

Final Independent External Peer Review Report for the White Oak Bayou Federal Flood Damage Reduction Plan

Prepared by
Battelle Memorial Institute

Prepared for
LJA Engineering & Surveying, Inc.

Subcontract Agreement Dated September 30, 2010
LJA Job Number: 0344-1607

January 11, 2011



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for the
White Oak Bayou Federal Flood Damage Reduction Plan**

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Columbus, OH 43201**

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**FINAL
INDEPENDENT EXTERNAL PEER REVIEW REPORT
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White Oak Bayou Federal Flood Damage Reduction Plan

EXECUTIVE SUMMARY

White Oak Bayou, a tributary of Buffalo Bayou, originates in northwest Harris County, Texas and flows southeast for approximately 25 miles through the City of Jersey Village and the City of Houston where it outfalls into Buffalo Bayou in downtown Houston. White Oak Bayou watershed drains approximately 110 square miles and is approximately 90 percent developed. Elevations in the watershed vary from approximately 135 feet to approximately 40 feet and the average streambed slope is about 4 feet per mile.

The existing Federal channel in the lower reach of White Oak Bayou was completed in the mid-1970s under the authorization of the Flood Control Acts of 1954 and 1965 for Buffalo Bayou and Tributaries. The 11.4 miles of channel improvements comprise the existing Federal project that extends from the confluence of White Oak Bayou and Buffalo Bayou to Cole Creek.

The Upper White Oak Bayou project is authorized by the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662) and based on *Buffalo Bayou and Tributaries Main Report on Upper White Oak Bayou Feasibility Report for Flood Damage Prevention* (U.S. Army Corps of Engineers [USACE], 1979). The project authorization is currently in the inactive category. The existing Federal channel reach in the lower 10.7 miles of White Oak Bayou was evaluated as part of the *Feasibility Report on Buffalo Bayou and Tributaries* (USACE, 1988). Since the benefit/cost ratio was less than 1, Federal participation in the project was not recommended.

The two most recent severe floods occurred during Tropical Storm Frances in September 1998 and Tropical Storm Allison in June 2001. The former flooded approximately 1,200 homes and the latter flooded approximately 11,000 residences within the White Oak Bayou watershed. Approximately 1,333 and 6,074 structures, respectively, are in the 10 percent and 1 percent flood plain.

Section 211(f) of the Federal Water Resources Development Act of 1996 (WRDA 1996) (Public Law 104-303) authorized the Harris County Flood Control District (HCFCD) to develop a flood reduction risk management plan for White Oak Bayou. The purpose of this study was to determine if a Federal flood risk management control project along White Oak Bayou is justified and to provide the documentation needed to request approval from the Assistant Secretary of the Army, Civil Works (ASA(CW)) and Federal funding for construction of the recommended plan.

This General Reevaluation Report (GRR) study was conducted following the published procedure, methodology, and guidance of USACE. The USACE HEC-HMS, HEC-RAS, and HEC-FDA computer models were used to determine the flood damages for the without project condition and to evaluate the effectiveness of the alternative flood damage reduction plans. The

average annual flood damage under the without project condition is estimated to be \$58.6 million along the main stem of White Oak Bayou. More than 90 different configurations of structural and nonstructural components were evaluated, including channel modification, detention, bypass channels, flood protection levees, replacement or modification of existing bridges, elevating structures, and permanent relocation. More than 300 different combinations were considered.

The plan that is supported by The HCFCD, the Local Sponsor is the National Economic Development (NED) plan, which consists of the following components:

1. Earthen channel modifications along 15.4 miles from Cole Creek to FM 1960.
2. Four detention basins along White Oak Bayou providing approximately 3,386 acre-feet storage.

The NED Plan reduces the average annual flood damages by \$36.6 million, or approximately 62 percent. No significant adverse environmental impacts were identified. Detention basins with tree and shrub plantings will promote the reintroduction of native habitat for wildlife and provide an opportunity for their use as multipurpose facilities with recreation elements as well. The support for this plan has been expressed by the White Oak Bayou Advisory Committee and by the public in general, based on the public meetings held during the planning process.

The NED Plan affects 13.24 acres of isolated and fragmented wetland areas along the bayou. The cost of the mitigation will be approximately \$217,000. In addition, habitat that is disturbed by construction will be restored to its pre-construction condition.

No significant adverse social effects result from the plan. The proposed project plays an important role in social aspects of the community by reducing the impacts of flooding, improving safety, and contributing towards community cohesion.

Regional economic development impacts are positive. The damage reduction and construction investment both are positive factors for the economy of the Houston region.

The proposed flood risk management control project reduces average annual damages from \$58.6 million to approximately \$22.0 million, providing an annual benefit of approximately \$36.6 million, and has a benefit/cost ratio of approximately 3.1. Net economic benefits are \$25.2 million. The estimated first cost based on the Micro-Computer Aided Cost Estimating System cost estimate is \$211.9 million and the fully funded cost is \$230.8 million. These costs are based on 2009 price levels, plus future escalation of \$4.7 million and interest during construction of \$14.2 million at the 2010 Federal interest rate of 4.375 percent. The Federal and non-Federal cost allocations for the project first cost are estimated to be \$146.3 million and \$65.6 million respectively. The proposed project reduces the extent of the 10 percent and 1 percent flood plain areas so that 1,285 and 1,511 structures, respectively, would now be located outside of the two reduced flood plain areas, leaving 48 and 4,563 structures, respectively, within the two reduced flood plain areas.

The proposed recreation plan has an estimated first cost of \$12.8 million, provides net benefits of \$ 1.67 million, and has a benefit-cost ratio of 3.5. The Federal and non-Federal first-cost share is \$ 6.4 million each.

HCFCFCD is conducting an Independent External Peer Review (IEPR) of the GRR for the White Oak Bayou Federal Flood Damage Reduction Plan (hereinafter White Oak Bayou GRR). As a 501(c)(3) nonprofit science and technology organization with experience in establishing and administering peer review panels for Civil Works projects, Battelle was engaged by LJA Engineering & Surveying, Inc. (here in after LJA) to conduct the IEPR of the White Oak Bayou GRR for the HCFCFCD. Independent, objective peer review is regarded as a critical element in ensuring the reliability of scientific analyses. The IEPR was external to USACE 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).

Four panel members were selected for the IEPR from more than 18 identified candidates. Based on the technical content of the White Oak Bayou GRR and the overall scope of the project, the final panel members were selected for their technical expertise in the following key areas: Civil Works planning, National Environmental Protection Act (NEPA), hydrology and hydraulics engineering, and economics. Although the Panel was disclosed to LJA/HCFCFCD, Battelle made the final decision on selecting the Panel.

The Panel received electronic versions of the White Oak Bayou GRR documents, totaling 2,225 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 HCFCFCD in developing the charge questions that were to guide the peer review, according to guidance provided in USACE (2010) and OMB (2004). LJA/HCFCFCD was given the opportunity to provide comments and revisions, and subsequently approved the final charge questions.

LJA/HCFCFCD briefed the Panel and Battelle during a kick-off meeting held via teleconference prior to the start of the review. In addition to this teleconference, a teleconference with LJA/HCFCFCD, the Panel, and Battelle was held halfway through the review period to provide the Panel an opportunity to ask questions of LJA/HCFCFCD and clarify uncertainties. The Panel produced more than 425 individual comments in response to the 107 charge questions.

IEPR panel members reviewed the White Oak Bayou GRR 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 LJA/HCFCFCD. 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, 14 Final Panel Comments were identified and documented. Of these, 1 was identified as having high significance, 10 had medium significance, and 3 had low significance.

Table ES-1 summarizes the Final Panel Comments by level of significance. Detailed information on each comment is contained in Appendix A of this report.

Table ES-1. Overview of 14 Final Panel Comments Identified by the White Oak Bayou GRR IEPR Panel

Significance – High	
1	The presentation of alternatives and the selection of the NED Plan using risk analysis within the HEC-FDA framework do not follow USACE guidance.
Significance – Medium	
2	The documentation and explanation provided for the development of the existing and future without project conditions do not meet the requirements of ER 1105-2-100.
3	The boundaries and constituents of the White Oak Bayou study area are not consistent in the GRR, Environmental Assessment, and supporting documentation.
4	Alterations in the watershed that may have occurred between 1998 and 2010, unrelated to the construction of NED Plan components, such as changes in land use, bridge modifications, and more critically, subsidence, are not discussed.
5	The relative value of residential properties included in the flood damage assessments have not been reevaluated to account for changes in flood risk perceptions that have occurred since 2002.
6	The discussion of the flood damages and expected damage reductions by reach does not provide sufficient detail to determine if the analytical methods were constructed or used appropriately.
7	The assumptions and procedures used in flood damage estimation for structure and content damages are inconsistent and may have affected the results of the analysis.
8	The Recreation Plan does not provide sufficient detail to evaluate the estimated recreational demand and the benefit-cost ratio for the Plan.
9	Further justification for the placement of trails and play/practice fields within detention basins is needed because the described recreational facilities do not appear to be compatible with detention basins.
10	The White Oak Bayou Environmental Assessment and Appendix E provide for protection and maintenance of existing prairie dawn flower populations, but do not address methods for increasing growth and expansion of the species.
11	Impacts from flooding of the recreational areas may not have been fully accounted for in the derivation of Operation, Maintenance Repair, Replacement, and Rehabilitation (OMRR&R) costs.
Significance – Low	
12	It appears that portions of the Hydrology and Hydraulics analysis were done at different times and it is not clear that they were integrated into the overall project analysis.
13	The actual cost of current property acquisitions and displacements associated with all examined feasible alternatives are difficult to confirm because of conflicting presentations of “current” conditions in the GRR and the appendices.
14	Documentation of public involvement in the White Oak Bayou project since 2004 is not provided, but is required to fully understand the project benefits, especially as they affect residents and businesses that have moved into the project area since 2004.

The IEPR panel members agree 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 White Oak Bayou GRR. In general, the Project follows standard planning guidance, but several components of the analysis were not consistent with USACE guidance. The White Oak Bayou project as reported meets the objectives put forward; however, due to the extensive study period beginning in 2002 that is likely the source of inconsistencies found in the documentation, the degree to which it meets some of the objectives is not clear. The majority of the Panel’s comments focus on the assumptions used to define “without project conditions” as a basis for development of the NED Plan, the assumptions made regarding changes in the study area since 2002, and how these assumptions might impact the analysis of the NED Plan. Other comments focus on details within the analysis that were not fully documented and/or discussed. The following statements summarize the Panel’s findings, which are described in more detail in the Final Panel Comments (see Appendix A).

Plan Formulation Rationale: Overall, the planning approach used in the White Oak Bayou project is appropriate and innovative. However, the documentation did not provide a clear and consistent definition of the project boundaries (hydrologic and hydraulic, economics analyses), as well as the definition of existing and future without project conditions. Per ER 1105-2-100, since impact assessment is the basis for plan evaluation, clear definition and full documentation of the without project condition are essential. Additional clarification is recommended to support the assumptions used in defining the without project conditions and study area.

Economics: From an economics perspective, additional clarification is required to demonstrate that the assumptions, analytical methods, and procedures were used appropriately to calculate flood damages and expected damage reductions. The White Oak Bayou GRR did not present a thorough risk analysis including benefit/cost ratios for all alternatives evaluated, as required by ER 1105-2-101. The Panel recommends that clarification be added to the White Oak Bayou GRR regarding the updating of property values from 2002 to 2009 and the assumptions about changes in flood risk perceptions since 2002. Several temporal inconsistencies were noted in the text and figures. More detail and clarification is required to provide a comprehensive, consistent report of the economic analysis.

Engineering: From a hydrologic and hydraulic engineering perspective, the White Oak Bayou project uses current state-of-practice methods, resulting in a thorough analysis. Extensive analysis and re-evaluation has been performed regarding storm frequency and other parameters as part of the precedent Tropical Storm Allison Recovery Project (TSARP) study, which forms the basis for modeling for this Project. The Hydrology and Hydraulics Appendix of the report is comprehensive and adequate. Some discrepancies exist within the White Oak Bayou GRR and models; however, it is assumed that these inconsistencies are due to the inadvertent inclusion of information that had not been updated from previous studies associated with the White Oak Bayou project. The Panel recommends that clarification be added regarding subsidence and other changes along White Oak Bayou that may have occurred since 1998 and their effects on the development and analysis of the NED Plan.

Environmental: The White Oak Bayou project identified and addressed a wide array of environmental issues very well. Due to its focus on an urban area, there should be minimal

impact to environmental resources. The White Oak Bayou GRR, however, did not thoroughly address methods for increasing growth and expansion of the prairie dawn flower and should be revised accordingly. The Panel also recommends that the White Oak Bayou GRR be updated with documentation of public involvement progress since 2004, if applicable.

