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Final Environmental Impact Statement

For the Occupancy and Use of National Forest Lands And Ocklawaha River Restoration

National Forests in Florida

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Final Environmental Impact Statement for the Ocklawaha River Restoration Project
Marion and Putnam Counties, Florida

Responsible Agencies: U.S.D.A. Forest Service (USFS) and the Florida Department of Environmental Protection (FDEP).

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Abstract: This final environmental impact statement (FEIS) was prepared for the proposal by the FDEP to continue to occupy national forest system land for operating and maintaining portions of Kirkpatrick Dam, Rodman Reservoir and Eureka Lock and Dam in conjunction with partial restoration of the Ocklawaha River. The USFS will make a decision to continue or discontinue to permit occupancy of Kirkpatrick Dam and Eureka Lock and Dam on national forest lands based on FDEP's management intentions and the environmental analysis. Four project alternatives were considered: full retention (no action), partial retention, partial restoration (preferred alternative), and full restoration. Potential impacts under both retention alternatives include limited or no floodplain restoration, extensive aquatic plant management, limited seasonal water level fluctuations and nutrient exchange, continued habitat fragmentation and tree loss. Potential impacts under restoration alternatives include restoration of the historic floodplain hydrology, sediment transport, nutrient exchange, water quality and vegetation. Limited short-term impacts to downstream nutrient and sediment transport are expected. Impacts to habitat for threatened or endangered species are predicted, although habitat connections will be restored for at least three listed species and nesting and roosting habitat will increase for colonial wading birds. Construction and costs are substantially less under partial, as opposed to full restoration. All alternatives have potential risk of looting and destruction of cultural artifacts, although exposure of land under restoration alternatives poses a greater potential of looting.

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1.0 Summary

1.1 Background

In an effort to promote navigation and the transport of products to coastal markets, proponents of the Cross Florida Barge Canal began lobbying efforts in the 1930s. Congress authorized the construction of the Cross Florida Barge Canal in 1942, ostensibly as an escape route from German submarines. Originally designed as a ship canal running from Yankeetown on the Gulf Coast to Palatka on the St. Johns River, the project included impounding the water of the Ocklawaha River. The construction of the barge canal itself began in 1964 and Kirkpatrick Dam was built in 1968, flooding about 3,400 acres of floodplain forest. Kirkpatrick Dam was completed in 1968, and the resulting impoundment, named Rodman Reservoir, flooded another 4,000 acres of floodplain forest to supply water to operate Buckman Lock.

Surrounded by controversy for decades, the project was officially deauthorized by Congress in 1991 and the U. S. Army Corps of Engineers (COE) transferred their land interests and structures in the Cross Florida Barge Canal to the State of Florida. As a result of the transfer, the State applied for and was issued a permit by the USDA Forest Service (USFS) for the occupancy of Kirkpatrick Dam and Eureka Lock and Dam. The permit expired and has been extended to provide time for the State to develop manatee protection for Kirkpatrick Dam and apply for a new occupancy permit describing their management intentions and environmental analysis to support their proposal. A Notice of Intent (NOI) to prepare a draft environmental impact statement for this project was prepared by the COE and published on February 6, 1996. The COE decisions include permitting activities for Section 9 and Section 10 of the Rivers and Harbors Act and for Section 404 of the Clean Water Act. The COE permitting decisions are several years away. The Forest Service decision is ripe for action at this time. A NOI to prepare an Environmental Impact Statement (EIS) for this project was prepared by the USFS and published in the federal register on March 20, 2001. The Forest Supervisor for the National Forests in Florida will decide whether or not to permit continued occupancy and use of national forest system land by the Florida Department of Environmental Protection (FDEP) for operating and maintaining portions of Kirkpatrick Dam, Rodman Reservoir, and Eureka Lock, and the disposition and management of currently submerged national forest land in conjunction with the implementation of the Partial Restoration by FDEP of the Ocklawaha River.

This EIS provides documentation of the analysis of the proposed action and three other alternatives for the Ocklawaha River restoration project. The Ocklawaha River restoration project has been developed by the FDEP to restore the historic river channel and flow between Eureka Dam and the St. Johns River. The project is also intended to restore floodplain forest, which is now permanently flooded as a result of the creation of the Rodman Reservoir. This EIS addresses significant issues and concerns identified through the scoping process for the project. The EIS is being submitted by the FDEP because FDEP is responsible for implementation of the project.

Major issues presently threatening the ecological integrity of the Ocklawaha River basin include chronic flooding and associated alterations in nutrient exchange and water quality, loss of hydrologic and habitat connections within and between the river and forest, increases in exotic and nuisance species, and changes in timing and quantity of discharges into the lower Ocklawaha River.

The 1993 Florida Legislature passed Chapter 93-213, Laws of Florida, with sections concerning the Cross Florida Barge Canal now codified in Chapter 253, *Florida Statutes,* in which the FDEP was directed to study the efficacy, both environmental and economic, of complete restoration of the Ocklawaha River, partial restoration of the river, total retention of the Rodman Reservoir, and partial retention of the reservoir.

Results of these studies are documented in *Environmental Studies Concerning Four Alternatives for Rodman Reservoir and the Lower Ocklawaha River*, which was prepared for the FDEP by the St. Johns River Water Management District (SJRWMD 1994). The SJRWMD study served as the basis for the environmental portions of this EIS and was supplemented by additional investigations to prepare a thorough analysis of the impacts of the four alternatives.

1.2 Proposed Action and Alternatives

Four alternatives to addressing river restoration were examined and compared: full retention, partial retention, partial restoration, and full restoration. Full retention was identified as the no action alternative, and partial restoration was subsequently identified as the proposed action. Physical, biological, and human resource components were analyzed to provide an analysis of the proposed action and three alternatives for the restoration. The four alternatives are described below.

Alternative 1: Full Retention (No Action). Retaining the reservoir at its current size and depth, with options for active management to enhance fish and/or wildlife (options are addressed in subsequent management sections). Removal and/or alteration of structures and topography would be limited.

Alternative 2: Partial Retention. Reducing the water level of the reservoir to 14 feet NGVD. Active management for fish and/or wildlife as described for the no action alternative would continue. Structural modifications and alterations in topography would be limited.

Alternative 3: Partial Restoration (Proposed Action). Restoring river hydrology and floodplain function to preconstruction conditions through breaching of the dam, with limited removal and/or alteration of structures and alteration of topography.

Alternative 4: Complete or Full Restoration of the Ocklawaha River. Restoring river hydrology and floodplain function to preconstruction conditions, removing all structures, and returning the topography in the impact area to preconstruction conditions.

The proposed action is the **partial restoration alternative**. As such, it involves those minimal efforts necessary to restore the *functions* of the Ocklawaha River and floodplain to preconstruction conditions, with limited removal and/or alteration of existing structures and topography. Major components include a 3-year phased drawdown to historic water levels, restoration of river and major tributary flows, channel stabilization and erosion control, limited plantings of native species, limited topographic restoration, and closure of the lock.

1.3 Effects of Alternatives

Differences in retention and restoration alternatives are primarily related to acreage of floodplain restored and fluctuations in seasonal water levels, and the types of recreational activities associated with each. As a result, comparisons of partial and full restoration alternatives with partial and full retention alternatives are distinct. Differences between partial and full retention and differences between partial and full restoration are not as distinct. Construction during any restoration activities may have short-term impacts on physical, biological, and human resource components in the Ocklawaha River basin. Potential impacts that may occur under the no action alternative are presented in Section 4 (Affected Environment), and environmental consequences of the alternatives are discussed in Section 5 (Environmental Consequences). Summaries of impacts to physical, biological, and human resource components are presented in the following sections.

1.3.1 Physical Components

Any deposition of sands, silts, or organic materials as a result of any of the four alternatives is expected to be negligible (SJRWMD 1994). At 18 feet National Geodetic Vertical Datum (NGVD), the 5,980-acre reservoir has a mean depth of 8.4 feet and a maximum depth of 31 feet. The bottom of the channel ranges from an elevation of +4 to -7 feet NGVD. Channel widths range from 110 feet to 260 feet. Sediment thickness in the channel ranges from 0.0 feet to 3.2 feet, although sediments are typically less than 2.0 feet thick.

Hazardous and toxic wastes are not expected to pose a risk under any of the project alternatives. Data sources examined to date do not indicate the presence of hazardous and toxic wastes in the reservoir, and the risk to aquatic organisms is considered minimal (SJRWMD 1994).

1.3.1.1 Full Retention (No Action)

Under the full retention alternative, the existing pool elevation in the reservoir would be retained at 18 feet NGVD, and the average flow velocity would be approximately 1,674 cubic feet per second (cfs). No seasonal fluctuations in water level would occur under the full retention alternative, which means any seasonal exchange of nutrients between the reservoir and adjacent floodplain forest would be limited. Under continued full retention, the 20 springs in the reservoir would remain inundated or altered.

Vegetation in the reservoir presently assimilates nutrients flowing into the reservoir and prevents their transport downstream. Estimated total phosphate and nitrate values in the reservoir are 0.14 and 0.10 mg/l, respectively, and are four and eight times less than those predicted for the full restoration alternative.

Any submerged archeological sites undergoing erosion or deflation will continue to degrade in that manner. Unconsolidated sediments may be protecting submerged cultural resources from erosion, deflation and looting.

1.3.1.2 Partial Retention

Under the partial retention alternative, the pool depth would be reduced from 18 to 14 feet NGVD. The lowered pool depth was modeled by SJRWMD (1994) and is predicted to result in restoration of river hydrology and floodplain to 2,331 acres of floodplain forest above the Kirkpatrick Dam.

Predicted average flow would be 1,687 cfs and, like the full retention alternative, there would be no seasonal water fluctuations. Some of the previously inundated springs might be exposed.

1.3.1.3 Partial Restoration (Proposed Action)

Partial restoration is expected to have significant positive environmental impacts on water quality and water supply. Nitrogen and phosphorus concentrations are predicted to increase temporarily by an order of magnitude during restoration activities, although they are expected to adsorb to sediments and will not be readily available to downstream vegetation. Pumping of the sediments from the reservoir during construction activities will help to alleviate predicted nutrient releases. It is expected the sediment will be pumped into the old borrow pit adjacent to the dam. Necessary permits will be acquired prior to pumping.

Under average discharge conditions, the elevation of the surface water at Kirkpatrick Dam will decrease from 18.2 feet NGVD to 3.8 feet NGVD. Changes in the surficial aquifer under partial or full restoration may result in an increase in exposure of local springs that were altered or flooded following construction of the dam.

1.3.1.4 Full Restoration

Under Full Restoration, the elevation of the surface water at Kirkpatrick Dam will decrease from 18.2 feet NGVD to 3.8 feet NGVD. Kirkpatrick Dam and all related structures will be removed, resulting in this alternative having the greatest impact on water quality, but those impacts will be temporary. Nitrogen and phosphorus concentrations will increase temporarily by an order of magnitude during restoration activities, although they are expected to adsorb to sediments and will not be readily available to downstream vegetation. Changes in the surficial aquifer may result in an increase in exposure of local springs that were altered or flooded following construction of the dam.

1.3.2 Biological Components

1.3.2.1 Full Retention (No Action)

Under the full retention alternative, impacts other than those already occurring are not expected. The Rodman Reservoir has increased aquatic habitat in the Ocklawaha River floodplain. Impacts to wildlife and plant communities under the different alternatives would be primarily related to differences in open water habitat and floodplain forest and the functioning of the connection between the upper and lower river channel.

Under this alternative, nearly 7,500 acres of reservoir and adjacent floodplain would remain submerged and would not be subject to seasonal fluctuations. The reservoir pool would remain nonforested and include shallow marsh, floating marsh, aquatic beds, and open water with hydrilla and associated submerged and emergent aquatic vegetation. In addition, submerged logs and trees would remain, and existing standing dead trees would eventually fall.

Twelve of the 37 state-listed threatened, endangered, candidate plant species, plant species of special concern, and rare plant species included for study based on their likelihood of occurrence in the study area were found in the project area.

The numbers and diversity of mammals associated with the reservoir are lower when compared to native floodplain forest, although the reservoir would continue to provide habitat for those species present. Three species typical of the area are beaver, muskrat, and river otter.

Manatees would continue to use the Buckman Lock as a portal from the St. Johns River to the Rodman Reservoir, upper Ocklawaha River, Silver River, and other upstream springs. The lock would continue to pose a risk of death or injury from vessel strikes and water control structures (there have been 10 recorded manatee deaths since 1977, and the lock is the only known source of water control structure mortality on the St. Johns River system).

Foraging habitat along the edges of the reservoir and among the dense vegetation surrounding stressed cypress would continue to support limpkins, little blue herons, snowy egrets, tricolor herons, and white ibis. Sandhill cranes and wood storks occur in marshes and wet prairies throughout Florida and nest just north of the reservoir in Cow Heaven Bay. Under this alternative, the foraging habitat of these species would not change. Two kestrals have been sighted at the reservoir in winter (non-breeding), and a single active bald eagle nest presently exists in the project vicinity. Available habitat for these species is not expected to change. The absence of trees under existing conditions provides fewer nesting sites for ospreys, double-crested cormorants, and great blue herons. In addition, the open water and marsh habitats provide no nesting or roosting habitat for the colonial wading birds. No bird species populations are expected to increase as a result of this alternative. The state-listed bluenose shiner and southern tesselated darter would continue to be absent from the Ocklawaha River. Both of these species, however, should continue to survive within Orange Creek unless increases in aquatic vegetation negatively affect this habitat.

Historically, 69 freshwater fish species from 22 families have been identified in the St. Johns River basin. Forty-two species from 18 families were found during the SJRWMD study. The decrease is likely due to the change from a flowing system to the standing reservoir. Although some migratory fish are passing through the Buckman Lock, the dam appears to pose a barrier to the spread of a variety of migratory fishes that historically used the system. Individual fish biomass is greater in the reservoir when compared with the downstream channel under the existing full retention conditions, although abundance and total biomass are greater downstream of the dam.

1.3.2.2 Partial Retention

Lowering the pool depth to 14 feet NGVD has been predicted to restore river hydrology and floodplain to 2,331 acres of floodplain forest above the Kirkpatrick Dam (SJRWMD 1994). Artificially created surface features would remain, and seasonal water fluctuations would be limited to the restored area.

The primary difference between partial and full retention alternatives is that partial retention is predicted to increase marsh habitat, which is expected to enhance marsh-dwelling species populations. At 14 feet NGVD, marsh and aquatic habitats would be converted to shrub swamp and eventually floodplain swamp in those areas where historic hydrology has been restored. As a result, some species associated with the forest, as opposed to the reservoir, might reappear. Under partial retention, impacts to the remaining biological components would be the same as those described for the full retention alternative.

1.3.2.3 Partial Restoration (Proposed Action)

The major change under the partial restoration alternative is the restoration of the floodplain forest habitat and the historic connection through the floodplain forest, which is important in providing sufficient contiguous habitat important to many native vertebrates in the region.

Pre-reservoir area of habitat types within the area now occupied by Rodman Reservoir between Kirkpatrick Dam and Eureka Dam has been estimated to include over 9,500 acres (SJRWMD 1994). Using existing conditions and trends in water level stage, it is predicted that nearly 7,500 acres of floodplain swamp will be restored under partial restoration (FDEP 1997). Hardwood trees greater than 14 feet in height are expected after 10 years, with canopy development after approximately 30 to 40 years.

Rare and endangered birds and mammals are more likely to be found in cypress swamps and mixed hardwood swamps than in other kinds of swamps. Of the 68 birds listed as rare and endangered in all of Florida, 12 are found in cypress and hardwood swamps (Ewel 1986). In addition, the black bear and the Florida panther are now concentrated in swamps because of widespread destruction of upland habitat.

The FDEP has assessed the terrestrial wildlife population(s) that may be displaced or eliminated by conversion of the Rodman Reservoir to a flowing river channel in cooperation with the Florida Fish and Wildlife Conservation Commission (FWCC), U.S. Fish and Wildlife Service (USFWS), and the SJRWMD. Appropriate measures will continue, as needed, to compensate for any losses of wildlife. Protection measures as outlined in the *USFWS Biological Opinion* (Appendix F) will be implemented during any construction.

As with other animals, increased acreage of floodplain forest is expected to lead to commensurate increases in mammal species that use this habitat. Restoration of nearly 7,500 acres of flooded forest is expected to increase the habitat available for mammals in the Ocklawaha River basin.

Approximately 20 mammals have been recorded or are likely to occur in the Ocklawaha floodplain, and typical mammals under restored natural conditions are expected to include opossum, southeastern shrew, short-tailed shrew, beaver, wood rat, rice rat, cotton mouse, golden mouse, bear, raccoon, and bobcat.

Partial restoration will include reopening the manatee access corridor via the lower Ocklawaha River to the rest of the Ocklawaha (Smith 1997), and eliminating a known source of manatee mortality and the only known source of water control structure mortality on the St. Johns River system. Restoration of the floodplain is also expected to provide increased black bear habitat and may provide a more direct north-south corridor through the Ocala National Forest. The Ocklawaha River floodplain does not provide suitable habitat for the Florida panther and has not been identified as a potential reintroduction site by the FFWCC.

The loss of aquatic foraging and nesting habitats under the partial restoration alternative is likely to impact foraging habitat for listed little blue heron, snowy egret, and tricolor heron. The loss of open water habitat under partial restoration may result in declines in open-water and marsh- dwelling species, including herons, egrets, ospreys, ducks, rails, and limpkin. Increases in forest species, such as warblers, vireos, wrens, cardinals, and owls, may be expected.

Eastern indigo snake habitat will increase as forested floodplain is restored. Habitat for reservoir-dependent reptile and amphibian species will be reduced under partial restoration. Alligator densities may change in response to a shift to from aquatic and marsh habitat to floodplain swamp, but the conversion of deeper water to shallow water and marsh will continue to provide alligator habitat.

Elimination of the reservoir will lead to reestablishment of tributary flows to the river from Orange and Deep Creek, increasing available stream habitat and potentially repopulating the river with state-listed bluenose shiner and southern tesselated darter. An increase in migratory fish populations is expected as a result of the restored historic connection to the St. Johns River. An increase in fish diversity combined with a decrease in fish densities, e.g. bullhead and shiners, may also occur.

Twelve of the 37 state-listed threatened, endangered, candidate plant species, plant species of special concern, and rare plant species included for study based on their likelihood of occurrence in the study area were found in the project area (see Appendix B for a detailed analysis). These include: giant leather fern, garberia, needle palm, cardinal flower, Florida spiny-pod, buckthorn, cinnamon fern, royal fern, Florida pinkroot, Florida willow, grass of parnassus, and variable-leaf Indian plantain. All 12 species are expected to increase as suitable habitat increases with the restoration of the historic floodplain.

1.3.2.4 Full Restoration

Initial disturbance associated with construction and earth-moving during the restoration process will have greater impacts to habitat and wildlife. Construction activities may result in the death of individuals of burrowing species such as reptiles, amphibians, and small mammals such as mice, shrews, moles and rabbits. Effects of these activities will be temporary and those species are

expected to easily repopulate the restored habitat. The additional acres of exposed national forest system lands will create more acres of habitat for both common species and rare and endangered species. Wildlife populations and habitat succession will be similar to those expected for Alternative 3, Partial Restoration.

1.3.3 Human Resource Components

Land use, aesthetic resources, noise and air quality, hazardous and toxic wastes, and many other human resource components may be impacted, either negatively or positively, under any of the four alternatives. Each of the four alternatives has some direct, potential or cumulative effects upon cultural resources; see Section 5.16 and Appendix C for further information. Under either restoration alternative, a trailer and ramp navigation system will be implemented to maintain river traffic while the reservoir is being lowered to historic water levels.

Based on past records, expenses associated with aquatic plant management requirements will continue. Existing discharge rates (over 1,600 cfs) preclude the cost-effective use of fluridone to control hydrilla in all but protected areas of the reservoir. With a drawdown every 3 years, aquatic plant management cost estimates for this alternative range from $14,000 per year for treating floating leaved aquatic plants to $270,000 per year if, or when, hydrilla is treated. Without drawdown as a management tool, the cost will probably range from $75,000 to $270,000 per year due to increased population levels of floating leaved plants and hydrilla. These costs would increase under the partial retention alternative. Management of aquatic plants is expected to continue during restoration until native species are established.

Potential impacts to socioeconomic and recreation components are discussed below.

1.3.3.1 Full Retention (No Action)

Current recreational opportunities are not expected to be impacted under this alternative. Visitors to the Rodman Reservoir in 1994 accounted for about $7.5 million in both direct and indirect expenditures. Of the $7.5 million, $3.32 million can be attributed to direct reservoir-based activities and accounts for 0.096 and 0.039 percent of economic base in Putnam and Marion counties, respectively. Considered as a share of the overall economic activity of the counties (individually, and even more so when the two are combined), expenditures by visitors to Rodman Reservoir are quite small.

The total costs of operating the Buckman Lock and Kirkpatrick Dam during fiscal years 1995-1996 and 1996-1997 were $268,911 and $333,437 respectively. These costs are expected to continue.

1.3.3.2 Partial Retention

Under this alternative, visitor attendance is estimated to be 54 percent less than full retention. Impacts to the local and regional economy are expected to be greater than those described for full retention, possibly a result of the decrease in aesthetics following the 4-foot drawdown in lake level. Costs of operation of the dam will continue.

1.3.3.3 Partial Restoration (Proposed Action)

Approximately 56 percent of all existing gross expenditure and earnings estimates associated with the reservoir can be expected to remain under the partial restoration alternative. Additionally, much of the lost recreational activity will be dispersed throughout other lakes and rivers within the region, such as Lake George, Crescent Lake, St. Johns River, Lake Kerr, Orange Lake, Lake Lochloosa, and the Interlachen Chain of Lakes. It is important to remember that restoration of the river does not preclude all current recreational activities, and therefore expenditures, in the Rodman area of the Ocklawaha River.

Costs associated with the maintenance and use of the Buckman Lock will be eliminated under this alternative.

1.3.3.3 Full Restoration

This alternative is similar to Partial Restoration in that approximately 56 percent of all existing gross expenditure and earnings estimates associated with the reservoir can be expected to remain. Much of the lost recreational activity will be dispersed throughout other lakes and rivers within the region, such as Lake George, Crescent Lake, St. Johns River, Lake Kerr, Orange Lake, Lake Lochloosa, and the Interlachen Chain of Lakes. Restoration of the river does not preclude all current recreational activities, and therefore expenditures, in the Rodman area of the Ocklawaha River. Alternative sources of revenue and employment may arise as new recreational opportunities, such as ecotourism and nature-based recreation, are developed.

Costs associated with the maintenance and use of the Buckman Lock will be eliminated under this alternative.

2.0 Purpose of and Need for the Proposed Action

2.1 Introduction

The FDEP has applied for authorization from the USFS for the continued occupancy and use of National Forest system land in conjunction with the proposed action of the partial restoration of the Ocklawaha River. National Forest system lands affected include areas on the Ocala National Forest containing a portion of Kirkpatrick Dam, Eureka Lock and Dam and approximately 600 acres inundated by Rodman Reservoir. This EIS provides documentation of the analysis of FDEP's proposed action and three alternatives for the Ocklawaha River restoration project.

2.2 Purpose and Need

The *purpose and need* for the project is to restore the ecological functions of the lower Ocklawaha River and its floodplain forests as reflected in the will and directives of the State of Florida and to regain submerged national forest system lands inundated by the dam and reservoir. Additional specific purposes of the proposed project include:

1. Restoration of water quality in the Ocklawaha River upstream of the existing Kirkpatrick Dam to a riverine system.

2. Increasing fish and shellfish productivity in the Ocklawaha River downstream of the existing Kirkpatrick Dam.

3. Restoration of historically contiguous aquatic and terrestrial habitat and plant and wildlife dispersal corridors on public lands.

4. Reduction in the coverage of nuisance and exotic species in the Ocklawaha River basin.

2.3 Decision to be Made

The USFS must decide whether to authorize occupancy and use of National Forest system lands for Kirkpatrick Dam and Eureka Lock and Dam based on FDEP's management intentions and analysis in this EIS. In addition, the Forest Service must decide if the continued use of National Forest system lands for impoundment of the Rodman Reservoir is consistent with the long-term management goals of the National Forests in Florida. Those long-term goals, stated in the Revised Land and Resource Management Plan for the National Forests in Florida, include the following:

- Maintain or, where necessary, restore ecosystem composition, structure, and function within the natural range of variability in all ecosystems, with emphasis on longleaf pine-wiregrass, sand pine-oak hardwood, pine flatwoods, hardwood/cypress, oak, hammock ecosystems, another imperiled specialized communities.

- Manage floodplains, groundwater, lakes, riparian areas, springs, streams and wetlands to protect or enhance their individual values and ecological functions.

- Conserve and protect important elements of diversity-such as endangered and threatened species habitat, declining natural communities, and uncommon biological, ecological, or geological sites.

- Protect rivers and preserve their cultural/historical, ecological, fish and wildlife, recreational, geological, or scenic values.

- Obtain a national forest ownership pattern that reduces management costs and helps meet ecosystem management objectives. Acquire land to connect large tracts of public ownership to maintain biologic and hydrologic linkages in partnerships with other public agencies.

2.4 The Need for Restoration

The Ocklawaha River basin is a unique natural resource consisting of a meandering river channel and its associated floodplain forest, hydric hammocks, marshes, and springs. The wildlife in this system is particularly diverse due to the fact that many populations are either the most northern or most southern representatives of their species (Lugo and Brown 1986 after Layne 1970). Unlike many Florida riverine swamps, the Ocklawaha River system has undergone considerable study. The high diversity of wetland species, as well as habitat for state-listed endangered and threatened species such as Florida sandhill crane, wood stork, Eastern indigo snake, black bear, and manatee, is well documented.

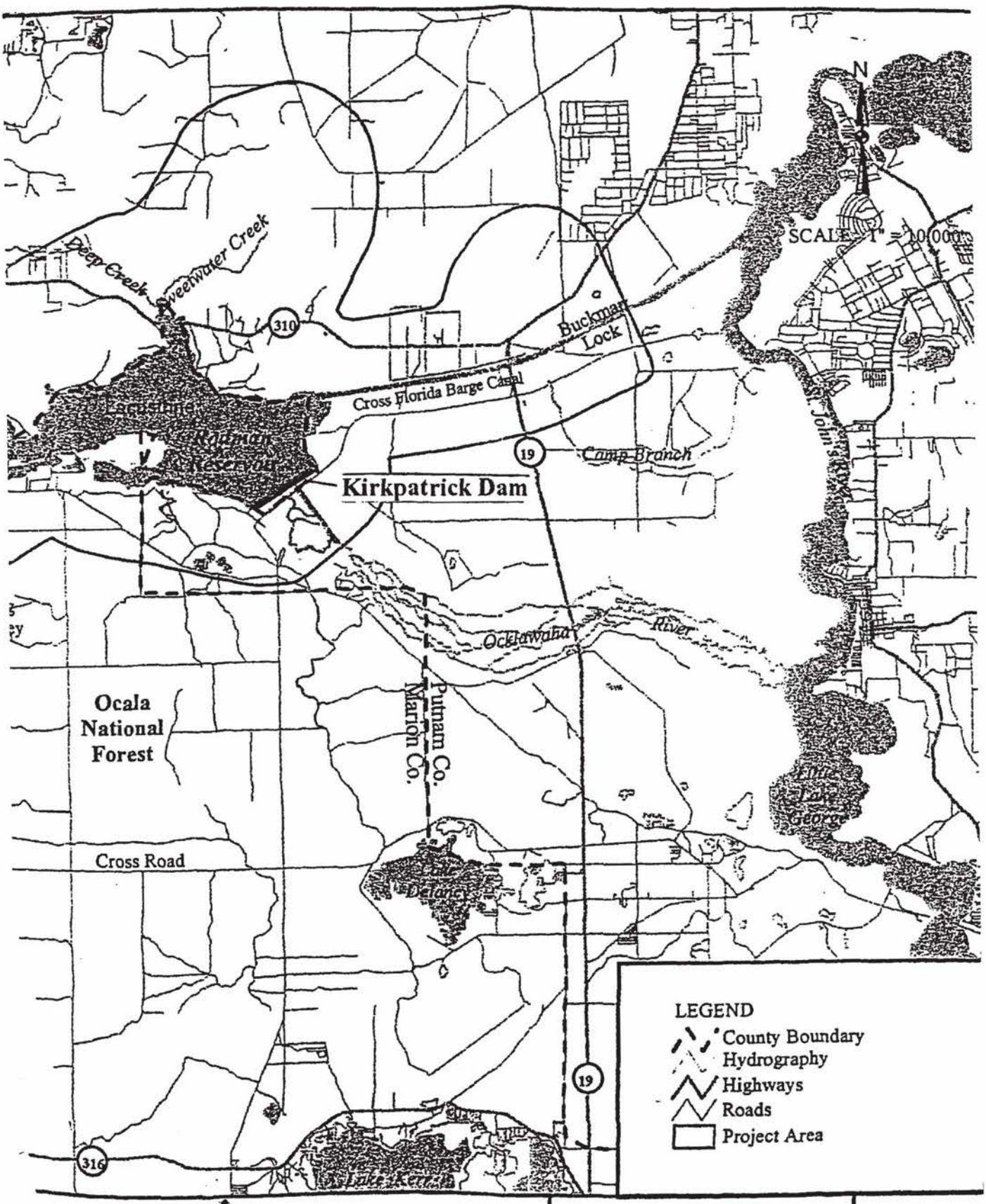
The Ocklawaha River is located in Putnam and Marion Counties in north central Florida (see Figure 2-1). It is the primary tributary to the St. Johns River and, like the St. Johns River; it is hydrologically distinctive in that it flows north. The Ocklawaha River originates at Lake Griffin in the chain of lakes in the central peninsular highlands of Florida. Its major tributaries include Silver Springs, Lake Eaton, and Orange Lake.

The loss of floodplain forests along the Ocklawaha River has been extensive. Construction activities associated with the barge canal resulted in the destruction of approximately 3,400 acres of floodplain forest. When the Kirkpatrick Dam was completed in 1968 and the Rodman Reservoir was created, approximately 4,000 additional acres of floodplain forest were flooded (Lugo and Brown 1986), including approximately 600 acres of national forest system lands. As a result of the persistent flooding, seeds did not germinate, trees died, and soil conditions became toxic to plants.

Over the years, management priorities of the Ocklawaha River basin have included navigation, aquatic plant management, recreation, and in recent years, protection of the natural resources. The upper Ocklawaha River, from Eureka Lock and Dam to 20 miles south, has been designated an Outstanding Florida Water (OFW) due to its ecological and recreational significance. The waters of

the Ocklawaha River and Rodman Reservoir are also designated as Class III surface waters. The St. Johns River Water Management District (SJRWMD) has identified the upper Ocklawaha River basin as a priority water body and is restoring a portion of the river upstream of the Rodman Reservoir. As a result of the emphasis on resource protection, Governor Lawton Chiles issued the mandate in 1995: "to proceed immediately in applying for permits to restore the Ocklawaha River and in moving forward with a plan to begin an orderly and phased drawdown of the Rodman Reservoir."

The Ocklawaha River basin includes unique natural resources, including plant and animal communities dependent on a complex array of water management and water quality conditions. Major issues presently threatening the ecological integrity of the Ocklawaha River basin are outlined below.



Project Area and Vicinity

Source(s): U.S.G.S.; U.S. Census Bureau

FIGURE 2-1

1. **Chronic inundation of the floodplain has resulted in degraded water quality in the Rodman Reservoir and upper river.** Limited flushing and trapping of upstream nutrient inputs have resulted in hyper-eutrophic conditions in the Rodman Reservoir. Low dissolved oxygen concentrations, soil toxins produced from anaerobic soil conditions, and decreased light penetration in the reservoir have been documented. These changes have resulted in periodic fish kills and have prevented seed germination and tree regeneration in the reservoir and upper river.

2. **The trapping of particulate nutrients within the Rodman Reservoir has reduced downstream fish and shellfish productivity.** The downstream export of detritital material, especially nitrogen, is inhibited by the Kirkpatrick Dam (Tomlinson et al. 1994). While the magnitude and frequency of hydrologic discharges have not been significantly altered below the dam (Rao et al. 1994), the downstream transport of particulate nutrients has been severely depressed, resulting in reduced fish and shellfish productivity in the lower Ocklawaha River and adjacent St. Johns River.

3. **Fragmentation of the once contiguous Ocklawaha River and floodplain habitat has eliminated critical plant and wildlife dispersal corridors.** Floodplain forests provide important natural wildlife corridors because they link lowlands to uplands and aquatic food chains to upland food chains. Normal stream flow and periodic flood events coursing through the floodplain disperse plant propagules and facilitate animal movements across larger geographic areas. In addition, the contiguous aquatic habitat provided to migratory fishes, such as the striped bass, as well as the endangered West Indian manatee, by a free-flowing river has been hampered by the Kirkpatrick Dam.

4. **Stagnant water levels and flow velocities created by the Kirkpatrick Dam have increased the coverage of exotic and nuisance plant species.** Following completion of the dam in 1968, hydrilla was first noted in the reservoir in 1971, and by 1974 it was the dominant submerged species. Since then, other exotic species including water hyacinth and water lettuce have become management problems in the reservoir. The stabilization of water levels and the reduction of stream flow velocities upstream of the Kirkpatrick Dam have created ideal conditions for the proliferation of exotic and nuisance plants species, which create navigational and trophic-related problems in the reservoir. To minimize these problems, costly active aquatic plant management is needed.

In addition to the above-listed environmental benefits, there are socioeconomic benefits expected to be generated by the proposed project. These benefits include the elimination of public tax expenditures for the operation and maintenance of Buckman Lock and a reduction in expenditures for the continued management of exotic and nuisance aquatic vegetation, as well as the enhancement of recreational opportunities on the restored river.

3.0 Alternatives

This section presents the environmental impacts of four alternatives for the proposed project in comparative form and forms the basis for decision among the alternatives. Although some of the information may be repetitive, the format is intended to provide the reader a thorough understanding of the alternatives. The alternatives considered are:

Alternative 1: Full retention of Rodman Reservoir (no action alternative)
Alternative 2: Partial retention of Rodman Reservoir
Alternative 3: Partial restoration of Ocklawaha River (proposed action)
Alternative 4: Full restoration of Ocklawaha River.

3.1 Background

The 1993 Florida Legislature passed Chapter 93-213, Laws of Florida, with sections concerning the barge canal now codified in Chapter 253, Florida Statutes. Section 54 of Ch. 93-213 mandated a study of the restoration of the Ocklawaha River, as provided below.

> (2) Prior to a final determination of the disposition of the canal works impounding the Ocklawaha River at Rodman Reservoir being made, the Department of Natural Resources shall study the efficacy, both environmental and economic of complete restoration of the Ocklawaha River, partial restoration of the river, total retention of the Rodman Reservoir, and partial retention of the reservoir. The department shall present its findings and recommendations to the Governor and Cabinet, the President of the Senate, and the Speaker of the House of Representatives by January 1, 1995. The final determination as to the disposition of the Rodman Reservoir shall be made following the submission of these findings and recommendations.

Environmental issues related to the four alternatives specified by the legislature were examined by the St. Johns River Water Management District (SJRWMD). Results of these studies are documented in Environmental Studies Concerning Four Alternatives for Rodman Reservoir and the Lower Ocklawaha River, which was prepared for the Florida Department of Environmental Protection (FDEP) by SJRWMD (SJRWMD 1994). The SJRWMD study served as the basis for the environmental portions of this Environmental Impact Statement (EIS) and was supplemented by additional investigations to prepare a thorough analysis of the impacts of the four alternatives.

3.2 Description of the Alternatives

One component of the mandate from the Florida Legislature that required further consideration was the definition of the various project alternatives. Chapter 93-213 of the Florida Statutes defines the four alternatives to be considered only as "complete restoration of the Ocklawaha River, partial restoration of the river, total retention of the Rodman Reservoir, and partial retention of the reservoir." However, more detailed working definitions were needed, especially with regard to the partial retention and partial restoration alternatives, so that all parties involved with evaluating the

impacts of the four alternatives would use the same definitions. Therefore, SJRWMD and FDEP developed the following definitions, which are to be used for the impact evaluations.

1. Total or Full Retention: Retaining the reservoir at its current size and depth, with active management to enhance fish and/or wildlife. Removal and/or alteration of structures and topography would be limited. The reservoir would be maintained at an elevation of 18 feet NGVD.

2. Partial Retention: Reducing the size of the reservoir to the extent that a part of the river can be restored and a part of the reservoir can be retained. This alternative would involve active management for fish and/or wildlife in that part of the reservoir to be maintained and would involve restoration of river hydrology and floodplain function in that part of the river to be restored. There would be limited removal and/or alteration of structures and alteration of topography. Based on bathymetric and hydrologic modeling results, SJRWMD determined that the reservoir for this alternative would be maintained at an elevation of 14 feet NGVD.

3. Partial Restoration: Restoring river hydrology and floodplain function to preconstruction conditions through breaching of the dam, with limited removal and/or alteration of structures and alteration of topography.

4. Complete or Full Restoration of the Ocklawaha River: Restoring river hydrology and floodplain function to pre-construction conditions, removing all structures, and returning the topography in the impact area to pre-construction conditions.

The proposed action is the partial restoration alternative. As such, it involves those efforts necessary to restore submerged national forest system lands and to restore the functions of the Ocklawaha River and floodplain to preconstruction conditions, with limited removal and/or alteration of existing structures and topography. The major components of the partial restoration alternative are listed below.

1. A phased drawdown of the reservoir to be accomplished in three phases over 3 years

2. Limited construction of channel stabilization and erosion control structures in the Ocklawaha River

3. Limited planting of native tree species to provide for erosion control

4. Partial leveling of the exposed barge canal side-cast spoil berms

5. Restoration of the historic Ocklawaha River channel flow by filling the barge canal where it intersects the river channel

6. Restoration of the historic Deep Creek channel flow by filling the barge canal where it intersects the creek channel

7. Restoration of the historic Camp Branch floodplain and channel flow by filling the barge canal where it intersects the creek channel

8. Closure and securing of the Buckman Lock

9. Removal of 2,000 feet of the Kirkpatrick Dam

10. Partial filling and restoration of the spillway tailrace to natural grade.

These major components of the project are depicted on Figure 3-1. Table 3-1 provides a detailed description of the proposed phasing and construction plan for the project. A map of the floodplain area exposed during each phase of the partial restoration is presented in Figure 3-2.

An operating plan will be required before project work can begin that will include monitoring, and mitigation measures for several components, including cultural resources. Any earth-disturbing activity will require archeological testing and inventorying. As part of any management strategy under either full or partial retention, a decision regarding the disposition of the Buckman Lock will be made. The lock will be closed, secured, and abandoned under either restoration alternative.

In all alternatives, the disposition of Eureka Lock and Dam will remain as currently managed and facilities will remain in place.

3.3 Comparison of the Alternatives

Physical environmental components compared in the SRJWMD study include sediment transport, sediment loading, hydraulics, hydrology, and surface water quality. Biological components addressed in the study include fish, aquatic plant management, forest succession, threatened and endangered species, birds, and habitat. The SJRWMD study also analyzed elevation, bathymetry, sediments, toxins, and topography in general but did not compare these components for the four alternatives. A summary of environmental impacts, based on the results of the SJRWMD study, is presented in Table 3-2.

To augment the SJRWMD study, the work effort to compile this EIS included an examination of existing literature regarding amphibians, reptiles, and mammals. In addition, there are a number of environmental issues of particular interest that were not addressed as part of the SJRWMD study, which will be matters for consideration a restoration alternative is the proposed action. These issues are discussed in this EIS as management options to control aquatic plants and protect wildlife.

In addition to environmental considerations, this EIS investigated the impacts of the four alternatives on human resources. The human resource components addressed include: land use/property ownership, cultural resources, aesthetic resources, noise, air quality, hazardous and toxic wastes, recreation, socioeconomic impacts to the regional economy, navigation, flood hazards, shoreline erosion and accretion, water supply and conservation, energy needs, safety, food and fiber production, mineral needs, needs and welfare of people, secondary and cumulative effects, relationship between local short-term uses of man's environment and the maintenance and

establishment of the long-term productivity, and irreversible and irretrievable commitment of resources. This section of the EIS provides a general comparison of the four alternatives considering all of the components addressed.

The main differences between the four alternatives are primarily related to acreage of floodplain restored and fluctuations in seasonal water levels. There are also clear differences in hydrology (water flows) and hydraulics (depth stage) when the full and partial retention alternatives are compared to the full and partial restoration alternatives.

Differences between restoration and retention alternatives are distinct. The partial retention alternative differs from the full retention alternative primarily in the amount of floodplain and marsh habitat revealed by the 4-foot difference in NGVD, limited structural changes, and greater aquatic plant management activities that would occur under the partial retention alternative. Differences in environmental impacts between the full and partial restoration alternatives include the amount of temporary disturbance due to construction equipment and the visual impact on the landscape of man-made structures that would remain under the partial restoration alternative. Environmental effects of both restoration alternatives would be very similar, since both would permit the river to return to its natural flow and allow pre-construction ecological processes to return.

Table 3-1

Phasing and Construction Plan

Task Number	Time Period	Task Description	Comments
Predrawdown Activities			
Task 0-1	July, Year One	Improve Access/Haul Road: Improve approximately one mile of the forestry management road leading to the southern borrow pit and the southwest end of the dam embankment.	The southern borrow pit will serve as the treatment and disposal area for unconsolidated sediments dredged from the river channel. The road needs improvement to allow for heavy equipment access to the borrow pit. Improvements will include placement of crushed lime rock gravel roadbed.
Task 0-2	August, Year One	Prepare Southern Borrow Pit: Prepare the southern borrow pit to function as a dredged spoil dewatering and disposal area.	Preparation of the southern borrow pit will include the construction of a series of settling and infiltration cells. In addition, this task will involve the relocation of T&E plant and animal species.
Task 0-3	August, Year One	Transport Barge-Mounted Construction Equipment to Reservoir: Move barge-mounted equipment into the Rodman Reservoir via the CFBC.	Three construction barges will be deployed in the reservoir carrying the following heavy equipment: 1) a large hydraulic dredge; 2) a small suction dredge; and 3) a hydraulic crane mounted on a small transport barge.
Task 0-4	September, Year One	Install Floating Turbidity Barriers in Interconnect Canal: Place turbidity barriers in the interconnect canal between the tailrace and the natural river channel downstream of the dam.	Floating silt screens will be installed to prevent increased turbidity in the natural river channel. A turbidity variance will be applied to the tailrace which will serve as a sediment settling area during the phased drawdown.
Task 0-5	July - September, Year One	Complete Scour Evaluation of Bridges Affected by Drawdowns: Four bridges in the vicinity of Rodman reservoir will be reevaluated for scour prior to the initiation of drawdown.	Four bridges in FDOT District Two have already been evaluated for scour potential. The drawdown will change certain hydrologic/hydraulic conditions, requiring that these bridges be reevaluated. The bridge over Deep Creek will require additional slope protection.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Phase-I Restoration Activities			
Task I-1	August - September, Year One	Implement Exotic/Nuisance Plant Control: Implement exotic and nuisance species controls along the river and reservoir perimeter.	Air boats will be used to access the perimeter of the river and the reservoir, from the Eureka Lock to the Rodman Dam. Areas of heavy exotic and nuisance species infestations will be identified and treated with herbicides. Treatment prior to the Phase-I drawdown will limit the spread of nuisance and exotic species following floodplain exposure.
Task I-2	September, Year One	Dredge Natural River Channel: Move the small suction dredge from the CFBC into the natural river channel. Dredge unconsolidated sediments in the natural river channel from the earthen dam to about 2,000' upstream.	A considerable volume of fine-grained sediments has accumulated in the diked river channel adjacent to dam. This material will be hydraulically pumped to the southern borrow pit prior to initiating the Phase-I drawdown to minimize sediment resuspension, and to create a settling area for additional sedimentation.
Task I-3	September - October, Year One	Excavate Spoil Berms and Construct Plugs Along the CFBC: Move the large hydraulic dredge upstream to the west end of the CFBC dredge cut. Excavate lateral spoil berms and fill the CFBC dredge cut in strategic locations.	Geotubes will be placed in several locations within the CFBC dredge cut and filled with dredge spoil excavated from the CFBC channel berms to prevent the river from entering the CFBC during high flow periods. A portion of the CFBC dredge cut below the geotubes will be filled with material excavated from the channel berms and restored to grade.
Task I-4	**October - December, Year One**	**Complete Phase I Drawdown: Lower the water surface elevation in the reservoir from approximately elevation 18 to 12 NGVD.**	**This is the first of a three-phase water level drawdown of the Rodman Reservoir. This drawdown will drop the reservoir to approximately one-foot below the previous maintenance drawdown elevation of 13 feet NGVD.**
Task I-5	November - December, Year One	Provide Navigation Improvements Within Rodman Reservoir: The Phase I drawdown and the creation of plugs in the CFBC require that a new navigation channel be developed between the CFBC and the river channel.	The creation of plugs in the CFBC at Deep Creek requires that the spoil berms adjacent to the canal be breached and a new navigation channel be created between the canal and the historic river channel located within the reservoir. Woody debris in the floodplain may need to be moved.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task I-6	October Year One - February, Year Two	Transport Channel Stabilization/Planting Materials: Transport channel stabilization and planting materials upstream to strategic staging and construction areas using the small transport barge.	Channel stabilization will require the construction of cribbing units and vegetative strips, combined with the planting of trees, to increase channel roughness and to improve erosion resistance. This task involves the upstream transport of construction materials to predetermined staging areas.
Task I-7	October Year One - March Year Two	Install Vegetation Strips in the Exposed Floodplain: Install vegetation strips at strategic locations along the floodplain deemed to be vulnerable to erosion following the Phase-I drawdown.	Vegetation strips will be constructed across the cleared portion of the barge canal corridor via manual labor.
Task I- 8	October Year One - March Year Two	Install Channel Bank Protection: Install cribbing units at strategic locations along the channel deemed to be vulnerable to erosion and overflow following the Phase-I drawdown.	The transport barge will move downstream concurrent with the Phase-I drawdown and the barge-mounted crane will be used to construct cribbing units along the channel banks.
Task I-9	October Year One - March Year Two	Reconstruct Yazoo Channels: Yazoo channels that originate from springs in the floodplain will need to be cleared of woody debris and stabilized following the Phase I drawdown.	Crushed trees will likely block flow in yazoo channels as they appear following drawdown. This woody material will need to be selectively remove and placed on the bank. Other bank/channel improvements may also be required such as the installation of coir fabric and plantings.
Task I-10	January, Year Two	Install Temporary Pipeline at Camp Branch: Impound the north channel of Camp Branch where it intersects with the CFBC and install a temporary pipeline to convey channel flow across the CFBC.	Following the Phase-I drawdown, a means to convey flow from upper Camp Branch across the lowered water level in the CFBC will be needed. Steel sheet piling will be installed at the mouth of the north channel of Camp Branch where it intersects with the CFBC, and a temporary pipeline will be laid across the bottom of the CFBC and into the south channel of Camp Branch.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task I-11	January - March, Year Two	Reconstruct Ocklawaha River at CFBC Intersection: Move the large hydraulic dredge to the intersection of the CFBC dredge cut and the natural river channel. Plug the CFBC dredge cuts at both the upstream and downstream ends of the natural channel intersection, and restore the natural river channel profile.	Geotubes will be placed at both the upstream and downstream ends of the CFBC, and along the south bank of the natural channel oxbow. The hydraulic dredge will be used to fill the geotubes with spoil material excavated from the CFBC channel berms, and then to dredge the natural river channel back to its original alignment and profile.
Task I-12	April - June, Year Two	Reconstruct Deep Creek at CFBC Intersection: Move the large hydraulic dredge to the intersection of the CFBC dredge cut and the approximate historic Deep Creek channels. Plug the CFBC dredge cuts at both the upstream and downstream ends of the natural channel intersections, and restore the natural floodplain grade between the plugs.	Geotubes will be placed at both the upstream and downstream ends of the CFBC, along side of two historic Deep Creek channels, as determined from predam photographs. The hydraulic dredge will be used to fill the geotubes with spoil material excavated from the CFBC channel berms, and then to restore the area between the plugs back to the adjacent floodplain grade.
Task I-13	July - August, Year Two	Reconstruct Camp Branch at CFBC Intersection: Move the large hydraulic dredge out of the reservoir and into the CFBC, to the intersection with Camp Branch. Plug the CFBC on both the east and west ends of the historic Camp Branch floodplain. Upon completion, exit the barge through Buckman Lock and out of the CFBC.	Geotubes will be placed at both the east and west ends of the CFBC, approximately where the limits of the historic Camp Branch floodplain once existed. The hydraulic dredge will be used to fill the geotubes with spoil material excavated from the adjacent earthen banks.
Task I-14	October, Year One - September, Year Two	Monitor Water Quality, Erosion, and Vegetation Succession: These activities will be conducted continuously during the Phase I restoration effort.	Monitoring plans for assessing channel and floodplain erosion, reservoir and river water quality, and exotic and nuisance species coverage will be implemented throughout the Phase-I restoration period.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task I-15	January - September, Year Two	Replace Affected Shallow Groundwater Wells: The Phase I drawdown will lower adjacent shallow groundwater elevations by approximately 6 feet. Impacted water supply wells will be replaced.	FDEP will assess existing wells that may have been impacted by the Phase I drawdown, and replace those that have experienced significant reduced water supply capacity.
Phase-II Restoration Activities			
Task II-1	August - September, Year Two	Continue Exotic and Nuisance Plant Control: Herbicides will be applied to undesirable plant species along the river and reservoir perimeter at the beginning of the Phase II restoration effort.	Air boats will be used to access the perimeter of the river and the reservoir. Areas of heavy exotic and nuisance species infestations will be identified and treated with herbicides. Treatment prior to the Phase-II drawdown will limit the spread of nuisance and exotic species following the exposure of the new floodplain area.
Task II-2	September, Year Two	Dredge Natural River Channel (Second Time): Dredge unconsolidated sediments in the natural river channel from the earthen dam to about 2,000' upstream using the small suction dredge.	The suction dredge will be used to dredge any new fine-grained sediments that may have accumulated in the diked river channel adjacent to dam during the Phase-I restoration period. This material will be hydraulically pumped to the south borrow pit prior to initiating the Phase-II drawdown to minimize sediment resuspension, and to create a settling area for additional sedimentation.
Task II-3	**October - December, Year Two**	**Complete Phase II Drawdown: Lower the water surface elevation in the reservoir from approximately elevation 12 feet to 6 feet NGVD.**	**This is the second of a three-phase water level drawdown of the Rodman Reservoir. This second drawdown will drop the water level in the reservoir to the spillway sill elevation.**
Task II-4	October - December, Year Two	Implement Temporary Portage System: Implement a temporary boat portage system across the earthen dam between the existing Rodman Dam boat ramp and the reservoir.	A temporary portage system will be required to maintain navigable access between the reservoir and the tailrace after the Phase-II drawdown and resulting closure of the CFBC. A temporary boat ramp will be constructed on the upstream side of the dam, and boats will be trailered to and from the reservoir and the existing boat ramp located adjacent to the tailrace.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task II-5	October, Year Two - February, Year Three	Transport Channel Stabilization/Planting Materials: Transport channel stabilization and planting materials upstream to strategic staging and construction areas using the small transport barge.	Channel stabilization will require the construction of cribbing units and vegetative strips, combined with the planting of trees, to increase channel roughness and to improve erosion resistance. This task involves the upstream transport of construction materials to predetermined staging areas.
Task II-6	October Year Two - March Year Three	Install Vegetation Strips in the Exposed Floodplain: Install vegetation strips at strategic locations along the floodplain deemed to be vulnerable to erosion following the Phase-II drawdown.	Vegetation strips will be constructed across the cleared portion of the barge canal corridor via manual labor.
Task II-7	October Year Two - March Year Three	Install Channel Bank Protection: Install cribbing units at strategic locations along the channel deemed to be vulnerable to erosion and overflow following the Phase-II drawdown.	The transport barge will move downstream concurrent with the Phase-II drawdown and the barge-mounted crane will be used to construct cribbing units along the channel banks.
Task II-8	October Year Two - March Year Three	Reconstruct Yazoo Channels: Yazoo channels that originate from springs in the floodplain will need to be cleared of woody debis and stabilized following the Phase II drawdown.	Crushed trees will likely block flow in yazoo channels as they appear following drawdown. This woody material will need to be selectively remove and placed on the bank. Other bank/channel improvements may also be required such as the installation of coir fabric and plantings.
Task II-9	January - March, Year Three	Reconstruct Ocklawaha River Channel at CFBC Intersection: Continue those elements of the reconstruction that were not completed during the Phase I restoration effort.	Certain elements of the channel reconstruction, such as the installation of plantings, will likely take place during the Phase II restoration effort.
Task II-10	April - June, Year Three	Reconstruct Deep Creek at CFBC Intersection: Continue those elements of the reconstruction that were not completed during the Phase I restoration effort.	Certain elements of the channel reconstruction, such as the installation of plantings, will likely take place during the Phase II restoration effort.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task II-11	April - June, Year Three	Provide Drainage Improvements Along Camp Branch: Reconnecting of Camp Branch at the CFBC will increase peak discharges downstream of the canal, requiring that certain drainage improvements take place along Camp Branch.	Double 10 ft. X 10 ft. box culverts are required for the main evacuation road from the Boys Ranch, and slope protection is required at three other roads that will be over topped during peak design storms.
Task II-12	July - August, Year Three	Reconstruct Camp Branch at CFBC Intersection: Using land-based earthmoving equipment, cover the geotube plugs in the CFBC. Restore the natural grade and profile of the Camp Branch floodplain and streambed. This task will be performed during the dry season when streamflows in Camp Branch are minimal.	Fill material from the earthen berms adjacent to the CFBC will be used to restore the natural grade of the Camp Branch floodplain between the geotube plugs. Following the filling and grading of the Camp Branch floodplain, the sheet pile impoundment in the north channel, and the control structure in the south channel will be removed, and the stream will be allowed to flow through the restored floodplain. The channel banks of the restored streambed will be planted with desirable woody species to reduce erosional scour.
Task II-13	June - August, Year Three	Close and Secure Buckman Lock: Following the Phase II drawdown, navigation through the CFBC will not be possible and Buckman Lock can be closed and secured.	With the plugging of the CFBC and the completion of the Phase-II drawdown, the Buckman Lock will no longer be a viable lock structure. Closure of the lock will involve partial dismantling of the mechanism and immobilization the lock gates, removal of hazardous materials from the site, and the securing of all structures from public access.
Task II-14	September, Year Two - September, Year Three	Monitor Erosion, Water Quality, and Vegetation Succession: These activities will be conducted continuously during the Phase II restoration effort.	Monitoring plans for assessing channel and floodplain erosion, reservoir and river water quality, and exotic and nuisance species coverage will be implemented throughout the Phase-II restoration period. If target conditions are met, the Phase-III restoration will be initiated.
Task II-5	January - September, Year Three	Replace Affected Shallow Groundwater Wells: The Phase II drawdown will lower adjacent shallow groundwater elevations by approximately 6 feet. Impacted water supply wells will be replaced.	FDEP will assess existing wells that may have been impacted by the Phase II drawdown, and replace those that have experienced significant reduced water supply capacity.
Phase-III Restoration Activities			

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task III-1	August - September, Year Three	Continue Exotic and Nuisance Plant Control: Herbicides will be applied to undesirable plant species along the river and reservoir perimeter at the beginning of the Phase III restoration effort.	Airboats will be used to access the perimeter of the river and the reservoir. Areas of heavy exotic and nuisance species infestations will be identified and treated with herbicides. Treatment prior to the Phase-III drawdown will limit the spread of nuisance and exotic species following the exposure of the new floodplain area.
Task III-2	September, Year Three	Dredge Natural River Channel (Third Time): Dredge unconsolidated sediments in the natural river channel from the earthen dam to about 2,000' upstream using the small suction dredge.	The suction dredge will be used to dredge any new fine-grained sediments that may have accumulated in the diked river channel adjacent to dam during the Phase-II restoration period. This material will be hydraulically pumped to the southern borrow pit prior to initiating the Phase-III drawdown to minimize sediment resuspension, and to create a settling area for additional sedimentation.
Task III-3	September - November, Year Three	Reconstruct Channel at Dam Embankment: Reconstruct a the historic river channel at the intersection with the dam embankment.	Temporary steel sheet pile walls will be installed on both sides of the dam embankment. The upstream wall will be slotted to hold riser boards for water level drawdown control. Following the installation of the steel sheet pile, the portion of the earthen dam between the sheet pile will be excavated to natural river channel bottom elevation, and the side banks will be stabilized with erosion control fabric and plantings.
Task III-4	**December, Year Three**	**Complete Phase III Drawdown: Lower the water surface in the reservoir from approximately elevation 6 feet NGVD to the final restoration water elevation (approximately 4 feet NGVD).**	**This final drawdown will equalize the water level in the reservoir with that of the natural river. The drawdown will be accomplished by sequentially removing riser boards from the slotted sheet piling over an approximately one-month drawdown period.**
Task III-5	January - February, Year Four	Transport Channel Stabilization/Planting Materials: Transport channel stabilization and planting materials upstream to strategic staging and construction areas using the small transport barge.	Channel stabilization will require the construction of cribbing units and vegetative strips, combined with the planting of trees, to increase channel roughness and to improve erosion resistance. This task involves the upstream transport of construction materials to predetermined staging areas.

