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## MEMORANDUM

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Distribution

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**Subject:** Borrow Evaluation, STA-2 Enhancement  
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### EXECUTIVE SUMMARY

The South Florida Water Management District (SFWMD) plans to implement enhancements at STA-2 as part of the program to achieve long-term water quality goals for the Everglades Restoration Project. The conceptual design for enhancing the treatment areas generally consists of dividing each of the existing cells (Cells 1,2 and 3) into two sub-cells each. The planned modifications to enhance STA-2 generally consist of converting the southern portion of the newly sub-divided cells (new Cells 1A, 1B and 1C) into submerged aquatic vegetation (SAV) cells. Modifications of the cells will include the following: a) construction of approximately 3.3 miles of levee, b) construction of new water control structures, c) extension of the overhead power lines, d) adding a pump station in Cell 2 for water level control, and e) herbicide treatment in portions of the new sub-divided cells. This memorandum was prepared to evaluate potential borrow sources for the earthwork related portion of the project only.

Twelve different sites have been identified that could potentially provide the borrow material needed to construct the interior levees. Levee construction material would consist of sandy soil, limestone formation (cap-rock) and inter-bedded limestone strata, clay and shell, with some peat. Borrow sources evaluated included shallow overburden soil (silty to slightly silty, calcareous sand and clay with limestone fragments) and deep, well-cemented limestone (cap-rock). STA-2 was used as a baseline site for comparison of the feasibility and cost effectiveness of the sites.

The evaluation process consisted of screening and ranking of the alternatives in three steps. Step 1 consisted of a screening to identify which sites could meet the basic project requirements. Based on the first screening step, 7 sites were selected for further analysis and screening. The seven sites from Step 1 were then evaluated in groups of similar ranking, in Step 2. Ranking criteria in Step 2 was based on potential impacts to highway traffic, permitting requirements, comparative unit cost of borrow, and the potential to impact future siting of the EAA storage

reservoir. The third step of the evaluation process consisted of a weighted factor using the estimated unit cost of borrow at each site, and the ranking value developed in Step 2.

Borrow sites ranged from less than one mile to more than 18 miles from STA-2, and five of the sites would require portions of the hauling on U.S. Highway 27. Evaluation of the 11 sites that comprised the full range of borrow sources considered, shows that the major difference in unit cost per cubic yard between the sites is primarily dependent on whether the borrow is limited to excavation above the cap-rock versus excavation through the cap-rock, followed by the length of haul. In areas where the excavation is limited to borrow above the cap-rock only, the unit cost of excavation ranges from 2.5 to 8 times the cost of borrow from sources that utilize cap-rock for fill material, regardless of the length of the haul that was evaluated. The estimated unit cost for borrow excavated above the cap-rock ranged from \$8 per cubic yard to about \$30 per cubic yard. The estimated unit cost for borrow excavated through the cap-rock layer ranged from \$3.82 to about \$13 per cubic yard, with most of the sites ranging from about \$4.00 to \$5.00 per cubic yard.

Based on our review and analysis of the alternative borrow areas, advantages, disadvantages and comparative unit costs of the sites, the following recommendations are made:

- Ø Site 1d (deep), borrow through the cap-rock at the Carroll/Eveready site adjacent to the west side of STA-2, could be used because: a) the new penetration through the cap-rock that would be required would be located on the perimeter of the area under consideration for siting of the EAA storage reservoir, and the borrow area could be located along a conceptual alignment for a seepage collection canal between STA-2 and the EAA reservoir; b) it would have the least impact on traffic on U.S. Highway 27 and with farming activities; and c) the unit cost of the borrow is reasonable, as well as the lowest expected unit cost of all of the sites evaluated.
  
- Ø Alternatively: 1) Site 6, the old Florida Crystals Quarry, could be used because: a) developing this site would not involve disturbance of a new area; b) it would involve only a small (about 20 to 30 %) increase in the footprint of the existing quarry; c) it would not require establishing a new penetration through the cap-rock; d) the impact to the traffic on U.S. Highway 27 would be minimal; and e) the unit cost of borrow is reasonable.
  
- 2) Site 3, East Bank of the North New River Canal, could be used because: a) developing this site would not involve disturbing a new area; b) it would not require establishing a new penetration through the cap-rock; c) widening the canal is an integral component of the proposed EAA project.

## 1.0 DESCRIPTION OF PROJECT OBJECTIVES

The South Florida Water Management District (SFWMD) plans to implement enhancements at STA-2 as part of the program to achieve long-term water quality goals for the Everglades Restoration Project. The conceptual design for enhancing the treatment areas generally consists of dividing each of the existing cells (Cells 1,2 and 3) into two sub-cells each. It is desirable to maximize continued operation of STA-2 during the construction and conversion period to reduce the impacts on the overall performance of STA-2, and in particular in Cells 1 and 2 that are presently performing better than anticipated.

The JM/JV staff has evaluated several borrow sources that could be used to construct the new interior levees, the various limitations/complications of each source, with the comparative construction costs and other factors related to the improvements at STA-2.

### 1.1 EXISTING STORM TREATMENT AREA

STA-2, located along the west side of the L-6 Borrow Canal, provides a storm water treatment area of about 6,340 acres for runoff from upland areas. STA-2 is shown below on Figure 1. STA-2 treats storm water inflows conveyed from the Hillsboro Canal and is composed of three cells: Cell 1-1,800 acres, Cell 2 – 2,270 acres and Cell 3 – 2,270 acres (as shown on Figure 2), with water entering near the north east corner and with a southerly flow through the STA cells. Cells 1 and 2 are populated primarily with emergent macrophytic vegetative communities and Cell 3 primarily contains submerged aquatic vegetation (SAV).



Figure 1 – Location Map, Storm Water Treatment Area STA-2

## 1.2 PLANNED MODIFICATIONS

The Conceptual Plan for Achieving Long-Term Water Quality Goals (Burns & McDonnell, March 17, 2003) recommended enhancement of STA-2 by sub-dividing the existing cells with the construction of new interior levees. The planned modifications to enhance STA-2 will consist of converting the southern portion of the newly sub-divided cells (new Cells 1A, 1B and 1C) into submerged aquatic vegetation (SAV) cells. Modifications of the cells will include the following: a) construction of approximately 3.3 miles of levee, b) construction of new water control structures, c) extension of the overhead power lines, d) adding a pump station in Cell 2 for water level control, and e) herbicide treatment in portions of the new sub-divided cells. The borrow evaluation described in this memo is for the earthwork related portion of the project only.

Construction would be performed in the dry season (November through April) to provide for maximum operation of STA-2 during construction of the interior levees and is to be completed by December 31, 2006. The interior levees are planned to be approximately 7 feet high, have a 14-foot wide crest. Volume estimates of levee fill assuming a 14-foot crest width, range from about 125,000 cy (assuming 3Horizontal:1Vertical side slopes) to 235,000 cy (assuming 4H:1V), and settlement of the foundation under the levee of 1 foot. An estimated minimum volume of 200,000 cubic yards was used for this analysis of the alternative borrow sites, for construction of the interior levees.

Based on the need to maintain treatment of storm water, the recommended construction implementation plan (Burns and McDonnell, March 12, 2003) is to construct the interior levees by working in one cell at a time, with construction sequenced to occur over a three-year period (i.e. dry season 2004/05, 2005/06 and November-December/06). However, in order to complete all three interior levees by December 31, 2006 with extended operational use of existing Cells 1 and 2, construction of the third season late in 2006 would likely need to be started before the end of the rainy season, and/or accelerated.

## 1.3 MATERIAL REQUIREMENTS

Levee construction material would consist of sandy soil, limestone formations (cap-rock) and inter-bedded limestone strata, clay and shell, with some peat. Boulders in excess of 24 inches in diameter and organic matter (including peat) greater than 8 % percent (by weight) would not be allowed in the fill for the planned interior levees. Peat would be suitable for interior levee fill when it is thoroughly mixed with inorganic soil and rock. Additionally, roots and woody, non-decomposed vegetative matter in excess of 3 % by volume would not be acceptable in the interior levee fill.

Blasted rock for fill will range in size from 1” to 24”, with no more than 10 % ranging from 18” to 24” in size, would be considered acceptable for interior levee fill materials.

## 2.0 POTENTIAL BORROW SOURCES

### 2.1 GENERAL

Eleven different sites have been identified, in addition to STA-2, that could potentially provide the borrow material needed to construct the interior levees, at the locations shown on Figure 2. STA-2 was used as a baseline site for obtaining borrow material for comparison of the feasibility and cost effectiveness of the sites. There are numerous factors that will affect the suitability of the potential borrow areas under consideration. Some of the primary factors that were evaluated include:

- Ø Excavation requirements. Type of excavation, blasting required or not required? Can borrow be obtained without penetrating the “cap-rock” within the footprint of the proposed EAA Storage Reservoir? Will blasting be required near the Florida Power and Light transmission lines?
- Ø Haul distance and route. How long is the truck haul and the cost associated with each source? Will a significant amount of truck hauling on U.S. Highway 27 or a permit (for blasting adjacent to U.S. Highway 27) be required? Will farm traffic be affected? Does the borrow source require upgrading the existing access road or a new canal/ditch crossing?
- Ø When will the land be available for borrow and can the completion deadline be met? Were Federal funds for the EAA Storage Reservoir involved in the purchase of the potential borrow source?

Each of the potential borrow sources are described in detail in the following sections, and a comparison of advantages and disadvantages of each site is provided in Table 1. Assumed haul routes from the potential borrow sites to STA-2 are shown on Figure 3.

#### 2.1.1 BASELINE – EXISTING STA-2 CELLS

Borrow for the interior levees could be obtained from STA-2 by dewatering the site, taking the STA out of service, removing the muck, and excavating the overburden soil and weathered bedrock, and/or limestone cap-rock for use as levee fill. Geotechnical investigations for STA-2 were available from previous investigations at the site (Brown & Caldwell, January 26, 1996.) The information consists of 95 drill hole logs. The borings were drilled from the crest of the levees forming the perimeter of the STA-2 cells. No drill hole information was available for the interior of the cells.

