APPENDIX A – JANUARY 21, 2009 DESIGN DOCUMENTATION REPORT

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January 21, 2009

KISSIMMEE RIVER RESTORATION
RIVER ACRES FLOOD MITIGATION PROJECT (CNT 15)
OKEECHOBEE COUNTY, FL

DESIGN DOCUMENTATION REPORT

Contract No. W912EP-09-_-00_

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US Army Corps
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APPENDIX B TECHNICAL SPECIFICATIONS (under separate volume)
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APPENDIX D DATA AND CALCULATIONS
APPENDIX E CONFERENCE MEMORANDA AND CORRESPONDENCE

1.0 Syllabus

The Kissimmee River Restoration (KRR) project is intended to restore over 40 square miles of river and floodplain ecosystem including 43 miles of meandering river channel and 27,000 acres of wetlands. Restoration efforts will re-establish an environment conducive to the fauna and flora that existed there prior to the river channeling efforts in the 1960s. The work described by this Design Documentation Report is mitigation for raised flood stages along the River Acres subdivision due to implementation of the KRR project. The River Acres subdivision consists of 135 lots, of which approximately 65 will be impacted by the KRR project.

2.0 Pertinent Data

The following project design water surface elevations were used (dated 7 August, 2002):

Headwater/ Tailwater Levels (EL, feet, NGVD 29)	Seepage Levee		CSX Railroad Embankment		Tieback Levee	
Design Conditions	HW	TW	HW	TW	HW	TW
Normal Pool	24-31	24-26	24-26	20-21	24-30	20-21
Wet Season	31	26	26	21	30	21
10-Year Flood	≈33.1	26	26	≈23.4	30.7	≈23.4
100-Year Flood	33.7	26	26	≈24.5	32.6	≈24.5
SPF	34.5	26	26.4	26.4	32.6	26.4

Notes:

1. HW = Head water or Upstream Water Level on Feature
2. TW = Tail water or Downstream Water Level on Feature
3. Seepage Levee design section: crest elevation of 37.1 ft, crest width of 14 feet, with 4H:1V side slopes. Seepage and stability analysis has been performed previously during conceptual design using HW=34.5, TW=26, but with a crest elevation of 36.6 feet.
4. CSX Railroad embankment as-built section: (varies, refer to survey cross-sections)
5. Tieback Levee design section: crest elevation of 36.6 feet, crest width of 12 feet, with 4H:1V and 6H:1V side slopes.
6. SPF = Standard Project Flood

3.0 Project Description

The Kissimmee River Restoration project was authorized by the following Water Resource Development Act (WRDA) Sections:

- Section 1135 of the WRDA 1986 (Public Law 99-662)
- Section 46 of the WRDA 1988 (Public Law 100-676)
- Section 116 (h) of the WRDA 1990 (Public Law 101-640)
- Section 101 (8) of the WRDA 1992 (Public Law 102-580)

River Acres is a platted subdivision in Okeechobee County, Florida. The subdivision consists of 135 lots including vacant lots, lots with mobile homes, and lots with conventional houses. The next phase of construction of the Kissimmee River restoration project will impact the River Acres subdivision. In 1992, the South Florida Water Management District (SFWMD) assured this community that residences in this subdivision would not be flooded or forced to sell their homes. The SFWMD and the U.S. Army Corps of Engineers (USACE) developed a recommended engineering alternative to mitigate flood impacts for the residents. Flood mitigation is to be accomplished by construction of a tieback levee on the northwest corner of the subdivision, a seepage levee and canal north of the CSX right-of-way, canal extension and improvements, and a bridge across the new canal extension. All of these project elements are described in Section 5.0.

4.0 TEAM MEMBERS

Civil Section ------Tony Smith, P.E.

Geotechnical Section ------Sam Honeycutt

Hydraulic Section ------Tim Gysan, P.E.

Structural Section ------Jose A. Pena-Ramos, P.E.

Cost Engineering ------Manuel Perez, P.E. & Kirby Ray Clifton

Environmental Section ------Javier Cortez

5.0 Design Analysis

5.1 GENERAL PARAMETERS

5.1.1 Surveys

The property boundaries for the River Acres subdivision and the CSX railroad right-of-way are described in a survey by F.R.S. and Associates (14 May, 2001), prepared for Kisinger Campo & Associates Corp. (KCA). Topographic survey data of the project site is described in a data collection performed by Johnson-McAdams Survey and Mapping, LLC in March 2003. See General Section drawing GI002 for additional survey notes and information.

