Christy Ostrander, Project Manager) for creation of cross charge labor codes.

4. The ATRT shall review the items submitted to ensure that they were prepared in

accordance applicable professional principles, practices, codes, criteria, and for compliance with laws and policy.

5. The ATRT members shall focus on their respective disciplines, but should review all information to ensure consistency of the products.

6. DrChecks shall be used to by the ATRT to provide substantive comments on items reviewed. Flagging a comment as "Critical" in DrChecks indicates that the concern could have significant impacts on the study results or schedule. The use of the "Critical" comment flag should be reserved for those comments that the reviewer feels are of high significance.

7. ATRT members shall keep the ATRT Lead aware of the status of "Critical" and unresolved comments. If the ATRT and the PDT are not able to reach agreement on those comments, the Review Management Organization will be engaged to provide direction and facilitate resolution of the comments. If a comment cannot be resolved, then it shall be documented and brought to the attention of the Regional Integration Team as part of the submission package.

8. In some situations, especially addressing incomplete or unclear information, comments entered into DrChecks may seek clarification in order to then assess whether further specific concerns may exist. For these instances, the ATRT member will coordinate the comment with the ATRT Lead prior to submission into DrChecks.

9. The ATRT shall backcheck PDT evaluations to the review comments and either closes the comment or attempt to resolve any disagreements. Conference calls shall be used to resolve any conflicting comments and responses. A summary of these discussions will be included in backcheck documentation in DrChecks. ATRT members may "agree to disagree" with any comment response and close the comment with a detailed explanation for "Non-Critical" comments.

10. Grammatical comments shall not be submitted into Dr Checks. Grammatical comments should be submitted to the ATRT Lead via electronic mail as a Word document in track changes or as a separate Word document that outlines the comments. The ATRT Lead should consolidate and shall provide these grammatical comments to the PDT Lead outside of DrChecks.

11. Reviewers that do not have any substantive comments shall enter a comment in DrChecks indicating such.

12. The ATRT members shall regularly monitor their respective labor code balances and alert the ATRT Lead to any possible funding shortages. Additional funding requirements by the ATRT will be coordinated through the ATRT and PDT Lead in advance of a negative charge occurring.

4. ATR Review

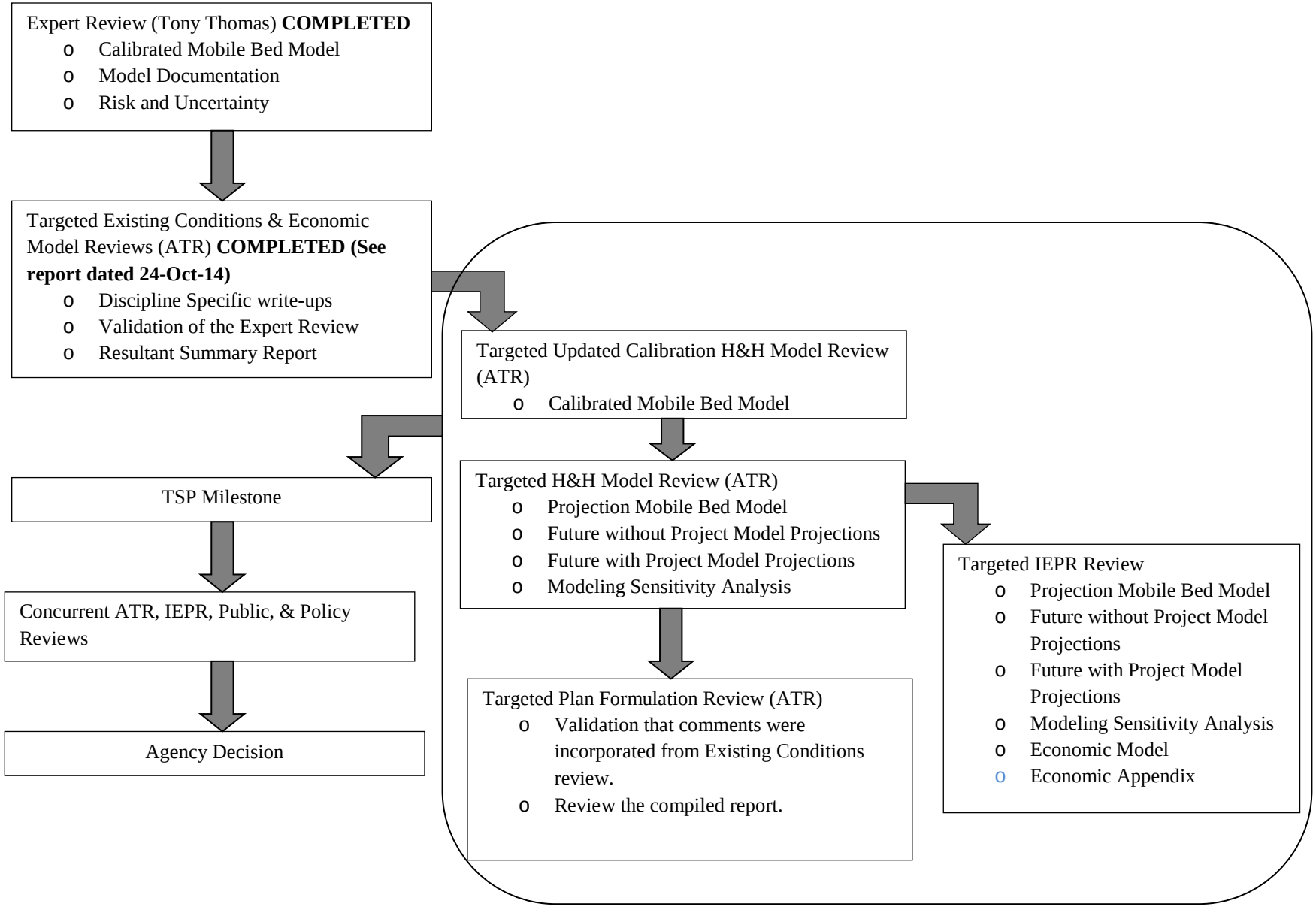
The targeted review of preliminary hydraulic and economic models, technical assumptions, and existing and future without project conditions was conducted in March through August 2014. The mobile bed model has since been updated due to stakeholder comments, survey monument errors, and a software bug. The first review covered by this charge is a targeted H&H review of the updated calibration sediment model. It will be useful to have this model, associated documentation, and DQC reviewed by the ATRT as the PDT engages in coordination with the vertical team. Additional ATR of the draft report, which is not included in this charge, will be necessary in the future.

4.1 ATR Reviews Defined Under This Charge

1. A targeted review is requested to be conducted over the Mobile Bed Model, calibration, associated model documentation, and DQC documentation. Because the Mobile Bed Model is a critical component of the project and the basis upon which the future projections model will be built, the targeted review is intended to get the information in front of the reviewer sooner than later, allow for comments to be provided sooner than later, and allow for the incorporated resolution of comments be included in the projection mobile bed model and the report for the targeted plan formulation review.

2. The next review will be of the Projection Mobile Bed Model, future without project projections, future with project projections, risk & uncertainty, and sensitivity analysis documentations. Because the Projection Mobile Bed Model is a critical component of the project, the targeted review is intended to get the information in front of the reviewer sooner than later, allow for comments to be provided sooner than later, and allow for the incorporated resolution of comments be included in the report for the targeted plan formulation review.

3. The targeted plan formulation review will be the subsequent round of full ATR and will focus on the plan formulation with the documents described in item (1), economic documentation including risk and uncertainty, and updated engineering discipline specific write-ups. A compiled report including chapters of the main body and those pieces formerly mentioned will be provided for the targeted plan formulation review.


Expert Review (Tony Thomas) **COMPLETED**
o Calibrated Mobile Bed Model
o Model Documentation
o Risk and Uncertainty
Targeted Existing Conditions & Economic Model Reviews (ATR) **COMPLETED (See report dated 24-Oct-14)**
o Discipline Specific write-ups
o Validation of the Expert Review
o Resultant Summary Report
Targeted Updated Calibration H&H Model Review (ATR)
o Calibrated Mobile Bed Model
Targeted H&H Model Review (ATR)
o Projection Mobile Bed Model
o Future without Project Model Projections
o Future with Project Model Projections
o Modeling Sensitivity Analysis
Targeted IEPR Review
o Projection Mobile Bed Model
o Future without Project Model Projections
o Future with Project Model Projections
o Modeling Sensitivity Analysis
o Economic Model
o Economic Appendix
Targeted Plan Formulation Review (ATR)
o Validation that comments were incorporated from Existing Conditions review.
o Review the compiled report.
TSP Milestone
Concurrent ATR, IEPR, Public, & Policy Reviews
Agency Decision

5. Considerations for Review

Products will be reviewed for compliance with guidance, including Engineer Regulations, Engineer Circulars, Engineer Manuals, Engineer Technical Letters, Engineering and Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE.

5.1 Key General Review Considerations

1. Are there any deviations from USACE policy documented in the submission package?

2. Does the study conform to the intent of the cited study authority?

3. Is the formulation and evaluation of alternatives consistent with applicable regulations and guidance?

4. Was the selection of models appropriate for use in evaluations?

5. Was the application of data within those models appropriate?

6. Was the interpretation of and conclusions drawn from model results reasonable?

7. What is the status of the certification/approval for use of the planning models used in the study?

8. Are the sources, amounts, and levels of detail of the data used in the analysis appropriate for the complexity of the project?

9. Do the main decision document and appendices form an integrated and consistent product?

5.2 Project Specific Review Considerations

1. The project is being executed under the SMART planning principles. It is asked of the ATRT to take into consideration these principles.

2. The comments provided regarding review of the existing conditions write-ups have been closed predominately due to the response provided by the PDT. The targeted plan formulation review should be used to validate the response of those comments in addition to reviewing new content and the report as a whole.

3. The targeted plan formulation review should also be used to validate the response of those comments provided during the targeted review of the H&H documents.

5.3 H&H, Sedimentation, and Modeling Specific Review Considerations

1. Three documents will be provided to the ATR reviewer. These documents are very similar to the documents already reviewed. Appendix A, is a list of statements and questions for consideration by the reviewers and detailed comments are requested. ATR and PDT will coordinate comments and clarifications.

5.4 Specific Risk and Uncertainty Review Considerations

1. Does the economic spreadsheet model adequately reflect uncertainty regarding costs and inputs supporting economic benefits?

2. Does the overall analytical approach (including the economic model, mobile bed model, sensitivity analyses and scenario analyses) adequately address risk and uncertainty?

5.5 For a Compiled Report Submittal

1. The definition of a compiled report is the shell of the report with several of the written components in place including the main body of the report and appendices. This report documents plan formulation with engineering evaluations and initial economic evaluations. The PDT is moving forward with plan formulation with required coordination with the vertical team. The PDT recognizes there will be information gaps at this time including environmental evaluations and NEPA documentation.

2. Has the District provided the draft decision document and the preliminary draft NEPA document in its entirety? Reference ER1105-2-100, Exhibit G-7.

3. Does the report address the general evaluation guidelines presented in Exhibit G-1?

4. Does the report indicate that the sponsor and agency views are preliminary, pending the upcoming public review?

5. Does the report text for public and agency involvement cover the results of the NEPA Scoping Meeting and the results of other coordination and public involvement efforts to date?

6. Are all supporting analyses complete?

7. Has the District prepared all of the required components of a Draft Document review as outlined in Exhibit H-5 item 2 (i.e., Project Study Issue Checklist, status of Environmental Compliance, Status of Engineering Activities, Status of Legal Review, Project Schedule, PGMs, Compliance Memorandum(s), and any other pertinent

information)?

6. Products for Review

All products are considered draft and pre-decisional and shall not be released outside the Corps of Engineers. It is the intent of the PDT to have an intermediate review of the H&H products prior to the Plan Formulation review. Following is a list of products to be reviewed.

6.1 Calibration Model H&H Review

1. Updated calibration model
2. Calibration model documentation
3. DQC documentation
4. Prior ATR documentation (from October 2014 and December 2014)

6.2 Targeted Projection Model H&H Review

1. Technical Appendix: Future Without Project Model Projections
   The purpose of this appendix is to document the degradation projections conducted in conjunction with the Missouri River Bed Degradation Feasibility Study for the Future Without Project condition. This appendix describes updates to model geometry, explains the development of the hydrologic boundary condition for the projection period and provides Future Without Project bed elevation and water surface elevation projections.

2. Technical Appendix: Future With Project Model Projections
   The purpose of this appendix is to document the degradation projections conducted in conjunction with the Missouri River Bed Degradation Feasibility Study for the Future With Project condition. Bed bathymetry, structure heights, hydrologic input, dredging condition, output time step, and temporal smoothing are all the same as for the Future Without Project analysis, as described in the previous appendix. Analysis for fifteen alternatives are presented in this appendix. Each alternative includes of one of five structural actions (indicated by a letter designation) and one of three dredging conditions (indicated by a number designation).

3. Technical Appendix: Modeling Sensitivity Analysis
   The purpose of this appendix is to define the sensitivity of degradation projections under hydrologic scenarios, dredging conditions, and sediment loadings that differ from those used in the FWOP and FWP model runs.

4. Additional Risk and Uncertainty Documents: October 2014 ATR Report and comments, Economic model documentation, Economic spreadsheet model, etc.

6.3 Targeted Plan Formulation Review

1. Compiled Report: The Compiled Report is essentially the beginning stages of a draft report. It will include all chapters of the report and appendices that are complete including those components that have been reviewed under the Targeted Review.

2. SMART Planning Documents: Risk Register, Decision Log, Decision Management Plan, Project Study Issue Checklist. See PB 2013-03 at: http://planning.usace.army.mil/toolbox/library/pb/PB2013_03.pdf

7. ATR Schedule

Activity	**Start Date**	**End Date**
Transmittal of files for Targeted Calibration Model H&H Review	04 Jan 2016	
Targeted Calibration Model H&H Review	04 Jan 2016	25 Jan 2016
Targeted Projection Model H&H Review	Feb 2016	
Evaluation of Comments from Targeted H&H Reviews	TBD	
Backcheck Comments from Targeted H&H Reviews	TBD	
Targeted Plan Formulation Review	Feb 2016	
Evaluation of Comments from Targeted Plan Formulation Review	TBD	
Back check Comments from Targeted Plan Formulation Review	TBD	
TSP Milestone	Sep 2016	

Appendix A

H&H, Sedimentation, and Modeling
Specific Review Considerations

INTRODUCTION

Appendix A, is a list of statements and questions to be considered by the ATR Reviewers.

1. Model Creation/Calibration

a. Is use of quasi-steady, 1 dimensional flow, HEC-RAS v 5.0 beta, with the bed mixing algorithm (Exner 5), including the cover layer gradations which coarsen and dynamically armor underlying finer sands, an appropriate software / approach for the study?

b. Are the grain size fractions of degradation reasonable?

c. Is dredging appropriately included in the model?

d. Does the model correctly compute sediment transport?

e. Is the effect of not adjusting dikes and sills over time negligible to the model calibration?

f. Is calibration to mass or volume appropriate, rather than calibrating to channel invert or average bed elevation of individual cross-sections?

g. Is cross-section spacing appropriate to assess the effects of study alternatives, including dike/sill modifications and dredging restrictions?

h. Are Manning 'n' values reasonable and appropriate?

i. Is the mobile bed model adequately calibrated considering sediment volumes, velocities, and water surfaces?

2. Future without Project

a. Is the update of the model to 2013 bed geometry and dike/sill elevations appropriate?

b. Is the FWOP flow condition reasonable and appropriate?

c. Is the FWOP dredging condition reasonable and appropriate?

d. Does not "dynamically adjusting" dikes over time introduce negligible error?

3. Alternatives

a. Are the alternatives correctly reflected in the RAS geometry?

b. Does the model provide an adequate means for assessing changes to BSNP geometry for screening, ranking, and evaluating the effectiveness of measures for impacting the rate of degradation?

c. Does the model provide an adequate means for assessing how changes to commercial dredging extraction rates impact the rate of degradation?

4. Sensitivity Analysis

a. Is the variability in future flows adequately assessed and are reasonable bounds provided, understanding that robust statistical tools are not available for mobile-bed modeling?

b. Has commercial dredging been a significant driver of bed degradation in Kansas City?

c. Will commercial dredging at the currently permitted level result in significant additional degradation, regardless of the flow scenario that occurs?

d. Are the effects of potential future increases or decreases to sediment load assessed?

e. Is the sensitivity analysis provided sufficient to conclude the model's adequacy for estimating the effects of BSNP changes and dredging changes and for screening, ranking, and assessing impacts to the rate of degradation, and that uncertainty with major parameters is unlikely to alter the conclusions and relative ranking of alternatives?

Enclosure 2

DRCHECKS REPORT OF ALL COMMENTS

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Comment Report: All Comments
Project: Missouri River Bed Degradation Feasibility Study
Review: Targeted ATR - Mobile Bed Model
Displaying 5 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
5899306	Hydraulics	n/a	n/a	n/a

Comment Classification: **Public (Public)**

I have completed the Targeted ATR exercise, including Technical Appendices for the FWOP, FWP, and the Sensitivity Analyses Report. These documents included contrasts with the original Mobile Bed Model Calibration Report. As directed in the Charge to Reviewers for this Targeted ATR effort, I have addressed the Appendix A Questions. Detailed responses are included in a separate document forworded to our ATR Team lead.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Dec 19 2014
Evaluation not conducted

5899341	Hydraulics	n/a	n/a	n/a

Comment Classification: **Public (Public)**

Concern: Updated geometry verification data is largely based on the existing Calibration data, and calculated sediment transport by size class should be verified at a downstream gage location. Significance: The targeted questions aimed at potential issues with geometry and cross-section spacing, roughness coeficients, and solution quality could be presented with higher confidence by expanding the updated geometry verification results. Action Required: update verification to the level of previous reporting and include the size class transport at downstream gage component

Submitted By: Michael Alexander (601-631-5044). Submitted On: Dec 19 2014
Evaluation not conducted

5899360	Hydraulics	n/a	n/a	n/a

Comment Classification: **Public (Public)**

Concern: Model solution instabilities. Significance: The time step of 30 minutes seems very small, and the sediment transport solution output averaging method implies improved accuracy could be achieved. The suggested verification improvements might allow improved transport accuracy. Action needed: Adjust time step based on updated verification/cross section spacing.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Dec 19 2014

Evaluation not conducted

5899367	Hydraulics	n/a	n/a	n/a

Comment Classification: **Public (Public)**

Concern: The model does a great job defining transport relative to dredging volumes. However, grade control structure simulations are more of a site specific (versus) reach model application. Significance: Local effects and suggested additional downstream grade control structures based on the present model might be different using a site specific evaluation. Action Required: Validate or define the need for additional work required for the present grade control structure evaluation.

Submitted By: Michael Alexander (601-631-5044). Submitted On: Dec 19 2014

Evaluation not conducted

6337485	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**
(Document Reference: Comment #5899306)

Comment #5899306 refers to Detailed resonses to ATR Charge, Appendix A Questions, provided in the attached file: Response_to_App_A_Questns_Dec2014.docx

(Attachment: Response_to_App_A_Questns_Dec2014.docx)

Submitted By: Craig Evans (651-290-5594). Submitted On: Dec 23 2015

Evaluation not conducted

Filename: Response_to_App_A_Questns_Dec2014.docx

<u>Detailed Comments for Targeted Review Questions, Missouri River Bed Degradation ATR</u>

Mike Alexander
Hydraulics and Hydrology
Agency Technical Review

December 2014

1. Model Creation/Calibration

a. Is use of quasi-steady, 1 dimensional flow, HEC-RAS v 5.0 beta, with the bed mixing algorithm (Exner 5), including the cover layer gradations which coarsen and dynamically armor underlying finer sands, an appropriate software / approach for the study?

Complex issues with bed armoring and sediment transport accuracy in general are difficult to determine with any model application. Even sediment samples and acoustic field data require a degree of modeling for developing rating curve data.

The Exner 7 algorithms would appear better related to Missouri River grain sizes but evidently this was investigated, and the Exner 5 method performed better. However, yes, the HEC-RAS v5, even though it is a beta version, has been verified to perform like the original v4.1.2 and the Exner 5 sediment transport algorithm is appropriate.

b. The Missouri River mobile bed model shows degradation in Medium Sand and deposition in Fine Sand. Does empirical evidence, including the bed composition, the dredging levels, and the gradation of the incoming load, support this model result?

The Calibration report states that measured data showed no trend in bed gradation over time. There is concern if the model is showing a significant change. Perhaps the problem is related to the bed layer that HEC-RAS is using to describe the bed gradation in the output. I did not see any calibration/verification information in the report showing a comparison of measured and calculated sediment transport by size class at a downstream gage. It is critical that the selected transport equation and armoring algorithm combination correctly calculate the size class transport. It is also possible that the inflow percentage of very fine sand is too high. However, I would expect that this would be an issue only in the upstream reach in the vicinity of the boundary.

c. Is dredging appropriately included in the model?

It appears to be appropriately included from graphics and tables displayed in the reports. Dredging volumes are a known quantity, extracted from known permitted reaches over a known time. It looks like this was done.

d. Does the model correctly compute sediment transport?

RE: Figure 34 in the Feb 2014 Calibration Report, it looks correct for defining mass change with and without dredging. As mentioned, calculated sediment transport by size class should be verified at a downstream gage.

e. Is the effect of not adjusting dikes and sills over time negligible to the model calibration?

At least one or two reaches with adjustments should be tested to see if there is a significant impact over a long distance. I would expect a significant difference locally, but not too much over many miles.

f. Is calibration to mass or volume appropriate, rather than calibrating to channel invert or average bed elevation of individual cross-sections?

I'd recommend site-specific analysis if a grade control structure is selected for design in the future. Over the years, modeler conversations offer an order of preference: 1) comparison of accumulated sediment transport differences at gages, 2) mass/volume changes from hydrographic survey data, 3) changes in average bed elevation, and lastly, 4) changes in channel invert. Determining mass/volume changes from measurements can be challenging due to the movement of bed forms. If one survey is taken at a bed form trough and the next at a bed form peak, then conclusions with respect to degradation can be misleading. However, with the large number of cross sections used to make prototype calculations, errors should be evened out. I do think bedforms were given careful attention with this model, and volume change calibration is appropriate.

g. Is cross-section spacing appropriate to assess the effects of study alternatives, including dike/sill modifications and dredging restrictions?

This is a modeler question, and is classically a part of verification. The report describes how the cross section spacing and flow training structures were applied to the geometry. Model geometry appears good for dredging restriction volume alternatives, the cross-section spacing with interpolated structures should, and appears to do so, handle the dredging volumes and reduced

dredging volumes well. Cross section spacing can be large if the study purpose is to evaluate long-term reach changes, which seems to be the primary purpose of this study. Cross sections need to be closer together in the project reach if the study purpose is to evaluate the effect of new sills and dikes.

h. Are Manning 'n' values reasonable and appropriate? Do we have wse plots versus field data?

The n-values are in a normal range, and I felt like the Calibration Report included good consideration for bedforms. There are a couple of wse plots in the Calibration Report. There is one difference plot in the FWOP Technical Appendix (Oct 14). I'd recommend defining the updated geometry with a real profile comparison and a channel volume difference explanation. The range of differences in Figure 4, and the statement that it is likely due to rebounding conditions that were going on with the geometry from the Calibration Report is weak for such a sensitive study. Figure 4 needs to show the previous (1994 data) Calibration differences, too.

Since I am largely a 2D, finite element modeler, this paragraph includes pertinent information from my peers. Considering that this is long-term simulation over many annual hydrographs, measured-calculated plots at gages of daily stage versus discharge on an annual basis (or over several years if there is no significant bed change) are recommended. Since sediment transport is calculated on both the rising and falling limbs of the hydrograph using the same roughness coefficient, it is important that the roughness coefficient produces an "average" water surface. Using high water marks from a flood event is fine for calculating flood profiles, but not necessarily for calculating average sediment transport to determine aggradation/degradation.

i. Is the mobile bed model adequately calibrated considering sediment volumes, velocities, and water surfaces?

This response follows question "h." above. The velocities mentioned in text for the revised geometry (FWOP Technical Appendix Oct 14) were "found on average to be less than a tenth of a foot-per-second lower than the original model". Since differences can change from low to high flows, I recommend looking at velocities like Figure 35 in the Calibration Report. This question also relates to the need for calibrating the model to sediment transport by size class.

2. Future without Project

a. Is the update of the model to 2013 bed geometry and dike/sill elevations appropriate?

Water levels from the Sensitivity Report and the Calibration Report (from Feb 2014) are generally higher compared to field data. However, the Calibration Report values are not excessively high, though, and I would like to see the profiles in Figure 4 of the FWOP Technical Appendix and not just the difference plot. Given the updated geometry, reproducing the existing level of verification shown in the Calibration Report would be typical or normal for a model study.

b. Is the FWOP flow condition reasonable and appropriate?