Table 3-1 (continued)

Task Number	Time Period	Task Description	Comments
Task III-6	January - March, Year Four	Install Channel Bank Protection: Install cribbing units at strategic locations along the channel deemed to be vulnerable to erosion and overflow following the Phase-III drawdown.	The transport barge will move downstream concurrent with the Phase-III drawdown and the barge-mounted crane will be used to construct cribbing units along the channel banks.
Task III-7	January, Year Four	Install Floating Turbidity Barriers in Tailrace: Place turbidity barriers at the downstream end of the tailrace.	Prior to the filling of the tailrace turbidity, barriers will be placed across the downstream end to prevent excessive turbidity in the natural river channel below the tailrace.
Task III-8	January - February, Year Four	Demolish Gated Structure: Dismantle the spillway superstructure and deposit the material in the tailrace.	The spillway superstructure, composed primarily of concrete and steel, will be demolished and deposited in the tailrace, and covered with earthen material from the dam embankment.
Task III-9	February - April, Year Four	Complete Excavation of Dam Embankment: Excavate 2,000' of the earthen dam embankment and deposit the material in the southern borrow pit and the tailrace.	Approximately 1,250' and 750' of the earthen dam will be excavated southwest and northeast of the reconstructed river channel, respectively. Material southwest of the channel will be deposited in the southern borrow pit, and material northeast of the channel will be deposited in the tailrace.
Task III-10	April - May, Year Four	Close and Restore Southern Borrow Pit: Following the placement of embankment material in the borrow pit it will be restored,	The final ground contours on the southern borrow pit will match surrounding grades. The restored borrow pit ground will also be revegetated.
Task III-11	May - June, Year Four	Restore Filled Portion of the Tailrace: Restore the filled portion of tailrace and remove turbidity barriers from the interconnect canal and the south end of the tailrace.	A portion of the tailrace will be backfilled to the adjacent floodplain grade and planted with native woody species. The interconnect canal will be maintained to allow navigable access to the existing Rodman Dam boat ramp.
Task III-12	September, Year Three - June, Year Four	Monitor Erosion, Water Quality, and Vegetation Succession: These activities will be conducted continuously during the Phase III restoration effort.	Monitoring plans for assessing channel and floodplain erosion, reservoir and river water quality, and exotic and nuisance species coverage will be implemented throughout the Phase-III restoration period.

3.3.1 Physical Components

3.3.1.1 Bathymetry, Elevations, and Topography

While no comparisons were made between alternatives for elevation and bathymetry, results of these studies provide a useful characterization of the existing reservoir and floodplain.

At 18 feet National Geodetic Vertical Datum (NGVD), the 5,980-acre reservoir has a mean depth of 8.4 feet and a maximum depth of 31 feet. A 50 percent removal of water from the reservoir will result in a 4.7-foot decrease in reservoir stage, while a 1-foot decrease in stage will result in a 4.7 percent decrease in reservoir surface area and an 11.4 percent decrease in volume

The bottom of the channel ranges from an elevation of +4 to -7 feet NGVD. Channel widths range from 110 feet to 260 feet. Sediment thickness in the channel ranges from 0.0 feet to 3.2 feet, although sediments are typically less than 2.0 feet thick.

3.3.1.2 Sediments

Any deposition of sands, silts, or organic materials as a result of any of the four alternatives is expected to be negligible (SJRWMD 1994). Core samples in 97 indicated that Total Phosphorus levels are less than and the percentage of organic content is within the range expected for a normal lake in Florida (Appendix E).

3.3.1.2.1 Alternative 1: Full Retention (No Action)

Under existing conditions, the primary cause of sediment transport is scouring of river channel sediments during 25-year or stronger storm events, or resuspension of sediments during strong wind events. With full retention, all incoming sediments are trapped by the reservoir. Given 100 percent trap efficiency, it would be 8,000 years before the 60,000 acre-feet (ac-ft) of capacity of the reservoir would be depleted.

3.3.1.2.2 Alternative 2: Partial Retention

Deposition of sand would occur farther downstream with a drop in pool level. At a pool depth of 14 feet NGVD, deposition would be concentrated in a 4-mile stretch of river centered at the Orange Creek confluence with the reservoir. The results are similar to those described for the full retention alternative.

3.3.1.2.3 Alternative 3: Partial Restoration (Proposed Action)

Erosion rates are expected to remain low enough to maintain existing topsoil profiles due to the mild floodplain slopes and existing rural land use in the project area. During removal and relocation of sediments, resuspension will occur in the reservoir. Water flow velocities are controlled by the Kirkpatrick Dam; velocities will slow following the initial dam breach, and sediments will settle in the tailrace just downstream of the dam.

When the dam is breached during the last phase of restoration, resuspended sediments may be transported back through the interconnect canal where the tailrace is connected to the natural channel. Extensive control measures, such as stilt fencing, floating silt screens, turbidity barriers,

channel blankets, and geotubes, will be taken to control turbidity. In addition, a water quality and monitoring plan has been designed to ensure the control of downstream turbidity and is presented in Appendix E.

Control of suspended sediments and turbidity during partial restoration is desirable in order to control down stream nutrient loads. Nutrients are adsorbed onto the surface of sediment particles. By controlling release of these sediments and reducing turbidity levels during restoration activities, one can control the nutrients that are associated with them from being released into the water column.

3.3.1.2.4 Alternative 4: Full Restoration

The phased drawdown, combined with mild slopes in the floodplain forest, will keep erosion rates low and maintain existing topsoil profiles. Removal of the dam, locks, and other structures will require earth-moving activities. This may increase the amount of sediments and nutrients temporary transported by the river. The extensive erosion control methods included for Alternative 3 would be needed under this alternative also. This alternative would require a water quality monitoring plan and a revegetation plan.

3.3.1.3 Water Quality, Hydrology, Hydraulics, and Aquifer

3.3.1.3.1 Alternative 1: Full Retention (No Action)

Under the full retention alternative, the existing pool elevation in the reservoir would be retained at 18 feet NGVD, and the average flow velocity will be approximately 1,674 cubic feet per second (cfs). No seasonal fluctuations in water level would occur under the full retention alternative, which means any seasonal exchange of nutrients between the reservoir and adjacent floodplain forest would be limited.

Examination of over 25 years of historical water quality data identified a trend in only total nitrate + nitrite. Trends towards increasing nitrogen upstream of Eureka Dam and in the transition zone of Rodman Reservoir and decreasing nitrogen downstream of Kirkpatrick Dam indicate that reservoir plants, most notably hydrilla, are assimilating nitrogen and limiting its transport downstream.

Plants in the reservoir presently function to assimilate nutrients and prevent their transport downstream. Estimated total phosphate and nitrate values are 0.14 and 0.10 mg/l, respectively, and are four and eight times less than those predicted for the full restoration alternative. Phosphorus accumulation in the reservoir is much lower when compared with other Florida lakes (Appendix E).

Chronic flooding of forests along the lower Ocklawaha River basin occurs upstream of the dam to approximately 1 mile downstream of Eureka. These conditions contrast strongly with the seasonal flooding of the undisturbed Ocklawaha River floodplain. The pool of water associated with the reservoir presently extends 49,000 feet upstream with water level stages 2.4 to 4 feet higher than historic depths. Under continued full retention, the 20 springs in the reservoir would remain inundated or altered.

3.3.1.3.2 Alternative 2: Partial Retention

Under the partial retention alternative, the pool depth would be reduced from 18 to 14 feet NGVD. The lowered pool depth would restore river hydrology and floodplain to less than 3,000 acres of floodplain forest above the Kirkpatrick Dam. Predicted average flow is 1,687 cfs and, like the full retention alternative, there would be no seasonal water fluctuations. Some of the previously inundated springs may be exposed.

3.3.1.3.3 Alternative 3: Partial Restoration (Proposed Action)

With adequate water quality control and phased drawdown of the reservoir, nutrient loads that may be released when the dam is breached can be avoided. Additionally, pumping of the sediments from the reservoir during construction activities will alleviate potential nutrient release impacts.

Recent studies (Appendix E) indicate that phosphorus resuspension and movement will not cause significant downstream problems when the reservoir is drawn down. In addition, total phosphorus content indicates that nutrient enrichment from the reservoir sediments will not be significantly different than that for other Florida Lakes.

Under average discharge conditions, the elevation of the surface water at Kirkpatrick Dam will decrease from 18.2 feet NGVD to 3.8 feet NGVD. Water levels within the surficial and Upper Floridan aquifers in the immediate area of the reservoir will be lowered following restoration. Changes in the surficial aquifer under partial or full restoration may result in an increase in exposure of local springs that were altered or flooded following construction of the dam. While flooded by Rodman Reservoir, these springs had reduced discharges due to the pressure of lake water existing at the outflow vents. By removing this pressure, spring flows will return to pre-construction amounts. These increased flows could lower the water levels in the aquifers in the immediate discharge area.

3.3.1.3.4 Alternative 4: Full Restoration

Water quality and aquifer impacts will be similar to the partial restoration alternative. Full restoration is expected to impact water quality and water supply temporarily, but historical water quality is expected to return once construction activities are completed. Nitrogen and phosphorus concentrations are predicted to increase temporarily by an order of magnitude during restoration activities, although they are expected to adsorb to sediments and not be readily available to downstream vegetation.

3.3.2 Biological Components

Under biological components, potential impacts to plants and animals under each of the four alternatives are addressed. In addition to Section 3.3.2.1 (Wildlife), listed animal species are also addressed under Section 3.3.2.2 (Threatened and Endangered Species). Plants are discussed in Section 3.3.2.2 (Threatened and Endangered Species) and Section 3.3.2.3 (Habitat and Vegetation).

3.3.2.1 Wildlife

The Rodman Reservoir has increased aquatic habitat in the Ocklawaha River floodplain and disconnected the upper Ocklawaha River floodplain from the lower Ocklawaha River floodplain and the St. Johns River. Impacts to wildlife under the different alternatives are primarily related to

differences in open water habitat and floodplain forest and the absence or presence of the habitat connection between the upper and lower river channel.

3.3.2.1.1 Alternative 1: Full Retention (No Action)

The reservoir would continue to interrupt connections and fragment the habitats of the Ocklawaha River basin. Because swamps are used by many species of mammals with large territories, breaking up habitat may prevent movement of these mammals from one area to another.

At least 20 species of mammals occur or are likely to occur within the Ocklawaha River. The numbers and diversity of mammals associated with the reservoir are lower when compared to native floodplain forest, although the reservoir would continue to provide habitat for those species present. Three species typical of the area are beaver, muskrat, and river otter.

Because of the loss of trees, there are fewer nesting sites for ospreys, double-crested cormorants, and great blue herons, and possibly limpkins, under this alternative. No bird species populations are expected to increase as a result of this alternative. The reservoir would continue to provide foraging habitat for several species of wading birds.

There are currently 15 species of amphibians and 18 species of reptiles recorded or likely to occur in the reservoir and river. Under the full retention alternative, the reservoir would continue to provide habitat for many species of amphibians and reptiles, including the Alabama water dog, river frog, American alligator, snapping turtle, alligator snapping turtle, river cooter, Florida cooter, peninsular cooter, stinkpot, spiny softshell, redbelly watersnake, and brown watersnake.

Estuarine fish have access to the Ocklawaha River through the St. Johns River and may move upstream via saltwater wedges beyond the confluence of the Ocklawaha River. Although some migratory fish pass through the Buckman Lock, the dam appears to pose a barrier to the spread of a variety of migratory fishes that historically used the system. Historically, 69 freshwater fish species from 22 families have been identified in the St. Johns River basin. Forty-two species from 18 families were found during the SJRWMD study. The decrease is likely due to the change from a flowing system to the standing reservoir.

Individual fish biomass is greater in the reservoir when compared with the downstream channel under the existing (full retention) conditions, although abundance and total biomass are greater downstream of the dam. Data from over 100 U.S. reservoirs show that sport fish harvest is negatively correlated with reservoir age, but that reservoir age has no effect on total fish standing stocks (Kimmel and Groeger 1986). As a result, sport fisheries production is not expected to continue at the present level.

3.3.2.1.2 Alternative 2: Partial Retention

The primary difference between partial and full retention alternatives is that partial retention is predicted to increase marsh habitat, which is expected to enhance marsh-dwelling species populations. At 14 feet NGVD, marsh and aquatic habitats would be converted to shrub swamp and eventually floodplain swamp in those areas restored to historic hydrology. As a result, some species associated with the forest as opposed to the reservoir may reappear.

Mammals that use the aquatic habitat include the beaver, muskrat, and river otter. Although the partial retention alternative would provide more habitat for large mammals, it would not provide a north-south connection or corridor to the Ocala National Forest, and the fragmenting effects of the reservoir would continue under this alternative.

This alternative would also result in an increase in shallow water habitat. Increased marsh would increase foraging habitat for some bird species, including limpkins, little blue herons, tricolored herons, snowy egrets, and white ibis.

Alligator densities may change in response to a shift from aquatic and marsh habitat to floodplain swamp, but the conversion of deeper water to shallow water and marsh would continue to provide alligator habitat. A reduction in species such as aquatic salamanders, leopard and pig frogs, and the peninsular cooter could be expected.

3.3.2.1.3 Alternative 3: Partial Restoration (Proposed Action)

The major change under the partial restoration alternative will be restoration of the wildlife habitat and the historic connection through the floodplain forest that is important in providing sufficient contiguous habitat for many vertebrates.

As with other animals, increased acreage of floodplain forest is expected to lead to commensurate increases in mammal species that use this habitat. Restoration of nearly 7,500 acres of floodplain forest is expected to increase the habitat available for terrestrial mammals in the Ocklawaha River basin. Approximately 20 mammals have been recorded or are likely to occur in the Ocklawaha floodplain. Typical mammals include opossum, southeastern shrew, short-tailed shrew, beaver, wood rat, rice rat, cotton mouse, golden mouse, bear, raccoon, and bobcat.

Because they are adjacent to seed-producing bottomland hardwoods and adjoining mesic forests, floodplain forests provide perhaps the greatest density and diversity of wildlife in Florida (Ewel 1986). The beaver, which was trapped out of Florida by the middle of the twentieth century, has returned to north Florida where it is most common in floodplains of small streams. Large, uncommon mammals, such as the black bear, are now concentrated in swamps because of widespread destruction of upland habitat.

The loss of open water habitat under partial restoration may result in declines in open-water and marsh- dwelling habitat for some species, including herons, egrets, ospreys, ducks, rails, and limpkins. Increases in forest species, such as warblers, vireos, wrens, cardinals, and owls, may also be expected. While some species may lose nesting habitat under this alternative, those same species may gain foraging habitat. Another benefit to some wading birds in general is the increase in floodplain-riverine edge available for foraging as a result of the change from the reservoir to a meandering river channel under partial restoration.

Species that increased in numbers under impoundment conditions will likely be reduced locally, while temporary feeding areas may be available for species such as the American alligator, eastern indigo snake, and water snakes. Eventually, several species of salamanders and frogs typical of floodplain forests are expected to increase. Reptiles expected to increase under restoration conditions include several species of skinks, turtles, and snakes.

Fish assemblages will be confined to a smaller pool but are expected to remain under the same conditions as described for the full retention alternative. An increase in migratory fish populations is also expected as a result of the restored historic connection to the St. Johns River. An increase in fish diversity combined with a decrease in fish densities, e.g. bullhead and shiners, may also occur.

3.3.2.1.4 Alternative 4: Full Restoration

Following initial disturbance associated with construction and earth-moving during the restoration process, wildlife impacts under this alternative would be as expected under the partial restoration alternative. This alternative is expected to restore a similar amount of acres of submerged floodplain forests as Alternative 3, with a similar increase in plant and animal species that inhabit floodplain forests. It is possible that with the removal of all structures and berms associated with the barge canal, the area may regain a sense of wildness and naturalness that would encourage more of the larger, uncommon mammals that require large areas of remote habitat.

3.3.2.2 Threatened and Endangered Species

Findings from the rare plant and animal survey conducted by Florida Natural Areas Inventory (FNAI) along the Cross Florida Greenbelt were incorporated into the SJRWMD survey of threatened and endangered species. The USFWS has provided a Biological Opinion (Appendix F) in which potential impacts of the proposed restoration activities were addressed. A comparison of wildlife habitat impacts under each alternative is presented in detail in Section 5.12, Threatened and Endangered Species.

3.3.2.2.1 Alternative 1: Full Retention (No Action)

Mammals. Under the full retention alternative, marsh and aquatic habitats would persist for many years and provide habitat for round-tailed muskrats, beaver, and manatees.

Manatees would continue to use the Buckman lock as a portal from the St. Johns River to the Rodman Reservoir, upper Ocklawaha River, Silver River, and other upstream springs. The lock continues to pose a risk of death or injury from vessel strikes and water control structures. (There have been 10 recorded manatee deaths since 1977. In addition, the lock is the only known source of water control structure mortality on the St. Johns River system.)

Although continued retention does not provide suitable black bear habitat, at least eight individuals occur in the northern portion of the Ocala National Forest adjacent to the project area. The mobility of bears allows them to cross the project area where the river channel narrows, and there have been documented occurrences of four bears crossing the Ocklawaha River, as well as observations of bears swimming across the canal near the SR 19 bridge.

Under full retention, the habitat is not suitable for the Florida panther, and the project area has not been identified as potential panther relocation habitat due to the density of human population.

Birds. Twelve threatened and endangered species; species of special concern, and candidate species were identified as possible species occurring within the project area.

Limpkins, little blue herons, snowy egrets, tricolor herons, and white ibis forage along the edges of the reservoir and among the dense vegetation surrounding stressed cypress trees. Sandhill cranes and wood storks occur in marshes and wet prairies throughout Florida; both of these species nest just north of the reservoir in Cow Heaven Bay. Under this alternative, the foraging habitat of these species would not change.

Both kestrels and bald eagles nest in dead trees and forage over open areas. Two kestrals have been sighted at the reservoir in winter (nonbreeding), and a single active bald eagle nest presently exists in the project vicinity. Available habitat for these species is not expected to change.

Reptiles and Amphibians. Listed reptiles potentially found within the Ocklawaha River basin include the American alligator, eastern indigo snake, spotted turtle, and Suwannee cooter. No listed amphibian species were documented for the project area.

The area would continue to provide excellent habitat for the American alligator. The reservoir and flooded forest do not provide suitable habitat for the eastern indigo snake. The Suwannee cooter has been introduced to the Ocklawaha from rivers entering the Gulf of Mexico, and eight individuals have been collected in the river and reservoir, compared with 88 from an impoundment on the Withlacoochee River, which drains into the Gulf of Mexico.

Fish. Although absent in the Ocklawaha River, the endangered southern tessellated darter should continue to survive within Orange Creek unless increases in aquatic vegetation negatively affect this habitat.

Plants. Piedmont water milfoil is the only subject plant species that inhabits shallow lakes; this species was not found in the project area despite a thorough search for it. Twelve of the 37 threatened, endangered, candidate plant species, plant species of special concern, and rare plant species included for study based on their likelihood of occurrence in the study area were found in the project area (see Appendix B for a detailed analysis). These include: giant leather fern, garberia, needle palm, cardinal flower, Florida spiny-pod, buckthorn, cinnamon fern, royal fern, Florida pinkroot, Florida willow, grass of parnassus, and variable-leaf Indian plantain. No federally threatened or endangered species were found in the project.

No other threatened, endangered, candidate plant species, plant species of special concern, or rare plant species were found within the study area during this survey. Only one of these species, giant leather fern, occurs in marsh habitat.

3.3.2.2.2 Alternative 2: Partial Retention

Impacts due to partial retention are similar to those described for the full retention alternative. Under this alternative, lacustrine habitat would be reduced and floodplain increased by approximately 2,300 acres. Marsh habitat would increase, along with marsh-dwelling species. Some of the aquatic and marsh habitats would be converted to shrub swamp and eventually to approximately 2,300 acres of floodplain forest, with an associated increase in plant species associated with those forests. Seasonal fluctuations would be limited to the restored floodplain forest. At 14 feet NGVD, aquatic plant control activities would be increased.

3.3.2.2.3 Alternative 3: Partial Restoration (Proposed Action)

Rare and endangered birds and mammals are more likely to be found in cypress swamps and mixed hardwood swamps than in other kinds of swamps. Of the 68 birds listed as rare and endangered in all of Florida, 12 are found in cypress and hardwood swamps. In addition, the black bear is now concentrated in swamps because of widespread destruction of upland habitat.

Mammals. It is the opinion of the USFWS that the proposed project is not likely to jeopardize the continued existence of the manatee (refer to Appendix F). The most conspicuous change in mammal habitat will be corridor opening for the manatee. Removal of the Kirkpatrick Dam will open a manatee access corridor via the lower Ocklawaha River to the rest of the Ocklawaha system. Reopening the manatee access corridor via the lower Ocklawaha River to the rest of the Ocklawaha (Smith 1997) will eliminate a known source of manatee mortality and the only known source of water control structure mortality on the St. Johns River system. There may, however, be an increase in manatee/boat collisions as the reservoir pool is converted to a more confined river channel. The potential for these collisions can be mitigated with speed controls.

Restoration of the floodplain is expected to provide increased black bear habitat and may provide a more direct north-south corridor through the Ocala National Forest. The Ocklawaha River floodplain does not provide suitable habitat for the Florida panther and has not been identified as a potential reintroduction site by the FFWCC.

Birds. The loss of aquatic foraging habitats under the partial restoration alternative is likely to result in a commensurate decrease in little blue heron, snowy egret, white ibis, and tricolor heron presently using the reservoir. Unlike the other species, however, limpkins forage along tree edges, and white ibis frequently forage in the flooded forest. These species may benefit from the increase in the riverine edge foraging habitat. Importantly, all but the limpkins are colonial nesting birds and will benefit from the change to floodplain forest due to the increase in nesting and roosting habitat.

Conclusions outlined in the Biological Opinion (Appendix F) included a determination that "the wood stork, and snail kite are not likely to be adversely affected" by the proposed restoration alternatives and that "the proposed project is not likely to jeopardize the continued existence of the... bald eagle". In fact, the conversion to floodplain forest will provide greater roosting and nesting habitat for wood storks.

Although the shift to a forested floodplain may force the bald eagle pair and kestrals in the project area to relocate, nearby Orange Lake and the St. Johns River presently support numerous pairs of eagles and are expected to continue to provide nesting and habitat for both of these species.

The absence of the migrant Kirtland's warbler is not expected to be affected by this alternative. In addition, FNAI (1997) reports no documented occurrences of snail kites or least terns in either Marion or Putnam Counties.

Reptiles and Amphibians. Under the partial restoration alternative, the American alligator is expected to continue to thrive in remaining marsh and riverine habiat. Habitat for the eastern indigo snake will increase as floodplain forest increases following restoration (Appendix F). Because the Suwannee cooter has been introduced from rivers flowing to the Gulf of Mexico, predictions

regarding the effects of continued impoundment on the Suwannee cooter would be premature without further study.

In addition to these wetland species, the gopher tortoise occurs in the proposed spoil disposal area on the south side of the dam. In addition to species using the reservoir, gopher tortoises (species of special concern) and Forest Service sensitive species occur in the sand pine scrub located in the west end borrow pit. These animals will be relocated with proper coordination with FFWCC if it appears construction activities may impact them.

Fish. Both the bluenose shiner and the southern tessellated darter have been collected regularly from Orange Creek since 1975. Elimination of the reservoir will reestablish tributary flows to the Ocklawaha River from Orange and Deep Creek, increasing available stream habitat and potentially repopulating the river with these species.

Plants. Findings from the rare plant and animal survey conducted by FNAI along the Cross Florida Greenbelt were incorporated into the SJRWMD survey of threatened and endangered species. No long-term adverse impacts to any threatened or endangered species or to critical habitat of any threatened or endangered species are predicted under existing conditions. In addition, a recent study by Dr. David Hall confirmed these findings (Appendix B).

3.3.2.2.4 Alternative 4: Full Restoration

The potential impacts to endangered or threatened species are similar to those for the partial restoration alternative. Due to the greater construction and earth-moving activities associated with full restoration, impacts to wildlife under the full restoration alternative may occur to a greater extent. Potential benefits of full restoration include a natural landscape without man-made structures, and this may attract the larger uncommon mammals such as black bear that prefer large areas of natural or remote habitat.

3.3.2.3 Habitat and Vegetation

Existing marsh and aquatic habitats characteristic of the partial and full retention alternatives will be converted to shrub-dominated and eventually tree-dominated floodplain swamp throughout the Ocklawaha River basin under partial and full restoration alternatives. Existing vegetation and plant communities are described in detail in Appendix B.

3.3.2.3.1 Alternative 1: Full Retention (No Action)

Under this alternative, nearly 7,500 acres of reservoir and adjacent floodplain would remain submerged and would not be subject to seasonal fluctuations. The reservoir pool would remain nonforested and include shallow marsh, floating aquatics marsh, and open water with hydrilla and associated submerged and emergent aquatic vegetation. In addition, submerged logs and trees would remain, and existing standing dead trees would eventually fall.

Germination of floodplain trees is inhibited in these permanently flooded sites, and sprouting is the only means of regeneration for trees in the inundated area (Davis 1990). As a result, no new tree

seedlings are predicted under the full retention alternative, and no trees can be expected without planting of flood-tolerant saplings.

Surface features such as berms, canals, and spoil piles were artificially created as a result of construction activities associated with the Rodman Reservoir and the Cross Florida Barge Canal and would remain under the full retention alternative. Berms presently occur over nearly 30 acres of the project site, while dead or stressed trees occur over 1,171 acres of the same area. There are 3,853 acres of open water and only 1,379 acres of characteristic floodplain forest.

3.3.2.3.2 Alternative 2: Partial Retention

Lowering the pool depth to 14 feet NGVD is predicted to restore river hydrology and floodplain to approximately 2,300 acres of floodplain forest above the Kirkpatrick Dam. Artificially created surface features would remain, and seasonal water fluctuations would be limited to the restored area. Germination of floodplain tree species can be expected on the approximately 2,300 acres of regained floodplain forest. Marsh habitat would increase, and some aquatic and marsh habitats would be converted to shrub swamp and floodplain forests.

3.3.2.3.3 Alternative 3: Partial Restoration (Proposed Action)

Under partial restoration, the long-term changes in vegetation and habitat are the same as those for full restoration. Partial restoration differs from full restoration in that structural changes and earth-moving required to restore the historic topography of the river and adjacent floodplain will be limited. As a result, some of the surface features described for the partial and full retention alternatives will remain.

Reports regarding the area of floodplain forest originally impacted by the impoundment of the Ocklawaha River vary considerably in the available literature. In order to determine the extent and nature of the original habitat impacts, as well as the area of potential habitat restoration associated with the reservoir drawdown, a geographic information system-based (GIS-based) quantitative habitat analysis was performed.

The extent of the floodplain forest prior to the impoundment of the Ocklawaha River was identified by photo interpreting and digitizing the floodplain forest line on 1964 Soil Conservation Service (SCS), 1"=2000' scale, black and white aerial photography of the study area. This coverage was then overlayed by the reservoir impact area coverage (e.g., the 20-foot contour line), and the historic floodplain forest coverage was overlain with the SJRWMD 1990 Florida Land Use Cover Code System (FLUCCS) land use. The results were acreage conversions of historic floodplain swamp and upland communities in the reservoir impact area resulting from the flooding of the reservoir. These results indicate that the extent of the historic floodplain swamp within the reservoir impact area was approximately 8,506 acres; and that flooding of the Rodman Reservoir resulted in:

1. The creation of 1,929 acres of new wetlands from historic uplands
2. The conversion of 6,251 acres of historic floodplain swamp to open water/herbaceous wetlands
3. No change to 2,067 acres of historic floodplain swamp.

The next step in the analysis was to overlay the modeled pool areas associated with each of the phases of the drawdown, under 50 percent exceedance flow conditions, to calculate the habitat conversions associated with the removal of the Kirkpatrick Dam. The results are mapped in Figure 3-2. The Phase I drawdown will result in the greatest area of floodplain exposure (3,461 acres), followed by the Phase II (2,955 acres) and Phase III (761 acres) drawdowns. The complete drawdown of the Rodman Reservoir will result in:

1. The exposure of 7,177 acres of previously inundated floodplain area
2. The reduction of open water and river channel area to 340 acres
3. No change to 168 acres of existing forested wetlands.

Under partial and full restoration conditions, characteristic floodplain forest species and densities are expected after 40 years. Hardwood trees greater than 14 feet in height are expected after 10 years, with canopy development after approximately 30 to 40 years. Under partial restoration, nearly 7,500 acres of floodplain will no longer be submerged.

These forest habitats predicted under restoration are similar to those upstream of Eureka Dam and are dominated by pumpkin ash, bald cypress, red maple, swamp tupelo, American elm, and dahoon holly. Structurally, the undisturbed Ocklawaha River floodplain forest is more complex than most other freshwater forested wetlands in Florida, but less than tropical swamp forests (Lugo and Brown 1984). Different habitat types are associated with differences in elevation, hydrology, and disturbance in the project area.

Under this alternative, the upper and lower Ocklawaha River systems will be reconnected with the St. Johns River system. An estimated 341 acres of stressed cypress habitat within Rodman Reservoir will be restored to a hardwood swamp forest. In addition, floodplain swamp forest that is currently permanently flooded by the reservoir waters will revert back into a seasonally flooded hardwood swamp forest.

Restored water level fluctuations are likely to inhibit expansive growth of dense stands of exotics or potentially troublesome native plant species. Successional stages leading to restored floodplain forests are expected to be dominated by native species with some management actions necessary to control exotics or potentially troublesome natives, such as cattails and willows. There is concern over the invasive species shading and out-competing a more diverse plant species assemblage, and control action for these species can begin early to minimize costs.

3.3.2.3.4 Alternative 4: Full Restoration

Full restoration involves greater structural changes and earth-moving to restore the historic topography of the river and adjacent floodplain. Under full restoration, the same acreage of floodplain would be restored as under the partial restoration alternative.

3.3.3 Management

3.3.3.1 Aquatic Plants

3.3.3.1.1 Alternative 1: Full Retention (No Action)

Based on past management records, aquatic plant communities would likely continue to fluctuate as they have for the past 25 years and cover more than 60 percent of the reservoir. Existing discharge rates (over 1,600 cfs) preclude the cost-effective use of fluridone to control hydrilla in all but protected areas of the reservoir. With a drawdown every 3 years, aquatic plant management cost estimates for this alternative range from $14,000 per year for treating floating leaved aquatic plants to $270,000 per year if, or when, hydrilla is treated. Without drawdown as a management tool, the cost would probably range from $75,000 to $270,000 per year due to increased management of floating leaved plants and hydrilla.

3.3.3.1.2 Alternative 2: Partial Retention

Due to exposure of formerly submerged tree hazards, the only area safely accessible by aquatic plant management crews would be the small section of newly restored river and shallow littoral areas. As a result, more intensive management would be required for aquatic plant management under this alternative. Until there is sufficient canopy, aggressive colonizers such as torpedo grass, cattails, and willow are expected to dominate the area. Hydrilla and other submerged species typical of flowing water, e.g. tape grass and pondweed, are expected to occur over much of the shallow restored river channel.

Additionally, because the reservoir would be shallower and light penetration would be greater, hydrilla would reestablish quickly and require intense management. With a drawdown every 3 years, aquatic plant management costs for this alternative may range between $14,000 per year when only floating plant control is necessary and $190,000 per year if, or when, hydrilla is treated in protected areas of the reservoir where flow rates are lower and some control is possible. Without a drawdown every 3 years, the cost may range from $50,000 to $190,000.

3.3.3.1.3 Alternative 3: Partial Restoration (Proposed Action)

Although it is unlikely that hydrilla and other exotic plants such as water lettuce and water hyacinth will be eliminated, the natural succession of the hydric flood plain to a wetland community dominated by hardwood species will most likely result in shaded, tannin-stained river waters where native submerged aquatic vegetation species can compete with non-native plants (BAPM 1994; Burks 1996).

The projected cost range for aquatic plant management under the partial restoration alternative is $14,000 to $200,000 per year. Drawdowns will be unavailable for management, but open water areas will be smaller, and seasonal water fluctuations will promote the decomposition of plant biomass.

3.3.3.1.4 Alternative 4: Full Restoration

As in partial restoration, the natural succession of the hydric flood plain to a wetland community dominated by hardwood species will most likely result in shaded, tannin-stained river waters where native submerged aquatic vegetation species can compete with non-native plants. Projected costs for aquatic plant management would be the same as for Alternative 3, i.e., $14,000 to $200,000 per year.

3.3.3.2 Wildlife

3.3.3.2.1 Alternative 1: Full Retention (No Action)

Existing management is limited to aquatic plant control and maintains the reservoir at 18 feet NGVD. An option under this alternative may include increased management to enhance fisheries and/or wildlife with limited removal and/or alteration of structures and topography. Due to limnological and ecological changes associated with reservoir aging, including a decline in fish harvest as a reservoir ages, existing management of fisheries may need to be readdressed as the reservoir ages.

3.3.3.2.2 Alternative 2: Partial Retention

Changes in management for fish and wildlife in the reservoir would be implemented as needed. Like the full retention alternative, increased management of fisheries and wildlife with limited structural changes is an option under the partial retention alternative.

3.3.3.2.3 Alternative 3: Partial Restoration (Proposed Action)

Under partial restoration, there will be an increase in floodplain forest habitat along the Ocklawaha River, providing increased opportunities for nature-oriented recreation, wildlife viewing, bird watching and hunting. As a result, there will be changes in management designed to reflect changes in fisheries and wildlife. USFS will work with FFWCC on any changes to Wildlife Management Area (WMA) activities.

The FDEP, in cooperation with the FFWCC, USFWS, and the SJRWMD, has assessed the terrestrial wildlife population(s) that will be displaced or eliminated by conversion of the Rodman Reservoir to a flowing river channel. Mitigation measures to protect threatened and endangered species will be included in the Special Use Permit. .

3.3.3.2.4 Alternative 4: Full Restoration.

Long-term management of wildlife under the full restoration alternative is the same as that described for partial restoration.

3.3.3.3 Buckman Lock

3.3.3.3.1 Alternative 1: Full Retention (No Action)

Under existing conditions, the lock is open and functional. The role of the lock in navigation from the St. Johns River to the Ocklawaha River has been previously discussed. Because of navigation concerns, the Buckman Lock will most likely remain operational under the full retention alternative. If not, management strategies will be necessary which take into consideration the effects of the closed lock.

The effects of the lock on manatees have been described. Existing management is limited to aquatic plant control, but manatee protection measures planned for the lock will require additional wildlife management actions.

3.3.3.3.2 Alternative 2: Partial Retention

Changes in management for fish and wildlife in the reservoir would be implemented as needed. Like the full retention alternative, increased management of fisheries and wildlife with limited structural changes is an option under the partial retention alternative. Buckman Lock operation or closure is also an option under this alternative and has been addressed under the full retention alternative. Installation of manatee protection measures will require wildlife management actions.

3.3.3.3.3 Alternative 3: Partial Restoration (Proposed Action)

Under partial restoration, the Buckman Lock will be closed, and its operation will not be a management consideration except for navigation (see Section 5.23).

3.3.3.3.4 Alternative 4: Full Restoration.

Management considerations regarding the Buckman Lock under the full restoration alternative are the same as described for partial restoration (see Section 5.23, navigation).

3.3.4 Human Resource Components

3.3.4.1 Land Use and Consideration of Property Ownership

3.3.4.1.1 Alternative 1: Full Retention (No Action)

Lands to the south of the project are almost entirely in public ownership (U.S. Forest Service). To the north side of the reservoir and around Deep Creek, lands include both state-owned and Conservation and Recreation Lands (CARL) lands. These two land types make up the majority of land use in the project area and include predominantly open water, vegetated wetlands, and wetland hardwood forest (see Section 4, Figure 4-8). Small portions of the area are in private ownership (see Section 4, Figure 4-9). There are small areas of medium- and low-residential housing adjacent to the project area, located primarily in Hog Valley and near the Eureka dam. This alternative would not restore any acres of national forest system lands.

3.3.4.1.2 Alternative 2: Partial Retention

Land use and property ownership under this alternative are expected to remain the same as that described for the full retention alternative except for minor changes in the acreage of lands that may occur when the reservoir is drawn down to 14 feet NGVD. Some acres of national forest system lands would be regained as marsh habitat and possibly floodplain forest.

3.3.4.1.3 Alternative 3: Partial Restoration (Proposed Action)

Nearly all the lands in and adjacent to the project area are in public ownership, although there are some small, privately owned parcels beneath the reservoir that have been identified for purchase by the state under this restoration alternative. Adjacent land use is not expected to change under this alternative. Approximately 600 acres, which are submerged beneath Rodman Pool, will revert to national forest system land managed by the Forest Service. These lands would be in Management Area 5.0, Hardwood/Cypress Forest, No Timber Production. This alternative would meet the goals of the Revised Forest and Land Management Plan to restore ecosystem composition, structure and

function, manage floodplains and other wetlands to protect or enhance their values and ecological functions, and protect rivers and preserve their cultural, historic, ecological, fish and wildlife, recreational, geological, or scenic values.

3.3.4.1.4 Alternative 4: Full Restoration

Land use and property ownership under this alternative are the same as that described for the partial restoration alternative.

3.3.4.2 Cultural Resources

3.3.4.2.1 Alternative 1: Full Retention (No Action)

Under the full retention alternative, any submerged archeological sites undergoing erosion or deflation will continue to degrade in that manner. Unconsolidated sediments may be protecting submerged cultural resources from erosion, deflation and looting. Detailed discussion of the direct, indirect, and cumulative effects is provided in Section 5.16 and Appendix C.

3.3.4.2.2 Alternative 2: Partial Retention

Impacts associated with the partial retention alternative are the same as those described for full retention. However, some archeological sites may be exposed, increasing their potential for being looted, altered by environmental conditions or damaged by recreational activities.

3.3.4.2.3 Alternative 3: Partial Restoration (Proposed Action)

Partial restoration is expected to effect cultural resources in the project area. At least 19 archeological sites occur within the area of potential effect, but many more are suspected to occur. Direct effects include drying of submerged wooden artifacts, dredging, organic debris removal, berm removal and other ground disturbing activities. Indirect effects include increasing the potential of archeological looting by exposing submerged sites and damage from recreational activites. As in any of the alternatives, an operating plan detailing how archeological resources are to be identified, monitored, and protected will be required as part of the special use permit to continue occupancy and use of the land.

3.3.4.2.4 Alternative 4: Full Restoration

This alternative would offer a high degree degree of protection of cultural and historic resources by restoring the historic landscape as much as possible. Removal of all structures, berms and canals may impact cultural resources. The land has previously been disturbed and surveyed for cultural sites, but additional surveys will need to be done. More archeological sites may be exposed under this alternative than Partial Restoration.

3.3.4.3 Aesthetic Resources

Aesthetic resources describe the physical characteristics of a landscape that determine its scenic quality in relevant value to the viewing public.

3.3.4.3.1 Alternative 1: Full Retention (No Action)

Under the full retention alternative aesthetic values would be those associated with a lake as opposed to a riverine vista. The open water vista and perimeter marshes, as well as attractions such as open water fishing and boating, would be unaffected. The berms, canals, spoil piles, and concrete barriers associated with the reservoir would remain.

3.3.4.3.2 Alternative 2: Partial Retention

Although the definition of Partial Retention (see page 3-2) includes limited removal and/or alteration of structures and alternation of topography, the major difference between Alternatives 1 and 2 is the change in reservoir elevation from 18 feet NGVD to 14 feet NGVD, and it is unlikely there would be removal of any structures. Visual impacts of the structures, canals and berms would be similar to Alternative 1 in that they would continue to exist and reflect the impact of human influence on the environment. The open water vistas would be slightly reduced, with the appearance of more marsh habitat.

3.3.4.3.3 Alternative 3: Partial Restoration (Proposed Action)

Under the partial restoration alternative, the reservoir and associated marsh will be replaced by a riverine system. The shift in aesthetics will be to a meandering river channel with overhanging trees, and lake attractions will be replaced with riverine boating and fishing, camping, and hiking. Open water vistas would be reduced. The meandering river channel would reduce the views of man-made structures and limit the amount of time the viewer sees works of man. There would be an increase in nature-dominated views and a reduction in views dominated by the works of man.

3.3.4.3.4 Alternative 4: Full Restoration

Full restoration would remove the works of man and reduce the visual impacts of human influence on the river environment. This alternative would provide the viewer with the highest degree of natural appearing vistas.

3.3.4.4 Noise

3.3.4.4.1 Alternative 1: Full Retention (No Action)

Rural undeveloped areas similar to the project area typically have noise levels in the range of 35 to 55 decibels. Additional noise on the reservoir is due primarily to motorized boats and other vehicles. There is no reason to expect the noise level to change under this alternative. Noises are generally confined to the immediate area of the project, specifically from operation of the dam and lock. Wildlife attracted to the reservoir would adapt to the noise or move.

3.3.4.4.2 Alternative 2: Partial Retention

Noise impacts under this alternative are the same as those described for full retention. The slight reduction in open water boating environment from lowering the reservoir to 14 feet NGVD would be

negligible in reducing the amount of noise from motorboats. Noise from the operation of the dam and lock would continue, and wildlife attracted to the reservoir would adapt or move on.

3.3.4.4.3 Alternative 3: Partial Restoration (Proposed Action)

Increases in noise levels will be temporary and limited to construction equipment during restoration activities. The noises will be confined to the immediate area of the project. The level of noise associated with recreation is not expected to increase, although a shift to river-oriented boating from lake boating will occur. Noise from operation of the dam and lock will be eliminated, and it is possible that wildlife previously avoiding the area due to noise disturbance may once again frequent the area.

Initial noise levels associated with construction and earth-moving will be lower than for the full restoration alternative as a result of the limited construction. Although the construction phase of the partial restoration alternative may have noise levels ranging from 70 to 90 decibels at a distance of 50 feet, these levels will subside following initial restoration activities.

3.3.4.4.4 Full Restoration

Noise impacts associated with the project would be temporary and would result from operation of pumps, construction equipment, and human activities. Noise levels after construction activities would be similar to those listed in Alternative 3.

3.3.4.5 Air Quality

3.3.4.5.1 Alternative 1: Full Retention (No Action)

The project area is designated as an Attainment Area for all criteria air pollutants and meets National Ambient Air Quality Standards (FDEP 1997). These conditions are not expected to change under Alternative 1, full retention.

3.3.4.5.2 Alternative 2: Partial Retention

The project area is designated as an Attainment Area for all criteria air pollutants and meets National Ambient Air Quality Standards (FDEP 1997). These conditions are not expected to change under Alternative 2, partial retention.

3.3.4.5.3 Alternative 3: Partial Restoration (Proposed Action)

Due to the rural nature and land use in the project area, implementation of the partial restoration alternative is not expected to cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality.

3.3.4.5.4 Alternative 4: Full Restoration

Implementation of the full restoration alternative is not expected to cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality.

3.3.4.6 Hazardous and Toxic Wastes

Hazardous and toxic wastes are not expected to pose a risk under any of the project alternatives. Data sources examined to date do not indicate the presence of hazardous and toxic wastes in the reservoir, and the risk to aquatic organisms is considered minimal (SJRWMD 1994). Subsequent sampling and analysis of reservoir sediments was performed and results supported earlier conclusions by the SJRWMD that hazardous and toxic wastes do not pose a risk to aquatic organisms.

3.3.4.7 Recreation

3.3.4.7.1 Alternative 1: Full Retention (No Action)

None of the existing recreational facilities will be affected under the full retention alternative, leaving existing boat ramps and public recreational facilities available. Maintenance of existing facilities would continue under the full retention alternative. During drawdowns required for aquatic plant management, most of the existing facilities would not provide access to the reservoir (a list of the existing facilities is presented in Section 4.25). Five of the existing recreational facilities are located on U.S. Forest Service land and are the responsibility of the Forest Service.

3.3.4.7.2 Alternative 2: Partial Retention

Because the reservoir level would be maintained at 14 feet NGVD under the partial retention alternative, existing recreational facilities would be approximately 3/4 mile from the water, and therefore less attractive to visitors. Most existing boat ramps would be unavailable for access to the water. There is, however, a boat ramp at Kenwood Landing constructed for use during drawdowns at 13 feet NGVD. Kenwood Landing would receive increased use for ingress and egress and possibly result in crowding and increased waiting time to launch or take out.

3.3.4.7.3 Alternative 3: Partial Restoration (Proposed Action)

Partial restoration conditions will restore the historic river channel by eliminating the reservoir. As a result, boat ramps constructed for reservoir access following dam construction will no longer provide access to the reservoir, and the recreational facilities that accompany these boat ramps will be a considerable distance from the river and thus be less attractive to visitors.

New boat ramps would need to be constructed to provide access to the river, and additional recreational facilities may be needed to provide for picnicking, camping, hiking, and fishing. Decisions on improvements or new developments will be made after restoration and are not a part of this proposal. The continuity of the Florida National Scenic Trail (FNST), which currently crosses the Ocklawaha River at Kirkpatrick Dam, would need to be ensured.

3.3.4.7.4 Alternative 4: Full Restoration

Eliminating the reservoir and all structures under this alternative will have approximately the same effects as Alternative 3. Proximity of recreation sites to water is highly valued by visitors, and existing recreation facilities will no longer be near water and visitors will most likely not use them. As in Alternative 3, new boat ramps would need to be constructed to provide access to the river, and additional recreational facilities may be needed to provide for picnicking, camping, hiking, and fishing. Decisions on improvements or new developments will be made after restoration and are not a part of this proposal. The continuity of the Florida National Scenic Trail (FNST), which currently crosses the Ocklawaha River at Kirkpatrick Dam, would need to be ensured.

3.3.4.8 Socioeconomic Impact to Regional Economy

3.3.4.8.1 Alternative 1: Full Retention (No Action)

The total costs of operating the Buckman Lock and Kirkpatrick Dam during fiscal years 1995-1996 and 1996-1997 were $268,911 and $333,437, respectively (refer to Section 4.26, Socioeconomic Impact to Putnam and Marion Counties, for discussion). These costs would continue to be incurred by the State under full retention.

Visitors to the Rodman Reservoir in 1994 accounted for about $7.5 million in both direct and indirect expenditures. Of the $7.5 million, $3.32 million can be attributed directly to reservoir-based activities and accounts for less than 0.1 percent of economic base in either Putnam or Marion County. Considered as a share of the overall economic activity of the counties (individually, and even more so when the two are combined), expenditures by visitors to Rodman Reservoir are quite small.

Recreational benefits, based on 307,217 individual user days, contribute a total of $3.8 million to the service industry in Putnam and Marion counties under the full retention alternative. Additionally, in Putnam County, 45 employees (0.16 percent of the total work force) are supported within the retail and service industries that may be associated with the reservoir, while in Marion County, the number of employees is 57 (0.07 percent of the total work force).