5.1.2 Excavation Measurement and Payment

Tolerances for canal excavation finish grades are zero inches above grade and 6-inches below grade. The 6-inch below grade tolerance is included to accommodate an acceptable anticipated amount of over-excavation. The measurement and payment terms of the contract have been prepared to pay to the excavation grades shown on the drawings, since over-excavation (the 6 inch below tolerance) is not to be measured for payment.

5.1.3 General Construction Sequencing and Analysis.

The first order of work is the Bridge Construction on NW 83rd Trail. The second order of work is the canal excavation from Station 2+50 to Station 24+00. Plugs shall be left at the end of the canal until the bridge is complete. The canal shall not be opened until flow is stopped at Station 106+00. No additional approval will be required to begin construction of the berm, Seepage levee, and Seepage canal during this phase. The third order of work is S-65DX3. The residence shall be notified that the canal will be out of service prior to starting construction on the dewatering plan for S-65DX3. The notification shall occur 30 days prior to commencement of work. The duration the canal shall be out of service shall appear on the notification, but at no time shall it exceed 90 days. The fourth order of work is the existing canal dredging, remaining tieback levee construction, remaining berm construction, remaining Seepage canal excavation, and remaining seepage levee construction. This work can begin once the canal is blocked at Station 106+00.

5.1.4 Temporary Traffic Control.

Temporary traffic bypasses to accommodate the construction of the aforementioned project features will be determined by the order of work as described above. Notes on the drawings indicate the minimum sequencing restrictions placed on the Contractor to insure that each temporary blockage has a bypass available for as long as the blockage exists. In this way, the Contractor may sequence his work as freely as possible to gain the best possible efficiency and economy. It should be noted that the serviceability of existing roads may be required. Finally, roads that will permanently terminate in a dead-end due to the new facilities will simply be closed upon construction of the new features at that location. The drawings require permanent dead-end signing at these locations to be complete and in place immediately upon road closure due to construction. All temporary traffic will comply with MUTCD, 2004 EDITION Chapter 6.

5.2 Construction Drawings

The Construction Drawings for the River Acres Contract are included in Appendix A. The construction drawing list for that contract is included below.

<u>GENERAL</u>

GI001	INDEX TO DRAWINGS
GI002	MAPS AND CONTROL DATA
GI003	DISPOSAL AREAS AND HAUL ROUTES

<u>SURVEY</u>

VF 101	TOPOGRAPHIC AND HYDROGRAPHIC
VF 102	TOPOGRAPHIC AND HYDROGRAPHIC
VF 103	TOPOGRAPHIC AND HYDROGRAPHIC
VF 104	TOPOGRAPHIC AND HYDROGRAPHIC
VF 105	TOPOGRAPHIC AND HYDROGRAPHIC
VF 106	TOPOGRAPHIC AND HYDROGRAPHIC
VF 107	TOPOGRAPHIC AND HYDROGRAPHIC
VF 108	TOPOGRAPHIC AND HYDROGRAPHIC
VF 109	TOPOGRAPHIC AND HYDROGRAPHIC

<u>CANAL AND LEVEES</u>

CF 101	SITE PLAN 1
CF 102	SITE PLAN 2
CF 103	SITE PLAN 3
CF 104	SITE PLAN 4
CF 105	SITE PLAN 5
CF 106	SITE PLAN 6
CF 107	SITE PLAN 7
CF 301	TYPICAL CROSS SECTIONS
CF 302	SEEPAGE LEVEE CROSS SECTIONS STA. 0+00 – 40+00
CF 303	SEEPAGE LEVEE CROSS SECTIONS STA. 42+00 – 43+96
CF 304	CANAL CROSS SECTIONS STA. 0+00 – 40+00
CF 305	CANAL CROSS SECTIONS – STA. 44+00 – 84+00
CF 306	CANAL CROSS SECTIONS - STA. 86+00 – 106+00
CF 501	ROADWAY TYPICAL SECTIONS AND DETAILS
CF 502	DETAILS,SWALES,TURNOUTS, LOWWATER CROSSINGS
CF 503	BARBED WIRE FENCE DETAILS
CF 504	WOVEN WIRE FENCE DETAILS
CF 505	SIGN DETAILS