There is uniqueness here with the MO River degradation study that resulted in developing and revising the flow condition based on infrastructure requirements that must make adjustments

ahead of falling water levels (water intakes, etc.). I am in agreement with the recent revisions, and will defer to the Risk and Uncertainty specialists on this issue.

c. Is the FWOP dredging condition reasonable and appropriate? Yes. Extracting it from the reaches where it is dredged is the way it should be modeled. I pondered the exclusion of the Waverly Reach dredging volume (7.4%) that was downstream from the model boundary, but unless you extend the model, I agree with the exclusion. It's a small percentage.

d. Does not "dynamically adjusting" dikes over time introduce negligible error?
This seems to be Question 1.e., so the same testing recommendation applies. It would introduce error, because adjustments have been completed in the past due to degradation, and they would be expected in the future. The trend would be to increase scour and over-estimate degradation. Given how complex sediment transport science and simulations are, it is difficult to say this would be negligible without testing it.

Related comments:

I concur with using the same strategies for base to plan comparisons as noted from EM 1110-2-4000. (See Page 12 FWOP Technical Appendix.) The variation in Figure 7 is a concern. Not so much with lateral migration (for the 90-day averaging), but with the channel depth. I can't tell too much from the figure, but the point density looks pretty good at the lowest elevations on the raw data cross section, making me wonder if the averaging approach gets the best accuracy from the solution.

Defining accurate model sampling versus the large bed changes (spikes) defined as numerical noise on pages 11-12, seems a high priority issue. All modelers (self included) attribute bad data to numerical noise, but usually this is explained and corrected (minimized) by adjusting model geometry, adjusting time steps, or other adjustments unique to experience with a particular code

Again seeking institutional knowledge concerning this issue: time steps of 30 minutes is overkill. This is essentially a steady state model. If you need to decrease the time step that much the cross sections are too close.

Section 5.2 **Future Without Project Water Surface Elevations:** Table 3 includes a low flow (4600cfs) that is too small to consider for wse-based infrastructure rebuilds? I might be missing something, but I was having trouble understanding this section.

3. Alternatives

a. Are the alternatives correctly reflected in the RAS geometry?

They appear to be.

b. Does the model provide an adequate means for assessing changes to BSNP geometry for screening, ranking, and evaluating the effectiveness of measures for impacting the rate of degradation?

As stated in the FWOP Technical Appendix, "the degradation projection at an individual river location is much more variable than the associated reach average, particularly during and immediately following major flow events." I'm using this statement in two ways. 1.) I believe the model can discern rate of degradation between alternatives, is adequate, etc. , and I believe it provides "river reach" level information that is highly important for the dredging issues. 2) I believe that beyond screening the grade control structures, that a more localized study for this alternative would be required.

c. Does the model provide an adequate means for assessing how changes to commercial dredging extraction rates impact the rate of degradation?

I think it does, and I think this is what it does best.

4. Sensitivity Analysis

a. Is the variability in future flows adequately assessed and are reasonable bounds provided, understanding that robust statistical tools are not available for mobile-bed modeling?

I think variability is displayed and I support the decisions and data in the Sensitivity Analysis.

b. Has commercial dredging been a significant driver of bed degradation in Kansas City?

Yes, the study demonstrates this well.

c. Will commercial dredging at the currently permitted level result in significant additional degradation, regardless of the flow scenario that occurs?

Yes. I see this as a firm conclusion. (It makes me wonder about the flow release component of transport based on navigation, etc., but I recognize this is beyond the scope of present work.)

d. Is the sensitivity analysis provided sufficient to conclude the model's adequacy for estimating the effects of BSNP changes and dredging changes and for screening, ranking, and assessing impacts to the rate of degradation, and that uncertainty with major parameters is unlikely to alter the conclusions and relative ranking of alternatives?

As mentioned before, I think the changes due to dredging volumes are definitive. I also think screening other ideas is within the model capability.

Page 4 of the Sensitivity Report includes a discussion of Figure 3 data. The discussion states a "possible explanation" concerning why the 1% and 99% are nearly equal for bed transport. Recommend isolating the known dredging quantity from transported volumes in the model and

update the discussion.My response here concerning the grade control structures from “Section 3: Alternatives b.” above applies here as well.

Comment Report: All Comments
Project: Missouri River Bed Degradation Feasibility Study
Review: Mobile Bed Model EC and Calibration Rvw
Displaying 8 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
6443275	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

I have reviewed the subject report with respect to the targeted questions in the Charge to Reviewers, Appendix A, dated 28 Jan 2016.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

1-0 Evaluation **Concurred**
Concur

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016
Current Comment Status: **Comment Closed**

6443292	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

RE: appropriate application of quasi-steady, 1 dimensional flow, HEC-RAS v 5.0 beta, with the bed mixing algorithm (Exner 5). Yes, I continue in agreement with DQC and earlier evaluations supporting this code/strategy. One question though, would any of the code issues that led to the present study update make the Exner 7 suite more applicable?

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

1-0 Evaluation **Concurred**
I computed multiple, Exner 7 runs after the code changes to verify. Exner 7 still did not yield as good a calibration as Exner 5.

The attached jpeg shows the calibration period re-run with Exner 7 compared to Exner 5(which approximates the calibration data. I did try varying other parameters to see if Exner 7 could work in conjunction with other changes, but it did not calibrate as well as Exner 5.

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016 (Attachment: Exner_5_vs_7.jpg)

1-1 Backcheck Recommendation **Close Comment**
OK, Thanks.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016
Current Comment Status: **Comment Closed**

6443323 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Dredging looks properly incorporated. Are there any plans in development to augment the reach-level dredged volume degradation condition?

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

1-0 Evaluation **Concurred**
Concur.

Variations on the dredging level will be included in both the sensitivity analysis and the project alternatives.

The model spatial resolution is adequate to answer questions relating to reach-scale impacts of dredging, i.e. how dredging effects bed and water surface degradation.

This model is not intended to compute the timing of the filling of an individual dredge hole-- such analysis would require a finer spatial and temporal resolution.

Dredging causes a temporary, localized depression in the bed, i.e. a dredge hole. Available multi-beam surveys have shown, however, that the hole quickly re-fills over a few days, thus spreading out the effect of the removal over the reach.

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016

1-1 Backcheck Recommendation **Close Comment**
OK

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016
Current Comment Status: **Comment Closed**

6443330 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Sediment transport was addressed and applied in an appropriate manner. Sediment transport is difficult to measure in the field and extremely difficult to quantify in a model. The water level data shown in the report indicates a good long-term match with field degradation. I concur with and refer to the long-term calibration discussion on P 41.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

1-0 Evaluation **Concurred**

Concur.

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016

Current Comment Status: **Comment Closed**

6443380	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

RE: Sediment model Calibration to mass or volume: Yes, this is appropriate, and is currently the accepted practice for reach length changes.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

1-0 Evaluation **Concurred**

Concur.

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016

Current Comment Status: **Comment Closed**

6443382	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Concerning calibration and verification: I agree that data shown in figure 40 are reasonable. I was curious about how the ADCP data was collected, if it were profiled across the channel, showing a peak value that was on average a little higher than the RAS5 average computation? I do conclude that volume, velocity, and water surface verification offer an adequately calibrated model.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

1-0 Evaluation **Concurred**

Concur.

The reported ADCP velocity is an average not a maximum. USGS surveyed from the tip of the dike/sill to the start of the shallowing on the opposite bank, which roughly but not perfectly corresponds to the moveable bed extents of the model. The model output

is based on the model banks, which are at the top of the sill and a similar elevation on the revetment. This could lead to slightly increased velocity in the ADCP vs the model. In addition, the locations are not exactly coincident, but as you state, they still compare reasonably well.

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016

1-1 Backcheck Recommendation **Close Comment**
OK, thanks

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016
Current Comment Status: **Comment Closed**

6443394	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

This study is impressive and well done. It has great value as a planning tool.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Mar 21 2016

Revised Mar 22 2016.

1-0 Evaluation **Concurred**
Concur.

Submitted By: John Shelley (816-389-2310) Submitted On: Mar 22 2016

1-1 Backcheck Recommendation **Close Comment**
Closed without comment.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Apr 18 2016
Current Comment Status: **Comment Closed**

6590195	Planning - Plan Formulation	n/a	General	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Documentation of District Quality Control review was provided for the ATR team. DQC was adequate and all issues were addressed prior to release to the ATR team.

Submitted By: Craig Evans (651-290-5594). Submitted On: Jul 07 2016

1-0 Evaluation **Concurred**
Noted...thank you.

Submitted By: Ron Jansen (816-389-3610) Submitted On: Jul 08 2016

1-1 Backcheck Recommendation **Close Comment**
No action needed.

Submitted By: Craig Evans (651-290-5594) Submitted On: Aug 02 2016
Current Comment Status: **Comment Closed**

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Enclosure 3

COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW

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COMPLETION OF AGENCY TECHNICAL REVIEW

The Targeted Agency Technical Review (ATR) has been completed for the hydraulic model calibration and existing conditions for the Missouri River Bed Degradation Feasibility Study, for the Kansas City District. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy.

The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be effective. DQC review of the mobile bed hydraulic model and the calibration report was thorough; those comments and responses were provided to the ATR team as MS Word documents. The quality of the documents reviewed was sufficient for this review and indicated that adequate DQC was accomplished.

The review report notes that all comments have been addressed and closed in DrChecks. No further changes to the model were recommended.

2016.09.13 (Original)

Craig Evans Date
ATR Team Leader
CEMVP-RPEDN-PD-F

Christina Ostrander Date
Project Manager
CENWK-PM-PF

Enclosure 7

SEPTEMBER 2016 TARGETED ATR REPORT:
H&H projection model (future without project conditions with risk and uncertainty)

Missouri River Bed Degradation Feasibility Study

Targeted Agency Technical Review

Targeted review of H&H projection model (future without project conditions with risk and uncertainty)

Prepared for the FRM-PCX by

Craig Evans, ATR Lead
CEMVP-RPEDN-PD-F
September 2016

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TARGETED AGENCY TECHNICAL REVIEW REPORT

ENCLOSURES

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Subject: Review report for targeted review of H&H projection model (future without project conditions with risk and uncertainty) for the Missouri River Bed Degradation Feasibility Study, March 2016 through July 2016, Kansas City District.

1. **Scope and Purpose of Review:** The purpose of this review report is to document the targeted agency technical review (ATR) for the subject products. The review was conducted for the Kansas City District. The primary point of contact for the District was Ms. Christina Ostrander, CENWK-PM-PF.

The ATR team (ATRT) was led by Mr. Craig Evans, CEMVP-RPEDN-PD-F. The Flood Risk Management Planning Center of Expertise (FRM-PCX) was the lead center for managing this ATR.

2. **References**

a. This review report was prepared in response to EC 1165-2-214, 15 December 2012, Water Resources Policies and Authorities, CIVIL WORKS REVIEW. The review documents reside online at ProjNet (www.projnet.org). The DrChecks Project and Review title is "(400367) Missouri River Bed Degradation Feasibility Study, Mobile Bed Model FWOP and R/U Rvw," 3 Mar 2016 to 15 Apr 2016.

b. The review was conducted in accordance with the Review Plan dated February 11, 2013 and approved by the Northwest Division Commander on March 8, 2013.

3. **Project Description**

The study is authorized by Section 216 of Public Law 91-611, Flood Control Act of 1970. The purpose of the study is to identify and evaluate alternatives to address the impacts of river bed degradation that is occurring on the lower Missouri River, from Rulo, NE to the mouth at St. Louis, MO. The Missouri River Bank Stabilization and Navigation Project (BSNP) is the federal project of interest, both as a causal factor, and as part of the impacted federal infrastructure. The study will identify and evaluate alternatives to minimize or eliminate future impacts of the bed degradation to the federal infrastructure and local public infrastructure. The study will examine the effects of degradation on the long-term stability and sustainability of the BSNP. There are significant flood risk management features, located primarily within the Kansas City Reach and near St. Joseph, MO, that are dependent on the stability of the BSNP and are potentially also impacted by continued bed degradation. Recommendations for structural or operating changes that have potential for minimizing degradation impacts will be considered. In addition, the study will consider approaches to help or maintain or enhance the viability of federally constructed ecosystem projects such as constructed wetlands and shallow water habitat. The study will also inventory and assess measures that protect local and public infrastructures.

4. **Review Team.**

This targeted ATR team included a subset of the disciplines included in the full ATR team as identified in the review plan (reference 2b): ATR Lead (including Plan Formulation) and

Hydraulic Engineering (including Risk & Uncertainty). Additional disciplines will be added in subsequent review steps.

ATR Lead (including Plan Formulation)
Craig Evans, CEMVP-RPEDN-PD-F, serves as the Chief of the Plan Formulation Sections in St. Paul, MN and St. Louis, MO. He has 27 years of experience with the Corps of Engineers including 12 years in civil design and 15 years in planning and project management. He is a registered Professional Engineer in Minnesota, holds a masters degree in Public Administration, and is a 2005 graduate of the USACE Planning Associates Program. He is a certified ATR reviewer for Plan Formulation. He has led several reconnaissance studies, multi-purpose feasibility studies, watershed studies and construction projects. He has significant experience with plan formulation and report writing for flood risk management, ecosystem restoration and stream bank protection as well as civil engineering review and value engineering.

Hydraulic Engineering
Mike Alexander, CESAM-EN-HH, is a Registered Professional Engineer with over 35 years of USACE experience dealing with channel stability, navigation, and training structures design. Mike is a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Mike serves as Lead Hydraulic Engineer in the Hydrologic, Hydraulics, and Coastal Engineering Design Section. He started work with the USACE Laboratories in 1981 at the Waterways Experiment Station's Coastal Engineering Research Center and later working in the Coastal and Hydraulics Laboratory at the Engineering Research and Development Center (ERDC). Mike moved to the USACE Vicksburg District in 2000, where he was involved with developing 2-dimensional modeling and sediment transport expertise and capability. Project experience includes dredging equipment techniques/applications, dredged material production/disposal evaluations, and wetland restoration with dredged material. Over the last 15 years, work focused on 1-, 2-, and 3-dimensional numerical model studies for navigation and flood control projects, often with sediment transport modeling components. His current work after moving to Mobile District in 2015, is on strategic, quick-turnaround numerical model applications for navigation issues and associated training structure designs. He also presently serves as Acting Chief of the Hydrologic, Hydraulics, and Coastal Engineering Design Section, Water Resources Branch, Engineering Division, at Mobile District.

Hydraulic Engineering
Dr. Paul Boyd, CENWO-ED-HF, is a hydraulic engineer and Regional Technical Specialist for Sedimentation and Alluvial Processes in Omaha District. He is a registered Professional Engineer in Iowa and a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28. Dr. Boyd has been with the US Army Corps of Engineers since 2002, serving in numerous roles primarily associated with river and reservoir sediment transport and management, including 1-d and 2-d modeling of sediment transport, reservoir flushing modeling, emergent sandbar habitat design, reservoir data collection management, and senior technical review of USACE publications. He is currently working on advancing modeling tools for simulating hydraulic flushing at USACE reservoir projects. In addition, Dr. Boyd is heavily involved in the Missouri

River Recovery Program (MRRP) by working on habitat creation projects to protect endangered species. Most recently, he has been tasked as technical lead for reservoir sedimentation training and guidelines development with the Government of Lao PDR as part of the USAID Smart Infrastructure for the Mekong (SIM) River program. In addition, he is currently focused on developing plans for reservoir sustainability to extend the useful life of Federal reservoirs.

Hydraulic Engineering (including Risk and Uncertainty)
Daniel Pridal, CENWO-ED-HF, serves as Chief of the River and Reservoir Engineering Section, Omaha District Hydrologic Engineering Branch. He has 28 years of experience with the Corps of Engineers, serving as Section Chief for the past 9 years and as a regional technical specialist for hydraulic design and analysis for the preceding 6 years. He is a registered Professional Engineer in California and holds a Masters of Science degree in Civil Engineering. Dan is a certified ATR reviewer for sedimentation/surveys/models listed in the Corps of Engineers Reviewer Certification and Access Program (CERCAP) per ECB 2013-28 and he is a FRM-PCX certified subject matter expert for risk and uncertainty. He serves as technical expert and advisor on sedimentation, channel stabilization, and stream restoration activities. He has significant experience in the hydrologic design and analysis of technical projects for flood damage reduction projects, stream restoration, shallow water and emergent sandbar habitat projects for Missouri River recovery, O&M projects for the Missouri River reservoir system and navigation channel.

5. **Charge to Reviewers.**
See Enclosure 1.

6. **Summary.**

a. This targeted review was intended to verify that the hydraulic model properly defined future without project (FWOP) conditions and the study approach adequately addressed risk and uncertainty as related to the FWOP conditions.

b. Prior reviews.

- An initial targeted review documented in an October 2014 ATR report validated use of the mobile bed hydraulic model in conjunction with an economic spreadsheet model.
- The economic spreadsheet model was approved for one-time use on 10 Mar 2015 in accordance with EC 1105-2-412. The study approach includes risk and uncertainty features within the economic model in addition to a sensitivity analysis/scenario approach for hydraulic and hydrologic inputs. The 18-Feb-15 FRM-PCX review memo for the Economic Model says: "The Kansas City District and review team agreed that it wasn't practical to explicitly incorporate uncertainty around the engineering inputs (river bed and water stage elevations), so the District proposed addressing the uncertainty in engineering inputs through the use of sensitivity and scenario analyses . . . The proposed approach was considered by both the model review and ATR teams and judged to adequately address the review concerns. The sensitivity and scenario analyses will be subject

to future District Quality Control, ATR, and Independent External Peer Review as appropriate.

- A targeted review of the hydraulic model calibration to existing conditions was completed in March 2016 and is documented in a report dated September 2016.

c. The PDT posted the documents to be reviewed in DrChecks in March 2016. The following documents were provided:

- H&H FWOP report
- H&H R&U report
- H&H Model input and output files
- H&H FWOP DQC documentation
- H&H R&U DQC documentation
- Economic background information in five separate files (for reference only)

d. A kick-off teleconference was held on 17 Mar 2016. The ATR team conducted its review in March and April 2016. The PDT and ATR team held a teleconference on 15 Apr 2016 to discuss issues raised in the review prior to putting comments into DrChecks. The ATR team entered 13 technical comments into DrChecks on 18-19 Apr 2016 and provided editorial comments separately. PDT evaluation and ATR team backchecks were conducted in May, and all technical comments were closed by 8 Jun 2016. One comment was added in July 2016 to document that DQC documentation was provided to the ATR team prior to the ATR review.

e. The ATR comments were primarily concerned with clarifying the H&H results that would be used as inputs to the economic model and presenting more information about the hydraulic and hydrologic uncertainty associated with those inputs.

- The economic analysis relies on the mobile bed hydraulic model to estimate river bed elevations and water surface profiles over a future 50-year period. The hydraulic model results are sensitive to the timing of large flood events, and traditional probabilistic hydrologic methods cannot be applied to sediment transport modeling.
- The hydraulic model shows that the bed elevations fluctuate, with periods of degradation during floods followed by some bed recovery. It was not clear whether the elevations presented for use in the economic model represented the absolute low bed elevation or an averaged elevation representing a longer timeframe.
- Economic impacts from low water surface elevation are tied to both bed degradation and low flow conditions. The economic model relies on trigger elevations for the degraded river bed and lowered water surface. The ATR team requested that the model documentation more clearly describe what the hydraulic model outputs represent to ensure they are used correctly in the economic model.
- The ATR team acknowledged that the approved economic model relies on a scenario approach and sensitivity analysis for bed degradation. The ATR team recommended also including typical H&H modeling uncertainty following the R&U guidelines in EM 1619 to provide separate uncertainty for hydrologic,

hydraulic and bed degradation estimates. Kansas City District responded that this was not feasible for several reasons without extensive revisions to the model and a large effort requirement. Since the Economic analysis was not employing any H&H uncertainty parameters, Kansas City District recommended that employing risk and uncertainty analysis for this study was not warranted. The ATR team concluded that the adopted approach is non-traditional but acceptable for this limited single time application, given the limitations of the economic model.

- The ATR team recommended combining the R&U report with the FWOP report to reduce overlap, improve clarity and ensure nothing is omitted. The combined report should clearly state how the degradation estimate varies with time and by location, and the actual values to be used in the economic analysis. Trigger elevations in the economic model must be checked to verify that they represent appropriate assumptions for each damageable structure based on the hydraulic model results.

f. Critical Comments. No critical issues were identified.

g. Unresolved Comments. The PDT responded acceptably to all comments, and the ATR team closed all comments in DrChecks. Future ATR phases will verify that the issues raised in this review have been adequately addressed in the final analysis.

h. Lessons Learned. None.

7. DrChecks Report. The DrChecks report of all comments is attached as Enclosure 2

8. ATR Completion Statement.
Enclosure 3 contains the completion statement.

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Enclosure 1

CHARGE

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US Army Corps of Engineers ®

AGENCY TECHNICAL REVIEW

CHARGE TO THE MISSOURI RIVER BED DEGRADATION FEASIBILITY STUDY PROJECT DELIVERY TEAM & AGENCY TECHNICAL REVIEW TEAM FOR H&H PROJECTION MODEL REVIEW (Future Without Project Conditions with Risk & Uncertainty)

Missouri River Bed Degradation Feasibility Study, MO & KS
Section 216 of Public Law 91-611, Flood Control Act of 1970

Prepared by: Kansas City District, Degradation PDT
Date: 17 November 2014

Version 7 Updated: 13 April 2015
Version 8 Updated 21 Dec 2015
Version 9 Updated 28 Jan 2016
Version 10 Updated 16 Feb 2016
Version 11 Updated 17 Mar 2016

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AGENCY TECHNICAL REVIEW
CHARGE TO THE MISSOURI RIVER BED DEGRADATION FEASIBILITY STUDY PROJECT DELIVERY TEAM & AGENCY TECHNICAL REVIEW TEAM

1. General

Engineering Circular (EC) 1165-2-214 "Civil Works Review" provides procedures to ensure the quality and credibility of U.S. Army Corps of Engineers (Corps) work products for the nation. Technical, scientific, and engineering information used to support recommendations in decision documents must undergo a rigorous review process. A review plan is developed at the start of each study or project to describe the scope of review that will be needed in accordance with the EC 1165-2-214. As documented in the Missouri River Bed Degradation Feasibility Study Review Plan, Agency Technical Review (ATR) is one of the required levels of review for this study. ATR reviews must be conducted by professionals outside the home district with appropriate technical expertise. The purpose of this document is to provide a charge, or direction, to the Agency Technical Review Team (ATRT) and the Kansas City District Project Development Team (PDT) to conduct an Agency Technical Review of work products for the Missouri River Bed Degradation Feasibility Study. This charge will be included as an attachment to the projects review plan.

2. Project Delivery Team (PDT) Responsibilities

The PDT is comprised of individuals directly involved in the development of the Missouri River Bed Degradation Integrated Feasibility Study and Environmental Impacts Statement.

2.1 PDT Team Members

Name	Role	Office Symbol	Phone	Email
Christy Ostrander	Project Manager	CENWK-PM-PF	816-389-3143	Christina.Ostrander@usace.army.mil
Ron Jansen	Technical Lead/Civil	CENWK-ED-GC	816-389-3610	ronaldgjansen@usace.army.mil
Pendo Duku	Geotechnical	CENWK-ED-GD	816-389-3831	Pendo.M.Duku@usace.army.mil
Eddie Fernandez	Structural	CENWK-ED-DS	816-389-3237	Eduardo.H.Fernandez@usace.army.mil
John Shelley	H&H	CENWK-ED-HR	816-389-2310	John.Shelley@usace.army.mil
Kyle Haake	Cost Estimating	CENWK-ED-DC	816-389-2220	Kyle.W.Haake@usace.army.mil
Jen Henggeler	Economics	CENWK-PM-PF	816-389-3778	Jennifer.A.Henggeler@usace.army.mil
Jerry Diamantides	Economics	David Miller Associates	401-861-0084	jdiamantides@dma-us.com
Jesse Granet	Environmental Resources (NEPA)	CENWK-PM-PR	816-389-3470	Jesse.J.Granet@usace.army.mil
John Nicol	Real Estate	CENWK-RE-C	816-389-3755	John.M.Nicol@usace.army.mil

2.2 Specific PDT Responsibilities

1. A PDT Lead shall be designated for the ATR process. Ron Jansen, COE Kansas City District will serve as the PDT Lead.

2. The PDT Lead shall facilitate communications between the PDT and ATRT.

3. An electronic version of items to be reviewed in either Microsoft Word or a searchable Adobe Acrobat shall be provided at least one business day prior to the start of the review.

4. DrChecks shall be used to by the PDT to evaluate all substantive comments provided by the ATRT. Responses of "Concur" must include a description of what action was taken to resolve the review comment. Revised documentation will be provided if requested. "Non-Concur" responses shall state the basis for the disagreement or clarification of the concern and suggest actions to negotiate the closure of the comment. PDT members shall coordinate all "Non-Concur" responses with the PDT Lead who will consolidate and discuss "Non-Concur" responses directly with and the ATRT Lead for resolution.

5. The Project Manager shall provide labor funding by cross charge labor codes to the ATR Lead for the ATRT members.

6. The PDT Lead is responsible for organizing an ATR kick-off meeting in coordination with the ATR Lead before or during the first week of the review period.