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LIST OF ACRONYMS

AAE	Annual Average Expected (flood damages)
ASA(CW)	Assistant Secretary of the Army, Civil Works
ATR	Agency Technical Review
B/C	Benefit to Cost Ratio
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
COI	Conflict of Interest
CSVR	Content to Value Ratio
DrChecks	Design Review and Checking System
EA	Environmental Assessment
EGM	Economic Guidance Memorandum
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Agency
GRR	General Reevaluation Report
HCFCDD	Harris County Flood Control District
HEC-HMS	Hydrologic Engineering Center-Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HEC-FDA	Hydrologic Engineering Center-Flood Damage Reduction Analysis
IEPR	Independent External Peer Review
IWR	Institute for Water Resources
LIDAR	Light Detection and Ranging
LJA	LJA Engineering & Surveying, Inc.
NED	National Economic Development
NEPA	National Environmental Protection Act
NHR	North Houston-Rosslyn Road and Gulf Bank Road Detention Site
NMFS	National Marine Fisheries Service
NTP	Notice to Proceed
OMB	Office of Management and Budget
OMRR&R	Operation, Maintenance Repair, Replacement, and Rehabilitation
ROW	Right of Way
TPWD	Texas Parks & Wildlife Department
TSARP	Tropical Storm Allison Recovery Project
TSEQ	Texas Commission on Environmental Quality
UDV	Unit Day Values
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
WRDA	Water Resources Development Act

1. INTRODUCTION

White Oak Bayou, a tributary of Buffalo Bayou, originates in northwest Harris County, Texas and flows southeast for approximately 25 miles through the City of Jersey Village and the City of Houston where it outfalls into Buffalo Bayou in downtown Houston. White Oak Bayou watershed drains approximately 110 square miles and is approximately 90 percent developed. Elevations in the watershed vary from approximately 135 feet to approximately 40 feet and the average streambed slope is about 4 feet per mile.

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The objective of the work described here was to conduct an Independent External Peer Review (IEPR) of the studies that comprise the GRR for the White Oak Bayou Federal Flood Damage Reduction Plan (hereinafter White Oak Bayou GRR) in accordance with procedures described in the Department of the Army, U.S. Army Corps of Engineers 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 White Oak Bayou GRR. 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 White Oak Bayou GRR. Detailed information on the Final Panel Comments is provided in Appendix A.

2. PURPOSE OF THE IEPR

To ensure that White Oak Bayou GRR documents are supported by the best scientific and technical information, HCFCD followed the USACE process for peer review 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 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.

In this case, HCFCD conducted the IEPR of the White Oak Bayou GRR using contract support from Battelle, who was engaged by LJA Inc., HCFCD's prime contractor for this project. Battelle, an Outside Eligible Organization as defined under Section 501(c)(3) of the U.S. Internal Revenue Code 501(c)(3), is a nonprofit science and technology organization with experience in establishing and administering peer review panels for Civil Works projects.

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

After receiving the notice to proceed (NTP), Battelle held a kick-off meeting with LJA/HCFCD 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 NTP date of October 7, 2010. Note that the work items listed in Task 7 occur after the submission of this report. Battelle will enter the 14 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 HCFCD can review and respond to them. HCFCD will provide responses (Evaluator Responses) to the Final Panel Comments, and the Panel will respond (BackCheck Responses) to the Evaluator Responses. All HCFCD and Panel responses will be documented by Battelle.

Table 1. White Oak Bayou GRR IEPR Schedule

TASK	ACTION	DUE DATE
1	Notice to Proceed (NTP) Start	October 7, 2010
	Review documents available	October 11, 2010
	Battelle submits draft Work Plan ^a	October 25, 2010
	LJA/HCFCD provides comments on draft Work Plan	October 28, 2010
	Battelle convenes teleconference (if necessary)	October 28, 2010
	Battelle submits final Work Plan ^a	November 2, 2010
2	Battelle recruits and screens up to 18 potential panel members; prepares summary information ^a	October 21, 2010
	Battelle selects no more than four panel members	October 21, 2010
	Battelle submits list of selected panel members ^a	October 22, 2010
	LJA/HCFCD provides comments on selected panel members	October 26, 2010
	Battelle completes subcontracts for panel members	November 9, 2010
3	Battelle submits draft charge (combined with draft Work Plan – Task 1) ^a	October 25, 2010
	LJA/HCFCD provides comments on draft charge	October 28, 2010
	Battelle submits final charge (combined with final Work Plan – Task 1) ^a	November 2, 2010
	LJA/HCFCD approves final charge	November 3, 2010
4	LJA/HCFCD/Battelle kick-off meeting	October 13, 2010
	Battelle sends review documents to IEPR Panel	November 10, 2010
	LJA/HCFCD/Battelle/Panel kick-off meeting	November 15, 2010
	Battelle convenes mid-review teleconference for panel to ask clarifying questions of LJA/HCFCD	November 22, 2010

Table 1. White Oak Bayou GRR IEPR Schedule, continued

TASK	ACTION	DUE DATE
5	Panel members complete their individual reviews	December 7, 2010
	Battelle convenes a panel review teleconference	December 13, 2010
	Panel members provide draft Final Panel Comments to Battelle	December 21, 2010
6	Battelle submits Final IEPR Report to LJA/HCFCD ^a	January 11, 2011
7^b	Battelle inputs Final Panel Comments to DrChecks; Battelle provides Final Panel Comment response template to LJA/HCFCD	January 13, 2011
	HCFCD provides draft Evaluator Responses and clarifying questions to Battelle	January 24, 2011
	Battelle convenes a teleconference among Battelle, Panel, and LJA/HCFCD to discuss Final Panel Comments, draft responses, and clarifying questions	February 1, 2011
	HCFCD inputs final Evaluator Responses in DrChecks	February 10, 2011
	Battelle inputs the Panel's BackCheck Responses in DrChecks	February 18, 2011
	*Battelle submits pdf printout of DrChecks project file ^a	February 22, 2011
	Project Closeout	April 29, 2011

^a Deliverable

^b Task occurs after the submission of this report.

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 Works planning, National Environmental Protection Act (NEPA), hydrology and hydraulics engineering, and economics. These areas correspond to the technical content of the White Oak Bayou GRR and overall scope of the White Oak Bayou project.

To identify candidate panel members, Battelle reviewed 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 18 candidates for the Panel, evaluated their technical expertise, and inquired about potential COIs. Of these, Battelle chose seven of the most qualified candidates and confirmed their interest and availability. Of the seven candidates, four were proposed for the final Panel and three were proposed as backup reviewers. Information about the candidate panel members, including brief biographical information, highest level of education attained, and years of experience, was provided to LJA/HCFCD for feedback. Battelle made the final selection of panel members according to the selection criteria described in the Work Plan.

The four proposed primary reviewers constituted the final Panel. 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.

The candidates were screened for the following potential exclusion criteria or COIs.¹ These COI questions were intended to serve as a means of disclosure, and to better characterize a potential 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 firm² in any part of the White Oak Bayou Federal Flood Damage Reduction Plan, including any involvement in the following documents:
 - Buffalo Bayou and Tributaries Main Report on Upper White Oak Bayou Feasibility Report for Flood Damage Prevention (1979)
 - Feasibility Report on Buffalo Bayou and Tributaries (1988)
- Involvement by you or your firm² in any work related to the White Oak Bayou Federal Flood Damage Reduction Plan.
- Involvement by you or your firm² in flood damage reduction or flood risk management projects in Harris County, TX.
- Involvement by you or your firm² in the conceptual or actual design, construction or O&M related activities along White Oak Bayou located in Harris County, TX.
- Previous or current involvement by you or your firm² with paid or unpaid expert testimony related to the White Oak Bayou Federal Flood Damage Reduction Plan, or lawsuits related to White Oak Bayou flood events.
- Current or previous employment or affiliation with the non-Federal sponsors or any of the following cooperating Federal, State, County, local and regional agencies, environmental organizations, and interested groups: Harris County (TX) Flood Control District (HCFCD); City of Jersey Village, TX; City of Houston, TX; White Oak Bayou Citizen Advisory Committee; Bayou Preservation Association, Houston, TX; Federal Emergency Management Agency (FEMA); U.S. Army Corps of Engineers (USACE); U.S Fish & Wildlife Service (USFWS); Texas Parks & Wildlife Department (TPWD); National Marine Fisheries Service (NMFS); Environmental Protection Agency (EPA); or Texas Commission on Environmental Quality (TCEQ) (for pay or pro bono).
- Past, current, pending, or future interests (financial or otherwise) by you, your spouse or children related to the White Oak Bayou Federal Flood Damage Reduction Plan,

¹ 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."

² Includes any joint ventures in which your firm is involved.

including interest in White Oak Bayou Federal Flood Damage Reduction Plan-related contracts or awards from Harris County (TX) Flood Control District.

- Current personal involvement with other Harris County (TX) Flood Control District projects, including whether involvement was to author any manuals or guidance documents for Harris County (TX) Flood Control District. If yes, provide titles of documents or description of project, dates, location, and position/role.
- Previous or current firm² involvement with other Harris County (TX) Flood Control District projects. If yes, provide title/description, dates, location, and position/role.
- Any previous or current firm² or personal involvement with USACE Galveston District projects. If yes, please highlight role and discuss in greater detail.
- Any previous employment by the Harris County (TX) Flood Control District as a direct employee or contractor (either as an individual or through your firm²) within the last 10 years. If yes, provide title/description, dates employed, and place of employment, and position/role.
- Previous experience conducting technical peer reviews. If yes, please highlight and discuss any technical reviews concerning:
 - flood damage reduction
 - flood risk managementand include the client/agency and duration of review (approximate dates).
- A significant portion (i.e., greater than 50%) of personal or firm² revenues within the last 3 years came from Harris County (TX) Flood Control District contracts.
- Participation in relevant prior Federal studies/programs relevant to this project, such as:
 - Buffalo Bayou and Tributaries Main Report on Upper White Oak Bayou Feasibility Report for Flood Damage Prevention (USACE, 1979)
 - Feasibility Report on Buffalo Bayou and Tributaries (USACE, 1988)
- Participation in prior non-Federal studies/programs relevant to this project.
- Any publicly documented statement (including, for example, advocating for or discouraging against) related to the White Oak Bayou Federal Flood Damage Reduction Plan.
- Is there 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? If so, please describe.

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 consulting companies or were independent 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. Although the Panel was disclosed to LJA/HCFCD, Battelle made the final decision on selecting the Panel. Section 4 of this report provides names and biographical information on the panel members.

Prior to beginning their review and within 5 days of their 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, 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 LJA/HCFCD 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 LJA/HCFCD for evaluation as part of the draft Work Plan. LJA/HCFCD provided comments and revisions to the draft charge, which were used to produce the final charge. The final charge was submitted to LJA/HCFCD for approval. In addition to a list of 107 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 LJA/HCFCD presented project details to the Panel. Before the meeting, the IEPR Panel received an electronic version of the White Oak Bayou GRR documents and the final charge. A full list of the documents reviewed by the Panel is provided in Appendix B of this report. The Panel was instructed to address the charge questions/discussion points within a comment-response form provided by Battelle.

