Final Independent External Peer Review Report for the Tres Rios del Norte, Pima County, Arizona, Feasibility Study

Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Ecosystem Restoration Planning Center of Expertise
Mississippi Valley Division

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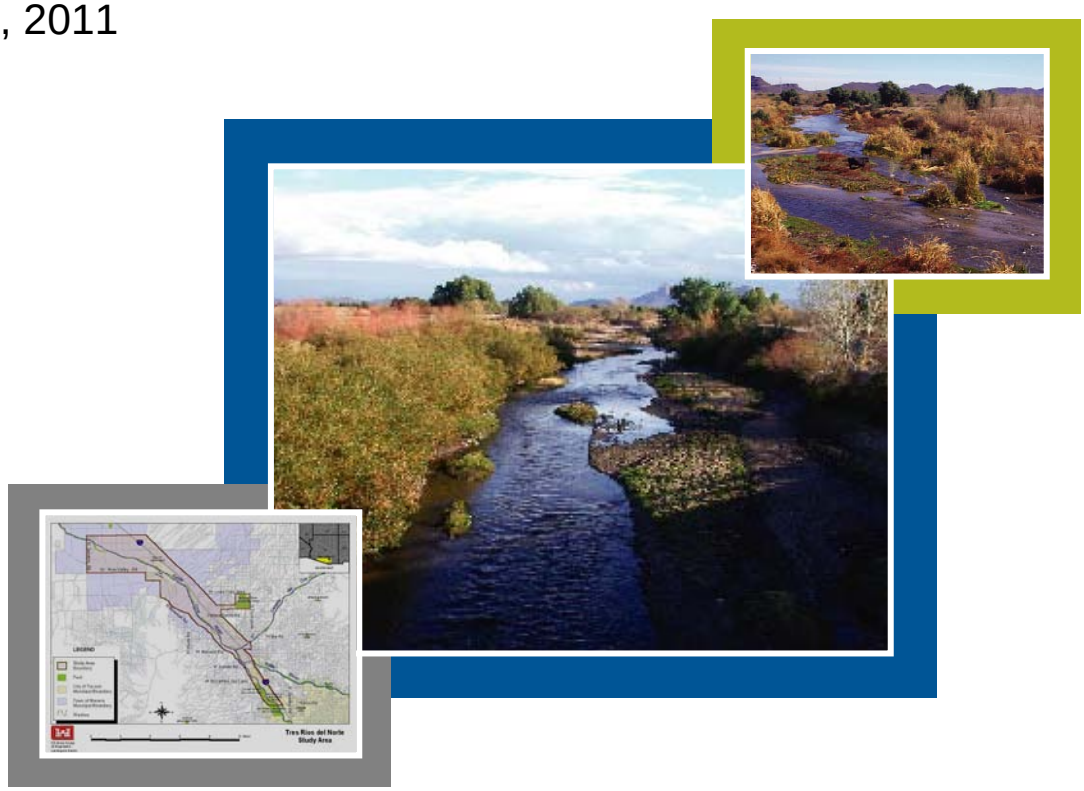

SHORT-TERM ANALYSIS SERVICE (STAS)

on

Final Independent External Peer Review Report
Tres Rios del Norte,
Pima County, Arizona, Feasibility Study

by

Battelle
505 King Avenue
Columbus, OH 43201

for

Department of the Army
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Scientific Services Program

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FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT
for the

Tres Rios del Norte,
Pima County, Arizona, Feasibility Study

EXECUTIVE SUMMARY

Project Background and Purpose

The Tres Rios del Norte study area is located in the Upper Sonoran Desert in the Santa Cruz River (SCR) Watershed, Pima County, Arizona. The Santa Cruz River headwaters are located in the San Rafael Valley in southeastern Arizona, flowing into Sonora Mexico before re-entering Arizona about six miles east of Nogales, Arizona. The SCR continues northward through Tucson and Pima County, then northwest to its confluence with the Gila River, 12 miles southwest of Phoenix.

The study area is an 18-mile reach of the Santa Cruz River that extends into northern Pima County. Within the study reach, the Santa Cruz River has confluences with two major tributaries, the Rillito River and the Cañada del Oro. It is from these features that the area derives its name, Tres Rios del Norte (Three Rivers of the North). The study area is situated within Pima County in the northwestern portion of the Tucson metropolitan area and includes portions of both the City of Tucson and the Town of Marana. Groundwater recharge, flood risk reduction, and recreation measures are also being formulated. It is anticipated that the Recommended Plan will include a combination of all these purposes.

The primary ecosystem problem in the study area is severe degradation and loss of riparian habitat. While this has occurred to some degree since the late 19th century, it has greatly accelerated in both extent and degree of severity in the last 50 years. Within the study area, it has been estimated that a corridor of 7,000 to 8,000 acres of dense riparian and floodplain riparian fringe habitat existed historically, supported by surface and groundwater flow in close proximity to the river. Increasing withdrawal of surface and groundwater flow to support agriculture and a growing human population gradually changed the Santa Cruz from a river with surface and subsurface flow to a primarily dry channel that flows throughout its length only in response to storm runoff and, most of the year, only in those reaches immediately downstream of effluent outfalls. As a result of these withdrawls, stands of native riparian habitat are rare throughout Pima County and Arizona, particularly in the study area. What remains is in isolated patches, supported entirely by effluent flows, with little physical connection to nearby habitats.

Independent External Peer Review Process

USACE is conducting an Independent External Peer Review (IEPR) of the Tres Rios del Norte, Pima County, Arizona, Feasibility Study (hereinafter TRDN Feasibility Study). As a 501(c)(3) non-profit science and technology organization, Battelle is independent, free from conflicts of

interest, and does not carry out or advocate for or against Federal water resources projects. Battelle has experience in establishing and administering peer review panels for USACE and was engaged to coordinate the IEPR of the TRDN Feasibility Study. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to the agency and conducted following USACE and Office of Management and Budget (OMB) guidance described in USACE (2010), USACE (2007), and OMB (2004). This final report describes the IEPR process, describes the panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel (the Panel).

Five panel members were originally selected for the IEPR from more than 37 identified candidates. Based on the technical content of the TRDN Feasibility Study and the overall scope of the project, the final panel members were selected for their technical expertise in the following key areas: civil/design construction cost engineering, Civil Works planning, economics, National Environmental Policy Act (NEPA) and biology, and hydraulics and hydrology. However, prior to the start of the review process, the TRDN Feasibility Study documents underwent significant revisions that necessitated a modification to the Statement of Work (SOW) and delayed the project schedule for 12 months. The modifications to the SOW resulted in the merging of the Civil Works planning and economics areas of expertise, bringing the final number of required experts to four, and extending the project period of performance. The final list of four panel members was presented to USACE, but Battelle made the final selection of the Panel.

The Panel received electronic versions of the TRDN Feasibility Study documents, totaling more than 3,000 pages, along with a charge that solicited comments on specific sections of the documents to be reviewed. The charge was prepared by Battelle to assist USACE in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). USACE was given the opportunity to provide comments and revisions, and subsequently approved the final charge questions.

The USACE Project Delivery Team briefed the Panel and Battelle during a kick-off meeting held via teleconference at the start of the review. In addition to this teleconference, a teleconference with USACE, the Panel, and Battelle was held halfway through the review period to provide the Panel an opportunity to ask questions of USACE and clarify uncertainties. The Panel produced more than 400 individual comments in response to the 172 charge questions.

IEPR panel members reviewed the TRDN Feasibility Study documents individually. The panel members then met via teleconference with Battelle to review key technical comments, discuss charge questions for which there were conflicting responses, and reach agreement on the Final Panel Comments to be provided to USACE. Each Final Panel Comment was documented using a four-part format consisting of: (1) a comment statement; (2) the basis for the comment; (3) the significance of the comment (high, medium, or low); and (4) recommendations on how to resolve the comment. Overall, 19 Final Panel Comments were identified and documented. Of these, 4 were identified as having high significance, 13 had medium significance, and 2 had low significance.

Results of the Independent External Peer Review

The Panel agreed among one another on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2010; p. D-4) in the TRDN Feasibility Study documents. In general, the Panel acknowledges that the methods, models, and assessments leading to the temporarily selected plan for ecosystem restoration, recreation, and water supply are appropriate and sufficient to achieve the study goals. The Panel has four primary concerns:

- The TRDN Feasibility Study does not include sufficient information from more recent pertinent scientific publications.
- Some sections of the TRDN Feasibility Study do not provide sufficient details to allow for a thorough review by the Panel.
- Some aspects of the cost-benefit analysis have inadequacies or, if not, are not sufficiently documented.
- Potential negative environmental impacts from the temporarily selected plan are not fully accounted for, and seemingly appropriate avoidance or mitigation measures are not applied.

The Panel agrees that the TRDN Feasibility Study would be improved if information in the appendices is brought to light and referenced in the corresponding sections of the main report. Table ES-1 lists the Final Panel Comments statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report. The following statements summarize the Panel's findings.

Plan Formulation: The TRDN Feasibility Study uses sound methods and appropriate models to formulate and evaluate alternative plans. However, the Panel has provided recommendations and suggestions to improve the analysis and interpretation of some aspects of the formulation process.

Economics: The TRDN Feasibility Study uses sound economic methods and appropriate models and approaches to conduct the cost effectiveness and incremental cost analyses (CE/ICA) for ecosystem restoration, recreation, and water supply. However, details necessary for conducting a thorough review are missing from some of the steps used for preliminary screening of management measures and elements. In addition, assumptions in the ecosystem restoration analysis are inaccurate.

Engineering: The TRDN Feasibility Study includes a very thorough analysis of large single-event hydraulics, scour and sediment transport, and sound regionally relevant engineering methods. Potential areas of concern, such as the Tucson Ready Mix pit, have been identified and thoroughly analyzed. The details of the effects of small flow events has not been adequately analyzed, including areas of inundation (i.e., flooding of new plantings), quantification of lateral seepage of effluent water from the river channel, and vertical channel stability when clean-water urban runoff dominates the flood regime. Introducing grade control reduces long-term erosion and contributes to the project's success; however, the number of grade control structures appears

to be insufficient to achieve project objectives. A more complete analysis of geomorphically based channel stability is needed to ensure a self-sustaining project.

Environmental: The TRDN Feasibility Study does not fully consider the environmental conditions necessary for the successful restoration of riparian vegetation, including the availability of a shallow water table following planting, and the capability of capturing sufficient water from other sources, including effluent, to maintain riparian plantings. The reference conditions to be used to evaluate restoration success are based on historic photos that do not predate early uses and changes of the riverine system being restored. In addition, upstream uses of the aquifer underlying the study area may impact the project. Information is also absent on the use of pumps to move effluent water that would sustain new riparian vegetation.

Table ES-1. Overview of 19 Final Panel Comments Identified by the TRDN Feasibility Study IEPR Panel

No.	Final Panel Comment
Significance – High	
1	The time period and scope of the Monitoring and Adaptive Management Plan does not appear to be sufficient to determine the success of the project.
2	The constructed multi-channel water recharge facility will likely result in reducing the actual number of Average Annual Functional Capacity Units (AAFCUs) generated by the project.
3	The optimal river dimensions and pattern, which are critical elements of the TRP, have not been quantified in the review documents.
4	The use of grade control for managing and preventing head-cuts and the secondary benefits of lateral spreading and recharge have not been fully investigated.
Significance – Medium	
5	The pumping of effluent water out of the channel may be possible from a volumetric perspective, but there is no discussion of the practical challenges with extracting large quantities of water from shallow wells in a sandy river bottom.
6	It has not been substantiated that stormwater harvesting from the tributaries and the main stem of the Santa Cruz River is a viable project component.
7	A guarantee that the effluent water supplies necessary to accomplish project goals will be available throughout the duration of the TRDN project life has not been provided.
8	The two proposed graded recharge channels are not necessary to meet the water recharge goals of the project, and this design does not allow for an increase in riparian habitat.
9	Cross-section examples along the restored areas of the channel, showing the relationship between important project elements such as planting locations, topography, and potential groundwater depths, are not included, but are necessary to illustrate the integration of project components.
10	The estimated unit costs of land acquisition for the TRP are not consistently reported and could result in the cost of the project being under- or overstated.
11	The rationale for not providing a cost estimate, net water supply benefits, and a rank for the potential non-structural alternative plan(s) (Table 5-19 and page 5-42, 43) is not fully discussed, which affects the evaluation of the plan formulation process.
12	The specific metrics used in the process to preliminarily screen the management measures and elements are not presented and so could not be evaluated.
13	It is unclear how the recreational facilities analysis was included in the future without project alternative.
14	The basis for ensuring the success of this project does not appear to rely on recent publications regarding ecosystem processes, functions, and services, or on literature demonstrating how riparian ecosystems function and respond to modifications of key environmental variables.
15	The statement that hazardous material plumes will not impact public water supplies has not been substantiated.

No.	Final Panel Comment
16	The Cultural Resources section does not document coordination with the State Historic Preservation Officer, plans for historic sites with National Historic Landmark status as well as archeological sites, or a plan for surveying the remaining one-third of the project area.
17	The potential impact of climate change on the success of the project has not been evaluated.
Significance – Low	
18	The potential impacts to the TRDN project that may occur due to future upstream water demands and uses in Santa Cruz county are not discussed.
19	The historic conditions of the riparian habitat description are not thoroughly developed to be used as a guide for the selection of possible reference conditions for an ecosystem restoration study.

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LIST OF ACRONYMS

AAFCUs	Average Annual Functional Capacity Units
ADWR	Arizona Department of Water Resources
AF/YR	Acre-Fee/Year
ASU	Arizona State University
ATR	Agency Technical Review
BLS	Below Land Surface
CE/ICA	Cost Effectiveness and Incremental Cost Analyses
COI	Conflict of Interest
CRREL	Cold Regions Research and Engineering Laboratory
DEIS	Draft Environmental Impact Statement
DrChecks	Design Review and Checking System
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERDC	Engineer Research and Development Center
FEMA	Federal Emergency Management Agency
HEC	Hydrologic Engineering Center
HTRW	Hazardous, Toxic, and Radioactive Wastes
IEPR	Independent External Peer Review
IWR	Institute for Water Resources
M&A	Montgomery and Associates
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NTP	Notice to Proceed
OMB	Office of Management and Budget
OMRR&R	Operations, Maintenance, Repair, Replacement and Rehabilitation
PDT	Project Delivery Team
P&G	Principles and Guidelines
PROSPECT	Planning Core Curriculum
SCR	Santa Cruz River
SOW	Statement of Work
TRDN	Tres Rios del Norte
TRP	Tentatively Recommended Plan
UA	University of Arizona
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WES	Waterways Experiment Station
WRDA	Water Resources Development Act

1. INTRODUCTION

The Tres Rios del Norte study area is located in the Upper Sonoran Desert in the Santa Cruz River (SCR) Watershed, Pima County, Arizona. The Santa Cruz River headwaters are located in the San Rafael Valley in southeastern Arizona, flowing into Sonora Mexico before re-entering Arizona about six miles east of Nogales, Arizona. The SCR continues northward through Tucson and Pima County, then northwest to its confluence with the Gila River, 12 miles southwest of Phoenix.

The study area is an 18-mile reach of the Santa Cruz River that extends into northern Pima County. Within the study reach, the Santa Cruz River has confluences with two major tributaries, the Rillito River and the Cañada del Oro. It is from these features that the area derives its name, Tres Rios del Norte (Three Rivers of the North). The study area is situated within Pima County in the northwestern portion of the Tucson metropolitan area and includes portions of both the City of Tucson and the Town of Marana. Groundwater recharge, flood risk reduction, and recreation measures are also being formulated. It is anticipated that the Recommended Plan will include a combination of all these purposes.

The primary ecosystem problem in the study area is severe degradation and loss of riparian habitat. While this has occurred to some degree since the late 19th century, it has greatly accelerated in both extent and degree of severity in the last 50 years. Within the study area, it has been estimated that a corridor of 7,000 to 8,000 acres of dense riparian and floodplain riparian fringe habitat existed historically, supported by surface and groundwater flow in close proximity to the river. Increasing withdrawal of surface and groundwater flow to support agriculture and a growing human population gradually changed the Santa Cruz from a river with surface and subsurface flow to a primarily dry channel that flows throughout its length only in response to storm runoff and, most of the year, only in those reaches immediately downstream of effluent outfalls. As a result of this change, stands of native riparian habitat are rare throughout Pima County and Arizona, particularly in the study area. What remains is in isolated patches, supported entirely by effluent flows, with little physical connection to nearby habitats.