7. The PDT Lead may conduct an in progress review to summarize comment evaluations as needed in cases of complex, interrupted, or extended reviews to facilitate the review process.

8. PDT members shall contact ATRT members or Lead as appropriate to seek clarification of a comment's intent or provide clarification of information in the submission package. These discussions may occur outside of DrChecks, but a summary of significant discussions should be provided in DrChecks.

9. The PM shall coordinate the proposed schedule and time for the relevant HQ Vertical Team milestones to ensure that the ATRT Lead will be able to participate.

3. Agency Technical Review Team (ATRT) Responsibilities

The ATRT is comprised of individuals from outside the Kansas City District who have not been involved in the day-to-day production of the project/product. They have been selected based on expertise, experience, and/or skills. The ATRT should note that this project is being executed

under the SMART Planning Principles. Reference: Planning Bulletin No. PB 2013-03-reissue, dated 14 March 2014, Subject: SMART Planning Milestones.

3.1 ATR Team Members

Name	Role	Office Symbol	Phone	Email	District	Org Code
Craig Evans	ATRT Lead and Plan Formulation	CEMVP -PD-F	651-290-5594	craig.o.evans@usace.army.mil	CEMVP	B6K2F00
Mike Alexander	H&H	CEMVK -EC-HH	601-631-5044	Michael.P.Alexander@usace.army.mil	CEMVK	B4L1715
Paul Boyd	H&H	CENWO -ED-HF	402-995-2350	Paul.M.Boyd@usace.army.mil	CENWO	G6L0HS0
Dan Pridal	Risk & Uncertainty w H&H	CENWO -ED-HF	402-995-2336	Daniel.b.pridal@usace.army.mil	CENWO	G6L0HS0

3.2 Specific ATRT Responsibilities

1. An ATRT Lead shall be designated for the ATR process. Craig Evans of the St. Paul District will serve as the ATRT Lead.

2. The ATRT Lead shall provide the PDT Lead with a statement of qualification for each of the reviewers.

3. The ATRT Lead shall provide organization codes for each team member and a responsible financial point of contact (CEFMS responsible employee) as needed to the Kansas City District (Christy Ostrander, Project Manager) for creation of cross charge labor codes.

4. The ATRT shall review the items submitted to ensure that they were prepared in accordance applicable professional principles, practices, codes, criteria, and for compliance with laws and policy.

5. The ATRT members shall focus on their respective disciplines, but should review all information to ensure consistency of the products.

6. DrChecks shall be used to by the ATRT to provide substantive comments on items reviewed. Flagging a comment as "Critical" in DrChecks indicates that the concern could have significant impacts on the study results or schedule. The use of the "Critical" comment flag should be reserved for those comments that the reviewer feels are of high significance.

7. ATRT members shall keep the ATRT Lead aware of the status of "Critical" and unresolved comments. If the ATRT and the PDT are not able to reach agreement on

those comments, the Review Management Organization will be engaged to provide direction and facilitate resolution of the comments. If a comment cannot be resolved, then it shall be documented and brought to the attention of the Regional Integration Team as part of the submission package.

8. In some situations, especially addressing incomplete or unclear information, comments entered into DrChecks may seek clarification in order to then assess whether further specific concerns may exist. For these instances, the ATRT member will coordinate the comment with the ATRT Lead prior to submission into DrChecks.

9. The ATRT shall backcheck PDT evaluations to the review comments and either closes the comment or attempt to resolve any disagreements. Conference calls shall be used to resolve any conflicting comments and responses. A summary of these discussions will be included in backcheck documentation in DrChecks. ATRT members may "agree to disagree" with any comment response and close the comment with a detailed explanation for "Non-Critical" comments.

10. Grammatical comments shall not be submitted into Dr Checks. Grammatical comments should be submitted to the ATRT Lead via electronic mail as a Word document in track changes or as a separate Word document that outlines the comments. The ATRT Lead should consolidate and shall provide these grammatical comments to the PDT Lead outside of DrChecks.

11. Reviewers that do not have any substantive comments shall enter a comment in DrChecks indicating such.

12. The ATRT members shall regularly monitor their respective labor code balances and alert the ATRT Lead to any possible funding shortages. Additional funding requirements by the ATRT will be coordinated through the ATRT and PDT Lead in advance of a negative charge occurring.

4. ATR Review

1. A targeted review is requested to be conducted over the Mobile Bed Model future without project projections, risk & uncertainty as related to the future without project conditions, associated model documentation, and DQC documentation.

5. Considerations for Review

Products will be reviewed for compliance with guidance, including Engineer Regulations, Engineer Circulars, Engineer Manuals, Engineer Technical Letters, Engineering and Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE.

4.1 Key General Review Considerations

1. Are there any deviations from USACE policy documented in the submission package?

2. Does the study conform to the intent of the cited study authority?

3. Is the formulation and evaluation of alternatives consistent with applicable regulations and guidance?

4. Was the selection of models appropriate for use in evaluations?

5. Was the application of data within those models appropriate?

6. Was the interpretation of and conclusions drawn from model results reasonable?

7. What is the status of the certification/approval for use of the planning models used in the study?

8. Are the sources, amounts, and levels of detail of the data used in the analysis appropriate for the complexity of the project?

9. Do the main decision document and appendices form an integrated and consistent product?

5.2 Project Specific Review Considerations

1. The project is being executed under the SMART planning principles. It is asked of the ATRT to take into consideration these principles.

5.3 H&H, Sedimentation, and Modeling Specific Review Considerations

1. These documents are similar to the documents already reviewed. Appendix A is a list of statements and questions for consideration by the reviewers; detailed comments are requested. ATR and PDT will coordinate comments and clarifications.

6. Products for Review

All products are considered draft and pre-decisional and shall not be released outside the Corps of Engineers. It is the intent of the PDT to have an intermediate review of the H&H products prior to the Plan Formulation review. Following is a list of products to be reviewed.

6.1 Future Without Project Projection Model H&H Review with Risk & Uncertainty

1. Calibrated model, including input and output files for future without project conditions (note: the executable file will not be provided, since it is the same as was currently provided for the existing conditions calibration model)
2. Future without project model documentation report. The purpose of this report is to document the degradation projections conducted in conjunction with the Missouri River Bed Degradation Feasibility Study for the Future Without Project condition. This report describes updates to model geometry, explains the development of the hydrologic boundary condition for the projection period and provides Future Without Project bed elevation and water surface elevation projections.
3. Risk & uncertainty report
4. DQC documentation
5. Economic information for information only. While not specifically the subject of this review, the economic information is intended to enable reviewers to understand what risk & uncertainty is addressed in the economic model (versus the H&H model) so as to assess the adequacy of the overall study approach. Economic information includes:
    a. Conditional single use approval model from HQUSACE (Mar 2015)
    b. The memo that was transmitted from the FRM PCX to HQUSACE asking for review of the model (Feb 2015)
    c. The MO R econ model review report (Jan 2015) Note: Specific items which may be of interest to reviewers in this report include:
        i. Main report--Under "Single-use" concerns A & B there is discussion of Risk and Uncertainty (page 6/79)
        ii. Enclosure B- Final Risk and Uncertainty Discussion/Resolution for Econ Model Review Team (page 26/79)
        iii. Enclosure C_the Targeted Agency Technical Review Report, please see Section g.1 -2 (page 35/79) for uncertainty bullets; DrChecks comment #5521958 (page 52/79), #5598568 (page 67/79), and #5598611 (page 68/79)
    d. The MO R econ model review plan (Sep 2013)

7. ATR Schedule

Activity	Start Date	End Date
Transmittal of files for Projection Model Review with R&U	17 Mar 2016	
Targeted Projection Model Review with R&U	17 Mar 2016	15 Apr 2016
Evaluation of Comments	TBD	
Backcheck Comments from	TBD	
Screening IPR	Aug 2016	
TSP Milestone	Aug 2017	

Appendix A

H&H, Sedimentation, and Modeling
Specific Review Considerations

INTRODUCTION

Appendix A, is a list of statements and questions to be considered by the ATR Reviewers.

1. Future without Project

a. Is the update of the model to 2014 bed geometry and dike/sill elevations appropriate?

b. Is the FWOP flow condition reasonable and appropriate?

c. Is the FWOP dredging condition reasonable and appropriate?

d. Are the sediment assumptions reasonable and appropriate?

e. Are the floodplain deposition assumptions reasonable and appropriate?

2. Risk & Uncertainty

a. Are there any significant gaps between risk and uncertainty in the H&H model and risk and uncertainty in the economic model?
b. Is the split of risk & uncertainty between the H&H model and the economic model reasonable and appropriate?
c. Is the overall study approach to risk & uncertainty adequate?

Enclosure 2

DRCHECKS REPORT OF ALL COMMENTS

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Comment Report: All Comments
Project: Missouri River Bed Degradation Feasibility Study
Review: Mobile Bed Model FWOP and R/U Rvw
Displaying 14 comments for the criteria specified in this report.

Id	Discipline	Section/Figure	Page Number	Line Number
6483390	Hydraulics	n/a	General	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

A track change version of both documents was provided with multiple comments. Many of these are small and editorial in nature. In general, additional content and clarifying text is requested to thoroughly document the analysis performed and the information provided by H&H to the Economic team member.
An alternative to this approach would be to use R&U to establish envelope curves, use those curves to get bed change in ft/yr, separate into Econ time blocks, etc. Refer to EM 1619 for comparing calibration profiles and high water marks for how to evaluate in R&U.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

Revised Apr 18 2016.

1-0 Evaluation **Concurred**

Additional clarifying text has been added. Portions of the EM1619 have now been adopted to combine uncertainties in the model and the boundary conditions.

Ultimately, the typical risk and uncertainty procedure used for flood risk management studies, which includes the software FDA, was decided against for the following reasons:

1- In consultation with HEC staff, it was determined that the current, certified version of FDA is insufficient to perform the required Annual Exceedance Probability analysis. A new version of FDA is forthcoming (release date unknown) that includes the needed functionality, but at the time of this study the needed model version is uncertified, not available on the HEC website, and not ACE-IT approved for installation.

2- The already approved one-time-use economic model for this study assesses single scenarios, not probabilities of exceedance. In order to interface with the economic model, a base case, less degradation, and more degradation scenario is needed.

3- Computational tools are not available for facilitating the computation of uncertainty in sediment transport modeling and its contribution to non-flood-related damages. For example, damages assessed in the Degradation Study are related to low flows or are tied to bed elevations which are largely independent of flow rate.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483392	Hydraulics	n/a	FWOP pg 3 and 4.	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

New Model Geometry. Text discusses a new survey and process to update elevations for structures. However, the extent of changes from the calibrated model is not clear. Recommend to provide text discussing a summary of structure elevation changes in the model. Consider adding typical calibration info to the report for the revised model. Plots comparing model results from the former calibration report to the new model at three or more flows (CRP, mid bank, top of bank). The intent is to evaluate if water surface profiles have changed significantly from the calibrated model. Assuming that the calibrated model was the best estimate of current conditions, identify to what extent using the geometry revisions without altering model calibration could affect results.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

1-0 Evaluation **Concurred**

The average adjustment in dike height (-3.0 ft) and sill height (-3.0 ft) was added in the text.

These lower structure elevations are a function of the lowering of the Construction Reference Plane by 2.6 ft between the 1982 and 2010 CRPs. Perched structures in the most degraded reaches were mechanically lowered and when deficient structures were repaired, they were repaired based on the most recent (degraded) CRP.

Steady flow profiles were run and the velocities compared. At low flow, minimum navigation flow, 10-year flow and 50-year flow the velocities varied by less than 0.1 ft/s.

To be conservative, the larger standard error for this one year of simulation is used in the uncertainty computations instead of the long term calibration standard error.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483393	Hydraulics	n/a	FWOP pg 7	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The cumulative bed material ranking is based on the total annual sediment. In theory, you could have a flow year with a large flood event for a two or three week period that caused higher degradation levels, combined with lower flow in other periods, that would have a greater degradation value than a flow year without flood event(s) which had a greater total sediment. Was this examined with the RAS model? Is the link from sediment inflow to degradation clearly established? It is not clear that assigning a 50% rank based on annual sediment load is for the degradation. To assist with this, considering performing an evaluation on the developed flow series and comparing to hydrologic frequency using gage stem statistics (perhaps annual or monthly volumes, as well as 14 day, flow peaks)? Perhaps an SSP duration evaluation at KC, and compare to the annual peaks from the flow freq study?

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

Revised Apr 18 2016.

1-0 Evaluation **Concurred**

The rate of geomorphic change is expected to be linked to the rate of sediment movement, which is approximated using a bedload rating curve. The power on the bedload rating curve accounts for the non-linear response between flow and sediment movement. A high flow that lasts a single day would transport more sediment than half the flow that lasts two days. However, if half the flow lasts ten days, it would transport more than the single day of high flow. The power on the bedload rating curve sorts it out.

Ultimately, what is produced is a set of flows that transport a median amount of sediment. You are correct that there is not a 1:1 relationship between flow (even flow transformed to a bedload transport) and degradation. The point is a reasonable 50-year projection and a reasonable range of for the uncertainty.

I have now plotted the previous 50-years of flow on the same axis as the future 50-years (see Figure 7). As seen, the previous 50-years is very close to the median set of flows from a sediment transportation standpoint. The difference is mostly at the end, when the historic flows had both a 1993 and a 2011 event.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483394	Hydraulics	n/a	FWOP pg 15	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Bed averaging. The impact of the bed averaging period on data provided to Econ is not clear. If comparison is on average bed, impact assessment is recommended by comparing the different methods for the entire reach and evaluate. Alternatively, the minimum elevations for each method could be collected into a profile on an annual or suitable period and provided to Econ for analysis. Relating the bed change to water surface elevation, to better assess impact on Econ, is recommended. Economic damage is related to absolute elevation but that is also dependent on flow profile change. The smoothing may or may not be obscuring possible impacts but that should be evaluated. Impacts to water users are most likely to occur in the winter season with low flow after a degradation event. Was consideration given to using model results to determine the annual minimum for input to the Econ model? The plot would imply a 1 ft range per year in the bed change. However, this may vary according to the amount of total degradation. Would it be feasible to plot minimum values in a profile for all 50 years and evaluate?
An alternative to this approach would be to use R&U to establish envelope curves, use those curves to get bed change in ft/yr, separate into Econ time blocks, etc. Refer to EM 1619 for comparing calibration profiles and high water marks for how to evaluate in R&U.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

Revised Apr 18 2016.

1-0 Evaluation **Concurred**

The bed averaging has been removed. The model was "noisier" in earlier iterations and the bed averaging bed sense.

That the economic model takes the minimum elevation for each feature has been clarified in the text.

An example feature has also been added to the report to illustrate the output to the econ model.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483407	Hydraulics	n/a	FWOP Fig 9	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The crossing of the future low water elevations in the plot is concerning. It appears that the 2025 and 2040 profile aggrade for the center 20 mile reach or so (near RM 370) and the 2065 profile severely degrades throughout the model. Is there a physical reason for this trend reversal? Where does the Kansas River enter the model? Any explanation for the deep trough around RM 325 in the 2065 profile? Clarifying text to help interpret the figure would be helpful. What time interval was used to provide output data (both water surface elevation and bed elevation) to Econ for analysis?

Does the time interval capture this reversal from aggradation to degradation?

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

Revised Apr 18 2016.

1-0 Evaluation **Concurred**

The physical reason has now been added to the model.

The Kansas City metro (RM 350 to 370) is expected to experience slight recovery in the short term (and it confirms what we've seen recently in the bathymetric measurements). This is due to an increased sediment load from headcutting in the channel upstream of Kansas City. Over time two factors influence a return to a degradational trend, (1) as the headcut moves further upstream, the contribution of the increased sediment load to Kansas City decreases, (2) as dredging continues near the upstream end of the Waverly reach (around RM 350), new degradation headcuts into Kansas City. Both these processes take time to affect Kansas City.

The Kansas River enters at around RM 367.

The model output is several times per year with the minimum elevation per year given as input to the economic model. This does capture the trend reversal.

The deep trough near RM 325 is likely related to dredging. There is a significant dredging operation near there. The trough does not occur in the "No Dredging" model run.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483417 Hydraulics n/a Sensitivity Analysis, pg 1. n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The sensitivity analysis is focused on the sediment aspect of the HEC-RAS modeling effort only. Consider including typical H&H modeling uncertainty for projects following the R&U guidelines in EM 1619. This would provide separate uncertainty for hydrologic, hydraulic, and bed degradation estimates. The effect of bed degradation estimates on the water surface profiles would then be evaluated. Different parameters from the sensitivity analysis could be used with guidance following EM 1619 for combining multiple factors contributing to stage uncertainty. Assigning uncertainty to water surface profiles estimates is feasible whether a sophisticated modeling approach is used or if less detailed analysis is used. How the degradation estimate varies with time and by location, and the actual values used in the Econ analysis, should be clearly stated.
There is some overlap with the FWOP report. Consider combining into a single report so as to

improve clarity and not omit section from one report or the other. Suggest that the introduction should include a discussion of the intent of the sensitivity analysis and how it was incorporated into the final water surface profiles used by Econ.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

Revised Apr 18 2016.

1-0 Evaluation **Concurred**

An approach more similar to EM1619 has now been undertaken.

Model uncertainty has now been quantified. This integrates hydraulic and sediment transport uncertainties. To be conservative and to account for potential added uncertainty from updating model geometry, the larger values from 1 year of testing were included rather than the smaller uncertainty values generated from 20 years of calibration.

In addition, future boundary condition uncertainty has been quantified, which includes uncertainty in the flow series, sediment load trend, dredging locations, and (in some years and just for the bed) temporary degradation.

FWOP and Risk and Uncertainty reports have now been combined. The new document is much more clear about what is given to the econ model.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

KC District indicated they had coordinated analysis method with NWD regarding risk and uncertainty analysis. Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483418	Hydraulics	n/a	Sensitivity Analysis, table 3, 4, 5.	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

. How these values were used to adjust the H&H values provided to the Econ analysis should be clearly stated. Was this used to modify the water surface profiles? For all time frames? Some of the tabulated differences are very low. Consider that in a standard R&U analysis, the hydraulic uncertainty alone is usually a minimum of 0.5 to 0.7 ft and often in the 1 to 2 ft range.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

1-0 Evaluation **Concurred**

I agree that the old framework/document was not clear. The updated framework combines uncertainties and is explicit in how it is used.

By including the model uncertainty (which includes hydraulic and sediment transport) as well as boundary condition uncertainty, the overall uncertainty bounds are closer to what you might expect.

How well calibrated, average relationships can yield the same overall outcomes as the highly variable measured data is assessed in the model standard deviation of error term.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483424	Hydraulics	n/a	Sensitivity Analysis, pg 16, 7 Fig 10, Fig 11, table 7	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Does this accurately provide information to the Econ model? Bed degradation around infrastructure is likely not the same as the average bed shown in Fig 10. Fig 11 shows variability in the section. A methodology to adjust values in a response to an ongoing major flood should be thoroughly explained including what events are assumed to incur temporary flood scour and how the input to the Econ model was adjusted. Questions to address: How is this added to the Econ analysis? When is it triggered? Does it vary by flow year?
This plot is for only one location. We would expect variation in the temporary degradation strongly correlated to river features (width, structures, etc.). Also define how was this extrapolated to the remainder of the study reach?
What actually informs the decision process for Econ – is it bed measurements or would it be keyed off of water surface elevation?
With respect to the bed change following the flood, identify how this was included in the overall estimate or in the econ model. The Econ appendix might application to damage, but the H&H values provided to the Econ analysis should be clearly stated. Was this used to modify the water surface profiles or bed elevations?

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 18 2016

Revised Apr 18 2016.

1-0 Evaluation **Concurred**

This has been significantly clarified.

Analysis at the Kansas City gage indicates that this temporary, flood-related degradation occurs at flows higher than 220,000 cfs, which is between a 20% and 10%

exceedance value (5 to 10 year flood). During the 1987, 1993, and 2007 high flow events, bed recovery lagged behind the end of the flood hydrograph by several months, i.e. the flood waters receded but the bed remained degraded.

However, money was spent in 2011 where this temporary degradation coincided with already degraded reaches.

The mobile-bed model does not reflect this level of quick drop and rebound. This temporary effect is added via an empirical analysis to the elevation estimate for the years that include floods of a sufficient magnitude. This occurs in future simulation years 12, 16, 17, 23, 44, 45, and 50.

Based on 2,125 paired bathymetric measurements taken in 2009, November of 2011, and 2014 (during, immediately after, and three years after the 2011 flood), the mean temporary bed change is -1.54 ft, with a range from -3.26 to +0.87 and a standard deviation of 0.86 ft.

The locations of change may be tied to specific locations that persist, but with data for only one flood, that can't be said for certain. It is very likely that the temporary degradation is related to the location of head cuts on the river, with the most change occurring over that reach through which a headcut passes. Rather than attempt to define the spatial component with lacking data, the standard deviation is included in the risk and uncertainty.

Some damages are tied to bed elevation. Revetment toes and bridge piers fall under this category.

Other damages are tied to low water surface elevation. Water intakes fall into this category.

The temporary degradation only applies to the bed-dependent features. Water-dependent features have not historically responded to temporary degradation, just to longer term trends. Short term releases have occurred to bridge temporary needs.

I do not have the definitive list of features, so I can't provide a table for each feature individually. But the report now includes an example to clarify.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**
Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016

Current Comment Status: **Comment Closed**

6483706	Hydraulics	n/a	n/a	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

I have reviewed the subject reports, Missouri River Bed Degradation Study, FWOP Technical Appendix, and the FWOP Risk and Uncertainty/Modeling Sensitivity Analyses.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 18 2016

1-0 Evaluation **Concurred**

Thank you.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

Closed without comment.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Jun 07 2016

Current Comment Status: **Comment Closed**

6483769 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

The mobile bed model is quite an achievement, and it can identify reaches where degradation issues over time will require industry/users to make adjustments. Given that model output is reach-based (5 mile averaging), and given AT reviewer team consensus was reached, I echo the recommendation to add additional text that defines the risk and uncertainty associated with water surface elevation profiles.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 18 2016

1-0 Evaluation **Concurred**

Note: The 5-mile reaches are provided to present trends and to quantify uncertainty.

The output to the econ model is interpolated from model output at the two bounding cross sections. See the final figure in new, combined report for an example of what is provided to the econ model.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

OK

Submitted By: Michael Alexander (251-441-6641) Submitted On: Jun 07 2016

Current Comment Status: **Comment Closed**

6483787 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

I note that the FWOP technical appendix does not directly show dredging/mining effects like those seen in the Risk and Uncertainty document (re: Effect of Dredging over the Calibration Period 1994-2014). How was Figure 6 developed relative to the reach averaging method in the FWOP document?

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 18 2016

1-0 Evaluation **Concurred**

The two documents have now been combined, and the dredging discussion has been clarified. It now includes:

1-The effect of turning dredging off in the calibration period.

2-The effect of varying the level of dredging in the future 50-year period.

3-The effect of the dredging locations varying.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**

OK. In closing, I note that the best evaluation of dredged sediment removal in a reach is based on permit and hydrographic survey quantities. Modeling/averaging these known quantities often allows support for either side of a dredging issue.

Submitted By: Michael Alexander (251-441-6641) Submitted On: Jun 07 2016

Current Comment Status: **Comment Closed**

6483812 Hydraulics n/a n/a n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Short-term flood related degradation and associated issues are known from past events in 1951, 1952, 1993, and 2011. Figure 10 in the Risk and Uncertainty document shows post-flood degradation of 6 ft for the 1993 flood that recovers about 6 ft over a 1-yr or so period. My concern is informing users of potential degradation-recovery issues - but this comment is mostly a reiteration of the previous comment concerning risk and uncertainty clarification for water surface profiles.

Submitted By: Michael Alexander (251-441-6641). Submitted On: Apr 18 2016

1-0 Evaluation **Concurred**

This section has been made more robust and clarified to include:

1-The flow conditions over which this has been observed,

2-The average, min, max, and standard deviation of change observed from cross sectional measurements.

This effect is now included in the years with peak flows greater than 220 kcfs at Kansas City, and the uncertainty is included in the "more degradation" and "less degradation" scenarios.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**
OK. thanks

Submitted By: Michael Alexander (251-441-6641) Submitted On: Jun 07 2016
Current Comment Status: **Comment Closed**

6484323	Hydraulics	n/a	R&U doc, pg 18	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Prior to the conclusions, consider adding a section to discuss how the sensitivity analysis was used to derive uncertainty in the profiles provided to Econ. This should be a combination of hydrologic, hydraulic, and sediment modeling. See EM 1619. Perhaps summary text, and then tables or plots as an attachment. Following EM 1619 and ER 1105-2-101 provide example tables of output from a R&U analysis. Consider using FDA to generate the tables. FDA can be run without Econ data, using only H&H. Determining annual exceedance probability (or non-exceedance in the case of degradation) would be really helpful to compare alternatives.

