CERP L-31 North (L-30) Seepage Management Pilot Project
Integrated Pilot Project Design Report and Environmental Assessment

FINAL
USACE Response to Independent External Peer Review
15 July 2009

Independent External Peer Review (IEPR) was conducted for the subject project in accordance with Section 2034 of WRDA 2007, EC 1105-2-410, 33 CFR §385.12(d) for Comprehensive Everglades Restoration Plan (CERP) pilot projects, and the Office of Management and Budget's *Final Information Quality Bulletin for Peer Review* (2004).

Prior to implementing a CERP pilot project, a Pilot Project Design Report is prepared and must include technical information necessary to construct the pilot project including engineering and design, cost estimates, real estate analysis, and appropriate NEPA documentation. The recommended plan for the L-31N pilot project tests two structural seepage reduction technologies (steel sheet pile and slurry wall), while also testing the ability to seasonally manage seepage flows through pumping operations with extraction and injection wells to create a "hydraulic barrier". The project cost estimate is $15,275,000 including construction, PED, and construction management. Monitoring will take place for two years. Upon completion of monitoring a Technical Data Report will be written documenting the results of the pilot project. Critical information from the pilot project will be used for formulation of a full scale Everglades National Park Seepage Management Project. The pilot project will be turned over to the local sponsor or possibly decommissioned after monitoring.

The IEPR was conducted by the Battelle Memorial Institute through their contract with the Army Research Office. The IEPR panel consisted of three individuals selected by Battelle with the technical expertise in hydrology; cost engineering and construction management; and geosystems.

The IEPR panel reviewed the draft L-31N Integrated Pilot Project Design Report (PPDR) and Environmental Assessment (EA). The Final Report from IEPR was issued 10 March 2009. Overall, 19 final comments were identified and documented. Of the 19 comments, eight were identified as having high significance, six were identified as having medium significance, and five were identified as having low significance.

The following discussions present the USACE Final Response to the 19 IEPR comments. Further details on each comment, such as the Basis for Comment, Significance, Comments Cross-Reference, and Recommendations for Resolution can be found in the IEPR Final Report referenced above.

1. IEPR Comment - High Significance: There are uncertainties in the [FEMWATER groundwater] model and it is unclear how these are carried through in the design elements and costing.

USACE Response: Adopted. The report has been modified to clarify the types of uncertainty analyses conducted, and how they have impacted the design elements and costing. One of the main purposes of this pilot project is to address uncertainties (such as hydraulic conductivity) through on-site analysis, and to provide feedback and recommendations for the future full scale seepage management project.

A sensitivity analysis was conducted by choosing a conservative (high value) for hydraulic conductivity (Text has been added in Section C.1.5.6 *Assumptions and Limitations* and in Section C.1.6.1 *Simulation of Existing Condition* to acknowledge that this sensitivity analysis was conducted). In addition, the FEMWATER model is a component of the already calibrated MODBRANCH groundwater model.

Uncertainties in the hydraulic parameters are accounted for in the key design elements of the recommended plan. By incorporating flexibility into pump design, if hydraulic conductivity values are much less than predicted, the effectiveness of a lower flow rate that is extracted and injected can still be tested. Groundwater velocities will also be confirmed during monitoring of the pilot project, thus reducing uncertainty for a full-scale seepage management project. The report has also been clarified to include both the Darcy and seepage velocities in the Engineering Appendix.

To account for uncertainties associated with groundwater velocities, the window was designed so that a 400 percent increase in the anticipated velocities would be measured. The design of the barrier is not impacted by uncertainties in the hydraulic modeling since the wall depth and desired permeability are designed to cut off groundwater flow. Since uncertainties pertaining to hydraulic parameters do not directly affect the structural components of the seepage management system – only the non-structural (pump capacity and window size, both of which have been designed conservatively), there are limited cost considerations for these hydraulic uncertainties.

Finally, a 25 percent contingency was added to the cost estimate for installation of the structural components (barrier wall) due to uncertainties in the geologic conditions.

2. IEPR Comment - High Significance: It is questionable how the sheet pile and slurry wall will be installed given that no pre-blasting will be used in the construction methodology.

USACE Response: Adopted. The report has been revised (Sections 4.2 and 5) to clarify that blasting will not be allowed as an installation method for this project. Section 5 of the report has been updated to include specific types of machinery and methods that are available in industry to successfully install slurry cutoff walls.