<u>STRUCTURE 65DX-3</u>

SS101	SITE PLAN
SS102	DEWATERING PLAN
SB103	CONCRETE – PLAN AND SECTIONS
SB304	REINFORCEMENT – PLAN AND SECTIONS
SB505	MISCELLANEOUS METAL DETAILS

<u>CULVERTS</u>

SS106	CULVERT NO.1 - PLAN AND SECTION
SS107	CULVERT NO.2 - PLAN AND SECTION
SS108	CULVERT NO.3 - PLAN AND SECTION
SS109	CULVERT NO.4 - PLAN AND SECTION

5.3 Technical Specifications

Technical specifications are included as Appendix B, a separate volume.

5.4 Cost Estimate

Final quantity estimates, MCACES Cost Estimates are included in Appendix C (under separate cover).

5.5 Civil Engineering

Bentley InRoads XM Edition software was used for earthwork analysis, including quantity estimating, in the development of embankments, ramps, canals and other excavations and fills. USACE CADD standards were used with Microstation V8 XM Edition for development of plans.

5.5.1 Seepage Canal

The existing ditch north of the CSX railroad will be maintained as needed to function as the seepage canal. The seepage canal will have side slopes of 4H:1V (in areas of new construction) with an overflow elevation of 26.0 NGVD 29.

5.5.2 Seepage Levee

A seepage levee is proposed north of the CSX railroad to protect the existing railroad embankment. The levee will have a top width of 14 feet with 4H:1V side slopes and a crest elevation of 37.1 NGVD 29 (minimum of two feet of clearance over the USACE Standard Project Flood elevation of 34.5, and four feet of clearance above the proposed 10-year flood elevation of 33.1 upstream of the CSX railroad embankment). There is approximately 1,600 feet of levee on the eastern end that will have a top elevation of 34.5. The design crest elevation of the seepage levee was established from criteria published in the Kissimmee River Basin General Memorandum (October 8, 1956). The total length of the seepage levee is approximately 4,700 linear feet.

5.5.3 Tie-Back Levee

A tie-back levee will be constructed in the (west) side yard of Lot 8, crossing the canal and tying to the railroad embankment to isolate the existing canal from the Kissimmee River upstream of Structure S-65D. The tie-back levee will have a top width of 12 feet with 4H:1V upper side slopes and 6H:1V lower side slopes. The tie-back levee will have a crest elevation of 36.6 NGVD 29 which provides four feet of clearance above the USACE Standard Project Flood elevation of 32.6 and 5.9 feet of clearance above the proposed 10-year flood elevation of 30.7 adjacent to River Acres. The tie-back levee is approximately 600 linear feet in length. A stop-log riser culvert (weir) will be

installed through the tie-back levee in order to provide minimum (non-stagnating) flows from C-38 canal to the existing/proposed canal. The weir control elevation will be set at elevation 23.0 with the top of the riser at elevation 34.0.

5.5.4 River Acres Levee

An earthen berm will be constructed along the east side of Lots 1 through 7 that border the Kissimmee River (adjacent to N.W. 80th Drive). The minimum crest elevation of this berm is 34.5 NGVD 29 with 6H:1V side slopes. Several smaller berms are proposed to complete this protective enclosure.

A new shell rock road (with hard base surface) will tie into N.W. 80th Drive. This road will provide access to the lock operator's residence. The road will be in the 40-foot maintenance easement and will be a minimum of 18 feet wide with 4-foot shoulders.

5.5.5 River Acres Canal

The subdivision's existing canal will be slightly realigned and deepened, as well as extended to the south. This will allow the resident's access to the Kissimmee River downstream of Structure S-65D. During the 30% design phase, many significant encroachments to lots bordering this canal were identified with the 25 feet canal bottom width as proposed in the KCA Report. A USACE site visit confirmed the property infringements. After gaining concurrence from SFWMD that a reduced canal cross section would still serve the residents' navigational needs, the USACE reduced the canal bottom width to 10 feet, which has been incorporated into the construction plans. This is a deviation from the original Scope of Work (see internal team correspondence dated 16 June, 2003 in Appendix E). Review of the new 10 foot bottom cross section cut in the existing canal channel along with placing the canal's normal water level at elevation 21.0 revealed many unsafe shoals. To maintain safety, even during the 10-year storm event (elevation 23.4), these shoal areas will be filled in and the canal side slopes will be benched at elevation 24.0.