3.3.4.8.2 Alternative 2: Partial Retention

Under this alternative, attendance is estimated to be 53.53 percent less than under the full retention, or roughly 145,868 user days. Impacts to the local and regional economy under the partial retention alternative are expected to be greater than those described for the full retention alternative. Perhaps because it would be less attractive for recreation for both river and lake users, the partial retention alternative would produce the fewest recreational benefits.

3.3.4.8.3 Alternative 3: Partial Restoration (Proposed Action)

A minimum of 55.68 percent of all existing gross expenditure and earnings estimates can be expected to remain under the partial restoration alternative. Additionally, much of the lost recreational activity will be dispersed throughout other lakes and rivers within the region such as Lake George, Crescent Lake, St. Johns River, Lake Kerr, Orange Lake, Lake Lochloosa, and the

Interlachen Chain of Lakes. Existing recreation facilities would be at an undesirable distance from the river and would receive less use.

Under the partial restoration alternative, an estimated 171,075 recreation days are predicted, amounting to a total user recreational value of $2,081,983. It is important to remember that restoration of the river does not preclude all current recreational activities, and therefore expenditures, in the Rodman area of the Ocklawaha River. Activities such as camping and fishing are expected to continue under this alternative. This alternative has the potential to provide new recreation opportunities, especially related to eco-tourism and nature-based recreation.

The remaining artificially created surface features may account for the smaller number of users under partial restoration when compared with full restoration. Since fishing could continue at the partially restored river, there will be a continued demand for the services provided by guides, although, as noted above, the projected number of visitor days to the restored river suggests that demand would be reduced. Nearby lakes continue to provide lake fishing opportunities for bass anglers.

3.3.4.8.4 Alternative 4: Full Restoration

Most of the impacts discussed under partial restoration apply to full restoration. The area would receive less use due to the lack of boat ramps and access to the water and less use of recreation facilities that are deemed undesirable due to their distance to the water. Under Full Restoration, however, the removal of all structures, canals, berms, and other works of man could restore a more natural appearing landscape that would encourage those activities that require a semi-primitive or remote setting. This alternative has the highest potential for encouraging eco-tourism and nature-based recreation.

3.3.4.9 Navigation

The report Navigation Alternatives for the Restoration of the Ocklawaha River (PBS&J 1997) provides an analysis of alternatives designed to deal with the problem of continuing navigation across the Kirkpatrick Dam during construction and restoration activities.

3.3.4.9.1 Alternative 1: Full Retention (No Action)

Under existing conditions, the Buckman Lock would continue to provide a navigable waterway between the Rodman Reservoir and the St. Johns River. Although the lock was designed to facilitate navigation of vessels with drafts up to 14 feet, these larger vessels are unable to turn around and return through the lock. The largest vessels using the lock under existing conditions are generally recreational vessels no more than 20 feet in length.

3.3.4.9.2 Alternative 2: Partial Retention

Because the Buckman Lock remains functional at 14 feet NGVD, navigation through the lock is not impacted under this alternative.

3.3.4.9.3 Alternative 3: Partial Restoration (Proposed Action)

Partial restoration requires that a navigation system be implemented to maintain river traffic while the reservoir is being lowered to historic water levels. The river stage will be reduced below 9.2 feet

NGVD during construction and restoration activities, and a portage system will be required. After restoration activities are completed, navigation of the river will return to historic levels. Recreational vessels that currently use the lock (those approximately 20 feet in length) will continue to be able to navigate the river.

3.3.4.9.4 Alternative 4: Full Restoration

As under partial restoration, the river stage would be reduced below 9.2 feet NGVD during construction and restoration activities, and a portage system would be required. After restoration activities are completed, navigation of the river will return to historic levels. Recreational vessels that currently use the lock (those approximately 20 feet in length) will continue to be able to navigate the river. Thus, recreational vessels using a restored river will generally be those that currently use the reservoir, and existing use would not change.

3.3.4.10 Flood Hazards

3.3.4.10.1 Alternative 1: Full Retention (No Action)

Under this alternative, peak discharges for 25- and 100-year return periods at Kirkpatrick Dam were estimated to be about 9 and 21 percent greater when compared to corresponding estimates for Riverside Landing in the natural river channel. During storm events, discharges at Kirkpatrick Dam have been higher when compared with discharges without the dam. Because the reservoir has been maintained at different water levels during different periods, no conclusions can be drawn regarding variation of water levels in the reservoir.

3.3.4.10.2 Alternative 2: Partial Retention.

Flood hazards are expected to be slightly less under this alternative due to a reduction in water levels in the reservoir. Seasonal fluctuations will be limited to those acres of floodplain forest and marsh habitat restored by the reduced water levels.

3.3.4.10.3 Alternative 3: Partial Restoration (Proposed Action)

Under partial restoration, potential flood hazards will be decreased due to the estimated 9 to 21 percent decrease in peak discharges for 25- and 100-year floods. Based on Federal Emergency Management Agency (FEMA) maps, one residence is located within the flood zone and may be subject to flooding.

3.3.4.10.4 Alternative 4: Full Restoration

Impacts due to flooding under this alternative are the same as those described for the partial restoration alternative.

3.3.4.11 Shoreline Erosion and Accretion

3.3.4.11.1 Alternative 1: Full Retention (No Action)

Impacts to shoreline erosion and accretion would not change under the full retention alternative. There may be erosion impacts during management drawdowns.

3.3.4.11.2 Alternative 2: Partial Retention

Under the partial retention alternative, erosion impacts could increase due to the reduction to 14 feet NGVD, exposing more areas of previously submerged land. Erosion impacts that presently occur under drawdown conditions will continue.

3.3.4.11.3 Alternative 3: Partial Restoration (Proposed Action)

Potential shoreline erosion impacts will be increased under restoration as previously submerged acres are exposed. Shoreline erosion will be monitored and controlled during all restoration activities. Shoreline stabilization is a primary component of the restoration activities and is specifically addressed in Table 3-1 (Concept Plan), as well as in Section 4.8, Surface Water Quality, and Section 4.4, River Sediments, of this EIS.

3.3.4.11.4 Alternative 4: Full Restoration

Potential shoreline erosion impacts will be greatest under this alternative due to a combination of earth-moving disturbance as structures are removed and previously submerged acres becoming exposed. Shoreline erosion will be monitored and controlled during all restoration activities. Shoreline stabilization is a primary component of the restoration activities and is specifically addressed in Table 3-1 (Concept Plan), as well as in Section 4.8, Surface Water Quality, and Section 4.4, River Sediments, of this EIS.

3.3.4.12 Water Supply and Conservation

3.3.4.12.1 Alternative 1: Full Retention (No Action)

The impounded water in the Rodman Reservoir provides recreation and fisheries as opposed to a potable water supply. Any water supply would more likely be obtained from springs that feed the river.

3.3.4.1.2.2 Alternative 2: Partial Retention.

As in Alternative 1, the impounded water in the Rodman Reservoir provides recreation and fisheries as opposed to a potable water supply. Any water supply would more likely be obtained from springs that feed the river.

3.3.4.12.3 Alternative 3: Partial Restoration (Proposed Action)

Potential impacts of reservoir drawdowns on the Floridan aquifer may be minimal. However, there may be effects on water table elevations in the surficial aquifer. Six of the 79 wells identified in the project area connect with the surficial aquifer, and the status of 24 wells is unknown. The estimated cost of replacing these surficial wells is less than the cost to obtain more accurate impact predictions, and the wells will be replaced, if need be, under this alternative.

3.3.2.1.2.2 Alternative 4: Full Restoration

Potential impacts of reservoir drawdowns on the Floridan aquifer may be minimal. However, there may be effects on water table elevations in the surficial aquifer. Six of the 79 wells identified in the project area connect with the surficial aquifer, and the status of 24 wells is unknown. The estimated cost of replacing these surficial wells is less than the cost to obtain more accurate impact predictions, and as in Alternative 3, the wells will be replaced if necessary.

3.3.4.13 Energy Needs

3.3.4.13.1 Alternative 1: Full Retention (No Action)

Under the full retention alternative, energy requirements related to the operation of the Buckman Lock would remain or increase as energy costs increase. Utility costs for operation of the Buckman lock were $3,195.43 and $2,063.50, respectively, for fiscal years 1994-95 and 1995-96.

3.3.4.13.2 Alternative 2: Partial Retention

Energy needs under this alternative are the same as those described for full retention.

3.3.4.13.3 Alternative 3: Partial Restoration (Proposed Action)

Energy needs under this alternative will decrease as a result of closing the Buckman Lock and no longer incurring utility costs.

3.3.4.13.4 Alternative 4: Full Restoration

Energy needs under this alternative are the same as those described for full retention.

3.3.4.14 Safety

3.3.4.14.1 Alternative 1: Full Retention (No Action)

Partially and fully submerged logs in the reservoir pose a safety concern. Under this alternative, the number of logs in the reservoir is expected to increase as the stressed trees farther upstream fall and are transported downstream to the reservoir. Standing dead trees pose a risk to boater by presenting an obstacle they must maneuver around. In addition, logs pushed to the ground during construction of the reservoir now float to the surface and pose a safety hazard to boaters. Safety precautions associated with the dam and lock include fences and security and maintenance personnel.

3.3.4.14.2 Alternative 2: Partial Retention

Impacts to safety under this alternative are the same as those described for the full retention alternative.

3.3.4.14.3 Alternative 3: Partial Restoration (Proposed Action)

Under the partial restoration alternative, safety hazards due to the floating and submerged logs in the reservoir will decrease. Submerged logs will be exposed, and any remaining in the channel will require removal. Since there are no live trees in the reservoir, dead trees will fall in the newly

exposed areas until the floodplain expands into these restored areas. Deadfall and standing snags may represent a risk to those hiking through the area or canoeing. Construction activities during restoration pose safety hazards to personnel performing those activities.

3.3.4.14.4 Alternative 4: Full Restoration

Impacts to safety under this alternative are similar those described for the partial restoration alternative. In addition, the dam would be removed and the lock abandoned. The more extensive activity related to removal of all structures, canals and berms pose a risk to all personnel performing restoration activities, and those risks will be present for a longer period of time than in Alternative 3.

3.3.4.15 Food and Fiber Production

This public interest factor is not affected by this project.

3.3.4.16 Mineral Needs

This public interest factor is not affected by this project.

3.3.4.17 Needs and Welfare of the People

3.3.4.17.1 Alternative 1: Full Retention (No Action)

Under the full retention alternative, there would be few impacts to the needs and welfare of the people who presently enjoy using the dam and the reservoir. Those who enjoy open water sport fishing and look forward to catching the larger fish that are associated with the reservoir as compared to the river would continue to enjoy the benefits of the reservoir. The reservoir provides recreational and economic benefits to the people in the area, and this is not expected to change under the full retention alternative. However, other visitors feel impacted by the loss of a free-flowing river and functioning floodplain forest and their desire to see the river restored is curtailed.

3.3.4.17.2 Alternative 2: Partial Retention

This alternative is similar to Alternative 1 in that visitors who enjoy the dam and the reservoir as it now exists would continue to use and enjoy them. Approximately 2,300 acres of floodplain forest would be restored by lowering the reservoir to 14 feet NGVD and this would provide new recreational opportunities related to land based nature activities.

3.3.4.17.3 Alternative 3: Partial Restoration (Proposed Action)

Under this alternative, there would be impacts to the needs and welfare of the people who presently enjoy using the dam and the reservoir. Those who engage in open water sport fishing prize the larger fish associated with the reservoir and a restored river would displace them, although there are many other lakes in the area.

An identified need for the project is to address the public's desire to restore the lower Ocklawaha River back to a more natural condition, as reflected in the will and directives of the State of Florida. In this regard, it must be emphasized that the proposed project is an ecological restoration project, and as such is expected to generate numerous net environmental benefits. These benefits are

presented in Section 2 of this document and include improved water quality, biological productivity, wildlife corridors, as well as reductions in nuisance plant species.

In addition, socioeconomic benefits are expected to be generated by the proposed project including the elimination of public tax expenditures for the operation and maintenance of Buckman Lock, continued management of exotic and nuisance aquatic vegetation, and enhanced recreational opportunities.

3.3.4.17.4 Alternative 4: Full Restoration

Impacts on the needs and welfare of the people in this alternative are the same as in Alternative 3.

3.3.4.18 Secondary and Cumulative Effects

Cumulative impacts are those impacts likely to result from the proposed action (partial restoration) or alternatives in combination with other past, present, and reasonably foreseeable future actions (see Section 5.31 for a comparison of cumulative effects for the various alternatives).

3.3.4.18.1 Alternative 1: Full Retention (No Action)

The full retention alternative would result in no significant secondary or cumulative impacts to land use, cultural resources, aesthetic resources, noise, air quality, or recreation resources within the project area.

Cumulative impacts associated with wildlife and fisheries are expected under this alternative due to the chronic flooding throughout the floodplain forest and the commensurate loss of existing and future trees. The reservoir fisheries may decline as the reservoir ages, resulting in decreasing numbers and biomass of fish. Current low levels of dissolved oxygen will continue, as well as continued assimilation of nitrogen by reservoir plants, limiting its transport downstream. Fish kills will likely occur in the future as they have in the past.

3.3.4.18.2 Alternative 2: Partial Retention

The secondary and cumulative effects under this alternative are the same as those described for the full retention alternative. Maintaining the reservoir at 14 feet NGVD will continue the effects on wildlife and fisheries, and the reservoir fisheries may decline as the reservoir ages, resulting in a decline in the numbers and biomass of fish. Problems with water quality will continue, and fish kills will likely occur in the future.

3.3.4.1.8.3 Alternative 3: Partial Restoration (Proposed Action)

Based on the analysis conducted for this EIS, positive impacts are expected to occur under partial restoration. Construction activities associated with the proposed restoration are expected to have minor negative impacts to existing vegetation, wildlife, land use, cultural resources, aesthetic resources, noise, air quality, and recreation resources within the project area. Restoration of the floodplain, as proposed, will result in significant long-term positive impacts to the Ocklawaha River basin by restoring hydroperiod and, ultimately, historic floodplain forest and habitat.

A shift in recreational opportunities associated with the reservoir is also expected as active boat fishing and recreational boating change to more passive uses such as shore fishing, canoeing, nature-based activities, camping, and hiking.

Considering impacts due to the proposed action, geographic boundaries of the impact, impacts resulting from past actions, and potential impacts of reasonably foreseeable future actions, construction associated with the partial restoration alternative is expected to have temporary negative impacts, confined primarily to the immediate area of project features and facilities. In the long run, restoring the health of the ecosystem will have positive impacts.

3.3.4.18.4 Alternative 4: Full Restoration

The secondary and cumulative effects under this alternative are the same as those described for the partial restoration alternative. In addition, removal of all man-made structures will increase the scenic and "naturalness" qualities of the landscape, especially in the long term, as future generations will have the opportunity to experience the river in its natural state.

4.0 Affected Environment

This section provides the information necessary for a thorough understanding of the existing environment affected by the alternatives under consideration. While general environmental conditions, such as climate and rainfall, will not be affected, other environmental elements, such as natural communities, will be. This section is based on issues identified through the scoping process as well as information presented in the St. Johns River Water Management District (SJRWMD) document entitled *Environmental Studies Concerning Four Alternatives for Rodman Reservoir and the Lower Ocklawaha River* (SJRWMD 1994).

In this Environmental Impact Statement, the no action alternative is the full retention alternative. Therefore, the information presented in this section describes the full retention alternative as the existing affected environment.

4.1 Location and General Climate

4.1.1 Location

The extent of the project can be defined in terms of three concentric areas: (1) the restoration area; (2) the reservoir impact area; and (3) the project area. The *restoration area* is defined as the modeled extent of the 18-foot pool of the Rodman Reservoir, under 50 percent flow exceedance conditions. This area is approximately 7,685 acres in size, and represents the area that will be directly affected by the reservoir drawdown (refer back to Figure 2-1).

The *reservoir impact area* encompasses the Ocklawaha River and the Rodman Reservoir from the Eureka Lock on the west, to the Buckman Lock and the Kirkpatrick Dam on the east, and extending landward to the existing 20-foot contour line including the upstream portions of all affected tributaries. This area is approximately 10,835 acres in size. The area represents the maximum extent of the historic floodplain and watershed that was impacted by the impoundment of the Ocklawaha River (the original pool elevation of the Rodman Reservoir was 20 feet NGVD). The *reservoir impact area* has been defined and mapped for the purposes of calculating historic habitat impacts, and for estimating potential ecological and hydrologic affects the proposed project.

The project site is located within Marion and Putnam Counties in the north central region of peninsular Florida. The Ocklawaha River drains 2,747 square miles of land at Kirkpatrick Dam and originates in Lake Griffin, located in the chain of lakes in the central peninsular highlands of Florida. Silver Springs, Lake Eaton, and Orange Lake feed into the Ocklawaha River. The Ocklawaha River then drains north, meandering for about 70 miles, and empties into the St. Johns River. It is the primary tributary into the St. Johns River, which continues to flow north, roughly parallel to the Atlantic Ocean, until just north of Jacksonville where it turns eastward to the Atlantic Ocean.

4.1.2 Climate

Growing conditions in the Ocklawaha River basin are characterized by a long, warm growing season (about 300 days, mean annual temperature of 21.4°C, and fewer than 10 days/year at or below freezing). Average minimum temperatures during the coolest months are in the mid 40's but frosts and freezes occur periodically at Rodman Reservoir. July and August temperatures are the warmest, and December and January temperatures are the coolest. It is extremely rare for temperatures to remain below freezing throughout the day. The mean annual water temperature in the river is 21.8°C.

The area receives abundant rainfall (53.4 inches annually), nutrient-rich runoff, and sunshine and is best characterized as humid subtropical. The maritime influence of the Caribbean Sea and the Gulf of Mexico brings hours of heavy rain in late summer and early autumn. Fronts from the North American continent also sweep over the state in late fall, winter, and early spring, and cool, dry season followed by a warm, rainy season constitute a strong climatic cycle. The dry season, with low monthly rainfall, is from October or November to May. Wet season, with relatively uniform temperatures and high monthly rainfall, runs from June through September or October.

Summer heat is tempered in Florida by frequent and/or early evening thunderstorms. These showers, which occur on the average of about half of the summer days, are accompanied frequently by a rapid 10- to 20- degree drop in temperature. Because most of the large-scale wind patterns affecting Florida have passed over water surfaces, hot drying winds seldom occur (Marth 1996).

4.1.3 Rainfall

River discharge is seasonal and responsive to rainfall. During the dry season, most of the river flow is discharged from the Silver River, one of the Ocklawaha's tributaries, which originates in Silver Springs.

The average rainfall for the state of Florida in 1996 was 54 inches. Evaporation, however, reduces the available rainfall to about 40 inches annual. Rainfall varies greatly from year to year; wet years sometimes experience double the amount of rain received during a dry year.

The Office of Greenways and Trails measures the rainfall each day at Buckman Lock. Table 4-1 lists the total rainfall by month for 1995, 1996, and part of 1997.

Relative humidity in the project area varies minimally from one place to another. Humidities range from about 50 to 65 percent during the afternoon hours to about 85 to 95 percent during the night and early morning hours.

4.2 Geology and Soils

The Ocklawaha River flows over a fault zone, and its floodplain is composed of peat, muck, and freshwater marl dating back 18,000 years. The alkalinity of the water reflects the limestone formations of the region. A floodplain with nonclastic sediments, such as the Ocklawaha River

floodplain, although common in Florida, is in itself an unusual feature not ordinarily found anywhere else in the world. The Ocklawaha River bottom is a sand-bottomed, as opposed to a calcareous, stream. The stream flows are moderate to swift, frequently shifting, and slightly acidic. A map of hydric soils in the project area is presented in Figure 4-1

Table 4-1

Rainfall Measured at Buckman Lock

	Rainfall (inches)		
Month	1995	1996	1997
January	1.93	2.69	2.39
February	0.90	0.78	0.62
March	1.36	7.08	1.96
April	3.50	2.51	8.12
May	3.63	0.61	3.04
June	10.74	3.65	
July	4.13	3.99	
August	10.98	4.77	
September	8.04	2.78	
October	8.94	7.81	
November	1.05	1.19	
December	1.01	3.91	
Totals	**56.21**	**43.77**	

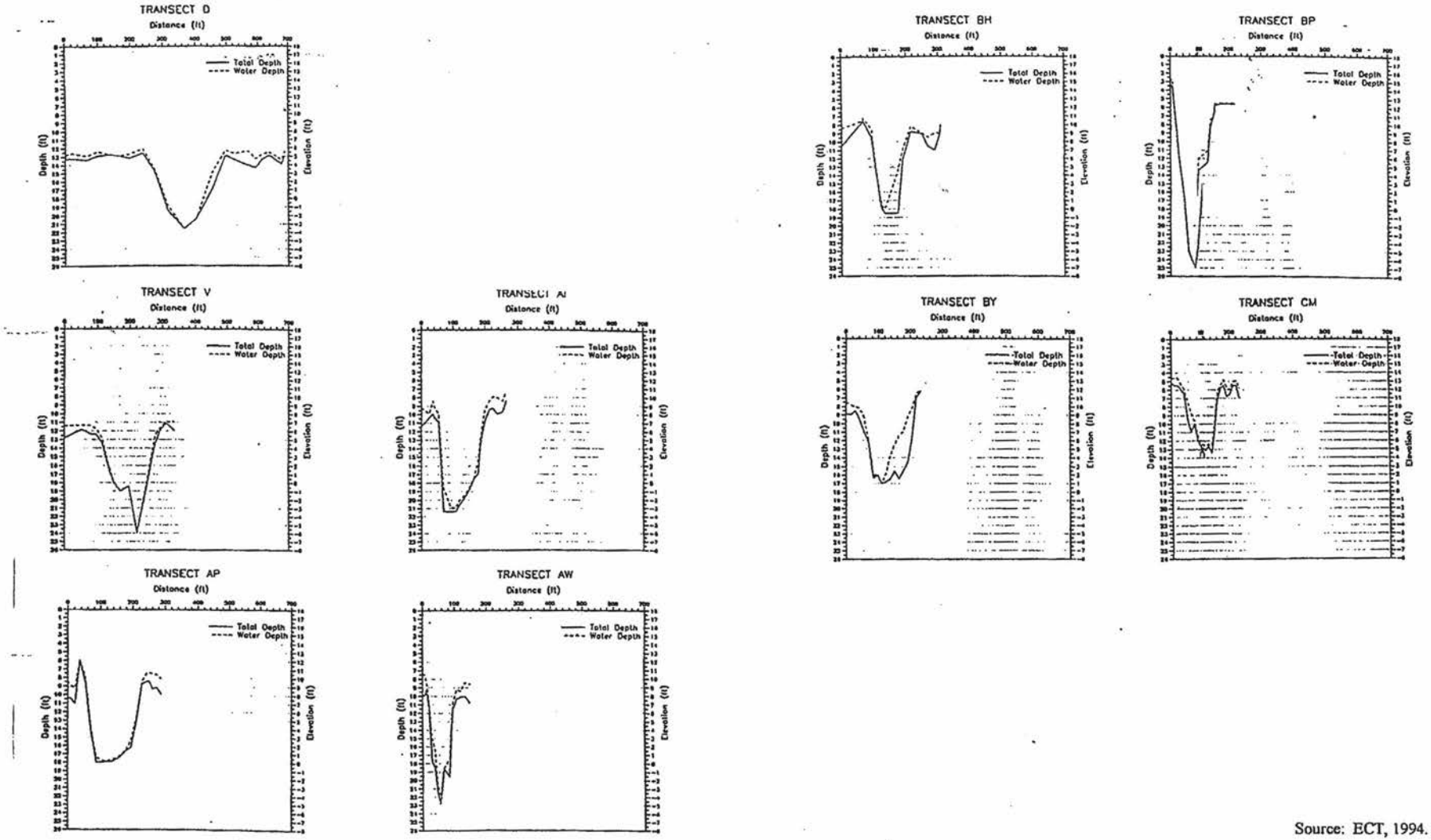
Source: FDEP, Office of Greenways and Trails

4.3 Elevations and Bathymetry

At 18 feet National Geodetic Vertical Datum (NGVD), the 5,980-acre Rodman Reservoir has a mean depth of 8.4 feet and a maximum depth of 31 feet. A 50 percent removal of water from the reservoir will result in a 4.7-foot decrease in reservoir stage, and a 1-foot decrease in stage will result in a 4.7 percent decrease in reservoir surface area and an 11.4 percent decrease in volume. Cross sections from a survey of the Ocklawaha River channel taken from the SJRWMD study are presented in Figure 4-2. As seen in the figure, the bottom of the channel ranged from an elevation of +4 feet to -7 feet NGVD, or 14 feet (transect CM) to 25 feet (transect BP) deep (relative to a lake level of 18 feet NGVD). Channel widths ranged from 110 feet (transect AW) to 260 feet (transect D). Sediment thickness in the channel ranged from 0.0 feet to 3.2 feet, although sediments were typically less than 2.0 feet thick. An examination of the relict Ocklawaha River and tributary channels indicates that a tributary enters the Ocklawaha River channel in this vicinity.

4.4 River Sediments

Depths of soft sediments in the river channel vary from about 1.5 to 23.4 inches at water depths ranging from 15.7 to 24.6 feet. Thicknesses generally range from 6.2 to 9.4 inches, are gelatinous, and have a high moisture content. Approximately 90 percent of the river channel bottom is covered in soft sediments; 43 percent of the reservoir has soft sediments 1 foot deep, and 36 percent of the reservoir has soft sediments greater than 2 feet deep.



Source: ECT, 1994.

PBS&J Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration - River Channel Cross Sections

(Left axis-depth at water level of 18 ft-NGVD29 and right axis elevation NGVD29)

Figure 4-2

At upstream sites (approximately 2 miles upstream of Eureka and beyond the effects of the reservoir), soft sediment depths range from 0 to 5 inches due to low velocities and sedimentation rates. Soft sediment depths and types in the submerged channel are consistent with depths and types in the upstream and downstream portions of the river channel. There are zones in the submerged channel with no sediment accumulation due to flows. Organic sediment values in the reservoir are similar to those for other Florida lakes (Appendix E). Sustained winds above 15 mph from the west (268 degrees clockwise from north) will initiate sediment resuspension in the inundated floodplain. It is, therefore, recommended for reservoir management that discharges through Kirkpatrick Dam during drawdowns be curtailed to the minimum when strong wind events occur.

4.5 Toxics Analysis of Rodman Reservoir Sediments

The SJRWMD study analyzed sediments to determine the presence of toxic substances and pollutants in the sediments in the transitional and lacustrine zones of the Rodman Reservoir. Fifteen samples were analyzed for toxics including 137 organic analytes (organochlorine pesticides, PCBs, volatile organics, and semi-volatile organics) and 16 metals (SJRWMD 1994). Concentrations for all the toxic organic compounds sampled were less than the method detection limits (MDLs). Based on a comparison (both direct and indirect) of the concentrations of toxic metals in the sediments of Rodman Reservoir with the concentrations in another regional lake, there is minimal risk to aquatic organisms (Danek et al. 1994).

Also, the Ocklawaha River flows north from Lake Apopka through the Central Highlands to the St. Johns River just south of the town of Welaka. The Central Valley has historically been an agricultural center for Florida, especially in the southern portion of this region where much of the source water for the river originates. Restoration efforts within the watershed have focused both on cleaning up Lake Apopka and the Upper Ocklawaha River Basin and conversion of muck farms along the river channel back into natural functioning marshlands. These efforts have removed much of the source for both nutrients and organochlorine pesticides to the river, and therefore it is not expected to find excessive amounts of toxins in these sediments.

Finally, during partial restoration of the river, a phased drawdown of the reservoir will be accomplished in three stages over three years. This will allow plenty of time for water removal from the reservoir so that sediments will not be disturbed. Sediments from within the channel and around the dam area will be pumped into the southern borrow pit for dewatering and disposal. These combined efforts will greatly reduce the risk of excessive lake sediments moving downstream.

4.6 Topography

The SJRWMD study also characterized the topography of cross sections of the flooded Ocklawaha River channel. The bottom of the channel ranged from +4 feet to -7 feet NGVD, and channel widths ranged from 110 feet to 260 feet. Sediments were less than 2 feet deep. Topographic maps of the area are presented in Figure 4-3.

4.7 Hydraulics and Hydrology

The existing pool elevation in the reservoir is 18 feet NGVD, and average flow velocity is 1,674 cubic feet per second (cfs). No seasonal water fluctuations occur under the existing conditions. The pool of water extends 49,000 feet upstream with depths 2.4 feet to 4 feet greater than historic depths. Approximately 9,600 acres of floodplain forest are chronically flooded.

Like the natural forests upstream of the Eureka Dam, flooding occurs seasonally, and the periods of highest water generally occur in fall/winter. When the reservoir was created in 1968, water levels were held at 20 feet NGVD. A backwater effect extended all the way to Eureka Dam, and all forests within this area were flooded. Water levels were held at 20 feet for approximately 1.5 years and then lowered to 18 feet where they have been held except during temporary drawdowns. When the reservoir is held at 18 feet NGVD, the backwater effect ends approximately 1.2 miles north of Eureka Dam.

The drainage area of the Ocklawaha River basin at the mouth is approximately 2,769 square miles (mi^2); at Kirkpatrick Dam, the drainage area is 2,747 mi^2 (Foose 1981). At Eureka, the drainage area decreases to 1,367 mi^2 (50 percent); however, the mean flow only decreases to 1,244 cubic feet per square second (cfs) (92 percent) for two reasons. First, according to Paulic and Hand (1994), "[r]unoff provides little input to this [Ocklawaha River] system." Secondly, and more importantly, the Silver River, which originates about 5 miles upstream at Silver Springs, contributes a mean flow of 799 cfs (59 percent). In fact, upstream of Rodman Reservoir, the mean flow of the Silver River represents 73 percent of the total flow of the Ocklawaha River (measured at Conner). The Silver River, therefore, has a significant impact on both the total flow of the Ocklawaha River as well as the water quality of the Ocklawaha River and Rodman Reservoir.

4.8 Surface Water Quality

According to Chapter 62-302, Florida Administrative Code (F.A.C.), the waters of the Ocklawaha River and Rodman Reservoir are designated as Class III surface waters. The Ocklawaha River is further designated as an Outstanding Florida Water (OFW) from Eureka Dam upstream to a point approximately 6 miles upstream of the confluence with the Silver River. Marshall Swamp and all other tributaries are excluded from the OFW classification. Additional tributaries to the Ocklawaha River included in the OFW classification are Silver River, Turkey Creek, Strouds Creek, Dead River, Cedar Creek, and Fish Creek.

The water of the Ocklawaha River is warm, slightly alkaline, laden with organic substances and tannins, and rich in nutrients. Dissolved oxygen (DO) concentrations remain relatively high [4 to 5 milligrams per liter (mg/l)] throughout a typical diurnal period and fluctuate less than the waters in the reservoir. The alkalinity of the water reflects the limestone formations of the region. Tannins and organic substances in the water are exported from the floodplain forests into the river, and values for tannins and total organic substances exhibit the largest variation, reflecting seasonal inputs from the forested wetlands. High nutrient concentrations are due to the influence of eutrophic lakes in the upper reaches of the river, as well as inputs from the Silver River.

Water quality in the Rodman Reservoir, the Ocklawaha River, and its tributaries upstream to Eaton Creek are classified by the Florida Department of Environmental Protection (FDEP 1994) as good. Farther upstream, water quality is classified as fair, and Sweetwater Creek is poor. Values for total nitrate (NO_2+NO_3) and dissolved oxygen (DO) are lower in lacustrine and transition zones and downstream of the dam.

According to Hand and Paulic (1992), the overall water quality for the Silver River and the Ocklawaha River above Orange Creek has improved over the last 10 years; downstream of Orange Creek, the overall quality has remained stable. In the Silver River, Hand and Paulic (1992) specifically identified improvements in turbidity, DO, and total phosphorus. They did note, however, a degradation in pH. In the Ocklawaha River (and Rodman Reservoir) above Orange Creek, there was an improvement in turbidity, but some degradation with respect to pH.

Of the water quality parameters examined, DO is perhaps the single most important parameter because:

1. It indicates the overall health of a water body.
2. Fish rely on DO for survival.
3. Historically, there have been problems with low DO concentrations in Rodman Reservoir.

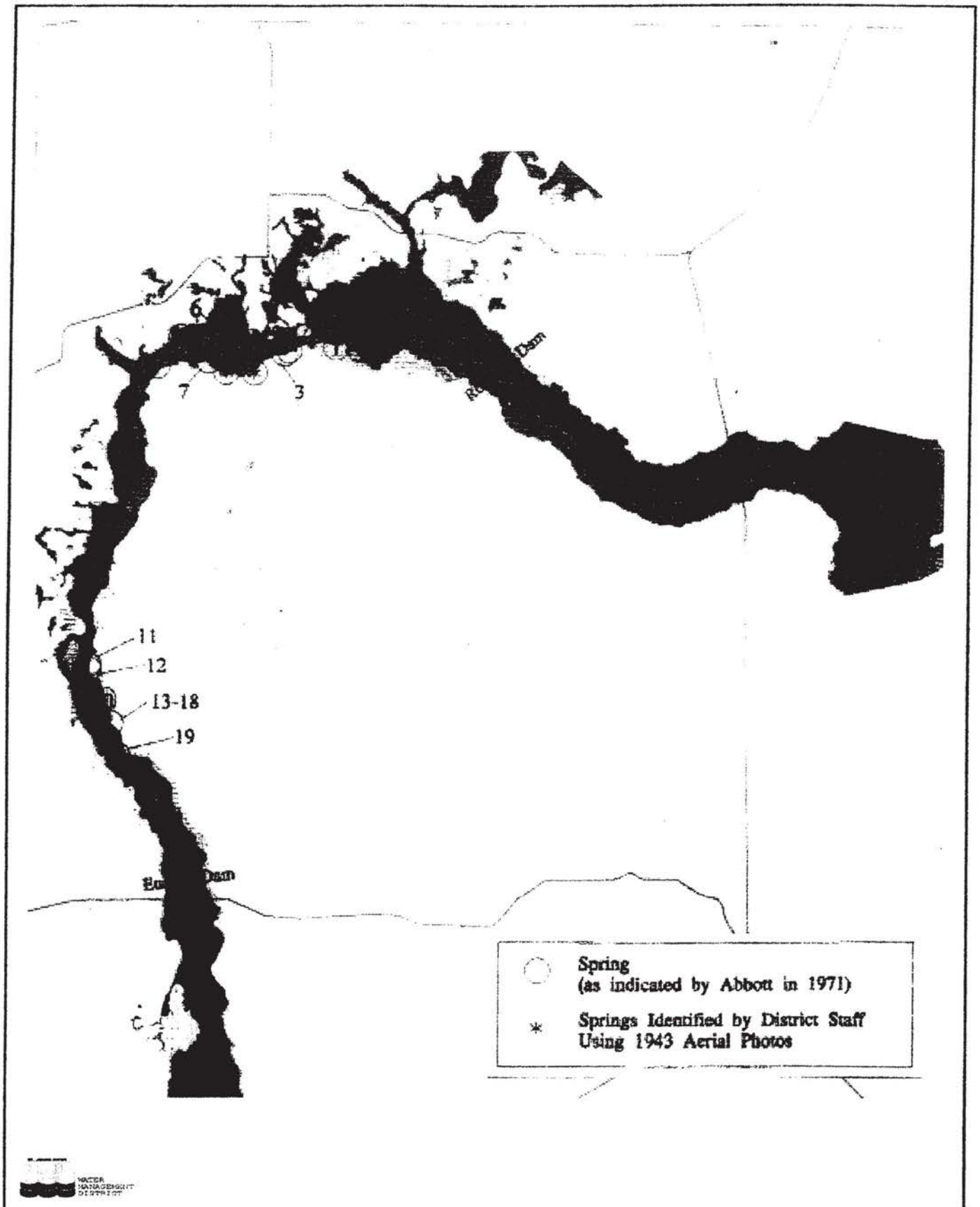
Plant biomass in the reservoir functions as a nutrient sink by assimilating nutrients and inhibiting their transport downstream. Without seasonal water fluctuations, nutrient and material exchanges between open water and forest is limited. The median values for dissolved nitrate + nitrite range from a high of 0.829 mg/l as nitrogen (mg/l-N) on the Ocklawaha River 200 yards downstream of the Silver River confluence to 0.077 mg/l-N downstream of Kirkpatrick Dam. This represents a 90

percent decrease in dissolved nitrate + nitrite. Dissolved phosphorus concentrations averaged 0.039 mg/l-P upstream of the dam to 0.014 mg/l-P downstream of the dam, demonstrating a 66-percent decrease in dissolved phosphorus concentrations in the water leaving the reservoir.

4.9 Floridan and Surficial Aquifers

The Floridan aquifer is affected minimally by the Ocklawaha River and the Rodman Reservoir in the project area. No data are available for the surficial aquifer. A total of 79 wells have been identified in the area, and only six of 55 wells for which well depths are known use the surficial aquifer. The status of the remaining 24 wells is unknown. The mitigation cost to replace these surficial wells is predicted to be less than the cost to obtain more accurate impact predictions through three-dimension modeling of reservoir water level reductions on the surficial aquifer.

Prior to the creation of Rodman Reservoir, several springs existed between Eureka and Kirkpatrick Dam. A research paper dated 1971 by a University of Florida Geology student, Elizabeth Abbott, describes 20 springs that existed before the reservoir was created. Abbott (1971) observed some of these springs, and the others were described and located on aerial photos by local people. At the time of her research, some of the higher springs were altered, but still present, and the lower ones were flooded as a result of the dam. Many of the springs have been inundated under the full retention of the reservoir. Figure 4-4 shows the locations of springs as described by Abbott (1971).



	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	Location of Springs in Study Area Prior to Creation of Reservoir	**FIGURE 4-4**

4.10 Fish Populations

Estuarine fish species have access to the Ocklawaha River through the St. Johns River, and some take advantage of saltwater wedges that move upstream through the St. Johns River beyond the confluence of the Ocklawaha River. Although some migratory fish are passing through the Buckman Lock, the dam appears to pose a barrier to the spread of a variety of migratory fishes that historically used the system.

The historical data reviewed for the Ocklawaha River and the Rodman Reservoir produced a list of 69 fish species and 22 families. Forty-two species of fish from 18 families were found during the SJRWMD study (1994). The decrease is probably due to the change from a flowing river system to a standing reservoir system. Individual fish biomass is expected to be greater under the full retention (no action) alternative.

Reid (1970) reported 110 fish species in the Ocklawaha River, including such migratory species as striped bass and mullet. Several species on the list have not been recorded from the reservoir since routine fishery sampling began in 1971. These fish include relatively uncommon species such as the dusky and bluenose shiner, the Southern tessellated darter, and snail bullhead. The lack of these species may be due to the change in overall habitat from a flowing system to the reservoir, which favors species that thrive in lakes and are associated with the dense vegetation found in the reservoir.

Two major fish kills have occurred in Rodman Reservoir during the 1980s. In August 1985, an estimated 8.5 million fish died. Spotted sunfish, warmouth, redear sunfish, largemouth bass, and bluespotted sunfish represented 52 percent of the total dead fish. The second kill occurred in October 1988 when an estimated 2.5 million fish died in the lacustrine and transition reservoir zones. An estimated 70,000 largemouth bass died; over half were older than one year. Both kills occurred when DO levels dropped below 1 part per million (ppm). Decomposition of excess organic matter input from terrestrial sources, coupled with low flow and high turbidity, may have resulted in low DO levels in the reservoir (Continental Shelf Associates 1994).

In the SJRWMD study (1994), fish were collected from sites upstream and downstream of Kirkpatrick Dam. The greatest difference between sites was the relative proportion of gizzard shad in the fish collected (Tables 4-2 and 4-3). Gizzard shad comprised 9 percent (n=3) and 8 percent (n=3) of the fish from the two zones above Kirkpatrick Dam, whereas this species comprised 82 percent (n=29) and 64 percent (n=56) of the collection from the two zones below Kirkpatrick Dam. Although four times as many fish of all species were collected from the sites below Kirkpatrick Dam, there were more species collected from upstream sites (S=15) than from downstream sites (S=12). (Note: In this analysis, n represents number of fish collected and S represents number of species). Results of this study are discussed below.

Striped bass were not collected above or below Kirkpatrick Dam during sampling, although striped bass carcasses were collected from Rodman Reservoir during a fish kill (Estes 1989). A total of 53 striped bass were collected from the barge canal and the St Johns River immediately outside the barge canal.

No adult eels were captured during this study, although a single adult eel was observed swimming in the vegetation immediately below Kirkpatrick Dam. A single elver was collected during sampling below the spillway of Kirkpatrick Dam. Overall, commercial harvest of elvers during the spring of 1994 was somewhat better than during the last 4 to 5 years at this site (SJRWMD 1994).

Striped mullet were collected above Kirkpatrick Dam at the Eureka site and unpublished FFWCC data indicate greater numbers of mullet below Kirkpatrick Dam (n=21) than above Kirkpatrick Dam (n=10).

The SJRWMD study provides an analysis of fish population data collected from the lower Ocklawaha River and Rodman Reservoir for existing and historical trends in species composition, relative abundance, and density. For temporal comparisons, data were summarized within three time periods as follows: time period I (1968-1976), time period II (1977-1985), and time period III (1986-1994). When possible, spatial comparisons were made among the lacustrine, riverine, and transition zones of the reservoir, and the Ocklawaha River.

Existing fish populations in the Ocklawaha River and Rodman Reservoir lacustrine and riverine zones were described using data collected between 1992 and 1994. These data revealed a fish assemblage composed of 42 species from 18 families. Eight species characteristic of slow-flow conditions, including tadpole, madtom, redfin pickerel, golden topminnow, flagfish, eastern mosquitofish, sailfin molly, and Everglades pygmy sunfish, were collected only in the lacustrine zone. Four species more characteristic of higher-flow conditions (speckled madtom, hogchoker, pugnose minnow, and channel catfish) were collected only in the Ocklawaha River.

Relative abundances for fish in the lacustrine zone were highest for bluespotted sunfish (36.6 percent), bluefin killifish (18.2 percent), and eastern mosquitofish (10.1 percent), all small-sized species closely associated with vegetation. Popular game fishes were represented in small proportions in the lacustrine zone: bluegill (6 percent), redear sunfish (2.6 percent), warmouth (2.4 percent), largemouth bass (2.0 percent), and black crappie (0.5 percent). Largemouth bass are management indicator species for aquatic habitats on the National Forests in Florida.

In the riverine zone of the reservoir, 90 percent of the sampling done by electrofishing was comprised of sunfishes and largemouth bass; bluegill sunfish (42.1 percent) and redbreast sunfish (20.5 percent) were the most important. Upstream of the Eureka Dam, the fish assemblage was equally dominated by sunfishes. Bluegill (49.1 percent), redbreast (14.2 percent), redear (10.1 percent) and spotted (7.5 percent) sunfishes; largemouth bass (6.6 percent); and warmouth (6.1 percent) were the major contributors. The high proportions of game fishes reported from the river and the riverine zone may reflect the bias of electrofishing for larger-sized fish.

There have been pronounced shifts in relative abundances of several fish species since creation of the reservoir. From time period I to time period II, seven sportfishes (largemouth bass, black crappie, and redbreast, warmouth, bluegill, redear, and spotted sunfishes) comprised 66.7 percent of the lacustrine zone fish assemblage; in time period III, this group represented only 16.2 percent. Commensurate increases occurred in other species, such as eastern mosquitofish, bluespotted sunfish, sailfin molly, and dollar sunfish.

Relative abundance of fish species in the Ocklawaha River and reservoir revealed few changes among the three time periods. Bluegills increased in proportional abundance in both areas, while largemouth bass decreased appreciably in the riverine zone and only slightly in the river.

Total lacustrine biomass was quite similar for time periods I and II, averaging 124.3 kilograms per hectare (kg/ha) and 126.7 kg/ha, respectively, and then increased to 151.9 kg/ha in time period III. This increase was the result of a proliferation of nongame species. The greatest increases in biomass in time period III occurred for Florida gar, bowfin, lake chubsucker, chain pickerel, bluefin killifish, and bluespotted sunfish. Species that decreased in the lacustrine biomass over the three time periods included the American eel, gizzard shad, taillight shiner, channel catfish, and redear sunfish. Bluegill dominated the lacustrine biomass in all three time periods.

Southern tessellated darters were found within Orange Creek. None were found at any other sites. Four Southern tessellated darters were collected from Orange Creek at SR 315 on two different sampling days. These four tessellated darters were taken from a depth of about 4.9 feet from the middle of the channel. The current was about 1.6 feet per second (ft/sec), and the bottom was sand and detritus. Other sites appeared to have similar habitat, but the Southern tessellated darter was not found in these areas.

Past studies, as well as the current sampling, indicate that the bluenose shiner is extremely rare or may have been extirpated from the Ocklawaha River. Bluenose shiners prefer quiet, densely vegetated areas and deep pools. Although such habitat types were sampled within most sites, no bluenose shiners were found. A more detailed discussion of the results can be found in Jordan (1994).

Sampling data and additional historical data were examined to describe migratory fish assemblages. During 200 hours of gill and trammel net sampling, target fish species, including shortnose sturgeon, Atlantic sturgeon, American shad, hickory shad, and blueback herring, were not encountered. These results are corroborated by the absence of these species during electrofishing efforts by the FFWCC from 1984 to 1996.

Largemouth bass and Bald Eagle are management indicator species that are monitored on the National Forests in Florida to indicate effects of management activities. Forest-wide population trends for these species can be found in the 2000 Monitoring and Evaluation Report for the National Forests in Florida. The bald eagle population in the Ocala National Forest has been stable to increasing over the past 10 years. Population samples of largemouth bass in natural lakes occurring on the Ocala National Forest show a decreasing trend.

Table 4-2

Numbers of Fishes Collected by Gill and Trammel Nets Totaled by Station

	Canal	Eureka	Payne	Rodman	SJR	SR 19	Totals
Amia calva	1	0	0	1	0	0	2
Lepomis auritus	5	1	0	0	0	0	6
Ameiurus catus	2	5	4	5	0	21	37
Dorosoma cepedianum	240	3	3	292	121	56	715
Elops saurus	1	0	0	0	0	0	1
Erimyzon sucetta	9	5	11	2	0	5	32
Esox niger	0	0	0	1	0	0	1
Lepomis gulosus	0	0	3	0	0	0	3
Morone hybrids	16	0	0	0	2	0	18
Lepomis macrochirus	3	0	9	3	0	0	15
Lepomis microlophus	7	1	7	2	0	0	17
Mugil cephalus	2	3	0	0	0	0	5
Ameiurus nebulosus	1	7	2	0	0	0	10
Notemigonus chrysoleucas	0	1	0	0	0	0	1
Lepisosteus osseus	5	2	7	43	1	4	62
Lepisosteus platyrhinchus	0	0	3	1	0	1	5
Pomoxis nigromaculatus	7	0	1	1	1	0	10
Ictalurus punctatus	7	6	1	3	0	2	19
Micropterus salmoides	3	2	0	1	0	0	6
Morone saxatilis	33	0	0	0	2	0	35
Tilapia auriae	2	0	0	0	0	0	2
Totals	**344**	**36**	**51**	**355**	**127**	**89**	**1,002**

Source: SJRWMD (1994)
SJR = St. Johns River immediately adjacent to the barge canal

Table 4-3

Numbers of Fishes Collected by Gill and Trammel Nets Totaled by Sampling Period

	Jan 14	Jan 25	Feb 8	Feb 22	Mar 8	Mar 22	Apr 12	Apr 25	May 10	Jun 5	Totals
Amia calva	0	1	0	1	0	0	0	0	0	0	2
Lepomis auritus	0	0	0	0	1	1	4	0	0	0	6
Ameiurus catus	0	1	1	1	2	5	6	2	3	16	37
Dorosoma cepedianum	88	364	30	23	25	51	16	22	43	53	715
Elops saurus	1	0	0	0	0	0	0	0	0	0	1
Erimyzon sucetta	1	7	15	5	2	0	1	1	0	0	32
Esox niger	1	0	0	0	0	0	0	0	0	0	1
Lepomis gulosus	0	1	0	0	2	0	0	0	0	0	3
Morone hybrids	0	4	0	1	2	10	0	1	0	0	18
Lepomis macrochirus	0	0	6	1	0	0	3	3	1	1	15
Lepomis microlophus	0	0	8	1	0	0	7	0	0	1	17
Mugil cephalus	0	0	1	0	0	1	3	0	0	0	5
Ameiurus nebulosus	1	0	3	1	5	0	0	0	0	0	10
Notemigonus chrysoleucas	0	0	0	1	0	0	0	0	0	0	1
Lepisosteus osseus	1	5	3	7	7	8	12	7	5	7	62
Lepisosteus platyrhinchus	0	0	4	0	0	0	1	0	0	0	5
Pomoxis nigromaculatus	1	4	1	0	2	0	1	0	0	1	10
Ictalurus punctatus	1	0	0	3	7	0	2	1	1	4	19
Micropterus salmoides	0	0	0	1	0	1	2	1	1	0	6
Morone saxatilis	2	4	1	5	1	16	1	1	2	2	35
Tilapia auriae	2	0	0	0	0	0	0	0	0	0	2
Totals	**99**	**391**	**73**	**51**	**56**	**93**	**59**	**39**	**56**	**85**	**1,002**

Source: SJRWMD (1994)

4.11 Bird Populations

The existing reservoir and associated habitat provide a diversity in bird habitat. Habitat is primarily aquatic, but includes some marsh and standing dead trees in the reservoir, in addition to a small floodplain forest around the reservoir. This in turn provides habitat for wading birds, as well as some forest species.

A 7-month survey was performed by the SJRWMD in an effort to describe the bird population in the project area. Survey results were combined with historic data to examine bird use within the area of the Rodman Reservoir and the lower Ocklawaha River. During the winter season, 6,744 individual birds belonging to 73 species were counted in the sampling plots. An additional 20 species were seen within the study area but outside the sampling plots.

During spring and summer, 2,619 individual birds of 79 species were seen, with eight additional species outside the sampling plots. The most abundant species was the American coot, which occurred in six habitats. Most of this species occurred in large groups in the open water during the winter. The most widespread species were the common moorhen and the anhinga, which were seen in 11 of the 15 habitat types. Thirteen species, including the great cormorant, wood stork, winter wren, sora, and merlin, were seen only once within the study area. Because of the sparsity of trees, there are few nesting sites for ospreys, double-crested cormorants, great blue herons, and limpkins.

4.12 Amphibians and Reptiles

This type of lake system creates important breeding areas for many terrestrial and semi-aquatic amphibians and reptiles. The reservoir provides habitat for a number of species, including the American alligator, banded water snake, cottonmouth, garter snake, ribbon snake, bullfrog, pig frog, and Southern leopard frog. Amphibians and reptiles were not surveyed for the SJRWMD study, but historic data are presented below.

4.12.1 American Alligator

The average annual alligator population in Rodman Reservoir between 1985 and 1992 was estimated to be 1,850, ranging from 1,374 to 3,184. Average annual population size of harvestable alligators (greater than 4 feet in length) was estimated to be 1,127, ranging from 848 to 1,886. These estimates are based on night-light surveys, which are adjusted to account for a certain number of alligators that are not counted because they are submerged or are inhabiting inaccessible areas (Woodward 1994). The American Alligator is listed as a Species of Special Concern in Florida and federally listed as Threatened because of similarity in appearance to endangered crocodiles and caimans. Alligators are hunted with regulation by FFWCC.

4.12.2 Eastern Indigo Snake

Eastern indigo snakes are known to occur within the Ocala National Forest, but there is no information on the population size within this area (Moler 1993). During the Cross Florida Barge Canal restudy, Eastern indigo snakes were recorded in various habitats along the canal route, including hydric hammock, but they were not recorded in mixed swamp habitat (FGFWFC 1976). The Ocklawaha River floodplain, however, provides suitable habitat for the Eastern indigo snake, especially because it is adjacent to the Ocala National Forest, where suitable habitats with gopher tortoise burrows are common. The Eastern indigo snake is listed as a Threatened species at both state and federal levels.