Submitted By: Dan Pridal ((402)995-2336). Submitted On: Apr 19 2016

1-0 Evaluation **Concurred**
FDA wasn't used for reasons stated in the document, but summary graphs have now been added that demonstrate the combination of the various uncertainties.

The approved, one-time use econ model requires scenarios. A base case, a more degradation, and a less degradation scenario have been developed using equations patterned after EM1619.

Submitted By: John Shelley (816-389-2310) Submitted On: May 24 2016

1-1 Backcheck Recommendation **Close Comment**
KC District indicated they had coordinated analysis method with NWD regarding risk and uncertainty analysis. Response is adequate.

Submitted By: Dan Pridal ((402)995-2336) Submitted On: Jun 08 2016
Current Comment Status: **Comment Closed**

6590197	Planning - Plan Formulation	n/a	General	n/a

Comment Classification: **Unclassified\\For Official Use Only (U\\FOUO)**

Documentation of District Quality Control review was provided for the ATR team. DQC was adequate and all issues were addressed prior to release to the ATR team.

Submitted By: Craig Evans (651-290-5594). Submitted On: Jul 07 2016

1-0 Evaluation **Concurred**

Noted....thank you.

Submitted By: Ron Jansen (816-389-3610) Submitted On: Jul 08 2016

1-1 Backcheck Recommendation **Close Comment**

No action needed.

Submitted By: Craig Evans (651-290-5594) Submitted On: Aug 02 2016

Current Comment Status: **Comment Closed**

Enclosure 3

COMPLETION STATEMENT OF AGENCY TECHNICAL REVIEW

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COMPLETION OF AGENCY TECHNICAL REVIEW

The Targeted Agency Technical Review (ATR) has been completed for the H&H projection model (future without project conditions with risk and uncertainty) for the Missouri River Bed Degradation Feasibility Study, for the Kansas City District. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy.

The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be effective. DQC review of the mobile bed hydraulic model and the calibration report was thorough; those comments and responses were provided to the ATR team as MS Word documents. The quality of the documents reviewed was sufficient for this review and indicated that adequate DQC was accomplished.

The review report notes that all comments have been addressed and closed in DrChecks. Appropriate changes to the FWOP and R&U documentation were recommended to clarify how outputs of the hydraulic analysis should be used in the economic model.

2016.09.13 (Original)

Craig Evans — Date
ATR Team Leader
CEMVP-RPEDN-PD-F

Christina Ostrander — Date
Project Manager
CENWK-PM-PF

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Appendix Q

Letter from Stoel Rives, November 2014

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November 20, 2014

Christina Ostrander, Project Manager
U.S. Army Corps of Engineers
601 E. 12th Street, Room 529
Kansas City, MO 64106

Re: Ongoing Concerns About and Continued Information Gaps in Public Information Supporting Comment Solicitation on the Missouri River Mobile Bed Model

Dear Ms. Ostrander:

On behalf of Holliday Sand & Gravel, LLC ("Holliday"), I am providing the attached Technical Memorandum, prepared by Holliday's expert consultants, Dr. David T. Williams and Mr. Brad R. Hall, which summarizes the current results of Holliday's technical review of the Missouri River Mobile Bed Model (the "Model"). As outlined in the attached, given the significant challenges Holliday's experts have faced in trying to critique the Model due to the incomplete nature of the information provided by the U.S. Army Corps of Engineers ("USACE"), despite numerous requests over the past year for the data and other information supporting the USACE's development and implementation of the Model, significant questions remain about the Model that only the USACE can answer. Furthermore, as clearly evidenced in the attached, Holliday's ongoing review of the information that has been provided has only served to further validate concerns that Holliday has expressed to the USACE since first learning of the Model's development:

> The process for developing and implementing the Model, as well as the Model itself, suffer from significant deficiencies that clearly call into question the very foundations of the Model. Consequently, the USACE should pause the development of the Model, in particular the alternatives analysis, and the environmental impact statement supporting it until these issues have been adequately and transparently addressed by the USACE in collaboration with stakeholders like Holliday. Anything short of such a course would be in clear contravention of the National Environmental Policy Act and the USACE's own regulations and formal directives.

As Holliday has stated in the past, given the significant environmental and socioeconomic implications of the outcome of this modeling effort, it is in the USACE's and the public's best interest to have a robust and comprehensive review of the Model. As evidenced in previous

correspondences and the attached Technical Memorandum, such a review has not occurred and cannot occur without providing the public access to ALL of the information relevant to the Model's development and implementation, as well as providing adequate time for the public to evaluate the information.

Very truly yours,

Aaron C. Courtney

ACC:dew
Enclosure
cc: Matthew P. Jeppson, U.S.A.C.E.

Technical Memorandum

Date: November 18, 2014

Subject:

Review of Kansas City Corps of Engineers' HEC-RAS Mobile Bed Model (MBM), Accompanying Documents for the Lower Missouri River (LMR) and the Overall Review Process

To:

John Nelson and Mike Odell (Holliday Sand and Gravel/Ash Grove Cement Company) and Aaron Courtney (Stoel Rives, LLC)

From:

David T. Williams (MO PE # 2012015265, DTW and Associates - DTW) and

Brad Hall (Northwest Hydraulic Consultants - NHC)

1.0 Introduction

DTW and NHC were retained to review and evaluate the U.S. Army Corps of Engineers (USACE)--Kansas City District's (The District) "calibrated" HEC-RAS mobile bed model (MBM) of the Lower Missouri River. This review included examination of the MBM and its input and outputs, the associated Calibration Report, GIS information, PowerPoint (PPT) presentations made by Dr. John Shelley and Ms. Christina Ostrander (from the District) on September 24, 2014 and other miscellaneous relevant documents and information, some of which was provided by the District and other of which we assembled unilaterally. This information is presented in detail in section 2.0. Also examined was the overall District review process in respect to having a robust internal and external review of the MBM model and the methodologies used so that it can confidently be used to assess the effectiveness of remediation measures.

Our preliminary review comments are included in this Technical Memorandum (TM). Note that as of the date of this TM, we have not had the opportunity to conduct a full review of the MBM and supporting documents/files because needed information has not been received (this information has been requested by an initial FOIA and a supplementary FOIA by Mr. Courtney (see references Q and R below) and GIS related computer files readable by the review team were just recently received. If receipt of the requested or any updated information casts new light on our comments, we reserve the right to modify our comments with a supplementary TM.

Please note that some of the review comments have been previously sent to the District via letters by Mr. Courtney. However, for completeness and in case reviewers of this TM were not provided the prior comments and critique, all of it is presented herein.

2.0 Data and Documents

The MBM and Calibration Report, along with other supporting files, were downloaded on June 13, 2014 from the website provided by the District. An updated MBM model input files and documents was provided by the District on August 13, 2014 via mailed CD to Mr. Courtney.

The important files/documents/references that were used in this TM are as follows (items that were obtained through independent searches by us are starred):

A. MBM, Executed using HEC-RAS Version 5.0, program version dated June 2014
B. Missouri River Bed Degradation Study Mobile Bed Model Calibration Report, February 2014, by Dr. John Shelley
C. Existing Condition Of the Bank Stabilization and Navigation Project Structures, River Miles 330 and 400, 25 December 2013
D. Review Comments by Mr. Tony Thomas
E. Review Comments by the Agency Technical Review (ATR)
F. Spreadsheets with input data and analyses for the MBM
G. GIS related files. Note that most of these files were corrupted and replacement files were provided on Nov. 7 by the District. Specifically, the corrupt files were:

   CrossSectionLocations.zip
   DikeShapeFile.zip
   Nov2011.csv (empty)
   2009.csv (empty)

H. PPT presentations made by Dr. John Shelley and Ms. Christina Ostrander at the September 25, 2014 Missouri Riverbed Degradation Stakeholder Meeting
I. *David C. Heimann, Patrick P. Rasmussen, Teri L. Cline, Lori M. Pigue, and Holly R. Wagner, 2010; *Characteristics of Sediment Data and Annual Suspended-Sediment Loads and Yields for Selected Lower Missouri River Mainstem and Tributary Stations, 1976–2008*; Prepared by the USGS in cooperation with the U.S. Army Corps of Engineers, Kansas City District Data Series 530
J. Missouri River Bed Degradation Reconnaissance Study, Section 905(b) (Water Resources Development Act of 1986) Analysis, August 2009

K. USACE (2011). Missouri River Commercial Dredging Final Environmental Impact Statement (EIS). U.S. Army Corps of Engineers, Kansas City District. Kansas City, MO., Prepared by Cardno-Entrix, Seattle, WA
L. Missouri River Bed Degradation Feasibility Study, Milestone Decision: Viable Array of Alternatives, In-Progress Review, October 2013
M. Existing Condition Of the Bank Stabilization and Navigation Project Structures, River Miles 330 and 400, 25 December 2013
N. Review Plan For Missouri River Bed Degradation Feasibility Study, PN 146254, *Kansas City District, February 11, 201*
O. * National Planning Centers of Expertise, Agency Technical Review, ATRT Review Report for Decision Documents (Template) from: http://planning.usace.army.mil/toolbox/library/Misc/PCXGuildATRReview090112.pdf
P. Missouri River Bed Degradation, Preliminary Modeling Results and Alternatives Analysis, August 2013, PPT presentation by Dr. John Shelley
Q. Freedom of Information Act (FOIA) letter to the District by Mr. Courtney, dated October 31, 2013
R. Freedom of Information Act (FOIA), Supplemental, letter to the District by Mr. Courtney, dated October 24, 2014

3.0 Comments on Calibration Report

We were provided the RAS input files (MRcalibrationperiod.prj and associated geometry and boundary condition files), but no output files referenced in the report were available. We ran the input files using HEC-RAS 5.0.0 Beta, dated June 2014, which is the version that the latest MBM model used. We are aware that a new Beta Version dated October 1, 2014 (still named Version 5.0) is available but we are not certain if the District will re-run the MBM with this version. Therefore, all information extracted in our model runs were from the June 2014 5.0 version. The simulation took approximately 2 hours to complete on a laptop. We reviewed the output files and got results consistent with what Dr. John Shelley presented in the Calibration Report, but we cannot say they are exactly the same. We will have additional comments on the USACE model results upon review of their HEC-RAS solution files.

Following are specific comments on the Calibration Report.

3.1 Acknowledgement – "Independent technical review provided by Tony Thomas, PE of Mobile Boundary Hydraulics, PLLC. " It should be pointed out that this review is not the same as the Independent External Peer Review (IEPR) that is required by reference N.

3.2 Section 2.1 – The last paragraph on page 1 states that dams store a significant amount of water but it should also state that these dams also store a significant amount of sediment that would normally go downstream.

3.3 Section 2.2 – "dredging has decreased in the last 3 years to levels approximately equal to those from 1974 to the early 1990's." Dredging has not "remained high" through the 2000's as stated but in fact, has decreased significantly since 2002 (page 2).

3.4 Section 2.3 – It says that in recent years, the bed has been degrading; however, in Figure 4 (the Kansas City reach) for 20,000 cfs, it shows the current degradation trend (which is essentially a straight line) started in 1940, which is almost 75 years ago. Not exactly recent. The degradation from 1940 to 1990 was about 7. 5 feet and from 1990 to 2012 (the period of the most dredging), it was about 4 feet for a total of about 11.5 feet since 1940. For the current degradation trend, 65% of the degradation occurred before the time period of significant dredging. Section 2.3 - Figure 7 shows the last survey was 2009. There have been more surveys since, so the results of these surveys should be plotted.

3.5 Section 2.3 - Figure 7 shows a large drop in the water surface elevation at St. Joseph from 1994 to 2009 and, as a percentage, is greater than the drop in the Kansas City reach. What activities are causing this in the St. Joseph area?

3.6 Section 2.3 - On page 9, it states "In addition, the time period included a range of high and low flow years and the effects of the major 1993 flood." It would be helpful to include a hydrograph of the time period.

3.7 Section 2.4 - The method used to develop the accumulated bed material mass change requires further explanation. Were bathymetric surfaces compared or end area calculation made? Does the analysis account for bed material deposition or erosion between dikes? This is critical information from which a comparison to the RAS model results are presented, so further illustration of the data, supporting GIS or CAD data files, and analysis methods is required (page 10).

3.8 Section 2.4 - On page 10, second paragraph, it states that "In Kansas City, the flow remained above 142,000 cfs (a 2-year flow) for 99 days." To get a better understand of the severity of this event, a frequency-duration should be assigned to this. Also, if the flows were sustained mostly by reservoir releases as they are being reduced from full to regular operating levels, most of the flow has been sediment "starved" for a long time period, resulting in degradation of the bed.

3.9 Section 2.4 - The report states that 52 million tons (MT) of sediment was extracted in the Kansas City reach from 1994 to 2009. Figure 9 (page 11) shows for the '94 – '09 time period approximately 20 MT of bed material loss from St Joseph to the RM 380, the upstream limit of dredging. The figure shows approximately 10 MT of bed material loss through the dredging reach from RM 380 to RM 355. Downstream of the dredging reach, only 5 MT of bed material loss is observed. Accordingly, it is apparent that dredging had nothing to do with the 20 MT of bed material loss upstream of RM 380. The analysis, as presented by the MBM, begs the question of why there is actually less degradation through and downstream of the dredging reach than what is observed upstream.

3.10 Section 2.4 - It state on page 11 that "The change in slope in Kansas City seen in both curves coincides with BSNP design criteria for a wider channel downstream of the Kansas River confluence." Does this mean that the cumulative mass changes and associated changes in bed elevation (degradation) were due to the BSNP and wider channel? If so, this implies that such actions have significant effects on the degradation.

3.11 Section 2.4 – Figure 9 shows that from the cumulative mass curve from 1994 to 2009, about 27 million tons was lost between St. Joseph and Kansas City and about 60 million tons was lost from 1994 to 2011. This means that from 2009 to 2011, 33 million tons (60 – 27) was lost. From Figure 4, about 4.3 million tons was dredged in the Kansas City reach which implies that only 13 % of the mass loss between St. Joseph and the Kansas City reach can be attributed to dredging.

3.12 Section 2.4 - The description of the 2011 high flow event lacks any description of observed bed degradation upstream of St Joseph. Was significant bed degradation observed from the most downstream main stem dam to the study reach (page 10)?

3.13 Section 2.4 - Figure 10, page 11. No tic marks are shown in the Figure so we cannot compare data with other data sources. Also, is the figure for total suspended sediment or total suspended bed material? Suspended bed material is of interest as fine sediment (silts and clays) do not deposit in the bed of the LMR and influence stage discharge relationships.

3.14 Section 2.5 – In the second paragraph, it states "Now, BSNP river training structures constrain the river to a narrow corridor, which both induces high velocities and limits access to bank and floodplain sediments. The result is tremendous bed degradation during floods, as evidenced by the drop in water surface evident in Figure 8 and the mass loss evident in Figure 9." Does this mean that the District acknowledges that the main cause of the degradation is the BSNP since Figure 8 is used to identify severe degradation? This acknowledgment is supported, in the same paragraph "While flooding is a natural phenomenon that occurs with or without a federal project in place, the current river's degradational response to flooding is a function of the BSNP and related levees."

3.15 Section 2.5 - 3rd paragraph, last sentence ("With no commercial dredging….). There is no supporting calculations, observations, measurements, analysis (this could be done in the MBM), or reason to support this statement. It is ludicrous to make this statement without solid supporting evidence (page 12). Such contention could have easily been determined using the MBM but the District has not done this.

3.16 Section 2.5 - 4th paragraph. The pre and post '93 flood sediment discharge relationship is not shown for comparison. Nearly 3 years have passed since the '11 high water event. Do recent USGS sediment discharge measurements indicate any change or recovery to pre-flood conditions of the sediment discharge relationship?

3.17 Section 3.3 - Cross Sections. We will provide a more thorough review of the RAS cross section input file when we examine the GIS files that were corrupted.

3.18 Section 3.3 - Bed Sediment Gradation. We will provide a more thorough review of the RAS bed material data and correspondence with what is provided in the report in Table 3, (page 20).

3.19 Section 3.4 - Boundary Conditions, Flows. Uniform lateral flows are both added and subtracted flow from the river. The approach and comparison of observed to modeled flows requires further explanation. The effects of adding or removing flow on the sediment budget are not described. Do inflowing lateral flows carry sediment and are there diversions of sediment from specifying negative lateral flows (page 22)?

3.20 Section 3.4 - Boundary conditions, sediment load. Much more information is required to review the procedures and results of this critical boundary condition. Does Figure 19 represent total or bed material load? Tic marks are also required on the figure to compare the information with other data sources. There is no flow-sediment load table presented for the Missouri River (however, there is for Kansas and Platte rivers).

3.21 Section 3.4 - Page 26, first paragraph. "The gradation of the incoming total sediment load…" We are only interested in bed material load. Figure 21 shows silt and clay (<0.0625 mm size) 30-70% of the total load. In essence the entire bed is coarser than 0.0625 mm (Table 3, page 21) so the description of sediment loads should focus on these bed material sized sediments.

3.22 Section 3.4 - Table 6, Page 28. The Kansas River flow-sediment load rating differs from the sediment load rating provided in the RAS input files. Which is correct?

3.23 Section 3.4 - Boundary conditions, dredging, page 30. The report states "commercial dredging….was a significant driver of bed degradation during the calibration period". This statement is unsubstantiated and unproven. Similar to cross sections and bed material gradations, we will have to analyze the RAS input file specifications of dredging to check agreement with what is described in the report, but such an effort would not otherwise be required were the report prepared to customary USACE standards.

3.24 Section 3.5 - Sediment transport formula. Silt is not found in the bed of the LMR and is not of interest for the bed degradation modeling. Suspended silt concentrations have an influence on sediment transport but the Missouri River silt concentrations are too low to have any effects.

3.25 Section 3.5 - Bed Material mixing. The report describes that a bed material sorting algorithm provided "too little armoring". Has armoring been observed on the LMR? With the exception of a few isolated samples in the Kansas City reach, the river bed material (Table 3) is entirely sand. "Armoring" in active sand bed rivers with dunes (from which bed load estimates were made) is not a significant process. The report needs to describe bed material and surface layer gradations over time and show that bed material gradations agree with measurements at time periods throughout the calibration time window (page33).

3.26 Section 3.6 - Calibration/Verification. The report does not show any comparisons of computed sediment discharge and sediment yield at Kansas City, where USGS sediment

measurements are available. The total sediment yield at the inflow, within, and at the downstream end of the model, needs to be shown in accordance with sediment measurements, about which there is a wealth of information on the LMR. Bed degradation is a result of the sediment transport (and dredging) throughout a reach and has more influence than the sediment inflow. To simply present cumulative bed material loss through a reach (Figure 34, page 44, needs tic marks) does not verify the sediment transport model. You have to demonstrate the model being in accordance with sediment flux and demonstrate that the model is correctly computing the sediment budget.

3.27 Section 3.6 - Robustness, page 45. Insufficient detail is provided on this model application. What were the bed material gradation and cross section starting conditions? Was the sediment inflow load the pre or post 2011 sediment discharge relationship? How was the effective discharge computed (details of the flow duration and bed material sediment discharge relation are required)?

3.28 References - The USGS reports that are cited in the main report are not in the references.

3.29 General. The calibration report states that the MBM was developed in accordance with "Guidelines for the Calibration and Application of Computer Program HEC-6", 1982. This document states "the representative load is one which produces the proper annual volume of sediment when integrated with the water discharge hydrograph for the year in question". No such comparisons of the annual yield over the simulation time period at the MBM boundary and interior locations (inflow, interior, and outflow points) were presented in the Calibration report. Annual sediment yields at St Josephs and Kansas City, which have been peer reviewed internally by the USGS and published by the USGS, have not been compared to the MBM results.

3.30 General. The MBM model was developed based on cross section and dike conditions in 1994. Numerous dike modifications such as crest lowering and notching were accomplished after 2002. The MBM calibration model documentation should provide a chronology of river training structure modification activities (aerial extent and timing), how such activities were or were not incorporated in the geometric data of the MBM, and why the MBM is valid in spite of not incorporating such historic geometric changes in the geometry of the model.

3.31 General. A primary purpose of the development and application of the MBM is to quantify changes in the low water construction reference plane (CRP) over time due to channel degradation. No such comparison of the computed CRP over the calibration time period of 1994 thru 2011 is provided, although measured changes in the CRP throughout the study reach are provided in Figures 7 and 8 of the MBM calibration report.

3.32 General. The 2009 USACE degradation reconnaissance study (reference J) discusses degradation and projected limits to degradation on page 28. The Reconn study indicates "that bed degradation is assumed to continue at its present rate for the next 10 years." Also inherent in the discussion are the assumptions that the rate of degradation will begin to slow from 10 years in the future forward and reach a quasi-stable configuration in the

Kansas City reach in the next 50 years. A comparison of the rates of degradation and long term degradation trends, as computed by the MBM and from the Reconn study projection, is not provided in the Calibration report. No discussion of any differences in assumption or extrapolations between these two documents is provided that explains the discrepancies. The presentation during the Technical meeting at the USACE office on September 24, 2014 showed that the MBM degradation prediction over the next 5 years was essentially a straight descending line with no leveling off at 10 years or any year. The Calibration Report references the Reconn report only where it is convenient and supports the MBM model but does not present Reconn results and conclusions that are contrary to the MBM results.

4.0 Comments on the MBM model and Overall Modeling Techniques

We have reviewed the HEC-RAS output data files provided by the District. The files were downloaded on September 3, 2014 and stored on the NHC server at the NHC office in West Sacramento, CA and on a DTW laptop in Fort Collins, CO. We have some specific comments on a few aspects of the the HEC-RAS model and its results and have listed these comments in the following paragraphs. Our review of the HEC-RAS model is not complete and we will certainly have additional comments on the model's setup, application, and results pending additional data provided by the District per the October 24, 2014 Supplemental FOIA letter by Mr. Courtney and our subsequent analyses.

4.1 Bed Sediment Mixing and Armouring

The HEC-RAS model simulates the time period from 1 August 1994 to 30 November 2011, which is the cailbration period. The calibration report (pg 33) discusses the bed mixing algortithm and armouring. Armouring (i.e., surface coarsening of the bed materials through selective transport) is generally not observed on sand bed rivers such as the Missouri River, especially sand bed rivers that move bed material sediments mosty as dunes as is observed on the river. We have briefly reviewed some of the results of the HEC-RAS model and question whether the model is properly simulating bed mixing and resulting sediment transport. If the model is not properly simulating sediment transport processes, then the validity of the model and its applicability to simulating bed degradation on the river is not fully established. As an example, we chose XS 365.56 (note that XS also is the River Mile – RM), which lies near the center of the reach near Kansas City where the vast majority of dredging occurred during the calibration time period. The following Figure 1, from the MBM model, shows the cross section at the beginning and the end of the calibration simulation. The difference in cross sectional area and invert elevation is very neglible over the calibration time period, indicating very little net erosion or degradation at this cross section.

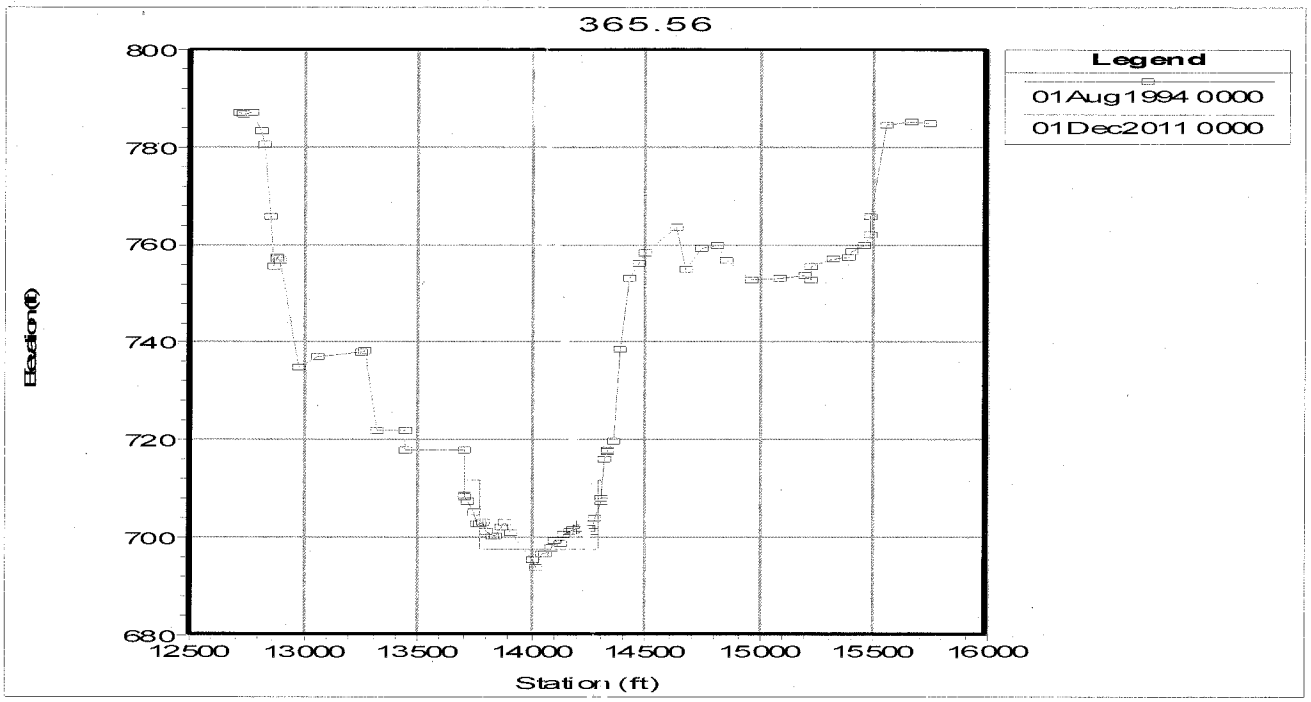


Figure 1. Stream Bed Changes, Cross section 365.56

The following two figures show the D90 and D50 (grain size for which 90% and 50% of the bed material is finer) at this cross section. The higher the values of D90 and D50, the coarser the stream bed. Figure 1 shows the D90 and D50 for the surface (bed cover layer) and subsurface materials in the computed bed material at XS 365.56 as it changes over the entire calibation time period. D90 and D50 change in response to the flow conditions. Figure 2 shows the same information but only for a shorter time period chosen at random during the simulation. The figures indicate that the D90 and D50 of the cover layer are greater than 2mm for fairly long durations during the simulation. Note that all references to sediment size and particle decriptions (clay, silt, sand, gravel, etc.) are according to the convention adopted by the American Geophysical Union (AGU). Note that HEC-RAS uses the same convention. Sediment sizes greater than 2mm are gravel sediments and a D50 of 2mm means over 50% of the cover layer is gravel or coarser. It is surprising to see a bed cover layer so coarse (i.e., so much gravel) on a predominately sand bed river. The Calibration Report shows bed material gradations in Table 3 of the report. The gradations shown in Table 3 indicates D90 is less than 2 mm at this location and there was only two locations (RM 330 and 345) where the D50 was greater than 0.5mm (medium sand size). The extent of the surface layer coarsening, as computed by the model, seems unrealistic. The bed gradation, and especially the surface layer, are important parameters in sediment transport predictions.