5.5.6 Road Relocation

The proposed roadway at N.W. 83rd Terrace will tie into the proposed bridge over the new canal extension and will have two 12-foot travel lanes and two 8-foot outside shoulders. The proposed roadway will taper (10:1) back to the existing roadway at either side of the proposed bridge.

The roadway design shall comply with all state, local and federal requirements including the USACE Standards. The applicable state code is FDOT Standard Specifications for Road and Bridge Construction (2000 Edition) and supplements thereto. See Appendix D for road relocation design parameters.

5.6 Hydraulic Engineering

5.6.1 Levees

The unsteady flow, hydraulic routing model UNET was developed to model the Kissimmee basin for pre and post restoration conditions. Peak stages for hypothetical flood events from the June 1998 UNET model run were the basis for developing the original alternatives for the River Acres flood mitigation. Locations where stage data is referenced are shown in Appendix D4 Figure 1.

5.6.1.1 Seepage Levee

The stages used for the preliminary seepage levee design just upstream of the CSXT railroad embankment were those predicted for the location at the downstream end of Kissimmee River backfill at C-38 River Mile17.32. The downstream terminus of the backfill, upon completion, will be a U-shaped weir tied into the seepage levee and CSXT railroad embankment along the existing C-38 canal. The resulting headwater stages, 34.13ft NGVD for the SPF event and 33.6ft NGVD for the 100yr event, at the weir also reflect the stage in the flood plain which extends south to the north side of the CSXT railroad embankment. The original crest elevation for the seepage levee was set at 36.6ft NGVD based on these stages to provide 2.5ft of freeboard for the SPF stage and about 3 feet of freeboard for the 100-yr stage.

Further refinement of the crest elevation for the seepage levee was done in 2002 using a simple spreadsheet model that computes submerged flow at the U-shaped weir and that considers the relationship of stage and discharge between the U-shaped weir and the S-65D headwater. Various scenarios were looked at including stages and flows that needed to be passed during the 100-yr event, the SPF event, and the maximum stage event of el. 34.5 feet at S-65D that would result in overtopping of the S-65D tieback levee. Results show that a crest elevation set at 37ft NGVD would be adequate to address the different stage and flow scenarios (i.e., discharging 24, 300 cfs under the 100-year event

and not exceeding el. 33.63 feet at the U-shaped weir and discharging 31,000 cfs under the SPF event and not exceeding el. 34.13 feet at the U-shaped weir). Given the absolute worst-scenario of the maximum possible stage event of el. 34.5 feet at S-65D tieback levee and still attempting to pass SPF flows downstream, the spreadsheet predicts a maximum water surface of between el. 35.5 and el. 36 feet at the U-shaped weir, which would still not overtop the seepage levee. Appendix D.4 Table 1 shows the model and results from the analysis.

Additionally, the original C&SF design documents for establishing levee heights in this area of the project were consulted to confirm the original design criteria. These documents established the levee crest as the controlling design of the following three criteria: 1) levee crest as 4 feet above the 10-year peak flood stage; 2) levee crest as 3 feet above the 100-year peak flood stage; 3) levee crest as 2 feet above the SPF peak flood stage. Given UNET model results predicting the 10-year, 100-year and SPF peak flood stage at the U-Shaped Weir as el. 32.89, el. 33.63 and el. 34.13 feet respectively, the corresponding levee crest designs would be el. 36.89, el. 36.63 and el. 36.13 feet, respectively. Since the el. 36.89 design controlled, the established crest elevation of 37 feet for the seepage levee was again confirmed reasonable. .

