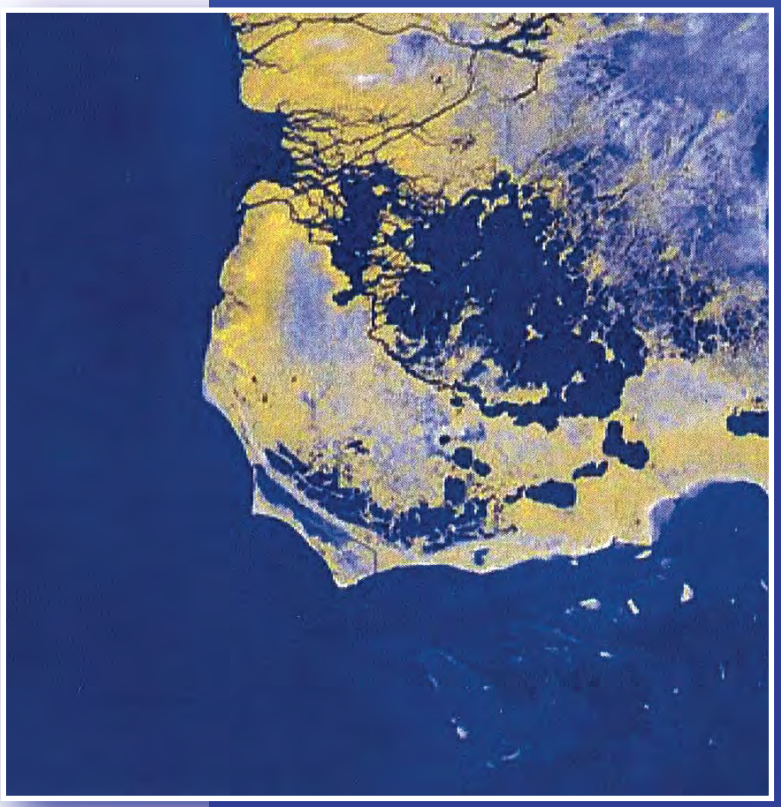
Chapter 2
The Alternatives



CHAPTER 2: THE ALTERNATIVES

2.0 Development of the Alternatives

NEPA implementing regulations provide guidance on the consideration of alternatives in an EA. NEPA implementing regulations require the decision-maker to consider the environmental effects of the proposed action and a range of alternatives (40 CFR § 1502.14). The range of alternatives includes reasonable alternatives that must be rigorously and objectively explored, as well as other alternatives that are eliminated from detailed study. To be "reasonable," an alternative must meet the stated purpose of and need for the project. Project alternatives may originate from the proponent agency, local government officials, or members of the public, at public meetings, or during the early stages of project development. Alternatives may also be developed in response to comments from coordinating or cooperating agencies. The alternatives analyzed in this document, in accordance with NEPA, are the result of internal scoping and public scoping.

The purpose of including a No Action alternative in the environmental analysis is to ensure that agencies compare the potential impacts of the proposed action to the known impacts of maintaining the status quo. Current conditions are used as a benchmark. By using the current conditions as the No Action Alternative, impacts of the proposed alternatives would be directly compared to the existing baseline.

The No Action Alternative represents the current conditions present in the project area. Action alternatives considered in this EA were developed by the NPS and input by the public during project scoping. The collective efforts of these individuals in documenting the requirements for the project formed the basis for development of the proposed action alternatives, including the Preferred Alternative.

The Preferred Alternative represents the NPS preferred approach for achieving the proposed action and defines the rationale for the action in terms of resource protection and management, visitor use and operational use, and other applicable factors.

NEPA regulations require that the action proponent assess means to mitigate adverse environmental impacts associated with implementation of the proposed alternatives (40 CFR § 1502.16). Each alternative analyzed in this EA includes mitigation measures intended to reduce the environmental effects of restoring the failed dams on the East Cape Extension and Homestead canals. Mitigation measures, such as Best Management Practices and Standard Operating Procedures that would be implemented under any of the proposed actions are included in the description of the alternatives.

The Preliminary Engineering Analysis for the Restoration of the Cape Sable Dams (URS Corporation 2007) describes six alternative solutions and discusses each alternative using a matrix rating direct impacts, indirect impacts, constructability, dredging, cost, stability, and safety. Upon completion of the preliminary study, the No Action (representing the current condition) and Action Alternatives derived were further discussed/refined during the Internal Scoping Meeting, Public Scoping meeting and NPS Alternatives Workshop. As a result of these meetings, the No Action alternative for both dam sites, three Action Alternatives for the East Cape Extension canal dam site and five Action Alternatives for the Homestead canal dam site were carried forward in this EA to analyze the impacts that would potentially result from implementation of these alternatives, in accordance with all applicable laws and policies.

2.1 Project Alternatives

Based on the preliminary analysis, internal scoping with the NPS, and the public input related to the proposed project, the following alternatives were carried forward for analysis in the EA. As reference, alternative drawings (Figures 2.7 through 2.16), alternative comparison tables (Tables 2.2 and 2.3) and Class C Cost Estimates (Tables 2.4 through 2.11) for the East Cape Extension and Homestead canal sites are included at the end of Chapter 2 for review. Figures 2.1 and 2.2 depict close up aerial views of the existing failed dams at the East Cape Extension and Homestead canals.

Figure 2.1 – East Cape Extension Canal Failed Dam Site (Facing South)

Figure 2.2 – Homestead Canal Failed Dam Site (Facing West)

2.1.1 East Cape Extension Canal and Homestead Canal Alternatives

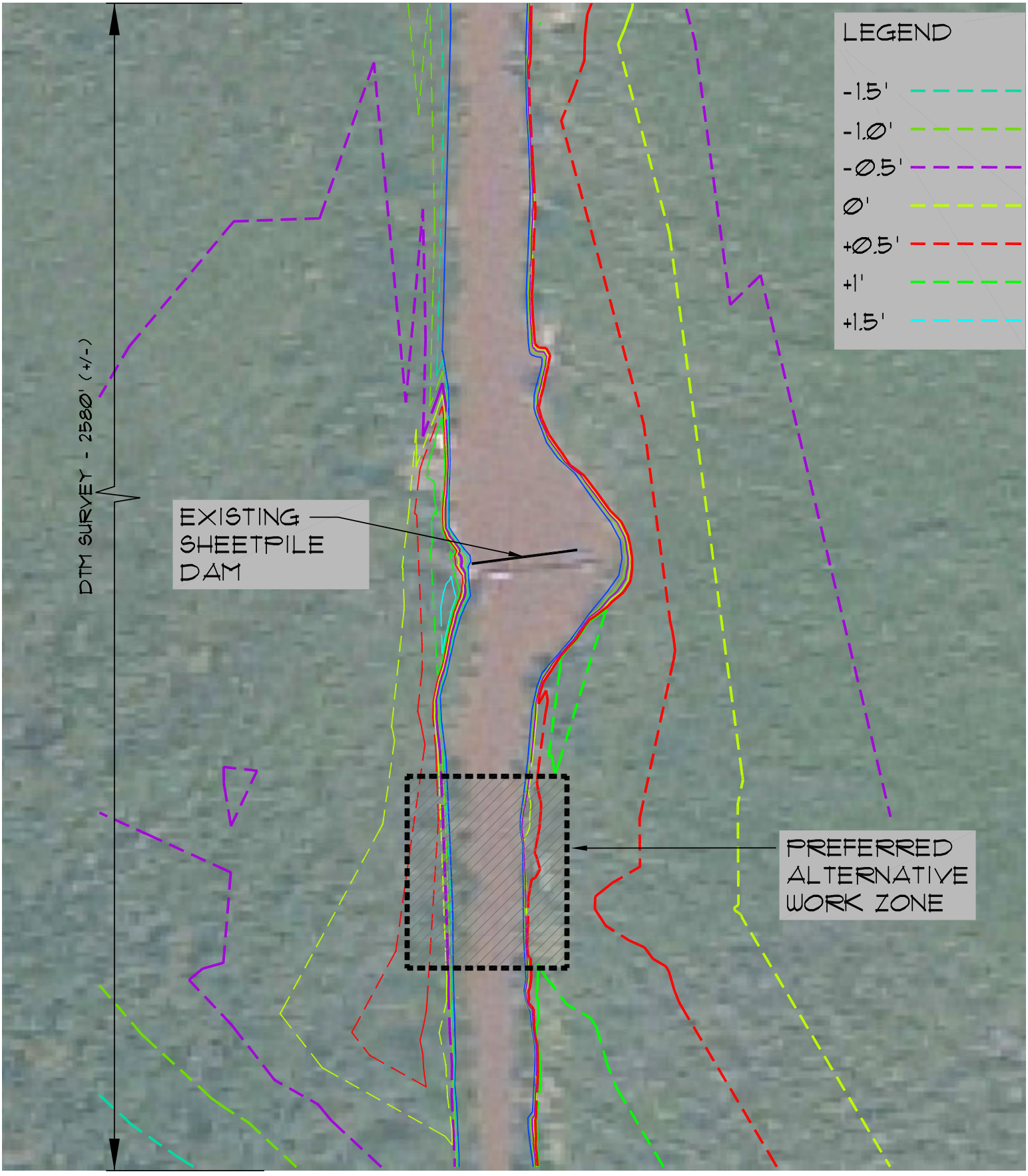
Prior to finalizing the location of each of the proposed alternatives, a Digital Terrain Model (DTM) based on aerial photography was recently created in March of 2009 for each of the failed dam sites. The purpose of the DTM was to determine the topographic features for each of the proposed restoration alternatives. The DTM was developed by contouring lands above the lowest possible tidal water line for the East Cape Extension and Homestead canal dam sites to determine the most suitable location along each canal that coincides with the highest elevation points of the adjacent low relief marl ridges. Each site was over-flown obtaining new high-resolution black and white aerial photography for photogrammetric compilation by stereo plotting methods. A survey crew using Real-Time Kinematic (RTK) – Geographic Positioning System (GPS) survey equipment surveyed (on the ground) the 3-dimensional locations of specific photo-identifiable (PID's) topographic features present in the aerial photography to 3-dimensional scale and rectified the photography.

Modeling technologies were used to develop the 3-dimensional spot elevations from the water line and above on any lands present within the prescribed area for both canal dam sites. The spot elevations peppered about the prescribed site were processed to create an AutoCAD 3-D triangular irregular network (TIN), a 3-D mesh of triangular lines connecting the 3-dimensional spot elevation points. From the TIN, contours were generated which graphically display relative elevation differences land formations above the water line. Please refer to Figures 2.3 and 2.4 below for details. Due to the remoteness of the sites, these elevation differences have not yet been correlated to NAVD 88 elevation datum. NAVD 88 datum and vertical control for the site will be completed in the near future in support of future design related activities.

The results of the DTM are represented in Figures 2.3 and 2.4 below. Figure 2.3 shows the approximate location of the preferred alternative for the East Cape Extension canal with respect to these DTM (highest) elevations. Comparative elevations in the vicinity of the existing and proposed dams are comparatively small and tend more to be sloping gently away from the canal. Such elevation changes are more indicative of the placement and speading of excavated material away from the canal excavation during the original canal construction. There appears to be minimal topographic relief which can be associated with a low lying Marl ridge paralleling the Lake Ingram shoreline in the vicinity of the existing dam.

Figure 2.4 shows the approximate location of the preferred alternative for the Homestead canal with respect to these (highest) elevations. The results of the DTM survey also identified a low lying area along the Homestead Canal just south of the existing failed sheetpile structure. This low lying area is approximately 40 feet by 150 feet and would require approximately one foot of fill to mitigate the potential for short-circuiting the proposed restoration alternatives. Additional filling of the canal bank area should be performed in this area to re-establish the elevated fill berm along the edge of the canal. Such filling is recommended so that flow around and south of the proposed plug area maintains a slow overland sheetflow course and does not short circuit such overland flow by discharge into the canal. These filling activities are addressed in each of the proposed alternatives presented below, except for Alternative C, since this low lying area is located in the immediate vicinity of the failed dam and the area will be filled as part of Alternative C.

The DTM survey is available for review from the National Park Service upon request.



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SCALE OF FEET

FIG. 2.3 - LOCATION OF PREFERRED ALTERNATIVE EAST CAPE EXTENSION CANAL

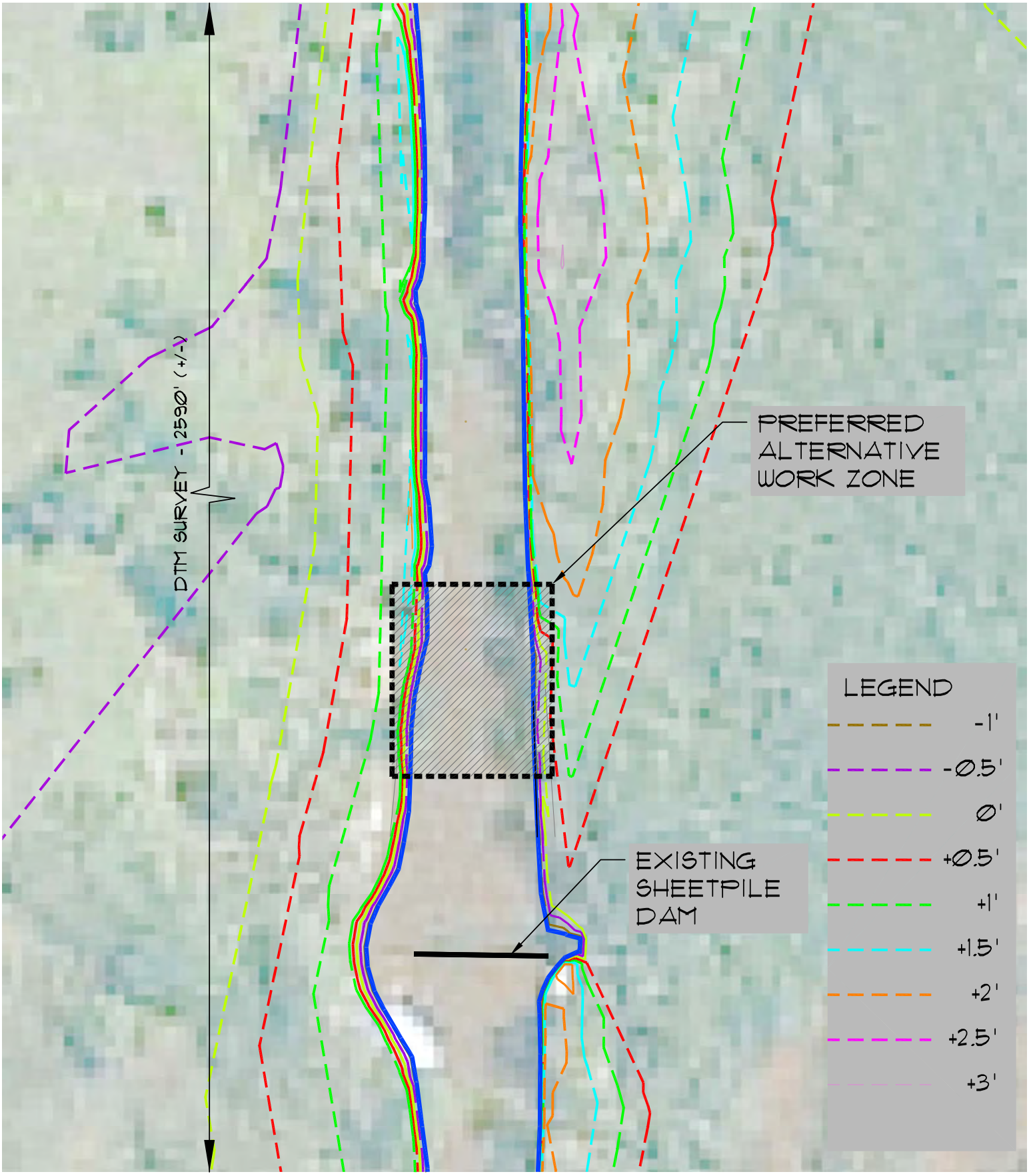

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FIG. 2.4 - LOCATION OF PREFERRED ALTERNATIVE HOMESTEAD CANAL

2.1.1.1 Alternative A (No Action - Continue Current Management)[2]

The No-Action alternative involves leaving the existing sheetpile in the East Cape Extension and Homestead canals where it is today and allowing the channel to continue to widen through natural erosional processes. This alternative would fail to accomplish the goals of the NPS and the U.S. Fish and Wildlife Service (USFWS), which are to meet the project objectives of improving fish and wildlife habitat, correct safety hazards associated with the failed structures, and preventing motorized vessel entry into Cape Sable wilderness. In addition, no action would also require NPS personnel to continue their routine inspection and maintenance program of the failed dam structures in perpetuity to prevent access to unsafe and dangerous areas. Since the failed dam structures create strong white water currents during tide changes, NPS has been using floating buoys and cables to prevent unauthorized access. Unfortunately, due to the remote location of these failed structures and the desire for people to access the fishing areas behind these structures (interior marshes), vandalism has become an on-going maintenance issue for NPS personnel to prevent unauthorized access.

2.1.1.2 Action Alternative C (Repair in Place)

Repairing the existing steel sheetpile walls includes extending them further inland. This alternative strengthens the existing dams by adding additional sheetpile landward on both sides of the dams. The landward sheetpile would be installed to form a flow deflector wingwall to prevent seepage and tunneling through the marl. The deflector wingwalls would also help to prevent illegal motorized boat entry into the wilderness area minimizing opportunities for vandals to alter the banks beyond the edge of the sheetpile walls.

Subsequent to sheetpile installation, fill material would be placed adjacent to the sheetpile walls (2.5:1 slope from the sheetpile to the ground) to substantially increase the lateral support for the dams. Additionally, graded riprap would be placed on top of the fill material and along the deflector wingwalls to provide erosion resistance. The repair of the existing dams would also include an engineering component to provide safe passage over the restored dam for non-motorized boaters (canoeists/kayakers).

In addition to the above, Action Alternative C for the Homestead canal dam site would require dredging a 52-foot wide by approximately 8,320 feet long temporary access channel within Lake Ingraham from the western terminus of the Ingraham canal to the Homestead canal due to the shallow water depths of Lake Ingraham. Per NPS staff, the current water elevations at high tide in Lake Ingraham are up to 2 feet above existing substrate with portions becoming exposed at low tide due to accelerated sediment deposition. According to Wanless and Vlaswinkel (2005), portions of the lake have transitioned from an open water system to a mud flat system in recent years. The channel would be dredged to a depth of approximately 6 feet below the mean low water elevation. To minimize impacts caused by dredging, a mechanical (bucket) dredge would be used. While both hydraulic and mechanical dredging methods would successfully remove the accumulated sediments within the channel, mechanically dredged sediment would be placed along the sides of the channel (less impact), versus hydraulic dredging which would require an off-site dewatering area and possible treatment equipment to allow dredge water effluent to be returned back to Lake Ingraham. For mechanical dredging operations within Lake Ingraham,

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2 Current Management includes, but is not limited to, public education about wilderness restrictions and safety hazards; maintenance of cables, floats and signs warning boaters of hazards; enforcement of regulations prohibiting motorized boats from entering wilderness area above the dams; monitoring of resource conditions and safety hazards.

accumulated sediments in the channel would be removed with a conventional barge-mounted long-reach excavator (40 to 60-ft reach). The width of the base of the dredged channel would not exceed 40 feet with anticipated 3:1 side slopes for a total top cross-sectional channel width of approximately 52 feet. The dredged material [approximately 40,000 cubic yards (CY)] would be temporarily stockpiled in areas adjacent to the dredged channel or other suitable area. Some of the dredged material would disperse through natural wave energy and erosional processes. However, construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts. A turbidity monitoring plan would be implemented during construction to ensure continued compliance with State water quality criteria. Upon completion of construction, the remaining material would be pulled back into the channel via a barge and heavy equipment (e.g., clam shell, backhoe, etc.). Over time, the dredged channel would be returned to pre-construction condition via natural processes.

2.1.1.3 Action Alternatives D (New 100' Plug - Marl Ridge Location) and G (New 370'/430' Plug – Marl Ridge Location)

This alternative includes the extraction and relocation of the existing free-standing sheetpile walls (previous dam structures) to narrower more suitable locations that are in better alignment with the marl ridge. It is anticipated that 80% of the extracted steel sheetpile would be reused. Additionally, earthen plugs would be constructed by installing a second sheetpile wall upstream or downstream of the first wall within the canals. For Alternative D, the two sheetpile walls would be placed a distance of approximately 100 feet apart, and for Alternative G, the two sheetpile walls would be placed a distance of approximately 370 feet (for the East Cape Extension canal dam site) or 430 feet (for the Homestead canal dam site) apart. The area between the two walls would be filled and planted with wetland vegetation to reduce the potential for erosion. The fill material would originate from an off-site location. Landward sheetpile would be installed in all four quadrants of the plugs to form flow deflector wingwalls to promote surface sheetflow away from the dam structures and thus prevent seepage and tunneling through the marl. Additionally, fill material would be placed adjacent to each sheetpile wall (2.5:1 slope from the sheetpile to the ground on the waterward side) to substantially increase the lateral support for the dams. Graded riprap would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion resistance. These alternatives would also include an engineering component to provide safe passage over the restored dams for non-motorized boaters (canoeists/kayakers).

In addition to the above, Action Alternative D or G for the Homestead canal dam site would require dredging a 52-foot wide by approximately 8,320 feet long temporary access channel as described in Alternative C.

To restore the low lying area identified in the DTM survey, additional fill will be added along the southern bank of the Homestead canal (only) just east of the failed dam structure to raise the elevation along the bank by approximately one foot. It is estimated that approximately 500 cubic yards of fill will be required. Since an access channel will be provided, a shallow draft barge will be used to transport the fill material to the site. Once the barge has been positioned at the site, a long reach excavator will be used to transport the fill from the barge to the low lying area. A small front end loader will than be used to grade the fill placed in the low lying area to match the adjacent topographic elevation.

2.1.1.4 Homestead Canal Modified Alternatives

Impact minimization efforts have been considered during this study to reduce impacts to the adjacent wetland/surface water systems to the maximum extent possible while maintaining safe and sound engineering and construction practices. Therefore, modified alternatives of the above

described Action Alternative D (New 100' Plug – Marl Ridge Location) and Action Alternative G (New 430' Plug – Marl Ridge Location) were developed and carried forward in the EA for further analysis for the Homestead canal only. These modified alternatives provide a construction option for the Homestead canal dam site (only) that allows for further avoidance and minimization of impacts to natural resources through eliminating the need to dredge the 52-foot wide by approximately 8,320 feet long navigational channel through Lake Ingraham as described above for Alternatives D and G for dam site access.

2.1.1.4.1 Action Alternatives D1 (New 100' Plug - Geotubes) and G1 (New 430' Plug - Geotubes)

Dredging of an access channel in Lake Ingraham would not be required with these modified alternatives of Alternatives D and G. Geotubes would supplant the proposed sheetpile walls associated with Alternatives D and G. Geotubes are large tubular sand bags that are filled in place by pumping sand or slurry through a pipe from a barge. They are typically used to build structures such as breakwaters, shoreline protection or island creation. For these modified alternatives, fill material would be transported to the Homestead canal work area through a constructed floating pipeline. The 6 to 8 inch pipeline would be constructed using a shallow draft barge and would run from the work area to a larger barge located at a designated staging area at the western terminus of the Ingraham canal (eastern mouth of Lake Ingraham) for a distance of approximately 1.5 to 2 miles. The constructed floating pipeline would be anchored to the northern edge of the existing channel in Lake Ingraham and the eastern edge of the approach channel to the Homestead canal. The water depths within the Ingraham canal are sufficient and would not require dredging. Fill material would be transported to the staging area at the Ingraham canal and conveyed through the pipe via hydraulic pumping to the work area in order to avoid potential adverse impacts to the lake from dredging activities. In addition, the existing sheetpile dam would be cut off at a suitable level using a torch in place of extracting the sheetpile with heavy equipment as with Alternatives D and G. The sheetpile would be removed for safety. Please reference Figure 2.5 for an aerial-view schematic of the proposed pump/pipeline system.

To restore the low lying area identified in the DTM survey, additional fill will be added along the southern bank of the Homestead canal (only) just east of the failed dam structure to raise the elevation along the bank by approximately one foot. It is estimated that approximately 500 cubic yards of fill will be required. Since an access channel will not be available to allow for a shallow draft barge to enter the work area, a helicopter will be used to transport fill material to the site to place the fill material in the low lying area. Due to the difficulty in transporting heavy equipment to the work site, manual labor will be used to grade the fill to match the adjacent topographic elevation.