The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the TRDN Feasibility Study in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers (USACE) Engineer Circular *Civil Works Review Policy* (EC No. 1165-2-209) (USACE, 2010), USACE CECW-CP memorandum *Peer Review Process* (USACE, 2007), and Office of Management and Budget (OMB) bulletin *Final Information Quality Bulletin for Peer Review* (OMB, 2004). Battelle, as a 501(c)(3) non-profit science and technology organization with experience in establishing and administering peer review panels, was engaged to coordinate the IEPR of the TRDN Feasibility Study. Battelle is independent, free from conflicts of interest, and does not carry out or advocate for or against Federal water resources projects. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses.

This final report details the IEPR process, describes the IEPR panel members and their selection, and summarizes the Final Panel Comments of the IEPR Panel on the existing environmental,

economic, and engineering analyses contained in the TRDN Feasibility Study. The full text of the Final Panel Comments is presented in Appendix A.

2. PURPOSE OF THE IEPR

To ensure that USACE documents are supported by the best scientific and technical information, USACE has implemented a peer review process that uses IEPR to complement the Agency Technical Review (ATR), as described in USACE (2010) and USACE (2007).

In general, the purpose of peer review is to strengthen the quality and credibility of the USACE decision documents in support of its Civil Works program. IEPR provides an independent assessment of the economic, engineering, and environmental analysis of the project study. In particular, the IEPR addresses the technical soundness of the project study's assumptions, methods, analyses, and calculations and identifies the need for additional data or analyses to make a good decision regarding implementation of alternatives and recommendations.

3. METHODS

This section describes the method followed in selecting the members for the IEPR Panel (the Panel) and in planning and conducting the IEPR. The IEPR was conducted following procedures described by USACE (2010) and in accordance with USACE (2007) and OMB (2004) guidance. Supplemental guidance on evaluation for conflicts of interest (COIs) was obtained from the *Policy on Committee Composition and Balance and Conflicts of Interest for Committees Used in the Development of Reports* (The National Academies, 2003).

3.1 Planning and Schedule

Prior to the start of the review process, the TRDN Feasibility Study documents underwent significant revisions that necessitated a modification to the Statement of Work (SOW) and delayed the project schedule for 12 months. The modifications to the SOW resulted in the merging of the Civil Works planning and economics areas of expertise, bringing the final number of required experts to four, and extending the project period of performance. After receiving the modified Statement of Work and notice to proceed (NTP), Battelle held a kick-off meeting with USACE to review the preliminary/suggested schedule, discuss the IEPR process, and address any questions regarding the scope (e.g., clarify expertise areas needed for panel members). Any revisions to the schedule were submitted as part of the final Work Plan.

Table 1 defines the schedule followed in executing the IEPR. Due dates for milestones and deliverables are based on the modified NTP of July 1, 2011. Note that the work items listed in Task 7 occur after the submission of this report. Battelle will enter the 19 Final Panel Comments developed by the Panel into USACE's Design Review and Checking System (DrChecks), a Web-based software system for documenting and sharing comments on reports and design documents, so that USACE can review and respond to them. USACE will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All USACE and Panel responses will be documented by Battelle.

Table 1. TRDN Feasibility Study IEPR Schedule

Task	Action	Due Date
1	**Original Notice to Proceed (NTP)**	12/9/2009
	Notice to Proceed (NTP), Based on Contract Modification	7/1/2011
	Review documents available	7/18/2011
	Battelle submits draft Work Plan [b]	2/2/2010
	USACE provides comments on draft Work Plan [b]	6/3/2010
	Battelle submits final Work Plan [b]	6/3/2010
	Battelle submits revised final Work Plan [b, d]	7/20/2011
2	Battelle requests input from USACE on the conflict of interest (COI) questionnaire	1/19/2010
	USACE provides comments on COI	1/21/2010
	Battelle submits list of selected panel members [b]	6/10/2010
	USACE confirms panel members have no COI	6/14/2010
	Battelle complete subcontracts for panel members	6/28/2010
	Battelle completes subcontract modifications for panel members	7/18/2011
3	Battelle submits Draft Charge (combined with draft Work Plan – Task 1) [b]	2/2/2010
	USACE provides comments on draft charge	6/3/2010
	Battelle submits Final Charge (combined with final Work Plan – Task 1) [b]	6/16/2010
	USACE approves Final Charge	6/17/2010
	USACE provides revised Charge to be included in revised Work Plan [b]	7/1/2011
4	USACE/Battelle Kick-off Meeting	7/25/2011
	Battelle sends review documents to panel members	7/22/2011
	Battelle/IEPR Panel Kickoff Meeting	7/29/2011
	USACE/Battelle/IEPR Panel Kickoff Meeting	7/29/2011
	Battelle convenes Mid-Review Teleconference	8/5/2011
5	Panel members complete their review	8/19/2011
	Convene Panel Review Teleconference	8/26/2011
	Panel members provide draft Final Panel Comments to Battelle	9/7/2011
	Final Panel Comments finalized	9/16/2011
6	Battelle submits Final IEPR Report to USACE [b]	9/26/2011

Task	Action	Due Date
7 [c]	Battelle inputs Final Panel Comments to DrChecks; Battelle provides Final Panel Comment response template to USACE	9/28/2011
	Teleconference between Battelle and USACE to review the Comment Response Process	9/28/2011
	Teleconference between Battelle and Panel to review the Comment Response Process (if necessary)	9/28/2011
	USACE PDT provides draft Evaluator Responses and clarifying questions to Battelle	10/5/2011
	Teleconference between Battelle, IEPR Panel, and USACE PDT to discuss Final Panel Comments, draft responses, and clarifying questions	10/18/2011
	USACE inputs final Evaluator Responses in DrChecks	10/25/2011
	Battelle inputs the Panel's BackCheck Responses in DrChecks	11/4/2011
	Battelle submits pdf printout of DrChecks project file [b]	11/4/2011
	End of Period of Performance	1/13/2012

[b] Deliverable.

[c] Task 7 will occur after the submission of this report.

[d] The final Work Plan was revised according to the modified SOW and period of performance.

3.2 Identification and Selection of IEPR Panel Members

The candidates for the Panel were evaluated based on their technical expertise in the following key areas: civil/design construction cost engineering, Civil Works planning, economics, National Environmental Policy Act (NEPA) and biology, and hydraulics and hydrology. These areas correspond to the technical content of the TRDN Feasibility Study and overall scope of the TRDN Feasibility Study project.

To identify candidate panel members, Battelle reviewed the credentials of the experts in Battelle's Peer Reviewer Database, sought recommendations from colleagues, contacted former panel members, and conducted targeted Internet searches. Battelle initially identified more than 37 candidates for the Panel, evaluated their technical expertise, and inquired about potential COIs. Of these, Battelle chose four of the most qualified candidates and confirmed their interest and availability. The remaining candidates were not proposed for a variety of reasons, including lack of availability, disclosed COIs, or lack of the precise technical expertise required. Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to USACE for

feedback. Battelle made the final selection of panel members according to the selection criteria described in the Work Plan.

The candidates were screened for the following potential exclusion criteria or COIs.[a] These COI questions were intended to serve as a means of disclosure and to better characterize a candidate's employment history and background. Providing a positive response to a COI screening question did not automatically preclude a candidate from serving on the Panel. For example, participation in previous USACE technical peer review committees and other technical review panel experience was included as a COI screening question. A positive response to this question could be considered a benefit.

- Involvement by you or your firm[b] in the in any part of the Tres Rios del Norte Feasibility Study.
- Involvement by you or your firm[b] in any work related to the Santa Cruz River, including the Tres Rios del Norte Project.
- Involvement by you or your firm[b] in any work related to the Sonoran Desert Conservation Plan.
- Current employment by the U.S. Army Corps of Engineers (USACE).
- Involvement with paid or unpaid expert testimony related to the Tres Rios del Norte Project, the Santa Cruz River, or the Sonoran Desert Conservation Plan.
- Current or previous employment or affiliation with members of the cooperating agencies or local sponsors, including the Town of Marana, the City of Tucson, Pima County Flood Control District, the U.S. Fish and Wildlife Service, the State of Arizona Game and Fish Department, and the State of Arizona Department of Environmental Quality <u>and</u> currently working on Santa Cruz River Watershed -related projects (for pay or *pro bono*).
- Past, current, or future interests or involvements (financial or otherwise) by you, your spouse, or your children related to the Tres Rios del Norte Project, the Santa Cruz River, or the Sonoran Desert Conservation Plan.
- Current personal involvement with other USACE projects, including whether involvement was to author any manuals or guidance documents for USACE. If yes, provide titles of documents or description of project, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role. Please highlight and discuss in greater detail any projects that are *specifically* with the Los Angeles District.
- Current firm[b] involvement with other USACE projects, *specifically* those projects/contracts that are with the Los Angeles District. If yes, provide title/description, dates, and location (USACE district, division, Headquarters, ERDC, etc.), and position/role.

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[a] Battelle evaluated whether scientists in universities and consulting firms that are receiving USACE-funding have sufficient independence from USACE to be appropriate peer reviewers. See OMB (2004, p. 18), "….when a scientist is awarded a government research grant through an investigator-initiated, peer-reviewed competition, there generally should be no question as to that scientist's ability to offer independent scientific advice to the agency on other projects. This contrasts, for example, to a situation in which a scientist has a consulting or contractual arrangement with the agency or office sponsoring a peer review. Likewise, when the agency and a researcher work together (e.g., through a cooperative agreement) to design or implement a study, there is less independence from the agency. Furthermore, if a scientist has repeatedly served as a reviewer for the same agency, some may question whether that scientist is sufficiently independent from the agency to be employed as a peer reviewer on agency-sponsored projects."

[b] Includes any joint ventures in which your firm is involved and if your firm serves as a prime or as a subcontractor to a prime. Please clarify which relationship exists.

- Previous employment by USACE as a direct employee or contractor (either as an individual or through your firm[2]) within the last 10 years, *notably* if those projects/contracts are with the Los Angeles District. If yes, provide title/description, dates employed, and place of employment (district, division, Headquarters, ERDC, etc.), and position/role.
- Other USACE affiliation [e.g., scientist employed by USACE].
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning arid region habitat restoration, and include the client/agency and duration of review (approximate dates).
- Pending, current, or future financial interests in Tres Rios del Norte-, Santa Cruz River-, or Sonoran Desert Conservation Plan-related contracts/awards from USACE.
- A significant portion (i.e., greater than 50%) of personal or firm[2] revenues within the last 3 years came from USACE contracts.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the Santa Cruz River, the Tres Rios del Norte Project, or the Sonoran Desert Conservation Plan.
- Participation in relevant prior Federal studies/programs relevant to this project, such as, Aquatic Vertebrate Conservation in Pima County: Concepts and Planning Development; Gila River and Tributaries, Arizona and New Mexico, Santa Cruz River Watershed Basin Final Reconnaissance Study Arizona; the Draft Santa Cruz River Watershed Feasibility Study; the Rillito River Flood Control Project; the Tucson Drainage (Arroyo Chico) Project; the Ajo Detention Basin Project; or the Santa Cruz River Bank Stabilization Project.
- Participation in relevant prior non-Federal studies/programs relevant to this project, such as the Tucson Water Resources Plan 1990-2100 or the Reclaimed Water System Master Plan for Tucson Water
- Any past, present, or future activity, relationship, or interest (financial or otherwise) that could make it appear that you would be unable to provide unbiased services on this project.

In selecting the final members of the Panel from the list of candidates, Battelle chose experts who best fit the expertise areas and had no COIs. The four final reviewers were either affiliated with academic institutions or consulting companies or were independent engineering consultants. Battelle established subcontracts with the panel members when they indicated their willingness to participate and confirmed the absence of COIs through a signed COI form. USACE was given the list of candidate panel members, but Battelle made the final selections of the Panel. Section 4 of this report provides names and biographical information on the panel members.

Within 9 days of their modified subcontracts being finalized, all members of the Panel attended a kick-off meeting via teleconference planned and facilitated by Battelle in order to review the IEPR process, the schedule, communication procedures, and other pertinent information for the Panel.

3.3 Preparation of the Charge and Conduct of the IEPR

Battelle drafted a preliminary charge document, including specific charge questions and discussion points. The charge was prepared by Battelle to assist USACE in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). The draft charge was submitted to USACE for evaluation as part of the draft Work Plan. USACE provided comments and revisions to the draft charge based on revisions to the TRDN Project documents, which were used to produce the revised final charge. The revised final charge was submitted to USACE as part of the revised final Work Plan. In addition to a list of 172 charge questions/discussion points, the final charge included general guidance for the Panel on the conduct of the peer review (provided in Appendix B of this final report).

Battelle planned and facilitated a final kick-off meeting via teleconference during which USACE presented project details to the Panel. Before the meeting, the IEPR Panel received an electronic version of the final charge and the TRDN Feasibility Study documents and reference materials listed below. The documents and files in bold font were provided for review; the other documents were provided for reference or supplemental information only.

- **Tres Rios del Norte, Pima County, Arizona Draft Feasibility Report**
    - **Appendix A – Without-Project Hydraulics**
    - **Appendix B – With-Project Hydraulics**
    - **Appendix C – Cost Estimating**
    - **Appendix D – Design**
    - **Appendix E – Economics**
    - **Appendix F – Ecosystem Restoration Functional Assessment**
    - **Appendix G – Geological Characteristics**
    - **Appendix H – Groundwater Modeling**
    - **Appendix I – Real Estate Plan**
    - **Appendix J – Preliminary Phase I Environmental Site Assessment**
- **Tres Rios del Norte, Pima County, Arizona Environmental Impact Statement**
- USACE guidance *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010
- CECW-CP Memorandum dated March 31, 2007
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

About halfway through the review of the TRDN Feasibility Study documents, a teleconference was held with USACE, the Panel, and Battelle so that USACE could answer any questions the Panel had concerning either the review documents or the project. In addition, throughout the review period, USACE provided additional documents at the request of panel members. These additional documents were provided to Battelle and then sent to the Panel as supplemental information only and were not part of the official review. During the review process, the Panel requested the following supplemental information from USACE:

- A Planning-based Wetlands Functional Assessment Model for Southern Arizona's Arid Riverine Systems and Their Associated Riparian Habitats

- Montgomery & Associates. 2002. Baseline Groundwater Flow Modeling for Tres Rios Del Norte Project, Pima County, Arizona, Errol L. Montgomery & Associates, July 2002.
- Draft Planning Model Quality Assurance Review Comments on: A Planning-based Wetlands Functional Assessment Model for Southern Arizona's Arid Riverine Systems and Their Associated Riparian Habitats
- Memorandum For Record: Action to address Planning Model Quality Assurance Review Comments On: A Planning-based Wetlands Functional Assessment Model for Southern Arizona's Arid Riverine Systems and Their Associated Riparian Habitats

3.4 Review of Individual Comments

The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle. At the end of the review period, the Panel produced approximately 400 individual comments in response to the charge questions/discussion points. Battelle reviewed the comments to identify overall recurring themes, areas of potential conflict, and other overall impressions. As a result of the review, Battelle summarized the 400 comments in a preliminary list of 34 overall comments and discussion points. Each panel member's individual comments were shared with the full Panel in a merged individual comments table.

3.5 IEPR Panel Teleconference

Battelle facilitated a 4-hour teleconference with the Panel so that the panel members, many of whom are from diverse scientific backgrounds, could exchange technical information. The main goal of the teleconference was to identify which issues should be carried forward as Final Panel Comments in the Final IEPR Report and decide which panel member would serve as the lead author for the development of each Final Panel Comment. This information exchange ensured that the Final IEPR Report would accurately represent the Panel's assessment of the project, including any conflicting opinions. The Panel engaged in a thorough discussion of the overall positive and negative comments, added any missing issues of high-level importance to the findings, and merged any related individual comments. In addition, Battelle confirmed each Final Panel Comment's level of significance to the Panel.

The Panel also discussed issues where there appeared to be disagreement among panel members. The issues were resolved based on the professional judgment of the Panel, and all issues were determined not to be conflicting. Each issue was either incorporated into a Final Panel Comment, determined to be consistent with other Final Panel Comments already developed, or determined to be a non-significant issue.

At the end of these discussions, the Panel identified 19 comments and discussion points that should be brought forward as Final Panel Comments.