Based on the available geotechnical information reviewed, the near surface material at STA-2 generally consists of Type 2A (dark brown fibrous peat with trace organic silt and clay “muck”) and Type 2B soil (dark brown organic silt and clay with some fibrous peat “muck”), underlain by Type 3B and Type 3C material (gray to dark gray, tan to brown, silty to slightly silty, calcareous sand, clay or silt with limestone seams and fragments, shell, and occasional organics “suitable

borrow material”). The near surface muck layer averaged about 3 feet in thickness across the site and the underlying Type 3B and Type 3C material averaged about 0.3 feet in thickness, ranging from 0 to about 7.5 feet thick. STA-2 is underlain by cap-rock (Type 3A) material at a depth of about 1 to 11 feet. Type 3A material generally consists of gray, tan and brown, well-cemented limestone.

The suitable borrow layer (Type 3B and Type 3C material) is relatively thin on average based on the existing drill holes, and borrow development and excavation would require additional investigation in the active treatment area to identify areas where the suitable borrow material may be relatively thick. Based on the “average” soil profile across STA-2, we calculated that approximately 414 acres would need to be excavated to obtain the required 200,000 cubic yards of borrow for the levees, assuming that the cap-rock is not used for levee borrow. In addition, we estimate that more than 2,000,000 cubic yards of overburden muck would have to be moved to expose the suitable borrow.

Alternatively, assuming that cap-rock is used for the borrow source, approximately 8 acres would be required, if 20 feet of overburden soil (Type 3B and Type 3C), and Type 3A (cap-rock) is excavated. About 40,000 cubic yards of muck clearing would be required to develop the borrow pit. The primary construction activities that would be required for development of the Baseline site as a borrow source are summarized in Table 2.

STA-2 is currently owned and operated by the SFWMD and is presently available for excavation. Advantages of STA-2 as a borrow source include:

- ≠ On-site excavation would require the shortest haul distance.
- ≠ Minimal impact on the final siting of the EAA Storage Reservoir since the site is located outside of the area currently being considered for siting of the storage reservoir.
- ≠ Little or no impact to farming of the surrounding land since the majority of the construction traffic would occur on site.
- ≠ Limited traffic impacts to U.S. Highway 27 since the borrow hauling would primarily be on-site.

Disadvantages with STA-2 as a borrow source include:

- ≠ STA-2 is successfully being operated as a treatment area. In order to construct the new interior levees, individual cells (Cells 1, 2 and 3) will need to be taken off line to minimize water quality impacts to the downstream receiving waters. Using the treatment cells as the borrow site would add to the period that each cell would be taken off line.
- ≠ A significant amount of overburden (muck) clearing would be required in order to obtain the required borrow material, or a smaller area with penetration through the cap-rock would be

needed to reduce the quantity of muck clearing. Penetration of the cap-rock to obtain levee borrow would likely change the operation and water balance (Burns and McDonell, March 17, 2003) in the affected portion of STA-2. This may impact the "better than expected performance" of STA-2.

- ⚡ The previous drainage system used to dewater the site for farming has been degraded, making dewatering of the site more difficult and expensive.
- ⚡ STA-2 is actively being used as a treatment area with water ponded over the site, increasing the time, difficulty and cost associated with dewatering the site in order to develop a borrow area.
- ⚡ The anticipated duration of this activity could result in completion of the project beyond the required completion date of December 2005.
- ⚡ Very high cost for overburden borrow alternative.

We have also developed an opinion of the relative construction cost using STA-2 as the borrow source. The development of the unit cost for the major construction activities is described in Section 3 of this report.

## **2.2 ALTERNATIVE BORROW SITES**

### **2.2.1 SITE 1 – CAROLL/EVEREADY PROPERTY**

Borrow from Site 1 could be obtained from overburden soil and weathered bedrock overlying the limestone cap-rock. There is some geotechnical information from the western portion of this site that indicates that the soil profile would be similar to STA-2. Therefore, approximately 414 acres would need to be excavated to obtain the borrow material for the levees, or about 8 acres using cap-rock and suitable overburden material as the source. Dewatering would be less difficult at this site than STA-2, and the haul distance would only be marginally longer. Construction of a crossing over the seepage collection ditch between the Carroll/Eveready Property and STA-2 would be necessary to transport borrow to the construction area. The primary construction activities that will be required for development of Site 1 as a borrow source are summarized in Table 2.

Site 1 is currently owned by the SFWMD and is available for excavation. Advantages of Site 1 as a borrow source for the interior levees include:

- ⚡ Site 1 is adjacent to STA-2 allowing for a relatively short haul distance with the construction of an access bridge along the west side of STA-2.
- ⚡ The site is ready for borrow development.

- ⚡ Dewatering requirements would be less than STA-2, and the construction period would be shorter.
- ⚡ The USACE may be supportive of excavating weathered type 3B and 3C material overlying the indurated limestone cap-rock.
- ⚡ Limited traffic impacts (primarily contractor employees) to U.S. Highway 27 if an access bridge is constructed on the west side of STA-2.
- ⚡ Excavation through cap-rock (Alternative 1d) for deep borrow could be sited on the margin of the area being considered for siting of the EAA storage reservoir, and the reservoir could be routed around a borrow pit on the east side of Site 2. A borrow alignment that conceptually could be used as a seepage collection canal (100 ft wide by 3500 ft long) between STA-2 and the EAA reservoir would balance the multiple project needs.

Disadvantages with Site 1 as a borrow source include:

- ⚡ A significant amount of overburden (muck) clearing would be required in order to obtain the required borrow material.
- ⚡ Dust control in the borrow area would be an important consideration with this location due to the nearby adjacent highway.
- ⚡ The haul distance would be somewhat longer and a new access point would have to be constructed along the west side of STA-2 to provide the shortest haul distance.
- ⚡ Site 1 lies within the area currently being considered for siting of the EAA Storage Reservoir, as shown on Figure 3. The USACE may have concerns with a deep borrow pit that would penetrate the cap-rock. However, the penetration along the margin of the EAA storage reservoir siting would be the similar to expanding the North New River at Sites 3 and 7, discussed below.

We have also developed an opinion of the relative construction cost using Site 1 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.2 SITE 2 – SOUTH OKEELANTA LEASE NEAR S-7**

Borrow from Site 2 could be obtained from overburden soil and weathered bedrock overlying the limestone cap-rock. Dewatering would be less difficult at this site than STA-2, but the haul distance would be somewhat longer. There is no geotechnical information available for the property. If the subsurface conditions are similar to STA-2, then approximately 414 acres would be needed as described above, if cap-rock is not included as the source. However, at some of the construction projects in the area, overburden soil that could be used for levee fill has ranged from

two to four feet thick. If the suitable overburden material (overlying the cap-rock) at Site 2 ranged from two to four feet thick, a borrow area ranging from 31 to 62 acres could be developed to provide the required borrow.

Site 2 is located within the area currently being considered for siting of the planned EAA Storage Reservoir. However, since it is located near an outlying end of the area, developing a borrow pit along the perimeter of the site would have minimal impact to the EAA reservoir which could be routed around the borrow site. The two areas that would have the least affect on the EAA reservoir would be along the southeast and the southwest portions of the triangular shaped site. These alignments are close to U.S. Highway 27 and/or existing power lines, therefore permitting could be required if blasting is needed to produce levee fill material.

The required borrow area using overburden soil would range from 1640 feet by 1640 feet to 1160 feet by 1160 feet, for borrow thickness of 2 feet and 4 feet, respectively.

Alternatively a site approximately 520 feet long by 520 feet wide could be developed by excavating through the cap-rock in the southern tip of site 2. Excavation along the southeast segment would have little or no impact to highway traffic and could be readily located 500 to 1000 feet (assuming the same 20 foot excavation depth described above) from the power line to minimize potential conflicts with the utility. This location also would have minimal impact on the planned EAA reservoir siting since it is located at the tip of the triangle, which is a very inefficient geometry for storage. The primary construction activities that would be required for development of Site 2 as a borrow source are summarized in Table 2.

Site 2 is currently owned by FLO-SUN and would require a re-negotiation of the lease in order to commence excavation activities. Advantages of Site 2 as a source for the STA-2 borrow would include:

- ≠ Site 2 is relatively close to STA-2 allowing for a moderate haul distance along the L-6 levee.
- ≠ Shallow borrow may not require blasting or impact the Florida Power & Light Company's transmission lines in the vicinity. Developing a deep borrow pit through the cap-rock could be located at a sufficient distance from the FP&L facilities to avoid potential conflicts.
- ≠ There would be limited traffic impacts to U.S. Highway 27 since hauling would primarily be along the L-6 levee.
- ≠ The USACE may be supportive of excavating weathered type 3B and 3C material overlying the indurated cap-rock. Excavation of borrow into the cap-rock at the southern tip of the site may also be acceptable, since the EAA storage volume per lineal foot of levee is very small (i.e. the southern portion of triangle area of the site could be avoided without affecting the reservoir siting to provide the required storage volume).

Disadvantages with the site include:

- ⊘ The current tenant is farming on this property. Obtaining borrow material from this site would require a re-negotiation of the lease.
- ⊘ Subsurface conditions are not well known at this time. There could be a significant amount of overburden (muck) clearing per cubic yard of borrow required in order to obtain the required borrow material, if the suitable fill is not very thick.
- ⊘ Site 2 would have some impact the final siting of the EAA Storage Reservoir since the site is located within the area currently being considered for siting of the reservoir.

We have also developed an opinion of the comparative construction cost using Site 2 as the borrow source. . Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.3 SITE 3 – EAST BANK OF NORTH NEW RIVER**

Borrow from Site 3 could be obtained from material excavated from enlarging a portion of the North New River Canal. We understand that enlarging the canal to increase conveyance capacity is under consideration as part of the overall Everglades Restoration Project. In order to estimate potential quantities of borrow material that could be generated by enlarging a portion of the canal, we obtained a cross section of the existing canal at about station 785+33, located in the vicinity of Site 3. The cross section is shown on Figure 4. Using this cross section, calculations show that approximately 47,000 cubic yards over the 4800 lineal feet of widened canal, would be generated by increasing the cross sectional area of the canal by 25%. Additional material quantities would be generated by further enlargement of the canal. Potential levee fill quantities that could be generated would be: approximately 100,000 cubic yards by increasing the cross-sectional area by 50%, and approximately 225,000 cubic yards for an increase in cross-sectional area of 100%, over the 4800 lineal feet of canal. The primary construction activities that would be required for development of Site 3 as a borrow source are summarized in Table 2.