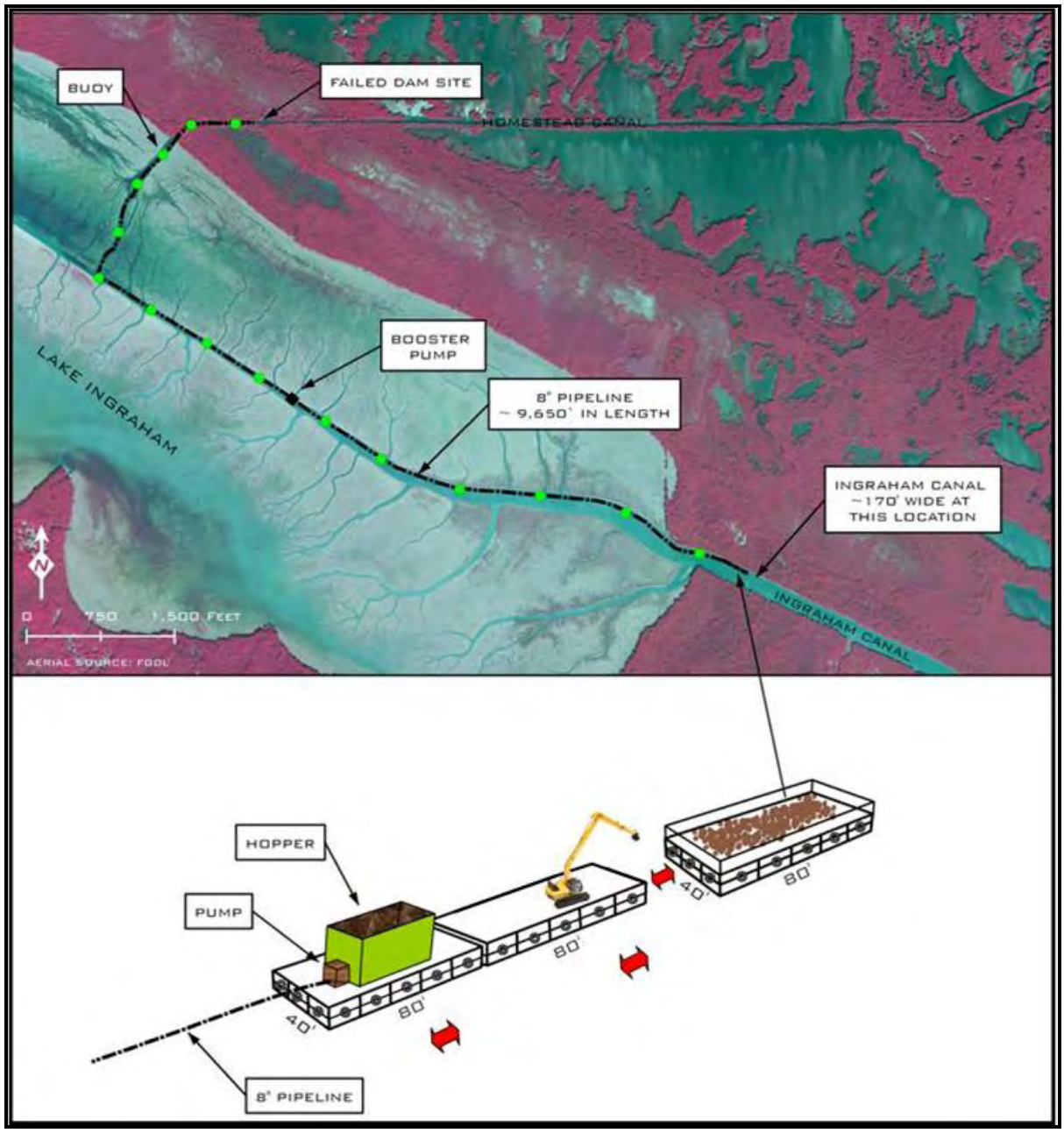


Figure 2.5 – Aerial View Schematic of Proposed Pump/Pipeline System

2.1.1.5 Elements Common to all Action Alternatives

Several of the elements proposed as a part of this project would be common to all the alternatives considered, excluding the no action alternative. These elements are described below.

Signage

To ensure safety, warning signs would be posted at each of the proposed dam structures. Signs would constructed of reflective material and posted a minimum of 5-ft above mean high water.

Floating Mooring Buoys

Floating mooring buoys would also be installed downstream (towards Lake Ingraham) of the dam structures for motorized vessel anchoring. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation.

Florida Keys Staging Area

All the necessary equipment and fill (earthen fill and riprap) would be mobilized to a suitable water transportation staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) by conventional dump trucks due to a lack of a suitable staging area in Everglades National Park and to further meet the criteria for avoidance and minimization of impacts to wetland resources. The exact location of the staging area in the Florida Keys would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.). Construction materials would be transported to the East Cape canal via barges and tugs to the respective construction staging/work areas. The barges are anticipated to access the East Cape canal through existing navigational channels and/or deep water areas of the Gulf of Mexico and Florida Bay originating from the designated staging area in the Florida Keys. A potential barge route is depicted in Figure 2.6. The barge route was determined using available Geographic Information System (GIS) data layers obtained from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center documenting bathymetric contours for the state of Florida and surrounding areas (NOAA CSC, 2000). The exact route would be determined by the awarded contractor; however, the route would be restricted to existing navigational channels and/or deep water areas of the Gulf of Mexico and western Florida Bay to avoid potential adverse impacts to the submerged resources.

Woody Vegetation Clearing and Trimming

Clearing of woody vegetation would be performed where necessary, along the banks of the canal for equipment access and construction within the limits of a designated safe work zone. Trimming of overhanging mangrove trees may also need to occur within the western portion of the Homestead canal and the southern portion of the East Cape Extension canal for barge access to the designated work zone (dam site). Trimming would be conducted per the requirements of the Florida Department of Environmental Protection's (FDEP) Mangrove Trimming Permit (to be acquired prior to commencement of construction).

Restoration of Disturbed Areas

Areas located within the designated work area that are disturbed but not permanently filled as part of the construction would be restored. The exact type of restoration would depend on the size and location of the area, but would generally include removal of any construction materials and incidental fill material, followed by regrading to the historic contours. Any non-native vegetation observed within or directly adjacent to the work area would be removed concurrent with the regrading activities. Regrading would facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area, native vegetation will be planted in the area. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of up to five years.

Waste Management

Waste is primarily expected to be generated from servicing and maintenance of equipment. This waste is expected to be maintained on the barge. Portable toilets would be arranged and placed at the dam site. The waste from the portable toilets would be pumped out, removed from park and disposed at an appropriate disposal facility.

Turbidity Control

Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts. A turbidity monitoring plan would be implemented during construction to ensure continued compliance with State water quality criteria.

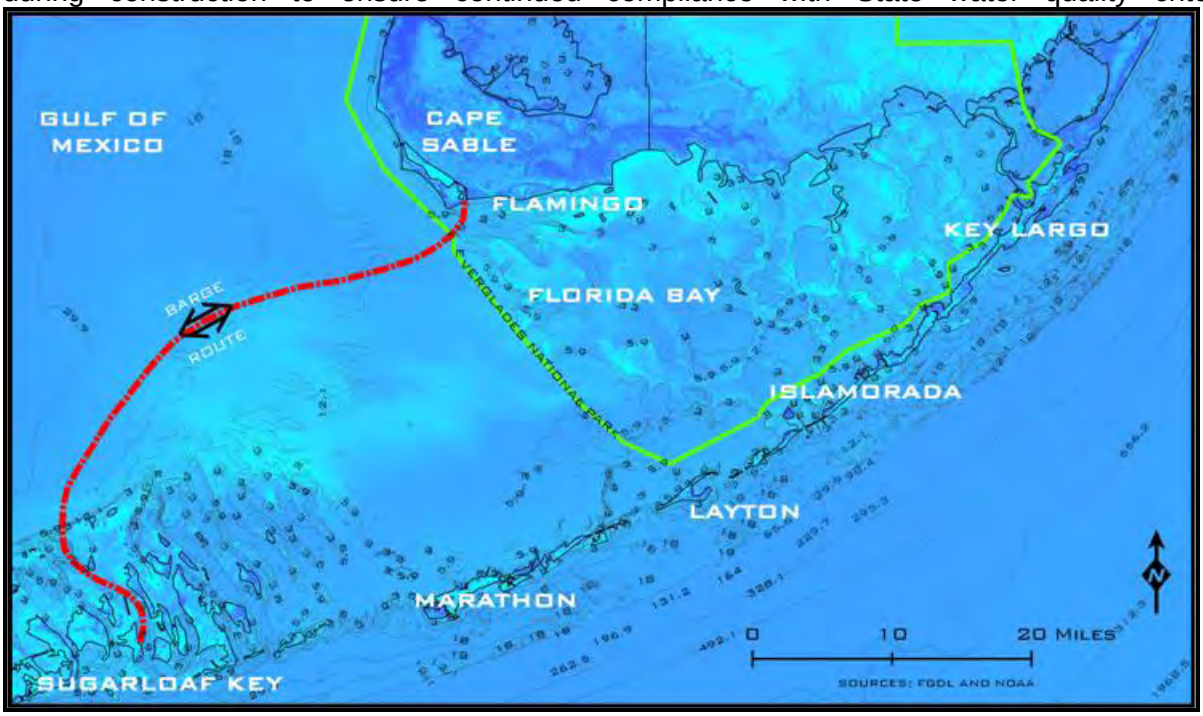


Figure 2.6 – Potential Barge Route

Monitoring

Anticipated monitoring during construction would include water quality/turbidity monitoring and monitoring for protected wildlife species. Standard USFWS and FFWCC guidelines for the protection of protected species that have the potential to occur within the project area (including but not limited to manatees, turtles, crocodiles, and smalltooth sawfish) would be implemented during construction activities to prevent injury. Anticipated long term monitoring/maintenance would include periodical riprap monitoring/maintenance. The structural aspects of the dam would also be monitored on a quarterly basis and after each major storm event. The construction phase of the project would be conducted outside of crocodile nesting season to avoid adverse impacts to this protected species.

Canoe/Kayak Portage

Repair of the existing breached dam would prevent illegal motorized boat entry into the wilderness area. However, the potential exists for vandals to attempt to alter the banks of the canal beyond the outer edges of the dam, enabling access for illegal motorized boats. Installation of the deflector wingwalls and/or riprap would mitigate this type of activity. Also, the repair of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters (canoeists/kayakers). To provide safe portage, a floating dock structure (approximately 10-ft by 10-ft) would be constructed in the center of each dam entrance. The dock would be constructed using a wood-plastic composite lumber composed of wood and recycled plastics. The dock structure would be constructed so that a portion of the structure would extend over the water. A ladder would be placed on each dock to allow for access. For Alternatives D/D1 and G/G1, a hardened path would be installed across

the proposed plug/dam using articulated block riprap (interlocking mats) to provide safe and sustainable passage across the plug/dam (see Alternative Drawings at the end of Chapter 2 for portage details).

Bank Stabilization

Banks would be stabilized within the limits of the work area to prevent internal piping and erosion of the marl into and through the riprap. This is accomplished by first placing a layer of fine sand fill over the existing sub-grade to establish a 2.5:1 side slope, which would act as both a graded filter and drainage exit for water seeping around the ends of the sheetpile and would prevent internal piping movement of the lime silts. The fine sands would be covered by a layer of non-woven geotextile fabric to prevent movement of the fine sands into the riprap. The fabric would be covered by a riprap system consisting of a coarse bedding sand/small gravel layer overlain by a coarse riprap surface cover.

2.2 Mitigation Measures

Mitigation measures would be used to prevent or minimize potential adverse impacts associated with the selected alternative, and these measures have been included in the evaluation of impacts of all action alternatives. Mitigation measures that would be undertaken during project implementation include, but are not limited to, those listed below.

2.2.1 General Construction Mitigation Measures

- Pre- and post-construction erosion control BMPs would be implemented, including the installation and inspection of silt fences, straw bale barriers, sediment traps, or other equivalent measures, and revegetation of area to control erosion, preserve water quality, protect wildlife and habitat, protect marine resources and EFH, and prevent soil contamination. Erosion and sediment control BMPs would be inspected and maintained on a regular basis and after each measurable rainfall to ensure they are functioning properly.
- Steps would be taken to minimize the introduction of non-native species and would include washing equipment before entering the park; minimizing disturbances; and initiating revegetation of disturbed areas immediately after construction. The NPS would follow all of the guidelines outlined in the South Florida and Caribbean Parks Exotic Plant Management Plan and the Everglades National Park Hurricane Plan.
- Environmental training would be implemented to help educate construction personnel with the intent of reducing impacts on water quality, wetland resources, wildlife, and marine resources and EFH.
- All construction areas would be protected to confine potentially adverse activities to the minimum area required for construction. All protection measures would be clearly stated in the construction specifications, and workers would be instructed to avoid conducting activities beyond the construction zone. The use of previously undisturbed areas would be minimized to the extent possible by selectively choosing staging areas and clearly defining and marking construction zones and perimeters.

2.2.2 Geology, Topography and Soils

- Spill prevention, control, and countermeasure procedures, as well as storm water pollution prevention measures, would be implemented to protect soils from erosion and contamination.

- The use of tarps or similar cover materials would be used on stockpiled fill and other erosion prone areas during construction to minimize erosion as a result of storm events.

2.2.3 Water Resources

- A spill prevention, control, and countermeasures plan would be completed and implemented for any fuel storage tanks, which would meet all applicable standards for construction and leak detection. Areas used for refueling would be limited to areas where these activities currently occur.
- Equipment containing fuels would be checked frequently for leaks.
- Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts.
- A turbidity monitoring plan would be implemented to ensure compliance with State water quality criteria.
- A temporary “no wake zone” would be established in and near the project area during construction to eliminate further dispersal of suspended sediments.
- Impacts to wetland resources would be avoided and minimized to the maximum extent feasible through the implementation of construction BMPs. All unavoidable impacts would be mitigated.

2.2.4 Wildlife and Habitat

- Revegetation efforts would include using seeds from native species during revegetation; monitoring reclamation; and implementing exotic species control as necessary.
- Pre- and post-survey construction surveys for selected species (e.g. crocodiles, Eastern indigo snakes, and smalltooth sawfish) would be implemented.
- Spill prevention, control, and countermeasure procedures, as well as storm water pollution prevention measures, would be implemented to reduce the potential for petroleum products from leaking equipment or vehicles to reach surface waters.
- Per NPS *Management Policies 2006*, artificial lighting would not be used in locations where its presence would disrupt wildlife dependent on the dark; minimal-impact lighting techniques would be used (e.g., consideration of yellow versus white lights, use of timers); artificial lighting would be shielded and directed, where necessary, with regard for natural night sky conditions. The use of lighting is not anticipated in view of the fact that all construction activities are expected to take place during daylight hours. However, construction crews may carry emergency/safety lighting and would be instructed to abide by the NPS *Management Policies 2006.*

2.2.5 Marine Resources and Essential Fish Habitat

- Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts.
- A turbidity monitoring plan would be implemented to ensure compliance with State water quality criteria.
- Impacts to marine resources would be avoided and minimized to the maximum extent feasible through the implementation of construction BMPs and standard USFWS, NOAA and FFWCC protection measures. All unavoidable impacts would be mitigated.

2.2.6 Special Status Species

- To reduce potential impacts on wildlife, construction activities occurring near sensitive habitats would be scheduled to minimize potential impacts during periods of breeding, nesting, and rearing of young (especially noting the American crocodile nesting season). Construction would occur only during daylight hours to reduce effects on nocturnal foraging or rest.
- Pre-construction surveys would be conducted to identify any federal- and state-listed species occurring in the area. Should individuals or nest sites be identified, additional measures would be taken to avoid impacts (e.g., fencing nest sites, providing information to contractors about the species).
- Construction would include all applicable environmental regulatory agencies' standard protection measures (including, but not limited to manatee, sea turtle and smalltooth sawfish), including no wake zones and monitoring during construction. Additional specific measures may be indentified during Section 7 consultation with the agencies for the project permits
- Measures listed under "Wildlife" and other resource protection mitigation would also serve to reduce impacts on special status species.

2.2.7 Wilderness

- Measures listed above under "Water Resources" and "Wildlife" would serve to protect wilderness values and quality as well.
- Construction procedures would follow the minimum tool analysis for construction and would include provisions to minimize impacts to natural resources that contribute to wilderness values, including use of turbidity curtains during construction.

2.2.8 Cultural Resources

- To avoid damage to previously unknown archaeological resources, archaeological surveys and testing activities in previously un-surveyed and/or undisturbed areas would be conducted prior to ground-disturbing activities. If any resources are encountered, mitigation of project impacts (in consultation with appropriate agencies) or adjustment of the project design would take place to avoid or limit the adverse effects on prehistoric and historic archaeological resources. Stop-work provisions would be included in the construction documents should archaeological or paleontological resources be uncovered. It should be noted there is a low probability that the project area contains undiscovered archeological resources.
- Monitoring would be done if any excavation exceeds the depth of existing ground disturbance. In the event that cultural resources are encountered during any necessary excavation work, project work would be halted and the discovery process would be initiated.
- If previously unknown archaeological resources are discovered, work would be stopped in the area of any discovery and the NPS would consult with affiliated tribes, pursuant to NAGPRA and the *Draft Park NAGRPA Plan of Action for Inadvertent Discoveries, Everglades National Park and Associated Tribes* (May 2008)

2.2.9 Visitor Use and Experience / Public Safety

- Construction information and general information about the project would be posted at the park, distributed to visitors, and made available on the park's web site. Signage and notices would be used to inform visitors about the purpose of the project and to protect visitor and staff safety during construction activities.
- Artificial lighting, including minimum illumination levels, light-emitting diodes (LED), limited color spectrum (e.g., yellow) lights, and timers and sensors would be used, where applicable, to ensure safety.
- The use of artificial lighting would be restricted to areas where security, basic human safety, and specific cultural resource requirements must be met.

2.2.10 Noise/Soundscapes

- Construction activities for the Cape Sable Dams Restoration Project would involve multiple pieces of heavy equipment for placement of sheetpile and fill material. Best management practices for noise, such as using mufflers on heavy equipment and noise-muffling construction materials, would be implemented at Cape Sable, resulting in short-term minor impacts to soundscapes. Assuming that heavy equipment operates at 80 to 90 decibels (dB), and that sound levels decrease approximately 6 dB with the doubling of distance (Harmon 2006), it would be estimated that natural attenuation would decrease the noise from these activities to no greater than 32 to 42 dB at a distance of about 1,500 feet from the work area; noise would continue to dissipate with increased distances from the area.

2.2.11 Air Quality

- Everglades National Park enjoys a Class I clean air status. If dust were generated during construction, best management practices for dust suppression would be initiated. Emissions from construction vehicles would be kept to a minimum by restricting idling time.

2.3 Cost Analysis of the Alternatives

A preliminary cost analysis of the no action and action alternatives was conducted to estimate the financial feasibility of the proposed Cape Sable Dam Restoration project under each of the scenarios. Rough "Class C" costs were estimated for each of the alternatives based on unit prices obtained from vendors and R.S. Means (see Tables 2.6 through 2.13 at the end of Chapter 2). Class C estimates are cost estimates that occur at the conceptual level of planning. All estimates for construction include government factors to account for the remote location, federal wage rate factor, design contingency, government general conditions, prime fees, contracting method adjustment, and escalation. All of these estimates are represented in 2009 dollars and were based on single-unit costs, and costs were not adjusted to account for possible volume discounts or similar cost savings.

As project implementation moves forward, Class B (Budgetary Estimates) would be developed at the schematic design phase, and Class A (Actual Estimates) would be developed for the associated construction documents.

The Value Analysis/Choosing By Advantages (VA/CBA) Workshop was conducted on April 2-3, 2009 in which the preferred alternatives were identified. Please see Section 2.7 "Preferred Alternatives" for details.

2.4 Alternatives Considered and Dismissed

Based on the preliminary analysis, internal scoping with the NPS, and the public input related to the proposed project, the following alternatives were considered and dismissed from further analysis in the EA:

2.4.1 Action Alternative B - Relocate Existing Failed Sheetpile Dams to Narrower Locations

This alternative would relocate the existing failed sheetpile dams to a narrower location upstream in the canals. The relocated dams would be strengthened by adding sheetpile wingwalls landward on both sides of the dams. The wingwalls would deflect surface flows away from the dams, help prevent illegal motorized boat entry into designated wilderness and reduce opportunities for vandals to alter the banks beyond the edge of the sheetpile walls. This alternative was considered but dismissed because it is similar to retained alternative C, it would require extracting and moving the existing sheetpile to currently undisturbed areas, and because a more sustainable solution, such as a plug configuration, would be preferable.

2.4.2 Action Alternative E - Plug from Mouths of Canals Upstream to the Existing Dams

This alternative proposes plugging the two canals from their mouths upstream to the site of the existing dams to reduce tidal inflow up to the repaired dams. A sheetpile or geotube dam would be installed at the mouths of the canals which would be filled up to the existing dams or a reasonable distance beyond the highest elevation point of the marl ridge (based on the digital terrain model described in Section 2.1.1.3). This alternative was considered but dismissed because it is similar to retained Alternatives G and G1 and would not be optimally cited along the high topographical point at the marl ridge. Furthermore, it was deemed economically infeasible due to the increased costs of filling longer reaches of the canals.

2.4.3 Action Alternative F - Backfill East Cape Canal from Florida Bay to the Existing Dam

This alternative proposes backfilling the East Cape Canal from Florida Bay to the existing failed dam or a reasonable distance across the marl ridge at the East Cape Canal Extension. It would also consist of plugging the Homestead Canal across the width of the marl ridge. This stretch of the East Cape Canal is approximately one mile long, 250 feet wide and ten feet deep. Due to the extensive size and volume of fill required for East Cape Canal, this alternative was deemed economically infeasible and would not be implemented in a timely manner. In addition, filling the East Cape Canal from Florida Bay to the existing failed dam at the East Cape Extension Canal would cut off boat access to Lake Ingraham and the backcountry from the southern edge of Cape Sable, requiring park visitors to travel almost eight miles to the western entrance to Lake Ingraham. For these reasons, this alternative was dismissed from further consideration.

2.4.4 Action Alternative H - Backfill as Much of the Canals as is Feasible

This alternative proposes backfilling as much of the East Cape Extension and Homestead Canals as is feasible. This alternative would be very similar to two other retained alternatives, Alternatives G and G1 that include an amount of fill that was considered to be economically feasible. In addition, the East Cape Extension and Homestead Canals are both National Register-eligible historic resources and backfilling substantial portions of the canal would substantially affect the historic character of the resources. Filling the East Cape Extension and Homestead Canals would also cut off non-motorized boat access into the designated wilderness from Lake Ingraham and the East Cape Canal. This change would likely be controversial and

potentially result in a moderate to major adverse effect on visitor use and experience. For these reasons, this alternative was dismissed from further consideration.

2.4.5 Action Alternative I - Plug Canals in Several Places with Geotubes or Fill

This alternative would plug the East Cape Extension and Homestead Canals in several places rather than the current configuration of only one dam at each canal. One of the objectives of the dam restoration project is 50-year sustainability of the replacement structure. This alternative would be less likely to fail than Alternatives B or C but probably would not be substantially more reliable that Alternatives D or G. Therefore, the alternative of multiple plugs in each canal was determined to be unnecessarily redundant since other alternatives put forward with only one dam location are being designed to meet the 50-year sustainability objective. Therefore, this alternative was dismissed from further consideration.

2.4.6 Action Alternative J - Completely Fill in the Canals

This alternative proposes backfilling the entire length of the East Cape Extension and Homestead Canals. The extensive size and volume of fill required for this alternative makes it economically infeasible and it would not be implemented in a timely manner. In addition, the East Cape Extension and Homestead Canals are both National Register-eligible historic resources and backfilling substantial portions of the canal would substantially affect the historic character of the resources. Filling the East Cape Extension and Homestead Canals would also cut off non-motorized boat access into the designated wilderness from Lake Ingraham and the East Cape Canal. This change would likely be controversial and potentially result in a moderate to major adverse effect on visitor use and experience. For these reasons, this alternative was dismissed from further consideration.

2.4.7 Action Alternative K - Repair Middle Cape at Gulf and East Cape Canal at Florida Bay

This alternative proposes repairing the Middle Cape Canal at the Gulf of Mexico and the East Cape Canal at Florida Bay. Blocking these larger canals at the coast may substantially limit spring tide incursions into the interior marshes; however, due to the extensive size and volume of fill required for this alternative, it was found to economically infeasible and would not be implemented in a timely manner. In addition, filling of the Middle Cape Canal and East Cape Canal would entirely sever boat access to Lake Ingraham and the backcountry, prohibiting park visitors from traveling into these areas. This change would likely be controversial and potentially result in a moderate to major adverse effect on visitor use and experience. For these reasons, this alternative was dismissed from further consideration.

2.5 How Alternatives Meet Project Objectives

As stated in Chapter 1, Section 1.1 “Purpose of and Need for Action”, all action alternatives selected for analysis must meet all objectives to a large degree to be considered reasonable. The action alternatives must also address the stated purpose of the plan and resolve the need for action. Alternatives were assessed as to how well they would meet the plan objectives. Tables 2.12 and 2.13 (located at the end of Chapter 2) summarize the results of this assessment. The action alternatives would meet the objectives either fully or to a large degree.

2.6 Environmentally Preferable Alternatives

In accordance with DO-12 (NPS 2001), the NPS is required to identify the “environmentally preferred alternative” in all environmental documents, including EAs. According to Council on Environmental Quality (CEQ) guidelines, the environmentally preferred alternative is the

alternative that would promote the national environmental policy, as expressed in Section 101 of the National Environmental Policy Act (NEPA), to:

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural and natural aspects of our national heritage; and maintain, wherever possible, an environment which supports diversity, and variety of individual choices;

(5) achieve a balance between population and resource use which would permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

A description of how each alternative would or would not achieve the requirements of sections 101 and 102(1) of the NEPA criteria is provided below and illustrated through a rating system in Table 2.1.

Criterion 1 — Everglades National Park is a unit of the national park system, and as the trustee of this place the National Park Service would continue to fulfill its obligation to protect this area for future generations. Alternative A (the no-action alternative) would not adequately protect and preserve the Cape Sable area for future generations - conditions associated with the failed sheetpile dams would continue and potentially increase the anthropomorphic impacts on erosional processes within the two canals and the greater Cape Sable area, further deteriorating the environmental values of the area. Each of the action alternatives would meet the objectives of preventing further saltwater intrusion and restoring the freshwater marshes of the area; however, the long-term sustainability of the Alternative C design is less than that of Alternatives D/G and D1/G1. Therefore, Alternatives D/G and D1/G1 would do a better job at providing a long-term solution for the area – they would provide the greatest level of protection for park resources over time.