Although the cost estimate completed during the Value Engineering study contained blasting, the current cost estimate for the recommended plan does not include blasting as an installation method for the seepage barrier. Additionally, the cost estimate was based on a particular type of mechanical excavation; however, the construction means and methods will be open (except for blasting) for the contractor to propose based on the provided geotechnical subsurface conditions included in the plans and specifications. Currently there are three separate contractors that are successfully installing slurry cutoff walls along Reach 1 of the Herbert Hoover Dike (surrounding Lake Okeechobee) without blasting. One firm is utilizing the Trench cutting Remixing Deep (TRD) wall method; a second firm is using the Cutter Soil Mix (CSM) method; and the third firm is using the Hydromill trench cutter to install slurry cutoff walls. Therefore, it is reasonable to expect that excavation and installation of material for this project can be conducted without blasting. Undoubtedly, uncertainties remain surrounding the installation of a cutoff wall to the depths recommended in the referenced geologies in the Pilot Project Design Report. However, these uncertainties are counterbalanced against experiences at nearby Herbert Hoover Dike and the objective of the pilot project which is to identify potential problems and issues associated with the construction of seepage walls along the urban/Everglades boundary.

3. IEPR Comment - High Significance: **The window width selected for the pilot project requires further detailed analysis as it was not really configured sufficiently to allow scaling up to a full scale project.**

USACE Response: Adopted in Part. Report text has been expanded to clarify that the pilot project is not intended for a direct scaling up to a full scale project. The purpose of the pilot project is to address uncertainties associated with seepage management technologies and to test the constructability and effectiveness of seepage management technologies in the unique south Florida hydro-geologic conditions. Lessons learned from the pilot will be incorporated into design and implementation of the full scale project, which will be developed during a separate plan formulation process. Specific uncertainties that will be addressed by the pilot and questions answered are included on page 1-1 of the report. A Technical Data Report will be completed after the two year testing and monitoring phase of the pilot project, which will make recommendations for future full scale seepage management projects. Alternatives for full scale seepage management will be developed in a Project Implementation Report (PIR). Impacts associated with each alternative will be evaluated in either an Environmental Impact Statement or Environmental Assessment prior to selecting a recommended plan in the PIR. Additional geotechnical investigations will likely be required for the full scale project to characterize the eight mile project area. Detailed hydrologic modeling will be completed to ensure that the recommended plan for the full scale seepage management project does not impact water supply and flood protection. Text within Section 6.7.1 of the Pilot Project Design Report has been revised to better explain the analysis supporting window sizing relative to the clarified goals of the pilot project.

4. IEPR Comment - Medium Significance: The subsurface geological conditions are important to the many aspects of the design, costing, and construction of the pilot project and need a more detailed discussion.

USACE Response: Adopted in Part. Subsequent to the release of the draft Pilot Project Design Report (PPDR), additional geotechnical field investigations were conducted to better characterize the subsurface conditions at the pilot project location. These subsurface characteristics (specifically depths of less-permeable "hard limestone", and flow zones) are the conceptual basis for the hydrologic model. These supplementary lithologic data were incorporated into the Geotechnical Data Report (part of the Design Documentation Report, and also the Plans and Specifications) instead of the PPDR so that contractors bidding on the pilot project will have sufficient information to complete the bidding process. Additional supplementary data consists of subsurface borehole optical images, geophysical logs (including relative strength of limestone), lithologic logs, sample photos, and archived cores. Appendix C (page C-6) of the PPDR has been updated to explain how the hydraulic conductivity value of 91,000 ft/d was calculated and selected. The large contrasts in hydraulic conductivity (K) values are represented in the groundwater model. Section 5 of the PPDR was revised to reflect that these K values were determined adjacent to the pilot project site as displayed in Figure 5-2. Section 5.3.3 was updated to better explain why dissolution of the limestone is not anticipated with the increased velocities. Other IEPR concerns *will be addressed by the data collection effort during evaluation of cut-off wall performance.* Specifically, quantification of flow velocities around the wall using heat-pulse flowmeters, coupled with water-quality monitoring will enable USACE hydrologists to evaluate impacts to ground water flow rates in subsurface cavities and voids, and also whether limestone dissolution at and around the cut-off wall is significant.

5. IEPR Comment - High Significance: The [FEMWATER] model is conceptually acceptable; however it is unclear as to how the model was used in the final design, costing, and construction, and how the uncertainties were included in the project planning.