3.4 Review of Individual Comments

Prior to completion of the review of the White Oak Bayou GRR documents, a teleconference with the LJA/HCFCD PT, the Panel, and Battelle was held halfway through the review period to provide the Panel an opportunity to ask questions of the LJA/HCFCD PT and clarify uncertainties. At the end of the review period, the Panel produced approximately 425 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 was able to summarize the 425 comments into a preliminary list of 21 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 experts, 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 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 responses to two specific charge questions where there appeared to be disagreement among panel members. The conflicting comments were resolved based on the professional judgment of the Panel. Each comment 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 17 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 White Oak Bayou GRR:

- **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 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 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 has 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 that there were data or report section not clearly described or presented.
- **Guidance for Developing the Recommendation:** The recommendation was to include specific actions that LJA/HCFCD 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, 14 Final Panel Comments were prepared and assembled; significant issues identified in three of the original 17 comments not brought forward as Final Panel Comments were merged with related existing comments. 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 LJA/HCFCD 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 LJA/HCFCD 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. White Oak Bayou GRR IEPR Panel: Technical Criteria and Areas of Expertise

	Jones	Looney	Espey	Milon
Civil Works Planning	X			
Minimum 10 years demonstrated experience in Civil Works planning	X			
Familiar with large, complex Civil Works projects with high public and interagency interests	X			
Experience with the plan formulation process	X			
Familiar with the evaluation of alternative plans for flood risk management projects	X			
Familiar with USACE standards and procedures	X			
Degree in planning or civil engineering	X			
NEPA and Biology		X		
Minimum 10 years demonstrated experience in biology/ecology and NEPA requirements		X		
Familiar with large, complex Civil Works projects with high public and interagency interests		X		
Knowledge of and experience in the preparation of Environmental Assessments and Environmental Impact Statements		X		
Familiar with all NEPA requirements		X		
Experience in wetlands and wetlands mitigation in urbanized areas along the Gulf Coast		X		
Experience with isolated urban wetlands		X		
At least an M.S. degree in ecology or biology		X		
Hydrology and Hydraulics Engineering			X	
Minimum 10 years demonstrated experience in hydrologic and hydraulic engineering			X	
Familiar with large, complex Civil Works projects with high public and interagency interests			X	
Experience with engineering analyses related to flood damage reduction in urbanized areas along the Gulf Coast			X	
Experience with urban channels (non-storm sewer design), preferably experience with non-supercritical flow			X	
Familiar with standard USACE hydrologic and hydraulic computer models such as:			X	
HEC-HMS			X	

	Jones	Looney	Espey	Milon
HEC-RAS			X	
HEC-FDA			X	
Licensed Professional Civil Engineer			X	
Minimum B.S. degree in civil engineering or hydrology and hydraulics			X	
Economics				X
Minimum 10 years demonstrated experience in economics				X
Familiar with large, complex Civil Works projects with high public and interagency interests				X
Able to evaluate the appropriateness of cost effectiveness and incremental cost analysis (CE/ICA), as applied to dollar costs and flood damage reduction and recreation benefits				X
Familiar with the USACE tool for CE/ICA called IWR Planning Suite				X
Experience with National Economic Development analysis procedures, particularly as they relate to flood damage reduction and recreation projects				X
Degree in economics or a related field				X

Mr. Jerry Jones

Role: This panel member was chosen primarily for his civil works planning experience and expertise.

Affiliation: Malcolm Pirnie, Inc.

Jerry Jones is a vice president at Malcolm Pirnie, Inc. in Birmingham, AL. He earned his M.S. degree in civil engineering from Colorado State University in 1995 and has more than 24 years of experience in the environmental evaluation of large Civil Works projects, including water supply, flood control, and ecosystem restoration projects.

Between 1986 and 2005, Mr. Jones was a senior planner and project manager at USACE, Mobile District where he worked on more than 25 large Civil Works projects and implemented over 15 of them. He served as the lead planner in the Mobile District for five years, working on projects such as the Village Creek Flood Damage Reduction and Ecosystem Restoration project for the City of Birmingham, AL. For this project, Mr. Jones developed the model for calculating the economic benefits for the proposed environmental features and subsequent integration of the results with the USACE IWR Plan to determine the best buy plan. This project has continued during his tenure with Malcolm Pirnie, and he has been responsible for several aspects of the plan formulation including project scoping, needs assessment, and alternatives analysis. While at USACE, he also worked on regional planning for Georgia's long-term water resources needs and a flood damage reduction and ecosystem restoration project for Peachtree and Nancy Creeks in Atlanta, GA.

Mr. Jones is currently working on a comprehensive watershed study for Lake Allatoona and the Upper Etowah River in GA, one of the first projects in the nation to focus on comprehensive watershed management aimed at flood damage reduction, ecosystem restoration, shoreline erosion, and water and wastewater planning. Mr. Jones worked on the feasibility study for this project, which resulted in the development and implementation of a statistically-based environmental monitoring program that was used to evaluate the potential impacts of land use on the watershed. The final plan will include development of a module to capture the project's economic benefits.

Mr. Paul Looney, PWS, CSE, CEP

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

Affiliation: Volkert, Inc.

Paul Looney is a senior project manager at Volkert Environmental Group, Inc. in Mobile, AL. He earned his M.S. degree in coastal zone studies in 1992 from the University of West Florida and has 21 years of experience in ecological studies and NEPA compliance. Familiar with all NEPA requirements, he has been involved in the preparation and development of more than 20 water resource-related Environmental Impact Statements (EISs), Environmental Assessments (EAs), and Findings of No Significant Impact, in addition to formal and informal Section 7 consultations with Federal agencies. For all of these NEPA documents, Mr. Looney has been

either responsible for the entire document or responsible primarily for the biological/ecological portions.

His experience with large, complex Civil Works projects includes his recent involvement in a peer review of a large flood control project in Sacramento, CA and his participation in ecological studies for, and public meetings associated with, the development of a container ship port in Mobile, AL. Mr. Looney's experience in Gulf Coast urbanized wetlands includes his involvement in NEPA-related projects in Louisiana, Alabama, and Florida that included habitat restoration and hurricane recovery of coastal systems. In addition, Mr. Looney's responsibilities at Volkert include the delineation, mitigation evaluation, and permitting of wetlands (including isolated urban wetlands), primarily associated with transportation projects. He has prepared specific mitigation plans for coastal wetland habitat in Alabama and Florida, the former of which required him to develop a specific hydrogeomorphic model for Alabama coastal wetlands and to work with the USFWS, National Marine Fisheries Service, USACE, EPA, and state regulatory agencies to determine suitable reference wetlands for model validation. Mr. Looney is also very familiar with Harris County, TX and the Buffalo Bayou drainage basin.

Dr. Bill Espey

Role: This panel member was chosen primarily for his hydrology and hydraulics engineering experience and expertise.

Affiliation: Espey Consultants, Inc.

Dr. Bill Espey. president of Espey Consultants, Inc., earned his Ph.D. in civil engineering from the University of Texas at Austin in 1965. He is a registered professional engineer in Texas, Louisiana, Mississippi, and Oklahoma. Dr. Espey has more than 50 years of experience in hydrologic and hydraulic engineering. His teaching/research and consulting experience focus mainly on the fields of water resources and oceanography and include expertise on flood frequency, urban hydrology, hydraulics, sedimentation, drainage, and flood control.

Dr. Espey has experience with engineering analyses related to flood damage reduction in urbanized areas of the Gulf Coast, including his work on the Lowland Flooding and Sediment Transport Study for the Willacy and Hidalgo Drainage Districts, TX; the Sienna Plantation Drainage/Flood Protection Improvements in Fort Bend County, TX; the Armand Bayou Channel Improvements in Harris County, TX; and Master Stormwater Drainage/Flood Control Plan/Studies for the cities of Rosenberg and Pasadena, TX. Dr. Espey also has experience with urban channels and non-supercritical flow, including determining the impact of a concrete lining on North Diversion Channel (USACE, Albuquerque District); conducting hydraulic studies in northwest El Paso, TX for USACE, Albuquerque District; and developing channel modifications for the Dallas Floodway Channel on the Trinity River. Dr. Espey is familiar with standard USACE hydrologic and hydraulic computer models such as HEC-HMS, HEC-RAS, and HEC-FDA, having used them for more than 30 projects. He also has experience with large, complex Civil Works projects, including design of the Lock and Dam No. 4 for the Red River flood control; Waller Creek Flood Control Tunnel in Austin, TX; South Creek Drainage Improvements in Round Rock, TX; Proposed Drainage/Flood Control Improvement for the Trinity River Flood Plain Corridor in Dallas, TX; and Williamson Creek Flood Control Alternatives in Austin, TX.

Dr. J. Walter Milon

Role: This panel member was chosen primarily for his economics experience and expertise.

Affiliation: University of Central Florida

Dr. J. Walter Milon is the Department Chair and the Provost’s Distinguished Research Professor in the Economics Department at the University of Central Florida’s College of Business Administration, where he teaches graduate level courses in benefit cost and social impact analyses, economic theory, and Natural Resource and Environmental Economics. He earned a Ph.D. in economics from Florida State University in 1978 and has 30 years of experience in natural resource and environmental economics, marine resources, and applied microeconomics.

Dr. Milon’s experience with cost effectiveness/incremental cost analysis (CE/ICA) includes conducting CE/ICA studies as a member of the Everglades Restudy Technical Assistance Committee in conjunction with USACE, Jacksonville District; serving as a technical consultant for USACE, Vicksburg District for the development of CE/ICA for environmental projects, and serving as a technical consultant for the EPA in the development of CE/ICA evaluation guidelines for ecosystem services projects. Dr. Milon has annually reviewed IWR-Plan and CE/ICA procedures as part of undergraduate and graduate courses taught at University of Florida and University of Central Florida, and he has included the IWR Planning Suite and flood damage reduction as part of various courses he has taught over the past 30 years. His experience with flood damage reduction projects includes his work on Everglades’s restoration (which included flood damage components).

Additionally, the property value studies he has conducted and the EPA wetlands project “A Consistent Framework for Valuation of Wetland Ecosystem Services Using Discrete Choice Methods” (2004-2008) had a flood zone component that assessed the effects of flooding risk on housing prices. Dr. Milon is also familiar with the USACE flood risk assessment guidelines based on his membership on the National Research Council’s Committee on Water Resources Science, Engineering and Policy. Recently, he served as the economist for Battelle on the IEPR for C-111 Spreader Canal Project Implementation Report. Dr. Milon’s experience with large, complex Civil Works projects includes his many years on Comprehensive Everglades Restoration Program projects.

5. SUMMARY OF FINAL PANEL COMMENTS

The IEPR panel members agree 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 White Oak Bayou GRR. In general, the Project follows standard planning guidance, but several components of the analysis were not consistent with USACE guidance. The White Oak Bayou project as reported meets the objectives put forward; however, due to the extensive study period beginning in 2002 that is likely the source of inconsistencies found in the documentation, the degree to which it meets some of the objectives is not clear. The majority of the Panel’s comments focus on the assumptions used to define “without project conditions” as a

basis for development of the NED Plan, the assumptions made regarding changes in the study area since 2002, and how these assumptions might impact the analysis of the NED Plan. Other comments focus on details within the analysis that were not fully documented and/or discussed. The following statements summarize the Panel's findings, which are described in more detail in the Final Panel Comments (see Appendix A).

Plan Formulation Rationale: Overall, the planning approach used in the White Oak Bayou project is appropriate and innovative. However, the documentation did not provide a clear and consistent definition of the project boundaries (hydrologic and hydraulic, economics analyses), as well as the definition of existing and future without project conditions. Per ER 1105-2-100, since impact assessment is the basis for plan evaluation, clear definition and full documentation of the without project condition are essential. Additional clarification is recommended to support the assumptions used in defining the without project conditions and study area.

Economics: From an economics perspective, additional clarification is required to demonstrate that the assumptions, analytical methods, and procedures were used appropriately to calculate flood damages and expected damage reductions. The White Oak Bayou GRR did not present a thorough risk analysis including benefit/cost ratios for all alternatives evaluated, as required by ER 1105-2-101. The Panel recommends that clarification be added to the White Oak Bayou GRR regarding the updating of property values from 2002 to 2009 and the assumptions about changes in flood risk perceptions since 2002. Several temporal inconsistencies were noted in the text and figures. More detail and clarification is required to provide a comprehensive, consistent report of the economic analysis.

Engineering: From a hydrologic and hydraulic engineering perspective, the White Oak Bayou project uses current state-of-practice methods, resulting in a thorough analysis. Extensive analysis and re-evaluation has been performed regarding storm frequency and other parameters as part of the precedent Tropical Storm Allison Recovery Project (TSARP) study, which forms the basis for modeling for this Project. The Hydrology and Hydraulics Appendix of the report is comprehensive and adequate. Some discrepancies exist within the White Oak Bayou GRR and models; however, it is assumed that these inconsistencies are due to the inadvertent inclusion of information that had not been updated from previous studies associated with the White Oak Bayou project. The Panel recommends that clarification be added regarding subsidence and other changes along White Oak Bayou that may have occurred since 1998 and their effects on the development and analysis of the NED Plan.

Environmental: The White Oak Bayou project identified and addressed a wide array of environmental issues very well. Due to its focus on an urban area, there should be minimal impact to environmental resources. The White Oak Bayou GRR, however, did not thoroughly address methods for increasing growth and expansion of the prairie dawn flower and should be revised accordingly. The Panel also recommends that the White Oak Bayou GRR be updated with documentation of public involvement progress since 2004, if applicable.

Table 3 lists the 14 Final Panel Comment statements by level of significance.