5.6.1.2 Tieback Levee

The predicted 100-yr and SPF stages within C-38 adjacent to the River Acres community (predicted to be about 0.5 feet higher than the SPF design headwater of el. 32.4 feet at the downstream S-65D spillway) were used to set the original crest elevation of the relatively short tie back levee that extends from the CSXT railroad embankment and ties into high ground at the northwestern corner of the River Acres community, providing flood protection from increased, post-restoration C-38 stages. . However, due to the relatively short length of the tieback levee and the potential for loss of life should it be overtopped, the design crest elevation was subsequently reconsidered and then established as a minimum of 2.1 feet above the maximum possible stage in the C-38 canal adjacent to River Acres. The maximum possible stage assumes that either due to an event occurring larger than the SPF or due to malfunction of the S-65D and S-65DX discharge structures, the downstream stage is able to reach the crest elevation (el. 34.5 feet) of the downstream tieback at S-65D that spans the Kissimmee River floodplain. Using this criteria, the crest elevation of the tieback

levee between CSXT railroad embankment and River Acres was set at el. 36.6 feet (= el. 34.5 + 2.1 feet).

5.6.2 Canals

5.6.2.1 Seepage Canal

H&H staff also performed additional analysis to provide flow and velocity information for use in design of armoring of both the bridge opening and the discharge of the seepage canal outlet culvert. Using the rational method, it was determined that the peak runoff flow into the seepage canal would be ~56 cfs. The rational method equation for estimating peak runoff is:

$$Q_p = k_c CiA$$

Where Q_p = peak flow (ft^3/s)
k_c = conversion factor from ac-in/hr to cfs
C = runoff coefficient = 0.35 for steep graded grassed areas*
i = rainfall intensity = 6 in/hr for SPF rainfall
A = catchment area = 26.6 ac (length of seepage levee, 4700 ft x width between crest of CSX railroad and crest of seepage levee, 245 ft)

The 56cfs flow was given to design staff used to evaluate the size of the discharge culvert into the adjacent canal. It was then calculated using a simple culvert formula that at the indicated culvert inverts the flow velocity discharging into the canal would be ~10.25 ft/s. This value was used as the reference velocity to determine the type and extent of rip rap required at the culvert outlet.

5.6.2.2 River Acres Access Canal

With construction of the tieback levee, the current access canal will be reconnected to the C-38 canal downstream of S-65D into Pool E. This will lower the stages in the channel to those at the control elevation of Pool E. In order to provide a small amount of flow down this canal preventing stagnation within the system, a small control orifice is to be constructed in the tieback levee. The design for the orifice plate has the following dimensions based on spreadsheet calculations done by H&H staff. Appendix D.4 Table 2 shows the spreadsheet

calculations.

Height = 2 ft
Width = 1.25 ft
Orifice Invert Elevation = 23 ft, NGVD1929
Orifice Top Elevation = 25 ft, NGVD1929
Orifice Angle = 34.71 degrees
Max Discharge = 17.25 cfs (Based on 100 year Stage of 32.6 ft)
Normal Discharge = 10 to 14.5 cfs (normal operating stages between el. 27 to 30 ft)
Pipe Outlet Velocities (Based on discharge through a 2 ft diameter pipe.)
Peak Velocity = 5.5 ft/sec; Average Velocities = 3.2 to 4.6 ft/sec

The redesign of the access channel requires the channel bottom be lowered to accommodate navigation. A minimum 3 foot depth is needed for navigation. Analysis of the low pool stages in the period of record for Pool E resulted in setting channel bottom of 16.8 ft NGVD, or 3 feet below the low pool stage of 19.8ft NGVD. To provide a basis for bank and bridge armament, peak channel velocities were calculated for the improved access channel. Again using the rational method, it was determined that the peak runoff from the residential area in River Acres would be ~275cfs.

For this case:

C = 0.25, suburban residential
I = 6 in/hr (SPF rainfall)
A = 191 ac (approximate area of River Acres)

To then determine a peak channel velocity, the simple relationship V = Q/A
was used:

WhereV = velocity (ft/s)
Q = flow (cfs),
A = area of flow (ft^2)

In this case, 330 cfs was used for total flow (275cfs plus the 56cfs peak

from seepage canal and assuming the flow would be shut off from the C-38). The area was computed using a very conservative assumption that peak flow rate was occurring at minimum depth. For this calculation, the minimum channel depth of 3 ft for navigation was used with the typical cross section for the channel (a bottom width of 25ft and a top width of 43ft). The area at this channel depth is 102ft^2. Based on these conditions, the resulting peak channel velocity through the bridge would be ~3.2 ft/s. This value was used as the standard for hydraulic design of the armoring for the bridge and channel banks and design of bridge pilings.