3.6 Preparation of Final Panel Comments

Following the teleconference, Battelle prepared a summary memorandum for the Panel documenting each Final Panel Comment (organized by level of significance). The memorandum provided the following detailed guidance on the approach and format to be used to develop the Final Panel Comments for the TRDN Feasibility Study:

- Lead Responsibility: For each Final Panel Comment, one Panel member was identified as the lead author responsible for coordinating the development of the Final Panel Comment and submitting it to Battelle. Battelle modified lead assignments at the direction of the Panel. To assist each lead in the development of the Final Panel Comments, Battelle distributed the merged individual comments table, a summary detailing each draft final comment statement, an example Final Panel Comment following the four-part structure described below, and templates for the preparation of each Final Panel Comment.
- Directive to the Lead: Each lead was encouraged to communicate directly with other IEPR panel members as needed and to contribute to a particular Final Panel Comment. If a significant comment was identified that was not covered by one of the original Final Panel Comments, the appropriate lead was instructed to draft a new Final Panel Comment.
- Format for Final Panel Comments: Each Final Panel Comment was presented as part of a four-part structure:
  1. Comment Statement (succinct summary statement of concern)
  2. Basis for Comment (details regarding the concern)
  3. Significance (high, medium, low; see description below)
  4. Recommendation(s) for Resolution (see description below).
- Criteria for Significance: The following were used as criteria for assigning a significance level to each Final Panel Comment:
  1. High: Describes a fundamental problem with the project that could affect the recommendation, success, or justification of the project. Comments rated as high indicate that the Panel analyzed or assessed the methods, models, and/or analyses and determined that there is a "showstopper" issue.
  2. Medium: Affects the completeness of the report in describing the project, but will not affect the recommendation or justification of the project. Comments rated as medium indicate that the Panel does not have sufficient information to analyze or assess the methods, models, or analyses.
  3. Low: Affects the understanding or accuracy of the project as described in the report, but will not affect the recommendation or justification of the project. Comments rated as low indicate that the Panel identified information (tables, figures, equations, discussions) that was mislabeled or incorrect or data or report sections that were not clearly described or presented.
- Guidance for Developing Recommendations: The recommendation section was to include specific actions that USACE should consider to resolve the Final Panel Comment (e.g., suggestions on how and where to incorporate data into the analysis, how and where to address insufficiencies, areas where additional documentation is needed).

At the end of this process, 19 Final Panel Comments were prepared. Battelle reviewed and edited the Final Panel Comments for clarity, consistency with the comment statement, and adherence to guidance on the Panel's overall charge, which included ensuring that there were no comments regarding either the appropriateness of the selected alternative or USACE policy.

There was no direct communication between the Panel and USACE during the preparation of the Final Panel Comments. The Final Panel Comments are presented in Appendix A of this report.

4. PANEL DESCRIPTION

Candidates for the Panel were identified using Battelle's Peer Reviewer Database, targeted Internet searches using key words (e.g., technical area, geographic region), searches of websites of universities or other compiled expert sites, and referrals. Battelle prepared a draft list of primary and backup candidate panel members (who were screened for availability, technical background, and COIs), and provided it to USACE for feedback. Battelle made the final selection of panel members.

An overview of the credentials of the final four primary members of the Panel and their qualifications in relation to the technical evaluation criteria is presented in Table 2. More detailed biographical information regarding each panel member and his or her area of technical expertise is presented in the text that follows the table.

Table 2. TRDN Feasibility Study IEPR Panel: Technical Criteria and Areas of Expertise

Technical Criteria	Hamilton	Pugh	Patten	Philips
Design and Construction Cost Engineering (one expert needed)				
Familiar with large, complex civil works projects with high public and interagency interests	X			
Demonstrated experience in performing cost engineering/construction management for all phases of ecosystem restoration or related projects	X			
Demonstrated experience in performing cost engineering/construction management for all phases of flood risk management or related projects	X			
Familiar with similar projects across U.S. and related cost engineering	X			
Experience in associated contracting procedures, total cost growth analysis, and related cost risk analysis	X			
Familiar with construction industry and practices used in wetland and riparian restoration in the arid Southwest	X			
MS degree or higher in civil engineering	X			
Civil Works Planner and Economics (combined role; one expert needed)				
Familiar with large, complex civil works projects with high public and interagency interests		X		
Experience in the plan formulation process		X		
Familiar with evaluation of alternative plans for ecosystem restoration projects		X		
Familiar with USACE standards and procedures	X	X		
Degree in planning,economics or a related field		X		
Ability to evaluate the cost effectiveness and incremental cost analysis (CE/ICA), as applied to dollar costs and ecosystem restoration benefits		X		
Familiar with the CE/ICA tool called IWR-Planning Suite		X		

Technical Criteria	Hamilton	Pugh	Patten	Philips
Civil Works Planner and Economics (combined role; one expert needed) continued				
Experience with National Economic Development analysis procedures, particularly as they relate to recreation and water supply projects	X	X		
Familiar with large, complex civil works projects with high public and interagency interests		X		
NEPA and Biology (one expert needed)				
Familiar with large, complex civil works projects with high public and interagency interests			X	
Knowledge of ecosystem restoration	X	X	X	
Familiar with all NEPA requirements	X	X	X	
Experience in wetland and riparian ecology of arid regions, preferably in the arid Southwest			X	
MS degree or higher in ecology or biology			X	
Hydrogeology and Hydraulics (one expert needed)				
Familiar with large, complex civil works projects with high public and interagency interests				X
Experience with engineering analyses related to riparian restoration or related projects in the arid Southwest				X
Familiar with standard USACE hydrologic and hydraulic computer models				X
Familiar with groundwater modeling	X			X
Registered Professional Engineer	X			X
MS degree or higher in civil engineering or hydrology and hydraulics	X			X

Douglas Hamilton, P.E.

Role: This panel member was chosen primarily for his civil design and construction cost engineering experience and expertise.
Affiliation: Exponent, Inc.

Mr. Douglas Hamilton is a principal engineer and the Director of Water Resources Engineering at Exponent, Inc. in Irvine, California. He earned his masters degree in civil engineering from the University of California at Davis in 1985, and has 22 years of experience in civil engineering, water resources, hydrology, and natural hazards in arid environments. He is a registered professional engineer in California.

Prior to joining Exponent, Mr. Hamilton worked for USACE's Hydrologic Engineering Center (HEC) where he was responsible for conducting flood hazard, sedimentation, and debris flow studies and was in charge of HEC-6 (Sediment Transport in Rivers and Reservoirs). Mr. Hamilton designed a vegetated, multipurpose channel at Del Webb's Sun City, Palm Desert, California that conveyed 31,000 cubic feet per second of stormwater for the 100-year (1%) chance flood event. He was responsible for optimizing and managing construction material (soil cement and natural rock) to isolate flood hazards; managing and minimizing costs; managing channel construction, installation, and permitting; coordinating with FEMA on flood hazard mitigation; and monitoring the performance of the channels and set-backs during actual floods.

Mr. Hamilton is also designing and cost- and construction-managing a segment of the East Valley Flood Control Project in the Coachella Valley, Riverside County, California, a major public works project that provides flood protection for areas north of Interstate 10. The project also has to coordinate with the adjacent Fringe Toed Lizard Preserve. The design includes maintenance for both flood flows and wind-blown sand dunes with the wind-blown sand being collected and placed at a location that would enhance the preserve. Another major project involves the restoration of Iraq marshlands, for which Mr. Hamilton is responsible for analysis, implementation, stakeholder coordination, and on-site cost control. Many of Mr. Hamilton's projects have included working with associated contracting procedures, total cost growth analysis, and cost risk analysis.

Steven Pugh

Role: This panel member was chosen primarily for his Civil Works planning and economics experience and expertise.
Affiliation: Independent

Mr. Steven Pugh is an independent consultant with 17 years of experience in planning and plan formulation, particularly focusing on planning and/or evaluating the results of wetland restoration or mitigation projects. These projects have ranged from studies in controlled wetland cells to monitoring tidal and freshwater wetland restoration projects on a watershed scale.

Between 1999 and 2007, at USACE, Baltimore District, Mr. Pugh served as the lead planner, ecologist, or environmental quality control specialist for more than 50 Civil Works projects and watershed studies. He participated in all phases of wetland, stream, and fish passage restoration projects from reconnaissance through monitoring and adaptive management. Mr. Pugh also acted as the lead team member responsible for compliance with the National Environmental Policy Act (NEPA) and other Civil Works-related environmental laws and policies. From 2002 to 2007, Mr. Pugh was the lead Civil Works planner and ecologist for the Chesapeake Marshlands restoration study and demonstration project, which involved evaluating the feasibility of restoring up to 20,000 acres of fresh/brackish water tidal wetlands, including a designated Ramsar site at Blackwater National Wildlife Refuge. Mr. Pugh also acted as the lead Civil Works planner for USACE's Anacostia River Watershed Restoration Study in Maryland and Washington, D.C. and the Middle Potomac River Study in Maryland. Mr. Pugh participated in the planning of watershed, ecosystem restoration, and reservoir water allocation projects while working with the USACE Baltimore District, including the use of CE/ICA to evaluate project alternatives.

In 2004, Mr. Pugh helped develop USACE's Planning Core Curriculum (PROSPECT) course on Planning Ecosystem Restoration Projects, which had a substantial component on CE/ICA and several modules on the use of IWR Plan, and served as a PROSPECT instructor from 2004 to 2007. Mr. Pugh also served as an instructor for USACE's "Planning Associates Program," and assisted in teaching a workshop on the use of an IWR Plan in the context of ecosystem restoration. Mr. Pugh is familiar with the basic principles of NED analysis related to recreation and waters supply projects and has received training in this area through the Planning Associates program.

While a biologist with the National Resource Conservation Service (1996-1999), Mr. Pugh was a team leader on studies related to the development of ecological performance measures for aquatic ecosystem restoration projects and conducted fish, reptile, amphibian, vegetation, aquatic invertebrate, soils, and hydrological studies for a number of wetland restoration projects

Duncan Patten, Ph.D.

Role: This panel member was chosen primarily for his NEPA and biology experience and expertise.
Affiliation: Montana State University

Dr. Duncan Patten has been a research professor at Montana State University since 1995 and is a professor emeritus at Arizona State University, where he previously taught for 30 years. He earned his Ph.D. in botany and ecology from Duke University in 1962, and has more than 30 years of experience conducting riparian and wetland research in the American southwest. From 1989 to 1996, he was a senior scientist with the U.S. Bureau of Reclamation and directed the research for the Glen Canyon (Arizona) Dam Environmental Impact Statement (EIS) and supported other research programs. He also served on the National Academy of Sciences' Glen Canyon Environmental Studies Committee for 10 years. His Glen Canyon-related research included determining appropriate flows and reservoir-release rules for the protection of Colorado River downstream habitats. He also conducted research on riparian vegetation restoration for the Provo River Restoration Project in Utah.

He has received numerous grants for conducting riparian and wetland research, including studying dam management, functional assessments of effluent-dominated riparian ecosystems, riparian vegetation and habitat enhancement, effects of surface and groundwater on riparian and wetland ecosystems in Nevada, the restoration of riparian grasslands and forests, and the restoration of the Colorado River ecosystem using planned flooding. Dr. Patten is a Certified Senior Ecologist with the Ecological Society of America and is a past president of the Society of Wetland Scientists (1996-1997) and the Arizona Riparian Council (1985-1989).

Christopher Philips, P.E.

Role: This panel member was chosen primarily for his hydrologic and hydraulic engineering experience and expertise.
Affiliation: Riverbend Engineering, LLC.

Mr. Christopher Philips is the owner and senior engineer at Riverbend Engineering in Albuquerque, NewMexico. He earned his Master's degree in civil engineering (with a specialty in water resources) in 1996 from the University of New Mexico and has 24 years of experience in hydrological and hydraulic engineering. He is a registered professional engineer in New Mexico, Colorado, and Texas, and a certified floodplain manager in New Mexico.

His extensive experience with riparian restoration experience includes Rio Hondo and Chama River in New Mexico (surveys, geomorphic evaluation, restoration design for habitat enhancement, construction management, permitting, and long-term monitoring); San Juan River in New Mexico (permitting and construction management for enhancement of fish habitat, wetland mitigation design including groundwater movement assessment and detailed grading

plan); Rio Ojo Sarco in New Mexico (designed 1.5 miles of river restoration, which included habitat enhancement, riparian area restoration, and improved groundwater storage); and San Pedro Creek in New Mexico (assessment and design for riparian restoration, stormwater reuse planning). He has used USACE hydrologic and hydraulic computer models in many of his projects, and is adept with HEC-1, HEC-2, HEC-HMS, and HEC-RAS.

Mr. Phillips is familiar with large Civil Works projects, having conducted the hydraulic design and cost estimating for the Alamogordo Flood Control Channels in New Mexico; the dam condition assessment, hydraulic capacity, spillway functions, breach assessment, and flood encroachment study for the Santa Ana Dam; and the hydrologic and hydraulic modeling and design of several storm drain systems and a 7-acre retention pond/recreational complex in Hobbs, New Mexico.

5. SUMMARY OF FINAL PANEL COMMENTS

The Panel agreed among one another on their "assessment of the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used" (USACE, 2010; p. D-4) in the TRDN Feasibility Study documents. In general, the Panel acknowledges that the methods, models, and assessments leading to the temporarily selected plan for ecosystem restoration, recreation, and water supply are appropriate and sufficient to achieve the study goals. The Panel has four primary concerns:

- The TRDN Feasibility Study does not include sufficient information from more recent pertinent scientific publications.
- Some sections of the TRDN Feasibility Study do not provide sufficient details to allow for a thorough review by the Panel.
- Some aspects of the cost-benefit analysis have inadequacies or, if not, are not sufficiently documented.
- Potential negative environmental impacts from the temporarily selected plan are not fully accounted for, and seemingly appropriate avoidance or mitigation measures are not applied.

The Panel agrees that the TRDN Feasibility Study would be improved if information in the appendices is brought to light and referenced in the corresponding sections of the main report. Table ES-1 lists the Final Panel Comments statements by level of significance. The full text of the Final Panel Comments is presented in Appendix A of this report. The following statements summarize the Panel's findings.

Plan Formulation: The TRDN Feasibility Study uses sound methods and appropriate models to formulate and evaluate alternative plans. However, the Panel has provided recommendations and suggestions to improve the analysis and interpretation of some aspects of the formulation process.

Economics: The TRDN Feasibility Study uses sound economic methods and appropriate models and approaches to conduct the cost effectiveness and incremental cost analyses (CE/ICA) for

ecosystem restoration, recreation, and water supply. However, details necessary for conducting a thorough review are missing from some of the steps used for preliminary screening of management measures and elements. In addition, assumptions in the ecosystem restoration analysis are inaccurate.

Engineering: The TRDN Feasibility Study includes a very thorough analysis of large single-event hydraulics, scour and sediment transport, and sound regionally relevant engineering methods. Potential areas of concern, such as the Tucson Ready Mix pit, have been identified and thoroughly analyzed. The details of the effects of small flow events has not been adequately analyzed, including areas of inundation (i.e., flooding of new plantings), quantification of lateral seepage of effluent water from the river channel, and vertical channel stability when clean-water urban runoff dominates the flood regime. Introducing grade control reduces long-term erosion and contributes to the project's success; however, the number of grade control structures appears to be insufficient to achieve project objectives. A more complete analysis of geomorphically based channel stability is needed to ensure a self-sustaining project.

Environmental: The TRDN Feasibility Study does not fully consider the environmental conditions necessary for the successful restoration of riparian vegetation, including the availability of a shallow water table following planting, and the capability of capturing sufficient water from other sources, including effluent, to maintain riparian plantings. The reference conditions to be used to evaluate restoration success are based on historic photos that do not predate early uses and changes of the riverine system being restored. In addition, upstream uses of the aquifer underlying the study area may impact the project. Information is also absent on the use of pumps to move effluent water that would sustain new riparian vegetation.

Table 3. Overview of 19 Final Panel Comments Identified by the TRDN Feasibility Study IEPR Panel

No.	Final Panel Comment
Significance – High	
1	The time period and scope of the Monitoring and Adaptive Management Plan does not appear to be sufficient to determine the success of the project.
2	The constructed multi-channel water recharge facility will likely result in reducing the actual number of Average Annual Functional Capacity Units (AAFCUs) generated by the project.
3	The optimal river dimensions and pattern, which are critical elements of the TRP, have not been quantified in the review documents.
4	The use of grade control for managing and preventing head-cuts and the secondary benefits of lateral spreading and recharge have not been fully investigated.
Significance – Medium	
5	The pumping of effluent water out of the channel may be possible from a volumetric perspective, but there is no discussion of the practical challenges with extracting large quantities of water from shallow wells in a sandy river bottom.
6	It has not been substantiated that stormwater harvesting from the tributaries and the main stem of the Santa Cruz River is a viable project component.
7	A guarantee that the effluent water supplies necessary to accomplish project goals will be available throughout the duration of the TRDN project life has not been provided.
8	The two proposed graded recharge channels are not necessary to meet the water recharge goals of the project, and this design does not allow for an increase in riparian habitat.
9	Cross-section examples along the restored areas of the channel, showing the relationship between important project elements such as planting locations, topography, and potential groundwater depths, are not included, but are necessary to illustrate the integration of project components.
10	The estimated unit costs of land acquisition for the TRP are not consistently reported and could result in the cost of the project being under- or overstated.
11	The rationale for not providing a cost estimate, net water supply benefits, and a rank for the potential non-structural alternative plan(s) (Table 5-19 and page 5-42, 43) is not fully discussed, which affects the evaluation of the plan formulation process.
12	The specific metrics used in the process to preliminarily screen the management measures and elements are not presented and so could not be evaluated.
13	It is unclear how the recreational facilities analysis was included in the future without project alternative.
14	The basis for ensuring the success of this project does not appear to rely on recent publications regarding ecosystem processes, functions, and services, or on literature demonstrating how riparian ecosystems function and respond to modifications of key environmental variables.
15	The statement that hazardous material plumes will not impact public water supplies has not been substantiated.