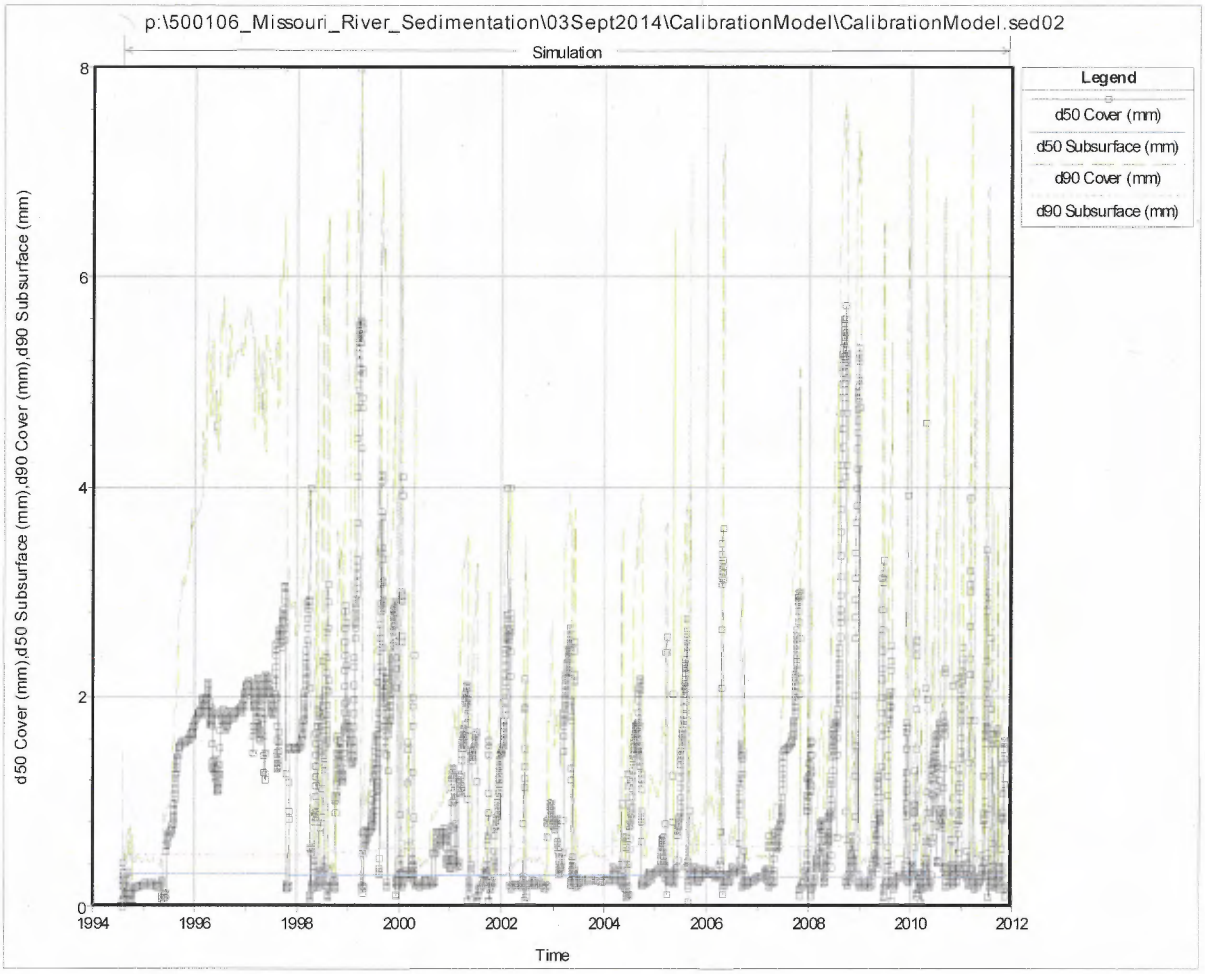


Figure 2. D50 and D90 of surface and subsurface bed material, calibration time period, RM 365.56

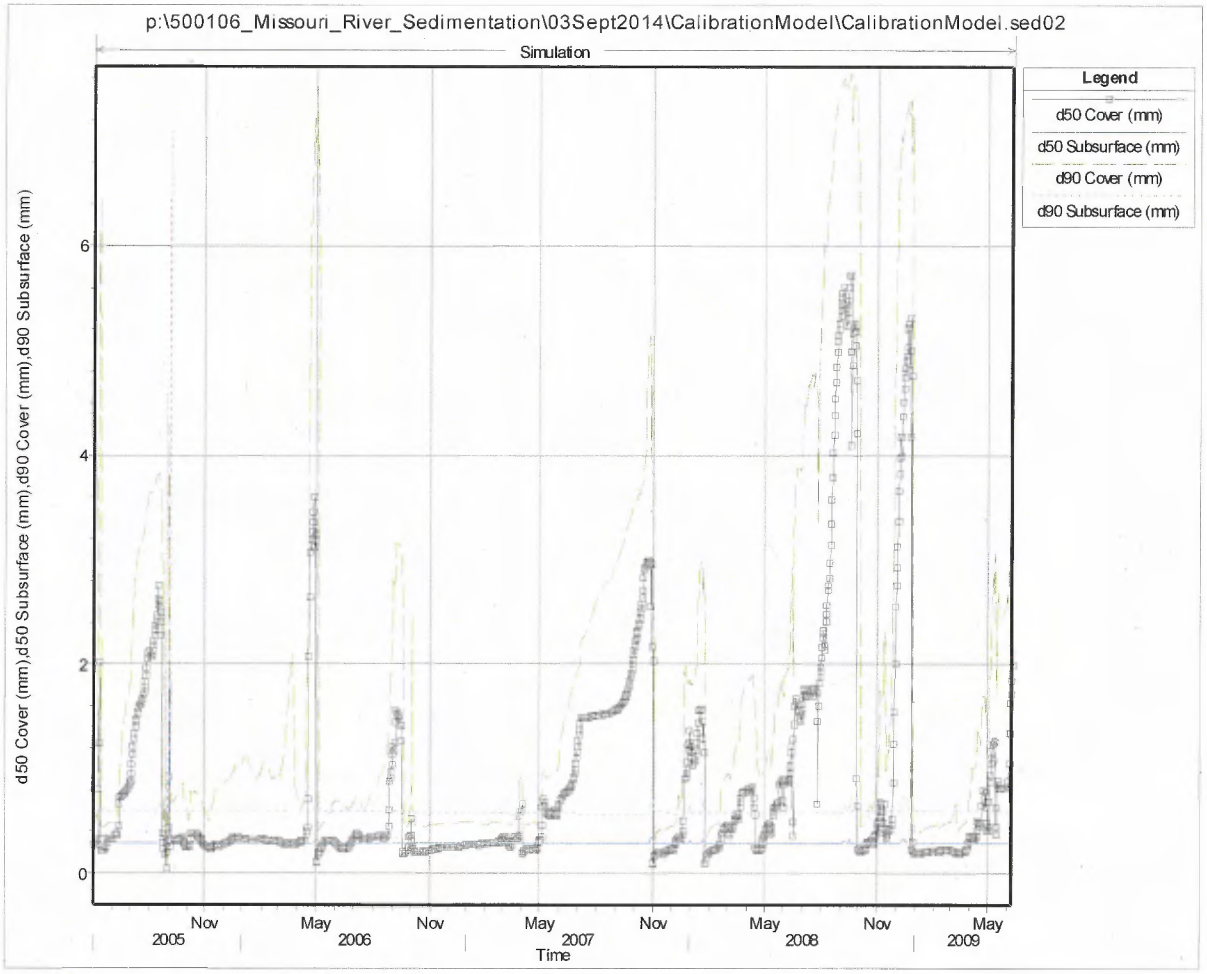


Figure 3. D50 and D90 of surface and subsurface material, RM 365.56

4.2 Sediment Mass Balance and Bed Elevation Change

HEC-RAS computes changes in the cross sectional elevation (also referred to as bed elevation change) by a mass balance of the inflowing sediment load minus the outflowing sediment load. The outflowing sediment load is a function of the transport capacity immediately upstream of the load location, the bed material size, and the availability of bed material for transport at the near cross section locations. The cumulative mass bed change at each cross section for the calibration time period is shown on the following Figure 4. The cumulative mass of dredge material is also shown on the same figure. The first observation is that a significant portion of the cumulative bed change occurs upstream of the dredging reach (~RM 350-380). Since the bed change is directly computed from what is coming in minus what goes out (the out includes dredging), then the computed bed changes upstream of RM 380 cannot be due to dredging. The second observation is that the computed bed change at the downstream portion of the dredge reach (RM

350 to 370) shown in Figure 5 indicates very little change in bed degradation over this reach where dredging occurred over the calibration time period.

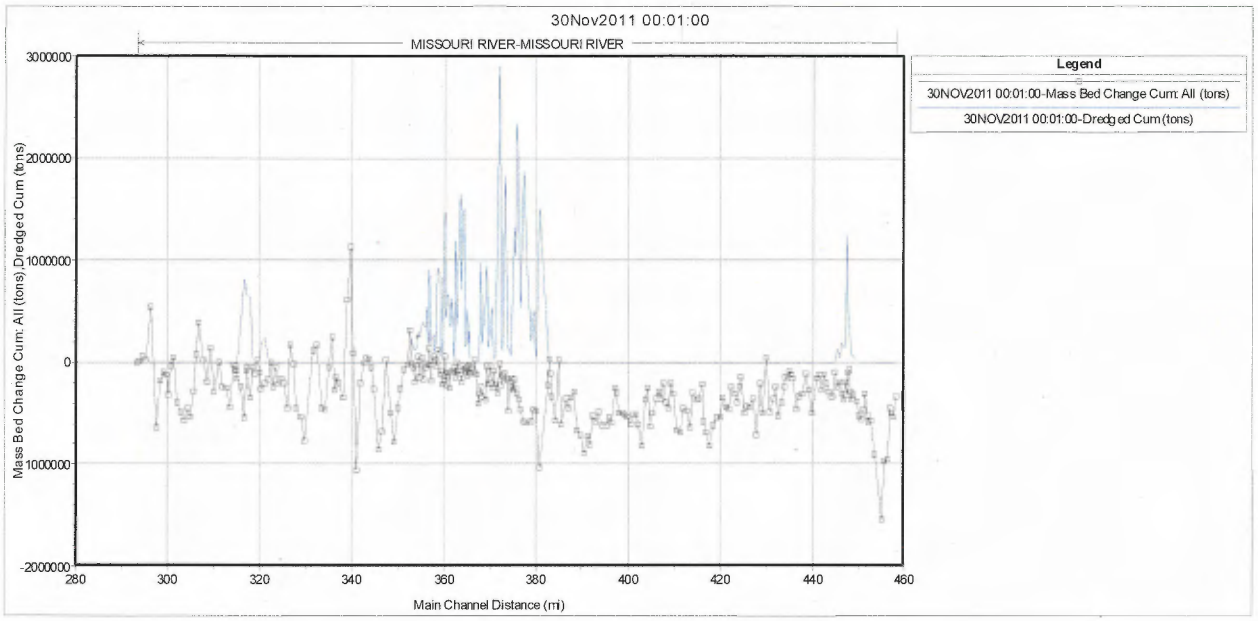


Figure 4. Computed mass bed change and specified dredging volumes, entire study reach

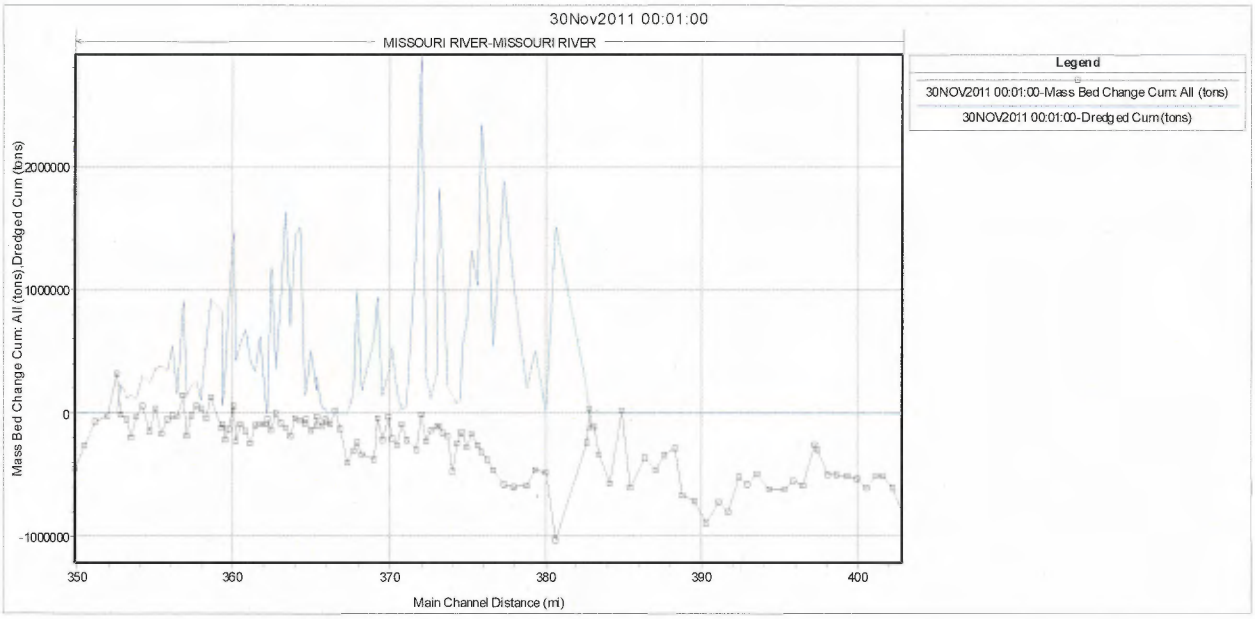


Figure 5. Computed mass bed change and specified dredging volumes, dredging reach

4.3 Bed Elevation Change

Another way to look at bed change in a mobile bed model such as HEC-RAS is to look at the change in invert elevation. The net channel area is most important for assessing changes in sediment storage throughout a reach. However, the changes in invert elevation, especially in a 1-dimensional model such as HEC-RAS, are indicative of net sediment erosion or deposition within a reach. The change in invert elevation for the calibration time period is shown on the following Figure 6. The invert elevation generally shows a decrease (i.e., erosion) upstream of the dredging reach, RM 350 – 380. The invert elevations through the dredging reach show fairly wide variability of both erosion and deposition which indicates that the dredging simulation in HEC-RAS does not seem to directly lead to excessive erosion in the dredging reach. In fact, there is more erosion upstream of the dredging reach than in the dredging reach and downstream areas. If there was a significant erosion effect of dredging, it would manifest itself downstream of the dredging reach. This computed reduction in invert elevation upstream of the dredging reach and lesser change of invert within the dredging reach (see Figure 7) is consistent with the cumulative mass changes shown in Figures 4 and 5 above. It had been argued that the erosion upstream of the dredging reach could be cause by a headcut or knickpoint migration but the dredging methods and lateral extent of the dredging operations is not conductive to the phenomena of headcutting.

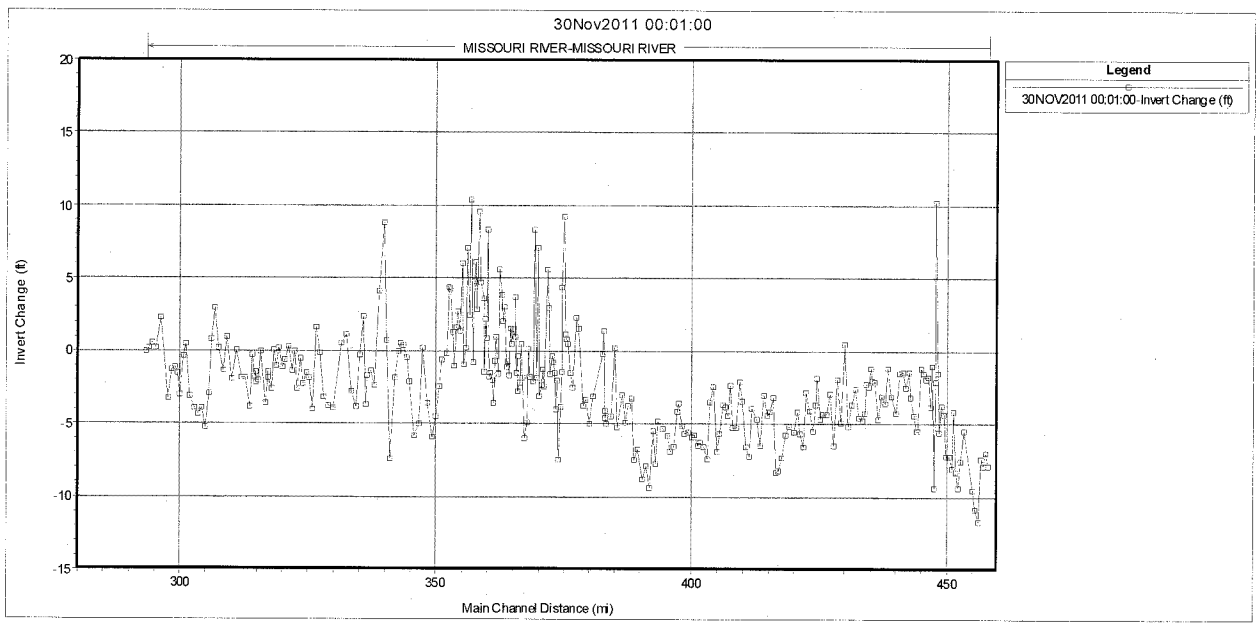


Figure 6. Computed invert elevation change

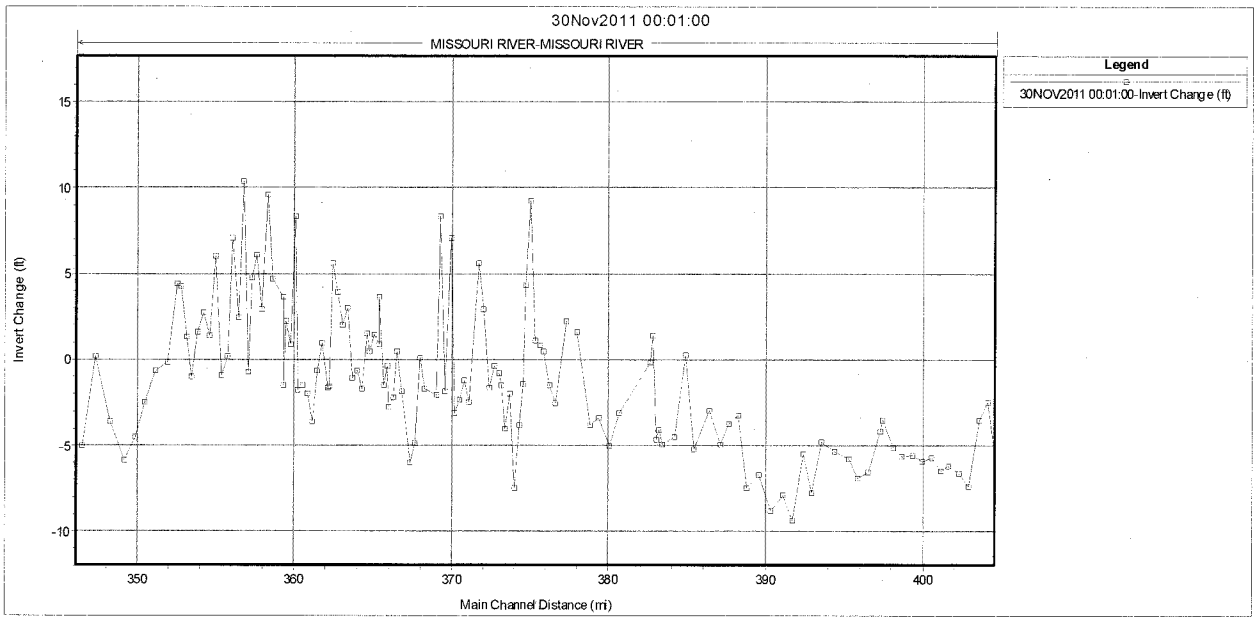


Figure 7. Computed invert elevation change, dredging reach

4.4 Sediment Transport by Grain Size

An additional observation in this initial model review is an inconsistency in computed sediment flux by grain size through the MBM model. Sediment transport theory indicates that the relative mobility of sediment decreases with increasing grain size. Looking at the net bed change by mass for each grain size, patterns of selective transport of coarser sediment over finer sediment is observed, which is contrary to sediment transport theory. In the following Figures 8 through 10, the accumulated mass change of sediment by grain size at each cross is plotted. Grain size 6 corresponds to very fine sand (<.125 mm), size 7 is fine sand (<.25 mm), size 8 is medium sand (<.5 mm) and size 9 is large sand (<1 mm). The net mass bed change for all size sediments is also plotted as the solid black line. The solid blue line on the figures indicate that there is very little net bed change due to erosion of very fine sand throughout the reach. This is consistent with the measurements that little very fine sand is found in the bed of the Missouri River in this reach. An inconsistency shows up in the computed zones of net erosion or deposition of fine sand (the green dashed line) vs. erosion or deposition of both medium sand and coarse sand (the pink and red dashed lines, respectively). There are locations (i.e., RM 375 – 390) where the HEC-RAS model computes net deposition of fine sand while net erosion of medium and coarse sand occurs in the same reach. This is inconsistent with both the relative mobility of these different size sediments as well as the plausible effects of any selective transport mechanisms.

