

Crabtree Swamp Aquatic Ecosystem Restoration Project



Appendix F 404b1 Analysis



US Army Corps
of Engineers ®



404(b) (1) Evaluation

Crabtree Swamp Aquatic Ecosystem Restoration Study

Conway, Horry County, South Carolina

I. PROJECT DESCRIPTION

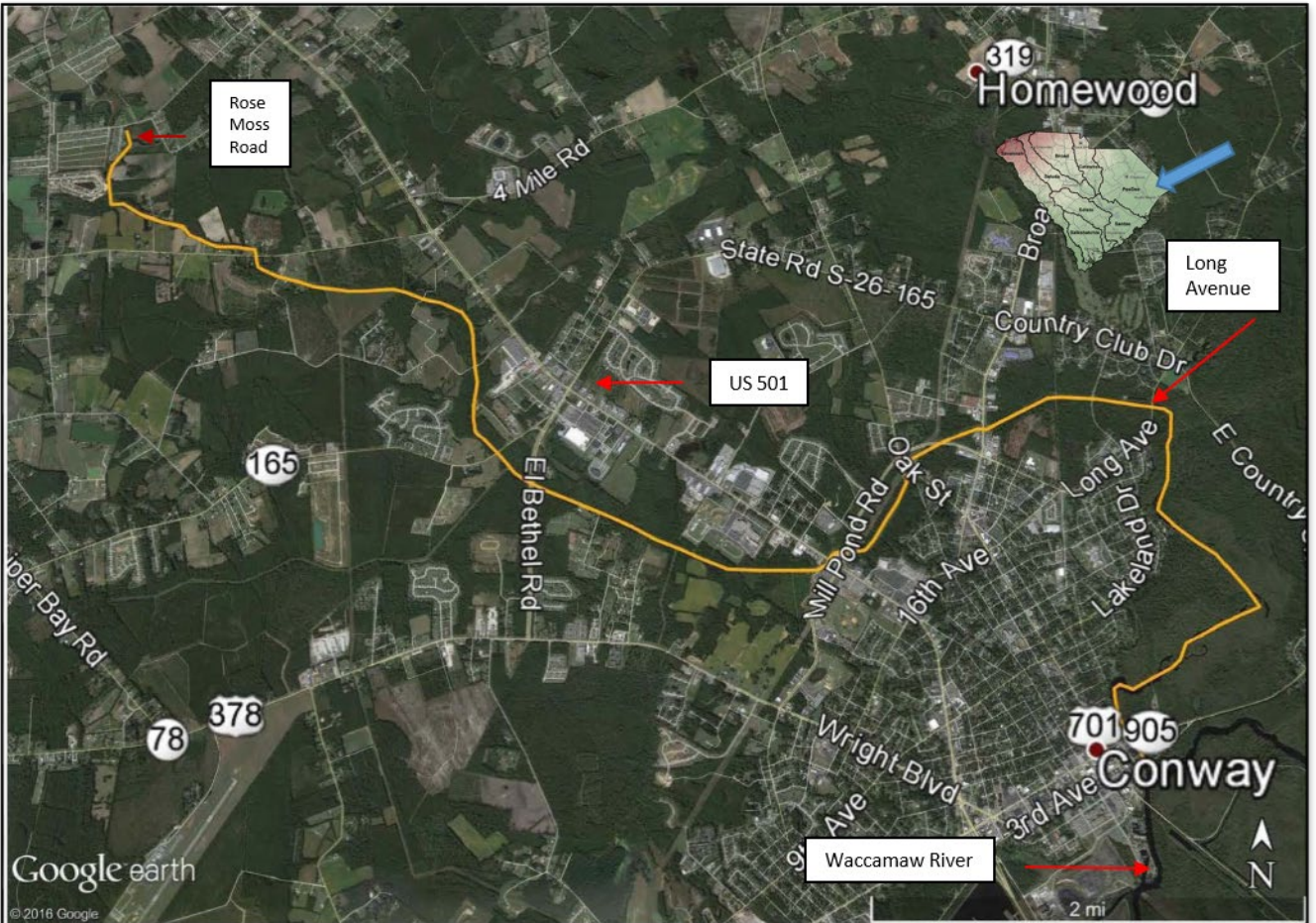


Figure 1. Project Area Map depicting Crabtree Swamp Highlighted in Yellow

- a. **Location and General Description.** The study area is located in the City of Conway, Horry County, SC (Figure 1). Crabtree Swamp originates northwest of the City of Conway, near Rose Moss Road, flows through Conway and terminates in Kingston Lake which flows into the Waccamaw River. The study area begins at Rose Moss Rd and terminates near the channel's intersection with Long Avenue. The study area is approximately 7.2 miles in length.

The Crabtree Swamp Basin has an area of approximately 18 square miles, with variable land use ranging from moderately urbanized and residential at the basin's downstream outlet to agriculture and upland forest at the basin head. The topography at the head of the basin is mostly flat with maximum elevation of approximately 60 ft-NAVD88, and a

minimum elevation of 23 feet NAVD at the basin's outlet, which is at the confluence with Kingston Lake.

- b. **Authority and Purpose.** Section 206 of the Water Resources Development Act of 1996 provides authority for the U.S. Army Corps of Engineers (USACE) to carry out aquatic ecosystem restoration and protection projects if the Secretary of the Army determines that the project will improve the quality of the environment and is in the public interest while being cost-effective. This study was initiated following receipt of a December 3, 2014 letter request from Horry County seeking assistance from the USACE to develop ecological restoration along one or more waterbodies located in Horry County, South Carolina.

Prior to channelization to support development, Crabtree Swamp was a bottomland hardwood wetland ecosystem. Historic channel modifications resulted in dredge material placement on the streambanks, disconnecting the floodplains and adjacent wetlands from the channel. As more intense urban land uses replaced agricultural uses, with subsequent increased stormwater