Table 3. Overview of 14 Final Panel Comments Identified by the White Oak Bayou GRR IEPR Panel

Significance – High	
1	The presentation of alternatives and the selection of the NED Plan using risk analysis within the HEC-FDA framework do not follow USACE guidance.
Significance – Medium	
2	The documentation and explanation provided for the development of the existing and future without project conditions do not meet the requirements of ER 1105-2-100.
3	The boundaries and constituents of the White Oak Bayou study area are not consistent in the GRR, Environmental Assessment, and supporting documentation.
4	Alterations in the watershed that may have occurred between 1998 and 2010, unrelated to the construction of NED Plan components, such as changes in land use, bridge modifications, and more critically, subsidence, are not discussed.
5	The relative value of residential properties included in the flood damage assessments have not been reevaluated to account for changes in flood risk perceptions that have occurred since 2002.
6	The discussion of the flood damages and expected damage reductions by reach does not provide sufficient detail to determine if the analytical methods were constructed or used appropriately.
7	The assumptions and procedures used in flood damage estimation for structure and content damages are inconsistent and may have affected the results of the analysis.
8	The Recreation Plan does not provide sufficient detail to evaluate the estimated recreational demand and the benefit-cost ratio for the Plan.
9	Further justification for the placement of trails and play/practice fields within detention basins is needed because the described recreational facilities do not appear to be compatible with detention basins.
10	The White Oak Bayou Environmental Assessment and Appendix E provide for protection and maintenance of existing prairie dawn flower populations, but do not address methods for increasing growth and expansion of the species.
11	Impacts from flooding of the recreational areas may not have been fully accounted for in the derivation of Operation, Maintenance Repair, Replacement, and Rehabilitation (OMRR&R) costs.
Significance – Low	
12	It appears that portions of the Hydrology and Hydraulics analysis were done at different times and it is not clear that they were integrated into the overall project analysis.
13	The actual cost of current property acquisitions and displacements associated with all examined feasible alternatives are difficult to confirm because of conflicting presentations of “current” conditions in the GRR and the appendices.
14	Documentation of public involvement in the White Oak Bayou project since 2004 is not provided, but is required to fully understand the project benefits, especially as they affect residents and businesses that have moved into the project area since 2004.

6. REFERENCES

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APPENDIX A

**Final Panel Comments
on the
White Oak Bayou GRR**

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Comment 1:
The presentation of alternatives and the selection of the National Economic Development (NED) Plan using risk analysis within the HEC-FDA framework do not follow USACE guidance.
Basis for Comment:
For flood damage reduction studies, ER 1105-2-101, Subsection 7.e, requires a risk analysis of all alternatives and a presentation of a probabilistic analysis to show whether net benefits are positive and the benefit/cost (B/C) ratio is at or above 1.0 for each alternative evaluated. This information is not provided in the White Oak Bayou GRR. The presentation and analysis of alternatives in Tables 4-7 to 4-26 only present single point estimates of net benefits, incremental benefits, and the B/C ratio.
Significance – High:
Risk and uncertainty analysis is an intrinsic part of flood damage studies and a requirement under USACE planning guidelines.
Recommendations for Resolution:
<ol style="list-style-type: none"> 1. Provide tabular presentations with the mean and standard deviation of Expected Annual Damages, Net Benefits, and the B/C ratio for each alternative and the NED Plan that are consistent with ER 1105-2-10.

Literature Cited:

USACE (2006). Risk Analysis for Flood Damage Reduction Studies. Department of the Army, U.S. Army Corps of Engineers, Washington, D.C. Engineering Regulation (ER) 1105-2-101. January.

Comment 2:

The documentation and explanation provided for the development of the existing and future without project conditions do not meet the requirements of ER 1105-2-100.

Basis for Comment:

ER 1105-2-100 (USACE, 2000; paragraph (b), p. 2-3) specifically states that “Since impact assessment is the basis for plan evaluation, comparison and selection, clear definition and full documentation of the without-project condition are essential.” After a detailed review of the White Oak Bayou General Reevaluation Report (GRR), the Panel was unable to find clear definitions and documentation in the GRR and associated reports of how the existing and future without project conditions were developed. Inadequate explanations coupled with discrepancies limit the Panel’s ability to independently evaluate the NED plan.

For example, the GRR states the following (paragraph 4.3, p. 20):

The base without project condition (base condition) is the watershed land use condition in the year 2010, assuming the configuration of the channel and detention facilities as of January 1, 1998. The base year of 2010 (base conditions) was selected as the beginning of the 50-year project life since it is the year in which the project was anticipated to be completed and benefits were expected to begin to accrue. The year 2060 future conditions based on the 50-year analysis period specified by USACE guidance documents were assumed to be equivalent to the 2010 conditions. This assumption is based on the requirements that all future development will have no impact on current flood levels....

Section 4.3.1 of the GRR (hydrology and hydraulics based conditions) does not provide any technical basis for making the claim that future without project conditions are equivalent to the base conditions. Nor is there any justification for the claim in the hydrology and hydraulics analysis (Appendix A).

In addition, analytical discrepancies make it difficult for the Panel to understand how the existing and/or without project conditions were defined. For example, the GRR (p. 7, Section 2.1) and the hydrology and hydraulics analysis in Appendix A (p. A-24, Section 4.9.2) both indicate that the watershed is 90% built out. The economic analysis in Appendix B (p. 9, Section 7.0), however, suggests the watershed is 80% built out.

Reasonable existing, without, and with project conditions cannot be established without these clarifications, and accurate economic analyses are not possible.

Significance – Medium:

If the basis for the future without project conditions is not adequately documented and subsequently verifiable, then it is not possible to validate the overall project justification.

Recommendations for Resolution:

1. Provide a more detailed explanation and basis for how the future without project condition would be equal to existing conditions.
2. Remove inconsistencies between the build-out conditions (percentages) noted in the GRR, Appendix A and Appendix B.

Literature Cited:

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

Comment 3:

The boundaries and constituents of the White Oak Bayou study area are not consistent in the GRR, Environmental Assessment, and supporting documentation.

Basis for Comment:

The Panel found inconsistent use and application of the study area boundaries and constituents throughout the various study documents.

For example, the lower reach of White Oak Bayou is not consistently evaluated in the different portions of the overall analysis:

- Page 29 of the White Oak Bayou GRR states that no components “downstream of Interstate 610” were evaluated for this project. However, several of the reaches that are listed as components of the economic analysis in Table 4-1 and Exhibit 4-3 are located in this section of the lower White Oak Bayou.
- Page 29 also states that the lower reach is considered to be part of the Buffalo Bayou and Lower White Oak Flood Damage Reduction Project; however, this project comprises an area distinct from that of the White Oak Bayou GRR.
- Exhibit A-2 in Appendix A states that the study area for the modeling includes all of White Oak Bayou.
- Appendix B (p. 3, Section 5.0) indicates that the economic analysis area is the area along the main stem of White Oak Bayou based upon the 0.2 percent chance of exceedance. However, it appears that claims for damages are possibly being made as a result of flooding along tributaries to White Oak Bayou which if so, is in direct conflict with the definition of the economic analysis.
- Section 5.6 (p. 130) of the White Oak Bayou GRR refers to an “...overall Recreation Plan” in Exhibit 5-13, which shows project components located in the lower reach of White Oak Bayou. The section also refers to the Recreation Plan in Appendix F, where Exhibit F-1 shows the NED Plan project as only consisting of the middle and upper reaches of White Oak Bayou.

Additionally, there are some inconsistencies between the economic and the hydrologic and hydraulic analyses regarding the economic study area (i.e., 500-year floodplain vs. 500-year floodplain plus 500-foot buffer). For example Appendix B (p. 3) states that the economic analysis area is the 2% exceedance floodplain plus a 500 foot buffer, whereas the hydrologic and hydraulic analysis (Appendix A, p. A-5) does not specify the study area used in the analysis and refers to Exhibit A-2, which only refers to an approximate 2% floodplain area. This raises questions that the application and subsequent development of data necessary to drive the hydrologic and hydraulic and the economics models might not be consistent and thus the associated results cannot be validated.

Significance – Medium:

A concise definition and map of the defined study and project areas as they relate to the hydrologic and hydraulic analysis and subsequent economics analysis are required in order to adequately assess the validity of the results.

Recommendations for Resolution:

1. Provide a definition and map of the study area for the engineering, economic, and recreation components of the analysis early in the White Oak Bayou GRR and discuss why any of the areas are different from other components of the analysis.
2. Provide a definition and map of the boundaries for the proposed project and the Buffalo Bayou and Lower White Oak Bayou Project.
3. Provide a rationale for including flood damage reduction in the lower reaches of White Oak Bayou as part of the benefits analysis for the proposed project.

Comment 4:

Alterations in the watershed that may have occurred between 1998 and 2010, unrelated to the construction of NED Plan components, such as changes in land use, bridge modifications, and more critically, subsidence, are not discussed.

Basis for Comment:

As stated on page A-2 of the Hydrology and Hydraulics Appendix, the date January 1, 1998 is used to establish the “without project” engineering conditions for the base year (2010). The Panel understands that the base without project conditions serve as the basis for evaluating the relative effects of the flood damage reduction components. However, changes in the watershed unrelated to the construction of NED Plan components may have occurred between 1998 and 2010, and may affect the evaluation of flood damage reduction components and development of the NED Plan. Furthermore, these changes may affect the evaluation of the flood damage reduction of the NED Plan.

According to page A-5 of the Hydrology and Hydraulics Appendix, hydraulic modeling is based on 2001 Light Detection and Ranging (LIDAR) data. However, development or redevelopment along White Oak Bayou between 2001 and 2010 (e.g., changes in land use, bridge modifications, new or modified structures within the floodplain, etc.) could impact hydraulic modeling results. While page A-5 states that subsidence is not expected over the study evaluation period, areas near City of Jersey Village continue to observe significant subsidence. Two subsidence monitoring stations are located northwest of Jersey Village along Farm to Market Road 1960, approximately one mile from White Oak Bayou. Monitoring records from these stations available on the Harris Galveston Subsidence District website (www.hgsubsidence.org) indicate subsidence of more than one foot between 2000 and 2010.

Significance – Medium:

Subsidence along White Oak Bayou and other changes within the watershed from 1998 to 2010 that are not discussed in the report may affect the optimization of the flood damage reduction components, the development of the NED Plan, and the analysis of flood damage reduction.

Recommendations for Resolution:

1. Provide an updated discussion of subsidence and its impact on the hydraulic and hydrologic analyses conducted as part of the White Oak Bayou GRR in Section 2.1.
2. Provide a discussion supporting the assumption that 2001 LIDAR is an appropriate basis for hydraulic modeling of 2010 conditions.

Literature Cited:

www.hgsubsidence.org

Comment 5:

The relative value of residential properties included in the flood damage assessments have not been reevaluated to account for changes in flood risk perceptions that have occurred since 2002.

Basis for Comment:

The property data used in the alternatives analysis were based on 2002 real property record maps (Appendix B, Sections 8.1–8.3). The property data for residential structures for the selected NED Plan were later updated to 2009 values based on a sampling analysis described in Attachment 3. The value updating procedure is technically correct, although it was based only on the estimated change in all properties within the study area. There was no statistical analysis to determine if the relative values of properties changed within each of the reaches used in the HEC-FDA simulations and what impact these changes would have on the selection of the NED Plan. For example, reductions in property values within the Jersey Village area after the 2001 storm could significantly reduce the overall flood reduction benefits since this area accounts for a large share of the total benefits.

This is a potentially important concern since several studies have shown that property values respond to changes in flood risk information (Morgan, 2007; Bin et al., 2008). Following the 2001 floods, properties in high risk areas would be expected to depreciate in value (or increase at a less rapid rate) compared to properties in low/no risk areas. This is partially mitigated by the use of replacement cost less depreciation for structure values (pp. 13–14), but it assumes that the replacement structure would be the same as the existing structure. The analysis does not address the potential for structure value changes and decreased replacement values in flood-prone areas. Therefore the updating procedure may overstate the expected flood reduction benefits. One measure of the potential error could be derived by reevaluating the property data described in Attachment 3 to account for flood risks by location/reach. Additional analysis would be needed to identify whether improvements/additions were more common in areas with lower flood risks since the sampling procedure excluded properties that had changes in structural improvements (Appendix B, Attachment 3, and Sections 3.0–4.0).

Significance – Medium:

Changes in the updating of residential property values to 2009 for flood damage estimation could influence the benefit-cost ratios for the alternatives and the NED Plan.

Recommendations for Resolution:

1. Revise the White Oak Bayou GRR and Appendix B to clearly state that the evaluation of alternative plans was based only on 2002 property value data and that the relative values of properties in different reaches may have changed since 2002. It could also be noted that changes in property values may influence the estimated flood reduction benefits of each alternative and the selected NED Plan.
2. Reevaluate the property value analysis described in Attachment 3 to determine if there were changes in relative values by reach within the study area.
3. Expand the existing analysis in Attachment 3 to include properties with changes in land

use and/or improvements across reaches to determine the impact of flood risk perceptions on property values and future land uses.

4. Provide an analysis to determine whether changes in property values across reaches would change the evaluation of the alternatives and the selection of the NED Plan.