Site 3 is currently owned by the SFWMD and is available for excavation of the spoil material. Advantages of Site 3 as a source for the STA-2 borrow would include:

- ⊘ Site 3 is in close proximity to STA-2 allowing for a short haul distance with the construction of an access bridge along the west side of STA-2.
- ⊘ Expanding the North New River Canal would be consistent with the goals of the EAA Reservoir Storage project.
- ⊘ There would be limited traffic impacts to U.S. Highway 27 (primarily contractor access) since hauling would primarily be on interior farm roads.

⚡ The USACE is supportive of borrow in areas such as Site 3 where the indurated limestone cap-rock has already been penetrated.

Disadvantages with the site include:

⚡ Site 3 is also a source of borrow material for future levees associated with EAA Storage Reservoir construction.

⚡ The timing for finalizing the enlargement plan may not meet the required time line for the STA-2 enhancement project.

⚡ The size of canal enlargement is unknown at this time, and may be insufficient to provide the require levee fill volume.

⚡ Blasting in this area will require a Maintenance of Traffic (MOT) plan for U.S. Highway 27.

⚡ A new access point would have to be constructed along the west side of STA-2 to facilitate the shortest haul distance.

⚡ A temporary road or detours would need to be constructed around the excavation area to accommodate farm traffic.

We have also developed an opinion of the comparative construction cost using Site 3 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

#### **2.2.4 SITE 4 – SPOIL MATERIAL ALONG EAST SIDE OF NORTH NEW RIVER**

Borrow from Site 4 could be obtained from excess spoil material located along the east side of the North New River Canal. The spoil material is available at two different locations along the canal, labeled 4a and 4b on Figure 3. The estimated borrow material that could be available is approximately 50,000 cubic yards at Site 4a and 62,000 cubic yards at Site 4b. Site 4 would have to be used in conjunction with another site(s) in order to provide the required quantity of levee fill. The primary construction activities that would be required for development of Site 4 as a borrow source are summarized in Table 2.

Site 4 is currently owned by the SFWMD and is available for excavation of the spoil material. Advantages of Site 4 as a source for the STA-2 borrow would include:

⚡ No new excavation or blasting would be required to obtain the borrow material.

⚡ Site 4 would not impact the final siting of the EAA Storage Reservoir since it does not impinge upon the area currently being considered.

⚡ The spoil is located on SFWMD right-of-way.

⚡ Site 4 is relatively close to STA-2 allowing for a moderate haul distance.  
Disadvantages with the site include:

- ⚡ A limited quantity of spoil material exists. There is not enough borrow material to provide the minimum 200,000 cubic yards required for the interior levees. Site 4 would have to be combined with another location to obtain the required borrow material.
- ⚡ Temporary roads/detours would have to be constructed to accommodate farm traffic while excavating the spoil.
- ⚡ There would be an increase of construction traffic along U.S. Highway 27 for material hauling.
- ⚡ A new access point would have to be constructed along the west side of STA-2 to provide the shortest haul distance for this source.
- ⚡ There is some unsuitable (primarily oversized) material contained within the spoil, which may reduce the actual quantity available and increase the cost for processing.

We have also developed an opinion of the comparative construction cost using Site 4 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.5 SITE 5 – LEVEE ON EAST SIDE OF L-6 LEVEE**

Borrow from Site 5 could be obtained from degrading the existing levee along the east side of the L-6 Levee. It has been estimated that approximately 12,000 cubic yards of borrow material would be available. The primary construction activities that will be required for development of Site 5 as a borrow source are summarized in Table 2.

Advantages of Site 5 as a source for the STA-2 borrow would include:

- ⚡ No new excavation or blasting would be required to obtain the borrow material.
- ⚡ Site 5 would not impact the final siting of the EAA Storage Reservoir since the site is located outside of the area currently being considered for the siting of the EAA Storage Reservoir.
- ⚡ Site 5 is relatively close to STA-2 allowing for a relatively short haul distance.
- ⚡ There would be limited traffic impacts to U.S. Highway 27 (primarily contractor access) since hauling would primarily be along the L-6 levee.



Disadvantages with the site include:

- ⚡ A limited quantity of spoil material exists. There is not enough borrow material to satisfy the minimum 200,000 cubic yard requirement for the proposed levee. Additional borrow material would need to be found at other locations. Developing and hauling borrow from multiple sources would increase the unit cost of the borrow.
- ⚡ There may be environmental resource permitting issues with the removal of sawgrass to degrade the levee.

We have also developed an opinion of the comparative construction cost using Site 5 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.6 SITE 6 – FLORIDA CRYSTALS QUARRY**

Borrow from Site 6 could be obtained from expanding an existing, inactive rock pit. Site 6 is currently owned by the SFWMD but may require a re-negotiation of the lease since the current tenant is actively farming on the surrounding property. The primary construction activities that would be required for development of Site 6 as a borrow source are summarized in Table 2.

Advantages of Site 6 as a source for the STA-2 borrow would include:

- ⚡ Site 6 is in close proximity to STA-2 with a short haul distance.
- ⚡ Expanding an existing pit would involve less disturbance than developing a new borrow site.
- ⚡ Expanding the existing pit at Site 6 would be cheaper than developing a new borrow pit. Expansion of the existing pit (approximately 25 acres) would result in only a 20 to 30 percent increase in penetration area of the cap-rock.
- ⚡ There would be limited traffic impacts to U.S. Highway 27 (primarily contractor access) since hauling would primarily be on interior farm roads.

Disadvantages with the site include:

- ⚡ The site is located within the area currently being considered for siting of the reservoir. The USACE may not support expansion of the existing quarry since it would affect reservoir siting.
- ⚡ Borrow excavation would be “in the wet” or extensive dewatering required to lower the water level in the quarry.

We have also developed an opinion of the comparative construction cost using Site 6 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.7 SITE 7 – EAST BANK NORTH NEW RIVER, EAST OF STA 3/4**

Borrow from Site 7 could be obtained from material excavated from improvements to the North New River Canal in this area. In order to estimate potential quantities of borrow material that could be generated by enlarging a portion of the canal, we obtained a cross section of the existing canal at about station 1097+70, located in the vicinity of Site 7. A cross section of the existing canal at this location is shown on Figure 4.

Using this cross section, calculations show that approximately 54,000 cubic yards per mile of widened canal, would be generated by increasing the cross sectional area of the canal by 25%. Additional material quantities would be generated by further enlargement the canal. Potential levee fill quantities that could be generated would be: approximately 105,000 cubic yards per mile by increasing the cross-sectional area by 50%, and approximately 222,000 cubic yards per mile for an increase in cross-sectional area of 100%. Therefore the canal would need to be widened over a length of 3.7, 1.9 and 0.9 miles to provide the minimum quantity of required levee fill. The primary construction activities that would be required for development of Site 7 as a borrow source are summarized in Table 2.

Site 7 is owned by the SFWMD and is currently being leased. Advantages of Site 7 as a source for the STA-2 borrow would include:

- ⚡ The USACE is supportive of borrow in areas such as Site 7 where the indurated limestone cap-rock has already been penetrated.
- ⚡ The current leaseholder may be interested in renegotiating the lease and removing the affected portion of this property from their current lease.
- ⚡ Site 7 is in close proximity to STA-2 allowing for a short haul distance.
- ⚡ Minimal impact on the final siting of the EAA Storage Reservoir since it is located along the margin of the area currently being considered for siting of the storage reservoir.

Disadvantages with the site include:

- ⚡ Blasting to widen the canal will require a Maintenance of Traffic (MOT) plan for U.S. Highway 27.
- ⚡ Dust control may be needed due to excavating and hauling adjacent to the highway.

- ⚡ A new access point would have to be constructed along the west side of STA-2 to facilitate a short haul distance.
- ⚡ A temporary road would need to be constructed around the excavation area to accommodate farm traffic, or, construction of the interior levees would need to be planned outside of the cane harvest season (October 15 through March 1).
- ⚡ Site 7 may be a source of borrow material for future levees associated with EAA Storage Reservoir construction.

We have also developed an opinion of the comparative construction cost using Site 7 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.8 SITE 8 – TALISMAN ROAD SPOIL**

Borrow from Site 8 could be obtained from spoil material that has been placed along an east/west road bisecting a large portion of Compartment A of the Talisman Exchange site. The amount of borrow material available from the spoil is unknown. The primary construction activities that would be required for development of Site 8 as a borrow source are summarized in Table 2.

Advantages of Site 8 as a source for the STA-2 borrow would include:

- ⚡ No excavation or blasting would be required to obtain the borrow material.

Disadvantages with the site include:

- ⚡ The quality of the material may not be suitable for the proposed levees. The spoil is very rocky and processing will be required before the material can be used for construction.
- ⚡ The quantity of the spoil available for use is unknown.
- ⚡ A long haul distance is required to transport the material to STA-2
- ⚡ A new access point would have to be constructed along the west side of STA-2.
- ⚡ There would be an increase in construction traffic along U.S. Highway 27.

We have also developed an opinion of the comparative construction cost using Site 8 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.9 SITE 9 – BOLLES/CROSS CANAL**

Borrow from Site 9 could be obtained from the expansion of the Bolles and Cross canals, identified as part of the EAA Storage Reservoir project. In order to evaluate borrow quantities from this site, we assumed that the cross sectional area of the Bolles and Cross canals are similar to the cross section of the New North River Canal taken at station 1097+70. Therefore, widening of the Bolles and/or Cross canals by 3.7, 1.9 and 0.9 miles, would provide the minimum 200,000 cy of levee fill required for STA-2, and increase the canal capacity by about 25, 50 and 100%, respectively. The primary construction activities that would be required for development of Site 9 as a borrow source are summarized in Table 2.

Advantages of Site 9 as a source for the STA-2 borrow would include:

- ≠ Widening of the Bolles/Cross Canal is planned as part of the EAA Storage Reservoir project.
- ≠ The canals are outside of the limits of the area currently being considered for siting of the planned EAA Storage Reservoir.

Disadvantages with the site include:

- ≠ The distance from Site 9 to STA-2 would require a very long haul.
- ≠ There may be significant right-of-way issues associated with widening the Bolles and Cross canals. Therefore developing this area as a borrow site would likely extend construction beyond the required completion date.
- ≠ A new access point would have to be constructed along the west side of STA-2.
- ≠ There would be an increase in construction traffic along U.S. Highway 27.