Criterion 2 — Alternative A (the no-action alternative) would not provide safe, healthful, productive, and culturally pleasing surroundings for all Americans because existing conditions would continue and likely worsen - the failed sheetpile dams would continue to pose safety concerns to park visitors and staff using the area. The eroded canal conditions would continue to appear unnatural and cause undesirable consequences to the natural and aesthetic resources of the area. Alternative C would pose safety concerns to park visitors due to the fact that the elevation of the sheet pile would be lower than that of the marl ridge and would allow water to flow over the dam itself, presenting a hazard to park visitors. Alternatives D/G and D1/G1 would all provide the same level of human safety through a design that provides for safe and effective portage of the dams for park visitors with non-motorized vessels such as canoes and kayaks. Alternatives D/G and D1/G1 include the planting of mangroves and other native vegetation on top of the plug, offering more natural and aesthetically pleasing surroundings. Furthermore, the canal and buoy system that would be required under Alternative C would be considered a visual detraction and nuisance to some visitors.

Criterion 3 — Alternative A (the no-action alternative) would continue to cause substantial adverse impacts to the environmental resources of the area. The Cape Sable system and its

resources would continue to degrade, resulting in undesirable environmental consequences that limit the beneficial uses and services that the environment provides to the South Florida region. The action alternatives would minimize adverse impacts to natural resources by decreasing the velocity of water passing through the canals during tidal flows, thereby reducing erosional processes along the canal banks. This would result in an increase in the retention of freshwater in the interior freshwater and brackish marshes during wet season rains. However, due to the design of Alternative C, saltwater intrusion and freshwater loss would occur more frequently than under Alternatives D/G and D1/G1, which include an earthen plug that would attempt to re-create the natural marl ridge topographic conditions that provide greater resistance from occasional overtopping with saline waters. Overtopping would still occur during high tide and major storm events, but the saline waters would have to pass over the marl ridge plug and would result in more natural environmental conditions than would occur under Alternative C. Furthermore, Alternatives D1/G1 would reduce adverse impacts to natural resources in the area by not including the dredging of portions of Lake Ingraham required for access under Alternatives D/G; therefore, Alternatives D1/G1 provide the greatest level of beneficial use of the environment while limiting unintended consequences.

Criterion 4 — Alternative A (the no-action alternative) does not adequately preserve the natural and cultural resources of the area and existing conditions limit visitor access and use of the area. Alternative C includes the least amount of impact to natural resources from construction due to the smaller footprint of the dam structures, while Alternatives D and G would cause greater impacts due to the dredging of Lake Ingraham needed to reach the Homestead canal. The long-term sustainability of Alternative C is less than that of Alternatives D/G and D1/G1; therefore, over time, Alternatives D/G and D1/G1 would better protect and preserve natural and cultural resources. The action alternatives also include the same level of recreational access and opportunities that lead to supporting diversity and individual choice. All of the action alternatives also would prevent boaters from illegally accessing the interior of the designated wilderness area.

Criterion 5 — Alternative A (the no-action alternative) does not adequately protect and enhance the environmental benefits of area. The area would still be used by park visitors, but not to the degree that fulfills the societal benefits and uses that the park is trying to provide. Each of the action alternatives protects and enhances the environmental values of the area and provides increased opportunities for resource use and enjoyment by society.

Criterion 6 — Each of the action alternatives would result in enhancing the quality of renewable resources through NPS management in the project area. According to the carbon footprint analysis (an analysis of greenhouse gas emissions resulting from the use and combustion of fuel, a non-renewable resource, used for the project) conducted for the project, Alternative C would result in the lowest level of use of depletable resources. Alternatives G/G1 consume the highest amount of fuel and would result in the lowest amount of recycling of depletable resources.

Table 2.1 – Environmentally Preferred Alternative Analysis

CRITERIA	ALTERNATIVES			
	A	C	D and G	D1 and G1
1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.	1	3	5	5
2. Ensure safe, healthful, productive, and aesthetically and culturally pleasing surroundings for all Americans.	1	4	5	5
3. Attain the widest range of beneficial uses	1	3	4	5

of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.				
4. Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and a variety of individual choices.	1	4	5	5
5. Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.	3	5	5	5
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.	1	4	3	3
Total Points*	**8**	**23**	**27**	**28**

* Five points were given to the alternative if it fully meets the criteria; four points if it meets nearly all of the elements of the criteria; three points if it meets more than one element of the criteria; two points if it meets only one element of the criteria; and one point if the alternative does not meet the criteria.

The environmentally preferable alternative for the Cape Sable Canals Dam Restoration project is Alternative G for the East Cape Canal and Alternative G1 for the Homestead Canal. According to the ratings included in Table 2.1, this alternative would surpass the other alternatives in realizing the full range of national environmental policy goals in Section 101. In particular, alternatives G/G1 best respond to criteria 1 and 3 by providing the greatest level of long-term sustainability and environmental protection/enhancement with the least amount of environmental impacts caused from project implementation.

For further information on how the environmentally preferred alternative was determined, please reference Table 2.14 (Environmental Consequences Summary) at the end of Chapter 2, which presents a summary comparison of the effects of the alternatives based on the evaluations of the impact topics in the Environmental Consequences section of this environmental assessment. The terms used to define the magnitude or intensity of the effects (e.g., negligible, minor) are described in Chapter 3.

2.7 Value Analysis and Preferred Alternatives

The NPS conducted a Value Analysis (VA) and Choosing By Advantages (CBA) workshop on April 2-3, 2009. The purpose of the workshop was to focus on the core purpose of the project, which is the ability of the dam alternatives to function for a 50-year life-cycle. There was consensus among the VA/CBA team that the ability of the dams to function for 50-years is the primary goal, since it would have secondary beneficial affects such as:

1) Preventing the loss of natural and cultural resources;

2) Providing greater visitor enjoyment;

3) Improving the efficiency of other Park operations.

The recommended alternative for the East Cape Extension canal dam is Alternative D. Under this scenario, the dam structure would function for a 50-year life-cycle, the natural and cultural resources would be protected and the safety hazards from the existing dam structure would be removed resulting in a positive visitor experience. The advantages of Alternative D, compared to the other action alternatives, would be similar with the exception that the construction costs greatly vary between the alternatives due to different engineering techniques. The cost is lower

for Alternative D and the advantages are higher; therefore, Alternative D would provide the most cost-effective solution for the Park for the East Cape Extension canal dam.

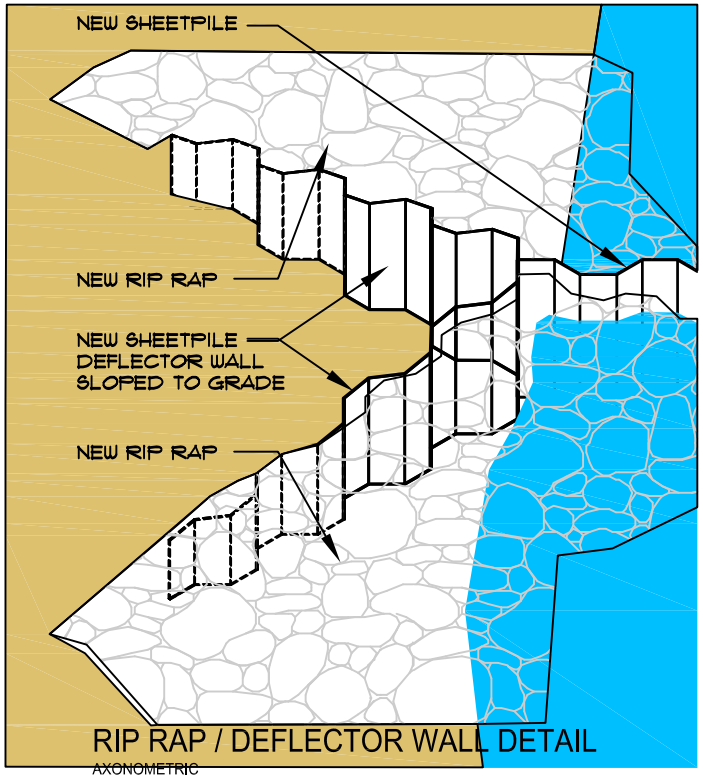
The recommended alternative for the Homestead canal dam is Alternative D1. Under this scenario, the dam structure would function for a 50-year life-cycle, the natural and cultural resources would be protected and the safety hazards from the existing dam structure would be removed resulting in a positive visitor experience. The advantages of Alternative D1, compared to the other action alternatives, would be similar with the exception that the construction costs greatly vary between the alternatives due to different engineering techniques. The cost is lower for Alternative D1 and the advantages are higher; therefore, Alternative D1 would provide the most cost-effective solution for the Park for the Homestead canal dam.

See Appendix D for the VA/CBA report (matrices and charts) showing the ratio between the importance of advantages and cost for each alternative.

2.8 Implementation

Table 2.15, at the end of Chapter 2, presents a preliminary implementation schedule for the Preferred Alternative.

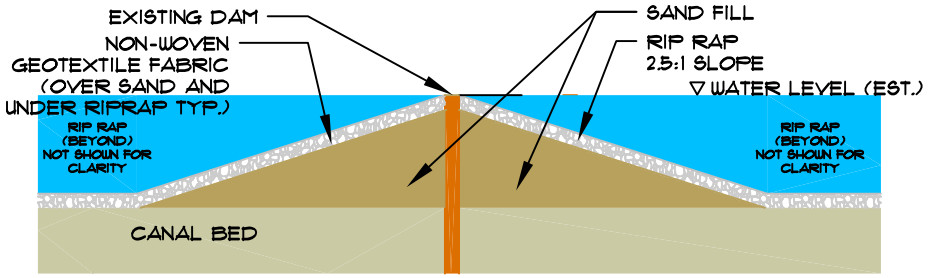
FIGURE 2.7 - EAST CAPE EXTENSION CANAL DAM - ALTERNATIVE C DRAWING



RIP RAP / DEFLECTOR WALL DETAIL

AXONOMETRIC

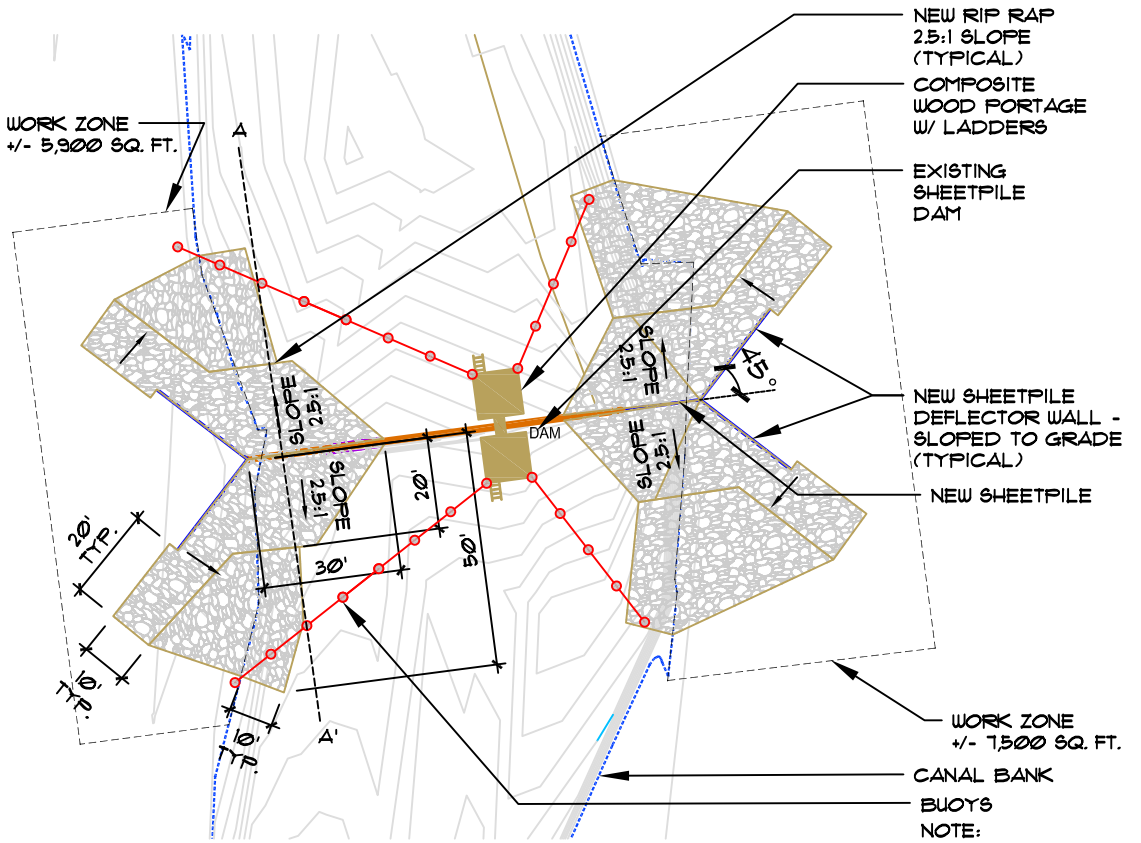
NOT TO SCALE



RIP RAP / DEFLECTOR WALL DETAIL

AXONOMETRIC - REAR DEFLECTOR WALL NOT SHOWN FOR CLARITY

NOT TO SCALE



EXISTING DAM

NEW SHEETPILE

RIP RAP 2.5:1 SLOPE

NOTE:
CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE

N

PLAN

EAST CAPE CANAL DAM

NOT TO SCALE

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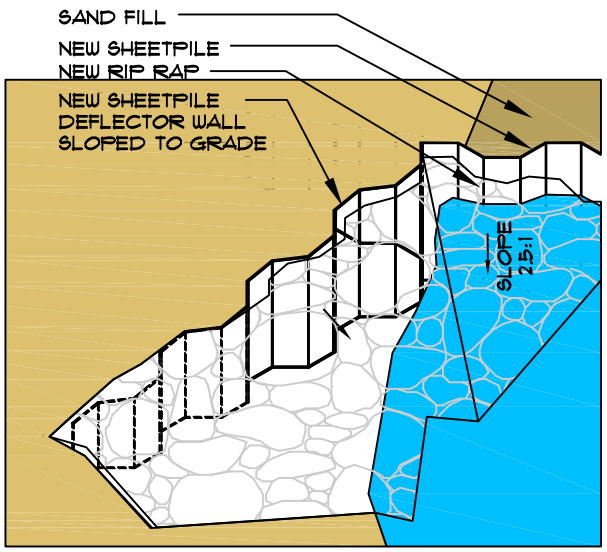
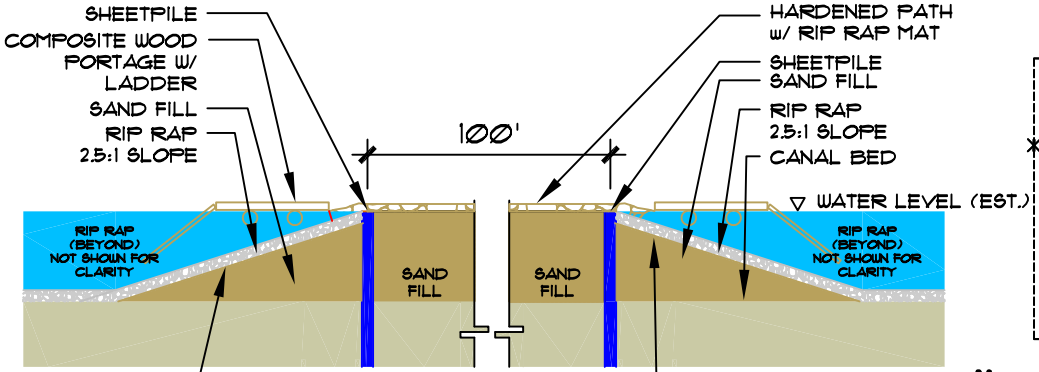
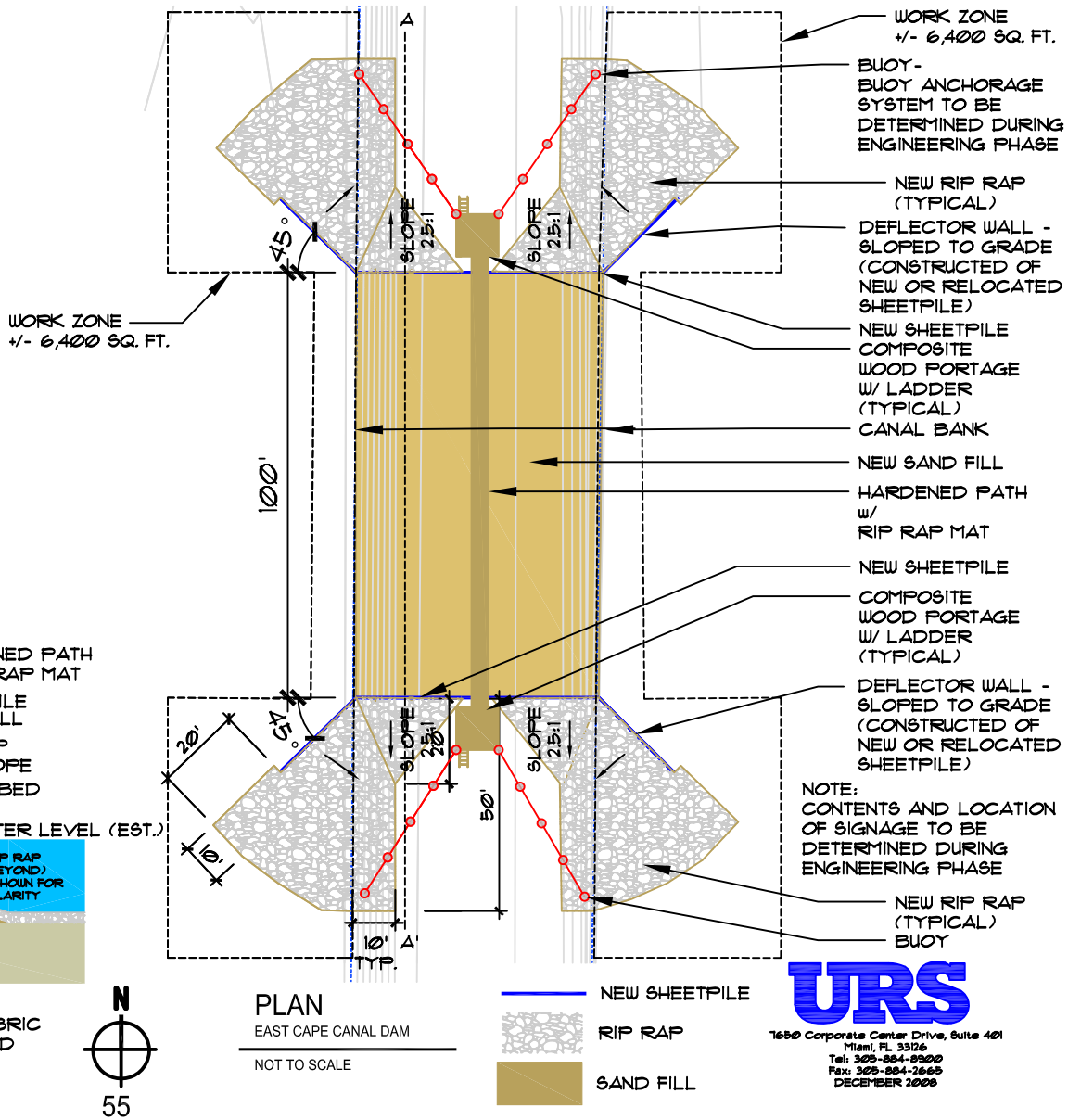
FIGURE 2.8 - EAST CAPE EXTENSION CANAL DAM - ALTERNATIVE D DRAWING



RIP RAP / DEFLECTOR WALL DETAIL
AXONOMETRIC
NOT TO SCALE



CROSS SECTION A-A'
EAST CAPE CANAL DAM
NOT TO SCALE



PLAN
EAST CAPE CANAL DAM
NOT TO SCALE

N

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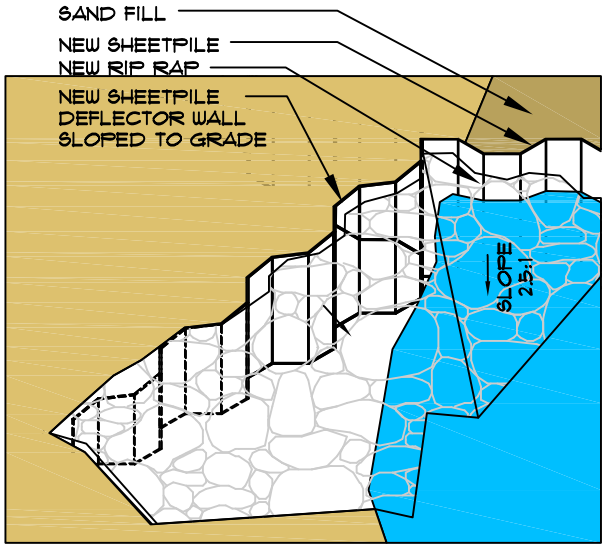
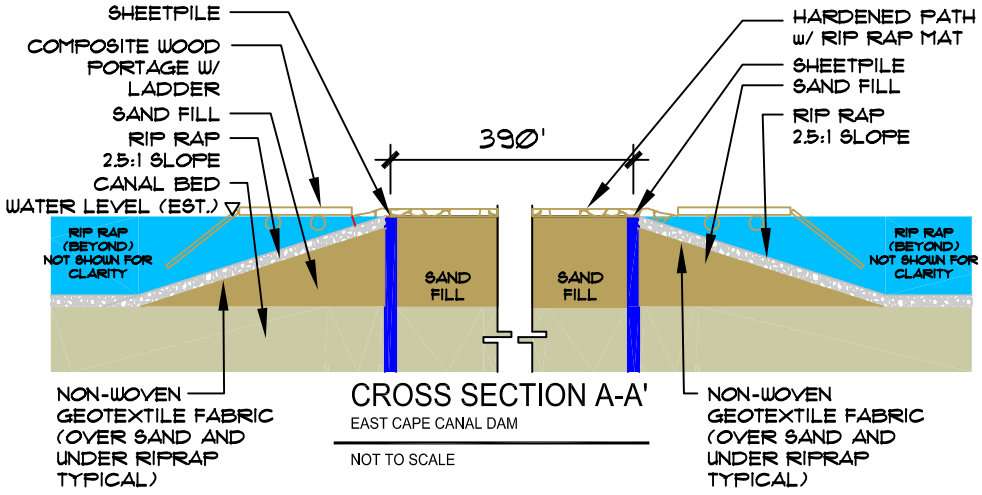
FIGURE 2.9 - EAST CAPE EXTENSION CANAL DAM - ALTERNATIVE G DRAWING



RIP RAP / DEFLECTOR WALL DETAIL

AXONOMETRIC

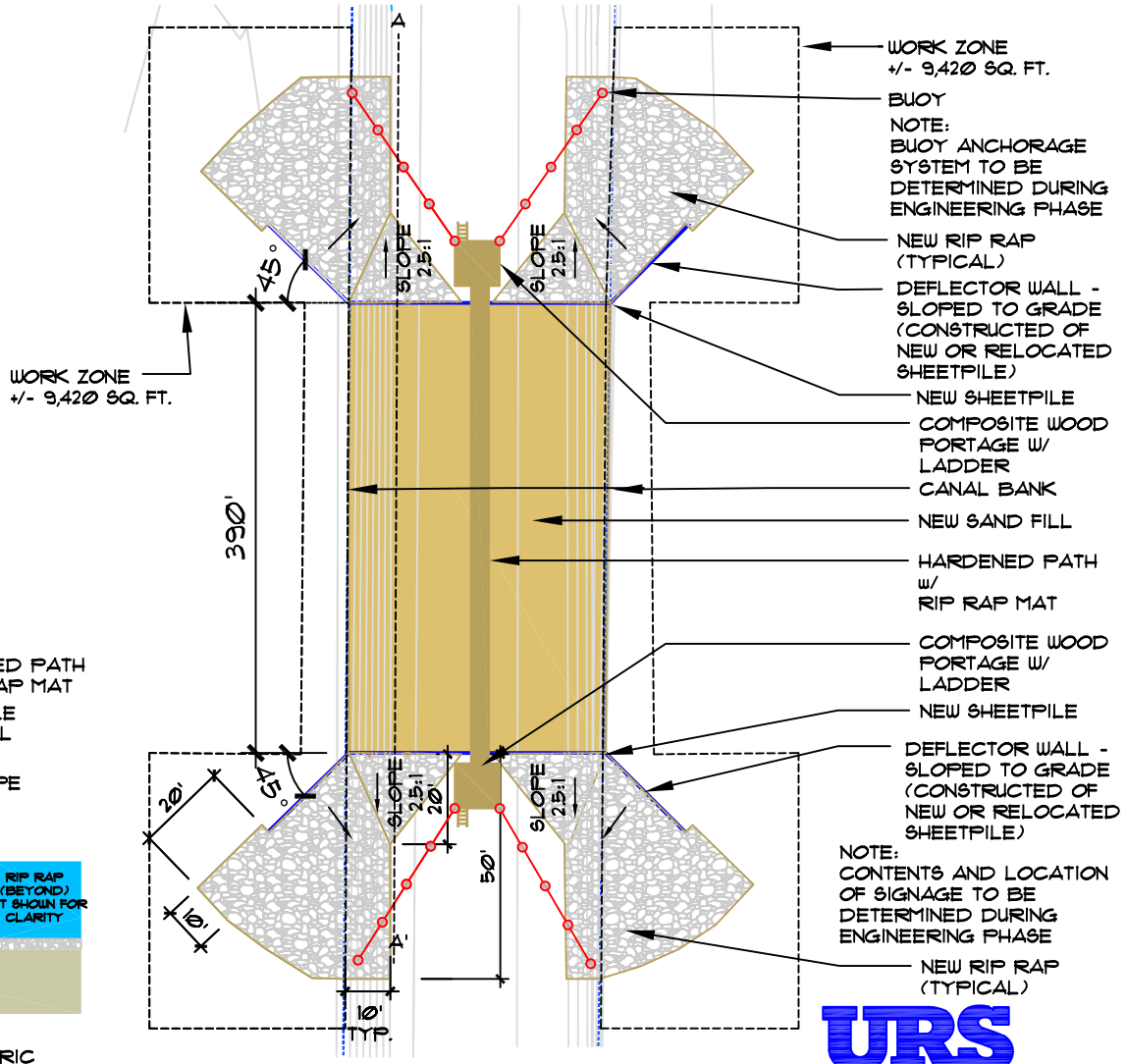
NOT TO SCALE



CROSS SECTION A-A'