Literature Cited:

Bin, O., J. Kruse, and C. Landry (2008). Flood hazards, insurance rates, and amenities: evidence from the coastal housing market. *J. Risk and Insurance*, 75(1): 63–82.

Morgan, A. (2007). The impact of Hurricane Ivan on expected flood losses, perceived flood risk, and property values. *J. Housing Research*, 16(1): 47–60.

Comment 6:

The discussion of the flood damages and expected damage reductions by reach does not provide sufficient detail to determine if the analytical methods were constructed or used appropriately.

Basis for Comment:

The Plan Formulation and Economic Base Conditions sections of the White Oak Bayou GRR do not provide enough details about the procedures used to define economic damages in the without project condition. Table 4-2 provides the first discussion of annual average expected (AAE) flood damages in the without project condition. Note 1 for Table 4-2 indicates the AAE damages of \$58.6 million include ‘risk and uncertainty,’ but this term is not defined in the context of the information presented. The preceding discussion in Section 4.3.1 and Figure 4-1 are not sufficient to explain what ‘risk and uncertainty’ mean in this context and how these concepts were integrated into the analysis.

Similarly, the more formal economic analysis in Appendix B, Section 11.1, provides an explanation of without project damages with and without uncertainty using the HED-FDA model. This section references Table 6, which shows the AAE damages estimates by reach, but this table is only briefly explained in the text and none of the discussion focuses on differences in the with and without uncertainty results. Table 6 shows significant differences in the without project damage results across different reaches, with the most dramatic differences occurring in the upper and middle reaches. The total expected annual damages vary by a ratio of 1.75 (\$58.6 vs. \$33.4 million), which is a large variation. A discussion explaining the reasons for this large variation, particularly in the reaches that would be most impacted by the project, is not provided.

Appendix B, Section 8.5; does not provide descriptions of all sources of risk used in the hydrological and economic analysis in this section. Tables 3a and 3b describe the uncertainty assumptions, but the discussion of economic statistics is spread throughout Attachments 1C, 1D, and 1E. These could be consolidated within Section 8.5 and discussed in terms of their relative significance in the risk analysis. For example, it would be very useful to highlight the most significant sources of uncertainty in the analysis and discuss how these sources influence the expected annual damages. This would augment the information provided in Appendix B, Table 22 that shows the cumulative effects of the uncertainty assumptions but does not explain why there are significantly different ratios of damages reduced across the different reaches at the 0.25, 0.5, and 0.75 levels of probability.

Additionally, the relatively small samples reported in Appendix B, Attachments 1A–D, are not discussed or explained in sufficient detail to establish the uncertainty statistics for structure values, especially for residential structures, which are the major source of damage estimates. Larger samples would improve the precision of the estimates and reduce this source of uncertainty in the analysis.

Significance – Medium:

Expected flood damage reductions are the primary benefit from the project, and a clear explanation of the analytical procedures and assumptions is necessary to evaluate the results and selection of the NED Plan.

Recommendations for Resolution:

1. Provide a discussion of the role of risk and uncertainty analysis.
2. Present the estimated without project expected annual damages using the with and without uncertainty assumptions.
3. Provide a more detailed discussion in Appendix B of the risk and uncertainty parameters in the HEC-FDA model.
4. Provide an analysis of the relative significance of the risk and uncertainty parameters in determining the range of flood damages reduced across the different reaches.
5. Provide more discussion on the sampling procedures and selected sample sizes for structure values to use in the uncertainty analysis.

Comment 7:

The assumptions and procedures used in flood damage estimation for structure and content damages are inconsistent and may have affected the results of the analysis.

Basis for Comment:

The flood damage estimation procedure is consistent with USACE guidelines and uses the HEC-FDA model. Some assumptions and explanations of how the model was used, however, are inconsistent and suggest potential errors in the analysis.

Sections 8.2 and 8.5 of Appendix B state that single family homes (i.e., one and two story) were assigned content-to-structure value ratio (CSVR) of 100 percent since generic depth-damage curves from EGM 01-03 were used in the analysis. The second footnote to Table 4 (p. 27), however, states that residential content values in the table “are based on 50 percent content-to-structure value ratio (CSVR).” The same footnote appears in Table 20 (p. 103) for the selected NED Plan. The approach noted in the footnote was consistent with flood damage estimates using the HED-FDA prior to the issuance of Economic Guidance Memorandum (EGM) 01-03.

This inconsistency raises concerns about the methods used and the validity of the results presented. For example, all of the estimated residential content value damages in Table 4 are approximately 50 percent of the estimated structure value damages regardless of the exceedance probability event. This is not consistent with the depth damage curves in EGM 10-03, which show significant differences in the percentage of damage for structures versus content as the level of flood inundation increases. Also, the analysis does not state that EGM 01-03 applies generic curves apply only to residential structures without basements.

Section 11.1 of Appendix B states that “Damages begin to accrue when the flood stage reaches within one foot of the finished floor elevation.” It is unclear if this assumption is consistent with the depth-damage curves in EGM 01-03, or if this assumption is used for all types of property.

Finally, the without project conditions assume that Harris County building regulations require new development at least 18 inches above the base flood elevation (Appendix A). If these regulations apply to redevelopment of existing flood-prone properties, then the expected without project damages will be lower than estimated as structures are rebuilt over the 50 year life of the project.

Significance – Medium:

Flood damage estimates for with and without project conditions are the main source of benefits for the economic analysis and selection of the NED Plan.

Recommendations for Resolution:

1. Describe the assumptions used for the CSVs and ensure that the same assumptions are represented in the text and tables.
2. Develop a procedure to estimate replacement of structures with the flood plain over the life of the project and the expected reductions in flood damage in the without project condition.
3. Verify that the damage estimates using the HEC-FDA that are reported in the GRR are consistent with the assumptions used in the analysis.

Comment 8:

The Recreation Plan does not provide sufficient detail to evaluate the estimated recreational demand and the benefit-cost ratio for the Plan.

Basis for Comment:

While an extensive overview is given for existing recreation facilities located in the study area, very little of Appendix F focuses on the demand and benefit estimation methodology. Surprisingly, the discussion of existing recreation facilities provides no estimates of current recreational demand in the study area. The White Oak Bayou GRR incorporates recreational use estimates transferred from “similar projects” briefly described in Section 4.1.1, but there is no justification for the projects selected. The Recreation Plan concludes that that the recreation aspect of the project adds a Benefit/Cost to the overall project of 3.49 (p. F-76).

Future recreational use is projected using per capita visitation rates transferred from other studies and based on current population in census tracts within the study area and forecasted population growth in Harris County. These expected attendance figures are not discussed, nor is there any discussion of the projections in relation to carrying capacity and inundation events within the proposed facilities. In general, the projections do not seem realistic given the existing highly developed nature of the study area and the limited car parking and rest room facilities (shown on site plans Exhibits F-6 to F-12) that will restrict access by users from outside the immediate neighborhoods.

The use of Unit Day Values (UDV) is consistent with USACE guidelines in lieu of local studies to identify recreation value for specific sites. There is a brief description in Section 4.1.3 of the UDV derivation for this study (limited to trail-type parks), but there is no discussion or justification for the estimates presented. Similarly, the benefit transfer analysis using the Forest Service model is not discussed and there is no presentation of the details for the values used in this study.

There is also no discussion of public involvement with the Recreation Plan. This is important given that the proposed facilities would be used primarily by residents in the adjoining neighborhoods. The residents’ perceptions and acceptance of visitors from outside the neighborhood using the recreation facilities are also important characteristics needed to determine future recreational demand.

Significance – Medium:

Additional information and discussion is needed to determine whether the estimated recreational use estimates and the benefit-cost ratio for the Recreation Plan were properly developed.

Recommendations for Resolution:

1. Document existing recreational use of facilities within the study area.
2. Justify the studies selected to transfer recreational use estimates and discuss the potential errors associated with transferring the use estimates to the study area.
3. Discuss the expected carrying capacity of the proposed facilities and expected impacts on usage from inundation events.

4. Justify the UDV and the benefit transfer analysis from the Forest Service model.
5. Revise the benefit-cost ratio that accounts for the uncertainty associated with the recreational use estimates, projected future use, and the benefit estimates.
6. Document public involvement in the development of the Recreation Plan.

Comment 9:

Further justification for the placement of trails and play/practice fields within detention basins is needed because the described recreational facilities do not appear to be compatible with detention basins.

Basis for Comment:

Appendix F of the White Oak Bayou GRR describes the plans for including recreation areas within several of the detention basins for the White Oak Bayou project. These recreation areas appear to be included in the calculations for the benefits of the project. It is not clear if these recreation areas, which include baseball and soccer fields, are actually compatible with the main use of these areas as on/offline detention basins for the White Oak flood control project.

The multipurpose aspects of detention basins having trails and playing/practice fields appear to have added benefit for the project. However, the locations (Santa Cruz, CA and Las Vegas, NV) cited as examples for providing recreational demand (and thus benefit) are not in similar climatological conditions.

The semi-tropical climate of Houston and the 48 inches of rain annually are problematic for recreational use, especially soccer and baseball fields. Additionally, historic annual rain events in the Houston area have included tropical storms and hurricanes capable of releasing tens of inches of rain that would inundate the detention basins during the summer months. Winter rains can also be severe.

The field types described in the White Oak Bayou GRR are maintenance-intensive under ideal, controlled conditions. As detention basins first, the proposed fields will be subject to annual inundation, if not multiple flooding events, throughout the year.

The added stress of inundation will likely require not only regular sod/grass replacement but if the fields are used before they are fully dry, the damage to the turf/sod will also be extensive. Thus, the playing surface will require regular repair to maintain a safe surface for use.

The GRR, Environmental Assessment (EA), and Appendix F do not discuss the projected amount of time that the basins would actually be used to store flood water and what the impact of flooding would be on the playing fields and linear parks.

The creation of playing fields and linear parks within the detention basins provides for the real possibility of the entire basin becoming inundated during a flood event. Yet there is no discussion of the potential time of inundation within the basins or the potential time for the soils to dry well enough to support intense recreation associated with sport activities such as soccer or baseball.

If the detention areas cannot provide the projected benefit for significant portions of the year, this needs to be discussed and factored into the determination of the actual benefit provided by these innovative ideas.

Significance – Medium:

The multiple use scenario presented in the recreation plan has great potential. However, the GRR, EA, and Appendix F do not address any of the potential problems associated with placing public recreation areas within detention basins.

Recommendations for Resolution:

1. Justify the placement of recreational facilities within detention basins as a viable and beneficial use of the open land. If this has been done successfully in other locations, provide the documentation, particularly in semi-tropical conditions involving high annual rainfall.
2. Expand on the information presented separately in the GRR and the Environmental Assessment concerning the weather patterns for the Houston area (rainfall totals and general periodic levels). Discuss the amount of time in a normal year that each retention basin can expect to see inundation and estimate the amount of time it will not be available for public use.

Comment 10:

The White Oak Bayou GRR provides for protection and maintenance of existing prairie dawn flower populations, but do not address methods for increasing growth and expansion of the species.

Basis for Comment:

The Texas prairie dawn flower has been observed in the Hollister Road basin and the Fairbanks-North Houston basin, both of which are proposed in the White Oak Bayou GRR as stormwater basins with shared recreational facilities. The prairie dawn flower is an endangered species protected on both Texas and Federal lists.

The EA describes the extent of the species (Section 4-5), and defines the management plan for the species (Section 5.4). The management approach is to preserve areas with species populations and or suitable habitat by excluding them from severe ground disturbance; mow areas with individual flowers or populations in the fall only; and seed with other known prairie species. This will protect and maintain existing prairie dawn flower populations.

Prairie habitat and prairie dawn flower, however, require regular disturbance for healthy growth and dispersal. Fire is a natural and critical disturbance that revitalizes the prairie ecosystem, but is not addressed in the EA. Nor does it contain enough information to sustain the argument that simply mowing will help increase the prairie dawn flower population. The Panel cannot ascertain from the White Oak Bayou GRR whether the proper disturbance regime and disturbance frequency have been determined. Both aspects are important for the continued growth and expansion of the existing prairie dawn flower population and the potential for expanding the population of this species into additional, similar habitats.

Significance – Medium:

Survival of the Texas prairie dawn flower in the White Oak Bayou study area depends on having a plan that preserves existing populations not only by avoiding harm, but also by replicating natural prairie disturbances and encouraging spread of the species.

Recommendations for Resolution:

1. Discuss how mitigation measures that imitate prairie disturbance, including fire, will be incorporated in the management of prairie dawn flower populations.
2. Provide a plan for developing additional habitat that would encourage the spread of the prairie dawn flower population.