USACE Response: Adopted. Section 5 and Appendix C of the report have been updated to discuss the uncertainties associated with the groundwater model and how the uncertainties in the model results are reflected in the design of the pilot seepage management system and the cost estimate for the project. Key design elements, such as the barrier "window" width and hydraulic barrier pump capacity, take into account that there is uncertainty in the hydraulic conductivity value. Although a conservative (high K value) was used to estimate the volumes of water flowing through the window during wet and dry conditions, the window was designed so that a 400 percent increase in the anticipated velocities would be measured to account for uncertainties associated with groundwater velocities. The hydraulic barrier pump capacity design also accounts for uncertainties with the hydraulic conductivity values modeled, by incorporating variable flow pumps that can be adjusted in 0.5 cfs increments from 0 up to 6 cfs. Therefore, by incorporating flexibility into pump design, if conductivity values are much less than predicted, the effectiveness of a lower flow rate that is extracted and injected can still be tested. Groundwater velocities will also be confirmed during monitoring of the pilot project, thus reducing uncertainty for a full-scale seepage management project. The design of the barrier is not impacted by uncertainties in the hydraulic modeling since the wall depth and desired permeability are designed to cut off groundwater flow. Since uncertainties pertaining to hydraulic parameters do not directly affect the structural components of the seepage management system there are limited cost considerations for these hydraulic uncertainties.

Additionally, a 25 percent contingency was added to the cost estimate for installation of the structural components (barrier wall) due to uncertainties in the geologic conditions.

6. IEPR Comment - High Significance: Until conditions have stabilized, quarterly monitoring of injection and surface water is an insufficient timeframe to fully evaluate effects on water quality.

USACE Response: Adopted in part. The frequency of groundwater monitoring for the pilot project has been increased from quarterly to monthly for the first year and increased to quarterly during the second year even though the USACE and Florida Department of Environmental Protection (FDEP) have determined that there is a very low risk that this project, when operating, will cause any change in the water chemistry. Section 6 (page 6-4) of the report has been revised to reflect this more aggressive water quality monitoring plan. During installation of the cutoff wall, turbidity monitoring will be in place in accordance with the water quality permit issued by FDEP and as stated under the 404 (b) evaluation conducted during the environmental assessment. If a slurry wall is the selected material for the barrier, the stabilization of the wall will be confirmed through verification borings taken by the contractor as part of a quality assurance program.

If observed parameters seem abnormal, the monitoring plan will be modified by either testing for additional parameters or increasing the frequency of monitoring. The contractor will be responsible to ensure that the method used to install the barrier wall will not impact groundwater quality by proposing a quality control plan that corresponds to the selected material chosen for installation.

7. IEPR Comment - High Significance: More site-specific hydraulic and lithologic data are needed to address all seepage conditions expected during the wet and dry seasons.

USACE Response: Adopted. Additional geotechnical field data has been collected since the draft report was written. The field work has been documented in Geologic Data Report which will be available for contractor use along with the final Plans and Specs, and will be included in the Geological Appendix of the final Pilot Project Design Report. Groundwater level data are currently being collected in 3 existing monitoring wells at L-30, to define pre-construction conditions during wet and possibly dry cycles. These data will support future calibration of FEMWATER models.

8. IEPR Comment - High Significance: Further clarification is needed on how velocities were determined.

USACE Response: Adopted. Report text has been modified to clarify how velocities were determined. In the present FEMWATER modeling analysis, the flow rates were obtained from the velocity vectors at the nodes of the elements and an average Darcy velocity was obtained by dividing the flow rates by the area of cross section. Future investigations include monitoring for groundwater hydraulic heads and seepage velocities. Through field investigation, hydraulic conductivity, porosity, and seepage and Darcy velocities will be established. Finally, the model results will be re-evaluated and compared with the field monitoring data. Seepage velocities were added to the report in Tables C-2 and C-4. Darcy velocities were specified in Section 5 and several times in the Engineering Appendix C. One of the main objectives for evaluation of cutoff wall performance will be to quantify and validate ground water flow velocities adjacent to the cutoff wall. Performance testing, coupled with ground water flow modeling, will enable USACE to evaluate the current cutoff wall design and improve upon it.

9. IEPR Comment - High Significance: The water quality concerns regarding the bentonite mixture percolating through the slurry walls and seeping into the adjacent canals and water bodies requires additional detail to validate that there will be no impact.

