EAA Storage Reservoir A-1
Basis of Design Report

January 2006
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ES-1. EXECUTIVE SUMMARY

ES-1.1 OVERVIEW OF RECOMMENDED PROJECT

The Everglades Agricultural Area (EAA) Reservoir A-1 Project includes the following components:

- Approximately 190,000 acre-feet of storage EAA Reservoir A-1 with a perimeter embankment and seepage canals
- Construction of a northeast pump station [3,600 cubic feet per second (cfs) capacity that pumps from North New River Canal (NNRC)]
- A connector canal from the NNRC to the new northeast pump station
- Evaluation of potential modifications to the existing G-370 pump station, (a 2,775 cfs pump station that currently pumps from the NNRC to the Stormwater Treatment Area 3/4 (STA-3/4) Supply Canal)
- Evaluation of potential modifications to the existing G-372 pump station, (a 3,700 cfs pump station that currently pumps from the Miami Canal to the STA-3/4 Supply Canal)
- Gated discharge structures
- Seepage pump stations
- Two new two-lane bridges on U.S. 27 across the new connector canal
- Improvements to conveyance capacity in the NNRC

The Opinion of Probable Cost for the recommended project, excluding contingency, is $401,000,000 and with cost contingencies is $482,900,000. The costs are summarized in Table ES1.1-1.

The total probable budget depends on the contingency applied to the Opinion of Probable Cost. The Design Criteria Memorandum (DCM) for estimating cost requires a 30 percent contingency for Basis of Design Report (BODR) level costing. However, the major costs in this Project are the embankment and northeast pump station. The embankment was studied extensively and design was based on the Test Cell Project analysis. The northeast pump station will be similar in design to existing pump stations and the Opinion of Probable Cost for it is based on detailed quantity take offs. Therefore, it is recommended that the contingency for these two major cost items be reduced to 20 percent. Therefore, the overall budgeted costs would be $483,000,000.
<table>
<thead>
<tr>
<th>Project Component</th>
<th>Description</th>
<th>Direct Cost (millions)</th>
<th>Indirect Costs (millions)</th>
<th>Total Cost (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Construction Indirects*</td>
<td>Project Reserve</td>
</tr>
<tr>
<td>Embankment and EAA Reservoir A-1</td>
<td>Excavation Embankment Slope Protection Seepage Cutoff Seepage Canal Rock Processing Imported Materials</td>
<td>$206.6</td>
<td>$89.0</td>
<td>$14.8</td>
</tr>
<tr>
<td>Northeast Pump Station</td>
<td>Pump Station Structures Pumps (6) Mechanical Equipment Electrical Equipment Connection Canal Site Work</td>
<td>$50.3</td>
<td>$16.8</td>
<td>$3.3</td>
</tr>
<tr>
<td>Control Structures</td>
<td>Southwest Gate Structure Southeast Gate Structure Northeast Gate Structure and Spillway</td>
<td>$10.4</td>
<td>$3.5</td>
<td>$0.7</td>
</tr>
<tr>
<td>U.S. 27 Bridge</td>
<td>Bridges (2)</td>
<td>$3.8</td>
<td>$1.2</td>
<td>$0.3</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td><strong>$271.1</strong></td>
<td><strong>$110.5</strong></td>
<td><strong>$19.1</strong></td>
</tr>
</tbody>
</table>

* Construction indirect costs include sales tax, general requirements, overhead and profit, and bonds and insurance.
ES-1.2  PURPOSE AND OBJECTIVES

The purpose of the EAA Storage Reservoir Project, as defined in the Comprehensive Everglades Restoration Plan (CERP), is to capture EAA basin runoff and regulatory releases from Lake Okeechobee, improve the timing of environmental water supply deliveries to Water Conservation Areas (WCAs) through STA-3/4, meet supplemental agricultural deliveries, reduce Lake Okeechobee regulatory releases to the estuaries, and increase flood protection within the EAA.