runoff, reaches of Crabtree Swamp started to exhibit associated stressors such as bank failure, erosive channel velocities, incising and scouring, loss of aquatic life habitat, episodic flooding, invasive vegetation, and blockages that prevented aquatic life passage. Crabtree Swamp is now an incised, trapezoidal channel with little remaining structural diversity, and prone to bank failures. The lack of aquatic habitat and physical barriers are inhibiting aquatic life passage. The purpose of this project is to restore aquatic habitat and improve stream functions by restoring floodplain connectivity and improving bedform diversity. This will provide flood storage capacity and, when combined with the removal of invasive species and re-planting of the riparian zone with native woody tree and shrub species, will allow for a more natural riverine ecosystem.

- c. **Alternatives Considered.** Section 404(b) (1) guidelines of the Clean Water Act requires that “except as provided under section 404(b) (2), no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.” The 404(b) (1) guidelines consider an alternative practicable “if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes”. During the alternative plan selection process, the following plans were thoroughly reviewed: No Action Alternative, and multiple Principles and Guidelines Based Alternatives (P&G alternative). The P&G and NEPA selected alternative that meets the project goal includes the following measures:

Floodplain Benching

Figure 2 is a schematic used as a template for this project. All floodplain benching will be of similar design: a 12-ft wide flat riparian bench followed by a 30-ft wide bench at 1.0% slope with a 1V:1H slope to tie into the natural grade. Placement and elevation will differ according to the location. Floodplain benching is proposed for Reach 1 and Reach 2. All floodplain benching will be accompanied by re-vegetation of the excavated area. This measure will increase storage capacity for storm flows, reducing storm flow velocities and providing groundwater recharge. The riparian vegetation will provide a source of woody debris and shading for the stream, providing aquatic habitat and reducing stream temperatures during fish spawning season.