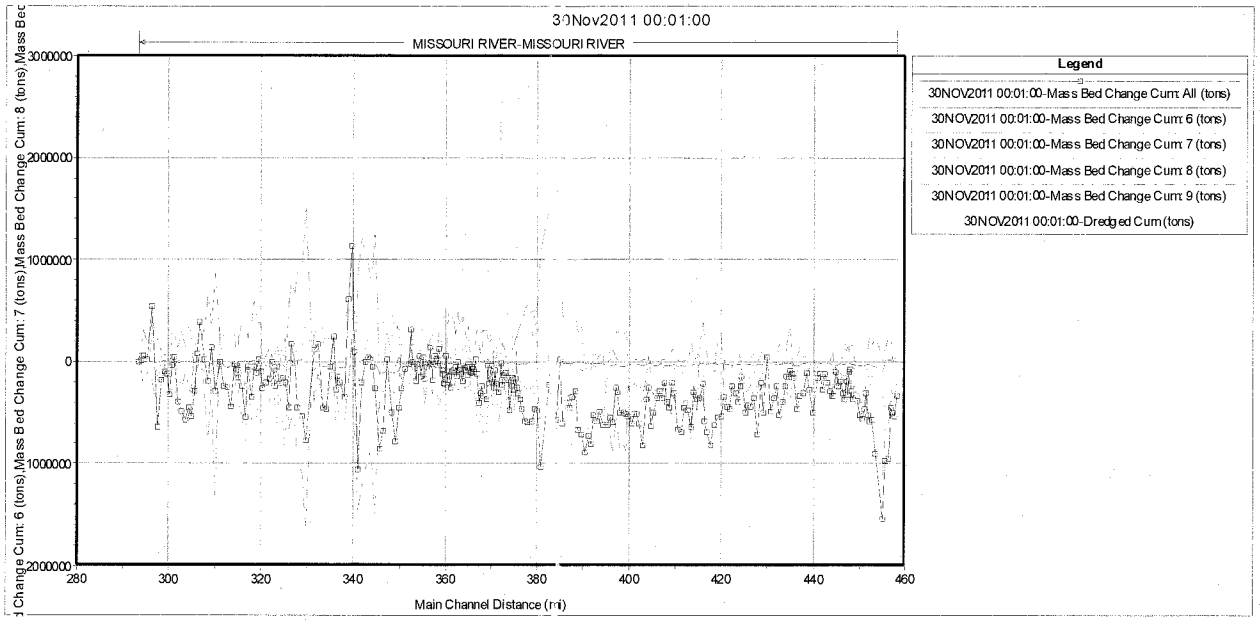


Figure 8. Computed bed material mass changes by grain size

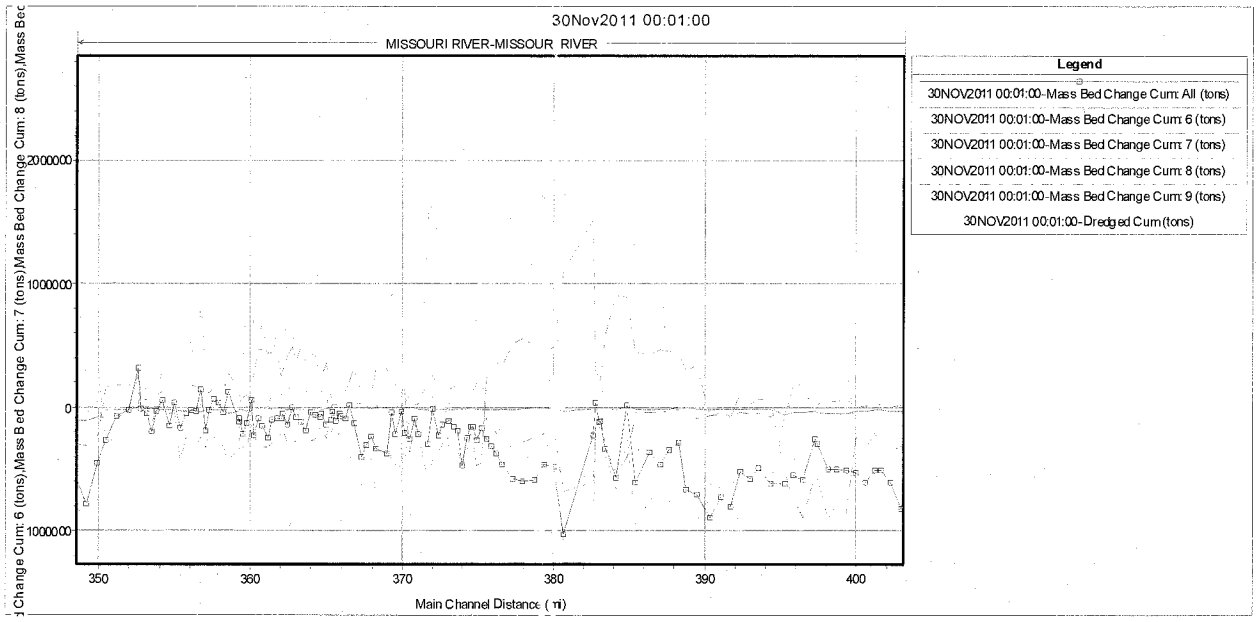


Figure 9. Computed bed material mass changes by grain size, dredging reach

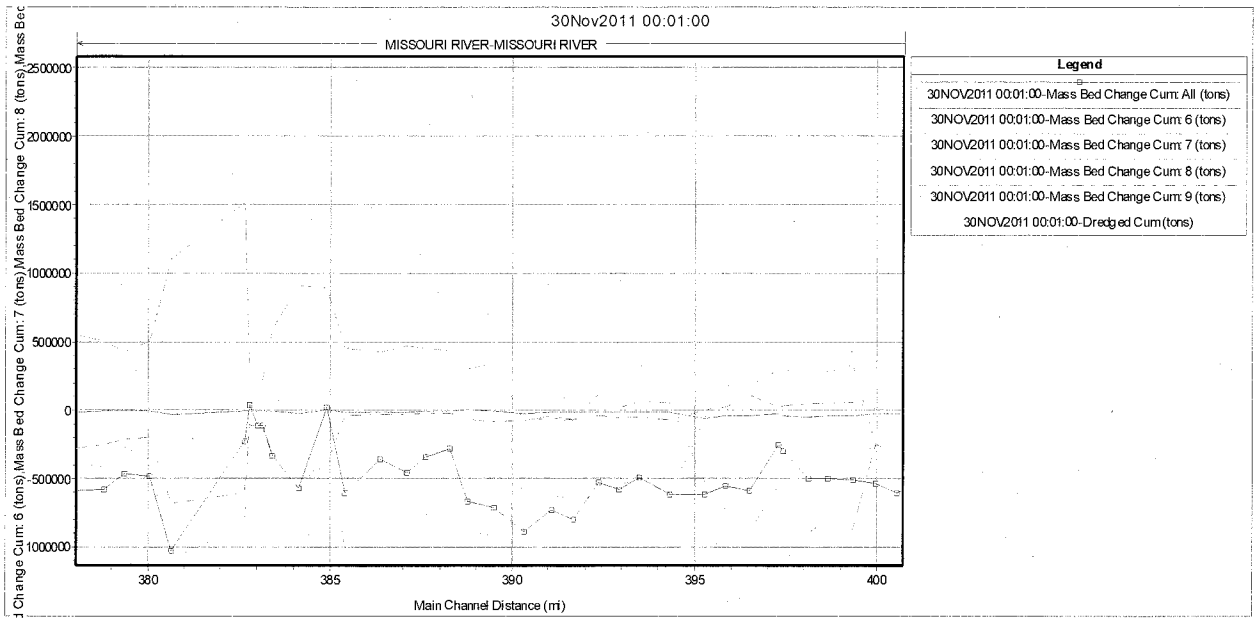


Figure 10. Computed bed material mass changes, upstream of dredging reach

4.5 Comparison of Low Water Profile Reference Plan to USGS Measurements

A key piece of information that is lacking in both the calibration report and in the HEC-RAS model is any comparison of the observed reduction in the Low Water Profile reference plane versus computed changes in stage discharge relationships at USGS gage locations. At a minimum, this should be presented in the analysis.

4.6 Sediment Yield Comparisons

4.6.1 There are inconsistencies in reported sediment yields (i.e., total tonnage of sediment passing specific locations over given time interval, typically reported as total tons per year) between the calibrated MBM RAS model, the dredging EIS, and from the USGS sediment gauges. The MBM and EIS both report annual sediment yields of bed material (i.e., sediments coarser than 0.0625 mm, very fine sand and coarser). Both documents indicate that sediment yields were developed from the USGS measurement at St. Joseph on the Missouri River and for tributary inflows from the Kansas and Platte Rivers. The USGS reports[1] annual sediment yields of total (i.e., suspended clay, silt, and sand) as well the total yield of suspended sand (> 0.0625 mm). We recognize that the USGS is reporting total "suspended" bed material yield. The "bed

[1] David C. Heimann, Patrick P. Rasmussen, Teri L. Cline, Lori M. Pigue, and Holly R. Wagner, 2010; Characteristics *of Sediment Data and Annual Suspended-Sediment Loads and Yields for Selected Lower Missouri River Mainstem and Tributary Stations, 1976–2008*; Prepared in cooperation with the U.S. Army Corps of Engineers, Kansas City District Data Series 530

load" component of the bed material yield through processes such as dune movement or saltation is typically estimated as ~5% of the total suspended bed material load in sand bed channels and an adjustment could be made to the values presented by the USGS. We have not done that here, as we need to have the peer reviewed values developed by the USGS for comparison.

4.6.2 We extracted annual sediment yields from the MBM model (based on USGS water year from 1 Oct thru 30 September) for total bed material (i.e., sediment coarser than 0.0625 mm) sediment yield and compare those values with values reported by the USGS for specific water years. A similar comparison is provided for the annual average bed material sediment yield reported in the EIS on Table 3.4-18. This comparison is provided in the following tables.

Table 1. Comparison of HEC-RAS to USGS Annual Bed Material Sediment Yield

Water Year	St. Joseph, T/year HEC-RAS	St. Joseph, T/year USGS	Kansas City, T/year HEC-RAS	Kansas City, T/year USGS
1995	21,067,915	8,880,000	20,729,812	11,900,000
1996	25,922,490	10,600,000	27,175,078	14,200,000
1997	32,519,078	14,800,000	32,883,479	20,700,000
1998	23,863,309	22,800,000	25,284,389	31,200,000
1999	23,506,519	14,700,000	26,603,369	18,000,000
2000	12,122,701	13,300,000	13,569,159	16,500,000
2001	13,254,807	6,120,000	16,116,321	5,380,000
2002	7,576,474	7,400,000	8,793,666	6,000,000
2003	8,187,315	3,790,000	8,890,776	3,480,000
2004	8,943,030	3,910,000	10,800,089	3,550,000
2005	7,484,384	4,840,000	9,078,806	5,400,000
2006	6,719,494	2,860,000	8,035,932	4,300,000
Total	191,167,516	114,000,000	207,960,876	140,610,000
Average annual	15,930,626	9,500,000	17,330,073	11,717,500

Table 2. Comparison of HEC-RAS and EIS Annual Bed Material Sediment Yield

Water Years	St. Joseph, T/year HEC-RAS	St. Joseph, T/year EIS	Kansas City, T/year HEC-RAS	Kansas City, T/year EIS
2000 thru 2009	10,014,431	3,508,070	12,295,442	5,352,153
1995 thru 2009	15,275,747	5,716,410	17,150,227	8,202,467

The values of annual and average annual sediment yield provided in Table 1 indicate that the MBM values exceed the values developed by the USGS by approximately 50% on an average annual basis for both the St. Joseph and Kansas City gauges. The MBM upstream boundary conditions are stated to be developed from USGS measurements but why the values specified by

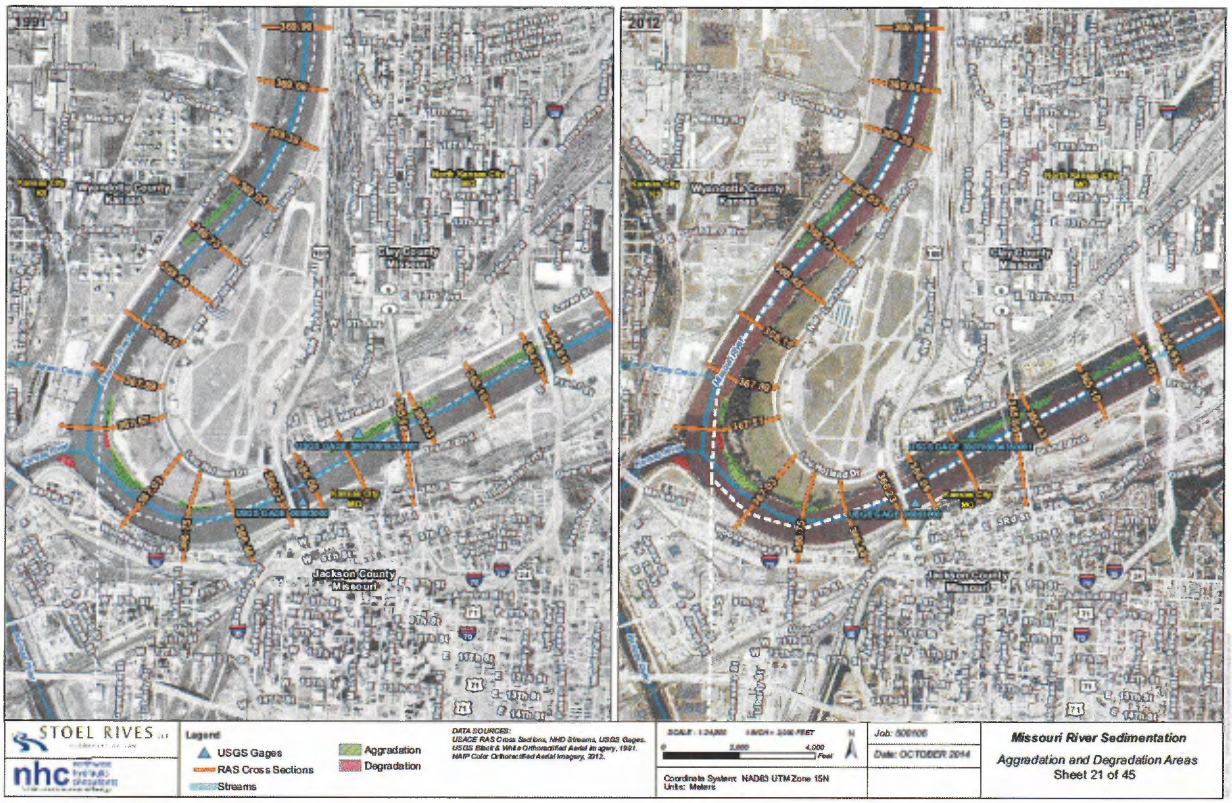
the District's MBM model greatly exceed the previously peer reviewed values developed by the USGS is not explained in the Calibration report. As developed, the MBM values appear to be incorrect. Similarly, the average annual bed material sediment yield computed by the MBM is also significantly higher than the values of average annual sediment yield developed and presented in the dredging EIS, as shown in Table 2.

4.6.3 The Calibration report fails to present a comparison of the MBM model and USGS gauge sediment yield at Kansas City, even though the Kansas City USGS measurements are completed with funding provided by the District. In fact, the sediment information from the Kansas City USGS gauge is not even referenced in the Calibration model. The Calibration report references the EIS document but fails to make this critical comparison and explain the significant differences between the sediment yields from these two District documents. The MBM model should have been calibrated to the USGS Kansas City sediment gauge, an important internal boundary calibration check.

4.7 Moveable Bed Limits Between Dikes

4.7.1 The moveable bed width in the MBM is specified as the channel width between the dike ends. Sediment deposits and erodes at locations between dikes with variations in stage and flow. Limiting the moveable bed width to the extent between dike ends does not account for these intra-dike erosion and deposition processes. The accumulated mass change provided in Figure 9 of the MBM calibration report inexplicably does not account for these processes. Figures 4 and 5 of the USACE Existing Condition of the Bank Stabilization and Navigation Project Structures (25 December 2013) shows two cross sections indicating both deposition and erosion in this intra-dike region. As developed, the MBM model, which fundamentally is accounting for the sediment budget of erosion and deposition processes, is missing an accounting of this portion of the overall sediment budget. We have requested the cross sectional information in the FOIA letters so that an assessment of this intra-dike sediment deposition or erosion can be made and compared with the findings of the MBM.

4.7.2 To assess if intra-dike erosion or deposition is a significant contribution to the sediment budget, we obtained aerial photographs from 1991 and 2012 of the entire calibration reach and geo-referenced them. We then determined the movement of the areas between the dikes and color coded the changes in terms of erosion and deposition zone. The next page shows a sample reach. The results show that there is significant movement between the dike tips. These areas therefore add and take away significant amounts from the overall sediment budget. As mentioned earlier, these areas are not modeled in the MBM.



4.8 Percent Dredging Volume vs. Total Sediment Flux

A prudent analysis would be to determine the total bed material sediment flux over the calibration period and compare it to the volume of dredging as a percent for the Kansas City reach. This can also be done for any time period such as a 10 year period of the most intense dredging.

4.8 Robustness Test Using No Dredging Scenario

A common test for robustness of a sediment transport model is to use the historic record (calibration period in this instance) to simulate a condition without the significant human intervention. For instance, when modeling the enlargement of an existing delta formation at the upstream limit of a reservoir, one would model the condition before the reservoir was impounded and not have the dam in the model. The results should show a relatively stable model with insignificant scour and/or deposition. Then when putting in the dam in the model, one is assured that the deposition in the delta area is indeed due to the dam instead of depositing regardless of

the dam. The analogy to this is to run the calibration period with the same boundary conditions but do not turn on the dredging option. This would assess the historic impact of dredging and give insight on future dredging impacts. Inexplicably, this has not been done.

4.9 General Comments

The inconsistencies that violate recognized sediment transport theory bring into question the overall validity of the HEC-RAS model calibration. In addition, there have been omissions of prudent important analyses that are normally seen in complex sediment transport analysis. The utility of applying the presented "calibrated" model to evaluate project alternatives or assess impacts of dredging has not been proven.

5.0 General Discussion

5.1 ATR review (note: ATRT is the ATR Team)

Note that the Freedom of Information Act (FOIA) October 31, 2013 letter to the District by Mr. Courtney requested "Any and all internal and external review document documentation of the Model itself, applications of the model ...". This request includes the ATR and review by Mr. Thomas.

5.1.1 The ATR process described by the USACE in the meeting held in September 2014 does not appear to be in accordance with USACE requirements and regulations. The documents provided regarding the ATR review was very short and comprised of 4 paragraphs. If this is the full extent of the review, the level of review is surprisingly sparse for a modeling analysis in support of a project as complex as the LMR degradation studies. As per the ATR requirements from reference N, "The review will assess whether the analyses presented are technically correct and comply with published USACE guidance, and that the document explains the analyses and the results in a reasonably clear manner for the public and decision makers." An explanation of neither the ATR analysis nor the results was presented in the ATR document.

5.1.2 The ATR documentation should be consistent with the report format from reference O and does not follow "... published USACE guidelines ..." from item 5.1.1 above. This has not been done.

5.1.3 The ATR documents did not provide the names or the expertise of the reviewers. Per reference N, the ATR engineering members should be licensed engineers with a minimum of 10 years in the appropriate field. For the ATR hydraulic engineer, the engineers should have "10 years experience in analysis of large complex river systems. Individual must have experience with Corps of Engineers hydraulic AND sedimentation models (HEC-RAS). Individual must have experience with sediment transport AND is strongly desired to have experience with degradation problems." The information on the qualifications of the ATR members was not presented therefore we cannot determine if the ATR review team fulfilled the District and USACE requirements.

5.1.4 Reference O also states that "Design Review and Checking System (DrChecks) software will be used to document all ATR comments, responses and associated resolutions accomplished throughout the review process." Although the FOIA has requested all information related to the ATR and other reviews (reference Q and R), the DrChecks output has not been produced.

5.1.5 Reference O also states that:

"The ATRT will prepare a Review Report which includes a summary of each unresolved issue; each unresolved issue will be raised to the vertical team for resolution. Review Reports will be considered an integral part of the ATR documentation and shall also:

Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;

- *Include the charge to the reviewers prepared by the PCX;*
- *Describe the nature of their review and their findings and conclusions; and*
- *Include a verbatim copy of each reviewer's comments and the PDT's responses."*

The above documentation has not been presented.

5.1.6 There were not dates associated with the comments in the ATR document.

5.1.7 The ATR document stated that the ATR received several document for their review. These were the 1) Model Calibration Report, 2) the Future Without Project Appendix, 3) the Future with Project Appendix, and 4) the Sensitivity Appendix.

Although the FOIA requested all ATR related documents, items 2, 3, and 4 documents have not been produced.

5.2 Review by Mr. Tony Thomas and Presentation by Dr. Shelley

Mr. Tony Thomas review comments in the file named "Missouri River Bed Degradation Study, Tony Thomas Review", there are no dates associated with the reviews. The latest date that could be inferred is July 17, 2013, which is a date that another document has been sent to Dr. Shelley. A PowerPoint presentation (reference P) by Dr. Shelley presents results of proposed alternatives. Given the short time between the finalization of the calibration model review by Mr. Thomas and the presentation of the alternatives modeling, this implies that the alternatives modeling was initiated before the final review. To start alternatives modeling before completion and confirmation of the "base" (calibrated) model is highly unusual.

5.3 Future Public Presentation by Dr. Shelley

We note that Dr. Shelley will be presenting a paper on the MBM modeling at the HYDSED 2015 conference in Reno, NV on April 2015. Our understanding is that the IEPR review of the MBM will not be completed by that time. We are concerned that Dr. Shelley will be presenting

preliminary results from a modeling effort that has not gone through the full review process established by the U.S. Army Corps of Engineers. Please see below the link to his presentation proposal.

http://sedhyd.org/2015/openconf/modules/request.php?module=oc_program&action=summary.php&id=29

5.4 Evaluation of Future Scenarios

5.4.1 Many presentations by the District have shown mitigation scenarios using the MBM. In fact, there has been preliminary cost estimates based upon the results of the MBM and presented to the stakeholders. It is unusual to initiate modeling these scenarios without full confidence in the baseline modeling which these scenarios are based upon. It is even more unusual to present the results to the public, develop cost estimates and determine benefits (benefits are determined by comparison to a base condition) while the review process is going on.

5.4.2 We have not been given the MBM model that contains the scenarios nor the detailed report that documents how these scenarios are constructed in the model. We cannot assess the correctness of the model until we have these items and supporting information.

6.0 Conclusions

Both procedurally and substantively, the development and execution of the MBM and associated reports are replete with glaring data and analytical omissions and inconsistencies and as such, is fundamentally flawed. Based upon our 75 years of combined water resources engineering experience which includes many years with the USACE, it is apparent to us that the procedures used and methodology employed by the District were incomplete and contrary to USACE regulations and official directives. In fact, the review process that the MBM has gone through is lacking and does not even achieve the standards that the District had set up specifically for this project. Given the deficiencies outlined in this TM, the District has failed to produce a robust, defensible and reliable "Calibration" MBM model; as such, it should certainly not be a basis for any regulatory or policy decision making.

Appendix Q

Response to Stoel Rives Review of MBM

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Memorandum for Record

May 31, 2017

Subject: Stoel Rives, LLP letter dated November 20, 2014, regarding Ongoing Concerns About Continued Information Gaps in Public Information Supporting Comment Solicitation on the Missouri River Mobile Bed Model.

Introduction

The U.S. Army Corps of Engineers Kansas City District with significant involvement by the Hydrologic Engineering Center developed a mobile-bed sediment model. This model was built using measured bathymetric information, flow, dredging, and other data known to exist since 1994. Appendix B describes the model set up and compares model output to measured values from 1994 to 2014. This model was used to make projections for bed and water surface elevations given flows and other boundary conditions that can reasonably be expected to occur in the future (see Appendix C) and to test various alternatives for reducing future bed degradation (see Appendix N).

Stoel Rives, a law firm retained by Holliday Sand and Gravel, made a request to the Corps and the Sponsor and stakeholder group to perform their own review to evaluate the development and calibration of the mobile bed model. The sponsor and stakeholder group were supportive of undertaking this review. Stoel Rives hired consultants Mr. Brad Hall (Northwest Hydraulic Consultants) and David Williams (David Williams and Associates) to perform the review.

A letter from Mr. Aaron Courtney, Stoel Rives, LLP dated 20 November 2014 included a Technical Memorandum prepared by Mr. Hall and Williams (dated 18 November 2014). The Technical Memorandum included a consolidated set of the consultants' technical comments related to the development of the model and the associated documentation. A technical meeting was held on January 12, 2015 to afford the consultants the opportunity to present their findings in an informal setting.

The potential concerns expressed in these comments were kept in mind through model revisions since 2014 while further model development and the Corps of Engineers review processes were being undertaken. In order for our review processes to remain independent and to provide for an unbiased review, the Stoel Rives letters and Technical Memorandum were not provided directly to the ATR or IEPR reviewers. However, areas of potential concern identified in this letter were included in the ATR and IEPR Charges to Reviewers.

The review process for this model has been robust, including reviews by very qualified and experienced engineers, including Mr. Tony Thomas, Mr. Mike Alexander, Mr. Dan Pridal, Dr. Paul Boyd, and Dr. David Jaffe, as well by professional engineers at the Kansas City District. Written responses to the 20 November 2014 letter would have been premature prior to

completion of the formal review process, as each review prompted additional model and documentation revisions. At stakeholder meetings over the course of the project, some of these comments were discussed using preliminary modeling information. Now that the model has been finalized and formal reviews are complete, this memo formally responds to the technical items in 20 November 2014 letter.

Comments and Responses

3.1 The expert review by Mr. Tony Thomas was in additional to all required reviews.

3.2 Additional discussion on the dams has been added to the technical report.

3.3 "Remained high" has been removed from the text. The graph is self-explanatory, and the model includes dredging amounts and locations as reported by Holliday Sand and Gravel to USACE Regulatory.

3.4 The stage trend for 20,000 cfs at Kansas City indicates the rate of degradation increased in the 90s at the Kansas City gage. Additional cross section analysis has now been included in the technical report that confirms continued degradation, though the zone of degradation has migrated upstream.