We have also developed an opinion of the comparative construction cost using Site 9 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.10 SITE 10 – STA 3/4 GRIFFIN PIT**

Borrow from Site 10 could be obtained from an existing borrow pit at the southwest corner of STA 3/4. The Griffin pit has been used for providing construction material at STA3/4 and could also be used for STA-2. The primary construction activities that will be required for development of Site 10 as a borrow source are summarized in Table 2.

Advantages of Site 10 as a source for the STA-2 borrow would include:

- ≠ Expanding an existing pit would involve less disturbance than developing a new borrow site.

⚡ Expanding the existing pit at Site 10 would be cheaper than developing a new borrow pit.

⚡ The property is controlled by the SFWMD.

⚡ Site 10 would not impact the final siting of the EAA Storage Reservoir since it is located outside of the area currently being considered for siting of the storage reservoir.

Disadvantages with the site include:

⚡ The location of Site 10 to STA-2 would require a long haul, and the existing road would need to be improved.

⚡ Borrow excavation would be “in the wet” or extensive dewatering required to lower water levels in the quarry.

We have also developed an opinion of the comparative construction cost using Site 10 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### **2.2.11 SITE 11 – OFFSITE COMMERCIAL QUARRY**

Site 11 assumes that borrow will be purchased from an offsite commercial quarry. The nearest commercial quarry is the Starr quarry located about 20 miles northwest of the STA-2.

Advantages of Site 11 as a source for the STA-2 borrow would include:

⚡ There would be no impact on the final siting of the EAA Storage Reservoir since this option is located outside of the area currently considered for siting of the reservoir.

Disadvantages with the site include:

⚡ The proximity of Site 11 to STA-2 would require a relatively long haul distance.

⚡ The cost of the quarry rock from a commercial source.

⚡ There would be an increase in construction traffic on U.S. Highway 27.

We have also developed an opinion of the comparative construction cost using Site 11 as the borrow source. Our estimate of the unit cost for the major construction activities is described in Section 3 of this report.

### 3.0 COST COMPARISON

#### 3.1 OPINION OF PROBABLE CAPITAL COST FOR INTERIOR LEVEE BORROW

Comparative capital cost estimates were prepared for each of the potential borrow sources evaluated as part of this study. The objective of the capital cost estimate was to provide a quantifiable basis for comparing the alternatives.

#### 3.2 UNIT COST ESTIMATING

Unit costs were developed for the major construction activities associated with the alternative borrow sources. The type of borrow sources evaluated ranged from developing a new “borrow pit” on adjacent farmed land, to widening one of the existing canals, to importing from an existing off-site commercial quarry. The major construction activities that were evaluated consisted of the following:

- Ø Site Dewatering
- Ø Clearing & Grubbing
- Ø Stripping & Muck Removal
- Ø Drilling and Blasting
- Ø Borrow Excavation
- Ø Hauling
- Ø Haul Road Grading and Watering
- Ø Major Temporary Crossing
- Ø Mobilization

Unit costs were based on data from contractors with bidding and construction experience in the area, Means Heavy Construction Cost Data, and our experience in construction of levees and embankment structures. The unit costs were developed for use in comparing the alternative sites at a feasibility level, based on the Conceptual design description in the Burns & McDonnell March 17, 2003 report. ***The cost estimate is not suitable for estimating the construction cost for the STA-2 enhancement project. A reconnaissance level cost estimate (using an average unit cost of levee fill material) was calculated for this borrow evaluation, and the cost estimates would be expected to be on the order of + 50 percent to - 30 percent. The cost estimate described in this memorandum does not include major features that will be required as part of the enhancement project (e.g. water control structures, pumping stations, electrical controls and electrical power distribution modifications). A design for this project and a detailed cost estimate will be required to estimate the project cost.***

The unit costs were used to estimate capital construction costs for comparison of the sites, based on the individual requirements associated with the different borrow sources. The detailed comparative construction cost estimates for each site are shown in Table 3.

The estimated comparative cost between the 12 sites shows that the major difference in unit cost per cubic yard between the sites is primarily dependent on whether the borrow is limited to excavation above the cap-rock versus excavation through the cap-rock. In areas where the excavation is limited to borrow above the cap-rock only, the unit cost of borrow ranges from 2.5 to 8 times the cost of borrow from sources that utilize cap-rock for fill material, regardless of the length of the haul evaluated. The estimated unit cost for borrow excavated above the cap-rock ranged from \$8 per cubic yard if suitable material is at least 2 feet thick, to about \$30 per cubic yard. The estimated unit cost for borrow excavated through the cap-rock layer ranged from \$3.82 to about \$13 per cubic yard, with most of the sites ranging from about \$4.00 to \$5.00 per cubic yard.

#### 4.0 ANALYSIS AND RECOMMENDATIONS

There are numerous borrow sites that could be used to provide material for construction of the planned interior levees at STA-2. Twelve potential borrow sites were evaluated to identify the most suitable site(s). The evaluation process consisted of screening and ranking of the alternatives in three steps. The first step consisted of a screening to identify which sites could meet the basic project requirements. The criteria for this basic screening consisted of: 1) construction could be completed by December 31, 2006 without significant construction during the rainy season; 2) construction that would not negatively impact the successfully operating storm water treatment area except along the planned levee alignments during construction; and 3) sufficient borrow material available from one site (i.e. multiple borrow sites would not be required to provide the required borrow quantity). Based on the first screening seven sites were selected for further analysis and screening, as shown on Table 4. The sites that were eliminated from further consideration after the first screening step were:

- Ø The existing STA-2 (Baseline site) was eliminated from further consideration because borrow excavation within the successfully operating STA-2 would require removing at least one of the cells out of operation for 2 years to dewater the site and conduct excavation operations for the 2 construction seasons. This type of disruption could also change the operational balance in the adjacent cell as a result of dewatering. In addition, more than 400 acres would be permanently affected by the excavation of material above the cap-rock, and the water balance operation when the cell is returned to operation as a storm water treatment area, with an unknown affect on returning the STA-2 to successful operation, if the cap-rock is penetrated for the deeper excavation.
- Ø Borrow from the spoil along the east side of the North New River, the levee on the east side of L6, the Talisman Road spoil (Sites 4, 5 and 8 respectively), were eliminated due to insufficient quantity, requiring the development of multiple borrow sites.
- Ø The Bolles/Cross Canal, Site 9, was eliminated due to the time required to obtain right-of-way (ROW). ROW acquisition would limit the ability to complete the interior levee construction by the required date.

The seven remaining sites were then evaluated in Step 2, based on the following three factors: 1) would truck traffic be significantly increased on U.S. Highway 27, or permits for blasting adjacent to U.S. Highway 27 would be required, and/or would excavation activities at the borrow site potentially impact Florida Power and Light transmission lines; 2) the comparative capital construction cost for each site, and 3) potential to impact siting of the planned EAA Storage Reservoir. A scoring system was set up for each of the three evaluation categories. The scoring values used were 1, 2 and 3, and the sum of the scores was then used to rank the sites, with the lowest score being ranked as most favorable. In order to apply the score a definition was developed to be applied in each category, as described below.

1. Traffic changes on U.S. Highway 27 would be primarily related to construction personnel traveling to and from the site each day; and the comparative unit cost for construction is less than \$6.00 per cubic yard of fill; and indicates that there would be no direct impact to potential seepage from the EAA Storage Reservoir.
2. Traffic changes on U.S. Highway 27 would consist of construction personnel traveling to and from the site each day and use of up to 3 miles of the highway for hauling, and/or obtaining a MOT permit with the Department of Transportation for blasting operations in the canal adjacent to the highway; the comparative unit cost for construction would be between \$6.00 and \$15.00 per cubic yard of fill; and indicates that the potential impact to the EAA Storage Reservoir is low because the borrow area would be along the perimeter of the area currently being considered for siting of the reservoir, or would be an expansion of an existing penetration through cap-rock
3. Traffic would involve significantly more truck miles on U.S. Highway 27 for hauling borrow to the site; the comparative unit cost for construction would be more than \$15.00 per cubic yard of fill; and indicates that the borrow area is within the area currently being considered for siting of the planned EAA Storage Reservoir.

A summation of the score for each of the evaluation factors was used to rank the sites. The results are shown in Table 4. The results of the Step 2 in the evaluation process can be grouped into 2 groups, based on similar ranking values. The preferred sites grouped together based on the ranking criteria were as follows:

Group 1 (Score = 4).

- Ø Site 1d – Excavation from the Carroll/Eveready Property
- Ø Site 2d – Excavation into the cap-rock at the South Okeelanta Lease
- Ø Site 6 – Florida Crystal Quarry

The 3 highest ranked sites are similar in that the potential impact to the planned EAA Storage Reservoir is minimal since the borrow would be either a) located in an area where the cap-rock has already been penetrated (Site 6); or b) is located along the perimeter of the area being considered for the EAA Storage Reservoir (Sites 1d and 2d) and the potential impact would be minimal or could be mitigated by a minor re-routing of the perimeter alignment of the reservoir. Selecting Site 2d would have some potential to impact the FP&L transmission lines. However,

the required surface area (approximately 8 acres is relatively small, and could be easily located away from the transmission lines and U.S. Highway 27 if a location in the southwest portion of the parcel is selected. The estimated costs from each of these 3 sites are also similar. As the third step in the evaluation matrix, we calculated a weighted score based on the product of the ranking value and the estimated unit cost. The weighted score for these 3 sites ranged from 15 to 20.

Group 2 (Score = 5).

- Ø Site 1s – Shallow excavation above the cap-rock
- Ø Site 2s – Shallow excavation above the cap-rock (if there is suitable material at least 2 feet thick)
- Ø Site 3 – Excavation along the East Bank of the North New River
- Ø Site 7 – Excavation along the East Bank of the North New River, east of STA3/4
- Ø Site 10 – STA 3/4 Griffin Quarry
- Ø Site 11 – Starr Quarry

The next 6 sites each would generally have impacts on the traffic on U.S. Highway 27 ranging from relatively low to high, and 4 sites (Site 1s (shallow), Site 2s (shallow), Site 10 and Site 11) would have no impact on the EAA Storage Reservoir. However the unit costs vary widely between the sites.