4.12.3 Spotted Turtle

The Ocklawaha River drainage in Putnam County appears to be an important area for this species due to the relatively large number of specimens found here (Moler 1992). There are records of this species from streams that flow into Rodman Reservoir, such as Deep Creek (Moler 1994). While Moler states that it is impossible to estimate past or current population sizes for this species, it seems very likely that adverse impacts on Florida's forested wetlands will have an adverse impact on the species.

4.12.4 Suwannee Cooter

The *Central Florida Barge Canal Restudy Report* states that the following numbers of Suwannee cooters were collected within the study area: Rodman Reservoir - 2; the Ocklawaha River - 2; and the Silver River - 4. In comparison, 88 were collected in Lake Rousseau, an impoundment of the Withlacoochee River at the western end of the canal, which drains into the Gulf of Mexico (FGFWFC 1976). The Suwannee cooter was introduced into the Ocklawaha River, but no other information is available on its population in this system (Moler 1994). The Suwannee cooter is a state-listed Species of Special Concern.

4.13 Mammals

Several studies document the mammal species found in the project area.

Layne (1970) reported 41 mammal species throughout the reservoir and floodplain, and three typical species present include the beaver, muskrat, and river otter. Considering all the available information, at least the following species of mammals are characteristic of hydric hammock: opossum, southeastern shrew, short-tailed shrew, armadillo, gray squirrel, flying squirrel, cotton mouse, raccoon, feral hog, and white-tailed deer (Vince et al. 1989).

Manatees have also been observed in the reservoir, and panthers historically occurred in the Ocklawaha River floodplain. These two mammals are discussed in detail in Section 4.15, *Threatened and Endangered Species*. Results of the mammal survey performed by SJRWMD (1994) are outlined below.

Surveys for round-tailed muskrat houses were conducted within the marsh areas of Rodman Reservoir on May 12, June 21, and August 30, 1994. A total of 67 round-tailed muskrat houses were observed in marsh areas of the Rodman Reservoir. Seventy percent of the 20 houses that were examined contained fresh green vegetation, indicating that the houses had been used recently.

The extent to which Rodman Reservoir has inhibited or impaired bear movements from the Ocala National Forest to more northern areas is unknown. According to John Wooding, FFWCC bear biologist, Rodman Reservoir could hinder the movement of black bears in the immediate area of the reservoir (see Section 4.15.3 for more detailed discussion).

4.14 Forest Succession

Under the existing conditions, nearly 7,500 acres of floodplain forest are submerged, and there are no seasonal fluctuations in water level. No new trees are predicted under the existing conditions without the planting of flood-tolerant saplings.

At 18 feet NGVD, under the present conditions, the reservoir will continue to support submergent and emergent aquatic vegetation, dead trees and submerged logs and trees. Standing dead trees will become submerged, and no new trees will germinate. The submerged seedbank, which contains no viable tree seeds, includes approximately 80 percent native herbaceous species (Burks 1994).

4.15 Threatened and Endangered Species

Because swamps are used by many species of mammals with large territories, and in particular by endangered species as refugia, the spatial arrangement of the remaining natural areas in Florida must be carefully examined when formulating land acquisition policies. Linking large natural areas with corridors of natural vegetation is an important strategy in providing sufficient contiguous habitat for the survival of many vertebrates.

Using a list of Federal- and State-listed endangered species, threatened species, species considered candidates for listing, and species of special concern that potentially occur within the study area, a survey of plants and animals was made for the project area. A list of threatened an endangered species is presented in Table 4-4.

4.15.1 Plants

Findings from the rare plant and animal survey conducted by Florida Natural Areas Inventory along the Cross Florida Greenbelt were incorporated into the SJRWMD survey of threatened and endangered species

Twelve of the 38 state-listed threatened, endangered, candidate plant species, plant species of special concern, and rare plant species included for study based on their likelihood of occurrence in the study area were found in the project area (see Appendix B for a detailed analysis). These include: giant leather fern *(Acrostichum danaeifolium)*, Garberia *(Garberia heterophylla)*, needle palm *(Rhapidophyllum hystrix)*, Cardinal flower *(Lobelia cardinalis)*, Florida spiny-pod *(Matelea*

floridana), buckthorn *(Bumelia lycioides)*, cinnamon fern *(Osmunda cinnamomea)*, royal fern *(Osmunda regalis)*, Florida pinkroot *(Spigelia loganioides)*, Florida willow *(Salix floridana)*, grass of Parnassus *(Parnassia grandifolia*, and variable-leaf Indian plantain *(Cacalia diversifolia)*. No federally threatened or endangered species were found in the project area (see Table 4-5). The following species are considered sensitive species by Region 8, USFS: Lavender basil *(Calamintha ashei),* Yellow star-anise *(Illicium parviflorum),* Scrub eulophia (Scrub eulophia), Florida willow *(Salix floridana).*

Three species were found in two general areas during a survey. Atlantic white cedar (*Chaemacyparis thyoides*), buckthorn (*Bumelis lyciodes*), and variable-leaf Indian plantain (*Arnoglossum diversifolium*) were found in floodplain forests along Deep Creek. FNAI (1991) reported two additional species within this white cedar community: *Selaginella apoda* and *Selaginella ludoviciana.* Buckthorn was also found in inundated floodplain swamp forests within Rodman Reservoir, in floodplain swamp forests upstream of the backwater effect of Kirkpatrick Dam, and downstream of Kirkpatrick Dam.

Table 4-4

Effects Upon Listed Species Under the Complete Retention of the Rodman Reservoir Alternative

Common Name	Status State	Federal	Anticipated Effects
Birds			
Bald Eagle	T	T	Current use will probably continue
Florida sandhill crane	T	S	Small habitat area potentially created
Least tern	T	N	Infrequent visitor/no change expected
Limpkin	SSC	N	Limpkin populations may eventually decrease
Little blue heron	SSC	N	No changes expected
Kirtland's warbler	E	E	No found in project area, no expected change in current population
Snail kite	E	E	Unlikely to occur
Snowy egret	SSC	N	Remain similar to current levels
Southeastern American kestrel	T	N	Northern subspecies may be found in winter
Tricolored heron	SSC	N	Local population may decrease
White ibis	SSC	N	Foraging should not change from current levels
Wood stork	E	E	Species will most likely continue to visit the area
Fish			
Bluenose shiner	SSC	N	Does not provide suitable habitat
Southern tessellated darter	SSC	N	Should continue to exist within Orange Creek
Plants			
Buckthorn	E	N	No change in existing population
Florida spiny pod	E	N	No change in existing population
Grass of parnassus	E	N	No effect
Giant leather fern	C	N	No change in existing population
Garberia	T	N	No change in existing population
Cardinal flower	T	N	No change in existing population
Cinnamon fern	C	N	No change in existing population
Royal fern	C	N	No change in existing population
Needle palm	C	N	No change in existing population
Florida willow	E	N	No change in existing population
Florida pinkroot	E	N	No change in existing population
Variable-leaf Indian plantain	T	N	No change in existing population
Mammals			
Black bears	T	S	Not suitable habitat, movement is possibly hindered
Florida panther	E	E	Not suitable habitat
West Indian manatee	E	E	Reservoir provides suitable habitat, although movement through the lock system is dangerous

Table 4-4 (Continued)

Common Name	Status State	Federal	Anticipated Effects
Reptiles			
American alligator	SSC	S/A	Excellent habitat
Eastern indigo snake	T	T	Will not benefit this species
Suwannee cooter	SSC	N	Unknown

State = State Listing by the Florida Department of Agriculture and Consumer Services, Division of Plant Industry
Federal = Federal Listing by the U. S. Fish and Wildlife Service; S = Forest Service Sensitive
E = Endangered; T = Threatened; C2, C1 – Candidate Species; N = Not listed; SSC = Species of Special Concern

Table 4-5

Threatened and Endangered Plant Species, Plant Species of Special Concern, and Candidate Plant Species That May Occur Within the Study Area

Species Name		Species Status	
Scientific Name	Common Name	State	Federal
Acrostichum danaeifolium	Giant leather fern	T	N
Adiantum capillus-veneris	Venus' - hair fern	T	N
Arnoglossum diversifolium	Variable-leaf Indian plantain	T	N
Bumelia lycioides	Buckthorn	T	N
Carex chapmanni	Chapman's sedge	N	N
Chaemacyparis thyoides	Atlantic white cedar	N	N
Drosera intermedia	Water sundew	T	N
Hartwrightia floridana	Hartwrightia	T	N
Helianthus carnosus	Lake-side sunflower	E	N
Illicium parviflorum	Yellow star anise	T	N
Litsea aestivalis	Pond-spice	T	N
Matelea floridana	Florida milkweed	E	N
Monotropsis reynoldsiae	Pigmy pipes	E	N
Myriophyllum laxum	Piedmont water milfoil	N	N
Parnassia grandifolia	Grass of parnassus	E	T
Peltandra sagittifolia	Spoon flower	N	N
Peperomia humilus	Terrestrial peperomia	E	N
Pteroglossaspis ecristata	Wild coco	T	N
Salix floridana	Florida willow	T	N
Salpinogostylis coelestina	Bartram's ixia	E	N
Spigelia loganioides	Florida pinkroot	E	N
Selaginella apoda	Meadow spikemoss	T	N
Selaginella ludoviciana	Gulf spikemoss	T	N
Ulmus crassifolia	Cedar elm	N	N
Vicia ocalensis	Ocala vetch	E	N

State= State Listing by the Florida Department of Agriculture and Consumer Services, Division of Plant Industry.
Federal = Federal Listing by the U.S. Fish and Wildlife Service
E = Endangered; T = Threatened; C2, C1 = Candidate Species; N = Not listed, S = Forest Service Sensitive

Although Atlantic white cedar is not listed as threatened or endangered, it is an uncommon species in peninsular Florida and is indicative of a relic plant community containing numerous other uncommon plants. It is found in only two isolated stands in north peninsular Florida: along Juniper Creek and Mormon Branch in the Ocala National Forest and along Deep Creek, which discharges into Rodman Reservoir (Ward and Clewell 1989). The Deep Creek stand is approximately 4 miles long with 2,000 to 5,000 Atlantic white cedar trees. The surveys focused downstream of this isolated community to determine the extent of the population and how far it extended toward Rodman Reservoir.

No other threatened, endangered, candidate plant species, plant species of special concern, or rare plant species were found within the study area during this survey. Only one of the listed species, giant leather fern, utilizes marsh habitats. Piedmont water milfoil (*Myriophyllum laxum*) was the only subject plant species that inhabits shallow lakes; this species was not found in the project area despite a thorough search for it.

4.15.2 Birds

Twelve threatened and endangered, species of special concern, and candidate species were identified as possible species occurring within the project area. Of the twelve species, two species, the migrant Kirkland's warbler and the snail kite, were not found. The snail kite and least tern are not listed as occurring in Putnam or Marion Counties (FNAI 1997).

Limpkins, little blue herons, snowy egrets, tricolor herons, and white ibis forage along the edges of the reservoir and among the dense vegetation around stressed cypress trees. Sandhill cranes and wood storks occur in marshes and wet prairies throughout Florida. Both of these species were sighted and appear to nest just north of the reservoir in Cow Heaven Bay.

Both kestrels and bald eagles nest in dead trees and forage over open areas. Two kestrels have been sighted at the reservoir in winter (nonbreeding), and a single active bald eagle nest exists in the project vicinity. Bald eagles are a management indicator species for aquatic habitats and bottomland Forest on the National Forests in Florida.

4.15.3 Mammals

Within the past few years, manatees have been observed within the Rodman Reservoir, the Ocklawaha River upstream of Eureka, and within the Silver River. Based on FFWCC's records from 1977 to 1999, at least 10 manatees were crushed and drowned in Buckman Lock and Kirkpatrick Dam during that period.

The *Cross Florida Barge Canal Restudy Report* states that lock tenders across the state reported manatees moving through locks (FGFWFC 1976). As part of this restudy, an aerial survey for manatees was conducted along canal lands in February 1973. Between Palatka and Lake George, 29 manatees were sighted in the St. Johns River. There were two sightings of manatees in Buckman Lock and reports of manatees passing through the lock into Rodman Reservoir. The restudy report

also mentions several unconfirmed reports of manatees in the Ocklawaha River downstream of Kirkpatrick Dam at Eureka and in the Silver River.

Table 4-6 lists the manatee mortality record for the Rodman area, including Kirkpatrick Dam, Buckman Lock, and the Ocklawaha River. This information was obtained from FDEP's Office of Greenways and Trails in cooperation with the Office of Protected Species.

Table 4-6

Manatees Killed by Kirkpatrick Dam or Buckham Lock, 1974 – 2000

DATE	CASE NUMBER	SIZE/SEX	STRUCTURE
10-23-77	M093	310cm, male	Buckman Lock
05-11-79	M149	263cm, female	Kirkpatrick Dam
06-30-80	M195	276cm, female	Buckman Lock
06-22-83	M338	340cm, female	Kirkpatrick Dam
06-23-83	M339	291cm, male	Kirkpatrick Dam
08-08-83	M344	310cm, female	Kirkpatrick Dam
06-24-91	MNE9113	275cm, male	Kirkpatrick Dam
08-09-95	MNE9514	331cm, male	Kirkpatrick Dam
08-20-95	MNE9515	279cm, male	Kirkpatrick Dam
02-22-99	MNE9907	385cm, female	Buckman Lock

Florida Fish and Wildlife Conservation Commission
Bureau of Protected Species Management
3-1-2001

According to Charlie McClung (FDEP, Office of Greenways and Trails), locktender at Buckman Lock, manatees regularly attempt to move into the locks. He reports that he has often seen four or five manatees trying to swim into the locks heading toward Rodman Reservoir. Manatees are generally kept out of the reservoir through the use of a bubble device on the lock; but on rare occasion, a manatee slips through the system. McClung's log books record as many as 28 manatee sightings at Buckman Lock in one month (McClung 1994).

Manatees will continue to use the Buckman Lock as a portal from the St. Johns River to the Rodman Reservoir, the upper Ocklawaha River, and the Silver River. Manatees are forced to use the Buckman Lock to reach the reservoir and the upstream springs, and there have been 10 recorded manatee deaths since 1977. The lock places manatees at risk of death or injury from vessel strikes and from water control structures.

Continued retention does not provide suitable black bear habitat, but at least eight individuals occur in the northern portion of the Ocala National Forest adjacent to the project area. The mobility of bears allows them to cross the project area where the river channel narrows, and there have been four documented occurrences of bears crossing the Ocklawaha River, as well as observations of bears swimming across the canal near the SR 19 bridge. Bears are able to move to and from the Ocala

National Forest by going around Rodman Reservoir, but it is not a direct path as would be the area now occupied by the reservoir and barge canal.

Although panthers historically occurred in the Ocklawaha River floodplain, the habitat is not suitable for the Florida panther, and the Rodman Reservoir area is not considered a potential panther reintroduction site by the FFWCC due to the density of human development within the Ocala National Forest.

4.15.4 Reptiles and Amphibians

Listed reptiles potentially found within the Ocklawaha River basin include the American alligator, Eastern indigo snake, spotted turtle, and Suwanne cooter. No listed amphibian species were documented for the project area, although this certainly does not preclude their presence.

The aquatic habitat will decrease in the reservoir but will continue to provide excellent habitat for the American alligator. The reservoir and flooded forest do not provide suitable habitat for the Eastern indigo snake. The Suwanee cooter has been introduced to the Ocklawaha from rivers entering the Gulf of Mexico, and eight individuals have been collected in the river and reservoir, compared with 88 from an impoundment on the Withlacoochee that drains into the Gulf of Mexico.

4.15.5 Fish

Although neither the bluenose shiner nor the southern tessellated darter have been collected from the main river channel since 1949, the darter has been collected regularly from Orange Creek (and some other tributaries) since 1975, and the southern tessellated darter still occurs in some of the river tributaries. The darter should continue to survive within Orange Creek unless increases in aquatic vegetation negatively affect this habitat.

4.16 Plant Communities and Seed Bank

The existing seedbank includes 35 native species (Burks 1996). Four species, all natives, account for 79 percent of the germination: *Polygonum densiflorum*, the sedge *Carex albolutescens*, and the grasses *Echinochloa walteri* and *Saciolepis striata*. Approximately 13 percent of the sprouts include the native species *Lugwigia repens*, *Hydrocotyle ranunculoides*, *Pontederia cordata*, and *Eupatorium capillifolium*, and the non-native *Amaranthus viridis*.

4.17 Habitat

The Ocklawaha River originates in Lake Griffin, flows north for approximately 70 miles, and empties into the St. Johns River. It ranges in depth from 5.9 to 7.9 feet and in width from 53.1 to 100 feet (Lugo and Brown 1984). It is rich with tannins that are exported from the floodplain forests, and flooding occurs seasonally, primarily during the late summer and early fall. Silver Springs in the Silver River provides a large portion of the discharge to the lower Ocklawaha River. Numerous tributaries run into the Ocklawaha between the Silver River and Kirkpatrick Dam, including Daisy Creek, Mill Creek, Bruntbridge Brook, Orange Creek, Deep Creek, and Sweetwater Creek. The

latter three are major tributaries that are partially inundated by Rodman Reservoir. Project area wetlands are presented in Figure 4-5.

Historically, the Ocklawaha floodplain varied in width and was as wide as 1 mile in the area south of where SR 310 crosses Deep Creek. Approximately 5,498 acres of forest were crushed, and 4,023 acres of forest were flooded during construction of Rodman Reservoir (Lugo and Brown 1984). Habitats in the floodplain are heterogeneous because small changes in land elevation lead to dramatic changes in the conditions for plant growth and composition of vegetation. The Holdridge complexity index of the undisturbed Ocklawaha floodplain forest was calculated to be 93 by Lugo and Brown (1984). This is within the range of values reported for still-water wetlands of Florida, but higher than the complexity indices of other flowing-water wetlands in Florida. Structurally, therefore, the Ocklawaha River floodplain forest is more complex than most other freshwater forested wetlands in Florida, but it is less complex than tropical swamp forests. Animals benefit from this diversity of habitats.

The SJRWMD study (1994) provided information on historic and existing habitats of the project area. Descriptions and acreages of the natural and artificial habitats included in the SJRWMD study are provided in the following sections.

4.17.1 Artificially Created Habitat

Construction activities associated with the Cross Florida Barge Canal resulted in damage and loss of the floodplain forest. These alterations included the creation of a berm on either side of the canal, spoil piles, channels, and dikes which changed the surface characteristics of the project site.

Approximately 2,090 acres were cleared with a tree crusher (Table 4-7). The total width cleared on either side of the berm was 400 feet. Clearing and cleanup were also conducted in the following areas: (1) in the northeastern portion of Rodman Reservoir, (2) in the Deep Creek area, (3) in the area west of Kenwood past Orange Springs, and (4) in a continuous, if uneven, strip all the way to Eureka Dam. The total area cleared and cleaned up within the reservoir (excluding that done along the Cross Florida Barge Canal) was 3,400 acres. Where areas were not cleared and cleaned up, primarily on either side of the Ocklawaha River channel, sporadic timber was left standing. About 1,910 acres of the forested area were left intact. There was selective clearing of 500 acres along portions of the shoreline. In addition, approximately 250 acres of land along the river channel and the proposed boat trail were partially cleared and snagged.

Information about spoil bank locations was obtained from aerial photographs from the SJRWMD and information from current and former U.S. Army Corps of Engineers (USACOE) personnel. Spoil-like features identified from the USACOE aerial photomosaics include:

1. Cross Florida Barge Canal berm
2. Dikes
3. Drainage ditch spoil piles
4. Relict submerged roads.

The feature most evident in the aerial photomosaics is the berm associated with the barge canal. There is also a minor canal and berm feature located just east of Kenwood Gap in several aerial

photomosaics. This feature appears to be a short (less than 500 feet) canal with spoil piled on either side of the canal. The canal does not appear to connect with any other features such as the barge canal or the stream channel.

Another feature that resembles the barge canal berm is evident on the aerial photomosaics taken just south of Orange Springs. There are at least seven other linear features associated with this feature, identified as drainage ditches by Mr. Dave Bowman (1994) and Mr. Bob Freeman of the SJRWMD (Freeman 1994). They generally extend out laterally from the edge of the dikes and head east toward the Ocklawaha River channel or west toward the shoreline.

Submerged relict roads, another less obvious feature, are evident on the aerial photomosaics. Most notable are the road to the Orange Springs ferry crossing and an east-west road at the southern tip of Kenwood peninsula.

According to Mr. Cleve Powell (1994), the U.S. Forest Service constructed a boat ramp and canal into Rodman Reservoir about 7,000 feet west of Kirkpatrick Dam. This ramp and canal are evident in several aerial photomosaics; however, there are no spoil features observed in the reservoir. It is possible that the spoil for the ramp and canal was disposed of on land.

Table 4-7

Approximate Areas of Specific Clearing Activities

Bottom Clearing Activity*	Zone*	Area (Acres)†	Percent of Total
Crusher area (below 12 feet NGVD 29)	1	2,090	24.5
Cleared and grubbed along barge canal	2	380	4.4
Cleared and cleaned up	3	3,400	39.8
Selectively cleared	4	510	6.0
Partial clearing adjacent to boat trails	5	30	0.4
Partial clearing and snagging along river	6	220	2.6
No clearing (i.e. trees left standing)	7	1,910	22.4
Total		**8,510**	**100.0**

* As defined by USACOE (1969).
† Because the shoreline depicted on original USACOE map was an approximation, ECT used the shoreline as depicted in Danek, et al., (1994), which is based on various USGS maps and field measurements.

Sources: USACOE, 1969.
ECT, 1994.

4.17.2 Rodman Reservoir Habitat

The reservoir is divided into three main parts: (1) pool or lacustrine zone, (2) transitional zone, and (3) riverine zone (refer back to Figure 2-1). The pool section is characterized by large areas of submergent and emergent aquatic vegetation, standing dead trees, and submerged logs and trees. The transitional zone contains dead standing trees and emergent and submergent aquatic vegetation, but it also contains forested areas with living, but stressed, trees. The riverine zone resembles the natural Ocklawaha River floodplain.

Approximately 1 mile downstream of Eureka Dam, the forests are flooded permanently as a result of Kirkpatrick Dam, unlike the natural Ocklawaha floodplain swamps, which are flooded seasonally. Germination is prevented in these permanently flooded sites, and sprouting is the only means of regeneration for trees (Davis 1990). Upstream of the backwater effect (which ends approximately 1 mile north of Eureka), the hydrology is more natural. The habitat types within Rodman Reservoir are shown in Figure 4-6. Habitat acreages were calculated for the area from Eureka Dam to Kirkpatrick Dam. The following subsections describe and quantify these habitats.

4.17.2.1 Berms (28.61 Acres)

Berms are artificial dikes vegetated by trees, shrubs, and vines. Dominant trees include bald cypress, sweetgum, and red maple. Carolina willow and wax myrtle are also common.

4.17.2.2 Dead Trees with Surface Aquatic Vegetation (396.36 Acres)

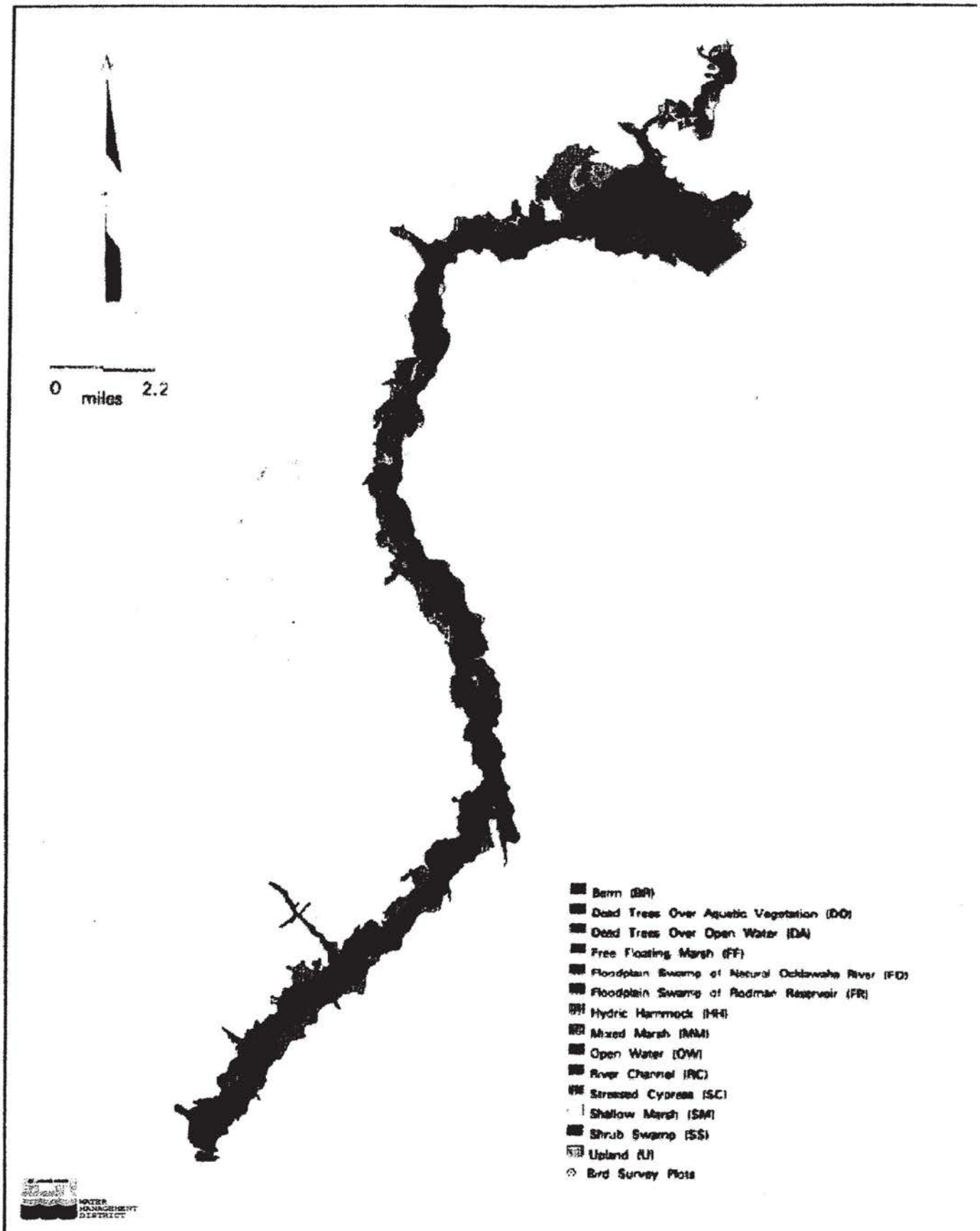
In this habitat type, mats of surface aquatic vegetation (SAV) grow underneath dead trees. Vegetation is similar to that growing in the floating leaved aquatics marsh habitat.

4.17.2.3 Dead Trees Over Open Water (228.45 Acres)

In this habitat, there are dead, standing tree trunks of varying heights with very little or no SAV growing underneath the tree trunks during much of the year. During the late summer, water lettuce becomes abundant in this habitat type.

4.17.2.4 Floating-leaved Aquatics Marsh (1,088.6 Acres)

In the free-floating marsh, vegetation primarily floats on the surface of the water, although some of it is rooted in the reservoir bottom. There are two basic types of marsh: (1) those in deeper areas dominated by spatterdock with other emergent vegetation and (2) those dominated by mat-forming species, such as *Polygonum*, pennywort (*Hydrocotyle sp.*), alligator weed (*Alternanthera*), and frog's bit (*Limnobium*). The amount of water lettuce varies throughout the year and reaches highest densities in the late summer and fall.



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Habitat Types within Rodman Reservoir and Ocklawaha River Study Area

FIGURE 4-6

4.17.2.5 Floodplain Swamp in Rodman Reservoir (1,379.16 Acres)

This habitat type consists of the floodplain swamp forests between Paynes Landing and Eureka Dam. From a point approximately 1 mile north of Eureka Dam to Paynes Landing, these forests are permanently flooded except during drawdowns. Upstream of the backwater effect (which ends approximately 1 mile north of Eureka), the hydrology is more natural. The vegetation of the permanently inundated floodplain swamp is described in the following paragraphs.

A tree species survey was conducted in three plots within three habitat types downstream of Eureka Dam: (1) stressed cypress forest within Rodman Reservoir, (2) permanently inundated floodplain swamp within Rodman Reservoir, and (3) floodplain swamp that is unaffected or only slightly affected by Kirkpatrick Dam. Field data recorded included species composition, average age, and diameter at breast height (dbh) of each species, and average water depth. Table 4-8 presents the result of these surveys.

Davis (1990) compared importance values of tree species in natural floodplain forests of the Ocklawaha River to species in floodplain forests in Rodman Reservoir inundated by different water depths (Table 4-9).

Table 4-8

Average dbh and Age for Each Species in the Ocklawaha Floodplain Swamp, the Permanently Flooded Forest Within Rodman Reservoir and the Stressed Cypress Habitat*

	Natural Floodplain Swamp (Ave. Water Depth =1.9 ft.)			Permanently Flooded Forest (Ave. Water Depth = 5 ft.)			Stressed Cypress Forest (Ave. Water Depth = 6.8 ft.)		
Species	N	dbh (in.)	Age (yr.)	N	dbh (in.)	Age (yr.)	N	dbh (in.)	Age (yr.)
Acer rubrum	24	25.94 ± 22.27	36.47 ± 31.31	9	22.18 ± 4.92	31.19 ± 20.98	1	7.37 ± 0.00	10.36 ± 0.00
Cephalanthus occidentalis	1	5.08 ± 0.00	no data	0	No trees		0	No trees	
Fraxinus profunda	90	25.06 ± 15.58	57.76 ± 35.91	91	33.70 ± 26.05	77.68 ± 60.05	17	16.25 ± 9.62	37.46 ± 22.17
Ilex cassine	10	10.66 ± 5.07	27.98 ± 16.61	2	20.96 ± 12.75	55.01 ± 33.46	0	No trees	
Nyssa sylvatica biflora	16	41.55 ± 18.37	99.14 ± 43.83	13	39.07 ± 24.02	93.22 ± 57.31	27	31.61 ± 13.79	75.42 ± 32.90
Sabal palmetto	14	29.53 ± 3.52	no data	6	31.24 ± 30.07	no data	0	No trees	
Taxodium distichum	37	12.14 ± 15.21	24.1 ± 30.21	28	32.18 ± 30.07	63.89 ± 59.70	81	43.69 ± 17.88	86.74 ± 5.50
Ulmus americana	11	20.71 ± 12.09	42.08 ± 24.57	1	6.86 ± 0.00	13.94 ± 0.00	0	No trees	

*Based on Field Data Gathered in September 1994
N = Sample size for trees measured for dbh for each species within each habitat type.
Age and dbh data are averages from three plots within each habitat type.
Cores for aging were generally taken from at least three trees per species from each of the three plots within each habitat type.

Table 4-9

Importance Value of Tree Species in Natural Floodplain Forest of the Ocklawaha River and Permanently Flooded Forest in Rodman Reservoir by Water Level (in) and Distance to Rodman Dam (mi*)

Species	Sprouts	Importance Value						
		10.1 in -0.8 mi	7.8 in 6.5 mi	20.3 in 7.1 mi	25.7 in 8.4 mi	32.4 in 9 mi	40.2 in 9.6 mi	46.8 in 10.2 mi
Taxodium distichum	Rare	13.5	18.8	15.6	23.2	32.6	62.0	67.5
Nyssa sylvatica var biflora	Rare	7.3	3.7	. 7	6.3	10.6	24.2	17.5
Sabal palmetto	None	3.9	7.4	4.3	4.9	0	1.9	1.5
Fraxinus spp.	Many	44.7	40.5	47.1	44.8	49.4	8.4	
Acer rubrum	Many	14.2	12.3	13.2	12.7	6.1	3.7	
Ulmus americana var floridana	Few	5.8	6.6	2.7	2.2	1.3		
Ilex cassine	Many	5.4	7.6	7.6	3.2			
Cornus foemina	Few	0.8	1.7	2.5	2.7			
Quercus laurifolia	Few	1.6	1.0					
Persea palustrus	Few	0.3						
Magnolia virginiana	Few	2.5						
Crataegus spp.	Few	0.3						

* = A negative number indicates a site downstream of the Rodman Dam. A positive number indicates a site upstream of the dam.

Importance values represent the sum of the relative density, relative dominance, and relative frequency of a species in a community (Smith 1986).

These comparisons indicate that tree species richness decreases as water level increases. In addition, importance values also change. Generally, species with low importance values in the natural forests (sweetbay, dogwood, and elm) decreased further in inundated areas, with the exception of the swamp tupelo and the cabbage palm (Davis 1990). Mortality rates increased with water depth, and tree species differed in their tolerance to flooding.

Harms et al. (1980) found that in 1972, 3 years following flooding, most trees had died in the deeply flooded portions of the Rodman Reservoir (depths of 3.9 feet or more), and 68 percent of the original trees had died in the area that is now considered the stressed cypress forest, which has an average water depth of 3.5 feet. In areas with water levels averaging 2.7 feet deep, 41 percent of trees had died by 1972. The mortality was estimated at 4 percent in areas upstream of the backwater effect of the dam, and tree root mortality increased with increasing water depth. By 1972, bald cypress and tupelo began to develop new secondary root systems, but ash and red maple died 3 years after flooding. Based on surveys conducted in 1972 and 1975, Harms et al. (1980) predict that bald cypress and swamp tupelo will tolerate flooding up to 2 feet, but ash and red maple will eventually die at these depths.

In contrast, Davis (1990) found that ash and red maple, as well as some subdominants, were able to maintain high importance values by reproducing vegetatively. Davis's work revealed that recovery of stem densities in moderately deep portions of the reservoir occurred between 1975 and 1987 in areas inundated by up to 22.1 feet due to the sprouts produced by living individuals (primarily ash) (Davis 1990). The condition and the species composition of permanently flooded forests within Rodman Reservoir are functions of the degree of inundation. Areas flooded by over 2 feet exhibit greater decreases in stem densities from the permanently flooded forests downstream to the stressed cypress. The stressed cypress and permanently inundated floodplain forests are discussed further in the following paragraphs.

4.17.2.5.1 Stressed Cypress Area

The area referred to as the stressed cypress habitat is located downstream of the permanently flooded forests extending from a point just south of Paynes Landing to a point approximately 2.6 miles north of Paynes Landing. The average water levels are approximately 3.3 feet when the reservoir is held at 18 feet NGVD (Davis 1990). In this area, almost all trees except cypress have died due to flooding stress. Scattered swamp tupelo, ash, and red maple are also found.

4.17.2.5.2 Permanently Inundated Floodplain Swamp

Upstream of the stressed cypress forest, a permanently flooded forest exists with species typical of the natural Ocklawaha River floodplain. The average water levels within this area range from approximately 1.7 to 2.7 feet when the reservoir is held at 18 feet NGVD. Davis (1990) found that in areas permanently inundated by up to 2 feet, many species have maintained importance values similar to those in the natural Ocklawaha floodplain forests. Ash, red maple, and many subdominant

species survive within permanently flooded sections of the reservoir by sprouting. Cypress and swamp tupelo have survived in many sections as long-lived stems with no sexual or asexual regeneration. These forests are similar to those upstream of Eureka and are dominated by pumpkin ash, bald cypress, red maple, swamp tupelo, American elm, and dahoon holly. Swamp dogwood, sabal palm, laurel oak, bay, and sweetbay also occur. The understory is dominated by false nettle (*Boehmeria cylindrica*), spider lilly (*Crinum americanum*), panic grass (*Panicum sp.*), lizard's tail (*Saururus cernuus*), and poison ivy (*Toxicodendron radicans*).

4.17.2.6 Hydric Hammock (947.03 Acres)

Hydric hammock includes areas where the elevation is slightly higher than in the floodplain swamp. These areas are not flooded on an annual basis but are sometimes inundated during flooding events. They are vegetated by species found in bottomland hardwoods including loblolly pines (*Pinus taeda*), slash pine (*Pinus elliotti*), and Southern magnolia (*Magnolia grandiflora*).

4.17.2.7 Mixed Marsh (592.57 Acres)

Mixed marsh areas have open water and 30 percent to 70 percent vegetation cover by various marsh species including cattail, pickerel weed (*Pontederia cordata*), spatterdock (*Nuphar luteum*), and bullrush (*Scirpus* spp.).

4.17.2.8 Open Water (3,852.71 Acres)

This habitat type includes areas within the reservoir that are free of emergent or floating vegetation but often have considerable SAV (primarily *Hydrilla verticillata*). There are floating stumps and logs, some with weeds growing on them.

4.17.2.9 River Channel (316.51 Acres)

The river channel ranges in depth from 5.9 to 7.9 feet and in width from 53 to 100 feet. It is vegetated with emergent and submerged vegetation, such as tape grass (*Vallisneria americana*), pondweed (*Potamogeton illinoensis*), and duck potato (*Sagittaria lancifolia*).

4.17.2.10 Stressed Cypress (546.42 Acres)

Stressed cypress areas are permanently flooded forests with cypress trees that appear to be stressed. Often the tops of the trees are dead, and the side branches are short and dead at the tips. A few small ashes and swamp tupelo are present. This habitat is further described earlier in Section 4.17.2.5.

4.17.2.11 Shallow Marsh (698.91 Acres)

Shallow marsh is characterized by dense cattail (*Typha latifolia*) marsh with very little open water. This habitat is common in the pool and transition zones and occurs in the barge canal cut upstream.

4.17.2.12 Shrub Swamps (446.86 Acres)

Shrub swamps occur in areas that were clear-cut at the time the reservoir was created, but they are not as deeply flooded as marsh and open water habitats. Dominant plants are willow and wax myrtle.

4.17.3 Existing Native Floodplain Communities

Two types of forested communities occur within the natural Ocklawaha River floodplain within the project area: floodplain swamp and hydric hammock. The soils of the Ocklawaha floodplain are mucks and sandy loams underlain by freshwater marls and mucks. Most common soils are Terra-Ceia muck, Placid-mucky fine sand, and Anclote-Tomoka association soils (Harms et al. 1980) (Appendix D). The Ocklawaha River floodplain floor has numerous hammocks, hollows and sloughs.

The floodplain swamp forests of the Ocklawaha River are dominated by red maple (*Acer rubrum*), bald cypress (*Taxodium distichum*), swamp tupelo (*Nyssa sylvatica* var. *biflora*), and pumpkin ash (*Fraxinus profunda*). Common subdominants are dahoon holly (*Ilex cassine*) and swamp dogwood (*Cornus foemina*). Shrubs include Virginia willow (*Itea virginica*), laurel oak (*Quercus laurifolia*), and buttonbush (*Cephalanthus occidentalis*) (Davis 1990, this study 1994). Ground cover species include lizard's tail (*Saururus cernuus*), saw palmetto (*Serenoa repens*), Southern shield fern (*Thylepteris kunthii*), and poison ivy (*Toxicodendron radicans*). Floodplain swamp forests are considered very productive systems. Nutrients are provided from flood waters, taken up by plants, and later exposed to downstream areas as detritus.

Hydric hammock forests occur in areas where the elevation is slightly higher than in the floodplain swamp. They are not regularly flooded on an annual basis but are sometimes inundated during flooding events. Hydric hammocks are found along the Ocklawaha River upstream of Eureka near Gores Landing and along the northern shore of Rodman Reservoir in the Kenwood Bay area. The soil in the hydric hammocks near Gores Landing and within Kenwood Bay is the poorly drained Holopaw sand. These hydric hammocks are vegetated by cabbage palm, sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), slash pine (*Pinus elliottii*), swamp chestnut oak (*Quercus michauxii*), water oak (*Quercus nigra*), and Southern magnolia (*Magnolia grandiflora*). Other than these two areas and a number of smaller patches along tributaries, the amount of hydric hammock in the Ocklawaha floodplain is limited to narrow bands between the floodplain swamp and uplands.

Another important community occurring within the Ocklawaha River floodplain is the Atlantic white cedar swamp along Deep Creek. The southern range of Atlantic white cedar occurs in north-central Florida, and the community along Deep Creek represents one of the few such communities in peninsula Florida. Other tree species found among the Atlantic white cedars are red maple, tag alder (*Alnus serrulata*), swamp dogwood, ash species, sweet bay (*Magnolia virginiana*), swamp tupelo, and bald cypress. Several uncommon plants are found in this community including Florida willow (*Salix floridana*), variable leaf Indian plantain (*Arnoglossum diversifolium*), grass of parnassus (*Parnassia grandifolia*), and Chapman's edge (*Carex chapmanii*).

4.17.4 Historic Cover Types Within the Rodman Reservoir

The area currently inundated by the reservoir was primarily floodplain swamp within the Ocklawaha River floodplain. The major canopy trees of the Ocklawaha floodplain swamp were pumpkin ash (*Fraxinus profunda*), Carolina ash (*Fraxinus caroliniana*), bald cypress (*Taxodium distichum*), red maple (*Acer rubrum*), and swamp tupelo (*Nyssa sylvatica* var. *biflora*).

A small amount of hydric hammock also occurred in the floodplain. It was a forested community dominated by a mixture of cabbage palm (*Sabal palmetto*), broadleaved evergreens such as loblolly bay (*Gordonia lasianthus*), sweetbay (*Magnolia virginiana*), and red bay (*Persea palustris*), and deciduous tree species such as ash, red maple, and cypress. Some pine flatwood depressions were inundated by the impoundment of the reservoir. Very small sections of uplands were also inundated by the reservoir in areas that now mark the margins of the reservoir, primarily in the Rodman Recreation Area and along the eastern edge of Deep Creek.

For the SJRWMD study, the Soil Conservation Service's (SCS) 1943 series black and white aerial photos (1:24,000) were interpreted to determine the historical vegetation of the area now occupied by Rodman Reservoir. Interpretations were digitized and entered into SJRWMD's geographic information system (GIS) database. Vegetation maps were produced on a scale of 1:24,000. The pre-reservoir vegetation communities are outlined in Figure 4-7. The area currently inundated by the reservoir was primarily hardwood swamp within the Ocklawaha River floodplain and is referred to here as floodplain swamp. The major canopy trees of the Ocklawaha floodplain swamp were pumpkin ash (*Fraxinus profunda*), Carolina ash (*Fraxinus caroliniana*), bald cypress (*Taxodium distichum*), red maple (*Acer rubrum*), and swamp tupelo (*Nyssa sylvatica* var. *biflora*). Important understory species were button bush (*Cephalanthus occidentalis*), dahoon holly (*Ilex cassine*), wax myrtle (*Myrica cerifera*), and ironwood (*Carpinus caroliniana*).

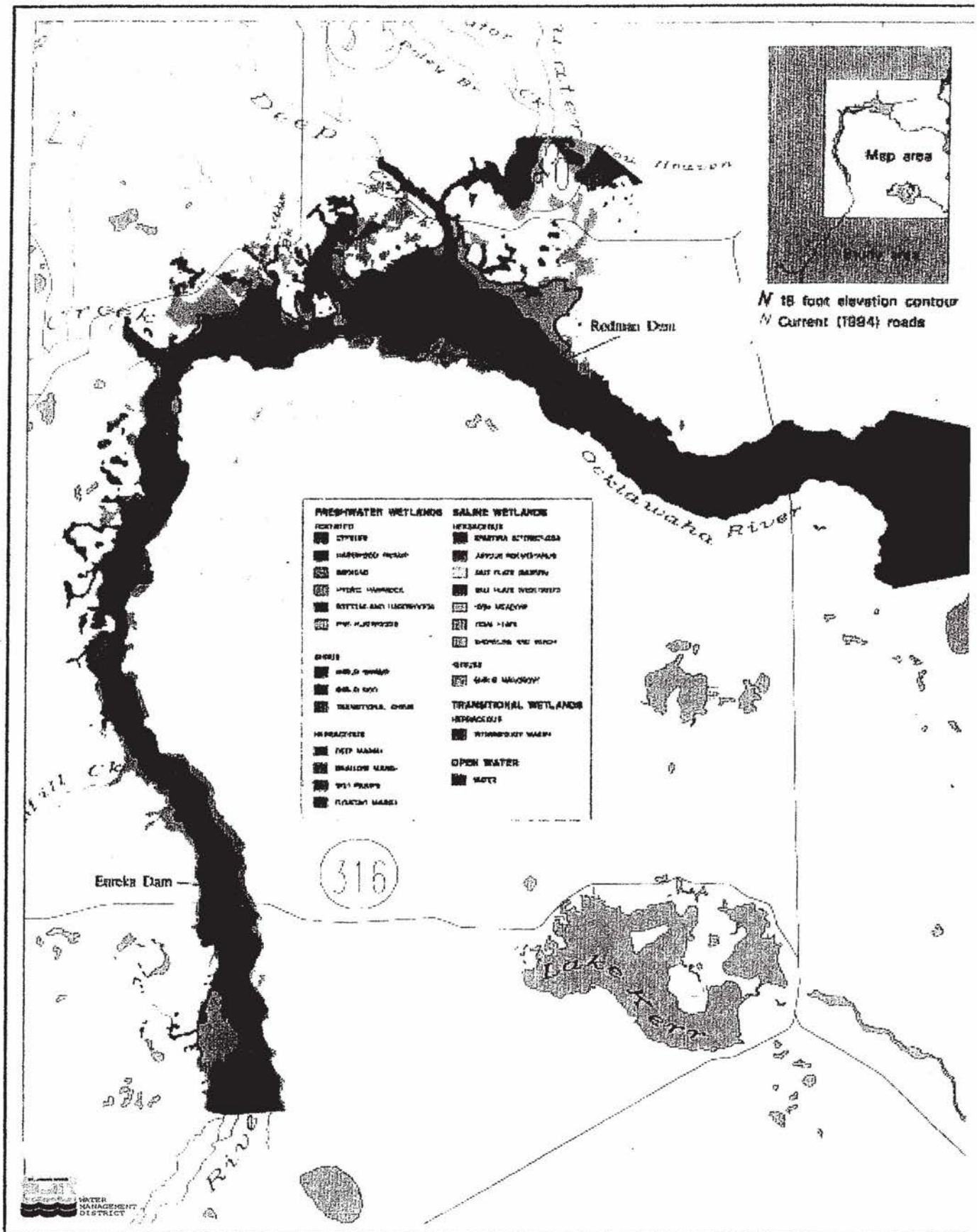
Photo interpretation of the small sections of uplands inundated by the reservoir indicates that these uplands were primarily pine-dominated forests. Many of these uplands were clear-cut areas with a few standing pines when the 1943 photos were taken. Some of the uplands appeared to include oak communities. It is not possible to determine the species of pine or the exact habitat type from the black and white aerial photography. Before Rodman Reservoir was created, several springs existed between Eureka and Kirkpatrick Dam. At the time of Elizabeth Abbott's research (discussed in Section 4.9), some of the higher springs were altered but still present, and the lower springs were flooded as a result of the dam (Table 4-10).

The largest spring in the area was known as Blue Spring. Abbott (1971) described the spring as outlined by dead cypress trees on one side and hardwood hammock trees on the other side. Indian Creek was the spring run from Blue Spring to the Ocklawaha River. The river was also fed by another small spring coming out from the foot of the bluff on the southern side of the reservoir (Abbott 1971). On October 8, 1935, the discharge of Blue Spring was 10.6 cfs. During high water periods, backwater cut off the flow from the spring (Florida Bureau of Geology 1977).

Several springs have been observed within the reservoir during past drawdowns. Robert Andry, owner of a lakefront home on Rodman Reservoir, located a spring on the southern edge of the

reservoir between Blue Spring and Sim's Spring during a past drawdown. This spring is visible in the 1943 aerial photos and is indicated in Figure 4-4 by an asterisk (*). The USACOE attempted to run a pipe into Bright Angel Spring along the northern edge of the reservoir just east of Kenwood Campground to be used as water for the campground, but they were unsuccessful. Sim's Spring is protected by a coffer dam and is located on the edge of the reservoir at the base of a bluff across from Kenwood boat landing. There currently is a campground on the bluff, but in the past there was an orange grove on the bluff. Water from the spring was pumped to the top of the bluff to provide irrigation for the grove.

Several local individuals spoke of Cannon Springs, located toward Eureka on the eastern side of the river. The main pool area of Cannon Springs is now inundated by the reservoir. The pool area of the spring is approximately 98.4 feet in diameter along the edge of an upland community in the Ocala National Forest. A spring run heads to the north and joins the Ocklawaha River.



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Historical Wetland Vegetation of the Study Area (1943)

FIGURE 4-7

Table 4-10

Historical Springs from the Ocklawaha River between Eureka and Rodman Dam

No.	Name	Approximate Dimensions	Run	Comments
1	Blue Spring (v)	200' wide by 350' long, 22' deep	5 miles long, 40' wide, 6' deep	Largest spring
2	Bright Angel Spring	Round pool, 30' diam., 25' deep	2 runs, 8' wide and 2' deep; 1 into river and 1 into Horseshoe Creek	-
3	Catfish Spring	Round pool, 50' diam.	100' long, 30' wide	Large volume, turbulent flow
4	Cedar Landing Spring	Round pool, 8' diam.	150' long	Small spring
5	Unknown Name	No pool, just orifice	No run	On edge of river
6	Unknown Name	Cluster of several boils in rocky confluence	No run	-
7	Sim's Spring (v)	No pool, flows out of cliff face	No run	Protected by coffer dam
8	Unknown Name	No dimensions	No data	Strong flow
9	Bud Spring	Round pool, 35' diam.	650' long; 50' wide, 3' deep	Shallow run
10	Mullet Cove Spring	2 small boils	No data	-
11	Indian Bluff Spring	No data	No data	Clear water flowing out of swamp
12	Unknown Name	No data	No data	Small
13 thru 18	Cannon Springs (v)*	At least 3 large springs and 3 small springs; one was round pool, 50' diam.	200', in slough	At least 3 large and 3 small springs
19	Unknown Name	No data	No data	-
20	Dudley Spring	No data	No data	-

Adapted from Abbott (1971)
v = verified by literature, spring observation, local interviews, or aerial photos.
* = only one pool area observed and known to exist by adjacent landowner by may include serveral boils.
Two additional springs were found using historical aerial photos from 1943.

4.18 Management

4.18.1 Aquatic Plants

Currently Rodman Reservoir is maintained at 18 feet NGVD and is approximately 9,600 acres in size. If past management practices continue, aquatic plant communities will likely continue to fluctuate as they have for the past 25 years and cover more than 60 percent of the reservoir. Discharge rates of over 1,600 cfs are predicted for this alternative (Rao et al. 1994), which does not make it cost effective to use fluridone to control hydrilla except in protected cove areas of the reservoir. In these protected areas, flow rates may be low enough to use fluridone or other herbicides to control hydrilla.

With a drawdown every 3 years (Haller and Shireman 1984), aquatic plant management costs for this alternative will probably range from the 22-year average of $14,000 per year (when only floating plants are treated) to approximately $270,000 per year (when hydrilla is treated). Without drawdown as a management tool, the cost will probably range from approximately $75,000 to $270,000 per year due to increased management of floating plants and hydrilla.

4.18.2 Wildlife

Under existing conditions, active fisheries and wildlife management of the Rodman Reservoir are not practiced. This does not preclude more active management in the future if adequate funding is available. Management of fisheries may include stocking of fish and hunting activities may be more actively managed as well.

4.18.3 Buckman Lock

Although existing management is limited to aquatic plant control, future management of the area will depend on the alternative chosen and will be modified to meet changing needs. An option under this alternative may include increased management to enhance fisheries and/or wildlife with limited removal and/or alteration of structures and (Appendix E), including operation or closure of the Buckman Lock. Under existing conditions, the lock is open and functional. The role of the lock in navigation from the St. Johns River to the Ocklawaha River has been previously discussed. Because of navigation concerns, the Buckman lock will most likely remain operational. If not, management strategies designed to take into consideration the effects of the non-operational lock will be necessary. The effects of the lock on manatees have also been described. Closure of the lock would eliminate manatee deaths associated with it.