No.	Final Panel Comment
16	The Cultural Resources section does not document coordination with the State Historic Preservation Officer, plans for historic sites with National Historic Landmark status as well as archeological sites, or a plan for surveying the remaining one-third of the project area.
17	The potential impact of climate change on the success of the project has not been evaluated.
Significance – Low	
18	The potential impacts to the TRDN project that may occur due to future upstream water demands and uses in Santa Cruz county are not discussed.
19	The historic conditions of the riparian habitat description are not thoroughly developed to be used as a guide for the selection of possible reference conditions for an ecosystem restoration study.

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APPENDIX A

Final Panel Comments

on the

TRDN Feasibility Study

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Comment 1

The time period and scope of the Monitoring and Adaptive Management Plan does not appear to be sufficient to determine the success of the project.

Basis for Comment:

The Guidelines for the Development of a Monitoring and Adaptive Management Plan for the Tres Rios del Norte Ecosystem Restoration (EIS, Appendix E, Section 1.0, p. 1-1) states, "The TRDN restoration project would be monitored both qualitatively and quantitatively for five years following the construction year." Although five years of monitoring can be informative, it is not likely to be a sufficient duration to determine if the targeted habitat types or characteristic channel dynamics (physical processes and structural attributes) have been achieved to obtain the projected functional capacity that is the basis for this project.

During the first few years, vegetation plantings and re-plantings, along with changes in water delivery regimes and re-grading, are likely to occur based on information obtained from monitoring activities. The Panel believes it is unlikely that all of the proposed habitat types will be fully established throughout the study area within five years. The Panel agrees that a more intensive quantitative monitoring approach may be more appropriate in the early stages after construction, and understands that existing policies guide the duration of monitoring and adaptive management activities that are cost shared with Federal dollars. That being said, an effective monitoring and adaptive management strategy, for the duration of the project life, is necessary to ensure the optimum opportunity for the project to deliver the predicted ecosystem benefits.

The TRDN Draft Feasibility Report indicates that maintenance activities will be required periodically during the lifetime of the project, some of which are necessary to ensure habitat conditions capable of achieving the proposed benefits. Two examples are the replacement of vegetation following tear-out during flood events (Table 6-6, p. 6-9) and the removal of Saltcedar (Section 6.4.1.6, pp. 6-10, 6-11). Including these maintenance activities as components of monitoring and adaptive management would create a seamless plan that extends through the life of the project regardless of changes in phase, cost share, or other variables.

Significance – High:

To achieve the predicted benefits, the project requires a plan to monitor and implement adaptive management measures or maintenance activities that directly affect habitat features for the entire 50-year project life. .

Recommendations for Resolution:

1. Develop a single plan for monitoring and adaptive management for the duration of the 50-year project life. The plan should describe the monitoring activities that should take place in the construction phase, post-construction intensive monitoring and adaptive management phase, and the operations and maintenance phase. The plan should identify responsible parties for funding and conducting monitoring and adaptive management activities for each phase. If the information regarding monitoring and adaptive management requirements for the operations and maintenance period is addressed in the operations and maintenance manual (plan), then this should be stated in the monitoring and adaptive management plan.

2. Consider extending the five year intensive monitoring and adaptive management period by scheduling monitoring activities on non-successive years where appropriate.

Comment 2

The constructed multi-channel water recharge facility will likely result in reducing the actual number of Average Annual Functional Capacity Units (AAFCUs) generated by the project.

Basis for Comment:

The TRDN Draft Feasibility Report states, "The primary ecosystem problem evident along the study reach of the Santa Cruz River is severe degradation and loss of riparian habitat" and "Today, less than 500 acres (approximately six to seven percent) of the historic riparian habitat remains…" (p. E-1). The report further states, "Johnson and Haight (1984) called Southwest riparian ecosystems some of the most endangered in the world due to their support of rich biota and the fact that between 75 and 90 percent have been destroyed" (p. ES-2). This information suggests that increasing the quantity and quality of the native riparian/wetland habitat benefits the ecosystem within the study area. The report presents similar plans for restoring habitat that produce dissimilar amounts of habitat in terms of acres; these plans should not be considered to have equivalent National Ecosystem Restoration (NER) benefits.

Plan C High proposes to restore 1,402 acres of habitat (Table 5-8, p. 5-26) and produce 1,343 Average Annual Functional Capacity Units (AAFCU) (Table 5-51, p. 5-34). Plan C High has been determined to be both cost-effective and a best buy according to Table 5-17, p. 5-37. The defined NER plan proposes to restore 1,360 acres of riparian/wetland habitat (Table 5-27, p. 5-52) and produce 1,343 AAFCU (Section 5.8.1.1, p. 5-52). The combined plan, which is also the tentatively recommended plan (TRP), proposes to restore 1,360 acres of riparian/wetland habitat, but will destroy a minimum of 23 acres of existing riparian/wetland habitat to build the multi-channel groundwater recharge facility (Section 5.8.4.1 and Table 5-33, p. 5-64). An additional 18 acres of existing cottonwood-willow habitat will be dewatered and destroyed by the construction of the recharge facility. The report states that a similar number of acres of cottonwood-willow habitat are "likely" to re-establish along the multi-channel groundwater infiltration system, but does not propose a plan to ensure that the acres destroyed by the construction of the recharge facility are properly mitigated. The report also does not propose a plan to mitigate for the dewatering of 12 acres of river bottom wet habitat. The net gain in acres of Plan C High (the cost-effective and best buy plan) is 65 to 83 acres more than that of the TRP. This represents a decrease in acres produced ranging from 4.6-6.0% when compared the TRP is compared to the Plan C High. This being the case, it is doubtful that the TRP will produce 1,343 AAFCUs (as reported in Section 6.1.1., p. 6-1) which is equal to that of Plan C High.

As a secondary point, if the TRP does produce an equal number of AAFCUs as Plan C High ,while losing 65-83 acres of riparian/wetland habitat, then Plan C High is likely not a cost-effective plan. One of the three criteria used to determine a non-cost-effective plan (as stated on p. 5-37 of the report) is "the same level of output could be produced by another plan of less cost." If a plan exists that can produce the same number of AAFCUs as Plan C High while restoring 65-83 acres less, then that plan would likely be considerably less expensive than Plan C High, making it not cost-effective.

Significance – High:

The TRP results in 65–83 acres less net gain than Plan C High and is not likely to produce the projected benefits as stated in the report.
Recommendations for Resolution:
1. Analyze the ecosystem restoration component of the TRP in the Tres Rios del Norte hydrogeomorphic based functional assessment model to determine the actual number of AAFCUs expected to be produced. 2. Prepare a plan to mitigate for the dewatering of the existing 18 acres of cottonwood-willow habitat and 12 acres of river bottom wet habitat. If a plan is not developed to mitigate for the loss of wetland habitat, the report should provide supporting documentation as to why it is not a necessary component of National Environmental Policy Act (NEPA) and/or Clean Water Act compliance.

Comment 3
The optimal river dimensions and pattern, which are critical elements of the TRP, have not been quantified in the review documents.
Basis for Comment:
The TRP does not include either an assessment of the existing conditions of the Santa Cruz River's morphological form or recommendations for the restored form of the river channel. A consistent channel cross-section and channel gradient will ensure long-term channel stability (Watson et al., 1999). A consistent channel cross-section will improve sediment transport continuity throughout the river's length. Determination of the appropriate channel meander pattern will guide the grading and planting plan, allowing for maximization of effluent water contact with new riparian planting areas. An over-wide channel bottom may prevent the managed recharge effluent from maintaining contact with the new riparian plantings. Lateral infiltration of effluent water from the river channel will be limited, so the effective zone of sub-irrigation will be relatively narrow. This critical habitat zone must be ensured a steady supply of water to establish and maintain riparian vegetation. Natural and anthropogenic impacts to the Santa Cruz River over the past 100+ years have altered the river's form (Field and Lichvar, 2007), and a geomorphically based analysis was not presented in the TRDN Feasibility Study to justify that the current form of the river is also the future with-project sustainable form.
Significance – High:
A baseline data assessment of the Santa Cruz River channel cross-sectional dimensions and sustainable meander pattern, based on the principles of fluvial geomorphology, must be included as part of the TRP to ensure the long-term stability of the channel and low floodplains, and maximum benefit from managed recharge effluent water.
Recommendations for Resolution:
1. Prepare detailed field assessments of the existing channel form (Biedenharn et al., 1997). 2. Develop a morphologically based plan for a sustainable channel form (dimensions and pattern) by identifying locations on the Santa Cruz River where channel width and depth and the influence of riparian vegetation on the river's banks have created a self-sustaining form. 3. Adjust the locations and elevations of low floodplains adjacent to the river channel based on the proposed stable channel form.

Literature cited

Field, J.J., and R. W. Lichvar. 2007. Review and Synopsis of Natural and Human Controls on Fluvial Channel Processes in the Arid Southwest. ERDC/CRREL TR-07-6, Cold Regions Research and Engineering Laboratory, U.S. Army Engineer Research and Development Center, Hanover, NH, September.

Watson, C.C., D.S. Bidedenbaum, and S.H. Scott. 1999. Channel Rehabilitation: Processes, Design, and Implementation. Workshop, U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, July.

Biedenharn, D.S., C.M. Elliott, and C.C. Watson. 1997. The WES Stream Investigation and Streambank Stabilization Handbook. Workshop, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS.

Comment 4

The use of grade control for managing and preventing head-cuts and the secondary benefits of lateral spreading and recharge have not been fully investigated.

Basis for Comment:

The TRP includes seven grade control structures over the course of 18 miles, and no grade control structures on any of the tributary drainages. Local channel degradation has been observed at Ina Rd, where a 12 foot tall drop structure is controlling channel grade. Historic cycles of channel head-cutting are cited in the TRDN Feasibility Study and in the literature (Field and Lichvar, 2007). Grade control structures located at regular intervals throughout the project would prevent head-cutting, ensure as much sub-irrigation as possible, and improve lateral infiltration for new riparian plantings (Biedenharn et al., 1997)

The TRDN Feasibility Study evaluates the long-term trends in sediment movement in the system when infrequent, large magnitude flood events occur, and concludes that the river system is slowly aggrading. However, frequent flow events originating in an urban watershed will usually accelerate channel degradation because the runoff water contains only small quantities of sediment. The Study does not consider impacts of the smaller, more frequent flow events and the potential for channel bed degradation (Watson et al., 1999).

Significance – High:

When channel degradation does occur, there is a high potential to create a disconnect between the new vegetation and the effluent water in the river channel; regular and frequent spacing of grade control structures will ensure a consistent groundwater regime during the plant establishment period.

Recommendations for Resolution:

1. Analyze the frequency and magnitude of (smaller) flood flow events from the urban areas of Tucson, and the resulting mass sediment balance in the system (i.e., urban inflows will contribute only small quantities of new sediment to the river system).
2. Extrapolate the calculated sediment deficit to the design life of the project to determine the magnitude of channel degradation that can be expected. If the resulting channel degradation would compromise the sub-irrigation of new riparian plantings, then add grade control structures as frequently as needed. This may entail the addition of two to four structures per mile.
3. Locate grade control structures to maximize their benefit: on tributary drainages above the confluence; on the main stem of the Santa Cruz River where scour potential on existing bank protection can be controlled; on the main stem river at the downstream end of new planting areas to ensure the maximum water capture, both from lateral channel sub-irrigation and from overbank flooding.
4. Include grade control structures with a "low flow" notch consistent with the 2-5 year return frequency flood event. This will guide the location of the main river channel and may be used to control channel migration into undesirable areas.

Literature cited

Field, J.J., and R. W. Lichvar, 2007. Review and Synopsis of Natural and Human Controls on Fluvial Channel Processes in the Arid Southwest. ERDC/CRREL TR-07-6, Cold Regions Research and Engineering Laboratory, U.S. Army Engineer Research and Development Center, Hanover, NH, September.

Watson, C.C., D.S. Bidedenbaum, and S.H. Scott. 1999. Channel Rehabilitation: Processes, Design, and Implementation. Workshop, U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, July.

Biedenharn, D.S., C.M. Elliott, and C.C. Watson. 1997. The WES Stream Investigation and Streambank Stabilization Handbook. Workshop, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS.

Comment 5
The pumping of effluent water out of the channel may be possible from a volumetric perspective, but there is no discussion of the practical challenges with extracting large quantities of water from shallow wells in a sandy river bottom.
Basis for Comment:
The annual amount of effluent flow and captured ephemeral stormwater flow that will persistently provide the shallow water table required to sustain new riparian vegetation is not quantified in the TRDN Feasibility Study. Identifying the reliable, cumulative amount of available water flow during the growing season is important because the long-term water use of the additional riparian vegetation that will be installed will depend on this water volume to become established and permanent. If the annual reliable water flow is insufficient to meet the water use of the additional plantings, it could affect the success of the project. The proposed method of using pumps capable of withdrawing water reliably from the upper several feet of alluvial streambed strata is challenging: (1) shallow aquifer drawdown will be acute and could interrupt the supply of pumped water, and (2) during periods of flooding, this shallow aquifer well pumping system could be washed away (Cutler Prior, et.al., 2003). The creation of a shallow water table by pumping effluent out of the main river channel will diminish the amount of water available to the existing, in-channel riparian vegetation and reduce overall project benefits. The Feasibility Study does not present diagrams, dimensions, and pumping cycles for this aspect of the TRDN. It is not clear if the success of the TRDN relies on permanent pumping of shallow groundwater from the streambed to higher alluvial terraces in which newly planted riparian vegetation will inhabit. It is also not demonstrated that all of the project elements, in their entirety, will create an adequate shallow groundwater aquifer that can sustain the proposed acreage of new riparian vegetation as designated in the adopted project.
Significance – Medium:
The use of pumped effluent for the purpose enhancing vegetation requires further discussion to understand the potential impacts to the existing and proposed riparian vegetation.
Recommendations for Resolution:
1. Provide diagrams, dimensions of depth and diameter, and pumping cycles for this aspect of the TRDN. 2. Clarify if the success of the TRDN relies on permanent pumping of shallow groundwater from the streambed to higher alluvial terraces in which newly planted riparian vegetation will inhabit. 3. Clarify whether all of the project elements, in their entirety, will create an adequate shallow groundwater aquifer that can sustain the proposed acreage of new riparian vegetation as designated in the adopted project.

Literature cited

Cutler Prior, J., J.L. Boekoff, M.R. Howes, R.D. Libra, P.E. VanDorpe 2003. Iowa's groundwater basics. Iowa Geological Survey Educational Series 6, Iowa Department of Natural Resources, pp 58-67.

Comment 6

It has not been substantiated that stormwater harvesting from the tributaries and the main stem of the Santa Cruz River is a viable project component.

Basis for Comment:

Stormwater harvesting as a component of the TRDN Feasibility Study is only discussed in general terms. There are few specifics provided regarding the capture and use of this water, although it is accounted for in the water balance summaries. The TRDN project plans to use approximately 3370 acre-fee/year (af/yr) of tributary storm flow harvesting (Draft Feasibility Report, Table 5-35) as a water source. The 3370 af/year of tributary water harvested may be a reasonable number, but little evidence is given to support how 3370 af/year will be captured by gravel-filled trenches. Assuming 30% pore space in the gravel and no sand/silt clogging, approximately 18 million cubic yards of gravel would be required to capture this amount of water in one storm event.

As described, the project will use stormwater harvested in the mainstem of the Santa Cruz River. This harvest will also include stormwater from the tributaries that flow directly into the main channel. These water sources are essentially groundwater recharge. The project also proposes to construct tributary infiltration basins (Appendix D Design, Plate 7) to capture stormwater runoff and allow it to infiltrate the soil where "it can help support the more xeric vegetation types." Drop structures will also be constructed in the mainstem of the Santa Cruz River that may enhance stormwater infiltration and groundwater recharge.