As the third step in the evaluation process, we calculated a weighted score based on the product of the ranking value and the estimated unit cost as shown in Table 4. The weighted score for these 6 sites ranged from 20 to 144. The lowest weighted scores in Group 2 were for Sites 3 and 7 (expansion of portions of the North New River Canal). The weighted score at these two sites are significantly lower than the weighted scores for the other 4 sites in Group 2 and have similar values to the 3 sites in Group 1. This is due to the fact that these sites would have the relatively low unit costs for borrow. However, the effect on traffic on U.S. Highway 27 (both higher truck miles and permitting for blasting adjacent to the highway) moved them in to Group 2. The potential to impact the planned EAA reservoir siting by utilizing borrow from these sources, should also be further assessed.

There is a second category of potential borrow sources with weighted factors ranging from 55 to 65 (Sites 10 and 11). Sites 10 and 11 could also be viable, however, the comparative unit costs are generally twice as expensive as the Group 1 Sites. In addition, there would be more potential impacts to existing traffic with the increased hauling on U.S. Highway 27 than all of the other borrow sources. The lower ranked site in this category of Group 2 is the Starr Quarry. The site is ranked lower since it would have a relatively high impact on U.S. Highway 27 traffic, and the unit cost is higher than all of the sites except for three alternatives using shallow borrow above the cap-rock.

The two sites with the highest weighted score (140 and 144) are Site 2s (shallow excavation at the Okeelanta site) and Site 1s (shallow excavation at the Carroll/Eveready site), respectively. The estimated unit cost reflects the difficulty of excavating a large volume of material from a

relatively thin layer of suitable material. Excavating suitable material from a borrow area with an average thickness of 0.3 feet while possible, would generally be considered impractical from a constructability aspect. And there would be more concern with uncertainty in construction and change orders during construction. Assuming that an area with at least a 2 foot thickness of suitable material can be identified (potentially at Site 2s), the constructability becomes more practical, and cost effective. The weighted value would decrease to 38 with if at least 2 feet of suitable material overlying the cap-rock could be identified at Site 2.

#### 4.1 Conclusions and Recommendations

**4.1.1 Conclusions.** The analysis to identify a borrow site(s) that could be used to provide interior levee fill for the enhancement at storm water treatment Cells 1, 2 and 3 at STA-2 has resulted in the identification of several suitable borrow sites. Based on the analysis and ranking evaluation we have concluded the following:

- Ø Suitable borrow can be obtained from Sites 1d, 2d or 6. Borrow from Site 1d along the west side of STA-2, and 2d from an area along the southeast or southwest limits of the site, would be excavated into the cap-rock. A borrow pit located in these areas would minimize the potential to impact siting of the planned EAA reservoir, which could be easily routed around the borrow pit. Siting of the reservoir could include routing around a borrow pit at Sites 1d or 2d, with essentially no difference to the EAA surface area between routing the alignment around a borrow pit associated with widening of the North New River. In addition, an alignment that could be used as a seepage collection canal between STA-2 and the EAA reservoir would balance multiple project needs.

The area required for a borrow pit is on the order of about 8 acres (approximately 600 feet square), and a borrow pit in Site 2 could be located 1000 feet from the FP&L transmission lines and U.S. U.S. Highway 27, to limit the permitting and involvement of those agencies.

Site 6, the old Florida Crystal Quarry is also a very viable site. Site 6 would be an expansion of an existing penetration through the cap-rock, and would also consist of developing a previously disturbed area, in contrast to development of a new site. Further expansion of Site 6 would not change the impact to the planned EAA reservoir, when compared to expanding the existing North New River at Sites 4 and 7. For example, seepage is based on the hydraulic gradient (hydrostatic head over length of the seepage path), permeability, and area of flow. The reservoir head, seepage path length and permeability of penetrations through cap-rock, would be essentially the same when comparing an increase in penetration area at Site 6, with Sites 3 and 7. Therefore the expected quantity of seepage through the cap-rock would not be expected to differ, measurably, whether the area of penetration is at Site 6 or at Site 3 or 7.

The comparative unit cost at these three sites ranges between about \$4.50 and \$5.50 per cubic yard. Therefore the construction costs would not be expected to vary significantly.

- Ø Borrow from Sites 3 and 7 should also be considered viable, even though they ranked in Group 2. The USACE has indicated that they could support widening of the areas along the canals that have already penetrated that cap-rock. In addition, widening of the North New River is being already being considered. Widening of the North New River Canal is an integral component of the proposed EAA project and would provide specific information on final widening that could be used in the project. Consequently borrow from either Site 3 and 7 could provide multiple benefits.

Some scheduling/sequencing with farming operations during the construction at STA-2 would be needed due to the use of the existing levees as farm access roads. These 2 sites would also be expected to have lower unit cost for borrow material than Site 2d. The primary reason that these sites ranked lower in the evaluation process than sites 1d, 2d and 6 is due to the need for some hauling on U.S. Highway 27

**4.2.2 Recommendations.** Based on our review and analysis of the alternative borrow areas, advantages, disadvantages and comparative unit costs of the sites we recommend the following.

1. Site 1d, borrow through the cap-rock at the Carroll/Eveready site adjacent to the west side of STA-2 would be the preferred borrow site because: a) the new penetration through the cap-rock that would be required would be located on the perimeter of the area under consideration for siting of the EAA storage reservoir, and the alignment of the reservoir impoundment could be routed around the borrow pit; b) would have the least impact on traffic on U.S. Highway 27 and with farming activities; and c) the unit cost of the borrow is reasonable, as well as the lowest expected unit cost of all of the sites evaluated.
2. Alternatively Site 6, the old Florida Crystals Quarry, could be used because: a) developing this site would not involve disturbance of a new area; b) it would involve only a small (about 20 to 30 % increase in the footprint of the existing quarry); c) would not require establishing a new penetration through the cap-rock; d) the impact to the traffic on U.S. Highway 27 would be minimal; and e) the unit cost of borrow is reasonable.

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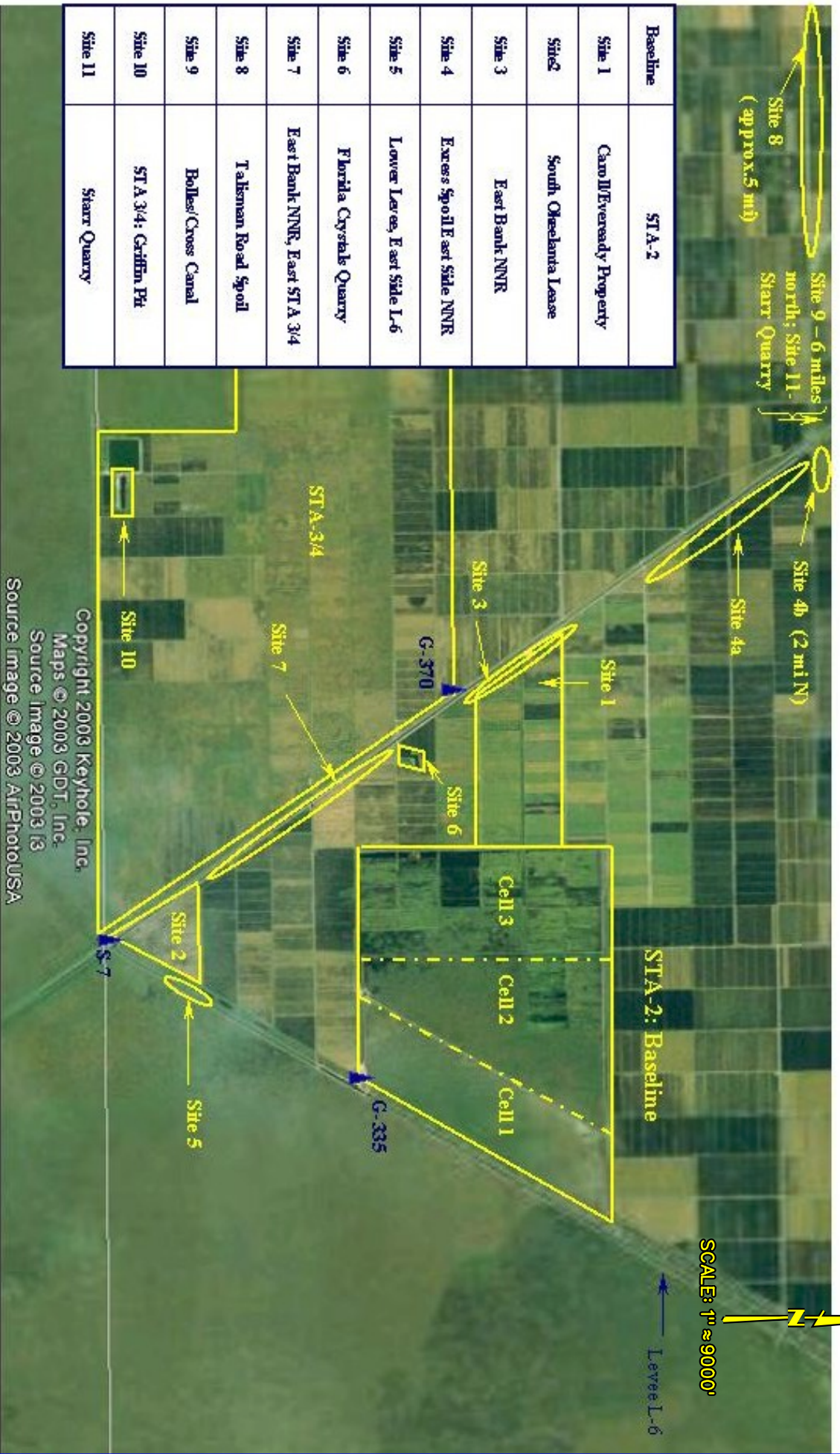
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Baseline	STA-2
Site 1	Camp/Everready Property
Site 2	South Okechanta Lease
Site 3	East Bank NNR
Site 4	Express Spoil East Side NNR
Site 5	Lower Level, East Side L-6
Site 6	Florida Crystals Quarry
Site 7	East Bank NNR, East STA 3/4
Site 8	Talsman Road Spoil
Site 9	Bolles/Cross Canal
Site 10	STA 3/4: Griffin Pt
Site 11	Sharr Quarry