EAST CAPE CANAL DAM

NOT TO SCALE



PLAN

EAST CAPE CANAL DAM

NOT TO SCALE

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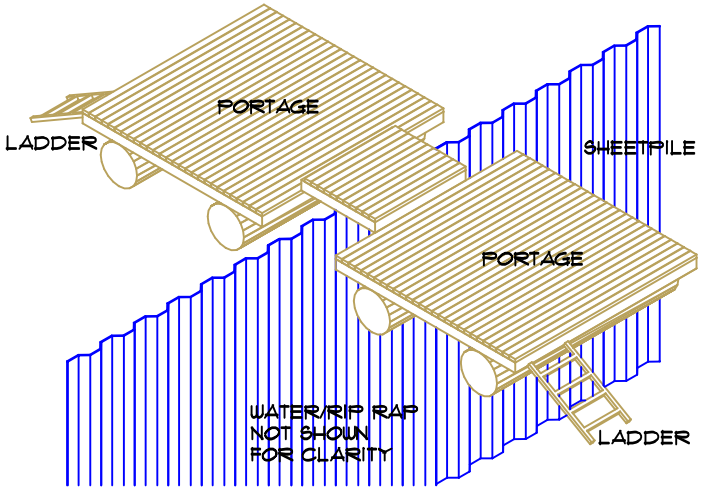
FIGURE 2.10 - EAST CAPE EXTENSION CANAL DAM - PORTAGE DETAILS DRAWING

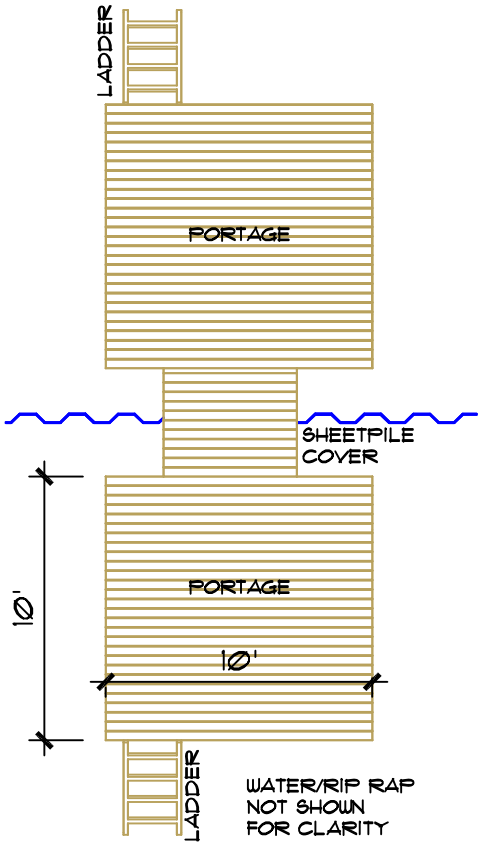
NOTES:

1. BUOY ANCHORAGE SYSTEM TO BE DETERMINED DURING ENGINEERING PHASE

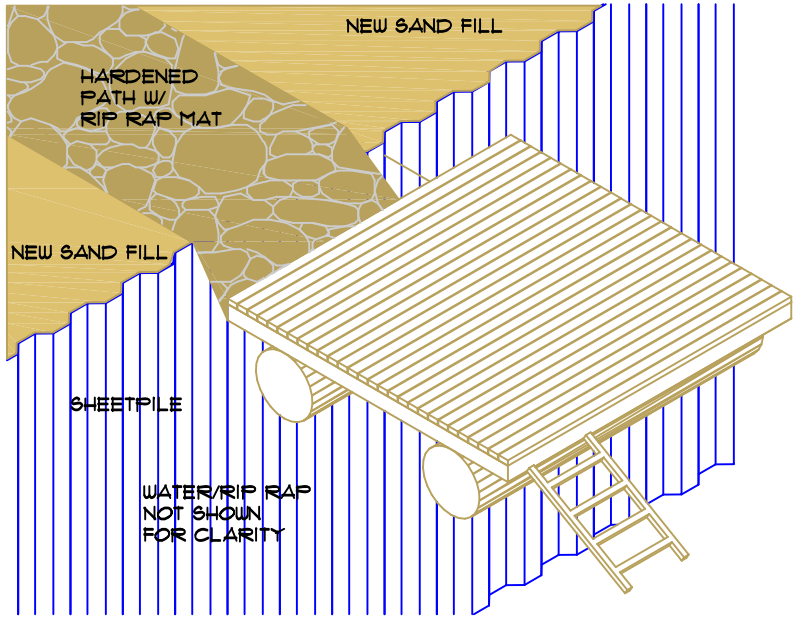
2. CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE



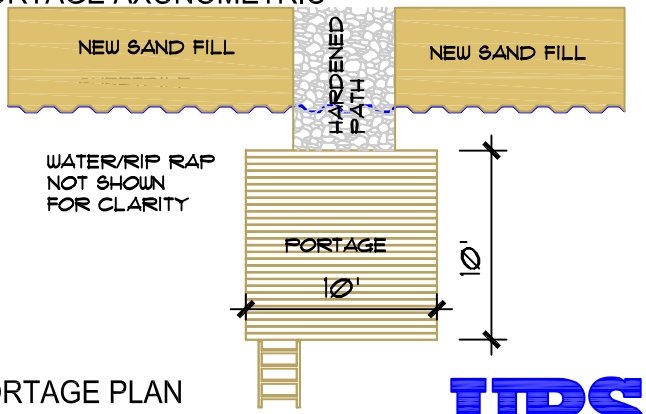
PORTAGE AXONOMETRIC



PORTAGE PLAN



PORTAGE AXONOMETRIC



PORTAGE PLAN

PORTAGE DETAILS AT ALTERNATIVE C

NOT TO SCALE

PORTAGE DETAILS AT ALTERNATIVES D & G

NOT TO SCALE

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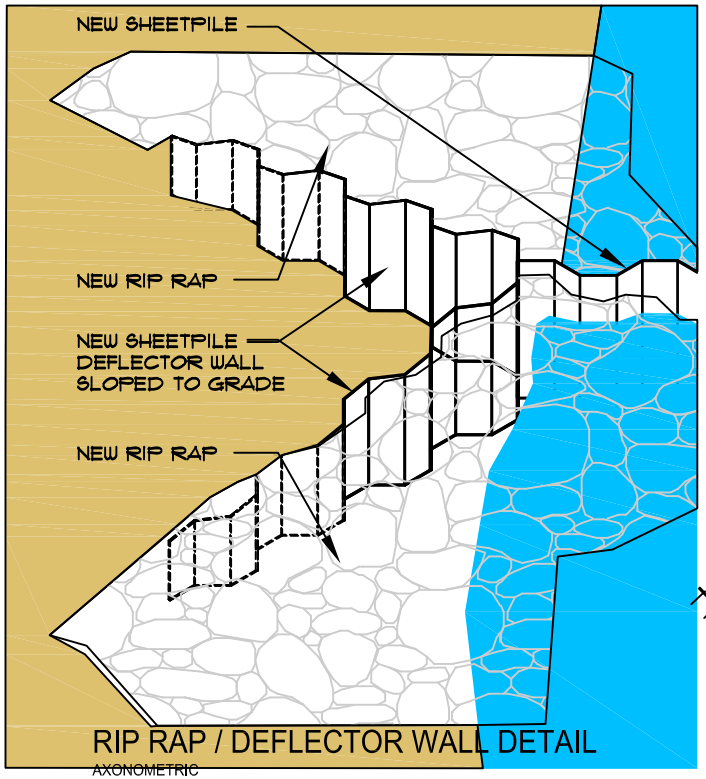
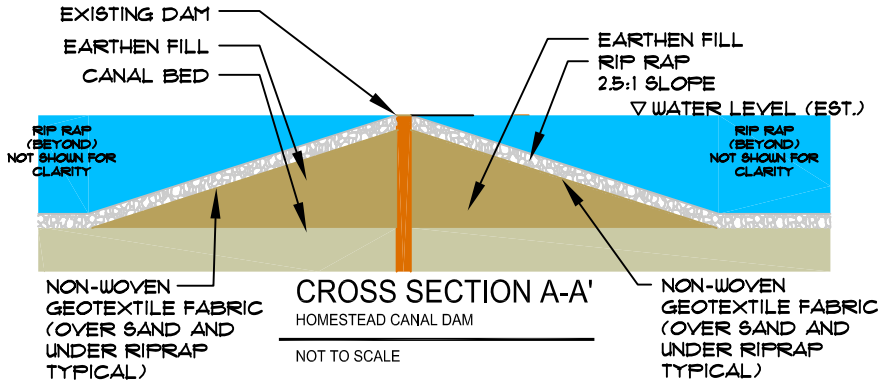
FIGURE 2.11 - HOMESTEAD CANAL DAM - ALTERNATIVE C DRAWING



RIP RAP / DEFLECTOR WALL DETAIL

AXONOMETRIC

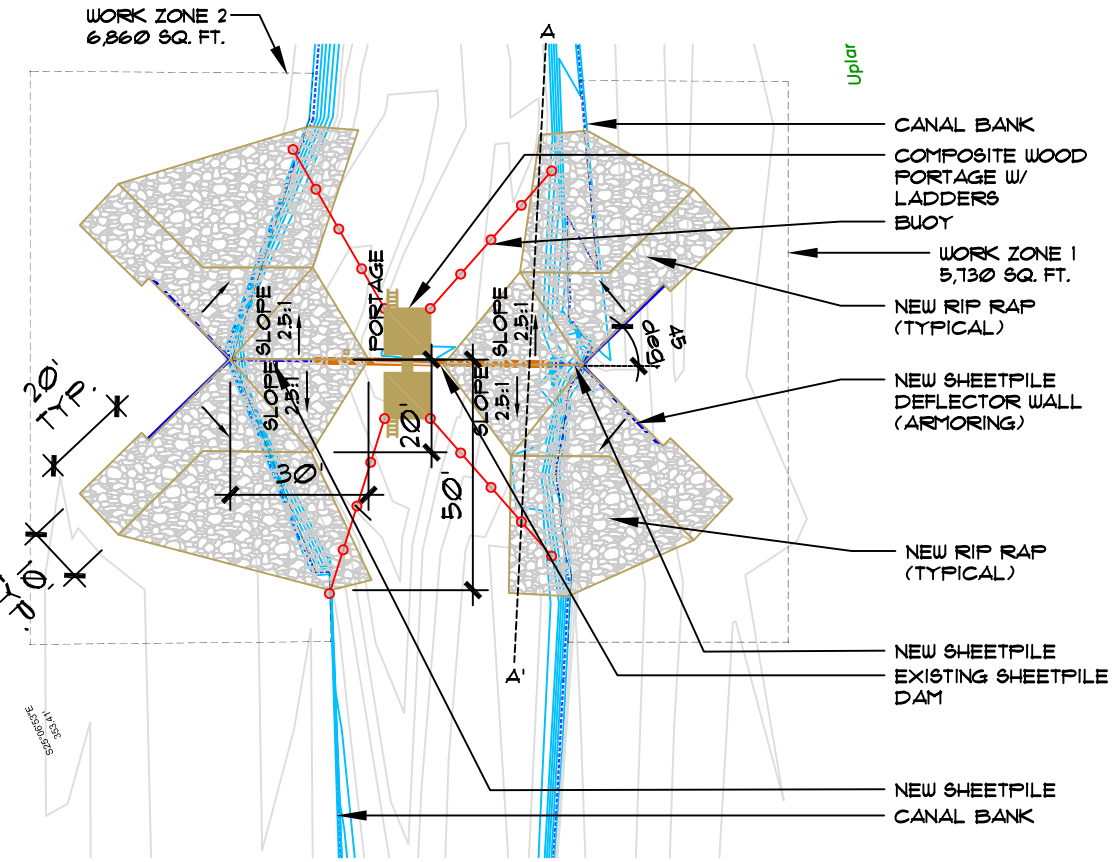
NOT TO SCALE



CROSS SECTION A-A'

HOMESTEAD CANAL DAM

NOT TO SCALE



EXISTING DAM

NEW SHEETPILE

RIP RAP

NOTES:

1. BUOY ANCHORAGE SYSTEM TO BE DETERMINED DURING ENGINEERING PHASE

2. CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE

N

PLAN

HOMESTEAD CANAL DAM

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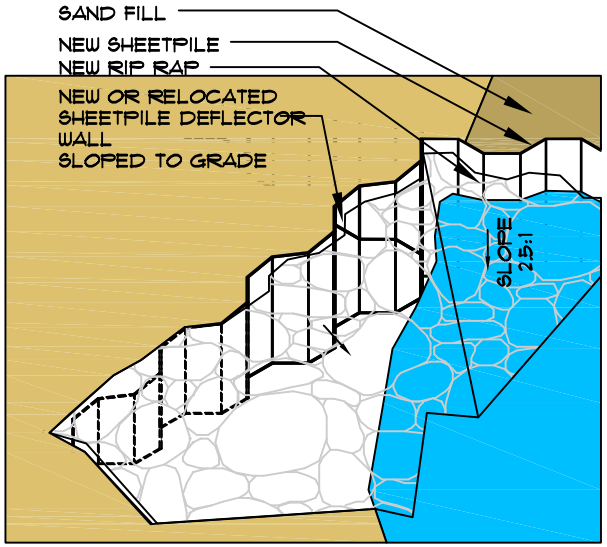
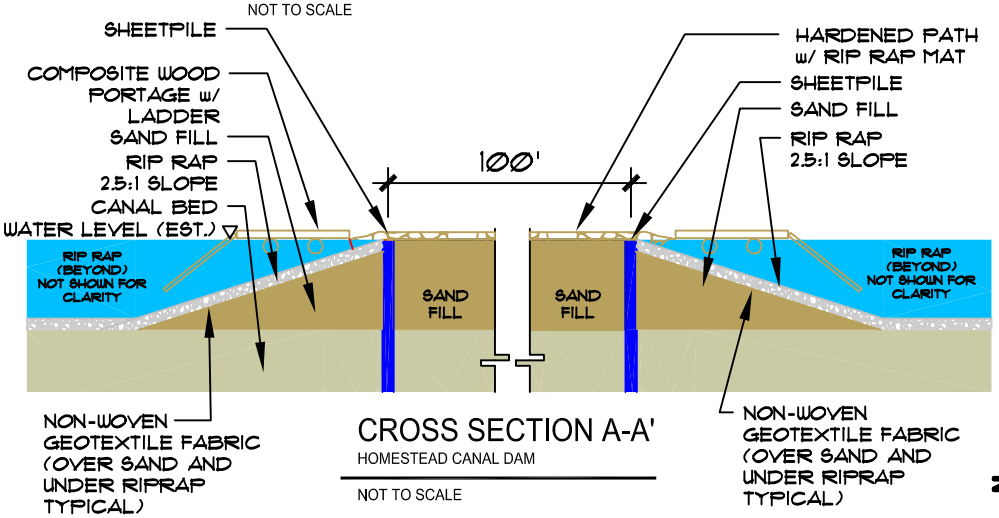
FIGURE 2.12 - HOMESTEAD CANAL DAM - ALTERNATIVE D DRAWING



RIP RAP / DEFLECTOR WALL DETAIL
AXONOMETRIC
NOT TO SCALE



CROSS SECTION A-A'
HOMESTEAD CANAL DAM
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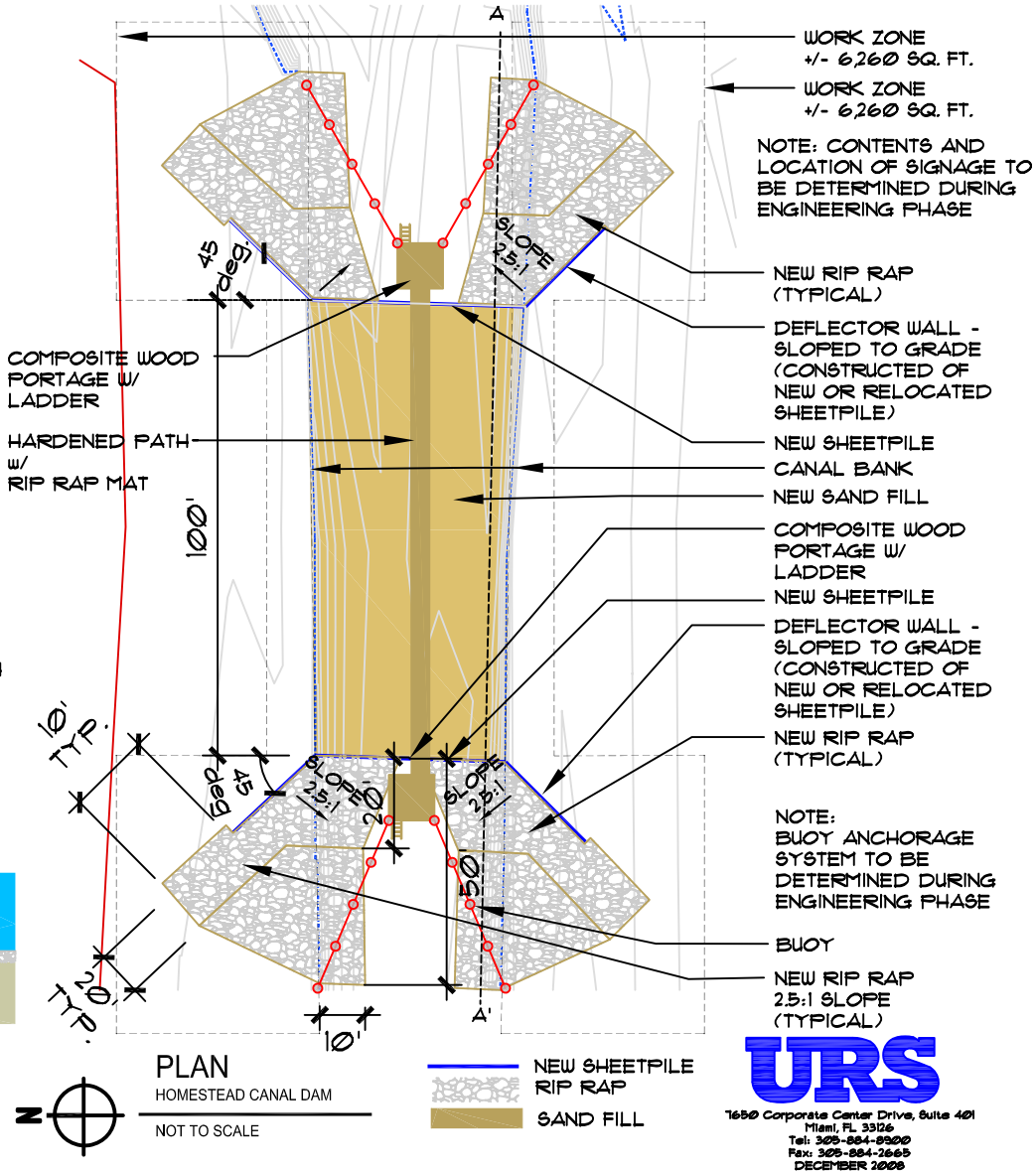

PLAN
HOMESTEAD CANAL DAM
NOT TO SCALE

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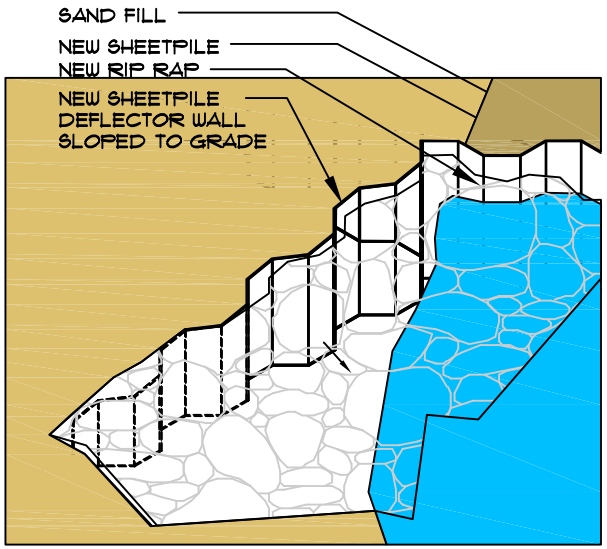
DECEMBER 2008

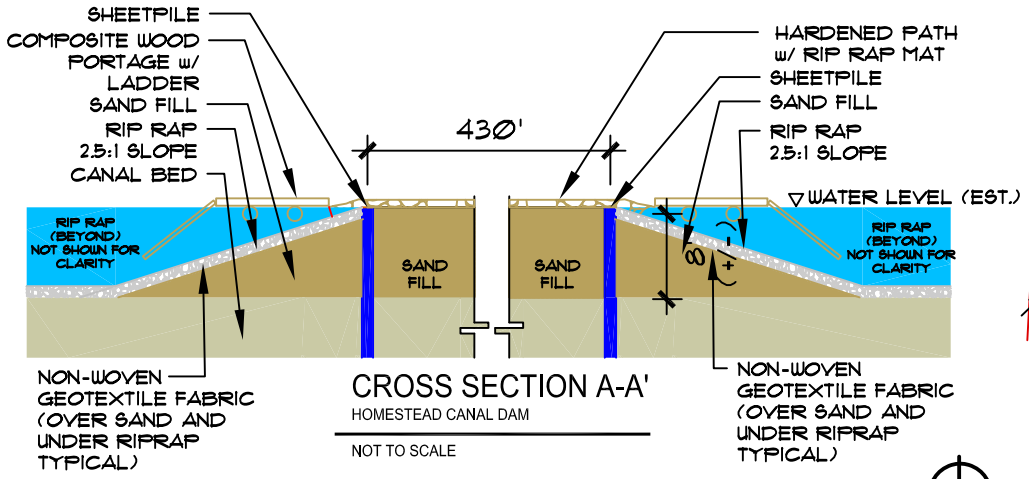
FIGURE 2.13 - HOMESTEAD CANAL DAM - ALTERNATIVE G DRAWING



RIP RAP / DEFLECTOR WALL DETAIL

AXONOMETRIC

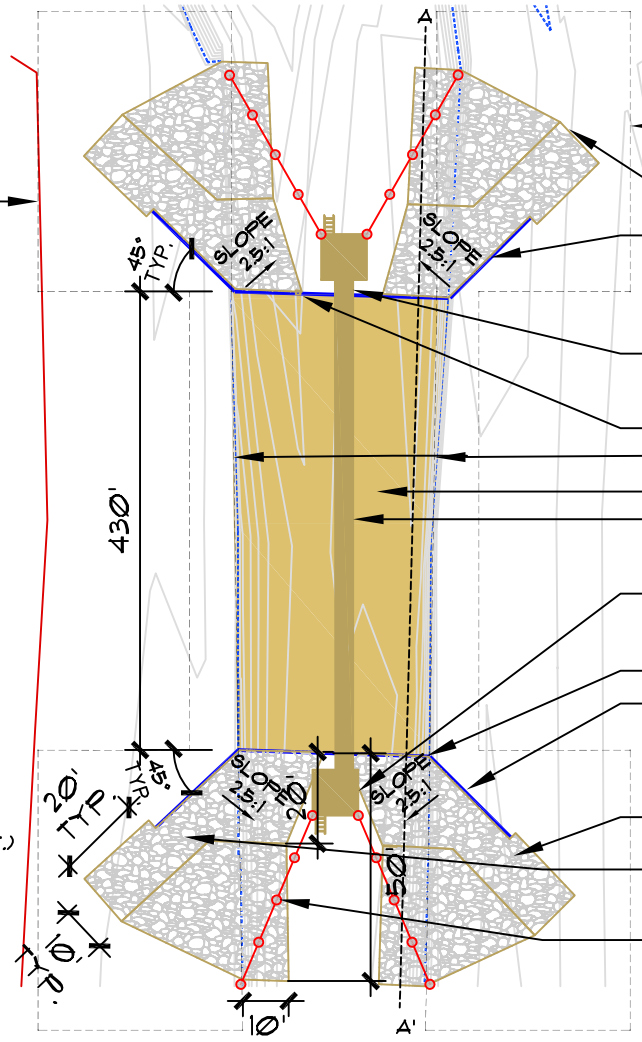
NOT TO SCALE



CROSS SECTION A-A'

HOMESTEAD CANAL DAM

NOT TO SCALE



NOTE: CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE

WORK ZONE +/- 9,560 SQ. FT.