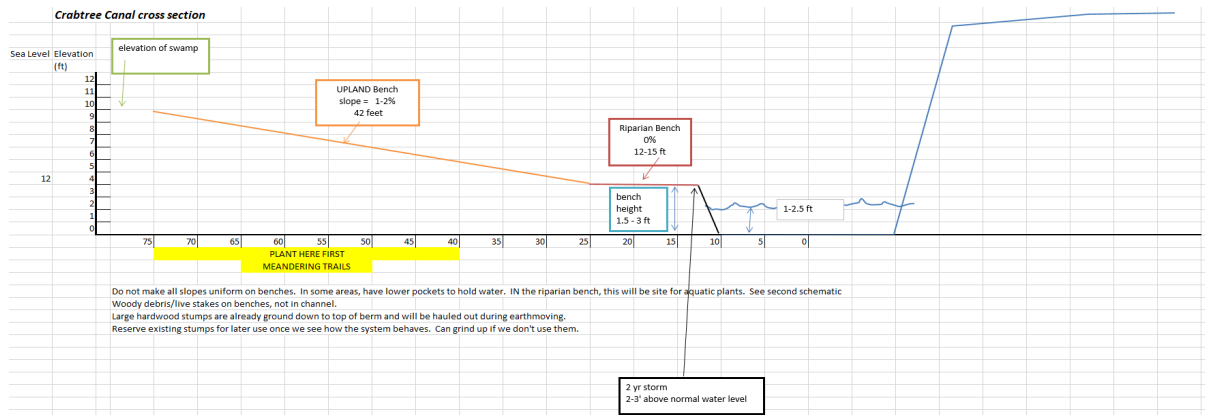


Figure 2. Schematic of Floodplain Bench.

Log-drop Structure

The log drop structure will be 24-inches in diameter, placed across the channel at an elevation that is largely submerged. It will penetrate 10-ft into the bank on each side and anchored by approximately 2 cubic yards (CY) of riprap. It will be designed to withstand the 25-year storm velocities and the riprap will be covered with topsoil and re-vegetated. This measure will increase bed diversity and provide habitat for fish and other aquatic species.

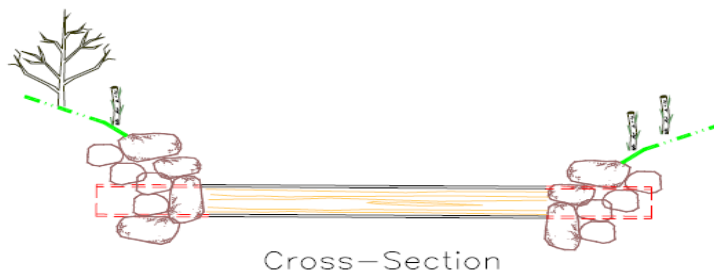


Figure 3. Drawing of Log-drop Structure.

Root Wads

Root wads will be installed along the stream bank where the trunk of the tree will be embedded into the bank. Approximately 2/3 of the root wad would be above the average water level and 1/3 of the root wad would be below the average water level (Fig 4). Each root wad will extend 10 LF along the length of the channel and will be installed on opposite banks. Some coir material will be used to reinforce the bank, covered with topsoil and the area re-vegetated. Roots wads will provide bank protection during storm flows and a refuge for fish species.



Figure 4. Example of Root Wads Placed along a Stream Bank

Berm Breaching

Six cuts will be made in existing berms located on both sides of the channel along Reach 3. The berm cuts will be made at existing low elevations where erosion is already occurring. The design proposes each cut to elevation 6.0-ft NAVD 88 and will range from 150 linear feet (LF) to 370 LF in length. The side slopes will be constructed to 3H:1V on each side, up to grade and will be armored with articulated concrete block mat (ACBM) to prevent erosion (Fig. 5). Topsoil will be replaced at the top of the berm cuts and the area will be re-vegetated. Berm cuts will allow connectivity between the stream channel and the adjacent wetlands, reducing storm flow velocities, increasing wetland hydrology, and providing additional habitat for species.