Comment 11:

Impacts from flooding of the recreational areas may not have been fully accounted for in the derivation of Operation, Maintenance Repair, Replacement, and Rehabilitation (OMRR&R) costs.

Basis for Comment:

In reading the GRR and associated documents, the Panel has found that Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) costs are referred to variously as OMRR&R (GRR and EA), O&M (Appendix F), and OM&R (Appendix C). The Panel assumes that all the abbreviations refer to the same costs.

Appendix F (p. F-76) estimates the annual O&M cost for the Recreation Plan as \$35,800. In the EA, the cost is rounded to \$36,000 for the NED Plan. This sum is to be spread over the proposed three linear parks and six detention basins (Master Plan, pp. F-69 and F-70; and Recreation Plan, Exhibits F-6 - F-12). Divided evenly over the sites, this amounts to less than \$4,000 annual maintenance cost per park.

The typical OMRR&R activities will be mowing right-of-way (ROW), slope repair, riprap or concrete slope protection, maintenance of inlet and outlet control structures, weed control, debris removal, turf maintenance, desilting, and backslope drain system repair (EA, Section 3.3.5, and GRR, Section 5.7). Of these activities, only mowing the ROW and turf maintenance will be directly related to the annual maintenance of the proposed parks.

In the short discussion of OM&R costs and how they were determined (Appendix C, p. C-39); however, there is no contingency for potential damage to recreation areas related to flooding and inundation of the playing fields and linear parks. The added stress of inundation will likely require not only regular sod/grass replacement, but if the fields are used before they are fully dry, the damage to the turf/sod will also be extensive.

In the opinion of the Panel, the OMRR&R costs associated with maintaining the recreation areas have not been discussed in sufficient detail.

Significance –Medium:

Without taking into account impacts from flooding of the recreational areas, actual OMMR&R costs associated with maintaining recreational areas cannot be evaluated.

Recommendations for Resolution:

1. Ensure that the OMRR&R cited in the GRR is the same as the OM&R cited in Appendix F (Unnumbered Table in Section 4.3), and make appropriate changes to all project documents (i.e., GRR, Appendix C, and EA).
2. Provide a discussion in Appendix F that includes OMRR&R activities in addition to mowing.

Comment 12:

It appears that portions of the hydrology and hydraulics analysis were done at different times and it is not clear that they were integrated into the overall project analysis.

Basis for Comment:

A review of the report and the models provided reveals inconsistencies among the peak flows calculated using unsteady HEC-RAS, peak flows applied in the steady HEC-RAS model, peak flows reported in Table 21 (p. A-95) of the Hydrology and Hydraulics Appendix, and peak flows shown on the hydrographs in Exhibits A-24 through A-35. Differences between peak flows reported in Table 21 and peak flows shown in Exhibits A-24 through A-35 are as high as 3,100 cfs. Additionally, Exhibit A-29 shows that the NED Plan 4% exceedance peak flow at stream station 87508 is approximately 300 cfs *greater* than the without project conditions peak flow, whereas Exhibit A-33 shows the NED Plan 1% exceedance peak flow is approximately 300 cfs *less* than the without project conditions peak flow at this location. The Panel assumes that these inconsistencies are due to the inadvertent inclusion of information that had not been updated from previous studies associated with the White Oak Bayou GRR.

Accurate modeling of water surface elevations along White Oak Bayou is critical to the development of the NED Plan and the evaluation of flood damage reduction. Peak flows computed from the unsteady HEC-RAS model should be properly entered in the steady HEC-RAS model, and the tables and exhibits in the White Oak Bayou GRR should portray a comprehensive report of the hydrologic and hydraulic analysis.

Significance – Low:

Several inconsistencies in the White Oak Bayou GRR and models, which most likely are differences between results of the 2010 GRR and artifacts from previous GRR study efforts, lead to confusion regarding the hydrologic and hydraulic modeling used in the project.

Recommendations for Resolution:

1. Confirm that the HEC-RAS models provided are from the same modeling exercise associated with the White Oak Bayou GRR or provide appropriate models.
2. Revise the Hydrology and Hydraulics Appendix (e.g., Table 21 and Exhibits A-24 through A-35) to include results from the same modeling exercise associated with the White Oak Bayou GRR.

Comment 13:

The actual cost of current property acquisitions and displacements associated with all examined feasible alternatives are difficult to confirm because of conflicting presentations of “current” conditions in the GRR and the appendices.

Basis for Comment:

The Panel finds there is considerable confusion as to what constitutes “current” conditions in the White Oak Bayou project. The GRR and EA refer to developed areas that are clearly undeveloped in the Real Estate and Engineering appendices (D and E). The confusion arises from the use of aerial photographs in the appendices, taken of the sites in 2002 when they were undeveloped, whereas they now support residential and business properties. As a result, the property acquisition costs and plans for property acquisition contained in Appendices D and E are out of date.

The reliance on 2002 photographs also makes it difficult to reconcile discussions in Appendices D and E with similar discussions in the GRR and the EA. For example, the Panel could not identify which detention basin, levee, and channel options are contained in Appendix D, or how they are related to the EA and GRR alternatives.

The same problem exists with matching up sites discussed as undeveloped in the appendices (relying on the 2002 photographs) and presented as developed in the main text. For example, Section 4.2.2 of Appendix D discusses an option for the North Houston-Rosslyn (NHR) basin configurations, and illustrates it with Exhibit D-12.5, an aerial photograph that shows that the NHR4 site is not developed. The accompanying text describes a potential for a take of 84 homes. However, the Panel reviewed newer aerial photographs (See Figure 1) of the project area that clearly shows the northeast corner of the NHR4 area as a fully developed subdivision.

The appendices also show other basins (Hollister, for example) as undeveloped property associated with the proposed basin components (Exhibits D 13.1 - 13.4). Yet new aerial photographs clearly show these areas as developed (See Figure 2).

As a result of these discrepancies, the Panel cannot determine if the basin acquisition costs discussed in the Engineering and Real Estate appendices and in the White Oak Bayou GRR include or exclude the developed areas. Nor can the Panel understand which acquisitions are already done and what remains to be acquired. Thus, the costs for the project cannot be easily determined.

Significance – Low:

The cost of property acquisitions and displacements associated with all examined feasible alternatives must be based on current condition within the study area and consistently described in the White Oak Bayou GRR for the project cost estimates to be fully understood.

Recommendations for Resolution:

1. Update all aerial photography in the various reports and appendices.
2. Provide a complete accounting of properties that have been built and which still need to be acquired to complete the project, and correlate with updated aerial photographs.
3. Ensure consistency of text and exhibits between the main report and the appendices.

NH4
BASIN
COMPONENTS

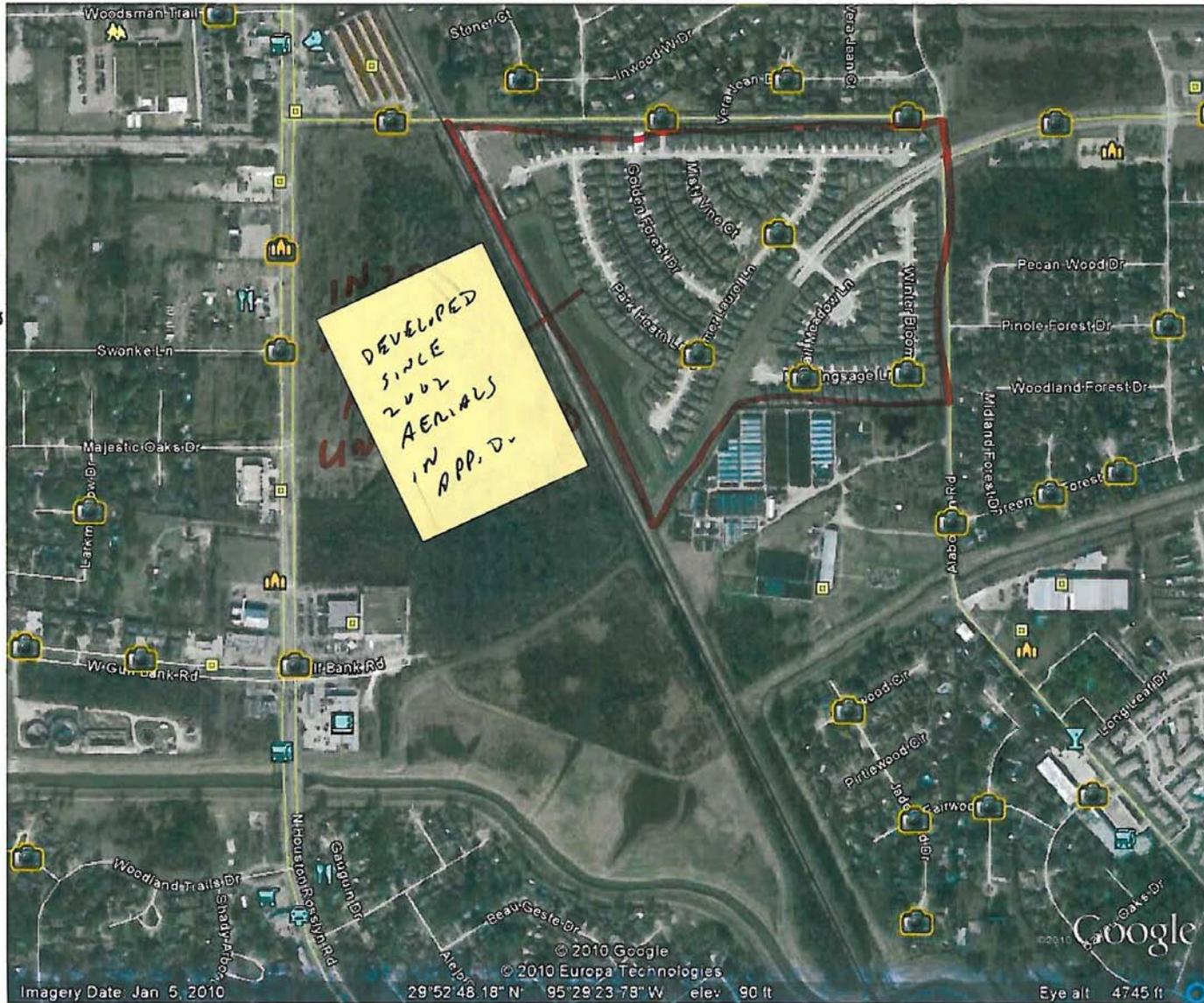


Figure A-1. Aerial Photograph of NH4 Basin Components Post 2002



Figure A-2. Aerial Photograph of Hollister Basin Components Post 2002

Comment 14:

Documentation of public involvement in the White Oak Bayou project since 2004 is not provided, but is required to fully understand the project benefits, especially as they affect residents and businesses that have moved into the project area since 2004.

Basis for Comment:

The Panel finds there is a lack of documentation on public involvement in the White Oak Bayou project since October 2004. The White Oak Bayou GRR is being published in 2011, so it has been more than five years since the public was last involved.

The EA reports (Section 6.2) that public meetings were held from 1998 through Fall 2000. It also provides documentation of public involvement up to October 2004 (Section 3). A Citizen's Advisory Board was active from July 1998 to July 2001. The White Oak Bayou Association was involved in the project until August 2001. Section 5.10 of the White Oak Bayou GRR contains summary information of public involvement, but there is no record of recent public involvement after the preliminary design phase was completed. Section 6.2.3 of the EA ends with the following sentence: "The HCFCD would conduct continued agency and public meetings as the proposed action progresses." However, there is no documentation provided after 2004.

The White Oak Bayou GRR describes much of the benefit of the White Oak Bayou project in terms of the benefits to the general public. However, it does not specifically address the public's concerns, approval, or disapproval of the proposed alternative. As a NEPA document, White Oak Bayou GRR should not only identify specific comments and questions recorded from the public meetings (Public Involvement Appendices of the GRR and the Environmental Assessment), but also respond to them. This does appear to have occurred.

In addition, specific offers by citizens and citizen organizations to help HCFCD develop suitable project solutions (included in the public involvement appendices of the EA or the GRR) do not appear to have been considered in the completion of this project.

Several areas that are now planned to be included in the detention basins were originally undeveloped areas. They were last photographed by air in 2002. Since the photographs were taken, the areas have been converted into housing or business developments. Current conditions of the new housing and businesses are not included in the supporting documentation. The White Oak Bayou GRR does not record any public information effort expended in these recently developed areas, and provides no documentation on the involvement of the business owners or the development of potential impacts on businesses as part of the White Oak Bayou project in any of the appendices related to public involvement.

A generic phrase in the White Oak Bayou EA (Section 5.11.1) states, "for the commercial and residential structures that are located within the proposed ROW, relocation is not expected to be a constraint as there is an adequate supply of decent, safe, and sanitary replacement housing in the study area." While this is a required statement, the Panel feels there is not enough recent documentation to be assured.