4.19 Land Use

Under existing conditions, lands to the south of the project are almost entirely in public ownership (U.S. Forest Service). To the north side of the reservoir and around Deep Creek, lands include both State-owned and Conservation and Recreation Lands (CARL) lands. These two land types make up

the majority of land use in the project area and include predominantly open water, vegetated wetlands, and wetland hardwood forest (Figure 4-8). There are approximately 600 acres of submerged national forest land under Rodman Reservoir.

Presently, small portions of the area are in private ownership (see Figure 4-9). There are small areas of medium- and low-residential housing adjacent to the project area, located primarily in Hog Valley and near the Eureka Dam. Land use will not change as a result of the full retention alternative. Land uses not associated with natural vegetation or water include low- and medium-residential, recreational, canals and lock structures, some agricultural, and the extractive use associated with the borrow pit at the southeast corner of the reservoir.

4.20 Cultural Resources

Most of the affected environment of the cultural resources is currently unknown because the area of potential effect has never been thoroughly and systematically surveyed and recorded archeological sites have not been actively monitored. At least three archeological sites within the area of potential effect are known to contain or strongly expected to contain Native American human remains. The Native American Graves Protection and Repatriation Act provides legislation to follow for those occurring in federally managed areas and procedures to follow in the case of inadvertent human remains within those areas. Chapter 872, Florida Statutes protects human burials on public and private property.

4.21 Aesthetic Resources

Aesthetic resources is the term used to describe the physical characteristics of a landscape that determine its scenic quality in relevant value to the viewing public. These characteristics are frequently described by using basic design terms, such as form, texture, and pattern, and by actual reference to natural features in the environment (e.g. vegetation, water, ecological, formations, soils) that make up a specific landscape scene as viewed from various perspectives.

The existing resource provides an open water vista and perimeter marshes, as well as attractions such as open water fishing and boating. Rodman Reservoir appears as a large lake interspersed with dead stumps. The fact that the floor of the reservoir consists of dug canals, berms, and crushed trees is not obvious at 18 feet NGVD. The overall visual variety within this landscape is that associated with a lake system, as opposed to a riverine system. The diversity in landscape results from the subtle differences in landscape form, color, and texture. These structures present a modified environment influenced by the works of man.

The landscape of the project area was altered from natural conditions by the reservoir and associated construction activities. Berms, canals, spoil piles, and concrete barriers replaced historic floodplain forest. The landscape will have greater variation due to the edge effect of the lake shoreline, which may encourage the invasion of exotic and nuisance species. Under existing conditions, the existing aesthetic values associated with the reservoir and associated passive recreation areas will not be altered. In addition, the berms, canals, spoil piles, and concrete barriers associated with the reservoir will remain.

4.22 Noise

The vicinity of Rodman Reservoir is rural in character. These areas include agricultural and undeveloped lands with some interspersed rural residential areas. Existing sources of noise are vehicles that travel on SR 19, SR 310, and Kirkpatrick Dam Road and motorized boat traffic on the river and lake. One additional source of noise is the dam, where water exits the reservoir over the dam.

Noise measurements are not available for the project area. Rural, undeveloped sites typically have noise levels of 35 to 55 decibels, while levels associated with transportation average around 70 decibels.

This alternative will have the same noise impacts as the existing study area. Sources of noise include all-terrain vehicles, boats, airboats, agricultural equipment, vehicles traveling along roads, and hunting activities, such as dogs and guns, during season and, of course, the dam itself. Since no construction activities are planned, there will be no noises associated with such activities.

4.23 Air Quality

The project area meets all National Ambient Air Quality Standards (FDEP 1997). The full retention alternative is not expected to cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality.

4.24 Hazardous and Toxic Wastes

Buckman Lock contains a number of potential sources of hazardous and toxic wastes. Asbestos wall panels are installed in machinery buildings at the lock. The panels have been inventoried in an asbestos survey by SJRWMD. The panels are in good condition and pose no significant health hazard at the present time. There are underground storage tanks for petroleum fuels at Buckman Lock. They are in good condition, and all tanks meet State regulations. Herbicides are also stored at the lock. An internal environmental audit performed by the USACOE during December 1991 and January 1992 at Inglis Lock, Dam, and Spillways, Eureka Lock and Dam, Buckman Lock and Dam, and the Silver Springs office building found no significant hazardous and toxic material problems.

4.25 Recreation

Total attendance by visitors to Rodman Reservoir was estimated to be 307,217 total person-days in 1993. This number includes both visitors within the 75-mile radius of Rodman Reservoir and long-distance visitors. Based on the total days multiplied by the appropriate consumer surplus per person per day (CSPPD), the total user value was calculated to be $3,738,831.

The retention of the reservoir will preserve the current water level, except during drawdowns for management purposes. This alternative will maintain existing boat ramps and recreational facilities used by the public. None of the existing recreational facilities are expected to be affected under full retention alternative, leaving existing boat ramps and public recreational facilities available. During drawdowns required for aquatic plant management, most of the existing facilities will not provide access to the reservoir.

Existing recreational facilities for the Rodman Reservoir are listed below.

1. Eureka Dam East - Parking (20 vehicles and boat trailers), boat ramp, portable bathroom

2. Eureka Dam West - Parking (22 vehicles and trailers), boat ramp, trash receptacle, portable bathroom

3. Wards Boat Landing - Primitive boat landing

4. Tobacco Patch Landing - Primitive boat landing

5. Riverside Landing - Primitive boat landing

6. Paynes Landing - Boat ramp

7. Buzzard's Landing - Boat ramp and trash receptacle

8. Boat Ramp - Trash receptacle

9. Orange Springs Boat Ramp - West Side of River - Parking (30 vehicles and trailers), picnic area with four picnic tables, restroom, boat ramp, trash receptacle

10. Kenwood Recreation Area - Parking (75 vehicles and trailers), 16 campsites with tables and grills, picnic area (five tables), boat ramp, trash receptacles, dumpster, two sets of portable restrooms

11. H.H. Buckman Lock Visitors Area - Parking (60 spaces), two residences, restrooms, two picnic tables, dumpster

12. Buckman Lock - South Side Equestrian Trail - Parking (30 vehicles and trailers), hitching posts, restrooms, and trails

13. Rodman Area Campground - Thirty-nine campsites with picnic tables and grills, eight shelters with grills and 13 tables, boat ramp, dumpster, two sets of chemical restrooms, trash receptacles, boardwalk, overlook, trails - 1.3 miles, parking (30 spaces)

14. Kirkpatrick Dam Recreation Area - Two picnic tables, parking (60 vehicles and trailers), bathrooms, trash receptacles, handicapped fishing pier

15. Ocklawaha Area West - Parking (35 vehicles and trailers), restrooms, trash receptacles, dumpster, restrooms, picnic table

16. Orange Springs Boat Landing - East Side of River - Primitive boat landing

17. Cedar Landing - Primitive boat landing.

18. Florida National Scenic Trail.

4.26 Socioeconomic Impact to Putnam and Marion Counties

Based on results of a socioeconomic study (FDEP 1995), and supporting documentation from Bell (1992) and the Putnam County Chamber of Commerce (1992), in Putnam County, 45 employees (0.16 percent of the total work force) are supported within the retail and service industries, while in Marion County, the number of employees is 57 (0.07 percent of the total work force).

Recreational benefits to users of the reservoir are also addressed in this section and were estimated by: (1) collecting data on attendance in 1992, specifically, the number of recreational user days spent at the reservoir and (2) estimating a dollar value for a user day. The data for these estimates were collected by use of a series of telephone and on-site surveys of residents of central Florida and users who specifically use the reservoir. Information was collected on the number of days respondents used the reservoir as it existed at the time of the study 1993-94. Data were also collected on Ocklawaha River use and on visitation to lakes and rivers elsewhere in central Florida. Throughout this discussion, Rodman Reservoir refers to the entire impounded area upstream to Eureka Dam.

In addition, respondents were asked for their likely visitation and use patterns at Rodman under each of the four alternatives. A consumer surplus per-person per day (CS) estimate of recreational value was derived by use of the travel cost method (TCM), which collects survey information on costs incurred in the process of traveling to, and using, recreational resources.

Estimates of total value were derived by multiplying the CS estimates by the number of visitor days reported for each of the four alternatives. The TCM produced a CS valuation of $12.17 which, when applied to the number of estimated visitor days under each of the alternatives, produces total user values.

User value estimates are based on a particular definition of recreational value. While aesthetic, environmental and other considerations surely played a role in individual respondents' decisions regarding travel to the reservoir, the FDEP survey was designed to focus on recreation with regard to lake and river use. As such, the benefit estimates are most likely conservative as indicators of total value.

Estimated expenditures by Putnam and Marion County residents for activities at Rodman Reservoir in 1993 were approximately $323,613 in Putnam County and $940,000 in Marion County, for a total of $1,272,663. When the area surrounding Putnam and Marion Counties is included, estimated direct expenditures by residents in the region for activities at Rodman Reservoir are $3,029,185 in Putnam County and $3,579,167 in Marion County. Estimated expenditures by those users who traveled long distances were $2,844,641 in Putnam County and $2,384,282 in Marion County.

To put these expenditure estimates in some perspective, the total personal income (earnings, dividends, interest, and rental income) in Putnam County in 1992 was $801,739,000, and total taxable sales were $365,558,000. Of these totals, the services and retail trade sectors, which include the business activities that serve users of the Rodman Reservoir, combine for $133,777,000. The retail trade and services sectors had combined earnings of $606,532,000.

Using the export-based method of economic evaluation, visitors to the Rodman Reservoir in its configuration as of 1994 accounted for about $7.5 million in both direct and indirect expenditures. Of the $7.5 million, the $3.32 million that can be attributed to the reservoir accounts for only 0.096 and 0.039 percent of economic base in Putnam and Marion Counties, respectively. This statement should not be taken to mean that the impacts on particular businesses or individuals may not be important or noticeable, only that, when considered as a share of the overall economic activity of the counties (individually, and even more so when the two are combined), expenditures by visitors to Rodman Reservoir are quite small.

In addition to the impacts of restoration on the economics of Putnam and Marion counties, concern was expressed regarding the effect on businesses and activities that rely heavily on the existing reservoir. To investigate these concerns, surveys were sent to members of bass angler clubs, and to fishing guides in the area.

A series of surveys were sent to 25 bass clubs and 568 members in Florida. While the response of the bass club members was low (the response rate was 37.7 percent), the data gathered corresponds to the results of the statistically more reliable telephone survey. The survey of 27 local bass fishing guides was also plagued by a low response rate (6 responses, or 22 percent), but the results indicate a very small portion of the two counties economic activity can be attributed to these activities.

It is important to keep in mind that the area surrounding the existing reservoir is largely rural and undeveloped, very little of it privately owned. There is a bait and tackle shop on CR 310, about 3 miles from the nearest access to the reservoir, and a convenience store on U.S. 19, towards Palatka, about 10 miles away. There are no lodges, restaurants, or other businesses in the immediate area, therefore, there is very little business in the area to be affected.

Recreational benefits, based on 307,217 individual user days, contribute a total of $3.8 million to the service industry in Putnam and Marion counties under the no action/full retention alternative.

A second element associated with the economy is the cost of operating the Buckman Lock. The costs associated with operating the Buckman Lock and Kirkpatrick Dam during fiscal years 1995-1996 and 1996-1997 were $268,911 and $333,437 respectively. (Note: Cost figures include operation, maintenance and salaries. Figures used for FY 1996-1997are projected through end of FY 1997).

4.27 Navigation

Under existing conditions, the Buckman Lock will continue to maintain a navigable waterway between the Rodman Reservoir and the St. Johns River.

4.28 Flood Hazards

Under this alternative, peak discharges for 25- and 100- year return periods at Kirkpatrick Dam were estimated to be about 9 and 21 percent greater when compared to corresponding estimates for Riverside Landing in the natural river channel (based on Federal Emergency Management Agency (FEMA) maps). During storm events, discharges at Kirkpatrick Dam have been higher when

compared with discharges without the dam. Because the reservoir has been maintained at different water levels during different periods, no conclusions can be drawn regarding variation of water levels in the reservoir.

4.29 Water Supply and Conservation

Six of the 79 wells identified in the project connect with the surficial aquifer, while the status of the remaining 24 wells is unknown. Under existing conditions, these wells will not require replacement. The impounded water in the Rodman Reservoir provides recreation and fisheries as opposed to a potable water supply. Any water supply will more likely be obtained from springs that feed the river.

4.30 Energy Needs

As stated in section 3.3.4.13, Energy Needs, energy requirements related to the operation of the Buckman Lock will remain or increase as energy costs increase under the full retention alternative. Utility costs for operation of the Buckman lock were $3,195.43 and $2,063.50, respectively, for fiscal years 94-95 and 95-96. This public interest factor is not affected by this project.

4.31 Safety

Partially and fully submerged logs in the reservoir pose a safety concern. Under this alternative, the number of logs in the reservoir is expected to increase as the stressed trees farther upstream fall and are transported downstream to the reservoir. In addition, the loss this fiscal year (1998) of federal funding for snagging and clearing operations in the Ocklawaha River may further increase future hazards posed by fallen trees.

Safety precautions presently associated with the dam, the lock, and the canal include fences and security and maintenance personnel.

4.32 Food and Fiber Production

This public interest factor is not affected by this project.

4.33 Mineral Needs

This public interest factor is not affected by this project.

4.34 Needs and Welfare of the People

Marion and Putnam Counties' population over 65 years of age are 25.3% and 19.7% of the respective total population compared with the state average of 18.4%. (2000 Florida Statistical Abstract) The projection of black population for Marion and Putnam Counties are 11.5% and 17.4% respectively compared to a state average of 13.9%. The Hispanic population makes up 6.3% of Marion County, 3.8% of Putnam County compared to a state average of 16.3%. The median

household income of Marion County is $26,950 and $24,590 for Putnam County compared to a state average of $29,998. The percent of poor persons in the population of Marion County is 17.3% and for Putnam County is 24.2% compared to a state average of 15.2%. Socioeconomic, recreation, safety, and resource needs are specifically addressed in their respective sections. Health-related issues, such as impacts from hazardous waste or contaminated water, do not exist in the project area and are not addressed.

4.35 Plans and Programs

The Revised Land and Resource Management Plan for the National Forests in Florida (Forest Plan) addresses this proposal in several areas. Page viii of the Forest Plan states "The Forest Service is also committed to work in partnership with the State of Florida in the Ocklawaha River Restoration Project". Forestwide Goals include: "Maintain or, where necessary, restore ecosystem composition, structure, and function within the natural range of variability in all ecosystems..." and "Manage floodplains, groundwater, lakes, riparian areas, springs, streams, and wetlands to protect or enhance their individual values and ecological functions." The national forest land adjacent to the project area is in Management Area 5.1, which are areas of predominately bottomland hardwood and cypress/gum swamps with a management goal of retaining the bottomland hardwood forests with minimum disturbance.

5.0 Environmental Consequences

This section provides an analysis of potentially significant environmental impacts that could result from the implementation of the proposed alternatives considered in this Environmental Impact Statement (EIS). These impacts are based on detailed analyses of the elements considered in the EIS, which are derived from significant issues and concerns identified during the scoping process. The impacts are addressed in terms of the project components and associated impacts.

Examination of recent environmental conditions provides an understanding of the environment being affected in terms of the state of the reservoir and surrounding floodplain as they presently exist and as they would exist under the full and partial retention alternatives. In contrast, historic preconstruction information provides the best description of the river and surrounding floodplain, as they would exist under the partial and full restoration alternatives and supplies data necessary for predicting restoration conditions.

Based on the results of the St. Johns River Water Management District (SJRWMD) document *Environmental Studies Concerning Four Alternatives for Rodman Reservoir and the Lower Ocklawaha River*, differences were well defined when the retention alternatives were compared with the restoration alternatives. There were few distinct differences in environmental impacts when comparing the full restoration alternative to the partial restoration alternative. The differences between the two are attributable to removal and alteration of structures. The following sections provide comparisons of environmental impacts for each of the four alternatives. A summary comparison was presented in Table 3-2.

5.1 Elevations and Bathymetry

While the alternatives were not compared for elevation and bathymetry, results of the SJRWMD study were used in several subsequent studies of river sediments, hydrology, and hydraulics. At its current depth of 18 feet NGVD, the 5,980-acre reservoir has a mean depth of 8.4 feet and a maximum depth of 31 feet.

5.2 River Sediments

As with any naturally free-flowing stream system, there may be sediment deposition along lower velocity portions of the channel. However, any deposition of sands, silts, or organic materials as a result of any of the four alternatives will be negligible (SJRWMD 1994). Minimal erosion is expected for all four alternatives due to the mild slopes and existing land use. Sediments are approximately 80 percent water by volume and cover approximately 90 percent of the reservoir bottom.

5.2.0 Alternative 1: Full Retention

Under existing conditions, the primary cause of sediment transport is the scouring of the river channel during 25-year or stronger storm events, or resuspension of sediments during strong wind events. Channel and sediment stabilizing efforts were described in Table 3-2 under individual construction tasks.

5.2.1 Alternative 2: Partial Retention

Reducing the surface water level will result in deposition of sands and sediments farther downstream. At a pool depth of 14 feet NGVD, deposition will be concentrated in a 4-mile stretch of river centered at the Orange Creek confluence. Similar to the full retention alternative, the primary cause of sediment transport is the scouring of the river channel during 25-year or stronger storm events or resuspension of sediments following strong wind events.

5.2.2 Alternative 3: Partial Restoration (Proposed Action)

Under this alternative, the SJRWMD study made three recommendations intended to alleviate potential sediment deposition problems. These are described below.

1. Water flows be directed into the historic river channel as opposed to the canal.

2. The drawdown occur over several years so that sufficient vegetation and subsequent soil stabilization occurs.

3. Further modeling of river flows include two- and three-dimensional modeling, in contrast with the existing one-dimensional model.

In addition, once the surface water elevation is lowered to the spillway, sediments will be trapped until the newly exposed areas are vegetated and the exposed areas stabilized. The spillway gates can be restricted to prevent the escape of turbid waters during large rain events. Following reservoir basin stabilization, flow velocities can be controlled during dam breach. Turbidity levels are not anticipated to exceed water quality standards. Turbidity levels downstream of the dam will be continually monitored, and remedial actions will be taken in case of unforeseen water quality violations. Erosion controls are presented in detail in Appendix E.

During removal and relocation of sediments, resuspension will occur in the reservoir. Water flow velocities will be controlled by the Kirkpatrick Dam and are not expected to significantly affect sediment transport during the first two phases of restoration activities. Velocities will slow following the initial dam breach and sediments will settle in the tailrace just downstream of the dam.

When the dam is breached during the last phase of restoration, resuspended sediments will be transported through the spillway into the tailrace. These sediments may be transported back through the interconnect canal where the upstream portion of the tailrace is connected to the natural channel. Extensive control measures will be taken to control turbidity and include, but are not limited to, stilt fencing, floating silt screens, turbidity barriers, channel blankets, and geo-tubes. In addition, a suggested water quality monitoring plan is presented in Appendix E, but it is subject to change based on requirements of the permitting agencies.

5.2.3 Alternative 4: Full Restoration

The amount of sediments and turbidity will be greatest under this alternative, although due more to the earth-moving activities associated with removal of all structures, berms and canals than to the breaching of the dam. This effect will be temporary and the measures to alleviate potential sediment deposition listed in Alternative 3 would apply to this alternative.

Effects of breaching the dam would be similar to Alternative 3 and the same erosion control measures will apply to this alternative. Sediment transport and turbidity levels during the phases of restoration would also be the same as Alternative 3

5.3 Topography

Topography was not compared among the four alternatives. The overall topographic study provides a characterization of cross sections of the flooded Ocklawaha River channel, and high-resolution surveys of each cross section are included in the SJRWMD study. Survey results were presented in Figure 4-2.

5.4 Hydrology and Hydraulics

There are distinct differences in hydrology (water flows) and hydraulics (depth stage) comparing the two retention alternatives to the two restoration alternatives. The primary differences are in acreages of floodplain exposed and fluctuations in seasonal water levels. Differences between full retention and partial retention vary according to the surface water stage. Design and construction methodologies are presented in Appendix A.

5.4.0 Alternative 1: Full Retention

Surface water elevation of the reservoir will remain at 18 feet NGVD and average flow velecity at 1,674 cfs. No seasonal water level fluctuations will occur. The existing pool of water will continue to extend 49,000 feet upstream with depths 2.4 – 4 feet greater than historic depths. Approximately 9,600 acres of floodplain forest will remain flooded.

5.4.1 Alternative 2: Partial Retention

Under this alternative, the surface water elevation will be lowered to 4 feet NGVD. Average flow will be 1,687 cfs. There will be no seasonal water fluctuations. Approximately 7,300 acres of floodplain forest will remain flooded.

5.4.2 Alternative 3: Partial Restoration (Proposed Action)

Under this alternative, historic hydrology will be restored. Average flow velecity will be 1,736 cfs (commensurate with historic averages), and there will be seasonal fluctuations in the water level. Nearly 7,300 acres of chronically flooded forest will be restored to historic floodplain forest.

The creation of the Kirkpatrick Dam resulted in the creation of 1,929 acres of new wetlands from historic uplands and conversion of 6,251 acres of historic floodplain swamp to open water/herbaceous wetlands. There was no change to 2,067 acres of historic floodplain swamp. Restoration will restore historic conditions and result in the exposure of 7,300 acres of previously inundated floodplain area and the reduction of the open water and river channel area to 340 acres. There will be no change to 168 acres of existing forested wetlands.

5.4.3 Alternative 4: Full Restoration

As in Alternative 3, the historic hydrology of the river will be restored. Average flow will be 1,736 cfs, and there will be seasonal fluctuations in the water level. Nearly 7.300 acres of floodplain forest will be restored. The area of open water will be reduced to 340 acres. Removal of the structures, berms and canals may affect the hydrology by uncovering some natural springs and restoring connections between them and the river, but this is expected to return the historic hydrologic scheme to its original state.

5.5 Surface Water Quality

5.5.1 Alternative 1: Full Retention

To identify trends in water quality in Rodman Reservoir and the lower Ocklawaha River, over 25 years of historical water quality data were analyzed. Of the parameters examined (DO, biochemical oxygen demand, total phosphorus, and total nitrate + nitrite), only total nitrate + nitrite exhibited a definite trend. Upstream of Eureka Dam and in the transition zone of Rodman Reservoir, concentrations increased over time. Downstream of Kirkpatrick Dam, the dissolved nitrate + nitrite concentrations decreased over time, supporting the observation that the dense hydrilla populations in the lacustrine zone of the reservoir are assimilating the dissolved nitrate + nitrite in plant tissue, which then falls to the reservoir sediments when the plants die.

5.5.1 Alternative 2: Partial Retention

The plant biomass in the reservoir acts as a nutrient sink. With the reservoir intact, nutrients will not be released downstream. Without seasonal water fluctuations, the nutrient and material exchange between open water and forest will be limited. Levels of Dissolved Oxygen (DO), biochemical oxygen demand, total phosphorus, and total nitrate and nitrites are expected to continue present trends. These effects would be similar to Alternative 1.

5.5.2 Alternative 3: Partial Restoration (Proposed Action)

The dam breach would result in some increase in nutrients downstream. River flow through the existing reservoir will transport the nutrients downstream, and nitrogen and phosphorus concentrations are expected to increase by an order of magnitude. This effect would be temporary, lasting for one or two years until the area adjusts to seasonal fluctuations. Over time, water quality would return to pre-construction conditions. Water quality monitoring and control are presented in detail in Appendix E.

5.5.3 Alternative 4: Full Restoration

Effects of this alternative on surface water quality would be the same as in Alternative 3. Nutrient concentrations downstream would increase by an order of magnitude for a temporary period. Once the river is restored to its historic conditions, seasonal fluctuations would regularly flush nutrients through the system Surface water quality may be effected by the removal of structures, berms and canals but this will be temporary, lasting only during the period of the activity itself.

5.6 Floridan and Surficial Aquifers

Three approaches were used to investigate the impact of river restoration and reservoir retention scenarios on the ground water system. It was found that the potential impact of reservoir drawdowns on the Floridan aquifer should be minimal. However, the results of a MODFLOW model and a convolution time series analysis indicate potential effects on water table elevations in the surficial aquifer.

To more accurately quantify these impacts, a surficial aquifer monitoring system and data collection system for the Floridan aquifer water level could be implemented in the study area. Once the appropriate data are collected, a numerical three-dimensional groundwater flow model could be constructed, and the relationship between reservoir water level and the groundwater flow system in the surficial aquifer could then be more accurately predicted.

5.6.0 Alternative 1: Full Retention

The east side of the Ocklawaha River Basin is higher in elevation than the western flatwoods portion. These highlands are generally very permeable and the river provides the major surface drainage for this area. The small limestone springs in this area are generally artesian and they supply the perennial flow of the Ocklawaha River. The underlying water table follows the contour of the land. Where the water table becomes perched over clay lenses the spring may be a gravity flow spring subject to lower flow during droughts. These springs may be altered or even submerged by the impounded river.

A total of 79 wells have been identified in the area. Well depths are known for 55 of the wells, and only six of these wells use the surficial aquifer. The status of the remaining 24 wells is unknown. This alternative will have no significant effect on the Floridan aquifer.

5.6.1 Alternative 2: Partial Retention

With the reservoir reduced to 14 feet NGVD, some springs previously inundated may be exposed. As stated under Alternative 1, a total of 79 wells have been identified in the area. Well depths are known for 55 of the wells, and only six of these wells use the surficial aquifer. The status of the remaining 24 wells is unknown. This alternative would have no effect on the Floridan aquifer.

5.6.2 Alternative 3: Partial Restoration (Proposed Action)

Prior to the creation of Rodman Reservoir, several springs existed between Eureka and Kirkpatrick Dam. Changes in the surficial aquifer under partial restoration may result in an increase in local springs discharges. Locations of the springs were identified in Figure 4-4.

Changes in the groundwater relative to the surface in the immediate vicinity of the river channel and dam are expected under partial restoration where some structural changes, such as the removal of berms or earthen dams, would occur. Many of the previously inundated springs would be exposed, and would continue to augment flow of the Ocklawaha River.

The mitigation cost of replacing surficial wells is estimated to be less than the cost of obtaining more accurate impact predictions through three-dimensional modeling of reservoir water level reductions on the surficial aquifer.

5.6.3 Alternative 4: Full Restoration

Changes in the groundwater relative to the surface in the immediate vicinity of the river channel and dam are expected under partial restoration where structural changes, such as the removal of berms or earthen dams, would occur. Many of the previously inundated springs would be exposed and would continue to augment the flow of the Ocklawaha River. This alternative has the potential to expose more springs that were submerged, altered or blocked during construction of the canals, berms, and other structures.

5.7 Fish Populations

5.7.0 Alternative 1: Full Retention

Forty-two species from 18 families were found during the SJRWMD (1994) fish survey in the Ocklawaha River, compared with 69 freshwater species from 22 families historically found in the St. Johns River basin. The decrease is likely due to the change from a flowing system to the standing reservoir. Data shows that sport fish harvest is negatively correlated with reservoir age, but that reservoir age has no effect on total fish standing stocks (Kimmel and Groeger 1986).

No impacts to existing fish species are predicted for this alternative. Fish species which prefer open water habitat would remain at their current levels. Individual fish biomass is greater in the reservoir when compared with the downstream channel under the existing full retention conditions, although abundance and total biomass are greater downstream of the dam (Figures 5-1 and 5-2) (see section 3.3.2.1 for further information). Individual fish biomass may continue to be greater in the reservoir than in the river upstream and downstream of the dam, and relative abundance of species will continue at present levels. Some migratory fish species may continue to use the lock and move between the upper and lower parts of the river. The distribution of the state-listed bluenose shiner and tesselated darter will remain isolated from the Ocklawaha River channel.

5.7.1 Alternative 2: Partial Retention

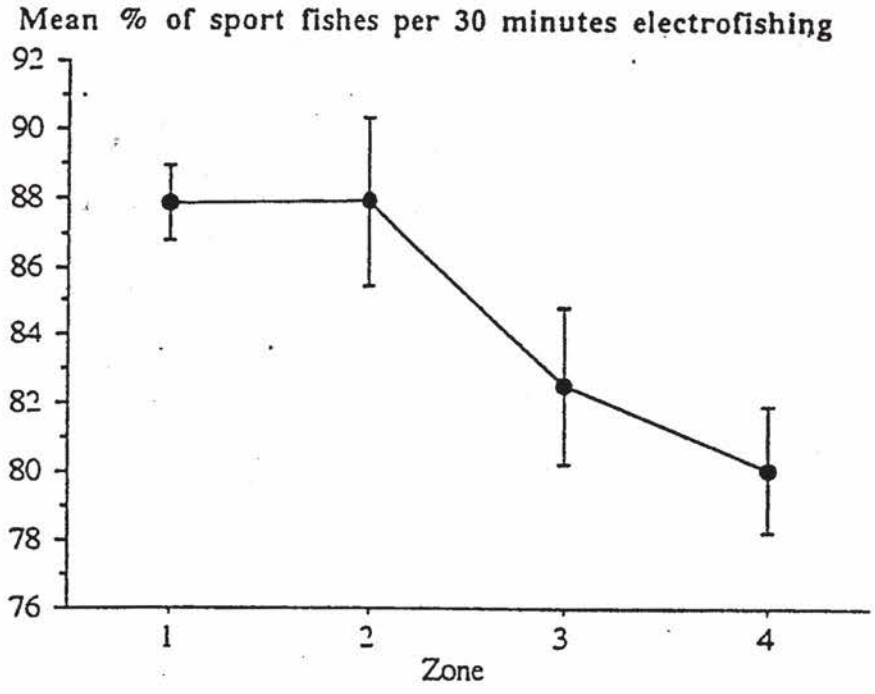
This alternative is similar to Alternative 1 in that existing fish species are predicted to continue at present levels. As with full retention, the distribution of the state-listed bluenose shiner and tessellated darter will remain isolated from the Ocklawaha River channel.

5.7.2 Alternative 3: Partial Restoration (Proposed Action)

There would be a shift in fish species from lotic (lake) species to species characteristic of flowing riverine systems. Although some migratory fish pass through the Buckman Lock, the Kirkpatrick Dam appears to pose a barrier to a variety of migratory fish that historically used the system.

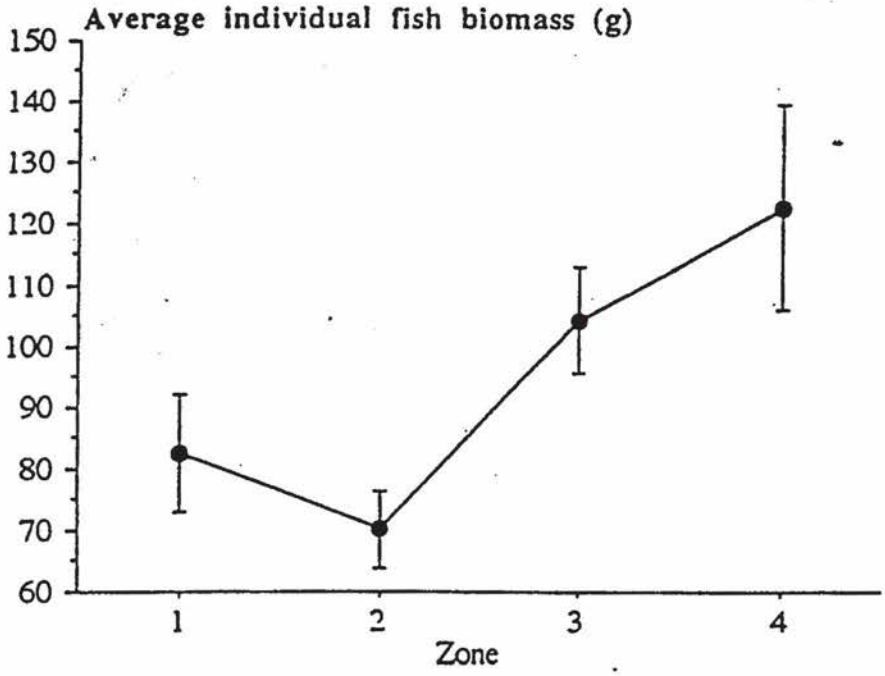
Individual fish biomass is greater in the reservoir when compared with the downstream channel under the existing full retention conditions, although abundance and total biomass are greater downstream of the dam (Figures 5-1 and 5-2) (see section 3.3.2.1 for further information). In general, fish densities are expected to decrease under the partial restoration, although diversity in fish species is not expected to decrease and may increase under the restoration alternatives.

Data from over 100 U.S. reservoirs show that sport fish harvest is negatively correlated with reservoir age, but that reservoir age has no effect on total fish standing stocks (Kimmel and Groeger 1986). With the loss of the reservoir, sport fisheries production is not expected to continue at the present level.



Note: Fishes collected at four zones in the Ocklawaha River. Zone 1 is farthest upstream, and Zone 4 is below Rodman Dam.
Source: J. Estes, FGFWFC.

ORIDA	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	RELATIVE ABUNDANCE OF SPORT FISHES COLLECTED BY ELECTROFISHING	FIGURE 5-1



Note: Fishes collected at four zones in the Ocklawaha River. Zone 1 is farthest upstream, and Zone 4 is below Rodman Dam.
Source: J. Estes, FGFWFC.

FLORIDA	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	AVERAGE INDIVIDUAL SIZE OF FISHES COLLECTED BY ELECTROFISHING	FIGURE 5-2

5.7.3 Alternative 4: Full Restoration

There would be a shift in fish species from lotic (lake) species to species characteristic of flowing riverine systems. Although some migratory fish pass through the Buckman Lock, the Kirkpatrick Dam appears to pose a barrier to a variety of migratory fish that historically used the system. Restoring the river would permit migratory fish species access to the entire river. In general, fish densities are expected to decrease under restoration, perhaps presenting more of a challenge to those practicing their fishing skills, although diversity in fish species may increase. As in Alternative 3, total fish biomass may be greater after restoration as compared with the existing fish biomass in the reservoir. With the loss of the reservoir, sport fisheries production is not expected to continue at the present level.

5.8 Bird Populations

Based on a 7-month survey and historic data, differences in bird populations are expected between the two retention alternatives and the two restoration alternatives. The differences are related primarily to habitat use by wading birds and forest-nesting species. Few differences are expected between partial and full retention alternatives or partial and full restoration alternatives. While some species may lose nesting habitat under one alternative, they may gain foraging or rookery habitat, and vice versa.

5.8.0 Alternative 1: Full Retention

The existing reservoir and associated habitat provide diversity in bird habitat. Habitat is primarily aquatic, but includes some marsh and standing dead trees as well as a small floodplain forest around the reservoir. This provides habitat for wading birds as well as some forest species. During spring and summer, birds of 79 species have been observed. The most abundant, coot, was observed in six types of habitat. The most widespread are the common moorhen and the anhinga, found in 11 of the 15 habitat types in the area. Because of the sparseness of trees, there are few nesting sites for ospreys, double-crested cormorants, great blue herons, and limpkins.

With the retention of Kirkpatrick Dam, it is likely that those species which prefer an open water environment, floating and mixed marsh habitat, and dead standing trees in open water will continue to be the most prevalent species, such as American coot, anhingas, boat-tailed grackles, and wading birds. Birds characteristic of floodplain forest and forest edge, such as warblers, vireos, wrens, cardinals, owls, woodpeckers and hawks, will be found in the smaller area of floodplain forest around the reservoir and at the forest edge.

5.8.1 Alternative 2: Partial Retention

At 14 feet NGVD, there would be a net increase in marsh habitat, which would enhance marsh-dwelling and foraging species populations. There would also be a small increase in the amount of floodplain forest, with a corresponding small increase in those species associated with that habitat. For the majority of the project area, the effects of the reservoir on birds species would be the same as Alternative 1, i.e., the characteristic species of the area would be those preferring open water and marsh habitat, such as herons, egrets, ospreys, ducks and rails.

5.8.2 Alternative 3: Partial Restoration (Proposed Action)

Under the partial restoration alternative, aquatic habitats would be replaced by shrub swamp and then floodplain swamp. There would, however, be an increase in floodplain-riverine edge available for foraging as a result of the change from the reservoir to a meandering river channel under partial restoration.

For colonial wading birds there would be a net loss in marsh foraging habitat but a net increase in roosting and nesting habitat. As a result, species that use open-water and marsh habitat, including herons, egrets, ospreys, ducks, and rails, may be impacted in terms of foraging. Limpkins, for example, would lose the foraging habitat associated with standing dead cypress, but would have more riverine edge for foraging.

As with other wildlife, a shift in bird species from those species associated with floating and mixed marsh and dead trees with open water to species more characteristic of floodplain forests and swamps is expected under the partial restoration alternative. Forest species, such as warblers, vireos, wrens, cardinals, and owls, will increase as forested floodplain increases.

A listing of bird species for each habitat type in the project area is presented in Table 5-1. A shift is expected from species such as American coots, anhingas, boat-tailed grackles, and several wading birds to woodpeckers, warblers, hawks, owls, wrens and other species associated with the forest and forest edges. Impacts to threatened and endangered species are discussed in section 5.12. While habitat for some species would change locally, regional habitat would continue to provide areas of relocation for species which move under the partial restoration alternative.

No threatened or endangered bird species are likely to be adversely affected by this alternative, although four species of special concern, including three species of herons and the limpkin, may be impacted due to changes in habitat (see Section 5.12 for a further discussion).

Table 5-1

Bird Species Found in the Fifteen Habitat Types in Order of Relative Abundance[1]

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Mixed Marsh (MM) 5 plots winter 8 plots spring/summer	American coot (90.84)	3	Common moorhen (9.92)	8
	Common moorhen (26.00)	5	Red-winged blackbird (2.99)	5
	Tree swallow (6.18)	3	Boat-tailed grackle (2.82)	7
	Ring-necked duck (4.90)	3	Wood duck (1.74)	2
	Red-winged blackbird (1.39)	3	American coot (1.64)	4
	Common yellowthroat (1.35)	1	Purple martin (0.90)	1
	Pied-billed grebe (1.23)	2	Pied-billed grebe (0.80)	4
	Little blue heron (0.56)	1	Little blue heron (0.77)	3
	Tricolored heron (0.45)	1	Anhinga (0.54)	3
	Palm warbler (0.26)	1	Spotted sandpiper (0.45)	1
	Anhinga (0.19)	1	Least bittern (0.38)	2
			Green-backed heron (0.31)	3
			Great blue heron (0.19)	1
			Tricolored heron (0.06)	1
Free Floating Marsh (FF) 6 plots winter 8 plots spring/summer	American coot (29.85)	6	Common moorhen (14.61)	8
	Common moorhen (17.90)	6	Boat-tailed grackle (6.60)	7
	Tree swallow (13.61)	1	Red-winged blackbird (4.52)	8
	Boat-tailed grackle (4.30)	6	Purple gallinule (1.19)	4
	Snowy egret (1.77)	5	Least bittern (0.93)	5
	Little blue heron (1.21)	4	Tricolored heron (0.64)	4
	Anhinga (1.01)	2	Great blue heron (0.46)	3
	Red-winged blackbird (0.83)	3	Wood duck (0.42)	2
	Glossy ibis (0.73)	4	Snowy egret (0.35)	2
	Pied-billed grebe (0.73)	4	Green-backed heron (0.34)	2
	Whit ibis (0.71)	3	Anhinga (0.33)	2
	Great egret (0.71)	2	Great egret (0.24)	2
	Tricolored heron (0.56)	2	Little blue heron (0.21)	2
	Great Blue heron (0.38)	2	American coot (0.20)	1

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Dead Trees with Open Water (DO) 6 plots	Pied-billed grebe (8.79)	5	Red-winged blackbird (4.58)	5
	Anhinga (5.53)	5	Purple martin (2.99)	5
	Boat-tailed grackle (4.05)	5	Boat-tailed grackle (2.92)	5
	Double-crested cormorant (3.98)	5	Anhinga (2.59)	5
	Tree swallow (2.90)	1	Osprey (2.29)	5
	Common moorhen (2.45)	2	Double-crested cormorant (1.78)	5
	Osprey (2.18)	4	Wood duck (1.41)	5
	Red-winged blackbird (1.50)	5	Common grackle (1.38)	4
	European starling (1.10)	1	European starling (0.62)	3
	Fish crow (0.91)	1	Eastern kingbird (0.58)	2
	Purple martin (0.55)	2	Red-bellied woodpecker (0.41)	3
	Ring-billed gull (0.42)	3	Common moorhen (0.29)	1
	Great egret (0.37)	1	Fish crow (0.26)	2
	Belted kingfisher (0.36)	2		
	Bald eagle (0.20)	1		
Dead Trees with Aquatic Vegetation (DA) 6 plots	Tree swallow (110.56)	3	Boat-tailed grackle (9.21)	6
	Common moorhen (18.56)	6	Common moorhen (8.07)	6
	Boat-tailed grackle (10.59)	6	Red-winged Blackbird (7.68)	6
	White ibis (6.49)	6	Double-crested Cormorant (3.64)	2
	Snow egret (4.06)	6	Osprey (2.36)	4
	Tricolored heron (3.67)	6	Anhinga (1.91)	5
	Anhinga (2.87)	5	Eastern kingbird (1.75)	3
	Little blue heron (2.45)	5	Common grackle (1.39)	4
	Glossy ibis (2.45)	5	Great egret (1.33)	4
	Red-winged blackbird (2.45)	4	Green-backed heron (1.14)	3
	Great blue heron (2.09)	5	Tricolored heron (1.13)	4
	Osprey (2.07)	6	Great blue heron (0.89)	2
	Fish Crow (1.34)	3	Purple martin (0.72)	3
	Pied-billed grebe (1.29)	3	Wood duck (0.69)	2
	Common grackle (1.15)	3	Snowy egret (0.60)	3
	Double-crested cormorant (1.06)	1	Least bittern (0.52)	2
	Green-backed heron (0.97)	3	Purple gallinule (0.42)	3
	Black-crowned night-heron (0.62)	2	Red-bellied woodpecker (0.34)	1
	Limpkin (0.55)	2	Black-crowned night-heron (0.22)	1
	Great Egret (0.48)	2	Little blue heron (0.16)	1
	Red-Shouldered Hawk (0.45)	2		
	Ring-billed gull (0.45)	2		
	Belted kingfisher (0.43)	2		

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Stressed Cypress (SC) 6 plots	Common grackle (49.84)	5	Boat-tailed grackle (6.76)	4
	Red-winged blackbird (23.72)	3	Anhinga (3.22)	6
	Tree swallow (7.45)	5	Common grackle (2.87)	3
	Yellow-rumped warbler (7.27)	5	Turkey vulture (1.50)	1
	White ibis (3.33)	5	Common moorhen (1.40)	3
	Anhinga (2.44)	6	Red-winged blackbird (1.15)	3
	Boat-tailed grackle (2.07)	3	Osprey (1.07)	3
	Black-crowned night heron (1.23)	2	Yellow-throated warbler (1.04)	4
	Great egret (1.19)	3	Limpkin (0.98)	4
	Common yellowthroat (1.16)	4	Fish crow (0.96)	3
	Northern flicker (0.91)	3	Red-bellied woodpecker (0.77)	2
	Limpkin (0.83)	3	Black vulture (0.75)	1
	Palm warbler (0.66)	2	Tricolored heron (0.64)	3
	Yellow-throated Warbler (0.62)	2	Red-headed woodpecker	1
	Red-bellied woodpecker (0.50)	3	White ibis (0.47)	2
	Common moorhen (0.49)	3	Black-crowned heron (0.47)	2
	Eastern phoebe (0.40)	2	Great egret (0.44)	3
	Swamp sparrow (0.37)	1	Red-shouldered hawk (0.40)	3
	Red-headed woodpecker (0.36)	1	Carolina wren (0.35)	2
	Red-shouldered hawk (0.36)	1	Great crested flycatcher (0.31)	2
	Osprey (0.33)	2	Northern parula (0.26)	2
	Tricolored heron (0.32)	2	Wood duck (0.25)	1
	Pileated woodpecker (0.28)	2	Common yellowthroat (0.23)	2
	Little blue heron (0.22)	1	Little blue heron (0.17)	1
	Black vulture (0.15)	1		
Floodplain Swamp in Rodman Reservoir (FR) 6 plots winter 8 plots spring/summer	Yellow-rumped warbler (13.23)	5	Prothonotary warbler (1.68)	6
	Northern parula (3.80)	6	Red-eyed viero (1.68)	8
	Tufted titmouse (1.99)	2	Northern parula (1.41)	7
	Red-bellied woodpecker (1.63)	4	Red-bellied woodpecker (1.06)	4
	Carolina wren (1.45)	4	White ibis (0.44)	2
	Common grackle (1.45)	1	Downy woodpecker (0.44)	3
	Red-winged blackbird (1.09)	1	Tufted titmouse (0.35)	2
	Yellow-throated warbler (0.91)	1	Northern cardinal (0.35)	2
	Pine warbler (0.73)	1	Pileated woodpecker (0.27)	1
	Yellow-bellied sapsucker (0.54)	3	Common grackle (0.27)	1
	Downy woodpecker (0.54)	2	Am. swallow-tailed kite (0.18)	1
	Northern cardinal (0.54)	2	Fish crow (0.18)	1
	Red-shouldered hawk (0.36)	1		

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Floodplain Swamp in Rodman Reservoir (FR) (continued) 6 plots winter 8 plots spring/summer	Pileated woodpecker (0.36) Eastern phoebe (0.36) Ruby-crowned kinglet (0.36) Solitary Viero (0.36)	1 2 1 2		
River Edge in Rodman Reservoir (RR) 6 plots winter 8 plots spring/summer)	Yellow-rumped warbler (6.25) Northern parula (1.67) White ibis (0.63) Red-bellied woodpecker (0.52) Purple martin (0.52) Northern cardinal (0.52) Black-and-white warbler (0.44) Yellow-throated warbler (0.42) Wood duck (0.31) Red-shouldered hawk (0.31) Limpkin (0.31) Tufted titmouse (0.31) Blue-gray gnatcatcher (0.31) Anhinga (0.21) Barred owl (0.21) Belted kingfisher (0.21) Yellow-bellied sapsucker (0.21) Eastern phoebe (0.21) Carolina wren (0.21) Common yellowthroat (0.21) Downy woodpecker (0.10) Ruby-crowned kinglet (0.10)	6 5 3 1 1 3 1 1 2 2 2 3 2 1 1 2 1 2 1 2 2 1	Prothonotary warbler (1.50) Northern parula (1.25) White ibis (0.94) Red-eyed vireo (0.94) Red-bellied woodpecker (0.75) Tufted titmouse (0.50) Blue-gray gnatcatcher (0.44) Carolina wren (0.38) Yellow-crowned night heron (0.31) Common grackle (0.31) Carolina chickadee (0.31) Northern cardinal (0.25) Little blue heron (0.19) Downy woodpecker (0.19) Great crested flycatcher (0.19) Yellow-throated vireo (0.19) Great blue heron (0.13) Wood duck (0.13) Limpkin (0.13) Mourning dove (0.13) Ruby-throated hummingbird (0.13) Pileated woodpecker (0.13) Acadian flycatcher (0.13) Anhinga (0.06)	6 8 5 5 7 5 4 4 4 1 1 1 2 3 1 2 1 1 2 2 2 1 2 1

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Open Water (OW) 6 plots winter 8 plots spring/summer	American coot (152.82)	2	Common Moorhen (0.59)	2
	Pied-billed grebe (3.73)	6	Pied-billed grebe (0.44)	4
	Double-crested cormorant (0.45)	3	Purple martin (0.29)	4
	Ring-necked duck (0.43)	1	Anhinga (0.28)	3
	Common moorhen (0.35)	2	Boat-tailed Grackle (0.28)	5
	Ring-billed gull (0.34)	2	Double-crested cormorant (0.25)	4
	Tree swallow (0.31)	1	Black tern (0.14)	1
	Anhinga (0.25)	2	Osprey (0.12)	2
	Wood duck (0.24)	1	Spotted sandpipe (0.09)	2
			Wood duck (0.09)	1
			Tree swallow (0.07)	2
			American coot (0.06)	1
Berms (BR) __ plots	Yellow-rumped warbler (34.17)	6	Fish crow (5.33)	3
	White ibis (4.03)	2	Boat-tailed grackle (4.11)	5
	Common moorhen (3.89)	5	Common moorhen (3.78)	6
	Common yellowthroat (2.92)	5	Red-winged blackbird (3.00)	5
	Common grackle (2.92)	2	Cattle egret (1.56)	1
	Blue-gray gnatcatcher (2.50)	5	Yellow-crowned night heron (1.33)	2
	Gray catbird (2.36)	4	Northern cardinal (1.11)	4
	Palm warbler (1.81)	5	Limpkin (1.00)	2
	Red-winged blackbird (1.39)	4	Green-backed heron (0.89)	3
	Tree swallow (1.11)	2	Tricolored heron (0.70)	3
	Anhinga (0.97)	4	Anhinga (0.67)	4
	Boat-tailed grackle (0.97)	4	Eastern kingbird (0.45)	1
	Ruby-crowned kinglet (0.69)	4	Carolina wren (0.45)	3
	Red-shouldered hawk (0.56)	3	Common grackle (0.45)	3
	Eastern phoebe (0.56)	3	Yellow-rumped warbler (0.44)	2
	Blue jay (0.56)	2	Little blue heron (0.33)	2
	Northern cardinal (0.56)	3	Blue jay (0.33)	2
	Limpkin (0.42)	1	Yellow-throated warbler (0.30)	1
	Red-bellied woodpecker (0.42)	1	White ibis (0.22)	2
	White-eyed vireo (0.42)	3	Red-shouldered hawk (0.22)	2
	Orange-crowned warbler (0.42)	2	Red-bellied woodpecker (0.22)	2
	Swamp swallow (0.42)	1	Barn Swallow (0.22)	1
	Great blue heron (0.28)	1	Osprey (0.11)	1
	Great egret (0.28)	2	Gray Catbird (0.11)	1
	Carolina wren (0.28)	1		
	Little blue heron (0.14)	1		

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Berms (BR) (continued) __ plots	Tricolored heron (0.14) Osprey (0.14)	1 1		
Edges of Rodman Reservoir (OE) 8 plots	Common moorhen (15.83) Yellow-rumped warbler (15.73) Boat-tailed grackle (3.23) Blue-gray gnatcatcher (2.29) Ruby-crowned kinglet (1.04) Gray catbird (1.04) Common yellowthroat (1.01) Red-winged blackbird (0.80) Swamp sparrow (0.66) American coot (0.63) White-eyed vireo (0.59) Snowy egret (0.52) Blue-winged teal (0.52) Anhinga (0.42) Little blue heron (0.31) Ring-necked duck (0.31) Great blue heron (0.28) Pied-billed grebe (0.21) Great egret (0.21) Bald eagle (0.21) Limpkin (0.21) Blue jay (0.21) Tufted titmouse (0.21) Pine warbler (0.21) Northern cardinal (0.21) Rufous sided towhee (0.21) Osprey (0.17) Tricolored heron (0.10)	4 6 3 2 1 3 4 3 2 3 4 2 1 2 2 1 3 1 3 1 2 2 1 1 2 1 1 1	Common moorhen (4.88) Boat-tailed grackle (2.67) Red-winged blackbird (2.35) Fish crow (0.85) Wood duck (0.75) Tufted titmouse (0.50) White-eyed vireo (0.48) Northern cardinal (0.44) Common yellowthroat (0.40) Chimney swift (0.38) Great blue heron (0.33) Limpkin (0.31) Great egret (0.27) Red-eyed vireo (0.25) Tricolored heron (0.23) Green heron (0.21) Least bittern (0.19) Carolina Wren (0.19) Yellow-throated warbler (0.19) Anhinga (0.13) Snow egret (0.13) Osprey (0.13) Pileated woodpecker (0.13) Great crested flycatcher (0.13) Barn swallow (0.13) Blue-gray gnatcatcher (0.13) Northern parula (0.13) Common grackle (0.13) Little blue heron (0.10) Mourning dove (0.08)	6 7 6 7 2 4 4 3 4 1 2 2 3 2 4 5 1 3 1 2 1 1 1 2 1 1 2 2 2 1

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Shallow Marsh (SM) 6 plots winter 8 plots spring/summer	Common moorhen (14.11)	5	Boat-tailed grackle (9.67)	8
	Tree swallow (13.01)	4	Common moorehead (6.21)	6
	Red-winged blackbird (2.76)	6	Red-winged blackbird (5.69)	8
	Common yellowthroat (2.58)	3	Least bittern (2.37)	3
	Boat-tailed grackle (1.08)	3	purple gallinule (0.65)	1
	Marsh wren (0.79)	3	Marsh wren (0.45)	3
	Swamp sparrow (0.36)	2	Swamp sparrow (0.30)	1
Floodplain Swamp of the Natural Ocklawaha River (OF) 6 plots winter 8 plots spring/summer	Red-bellied woodpecker (2.06)	6	Red-eyed vireo (2.30)	7
	Yellow-rumped warbler (1.91)	3	Carolina wren (2.12)	7
	Northern parula (1.33)	3	Northern parula (1.41)	6
	Yellow-bellied sapsucker (1.03)	4	Tufted titmouse (0.97)	3
	Carolina wren (0.88)	3	Red-bellied woodpecker (0.88)	5
	Common grackle (0.88)	1	Acadian flycatcher (0.44)	3
	Tufted titmouse (0.59)	2	Downy woodpecker (0.35)	2
	Pine warbler (0.59)	1	Yellow-throated vireo (0.18)	2
	Red-shouldered hawk (0.44)	2		
	Downy woodpecker (0.44)	4		
	Eastern Phoebe (0.44)	2		
	Solitary vireo (0.44)	1		
	Wild turkey (0.29)	1		
	Ruby-crowned kinglet (0.29)	2		
	American goldfinch (0.29)	1		
	Wood duck (0.21)	1		

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Edges of the Natural Ocklawaha River (RO) 6 plots winter 8 plots spring/summer	Yellow-rumped warbler (2.40)	4	Northern parula (1.69)	8
	White ibis (0.83)	1	Prothonotary warbler (0.88)	5
	Red-bellied woodpecker (0.63)	4	Red-eyed vireo (0.81)	6
	Northern parula (0.52)	4	Acadian flycatcher (0.63)	4
	Northern cardinal (0.42)	1	Tufted titmouse (0.63)	3
	Downy woodpecker (0.31)	1	Red-bellied woodpecker (0.50)	5
	American robin (0.31)	2	Carolina wren (0.50)	6
	Great blue heron (0.21)	1	Northern cardinal (0.38)	5
	Red-shouldered hawk (0.21)	2	Great blue heron (0.19)	3
	Tufted titmouse (0.21)	1	Wood duck (0.19)	2
	Carolina wren (0.21)	1	Yellow-billed cuckoo (0.19)	3
	Ruby-crowned kinglet (0.21)	2	Pileated woodpecker (0.13)	2
	Blue-gray gnatcatcher (0.21)	1	Yellow-throated vireo (0.13)	2
	Common grackle (0.21)	1		
Hydric Hammock (HH) 4 plots spring/summer	not sampled in winter		Northern parula (1.59)	4
			Red-bellied woodpecker (1.24)	2
			Tufted titmouse (1.24)	2
			Northern cardinal (1.06)	3
			Carolina wren (0.88)	2
			Great crested flycatcher (0.35)	2
			Downy woodpecker (0.35)	1
			Pileated woodpecker (0.35)	1
			Blue-gray gnatcatcher (0.35)	1
			Yellow-throated vireo (0.35)	1
			Hooded warbler (0.35)	1

Table 5-1 (continued)

Habitat Type	Winter		Spring/Summer	
	Species (Relative Abundance)	No. Plots Found	Species (Relative Abundance)	No. Plots Found
Shrub Swamp (SS) 5 plots spring/summer	not sampled in winter		Red-winged blackbird (1.26)	4
			Common yellowthroat (0.93)	4
			Northern cardinal (0.89)	3
			Blue-gray gnatcatcher (0.86)	3
			Northern parula (0.84)	2
			Boat-tailed grackle (0.78)	1
			Carolina wren (0.74)	3
			White-eyed vireo (0.52)	3
			Green heron (0.44)	1
			Great crested flycatcher (0.28)	2
			Red-eyed vireo (0.28)	2
			Gray catbird (0.25)	2
			Common Moorhen (0.25)	2
			Turkey vulture (0.14)	1
			Common grackle (0.14)	3

[1]Differences in ranking by relative abundance are not necessarily significant

5.8.3 Alternative 4: Full Restoration

The restoration of the river and the floodplain forest in this alternative would have similar effects as in Alternative 3. It is unlikely that the removal of all structures, berms, and canals called for in this alternative would result in any changes in bird species or numbers over Alternative 3. While the removal of these structures may result in a net increase in acres available for birds and other wildlife, it would not significantly differ from Alternative 3, Partial Restoration.