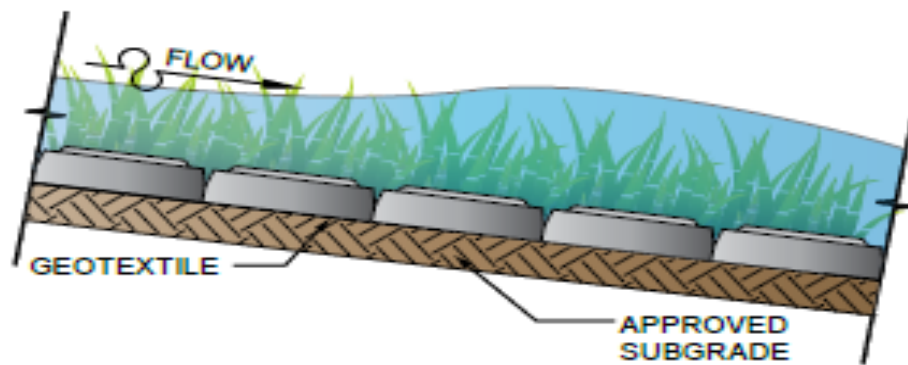


Figure 5. Drawing of Articulated Concrete Block Mats.

Monitoring and Maintenance: During the life of the project, monitoring and maintenance will be conducted to ensure stability of structures and vegetation survival

and growth. It is anticipated that herbicide applications may be necessary to control invasive species.

- d. **General Description and Quantities of the Dredged or Fill Material.** The proposed restoration project primarily involves the excavation of soil to create floodplain benching, construct berm cuts, and install structures. Topsoil will be retained and replaced where feasible to ensure growth and survival of planted vegetation.
- e. **Description of the Proposed Discharge Site(s).** All excavated soil not proposed for stockpiling and re-use will be transported offsite. Horry County will be responsible for excavated material discharge areas and plans to use existing upland locations. Area proposed for floodplain excavation are currently disconnected from the stream channel and do not have adequate hydrology to support wetlands.
- f. **Description of Disposal Method.** The proposed project involves excavation of floodplain benches, and expansion of existing berm cuts along the streambanks. Topsoil will be retained in upland areas and replaced prior to re-vegetation of disturbed areas. All other excavated materials will be transported to off-site upland storage facilities owned by the non-Federal sponsor.

II. **FACTUAL DETERMINATIONS.**

- a. **Physical Substrate Determinations.**
 - (1) **Substrate Elevation and Slope.** Ground elevation within the floodplain bench and berm cut areas would be reduced to a minimum 6 ft NAD 88. Within channel elevations should not be permanently affected by these measures.
 - (2) **Sediment Type.** The area proposed for excavation includes relic berms from previous dredging activities and the soil in these areas is primarily categorized as sands and loams. Topsoil will be retained and replaced to maximize growth and survival of planted vegetation.
 - (3) **Dredged/Fill Material Movement.** Excavated materials would be removed using mechanized equipment placed in uplands and the materials would be sidecast into dump trucks. The trucks would transport the materials to an offsite upland storage area owned by the non-Federal sponsor. Topsoil proposed for re-use would be stored in designated upland areas and replaced upon completion of excavation and prior to planting.
 - (4) **Physical Effects on Benthos.** The existing community of benthic organisms within the project area is limited to organisms that can persist in flashy flows typical of urban environments. Implementation of the proposed project would restore the area to a more diverse habitat type and increase the species richness of the benthic community. It is expected that organisms currently established downstream including more diverse assemblages of aquatic insects and other invertebrates would re-colonize the project area post-construction, as well as a variety of freshwater fish species. The re-colonization of fish species would also allow freshwater mussel species to re-establish in the project area.

- (5) **Actions Taken to Minimize Impacts.** The purpose of the proposed project is to restore aquatic habitat and improve stream functions. Construction activities will be conducted in an expeditious manner to reduce temporary impacts to water quality, and wildlife and aquatic species. All disturbed areas will be replanted with native vegetation. Any unanticipated excavated material will be used or disposed of outside of the project area outside of waters of the US.