In October 2003, the South Florida Water Management District (SFWMD) decided to pursue a “Dual Track” for the EAA Storage Reservoir Project. While the multi-agency Project Delivery Team, led by the US Army Corps of Engineers (USACE), continues to develop the Draft Integrated Project Implementation Report (PIR), the SFWMD is proceeding with the design and construction of a reservoir located in the Everglades Agricultural Area on the land known as the Talisman Exchange. The PIR considers compartment A of the EAA Reservoir Storage Project, which will contain 360,000 acre-feet of water. The SFWMD’s current focus is on the first phase of compartment A, or EAA Reservoir A-1, which will store 190,000 acre-feet of water. The regional project overview for the EAA Reservoir A-1 is shown on Figure ES-1.2-1.

Figure ES-1.2-1  Regional Project Overview
Implementation of the EAA Reservoir A-1 Project will meet objectives consistent with the ongoing work by the USACE. In accordance with the USACE’s Draft PIR, the objectives of the full reservoir project include:

- Reduction of the Lake Okeechobee regulatory releases to the estuaries and reduce backpumping runoff from the Study Area into Lake Okeechobee by sending the water to the EAA Reservoir A-1
- Improved environmental releases through the storage of water for later release to the Everglades when needed
- Improved regional water supply for the agricultural community currently served by the EAA canals and other areas served by Lake Okeechobee
- Flow equalization and optimization of treatment performance of STAs by storing peak storm event discharges in the EAA Reservoir A-1 for controlled release to the Everglades through STA-3/4
- Reduction of flood impacts

The Project benefits (success indicators to meeting the goals and objectives of CERP and plan formulation) are included in the USACE PIR for the EAA Storage Reservoir project. The PIR was published in September, 2005.

The success of the EAA Reservoir A-1 will be judged on how well the Project meets its design objectives where applicable to Compartment A in the PIR. In terms of consistency with the goals and objectives identified in the PIR, the EAA Reservoir A-1 will:

- Provide significant improvement in the water deliveries through the WCAs to STA-3/4
- Provide water for agricultural deliveries not previously available from the system
- Reduce the releases to the estuaries from Lake Okeechobee
- Improve flood protection in the EAA

The EAA Reservoir A-1 will store up to 190,000 acre-feet of water from stormwater runoff and releases from Lake Okeechobee at any given time. Without this Project, that water will potentially cause flooding in the EAA, will need to be pumped to STA-3/4, will be bypassed to tide, or will potentially be released to the estuaries from Lake Okeechobee. Thus there will be a reduction in the potential for flooding and releases to the estuaries once the Project is completed.

Highlighted in the Executive Summary are some of the major considerations that support the recommendations included in this BODR. These include EAA Reservoir A-1 configuration, embankment cross-section, water balance, seepage, operations, pump station sizing, control structures, and probable cost.
ES-1.3 REGULATORY CONSIDERATIONS AND PROJECT ASSURANCES

Within the Water Resources Development Act of 2000 (WRDA 2000), the U.S. Congress approved CERP’s objectives to restore, preserve, and protect the south Florida ecosystem while providing for water-related needs of the region. The components of CERP will increase storage and water supply for the natural system, as well as for agricultural and urban needs. Implementation of CERP must also be consistent with State law. As a local sponsor, SFWMD has responsibilities that are outlined in Section 373.1501(5) of the Florida Statutes (F.S.).

After the EAA Reservoir A-1 Project preferred alternative is selected by the SFWMD and the spatial extent of the EAA Reservoir A-1 effects is identified, separate comparisons of modeling simulations will be performed to satisfy the federal (WRDA 2000) and State (Section 373.1501 F.S.) assurances, and to identify the water available for the protection of fish and wildlife and for other water related needs. Separate comparative analyses are planned by the SFWMD to evaluate the following conditions:

- Section 373.1501 F.S. - Assurances analysis to evaluate the quantity of water available to existing legal users
- Section 373.1501 F.S. - Assurances analysis to evaluate the effects of the EAA Reservoir A-1 Project implementation on existing levels of flood protection
- WRDA 2000 - Quantification of water made available by the EAA Reservoir A-1 Project for the protection of fish and wildlife
- WRDA 2000 - Quantification of water made available by the EAA Reservoir A-1 Project for other water related needs

Project assurance had been considered in a preliminary manner as part of the evaluation of engineering alternatives for the EAA Reservoir A-1 in the BODR. The assurances as addressed in sections of the BODR are as follows:

- Alternatives to control seepage from the EAA Reservoir A-1 and provide protection from flooding due to seepage are described in Section 9.
- Modeling results, which describe the environmental deliveries to the WCAs, are presented in Section 6.
- Modeling results, which describe the agricultural deliveries to the farmlands are presented in Section 6.
- The EAA Reservoir A-1 will be operated to store water, which would otherwise be lost to tide or sent to the WCAs during wet seasons. This is presented in the Operations Plan described in Section 20.
ES-1.4  WATER BALANCE

A water balance analysis was performed for the EAA Reservoir A-1 to assess the hydrologic and hydraulic components of the system. The analysis was performed with a water balance model (WBM) developed by Black & Veatch Corporation (Black & Veatch), which was developed to analyze the EAA Reservoir A-1’s storage capacity and operations on a daily basis. A period of simulation (POS) was used, which employed meteorological records for 36 years from January 1, 1965 to December 31, 2000. The WBM was based on the South Florida Water Management Model (SFWMM), Everglades Construction Project (ECP) 2015 and 2010 simulation (version 5.4.2).

The WBM was used to optimize the storage capacity of the EAA Reservoir A-1, while evaluating the impacts to flows in the NNRC, Miami Canal, and the STA-3/4 Supply Canal. In addition, the model was used to evaluate pumping facility locations and sizing, and the distribution of releases from the EAA Reservoir A-1 for environmental and agricultural and sizing purposes.

For the recommended reservoir configuration, based on the ECP 2015 run, the average annual environmental delivery supplied by the EAA Reservoir A-1 via STA-3/4 is approximately 685,000 acre-feet over the POS, with a maximum of 1,486,746 acre-feet in water year 1983 and a minimum of 103,685 acre-feet in water year 1990. The current average annual inflow to STA-3/4 is approximately 656,000 acre-feet (Piccone, 2005). The total deliveries over the POS are approximately 24,000,000 acre-feet.

For the recommended reservoir configuration, based on the ECP 2010 run, the average annual agricultural delivery supplied by the EAA Reservoir A-1 is 84,000 acre-feet over the POS, with a maximum of 159,764 acre-feet in water year 1985 and a minimum of 18,922 acre-feet in water year 1970. The total deliveries are approximately 3,000,000 acre-feet.

Figure ES-1.4-1 illustrates the average annual inflows and outflows of the EAA Reservoir A-1. In addition, Figure ES-1.4-2, Figure ES-1.4-3 and Figure ES-1.4-4 illustrate the EAA Reservoir A-1 operations for the selected “Average” (1991-1992), “Wet” (1977 and 1978), and “Dry” period of water years (1971 and 1972), respectively. The performance of the EAA Reservoir A-1 for selected water years is also provided in Table 1.4-1.
Figure ES-1.4-1  Average Annual Inflows and Outflows of the EAA Reservoir A-1
Figure ES-1.4-2  EAA Reservoir A-1 Operation During an “Average” Water Year

Example of Typical EAA Reservoir A-1 Operation During an “Average” Water Year (October 1, 1991 to September 30, 1992)

Figure ES-1.4-3  EAA Reservoir A-1 Operation During a “Wet” Water Year

Example of Typical EAA Reservoir A-1 Operation During a “Wet” Water Year (October 1, 1977 to September 30, 1978)
**Figure ES-1.4-4** EAA Reservoir A-1 Operation During a “Dry” Water Year

![Example of Typical EAA Reservoir A-1 Operation During a “Dry” Water Year Period (October 1, 1970 to September 30, 1972)](image)

Table 1.4-1 Summary of Performance of the EAA Reservoir A-1 for Selected Water Years