3.5 Factors influencing degradation at St. Joseph were included in the model from 1994 to 2014, including the upstream boundary condition sediment load (as influenced by the dams), the dredging in St. Joseph, the dredging in Kansas City, actual flows, the channel configuration, etc.

3.6 Flow data is publically available on the USGS website. For convenience, a plot of the daily flow hydrograph at Kansas City from 1990 through 2014 is provided in Figure 1 below.

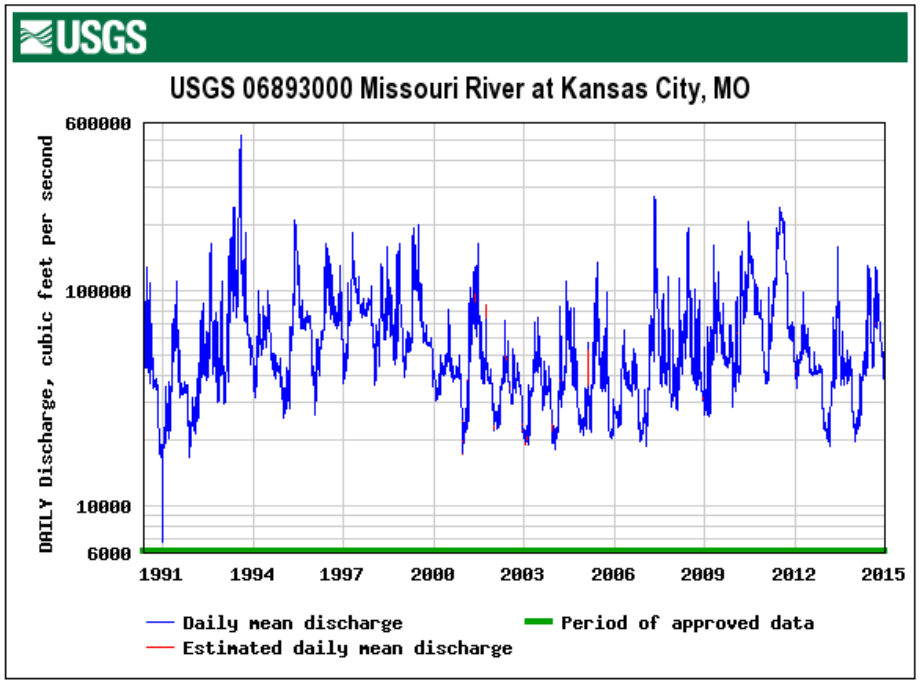

Figure 1. Hydrograph at Kansas City, MO

3.7 Volume change was computed using cross sections. For each reach of river bounded by an upstream and downstream transect locations, the volume change = average cross section area change times the distance between cross sections. This was facilitated using the XSViewer tool. Bed change did not include erosion or deposition within dike fields.

3.8 More information has been added about the 2011 event. Mr. Hall and Mr. Williams can refer to other published sources for further information.

3.9 What occurs in one segment of the river can affect both upstream and downstream segments. The model includes dredging at the correct locations, including dredging in the Kansas City metro area and upstream of Kansas City in the St. Joseph metro area. During the principal calibration period (1994-2009) the majority of commercial dredging took place in Kansas City. No attempt was made to implicate dredging or any other particular cause during model setup. Rather, realistic inputs and model parameters were selected and the model was calibrated to reproduce observed river behavior. The measured data indicates that from 1994 to 2009, the majority of the degradation did occur in Kansas City, where and when dredging was highest. The model reproduces this behavior (see Figures 2 and 3 below).

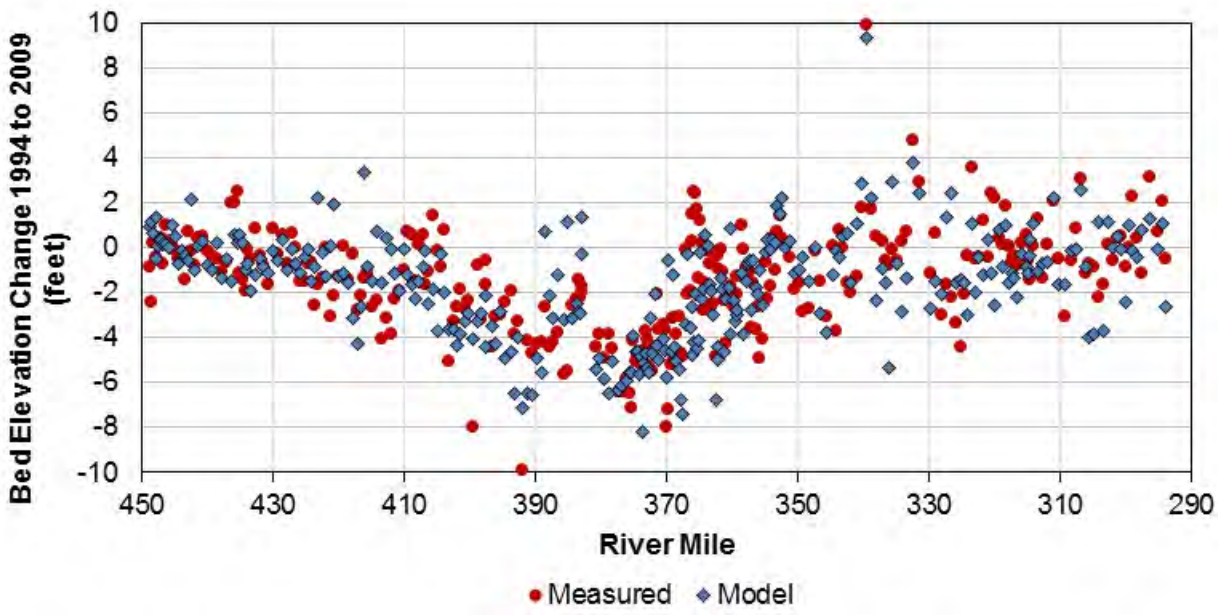

Figure 2. Modeled vs. measured bed elevation change from 1994 to 2009. (Figure 7-2 in the technical report)

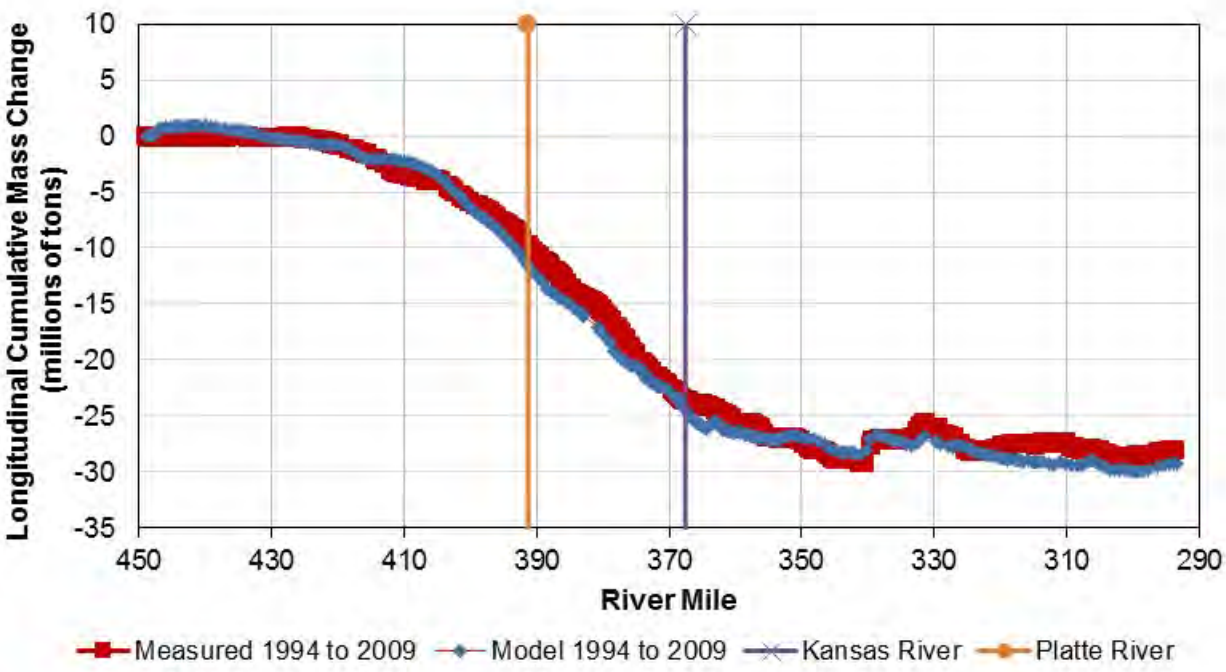

Figure 3. Modeled vs. measured mass change from 1994 to 2009. (Figure 7-4 in the technical report).

The measured data further indicates that during and following the 2011 flood event (from 2009 to 2014) the zone of degradation migrated upstream, and Kansas City experienced much less degradation (even some recovery) compared to upstream. The model reproduces this behavior as well (see Figures 4 and 5 below).

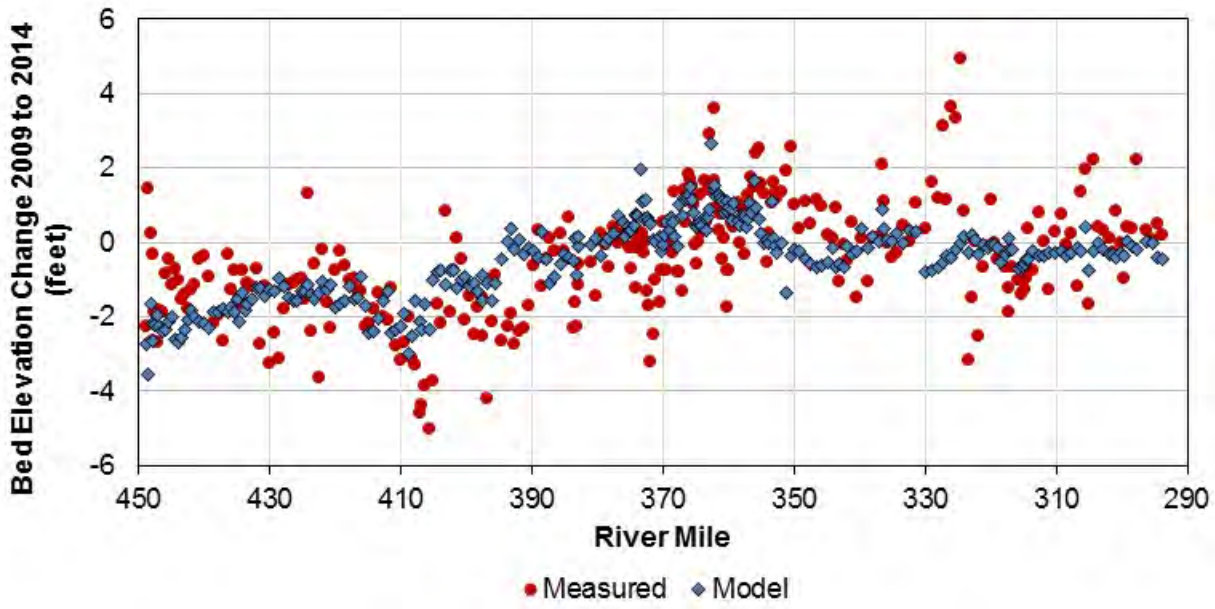

Figure 4. Modeled vs. measured bed elevation change from 2009 to 2014. (Figure 7-3 in the technical report)

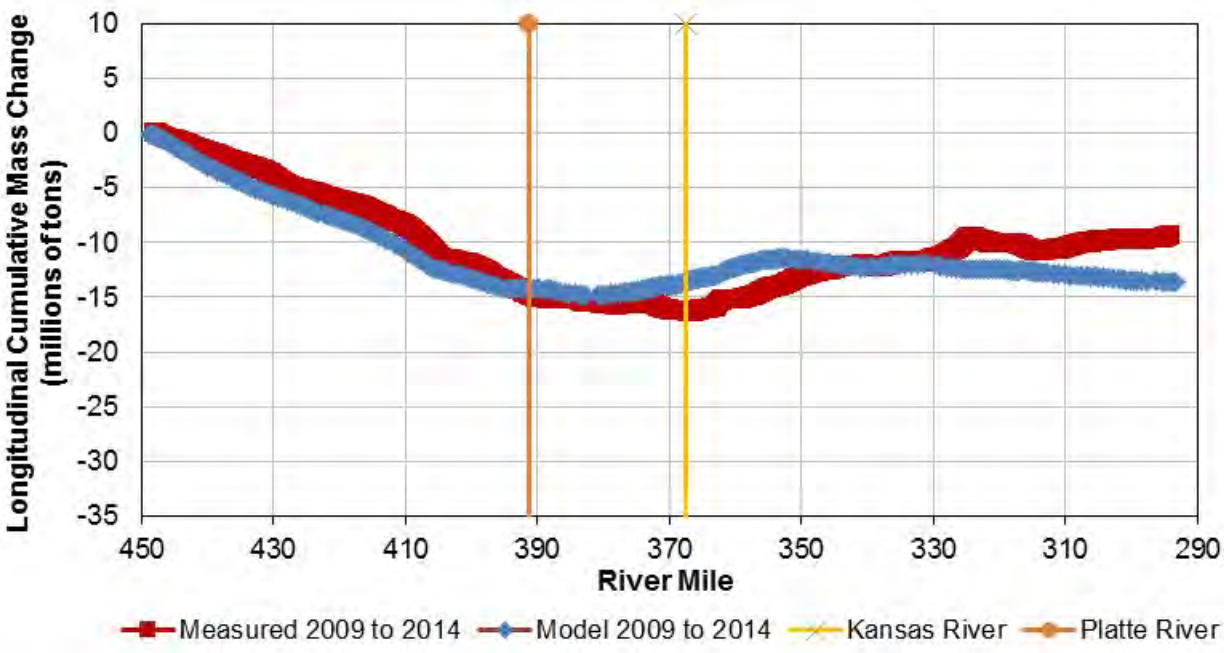

Figure 5. Modeled vs. measured mass change from 2009 to 2014. (Figure 7-5 in the technical report).

Model results indicate that in the absence of dredging since 1994 bed recovery rather than degradation would have occurred in Kansas City, inducing significantly less degradation upstream of RM 380 during the 2011 flood. Please refer to the technical report and appendices for further discussion.

3.10 Both the change in channel configuration and the sediment input of the Kansas River were included in model development and calibration and in future projections. BSNP alternations were modeled and evaluated in the alternatives. Note that as of the most recent survey, the region of the river marking a change in the rate of degradation shifted upstream and is no longer at the Kansas River confluence or at a change in BSNP criteria.

3.11 The model indicates that dredging since 1994 (most of which was in Kansas City) was a major factor in degradation from 2009 to 2011 that occurred St. Joseph. River segments are connected; the dredging in one segment of the river can headcut upstream, though this upstream migration takes time. See the technical report and appendices for more discussion on volumes.

3.12 Mr. Hall and Mr. Williams are hereby directed to the memo "Missouri River bed and water surface Changes 2009 to 2014 as they relate to Renewal of Commercial Dredging Permits under Section 404 of Clean Water Act and Section 10 of the Rivers and Harbors Act (Section 404/10 Permits)" used in the 2015 dredging permit renewal process for information on the lower 500 miles of river from 2009 to 2014. Analysis of the Missouri River upstream of RM 500 was not included in this study.

3.13 Explanation added and grid lines added.

3.14 No, the comment by Mr. Hall and Mr. Williams has incorrectly summarized the paragraph. This paragraph discusses the mechanism by which the BSNP could have an effect on river bed elevations during major floods. "A portion of the effect" does not mean "the main cause." The effect of the BSNP during major floods (as described in the cited paragraph) does not imply the long-term causation for degradation. The technical report and appendices actually quantify the long-term (50-year) effects of the project alternatives, including changes to the BSNP structures and changes to dredging. See the report and appendices for more information.

3.15 Analysis with the mobile-bed model on the effect of commercial dredging over the calibration period has now been performed. Statements in the final project report and appendices related to the effect of commercial dredging are supported by model results and/or bathymetric measurements. See Appendix C.

3.16 The data from 1987 through 2014 is now provided in Figure 11 in Appendix B.

3.17 Comment noted. Cross sections input files were checked in the model development and review process.

3.18 Comment noted. Bed sediment gradations were checked in the model development and review process.

3.19 Lateral flows are used to balance the water. The difference in flow between gages that is not brought in at tributary locations is brought in as a uniform lateral flow. No sediment is brought into or taken from the model in the uniform lateral flows.

3.20 More information is now included on the development of the sediment boundary condition at St. Joseph.

3.21 The model now only includes very fine sand and coarser. Silts and clays have been removed.

3.22 The sediment rating curve for the Kansas River has been verified and is consistent with Appendix B.

3.23 Statements regarding the effects of dredging over the calibrated period are substantiated using the mobile-bed model and measured bathymetric cross sections.

3.24 Silt has been removed from the model.

3.25 Statement has been revised for accuracy. Two bed mixing/armoring algorithms were tested: Exner 5 and Exner 7. Exner 5 yielded reasonable results for total bed degradation and was selected for use in the model. Exner 7 produced excessive degradation compared to the prototype. Natural variability and limited samples compared to the spatial extent make gradation a less useful calibration parameter, especially in a degradational system.

3.26 A comparison of sediment transport at the Kansas City gage is now included. The model estimate at Kansas City is within 6% of the USGS estimate for sand load (adjusted to include bedload.) This falls within the 95% confidence intervals.

3.27 This test consisted of running 43 kcfs, which for the Missouri River is just above the full service navigation flow (41 kcfs), for a period of 30 years starting with the initial 1994 geometry and gradations. For this robustness test, no dredging, floodplain deposition, or tributary inputs were included. In this Missouri River robustness test, aggradation occurred in previously degraded areas. At the end of the 30-year period, the standard deviation of bed elevation change

over the final 30 days was < 0.008 ft for 100% of the cross-sections (compared to only 3% of the cross sections for the first month), and the model was assumed to be reasonably robust.

3.28 Reference added.

3.29 Comparisons with USGS reported values now included. See response to 3.26.

3.30 Dike modifications were not included in the model over calibration period. Including them was not necessary because (1) the model calibrated well without dynamically adjusting dikes, including reproducing water surface elevations at the Kansas City and St. Joseph gages, and (2) alternatives testing with large reductions in BSNP dike elevations found very little effect on long-term degradation. Residual error has been quantified.

3.31 As documented in Appendix A, the CRP changed in the past either because the water surface elevation changed for a set CRP flow or because the CRP flow changed (i.e. an increased flow record yielded an updated value for the statistically-defined CRP flows.) Changes to the CRP are presented as evidence of degradation. A better calibration metric is the water surface itself, which is presented in the report.

3.32 Projections in the reconnaissance report were based on limited data, trend lines, and general geomorphic principles. The mobile-bed model was built using measured bathymetric information, flow, dredging, and other data known to exist since 1994. Appendix B describes the model set up and compares model output to measured values from 1994 to 2014. This model was used to make projections for bed and water surface elevations given flows and other boundary conditions that can reasonably be expected to occur in the future (see Appendix C) and to test various alternatives for reducing future bed degradation (see Appendix N). The final results presented in the technical report and appendices supersede projections from the recon study and preliminary results provided to stakeholders during the course of the study.

4.1 The model has been revised, and the final version of the model does not exhibit armoring behavior to the degree cited by Mr. Hall and Mr. Williams. For example, at RM 365.56, the d_{50} of the cover layer is always in the sand range. It is finer than 2 mm 100% of the time, finer than 1 mm 99.6% of the time, and finer than 0.5 mm 89.1% of the time. This is not excessive armoring for a model of a sand-bed river.

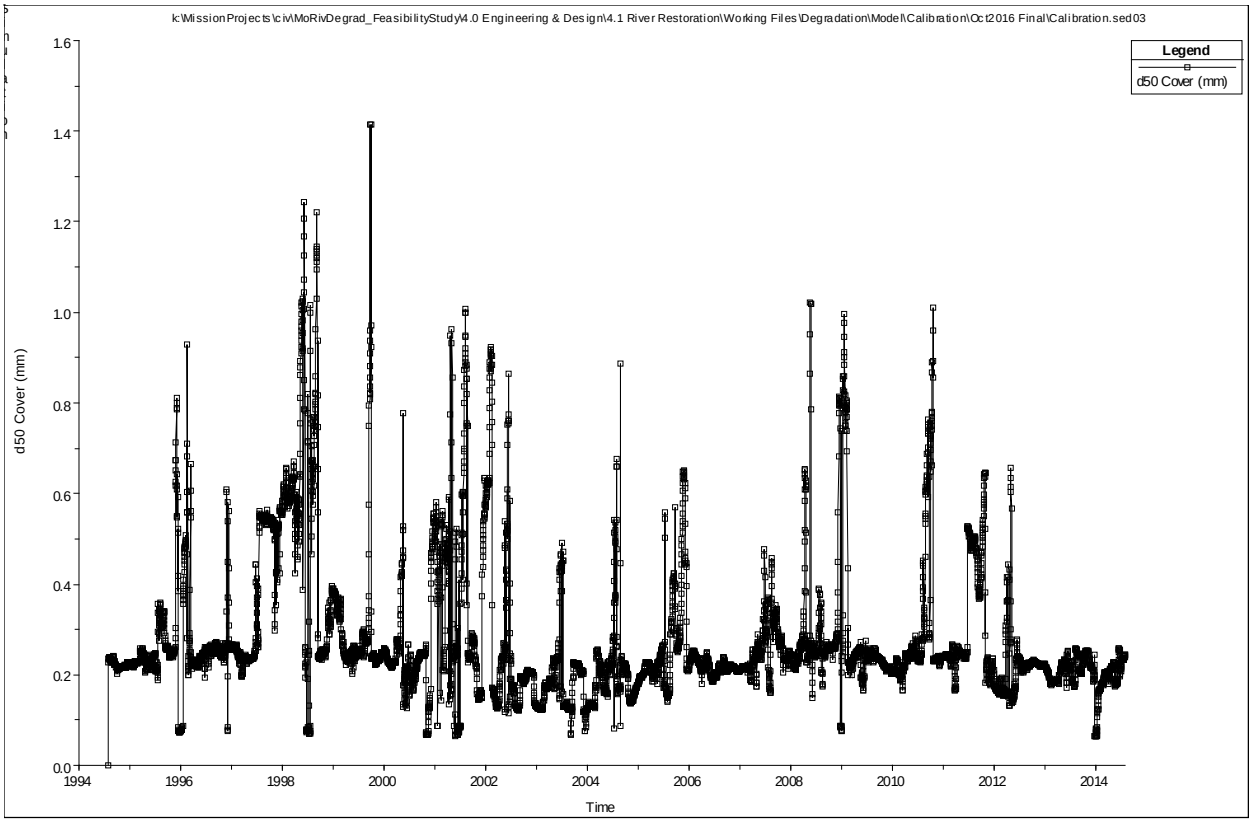

Figure 5. d50 of the cover layer over time at RM 365.56 .

4.2 See response 3.9.

4.3 The model output is compared to average bed elevation changes (Figures 1 and 3 above are included in the technical report and Appendix B). Measured cross sections indicate that the zone of degradation migrated upstream—behavior which the model replicates by modeling the hydraulic and sediment processes on the Missouri River with the locations and quantities of commercial dredging. Upstream headcutting can be caused by downstream degradation and is not restricted to a specific type of dredging or channel mining.

4.4 The model has since been revised, and the final version of the model does not exhibit this behavior to the degree cited by Mr. Williams and Mr. Hall. That said, grain sizes are variable in time and over space, depending on (1) the proportion of that grain size in the bed, (2) the ability of the water to move sediment, (3) the grain size of the sediment input from upstream or from tributaries, and (4) armoring effects (which tend to be temporary and cyclical). Due to all the above factors, plus commercial dredging, variation at individual cross sections is expected. Notwithstanding, the mobile-bed model replicates the overall geomorphic behavior and is adequate for modeling sediment in this study.

4.5 The model output is compared to USGS stages at low, medium, and high flows. Graphs and analysis of how well the model water surface elevation reproduces USGS measured elevations is provided in Appendix B. One example is provided in Figure 6, below.