NEW RIPRAP (TYPICAL)

DEFLECTOR WALL - SLOPED TO GRADE (CONSTRUCTED OF NEW OR RELOCATED SHEETPILE)

COMPOSITE WOOD PORTAGE w/ LADDER

NEW SHEETPILE

CANAL BANK

NEW SAND FILL

HARDENED PATH w/ RIP RAP MAT

COMPOSITE WOOD PORTAGE w/ LADDER

NEW SHEETPILE

DEFLECTOR WALL - SLOPED TO GRADE (CONSTRUCTED OF NEW OR RELOCATED SHEETPILE)

NEW RIPRAP (TYPICAL)

NEW RIPRAP 2.5:1 SLOPE (TYPICAL)

BUOY

NOTE:
BUOY ANCHORAGE SYSTEM TO BE DETERMINED DURING ENGINEERING PHASE

PLAN

HOMESTEAD CANAL DAM

NOT TO SCALE

N

NEW SHEETPILE

RIPRAP

SAND FILL

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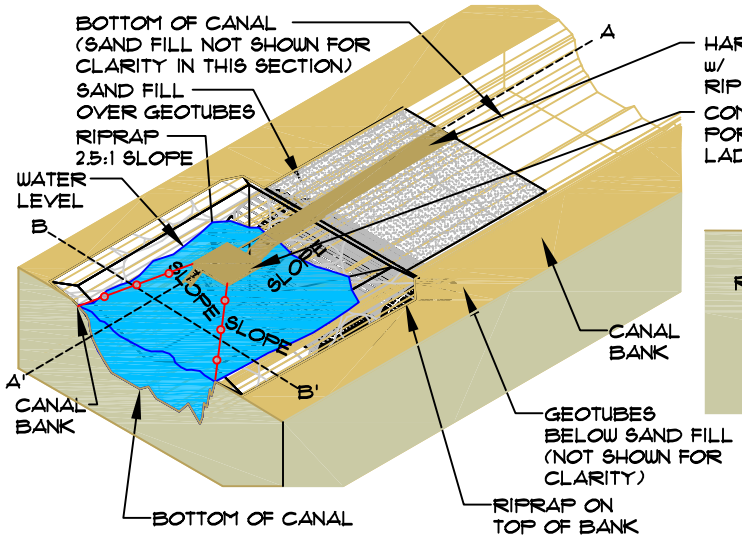
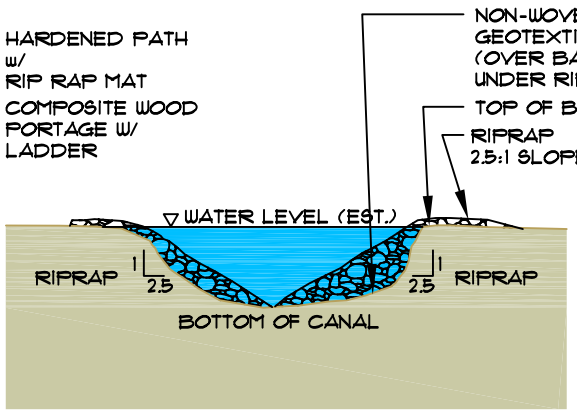
FIGURE 2.14 - HOMESTEAD CANAL DAM - ALTERNATIVE D1 DRAWING



AXONOMETRIC

HOMESTEAD CANAL DAM

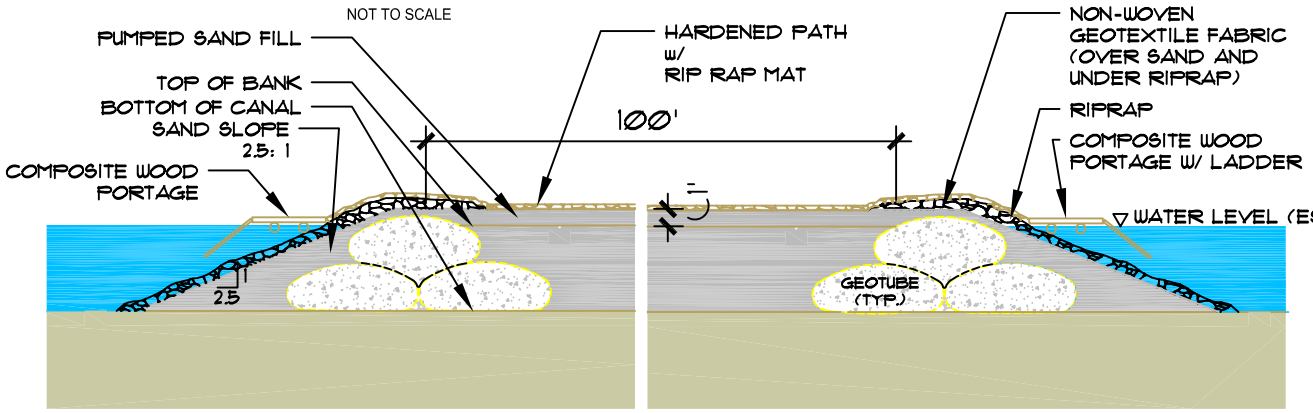
NOT TO SCALE



CROSS SECTION B-B'

HOMESTEAD CANAL DAM

NOT TO SCALE

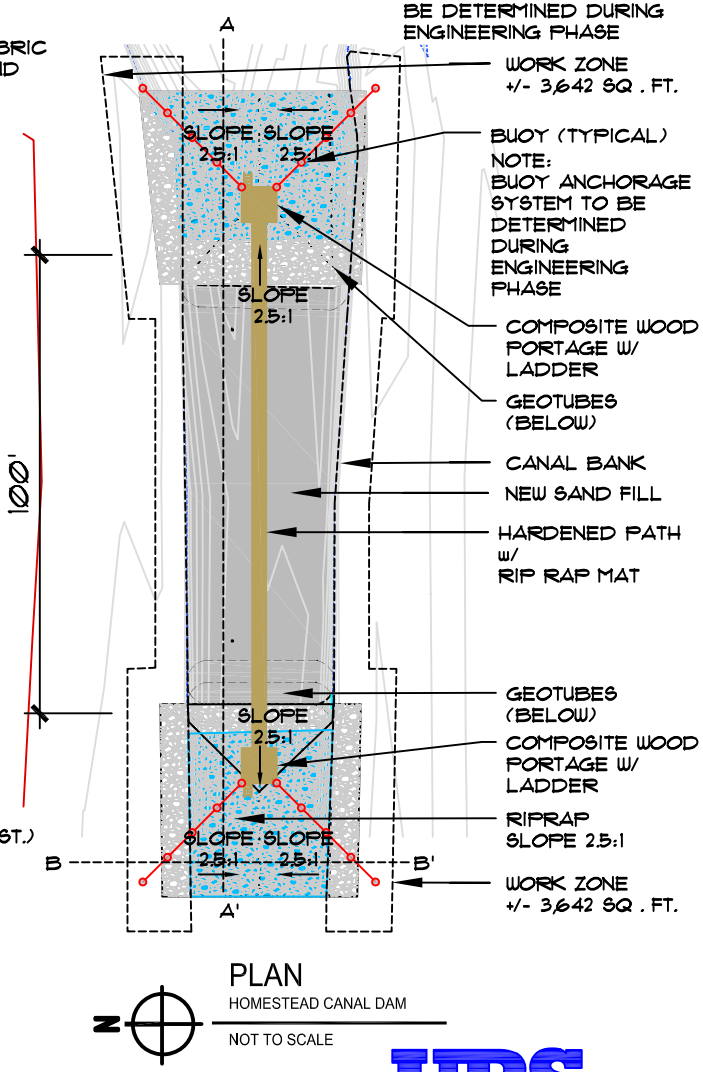


CROSS SECTION A-A'

HOMESTEAD CANAL DAM

NOT TO SCALE

NOTE: CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE



PLAN

HOMESTEAD CANAL DAM

NOT TO SCALE

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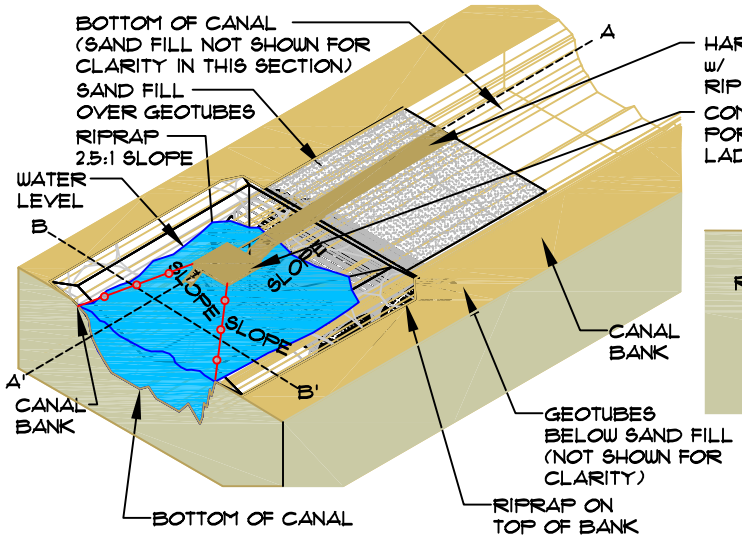
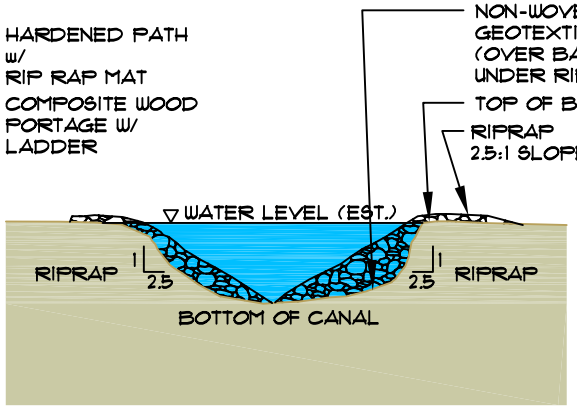
FIGURE 2.15 - HOMESTEAD CANAL DAM - ALTERNATIVE G1 DRAWING



AXONOMETRIC

HOMESTEAD CANAL DAM

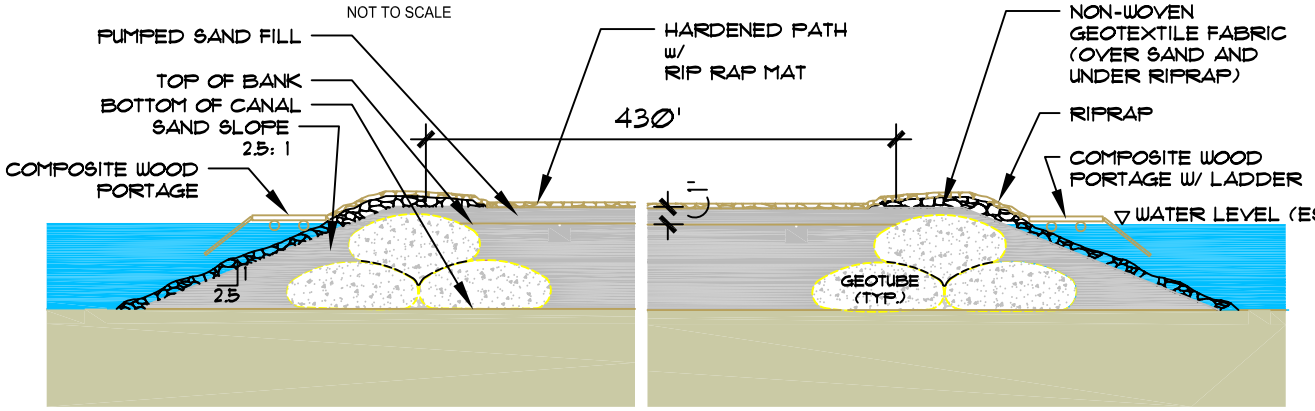
NOT TO SCALE



CROSS SECTION B-B'

HOMESTEAD CANAL DAM

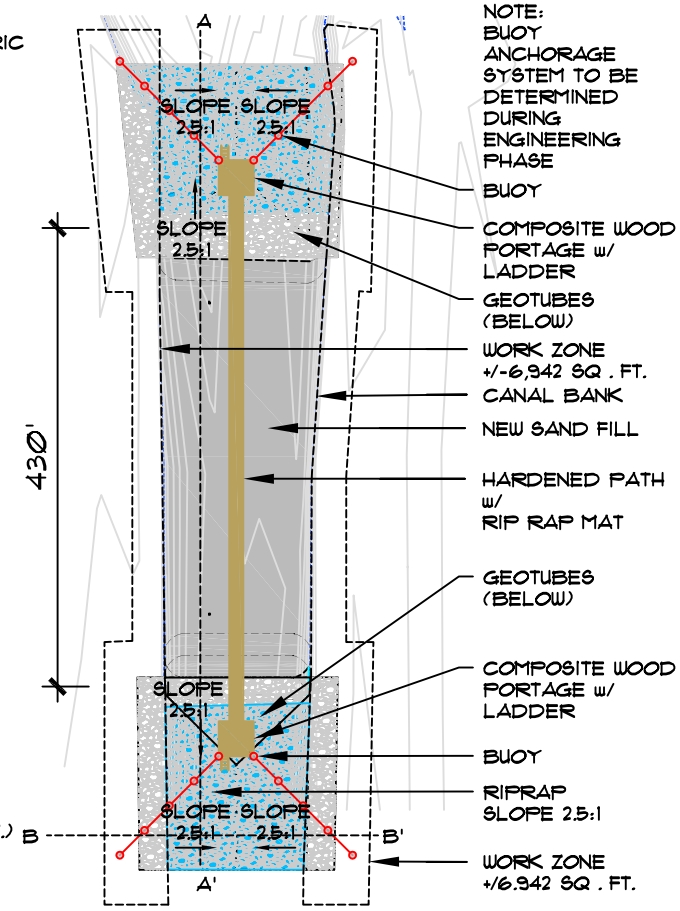
NOT TO SCALE



CROSS SECTION A-A'

HOMESTEAD CANAL DAM

NOT TO SCALE



NOTE: CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE

N

PLAN

HOMESTEAD CANAL DAM

NOT TO SCALE

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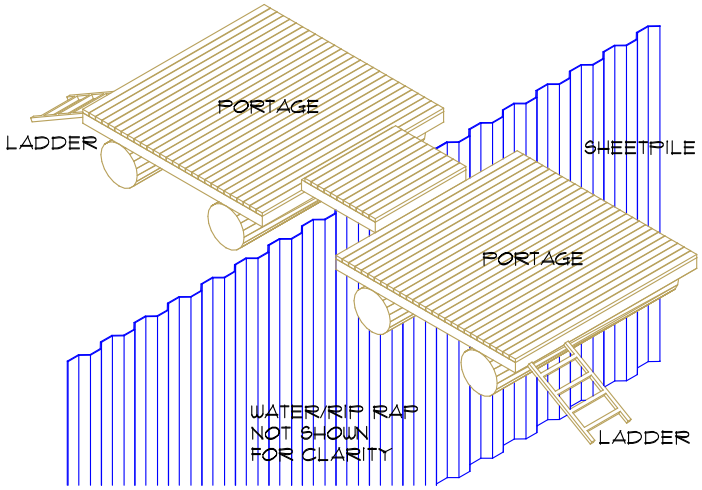
FIGURE 2.16 - HOMESTEAD CANAL DAM - PORTAGE DETAILS DRAWING

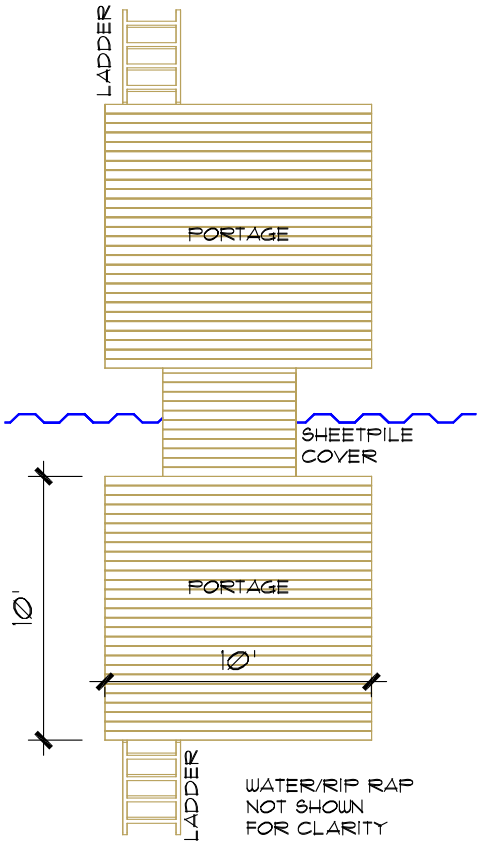
NOTES:

1. BUOY ANCHORAGE SYSTEM TO BE DETERMINED DURING ENGINEERING PHASE

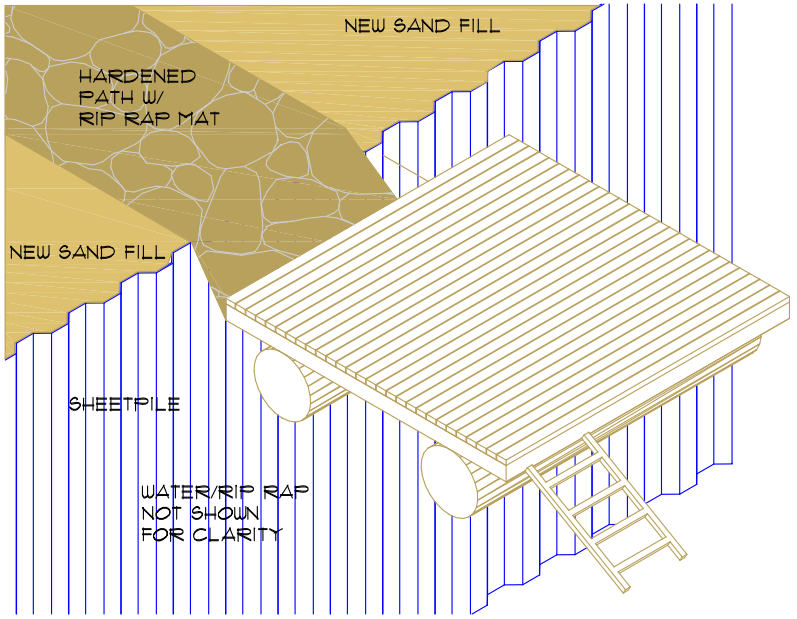
2. CONTENTS AND LOCATION OF SIGNAGE TO BE DETERMINED DURING ENGINEERING PHASE



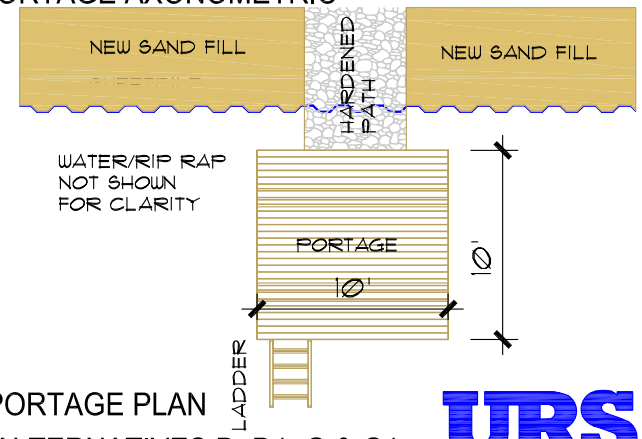
PORTAGE AXONOMETRIC



PORTAGE PLAN



PORTAGE AXONOMETRIC



TYPICAL PORTAGE PLAN

PORTAGE DETAILS AT ALTERNATIVE C

NOT TO SCALE

PORTAGE DETAILS AT ALTERNATIVES D, D1, G & G1

NOT TO SCALE

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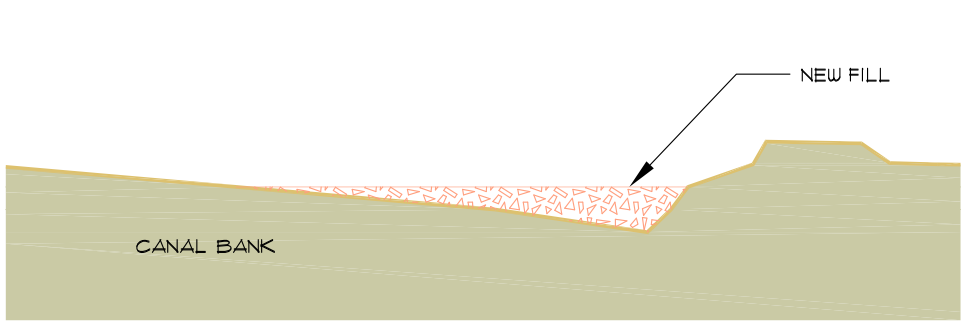
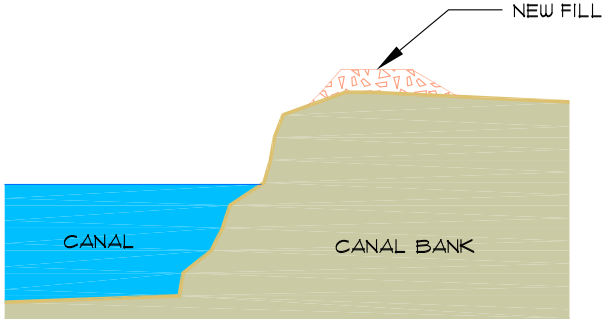
FIGURE 2.17 - HOMESTEAD CANAL DAM - SOUTHERN BANK FILL AREA



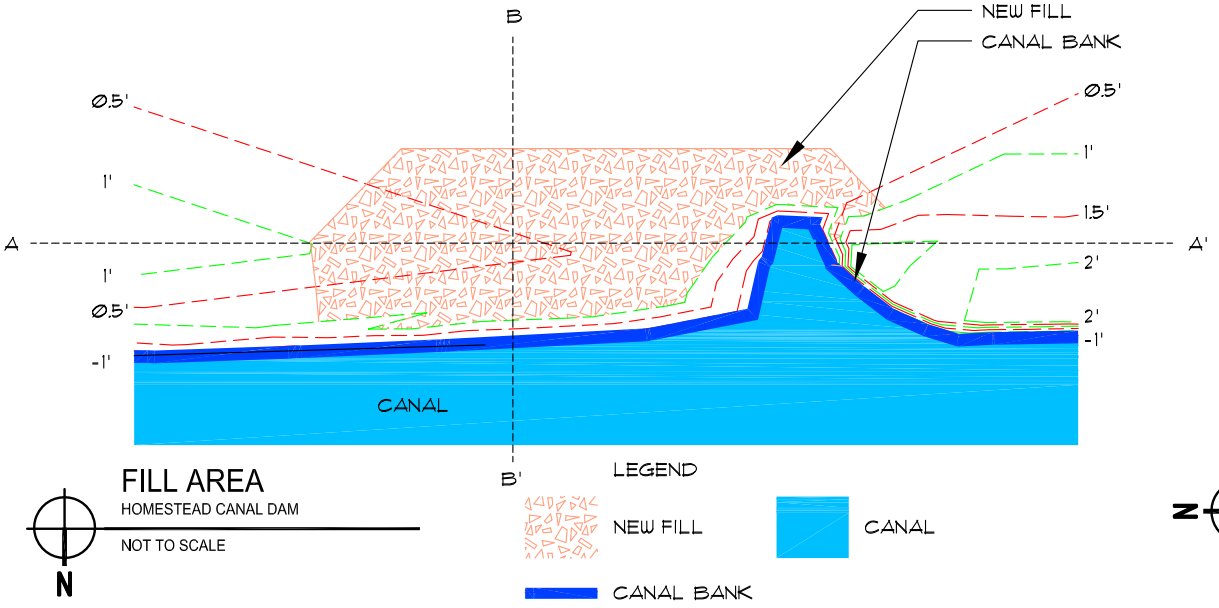
CROSS SECTION A-A'
HOMESTEAD CANAL DAM
NOT TO SCALE

LEGEND
NEW FILL
CANAL BANK
CANAL BANK
CANAL BANK EXISTING GRADE



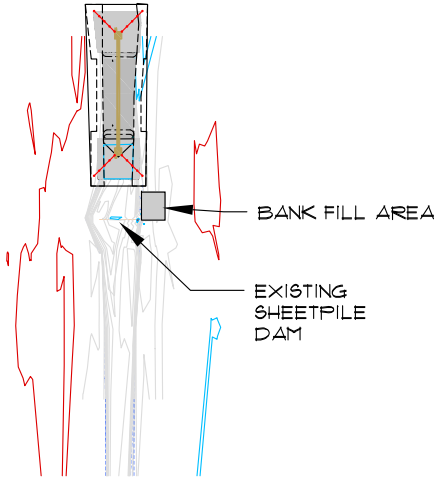
CROSS SECTION B-B'
HOMESTEAD CANAL DAM
NOT TO SCALE

LEGEND
NEW FILL
CANAL BANK
CANAL
CANAL BANK EXISTING GRADE



FILL AREA
HOMESTEAD CANAL DAM
NOT TO SCALE

LEGEND
NEW FILL
CANAL
CANAL BANK



LOCATION MAP
HOMESTEAD CANAL DAM
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Table 2.2 – Alternatives Comparison Matrix (East Cape Extension Canal)

Elements	Alt. C – Repair In Place	Alt. D – New 100' Plug (Marl Ridge Location)	Alt. G – New 370' Plug (Marl Ridge Location)
Summary description of the alternative	• Repair existing steel sheet pile walls by extending them further inland. • Landward sheet piles would be installed to form flow deflector wing walls • Select fill material would be placed adjacent to the sheet pile as support • Riprap would be used to provide erosion resistance.	• Extract and relocate existing free standing wall of steel sheet pile to a narrower site that is in better alignment with the marl ridge. • The plug would be constructed by installing two sheet pile walls 100-ft apart. • The plug consists of fill material from an off-site location and planted native vegetation. • Riprap would be used to provide erosion resistance.	Same as Alternative D, except that the plug would be constructed by installing two sheet pile walls 370-ft apart.
Mobilization and staging areas	• Equipment and material would be mobilized to a suitable water transportation staging area in the Florida Keys by dump trucks. • A staging area in Sugar Loaf Key is considered to develop the cost estimates. • Approximately 90-110 truck loads of soil and riprap would be transported to the staging area. • Materials would be loaded onto barges (approximately 100' long and 40' wide) and delivered to the project site (25-35 trips).	Same as Alternative C, except that approximately 140-160 truck loads and 40-50 barge trips would be required.	Same as Alternative C, except that approximately 400-450 truck loads and 90-110 barge trips would be required.
Location of dam and/or plug	At the existing dam location.	At a narrower site that is in better alignment with the marl ridge.	Same as Alternative D.
Materials needed and transport	Required fill materials include select sand fill material and graded riprap. **Fill Material:** • 1000 CY of select fill material. • 360 CY of fill for corners of the sheetpiles. • 180 CY of graded riprap for sheetpile wall. • 260 CY of riprap to cover 50 feet of canal length. • 160 CY of riprap for the deflector wing walls.	Required fill materials include select sand fill material and graded riprap. **Fill Material:** • 1,900 CY of fill material. • 360 CY of fill material to provide support for the dam. • 180 CY of graded riprap for sheetpile. • 260 CY of riprap to cover 50 feet of canal length • 160 CY of riprap for the deflector wing walls.	Required fill materials include select sand fill material and graded riprap. **Fill Material:** • 7,000 CY of fill material. • 360 CY of fill material as a support for the dam. • 180 CY of graded riprap for the sheetpile wall. • 260 CY of riprap to cover 50 feet of canal length. • 160 CY of riprap for the deflector wing walls