<table>
<thead>
<tr>
<th></th>
<th>1971 &quot;Dry&quot; Year</th>
<th>1992 &quot;Average&quot; Year</th>
<th>1978 &quot;Wet&quot; Year</th>
<th>Complete POS</th>
</tr>
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<tbody>
<tr>
<td>EAA Reservoir A-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NNRC inflow, acre-feet</td>
<td>179,165</td>
<td>470,155</td>
<td>346,118</td>
<td>12,906,675</td>
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<tr>
<td>Miami Canal inflow, acre-feet</td>
<td>227,050</td>
<td>529,297</td>
<td>233,841</td>
<td>13,229,975</td>
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<tr>
<td>Precipitation, acre-feet</td>
<td>53,443</td>
<td>71,879</td>
<td>78,144</td>
<td>2,423,429</td>
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<tr>
<td>EAA Reservoir A-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental deliveries, acre-feet</td>
<td>123,023</td>
<td>857,780</td>
<td>624,402</td>
<td>22,518,200</td>
</tr>
<tr>
<td>Agricultural deliveries, acre-feet</td>
<td>74,451</td>
<td>103,491</td>
<td>80,440</td>
<td>3,073,453</td>
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<td>Evaporation, acre-feet</td>
<td>59,730</td>
<td>62,708</td>
<td>52,156</td>
<td>2,081,752</td>
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<tr>
<td>Seepage, acre-feet</td>
<td>22,687</td>
<td>10,913</td>
<td>30,567</td>
<td>639,218</td>
</tr>
<tr>
<td>Excess volume outflows, acre-feet</td>
<td>12,599</td>
<td>0</td>
<td>0</td>
<td>185,494</td>
</tr>
<tr>
<td>EAA Reservoir A-1</td>
<td></td>
<td></td>
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<tr>
<td>Start of year (BOD), acre-feet</td>
<td>7,827</td>
<td>7,827</td>
<td>188,775</td>
<td>0</td>
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<tr>
<td>End of year (EOD), acre-feet</td>
<td>174,995</td>
<td>44,266</td>
<td>59,313</td>
<td>62,451</td>
</tr>
<tr>
<td>Environmental and Agricultural Deliveries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental deliveries, acre-feet</td>
<td>360,492</td>
<td>1,243,166</td>
<td>772,530</td>
<td>31,778,063</td>
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<td>Environmental deliveries supplied by canals, acre-feet</td>
<td>9,438</td>
<td>71,506</td>
<td>148,079</td>
<td>1,694,324</td>
</tr>
<tr>
<td>Percentage of environmental deliveries met</td>
<td>37%</td>
<td>75%</td>
<td>100%</td>
<td>76%</td>
</tr>
<tr>
<td>Agricultural deliveries, acre-feet</td>
<td>176,933</td>
<td>126,313</td>
<td>80,440</td>
<td>4,755,705</td>
</tr>
<tr>
<td>Percentage of agricultural deliveries met</td>
<td>42%</td>
<td>82%</td>
<td>100%</td>
<td>65%</td>
</tr>
</tbody>
</table>
ES-1.5 SEEPAGE CONTROL

As with other surface water features such as STA and canals, seepage will occur from EAA Reservoir A-1 because the soil is permeable to approximately 200 feet below the surface of the site. Both three-dimensional MODFLOW groundwater modeling and two-dimensional SEEP/W groundwater modeling were performed to analyze seepage from EAA Reservoir A-1. The groundwater models were used to evaluate the following major issues:

- The effect of seepage on embankment stability
- The amount of water the EAA Reservoir A-1 loses to seepage
- The percentage of seepage that can be collected and returned to the EAA Reservoir A-1
- The effectiveness of various seepage control alternatives
- The amount of unrecoverable seepage, if any, that migrates to surrounding areas from various seepage control alternatives
- The effect of any unrecoverable seepage on groundwater levels in the surrounding areas.

Although quite effective at reducing seepage, cutoff walls of practical depth cannot completely eliminate seepage from EAA Reservoir A-1. Additional seepage control measures were considered, including the effect of lowering the water level in the seepage canal as a way to draw seepage to the surface and the use of pressure-relief wells to intercept deep seepage before it migrates to surrounding areas. Five seepage control alternatives were evaluated with MODFLOW.