Although the project assumes stormwater can be harvested both on the tributaries and mainstem, it has not demonstrated that this harvested water can be used sufficiently and efficiently to enhance watering of restored plant communities. One issue that is not considered is the ephemeral nature of stormwater sources. Maintenance of riparian and even floodplain vegetation will require more frequent watering than might be expected by ephemeral flows, thus the apparent need for continual watering systems on the riparian species. Restoration of riparian plant species (e.g., cottonwood), and even floodplain species (e.g., mesquite) requires a consistent water source. In the Southwest, true xeroriparian species can survive on ephemeral flows, whereas other riparian species require maintenance of a shallow water table, one regularly accessible to the rooting system of the plants (e.g., Stromberg et al., 1993). The long-term success of this project is dependent on ephemeral water sources to supplement the perennial effluent water source, and during extended dry periods there may be insufficient water to maintain restored plant communities, even those including xeroriparian species.

Significance – Medium:

Additional information is necessary to demonstrate that water harvested from tributaries and mainstem of the Santa Cruz River is available and useable to ensure a consistent water source beyond recapturing it through groundwater withdrawal in the project area.

Recommendations for Resolution:

1. Develop demonstration tributary infiltration basins to test the assumption that these are viable water harvesting tools that make water available even to the xeroriparian species.
2. Develop inundation frequency maps, with quantified areas and calculated depths of (temporary) flooding, and stated assumptions about the volume of infiltration achieved to demonstrate that harvesting water with shallow flooding next to the main stem Santa Cruz at multiple locations is feasible.

Literature cited

Stromberg, J. C., S. D. Wilkins, and J. A. Tress. 1993. Vegetation-hydrology models as management tools for velvet mesquite (*Prosopis velutina*) riparian ecosystems. Ecol. Appl. 3(2):307-314.

Comment 7
A guarantee that the effluent water supplies necessary to accomplish project goals will be available throughout the duration of the TRDN project life has not been provided.
Basis for Comment:
The TRP identifies 25,430 acre feet of managed recharge occurring in the TRDN study area under existing conditions (Table 4.6). The projected total water demand for the TRP is slightly more for both the establishment period (years 1-5) and for the remaining project life (years 6-51). It is clear that the success of the project is dependent on effluent water. Under current conditions, the owners of the effluent are given a 50% recharge credit for disposal of their effluent in the river channel (i.e., managed recharge), and they are given a 100% recharge credit for effluent water disposed of in closed basin infiltration ponds (i.e., constructed recharge). Given the historic rates of population growth in the Tucson area, and the finite water resources available, it is conceivable that a larger portion of the total effluent water will be recharged in constructed recharge facilities in the future to meet municipal demands. If this occurs, there will be less managed recharge available for the TRDN ecosystem restoration project goals.
Significance – Medium:
To be complete, the TRP should include information demonstrating that the required effluent water will be available to accomplish the stated re-vegetation goals for the duration of the project.
Recommendations for Resolution:
1. Obtain Intergovernmental Agreements that effluent water for managed recharge will be provided at certain locations for the duration of the project's life cycle. 2. Obtain written contracts for the purchase and guaranteed delivery of effluent water for the duration of the project's life cycle. 3. Prioritize planting areas based on the level of certainty of water deliveries.

Comment 8

The two proposed graded recharge channels are not necessary to meet the water recharge goals of the project, and this design does not allow for an increase in riparian habitat.

Basis for Comment:

A significant flow event in the Santa Cruz River will mobilize bed sediments and destroy the two proposed recharge channels, requiring the local sponsors to take heavy equipment into the river channel to regrade both channels. In such a flow event, the box culverts will become filled with sediment and have to be cleaned out by the local sponsors. This design element appears to create frequent and unnecessary maintenance requirements.

Also of note, dimensions given for the graded recharge channels are conflicting. Design Sheet 9 (detail Typ-4) in the TRDN Feasibility Study shows a vertical dimension of 2 feet for the graded recharge channels. However, Section 6.2, Water Supply (Recharge) Features, states that "Each channel . . . will be 20 ft deep." It appears that the 2 foot vertical dimension is the correct proposed channel depth.

The primary goal of groundwater recharge through channel bed infiltration can be achieved in this reach through the installation of grade control structures at regular intervals. These grade control structures would also prevent local channel degradation next to soil cement bank protection from reaching a depth where the bank protection would be compromised. In addition, recharge through channel bed infiltration should occur regardless of the alignment or width of the recharge channels.

The lack of proposed riparian vegetation in this reach runs contrary to the overall project goals. Riverbed locations where consistent effluent flows are expected are the only locations where new riparian vegetation plantings can be guaranteed long-term success.

Significance – Medium:

The design of the two graded recharge channels increases future maintenance, and does not support maximization of new riparian plantings.

Recommendations for Resolution:

1. Consider converting box culverts to open notches with a bottom width wide enough for a front end loader or a bulldozer.
2. Add riparian plantings on the low terraces next to the recharge channel(s) and plan plantings relative to eventual development of a low-flow meander pattern.
3. Allow for regrading of the recharge channels on an "as needed" basis in the operations and maintenance documents.
4. Provide clarification if the anticipated relocation of low flow channels will affect the permanent restoration of riparian habitat.

Comment 9

Cross-section examples along the restored areas of the channel, showing the relationship between important project elements such as planting locations, topography, and potential groundwater depths, are not included, but are necessary to illustrate the integration of project components.

Basis for Comment:

Several components of the TRDN project must be integrated to ensure success of the project: water delivery systems from channels placed in the river bed to newly established riparian plantings, modification of floodplains to ensure availability of shallow wetted soils from river flows and effluent to plantings, and riparian plantings on new terraces with densities and distributions designed for success based on “local knowledge.” Some of the project components, such as irrigation of new plants, are temporary but may need to be enduring, whereas others, such as increased lateral groundwater flow and storage in streambanks, which may or may not support new plants, are enduring.

These project components must be designed to work together, and planning a complex project such as TRDN involves the development of river channel and floodplain cross-sections, illustrating how the whole project works as an integrated set of actions and processes . As Brookes (1990) points out, it is difficult to evaluate a project and its potential success and appropriate planning without these integrating diagrams. Kondolf (1996) also used cross-sections of various river restoration projects to evaluate potential outcomes. Although cross-sections of constructed components placed within the channel are provided in the project documents, details demonstrating the integration of modified project components important for riparian restoration are not. Cross-sectional diagram detail of these components would include channel and floodplain terrace elevations, planting locations, and water sources and groundwater depths resulting from effluent and "natural" river flow. Groeneveld and Griepentrog (1985) demonstrated the integration of several riverine components when they discussed the dependence of off-channel riparian vegetation on streamflow replenishment of shallow aquifers.

Significance – Medium:

It is difficult to evaluate project planning or the potential success of the project without diagrams integrating some or all of the riverine components that will be modified or used.

Recommendations for Resolution:

1. Develop appropriate channel/floodplain cross-sections for representative locations along the channel where plantings or other modifications occur that demonstrate the integrated nature of the project.
2. Identify the range of lateral distances of proposed new riparian vegetation from the main flow line(s) of the stream bed.

Literature cited

Brookes, A. 1990. Restoration and enhancement of engineered river channels: Some European experiences. Regulated Rivers: Research & Management 5:45–56.

Groeneveld, D.P. and T.E. Griepentrog. 1985. Interdependence of groundwater, riparian vegetation, and streambank stability: A case study. Symposium on Riparian Ecosystems and Their Management, Tucson, Arizona, April 16-18, 44-48.

Kondolf, G.M. 1996. A cross section of stream channel restoration. J. Soil Water Conserv. 51:119-125.

Comment 10

The estimated unit costs of land acquisition for the TRP are not consistently reported and could result in the cost of the project being under- or overstated.

Basis for Comment:

Multiple values estimated for cost-per-acre required to execute the TRP are provided in the TRDN Draft Feasibility Report (Table 5-16, p. 5-36, Table 6-7, p. 6-16); The Cost Estimate Appendix (Section 4.1.7, p. 19); and the Memorandum from the USACE Project Delivery Team (PDT) to the IEPR Panel (dated August 15, 2011). The specific values for these land acquisition costs taken from these documents are shown below.

- The real estate cost of the TRP (Table 6-7) is $49,781,000 for an acquisition of approximately 2,000 acres, which equates to approximately $25,000 per acre.
- Alternatively, a land cost of $28,814 per acre (Cost Estimate Appendix, p. 19) is recommended for acquiring public land, and $43,221 per acre for acquiring private land.
- The clarification memo provided by the TRDN PDT to the IEPR Panel states that the nine water supply parcels, a total of 200.7 acres, have a total cost of $883,830, which is $4,404 per acre.

Additional clarification of unit costs of land acquisition and potential cost in severance damage is necessary. The unit cost for acquiring private land is the highest at $43,221 per acre and the unit cost of water supply land is the lowest at $4,404 per acre. Based on a review of bare land for sale in Marana, Arizona at www.landwatch.com, this range in cost per acre seems reasonable. However, the basis for this range of unit costs for essentially adjacent parcels is not explained. While the corrected land costs are unlikely to affect the overall feasibility of the project, the overall land cost is second only to the construction cost for the TRDN project.

Significance – Medium:

If the unit land costs are not estimated in a consistent manner, the total cost estimate could significantly change.

Recommendations for Resolution:

1. Include a table or a summary in the main body of the TRDN Draft Feasibility Report of the corrected real estate information, including parcel size, the specific parcels, unit land costs, the potential severance damage, and the total acreage used as the basis for the total cost estimate of real estate ,

Comment 11

The rationale for not providing a cost estimate, net water supply benefits, and a rank for the potential non-structural alternative plan(s) (Table 5-19 and page 5-42, 43) is not fully discussed, which affects the evaluation of the plan formulation process.

Basis for Comment:

According to Section 5.7.3.3 of the TRDN Draft Feasibility Report, non-structural plans exist to address water supply issues within the proposed project area. Section 5.7.3.5 states, "As a stand-alone measure, the non-structural plan will likely outweigh all others in terms of net benefits" (p. 5-43). Table 5-19 indicates that the non-structural plan would have no negative impact on the NER plan. Section 5.7.3.5 states that a non-structural plan "may be pursued by local interests" (p. 5-43). Based on this information, it is unclear why non-structural measures were not fully developed to determine:

1. If structural measures that have a negative impact on the environment can be avoided while continuing to benefit water supply in the area
2. The future without project condition if non-structural measures were implemented.

An explanation for not including potential non-structural alternative(s) in the analysis provided in Table 5-19 is "the cost of achieving this plan is unknown so the net benefits are not calculated." If this is so, the Panel does not understand why some type of estimate could not be generated and why non-structural alternatives were not quantified and ranked in the analysis.

Significance – Medium:

It is difficult to evaluate the recommendations for structural measures that address water supply without understanding the potential costs and benefits of potential non-structural plans.

Recommendations for Resolution:

1. Clarify whether non-structural plans exist that could result in water supply benefits of a similar magnitude as structural alternatives. If so, the non-structural alternatives should be quantified and included in the analysis.
2. Clarify whether the non-structural plans referenced in the report lack the potential to substantially benefit water supply in the project area. This information should be documented and brought to light more fully in the report

Comment 12
The specific metrics used in the process to preliminarily screen the management measures and elements are not presented and so could not be evaluated.
Basis for Comment:
The screening of alternative plans for the TRDN project is discussed in Section 5.6 of the TRDN Draft Feasibility Report. As stated in Section 5.6.1.6, "…Continuing plan formulation efforts by the study team, therefore, focused on the following steps: • Screening of measures and elements to eliminate those that had little or no potential for meeting study objectives or those that were clearly inappropriate for Federal participation or un-supported by non-Federal sponsorship." (p. 5-14). • Assembling the remaining elements into various combinations to create a series of preliminary alternatives that adequately address the study goals and objectives, "(p. 5-14). Three reasons are provided for elements being screened out: 1. Not supported by non-Federal sponsor 2. Not appropriate for Federal participation (although one example given possibly is appropriate for Federal participation [but not USACE], i.e., "acquisition solely for the purpose of habitat preservation") 3. Beyond the ability of USACE to cost share in this study. No other details were provided regarding the metrics (i.e., zoning laws, competing land uses, incompatible land uses, or public safety issues) used for the original screening of measures and elements, or the efforts to collaborate with other agencies to determine if measures could be carried forward and implemented outside of USACE jurisdiction.
Significance – Medium:
More specific information regarding the particular metrics used in the initial screening is required to understand this stage of plan formulation.
Recommendations for Resolution:
1. Include available details regarding metrics used to conduct the preliminary screening in the report. Some potential examples of metrics: zoning laws, competing land uses, incompatible land uses, or public safety issues. 2. Highlight in the report, if appropriate, the ways in which USACE is collaborating with other agencies to promote measures/alternatives that may be implemented by others

Comment 13
It is unclear how the recreational facilities analysis was included in the future without project alternative.
Basis for Comment:
Step two of the six-step planning process specified in ER 1105-2-100 – Planning Guidance Notebook (and described in Section 5-1, p. 5-1 of the TRDN Draft Feasibility Report) states, "Existing and future without project conditions are identified, analyzed, and forecasted." It is difficult to garner from the report details on how this phase of the formulation was conducted, hence the relationship between the existing and the future without project recreation conditions is unclear. The future without project conditions should include projected recreational features that are reasonably expected to occur based on current planning objectives as discussed in the multiple local planning documents presented in Appendix E, Economics. The future without project conditions were not quantitatively compared to the existing conditions to establish a baseline to which all action alternatives could be compared.
Significance – Medium:
Details regarding how the future without project recreation alternative was developed are required to completely describe the plan formulation process.
Recommendations for Resolution:
1. Provide descriptive and quantitative analysis and documentation describing the difference between existing conditions and future without project conditions, or provide an explanation why this analysis is not necessary or possible.

Literature cited

USACE. 2000. Planning – Planning Guidance Notebook. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineer Regulation 1105-2-100. 22 April.

Comment 14

The basis for ensuring the success of this project does not appear to rely on recent publications regarding ecosystem processes, functions, and services, or on literature demonstrating how riparian ecosystems function and respond to modifications of key environmental variables.

Basis for Comment:

One of the primary goals of the TRDN project is to reestablish riparian plant communities along the Santa Cruz River in the Tucson basin. Establishing any plant community requires comprehensive knowledge about what conditions the selected plant species require for successful establishment and maintenance. In the case of the TRDN study area, the primary plant species are southwestern riparian trees and shrubs. Natural establishment of these species occurs in response to several elements, primarily proper hydrological and soil conditions. Southwestern (and especially southern Arizona) riparian and river systems have been studied significantly by researchers at Arizona State University (ASU) and University of Arizona (UA). Publications of these researchers and others, especially those of Drs. Stromberg (ASU) and Maddock (UA), are included in the literature list below.

Discussions of restoration and planting processes for riparian vegetation in the TRDN Draft Feasibility Report and EIS do not reference any of the many peer-reviewed publications of local researchers that could guide the riparian community reestablishment. Without the use of foundation information from scientific experts, it is questionable whether the riparian reestablishment that is at the heart of the TRDN project will succeed. In addition, a review of other riparian restoration projects in the Southwest would provide a valuable opportunity to evaluate the pros and cons of the various restoration or reestablishment methods used. Several documents, for example, Anderson (1989), which recommends research of sites before carrying out restoration, Dumrose et al. (2002), which recommends riparian planting techniques, and Briggs et al. (1994), which evaluates success of riparian restoration projects, are excellent sources to review as part of the literature background of the TRDN project. A review of the USACE publication by Guilfoyle and Fischer (2006), which provides guidelines for monitoring aridland riparian systems, would also benefit the TRDN project.

In addition to understanding the functions and services of riparian communities to better develop restoration methods, it is also important to understand such hydrological issues as controlling water infiltration into the river bed. The Santa Cruz River downstream of the wastewater treatment plants often develops an organic layer that may influence infiltration and thus groundwater recharge rates. Studies that have addressed this phenomenon (e.g., Galyean, 1996, and others under Organic Layer references below) are not referenced in the evaluation of historic recharge for the TRDN project, nor is the influence of organic layers in the river bed considered in estimated future recharge.

Significance – Medium:

The restoration concepts of the TRDN project are not supported with appropriate peer-reviewed references, which would demonstrate the correctness of the methods and evaluation procedures, and are necessary to ensure project success.

Recommendations for Resolution:
1. Conduct a thorough literature review to support the methods and procedures for riparian reestablishment and monitoring, and to understand organic effects on river recharge. Include these citations in the TRDN Draft Feasibility Study and EIS. Representative references are provided below for consideration. 2. Reevaluate and modify restoration methods where appropriate based on the findings of the literature review, and reconsider calculations of recharge rates (historic and present). 3. Contact local academic riparian and riverine experts (e.g., Stromberg and Maddock) who have published on riparian areas of the Santa Cruz River and region, and have them evaluate the planting procedures and associated hydrological controls used in the project.