5.9 Amphibians and Reptiles

5.9.0 Alternative 1: Full Retention

The existing lake system would continue to provide important breeding areas for many terrestrial and semi-aquatic amphibians and reptiles. The reservoir would continue to provide habitat for the American alligator, banded water snake, cottonmouth, garter snake, ribbon snake, pig frog, and Southern leopard frog. The existence of the reservoir would continue to fragment the habitat of the Ocklawaha River floodplain for some species.

5.9.1 Alternative 2: Partial Retention

At 14 feet NGVD, marsh and aquatic habitats would be converted to shrub-dominated during earlier stages of succession, then to tree-dominated floodplain swamp. There may be a small reduction in species such as aquatic salamanders, leopard and pig frogs, peninsular cooters, and American alligators. Eventually, floodplain species would increase in those areas where floodplain habitat is restored. The habitat-fragmenting effects of the reservoir would remain under this alternative.

5.9.2 Alternative 3: Partial Restoration (Proposed Action)

In riverine swamps, such as the Ocklawaha, where flood events are shorter and flow rates stronger than in stillwater swamps, amphibians and reptiles are not common, and arboreal species outnumber ground-dwelling species (Ewel 1990). These conditions are expected to return following partial restoration. Nevertheless, a variety of herpetofauna, such as alligators, amphiumas, and the less common glossy crayfish snake and striped crayfish snake, may be found. In general, tree-climbing snakes and burrowing sirens and amphiumas occur in the zones closer to the river, whereas salamanders may be closer to the upland.

Under this alternative, there would be reductions in population numbers of obligate reservoir species, i.e., species that require the reservoir as opposed to those who use it in addition to other habitat. There may be temporary feeding areas for species such as alligator, indigo snake, and water snake. Eventually, river species, such as red-bellied turtles, loggerhead musk turtles, and Florida soft-shelled turtle, are expected to increase. The restored habitat would reduce the effects of habitat fragmentation caused by the inundation of historically suitable habitat for the indigo snake.

In addition to species using the reservoir, gopher tortoises occur in the sand pine scrub located in the west end borrow pit (refer back to Figure 3-1 for location). These animals will be relocated if it appears construction activities may impact them.

5.9.3 Alternative 4: Full Restoration

The effects of full restoration will be very similar to those described for the partial restoration alternative. The removal of structures associated with the dam and lock, canals and berms may provide additional acres of habitat for amphibians and reptiles, and this alternative increase the population of those species slightly as they move into the restored habitat. This alternative would significantly reduce or eliminate the fragmentation effect currently resulting from the dam and other structures, and provide corridors of movement and exchange for some species.

5.10 Mammals

5.10.0 Alternative 1: Full Retention

The reservoir will continue to provide habitat for the mammals that presently reside there. Forty-one species have been reported throughout the reservoir and the floodplain, with the three typical species being beaver, muskrat, and river otter. Other species that use these habitats include opossum, southeastern shrew, short-tailed shrew, armadillo, gray squirrel, flying squirrel, cotton mouse, raccoon, feral hog, and white-tailed deer. Manatees have been observed in the reservoir. The extent to which the reservoir acts to inhibit or impair bear movements is unknown. While the reservoir could hinder bear movement in the immediate vicinity of the reservoir, bear have been observed crossing the Ocklawaha River at other points.

5.10.1 Alternative 2: Partial Retention

Under this alternative, approximately 7,300 acres of floodplain forest would be restored. Some species associated with the forest, as opposed to the reservoir, may reappear. Aquatic mammals that utilize the aquatic habitat include the beaver, muskrat, and river otter and may experience a slight decrease in habitat area, but this is unlikely to effect the existing population. Although the partial retention alternative would provide more habitats for large mammals, it would not restore the direct north-south corridor to the Ocala National Forest, and the habitat will remain fragmented.

5.10.2 Alternative 3: Partial Restoration (Proposed Action)

As with other animals, increased acreages of floodplain forest are expected to lead to commensurate increases in numbers of individuals of mammal species that use this habitat. The numbers and diversity of mammals associated with the reservoir may decline. However, species that can use the floodplain habitat or can move will be unaffected.

Restoration of approximately 7,300 acres of floodplain forest will increase the habitat available for mammals in the Ocklawaha River basin. Because they are adjacent to seed-producing bottomland hardwoods and close to adjoining mesic forests, floodplain forests provide perhaps the greatest density and diversity of wildlife in Florida (Ewel 1986). Several mammals are most commonly found in swamps, such as the southeastern shrew and the cotton mouse. Some small mammals, such as the golden mouse, nest in trees to escape floodwaters. River otters and mink feed heavily on crayfish in river swamps. The beaver, which was trapped out of Florida by the middle of the twentieth century, has returned to north Florida, where it is most common in floodplains of small

streams. Large, uncommon mammals, such as the black bear, are now concentrated in swamps because of the widespread destruction of upland habitat. Restoring the river will reduce the effects of fragmentation resulting from the reservoir (see Table 5-2).

Several mammal species are found in the Ocklawaha River basin and are expected to thrive under the restored floodplain forest conditions. This basin includes floodplain swamp and hydric hammock habitats. Floodplain swamps harbor a diverse array of animals, including both temporary and permanent residents. Typical mammals include the southeastern shrew, short-tailed shrew, beaver, wood rat, rice rat, cotton mouse, golden mouse, Florida black bear, raccoon, and bobcat. See section 5.12.2.3 for a discussion of threatened and endangered mammals.

5.10.3 Alternative 4: Full Restoration

Effects of this alternative on mammals would be similar to Alternative 3. Restored connections and removal of man-made structures may increase those species that prefer large areas of natural or remote environments. Effects of habitat fragmentation resulting from the reservoir would be least in this alternative.

Table 5-2

Effects Upon Listed Species Under the Partial Retention of The Rodman Reservoir Alternative

Common Name	Status State	Federal	Anticipated Effects
Birds			
Bald Eagle	T	T	Some habitat suitable for foraging eagles will likely remain
Florida sandhill crane	T	S	Some suitable nesting areas may be temporarily created
Least tern	T	N	May benefit migrating individuals*
Limpkin	SSC	N	Likely population will decrease
Little blue heron	SSC	N	Much suitable foraging habitat may be retained
Kirtland's warbler	E	E	Could benefit this species
Snail kite	E	E	Unlikely to occur*
Snowy egret	SSC	N	Population increases due to expansion of floodplain forest
Southeastern American kestrel	T	N	Subspecies may be found in winter
Tricolored heron	SSC	N	Breeding may increase due to greater nesting habitat
White ibis	SSC	N	Current populations could remain due to more cypress swamp
Wood stork	E	E	May use area during drawdowns for foraging
Fish			
Bluenose shiner	LS	N	Suitable habitat may expand
Southern tessellated darter	SSC	N	Suitable habitat may expand
Plants			
Buckthorn	E	N	No change in existing population
Florida spiny pod	E	N	No change in existing population
Grass of parnassus	E	N	No effect
Giant leather fern	C	N	No change in existing population
Garberia	T	N	No change in existing population
Cardinal flower	T	N	No change in existing population
Cinnamon fern	C	N	No change in existing population
Royal fern	C	N	No change in existing population
Needle palm	C	N	No change in existing population
Florida willow	E	N	No change in existing population
Florida pinkroot	E	N	No change in existing population
Variable-leaf Indian plantain	T	N	No change in existing population

Table 5 – 2 (continued)

Common Name	Status State	Federal	Anticipated Effects
Mammals			
Black bears	T	N	Small increase in habitat, movement still possibly hindered
Florida panther	E	E	Not suitable habitat
West Indian manatee	E	E	Manatee movement remains hindered
Reptiles			
American alligator	SSC	T S/A	Probably a slight decline due to net loss of water
Eastern indigo snake	T	T	Species should benefit
Suwannee cooter	SSC	N	Unknown

State = State Listing by the Florida Department of Agriculture and Consumer Services, Division of Plant Industry
Federal = Federal Listing by the U. S. Fish and Wildlife Service; S = Forest Service Sensitive
E = Endangered; T = Threatened; C2, C1 – Candidate Species; N = Not listed; SSC = Species of Special Concern; T(S/A) = Threatened by similarity of appearance; * = Not listed as occurring in Putnam or Marion County by FNAI (1997)

5.11 Forest Succession

5.11.0 Alternative 1: Full Retention

At the present conditions of 18 feet NGVD the reservoir will continue to support submergent and emergent aquatic vegetation, dead trees and submerged logs and trees. Standing dead trees will become submerged and no new trees will germinate. The submerged seedbank, which contains no viable tree seeds, includes approximately 80% native herbaceous species (Burks 1994). Nearly 7,300 acres of floodplain forest will remain submerged with no seasonal fluctuations in water level. No new trees are predicted under the existing conditions without the planting of flood-tolerant saplings.

5.11.1 Alternative 2: Partial Retention

Under the partial retention alternative (14 feet NGVD), 2,300 acres of floodplain forest will be restored. Those acres will experience a natural succession of species including herbaceous species, marsh species, shrub and tree species. Artificial regeneration through planting will speed this process. The remaining 7,300 acres will continue to be submerged, with no seasonal water level fluctuations necessary for new trees. In this area, there will be no new trees unless flood-tolerant saplings are planted.

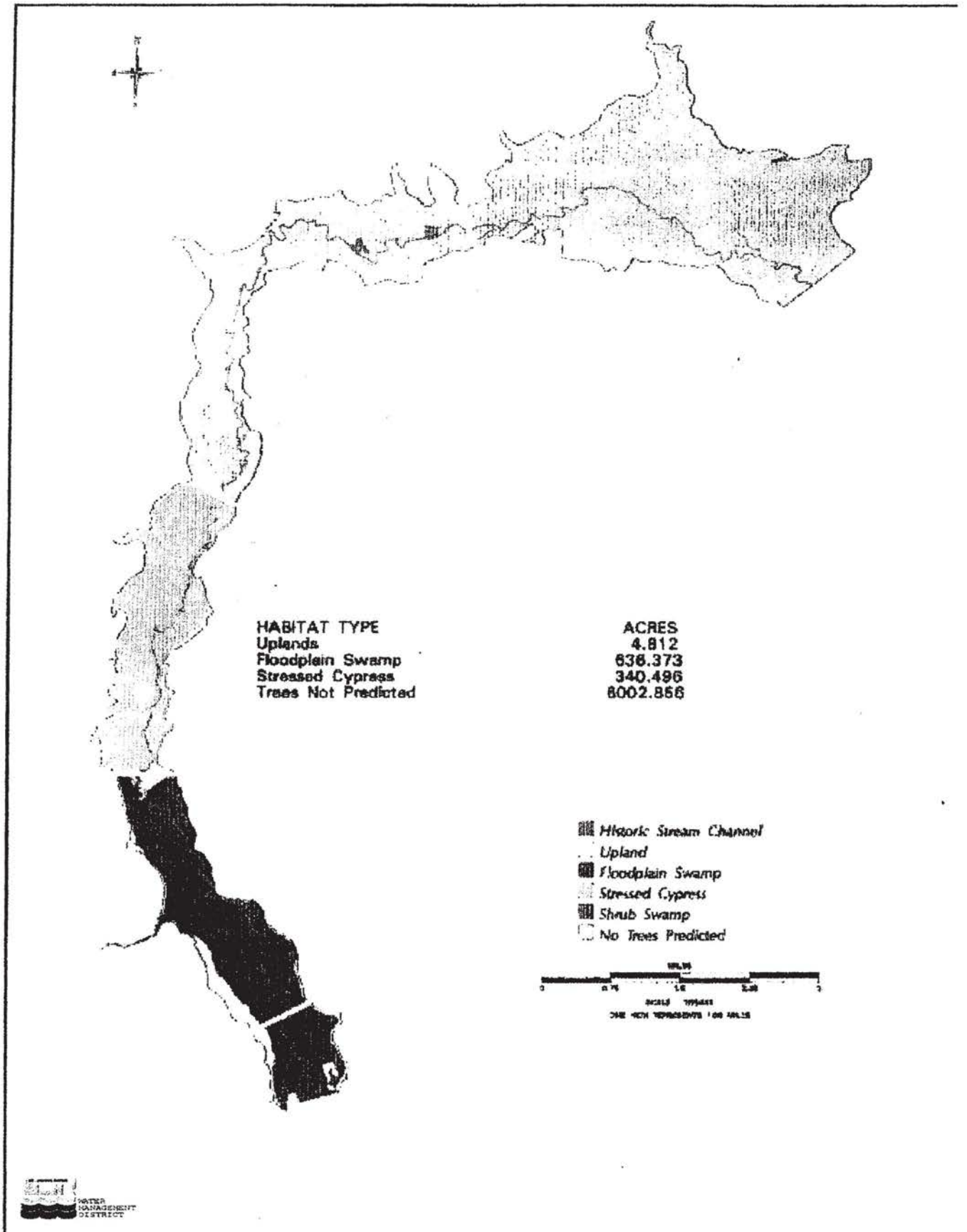
5.11.2 Alternative 3: Partial Restoration (Proposed Action)

Forest succession under partial and full restoration conditions was predicted using the FORFLO model, a forest succession model developed by the U.S. Fish and Wildlife Service (USFWS). Model inputs using various tree densities and species in planting scenarios did not give significantly different results. All scenarios, with and without planting, resulted in floodplain forest species succession, *when trees occurred.* That is, in areas suitable for tree growth, the same tree species assemblage appeared, regardless of species planted. Differences in species composition were subtle and likely due to changes in elevation. Exotics were not a model component. Acres of habitat restored were not a part of the FORFLO modeling, but are instead presented in section 5.13 Habitat.

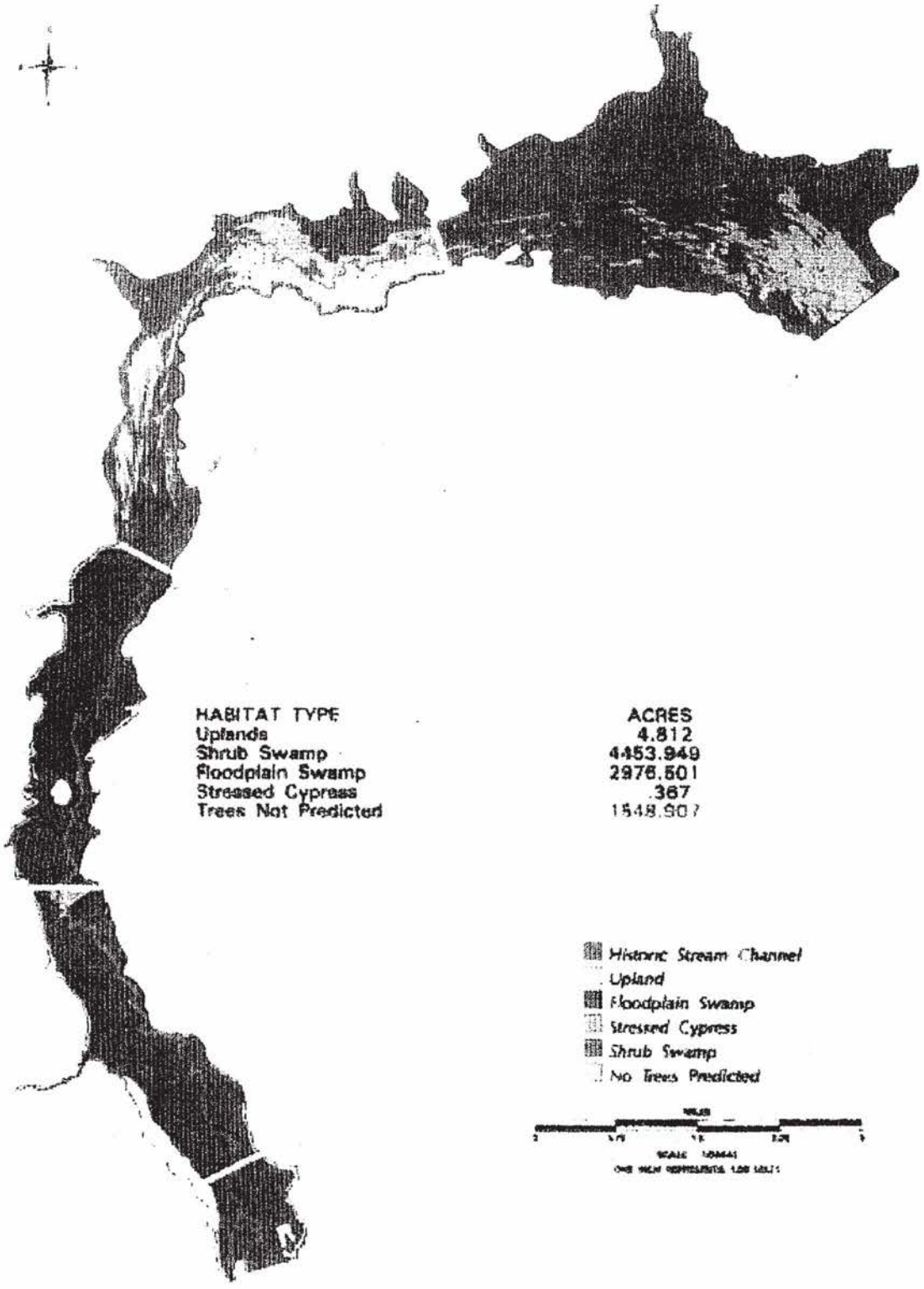
Under partial restoration, characteristic floodplain forest species and densities are expected after 40 years. Approximately 5,107 acres of floodplain will no longer be submerged. Another 2,264 acres will be in less than 2 feet of water and will be subject to seasonal exposure and subsequent seeding. The total area restored, including the historic river channel, would be approximately 7,300 acres.

The results of FORFLO modeling of the project area are presented in Figures 5-3 through 5-5. The series of figures represents the predicted acreages of uplands, floodplain swamp, stressed cypress and open water with no trees predicted at the time of restoration, 10 years later, and 50 years later. The modeling results indicate total recovery of the floodplain swamp, from 636 acres to over 7000 acres of trees after 50 years.

These results are consistent with those presented by Davis (1990) in which those portions of the Ocklawaha River floodplain not subjected to inundation stress had greater sprout production, diameters, and species diversity when compared to those areas subjected to flooding.



	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	Rodman Project Forflo Results, Year 0 Full or Partial River Restoration Alternative 12/15/94	**FIGURE 5-3**

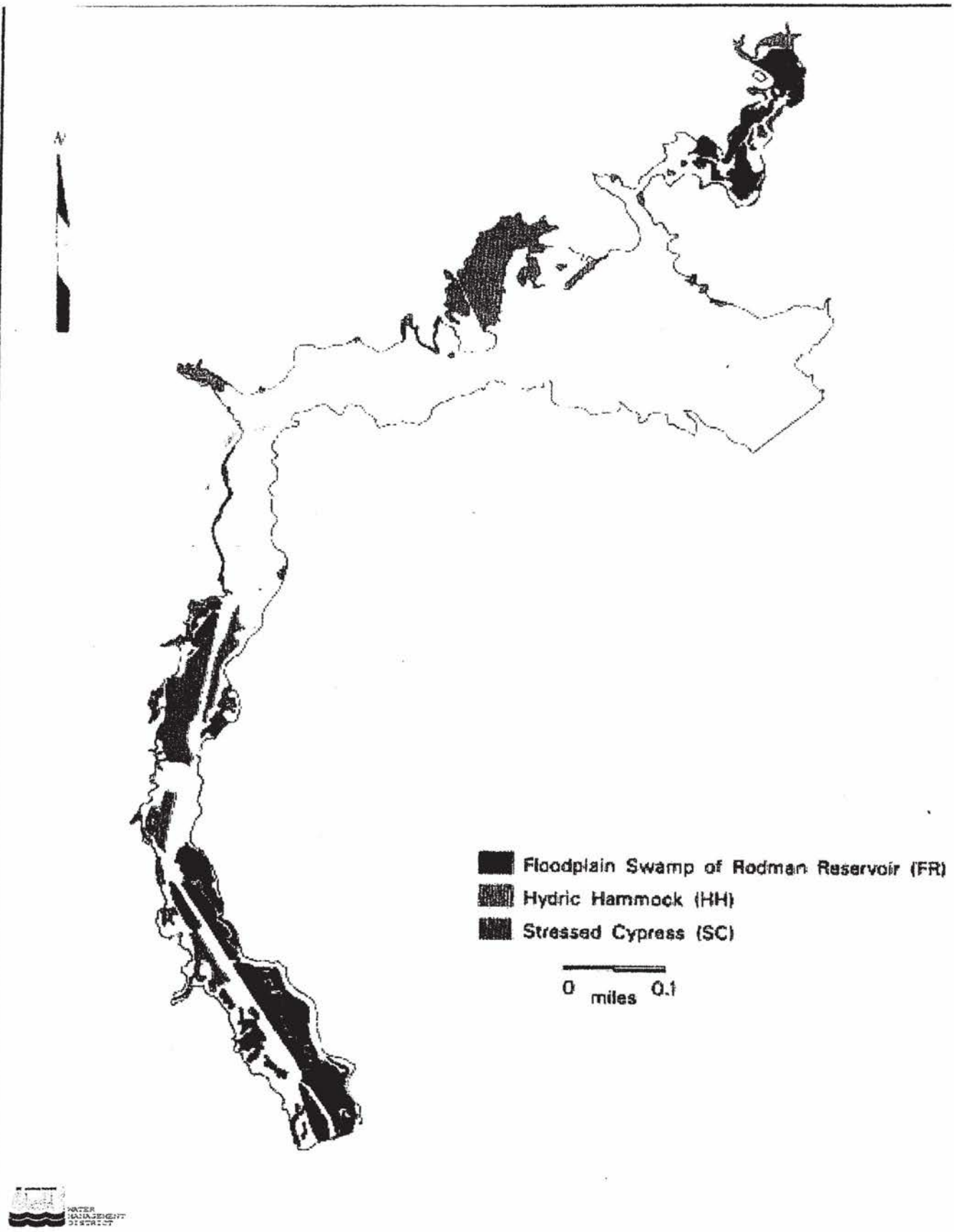


WATER MANAGEMENT DISTRICT

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Rodman Project Forflo Results, Year 10 Full or Partial River Restoration Alternative 12/15/94

FIGURE 5-4



FLORIDA	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	Rodman Project Forflo Results, Year 50 Full or Partial River Restoration Alternative 12/15/94	FIGUR 5-5

5.11.3 Alternative 4: Full Restoration

With restoration, characteristic floodplain forest species and densities are expected after 40 years. Under full restoration, 5,107 acres of floodplain would no longer be submerged. Another 2,264 acres would be in less than 2 feet of water and would be subject to seasonal exposure and subsequent seeding. The total area restored, including the historic river channel, would be 9,600 acres. Land presently used for the dam, canals and berms would have these structures removed and this would slightly increase the total number of acres of forest restored.

5.12 Threatened and Endangered Species

Using a list of Federal- and State-listed endangered species, threatened species, species considered candidates for listing, and species of special concern that potentially occur within the study area, a survey of plants and animals was made for the project area. This section discusses Federal- and State-listed species that have habitat requirements matching those of the project area.

The USFWS has provided a Biological Opinion (Appendix F) in which potential impacts of the proposed restoration activities were addressed. A comparison of wildlife habitat impacts under each alternative is presented in this section.

5.12.0 Alternative 1: Full Retention

Potential impacts to plants, birds, mammals, reptiles and fish under this alternative are presented in Table 4-4 (see Section 4, Affected Environment).

5.12.0.1 Plants

Under the full retention alternative, no long-term adverse impacts to any threatened or endangered plant species or to critical habitat of any threatened or endangered plant species are predicted under existing conditions. Twelve of the 37 state-listed threatened, endangered, candidate plant species, plant species of special concern, and rare plant species have been found in the project area. No federally listed threatened or endangered plant species were found in the project area.

Although Atlanta white cedar is not listed as threatened or endangered, it is an uncommon species in peninsular Florida and is indicative of a relic plant community containing numerous other uncommon plants. It is found in only two isolated stands in north peninsular Florida: along Juniper Creek and Mormon Branch in the Ocala National Forest and along Deep Creek, which discharges into Rodman Reservoir. The Deep Creek stand is approximately 4 miles long with 2,000 to 5,000 Atlantic white cedar trees.

5.12.0.2 Birds

Twelve threatened and endangered, species of special concern, and candidate species of birds were identified as possible species occurring within the project area. Of the twelve species, two species, the migrant Kirkland's warbler and the snail kite, were not found. The snail kite and the least tern are not listed as occurring in Putnam or Marion Counties.

Limpkins, little blue herons, snowy egrets, tricolor herons, and white ibis forage along the edges of the reservoir and in dense vegetation around stressed cypress trees. Sandhill cranes and wood storks have been sighted near the reservoir and appear to nest just north of the reservoir in Cow Heaven Bay. Under this alternative, the foraging habitat for these species will not change.

Both kestrels and bald eagles nest in dead trees and forage over open areas. Two kestrels have been sighted at the reservoir in winter (nonbreeding) and a single active bald eagle nest exists in the project area. Available habitat for these species is not expected to change in this alternative.

5.12.0.3 Mammals

Within the past few years, manatees have been observed in the reservoir, the Ocklawaha River upstream of Eureka, and within the Silver River. Based on FFWCC's records, at least 10 manatees have been crushed and drowned in Buckman Lock and Kirkpatrick Dam from 1977 to 1999. Manatees will continue to use the Buckman Lock as a portal from the St. Johns River to the Rodman Reservoir, the upper Ocklawaha River, and the Silver River. The dam and lock will continue to pose a risk of death and injury to manatees (see Table 4-6). Installation of manatee protection devices at the dam and lock will mitigate these risks.

Continued retention of the dam does not provide suitable habitat for black bear, but at least 8 individuals occur in the northern portion of the Ocala National Forest near the project area. Bears do cross the Ocklawaha River where the river channel narrows and have been seen swimming across the canal near the SR 19 bridge. Bears will continue to use the area and move between the Ocala National Forest and lands north of the river, but there is not a contiguous corridor because of the reservoir.

Panthers historically occurred in the Ocklawaha River floodplain, but because of the density of human population in the area of the Ocala National Forest, the Rodman Reservoir is not considered a potential panther reintroduction site.

5.12.0.4 Reptiles and Amphibians

Listed reptiles within the Ocklawaha River basin include the American alligator, Eastern indigo snake, spotted turtle, and Suwannee cooter. No listed amphibian species have been documented for the project area, although this does not preclude their presence.

In this alternative, the existing aquatic habitat will continue to provide habitat for the American alligator, spotted turtle, and Suwannee cooter. The reservoir and flooded forest does not provide suitable habitat for the Eastern indigo snake.

5.12.0.5 Fish

The dam will continue to act as a barrier to some fish. The bluenose shiner and the southern tessellated darter will continue to be excluded from the reservoir and lower Ocklawaha River, although their populations should continue to survive in Orange Creek and some of the other tributaries where they are presently found. This alternative would have no effect on the short-nosed sturgeon.

5.12.1 Alternative 2: Partial Retention

Potential impacts to plants, fish, reptiles, birds, and mammals under this alternative are presented in Table 5-2. Under the partial retention alternative, some permanently flooded swamp forest would be drained and restored into a seasonally flooded forest. Some floodplain swamp would be created, benefiting species such as *Bumelia lycioides*. Several springs that existed between Eureka Dam and Kirkpatrick Dam may be restored with the same results listed under the full and partial restoration alternatives. However, fewer springs would be restored than under the restoration alternatives. Some suitable bear habitat would increase as marsh and aquatic habitats are converted into floodplain swamp and as permanently flooded swamp is converted into seasonally flooded swamp.

Under this alternative, some additional habitat for Eastern indigo snakes, Southern tessellated darters, bluenose shiners, and spotted turtles may be created. The presence of the reservoir and the backwater would prevent the connection of flowing streams such as Orange Creek with the Ocklawaha River. Thus, this alternative is not likely to greatly benefit species requiring flowing systems.

This alternative would result in an increase in the amount of shallow water habitat, which would favor marsh development and may benefit round-tailed muskrats and some bird species including little blue herons, tricolored herons, snowy egrets, and white ibis.

Habitat for black bear would remain fragmented. Other impacts due to partial retention are the same as those described for the full retention alternative, including no effect on the short-nosed sturgeon. Under this alternative, lacustrine habitat would be reduced and floodplain increased by approximately 2000 acres.

5.12.2 Alternative 3: Partial Restoration (Proposed Action)

There would be impacts to habitat of threatened and endangered species under this alternative. Potential impacts to plants, fish, reptiles, birds, and mammals under this alternative are presented in Table 5-3. Rare and endangered birds and mammals are more likely to be found in cypress swamps and mixed hardwood swamps than in other kind of swamps. Of the 68 birds listed as rare and endangered in all of Florida, 12 are found in cypress and hardwood swamps. Large uncommon mammals, such as the black bear, are now concentrated in swamps because of widespread destruction of upland habitat. Protection measures as outlined in the *USFWS Biological Opinion* will be implemented during any construction.

Conclusions outlined in the Biological Opinion (Appendix F) included a determination that "the eastern indigo snake, wood stork, and snail kite are not likely to be adversely affected" by the proposed restoration alternatives. In addition, it is the opinion of the USFWS that the proposed project is not likely to jeopardize the continued existence of the manatee or the bald eagle. The FDEP, in cooperation with the FFNCC, USFWS, and the SJRWMD has assessed the terrestrial wildlife population(s) that would be displaced or eliminated by conversion of the Rodman Reservoir to a flowing river channel (SJRWMD 1994).

Table 5-3

Effects of the Partial Restoration of the Ocklawaha River Upon Listed Species

Common Name	Status State	Federal	Anticipated Effects
Birds			
Bald Eagle	T	T	Nesting may be relocated in local or regional area
Florida sandhill crane	T	S	Suitable habitat for several years due to remaining marsh
Least tern	T	N	May benefit migrating individuals
Limpkin	SSC	N	Loss of current foraging habitat except for remaining herbaceous marsh which may support apple snails
Little blue heron	SSC	N	Loss of foraging habitat, although nesting/roosting will increase with increase in forested floodplain
Kirtland's warbler	E	E	Infrequent use could continue
Snail kite	E	E	Unlikely to occur
Snowy egret	SSC	N	Loss of foraging habitat, although nesting/roosting will increase with increase in forested floodplain
Southeastern American kestrel	T	N	Northern subspecies may be found in winter
Tricolored heron	SSC	N	Loss of foraging habitat, although nesting/roosting will increase with increase in forested floodplain
White ibis	SSC	N	Loss of foraging habitat, although nesting/roosting will increase with increase in forested floodplain
Wood stork	E	E	Restored floodplain will increase nesting/roosting habitat
Fish			
Bluenose shiner	LS	N	Will restore historic connection with Ocklawaha River
Southern tessellated darter	SSC	N	Will restore historic connection with Ocklawaha River
Plants			
Buckthorn	E	N	Increase in population as habitat restored
Florida spiny pod	E	N	Habitat along Deep Creek may increase
Grass of parnassus	E	N	No effect
Giant leather fern	C	N	Increase in potential habitat
Garberia	T	N	Impacted by borrow pit/spoil disposal activities. Will be replanted or relocated
Cardinal flower	T	N	Increase in species due to more river bank habitat
Cinnamon fern	C	N	Increase due to increase in wetlands
Royal fern	C	N	Increase due to increase in wetlands
Needle palm	C	N	Increase in habitat will increase species distribution
Florida willow	E	N	Habitat (spring runs) for this species will increase
Florida pinkroot	E	N	Habitat available for colonization will increase
Variable-leaf Indian plantain	T	N	Following restortion, habitat available for colonization

Table 5 – 3 (continued)

Common Name	Status State	Federal	Anticipated Effects
Mammals			
Black bears	T	N	Will increase suitable habitat
Florida panther	E	E	Will increase suitable habitat
West Indian manatee	E	E	Will reduce mortality risks
Reptiles			
American alligator	SSC	S/A	Excellent habitat
Eastern indigo snake	T	T	Will increase suitable habitat
Suwannee cooter	SSC	N	Unknown

State = State Listing by the Florida Department of Agriculture and Consumer Services, Division of Plant Industry
Federal = Federal Listing by the U. S. Fish and Wildlife Service; S = Forest Service Sensitive
E = Endangered; T = Threatened; C2, C1 – Candidate Species; N = Not listed; SSC = Species of Special Concern; T(S/A) = Threatened by similarity of appearance

5.12.2.1 Plants

Listed plant species in the project area (Table 4-5) would increase in their distribution under the partial restoration alternative. Although marsh habitat would shift from the lake edges (full retention) to the inside bends in the channel where flows are attenuated, suitable marsh habitat would continue to be available under partial restoration.

Twelve of the 38 state-listed threatened, endangered, candidate plant species, plant species of special concern, and rare plant species included for study based on their likelihood of occurrence in the study area were found in the project area (Appendix B). These include: giant leather fern, Garberia, needle palm, Cardinal flower, Florida spiny-pod, buckthorn, cinnamon fern, royal fern, Florida pinkroot, Florida willow, grass of parnassus, and variable-leaf Indian plantain. No federally threatened or endangered species were found in the project area (see Table 4-5).

The only species expected to be affected by the restoration project is *Garberia*, which occurs in the sand pine scrub located in the west end borrow pit (refer back to Figure 3-1). It is proposed that any plants damaged by construction activities be replaced by using stock from local nurseries to replant.

5.12.2.2 Birds

The absence of the migrant Kirkland's warbler is not expected to be affected by this alternative. The loss of aquatic foraging and nesting habitats under the partial restoration alternative is likely to result in a commensurate decrease in the little blue heron, snowy egret, and tricolor heron presently using the reservoir.

Unlike the other species, however, limpkins foraged along tree edges and white ibis frequently forage in the flooded forest. These two species may be unaffected under the partial restoration alternative.

Impacts to bird species would be primarily related to net losses in marsh foraging habitat and four species of special concern, including three species of herons and the limpkin, may be impacted due to changes in habitat (Table 3-6). For colonial wading birds, including white ibis, snowy egret, tricolor heron, and little blue heron, there would be a net loss in marsh foraging habitat but the net increase in roosting and nesting habitat will benefit the species. Limpkins, little blue herons, snowy egrets, tricolor herons, and white ibis forage along the edges of the reservoir and among the dense vegetation around stressed cypress trees. Limpkins occur in floodplain swamps and marshes, alluvial and blackwater streams, and spring-run streams, while little blue herons, white ibis, and snowy egrets occur in various palustrine and estuarine habitats (FNAI 1997).

Conclusions outlined in the Biological Opinion (Appendix F) included a determination that "the wood stork and snail kite are not likely to be adversely affected" by the proposed restoration alternatives and that "the proposed project is not likely to jeopardize the continued existence of the... bald eagle". In fact, the conversion to floodplain forest would provide greater roosting and nesting habitat for wood storks.

Although the shift to a forested floodplain would result in relocation of the bald eagle pair and kestrels, nearby Orange Lake and the St. Johns River are expected to continue to provide nesting and

habitat for both these species and presently supports numerous pairs of eagles. Florida Game and Freshwater Fish Commission (FGFC) and the U.S. Fish and Wildlife Service (USFWS) comments indicate the restoration would not impact the regional population of bald eagles.

Both kestrels and bald eagles nest in dead trees and forage over open areas. Two kestrals have been sighted at the reservoir in winter (nonbreeding), although they are considered terrestrial and occur in sandhill, mesic flatwoods, and dry prairies (FNAI 1997). A single active bald eagle nest exists in the project vicinity. Available habitat for these species is not expected to change. FNAI (1997) reports no documented occurrences of snail kites or least terns in either Marion or Putnam Counties.

5.12.2.3 Mammals

Removal of Kirkpatrick Dam will open a manatee access corridor via the lower Ocklawaha River to the rest of the Ocklawaha system. The corridor was most likely used historically by these animals (Smith 1997). Habitat quality and accessibility would also likely improve. Dam removal would also eliminate a known source of manatee mortality and the only known source of mortality due to water control structures on the St. Johns River system; however, the installation of manatee protection devices now being installed at the dam will also eliminate this risk. Manatees would have freer access to significant sources of warm water, such as the Silver River and better access to potential warm water refuge sites, including Blue Spring, long buried under the artificial floodwaters of Rodman Reservoir.

Restoration of the floodplain is expected to provide increased black bear habitat and provide a more direct north-south corridor through the Ocala National Forest. The Ocklawaha River floodplain does not provide suitable habitat for the Florida Panther and has not been identified as a potential re-introduction site by FFWCC.

5.12.2.4 Reptiles and Amphibians

Under the partial restoration alternative, the American alligator is expected to continue to thrive and habitat for the eastern Indigo snake will be restored as the reservoir is eliminated. Because the Suwannee cooter has been introduced from rivers flowing to the Gulf of Mexico, predictions regarding the effects of continued impoundment on the Suwanee cooter would be premature without further study. No listed amphibians species were documented for the project area.

5.12.2.5 Fish

Neither the bluenose shiner nor the southern tessellated darter has been collected from the main channel of the river since 1949. The darter has been collected regularly from Orange Creek (and some other creeks) since 1975. The shiner and darter are extremely rare or may have been extirpated from the river, although the southern tessellated darter still occurs in some of the river tributaries. Elimination of the reservoir would lead to re-establishment of tributary flows to the river from Orange and Deep Creek, increasing available stream habitat, and potentially re-populating these species in the river. Partial Restoration would have no effect on the short-nosed sturgeon.

5.12.3 Alternative 4: Full Restoration

The potential impacts to endangered or threatened species would be similar to those described for the partial restoration alternative. Due to the greater construction and earth-moving activities associated with the full restoration, there is a greater potential for impacts to amphibians, reptiles, small mammals and fish. However, no listed threatened or endangered species of amphibians or small mammals occur in the project area. The only listed plant species that may be affected by restoration activities is Garberia, which occurs in the sand pine scrub and would not be affected by earth-moving activities associated with removal of structures, berms and canals. Full restoration would not affect the short nosed sturgeon.

It is possible that some individuals of the Eastern indigo snake may be killed during earth-moving activities during structure removal, and increased sediment in the river from these activities may temporarily lower water quality for some fish species such as the Suwannee cooter. However, the restoration of the floodplain forest habitat is expected to benefit the Eastern indigo snake population by restoring its habitat.

5.13 Habitat

5.13.0 Alternative 1: Full Retention

This alternative will continue to provide the existing open water habitat with some marsh and forest edge habitat. During construction of Rodman Reservoir, approximately 5,498 acres of forest were crushed and 4,023 acres of forest were flooded. Along with the loss of the historic floodplain forest, construction activities included the creation of a berm on either side of the Cross Florida Barge Canal, spoil piles, channels, drainage ditches and dikes which resulted in alternations to the previously existing habitat. Approximately 2,090 acres of trees were crushed and cleared away; in those areas where trees were not crushed (primarily on either side of the Ocklawaha River channel), sporadic timber was left standing. About 1,910 acres of forested area was left standing and were subsequently flooded, resulting in the trees dying and becoming dead snags.

Current habitat includes the pool or lacustrine zone, transitional zone, and riverine zone of Rodman Reservoir; berms vegetated with trees, shrubs and vines (28 acres); dead trees with surface aquatic vegetation growing under them (396 acres); dead trees over open water (228 acres); floating-leaved aquatic plant marsh (1,088 acres); and permanently inundated floodplain swamp (1,379 acres).

As discussed in Section 4, Affected Environment, importance values of tree species differs in natural floodplain forests of the Ocklawaha River as compared to species in the floodplain forests inundated by the reservoir (see Table 4-9). Importance values represent the sum of the relative density, relative dominance, and relative frequency of a species within a community. Comparisons indicate that tree species richness decreases as water level increases. Importance values also change. Species with low importance values in natural floodplain forests decreased further in inundated areas, with the exception of swamp tupelo and cabbage palm.

Three years following inundation of Rodman reservoir (1972), most trees died in the deeply flooded portions of the reservoir and 68% of the trees died in the area now considered the stressed cypress

forest. In areas where water levels averaged 2.7 feet deep, 41% of the trees had died. Bald cypress and tupelo began developing new secondary root systems three years after flooding, but much of the ash and red maple had died out. However, by 1990, Davis (1990) found that ash and red maple were able to reproduce vegetatively and maintain high importance values. In moderately deep portions of the reservoir, individuals were able to produce sprouts and maintain importance values similar to those in natural Ocklawaha floodplain forests. Ash, red maple, and many subdominant species survive within permanently flooded sections of the reservoir by sprouting. Cypress and swamp tupelo have survived through long-lived individuals with no sexual or asexual reproduction. These forests are similar to those upstream of Eureka and are dominated by pumpkin ash, bald cypress, red maple, swamp tupelo, American elm, and dahoon holly. Swamp dogwood, sabal palm, laurel oak, by, and sweetbay also occur.

5.13.1 Alternative 2: Partial Retention

At 14 feet NGVD, there would be a net increase in marsh habitat, which would enhance marsh-dwelling species populations. The reservoir would decrease in size, and estimates by the SJRWMD (1994) predict approximately 2,300 acres of floodplain forest will be restored.

Lowering the pool depth to 14 ft NGVD is predicted to restore river hydrology and floodplain to 2,331 acres of floodplain forest above the Kirkpatrick Dam. Artificially created surface features will remain and seasonal fluctuations will be limited to the restored area.

Forest species that can continue to revegetate by sprouting would continue to exist in the inundated areas of the reservoir, as well as some of the long-lived cypress and swamp tupelo individuals.

5.13.2 Alternative 3: Partial Restoration (Proposed Action)

Existing marsh and aquatic habitats characteristic of the partial and full retention alternatives would be converted to shrub-dominated and then tree-dominated floodplain swamp throughout the Ocklawaha River basin under partial and full restoration alternatives

Reports regarding the area of floodplain forest originally impacted by the impoundment of the Ocklawaha River vary considerably in the available literature. Some of these differences may be accounted for by the fact that SJRWMD (1994) estimates of restored floodplain were based on changes from 1943 photography, while the changes in acreages calculated for this report are based on 1964 photography. In addition, river flows in the last 10 years are lower when compared with average flows for the last 60 years of record, meaning that changes in floodplain exposed may be based on a higher water level in the SJRWMD report. Finally, the acreages of uplands converted to wetlands following impoundment and the acreages of wetlands converted to uplands for restoration may have been treated differently.

In order to determine the extent and nature of the original habitat impacts, as well as the area of potential for habit restoration associated with the reservoir drawdown, a GIS-based quantitative habitat analysis was performed. The objectives of this analysis were to: (1) quantify the acreage of historic acreage of floodplain forest within the reservoir impact area; (2) determine the type and

extent of habitat impacts associated with the flooding of the reservoir; and (3) determine the area of floodplain restored following the reservoir drawdown, under current hydrologic conditions.

The extent of the floodplain forest prior to the impoundment of the Ocklawaha River was delineated by photo interpreting and digitizing the floodplain forest line on 1964 SCS, 1"=2000' scale, black and white aerial photography of the study area. This coverage was then overlayed by the reservoir impact area coverage (e.g., the 20 foot contour line) and clipped. Then, historic floodplain forest coverage was overlain with the SJRWMD 1990 Florida Land Use Cover Code System (FLUCCS) land use coverage and acreage conversions were calculated for historic floodplain swamp and upland communities in the reservoir impact (refer back to Figure 4-7). These results indicate that the extent of the historic floodplain swamp within the reservoir impact area was approximately 8,506 acres; and that flooding of the Rodman Reservoir resulted in:

1. The creation of 1,929 acres of new wetlands from historic uplands;
2. The conversion of 6,251 acres of historic floodplain swamp to open water/herbaceous wetlands; and
3. No change to 2,067 acres of historic floodplain swamp.

The habitat conversions associated with the removal of the Kirkpatrick Dam were modeled for each of the drawdown phases and presented in Figure 3-2 previously. The Phase I drawdown would result in the greatest area of floodplain exposure (3,461 acres), followed by the Phase II (2,955 acres) and Phase III (761 acres) drawdowns. In addition, these results indicate that the complete drawdown of the Rodman Reservoir would result in:

1. The exposure of 7,300 acres of previously inundated floodplain area;
2. The reduction of the open water and river channel area to 340 acres; and
3. No change to 168 acres of existing forested wetlands.

Under partial and full restoration conditions, characteristic floodplain forest species and densities are expected after 40 years. Under partial restoration, the long-term changes in vegetation and habitat are the same as those for full restoration. Partial restoration differs from full restoration in that structural changes and earth moving required to restore the historic topography of the river and adjacent floodplain would be limited. As a result, some of the surface features described for the partial and full retention alternatives would remain. Under partial and full restoration conditions, characteristic floodplain forest species and densities are expected after 40 years.

These forests are similar to those upstream of Eureka Dam and are dominated by pumpkin ash, bald cypress, red maple, swamp tupelo, American elm and dahoon holly. Different habitat types are associated with differences in elevation, hydrology, and disturbance in the project area.

Under this restoration alternative, the upper and lower Ocklawaha River systems would be fully connected with the St. Johns River system. In addition, floodplain swamp forest that is currently permanently flooded by the reservoir waters would revert back into a seasonally flooded hardwood swamp forest.

The calculated Holdridge complexity index of the undisturbed Ocklawaha floodplain forest is 93 (Lugo and Brown 1984). This value is similar to those reported for still-water wetlands of Florida, but higher than the complexity indices of other flowing-water wetlands in Florida. Structurally, therefore, the undisturbed Ocklawaha River floodplain forest is more complex than most other freshwater forested wetlands in Florida, but less than tropical swamp forests.

Restored water level fluctuations are likely to inhibit expansive growth of dense stands of exotics or potentially troublesome native plant species. Successional stages leading to restored floodplain forests are expected to be dominated by native species with some management actions necessary to control exotics or potentially troublesome natives, such as cattails and willows. There is concern over exotic and invasive plant species competing more successfully for resources than desirable native species under newly exposed floodplain conditions.

The total area of floodplain forest restored under these conditions, including the historic river channel, would be nearly 7,300 acres. Although it is unlikely that hydrilla and other exotic plants, such as water lettuce and water hyacinth, would be eliminated, the natural succession of the hydric floodplain to a wetland community dominated by hardwood species will most likely result in shaded, tannin-stained river waters where native, submerged aquatic vegetation (SAV) species can compete with non-native plants (BAPM 1994; Burks 1996).

Under both full and partial restoration conditions, characteristic floodplain forest species and densities would occur after 40 years. The existing seedbank includes 35 native species (Burks 1996), which would dominate the earliest successional stages in the newly exposed floodplain. The estimated extent of the seedbank is presented in Figure 5-6.

Before floodplain tree species dominate the area, the floodplain would pass through various successional stages. First, herbaceous cover and marsh assemblages would dominate, followed by woody shrubs and fewer herbaceous species. Finally, once the canopy is developed, understory species and aquatic vegetation would be shaded and decline. Under full and partial restoration conditions, characteristic floodplain forest species and densities would occur after 40 years.

The restored forest would be similar to the forests upstream of Eureka, which are dominated by pumpkin ash, bald cypress, red maple, swamp tupelo, American elm, and dahoon holly. Swamp dogwood, sabal palm, laurel oak, bay, and sweetbay also occur. The understory is dominated by false nettle (*Boehmeria cylindrica*), spider lilly (*Crinum americanum*), panic grass (*Panicum sp.*), lizard's tail (*Saururus cernuus*), and poison ivy (*Toxicodendron radicans*).