b. **Water Circulation, Fluctuation and Salinity Determinations.**

(1) **Water.**

- (a) **Salinity.** Crabtree Swamp is categorized as a freshwater stream. While the lower reaches receive some tidal input, the project will have no impact on salinity levels.
- (b) **Water Chemistry.** Temporary changes in water chemistry related to increased turbidity levels at the construction site may occur. These changes would be temporary and minimal in nature. Turbidity levels should return to normal following construction and the project should result in improvements to both temperature and dissolved oxygen levels.
- (c) **Clarity and Color.** The water may become temporarily clouded at the project site during construction due to increased turbidity levels associated with disturbance of sediments. As noted above, this is expected to return to normal levels shortly after construction activities cease.
- (e) **Odor.** Breaching of the berm areas in Reach 3 could result in a release of hydrogen sulfide (rotten egg) odor from the disturbance of anaerobic soils. This will be a temporary impact and will not result in long-term effects.
- (f) **Taste.** Not applicable. The water is not used as a drinking water resource.
- (g) **Dissolved Gas Levels.** There may be minor impacts to dissolved oxygen levels as a result of increased turbidity levels. However, the impacts will be localized and temporary. Upon completion of the project dissolved oxygen levels should increase and allow fish to repopulate the area.
- (h) **Nutrients.** There are numerous sources of discharge to Crabtree Creek due to historic agriculture practices that may contribute nutrients to the stream. During periods of low flow, emergent vegetation is present in the channel. Once the project is complete, nutrient levels are expected to improve due to more natural stream flows.
- (i) **Eutrophication.** High nutrient loading causes eutrophication. The restored riparian benches will allow storm flows to filter slowly through soils, reducing storm flow velocities and providing recharge to groundwater. This should allow for more natural flows that will discourage eutrophication.

(2) **Current Patterns and Circulation.**

- (a) **Current Patterns and Flow.** The channel currently experiences flashy streamflows typical of urban environments. The proposed project would provide additional storage capacity for storm flows and recharge groundwater, contributing to more natural patterns and flow.
- (b) **Velocity.** The channel currently experiences high velocity storm flows that contribute to erosion. The proposed project would provide additional storage capacity for storm flows, contributing to more natural water velocities.
- (c) **Stratification.** Not applicable. Water body does not undergo stratification.
- (d) **Hydrologic Regime.** Crabtree Swamp is currently a trapezoidal canal lacking bedform diversity or riparian vegetation. The proposed project would improve the current hydrologic regime throughout the project area, which will allow the reestablishment of a more natural coastal riverine ecosystem.

(3) **Normal Water Level Fluctuations.** The channel currently exhibits high velocity flows during storm events that erode the stream bed and stream banks. The proposed project will provide additional storage capacity and recharge groundwater to the stream, reducing extreme water fluctuations.

(4) **Salinity Gradients.** Crabtree Swamp is classified as a freshwater stream. While the lower reaches are affected by tidal inputs, the project will not affect salinity gradients.

(5) **Actions That Will Be Taken to Minimize Impacts.** Work within the channel will be limited to the minimum necessary for the proposed project. In addition, the following conservation measures/Best Management Practices will be followed:

- Heavy equipment will be used only as necessary to minimize impacts.
- Any placement of fill will be minimized to the maximum extent practicable.
- Prior to the beginning of any construction activities, appropriate erosion control measures, such as silt fences, silt barriers, or other suitable devices, will be installed and maintained in a functioning capacity until the area is permanently stabilized upon project completion.
- Once initiated, the project will be carried to completion in an expeditious manner in order to minimize the period of disturbance to the environment.
- Upon completion, all disturbed areas will be permanently stabilized with vegetative cover.
- Excess soil will be removed to an approved upland disposal site.