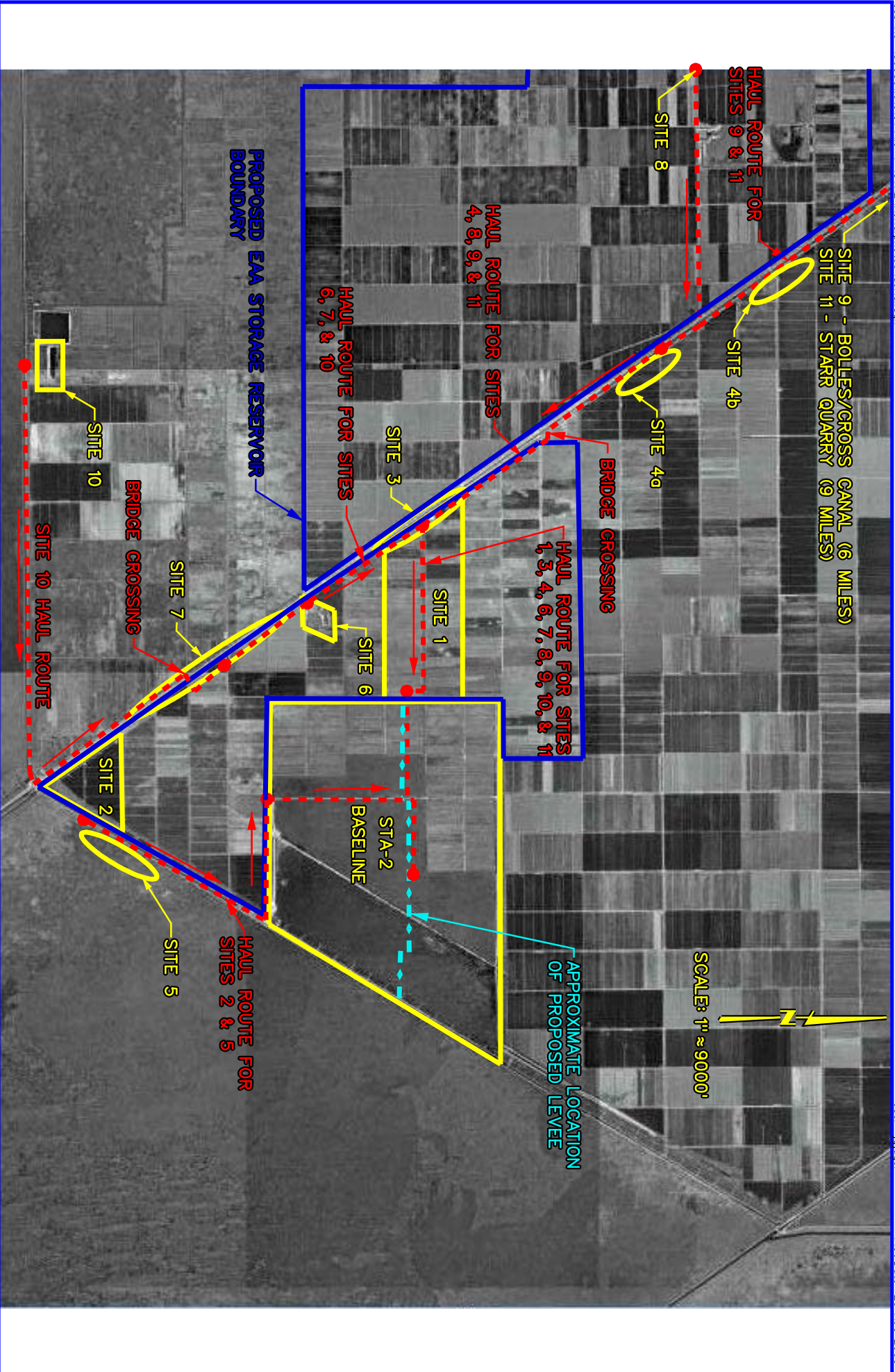


STA-2 LEVEL BORROW EVALUATION

POTENTIAL BORROW SITES

FIGURE 2

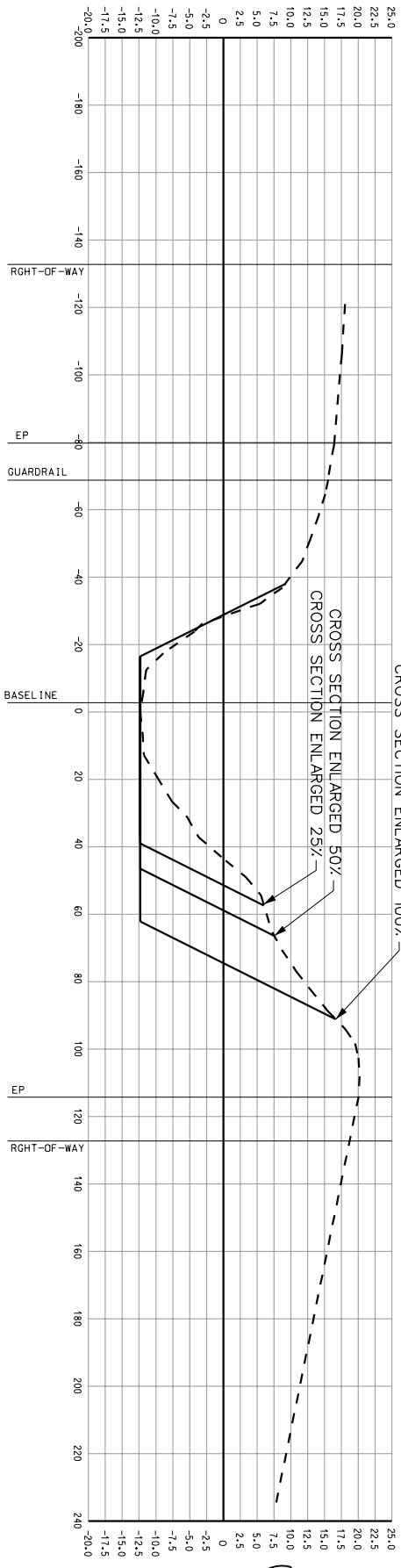
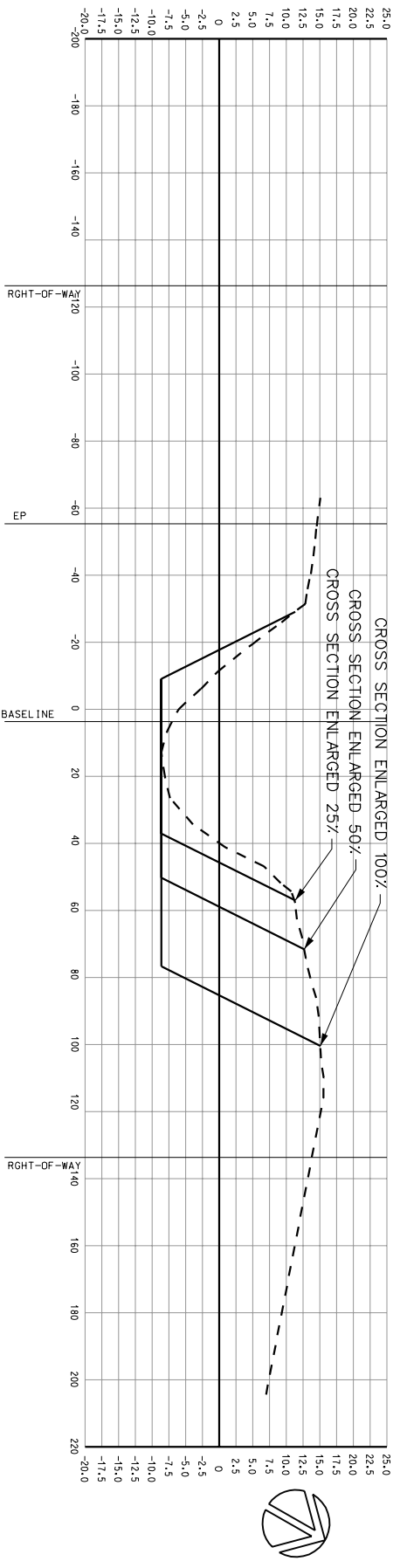




STA-2 LEVEE BORROW EVALUATION

BORROW MATERIAL HAUL ROUTES

FIGURE 3



STA-2 LEVEE BORROW EVALUATION

NEW NORTH RIVER CANAL CROSS SECTIONS

FIGURE 4



## **Attachment A**

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### Unit Cost Development for STA-2 Earthwork Borrow Comparative Analysis

## **Unit Cost Development**

Different activities will be required depending on the borrow area that is being considered. In general, the earthwork related activities will consist of drainage and dewatering of the borrow site at the Baseline Site and Sites 1 and 2, overburden muck clearing, excavating levee borrow material, loading and hauling to the site, and spreading and compaction. The basis for the development of each earthwork category is described below.

### **1.0 Site Dewatering**

This work item will generally consist of continuous pumping of the borrow pit from the commencement of drilling to completion of excavation. An 18 inch pump was assumed to be suitable to dewater about a 10 acre borrow pit. For sites larger than 10 acres, we have assumed that one pump would be required for every 10 acres. In the very large borrow operations, greater than 100 acres, we assumed that no more than 200 acres would be dewatered in each construction season. The dewatering equipment would include 18-inch pumps, a pump tender and fueling 24 hours per day, 7 days per week.

The estimated average cost would be \$1200/acre/month for each pump.

### **2.0 Clear and Grub Footprint**

This work item will consist of clearing the site of heavy brush.

The estimated cost for clearing and grubbing would be \$1500/acre.

### **3.0 Stripping and Muck Clearing**

This work item will generally consist of moving an average thickness of about 18 inches using dozer, to expose material suitable for levee fill. The muck would be moved approximately 200 feet in each direction by dozer to create a 400-foot wide borrow working area. After the borrow has been excavated, the stripping and muck clearing would be moved back in to the completed borrow excavation by dozer. Because of the low production due to the relatively thin layer of suitable material, we assumed that up to 6 dozers would be required for muck clearing to provide sufficient production of overburden borrow to complete the work in 2 construction seasons. The expected muck clearing production would be about 12,000 cubic yards per day. For relatively small borrow areas (say less than 20 acres), we assumed muck clearing production of 4000 cubic yards per day, using 2 dozers.

The estimated unit cost would be \$0.50 per cubic yard.

### **4.0 Drilling and blasting.**

This work item would include drilling and blasting to a depth of about 18 feet. A track hoe would be used to excavate to a depth of about 20 feet. Blasting

operations would produce a material with about 85 % minus 24 inches, and a maximum size in the range of 24 to 30 inches. Oversize material would be segregated by the track hoe loading trucks and/or by placing the oversize in the lower “bridging”, first lift of fill.