5.7 Geotechnical Engineering

5.7.1 Geologic Setting

The undisturbed portion of the area lies along the original Kissimmee River channel and is predominately overlain with Manatee, Floridana and Tequesta soils. The disturbed areas contain deposits of sandy soils and soil banks deposited during the channelization of the Kissimmee River.

5.7.2 Subsurface Exploration

Through a subcontract with KCA, Nodarse & Associates (Nodarse) performed a comprehensive soil investigation for the site as well as laboratory testing, analysis, and calculations. Nodarse drilled 26 borings [23 Standard Penetration Test (SPT) borings and 3 hand auger borings) at the site during their investigation from October 2000 to January 2001. The SPT borings ranged in depth from 20 to 80 feet. The hand auger borings were 5 feet deep.

At locations specified by Jacobs, the USACE drilled eight supplemental borings; five near the seepage levee and three along the CSX railroad track during April 2003. These SPT borings ranged in depth from 30 to 45 feet. Survey information on the boring logs was provided to Jacobs on June 17, 2003.

In general, the site at the levee areas consists of mostly sands, slightly silty sands, and silty sands to 30 feet below grade. Relative density varied from very loose to dense with the majority of the samples being medium dense. A variant, shallow, slightly clayey to clayey sand stratum occurs under a portion of the seepage levee. Deeper borings were made at the proposed bridge. Upper strata were similar to those described above and the lower strata, 30 to 69 feet, included a medium dense stratum of silty fine sand that contains shell and

limestone fragments. A still lower strata includes a green sandy clay to clayey sand. This soil profile will require deep, pile foundations for the bridge. The new canal extension consists of sand to slightly silty sand that is suitable for use in the construction of the levees. The supplemental borings made along the CSX railroad embankment have confirmed soil strata similar to the adjacent proposed levee areas. See Appendix D.2-01 for more information.

5.7.3 Soil Data Report (see Appendix D.2-02)

5.7.4 Slope Stability (see Appendix D.2-03)

5.7.5 Seepage (see Appendix D.2-04)

5.7.6 Bearing Analysis (see Appendix D.2-05)

5.8 Structural Engineering

5.8.1 Bridge

5.8.1.1 General Parameters

The precast modular bridge (CON/SPAN) will carry N.W. 83rd Trail over the new canal extension at about a 70 degree skew and will provide a minimum of 10 feet of clearance for navigation at normal high water. The length of the single span bridge between the quarters points of the span gave a 21.0-ft wide supported at both ends by cast in place foundations. Although the bridge will be located in a residential neighborhood the bridge deck will accommodate two 12-foot travel lanes and two 8-foot shoulders with traffic barriers on either side.

The structural design of the bridge shall include compliance to all state, local and federal requirements including any applicable USACE Standards. The applicable state code is Florida Department of Transportation Standard Specifications for Road and Bridge Construction (2008 edition) and supplements thereto.

The precast modular bridge shall be designed in accordance with the American Association of State Highway and Transportation Officials (AASHTO), LRFD Bridge Design Specifications 2007 edition and applicable interims and FDOT Structures Design Guidelines 2008 Edition.

5.8.1.2 Functional and Technical Requirements

The contractor will complete a shallow foundation or pile foundation design for the bridge from the soils information provided and determine what type of foundation is suitable for the bridge shown in the plans.

Minimum design loading for the bridge shall be HL-93 and no allowances for future wearing surfaces or utilities are required.

The bridge structural capacity shall be capable of supporting south Florida Water Management District's Truck Crane. The load produces by the truck crane shall not exceed the bridge structural capacity as determined by FDOT operating rating.
Weights and dimensions are the following:

P&H TRUCK MOUNTED 40 TON CRANE
Year: 1974
Model: 440 TC CRANE
Serial Number: 37146
Gross Weight: 76,700 POUNDS.

AASHTO Load and Resistance Factor Design method will be applied for all reinforced concrete elements. However, the loads on the pile will be based on service load combination. The minimum 28 day concrete strength is 5,500 psi (class IV) for both the superstructure and substructure elements.

Highway requirements, such as traffic stripes, marking, and signs for the bridge shall be coordinated with county's public works department and included in the plans and specifications.