Significance – Low:

The White Oak Bayou project will directly affect individuals and businesses, and documentation of public outreach that has occurred since 2004 will strengthen the project.

Recommendations for Resolution:

1. Provide figures and tables specifically needed to describe the public input to the project through 2010.
2. Provide information in the EA on the public outreach meetings held throughout the entire project development period and discuss how the public comments were resolved.
3. Document the number of displacements from 1998 to date and the others (e.g., residential/building purchases, etc.) that will be required to complete the project. This should include development that occurred since the 2002 aerial photographs were taken.
4. Discuss how the displacements have been documented and presented to the affected residents and businesses.
5. Document actual expected current (i.e., 2009 or 2010) displacements of residents and businesses, describe current conditions, and illustrate each drainage basin.
6. Ensure that all new information has been properly referenced on the aerial photography by either caption or map-based marking with suitable definition.

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APPENDIX B

Final Charge to the Independent External Peer Review Panel

as

Submitted to LJA/HCFCD on September 30, 2010

on the

White Oak Bayou GRR

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APPENDIX C
Final Charge Questions and Guidance to the Peer Reviewers
for the
White Oak Bayou Federal Flood Damage Reduction Plan

BACKGROUND

White Oak Bayou, a tributary of Buffalo Bayou, originates in northwest Harris County, Texas and flows southeast for approximately 25 miles through the City of Jersey Village and the City of Houston where it outfalls into Buffalo Bayou in downtown Houston. White Oak Bayou watershed drains approximately 110 square miles and is approximately 90 percent developed. Elevations in the watershed vary from approximately 135 feet to approximately 40 feet and the average streambed slope is about 4 feet per mile.

The existing Federal channel in the lower reach of White Oak Bayou was completed in the mid-1970s under the authorization of the Flood Control Acts of 1954 and 1965 for Buffalo Bayou and Tributaries. The 11.4 miles of channel improvements comprise the existing Federal project that extends from the confluence of White Oak Bayou and Buffalo Bayou to Cole Creek.

The Upper White Oak Bayou project is authorized by the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662) and based on *Buffalo Bayou and Tributaries Main Report on Upper White Oak Bayou Feasibility Report for Flood Damage Prevention* (U.S. Army Corps of Engineers [USACE], 1979). The project authorization is currently in the inactive category. The existing Federal channel reach in the lower 10.7 miles of White Oak Bayou was evaluated as part of the *Feasibility Report on Buffalo Bayou and Tributaries* (USACE, 1988). Since the benefit/cost ratio was less than 1, Federal participation in the project was not recommended.

The two most recent severe floods occurred during Tropical Storm Frances in September 1998 and Tropical Storm Allison in June 2001. The former flooded approximately 1,200 homes and the latter flooded approximately 11,000 residences within the White Oak Bayou watershed. Approximately 1,333 and 6,074 structures, respectively, are in the 10 percent and 1 percent flood plain.

Section 211(f) of the Federal Water Resources Development Act of 1996 (WRDA 1996) (Public Law 104-303) authorized the Harris County Flood Control District (HCFCD) to develop a flood reduction risk management plan for White Oak Bayou. The purpose of this study was to determine if a Federal flood risk management control project along White Oak Bayou is justified and to provide the documentation needed to request approval from the Assistant Secretary of the Army, Civil Works (ASA(CW)) and Federal funding for construction of the recommended plan.

This General Reevaluation Report (GRR) study was conducted following the published procedure, methodology and guidance of the USACE. The USACE HEC-HMS, HEC-RAS, and HEC-FDA computer models were utilized to determine the flood damages for the without project condition and to evaluate the effectiveness of the alternative flood damage reduction plans. The average annual flood damage under the without project condition is estimated to be

\$58.6 million along the main stem of White Oak Bayou. Over 90 different configurations of structural and non-structural components were evaluated, including channel modification, detention, bypass channels, flood protection levees, replacement or modification of existing bridges, elevating structures, and permanent relocation. Over 300 different combinations were considered.

The National Economic Development (NED) plan is the plan that is supported by the HCFCFCD, the Local Sponsor. The NED plan consists of the following components:

- (1) Earthen channel modifications along 15.4 miles from Cole Creek to FM 1960.
- (2) Four detention basins along White Oak Bayou providing approximately 3,386 acre-feet storage.

The NED Plan reduces the average annual flood damages by \$36.6 million, or approximately 62 percent. No significant adverse environmental impacts were identified. Detention basins with tree and shrub plantings will promote the reintroduction of native habitat for wildlife and provide an opportunity for use as multipurpose facilities with recreation elements as well. The support for this plan has been expressed by the White Oak Bayou Advisory Committee and by the public in general, based on the public meetings held during the planning process.

The NED Plan impacts 13.24 acres of isolated and fragmented wetland areas along the bayou. The cost of the mitigation will be approximately \$217,000. In addition, habitat that is disturbed by construction will be restored to its pre-construction condition.

No significant adverse social effects result from the plan. The proposed project plays an important role in social aspects of the community by reducing the impacts caused by flooding, improving the safety, and contributing towards community cohesion.

Regional economic development impacts are positive. The damage reduction and construction investment both are positive factors for the economy of the Houston region.

The proposed flood risk management control project reduces average annual damages from \$58.6 million to approximately \$22.0 million, providing an annual benefit of approximately \$36.6 million, and has a benefit/cost ratio of approximately 3.1. Net economic benefits are \$25.2 million. The estimated first cost based on the Micro-Computer Aided Cost Estimating System cost estimate is \$211.9 million and the fully funded cost is \$230.8 million. These costs are based on 2009 price levels, plus future escalation of \$4.7 million and interest during construction of \$14.2 million at the 2010 Federal interest rate of 4.375 percent. The Federal and non-Federal cost allocations for the project first cost are estimated to be \$146.3 million and \$65.6 million respectively. The proposed project reduces the extent of the 10 percent and 1 percent flood plain areas so that 1,285 and 1,511 structures, respectively, would now be located outside of the two reduced flood plain areas, leaving 48 and 4,563 structures, respectively, within the two reduced flood plain areas.

The proposed recreation plan has an estimated first cost of \$12.8 million, provides net benefits of \$ 1.67 million, and has a benefit-cost ratio of 3.5. The Federal and non-Federal first-cost share is \$ 6.4 million each.

OBJECTIVES

The objective of this work is to conduct an independent external peer review (IEPR) of the studies that comprise the General Reevaluation Report (GRR) for the White Oak Bayou Federal Flood Damage Reduction Plan (White Oak Bayou GRR) 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. The White Oak Bayou GRR studies and the project development team have been directed by the Harris County Flood Control District (HCFCD).

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.

This purpose of the IEPR is to “assess the adequacy and acceptability of the economic, engineering, and environmental methods, models, and analyses used” (EC 1165-2-209; p. D-4) for the White Oak Bayou GRR. 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, environmental, and plan formulation issues relevant to the project.

The IEPR Panel will be “charged” with responding to specific technical questions as well as providing a broad technical evaluation of the overall project. The Panel will identify, examine, and comment upon the assumptions underlying the analyses, as well as evaluate the soundness of models and analytic methods. The Panel will evaluate whether the interpretations of analyses and conclusions are technically sound and reasonable, provide effective review in terms of both usefulness of results and credibility, and have the flexibility to bring important issues to the attention of decision makers. The Panel may also offer 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 to be reviewed.** All other documents are provided for reference.

- **White Oak Bayou, Texas Flood Damage Reduction Plan**
 - **Main Report**

- **Environmental Assessment**
- **Environmental Assessment Appendices**
- **Notebook 1**
 - **Appendix A: Hydrology and Hydraulics**
 - **Appendix B: Economic Analysis**
 - **Appendix C: Cost Estimates**
- **Notebook 2**
 - **Appendix D: Engineering Design and Analysis**
 - **Appendix E: Real Estate Plan**
 - **Appendix F: Recreation Plan**
 - **Appendix G: Public Involvement**
- 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 IEPR Panel	11/10/2010
	Battelle/Panel kick-off meeting	<i>11/15/2010</i>
	LJA/HCFCD/Battelle/Panel kick-off meeting	<i>11/15/2010</i>
	Battelle convenes mid-review teleconference for panel to ask clarifying questions of LJA/HCFCD	<i>11/22/2010</i>
	Panel members complete their individual reviews	12/7/2010
Prepare Final Panel Comments and Final IEPR Report	Battelle provides Panel merged individual comments and talking points for panel review teleconference	12/10/2010
	Convene panel review teleconference	<i>12/13/2010</i>
	Battelle provides Final Panel Comments directive to Panel	12/14/2010
	Panel members provide draft Final Panel Comments to Battelle	12/21/2010
	Battelle provides feedback to Panel on draft Final Panel Comments; Panel provides revised draft Final Panel Comments per Battelle feedback (iterative process)	12/22/2010 - <i>1/3/2011</i>
	Final Panel Comments finalized	1/4/2011
	Battelle provides Final IEPR Report to Panel for review	1/6/2011
	Panel provides comments on Final IEPR Report	1/10/2011
	*Battelle submits Final IEPR Report to LJA/HCFCD	1/11/2011
Comment/ Response Process	Battelle inputs Final Panel Comments to DrChecks; Battelle provides Final Panel Comment response template to LJA/HCFCD	1/13/2011
	HCFCD provides draft Evaluator Responses and clarifying questions to Battelle	1/24/2011
	Battelle provides the Panel the draft Evaluator Responses and clarifying questions	1/26/2011
	Panel members provide Battelle with draft comments on draft Evaluator Responses (i.e., draft BackCheck Responses)	1/31/2011
	Teleconference with Battelle and Panel to discuss draft BackCheck Responses	<i>1/31/2011</i>
	Teleconference between Battelle, Panel, and LJA/HCFCD to discuss Final Panel Comments, draft responses, and clarifying questions	<i>2/1/2011</i>
	HCFCD inputs final Evaluator Responses in DrChecks	2/10/2011
	Battelle provides Evaluator Responses to Panel	2/14/2011
	Panel members provide Battelle with final BackCheck Responses	2/17/2011
	Battelle inputs the Panel's BackCheck Responses in DrChecks	2/18/2011
	*Battelle submits pdf printout of DrChecks project file	<i>2/22/2011</i>

NOTE: All dates in italics are tentative pending LJA/HCFCD PT and Panel availability.

CHARGE FOR PEER REVIEW

Members of this IEPR Panel are asked to determine whether the technical approach and scientific rationale presented in the General Reevaluation Report (GRR) for the White Oak Bayou Federal Flood Damage Reduction Plan (White Oak Bayou GRR) are credible and whether the conclusions are valid. The Panel is 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 engineering, economics, environmental and plan formulation issues. 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) are included in the general charge guidance, which is provided below.

General Charge Guidance

Please answer the scientific and technical questions listed below and conduct a broad overview of the White Oak Bayou GRR. 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, or prepared the subject documents.
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 panel members 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 December 7, 2010, 5 pm ET.

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**Independent External Peer Review
White Oak Bayou Federal Flood Damage Reduction Plan**

Final Charge Questions

GENERAL QUESTIONS

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

1. Are the assumptions that underlie the economic, engineering, and environmental analyses sound?
2. Are the economic, engineering, and environmental methods, models, and analyses used adequate and acceptable?
3. In general terms, are the planning methods sound?
4. Are the interpretations of analysis and conclusions based on the analysis reasonable?

EXECUTIVE SUMMARY

No Questions

SECTION 1.0 – INTRODUCTION

No Questions

SECTION 2.0 – Project Location and Description

No Questions

SECTION 3.0 – Problem Identification

5. Comment on whether the potential problems and opportunities to reduce flood risk have been adequately defined.
6. To what extent have the environmental problems and opportunities been clearly identified and defined?
7. To what extent have the recreational problems and opportunities been identified and clearly defined.

SECTION 4.0 – Plan Formulation

8. Comment if the “No Action Alternative” is clearly explained, is consistent with the Economic Analysis, and whether the baseline appears consistent with generally accepted economic principles.
9. Comment on the clarity of the alternative cost and benefit estimates presented.
10. Comment on the basic assumptions used to define the without-project conditions flooding and damages.
11. Comment on whether the constraints used to select alternatives for analysis are clearly stated.
12. Have all significant impacts of the plan been identified and adequately addressed?

4.1 Planning Goals, Objectives, and Constraints

13. Comment on whether the goals of the federal and local sponsors are complete.
 - a. Are the objectives listed complete and detailed given the plan scope?
 - b. To what degree have the constraints been defined?