USACE Response: Adopted in Part. These water quality concerns will be addressed through specifications in the installation contract for the barrier wall and through performance monitoring during implementation. Since the specifics of the seepage wall design will be proposed by the bidder and evaluated based on performance specifications, it is beyond the scope of the Pilot Project Design Report to assess the effectiveness of bentonite mixtures. Geologic heterogeneity and the depth of the seepage barrier will prove to be challenging, regardless of the composition of the wall.

In order to protect the surrounding water bodies, turbidity monitoring will be completed both upstream and downstream of construction every four hours unless monitoring data shows this to be excessive. In addition to turbidity monitoring, there are three monitoring wells downstream of the proposed wall. Finally, the contractor is required to submit a Contractor Quality Control Plan that will incorporate monitoring of slurry losses in the voids of the substrata, specific to the proposed design.

10. IEPR Comment - Medium Significance: Geological cross-sections would provide invaluable input and should be included in the report.

USACE Response: Adopted in Part. All relevant boring logs, optical boring logs and modified draw down test are being included in the Geologic Data Report of the final Plans and Specs, and have also been included in the Geological Appendix of the Design Documentation Report. An interpretive cross-section is not included as it is the final responsibility of the contractor for construction of the barrier wall to the specifications provided. A reference of the area-specific cross-section of Figure 5-11 has been added to Section 3.2 of the report.

11. IEPR Comment - Medium Significance: The hydrology is generally well defined, but limited in scope.

USACE Response: Adopted in Part. Additional geotechnical data (i.e. core borings, geophysical logs, optical images) was collected along the L-30 project site subsequent to the release of the Pilot Project Design Report. This additional information is included in the plans and specifications along with more detailed analysis of the hydrologic conditions at the project site. Potential water level changes during wet and dry season were evaluated for how they may affect the construction and implementation of the project. Considerations such as the limiting elevation for the optional temporary levee degradation and the minimum top of wall elevation were established based on hydrologic analysis to ensure continued flood protection during construction and during future conditions.

Unknown vertical seepage and groundwater flow regimes related to vertical geologic heterogeneity are key uncertainties involving the design of an effective seepage management feature. One of the defining conclusions from the pilot project may be the extent to which this variation affects horizontal seepage. General aquifer characteristics as well as site-specific hydrologic conditions are described in Section 3. The high variability in the Biscayne Aquifer suggests that planning a design for sites other than the L-30 location may be impractical. However, the versatility of a specific design may be a quality of the pilot that can be assessed in the technical data report. The purpose of the pilot project is to address these uncertainties. Lessons learned will be recorded in a Technical Data Report. This information will be invaluable to the full-scale project and provide critical information during the required planning process.

Design of the pilot project has incorporated all of the geologic and hydrologic data available including: depth of the seepage barrier, height of the “window”, and position and alignment of the flowmeters. Monitoring wells are being arranged to capture the expected the flow regimes as indicated from local stratigraphy. Each of monitoring wells will have an optical borehole image performed so that the most appropriate depth of monitoring flow is obtained.

12. IEPR Comment - Medium Significance. The assumption that long-term environmental impacts associated with the pilot project will be similar to those for the full scale project is not proven, and that long-term impacts of the pilot project were not fully discussed.

USACE Response: Adopted in Part. The report text has been revised to clarify the assessment of long-term environmental impacts of the pilot-project. The full-scale seepage management project will go through a complete planning effort, separate from that of the pilot study, to justify the full-scale project when requesting authorization and appropriation of the project, and therefore the recommendations for resolution are not applicable. The purpose of the pilot project is to address uncertainties associated with seepage management technologies. Lessons learned will be recorded in a technical data report. This information will be invaluable to the full-scale project and provide critical information during the required planning process. The *Introduction* (Section 1) and *Recommendations* (Section 9) sections of the report have been revised to clarify the relationship of the pilot to full scale.

13. IEPR Comment - Medium Significance. The plan does not specifically state how seepage will be measured along the slurry and sheet pile walls, and the expected accuracy of the measurement of the total seepage through the pilot project window.

USACE Response: Adopted. Section 6.4.2 of the report has been revised to add additional details in the monitoring plan for assessing seepage and flow through the transect, including establishing base conditions, measuring the effectiveness of the slurry wall, measuring the effectiveness of the hydraulic barrier, a general operations plan, and stage and flow measurements expected from the instrumentation. Furthermore, accuracy of the flowmeters will be evaluated against an observed velocity of a groundwater tracer prior to, and during, the monitoring period. The tracer test feature is not included in the report, but is planned as a separate effort from the general construction contract.