- **Alternative 1** - 34-foot cutoff wall and 13.5-foot deep seepage canal around entire EAA Reservoir A-1, seepage canal water level held 3.5 feet below the groundwater level in adjacent farmland
- **Alternative 2** - 34-foot cutoff wall and 10-foot deep seepage canal around west, north, and east sides; 10-foot cutoff wall and no seepage canal along STA-3/4 and Holey Land; seepage canal water level held at the same level as the groundwater in the adjacent farmland
- **Alternative 3** - 34-foot cutoff wall and 13.5-foot deep seepage canal around west, north, and east sides; 10-foot cutoff wall and no seepage canal along STA-3/4 and Holey Land; seepage canal water level held 3.5 feet below the groundwater level in adjacent farmland
- **Alternative 4a** - Pressure-relief wells spaced at 100 feet linked together in sets with a total of 21 pump stations of 3,900 gallons per minute (gpm) each; 34-foot cutoff wall and 10-foot deep seepage canal around west, north, and east sides; 10-foot cutoff wall and no seepage canal along STA-3/4 and Holey Land; seepage canal water level held at the same level as the water level in the adjacent farmland. Alternative 4b includes separate pumps in each well, each with a capacity of approximately 150 gpm, which discharge to the seepage canal.
Alternative 5a - Pressure-relief wells spaced at 200 feet linked together in sets with a total of 23 pump stations of 3,300 gpm each; 34-foot cutoff wall and 10-foot deep seepage canal around west, north, and east sides; 10-foot cutoff wall and no seepage canal along STA-3/4 and Holey Land; seepage canal water level held at the same level as the water level in the adjacent farmland. Alternative 5b is similar to Alternative 5a except that it includes separate pumps in each well, each with a capacity of approximately 275 gpm, which discharge to the seepage canal.

Alternative 1, including a 34-foot cutoff wall and a 13.5-foot deep seepage canal surrounding the entire EAA Reservoir A-1 and maintaining the water level of the seepage canal below the level in the surrounding farmlands, would be the most effective of the five alternatives evaluated. However, this alternative includes a significantly higher present worth cost of between $134 to $181 million more than the other alternatives evaluated.

The other seepage control alternatives allow migration of seepage to the Holey Land and STA-3/4, but essentially eliminate impacts to farms and U.S. 27.

Alternative 2 allowed seepage into the farmland and included an estimated cost for the seepage to be pumped off the land by the farmers. Modeling results for Alternative 3 indicate that maintaining the water level of the seepage canal below the water levels in the farmlands effectively prevents offsite migration of seepage. The installation of pressure-relief wells as described by Alternatives 4 and 5 is predicated upon capturing deep seepage at the point where water passes beneath the bottom of the cutoff wall.

Alternatives 2 and 3 are the lowest cost alternatives. Alternative 3 allows the SFWMD more control of the pumping rates in the seepage canal than alternative 2, which relies on the farmers to pump the seepage. These two alternatives will be further assessed during the EAA Reservoir A-1 design.

A monitoring program of groundwater levels in the farmland should be initiated during the construction of the EAA Reservoir A-1 and continued after construction is completed. This will provide information to the SFWMD for evaluating the effectiveness of the selected seepage control measures. The monitoring program is a means to document whether flood protection (from seepage) has been provided as required by the Project assurances, which are discussed in Section 4.

**ES-1.6 Reservoir Configuration**

The configuration of the EAA Reservoir A-1 embankment and seepage canals directly affect the total amount of storage for the EAA Reservoir A-1. In order to achieve the storage requirement of 190,000 acre-feet, setback requirements were balanced with the total area available to meet this requirement. This is presented in greater detail with respect to SFWMD, USACE, and U.S. Fish & Wildlife Service (USFWS) input, construction considerations, cost, and other factors in Section 8. Setbacks for each side of the EAA Reservoir A-1 embankment are summarized below.

The configuration provides storage in EAA Reservoir A-1 of 190,000 acre-feet at a depth of 12 feet and an EAA Reservoir A-1 footprint area of approximately 16,000 acres. The limits of the land for the proposed EAA Reservoir A-1 and EAA Reservoir A-2 site are shown on Figure ES-1.6-1. The configuration provides storage in EAA Reservoirs A-1 and A-2 of 360,000 acre-feet.
Figure ES-1.6-1  Reservoir Parcels A-1 and A-2

North Boundary and North Portion of West Boundary (Portion North of Future Reservoir A-2)
- 150-foot setback from EAA Reservoir A-1 boundary to the seepage canal
- 75-feet wide seepage canal
- 200-foot setback from seepage canal to the outside toe of the embankment for construction stockpiling and future wetland areas
- 300-foot setback from the inside toe of the embankment to the internal borrow excavation
- The cross-section for these setbacks is shown on Figure ES-1.6-2

Figure ES-1.6-2  North Boundary Setbacks
**East Boundary (Portion Adjacent to U.S. 27)**

- 50-foot setback from highway right-of-way to the seepage canal
- 75-foot wide seepage canal
- 150-foot setback from seepage canal to the outside toe of the embankment for construction stockpiling and future wetland areas
- 300-foot setback from the inside toe of the embankment to the internal borrow excavation
- The cross-section for these setbacks is shown on Figure ES-1.6-3.