4.3 Without Project Conditions Analysis

14. Given your expertise, comment on whether the future assumptions are pertinent.
15. Comment on the extent to which the approach to the economic analysis is summarized and consistent with and supported by the analyses presented in the respective appendices.

4.4 Description of Plan Formulation Process

16. Are the physical and geographic study limits defined for the evaluation of components valid?
17. Is the process used for plan formulation described adequately?
 - a. How well does the plan formulation process correspond to the USACE planning steps?

4.5 Step 1 Identification of Components

18. Comment on the list of non-structural components.
 - a. Is the inclusion and exclusion of components supported by information in the GRR?

19. Comment on the list of structural components.
 - a. Is the inclusion and exclusion of components supported by information in the GRR?
20. Comment on the completeness of component identification and the adequacy of the justification to include or exclude components from further consideration.

4.6 Step 2 Single Component Optimization

21. To what extent is the analysis of the Single Component Optimization comprehensive?
22. Comment on the appropriateness and sufficiency of the component optimization process.
23. Discuss the completeness and clarity of the summary of the evaluation of components.

4.7 Step 3 Identification of Anchor Components

24. Comment on the clarity of the component optimization process.
25. Comment on the extent to which the anchor elements are identified, explained and justified by the analysis.
26. Comment on whether the overall approach and analysis resulted in an adequately justified evaluation and comparison of alternative plans.

4.8 Step 4 Re-Optimization of Components with Anchor

27. Is the justification of the component re-optimization supported within the text?
28. Comment on whether the overall approach and analysis resulted in an adequately justified evaluation and comparison of alternative plans.

29. 4.9 Step 5 Incremental Addition of Components

30. Comment on whether the net benefits are reasonably maximized within each plan.
31. Comment on the appropriateness and clarity of the approach used to incrementally add the components.
32. Comment on whether the overall approach and analysis resulted in an adequately justified evaluation and comparison of alternative plans.

4.10 Step 6 Final Optimization

No Questions

4.11 Evaluation and Comparison of Alternatives Plans

33. To what extent is the plan comparison sufficiently detailed?

4.12 Cost Update

No Questions

4.13 Review of Economic Performance of Plan Components

No Questions

4.14 Identification of NED Plan

34. To what extent is the NED Plan sufficiently described?

35. To what extent does the NED Plan meet the planning objectives?

36. 4.15 Identification of NED Plan

37. No questions

SECTION 5.0 – NED Plan

38. Comment on the extent to which the NED Plan is adequately explained and is consistent with and supported by the analysis of component optimization.

39. Comment on the sufficiency of the economic considerations included in the NED Plan.

5.1 Summary of Plan Features

40. Comment on the comprehensiveness of the summary of plan features.

5.2 Flood Damage Reduction

No Questions

5.3 Environmental Quality Considerations of the NED Plan

No Questions

5.4 Flood Damage Reduction and Other Social Effects

No Questions

5.5 Regional Economic Development

No Questions

5.6 Recreation Plan

No Questions

5.7 Operation and Maintenance Considerations

No Questions

5.8 Plan Implementation

No Questions

5.9 Project Financial Analysis

41. Comment on the extent to which the project costs are comprehensive and adequately explained, and justified by the methods and assumptions of the analyses.

5.10 Public Involvement

No Questions

5.11 Section 575 Analysis

No questions

SECTION 6.0 – Summary and Conclusions

6.1 Summary and Conclusions

42. Comment on whether the conclusions and recommendations are consistent with and justified by the results of the study.

DOCUMENT: ENVIRONMENTAL ASSESSMENT AND APPENDICES

Section 1.0 Project Background

43. Comment on whether the potential negative effects of the project are completely documented in the EA, and whether the conclusions accurately reflect the details in the EA.
44. To what extent is the environmental screening comprehensive?

Section 2.0 Purpose and Need of the Proposed Action

45. To what extent have the projects needs and goals been fully described?
46. To what extent have the objectives been defined?
47. To what extent has the list of constraints been comprehensively described?

Section 3.0 Alternatives

3.1 No Action Alternative

48. Has the No-Action Alternative been thoroughly defined?

3.2 Plan Formulation Process No Questions

3.3 National Economic Development Plan

49. Comment on the process of identification of the NED Plan.
 - a. Is it supported by the text?

Section 4.0 Affected Environment

4.1 Definition of the Study Area and Project Area

50. Are the current and proposed conditions fully defined?

4.2 Physical Description

51. Comment on the comprehensiveness, and completeness of the information used to describe the physical characteristics of the affected environment.

52. Are the descriptions of the following components complete:

- a. Geology
- b. Climate
- c. Soil

4.3 Land Use

No Questions

4.4 Biological Resources

53. Comment on the comprehensiveness, and completeness of the information used to describe the vegetation and wildlife of the affected environment.

4.5 Threatened and Endangered Species

54. Comment on the comprehensiveness, and completeness of the information used in the threatened and endangered species surveys of the affected environment.

4.6 Floodplains, Drainage and Water Quality

55. Comment on the comprehensiveness, and completeness of the information used to describe the floodplain, drainage, and water quality conditions of the affected environment.

4.7 Aquatic Environment

56. Comment on the description of the habitat evaluation procedures ("HEP") modeling used to determine the habitat quality and to quantify impacts to the wetlands within the project area.

4.8 Cultural Resources

57. Have the archaeological and historical resources identified within the project area been described and appropriately considered? Please comment.

4.9 Hazardous, Toxic, and Radioactive Waste

58. Comment on the description of the Hazardous, Toxic, and Radioactive Waste ("HTRW") Assessment procedures used to identify potential environmental impacts and evaluate current conditions of the project area.

4.10 Air Quality

59. Comment on the comprehensiveness, and completeness of the information used to describe air quality characteristics of the affected environment.

4.11 Ambient Noise Levels

No Questions

4.12 Social and Economic Analysis

60. Are the demographic, employment, housing and overall socioeconomics thoroughly described?

4.13 Environmental Justice

No Questions

4.14 Recreation Resources

61. Have the existing recreational resources been adequately described within the study area?

4.15 Traffic Control and Safety

No Questions

Section 5.0 Environmental Consequences

5.1 Farmland Protection Policy Act Impacts

62. Are the impacts to farmland thoroughly described?

5.2 Land Use Impacts

63. Are the impacts to land use thoroughly described?

5.3 Impacts on Biological Resources

64. Comment on whether the discussion of the analysis of impacts to vegetation and wildlife within the project area is complete.

5.4 Threatened and Endangered Species

65. Comment on whether the discussion of the analysis of impacts to threatened and endangered species within the project area is complete.

5.5 Floodplains, Drainage and Water Quality Impacts

66. Comment on whether the discussion of the analysis of floodplain, drainage and water quality impacts within the project area is complete.

5.6 Aquatic Environment Impacts

67. Comment on whether the discussion of the analysis of impacts to streams and wetlands within the project area is complete.

5.7 Cultural Resources Impacts

68. Comment on whether the discussion of the analysis of impacts to archaeological and historical resources within the project area is complete.

5.8 Hazardous, Toxic, and Radioactive Waste Impacts

69. Comment on whether the discussion of the analysis of hazardous, toxic, or radioactive waste impacts to the project area is complete.

5.9 Impacts on Air Quality

No Questions

5.10 Noise

70. Have the potential sources of noise and noise impacts been thoroughly considered?

5.11 Social and Economic Impacts

71. Are the assumptions used for estimating social impacts realistic, and is the discussion of impacts from acquisitions and displacements complete?

5.12 Environmental Justice Impacts

72. Comment on whether the analysis of impacts to minority and low-income populations within the project area is complete.

5.13 Recreational Resources Impacts

73. Have impacts to existing recreational resources been thoroughly considered?

5.14 Traffic control and Safety Impacts

No Questions

5.15 Cumulative Impacts

74. Have the cumulative impacts been identified and thoroughly discussed?

5.16 Mitigation

75. Is the description of potential impacts from the NED plan and proposed mitigation and additional measures complete? Are there additional mitigation activities that should be considered?
76. Have mitigation plans been described for all the identified negative impacts?

Section 6.0 Coordination with Others

6.1 Agency Coordination

No Questions

6.2 Public Involvement

77. Have all appropriate public outreach activities been conducted?

Section 7.0 Regulatory Compliance

No Questions

Section 8.0 Summary

8.1 Alternative Formulation and Optimization Process

No Questions

8.2 Alternatives Given Consideration

No Questions

8.3 Recommendation of the National Economic Development Plan

78. Comment on whether the discussion and rationale supporting the NED Plan are complete.

Environmental Assessment Appendix A: Planning Aid Letter/Coordination Act Report

79. Comment on whether the impacts identified in the GRR match those identified in the EA.

Environmental Assessment Appendix B: Biological Assessment

80. Comment on whether the description of the biological assessment activities and NED Plan impacts to biological resources are sufficiently detailed and comprehensive.

81. Comment on the consistency of the description of the optimization and the NED Plan with the economic analysis in this study.

Environmental Assessment Appendix C: Coordination Letters

No Questions

Environmental Assessment Appendix D: Section 401 and Section 404(b)1 Evaluation

No Questions

Environmental Assessment Appendix E: Wetland Mitigation Cost Effective/Incremental Cost Analysis

No Questions

Environmental Assessment Appendix F: Public Involvement

No Questions

Environmental Assessment Appendix G: Cultural Resources Documentation

No Questions

NOTEBOOK 1

Appendix A: Hydrology and Hydraulics

82. Comment on the soundness of engineering calculations and modeling.
83. Comment on the use of the TSARP model as the basis for the without project conditions.
84. Comment on whether the methodology used to estimate flood damages has considered the range of storm events required by USACE guidance.
85. Comment on whether the approach taken and the results of the hydrologic modeling considered the impact of climate change in estimating project detention needs over life span of the project.

Appendix B: Economic Analysis

86. Comment on the completeness and clarity of the description of the time period and geographic area included in the study.
87. Comment on the extent to which the data collection and analysis procedures, including evaluation of risk and uncertainty, are appropriate and sufficient to determine the project benefits.
88. Comment on the extent to which the assumptions and methods used for determination of flood damages for without project condition are clearly explained, appropriate, justified, and used.
89. Comment on the extent to which the assumptions and methods used for

determination of flood damages for “with-project” alternatives are clearly explained, appropriate, justified, and consistent in application.

90. Comment on whether the NED Plan is adequately explained and consistent with the results of the analysis.

Appendix C: Cost Estimates

91. Comment on the extent to which the methodology is clearly explained and appropriate.
92. Comment on the extent to which the assumptions have been adequately identified and justified.
93. Comment on whether the cost estimates, summarized in Section 4.0 and detailed in Attachments C-3, C-4, C-5, and C-6 are consistent with and accurately reflect the application of the methodology described in Sections 2.0 and 3.0.
94. Comment on the clarity, adequacy and appropriateness of the cost estimation approach included in the systematic plan formulation and “fine-tuning”.
95. Comment on the extent to which uncertainty is adequately addressed.
96. Comment on the extent to which operation, maintenance, and repair costs are adequately identified and assumptions are documented and justified.

NOTEBOOK 2

Appendix D: Engineering Design and Analysis *(Note this Appendix is Comprised of Four Separate Documents)*

97. Comment on the soundness and completeness of the engineering assumptions and criteria for the four structural measures.
98. Comment on whether the overall approach and analysis resulted in an adequately justified evaluation and comparison of the alternatives for each of the four structural measures.
99. Comment on whether the geotechnical analysis found in Appendix D-1 provides adequate support for the channel modification and bypass options.
100. Comment on the comprehensiveness of the information used to describe the OMR&R methods and recommendations.

Appendix E: Real Estate Plan

101. Is the discussion of the project approach presented for the Real Estate Plan thorough and complete?
102. Are the components listed comparable with the NED components as listed in the GRR?
103. Comment on the extent to which the elements of real estate cost and corresponding assumptions have been identified, and the method and assumptions used in evaluating the costs have been explained and justified.
104. Comment on whether the NED real estate costs have been adequately determined and presented.

Appendix F: Recreation Plan

105. Comment on whether the components listed as part of the study area correspond to the study area as described in the GRR?
106. Comment on the extent to which the costs for recreation are complete and adequately justified.
107. Comment on the appropriateness and adequacy of using the Unit Day Values and benefit transfer approach to determine the recreational value of the parks and paths.
108. Comment on the extent to which the assumptions used in determining demand, costs and benefits of the recreational plan have been identified and adequately justified.
109. Comment on the overall extent to which the benefit cost analysis provides a clear and credible analysis of the net benefits of the recreation plan.

Appendix G Public Involvement

No Questions

FINAL OVERVIEW QUESTION

110. Do you have technical concerns with the document or its appendices that were not covered in your answers to the questions above? If so, please describe those concerns.