Erosion control revetment shall be18" Rip Rap with 6" Filter Stone..

5.8.1.3 Design Objectives and Provisions

It is our understanding that the bridge will be maintained by the County and have therefore included standard 8-foot shoulders per FDOT requirements. The spans for the bridge were derived by allowing for a 3H:1V side slope protection to the canal extension that passes under the bridge on a skew.

The finished bridge elevation ties into the existing N.W. 83rd Terrace road elevation at both ends of the bridge.

The hydraulic analysis for peak flow through this bridge was included in section 5.6.2.2.

Contractor shall provide a concrete 3-sided arch-type bridge that satisfies the geometry shown on the plans. Bridge culvert design shall be in accordance with AASHTO LRFD Bridge Design Specifications 2007, FDOT Structural Design Guidelines and FDOT Standard Specification for Road and Bridge Construction 2008.

5.8.1.4 Calculations

Contractor shall be responsible for bridge design, which includes, but not limited to, foundation, headwalls, superstructure and retaining walls. Contractor shall submit calculations and a set of plans for government approval that are signed and sealed by a professional engineer register in the state of Florida.

5.8.2 Culvert Structure

5.8.2.1 General Parameters

Several culvert structures are used in the Kissimmee River Pool D Flood Mitigation Project. The primary drainage structure is the culvert 65DX3. The culvert includes a control structure located at a third of the culvert and includes a weir plate that controls the flow. The project also includes three others culvert structures that do not have gates. Flows pass through the culverts uncontrolled. Culvert structures are classified as hydraulic structures.

All culvert structures use circular reinforced concrete pipe (RCP). RCP joints are in accordance with ASTM C 443, Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

RCP pipe is designed in accordance with EM 1110-2-2902, Conduits, Culverts and Pipes and shall be installed such that the spigot ends of the bell-and-spigot pipe and tongue ends of the tongue-and-groove pipe are pointing in the direction of flow. Class B bedding is used for pipe installation.

5.8.2.2 Functional and Technical Requirements

The control structure is constructed using reinforced concrete. Concrete

materials design is in accordance with engineering manual EM 1110-2-2000, Standard Practice for Concrete for Civil Works Structures. Cast-in-place concrete has a compressive strength of 4,000 psi.

A concrete materials design memorandum has not been prepared for this project. The type and quantity of concrete needed to construct storm water treatment area structures is available from local ready-mix plants.

Type II cement and aggregate that meets ASTM C 33 requirements have been specified for this project. Both materials are readily available in south Florida. Type II cement will provide moderate sulfate resistance for water-soluble sulfate that will be in contact with the concrete. Also, Type II cement will be used to moderate the heat of hydration and reduce temperature rise during concrete placement in warm weather. Required compressive strength for cast-in-place concrete is 4,000 psi.

5.8.2.3 Dewatering

Culvert structures will be constructed in the dry. The water control plan for site excavation includes a well point system and sump pumps. For a detailed description of the dewatering requirements, refer to the geotechnical section of this report.

5.8.2.4 Control Structure 65DX3 Stability

Each structure is analyzed for usual, unusual and extreme loading conditions, as defined by the engineering manual. Each structure meets the requirements for ordinary site information category and is classified as normal structures.

Flotation and bearing capacity analyzes have been performed and meet the required factors of safety. Results of the controlling load cases for stability are included in the appendix. For allowable bearing capacity calculations, refer to the geotechnical section of this report.

5.8.3 Structural Components

5.8.3.1 Pipe

Reinforced concrete pipe is designed in accordance with engineering manual EM 1110-2-2902, Conduits Culverts and Pipes. Ordinary soil and Class B bedding are assumed for pipe analyzes.

5.8.3.2 Handrails

Control structure handrails shall be galvanized steel. Galvanized steel rails and post shall be 1-1/2” Diameter Schedule 40 seamless tubing.

5.8.3.3 Grating

The grating shall be galvanized steel compose of 1-3/4” by 3/16” bearing bars and 1-3/16” cross bars at 4” spaced. Grating is designed for a live loading of 100 psf.

5.9 ENVIRONMENTAL

The USACE will be responsible for delineating any wetlands and identifying the habitat of endangered species. The USACE will prepare applications and perform any agency coordination that is necessary to secure any environmental and water quality permits.