c. **Suspended Particulate/Turbidity Determinations.**

- (1) **Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site.** Turbidity will increase during construction operations but will return to normal levels when construction is complete.
- (2) **Effects (degree and duration) on Chemical and Physical Properties of the Water Column.**
 - (a) **Light Penetration.** During construction, light penetration will diminish due to a temporary increase in turbidity levels as sediments are disturbed. Light penetration will return to normal or improve shortly after construction for the temporarily impacted wetland areas.
 - (b) **Dissolved Oxygen.** Dissolved oxygen (DO) levels may decrease during construction as a result of increased turbidity. However, DO levels should return to normal once construction activities cease.
 - (c) **Toxic Metals and Organics.** Testing of sediments from Crabtree Swamp has not been conducted. However, there are no known discharges of toxic metals or organic contaminants to Crabtree Swamp. Therefore, there is no expectation of contaminants in the sediments. While a temporary discharge of sediments into the water column may occur during construction, it is not anticipated that any unacceptable adverse impacts will occur. Further, sediment loading will return to normal levels following construction.
 - (d) **Pathogens.** Crabtree Swamp has been identified as having elevated levels of bacteria. While Crabtree Swamp does not have a TMDL for bacteria, studies are currently underway to determine the source. This project will have no impact on pathogens within the project area.
 - (e) **Aesthetics.** During construction a short-term degradation of visual aesthetics would occur due to turbidity from substrate disturbance. The visual aesthetics would be improved after completion of the project.
- (3) **Effects on Biota.**
 - (a) **Primary Production & Photosynthesis.** Primary production and photosynthesis may decrease temporarily during construction due to turbidity increases; however, these factors should return to normal shortly after construction is complete.
 - (b) **Suspension/Filter Feeders.** Temporary impacts would include increased turbidity, which may reduce oxygen levels and impact food intake. However, once the project is completed reduced flow velocities should enhance conditions for filter feeders.
 - (c) **Sight Feeders.** A minimal, temporary disruption due to construction activities is possible. A rapid recovery is expected since most sight feeders are transient and can relocate until construction activities are complete.

- (4) **Actions taken to Minimize Impacts.** The above noted impacts are temporary, and conditions should improve following construction. It is unlikely that further minimization in these areas is possible.
- d. **Contaminant Determinations.** The areas immediately adjacent to Crabtree Swamp are mostly forested or in agriculture except at road intersections. Highway 501 is the most populated intersection with a gas stations and retail located directed adjacent to the channel. There are no industrial facilities that discharge to Crabtree Creek and the majority of construction will occur upstream of these businesses and below Highway 701. As such, there is no reason to believe that unacceptable levels of contaminants would be present, and no further examination of contaminants is required.
- e. **Aquatic Ecosystem and Organism Determinations.**
- (1) **Effects on Plankton.** Effects on plankton would be related to turbidity associated with the construction activity. Effects would be minor and temporary in duration.
- (2) **Effects on Benthos.** Benthic activity at the construction site would be impacted as sediments are disturbed or removed. These disturbances will be temporary and re-colonization will occur following construction. It is anticipated that the benthic environment within the project area will improve after project is completed and allow for better foraging, spawning, and refuge areas for benthic organisms.
- (3) **Effects on Nekton.** The reduction in storm flow velocities and increase in aquatic habitat would enhance transport foraging and spawning opportunities for nekton and allow for the reintroduction of fish from reaches downstream from the project area.
- (4) **Effects on Aquatic Food Web.** The project should result in improvements to aquatic habitat for macroinvertebrates, fish, and amphibians which will have a positive effect to the aquatic food web.
- (5) **Effects on Special Aquatic Sites.**
- (a) **Sanctuaries and Refuges.** Not applicable.
- (b) **Wetlands.** No permanent adverse impacts to wetlands are anticipated. Floodplain benching will occur in upland areas adjacent to the stream channel and the breaching will occur along existing man-made berms. The berm cuts will provide hydrologic connectivity to wetland areas between Highway 701 and Long Avenue and the project could result in the formation of wetlands along the edges of the floodplain areas. The proposed measures are expected to provide a long-term beneficial effect to wetlands.
- (c) **Mud Flats.** Not applicable.
- (d) **Vegetated Shallows.** Not applicable.