Literature cited and Suggested References

Ecosystem processes representative references:

Baird, K.J., K.J., J. C. Stromberg, and T. Maddock. 2005. Linking riparian dynamics and groundwater: an ecohydrologic approach to modeling groundwater and riparian vegetation. Environ. Manage. 36:551-564.

Bouwer, H., and T. Maddock. 1997. Making sense of the interactions between groundwater and streamflow: Lessons for water masters and adjudicators. Rivers 6:19-31.

Scott, R.L., W. J. Shuttleworth, D.C. Goodrich, and T. Maddock . 2000.The water use of two dominant vegetation communities in a semiarid riparian ecosystem. Agri. Forest Meteorol.105: 241-256.

Shafroth, P.B., J.C. Stromberg, and D.T. Patten. 2000. Woody riparian vegetation response to different alluvial water table regimes. West. N. Am. Naturalist 60:66-76.

Shafroth, P.B., P.B., G.T. Auble, J.C. Stromberg, and D.T. Patten. 1998. Establishment of woody riparian vegetation in relation to annual patterns of streamflow, Bill Williams River, Arizona. Wetlands 18:577-590.

Stromberg, J.C., R. Tiller, and B. Richter. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: The San Pedro, Arizona. Ecol. Appl. 6:113–131.

Stromberg, J.C. 1993. Fremont cottonwood-Goodding willow riparian forests: a review of their ecology, threats, and recovery potential. J. Arizona-Nevada Academy of Science 27:97-110

Stromberg, J.C. 1993. Riparian mesquite forests: a review of their ecology, threats, and recovery potential. J. Arizona-Nevada Academy of Science 27:111-124

Stromberg, J.C., S.D. Wilkins, and J.A. Tress. 1993. Vegetation-hydrology models as management tools for velvet mesquite (*Prosopis velutina*) riparian ecosystems. Ecol. Appl. 3(2):307-314.

Stromberg, J.C., J.A. Tress, S.D. Wilkins, and S.D. Clark. 1992. Response of velvet mesquite to ground water decline. J. Arid Environ. 23, 45–58.

Webb, R.H., and S.A. Leake. 2006. Ground-water surface-water interactions and long-term change in riverine riparian vegetation in the southwestern United States. J. Hydrol. 320:302-323.

Riparian restoration/planting representative references:

Anderson, B.W. 1989. Research as an integral part of revegetaton projects. In: California Riparian Conference, 1988. USDA Forest Service Gen. Tech. Rep. PSW-110.

Anderson, B.W., and R.D. Ohmart. 1985. Riparian revegetation as a mitigation process in river and stream restoration. In: Gore, J. A., ed. The Restoration of Rivers and Streams. Boston: Butterworth Publishers; 47-79.

Briggs, M.K., B.A. Roundy, and W.W. Shaw. 1994. Trial and error: assessing the effectiveness of riparian revegetation in Arizona. Ecol. Restoration 12:160-167.

Bunting, D.P. 2011. Using existing agricultural infrastructure for restoration practices: Factors influencing successful establishment of *Populus fremontii* over *Tamarix ramosissima*. J. Arid Environ. 75:851-860.

Dumrose, R.K., L.E. Riley, and T,D, Landis. 2002. Riparian restoration in the Southwest – species selection, propagation, planting methods, and case studies. Forest Service, Rocky Mountain Research Station, Proceedings RMRS-P-24. 370 pp.

Friedman, J.M.. J.M., M.L. Scott, and W.M. Lewis. 1995. Restoration of riparian forest using irrigation, artificial disturbance, and natural seedfall. Environ. Manage.19:547-557.

Guilfoyle, M.P. and R.A. Fischer. 2006. Guidelines for Establishing Monitoring Programs to Assess the Success of Riparian Restoration Efforts in Arid and Semi-Arid Landscapes. USACE Engineer Research and Development Center, Vicksburg MS. Technical Note.

Stewart B. Rood, S.B., J. H. Braatne, and F. M. R. Hughes. 2003. Ecophysiology of riparian cottonwoods: stream flow dependency, water relations and restoration. Tree Physiol. 23:1113-1124.

Stromberg, J.C. 2001. Restoration of riparian vegetation in the south-western United States: importance of flow regimes and fluvial dynamism. J. Arid Environ. 49:17-34.

Organic layer references:

Battin, T.J., and D. Sengschmitt. 1999. Linking sediment biofilms, hydrodynamics, and riverbed clogging: evidence from a large river. Microbial Ecol. 37:185-196.

Galyean, K. 1996. Infiltration of Wastewater Effluent in the Santa Cruz River Channel, Pima County, Arizona. USGS WRI Report 96-4021.

Herbert, R.A. 1977. Effect of illuviated deposits on infiltration rates and denitrification during sewage effluent recharge. Hydrology and Water Resources in Arizona and the Southwest Vol. 7. Proceedings of the 1977 Meetings of the Arizona Section, American Water Resources Assn.; and the Hydrology Section, Arizona Academy of Science, April 15-16, Las Vegas, Nevada, p 183-190.

Iliuta, I., and F. Larachi. 2005. Modeling simultaneous biological clogging and physical plugging in trickle-bed bioreactors for wastewater treatment. Chem. Eng. Sci. 60:1477-1489.

Comment 15
The statement that hazardous material plumes will not impact public water supplies has not been substantiated.
Basis for Comment:
Tables 1 through 5 of the Hazardous, Toxic, and Radioactive Wastes Appendix identify 313 potential hazardous material sites: • 77 High Priority Sites for Agency Follow-up • 36 Medium Priority Sites for Agency Follow-up • 40 Low Priority Sites for Agency Follow-up • 57 Very Low Priority Sites for Agency Follow-up • 103 No Further Action Sites for Agency Follow-up. Excluding the sites where no further agency follow-up is required, there are approximately 210 sources of hazardous materials that could migrate toward the Santa Cruz River and/or the TRDN study area. The study performed by Environmental Data Resources, Inc. dated December 19, 2003, which is also included in this Appendix, provides details on each of the 313 potential hazardous material sources. However, neither the Environmental Data Resources, Inc. report nor the Appendix identify which of these sites could result in hazardous plumes migrating toward the TRDN study area. Furthermore, existing plumes of contamination could be reactivated or modified by the project, yet the potential of these plumes moving toward existing public and/or private wells is not discussed in the Appendix (GSA, 1999, pp. 9-14; ASTM, 2005),
Significance – Medium:
Extensive data have been presented identifying and characterizing potential pollution sources in the region, but the effect of the project, if any, on hazardous plumes has not been analyzed.
Recommendations for Resolution:
1. Prioritize the number of hazardous pollutant sources that could realistically contaminate to the TRDN study area. 2. Provide an analysis describing the possible effects of the TRDN project on hazardous plumes in the groundwater table and the potential to migrate toward existing public and/or private wells.

Literature cited

GSA.,1999. National Environmental Policy Act: NEPA Desk Guide, U.S. General Services Administration, Washington, DC, October.

ASTM Standard E1527 – 05. 2005. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process. ASTM International, West Conshohocken, PA, DOI: 10.1520/E1527-05, www.astm.org.

Comment 16
The Cultural Resources section does not document coordination with the State Historic Preservation Officer, plans for historic sites with National Historic Landmark status as well as archeological sites, or a plan for surveying the remaining one-third of the project area.
Basis for Comment:
Projects that use Federal funds and may impact areas that have been developed over a significant period of time are required to coordinate their actions with the State Historic Preservation Officer and identify possible historic sites or buildings. According to NEPA directives, the definition of "effects" requires that the Environmental Assessment/ Environmental Impact Statement (EA/EIS) address historic and cultural resources and that adverse and beneficial effects must be addressed in NEPA documents (40 CFR 1508.8). In addition, the "Affected Environment" section of an EA/EIS should provide background information on the prehistory and history of the area and describe known historic and cultural resources that may be affected by the project. (40 CFR 1502.15). The TRDN project along the Santa Cruz River adjacent to Tucson includes some of the oldest post-Columbian settlements in the U.S. In addition, the area, like many sections of the Santa Cruz, probably includes many Native American developments (Mabry et al., 1997). Pre-historic (archeological) cultural resource locations must be surveyed and subsequent action for preservation should be described. Although surveying the remaining one-third of the study area is mentioned in the TRDN Feasibility Study, it does not clearly state how this will be done or what actions will be taken if additional sites are located. The Study also does not discuss plans to treat the existence of historic sites with guidelines from the National Historic Preservation Act of 1966. In addition, under the American Indian Religious Freedom Act of 1978 and the Native American Graves Protection and Repatriation Act of 1990, Federal agencies are responsible for consulting with Indian Tribal Governments and traditional religious leaders to determine appropriate actions necessary for protecting and preserving Native American religious cultural rights and practices as well as archeological sites. Information on these procedures is not included in the TRDN Feasibility Study. .
Significance – Medium:
Federal action requires compliance with national acts that recognize historic and Native American sites. The project should ensure that all potential locations have been surveyed and treated according to the appropriate Federal act when historic or archeological sites are discovered.
Recommendations for Resolution:
1. Document project adherence to all appropriate Federal and state laws that pertain to historic and prehistoric sites. 2. Document the method for surveying the complete project area. 3. Report how the project will respond to findings of historic and archeological sites within the project area.

Literature cited

Mabry B., Jonathan, D.L. Swartz, H. Wocherl, J.J. Clark, G.H. Archer, and M.W. Linderman. 1997. Archaeological investigations of early village sites in the middle Santa Cruz Valley. Anthropological Papers. No. 18. Center for Desert Archaeology.

Comment 17

The potential impact of climate change on the success of the project has not been evaluated.

Basis for Comment:

Climate change, as discussed in the TRDN Feasibility Study, is only related to the potential production of greenhouse gases (EIS Section 5.3.1.2), which may be the only climate change Federal mandate applicable to USACE. However, anticipated changes in important aspects of the climate (i.e., water and temperature) in southern Arizona that may affect the project are not addressed.

Successful riparian restoration will depend on an assured supply of water and climatic conditions that will not stress establishing or marginally established plants. Most water to be used for long-term maintenance of the TRDN riparian plantings will come from effluent, a product of human consumption, and stormwater harvest from the mainstem of the Santa Cruz River and its tributaries, both being very ephemeral. These riparian plantings experience high levels of evapotranspiration, which will be exacerbated by anticipated changes in the climate in the study area.

With climate change potentially altering available water for human consumption as well as the fundamental hydrology of the Tucson basin, understanding the short- and long-term changes anticipated in water and temperature in the TRDN study area is essential to success of the project. Scientists at the University of Arizona (UA) have projected future climate scenarios for the Tucson and southern Arizona region and their impacts on hydrology (Serrat-Capdevila et al., 2007) and social vulnerability resulting from changing water availability (Liverman et al., 1997). Also, University of Arizona scientists in the Department of Geosciences continue to study potential climate changes, and the university extension office shares much of this information with the public.

Significance – Medium:

The omission of the potential effects of climate change may result in higher expectations of success, or potential long-term failure of riparian plantings.

Recommendations for Resolution:

1. Contact faculty in Geosciences at the University of Arizona (e.g., Drs. Hugh, Cole, and/or Overpeck) to determine expected changes in hydrology and temperature for the Tucson area over the next several decades.
2. Contact hydrological scientists at UA who have addressed anticipated changes in water availability (e.g., Dr. Maddock) resulting from climate change.
3. Review the literature on climate change in the Southwest and include these findings into expectations of success, or potential problems with the TRDN planning.

Literature cited

Serrat-Capdevila, A., J. B. Valdés, J. González Pérez, K. Baird, L. J. Mata, and T. Maddock. 2007. Modeling climate change impacts – and uncertainty – on the hydrology of a riparian system: The San Pedro Basin (Arizona/Sonora). J. Hydrol. 347:48-66.

Liverman, D., R. Merideth, and A. Holdsworth. 1997. Climate Variability and Social Vulnerability in the U.S.-Mexico Border Region: An Integrated Assessment of the Water Resources of the San Pedro River and Santa Cruz River Basins. Published by Latin American Area Center and Udall Center for Studies in Public Policy, The University of Arizona. (This paper is digested from *An Assessment of the Water Resources in the San Pedro River and Santa Cruz River Basins, Arizona and Sonora*, 1997, by Diana Liverman, Robert Merideth, Andrew Holdsworth, Luis Cervera, and Francisco Lara, A Report to the Commission on Environmental Cooperation, Montreal, Quebec (published by the Latin American Area Center and Udall Center for Studies in Public Policy, The University of Arizona), 75 pp.)

Comment 18
The potential impacts to the TRDN project that may occur due to future upstream water demands and uses in Santa Cruz county are not discussed.
Basis for Comment:
The hydrology and water quality discussion in the TRDN Feasibility Study relates to the immediate Tucson basin region. However, the aquifer below this basin is moving from southeast to northwest (Montgomery and Assoc., 2002), therefore much of the source of the aquifer comes from water inputs to the south (i.e., Santa Cruz County and environs). Several activities in Santa Cruz County can directly affect this aquifer, and thus the quantity and quality of the aquifer as it flows under the Tucson basin. In the 1950s, groundwater withdrawal upstream of Tucson greatly increased as agriculture had to replace diminishing sources of surface water (Webb and Leake, 2006). Later in the 20th century several large mines developed west of the Santa Cruz River and withdrew large amounts of groundwater for mining operations (Griffin et al., 1980, 1981). The existence of the mines and their activities has been shown by the Arizona Department of Environmental Quality to pollute local water sources. Additionally, the community of Green Valley greatly expanded using groundwater from, and returning effluent to, the Santa Cruz River watershed. All of these influences on the Santa Cruz River upstream of the TRDN project area have potential to influence the hydrology and water quality within the study area.
Significance – Low:
Including a discussion on the quantity and quality of the aquifer below the Tucson Basin would improve the understanding of the upstream influences on the project.
Recommendations for Resolution:
1. Consider upstream influences by analyzing the water quality and depth in several sequential groundwater wells upstream near the Pima/Santa Cruz county border, and determine how this may influence water recharge and groundwater use of the TRDN project.

Literature cited

Griffin, A.H., W.E. Martin, J.C. Wade. 1981. Water use and water conservation by the copper mining industry. JAWRA 17:57–61.

Griffin, A.H., W.E. Martin, J.C. Wade. 1980. The economic effects of changes in water use in the Tucson Basin, Arizona. JAWRA 16:849-855.

Montgomery & Associates. 2002. Baseline Groundwater Flow Modeling for Tres Rios Del Norte Project, Pima County, Arizona, Errol L. Montgomery & Associates, July 2002.

Webb, R.H., and S.A. Leake. 2006. Ground-water surface-water interactions and long-term change in riverine riparian vegetation in the southwestern United States. J. Hydrol. 320:302-323.

Comment 19

The historic conditions of the riparian habitat description are not thoroughly developed to be used as a guide for the selection of possible reference conditions for an ecosystem restoration study.

Basis for Comment:

Ecosystem restoration projects normally identify reference conditions as a target. Identification of these reference conditions can be based on historic data as well as intangible values (Patten, 2006). A river model based on several southern Arizona streams has been developed for the TRDN Feasibility Study; however, the model does not relate to either historic conditions or potential targets for riparian restoration. Historic photos are used in the project documents to describe what many consider to have been pre-Columbian historic conditions, that is, a cottonwood- lined river with extensive mesquite bosques on the floodplain.

Early Indian and Spanish use of the river probably modified its general channel dynamics (Logan, 1999), while trapping of beaver probably allowed development of a more extensive riparian forest, which replaced what were extensive cienegas and wetlands along the river channel (Ohmart, 1996, Parker et al., 1985, Webb and Leake, 2006). Following the downcutting period in the latter half of the 19th century, cottonwood stands developed along the entrenched river and mesquite established on the floodplain (Webb and Leake, 2006).

Consequently, if the reference model dictates a cottonwood riparian community along with mesquite bosque floodplain forests, then it should be recognized that these probably are not the early prehistoric riparian plant communities that occurred along the Santa Cruz River, but vegetation that established after arroyo development, human modifications, and beaver removal.

Significance – Low:

Further refining the pre-Columbian historic conditions of the study area will give a more accurate understanding of the post–project implementation conditions.

Recommendations for Resolution:

1. Revise the report to recognize that the historic conditions and riparian vegetation goals are based on relatively recent historic conditions as well as reference conditions from southwest Arizona rivers that have developed in beaver-free, modified channel environments that support riparian forests and associated vegetation that have developed in the past century.

Literature cited

Logan, M. 1999. Head-cuts and check-dams: changing patterns of environmental manipulation by the Hohokam and Spanish in the Santa Cruz River Valley, 200-1820. Environ. Hist., 4:405-430.

Ohmart, R.D., 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. In: Krauseman, P.R. (Ed.), Rangeland Wildlife. Society of Range Management, Denver, CO, pp. 245–279.