Elements	Alt. C – Repair In Place	Alt. D – New 100' Plug (Marl Ridge Location)	Alt. G – New 370' Plug (Marl Ridge Location)
	Sheetpiling: Approximately 2,600 SF. **Transportation:** Dump trucks and barges. **Equipment:** Barges (3), tug, crane w/vibratory pile driver, front end loader (3), excavators and backhoes (2).	**Sheetpiling**: Approximately 4,400 SF. **Transportation:** Same as Alternative C. **Equipment:** Same as Alternative C.	**Sheetpiling**: Same as Alternative D. **Transportation:** Same as Alternative C. **Equipment:** Same as Alternative C.
Clearing	6,000 SF along the banks for equipment access and approximately 2,400 SF for deflector wing walls (600 SF/each wing wall).	12,000 SF along the banks for equipment access and approximately 2,400 SF for deflector wing walls (600 SF/each wing wall).	15,000 SF along the banks for equipment access and approximately 2,400 SF for deflector wing walls (600 SF/each wing wall).
Work Zone	Approximately 6,000 SF	• Approximately 3,000 SF at each sheet pile • 1,000 SF area along each of the banks.	Same as Alternative D.
Construction crew requirements/logistics	Overall, a 10-man crew is anticipated to be required: 3- Barge operator/2 deck hands, 1- Landside supervisor, 1- On-water supervisor, 1- Landside operator, 1- Waterside operator, 2- Waterside field crew, 1- Water quality/Health and Safety officer	Same as Alternative C.	Same as Alternative C.
Waste management	• Waste is primarily expected from servicing and maintenance of equipment. • Waste would be maintained on the barge. • Portable toilets would be placed at the dam site.	Same as Alternative C.	Same as Alternative C.
Est. Cost	**$2,509,225**	**$4,006,617**	**$6,570,367**

Elements	Alt. C – Repair In Place	Alt. D – New 100' Plug (Marl Ridge Location)	Alt. G – New 370' Plug (Marl Ridge Location)
Mitigation Measures / BMPs	Construction outside crocodile nesting season, water quality monitoring, natural resources monitoring, turbidity monitoring, standard protection measures for Federally-listed species, periodical riprap maintenance	Same as Alternative C.	Same as Alternative C.
Structural Monitoring	Quarterly monitoring and after storm events.	Same as Alternative C.	Same as Alternative C.
Recreational Access/ Portage	• Prevents illegal motorized boat entry into the wilderness area. • Potential for vandals to attempt to alter the banks of the canal, enabling access for illegal motorized boats. • The deflector wing walls would mitigate this type of an activity. • Provides safe passage over the restored dam for non-motorized boaters. • Repair of the existing breached dam would still allow for tidal saltwater to overtop the dam during high water events. • To provide safe portage, an elevated floating dock structure (approximately 10'X10') would be constructed. • Warning signs would be posted in front of each of dock to notify boaters of a potential submerged dam structure.	• Prevents illegal motorized boat entry into the wilderness area. • The plug length would deter vandals from altering the canal banks. • The deflector wing walls would mitigate this type of an activity. • Provides safe passage over the restored dam for non-motorized boaters. • This requires a carry over the structure (100± feet). • An elevated floating dock structure (10'X10') would be constructed. • A hardened path would be constructed across the plug using a rip rap matt material. • Floating mooring buoys would be installed along the access channel to provide safe boat docking. • Warning signs would be posted in front of each of dock to notify boaters of a potential submerged dam structure.	Same as Alternative D, except that it requires a 370± feet carry over the structure.

Table 2.3 – Alternatives Comparison Matrix (Homestead Canal)

Elements	Alt. C – Repair Existing Dam	Alt D. – New 100' Earthen Fill Plug Alt G. – New 430' Earthen Fill-Marl Ridge Location	Alt D1. – New 100' Plug (Geotubes) Alt G1. – New 430' Plug Geotubes-Marl Ridge Location
Summary description of the alternative	• Repair existing steel sheet pile walls by extending them further inland. • Landward sheet piles would be installed to form flow deflector wing walls • Select fill material would be placed adjacent to the sheet pile as support. • Riprap would be used to provide erosion resistance.	• The plug would be constructed by installing two sheet pile walls 100'/430' apart. • The plug consists of fill material from an off-site location and planted native vegetation. • Riprap would be used to provide erosion resistance.	• Install an earthen dam using geotubes. • Existing sheetpile would be cut and removed. • The plug would be constructed by installing two sets of geotubes 100' /430' apart. • The plug consists of sand, top soil, and planted native vegetation. • Riprap would be used to provide erosion resistance.
Mobilization and staging areas	• Equipment and material would be mobilized to a suitable water transportation staging area in the Florida Keys by dump trucks. • A staging area in Sugar Loaf Key is considered to develop the cost estimates. • These materials would be loaded onto barges (approximately 100' long and 40' wide) and delivered to the project site. • Requires dredging the access channel within Lake Ingraham from the western terminus of the Ingraham canal to the Homestead canal due to the shallow water depths of the Lake.	Same as Alternative C.	• Same as Alternative C, except that fill material would be hydraulically pumped to the designated project site (and dredging would not be required) and the rip rap would be transported to the dam site from Lake Ingraham staging area using a helicopter.
Location of dam and/or plug	At the existing Dam location.	At a narrower site that is in better alignment with the marl ridge.	Geotubes would be positioned at the highest elevation point along the canals
Materials needed and transport	Required fill materials include sheetpile, select sand fill material and graded riprap.	Required fill materials include sheetpile, select sand fill material and graded riprap.	Required fill materials include select sand fill material and graded riprap.

Elements	Alt. C – Repair Existing Dam	Alt D. – New 100' Earthen Fill Plug Alt G. – New 430' Earthen Fill-Marl Ridge Location	Alt D1. – New 100' Plug (Geotubes) Alt G1. – New 430' Plug Geotubes-Marl Ridge Location
	Material: • 360 CY fill material to flatten canal slope. • 600 CY graded riprap for wing walls, the water, and the upland locations **Sheet Piling**: Approximately 2,700 SF. **Transportation:** Dump trucks and barges. **Equipment:** Barges (3), tug, crane w/vibratory pile driver, front end loader (3), excavators, backhoes (2) and mechanical dredge (1).	**Material:** • 2,000 CY/8,400 CY fill material for the plug between the two sheetpiles • 360 CY fill material for erosion control on the north and south sides and to flatten canal slope. • 600 CY graded riprap for wing walls, the water, and the upland locations **Sheet Piling**: Approximately 4,480 SF. **Transportation:** Same as Alternative C. **Equipment:** Same as Alternative C.	**Material:** • 2,000 CY/8,400 CY fill material for the plug between the two sets of geotubes • 30,000 CF geotube material and the select fabric to fill the geotubes • 535 CY graded riprap to cover geotubes at each end of the plug and the water. **Transportation:** • The materials would be transported to the Lake Ingraham staging area by barges. • A discharge pipeline would be extended from the staging area to the dam construction site and would be used to fill the geotubes and infill areas between the tubes. • The rip rap material would be airlifted by helicopter to the dam site. **Equipment:** Barges (9), tug, crane, front end loader (3), excavators and backhoes (2), hydraulic pipeline, booster pumps (2) and hopper barge (1), helicopter (1).
Upland Impact Area –Work Zone	Approximately 6,000 SF of area on each bank of the canal.	Same as Alternative C.	Approximately 2,000 SF of area as work zone on each bank of the canal
Clearing	7,000 SF along the banks and approximately 2,400 SF for deflector wing walls.	15,000 SF along the banks for equipment access and approximately 2,400 SF for deflector wing walls	15,000 SF along the banks and approximately 1,500 SF along the new proposed location.

Elements	Alt. C – Repair Existing Dam	Alt D. – New 100' Earthen Fill Plug Alt G. – New 430' Earthen Fill-Marl Ridge Location	Alt D1. – New 100' Plug (Geotubes) Alt G1. – New 430' Plug Geotubes-Marl Ridge Location
Construction crew requirements/ logistics	Overall, a 12-man crew is anticipated to be required as follows: 3- Tug boat operator/2 deck hands 1- Landside supervisor, 1- On-water supervisor, 1- Landside operator 1- Waterside operator 4- Waterside field crew 1- Water quality/Health and Safety officer.	Overall, a 16-man crew is anticipated to be required as follows: 3- Tug boat operator/2 deck hands 1- Landside supervisor 1-Dredge Operator 1- On-water supervisor 2-Deck ends 1- Landside operator 1- Waterside operator 4- Waterside field crew 2- Water quality/Health and Safety officer	Overall, a 15-man crew is anticipated to be required as follows: 3- Tug boat operator/2 deck hands 1- Landside supervisor 1- On-water supervisor 1- Landside operator 1- Waterside operator 4- Waterside field crew 2-Pipeline monitors 2- Water quality/Health and Safety officers
Waste management	• Waste is primarily expected to be generated from servicing and maintenance of equipment. • This waste is expected to be maintained on the barge. • Portable toilets would be arranged and placed at the dam site.	Same as Alternative C.	Same as Alternative C.
Estimated Cost	**$4,237,841**	**$6,398,121 / $9,961,511**	**$5,367,003 / $9,036,375**
Mitigation Measures / BMPs	Construction outside of crocodile nesting season, Water Quality monitoring, Natural Resources Monitoring, Turbidity Monitoring, Standard protection measures for Federally-listed species, Periodical riprap maintenance	Same as Alternative C.	Same as Alternative C.
Structural Monitoring	Quarterly monitoring and after storm events.	Same as Alternative C.	Same as Alternative C.

Elements	Alt. C – Repair Existing Dam	Alt D. – New 100' Earthen Fill Plug Alt G. – New 430' Earthen Fill-Marl Ridge Location	Alt D1. – New 100' Plug (Geotubes) Alt G1. – New 430' Plug Geotubes-Marl Ridge Location
Recreational Access/Portage	• This option would prevent illegal motorized boat entry into the wilderness area. • Potential exists for vandals to attempt to alter the banks of the canal beyond the outer edges of the dam, enabling access for illegal motorized boats. • The deflector wing walls would mitigate this type of an activity. • This option includes an engineering component to provide safe passage over the restored dam for non-motorized boaters. • However, repair of the existing breached dam would still allow for tidal saltwater to overtop the dam during high water events. • To provide safe portage, an elevated floating dock structure (approximately 10-ft by 10-ft) would be constructed. • A ladder would be placed on each dock to allow for in water access. • Floating mooring buoys would be installed along the access channel to provide safe boat docking. • Warning signs would be posted in front of each of dock to notify boaters of a potential submerged dam structure.	• This option would prevent illegal motorized boat entry into the wilderness area. • Due to the plug length, it would potentially deter and prevent vandals from altering the canal banks at this location. • The deflector wing walls would mitigate this type of an activity. • This option includes an engineering component to provide safe passage over the restored dam for non-motorized boaters. • However, this alternative would require a carry over the structure (100/430± feet). • To provide safe portage, an elevated floating dock structure (approximately 10-ft by 10-ft) would be constructed. • A ladder would be placed on each dock to allow for in water access. • A hardened path would be constructed across the plug using a rip rap matt material to provide passage across the plug to the other dock. • Floating mooring buoys would be installed along the access channel to provide safe boat docking. • Warning signs would be posted in front of each of dock to notify boaters of a potential submerged dam structure.	Same as Alternatives D/G

Table 2.4 – East Cape Extension Canal – Alternative C - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Sheetpile Installation Equipment - Mobilization**	1	LS	$50,000.00	$50,000
2	**Sheetpile Repair (30-linear ft)**				
	Sheetpile Material (30 ft by 20 ft) - 14 sections	14	EA	$2,500.00	$35,000
	Sheetpile Mobilization (14 sections/ 1 ton ea)	14	Tons	$3,500.00	$49,000
	Sheetpile Installation - Labor (3-4 sheets/day)	5	Day	$5,000.00	$25,000
	Fill Material to fill in erosion areas	1,000	CY	$50.00	$50,000
	Fill Material Mobilization	1,000	CY	$80.00	$80,000
3	**Sheetpile Deflector Wing Walls**				
	Sheetpile Material (25ft by 20 ft ea wing wall) - 45 Sections	45	EA	$2,500.00	$112,500
	Sheetpile Mobilization	45	Tons	$3,500.00	$157,500
	Sheetpile Installation - Labor (3-4 sheets/day)	15	Day	$5,000.00	$75,000
4	**Riprap**				
	Riprap Material Deflector Wing Wall (10-ft by 20-ft - 2 ft deep)	160	CY	$200.00	$32,000
	Riprap Mobilization Deflector Wing Wall Material	160	CY	$65.00	$10,400
	Riprap Material - Dam Sheetpile	180	CY	$200.00	$36,000
	Riprap Mobilization- Dam Sheetpile Material	180	CY	$65.00	$11,700
	Fill material - Dam Sheetpile (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Sheetpile	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
5	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$75,000.00	$75,000
	Portage	1	LS	$25,000.00	$25,000
	Erosion Control Measures	500	LF	$12.00	$6,000
	Subtotal Direct Construction Costs				**$981,800**
	Published Location Factor (-9.7 Percent)				($95,235)
	Remoteness Factor (20 %)				$196,360
	Federal Wage Rate Factor (0%)				$0
	Design Contingency (30 Percent)				$294,540
	Taxes (6.5% of materials and rental items)				$21,678
	Total Direct Construction Costs				**$1,377,465**
	Standard General Conditions (15 Percent)				$206,620
	Government General Conditions (7 Percent)				$96,423
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$20,662
	Subtotal NET Construction Cost				**$1,701,170**
	Overhead (15 Percent)				$255,175
	Profit (10 Percent)				$170,117
	Estimated NET Construction Cost				**$2,126,462**
	Contracting Method Adjustment (10%)				$212,646
	Inflation Escalation (24 Months)				$170,117
	Total Estimated NET Cost of Construction				**$2,509,225**

Table 2.5 – East Cape Extension Canal – Alternative D - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Sheetpile Installation Equipment - Mobilization**	1	LS	$50,000.00	$50,000
2	**Sheetpile Installation (40-linear ft)**				
	Sheetpile Material (60 ft by 20 ft) - 54 sections	54	EA	$2,500.00	$135,000
	Sheetpile Mobilization (54 sections/ 1 ton ea)	54	Tons	$3,500.00	$189,000
	Sheetpile Installation - Labor (3-4 sheets/day)	20	Day	$5,000.00	$100,000
	Remove Existing Sheetpile	22	EA	$500.00	$11,000
3	**Sheetpile Deflector Wing Walls**				
	Sheetpile Material (25ft by 20 ft ea wing wall) - 45 Sections	45	EA	$2,500.00	$112,500
	Sheetpile Mobilization	45	Tons	$3,500.00	$157,500
	Sheetpile Installation - Labor (3-4 sheets/day)	15	Day	$5,000.00	$75,000
4	**Riprap**				
	Riprap Material Deflector Wing Wall (10-ft by 20-ft - 2 ft deep)	160	CY	$200.00	$32,000
	Riprap Mobilization Deflector Wing Wall Material	160	CY	$65.00	$10,400
	Riprap Material - Dam Sheetpile	180	CY	$200.00	$36,000
	Riprap Mobilization- Dam Sheetpile Material	180	CY	$65.00	$11,700
	Fill material - Dam Sheetpile (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Sheetpile	360	CY	$80.00	$28,800
	Labor	12	Day	$3,000.00	$36,000
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
5	**Fill Material for Plug (100-ft by 60 ft by 8.5 ft)**				
	Fill Material (100-ft plug)	1,900	CY	$50.00	$95,000
	Mobilization of Fill Material (100-ft plug)	1,900	CY	$80.00	$152,000
	Labor - 12 days (150 cy/day)	12	EA	$7,500.00	$90,000
6	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$125,000.00	$125,000
	Portage	1	LS	$25,000.00	$25,000
	Erosion Control Measures	500	LF	$12.00	$6,000
	Subtotal Direct Construction Costs				**$1,564,800**
	Published Location Factor (-9.7 Percent)				($151,786)
	Remoteness Factor (20 %)				$312,960
	Federal Wage Rate Factor (0%)				$0
	Design Contingency (30 Percent)				$469,440
	Taxes (6.5% of materials and rental items)				$31,103
	Total Direct Construction Costs				**$2,226,517**
	Standard General Conditions (15 Percent)				$333,978
	Government General Conditions (7 Percent)				$155,856
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$33,398
	Subtotal NET Construction Cost				**$2,716,351**
	Overhead (15 Percent)				$407,453
	Profit (10 Percent)				$271,635
	Estimated NET Construction Cost				**$3,395,438**
	Contracting Method Adjustment (10%)				$339,544
	Inflation Escalation (24 Months, 4%)				$271,635
	Total Estimated NET Cost of Construction				**$4,006,617**

Table 2.6 – East Cape Extension Canal – Alternative G - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Sheetpile Installation Equipment - Mobilization**	1	LS	$50,000.00	$50,000
2	**Sheetpile Installation (60-linear ft)**				
	Sheetpile Material (60 ft by 20 ft) - 54 sections	54	EA	$2,500.00	$135,000
	Sheetpile Mobilization (54 sections/ 1 ton ea)	54	Tons	$3,500.00	$189,000
	Sheetpile Installation - Labor (3-4 sheets/day)	20	Day	$5,000.00	$100,000
	Remove Existing Sheetpile	22	EA	$500.00	$11,000
3	**Sheetpile Deflector Wing Walls**				
	Sheetpile Material (25ft by 20 ft ea wing wall) - 45 Sections	45	EA	$2,500.00	$112,500
	Sheetpile Mobilization	45	Tons	$3,500.00	$157,500
	Sheetpile Installation - Labor (3-4 sheets/day)	15	Day	$5,000.00	$75,000
4	**Riprap**				
	Riprap Material Deflector Wing Wall (10-ft by 20-ft - 2 ft deep)	160	CY	$200.00	$32,000
	Riprap Mobilization Deflector Wing Wall Material	160	CY	$65.00	$10,400
	Riprap Material - Dam Sheetpile	180	CY	$200.00	$36,000
	Riprap Mobilization- Dam Sheetpile Material	180	CY	$65.00	$11,700
	Fill material - Dam Sheetpile (30'long X 8'high at 2.5:1 slope	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Sheetpile	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
5	**Fill Material for Plug (370-ft by 60 ft by 8.5 ft)**				
	Fill Material (370 -ft plug)	7,000	CY	$50.00	$350,000
	Mobilization of Fill Material (370-ft plug)	7,000	CY	$80.00	$560,000
	Labor - 46 days (150 cy/day)	46	EA	$7,500.00	$345,000
6	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$175,000	$175,000
	Portage	1	LS	$25,000.00	$25,000
	Erosion Control Measures	500	LF	$12.00	$6,000
	Subtotal Direct Construction Costs				**$2,532,800**
	Published Location Factor (-9.7 Percent)				($177,296)
	Remoteness Factor (20 %)				$303,936
	Federal Wage Rate Factor (0%)				$60,787
	Design Contingency (30 Percent)				$759,840
	Taxes (6.5% of materials and rental items)				$47,677.50
	Total Direct Construction Costs				**$3,480,067**
	Standard General Conditions (15 Percent)				$626,412
	Government General Conditions (7 Percent)				$348,007
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$52,201
	Subtotal NET Construction Cost				**$4,454,486**
	Overhead (15 Percent)				$668,173
	Profit (10 Percent)				$445,449
	Estimated NET Construction Cost				**$5,568,108**
	Contracting Method Adjustment (10%)				$556,811
	Inflation Escalation (24 Months)				$445,449
	Total Estimated NET Cost of Construction				**$6,570,367**

Table 2.7 – Homestead Canal – Alternative C - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Sheetpile Installation Equipment - Mobilization**	1	LS	$50,000.00	$50,000
2	**Sheetpile Repair (35-linear ft)**				
	Sheetpile Material (35 ft by 20 ft) - 16 sections	16	EA	$2,500.00	$40,000
	Sheetpile Mobilization (16 sections/ 1 ton ea)	16	Tons	$3,500.00	$56,000
	Sheetpile Installation - Labor (3-4 sheets/day)	5	Day	$5,000.00	$25,000
3	**Sheetpile Deflector Wing Walls**				
	Sheetpile Material (25ft by 20 ft ea wing wall) - 45 Sections	45	EA	$2,500.00	$112,500
	Sheetpile Mobilization	45	Tons	$3,500.00	$157,500
	Sheetpile Installation - Labor (3-4 sheets/day)	15	Day	$5,000.00	$75,000
4	**Riprap**				
	Riprap Material Deflector Wing Wall (10-ft by 20-ft - 2 ft deep)	160	CY	$200.00	$32,000
	Riprap Mobilization Deflector Wing Wall Material	160	CY	$65.00	$10,400
	Riprap Material - Dam Sheetpile	180	CY	$200.00	$36,000
	Riprap Mobilization- Dam Sheetpile Material	180	CY	$65.00	$11,700
	Fill material - Dam Sheetpile (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Sheetpile	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
5	**Dredging**				
	Dredging Equipment Mobilization	1	LS	$100,000.00	$100,000
	Dredging Labor and Process	38,000	CY	$11.00	$418,000
	Based on dredge material being discharged on-site, permitting not included				
6	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$75,000.00	$75,000
	Fill material - Breach Area	500	CY	$50.00	$25,000
	Fill Material Mobilization - Breach Area	500	CY	$80.00	$40,000
	Portage	1	LS	$25,000.00	$25,000
	Erosion Control Measures	17,000	LF	$12.00	$204,000
	Subtotal Direct Construction Costs				**$1,644,800**
	Published Location Factor (-9.7 Percent)				($159,546)
	Remoteness Factor (20 %)				$328,960
	Federal Wage Rate Factor (0%)				$0
	Design Contingency (30 Percent)				$493,440
	Taxes (6.5% of materials and rental items)				$18,753
	Total Direct Construction Costs				**$2,326,407**
	Standard General Conditions (15 Percent)				$348,961
	Government General Conditions (7 Percent)				$162,848
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$34,896
	Subtotal NET Construction Cost				**$2,873,113**
	Overhead (15 Percent)				$430,967
	Profit (10 Percent)				$287,311
	Estimated NET Construction Cost				**$3,591,391**
	Contracting Method Adjustment (10%)				$359,139
	Inflation Escalation (24 Months, 4%)				$287,311
	Total Estimated NET Cost of Construction				**$4,237,841**

Table 2.8 – Homestead Canal – Alternative D - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Sheetpile Installation Equipment - Mobilization**	1	LS	$50,000.00	$50,000
2	**Sheetpile Installation (62-linear ft)**				
	Sheetpile Material (62 ft by 20 ft) - 56 sections	56	EA	$2,500.00	$140,000
	Sheetpile Mobilization (56 sections/ 1 ton ea)	56	Tons	$3,500.00	$196,000
	Sheetpile Installation - Labor (3-4 sheets/day)	20	Day	$5,000.00	$100,000
	Remove Existing Sheetpile	22	EA	$500.00	$11,000
3	**Sheetpile Deflector Wing Walls**				
	Sheetpile Material (25ft by 20 ft ea wing wall) - 45 Sections	45	EA	$2,500.00	$112,500
	Sheetpile Mobilization	45	Tons	$3,500.00	$157,500
	Sheetpile Installation - Labor (3-4 sheets/day)	15	Day	$5,000.00	$75,000
4	**Riprap**				
	Riprap Material Deflector Wing Wall (10-ft by 20-ft - 2 ft deep)	160	CY	$200.00	$32,000
	Riprap Mobilization Deflector Wing Wall Material	160	CY	$65.00	$10,400
	Riprap Material - Dam Sheetpile	180	CY	$200.00	$36,000
	Riprap Mobilization- Dam Sheetpile Material	180	CY	$65.00	$11,700
	Fill material - Dam Sheetpile (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Sheetpile	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
5	**Dredging**				
	Dredging Equipment Mobilization	1	LS	$100,000.00	$100,000
	Dredging Labor and Process	38,000	CY	$11.00	$418,000
	Based on Dredge material being discharged on-site, permitting not included				
6	**Fill Material for Plug (100-ft by 62 ft by 8.5 ft)**				
	Fill Material (100-ft plug)	2,000	CY	$50.00	$100,000
	Mobilization of Fill Material (100-ft plug)	2,000	CY	$80.00	$160,000
	Labor - 14 days (150 cy/day)	14	EA	$12,500.00	$175,000
7	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$150,000.00	$150,000
	Fill material - Breach Area	500	CY	$50.00	$25,000
	Fill Material Mobilization - Breach Area	500	CY	$80.00	$40,000
	Portage	1	LS	$25,000.00	$25,000
	Erosion Control Measures	17,000	LF	$12.00	$204,000
	Subtotal Direct Construction Costs				**$2,480,800**
	Published Location Factor (-9.7 Percent)				($240,638)
	Remoteness Factor (20 %)				$496,160
	Federal Wage Rate Factor (0%)				$0
	Design Contingency (30 Percent)				$744,240
	Taxes (6.5% of materials and rental items)				$31,753
	Total Direct Construction Costs				**$3,512,315**
	Standard General Conditions (15 Percent)				$526,847
	Government General Conditions (7 Percent)				$245,862
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$52,685
	Subtotal NET Construction Cost				**$4,337,709**
	Overhead (15 Percent)				$650,656
	Profit (10 Percent)				$433,771
	Estimated NET Construction Cost				**$5,422,136**
	Contracting Method Adjustment (10%)				$542,214
	Inflation Escalation (24 Months)				$433,771
	Total Estimated NET Cost of Construction				**$6,398,121**