**South Boundary and South Portion of West Boundary (Portion Adjacent to the STA-3/4 Supply Canal)**

To minimize cost and maximize storage, the configuration along the STA-3/4 Supply Canal will incorporate the northern embankment of the Supply Canal. This configuration is discussed in further detail in Section 8 of this BODR. A 300-foot setback from the inside toe of the embankment to the internal borrow excavation will apply. The cross-section for this embankment is shown on Figure ES-1.6-4; for clarity, the drawing does not show the extent of the setback.

**Figure ES-1.6-3  East Boundary Setbacks**

**Figure ES-1.6-4  Zoned Embankment along STA-3/4 Supply Canal**
Boundary Adjacent to Future Reservoir A-2

- 75 feet wide seepage canal
- 150-feet wide setback from seepage canal to the outside toe of the embankment for construction stockpiling
- 300 feet setback from the inside toe of the embankment to the internal Borrow Canal

Curved corners provide an additional benefit and will be utilized in the northwest and southeast corners of EAA Reservoir A-1. Both the northwest and southeast corners will be curved at a radius that aids construction of the embankment. Because of the acute angle, in the southeast corner, an embankment configuration that parallels the EAA Reservoir A-1 property line adds little additional storage. Therefore, attention will be given to cost when selecting the radius in the southeast. Additionally, the radius of the southeast corner must be sufficient to prevent relocation of existing facilities, including existing helipads. An overall site layout is shown in Figure ES-1.6-5

Figure ES-1.6-5  Overall Site Layout
Two fundamental types of embankments were considered for this site:

- A concrete gravity type dam using roller compacted concrete (RCC)
- A zoned embankment dam

Each type was considered in detail during the preparation of this BODR. A number of alternative arrangements for each type were considered and an opinion of probable cost prepared to evaluate the cost effective aspects of each alternative. The advantages, disadvantages, and risks of each section were considered. A summary of the evaluations and findings are presented in Section 8 of the BODR.

The evaluation of alternatives must consider initial and long-term stability, seepage control, foundation conditions, and probable costs with appropriate allowances for risks, uncertainties and the cost of mitigation measures. The construction sequence and requirements for each alternative has been considered in detail. The most favorable concrete dam and embankment sections are presented below.

The roller compacted concrete gravity dam section depicted in the most recent Tentatively Selected Plan prepared by USACE is composed of a three stepped RCC section with a vertical face on the interior of the dam. The advantages and disadvantages of the RCC dam are presented in Section 8. The cross-section for the RCC dam is shown in Figure ES-1.7-1.

A zoned embankment concept has been developed to utilize materials from the required seepage collection canal excavations and available on-site borrow resources, and to minimize sorting and processing of the excavated materials for embankment construction. The rockfill zone material will be produced from the caprock providing structural stability to the upstream slope. The advantages and disadvantages of a zoned embankment are presented in Section 8. The cross-
The purpose of the foundation seepage control is to mitigate seepage losses from the EAA Reservoir A-1, protect the foundation from possible damage by piping, and minimize excess uplift pressures to enhance stability. With higher head in the EAA Reservoir A-1, foundation stability issues are more critical and economic impacts due to pumping would experience on a long-term basis. Several different configurations to mitigate seepage from the EAA Reservoir A-1 and control exit pressures were evaluated: adequately sized key trench, cutoff wall or upstream blanket, and increasing the distance between the EAA Reservoir A-1 and seepage collection canal. In view of the potential for piping, a foundation cutoff wall to a minimum depth of 34 feet, or the base of the Fort Thompson Formation, is recommended for seepage control.
Based on the results of the technical and cost evaluation, the least cost alternative shown in Figure ES-1.7-2 and Figure ES-1.7-3 are preferred alternative to be advanced to 30 percent design.