Parker, M., Wood, F.J., Smith, B.H., Elder, R.G., 1985. Erosional downcutting in lower order riparian ecosystems: Have historical changes been caused by removal of beaver? In: Johnson, R.R., Ziebell, C.D., Patton, D.R., Ffolliott, P.F., Hamre, R.H. (eds.), Riparian Ecosystems and their Management: Reconciling Conflicting Uses, Tucson, AZ, First North American Riparian Conference, U.S. Department of Agriculture, Forest Service General Technical Report RM-120, pp. 35–38.

Patten, D.T. 2006. Restoration of Wetland and Riparian Systems: The Role of Science, Adaptive Management, History, and Values. JCWRE, 134:9-18.

Webb, R.H., and S.A. Leake. 2006. Ground-water surface-water interactions and long-term change in riverine riparian vegetation in the southwestern United States. J. Hydrol. 320:302-323.

APPENDIX B

Final Charge to the Independent External Peer Review Panel
as
Submitted to USACE on July 20, 2011
on the

TRDN Feasibility Study

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Final Charge Guidance and Questions to the Peer Reviewers
for the
Tres Rios del Norte, Pima County, Arizona, Feasibility Study

BACKGROUND

The Tres Rios del Norte study area is located in the Upper Sonoran Desert in the Santa Cruz River (SCR) Watershed, Pima County, Arizona. The Santa Cruz River headwaters are located in the San Rafael Valley in southeastern Arizona, flowing into Sonora Mexico before re-entering Arizona about six miles east of Nogales, Arizona. The SCR continues northward through Tucson and Pima County, then northwest to it's confluence with the Gila River, 12 miles southwest of Phoenix.

The study area is an 18-mile reach of the Santa Cruz River that extends into northern Pima County. Within the study reach, the Santa Cruz River has confluences with two major tributaries, the Rillito River and the Cañada del Oro. It is from these features that the area derives its name, Tres Rios del Norte (Three Rivers of the North). The study area is situated within Pima County in the northwestern portion of the Tucson metropolitan area and includes portions of both the City of Tucson and the Town of Marana. Groundwater recharge, flood risk reduction, and recreation measures are also being formulated. It is anticipated that the Recommended Plan will include a combination of all these purposes.

The primary ecosystem problem in the study area is severe degradation and loss of riparian habitat. While this has occurred to some degree since the late 19th century, it has greatly accelerated in both extent and degree of severity in the last 50 years. Within the study area, it has been estimated that a corridor of 7,000 to 8,000 acres of dense riparian and floodplain riparian fringe habitat existed historically, supported by surface and groundwater flow in close proximity to the river. Increasing withdrawal of surface and groundwater flow to support agriculture and a growing human population gradually changed the Santa Cruz from a river with surface and subsurface flow to a primarily dry channel that flows throughout its length only in response to storm runoff and, most of the year, only in those reaches immediately downstream of effluent outfalls. As a result of this change, stands of native riparian habitat are rare throughout Pima County and Arizona, particularly in the study area. What remains is in isolated patches, supported entirely by effluent flows, with little physical connection to nearby habitats.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the Tres Rios del Norte, Pima County, Arizona, Feasibility Study (TRDN Feasibility Study) in accordance with the Department of the Army, U.S. Army Corps of Engineers, Water Resources Policies and Authorities' *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010 and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. Peer review typically evaluates the clarity of hypotheses, validity of the research design, quality of data collection procedures, robustness of the methods employed, appropriateness of the methods for the

hypotheses being tested, extent to which the conclusions follow from the analysis, and strengths and limitations of the overall product.

The purpose of the IEPR is to assess the adequacy and acceptability of economic, engineering, and environmental methods, models, and analyses used for the TRDN Feasibility Study. The IEPR will be limited to technical review and will not involve policy review. The IEPR will be conducted by subject matter experts (i.e., IEPR panel members) with extensive experience in engineering, economics, and environmental issues relevant to the project. They should also have experience applying their subject matter expertise to ecosystem restoration.

The panel members will be "charged" with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. Per EC 1165-2-209, Appendix D, reviews should identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods. Review panels should be able to evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable. Reviews should focus on assumptions, data, methods, and models. The panel may offer their opinions as to whether there are sufficient analyses upon which to base a recommendation.

DOCUMENTS PROVIDED

The following is a list of documents and reference materials that will be provided for the review. **The documents and files presented in bold font are those which are to be reviewed**. All other documents are provided for reference.

Tres Rios del Norte, Pima County, Arizona Draft Feasibility Report

- **Appendix A – Without-Project Hydraulics**
- **Appendix B – With-Project Hydraulics**
- **Appendix C – Cost Estimating**
- **Appendix D – Design**
- **Appendix E – Economics**
- **Appendix F – Ecosystem Restoration Functional Assessment**
- **Appendix G – Geological Characteristics**
- **Appendix H – Groundwater Modeling**
- **Appendix I – Real Estate Plan**
- **Appendix J – Preliminary Phase I Environmental Site Assessment**

- **Tres Rios del Norte, Pima County, Arizona Environmental Impact Statement**
- USACE guidance *Civil Works Review Policy* (EC 1165-2-209) dated January 31, 2010
- CECW-CP Memorandum dated March 31, 2007
- Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* released December 16, 2004.

SCHEDULE

Task	Action	Due Date
Conduct Peer Review	Battelle sends review documents to panel members	7/22/2011
	Battelle/IEPR Panel Kickoff Meeting	7/29/2011
	USACE/Battelle/IEPR Panel Kickoff Meeting	7/29/2011
	Battelle convenes mid-review teleconference for Panel to ask clarifying questions of USACE	8/5/2011
	Panel members complete their review	8/19/2011
Prepare Final Panel Comments and Final IEPR Report	Battelle provides Panel merged individual comments and Talking Points for Panel Review Teleconference	8/25/2011
	Convene Panel Review Teleconference	8/26/2011
	Battelle provides Final Panel Comments directive to Panel	8/29/2011
	Panel members provide draft Final Panel Comments to Battelle	9/7/2011
	Battelle provides feedback to Panel members on draft Final Panel Comments; Panel provides revised draft Final Panel Comments per Battelle feedback (iterative process)	9/82011 - 9/15/2011
	Final Panel Comments finalized	9/16/2011
	Battelle provides Final IEPR Report to Panel for review	9/20/2011
	Panel provides comments on Final IEPR Report	9/22/2011
	***Battelle submits Final IEPR Report to USACE**	**9/27/2011**
Comment/ Response Process	Battelle inputs Final Panel Comments to DrChecks; Battelle provides Final Panel Comment response template to USACE	9/29/2011
	Teleconference between Battelle and Panel to review the Comment Response Process (if necessary)	9/29/2011
	USACE PDT provides draft Evaluator Responses and clarifying questions to Battelle	10/6/2011
	Battelle provides the Panel the draft Evaluator Responses and clarifying questions	10/12/2011
	Panel members provide Battelle with draft comments on draft Evaluator Responses (i.e., draft BackCheck Responses)	10/17/2011
	Teleconference with Battelle and Panel to discuss draft BackCheck Responses	10/18/2011
	Teleconference between Battelle, IEPR Panel, and USACE PDT to discuss Final Panel Comments, draft responses, and clarifying questions	10/20/2011
	USACE inputs final Evaluator Responses in DrChecks	10/27/2011
	Battelle provides Evaluator Responses to Panel	11/1/2011
	Panel members provide Battelle with final BackCheck Responses	11/4/2011
	Battelle inputs the Panel's BackCheck Responses in DrChecks	11/8/2011
	***Battelle submits pdf printout of DrChecks project file**	**11/8/2011**

Note: Deliverables are noted with an asterisk (*****).

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the TRDN Feasibility Study and supporting documents are credible and whether the conclusions are valid. The panel members are asked to determine whether the technical work is adequate, competently performed, properly documented, satisfies established quality requirements, and yields scientifically credible conclusions. The Panel is being asked to provide feedback on the economic, engineering, environmental resources, and plan formulation. The panel members are not being asked whether they would have conducted the work in a similar manner.

Specific questions for the Panel (by report section or Appendix) and general charge guidance are provided below.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the TRDN Feasibility Study. Please focus on your areas of expertise and technical knowledge. Even though there are some sections with no questions associated with them, that does not mean that you cannot comment on them. Please feel free to make any relevant and appropriate comment on any of the sections and appendices you were asked to review. In addition, please note the following guidance. Note that the panel will be asked to provide an overall statement related to 2 and 3 below per USACE guidance (EC 1165-2-209; Appendix D).

1. Your response to the charge questions should not be limited to a “yes” or “no.” Please provide complete answers to fully explain your response.
2. Assess the adequacy and acceptability of the economic and environmental assumptions and projections, project evaluation data, and any biological opinions of the project study.
3. Assess the adequacy and acceptability of the economic analyses, environmental analyses, engineering analyses, formulation of alternative plans, methods for integrating risk and uncertainty, and models used in evaluation of economic or environmental impacts of the proposed project.
4. If appropriate, offer opinions as to whether there are sufficient analyses upon which to base a recommendation.
5. Identify, explain, and comment upon assumptions that underlie all the analyses, as well as evaluate the soundness of models, surveys, investigations, and methods.
6. Evaluate whether the interpretations of analysis and the conclusions based on analysis are reasonable
7. Please focus the review on assumptions, data, methods, and models.

Please **do not** make recommendations on whether a particular alternative should be implemented, or whether you would have conducted the work in a similar manner. Also please **do not** comment on or make recommendations on policy issues and decision making. Comments should be provided based on your professional judgment, **not** the legality of the document.

1. If desired, panel members can contact one another. However, panel members **should not** contact anyone who is or was involved in the project, prepared the subject documents, or was part of the USACE Independent Technical Review.
2. Please contact the Battelle deputy project manager (Julian DiGialleonardo, digialleonardoj@battelle.org) or project manager (Karen Johnson-Young, johnson-youngk@battelle.org) for requests or additional information.
3. In case of media contact, notify the Battelle project manager immediately.
4. Your name will appear as one of the panelists in the peer review. Your comments will be included in the Final IEPR Report, but will remain anonymous.

Please submit your comments in electronic form to Julian DiGialleonardo, digialleonardoj@battelle.org, no later than August 19, 2011, 5 pm ET.

Independent External Peer Review
Tres Rios del Norte, Pima County, Arizona, Feasibility Study

Final Charge Questions

GENERAL QUESTIONS

1. To what extent has it been shown that the project is technically sound, environmentally acceptable, and economically justified?

2. Are the assumptions that underlie the economic, engineering, and environmental analyses sound?

3. Are the economic, engineering, and environmental methods, models, and analyses used adequate and acceptable?

4. In general terms, are the planning methods sound?

5. Are the interpretations of the analysis and the conclusions based on the analysis reasonable?

CHAPTER 1.0 – STUDY AUTHORITY

No questions.

CHAPTER 2.0 – PURPOSE, SCOPE, AND STUDY AREA

6. Comment on the completeness and clarity of the purpose and scope.

Section 2.1 Study Purpose

7. Is the purpose of the report clearly stated and is the purpose met?

Section 2.2 Study Scope

No questions

Section 2.3 Study Area

No questions

Section 2.4 Planning Process and Report Organization

8. Comment on whether the six steps outlined in Section 2.4 adhere to the USACE planning Principles and Guidelines (P&G).

CHAPTER 3.0 - PRIOR STUDIES, REPORTS, AND EXISTING PROJECTS

Section 3.1 Prior Studies or Projects

No questions

Section 3.2 Existing Projects

9. Comment on the comprehensiveness of the discussion relating to local flood risk management improvements.

Section 3.3 Master Planning

No questions

CHAPTER 4.0 – PROBLEMS AND OPPORTUNITIES

Section 4.1. Background, Historical Conditions, and Problem Development

Section 4.1.1 Hydrology and Geomorphology

10. Comment on the comprehensiveness of the discussion relating to water availability, including wastewater treatment plant effluent, and surface/groundwater interactions.

11. Is the discussion in this section complete with regard to recharge and infiltration rates?

12. How complete is the discussion of wastewater effluent volumes in this section?

Section 4.1.2 Historic Riparian Habitat

13. Comment on the discussion of the historic accounts of the riparian habitat. Does it provide sufficient detail in regard to significance and historic plant and wildlife populations to depict the habitat prior to degradation?

Section 4.1.3 Historic Growth

14. Comment on the thoroughness and robustness of the current population and historic population trends described.

Section 4.1.4 Problem Identification

15. Are the problems that have been described as leading to the need for restoration relevant, and have they been accurately and completely described?

16. Comment on the comprehensiveness of the discussion on the flooding impacts to structures located within the 500-year floodplain, including the materials extraction facility, bridge supports, and utilities.

17. Comment on the comprehensiveness of the data presented in Table 4-1 regarding population trends and projected growth.

Section 4.2 Opportunities

Section 4.2.1 Ecosystem Restoration

18. Comment on the description of ecological characteristics and structure of the study area as it pertains to the planned restoration.

19. Comment on comprehensiveness of the listing of specific opportunities.

Section 4.2.2 Flood Risk Management

20. Comment on the comprehensiveness of flood risk management opportunities discussion.

21. Comment on the thoroughness of the examples provided for structural vs. non-structural flood risk management opportunities.

Section 4.2.3 Water Supply and Water Resource Management

22. Comment on the completeness of this section with regard to groundwater recharge and effluent recovery opportunities.

Section 4.2.4 Recreation

23. Comment on the description of the potential recreation opportunities created by the proposed project.

Section 4.3 Development of Baseline and Future "Without-Project" Conditions

No questions

Section 4.4 Baseline Conditions

Section 4.4.1 Reach Delineation

24. Comment on the methodology used to delineate the project reaches.

Section 4.4.2 Land Use

No questions

Section 4.4.3 Water Resources and Availability

25. Comment on the description of the relationship between effluent and groundwater recharge given in this section.

26. Comment on the landscaping watering contributions to surface water in this reach of the Santa Cruz River.

27. Comment on the discussion of effluent monitoring.

28. Comment on the discussion of Central Arizona Project (CAP) for water resources in this section with regard to availability of water resources.

29. Comment on the water quality of the effluent given the depth to groundwater at the site.

30. Comment on the consistency of the information groundwater sections (a) and (c).

31. Comment on the average recharge rate adopted for use.

32. Comment on the techniques used to estimate the existing water demands in Table 4-7.

Section 4.4.4 Hydrology and Hydraulics

33. Is the listing of regional precipitation mechanisms complete? If not, what is missing?

34. Comment on the thoroughness of channel composition discussed in this section as related to flood level designations.

35. Comment on the impact of sediment deposition and erosion with regard to the potential impact on aquifer recharge and/or ecosystem restoration.

Section 4.4.5 Riparian Habitat Evaluation

No questions

Section 4.4.6 Baseline Habitat Evaluation

36. Comment on the use of Hydrogeomorphic (HGM) Assessment of Wetlands Approach for this project.

37. Comment on the inputs and associated results of the Arizona Riverine Model as related to the number and location of reference sites.

38. Comment on the soundness of the Functional Assessment methodology.

39. Comment on the thoroughness of the process, available information, and reference sites used to model wetland resources within the study area. Please consider information in the HGM appendix and Environmental Impact Statement (EIS) and appendices.

Section 4.4.7 Environmental Resources

40. Have the methods for protection of the native plants listed been sufficiently discussed?

41. Comment on the characterization of the archaeological sites of historic value within the Tres Rios del Norte study area.

42. Comment on the thoroughness of the descriptions of the Private Facilities.

43. Have the federally listed species, special status species, and native plant protection noted for the project area been accurately described? Please consider information in Section 4.5 of the EIS and Appendices A and G of the EIS.

Section 4.4.8 Geotechnical

44. Comment on the use of undercutting and piping to address bank instability.

Section 4.4.9 Hazardous, Toxic, and Radioactive Wastes

45. Comment on the process used to determine Hazardous, Toxic, and Radioactive Wastes (HTRW) sites and current findings of HTRW sites in the project area. Please consider the information included in the HTRW appendix, and Sections 4.8 and 5.8 of the EIS.

Section 4.4.10 Economics

46. Comment on the historic flood damages, demographics, employment, housing and overall socioeconomics described in this section.

Section 4.5 Future Without-Project Conditions

Section 4.5.1 Land Use

47. Are the major assumptions used in the formulation of the future land use trends valid?

Section 4.5.2 Future Water Resources

48. Comment on the adequacy of the future water recharge capacities described.

Section 4.5.3 Riparian Habitat

49. Comment on the completeness of the discussion of the without-project effects on riparian habitat.

50. Comment on the assumptions that were adopted for the future without-project environmental conditions in the project study area.