- (e) **Coral Reefs.** Not applicable.
- (f) **Riffle and Pool Complexes.** Upon completion of the proposed project riffle pool complexes may re-establish within the project area.
- (6) **Threatened and Endangered Species.** There are no known occurrences of federally threatened or endangered species within the project area. However, the study area could be used for foraging by the wood stork and the Northern long-eared bat. USACE has determined that the project may affect but is not likely to adversely affect the Northern long-eared bat, or the American wood stork, and would have no effect to any other threatened and endangered species listed for Horry County.
- (7) **Other Wildlife.** There would be temporary negative impacts to wildlife in the project area associated with the construction activities. Wildlife would be expected to leave the area during construction but would return when construction is complete. Over the long-term, the planted riparian areas will provide habitat and foraging benefits to wildlife.
- (8) **Actions to Minimize Impacts:** Plans and specifications for the project would include requirements to ensure impacts to the environment are minimized or avoided. In addition, the following conservation measures/Best Management Practices will be followed:
 - Heavy equipment will be used only as necessary to minimize impacts.
 - Any placement of fill will be minimized to the maximum extent practicable.
 - Prior to the beginning of any construction activities, appropriate erosion control measures, such as silt fences, silt barriers, or other suitable devices, will be installed and maintained in a functioning capacity until the area is permanently stabilized upon project completion.
 - Once initiated, the project will be carried to completion in an expeditious manner in order to minimize the period of disturbance to the environment.
 - Upon completion, all disturbed areas will be permanently stabilized with vegetative cover.
 - Excess soil will be removed to an approved upland disposal site.

f. **Proposed Disposal Site Determinations.**

- (1) **Mixing Zone Determination.** Not applicable.
- (2) **Determination of Compliance with Applicable Water Quality Standards.** The proposed project has been determined to be in compliance with the Nationwide Permit Number 27. The South Carolina Department of Health and Environmental Control certified Nationwide Permit Number 27 with 401 Water Quality Certification and Coastal Zone Consistency Specific Conditions and General Conditions on March 7, 2017. Both Coastal Zone Consistency and 401 Water Quality Certification Conditions are applicable and will be adhered to throughout the project. A Coastal Zone Consistency request will be submitted to the state for concurrence.

(3) Potential Effects on Human Use Characteristics.

- (a) Municipal and Private Water Supply.** This project will have no impact on municipal/private water supplies since Crabtree Swamp is not utilized for municipal or private water supply.
- (b) Water Related Recreation.** The proposed project will not increase swimming opportunities since no beaches are located along the project area and Crabtree Swamp has been identified as having high levels of bacteria. However, a greenway runs along one side of the channel and the improvements should allow for increased use of this trail.
- (c) Aesthetics.** Implementation of the proposed ecosystem restoration measures will have a negative impact on visual aesthetics during the construction phase. However, these impacts will be temporary. The project area will be re-planted once construction is complete, resulting in a long-term beneficial effect on aesthetics.

- g. Determination of Secondary and Cumulative Effects on the Aquatic Ecosystem.** Temporary negative effects related to this project include those associated with turbidity, aquatic and terrestrial species, and aesthetics. These effects are necessary to successfully improve aquatic habitat in Crabtree Swamp. The proposed project will restore stream functions and provide an overall improvement to the aquatic ecosystem.

III. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE.

- a.** No significant adaptations of the guidelines were made relative to this evaluation.
- b.** The proposed construction described in this evaluation would not cause or contribute to violations of any known applicable state water quality standards, which would result in permanent damage to the ecosystem. The proposed project would improve the ecosystem.
- c.** The proposed construction described in this evaluation would not cause or contribute to violations of any known applicable state water quality standard.
- d.** The proposed project will not violate the Endangered Species Act of 1973.
- e.** The proposed project will not result in significant adverse affects on human health and welfare regarding municipal and private water supplies, plankton, fish, wildlife, and special aquatic sites. The life states of aquatic life and other wildlife will not be adversely affected. Significant adverse affects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not occur.
- f.** Steps taken to minimize potential adverse impacts of the construction on aquatic ecosystems include limiting construction to the minimum alternative needed to provide the required protection. In addition, conservation measures and Best Management Practices will be incorporated into the plans and specs, which will minimize impacts to aquatic and terrestrial species.

- g.** The proposed project will not cause unacceptable adverse impacts to any known, significant historic sites.
- h.** On the basis of the guidelines, the proposed construction is specified as complying with the requirement of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

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