Environmentally sensitive areas identified are noise limitations for the residences and surface water disturbances to the canal. Alternative methods to install the bridge piling will be investigated to help address the noise issue. To control the silting/turbidity in the canal, riprap, floating turbidity barriers, and silt fences will be constructed. See Appendix B Technical Specifications Section “Environmental Protection” for additional requirements.

6.0 References

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Interim Guide for Design of Pavement Structures, 1972 edition, AASHTO

Highway Design and Operational Practices Related to Highway Safety, 1974 edition, AASHTO

ACI 318-95, Building Code Requirements for Structural Concrete
Concrete Pipe Design Manual, 1980 edition, American Concrete Pipe Association.

Applicable ASTM Standards

AASHTO LRFD Bridge Design Specifications, Latest Edition

FDOT Standard Specifications for Road and Bridge Construction

Codes, County of Okeechobee, Florida (Supplement No. 8)

APPENDIX A
CONSTRUCTION DRAWINGS

(under separate cover)

APPENDIX B
TECHNICAL SPECIFICATIONS

(under separate cover)

APPENDIX C
QUANTITY ESTIMATES, COST ESTIMATES, AND CONSTRUCTION SCHEDULES

(under separate cover)

APPENDIX D
DATA AND CALCULATIONS

D.1 Civil Engineering
D.2 Geotechnical Engineering
D.3 Structural Engineering
D.4 Hydraulic Engineering

D.1 Civil Engineering

D.1-01 Earthwork Quantities
D.1-02 Pavement Designs (road and Cul-de-sacs)

D.2 Geotechnical Engineering

D.2-01 Nordarse Report, Subsurface Exploration
D.2-02 Soil Data Report
D.2-03 Slope Stability
D.2-04 Seepage
D.2-05 Bearing Information

D.3 Structural Engineering

D.3-01 Control Structure S-65 DX3
D.3-02 Culverts

D.4 Hydraulic Engineering

D.4-01 Levees
D.4-02 Canals

D.1 CIVIL ENGINEERING

D.1- 01 EARTHWORK QUANTITIES
(under separate cover; calculations done with Inroads software)

D.1- 02 PAVEMENT DESIGNS

Road relocation

The roadway is designed in accordance with the American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets 2001 Fourth Edition and Manual on Uniform Traffic Control Devices (MUTCD), Millennium Edition.

The vertical profile for the proposed roadway will match the existing vertical profile since the canal will be excavated to get the necessary clearance for the proposed bridge. The proposed roadway is an open section allowing the rainfall runoff to drain to the roadside ditches. The existing roadside ditches will be reshaped as you get closer to the canal/bridge. W-beam barriers will be installed coming off the proposed bridge until the side slope becomes 4H:1V or flatter.

The proposed roadway matches the existing roadway as much as possible to require less new full depth pavement. The design speed of this roadway is 35 mph, therefore a K value of 91.5 for the vertical crest curve proved more than adequate. The taper from the 40 foot roadway section to a 24 foot roadway section for a 35 mph design speed (from the MUTCD Manual) is 6.7:1, so 10:1 was chosen.

The following calculations are submitted for review:

- Taper Length Design
- Stopping Sight Distance for Crest Vertical Curve

Cul-de-sacs

A cul-de-sac will be constructed on N.W. 189th Avenue where the road will dead end due to the canal extension. Lofton Road will dead end at the new canal extension where a cul-de-sac will also be constructed. The last cul-de-sac will be constructed where N.W. 80th Drive terminates at the new River Acres Levee. These cul-de-sacs will be designed and paved to conform to AASHTO, A Policy on Geometric Design of Highways and Streets 2001 Fourth Edition (Green Book) and any additional requirements as set by the Okeechobee County Standards.

D.2 GEOTECHNICAL ENGINEERING

(all sections under separate cover)

D.2-01 Nordarse Report, Subsurface Exploration
D.2-02 Soil Data Report
D.2-03 Slope Stability
D.2-04 Seepage
D.2-05 Bearing Information

D.3 STRUCTURAL ENGINEERING
(under separate volume)

D.4 HYDRAULIC ENGINEERING
(under separate volume)

APPENDIX E
MISCELLANEOUS CORRESPONDENCE
(under separate volume)