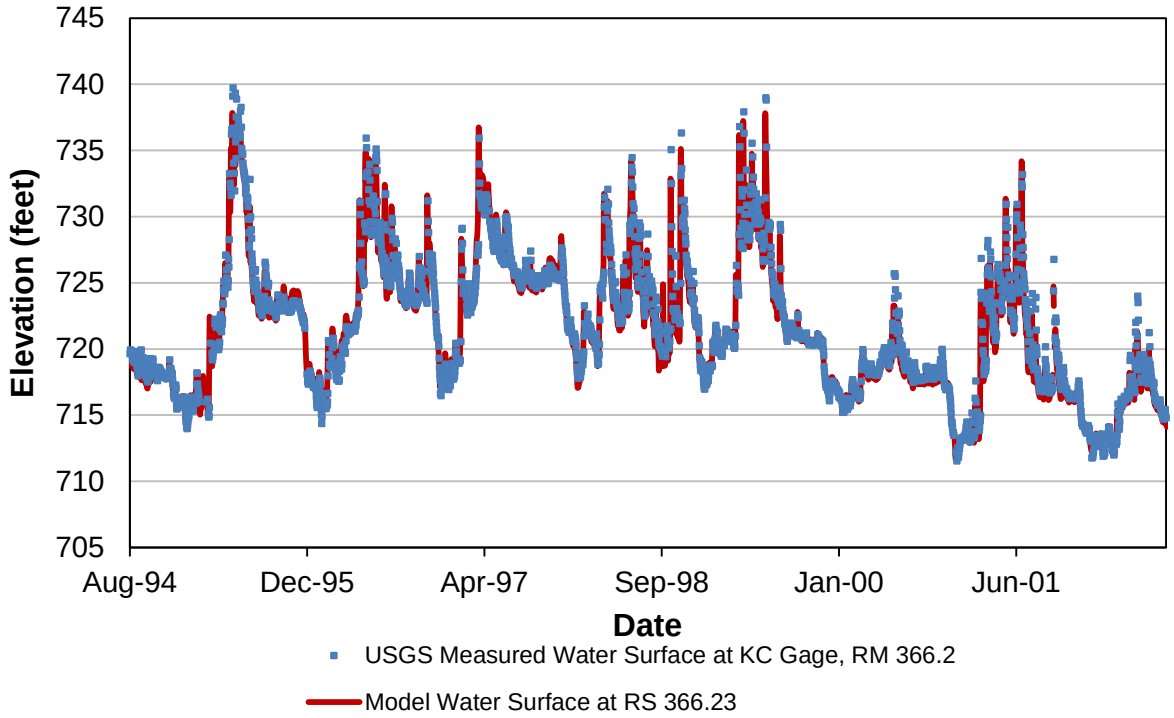

Figure 6. Example of modeled vs. measured water surface elevation at the Kansas City Gage from 1994 to 2002 (from Figure 7-1 in the technical report.)

This is a more robust comparison than the specific-discharge approach suggested by Mr. Williams and Mr. Hall as the minimum acceptable level of analysis, because it shows the agreement over the full range of flows. Furthermore, residual error is quantified and included in the risk and uncertainty computations described in Appendix C. The model reproduces historic degradation of the low water surface and is adequate for modeling sediment in this study.

4.6 The boundary condition has been revised and is now within 12% of the USGS reported loads (and within the 95% confidence interval). The model output is now compared to the sediment measurements at the Kansas City gage as well and is within 6% of the USGS estimate for sand load (adjusted to include bedload.) This also falls within the 95% confidence intervals.

4.7 The incoming sediment load is included as the sediment load at the upstream boundary and at two major tributaries (Platte River and Kansas River) which are calibrated parameters. Other sources and sinks beyond the active channel are implicitly included in these sediment input loads. If the rate of sediment flux to/from the inter-dike region were to be calculated explicitly (which would be very difficult given a general lack of available data in that region of the

channel) and included in the modeling (which would be very difficult in a 1D model), those loads would be subtracted from boundary conditions during calibration and not result in major differences. Residual error in model predictions vs. measured cross sections is described in the technical report and appendices.

4.8 A comparison between volume of degradation and the volume of commercial dredging has been added to the technical report.

4.8 (comment has same number) The calibration period has been re-run with the dredging turned off. This comparison has been added to the technical report and Appendix C.

4.9 The model reviewed by Mr. Hall and Mr. Williams was an early iteration of the model at an early point in the study when not all reviews had been completed and not all analyses performed. Many of the analyses suggested by Mr. Hall and Mr. Williams as "prudent important analyses" have now been performed. Furthermore, the model has benefitted from review by highly qualified sediment transport experts with comments closed to the satisfaction of the reviewers.

5.1. FOIA. Copies of all requested information was made available subject to the requirements and exclusions in the Freedom Of Information Act. Much of the information requested by Stoel Rives was under active revision or had not yet been developed. See FOIA response letters for further details.

5.1.1 Only a limited ATR had been conducted at the time of the model review by Mr. Hall and Mr. Williams. This was not represented as a final comprehensive ATR review for a decision document.

5.1.2 Due to the limited nature of this early in progress review, standard documentation and a full ATR report were not conducted. The final ATR report includes appropriate documentation.

5.1.3 As the ATR process was ongoing, names of reviewers were not provided. However, names of reviewers are provided in the final ATR report. ATR reviews were conducted by qualified experts, also named earlier in this response document.

5.1.4 DrChecks software was used to document ATR comments, responses and resolutions. Copies were provided.

5.1.5 An ATRT review report is required for completion of the ATR process for Corps of Engineers Decision Documents. This was an initial ATR in the early part of the study, not the final ATR. The final ATR is appropriately documented.

5.1.6 Omission of dates is regrettable. We were not able to ascertain the accurate dates for this memorandum of record.

5.1.7 Request documents were made available subject to the guidelines and exclusions of the Freedom Of Information Act. There have been a series of FOIA request letters for the project. All information provided has been maintained as a matter of record.

5.2 Omission of dates is regrettable. We were not able to ascertain the accurate dates for this memorandum of record.

5.3 The referenced presentation highlighted new features available in HEC-RAS 5.0. The calibration presented was the same as provided to Holliday Sand and Gravel and was characterized as preliminary. No model projections or alternatives testing were presented.

5.4.1 Preliminary study information was shared and characterized as such with the sponsor and stakeholder group in the interest of providing transparency. Final cost estimates and project benefits are based on the final model results, not preliminary results.

5.4.2 An early version of the mobile-bed model setup and calibration were provided to afford an opportunity to comment. These comments, the formal review by ATR and IEPR reviewers, subsequent data collection, and software updates were taken into consideration in completion of the final mobile-bed model. The final mobile-bed model will be made available upon request following publication of the technical report.

Conclusion

Engagement with an outside review by Holliday Sand and Gravel's consultants was done in the interest of providing increased transparency. In a letter dated 20 November 2014, Stoel Rives consolidated comments and concerns raised by consultants Brad Hall and David Williams about the sediment model used in the Missouri River Bed Degradation Feasibility Study and about the ATR review process.

The technical comments were taken into consideration and beneficially contributed to model revisions during model development from 2014 to 2017. This document provides responses to the comments. The technical report and appendices document that the mobile-bed model reproduces historic changes in the river, correctly computes sediment transport, and is technically adequate for the purposes of the Degradation Study. For further explanation and discussion, please refer to the main body of the technical report and appropriate appendices.

The 20 November 2014 letter criticizes the review effort for not meeting all requirements of a completed ATR review. As of 20 November 2014, a complete ATR report was not required or even possible because a full ATR had not been completed. The ATR is now complete and appropriate documentation is included in the report Appendix Q - Reviews.

A copy of this response and review documentation will be included in the final Technical Report for the study in the Appendix Q - Reviews.

Appendix Q

USACE Response to Interim Independent External Peer Review of the Missouri River Bed Degradation Feasibility Study

April 2017

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USACE Response to Interim Independent External Peer Review of the Missouri River Bed Degradation Feasibility Study
April 2017

An Interim Independent External Peer Review (IEPR) was conducted for the subject project in accordance with Section 2034 of the Water Resources Development Act of 2007, EC 1165-2-21), and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

The goal of the U.S. Army Corps of Engineers (USACE) Civil Works program is to always provide scientifically sound, sustainable water resources solutions for the nation. The USACE review processes are essential to ensuring project safety and quality of the products USACE provides to the American people. Analysis Planning and Management Institute, Inc. (APMI), a non-profit science and technology organization with experience in establishing and administering peer review panels for the USACE, was engaged to conduct the subject IEPR.

The Interim IEPR began in mid-2016 and officially ended in February 2017. This effort involved the review of several technical appendices documenting existing conditions sediment model calibration and future without project conditions including risk & uncertainty. A second round of IEPR was planned for review of the complete draft report, but was never conducted due to the failure of the project to identify a cost-shared construction project to recommend for congressional authorization, and the resulting termination of the project.

The IEPR panel consisted of two individuals selected by APMI with technical expertise in large river sediment modeling and economics.

The Final Report from the Interim IEPR was issued by APMI on September 9, 2016. Overall, the report contained twenty two comments. Of the twenty two comments, two were identified as having high significance, eight having medium significance, one having medium-low significance, and eleven having low significance.
All comments were resolved.

The following presents the USACE final response to the twenty two comments.

1. **Comment - Two different methods are used to develop the inflowing sediment boundary condition (inflowing sediment load), but it is unclear if the approach of combining the two methods is reasonable. The text needs to be revised to clarify for the reader the procedures utilized and the benefits and consequences of the approach.**

Two recommendations were proposed. The focus of these recommendations was to add clarifying text to the report.

<u>USACE Response</u>: Adopted

Action Taken: The document text was revised to clarify to the reader the procedures utilized and show the benefits and consequences of the approach. The rating curves were re-done so they are calibrated principally to discharge and still compare well to the cumulative suspended sand load.

2. **Comment - Other parameters may be better representative of floodplain sediment deposition than flood event duration.**

The panel recommended that a sensitivity analysis be performed for sediment deposition in the floodplain using other proxies for deposition.

<u>USACE Response</u>: Adopted

Action Taken: A sensitivity analysis for sediment deposition is now included with the documents. Two additional methods for scaling the floodplain deposition were completed that assessed and compared to the +/- 50% uncertainty already modeled. One method assumed the floodplain deposition is a percentage of the total suspended sediment load on the days when flow exceeded the flow threshold. The percentage assumed was based on the percentage from the 2011 flood event (i.e. the deposition amount divided by the volume of suspended sediment transported on the given days per USGS measurements). This incorporates both the non-linear nature of sediment transport and the effect of the unique 2011 sediment concentrations. The second method was to assume 100% of the bed material load on the days the flow exceeded the threshold was deposited as floodplain deposition—a maximum bound. Both measures yield amounts of floodplain deposition within the range already examined as a sensitivity analysis. The model results show very little variation in model outputs, indicating that incorporating a different method for floodplain deposition is not needed and the risk and uncertainty analysis is adequate.

3. **Comment - The Natural Valley Width was reported to have been computed using the 1% Annual Exceedance Probability (AEP) flows and removing levees from the FEMA floodway instead of Future Without Project conditions widths.**

The Panel asked that the Corps provide an explanation in the report narrative of why the Natural Valley Width was computed using the 1% Annual Exceedance Probability (AEP) flows and removing levees from the FEMA floodway.

<u>USACE Response</u>: Adopted

Action Taken: Figure 2 was updated and the following explanation added to better explain how the Natural Valley Width was computed. "Figure 2 graphically depicts the level of confinement imposed on the river corridor by levees vs. the natural floodplain width. The widths shown in Figure 2 were developed using existing models that include the lower 500 miles of river, not the degradation study model which (as explained later) runs from St. Joseph, MO to Waverly, MO (155 miles). The "Valley Width" line in Figure 2 indicates the floodplain width for the 1% AEP profile if there were no levees and is provided as a reasonable approximation for the valley width. Figure 2 is not used in the degradation modeling, but is provided for context to differentiate geologic constrictions from levee-induced constrictions. The FWOP and all degradation alternatives include the levees at the actual locations."

4. **Comment - Clearer reservoir discharges are expected to have lower sediment loading than other types of flows.**

The panel recommended that, if the point that flows passing through reservoirs have lower sediment loads, it should be explicitly stated in the documentation, and that clarification be provided in the text.

<u>USACE Response:</u> Adopted

Action Taken: Clarifying text was added to indicate that flows passing through reservoirs will have lower sediment loads:
"Reservoir releases contain less sediment than tributary inflows, making this flood event (2011) abnormally sediment-poor compared to other high flows and thus unrepresentative for long-term simulations."

5. **Comment - Although the resolution of model sections (section spacing) is generally good, no discussion is provided or references cited, which provides uncertainty for continuity and understanding bed change.**

The Panel recommended that a description be added in the documentation regarding the maximum, minimum and variation in section spacing, and the impact that model section spacing may have on the modeling results.

<u>USACE Response:</u> Adopted

Action Taken: The range in spacing was added to the report as follows: "There are 6 to 12 cross-sections per river bend. The spacing ranges from 422 ft to 10,666 ft, with 90% of the cross section spacing from 898 ft to 4,594 ft. While there are no fixed criteria for cross section spacing in sediment modeling, Figures 27 to 42 evidence that this this spacing is adequate for reproducing channel hydraulics and long-term degradation trends." Also, recognizing that the model XS spacing dictates the resolution of model outputs, the following explanation has been added to the report: "The model section spacing does not allow for the testing of local effects of the alternatives, such as the effect of an individual dike on local bank erosion or the erosion and sedimentation of a single dredge hole. Rather, the resolution of the dike spacing allows testing of reach-scale effects, e.g. the effect on bed change of lowering all dikes over several miles and the reach-averaged effects of commercial dredging."

6. Comment - Tributary sediment load discussion should be expanded.

The Panel recommended that the Corps expand the description of the tributary sediment loads, the determination of their values, and how they are implemented in modeling.

USACE Response: Adopted

Action Taken: Tributary sediment and loading has been better explained in the document, including and explanation that both development and implementation of the tributary sediment loads were developed from USGS sediment measurements to the extent that measurements and data exist.

7. Comment - Describe the sensitivity analysis for movable bed limits.

The Panel asked the Corps to expand the discussion of the movable bed limits to include the sensitivity analysis of this parameter and explain/describe the results of the analysis, noting that the analysis and description of it can follow the procedures of TD-13 or more recent guidance, as applicable.

USACE Response: Adopted

Action Taken: Expanded discussion and a graph were added to the document to indicate sensitivity to the moveable bed limits as follows:
"From RM 448.89 to 307.6, the moveable bed limits were set at the line connecting the tips of the training structures. The bed limits over the final 13.3 miles started with that definition and were moved inward by 120 ft from RM 306.81 to 299.62 and by 160 ft from 299.12 to 293.421 during calibration. This reduction in active width was required for the model to match the measured river bed change. This may be a boundary condition effect or the effect of suspected (but unconfirmed) bedrock outcroppings which may extend into the channel. Figure 47 compares model output under three different extents for the moveable bed limits, (1) As calibrated, (2) With no adjustment in the most downstream 13.3 miles, and (3) With the moveable bed limits set to the model bank points. As seen in Figure 47, the model as calibrated (with adjustment in the downstream 13.3 miles) better approximates the measured bed change for the Missouri River downstream of about RM 337. Upstream of RM 337, model output is relatively insensitive to this adjustment."

8. Comment - In Figure 39, "Comparison between National Weather Service and Model Annual Peak Elevations", of the "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report", the overall bias seems low, but individual station bias appears to exist.

The Panel asked that the Corps revise the analysis to address the bias and its significance to the modeling effort. Address the causes of the bias, the concerns about the observed results, and how the observed bias impact the modeling conclusions.

USACE Response: Adopted

Action Taken: The document was revised to discuss the analysis to address the bias and its significance to the modeling effort. This bias has been re-examined for opportunities to tighten the calibration, but some differences still exist. Most likely, differences between model and measured flow between flow gages account for the discrepancy. The model uses daily flows, is

steady state, and includes flow differences between gages as tributary lateral inflows and uniform lateral inflows. In contrast, the flows that induce the peak stages at the NWS gages include attenuation, timing of tributary inputs, event-specific levee failures, and other unsteady factors which are not reflected in the model. At USGS flow gages, where the flow matches the measured flow, the model shows much closer agreement to all stages (including peak stages). Note, however, that this study does not assess damages due to high flows, but due to bed degradation and low flow water surface elevations which are associated with bed degradation. The report now includes computation for the discrepancy between model bed elevation output and measured data. This error term includes the effects on bed elevation change from the simplification of the flow distribution and steady state vs. unsteady flow effects. This error term is now included in the risk and uncertainty modeling.

9. Comment - There is insufficient discussion of deviation of the model output from observed hydraulic parameters.

The Panel recommended that the Corps identify and describe the model deviation from observed data for a wide range of model output parameters, and list the possible causes of the observed deviations and their impact on the model results and any potential consequences of these results.

<u>USACE Response</u>: Adopt

Action Taken: Additional discussion on the model deviation from observed data for a wider range of model output parameters was added to the document. The error between model and measured water surface elevations at the St. Joseph and the Kansas City gages was previously quantified for this purpose and was moved from the Risk and Uncertainty document to the calibration document. To add more rigor of model comparison to prototype, the bed elevation change at individual cross sections has now been plotted in addition to the current plot showing longitudinal cumulative mass change. The standard deviation of error in bed elevation (1994 to 2009) is compared against the natural variability. Furthermore, a spatial error term for bed elevation has been calculated over 5-mile reaches. The risk and uncertainty analysis uses the model bed residual or model water surface residual (as appropriate) to encompass model uncertainty and natural variability. Discussions have been added in the document on the causes of the observed deviations and their impact on the model results and any potential consequences of these results. Sources of model error beyond natural variability are model approximations, such as steady state vs. unsteady state flow modeling, fixed moveable bed boundaries vs. dynamic boundaries, etc. and uncertainty in input data. The implications of these residual errors or deviation are that while the model can project trends and differences among alternatives, the actual bed elevation for an individual feature can be higher or lower than the predicted value. Note that model error is incorporated into the risk and uncertainty modeling.

10. Comment - Other types of dike orientation may need to be considered for length reduction.

The Panel recommended that the Corps show how effective dike length is independent of velocity and depth and of dike angle to the bank, and to indicate direction of flow and location of banks in dike figures.

<u>USACE Response</u>: Adopted

Action Taken: The following verbiage was added to the report text to further explain the

modeling approach and alleviate the concern:

"The procedure for including the effects of dikes is:
1- Determine the length of the dikes perpendicular to the flow.
2- Determine the average dike spacing.
3- Estimate the area that is within the dike footprint that is actually available to flow-- i.e. account for the tapering off for the zone of recirculating flow as you move away from the dike.
4- Reduce the blocked area for the dike in the cross section so the correct amount of area is open to flow to account for #3 above.

1D models cannot simulate 3D effects of dike orientation, but this procedure includes the 1D (i.e. downstream conveyance) effects of the dikes.".

11. Comment - No information is provided on the dredging quantities for the two periods in the "Missouri River Degradation Study, Technical Appendix, Future Without Project Model Projections with Risk and Uncertainty". As a result, the difference in the model output for the two periods cannot be reconciled.

The Panel recommended that information on the dredging quantity inputs be included for the model runs for the two periods documented and an explanation of why they are different in the Missouri River Degradation Study, Technical Appendix, Future Without Project Model Projections with Risk and Uncertainty, ATR Draft – 24 May 2016.

<u>USACE Response</u>: Adopted

Action Taken: Table 6 has been added that summarizes the dredging scenarios. Three analyses were performed. The first is to re-run the calibration period without dredging, but with all other boundary conditions staying the same. The dredging amount is listed in the paragraph below Figure 22 as 60.8 million tons. This model starts with 1994 geometry and runs forward to 2014.
The second analysis starts with 2014 geometry (dikes and bed elevations) and runs forward to 2065 (2014 – 2015 is a model spin-up year). Boundary conditions are the average conditions developed for the FWOP. This is not re-running of the calibration period with a different dredging level, this is running the future projection model with different dredging levels. The amount of dredging for these scenarios is provided in Table 7. In both time periods the relationship with dredging is very strong. In neither is it a 1:1 relationship, suggesting some geomorphic feedbacks. The third analysis varies the locations of dredging within the authorized segments..

12. Comment - Figure 2, "Valley Width and River Top Width at Different Flood Levels", of the "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report" needs a slight adjustment.

The Panel recommended that Figure 2 be revised to eliminate the 2% AEP top width being greater than the valley width at River Mile (RM) 500.

<u>USACE Response:</u> Adopted

Action Taken: The graphs were corrected in Figure 2, and clarifying text added to the document.

13. Comment - The first paragraph in Section 2.4 of the "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report" is confusing by not describing the return interval event for 1997.

The Panel requested that a discussion for the return interval be added to the first paragraph of Section 2.4 of the Calibration Report.

<u>USACE Response:</u> Adopted

Action Taken: A discussion of the return interval was added to the first paragraph of Section 2.4 of the calibration report for 1997. Additional discussion on the flows was added, and now gives a range of minimum to maximum daily flows over the calibration period.

14. Comment - Figure axes directions are inconsistent when identifying River Miles, making it difficult to interpret data in similar areas.

The Panel recommended that figure axes directions be determined and applied consistently.

<u>USACE Response</u>: Adopted

Action Taken: The figure axis directions were evaluated and revised as needed to be consistent within the document.

15. Comment - Paragraph 4, section 2.5, "Principal Causes of Degradation", of the "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report" provides summary values without any corresponding information to show how they were generated.

The Panel recommended that discussion be provided in section 2.5 Principal Causes of Degradation, of the Missouri River Bed Degradation Study Mobile Bed Model Calibration Report" explaining how this value was determined or calculated.

<u>USACE Response</u>: Adopted

Action Taken: Additional discussion and clarification was added to the summary values to Paragraph 4, section 2.5, "Principal Causes of Degradation", of the "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report".
.

16. Comment - Some model sections appear to be skewed (not perpendicular) to the channel center line.

The IEPR Panel recommended that the Corps describe how section skew is addressed in the modeling with respect to the development of the sections.

<u>USACE Response</u>: Adopted

Action Taken: This relates to two items. First, that the cross sections should be perpendicular to flow and second that the downstream reach lengths should represent the path the water takes. The cross sections are reasonably perpendicular to flow. The downstream reach lengths have

been further explained as follows: The overbank downstream reach lengths are intended to represent the center of mass of overbank flow. In a continuous model, the center of mass changes with stage, but only one downstream reach length for each overbank is allowed. In the case of this model, the downstream reach lengths are set to the sailing line distance for both channel and overbanks. This simplification is because the model banks are set to the tips of the training structures, which are within the channel. Most of the time (and particularly for the most effective flows) the "overbank" flow is within the channel. The actual downstream reach lengths are slightly different than the sailing line-- slightly shorter length on inside bends and slightly longer length on the outside bends. Using the actual distances for the edge of the rectified channel yields a negligible average difference in water surface elevation of 0.001 ft compared to using the same downstream distance for overbanks as for the channel.
.

17. Comment - Include drainage area maps.

The Panel recommended that maps be provided to illustrate locations of tributary inflow, and provide a table of inflow water and sediment discharges in the Flows subsection of section 2.4 of the "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report" when discussing the model assumptions for reader clarity.

<u>USACE Response</u>: Adopted

Action Taken: Maps have been added to the main report to enhance clarity.

18. Comment - The second paragraph under Sediment Load, section 3.4 of "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report", is unclear what is being discussed and how it relates to this subsection.

The Panel recommended that the second paragraph under Sediment Load, section 3.4 of "Missouri River Bed Degradation Study Mobile Bed Model Calibration Report" be revised for readability and improved comprehension.

<u>USACE Response</u>: Adopted

Action Taken: The paragraph was revised, per the Panel's recommendation.

19. Comment - Cumulative dredging by year in Figure 26, "Cumulative Dredging by River Mile as Percent of the Total Dredging 1997 – 2009", in the "Missouri River Bed Degradation Study, Technical Appendix, Future Without Project Model Projections with Risk and Uncertainty" are indistinguishable.

The Panel recommended that the figure be revised to make the different water years clear. This can be accomplished any number of ways as long as there is some distinguishing features that allow the reader to distinguish between the different water years.

<u>USACE Response</u>: Adopted

Action Taken: Clarification of the range of cumulative dredging by year in Figure 26, "Cumulative Dredging by River Mile as Percent of the Total Dredging 1997 – 2009", in the "Missouri River Bed Degradation Study, Technical Appendix, Future Without Project Model Projections with Risk and Uncertainty" was included in the document. The focus of the graph

wasn't to show individual years, per se, but rather to show the range. However, the addition of color does add clarity and more information.
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20. Comment - Figure 41, "Longitudinal Cumulative Mass Calibration: 1994 to 2009", in the "Missouri River Bed Degradation Study, Technical Appendix, Future Without Project Model Projections with Risk and Uncertainty", requires clarification.

The Panel recommended that the average, standard deviation, maximum and minimum of difference of Figure 41, "Longitudinal Cumulative Mass Calibration: 1994 to 2009", in the "Missouri River Bed Degradation Study, Technical Appendix, Future Without Project Model Projections with Risk and Uncertainty" be discussed, noting any important characteristics in the data.

USACE Response: Adopted

Action Taken: The figure has been clarified, as recommended by the Panel. A new plot that looks at cross section change (model vs. measured) has been added and appropriate statistics generated and included in the document.

21. Comment - Standardization of symbology should be considered between figures to increase comprehension of the report data.

The Panel asked that the Corps consider standardizing the symbology of all the figures and graphs in the various reports.

USACE Response: Adopted

Action Taken: The report was updated to include the use of standardized symbology, to the extent practicable.

22. Comment - The terminology bed load vs. bed flux and related terms needs to be clarified in the reports.

The Panel recommended that the use of terminology like bed load and bed flux be reviewed to ensure that they are used uniformly and according to their technical definitions to ensure clarity in the text..

USACE Response: Adopted

Action Taken: The document was reviewed and updated for consistency and clarity of terms.