Table 2.9 – Homestead Canal – Alternative G - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Sheetpile Installation Equipment - Mobilization**	1	LS	$50,000.00	$50,000
2	**Sheetpile Installation (62-linear ft)**				
	Sheetpile Material (62 ft by 20 ft) - 56 sections	56	EA	$2,500.00	$140,000
	Sheetpile Mobilization (56 sections/ 1 ton ea)	56	Tons	$3,500.00	$196,000
	Sheetpile Installation - Labor (3-4 sheets/day)	20	Day	$5,000.00	$100,000
	Remove Existing Sheetpile	22	EA	$500.00	$11,000
3	**Sheetpile Deflector Wing Walls**				
	Sheetpile Material (25ft by 20 ft ea wing wall) - 45 Sections	45	EA	$2,500.00	$112,500
	Sheetpile Mobilization	45	Tons	$3,500.00	$157,500
	Sheetpile Installation - Labor (3-4 sheets/day)	15	Day	$5,000.00	$75,000
4	**Riprap**				
	Riprap Material Deflector Wing Wall (10-ft by 20-ft - 2 ft deep)	160	CY	$200.00	$32,000
	Riprap Mobilization Deflector Wing Wall Material	160	CY	$65.00	$10,400
	Riprap Material - Dam Sheetpile	180	CY	$200.00	$36,000
	Riprap Mobilization- Dam Sheetpile Material	180	CY	$65.00	$11,700
	Fill material - Dam Sheetpile (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Sheetpile	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
5	**Dredging**				
	Dredging Equipment Mobilization	1	LS	$100,000.00	$100,000
	Dredging Labor and Process	38,000	CY	$11.00	$418,000
	Based on Dredge material being discharged on-site, permitting not included				
6	**Fill Material for Plug (430-ft by 62 ft by 8.5 ft)**				
	Fill Material (430 -ft plug)	8,400	CY	$50.00	$420,000
	Mobilization of Fill Material (100-ft plug)	8,400	CY	$80.00	$672,000
	Labor - 14 days (150 cy/day)	56	EA	$7,500.00	$420,000
7	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$200,000.00	$200,000
	Fill material - Breach Area	500	CY	$50.00	$25,000
	Fill Material Mobilization - Breach Area	500	CY	$80.00	$40,000
	Portage	1	LS	$25,000.00	$25,000
	Erosion Control Measures	17,000	LF	$12.00	$204,000
	Subtotal Direct Construction Costs				**$3,607,800**
	Published Location Factor (-9.7 Percent)				($349,957)
	Remoteness Factor (20 %)				$721,560
	Federal Wage Rate Factor (0%)				$0
	Design Contingency (30 Percent)				$1,082,340
	Taxes (6.5% of materials and rental items)				$52,552.50
	Total Direct Construction Costs				**$5,061,743**
	Standard General Conditions (15 Percent)				$911,114
	Government General Conditions (7 Percent)				$506,174
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$75,926
	Subtotal NET Construction Cost				**$6,479,032**
	Overhead (15 Percent)				$971,855
	Profit (10 Percent)				$647,903
	Estimated NET Construction Cost				**$8,098,789**
	Contracting Method Adjustment (Sole Source)				$1,214,818
	Inflation Escalation (24 Months)				$647,903
	Total Estimated NET Cost of Construction				**$9,961,511**

Table 2.10 – Homestead Canal – Alternative D1 - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Lake Ingraham Staging Area Mobilization and Setup**	1	LS	$200,000	$200,000
2	**Hydrualic Pipeline Placement and Setup**	1	LS	$100,000	$100,000
3	**Geotube Placement Preparation**				
	Fill for Canal Bottom Preparation (62-ft by 40-ft by by 2ft)/side	368	CY	$50	$18,400
	Material Mobilization to Lake Staging Area	368	CY	$80	$29,440
	Material Placement from Lake Staging Area to New Dam Site	4	Day	$12,500	$50,000
	Based on 150 cy/day				
4	**Geotube Material and Installation**				
	Geotube Material (180 cy/tube - total of 6 geotubes)	30,000	CF	$1.5	$45,000
	Fill (Sand) Material for Geotubes	1,080	CY	$50	$54,000
	Material Mobilization to Lake Staging Area	1,080	CY	$80	$86,400
	Material Placement from Lake Staging Area to New Dam Site	22	Day	$12,500	$275,000
	Based on 50 cy/day				
5	**Fill Material for Plug**				
	Fill Material (100-ft plug)	2,000	CY	$50	$100,000
	Mobilization of Fill Material (100-ft plug)	2,000	CY	$80	$160,000
	Labor - 14 days (150 cy/day)	14	Day	$12,500	$175,000
6	**Riprap**				
	Riprap Material - Geotubes Dam	275	CY	$200.00	$55,000
	Riprap Mobilization to Lake Ingraham from staging area	275	CY	$65.00	$17,875
	Riprap Mobilization from Lake to Dam Site- Dam Geotubes*	32	Hrs	$6,000.00	$192,000
	Fill material - Dam Geotube (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Geotubes	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
7	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$75,000	$75,000
	Fill material - Breach Area	500	CY	$50.00	$25,000
	Fill Material Mobilization - Breach Area (Helicopter)	24	Hrs	$6,000.00	$144,000
	Portage	1	LS	$25,000	$25,000
	Erosion Control Measures	500	LF	$12.00	$6,000
	Subtotal Direct Construction Costs				**$1,984,815**
	Published Location Factor (-9.7 Percent)				($138,937)
	Remoteness Factor (20 %)				$238,178
	Federal Wage Rate Factor (0%)				$47,636
	Design Contingency (30 Percent)				$595,445
	Taxes (6.5% of materials and rental items)				$31,876.00
	Total Direct Construction Costs				**$2,727,136**
	Standard General Conditions (15 Percent)				$490,884
	Government General Conditions (7 Percent)				$272,714
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$40,907
	Subtotal NET Construction Cost				**$3,490,734**
	Overhead (15 Percent)				$523,610
	Profit (10 Percent)				$349,073
	Estimated NET Construction Cost				**$4,363,417**
	Contracting Method Adjustment (Sole Source)				$654,513
	Inflation Escalation (24 Months)				$349,073
	Total Estimated NET Cost of Construction				**$5,367,003**

* Based on a total quantity of 275CY and verbal quote from Firehawk Helicopters, Inc. and Brainerd Helicopters, Inc.

Table 2.11 – Homestead Canal – Alternative G1 - Class C Cost Estimate

Item No.	Description	Quantity	Unit	Cost/Unit	Total
1	**Lake Ingraham Staging Area Mobilization and Setup**	1	LS	$200,000	$200,000
2	**Hydrualic Pipeline Placement and Setup**	1	LS	$100,000	$100,000
3	**Geotube Placement Preparation**				
	Fill for Canal Bottom Preparation (62-ft by 40-ft by by 2ft)/side	368	CY	$50	$18,400
	Material Mobilization to Lake Staging Area	368	CY	$80	$29,440
	Material Placement from Lake Staging Area to New Dam Site	4	Day	$12,500	$50,000
	Based on 150 cy/day				
4	**Geotube Material and Installation**				
	Geotube Material (180 cy/tube - total of 6 geotubes)	30,000	CF	$1.5	$45,000
	Fill (Sand) Material for Geotubes	1,080	CY	$50	$54,000
	Material Mobilization to Lake Staging Area	1,080	CY	$80	$86,400
	Material Placement from Lake Staging Area to New Dam Site	22	Day	$12,500	$275,000
	Based on 50 cy/day				
5	**Fill Material for Plug**				
	Fill Material (430-ft plug)	8,400	CY	$50	$420,000
	Mobilization of Fill Material (100-ft plug)	8,400	CY	$80	$672,000
	Labor - 14 days (150 cy/day)	56	Day	$12,500	$700,000
6	**Riprap**				
	Riprap Material - Geotubes Dam	275	CY	$200.00	$55,000
	Riprap Mobilization to Lake Ingraham from staging area- Geotube Dam	275	CY	$65.00	$17,875
	Riprap Mobilization from Lake to Dam Site- Dam Geotubes*	32	Hrs	$6,000.00	$192,000
	Fill material - Dam Geotube (30'long X 8'high at 2.5:1 slope)	360	CY	$50.00	$18,000
	Fill Material Mobilization - Dam Geotubes	360	CY	$80.00	$28,800
	Riprap Material - 50' along banks	260	CY	$200.00	$52,000
	Riprap Mobilization- 50' along banks	260	CY	$65.00	$16,900
	Labor	12	Day	$3,000.00	$36,000
7	**Allocations**				
	Clearing of Woody Vegetation	1	LS	$75,000	$75,000
	Fill material - Breach Area	500	CY	$50.00	$25,000
	Fill Material Mobilization - Breach Area (Helicopter)	24	Hrs	$6,000.00	$144,000
	Portage	1	LS	$25,000	$25,000
	Erosion Control Measures	500	LF	$12.00	$6,000
	Subtotal Direct Construction Costs				**$3,341,815**
	Published Location Factor (-9.7 Percent)				($233,927)
	Remoteness Factor (20 %)				$401,018
	Federal Wage Rate Factor (0%)				$80,204
	Design Contingency (30 Percent)				$1,002,545
	Taxes (6.5% of materials and rental items)				$52,676.00
	Total Direct Construction Costs				**$4,591,654**
	Standard General Conditions (15 Percent)				$826,498
	Government General Conditions (7 Percent)				$459,165
	Historic Preservation Factor (N/A)				$0
	Bonds and Permits (1.5%)				$68,875
	Subtotal NET Construction Cost				**$5,877,317**
	Overhead (15 Percent)				$881,598
	Profit (10 Percent)				$587,732
	Estimated NET Construction Cost				**$7,346,646**
	Contracting Method Adjustment (Sole Source)				$1,101,997
	Inflation Escalation (24 Months)				$587,732
	Total Estimated NET Cost of Construction				**$9,036,375**

* Based on a total quantity of 275CY and verbal quote from Firehawk Helicopters, Inc. and Brainerd Helicopters, Inc.

Table 2.12 – Analysis of How Alternatives Meet Objectives (East Cape Extension Canal)

Project Objectives	Objectives Matrix (East Cape Canal)			
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative G (Marl Ridge Plug)**
Natural Resources				
Restrict the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through these canals, thereby restoring the natural hydrology of the area	This alternative does not meet the project objective. The existing breached dam would allow continued flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby deteriorating the natural hydrology of the area. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby enhancing the natural hydrology of the area. However, the potential for erosion of the banks would still exist, although minimized with armoring. Additionally, overtopping of the dam would occur during high water events. *Rank: Moderate*	This alternative fully meets the project objective. Replacing the existing breached dam with a 100-foot plug constructed of sheet pile and fill material would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby enhancing the natural hydrology of the area. The potential for erosion is minimized due to the length of the plug. Overtopping damage would be minimal due to rooted vegetation (planted) and dissipation of energy over length of the plug. *Rank: High*	This alternative fully meets the project objective. Replacing the existing breached dam with a plug the width of the marl ridge - constructed of sheet pile and fill material - would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby enhancing the natural hydrology of the area. The potential for erosion is minimized due to the length of the plug and the location at the highest elevation in the area, which serves as a natural hydrologic barrier. Overtopping damage would be minimal due to rooted vegetation (planted) and dissipation of energy over length of the plug. *Rank: High*
Reduce freshwater loss from freshwater and brackish interior marshes through the East Cape and Homestead canals	This alternative does not meet the project objective. The existing breached dam would continue to allow freshwater loss from interior marshes through the East Cape canal. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would reduce freshwater loss from interior marshes through the East Cape canal. However, the potential for erosion of the banks would still exist, although minimized with armoring, which would allow minimal freshwater loss. *Rank: Moderate*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheet pile and fill material would substantially reduce freshwater loss from interior marshes through the East Cape canal. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug the width of the marl ridge - constructed of sheet pile and fill material - would substantially reduce freshwater loss from interior marshes through the East Cape canal. *Rank: High*

Project Objectives	Objectives Matrix (East Cape Canal)			
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative G (Marl Ridge Plug)**
Improve habitat for juvenile crocodiles, wading birds, forage fish and other wildlife within the freshwater and brackish marshes north of the marl ridge	This alternative does not meet the project objective. The existing breached dam would allow continued flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby deteriorating habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. The potential for erosion along the banks is also minimized with armoring. Additionally, overtopping of the dam would occur during high water events. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheet pile and fill material would substantially restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. While the potential exists for some crocodile nesting habitat to be temporarily removed during construction of the plug, the habitat would be replaced by the fill material used for the plug. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug the width of the marl ridge - constructed of sheet pile and fill material - would substantially restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. While the potential exists for some crocodile nesting habitat to be temporarily removed during construction of the plug, the habitat would be replaced by the fill material used for the plug. *Rank: High*
Slow the rate of marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes	This alternative does not meet the project objective. The existing breached dam would continue to allow marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. However, the potential for erosion of the banks would still exist, although minimized with armoring, which would allow minimal loss of sediment and nutrients. *Rank: Moderate*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheet pile and fill material would substantially reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug the width of the marl ridge - constructed of sheet pile and fill material - would substantially reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: High*

Project Objectives	Objectives Matrix (East Cape Canal)			
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative G (Marl Ridge Plug)**
Reduce/eliminate adverse impacts to marine resources	This alternative does not meet the project objective. The existing breached dam would allow continued flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby continuing to further deteriorate existing marsh and mangrove habitats (adversely impacting EFH). *Rank: Nil*	This alternative meets the project objective. Repair of the existing dam would restrict the saltwater flow into freshwater/brackish marshes north of the marl ridge, thereby increasing the potential for sustainability of the freshwater/brackish habitats north of the marl ridge. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Moreover, no marine wildlife would be adversely impacted during construction through the use of BMPs. Minimal impacts to coastal vegetation/habitat are anticipated due to construction. *Rank: Moderate*	This alternative meets the project objective. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Plugging of the existing dam would restrict saltwater flow into freshwater/brackish marshes north of the marl ridge (that constitute EFH for some marine species), thereby increasing the potential for sustainability of the freshwater/ brackish habitats north of the marl ridge. No marine wildlife would be adversely impacted during construction through the use of BMPs. Moderate impacts to coastal habitat are anticipated due to construction. *Rank: Moderate to High*	This alternative meets the project objective. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Plugging of the existing breached dam would restrict flow of saltwater into freshwater marshes north of the Cape Sable marl ridge (that constitute EFH for some marine species), thereby increasing the potential for sustainability of the freshwater/ brackish habitats north of the marl ridge. Moreover, no marine wildlife would be adversely impacted during construction through the use of BMPs. Moderate impacts to coastal vegetation/habitat are anticipated due to construction. *Rank: Moderate to High*
Cultural Resources				
Avoid adverse impacts to the Homestead and East Cape canals, which are historic structures, through project design or mitigation measures	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. However, the banks of the East Cape canal are being eroded by tidal flow into and out of the canal in the vicinity of the existing breached dam, thereby causing adverse impacts to the historic structure, and thus not meeting the project objectives. *Rank: Nil*	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. However, while the repair would alter the original function of the canal, the footprint/ configuration would not be altered, hence maintaining the integrity of the historic structure (causing the least impact to the historic integrity of the canal). Also, due to the minor amount of earthwork required for this alternative, potential impacts to archaeological and/or ethnographic resources are anticipated to be negligible, if any. Staging areas would avoid cultural resources identified through SEAC survey. *Rank: High*	This alternative mostly meets the project objective - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canal and potential unidentified resources from construction activities. While the 100-foot plug (sheet pile and fill material) would alter the original function of the canal, the footprint/configuration would only be slightly altered, hence mostly maintaining the integrity of the historic structure. Also, due to the substantial amount of earthwork required for this alternative (i.e., filling a 100-foot section of the canal), potential impacts to archaeological and/or ethnographic resources are anticipated to be minimal, if any. Staging areas would avoid cultural resources identified through SEAC survey. *Rank: Moderate*	This alternative mostly meets the project objective - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canal and potential unidentified resources from construction activities.. While the plug (sheet pile and fill material) would alter the original function of the canal, the footprint/configuration would only be slightly altered, hence mostly maintaining the integrity of the historic structure. Also, due to the substantial amount of earthwork required for this alternative (i.e., filling a section of the canal), potential impacts to archaeological and/or ethnographic resources are anticipated to be minimal, if any. Staging areas would avoid cultural resources identified through SEAC survey. *Rank: Moderate*

Project Objectives	Objectives Matrix (East Cape Canal)			
	Alternative A (No Build)	Alternative C (Repair)	Alternative D (100' Plug)	Alternative G (Marl Ridge Plug)
Replacement Structure Longevity				
Replacement dams or geotubes would be designed to prevent vandals from breaching a dam by trenching around or through it, or damaging the geotubes	This alternative does not meet the project objective. The existing dam structure has been breached. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would consist of additional sheet pile and armoring/reinforcement with riprap, which would discourage vandals from being able to trench around the immediate vicinity of the dam. However, this would not discourage vandals from creating a new pathway further landward of the outer edge of new sheet pile/riprap. *Rank: Moderate to Low*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheet pile and fill material and reinforced with riprap is anticipated to discourage vandals from trenching around the structure due to its length. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug constructed of sheet pile and fill material and reinforced with riprap is anticipated to discourage vandals from trenching around the structure due to its length. *Rank: High*
Replacement structures would be designed to last at least 50 years (barring severe damage by catastrophic hurricane events) with annual/bi-annual maintenance	This alternative does not meet the project objective. The existing dam structure has been breached and is in need of immediate repair and continued maintenance. *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would consist of additional sheet pile and reinforcement with armoring (riprap) with the goal of 50-year sustainability. However, the risk of a catastrophic failure of the structure from a hurricane event is slightly higher than Alternatives D or G. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheet pile and fill material and reinforced with armoring (riprap) with the goal of 50-year sustainability. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of sheet pile and fill material and reinforced with armoring (riprap) with the goal of 50-year sustainability. *Rank: High*
Visitor Use and Experience				
Provide safe passage over restored dams for canoeists/ kayakers	This alternative does not meet the project objective. The existing breached dam does not provide safe passage over the structure. Fast flowing water produces dangerous currents and eddies (around the breached dam), which would trap and capsize small watercraft. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, repair of the existing breached dam would still allow for tidal saltwater to overtop the dam during high water events, posing a safety hazard to motorized and non-motorized boaters. Rank: *Moderate*	This alternative meets the project objective. Plugging of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, this alternative would require a 100-foot carry over the structure (100 feet). Rank: *Moderate to High*	This alternative meets the project objective. Plugging of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, this alternative would require a 370-foot carry over the structure. Rank: *Moderateto High*

Project Objectives	Objectives Matrix (East Cape Canal)			
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative G (Marl Ridge Plug)**
Resolve safety issues associated with the existing failed sheetpile structures	This alternative does not meet the project objective. The existing breached dam is a safety hazard to visitors. Fast flowing water produces dangerous currents and eddies (around the breached dam), which would trap and capsize small watercraft. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would eliminate fast flowing water currents and eddies in vicinity of the repaired dam. However, there would still be potential for overtopping during high water events in which the dam would pose a safety hazard to motorized and non-motorized boaters. Additionally, the potential for erosion or vandalism of the banks and the associated safety hazard still remains. Rank: *Moderate*	This alternative meets the project objective. Plugging of a 100-foot section of the canal would eliminate fast flowing water currents and eddies in vicinity of the dam. Due to the length of the plug, the energy produced by overtopping waters would be dissipated resulting in a diminished or possibly negligible effect in regards to safety, especially once the fill material is stabilized with plantings. Rank: *High*	This alternative meets the project objective. Plugging of a section of the canal would eliminate fast flowing water currents and eddies in vicinity of the dam. Due to the length of the plug, the energy produced by overtopping waters would be dissipated resulting in a diminished or possibly negligible effect in regards to safety, especially once the fill material is stabilized with plantings. Rank: *High*
Improve the wilderness visitor experience by eliminating/reducing illegal motorized boat entry into the Marjory Stoneman Douglas Wilderness Area	This alternative does not meet the project objective. The existing breached dam allows illegal motorized boat entry into the wilderness area beyond the East Cape canal dam, thereby diminishing the wilderness visitor experience. *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. However, the potential exists for vandals to alter the banks of the canal beyond the outer edges of the dam, enabling access for illegal motorized boats. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheet pile and fill material would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. Due to the plug length, it would potentially deter vandals from altering the canal banks at this location. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of sheet pile and fill material would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. Due to the plug length, it would potentially deter vandals from altering the canal banks at this location. *Rank: High*

Legend:
Nil - Does not meet any elements of the project objectives
Low - Meets some elements of the project objectives
Moderate - Meets most elements of the project objectives
High - Meets all elements of the project objectives

Table 2.13 – Analysis of How Alternatives Meet Objectives (Homestead Canal)

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative D1 (100' Geotube Plug)**	**Alternative G (Marl Ridge Plug)**	**Alternative G1 (Marl Ridge Geotube Plug)**
Natural Resources						
Restrict the unnatural flow of saltwater into freshwater and brackish marshes north of the Cape Sable marl ridge through these canals, thereby restoring the natural hydrology of the area	This alternative does not meet the project objective. The existing breached dam would allow continued flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby deteriorating the natural hydrology of the area. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby enhancing the natural hydrology of the area. However, the potential for erosion of the banks would still exist, although minimized with armoring. Additionally, overtopping of the dam would occur during high water events. *Rank: Moderate*	This alternative fully meets the project objective. Replacing the existing breached dam with a 100-foot plug constructed of sheetpile and fill material would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby enhancing the natural hydrology of the area. The potential for erosion is minimized due to the length of the plug. Overtopping damage would be minimal due to rooted vegetation (planted) and dissipation of energy over length of the plug. *Rank: High*	This alternative fully meets the project objective. Replacing the existing breached dam with a 100-foot plug constructed of geotubes and fill material would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby enhancing the natural hydrology of the area. The potential for erosion is minimized due to the length of the plug. Overtopping damage would be minimal due to rooted vegetation (planted) and dissipation of energy over length of the plug. *Rank: High*	This alternative fully meets the project objective. Replacing the existing dam with a plug the width of the marl ridge - constructed of sheetpile - would restrict the flow of saltwater into freshwater marshes north of the marl ridge, thereby enhancing the natural hydrology of the area. The potential for erosion is minimized due to the length of the plug and the location at the highest elevation in the area, which serves as a natural hydrologic barrier. Overtopping damage would be minimal due to rooted vegetation (planted) and dissipation of energy over length of the plug. *Rank: High*	This alternative fully meets the project objective. Replacing the existing dam with a plug the width of the marl ridge - constructed of geotubes - would restrict the flow of saltwater into freshwater marshes north of the marl ridge, thereby enhancing the natural hydrology of the area. The potential for erosion is minimized due to the length of the plug and the location at the highest elevation in the area, which serves as a natural hydrologic barrier. Overtopping damage would be minimal due to rooted vegetation (planted) and dissipation of energy over length of the plug. *Rank: High*
Reduce freshwater loss from freshwater and brackish interior marshes through the East Cape and Homestead canals	This alternative does not meet the project objective. The existing breached dam would continue to allow freshwater loss from interior marshes through the Homestead canal. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would reduce freshwater loss from interior marshes through the Homestead canal. However, the potential for erosion of the banks would still exist, although minimized with armoring, which would allow minimal freshwater loss. *Rank: Moderate*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheetpile and fill material would substantially reduce freshwater loss from interior marshes through the Homestead canal. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of geotubes and fill material would substantially reduce freshwater loss from interior marshes through the Homestead canal. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug constructed of sheetpile and fill material would substantially reduce freshwater loss from interior marshes through the Homestead canal. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug constructed of geotubes and fill material would substantially reduce freshwater loss from interior marshes through the Homestead canal. *Rank: High*

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative D1 (100' Geotube Plug)**	**Alternative G (Marl Ridge Plug)**	**Alternative G1 (Marl Ridge Geotube Plug)**
Improve habitat for juvenile crocodiles, wading birds, forage fish and other wildlife within the freshwater and brackish marshes north of the marl ridge	This alternative does not meet the project objective. The existing breached dam would allow continued flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby deteriorating habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. However, the potential for erosion of the banks would still exist, although minimized with armoring, which would allow minimal saltwater intrusion. Additionally, overtopping of the dam would occur during high water events. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheetpile and fill material would substantially restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. While the potential exists for some crocodile nesting habitat to be temporarily removed during construction of the plug, the habitat would be replaced by the fill material used for the plug. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of geotubes and fill material would substantially restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. While the potential exists for some crocodile nesting habitat to be temporarily removed during construction of the plug, the habitat would be replaced by the fill material used for the plug. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of sheetpile and fill material would substantially restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. While the potential exists for some crocodile nesting habitat to be temporarily removed during construction of the plug, the habitat would be replaced by the fill material used for the plug. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of geotubes and fill material would substantially restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, improving habitat for juvenile crocodiles, wading birds, forage fish, and other wildlife within the marshes north of the marl ridge. While the potential exists for some crocodile nesting habitat to be temporarily removed during construction of the plug, the habitat would be replaced by the fill material used for the plug. *Rank: High*
Slow the rate of marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes	This alternative does not meet the project objective. The existing breached dam would continue to allow marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. The potential for erosion along the banks is also minimized with armoring. *Rank: Moderate*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheetpile and fill material would substantially reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of geotubes and fill material would substantially reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug the width of the marl ridge - constructed of sheetpile and fill material - would substantially reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug the width of the marl ridge - constructed of geotubes and fill material - would substantially reduce marsh collapse and loss of sediment and nutrients from the interior freshwater and brackish marshes. *Rank: High*