The estimated cost for drilling and blasting would be about \$0.60 per cubic yard.

## **5.0 Borrow Excavation**

Several different borrow methods will be employed depending on the type of material being excavated and the geometry of the excavation. The three major types of borrow activity would be: a) drilling and blasting where excavating through cap-rock, b) loader/backhoe excavation and loading where borrow is obtained from existing roads, and c) excavation by dozer and backhoe where the Type 3B and Type 3C overburden soil and rock, above the cap-rock is obtained.

Borrow obtained by drilling and blasting through cap-rock (Baseline site, and Sites 1, 2, 3, 6, 7, 9, and 10) will generally use an 8 cubic yard track hoe for excavating and loading the levee fill material. Production is expected to be about 3000 cubic yards per day. The estimated unit cost for excavating and loading would be about \$1.00 per cubic yard.

Borrow obtained from existing roads (sites 4, 5 and 8) will also likely use a track hoe, however the production is expected to be somewhat faster do to the shallower depth of material. However, more segregation of oversize material may be required and some finish grading of the side slopes would be required. We did include the cost for placing soil cover or re-vegetation of the side slopes of the road. The expected production would be about 2500 cubic yards per day. The expected unit cost for excavating and loading would be about \$1.10 per cubic yard.

Overburden soil and rock borrow obtained from new borrow pits, and without penetrating the cap-rock layer (Baseline site-shallow and sites 1s and 2s) will likely use dozers to scrap suitable material in to a pile for subsequent loading by track hoe. However, since the borrow layer ranges from non-existent to 2 to 4 feet thick, with an average thickness of 0.3 feet, production is expected to be very low. Two dozers and two track hoes, with an average equipment spread production of 300 cy per hour was assumed. The expected unit cost for excavating and loading assuming that the average thickness of suitable material is 0.3 ft would be about \$2.00 per cubic yard. If an area can be identified with a minimum of 2 feet of suitable material, we assumed that excavation production could be increased by about 30 percent, resulting in unit cost of excavation of about \$1.40 per cubic yard.

Hauling of borrow will range from relatively high speed on roads such as Hwy 27, to narrow, slow farm roads such as the road to Site 10 (the Griffin Pit) that will require improvement to meet a reasonable production rate. Because of the

combined public road/farm road hauling of most sites, Mack type highway hauling end dump trucks would be used. Production would generally consist of about 16 loose cubic yards (or about 12 compacted cubic yards) per truckload. The estimated cost for hauling on Highway 27 and wide farm roads (i.e. roads where two lane traffic can occur, such as the route down the center of the Carroll/Eveready site) would be about \$0.20 per cubic yard (compacted) mile.

Hauling on narrow farm roads that will require upgrading and/or temporary passing turnouts will have a higher hauling cost. The estimated cost for road improvement, passing turnouts etc. would be about \$0.50 per cubic yard (compacted) mile.

**6.0 Haul road grading and watering will be required to maintain the roads for safe operation.**

This work item will generally consist of watering gravel roads daily and grading twice per week. The estimated cost for grading and watering would be \$5000 per week.

**7.0 Dust Control**

Borrow operations adjacent to Highway 27 could generate sufficient dust close to the highway, which could cause traffic problems. Dust control would be required (Site 4 and potential Sites 3 and 7). Dust control would consist of a water truck and operator. The estimated cost for dust control would be \$400 per day.

**8.0 Major Crossing.**

A major crossing will be required to provide access across the seepage canal along the west side of STA-2. The crossing could consist of multiple large diameter (72-inch) culverts or a temporary bridge. The estimated cost for installation of the temporary crossing is about \$50,000.

**9.0 Fill Placement and Compaction**

Fill placement and compaction would consist of spreading the first “bridging” lift about 3 feet thick, and then placing in 18-inch lifts. An “extra heavy, vibratory steel drum roller would be used to compact the fill (primarily for the first, thick lift). Spreading and compacting the levee fill would have a unit cost of about \$0.50/cy.

**10.0 Mobilization**

Mobilization of equipment to set up a new borrow area, or re-open an old borrow pit will be required. The estimated mobilization cost would vary depending on the type of work required at the selected borrow source. There are several contractors in the area with the experience required for this type of work, and the necessary equipment. Therefore mobilization costs would be expected to be lower than average. Therefore we have estimated that the mobilization costs would be approximately 7 percent of the construction work involved.

Table 1  
STA - 2 Borrow Area Evaluation

Site No.	Baseline	1 (1s, 1d)	2 (2s, 2d)	3	4	5
Site Description	Borrow from Interior of Existing STA-2 cells	Carroll/Eveready Property-West of Cell 3 in STA-2	South Okelanta Lease near S-7	East Bank North New River	Spill along East side of North New River	Levee on East Side of L6
Ownership	SFVMD	SFVMD	Fib-Sun	SFVMD	SFVMD	SFVMD
Hauling						
Type of Road		Farm road (2-way traffic)	Levee Road	Farm road (2-way traffic)	2.7 miles along highway 27 6.5 miles on farm road (2-way traffic)	Levee road
Haul Distance		2.4 miles	7.0 miles	4.8 miles	9.2 miles	6.4 miles
Improvements Required for Hauling	No offsite hauling required	New access point along west side of STA-2	Limited	New access point along west side of STA-2	New access point along west side of STA-2	Limited
Temporary Detour Requirements		No	No	Yes, if construction is during harvest	Yes	No
Time to Implement						
Borrow Development						
Material Source	Excavating down to caprock	Excavating down to caprock	Excavating down to caprock	Spill from canal expansion	Existing spoil	Excavate 0.6 mi of levee road
Muck Removal	Yes	Yes	Yes	No	No	No
Dewatering Required	Yes	Yes	Yes	No	No	No
Blasting Required	Yes, for deep excavation	Yes, for deep excavation	Yes, for deep excavation	No, excavate in the wet	No	No
Depth to Caprock	No, for shallow excavation	No, for shallow excavation	No, for shallow excavation	Yes, but already penetrated	No	No
Quantity of Material Available	average of 3.3 ft	>>200,000 cy	>>200,000 cy	Yes, but already penetrated	No	No
Acquire or length needed to achieve desired quantity of 200,000 cy	414 acres	>>200,000 cy	>>200,000 cy	47,000 to 225,000 cy	50,000 (4d) + 62,000 (4d) cy	12,000 cy
Quantity of Muck Removal for above acreage	2,003,760 cy	2,003,760 cy, assuming geomorphology is similar to STA-2	2,003,760 cy, assuming geomorphology is similar to STA-2	Expansion of 4,800 linear ft of canal	N/A	N/A
Land Use						
Lease Status	N/A	N/A	Leased	N/A	N/A	N/A
Active Farmland	No	No	Yes	N/A	N/A	N/A
Within Footprint of EAA Storage Reservoir	No	Yes	Yes	Yes	No	No
Beneath Alignment of EAA Levee	No	No	Yes	No	No	No
Permitting Requirements						
MOT w/ FDOT for Hauling	No	No	No	Yes	No	No
FDOT for Hauling	No	No	Yes, if within 50 ft of transmission lines	Yes	Yes	No
FPL for Blasting	No	No	No	No	No	No

Site No.	6	7	8	9	10	11
Site Description	Florida Crystals Quarry	North New River East of STA 34	Talisman Road Spill	Bolles/Cross Canal	STA 3/4 Griffin Pit	Offsite Commercial Quarry
Ownership	SFVMD	SFVMD			SFVMD	
Hauling						
Type of Road	Farm road (2-way traffic)	Farm road	2.3 miles along highway 27 10.2 miles along farm roads	6.5 miles along highway 27 6.7 miles along farm roads	2.4 miles along highway 27 16.4 miles along farm roads	11.5 miles along highway 27 6.7 miles along farm road
Haul Distance	6.6 miles	7.9 miles	12.5 miles	15.2 miles	16.4 miles	18.2 miles
Improvements Required for Hauling	New access point along west side of STA-2	New access point along west side of STA-2	New access point along west side of STA-2	New access point along west side of STA-2	Improve farm road between pit and highway 27. New access point along west side of STA-2.	New access point along west side of STA-2
Temporary Detour Requirements	No	No	Yes	No	No	No
Time to Implement						
Borrow Development						
Material Source	Quarry	Spill from canal expansion	Excavating spoil	Spill from canal expansion	Quarry	Quarry
Muck Removal	Limited	No	No	No	No	No
Dewatering Required	No, excavation in the wet	No, excavation in the wet	No, excavation in the wet	No, excavation in the wet	No, excavate in the wet	No
Blasting Required	Yes	Yes	Yes	Yes	Yes	N/A
Depth to Caprock	Yes, but already penetrated	Yes, but already penetrated	Yes, but already penetrated	Yes, but already penetrated	Yes, but already penetrated	N/A
Quantity of Material Available	>>200,000 cy	>>200,000 cy	Unknown	Unknown	>200,000 cy	N/A
Acquire or length needed to achieve desired quantity of 200,000 cy	Approximately 8 acres	A 50% expansion of 2 miles of canal will provide enough material	Unknown	A 50% expansion of 2 miles of canal will provide enough material	Approximately 8 acres	N/A
Quantity of Muck Removal for above acreage	N/A	N/A	N/A	N/A	N/A	N/A
Land Use						
Lease Status	N/A	N/A	N/A	N/A	N/A	N/A
Active Farmland	Leased	N/A	N/A	N/A	N/A	N/A
Within Footprint of EAA Storage Reservoir	No	N/A	N/A	N/A	No	N/A
Beneath Alignment of EAA Levee	Yes	Yes	Yes	No	No	No
Permitting Requirements						
MOT w/ FDOT for Hauling	No	Yes	No	No	No	No
FDOT for Hauling	No	No	No	No	No	No
FPL for Blasting	No	No	No	No	No	No



Table 3  
Comparative Cost Estimate  
STA-2 Borrow Alternatives

Borrow Development for STA-2 Levees  
Assumed Borrow Required: 200,000 cubic yards