**ES-1.8 Pump Station and Discharge Structures**

**ES-1.8.1 Pump Station**

Figure ES-1.8-1 and Figure ES-1.8-2 show potential layouts for gates and pump stations at the EAA Reservoir A-1. Seven pumping and discharge alternatives were selected for preliminary consideration. In general, all alternatives except one were based on the addition of a new northeast pump station located adjacent to the NNRC in the northeast corner of the EAA Reservoir A-1 site.

**Figure ES-1.8-1 Pumping and Discharge Facilities - Alternative No. 2**
The operating level of the EAA Reservoir A-1 will fluctuate between elevation 8.6 and 20.6 NAVD88. The normal and maximum design operating elevations of the STA-3/4 Supply Canal are 13.6 and 16.6 NAVD88, respectively. Both G-370 and G-372 pump stations are designed to pump to these elevations. However, pumping to elevation 16.6 NAVD88 will rapidly diminish their respective design capacities. While it is possible to partially supply the EAA Reservoir A-1 from G-370 and G-372 pump stations without modifications, significant modifications would be required to pump to the full EAA Reservoir A-1 elevation of 20.6 NAVD88.

Further evaluations were completed using the WBM in an effort to optimize the performance of the pump stations and EAA Reservoir A-1. Two fundamental optimization criteria were considered:

- Optimization based on effectiveness of supplying environmental and agricultural deliveries
- Optimization based on effectiveness of capturing priority water sources. Listed in order of descending priority the water sources are runoff from the NNRC drainage and backpumping to Lake Okeechobee, and Lake Okeechobee releases.

Optimization was considered to be achieved when further increases in the size of the northeast pump station no longer provided significant benefit. Numerous combinations of northeast pump station sizes and modifications to existing G-370 and G-372 pump stations were evaluated.

Evaluations found that the optimization goal of installing the most cost effective pump capacity to meet maximum deliveries ran counter to the goal of maximizing pump capacity to capture local runoff, pump backs, and Lake Okeechobee regulatory releases:

- A northeast pump station sized for 1,500 cfs working with G-370 and G-372 pump stations unmodified would provide sufficient capacity during the first phase of operation to provide the maximum delivery percentages that can be expected with an EAA Reservoir A-1 of 190,000 acre-feet of storage volume. Further modifications to
the NNRC and to G-370 and G-372 pump stations to allow pumping capacities of 2,220 and 3,700 cfs respectively to full EAA Reservoir A-1 water depth would provide the additional capacity needed for the second phase of operation. A conveyance capacity of up to 6,400 cfs would be required in the NNRC depending on the alternative selected.

- A northeast pump station sized for 3,500 to 4,000 cfs working with G-370 and G-372 pump stations unmodified would be required to provide sufficient capacity during the first phase to maximize local runoff and pump back capture. NNRC modifications would also be required to increase conveyance capacity. Further modifications to G-370 and G-372 pump stations to allow pumping capacities to full EAA Reservoir A-1 water depth would provide the additional capacity needed for the second phase of operation.

The second alternative has several advantages over the first:

- The larger pump station can meet all of the delivery goals that a 1,500 cfs pump station would meet but the smaller station could not provide the same priority removal levels.
- A 3,500-4,000 cfs pump station would provide a significant increase in flood protection capacity.
- Having a substantial pumping capability in the northeast pump station will ease the disruption that will be experienced during the phase two modifications of G-370 and G-372 pump stations.
- The larger pump station allows for capture of most storm related peak flows.

The primary disadvantage for the larger pump station alternative is cost (about $15.4 million). In addition to the costs associated with a smaller pump station, the 1,500 cfs pump station can provide the optimum deliveries without canal modification for the first phase, and minimal canal modification for the second phase. To be effective, the larger pump station would require canal modifications that coincide with the first phase of construction.