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative D1 (100' Geotube Plug)**	**Alternative G (Marl Ridge Plug)**	**Alternative G1 (Marl Ridge Geotube Plug)**
Reduce/ eliminate adverse impacts to marine resources	This alternative does not meet the project objective. The existing breached dam would allow continued flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby continuing to further deteriorate existing marsh and mangrove habitats (adversely impacting EFH). *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would restrict the flow of saltwater into freshwater marshes north of the Cape Sable marl ridge, thereby increasing the potential for sustainability of the freshwater/brackish habitats north of the marl ridge. Additionally, the amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Moreover, no marine wildlife would be adversely impacted during construction through the use of Best Management Practices. Minor impacts to coastal vegetation/habitat are anticipated due to construction and short-term, moderate impacts to marine resources are anticipated due to dredging required for construction. *Rank: Moderate*	This alternative meets the project objective. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Plugging of the existing breached dam would restrict flow of saltwater into freshwater/brackish marshes north of the Cape Sable marl ridge (that constitute EFH for some marine species), thereby increasing the potential for sustainability of the freshwater/ brackish habitats north of the marl ridge. Moreover, no marine wildlife would be adversely impacted during construction through the use of Best Management Practices. Moderate impacts to coastal vegetation/habitat are anticipated due to construction and short-term, moderate impacts to marine resources are anticipated due to dredging required for construction. *Rank: Moderate to Low*	This alternative meets the project objective. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Plugging of the existing breached dam would restrict flow of saltwater into freshwater/brackish marshes north of the Cape Sable marl ridge (that constitute EFH for some marine species), thereby increasing the potential for sustainability of the freshwater/ brackish habitats north of the marl ridge. Moreover, no marine wildlife would be adversely impacted during construction through the use of Best Management Practices. Moderate impacts to coastal vegetation/habitats are anticipated due to construction. Also, impacts would be reduced because no dredging would be necessary. *Rank: Moderate to High*	This alternative meets the project objective. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Plugging of the existing breached dam would restrict flow of saltwater into freshwater/brackish marshes north of the Cape Sable marl ridge (that constitute EFH for some marine species), thereby increasing the potential for sustainability of the freshwater/ brackish habitats north of the marl ridge. Moreover, no marine wildlife would be adversely impacted during construction through the use of Best Management Practices. Moderate impacts to coastal vegetation/habitat are anticipated due to construction and short-term, moderate impacts to marine resources are anticipated due to dredging required for construction. *Rank: Moderate to Low*	This alternative meets the project objective. The amount of sediment flowing into and settling in Lake Ingraham would potentially be decreased. Plugging of the existing breached dam would restrict flow of saltwater into freshwater/brackish marshes north of the Cape Sable marl ridge (that constitute EFH for some marine species), thereby increasing the potential for sustainability of the freshwater/ brackish habitats north of the marl ridge. Moreover, no marine wildlife would be adversely impacted during construction through the use of Best Management Practices. Moderate impacts to coastal vegetation/habitats are anticipated due to construction. Also, impacts would be reduced because no dredging would be necessary. *Rank: Moderate to High*

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative D1 (100' Geotube Plug)**	**Alternative G (Marl Ridge Plug)**	**Alternative G1 (Marl Ridge Geotube Plug)**
Cultural Resources						
Avoid adverse impacts to the Homestead and East Cape canals, which are historic structures, through project design or mitigation measures	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities However, the banks of the Homestead canal are being eroded by tidal flow into and out of the canal in the vicinity of the existing breached dam, thereby causing adverse impacts to the historic structure. *Rank: Nil*	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. However, while the repair would alter the original function of the canal, the footprint/ configuration would not be altered, hence maintaining the integrity of the historic structure (causing the least impact to the historic integrity of the canal). Due to the minor amount of earthwork required for this alternative, potential impacts to archaeological and/or ethnographic resources are anticipated to be negligible, if any. Staging areas would avoid cultural resources identified through archeological survey. *Rank: High*	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. While the 100-foot plug would alter the original function of the canal, the footprint/ configuration would only be slightly altered, hence mostly maintaining the integrity of the historic structure. Due to the substantial amount of earthwork required for this alternative, potential impacts to archaeological and/or ethnographic resources are anticipated to be minimal, if any. Staging areas would avoid cultural resources identified through archeological survey. *Rank: Moderate*	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. While the 100-foot plug would alter the original function of the canal, the footprint/ configuration would only be slightly altered, hence mostly maintaining the integrity of the historic structure. Due to the substantial amount of earthwork required for this alternative, potential impacts to archaeological and/or ethnographic resources are anticipated to be minimal, if any. Staging areas would avoid cultural resources identified through archeological survey. *Rank: Moderate*	This alternative meets one of the project objectives - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. While the plug would alter the original function of the canal, the footprint/ configuration would only be slightly altered, hence mostly maintaining the integrity of the historic structure. Due to the substantial amount of earthwork required for this, potential impacts to archaeological and/or ethnographic resources are anticipated to be minimal, if any Staging areas would avoid cultural resources identified through archeological survey. *Rank: Moderate*	This alternative mostly meets the project objective - of avoiding impacts to the Historic Canals from addition of non-historic materials into the historic structures, and impacts to the canals and potential unidentified resources from construction activities. While the plug would alter the original function of the canal, the footprint/ configuration would only be slightly altered, hence mostly maintaining the integrity of the historic structure. Due to the substantial amount of earthwork required for this alternative, potential impacts to archaeological and/or ethnographic resources are anticipated to be minimal, if any Staging areas would avoid cultural resources identified through archeological survey. *Rank: Moderate*

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative D1 (100' Geotube Plug)**	**Alternative G (Marl Ridge Plug)**	**Alternative G1 (Marl Ridge Geotube Plug)**
Replacement Structure Longevity						
Replacement dams or geotubes would be designed to prevent vandals from breaching a dam by trenching around or through it, or damaging the geotubes	This alternative does not meet the project objective. The existing dam structure has been breached. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing breached dam would consist of additional sheetpile and armoring/reinforcement with riprap, which would discourage vandals from being able to trench around the immediate vicinity of the dam. However, this would not discourage vandals from creating a new pathway further landward of the outer edge of new sheetpile/riprap. *Rank: Moderate to Low*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheetpile and fill material and reinforced with riprap is anticipated to discourage vandals from trenching around the structure due to its length. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of geotubes and fill material and reinforced with riprap is anticipated to discourage vandals from trenching around the structure due to its length. The geotubes would also be armored to prevent puncturing. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug constructed of sheetpile and fill material and reinforced with riprap is anticipated to discourage vandals from trenching around the structure due to its length. *Rank: High*	This alternative fully meets the project objective. Plugging of the existing breached dam with a plug constructed of geotubes and fill material and reinforced with riprap is anticipated to discourage vandals from trenching around the structure due to its length. The geotubes would also be armored to prevent puncturing. *Rank: High*
Replacement structures would be designed to last at least 50 years (barring severe damage by catastrophic hurricane events) with annual/bi-annual maintenance	This alternative does not meet the project objective. The existing dam structure has been breached and is in need of immediate repair and continued maintenance. *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would consist of additional sheetpile and reinforcement with armoring (riprap) with the goal of 50-year sustainability. However, the risk of a catastrophic failure of the structure from a hurricane event is slightly higher than Alternatives D or G. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheetpile and fill material and reinforced with armoring (riprap) with the goal of 50-year sustainability. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of geotubes and fill material and reinforced with armoring (riprap) with the goal of 50-year sustainability. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of sheetpile and fill material and reinforced with armoring (riprap) with the goal of 50-year sustainability. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of geotubes and fill material and reinforced with armoring (riprap) with the goal of 50-year sustainability. *Rank: High*

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	Alternative C (Repair)	Alternative D (100' Plug)	Alternative D1 (100' Geotube Plug)	Alternative G (Marl Ridge Plug)	Alternative G1 (Marl Ridge Geotube Plug)
Visitor Use and Experience						
Provide safe passage over restored dams for canoeists/kayakers	This alternative does not meet the project objective. The existing breached dam does not provide safe passage over the structure. Fast flowing water produces dangerous currents and eddies (around the breached dam), which would trap and capsize small watercraft. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, repair of the existing breached dam would still allow for tidal saltwater to overtop the dam during high water events, posing a safety hazard to motorized and non-motorized boaters. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, this alternative would require a 100-foot carry over the structure. *Rank: Moderate to High*	This alternative meets the project objective. Plugging of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, this alternative would require a 100-foot carry over the structure. *Rank: Moderate to High*	This alternative meets the project objective. Plugging of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, this alternative would require a 430-foot carry over the structure. *Rank: Moderate to High*	This alternative meets the project objective. Plugging of the existing dam would include an engineering component to provide safe passage over the restored dam for non-motorized boaters. However, this alternative would require a 430-foot carry over the structure. *Rank: Moderate to High*
Resolve safety issues associated with the existing failed sheetpile structures	This alternative does not meet the project objective. The existing breached dam is a safety hazard to visitors. Fast flowing water produces dangerous currents and eddies (around the breached dam), which would trap and capsize small watercraft. *Rank: Nil*	This alternative mostly meets the project objective. Repair of the dam would eliminate fast flowing water currents and eddies in vicinity of the repaired dam. There would still be potential for overtopping during high water events in which the dam would pose a safety hazard to motorized and non-motorized boaters. Additionally, the potential for erosion or vandalism of the banks and the associated safety hazard still remains. *Rank: Moderate*	This alternative meets the project objective. Plugging of a 100-foot section of the canal would eliminate fast flowing water currents and eddies in vicinity of the dam. Due to the length of the plug, the energy produced by overtopping waters would be dissipated resulting in a diminished or possibly negligible effect in regards to safety, especially once the fill material is stabilized with plantings. *Rank: High*	This alternative meets the project objective. Plugging of a 100-foot section of the canal would eliminate fast flowing water currents and eddies in vicinity of the dam. Due to the length of the plug, the energy produced by overtopping waters would be dissipated resulting in a diminished or possibly negligible effect in regards to safety, especially once the fill material is stabilized with plantings. *Rank: High*	This alternative meets the project objective. Plugging of a section of the canal would eliminate fast flowing water currents and eddies in vicinity of the dam. Due to the length of the plug, the energy produced by overtopping waters would be dissipated resulting in a diminished or possibly negligible effect in regards to safety, especially once the fill material is stabilized with plantings. *Rank: High*	This alternative meets the project objective. Plugging of a section of the canal would eliminate fast flowing water currents and eddies in vicinity of the dam. Due to the length of the plug, the energy produced by overtopping waters would be dissipated resulting in a diminished or possibly negligible effect in regards to safety, especially once the fill material is stabilized with plantings. *Rank: High*

Project Objectives	Objectives Matrix (Homestead Canal)					
	Alternative A (No Build)	**Alternative C (Repair)**	**Alternative D (100' Plug)**	**Alternative D1 (100' Geotube Plug)**	**Alternative G (Marl Ridge Plug)**	**Alternative G1 (Marl Ridge Geotube Plug)**
Improve the wilderness visitor experience by eliminating/ reducing illegal motorized boat entry into the Marjory Stoneman Douglas Wilderness Area	This alternative does not meet the project objective. The existing breached dam allows illegal motorized boat entry into the wilderness area beyond the Homestead canal dam, thereby diminishing the wilderness visitor experience. *Rank: Nil*	This alternative meets the project objective. Repair of the existing breached dam would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. However, the potential exists for vandals to alter the banks of the canal beyond the outer edges of the dam, enabling access for illegal motorized boats. *Rank: Moderate*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of sheetpile and fill material would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. Due to the plug length, it would potentially deter vandals from altering the canal banks at this location. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a 100-foot plug constructed of geotubes and fill material would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. Due to the plug length, it would potentially deter vandals from altering the canal banks at this location. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of sheetpile and fill material would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. Due to the plug length, it would potentially deter vandals from altering the canal banks at this location. *Rank: High*	This alternative meets the project objective. Plugging of the existing breached dam with a plug constructed of geotubes and fill material would prevent illegal motorized boat entry into the wilderness area and improve the wilderness visitor experience. Due to the plug length, it would potentially deter vandals from altering the canal banks at this location. *Rank: High*

Legend:
Nil - Does not meet any elements of the project objectives
Low - Meets some elements of the project objectives
Moderate - Meets most elements of the project objectives
High - Meets all elements of the project objectives

Table 2.14 – Summary of Environmental Consequences

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Geology, Topography and Soils	Taking no action to address the issues associated with the dam on the canals would sustain the impacts of the erosional processes in the canal. These processes would continue to act at current or potentially increasing rates. Effects on soils or geologic features (soil erosion, effects on soil productivity or the ability of the soil to support native vegetation, and loss of sediment to Lake Ingraham) would be readily apparent, and would substantially change the soil or geologic characteristics over a potentially large area due to expected continued erosion of the canal bank. **Long-term moderate to major adverse impacts to soils and long-term negligible adverse impacts to geology and topography** would occur. There would be no impairment of soils, geology, or topography as a result of Alternative A.	This alternative would reduce the rate of saltwater intrusion into formerly freshwater marsh systems and subsequently protect peat soil. The rehabilitated dam would decrease the velocity of the flow dramatically during tidal flows, thus reducing erosional processes in the banks of the canal. Thus, erosion and channel widening would be expected to decrease, consequently reducing sediment deposition in the interior marshes and Lake Ingraham. Thus, **long-term beneficial impacts to soils, geology, and topography** would occur. There would not be an impairment of geology, topography, or soils as a result of the implementation of Alternative C.	Same as Alternative D. However, the potential for erosion is further minimized due to the length of the plug and the location at the highest elevation in the area, which serves as a natural hydrologic barrier.	Same as Alternative D, except a larger area would be impacted.	Same as Alternative D.	Same as Alternative G.

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Water Resources: Hydrology	Taking no action to address the issues associated with the dams would sustain the anthropomorphic impacts on hydrologic processes in the Cape Sable area. These anthropomorphic impacts include the loss of the marl ridge function as a hydrologic barrier, continued flow of saline waters through canals and marsh collapse north of the ridge, continued erosion and widening of the canals, and persistence of dangerous hydraulic conditions at the dam sites. **No beneficial effects and long-term moderate to major adverse impacts to hydrology are anticipated as a result of Alternative A**. There would be no impairment of hydrology as a result of Alternative A	This alternative would eliminate the anthropomorphic impacts that include the loss of the marl ridge function as a hydrologic barrier, continued flow of saline waters through canals and marsh collapse north of the ridge, continued erosion and widening of the canals, and persistence of dangerous hydraulic conditions at the dam sites. Alternative C would partially restore some of the natural hydrologic conditions that existed with an unbreached marl ridge. Because there would be a deceleration of erosional processes, Alternative C would result in **long-term beneficial impacts** to hydrology. There would be no impairment of hydrology as a result of the implementation of Alternative C.	Same as Alternative C, except that a plug would stop the flow past it.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Water Resources: Water Quality	**Long-term, regional, and moderate to major adverse impacts** on water quality under Alternative A would result from diminished quality of water via continued saltwater intrusion and loss of freshwater, sediment transport and deposition, and potential nutrient loading, There would be no impairment of water quality as a result of Alternative A.	Short-term, minor to moderate, and adverse impacts would occur from construction activities (i.e., temporary increase in turbidity). However, decrease of sedimentation and turbidity, and reduction of saltwater intrusion and retention of freshwater would lead to **long-term beneficial impacts** on water quality. There would not be an impairment of water quality as a result of the implementation of Alternative C.	Same as Alternative C	Same as Alternative C.	Same as Alternative C, except no water quality impacts from dredging would occur.	Same as Alternative D1.
Water Resources: Vegetation and Wetlands	No direct impacts to wetlands/surface waters would result with Alternative A. However, there would be **moderate to major adverse effects** to the greater Cape Sable wetland systems resulting from sustained erosional processes (i.e., interior marsh collapse. There would also be **long-term, negligible to minor adverse impacts** from ongoing visitor use in and around the existing dam site. **No beneficial effects to wetlands are anticipated.** There would be no impairment of vegetation and wetlands as a result of Alternative A.	For Alternative C, construction activities would result in **adverse, localized, direct effects on vegetation.** However, due to a reduction in saltwater intrusion and erosional processes, this action alternative would provide an **overall long-term benefit to local and regional wetlands** in the greater Cape Sable area, which far outweighs the direct impacts associated with construction. There would not be an impairment of vegetation and wetlands as a result of the implementation of Alternative C.	Same as Alternative C, except there would be a slightly larger impact area due to the fill placed for the plug.	Same as Alternative D, except that there would be a slightly larger impact area due to the longer plug.	Same as Alternative D, except that dredging would not be required.	Same as Alternative G, except that dredging would not be required.

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Wildlife and Habitat	No direct impacts to wildlife and wildlife habitat areas would result with Alternative A. Sustained hypersaline conditions in the interior marshes as well as continued erosion and channel widening processes would be expected to continue resulting in long term degradation of adjacent and upstream/downstream wildlife habitats (e.g. juvenile crocodile habitat and productivity of forage fish communities). This would result in **minor to moderate adverse impacts** to wildlife. There would be **long-term, negligible to minor adverse impacts** resulting from ongoing visitor use in and around the existing dam site. There would not be an impairment of wildlife and wildlife habitat as a result of Alternative A.	Over the **long- term, beneficial impacts** to wildlife species and habitats resulting from reduced visitor use, reduction of the rate of saltwater intrusion and erosional processes would occur. Construction activities would have **short-term, localized, negligible to minor adverse impacts** on wildlife and wildlife habitat, but long-term beneficial impacts far outweigh short-term impacts. There would be no impairment of wildlife or wildlife habitat as a result of the implementation of alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C, except that dredging would not be required.	Same as Alternative D1.

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Marine Resources and EFH	Under Alternative A, saltwater would continue to encroach into the interior freshwater and brackish of Cape Sable, which serve as EFH for many federally regulated species. The marshes beyond the canals would continue to collapse. Motorized boaters would continue to illegally access the designated wilderness area, thus further deteriorating the quality of the habitats. The continuation of saltwater intrusion and loss of freshwater through the breached dam would result in **long-term minor to moderate adverse effects to EFH.** There would not be impairment of marine resources and EFH as a result of Alternative A.	This project would result in some short-term, minor unavoidable adverse impacts to habitats designated as EFH for several federally managed species. This includes temporary disturbance to a small area of non-vegetated bottom and temporary degradation of the estuarine/marine water column due to an increase in suspended sediment concentrations; The reduction of turbidity, sediment export, sediment deposition in Lake Ingraham, saltwater intrusion and loss of freshwater through the breached dam, and the reduction of illegal motorized boaters would result in **long-term beneficial effects to EFH.** Alternative C would not result in the impairment of marine resources and EFH.	Same as Alternative C, except that a larger area would be impacted due to the fill placed for the plug.	Same as Alternative D, except that a slightly larger area would be impacted due to the longer length of the plug.	Same as Alternative D, except that dredging would not be required.	Same as Alternative G, except that dredging would not be required.

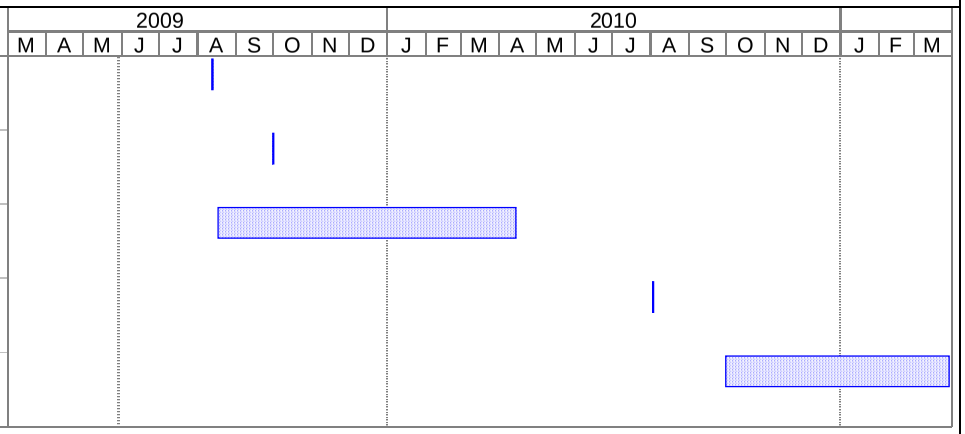
East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Special Status Species	Under Alternative A, no construction would take place and current conditions/processes would continue. There would be no direct adverse effect from construction on federally listed endangered, threatened, or special concern species and their habitat that currently occur within the project area. However, taking no action to address the issues associated with the sheetpile dam would only prolong the anthropomorphic impacts on erosional processes within this canal and the greater Cape Sable area. Alternative A would result in **long-term moderate to major, adverse impacts** to the American crocodile and Smalltooth sawfish in the Cape Sable Area. There would be no impairment of species of special concern as a result of Alternative A.	All Federally-listed species would benefit from improved hydrologic conditions and reduced saltwater intrusion. The rehabilitation of the dam would produce adverse, local, minor, short-term effects but beneficial long-term impacts to species of special concern. Additionally, protection would be afforded to species of special concern through the implementation of standard protection measures. The **short-term impacts are also compensated for by the long-term beneficial effects** that would result from the implementation of Alternatives C. There would be no impairment to species of special concern.	Same as Alternative C, except that the amount of crocodile nesting habitat would be increased by the fill material placed for the plug.	Same as Alternative D, except that a larger amount of fill material would be placed, creating more crocodile nesting habitat.	Same as Alternative D, except that dredging would not be required.	Same as Alternative G, except that dredging would not be required.

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Wilderness	Without rehabilitating the dam, saltwater would continue to encroach into freshwater and brackish marshes north of the Cape Sable marl ridge and surrounding areas. The marshes beyond the canals would continue to collapse. Motorized boaters would continue to illegally access the Marjory Stoneman Douglas Wilderness Area, thus not allowing for opportunities for solitude, and thus, not providing the enjoyment of the park as wilderness. Alternative A (no action) would have l**ong-term moderate to major indirect adverse effects** on the wilderness character. There would be no impairment of wildnerness as a result of Alternative A.	Alternative C would have negligible, short-term indirect effects on wilderness during construction activities due to noise and human presence. The repaired dam would prevent illegal boaters from accessing the wilderness, resulting in an immediate **long-term benefit** by providing an increased wilderness experience, minimizing noise, and human presence. There would be no impairment of wilderness as a result of alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.	Same as Alternative C.
Cultural Resources	Because there would be a degradation of the current existing conditions, the no action alternative would result in **long-term minor to moderate adverse impacts** to historic structures and a potential historic district. Alternative A would not result in impairment of cultural resources.	Alternative C would contribute to the deceleration of erosional processes in the canals. This alternative would have no short-term effects, and would not impact the character or function of this historic resource or affect its historic significance. Alternatives C would have **long-term beneficial impacts**. There would be no impairment of cultural resources as a result of the implementation of Alternative C.	Same as Alternative C, except that a plug would stop flow except at extremely high water events.	Same as Alternative D,.	Same as Alternative D.	Same as Alternative D.

East Cape Extension and Homestead Canals						
Impact Topic	**Alternative A (No-Action)**	**Alternative C (Repair Existing Dam)**	**Alternative D (New 100' Plug)**	**Alternative G (New 430' Plug)**	**Alternative D1 (New 100' Plug – Geotubes) (Homestead Canal Only)**	**Alternative G1 (New 430' Plug – Geotubes) (Homestead Canal Only)**
Visitor Use and Experience	If no action is taken to rectify the existing unsafe and undesirable conditions at the existing failed dam sites, the visitor use and experience at the site would decline. These conditions would be expected to worsen substantially within the 50-year timeframe of this study. **Long-term, moderate, and adverse impact** on visitor use and experience in the park are expected as a result of Alternative A.	If Alternative C is implemented, the existing unsafe and undesirable conditions at the existing failed East Cape Extension and Homestead canal dam sites would be partially remedied, including the provision for a safe portage over the dam and prevention of illegal motorized boaters beyond the dam into the wilderness area. However, visitor would still be subjected to slightly unsafe conditions during high water events during which water levels overtop the dams creating a hydraulic situation with rapid water flow. Impacts to visitor use and experience would be **long-term and beneficial**.	Same as Alternative C, except that the existing unsafe and undesirable conditions at the existing failed dam sites would be fully remedied. Also, during high water events during which water levels overtop the dams, water flows would be dissipated by vegetation over the length of the plug.	Same as Alternative D, except that water flows would be dissipated by vegetation over a longer length of the plug.	Same as Alternative D.	Same as Alternative G.
Park Management and Operations	If no action is taken at the dam sites, park management and operations would be adversely impacted both in the short-term and long-term with the need for maintenance and enforcement activities to ensure the protection of the park's natural resources and the safety of park visitors. The requirements for maintenance and enforcement and the quality of the interpretive features in the Cape Sable area would continue to put a burden on park resources and staff. Impacts to park management and operations would be **long-term, minor, and adverse**.	If Alternative C is implemented at the dam sites, park management and operations would be nearly unchanged. The natural resources and interpretive features of the area would be preserved by the implementation of Alternative C. Impacts to park management and operations would be **long-term, minor, and adverse**.	If Alternative D is implemented at the dam sites, park management and operations would be beneficially impacted with the need for maintenance and enforcement activities reduced. The natural resources and interpretive features of the area would also be preserved by the implementation of Alternative D. Impacts to park management and operations would be **long-term and beneficial**.	Same as Alternative D.	Same as Alternative D.	Same as Alternative D.

Table 2.15-Preliminary Implementation Schedule

ID	Task Name	Duration	Start	Finish
1	EA/FONSI	1 day	8/13/09	8/13/09
2	100% Design Documents	1 day	10/1/09	10/1/09
3	Permitting	240 days	8/18/09	4/14/10
4	Contract Award	1 day	8/3/10	8/3/10
5	Construction	180 days	10/1/10	3/29/11



Date: 5/29/09 | Task | Milestone | Project Summary