Section 4.5.4 Cultural Resources

No questions

Section 4.5.5 Recreation

51. Comment on the assumptions used to develop future without-project conditions recreational demand.

Section 4.5.6 Geotechnical

52. Comment on the completeness and accuracy of information presented in the geotechnical discussion.

Section 4.5.7 Hydrology and Hydraulics

53. Comment on the discussion of the relationship between runoff and future population estimates.

Section 4.6 Future Without-Project Conditions Summary

No questions

CHAPTER 5.0 - PLAN FORMULATION

Section 5.1 Study Methodology

No questions

Section 5.2 Planning Objectives

54. Comment on the completeness of the specific planning objectives listed in this section.

Section 5.3 Planning Constraints

55. Are the descriptions of planning constraints for this restoration project accurate and complete?

Section 5.4 Alternative Development Rationale

No questions

Section 5.5 Alternative Development and Evaluation Process

No questions

Section 5.6 Screening of Alternative Plans

Section 5.6.1 Potential Measures and Elements

56. Comment on the process and methods used to screen the alternatives during the preliminary alternatives analysis.

Section 5.6.2 Preliminary Alternatives Analysis

57. Comment on the method used to determine the cost effectiveness of the alternatives presented in Figure 5-17.

5.7 Final Array of Alternatives

Section 5.7.1 Ecosystem Restoration Alternative Plans

58. Comment on the completeness of the description and comparison of the alternatives. Consider the information in Chapter 3.0 of the EIS.

59. Comment on the accuracy of the cost-effectiveness analysis and incremental cost analysis.

60. Comment on the accuracy and thoroughness of the discussion of the restoration alternative plans.

61. Are the grade control structures for each of the nine plans and Plan D low sufficient to increase and sustain habitat benefits for the existing and the proposed vegetation?

Section 5.7.2 Flood Risk Management Alternatives Analysis

No questions

Section 5.7.3 Water Supply Alternatives Analysis

62. Comment on the adequacy of the water supply measures benefits and cost analysis.

63. Comment on the use of individual measures as the basis for the development of the water supply alternatives.

Section 5.7.4 Recreation Alternatives Analysis

64. Comment on the discussion of potential impacts to the recreational features.

65. Comment on the discussion of the costs (component costs, total costs, and origin of costs) for each recreation alternative.

66. Does the unit day valuation approach follow accepted non-market valuation techniques? Please explain.

67. Comment on the thoroughness of the valuation approach described.

Section 5.8 Plan Selection

68. Comment on the process and methods used to evaluate the five alternatives, including the System of Accounts analysis, the Associated Evaluation Criteria evaluation, and the Trade-Off Analysis.

Section 5.8.1 Tentatively Recommended Plans

No questions

Section 5.8.2 Systems of Accounts

No questions

Section 5.8.3 Associated Evaluation Criteria

69. Are the four evaluation criteria (completeness, effectiveness, efficiency, and acceptability) used to support decision making on the various alternatives appropriate?

Section 5.8.4 Trade-Off Analysis

No questions

Section 5.9 Plans Identified in the Draft Feasibility Report

Section 5.9.1 National Ecosystem Restoration Plan

No questions

Section 5.9.2 Water Supply Plan

No questions

Section 5.9.3 Combined NER/NED Plan

No questions

Section 5.9.4 The Locally Preferred Plan

No questions

Section 5.10 Selection of the Recommended Plan

Section 5.10.1 Ecosystems Restoration Significance

70. Comment on the completeness of the assessment of information gained from past studies.

CHAPTER 6.0 – DESCRIPTION OF THE TENTATIVELY RECOMMENDED PLAN

Section 6.1 Habitat Features

Section 6.1.1 Vegetation

No questions.

Section 6.1.2 Water Demand

71. Comment on the assumption that the existing cottonwood-willow and riverbottom-wet will be supported throughout the life of the project by maintaining the effluent discharges to the Santa Cruz River.

72. Comment on the assumption that tributary inflows can be harvested.

Section 6.1.3 Water Distribution Features

No questions.

Section 6.1.4 Stormwater and Rainwater Harvesting

No questions

Section 6.1.5 Structural Features

73. Comment on the comprehensiveness of the structural features presented in the recommended plan.

74. Comment on the function and long term viability of the structural elements included in the recommended plan including low flow channels and grade control.

Section 6.2 Water Supply (Recharge) Features

75. Comment on the conclusion that the facility goals will be met by maintaining effluent flow in the two graded channels.

Section 6.3 Recreation Features

76. Comment on the descriptions of the recreation features and the opportunities provided in this section.

Section 6.4 OMRR&R Considerations

Section 6.4.1 Restoration Features

77. Comment on the adequacy of the activities necessary to operate, maintain, repair, replace, or rehabilitate the areas of the final project.

78. Are the estimates of tear-out for each PWAA supported by the channel velocities and relative resistance of vegetation? If not, explain.

79. Comment on the completeness of the mosquito larvae management activities.

80. Comment on the conclusion that sediment transport characteristics of the river are not expected to be substantially affected by the proposed project.

81. Comment on the comprehensiveness of the performance measures outlined in this section.

Section 6.4.2 Water Supply Features

82. Comment on the completeness of the maintenance activities.

Section 6.4.3 Recreation Features

83. Comment on the operation and maintenance costs for the plan's recreation features.

Section 6.5 Monitoring and Adaptive Management Plan

84. Comment on the completeness of the monitoring and adaptive management plans. Consider also information provided in Appendix E of the EIS.

Section 6.6 Environmental Effects and Mitigation

No questions

Section 6.7 Cost Summary

85. Does the cost analysis use appropriate lifetimes, interest rates and other parameters consistent with current economic conditions and established economic practices? If not, explain.

86. Comment on the approach used to determine annual economic costs and benefits of the combined plan.

87. Comment on the extent to which the results are supported by and consistent with the detailed analyses presented in the Cost Appendix C.

88. Comment on the differences between the methodology used to develop the final cost estimate (MCACES vs. Mii) and the methodology used to develop the cost estimates for the plan formulation alternatives.

89. Comment on the costs associated with the monitoring and adaptive management plan.

Section 6.8 Associated Non-Federal Considerations

No questions.

CHAPTER 7 - PLAN IMPLEMENTATION

Section 7.1 Study Recommendation

No questions

Section 7.2 Division of Plan Responsibilities

No questions

Section 7.3 Cost Apportionment

No questions

Section 7.4 Current and Future Work Eligible for Credits

No questions

Section 7.5 Institutional Requirements

No questions

Section 7.6 Environmental Requirements

No questions

Section 7.7 Sponsorship Agreements

No questions

Section 7.8 Procedures for Implementation

90. Comment on the comprehensiveness of the list of future actions necessary for project implementation.

CHAPTER 8 – SUMMARY OF CONDITIONS & PUBLIC VIEWS

No questions

CHAPTER 9 – RECOMMENDATIONS

No questions

CHAPTER 10 – REFERENCES

No questions

APPENDIX A- WITHOUT-PROJECT HYDRAULICS

91. Do the hydraulic model boundary conditions and input parameters accurately describe actual conditions?

92. Discuss the implementation of Manning's "n" in the sediment transport model. Is the alternate implemented method appropriate for estimating this value?

93. Comment on the assumed default value.

94. Are the ranges of parameters used in SAM to select the appropriate sediment equations considered appropriate for representing site conditions? Why or why not?

95. Are the conclusions drawn from application of the hydraulic and sediment transport model supported by the modeling results? Why or why not?

APPENDIX B - WITH-PROJECT HYDRAULICS

96. Comment on the completeness of the hydraulic characteristics discussion of the overbank flood deposits and how the characteristics of this unit may affect recharge in the study area.

97. Comment on the discussion of the results from the subsurface investigations.

98. Comment on the flood control design for the proposed alternative.

APPENDIX C - COST ESTIMATING

99. Comment on the adequacy of the approach used to determine costs associated with the with-project restoration alternatives.

100. Comment on the extent to which the earthwork, grade control, and structural features restoration are supported by, and consistent with, the analyses presented in the Draft Feasibility Report and the Draft Environmental Impact Statement (DEIS).

101. Comment on the procedures and criteria used to develop the Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) costs for the restoration features.

102. Are the construction and maintenance horizons consistent with that presented in Section 6 of the document?

103. Comment on the adequacy of the unit pricing used for the recreation features and water supply features cost estimate.

104. Comment on the adequacy of the cost estimate prepared for the recommended plan.

105. Comment on the consistency of the Cost Appendix with that presented in Sections 5 and 7 of the Feasibility Report.

APPENDIX D - DESIGN

106. Does the material presented in Section 3 (Design Parameters) provide sufficient information to characterize each of the alternatives? Why or why not?

107. Is there sufficient analysis to support the excavation estimates associated with the restoration features and the tentatively recommended plan?

108. Please comment on comprehensiveness and methods used to evaluate the proposed water distribution system for the restoration alternatives and the tentatively recommended plan.

109. Comment on the comprehensiveness of the methodology used to develop the water demand estimates for both the preliminary alternatives (Section 3) and the tentatively recommended plan (Section 4).

110. Have the challenges presented in the Feasibility Report and the Design Appendix been quantified and met? Why or why not?

111. Is the initial array of components sufficient for comprehensively evaluating restoration alternatives?

112. Comment on the average recharge rate adopted for use in evaluating the restoration alternatives.

113. Do the referenced historical investigations support the selection of the assumed rate? Why or why not?

114. Comment on the accuracy and methods of estimating future inputs from tributary inflows.

APPENDIX E - ECONOMICS APPENDIX

115. Comment on the accuracy of how the benefits and costs were derived for each alternative.

116. Was the project life used in the analysis appropriate for the alternative? Please explain.

117. Address the extent to which the methods for performing the benefit cost analysis, including use of discount rate is adequately described and justified.

Appendix F – Ecosystem Restoration Functional Assessment

No questions

APPENDIX G – GEOLOGICAL CHARACTERISTICS

No questions

APPENDIX H - GROUNDWATER MODELING

118. Comment on the assumptions used to revise the Arizona Department of Water Resources (ADWR) groundwater predictive model.

119. Comment on the suitability of the boundary conditions developed by Montgomery & Associates (M&A) used for the baseline project simulations.

120. Is there sufficient information presented to verify the estimated annual artificial recharge volume at the six locations with the Tres Rios del Norte study area? Why or why not?

121. Comment on the stated existing and future effluent conditions and their resultant impact on project goals.

122. Comment on the assumptions and modeling results for analyzing the simulated groundwater elevations due to the Combined and NER plans, including the Tangerine Landfill site.

123. Comment on the methods used to determine the below land surface (bls) groundwater elevation differences between the existing and proposed project conditions.

124. Are the recharge rates used in the model accurate and consistent with those presented in the Draft EIS report?

125. Will the variability associated with water level predictions in the vicinity of the Tangerine landfill sites have a significant effect on the accuracy of model predictive capabilities throughout the study area?

126. Comment on the adequacy of the model results section.

127. Are the model input parameter distributions supported by measured data? Why or why not?

128. Comment on the completeness of the groundwater flow modeling report with regard to the exclusion of discussions on calibration and sensitivity analyses.

APPENDIX I – REAL ESTATE PLAN

No questions

APPENDIX J – PRELIMINARY PHASE 1 ENVIRONMENTAL SITE ASSESSMENT

No questions

DRAFT ENVIRONMENTAL IMPACT STATEMENT

ABSTRACT

No questions

EXECUTIVE SUMMARY

No questions

CHAPTER 1.0 – INTRODUCTION

129. Comment on the validity of the assumption that the existing conditions in the river corridor will remain unchanged between 2002/2003 and 2016.

130. Are the broad goals of the Tres Rios del Norte project, as listed in this section, adequate and complete?

CHAPTER 2.0 – RATIONAL AND PLANNING OBJECTIVES

131. Are the planning objectives of the Tres Rios del Norte project, as listed in this section, adequate and complete?

CHAPTER 3.0 – ALTERNATIVES

132. Comment on the completeness and appropriateness of the description of the plan formulation process used by USACE to develop the alternatives considered in the DEIS.

133. Comment on the effects of maintaining the effluent discharges to the Santa Cruz River (SCR) on the cottonwood-will and river bottom wetland throughout the life of the project.

134. Are the consumptive water use rates provided in Table 3-2 consistent with historical estimates? Please explain.

135. Comment on the potential for sediment generation during project construction? Should this factor be considered in estimating construction quantities?

136. Are the monitoring requirements for the selected alternative complete and adequate?

CHAPTER 4.0 – AFFECTED ENVIRONMENTS

137. Comment on the adequacy of subsurface and mountain front geology discussion.

138. Comment on the adequacy of the information provided to demonstrate the current hydrology and water quality conditions in the Tres Rios del Norte study area. Consider also information in Appendices A and I of the EIS.

139. Comment on the completeness of the discussion on hydrogeologic units and their effect on groundwater recharge to the aquifer.

140. Do the hydraulic characteristics of the aquifer support potential recharge associated with the selected alternative? Please explain?

141. Does the discussion of wildlife adequately characterize the historic conditions of the study area?

142. Comment on the accuracy of the discussion of the vegetation communities and of the data presented in Table 4.5-1

143. Comment on the completeness of the Active/Abandoned Agriculture and Developed sections. Does this section sufficiently address the presence of native vs. non-native wildlife species within the study area?

144. Comment on the accuracy and completeness of each of the discussions of the nine

federally protected species.

145. Does the plan presented in this EIS align with existing local and regional planning efforts? If not, explain.

146. Is the existing land use in the study area accurately and comprehensively described?

147. Are the existing recreational resources in the study area accurately and comprehensively described?

148. Is the regulatory environment affecting land use and recreation accurately and appropriately described in this section?

149. Is the description of hazardous, toxic, and radioactive waste in the study area complete and accurate?

150. Is the description of the existing noise environment in the study area complete and accurate?

151. Is the description of the existing transportation conditions in the study area complete and accurate?

152. Is the description of the existing public utilities in the study area complete and accurate?

153. Comment on the adequacy of the demographic, employment, housing and overall socioeconomics of the study area described in this section.

CHAPTER 5.0 – ENVIRONMENTAL CONSEQUENCES

154. Comment on the assessment that no significant impacts to geologic and geomorphologic conditions will occur within the project area.

155. Comment on the adequacy of criteria and parameters used to evaluate “substantial alteration” defined in this section.

156. Comment on the assessment that no significant adverse impacts to air quality would result from the implementation of the proposed alternatives. Consider also the information in Section 4.3 and Appendices A and F of the EIS.

157. Comment on the adequacy and comprehensiveness of the assessment of impacts to the areas hydrology and water quality.

158. Are there other significant hydrologic or water quality impacts that may result from implementation of the proposed alternative? If so, specify.

159. Comment on the impact of sediment deposition with regard to the potential impact on aquifer recharge.

160. Comment on the assumption that vegetative consumptive demand will decrease over time, thus increasing recharge volumes accordingly.

161. In general, are the biological resource impacts anticipated under the various alternatives reasonable and adequately described? Please, explain.

162. Comment on the potential impacts (positive and negative) of the recreational resources in each of the alternative plans.

163. Comment on the adequacy of the plan to identify and assess impacts to cultural resources throughout the project area.

164. Are the descriptions of hazardous, toxic, and radioactive waste-related environmental consequences for the alternative plans accurate and appropriate?

165. Comment on the soundness of the transportation impact evaluation.

166. Are the descriptions of transportation-related environmental consequences for the alternative plans accurate and appropriate?

167. Are the descriptions of safety-related environmental consequences for the alternative plans accurate and comprehensive?

168. Are the descriptions of utility-related environmental consequences for the alternative plans accurate and comprehensive?

169. Comment on the assessment that no significant adverse impacts to socioeconomics would result from the implementation of the proposed alternatives.

CHAPTER 6.0 – RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

170. Comment on the conclusion that the NER Plan and Combined Plan Alternatives are not expected to adversely affect the long-term productivity of the study area.

CHAPTER 7.0 - IRRETRIEVABLE OR IRREVERSIBLE COMMITMENTS OF RESOURCES

171. Are the descriptions of the irretrievable and irreversible commitments of resources accurate and complete?

CHAPTER 8.0 - COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

No questions

CHAPTER 9.0 – LIST OF PREPARERS AND QUALIFICATIONS

No questions

CHAPTER 10.0 – PERSONS AND ORGANIZATIONS CONSULTED

No questions

CHAPTER 11.0 – ORGANIZATIONAL CONFLICT OF INTEREST STATEMENT

No questions

CHAPTER 12.0 – DISTRIBUTION LIST

No questions

CHAPTER 13.0 – ACRONYMS AND GLOSSARY OF TERMS

No questions

CHAPTER 14.0 – REFERENCES

No questions

FINAL OVERVIEW QUESTION

172. What is the most important concern you have with the document or its appendices that was not covered in your answers to the questions above?