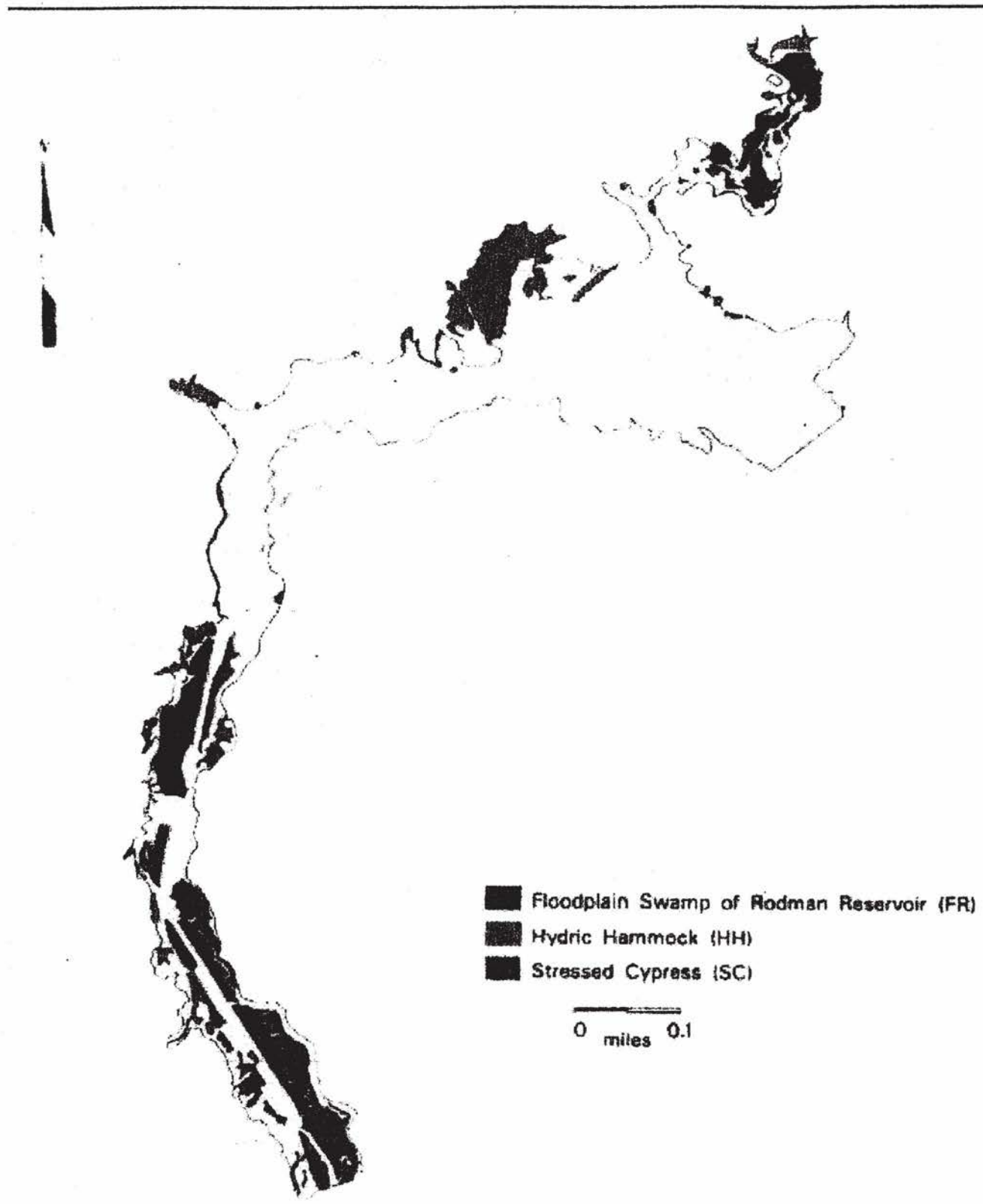
5.13.3 Alternative 4: Full Restoration

Under full restoration, nearly 7,300 acres of floodplain forest would be restored. Hardwood trees over 14 feet high are expected after 10 years, and canopy would develop after approximately 30 to 40 years. It is estimated that over 300 acres of stressed cypress habitat within Rodman Reservoir would be restored to a hardwood swamp forest. The existing seedbank includes 35 native species (Burks 1996), which would dominate the earliest successional stages in the newly exposed floodplain. The estimated extent of the seedbank is presented in Figure 5-6.

Full restoration includes greater structural changes and earth moving to restore the historic topography of the river and adjacent floodplain. Full restoration could result in greater floodplain swamp restoration, with only the footprint of the structures remaining. Over time, even these footprints would become muted or disappear under vegetation.

Before floodplain tree species dominate the area, the floodplain would pass through various successional stages. First, herbaceous cover and marsh assemblages would dominate, followed by woody shrubs and fewer herbaceous species. Finally, once the canopy is developed, understory species and aquatic vegetation would be shaded and decline. Under full and partial restoration conditions, characteristic floodplain forest species and densities would occur after 40 years. Forests would be similar to those upstream of Eureka Dam and dominated by pumpkin ash, bald cypress, red maple, swamp tupelo, American elm and dahoon holly.

Under this restoration alternative, the upper and lower Ocklawaha River systems would be re-connected with the St. Johns River system. In addition, floodplain swamp forest that is currently permanently flooded by the reservoir waters would revert back into a seasonally flooded hardwood swamp forest.



FLORIDA	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	Potential Seed Sources of Floodplain Swamp Tree Species	**FIGURE 5-6**

5.14 Aquatic Plant Management

5.14.0 Alternative 1: Full Retention

Under the full retention alternative, Rodman Reservoir will remain essentially unchanged from what it is today. It will be maintained at 18 feet NGVD and will be approximately 9,600 acres in size. If past management practices continue, aquatic plant communities will likely continue to fluctuate as they have over the last 25 years and cover more than 60% of the reservoir. Discharge rates of over 1,600 cfs are predicted under this alternative, which precludes the cost effectiveness of using fluridone to control hydrilla except in protected cove areas of the reservoir. In these protected cove areas, flow rates may be low enough to use fluridone or other herbicides to control hydrilla.

With a drawdown every 3 years, aquatic plant management costs for this alternative will probably range from the 22-year average of $14,000 per year (when only floating plants are treated) to approximately $270,000 per year (when hydrilla is treated). Without drawdowns as a management tool, the cost will probably range from approximately $75,000 to $270,000 per year due to increased management of floating plants and hydrilla.

5.14.1 Alternative 2: Partial Retention

Under this alternative, the reservoir will be maintained at 14 feet NGVD and will be reduced to approximately 7,300 acres. This alternative would create a smaller reservoir while restoring a small portion of the Ocklawaha River flood plain. Characteristics of the reservoir would include a large shallow littoral area and a smaller open water area. More intensive management would be required due to exposure of submerged tree hazards, and the only area safely accessible by aquatic plant management crews would be the small section of newly restored river and shallow littoral areas. Until there is sufficient canopy, aggressive colonizers, such as torpedograss, cattails, and willow, would dominate the area. Hydrilla and other submerged species typical of flowing water, such as tape grass (*Vallisneria americana*) and pondweed (*Potamogeton illinoensis*), are expected to occur over much of the shallow restored river channel.

Drawdowns under this alternative can be used to manage floating plants and hydrilla. Between drawdowns, however, aquatic plant control would be more difficult due to the submerged tree hazards. Additionally, because the reservoir would be shallower, and light penetration would be greater, hydrilla would reestablish quickly and require intense management. Discharge rates of over 1,600 cfs are predicted (Rao et al. 1994), which precludes the use of fluridone to control hydrilla in most of the reservoir.

Historical aquatic plant management costs are presented in Tables 5-4 and 5-5. With a drawdown every 3 years, aquatic plant management costs for this alternative are estimated to range between $14,000 per year, when only floating plant control is necessary, and $190,000 per year, when hydrilla is treated (in protected areas of the reservoir where flow rates are lower and some control is possible). Without a drawdown every 3 years, the estimated cost ranges from $50,000 to $190,000.

Table 5-4

Summary of Floating Aquatic Plant Control on Rodman Reservoir from 1969 through October 1994

Fiscal Year Year	Acres Treated	Method of Control	Approximate Cost	Comments
1969-1970	144	Herbicides	$ 7,200	
1970-1971	4,714	Herbicides by aircraft	$ 235,700	
1971-1972	4,352	Herbicides by aircraft	$ 217,600	
1972-1973	64	Herbicides & drawdown	$ 3,200	Court ordered drawdown
1973-1974	138	Herbicides	$ 6,900	
1974-1975	358	Drawdown	$ 17,900	Surcharge to 20.5 feet msl drawdown to 15feet msl
1975-1976	594		$ 29,700	
1976-1977	356		$ 17,800	
1977-1978	17		$ 850	
1978-1979	26		$ 1,300	
1979-1980	0	Drawdown	$ 0	Two experimental drawdowns to 14 feet msl
1980-1981	12	Drawdown	$ 600	Drawdown to 10 feet msl
1981-1982	0	Drawdown	$ 0	Drawdown to 13 feet msl

Table 5-4 (continued)

Fiscal Year Year	Acres Treated	Method of Control	Approximate Cost	Comments
1982-1983	0		$ 0	
1983-1984	0		$ 0	
1984-1985	0		$ 0	
1985-1986	0	Drawdown	$ 0	Large fish kill in Aug-Sept drawdown to 10 feet msl
1986-1987	0		$ 0	
1987-1988	71	Herbicides	$ 10,650	
1988-1989	40	Herbicides & drawdown	$ 6,000	Large fish kill in Aug-Sept drawdown to 13 feet msl
1989-1990	184	Herbicides	$ 27,450	
1990-1991	225	Herbicides	$ 33,750	
1991-1992	176	Herbicides & drawdown	$ 26,400	Drawdown to 13 feet msl
1992-1993	33	Herbicides	$ 4,950	
1993-1994	14	Herbicides	$ 2,100	
Total Floating Plant Management Costs 1969-1994			$650,050	

Source: U.S. Army Corps of Engineers, Jacksonville District, Jacksonville (1969-1993) and Florida Department of Environmental Protection (1993-1994).

Table 5-5

Summary of Hydrilla Control on Rodman Reservoir from 1969 through October 1994

Fiscal Year Year	Acres Treated	Method of Control	Approximate Cost	Comments
1969-1970	0			
1970-1971	0			
1971-1972	0			
1972-1973	0			Court ordered drawdown to 13 feet msl 8/72-3/73
1973-1974	0			
1974-1975	0			Surcharge to 20.5 feet msl Drawdown to 15.0 feet msl
1975-1976	0			
1976-1977	0			
1977-1978	0			
1978-1979	6			
1979-1980	0	Drawdown	$ 0	Two experimental draw- downs to 14 feet msl
1980-1981	0	Drawdown	$ 0	Drawdown to 10 feet msl
1981-1982	2	Drawdown	$ 0	Drawdown to 13 feet msl
1982-1983	6	Experimental	N/A	
1983-1984	0			
1984-1985	0			
1985-1986	0	Drawdown	$ 0	Large fish kill in Aug-Sept drawdown to 10 feet msl

Table 5-5

Fiscal Year Year	Acres Treated	Method of Control	Approximate Cost	Comments
1986-1987	6	Herbicides	$ 1,200	
1987-1988	0			
1988-1989	222	Herbicides &	$ 87,600	Large fish kill in Aug-Sept drawdown to 13 feet msl
1989-1990	0			
1990-1991	63	Herbicides	$ 36,400	
1991-1992	0	Drawdown	$ 0	Drawdown to 13 feet msl
1992-1993	0			
1993-1994	3	Herbicides	$ 1,800	
Total Hydrilla Management Costs 1969-1994			$127,000	

Source: U.S. Army Corps of Engineers, Jacksonville District, Jacksonville (1969-1993) and Florida Department of Environmental Protection (1993-1994).

5.14.2 Alternative 3: Partial Restoration (Proposed Action)

The projected cost for aquatic plant management under the partial restoration alternative ranges from $14,000 to $200,000 per year. Drawdowns would not be available for management; but open water areas would be smaller, and seasonal fluctuations in water level would promote the decomposition of plant biomass.

5.14.3 Alternative 4: Full Restoration

Similar to Alternative 3, the projected cost for aquatic plant management under full restoration ranges from $14,000 to $200,000 per year. Drawdowns would not be available for management; but open water areas would be smaller, and seasonal fluctuations in water level would promote the decomposition of plant biomass.

5.14 Land Use and Property Ownership

5.15.0 Alternative 11: Full Retention

Under existing conditions, lands to the south of the project area are almost entirely in public ownership (US Forest Service lands). To the north side of the reservoir and around Deep Creek, lands include both State-owned and Conservation and Recreation Lands (CARL) lands. These make up the majority of land ownership in the project area and include predominantly open water, vegetated wetlands, and wetland hardwood forest. There are approximately 600 acres of submerged national forest system lands under Rodman Reservoir.

Presently, small portions of the area are in private ownership (see Figure 4-9). There are small areas of medium- and low-residential housing adjacent to the project area, located primarily in Hog Valley and near the Eureka Dam. Land use will not change as a result of the full retention alternative. Land use not associated with natural vegetation or open water include low- and medium-residential, recreational, canals and lock structures, some agricultural, and the extractive use associated with the borrow pit at the southeast corner of the reservoir.

5.15.1 Alternative 2: Partial Retention

Under the partial retention alternative, recreation locations would change due to the decrease in water level to 14 feet NGVD. There will be a small increase in nonforested wetlands, which would eventually be replaced by floodplain forest as revegetation occurs. No other changes are expected, and land use will remain as described for the full retention alternative. Nearly all the lands in and adjacent to the project area are in state or CARL ownership, although there are some small, privately owned parcels beneath the reservoir that have been identified for purchase by the state under this restoration alternative.

Maintenance to existing recreational facilities would continue under this alternative. Partial retention does not preclude improvements in existing facilities or addition of recreational facilities should funds become available.

5.15.2 Alternative 3: Partial Restoration (Proposed Action)

Under the partial restoration alternative, more land would be exposed as the historic river channel is restored. Nearly all the lands in and adjacent to the project area are in public ownership, although there are some small, privately owned parcels beneath the reservoir that have been identified for purchase by the State under this restoration alternative. Adjacent land use is not expected to change under this alternative. In addition, the approximately 600 acres of submerged national forest land would be restored and available for public use. There would be significant changes in land use due to the transformation from open water and artificially created structures to historic natural floodplain features. Recreation facilities would be altered or moved to accommodate the change in water levels and to provide access to the water

Under this alternative, there may be minor changes in land use classification. The changes will include primarily berms and lock structure removals. They will not be as extensive as the changes under the full restoration alternative due to the limited structural changes under this alternative. Changes in other land uses (e.g. recreation) are described under the full restoration alternative.

5.15.3 Alternative 4: Full Restoration.

Residential land use would not change significantly. Under the full restoration alternative, topography would be restored to historic conditions. As a result, there would be significant changes in land use due to the transformation from open water and artificially created structures to historic natural floodplain features. Recreation facilities would be altered or moved to accommodate the change in water levels and to provide access to the water. Land use associated with canals and locks will eventually change to the adjacent, naturally-occurring land uses, such as forested and nonforested wetlands, resulting in increases in wetland forest and decreases in land uses associated with canals, lock structures, and extractive uses.

5.16 Cultural Resources

The Draft Environmental Impact Statement (DEIS) did not consider that most of the area of potential effect had not been archeologically surveyed. Therefore, the effects analysis of the four alternatives in the draft DEIS was based on incomplete information. Although the DEIS was shared with the Florida State Historic Preservation Office and Tribal Historic Preservation Officers of federally recognized Tribes with whom the National Forests in Florida have been consulting to date, there was insufficient information in the draft document to provide an opportunity for an informed response. Also, some sensitive information was inappropriately presented in the DEIS that has been removed from the Final.

5.16.0 Alternative 1: Full Retention

It is unknown exactly how many archeological resources occur within the area of potential effect and recorded sites have not been actively monitored. At least 19 sites occur in the area, but more are expected to occur. It is possible that one or more submerged archeological sites are undergoing erosion or deflation and will continue to degrade in that manner under this alternative.

Unconsolidated sediments may be protecting submerged cultural resources from erosion, deflation and looting.

5.16.1 Alternative 2: Partial Retention

Impacts associated with Partial Retention are the same as those described for full retention. However, some archeological sites may be exposed increasing their potential for being looted, altered by environmental conditions, or damaged by recreational activities.

5.16.2 Alternative 3: Partial Restoration (Proposed Action)

Direct effects of Alternative 3 include drying of submerged wooden artifacts, dredging, organic debris removal, berm removal and other ground disturbing activities. Indirect effects include increasing the potential of archeological looting by exposing submerged sites and damage from recreational activities. Since a comprehensive survey of the area has never been done, some degree of field data recovery would be necessary. An operating plan to identify, locate, monitor and mitigate impacts to cultural resources would be a requirement of the special use permit under this alternative. A major component of an operating plan would involve protecting exposed cultural resources from looting since the risk for this impact is considered extremely high.

Coordination among the US Forest Service, Florida Department of Environmental Protection and Florida Division of Historical Resources will be necessary in the development of an operating plan. The "lead" federal agency is responsible for compliance with the National Historic Preservation Act for federally funded undertakings or permitted undertakings that occur on lands they manage. This responsibility may not be delegated to a state agency. Although the USFS may be the lead federal agency for executing the special use permit for Kirkpatrick Dam, another federal agency may be considered the lead agency for subsequent federal undertakings or permitted undertakings associated with restoration.

5.16.3 Alternative 4: Full Restoration

Impacts associated with Full Restoration are the same as those described for Partial Restoration. However, more cultural resource sites would be exposed under this alternative.

5.17 Aesthetic Resources

Aesthetic resources describe the physical characteristics of a landscape that determine its scenic quality in relevant value to the viewing public.

5.17.0 Alternative 2: Full Retention

The existing resource provides an open water vista and perimeter marshes, as well as attractions such as open water fishing and boating. Rodman Reservoir appears as a large lake interspersed with dead stumps. The fact that the floor of the reservoir consists of dug canals, berms, and crushed trees is not obvious at 18 feet NGVD. The overall visual variety within this landscape is that associated with a

lake system, as opposed to a riverine system. The diversity in landscape results from the subtle differences in landscape form, color, and texture.

The landscape of the project area was altered from natural conditions by the reservoir and associated construction activities. Berms, canals, spoil piles, and concrete barriers replaced historic floodplain forest. The landscape will have a greater variation due to the edge effect of the lake shoreline. Under existing conditions, the aesthetic values associated with the reservoir and associated passive recreation areas will not be altered. In addition, the berms, canals, spoil piles, and concrete barriers will remain. The presence of these structures present a modified environment influenced by the works of man.

5.17.1 Alternative 2: Partial Retention

Impacts under this alternative are similar to those described for full retention. The variation in landscape, associated with the reservoir, would remain as it presently exists except for an increase in marsh vegetation and aquatic plants. Over time, the portion of the Ocklawaha River no longer inundated would be partially restored to a floodplain. The river section would gradually succumb to a landscape with intermediate diversity. As succession takes place, incremental differences in landscape form, color, and texture will result.

5.17.2 Alternative 3: Partial Restoration (Proposed Action)

From a coarse-grained landscape level, the overall variation in the project area would decrease. Over time, the project area would succeed to floodplain forest with a river channel flowing through it. The reservoir and associated marsh and vegetation would be reduced substantially. At a finer-grained level, however, the complexity and diversity of a mature and self-maintaining floodplain forest would result in increased diversity of habitat characterized by the small changes in elevation and hydrology of the restored conditions. Evidence of the works of man would be less noticeable, particularly from the river, as the twists and turns of the river reduce sight distances. Settings would be more oriented to the more remote and semi-primitive settings of a natural floodplain forest.

Under the partial restoration alternative, the reservoir and associated marsh would be replaced by a riverine system. The shift in aesthetics would be to a meandering river channel with overhanging trees and lake attractions would be replaced to riverine boating and fishing, camping, and hiking.

5.17.3 Full Restoration

Similar to the partial restoration alternative, from a coarse-grained landscape level, the overall variation in the project area would decrease. Over time, the project area would succeed to floodplain forest with a river channel flowing through it. The reservoir and associated marsh and vegetation would be reduced substantially. At a finer-grained level, however, the complexity and diversity of a mature and self-maintaining floodplain forest would result in increased diversity of habitat characterized by the small changes in elevation and hydrology of the restored conditions.

Evidence of the works of man would be less noticeable, particularly from the river, as the twists and turns of the river reduce sight distances. Settings would be more oriented to the more remote and

semi-primitive settings of a natural floodplain forest. This alternative would present an even more natural landscape as all berms, canals, spoil piles and other structures are removed. Over time, even the footprints of these structures would be obscured by encroaching vegetation.

5.18 Noise

5.18.0 Alternative 1: Full Retention

The vicinity of Rodman Reservoir is rural in character. These areas include agricultural and undeveloped lands with some interspersed rural residential areas. Existing sources of noise include vehicles that travel on SR 19, SR 310, and Kirkpatrick Dam, and motorboats on the river and reservoir.

Noise measurements are not available for the project area. Rural, undeveloped sites typically have noise levels of 35 to 55 decibels, while levels associated with transportation average around 70 decibels. Other sources of noise found in the area include all-terrain vehicles, airboats, agricultural equipment, activities associated with hunting such as guns and dogs, people recreating, and the dam itself.

5.18.1 Alternative 2: Partial Retention

This alternative would have the same noise impacts as the existing conditions described in Alternative 1. Limited structural changes would increase the noise level during any restoration activities.

5.18.2 Alternative 3: Partial Restoration (Proposed Action)

There would be an increase in noise levels associated with the breaching of the dam and the removal of some structures permitted in this alternative. The restoration-associated noise would subside after the construction phase. Noise associated with some types of recreation, such as motorboats moving at high speeds, may be reduced. Airboats may also have difficultly in navigating along the twists and turns of the restored river channel.

Noise impacts under this alternative would be generated by construction equipment, such as bulldozers, graders, front-end loaders, and large trucks, during restoration construction. This equipment would be maintained (e.g. mufflers and engine insulation) to minimize noise emissions. This type of equipment usually creates sound levels in the 70 to 90 decibel range at a distance of 50 feet. Such levels are generally audible within 1 mile. Noise impacts due to construction equipment is expected to be temporary and, due to the rural nature of the area, the noise would have a negligible impact on local residents.

5.18.3 Alternative 4: Full Restoration

There would be an increase in noise levels associated with the breaching of the dam and the removal of all structures, berms, canals, and related features permitted in this alternative. The restoration-associated noise would subside after the construction phase. Noise associated with some types of

recreation, such as motorboats moving at high speeds, may be reduced. Airboats may also have difficultly in navigating along the twists and turns of the restored river channel.

Noise impacts under this alternative are likely to be greatest and will be generated by construction equipment, such as bulldozers, graders, front-end loaders, and large trucks, during restoration construction. This equipment would be maintained (e.g. mufflers and engine insulation) to minimize noise emissions. This type of equipment usually creates sound levels in the 70 to 90 decibel range at a distance of 50 feet. Such levels are generally audible within 1 mile. Noise impacts due to construction equipment is expected to be temporary and, due to the rural nature of the area, the noise would have a negligible impact on local residents.

5.19 Air Quality

5.19.0 Alternative 1: Full Retention

The project area meets all National Ambient Air Quality Standards (FDEP 1997). The full retention alternative is not expected to cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality.

5.19.1 Alternative 2: Partial Retention

As with full retention, this alternative is not expected to cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality.

5.19.2 Alternative 3: Partial Restoration (Proposed Action)

The implementation of this alternative is not expected to not cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality. Hydrocarbons and other emission pollutants emitted from construction equipment during restoration activities are expected to be normal for construction activity of this type and would not generally be detectable by the time any reaches the nearest dwelling.

5.19.3 Alternative 4: Full Restoration

The implementation of this alternative is not expected to not cause or contribute to a violation of any of the National Ambient Air Quality Standards, nor is it expected to result in any incremental loss or significant deterioration of existing air quality. Hydrocarbons and other emission pollutants emitted from construction equipment during restoration activities are expected to be normal for construction activity of this type and would not generally be detectable by the time any reaches the nearest dwelling.

5.20 Hazardous and Toxic Wastes

5.20.0 Alternative 1: Full Retention

Buckman Lock contains a number of potential sources of hazardous and toxic wastes. Asbestos wall panels are installed in machinery buildings at the lock. The panels have been inventoried in an asbestos survey by SJRWMD. The panels are in good condition and pose no significant health hazard at the present time. There are underground storage tanks for petroleum fuels at Buckman Lock. They are in good condition, and all tanks meet State regulations. Herbicides are also stored at the lock. An internal environmental audit performed by the USACOE during December 1991 and January 1992 at Inglis Lock, Dam and Spillways, Eureka Lock and Dam, Buckman Lock and Dam, and the Silver Springs office building found no significant hazardous and toxic material problems.

5.20.1 Alternative 2: Partial Retention

This alternative would be similar to Alternative 1. While the locks, dams, and other structures do not pose any risk of hazardous or toxic exposure at present, they do exist there as potential sources.

5.20.2 Alternative 3: Partial Restoration (Proposed Action)

Data sources examined to date do not indicate the presence of hazardous and toxic wastes. From Volume 7 of the SJRWMD study (SJRWMD 1994), the risk to aquatic organisms is considered minimal based on a comparison of the metals concentrations in the sediments of Rodman Reservoir with the concentrations in another regional lake.

The procedures that would be implemented to minimize turbidity would also reduce metals levels in the water column (Appendix A). During a phased drawdown, vegetation would become established across the reservoir basin, preventing resuspension of the metals. In addition, the decreased water surface would reduce the effects of the wind in sediment resuspension and minimize the possibility of water quality violations. In the event that monitoring indicates violations of turbidity standard, discharges would be sampled to check for concentration of lead and silver in the water column.

5.20.3 Alternative 4: Full Restoration

This alternative would be similar to Alternative 3, Partial Restoration. Risks to aquatic organisms are considered minimal based on a comparison of the metals concentrations in the sediments of Rodman Reservoir with the concentrations in another regional lake. Phased drawdown procedures would have the same effects as Alternative 3. Full Restoration, however, would remove all structures, buildings, and potential sources of hazardous or toxic substances in the project area associated with the presence of the barge canal and structures. This would remove all potential sources of hazardous and toxic wastes from these structures in the future.

5.21 Recreation

5.21.0 Alternative 1: Full Retention

Total attendance by visitors to Rodman Reservoir was estimated to be 307,217 total person-days in 1993. This number includes both visitors within the 75-mile radius of Rodman Reservoir and long-distance visitors. Based on the total days multiplied by the appropriate consumer surplus per person per day (CSPPD), the total user value was calculated to be $3,738,831.

The retention of the reservoir will preserve the current water level, except during drawdowns for management purposes. This alternative will maintain existing boat ramps and recreational facilities used by the public. None of the existing recreational facilities are expected to be effected under the full retention alternative, leaving existing boat ramps and public recreational facilities available. During drawdowns required for aquatic plant management, most of the existing facilities will not provide access to the reservoir.

5.21.1 Alternative 2: Partial Retention

With the reservoir level at 14 feet NGVD, the boat ramp located at the Rodman Recreation Area will be affected. There would be no boat access at this point, and the recreational facilities would be approximately 3/4 mile from the water line.

The boat ramp at the Kenwood Recreational Area may not be functional at 14 feet NGVD. The camping facilities will be approximately 1/4 mile from the water. There is, however, a boat ramp constructed by the USACOE for use during drawdowns. Although currently flooded, at 14 feet NGVD the ramp will provide access to the reservoir and the upper portion of the Ocklawaha River.

The existing boat ramp at Orange Springs West will be 1/4 mile from the river under partial retention conditions. There is an existing road bed, which is submerged and leads to Old Ferry Landing, that will require extensive maintenance before it can provide access to the reservoir.

The existing boat ramps consist of concrete slabs that can be removed and installed in new areas. Thus, these facilities could continue to be used if relocated to new sites.

5.21.2 Alternative 3: Partial Restoration (Proposed Action)

Partial restoration conditions would restore the historic river channel by eliminating the reservoir. As a result, boat ramps constructed for reservoir access following dam construction would no longer provide access to the reservoir and the recreational facilities that accompany these boat ramps would be a considerable distance from the river. It would be possible to remove the existing concrete slabs of the boat ramps and install them at new sites along the restored river.

Under the partial restoration alternative, new recreation facilities may need to be constructed to provide access. Decisions on developments or improvements will be made after restoration and are not a part of this proposal. The Florida National Scenic Trail (FNST) would need to be relocated since it crosses Kirkpatrick Dam.

The restored river would offer new opportunities for recreation in a natural setting. Kayaking and canoeing, nature study and birdwatching, hunting and fishing, and hiking opportunities would continue. Opportunities for ecotourism and nature-based activities in a natural ecosystem setting would increase due to the increase in acreage of restored floodplain ecosystem. Visitation is expected to increase initially as residents and tourists alike will be curious about the environment of the restored river, and this would present increased opportunities for state and federal agencies to interpret the processes and management actions that have or are occurring.

According to the 2000 Statewide Comprehensive Outdoor Recreation Plan (SCORP, in Draft), eco-tourism is the fastest growing segment of Florida's tourism industry. With Florida being the nation's top tourist destination, opportunities for eco-tourism should be promoted at the local, state and regional level. Eco-tourism depends on conservation and protection of natural, cultural and historic resources, and an alternative that emphasizes restoration and conservation of public lands would increase opportunities for eco-tourism.

Comparisons of participation rates in various activities by alternatives is complicated by the fact that planning regions developed for the SCORP report places Putnam County in Region 4 (Northeast Florida) along with Duval, Flagler, St. Johns, Nassau, Baker and Clay. Marion County is placed in Region 5 (Withlacoochee) along with Citrus, Hernando, Levy and Sumnter. Participation rates for Putnam and Marion Counties cannot be isolated. Broadly speaking, however, both Region 4 and 5 showed projected demands for saltwater and freshwater beach activities. Since neither Putnam or Marion County provide saltwater fishing or saltwater beach activities, opportunities for providing more freshwater fishing and freshwater beach activities may increase in importance. A restored river environment may increase opportunities for a greater variety of freshwater activities. In addition, the SCORP noted a projected need to meet a greater demand for hiking by 2010 for Region 4 (which includes Putnam County), and a projected need to accommodate more bicycle riding by 2005 for Region 5 (which includes Marion County). Restoring the floodplain forest and environs may offer more acres for these activities than Alternative 1 or 2.

5.21.3 Alternative 4: Full Restoration

Recreational impacts under this alternative are the same as those described for the partial restoration alternative. With the river restored to its historic channel and the absence of the reservoir, existing recreational facilities would either be abandoned or be less desirable because of their distance to the water. As mentioned in Alternative 3, it would be possible to move the concrete slabs of the boat ramps and install them at new sites along the restored river. Also as in Alternative 3, the continuity of the Florida National Scenic Trail would need to be ensured.

The restored river would offer new opportunities for recreation in a natural setting by increasing the area of functioning floodplain forest ecosystem. Kayaking and canoeing, nature study and birdwatching, hunting and fishing, and hiking opportunities would continue. Opportunities for ecotourism and nature-based activities will increase. Visitation is expected to increase initially as residents and tourists alike will be curious about the environment of the restored river, and this would present increased opportunities for state and federal agencies to interpret the processes and management actions that have or are occurring.

5.22 Socio-economic Impact to Regional Economy

This socio-economic analysis addresses economic activity in Putnam and Marion Counties and the surrounding region in which the Rodman Reservoir and Ocklawaha River are located. Based on results of a socio-economic study (FDEP 1995), and supporting documentation from Bell (1992) and the Putnam County Chamber of Commerce (1992), none of the alternatives examined are expected to significantly impact the economic activity of Putnam and Marion Counties.

5.22.0 Alternative 1: Full Retention

Under continued full retention, economic opportunities are expected to remain at the present level. Estimated expenditures by Putnam and Marion County residents for activities at Rodman Reservoir in 1993 were approximately $323,613 in Putnam County and $940,000 in Marion County, for a total of $1,272,663. When the area surrounding Putnam and Marion counties is included, estimated direct expenditures by residents in the region for activities at Rodman Reservoir are $3,029,185 in Putnam County and $3,579,167 in Marion County. Estimated expenditures by those users who traveled long distances were $2,844,641 in Putnam County and $2,384,282 in Marion County. This information was collected by FDEP in 1992 by telephone and on-site surveys of residents of central Florida and users of the reservoir. It may not accurate portray expenditures by other types of recreationists in the area whose activities do not center on the Reservoir.

Total personal income (earnings, dividends, interest and rental income) in Putnam County in 1992 was $801,739,000, and total taxable sales were $365,558,000. The services and retail trade sectors, which include the business activities that serve users of Rodman Reservoir, had combined earnings of $606,532,000. In Putnam County, 45 employees (0.16% of the total work force) are supported within the retail and service industry; in Marion County, the number of employees is 57 (0.07% of the total work force).

Using the export-based method of economic evaluation, visitors to Rodman Reservoir in 1994 accounted for about $7.5 million in both direct and indirect expenditures. Of the $7.5 million, the $3.2 million that can be directly attributed to the reservoir accounts for 0.096 and 0.039 percent of the economic base in Putnam and Marion counties, respectively.

5.22.1 Alternative 2: Partial Retention

Under this alternative, attendance is estimated to be 53 percent less than under the full retention. Impacts to the local and regional economy under the partial retention alternative are expected to be greater than those described for the full retention alternative. Perhaps because it would be less attractive for recreation to river and lake users, the partial retention alternative would produce the fewest recreational benefits, estimated to be $1,775,142 and 145,868 recreation days. The state would continue to bear the cost of operation and maintenance of Buckman Lock and Kirkpatrick Dam.

5.22.2 Alternative 3: Partial Restoration

A minimum of 55.68 percent of all existing gross expenditure and earnings estimates can be expected to remain under the partial restoration alternative. Additionally, much of the lost recreational activity would be dispersed throughout other lakes and rivers within the region such as Lake George, Cresecent Lake, St. Johns River, Lake Kerr, Orange Lake, Lake Lochloosa, and the Interlachen change of Lakes.

Under the partial restoration alternative, an estimated 171,075 recreation days is predicted, amounting to a total user recreational value of $2,081,983. Under partial restoration, the surface features would not be completely restored and the dam will not be completely removed. This may account for the smaller number of users under partial restoration when compared with full restoration. It is important to remember that restoration of the river does not preclude all current recreational activities, and therefore expenditures, in the Rodman area of the Ocklawaha River. Some activities, such as camping and fishing, would continue although the FDEP survey indicates fewer visitor days under the restoration alternative.

Since fishing could continue at the partially restored river, there would be continued demand for the services provided by guides, although, as noted above, the projected number of visitor days to the restored river suggest that demand would be reduced. Nearby lakes continue to provide lake fishing opportunities for bass anglers.

5.22.3 Alternative 4: Full Restoration

Impacts to the local and regional economy under the full restoration alternative are expected to be similar to those described for the partial restoration alternative. The estimated total value of the river under full restoration, based on 171,075 user days, is $2.1 million.

5.23 Navigation

5.23.0 Alternative 1: Full Retention

Under this alternative, Buckman Lock will continue to maintain a navigable waterway between the Rodman Reservoir and the St. Johns River. The navigational limits of the Rodman Reservoir and canal are 4.5 feet of water. The deepest draft vessel observed using the reservoir is 1.5 feet deep, while the largest vessel that can safely navigate up the restored river channel would be 20 feet in length and have a draft of 1.5 feet. The navigation system is designed to accommodate a vessel up to 20 feet in length.

5.23.1 Alternative 2: Partial Retention

Because the Buckman lock remains functional at 14 ft NGVD, navigation through the lock is not impacted under this alternative. The navigational limits of the Rodman Reservoir and canal are 4.5 feet of water. The deepest draft vessel observed using the reservoir is 1.5 feet deep, while the largest vessel that can safely navigate up the restored river channel would be 20 feet in length and have a draft of 1.5 feet. The navigation system is designed to accommodate a vessel up to 20 feet in length.

5.23.2 Alternative 3: Partial Restoration (Proposed Action)

The report *Navigation Alternatives for the Restoration of the Ocklawaha River* (PBS&J 1997) provides an analysis of alternatives designed to deal with the problem of continuing navigation across the Kirkpatrick Dam during construction and restoration activities. The results of the analysis are presented for the appropriate alternatives.

Partial restoration requires that a navigation system be implemented to maintain river traffic while the reservoir is being lowered to historic water levels.

The navigational limits of the Rodman Reservoir and canal are 4.5 feet of water. The deepest draft vessel observed using the reservoir is 1.5 feet deep, while the largest vessel that can safely navigate up the restored river channel would be 20 feet in length and have a draft of 1.5 feet. The navigation system is designed to accommodate a vessel up to 20 feet in length. A portage system would be implemented at 9.2 ft MSL.

The costs of various portage systems ranged from $294,000.00 for a crane to lift a vessel over the lock to $83,000.00 for a trailer and ramp system. The other two alternatives were a forklift and travel lift. Rankings from best (1) to worst (4) were assigned to each of the four alternatives based on required operator skill, liability, portage time, and cost. The lowest rank, and therefore the first choice, was the trailer and ramp. Any portage system would be temporary during restoration activities.

5.23.3 Alternative 4: Full Restoration

As under full restoration, the river stage would be reduced below 9.2 feet MSL during construction and restoration activities, and a temporary portage system will be required (see Alternative 3).

5.24 Flood Hazards

5.24.0 Alternative 1: Full Retention

Peak discharges for 25- and 100-year return periods at Kirkpatrick Dam were estimated to be about 9 and 21 percent greater when compared to corresponding estimates for Riverside Landing in the natural river channel. During storm events, discharges at Kirkpatrick Dam have been higher when compared with discharges without the dam. Because the reservoir has been maintained at different water levels during different periods, no conclusions can be drawn regarding variation of water levels in the reservoir.

5.24.1 Alternative 2: Partial Retention

Effects of this alternative would be similar to the full retention alternative. It is possible that at 14 feet NGVD, a lower lake level in the reservoir would mitigate flooding slightly more than in Alternative 1.

5.24.2 Alternative 3: Partial Restoration (Proposed Action)

Under partial restoration, potential flood hazards would be decreased due to the estimated 9 to 21 percent decrease in peak discharges for 25- and 100-year floods. Based on Federal Emergency Management Agency (FEMA) maps, one residence is located within the flood zone and may be subject to flooding, (Figure 5-7).

5.24.3 Alternative 4: Full Restoration

This alternative would have similar effects as Alternative 3, Partial Restoration.

5.25 Water Supply and Conservation

5.25.0 Alternative 1: Full Retention

Six of the 79 wells identified in the project connect with the surficial aquifer, while the status of the remaining 24 wells is unknown. Under existing conditions, these wells will not require replacement. The impounded water in the Reservoir provides recreation and fisheries as opposed to a potable water supply. Any water supply will more likely be obtained from springs that feed the river.

5.25.1 Alternative 2: Partial Retention

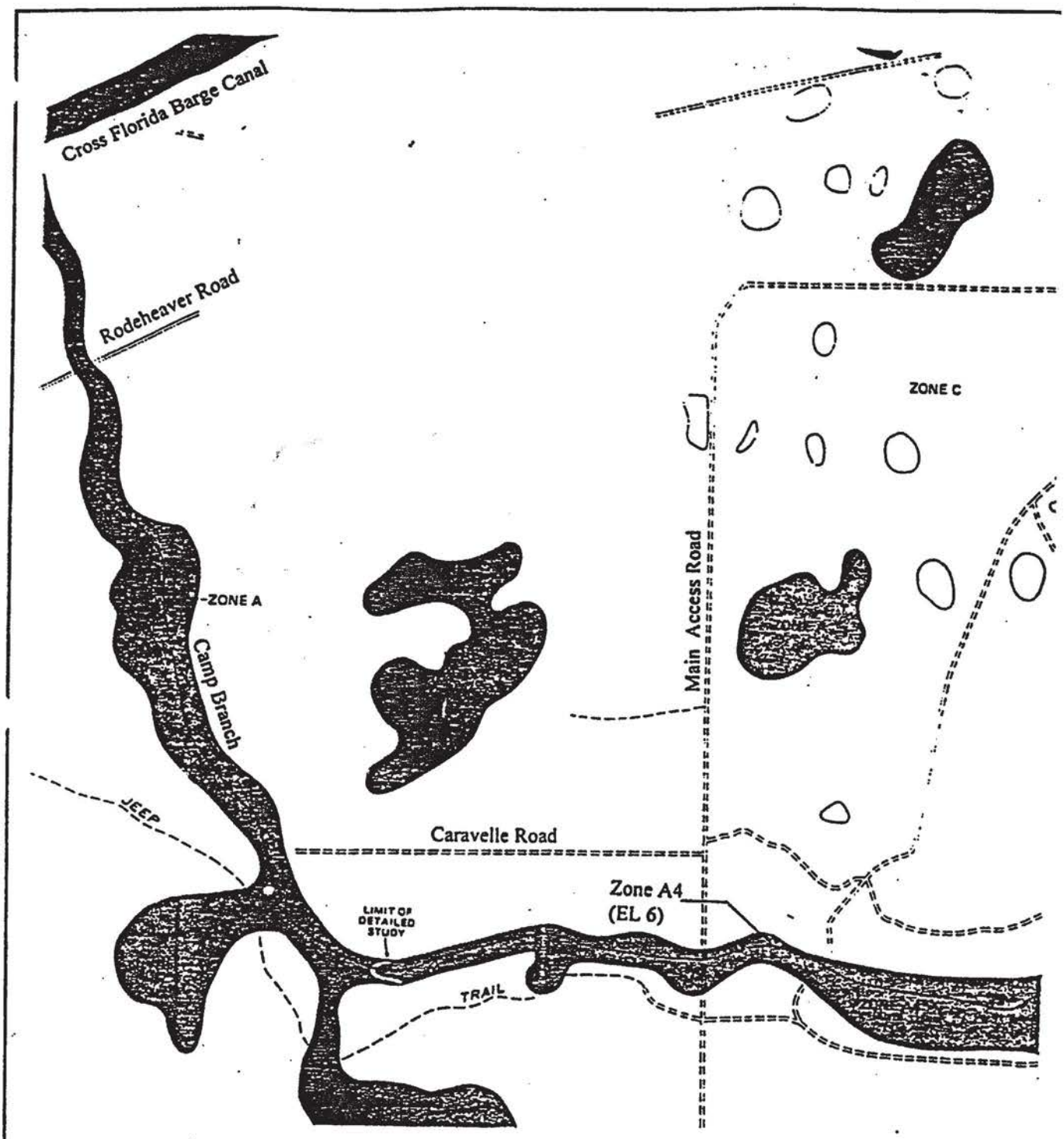
Six of the 79 wells identified in the project connect with the surficial aquifer, while the status of the remaining 24 wells is unknown. Under existing conditions, these wells would not require replacement. The impounded water in the Reservoir provides recreation and fisheries as opposed to a potable water supply. Any water supply will more likely be obtained from springs that feed the river.

5.25.2 Alternative 3: Partial Restoration (Proposed Action)

Downstream discharges will be restored under this alternative, and model results indicate that potential impacts of reservoir drawdowns on the Floridan aquifer would be minimal. However, modeling and time series analysis have demonstrated potential effects on water table elevations in the surficial aquifer. Six of the 79 wells identified in the project connect with the surficial aquifer, and the status of 24 wells is unknown. The estimated cost of replacing these surficial wells is less than the cost to obtain more accurate impact predictions through three-dimensional modeling. Restoring the river may expose some springs that were blocked by the reservoir.

5.25.3 Alternative 4:Full Restoration

Impacts to the water supply and conservation under this alternative are similar to those described for the partial restoration alternative. In addition, removal of all structures, canals and berms may re-open some springs that were blocked or buried during construction of the canals and locks.



Flood Insurance Rate Map
Putnam County, Florida
Effective Date: September 16, 1981
Panel 315 of 500

North

FLORIDA	PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.	Flood Insurance Rate Map - Camp Branch	FIGURE 5-7

5.26 Energy Needs

5.26.0 Alternative 1: Full Retention

Energy requirements related to the operation of Buckman Lock will remain or increase as energy costs increase. Utility costs for operation of Buckman Lock were $3,195.43 for fiscal year 94-95 and $2,063.50 for fiscal year 95-96.

5.26.1 Alternative 2: Partial Retention

Effects on energy needs would be similar to Alternative 1. See Alternative 1 for utility costs associated with Buckman Lock.

5.26.2 Alternative 3: Partial Restoration (Proposed Action)

Energy needs under this alternative would decrease as a result of closing the Buckman Lock and no longer incurring utility costs. These costs will no longer be incurred by the State of Florida.

5.26.3 Alternative 4: Full Restoration

As in Alternative 3, energy requirements would be reduced as a result of closing Buckman Lock.

5.27 Safety

5.27.0 Alternative 1: Full Retention

Partially and fully submerged logs in the reservoir pose a safety concern to boater, fishermen, and other recreationists. The number of logs in the reservoir is expected to increase under this alternative as stressed trees farther upstream fall and are transported downstream to the reservoir. In addition, the loss of federal funds in 1998 for snagging and clearing operations in the Ocklawaha River may further increase hazards posed by fallen trees.

Safety precautions presently associated with the dam, the lock, and the canal include fences and security and maintenance personnel.

5.27.1 Alternative 2: Partial Retention

In this alternative, partially and fully submerged logs in the reservoir would continue to pose a safety concern to boater, fishermen, and other recreationists. The number of logs in the reservoir is also expected to increase under this alternative, as stressed trees farther upstream fall and are transported downstream to the reservoir. In addition, the loss of federal funds in 1998 for snagging and clearing operations in the Ocklawaha River may further increase hazards posed by fallen trees.

Safety precautions presently associated with the dam, the lock, and the canal include fences and security and maintenance personnel.

5.27.2 Alternative 3: Partial Restoration (Proposed Action)

Under the partial restoration alternative, safety hazards due to the floating and submerged logs in the reservoir would decrease tremendously. Submerged logs would be exposed and any remaining in the channel may require removal. Since there are no live trees in the reservoir, dead trees would fall in the newly exposed areas until the floodplain expands into these restored areas.

In addition, the dam would be removed down to the spillway and lock abandoned. Physical barriers would be constructed in order to safely abandon the lock. Safe access to the river may need to be provided once the dam is breached.

During restoration activities, normal construction safety precautions would be taken.

5.27.3 Alternative 4: Full Restoration

Under full restoration, safety hazards due to the floating and submerged logs in the reservoir would decrease. Submerged logs would be exposed and any remaining in the channel may require removal. Since there are no live trees in the reservoir, dead trees would fall in the newly exposed areas until the floodplain expands into these restored areas. This may present a hazard to hikers and others who are walking through the area, as well as to canoeists and kayakers on the river.

All structures, berms and canals would be removed in this alternative. During restoration activities, normal construction safety precautions would be taken. With the removal of the dam, recreation facilities may need to be provided for safe access to the river at that point.

5.28 Food and Fiber Production

This public interest factor is not affected by this project.

5.29 Mineral Needs

This public interest factor is not affected by this project.

5.30 Needs and Welfare of the People

A review of Census 2000 tracts surrounding the project area revealed no disproportionate concentration of racial ethic or socioeconomic groups that would be adversely affected by the proposed action. (US Census Bureau)

5.30.0 Alternative 1: Full Retention

Under continued full retention, effects on the needs and welfare of the people are not expected to change. The river and the reservoir will continue to provide recreational, economic, scenic and aesthetic benefits. Socioeconomic, recreation, safety, and resource needs are specifically addressed in their respective sections. Health-related concerns, such as impacts from hazardous waste or contaminated water, are not issues in the project area and are not addressed in this document. The

needs of some members of the public, who prefer an open water environment with its associated sport fishing, will be emphasized over the needs of other members who prefer a more natural environment of a restored river.

5.30.0 Alternative 2: Partial Retention

Similar to Alternative 1, this alternative is not expected to alter the current benefits enjoyed by users of the river and reservoir. As in Alternative 1, the needs of some members of the public, who prefer an open water environment with its associated sport fishing, would be emphasized over the needs of other members who prefer a more natural environment of a restored river.

5.30.0 Alternative 3: Partial Restoration (Proposed Action)

This alternative proposes a change in the type of recreational, scenic and economic benefits that people would receive from the river. It emphasizes the needs of those who prefer a restored river and floodplain forest, with its associated habitat, over the needs of those who prefer an open water lake with it's developed sport fishery.

5.30.0 Alternative 4: Partial Restoration

This alternative, like Alternative 3, proposes a change in the type of recreational, scenic and economic benefits that people will receive from the river. It emphasizes the needs of those who prefer a restored river and floodplain forest, with its associated habitat, over the needs of those who prefer an open water lake with it's developed sport fishery.

5.31 Secondary and Cumulative Effects

Cumulative impacts are those impacts likely to result from the proposed action (partial restoration) or alternatives in combination with other past, present, and reasonably foreseeable future actions.

5.31.0 Alternative 1: Full Retention

Under this alternative, the effects of chronic flooding on the floodplain forest, specifically the loss of existing trees and the absence of new trees, are expected to continue. The reservoir will continue to provide open water space instead of a forest canopy. The lack of a forest canopy, combined with higher temperatures associated with unshaded areas, will result in continued high evaporation rates. Cumulative impacts on wildlife will be those associated with continued loss of habitat and fragmentation as the human population of the area slowly expands and the reservoir continues to serve the recreation needs of a growing Florida population. The reservoir fisheries may decline as the reservoir ages and dissolved oxygen levels decrease.

5.31.1 Alternative 2: Partial Retention

Secondary and cumulative effects under this alternative would be similar to those described for the full retention alternative.

5.31.2 Alternative 3: Partial Restoration (Proposed Action)

Based on the analysis conducted for the EIS, the project is expected to correct past and present negative impacts associated with the reservoir. Construction activities associated with the proposed restoration are expected to have minor negative impacts to existing vegetation, wildlife, land use, cultural resources, aesthetic resources, noise, air quality, and recreation resources within the project area. Restoration of the floodplain would result in significant long-term positive impacts to the Ocklawaha River basin by restoring hydroperiod and historic floodplain forest and habitat and the forest canopy.

Considering impacts due to the proposed action, geographic boundaries of the impact, impacts resulting from past actions, and potential impacts of reasonably foreseeable future actions, construction associated with the partial restoration alternative is expected to have minor negative impacts, be temporary, and confined primarily to the immediate area of project features and facilities. General negative and positive impacts resulting from the partial restoration are outlined in Table 5-6.

5.31.3 Alternative 4: Full Restoration

The secondary and cumulative effects under this alternative would be similar to those described for the partial restoration alternative.

5.32 Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

5.32.0 Alternative 1: Full Retention

Long-term productivity may be impacted the most by the Full Retention alternative. While it provides a productive sport fishery and many recreational benefits, long-term water quality and ecosystem diversity are reduced. Energy costs to operation the dam and lock represent a long-term commitment of funds and resources, especially in the arena of aquatic plant management. The reservoir represents a continued emphasis on the consumptive use of resources and requires land management agencies to follow a policy of producing goods and services instead of a policy of protecting the long-term health of the ecosystem.

5.32.1 Alternative 2: Partial Retention

The Partial Retention alternative is similar to the no action/ full retention alternative in that it continues to maintain a system based on producing a variety of goods and services from the environment. While this alternative also provides a productive sport fishery and many recreational benefits, long-term water quality and ecosystem diversity are reduced. Energy costs to operation the dam and lock represent a long-term commitment of funds and resources, especially in the arena of aquatic plant management.

5.32.2 Alternative 3: Partial Restoration (Proposed Action)

Negative impacts associated with implementing the proposed action would not be significant and will be temporary, associated with restoration activities. No important irreversible commitment of resources would occur. The short-term uses of resources (i.e. impacts) would not compromise the long-term environmental productivity of the project area, and in fact, would ensure and enhance the long-term productivity of the system. The Rodman Reservoir restoration project is the integral component of the restoration of the Ocklawaha River and would allow land management agencies to pursue a policy of conservation and protection of this unique ecosystem.