14. IEPR Comment - Medium Significance: The assumptions and specifics used to develop the cost estimates need additional detail.

USACE Response: Not Adopted. Cost estimating details could not be released to the IEPR reviewers, due to USACE contracting regulations. A less detailed cost estimate was provided. Assumptions used in the cost estimate were discussed with the IEPR reviewers. A detailed cost estimate review was conducted by the USACE Cost Engineering Center of Expertise at Walla Walla District for Agency Technical Review of cost estimates, construction schedules, and contingencies.

15. IEPR Comment - Low Significance: The form and content of the PPDR seems to suggest that the selected pilot project design and options are those currently favored for the full scale Everglades Seepage Management Project; however there are statements in the PPDR that the pilot project is not the final design.

USACE Response: Adopted. The Executive Summary and Section 1 of the Pilot Project Design Report have been revised to clarify this. The full scale seepage management project will go through a complete planning effort, separate from that of the pilot study, to justify the full scale project when requesting authorization and appropriation of the project. Therefore, the pilot project is not meant to be a direct transition into design for full scale seepage management. The full scale project has been delayed so that the results of the pilot project can be reviewed and analyzed prior to the full scale project moving forward in the planning process.

16. IEPR Comment - Low Significance: The impacts are generally well described from the perspective of the project, but not necessarily from the perspective of the affected ecosystems or organisms.

USACE Response: Adopted in Part. Report text has been expanded to include discussions of pilot project impacts on ecosystems and organisms. Impacts of a full scale project are not being addressed in this report, as they will be addressed during the planning phase of a full scale project. Local wildlife will not be impeded by the seepage barrier since it will be installed underground. It will not be a physical barrier to wildlife movement. Minimal temporary disturbances to wildlife will occur on the levee and adjacent 2-acre wetland during construction while installing the barrier. The pilot project footprint is small relative to the surrounding areas, where high quality habitat is available and abundant. Filling two acres of low quality wetlands, located between the levee and canal, will not have an effect on the ecosystem as a whole. Discussions of specific environmental impacts have been added in summary and in detail to Section 7 and throughout Section 4.

17. IEPR Comment - Low Significance: Proven technologies such as pre-cast concrete panels and secant walls have not been considered in the available technologies.

USACE Response: Adopted in Part. Other seepage management technologies (e.g. pre-cast concrete panels and secant walls) for installation of the seepage barrier will be considered during the evaluation of proposals for the pilot project. Proposals will be evaluated based on established performance criteria and technical merits included as part of the Source Selection Plan. The Value Engineering analysis of materials reviewed the June 2003 Seepage Technologies report which identified approximately 50 technologies including sheetpile and pipe pile, pre-cast concrete piles, slurry technologies with alternative trenching methods, slurry trench with HDPE liner, soil mixing, augur and jet grouting, and even ground freezing. Use of a performance specification contract allows any feasible technologies for a seepage barrier wall that meet permeability and dimensional criteria to be considered. Proposals will be evaluated based on expertise, performance, experience and constructability, and cost containment including competitive market influences for methods and materials. Pre-cast concrete panels and secant walls are not precluded from the proposal by the performance specifications.

18. IEPR Comment - Low Significance: In the comparison of alternatives, noise was not considered to be a significant criterion.

USACE Response: Adopted. Text has been added in Sections 3 and 4 of the Pilot Project Design Report (*Existing Conditions* and *Environmental Impacts of Alternatives*) to include more detailed descriptions of noise impacts. Noise impacts are not expected to be significant in the surrounding area during operation. Noise during construction is not expected to impact areas outside of the immediate project area.

19. IEPR Comment - Low Significance: Figures should be revised for clarity and to better support the documentation.

USACE Response: Adopted in Part. All recommendations for the figures were reviewed and the following revisions were made to add clarity to the report or better support the documentation. Elevations have been referenced to a common datum throughout the report where appropriate. Caption for C-4 has been revised to include the orientation of the section (looking northeast). Geologic unit labels have been added to Figure C-25. Vertical dimensions have been added to Figures C-13, C-14, C-18, and C-19. Precision of estimated flows in Appendix C have been revised to two significant figures. Figure 3-14 has been revised to include the referenced structures.

Several remaining recommendations were addressed outside the figures themselves by revising the descriptive text associated with these figures to clarify their intent.