Northeast pump station recommendation:

- Construction of a 3,600 cfs northeast pump station concurrent to the construction of EAA Reservoir A-1.
- Use of the G-370 and G-372 pump stations unmodified during phase one operation to pump into the EAA Reservoir A-1 when its water levels are less than eight feet and directly to the STA-3/4 Supply Canal when EAA Reservoir A-1 water levels are greater than eight feet.
- Modification of the G-370 and G-372 pump stations to pump 2,220 and 3,700 cfs, respectively, to full EAA Reservoir A-1 depth as part of the construction of phase two (EAA Reservoir A-2).
- Canal modifications to provide matching conveyance capacity, with an associated cost of up to $37 million depending on the alternative selected.
**ES-1.9 Discharge Structures**

Three gate structures are required for implementation of the recommended alternative as shown on Figures ES-13 and ES-14. Two structures located in the southern embankment would be required to provide a dual function of EAA Reservoir A-1 filling and environmental deliveries from the EAA Reservoir A-1. Some studies have suggested that a water quality benefit may result from passing water through EAA Reservoir A-1 prior to discharging to STA-3/4. Additional structures would be required in order to achieve the potential water quality benefit. Implementation of the latter alternative would increase the project cost by approximately $26 million. Because of the added cost and a relatively small (13 to 17 percent reduction in phosphorus loading) water quality benefit, the three gate structure option is recommended. Even with the recommended alternative, operational strategies can be implemented to achieve the goal of routing much of the water through the EAA Reservoir A-1 before passing to the STA-3/4.

In addition to the gate structures the EAA Reservoir A-1 will be equipped with an orifice-type spillway which will guard against overfilling. The spillway will be designed to limit overflow discharges to less than 500 cfs during rainfall events with less than a 100-year recurrence interval.

**ES-1.10 Operations**

A Project Operating Manual (POM), for day-to-day use in managing essentially all foreseeable conditions affecting the EAA Reservoir A-1 will be developed upon completion of the Project. However, a draft has been prepared as part of this BODR for use during the Draft Integrated Project Implementation Report/Environmental Impact Statement (PIR/EIS) phase of the EAA Reservoir A-1 Project. The manual will be modified and revised, as necessary, through several Project phases. During the detailed design phase, it will be modified to define any temporary operations to be used during construction, including start-up and filling. The Operation Manual for STA-3/4 will also be modified as required, to reflect operations during periods when construction in the embankments for the Inflow and Supply Canals could disrupt operations.

Knowledge gained from the Operational Testing and Monitoring Phase will then be incorporated into the Draft POM, which will be coordinated with SFWMD and the USACE Jacksonville District (SAJ), and will supersede all other iterations of the Draft POM. The final version of the POM will be used by SFWMD when they accept responsibility for long term operations of the EAA Reservoir A-1.

The EAA Reservoir A-1 will store runoff that would otherwise have gone to tide and will improve the quantity, timing, and distribution of water deliveries to the environment. It has been demonstrated using an area specific computer model, applied to a period of simulation data from the SFWMM (which is the same as the ECP 2010 and 2015 version 5.4.2 model), that approximately 685,000 acre-feet per year of water can be delivered to the environment by EAA Reservoir A-1. Operating criteria for EAA Reservoir A-1 will be developed in subsequent versions of this POM to be consistent with the water reservations or allocations for the natural system made by the State in accordance with the WRDA 2000.

EAA Reservoir A-1 will also provide water for substantial agricultural deliveries by capturing storm runoff. Agricultural deliveries that cannot be met by the EAA Reservoir A-1 will continue to be supplied from Lake Okeechobee. When water is available in the EAA Reservoir A-1 for agriculture, it will normally be released through the northeast gate structure located near the
northeast pump station from where it will flow to the NNRC via the connector canal from the pump station. When the EAA Reservoir A-1 water level is below that needed for gravity flow to the NNRC, pumps located in the northeast pump station will be activated to deliver water to the NNRC. It has been demonstrated using an area specific computer model that a high percentage of the agricultural needs along the NNRC can be provided by EAA Reservoir A-1.

The EAA Reservoir A-1 will be operated to assure that implementation of the project will not diminish flood protection in the EAA. During periods when the EAA Reservoir A-1 contains water and it is necessary to prevent seepage from impacting adjacent properties, the seepage canal water level will be pumped down as required to prevent the groundwater level from rising. A groundwater model has been utilized to verify that lowering the water level in the seepage canal will be effective in preventing flooding of adjacent properties.

The EAA Reservoir A-1 Project will also provide capacity to store storm runoff and will increase the pumping capacity from the NNRC. In addition, areas within the EAA Reservoir A-1 previously used for agriculture will no longer deliver runoff to the NNRC, thereby making available 500 cfs of NNRC water that was previously unavailable. Therefore, the Project will not diminish flood protection and should reduce flooding in the NNRC under most conditions.