Item #	Description	Unit	Used for Estimate	Baseline Shallow		Baseline Through Cap-rock		Site 1a - Shallow		Site 1d - Through Cap-rock		Site 2a - Shallow (less than 1 ft thick)		Site 2a - Shallow (borrow 2 ft. thick)		Site 2d - Through Caprock		Site 3		
				Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity
1a	Site Dewatering	acre/ month	1,200	\$2,888,372	414	\$2,715,070	8	\$35,721	414	\$2,715,070	8	\$35,721	72	\$281,302	8	\$125,023	0	\$0	0	\$0
1b	Drain Existing STA	month	\$50,000	\$150,000	3	\$150,000	3	\$150,000	3	\$150,000	3	\$150,000	3	\$150,000	3	\$150,000	0	\$0	0	\$0
2	Clear and Grub Footprint	acre	\$1,500	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	0	\$0	0	\$0
3	Site Preparation	acre	\$1,500	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	1	\$1,500	0	\$0	0	\$0
4	Drill and Blast	c.y.	\$160	\$160,000	1,000	\$160,000	40,000	\$6,400,000	2,000,000	\$320,000,000	40,000	\$6,400,000	350,000	\$56,000,000	40,000	\$6,400,000	200,000	\$32,000,000	200,000	\$32,000,000
5a	Borrow Excavation Truck Haul	c.y./mi	\$1.10	\$110,000	0	\$0	200,000	\$220,000	0	\$0	200,000	\$220,000	0	\$0	200,000	\$220,000	0	\$0	200,000	\$220,000
5b	Borrow Exc. From Roads	c.y.	\$1.10	\$110,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
5c	Borrow Exc. Shallow (Type BB-3C) <1 ft.	c.y.	\$2.00	\$200,000	200,000	\$400,000	0	\$0	200,000	\$400,000	0	\$0	200,000	\$400,000	0	\$0	0	\$0	0	\$0
5d	Borrow Exc. Shallow (Type BB-3C) 2-3 ft.	c.y.	\$1.40	\$140,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
6a	Hauling Hwy 27	c.y./mi	\$0.20	\$20,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
6b	Hauling Wide/Separated Farm Road	c.y./mi	\$0.20	\$20,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
6c	Hauling Narrow Farm Road w/	c.y./mi	\$0.20	\$20,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
7	Temporary Detours	week	\$0.50	\$50,000	1.2	\$120,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
8	Haul Road Grading & Watering	week	\$5,000	\$50,000	10	\$500,000	16	\$800,000	47	\$2,350,000	16	\$800,000	47	\$2,350,000	28	\$1,400,000	56	\$2,800,000	14	\$70,000
9	Dust Control	each	\$400	\$400	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
10	Major Canal Crossing	each	\$50,000	\$50,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
11	Embankment (Place & Compact)	c.y.	\$0.50	\$50,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000
11	Commercial Pit Rock	c.y.	\$5.40	\$540,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
	Subtotal			\$5,529,372		\$5,529,372		\$5,529,372		\$5,529,372		\$5,529,372		\$5,529,372		\$5,529,372		\$5,529,372		\$5,529,372
12	Mobilization	7%		\$387,056		\$387,056		\$387,056		\$387,056		\$387,056		\$387,056		\$387,056		\$387,056		\$387,056
13	Estimated Excavation Time	da	250		77		77		77		77		77		77		77		77	
14	Estimated Excavation Duration	wk	50		16		16		16		16		16		16		16		16	
15	Estimated Excavation Duration	mo	12		4		4		4		4		4		4		4		4	
	Cost Subtotal =			\$5,916,428		\$5,916,428		\$5,916,428		\$5,916,428		\$5,916,428		\$5,916,428		\$5,916,428		\$5,916,428		\$5,916,428

Item #	Description	Unit	Used for Estimate	Site 4		Site 5		Site 6		Site 7		Site 8		Site 9		Site 10		Site 11		
				Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity
1a	Site Dewatering	acre/ month	1,200	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
1b	Drain Existing STA	month	\$50,000	\$150,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
2	Clear and Grub Footprint	acre	\$1,500	\$1,500	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
3	Site Preparation	acre	\$1,500	\$1,500	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
4	Drill and Blast	c.y.	\$160	\$160,000	0	\$0	200,000	\$32,000,000	200,000	\$32,000,000	200,000	\$32,000,000	200,000	\$32,000,000	200,000	\$32,000,000	200,000	\$32,000,000	200,000	\$32,000,000
5a	Borrow Excavation Truck Haul	c.y./mi	\$1.10	\$110,000	12,000	\$13,200	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
5b	Borrow Exc. From Roads	c.y.	\$1.10	\$110,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
5c	Borrow Exc. Shallow (Type BB-3C)	c.y.	\$2.00	\$200,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
6a	Hauling Hwy 27	c.y./mi	\$0.20	\$20,000	2.7	\$540,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
6b	Hauling Wide/Separated Farm Road	c.y./mi	\$0.20	\$20,000	6.5	\$1,300,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
6c	Hauling Narrow Farm Road w/	c.y./mi	\$0.50	\$50,000	0	\$0	6.4	\$3,200,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
7	Haul Road Grading & Watering	week	\$5,000	\$50,000	1	\$5,000	16	\$80,000	16	\$80,000	14	\$70,000	16	\$80,000	14	\$70,000	16	\$80,000	14	\$70,000
8	Dust Control	each	\$400	\$400	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
9	Major Canal Crossing	each	\$50,000	\$50,000	1	\$50,000	1	\$50,000	1	\$50,000	1	\$50,000	1	\$50,000	1	\$50,000	1	\$50,000	1	\$50,000
10	Embankment (Place & Compact)	c.y.	\$0.50	\$50,000	112,000	\$56,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000	200,000	\$100,000
11	Commercial Pit Rock	c.y.	\$5.40	\$540,000	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0	0	\$0
	Subtotal =			\$693,200		\$693,200		\$693,200		\$693,200		\$693,200		\$693,200		\$693,200		\$693,200		\$693,200
12	Mobilization	7%		\$48,524		\$48,524		\$48,524		\$48,524		\$48,524		\$48,524		\$48,524		\$48,524		\$48,524
13	Estimated Excavation Time	da	45		5		5		5		5		5		5		5		5	
14	Estimated Excavation Duration	wk	9		1		1		1		1		1		1		1		1	
15	Estimated Excavation Duration	mo	2		0		0		0		0		0		0		0		0	
	Cost Subtotal =			\$74,044		\$74,044		\$74,044		\$74,044		\$74,044		\$74,044		\$74,044		\$74,044		\$74,044

Unit Cost (\$ /cy) =				\$29.58	\$4.48	\$27.91	\$3.82	\$28.90	\$7.57	\$6.51	\$4.06
Unit Cost (\$ /cy) =				\$4.76	\$6.22	\$4.53	\$4.72	\$8.36	\$8.29	\$11.12	\$13.00

Notes: 1. Comparative Capital construction cost is defined as the estimated cost for the primary construction work items that are expected to vary when comparing each of the sites. It is not an estimated construction cost for implementation of this project. This cost estimate is not a complete capital cost estimate to establish a representative cost of the STA-2 enhancement project. The quantities and estimated costs presented herein are based on the conceptual level design description of the levee borrow in the Burns & McDonnell March 17, 2003 report. See our JacobsMWH Joint Venture report for more details.

2. Site Dewatering for the existing STA-2, assumed that half of the borrow area would be dewatered for each of two construction seasons.

Table 4  
Alternatives Evaluation Matrix

Site No.	Baseline-s	Baseline-d	1-s	1-d	2-s	2-d	3	4	5	6	7	8	9	10	11
	Borrow (above caprock) from interior of Existing STA -2 cells	Borrow (through caprock) from interior of Existing STA -2 cells	Carroll/Ever Property (above caprock) - West of Cell 3 in STA-2	Carol/Ever Property (through caprock) - West of Cell 3 in STA-2	South Okeelanta Lease (above caprock) near S-7	South Okeelanta Lease (through caprock) near S-7	East Bank North New River	Spoil along East side of North New River	Levee on East Side of L6	Florida Crystals Quarry	North East of STA 3/4	Tallisman Road Spoil	Bolles/Cr loss Canal	STA 3/4 Griffin Pit	Starr Quarry
	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes*	Yes	No	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Unknown	Yes	Yes	Yes
	X	X	Site 1	Site 1	Site 2	Site 2	Site 3	X	X	Site 6	Site 7	X	X	Site 10	Site 11
<b>Step 1</b>	Sites still viable for borrow material														
	Allows continued successful operation of Stormwater Treatment Area 2														
	Interior Levee construction can be completed by December 31, 2005														
	Sufficient material for constructing interior levees														
<b>Step 2</b>	Effect on traffic on public highway 27/FP&L Powerlines														
	Potential to increase seepage from future EAA Reservoir														
	X	X	1	2	1	2	2	X	X	2	2	X	X	X	1
	X	X	3	1	3	1	1	X	X	1	1	X	X	2	2
	X	X	5	4	5	4	5	X	X	4	5	X	X	5	5
	<b>Ranking Value</b>														
<b>Step 3</b>	Comparative Unit Cost (per cubic yard of fill)														
	X	X	\$27.91	\$3.82	\$28.90	\$4.97	\$4.06	X	X	\$4.53	\$4.72	X	X	\$11.12	\$13.00
	X	X	140	15	144	20	20	X	X	18	24	X	X	56	65
	<b>Cost Weighted Score</b>														

**STEP 2 - RANKING CRITERIA DESCRIPTION**

- Traffic changes on Highway 27 would be primarily related to construction personnel traveling to and from the site each day; and the comparative unit cost for construction is less than \$6.00 per cubic yard of fill; and indicates that there would be no direct impact to potential seepage from the EAA Storage Reservoir.
- Traffic changes on Highway 27 would consist of construction personnel traveling to and from the site each day and use of up to 3 miles of the highway for hauling, and/or obtaining a MOT permit with the Department of Transportation for blasting operations in the canal adjacent to the highway; the comparative unit cost for construction would be between \$6.00 and \$15.00 per cubic yard of fill; and indicates that the potential impact to the EAA Storage Reservoir is low because the borrow area would be along the perimeter of the are currently being considered for siting of the reservoir, or would be an small increase in area of an existing penetration through the cap-rock.
- Traffic would involve significantly more truck miles on Highway 27 for hauling borrow to the site; the comparative unit cost for construction would be more than \$15.00 per cubic yard of fill; indicates that the borrow area is within the area currently being considered for siting of the planned EAA Storage Reservoir.