5.32.3 Alternative 4: Full Restoration

While restoration activities may result in temporary negative impacts to the system, they would result in the eventual maintenance and enhancement of the long-term productivity and health of the ecosystem. This alternative provides the most eco-centric approach to restoring the river by removing all man-made structures and restoring the historic landscape of the area.

Table 5-6a

Summary of Impacts to Wildlife

Positive	Negative
Restoring wetland habitat, function and diversity	
Gain in habitat for migratory fish	Loss of habitat for reservoir-dependent fish
Restoration of historic connection of Deep Creek and Orange Creek with river channel	Decrease in numbers of fish due to smaller area of open water
Increase in fish characteristic of flowing water	
Increase in herpetofauna habitat, especially for eastern indigo snake	Decrease in alligator numbers due to decrease in open water and marsh
Increase in habitat for tree dwelling birds and neotropical migrants	Loss of open water and marsh habitat for aquatic birds
Increase in roosting and nesting habitat for colonial wading birds and woodstorks	Net loss of foraging habitat for wading birds
No impacts to regional eagle populations	Relocation of existing eagle nest
Decrease in potential manatee deaths and/or injuries due to Buckman Lock	Possible increase in manatee/boat collisions due to decrease in channel width
Restoring manatee habitat conducive to historic migratory patterns	
Restoration of North-South terrestrial wildlife corridor through Ocala National Forest	
Decrease in invasive and exotic plants	
Increased floodplain forest available for listed plant species	

Table 5-6b

Summary of Impacts to Land Use and Recreational Facilities

Positive	Negative
Opportunity for camping facilities	Net loss of waterfront campsites
Opportunity for public access to river	Loss of private access to reservoir
More diverse recreational opportunities	Net loss of public boat ramp facilities
Increase in area for upland hunting	Decrease in area for waterfowl hunting
Increase in native vegetation throughout newly exposed flood plain	Loss of native vegetation due to construction of recreational facilities

Table 5-6c

Summary of Impacts to Water Quality

Positive	Negative
Water quality improved by restoration of natural flood plain	Possible temporary, short term pulse in nutrients downstream following breach of dam
Restoration of naturally occurring spring heads and habitats	
Water quality of surficial aquifer will increase as a result of floodplain reestablishment	

Table 5-6d

Summary of Impacts to Water Quantity

Positive	Negative
Restore natural flow patterns to the Ocklawaha	Loss of water storage capacity
Reduce loss of water resource due to evaporation	Potential loss of shallow wells
Reduce loss of water resource due to infiltration	

Table 5-6e

Summary of Impacts to Historic Resources

Positive	Negative
Ending potential erosion and deflation of inundated sites	Potential disturbance by dredging, berm leveling, re-shaping the borrow pit, erosion control, recreational use (esp. ATVs) and short and long term construction
Creates need to survey to identify unrecorded sites and relocate known sites and assess their condition, adding to the archeological record and establishing baseline data; prompts relocation of burial mounds so plans can be made to protect them and avoid them during restoration if at all possible	Underwater survey and the long-term curation of resulting cultural material requires special expertise and is costly and time consuming, terrestrial survey is costly and time consuming; at least one Tribe is opposed to archeological data recovery because "what is in the ground belongs in the ground"
Prompts need to plan and implement site monitoring and protection	Effective public notice and law enforcement support will be time consuming and costly; those who have looted before or plan to loot as a result of the restoration will likely protest enforcement of archeological laws
Increased public awareness of looting problem and law enforcement support in association with this project may help reduce looting elsewhere	Eliminating looting in one area may increase looting pressure on other areas that are not as patrolled as heavily
Accessibility to sites for archaeological and historical research	Accessibility to sites by looters; at least one Tribe does not endorse archeological research on their ancestors
Interagency cooperation will be required to make sure all necessary monitoring and mitigation occurs which may result in improved efficiency, resource protection and public service overall	Multiple agency involvement and mixed jurisdictional responsibilities increase the likelihood that resource protection needs are not met due to confusion over who is responsible for what and what law applies

Table 5-6f

Summary of Impacts to Navigation

Positive	Negative
Unimpeded navigation in the river channel	Reduces navigability by those vessels that can traverse the barge canal and cannot traverse the river
	Reduce navigation in the reservoir

Table 5-6g

Summary of Impacts to Aesthetics

Positive	Negative
Improve the color, texture and form by replacing an artificial reservoir system with a natural and diverse riverine system	At post drawdown, a temporary loss of aesthetics will occur due to construction and a lag before vegetation recovers

Table 5-6h

Summary of Impacts to Economics

Positive	Negative
Elimination of the costs associated with the maintenance and operation of Kirkpatrick Dam and Buckman Lock	.039% revenue loss for Marion County and .096% revenue loss for Putnam County
Potential revenue from timber production	
Potential opportunity for vendors	

5.33 Irreversible and Irretrievable Commitment of Resources

The term "irreversible commitment of resources" describes the loss of future options, while "irretrievable commitment of resources" refers to the loss of production, harvest, or use of natural resources. There would be no irreversible commitment of resources; however, it would be difficult and highly unlikely to rebuild the dam and replace the reservoir once either restoration alternative was implemented. Irretrievable commitment of resources would include the energy and materials used in restoration activities and the loss of the reservoir ecosystem and associated fish and wildlife habitat and recreational opportunities.

5.34 Compliance With Environmental Requirements

5.34.1 National Environmental Policy Act (NEPA) of 1969, as Amended

Environmental information on the project was gathered by the SJRWMD in a series of legislatively ordered studies. This information was compiled by FDEP, and a Draft EIS was prepared. An interdisciplinary approach was used; alternatives were studied, developed, and described; and ecological and biological information was developed and utilized. The Draft EIS was published and 103 comments were received from the public. These comments have been addressed by the U.S. Forest Service and are reflected in this Final EIS.

5.34.2 Endangered Species Act of 1973, as Amended

Formal consultation was initiated on July 17, 1996. Upon formal reply or concurrence by the USFWS, the project will be fully coordinated under the Endangered Species Act and will be in full compliance with the Act.

5.34.3 Clean Air Act of 1972, as Amended

Coordination on August 14, 1996 between the FDEP, Air Quality Division, and the Northeast SJRWMD Office determined that the proposed project is in partial compliance with the Clean Air Act. No permits will be required for this project. Full compliance will be achieved with receipt of comments on the EIS from the U.S. Environmental Protection Agency (USEPA).

5.34.4 Clean Water Act of 1972, as Amended

The project is in partial compliance. Full compliance will be achieved with the issuance of a Section 401 permit from the State of Florida and a Section 9, 10 and 404 permit from the USACOE. A Section 404(b)(1) evaluation is included in this report as Appendix G.

5.34.5 Coastal Zone Management Act of 1972, as Amended

This project is in partial compliance at this time. Full compliance will be achieved with receipt of comments from the State Clearinghouse. A federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as Appendix H.

5.34.6 Fish and Wildlife Coordination Act of 1958, as Amended

This Act is not applicable to this project because it is being planned and constructed by the State of Florida. The USACOE's role in the project is permitting only.

5.34.7 Land and Water Conservation Fund Act of 1965, as Amended

This Act is not applicable as this is a State project that is not Federally funded.

5.34.8 Marine Protection, Research, and Sanctuaries Act of 1972, as Amended

This act is not applicable. Ocean disposal of dredged material is not proposed.

5.34.9 Estuary Protection Act of 1968

This Act is not applicable since no estuaries will be affected by this project.

5.34.10 Federal Water Project Recreation Act of 1965, as Amended

This project is not applicable. This is a State project and is not Federally funded.

5.34.11 National Historic Preservation Act of 1966, as Amended

The study is in partial compliance at this stage. Full compliance will be achieved when cultural resource investigations are completed, and results are coordinated with the SHPO, the Advisory Council on Historic Preservation, and the Tribal Historic Preservation Officer.

5.34.12 Archeological and Historic Preservation Act of 1974, as Amended

Permits under the authority of this act may be required to inventory and evaluate cultural resources within the area of potential effect in compliance with NHPA. This is the authority used to prosecute individuals for looting archeological sites of federal property. In compliance with this Act, specific site location information will not be provided in the EIS or to the general public.

5.34.13 Coastal Barrier Resources Act (CBRA)

This Act is not applicable. The project area is not a designated CBRA unit.

5.34.14 Rivers and Harbors Appropriation Act of 1899

The project is in partial compliance at this time. A permit application has been submitted to the USACOE, and it is being reviewed in conjunction with this EIS. The proposed project will be in full compliance when review is completed, and a permit is issued.

5.34.15 Wild and Scenic River Act of 1968, as Amended

The project is in full compliance. No rivers designated under the Act are in the project area.

5.34.16 E.O. 11988, Floodplain Management

The project is in full compliance. The considered alternatives support avoidance of development in the floodplain, continue to reduce hazards and risks associated with floods and to minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values of the floodplain.

5.34.17 E.O. 11990, Protection of Wetlands

The project is in full compliance. The nature of the project involves working in wetlands, and there is no practical alternative to working in wetlands. Losses and degradation to the beneficial values of wetlands are minimized, and such values are preserved and enhanced. The public has been involved in early planning.

5.34.18 National Forest Management Act of 1976 (NFMA)

The National Forest Management Act of 1976 amends the Forest Rangeland Renewable Resources Planning Act of 1974 and sets forth the requirements for Land and Resource Management Plans for the National Forest System. The proposed action is consistent with the NFMA and the Revised Land and Resource Management Plan for the National Forests in Florida.

5.34.19 Marine Mammal Protection Act of 1972.

The MMPA addresses conservation planning for manatees by establishing a moratorium on the taking of marine mammals, including the West Indian Manatee. This project complies with the MMPA.

6.0 List of Preparers

The people who were primarily responsible for the preparation of this Environmental Impact Statement are listed below:

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4049 Reid Street
Palatka, FL 32177

Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Blvd.
Tallahassee, FL 32399-2100

Bronson Public Library
600 Gilbert Street
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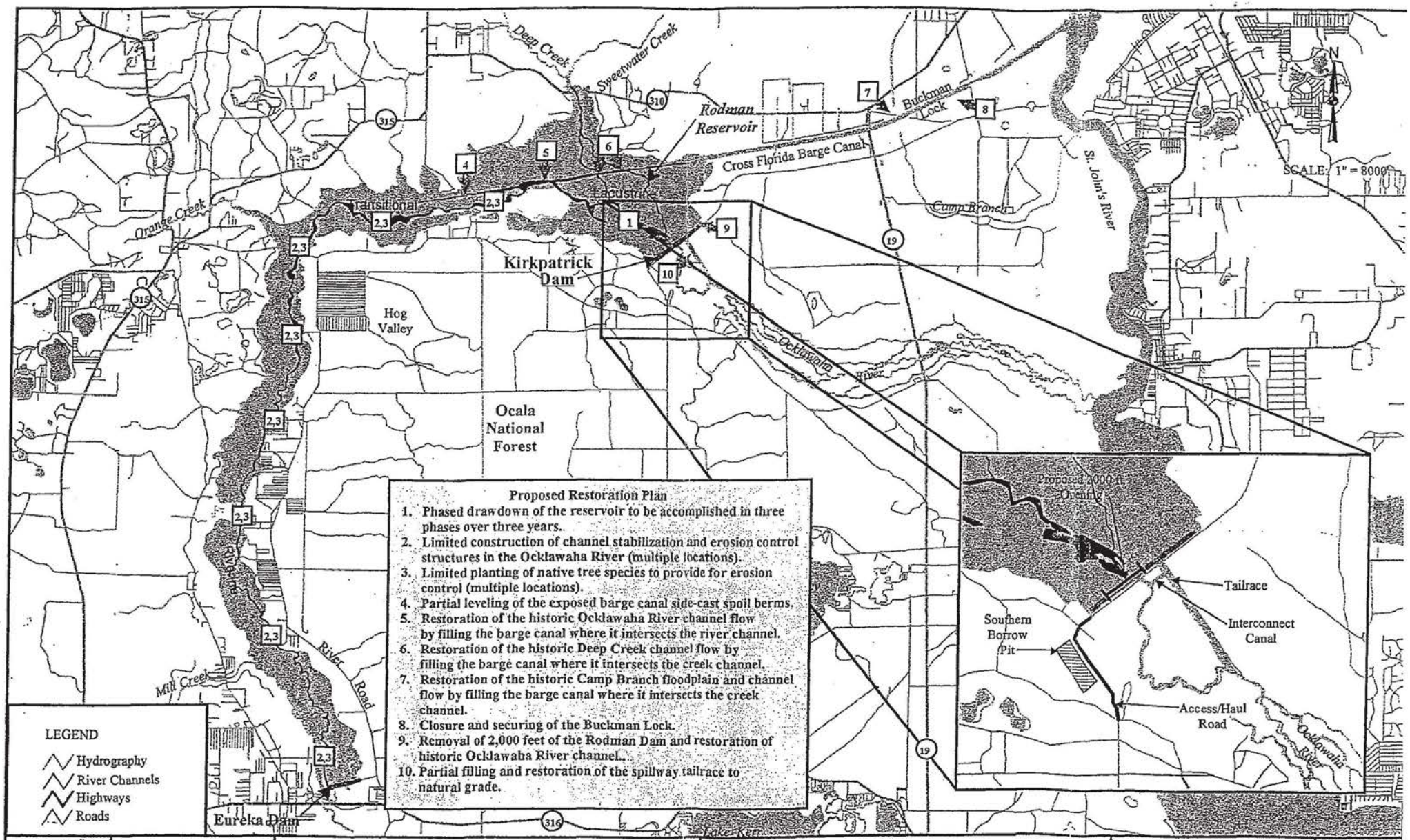
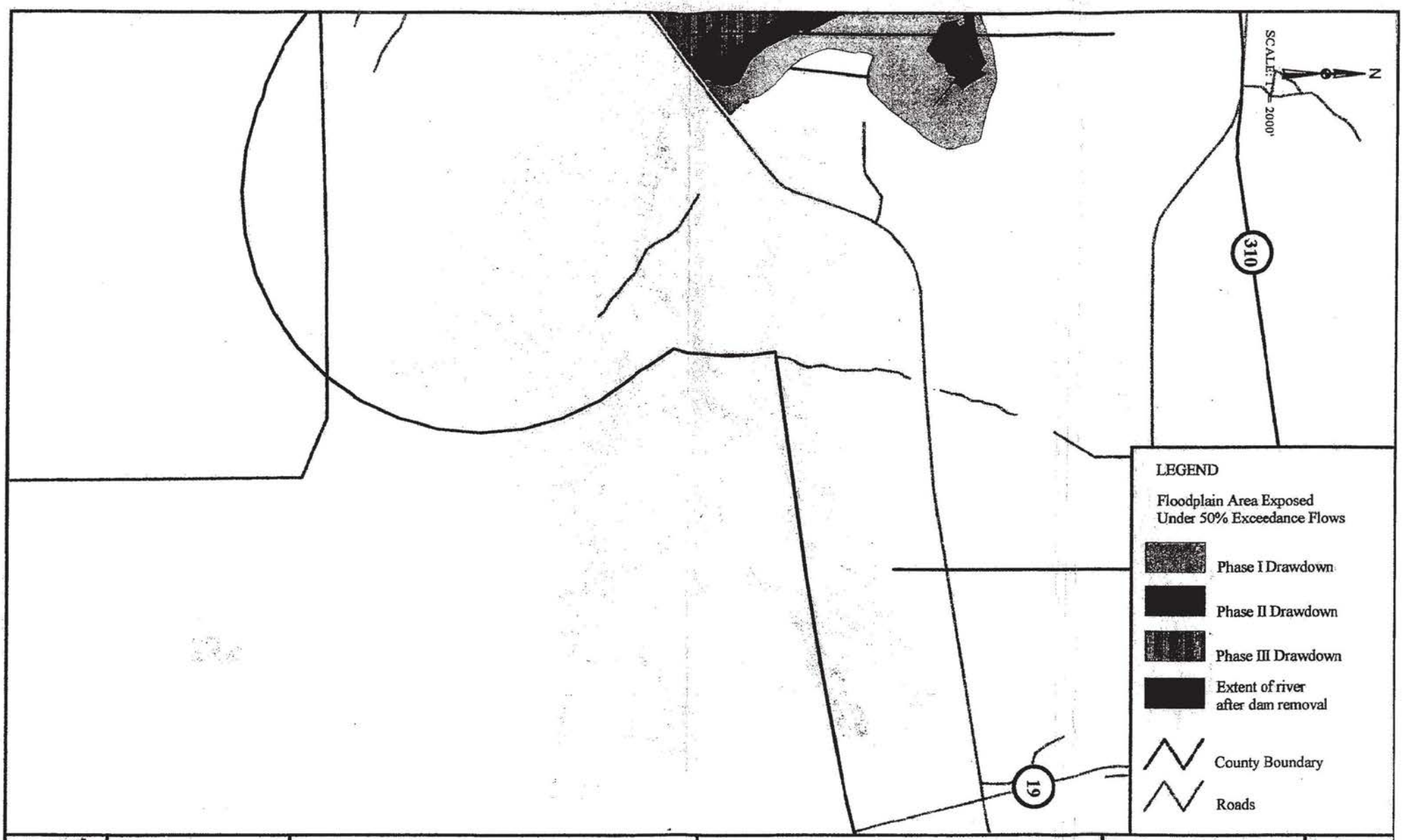


FLORIDA	PBS&J Post, Buckley, Schuh & Jernigan, Inc.	Ocklawaha River Restoration	Proposed Restoration Plan	Source(s): U.S.G.S.; U.S. Census Bureau — FIGURE 3-1



PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Floodplain Area Exposed with Phased Drawdown

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 3-2a

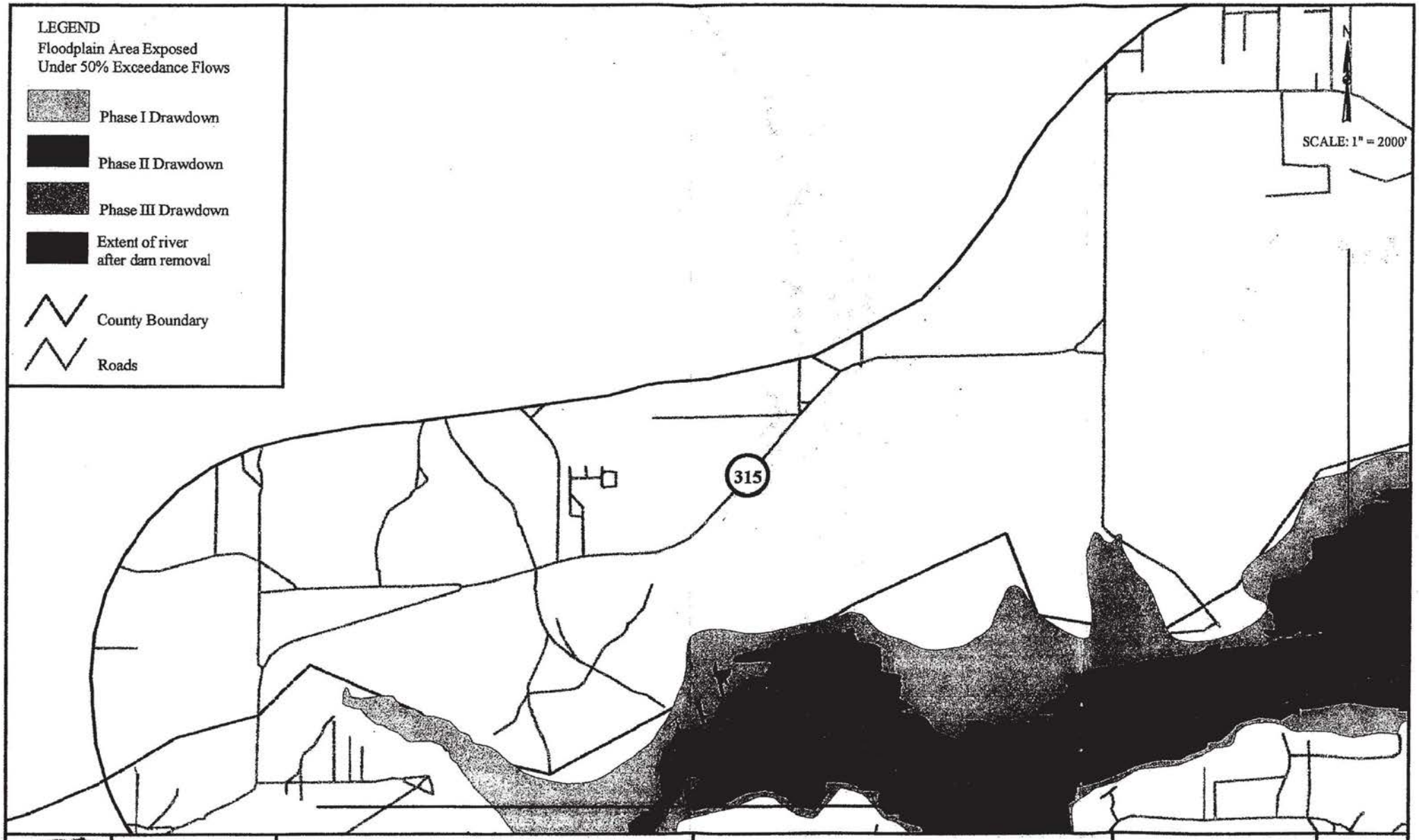
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Floodplain Area Exposed with Phased Drawdown

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 3-2b



PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Floodplain Area Exposed with Phased Drawdown

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 3-2c

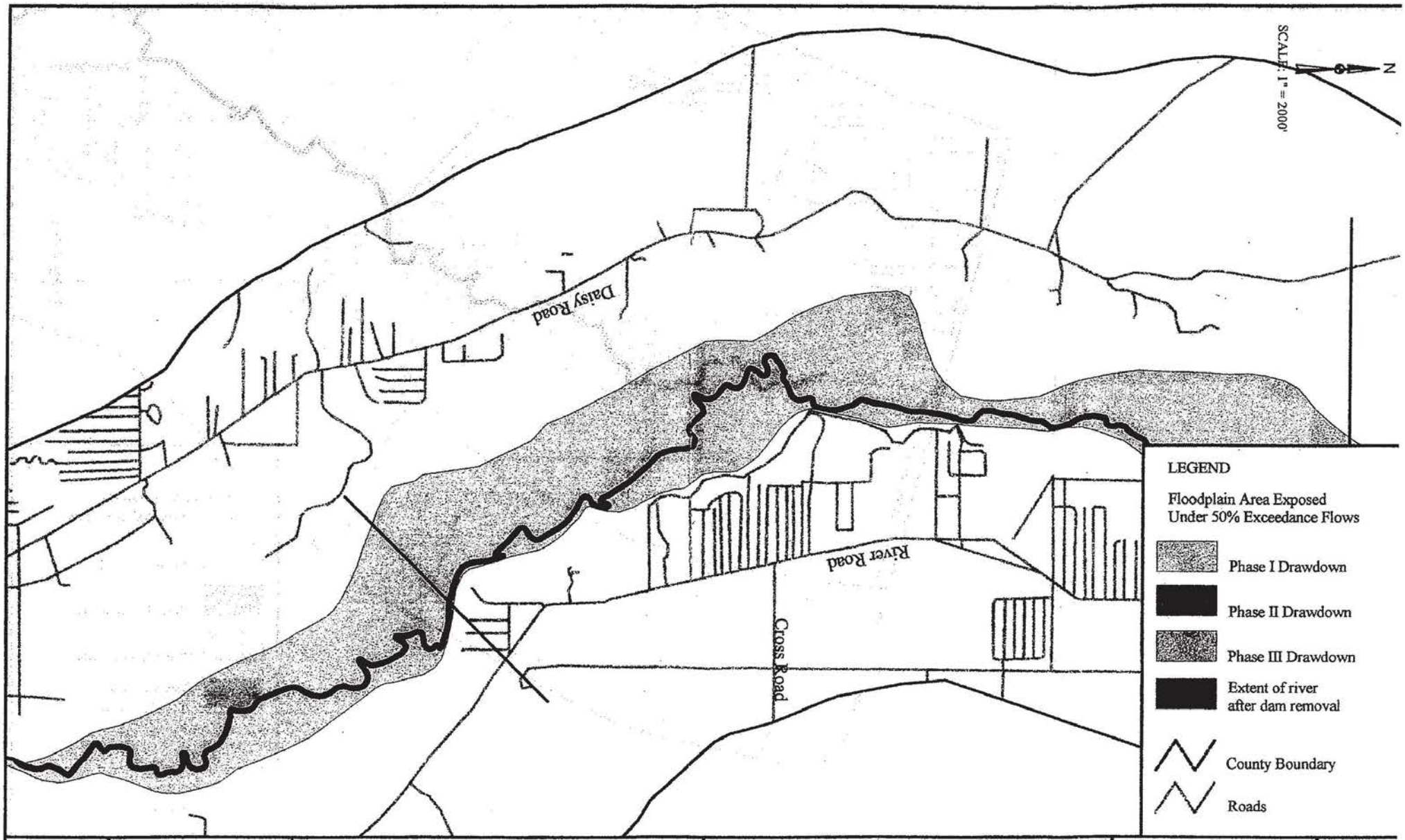
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Floodplain Area Exposed with Phased Drawdown

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 3-2d



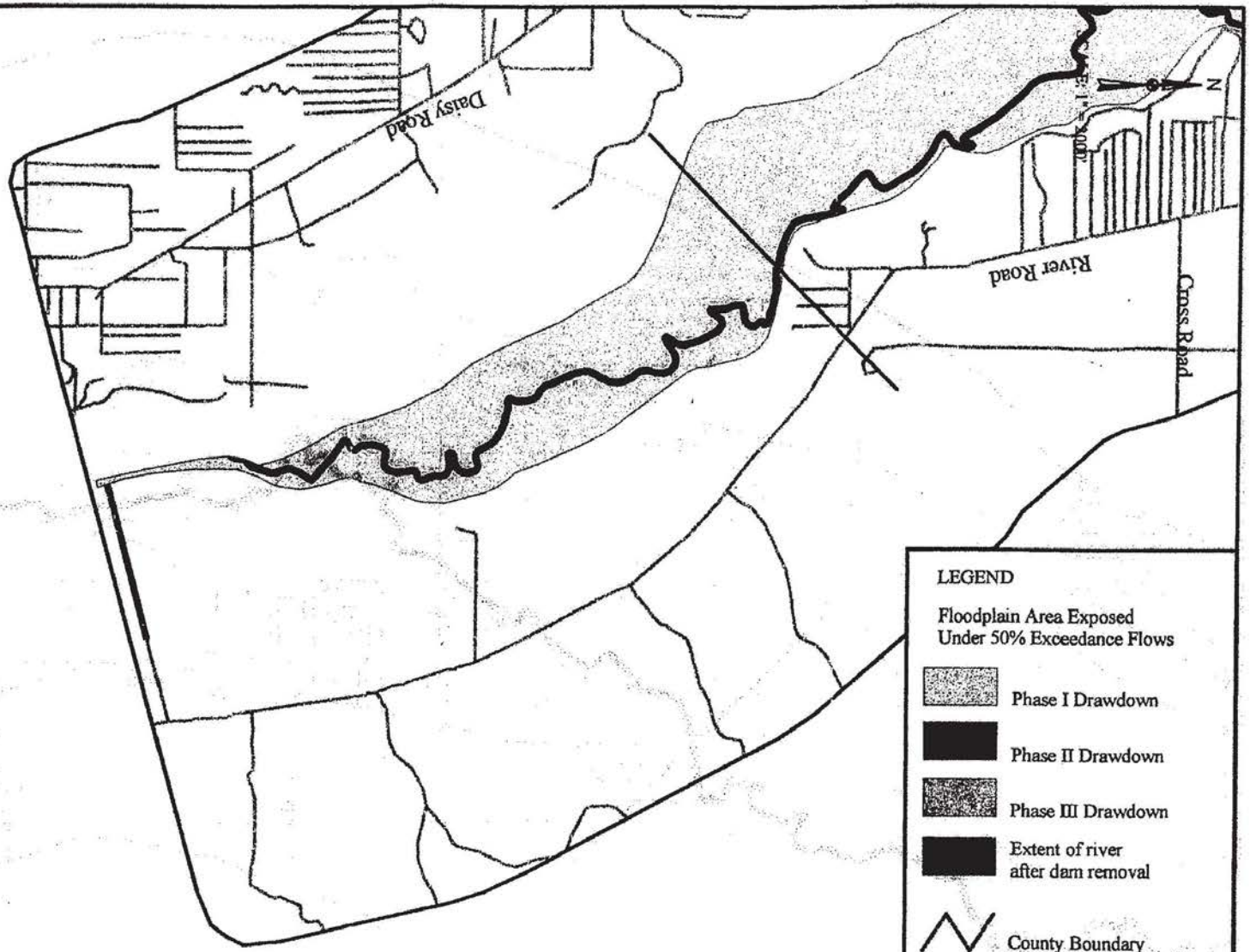
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Floodplain Area Exposed with Phased Drawdown

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 3-2e



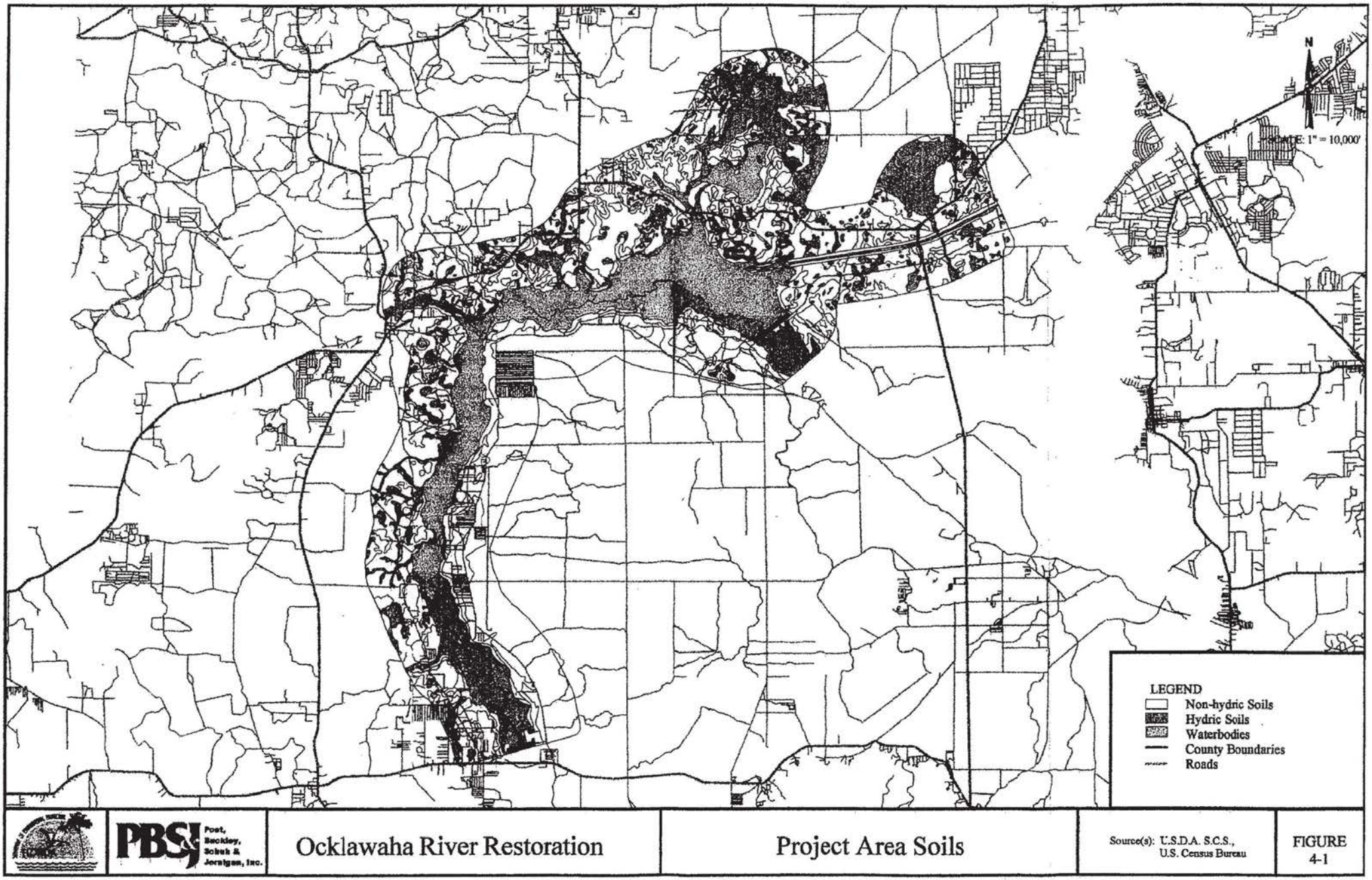
PBSJ Post, Buckley, Schuh & Jernigan, Inc.	Ocklawaha River Restoration	Floodplain Area Exposed with Phased Drawdown	Source(s): U.S. Census Bureau; SJRWMD	FIGURE 3-2f

Table 3-2

Summary of results presented in Environmental studies concerning four alternatives for Rodman Reservoir and the lower Ocklawaha River (SJRWMD 1994)*

Volume	Restoration alternatives for the Ocklawaha River restoration project			
	1. No action/ full retention. No change in existing management. All structures maintained for navigation. Includes plant management. (options under this alternative are presented later).	2. Partial retention. Reduce pool size to 14 ft. NGVD. Limited structural changes. Restore hydrology and floodplain function in upper river reaches (options under this alternative are presented later).	3. Partial restoration - proposed action alternative. Restore river hydrology and floodplain function to pre-dam conditions via dam breach, limited changes and/or removal of structures.	4. Full restoration. Restore river hydrology and floodplain an topography to pre-construction conditions via removal of all structures.
Vol. 2. Elev. surveys	Maps of 35 cross sections of the river were produced.			
Vol. 3. Bathymetric and sediment analysis	No comparisons made. Results used in hydrologic, hydraulic, sediment transport and characterization, toxics, pollutants, and other subsequent volumes. Appx. 90% of bottom (5136 ac) covered in soft sed.; 844 ac without soft sed.; 43% of reservoir has soft sediments 1 ft deep; 36% have soft sed. >2 ft deep. At 18 NGVD, the 5,980 ac reservoir has a mean depth= 8.4 ft; max.=31 ft. A 50% water volume removal=4.7f t dec. in stage; 1 ft dec in stage=4.7% dec in surface area, 11.4% dec in volume.			
Vol. 4. Bottom sediments	No comparisons made. No O.M. >1m below sediment surface. Low critical shear stress of sediments (highly erodable); velocity v. erosion used in subsequent volumes. Need more information, especially as it pertains to newly exposed sediments and vegetation.			
Vol. 5. Sediment transport	Erosion rates within limits for maintaining top soil layer due to mild slopes and existing land use. Retention scenarios were not included.		Erosion rates within limits for top soil due to mild slopes and land use. Tot. accumulated sediment outflows > inflows. Recommend directing flow into river, not canal; drawdown over several years for vegetation; further 2- and 3-D modeling.	
Vol. 6. Resuspension	No comparisons made. Resuspension of sediments in the channel due to wind is expected to be greater than in the shallows.			
Vol. 7. Sediments, tox-ics, seedbanks	No comparisons made. Sediments are appx. 80% water by volume, with densities only slightly > water (sp. Gravity=1.16). TOC higher in lacustrine zone. Only Pb and Ag exceeded Class III standards under worst-case scenario (release of 10% of sediments). No drawdowns during storms = no discharges= no downstream impacts. Primarily aquatic weeds germinated; no trees.			
Vol. 8. Topography	No comparisons made. Elevations of cross sections of flooded channel were +4 to -7 NGVD; Channel widths were 110 - 260 ft. Sediments were <2 ft deep.			
Vol. 9. Sediment loading	Sediments moved during 25yr or longer storm events; resuspension (<10%) during strong wind events. 15mph west wind required to resuspend sed.- discharges should be minimized during drawdowns and restoration scenarios.		Flocculent sediments transported downstream under normal flows. No sediment resuspension except during strong wind events.	
Vol. 10. Hydraulics and hydrology	*Hydrology.* 18 NGVD. 1674 cfs. *No seasonal fluctuations.*	14 ft. NGVD. 1687 cfs. *No seasonal fluctuations.*	*Seasonal fluctuations.* 1736 cfs.	
	Hydraulics. Pool extends 49,200 ft upstream with depths 2.4-4 ft > than with restoration. 9601 ac flooded.	14 ft NGVD pool extends 24,000 to 36,000 ft upstream, floods 7,270 ac., expect 2331 ac. of river restored.	Pool extends 19,400 ft upstream, floods 4490 ac., expect 5107 acres to be restored (under full restoration, 4,494 ac remain submerged avg. discharge and total area restored becomes 9,601 acres).	
vol. 11. Surface water quality	Differences in hydrology not accounted for in making comparisons over time. Period of time over which WQ variances may be required was not completely addressed. WQ in reservoir and river & tributaries, up to Eaton Creek., are classified by FDEP a "good." Farther upstream is "fair"; Sweetwater Creek is "poor." Lower total NO2+NO3 and DO in lacustrine and transition zones and downstream of dam. Reservoir plants are a nutrient sink. No nutrient/ materials exchange between open water an forest.			
	Predicted TP value =.014mg/L; dissolved NO3+NO2 value =.103mg/L.	Predicted TP=.025mg/L; NO3+NO2= .418mg/L.	Predicted TP=.039mg/L; NO3+NO2=.829mg/L. Worst case: erosion/ release of all nutrients over 2 months with mean discharge of 13 cfs results in tenporary inc. in TSS by 353 mg/L, TKN by 4.14 mg/L, TP .23 mg/L.	
Vol. 12. Aquifers	No data available for surficial aquifer. No significant effects on Floridan aquifer due to various alternatives. Replacing existing wells is less expensive than study of effects of surficial aquifer.			
Vol. 13. Darters	No bluenose shiners or tessellated darters collected from river since 1949. Four t-darters collected during study. Hydro.restoration could benefit species by increasing available stream habitat.			
Vol. 14. Migratory fish	Some migratory fish are passing through the Buckman Lock. The dam appears to pose a barrier to the spread of a variety of migratory fishes that historically used the system.		Increase in migratory fish populations expected.	
Vol. 15. Fish populations	42 spp from 18 families (compared to historic 69 spp from 22 families). Decrease is likely due to change from flowing to lotic system. Greater biomass of fish.		Inc. in fish diversity , although a decrease in fish densities, e.g. bullhead and shiners, is expected (compare to historic numbers).	
Vol. 16. Aquatic plant manage-ment	Requires drawdons and herbicides. $22,000/ year for floating plant control; $270,000 to include hydrilla control.	Most time and expense; $14,000/ year for floating leaved plants, $190,000 to include hydrilla.	$14,000 - 200,000/ year. Difficult to predict. Drawdowns unavailable for management, but there is less open water.	
Vol. 17. Forest succession	All scenarios, with and without planting, result in floodplain forest species, when trees exist; but no information on extent of forest available for succession. Comparisons at different elevations not made. Differences in species composition were subtle an likely due to changes in elevation. Exotics were not considered.			
Using FORFLO model	No new trees under flooded conditions without planting flood tolerant *saplings*. Floodplain forest after 50 - 200 years. Eastern section of Lacustrine zone requires tree planting.		Development of characteristic floodplain forest by 40 years.	
Vol. 18. Threatened and endangered species	Wading bird species, muskrats, alligators will remain. Loss of nesting sites for ospreys, great blues, limkins. Marsh and aquatic habitats will persist, no springs, limited floodplain forest.		Increase in forest may inc. habitat for Atlantic white cedar, Indigo snake, manatee, tessellated darter, and spotted turtle. Decrease in wading birds, alligators.	
Vol. 19. Birds	Fewer sites for nesting birds (as above).		Decreased open water and marsh spp., increase in forest spp. No threatened and endangered spp. Affected. Possible loss of species o special concern, 3 heron, Limpkin.	
20. Habitat	Fragmented floodplain, no connection of forest to open water, no corridors. dec. ecological integrity. Twenty springs were lost in reservoir construction. For >14 ft NGVD, will have hardwood seedlings after 30-40 yrs.		Development of floodplain forest by 40 years following restoration. Potential reappearance of springs. Decreased forest fragmentatio increased ecological integrity of system.	

*For the purposes of this study, it was assumed that the Buckman lock would remain operational as a navigational structure.



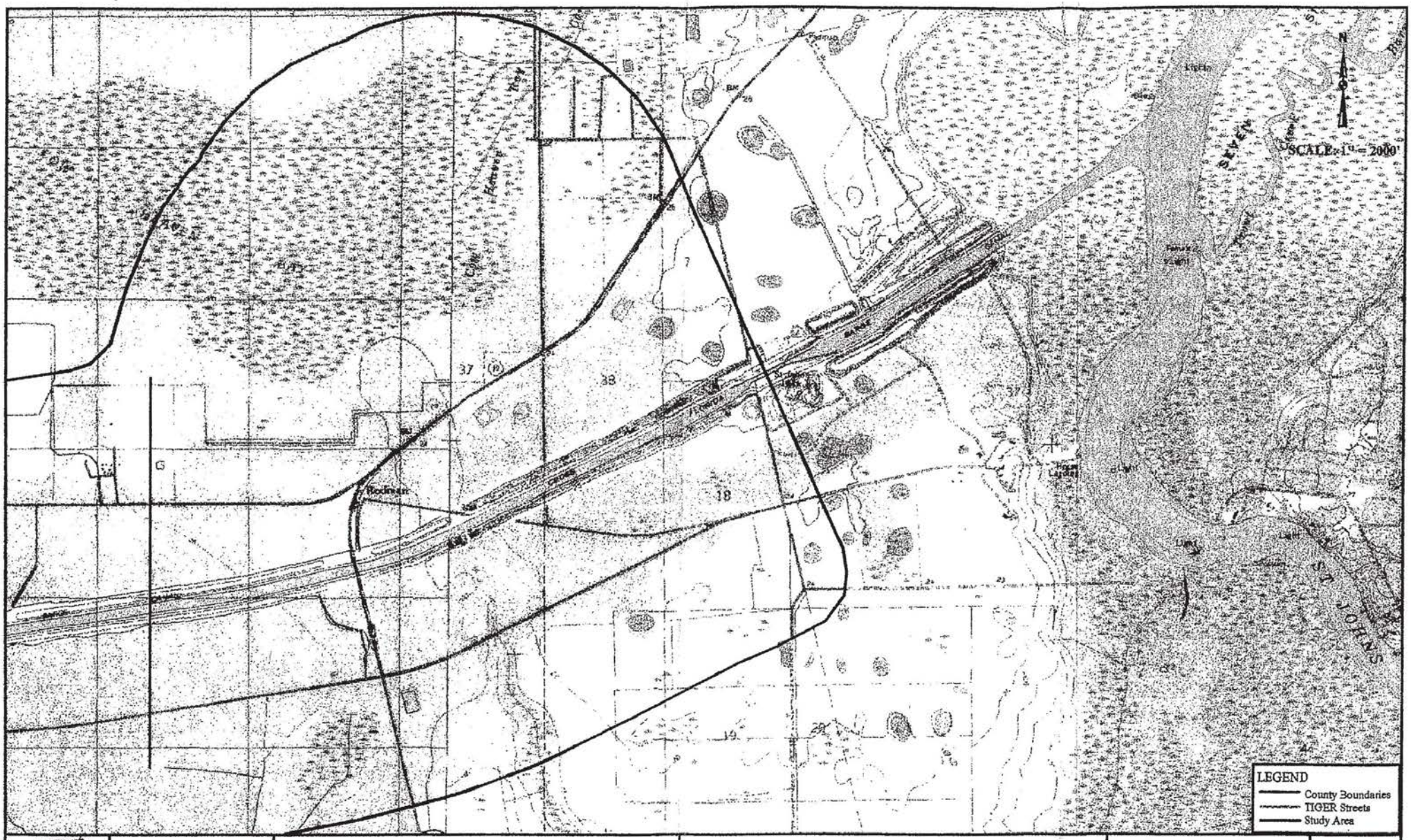
PBSJ Post, Beckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Soils

Source(s): U.S.D.A. S.C.S., U.S. Census Bureau

FIGURE 4-1



PBSJ Post, Buckley, Schuh & Jernigan, Inc.	**Ocklawaha River Restoration**	**Project Area Topography**	Source: U.S.G.S. 7.5 Min. Quadrangle	FIGURE 4-3a

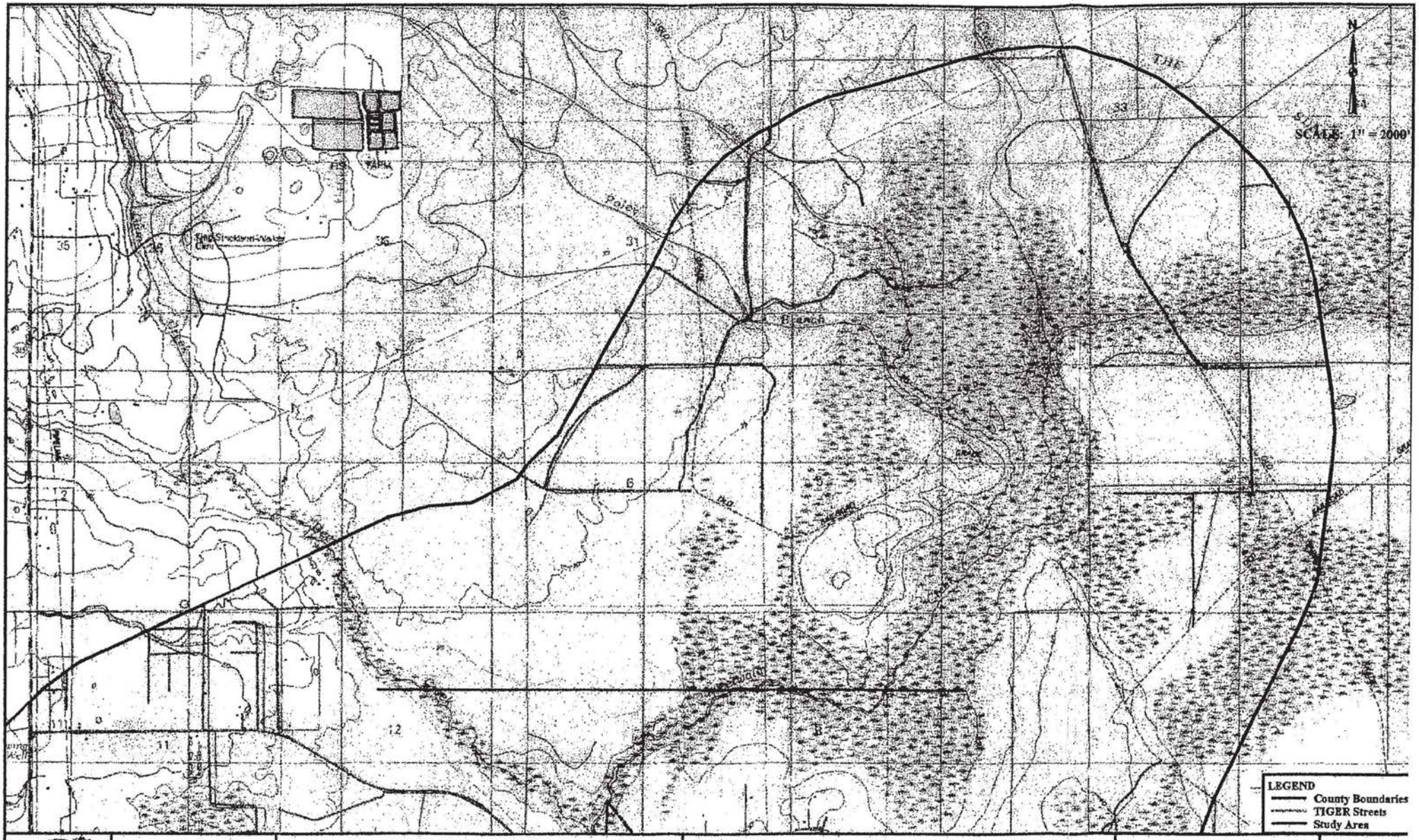
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Topography

Source: U.S.G.S. 7.5 Min. Quadrangle

FIGURE 4-3b



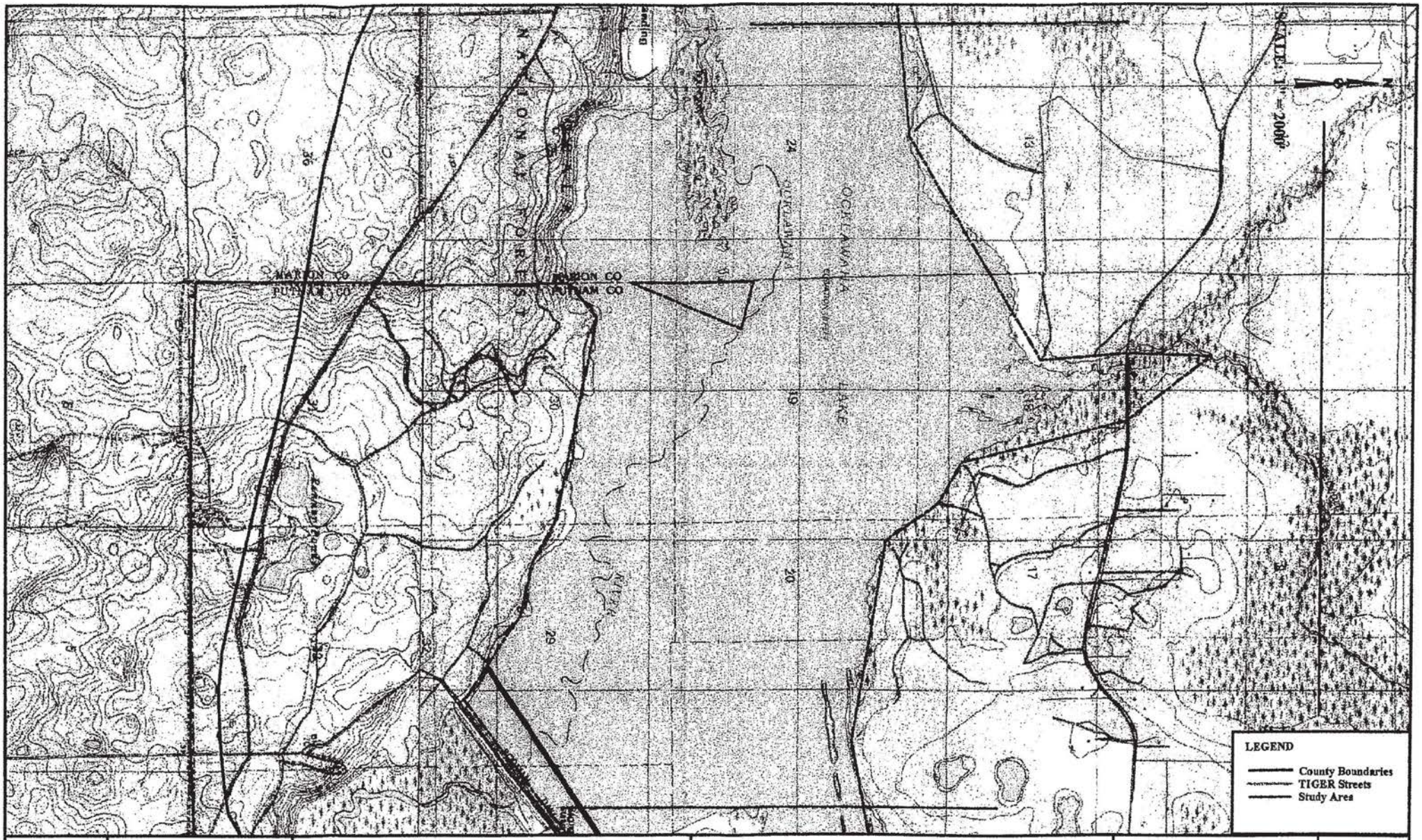
PBS&J Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Topography

Source: U.S.G.S. 7.5 Min. Quadrangle

FIGURE 4-3c



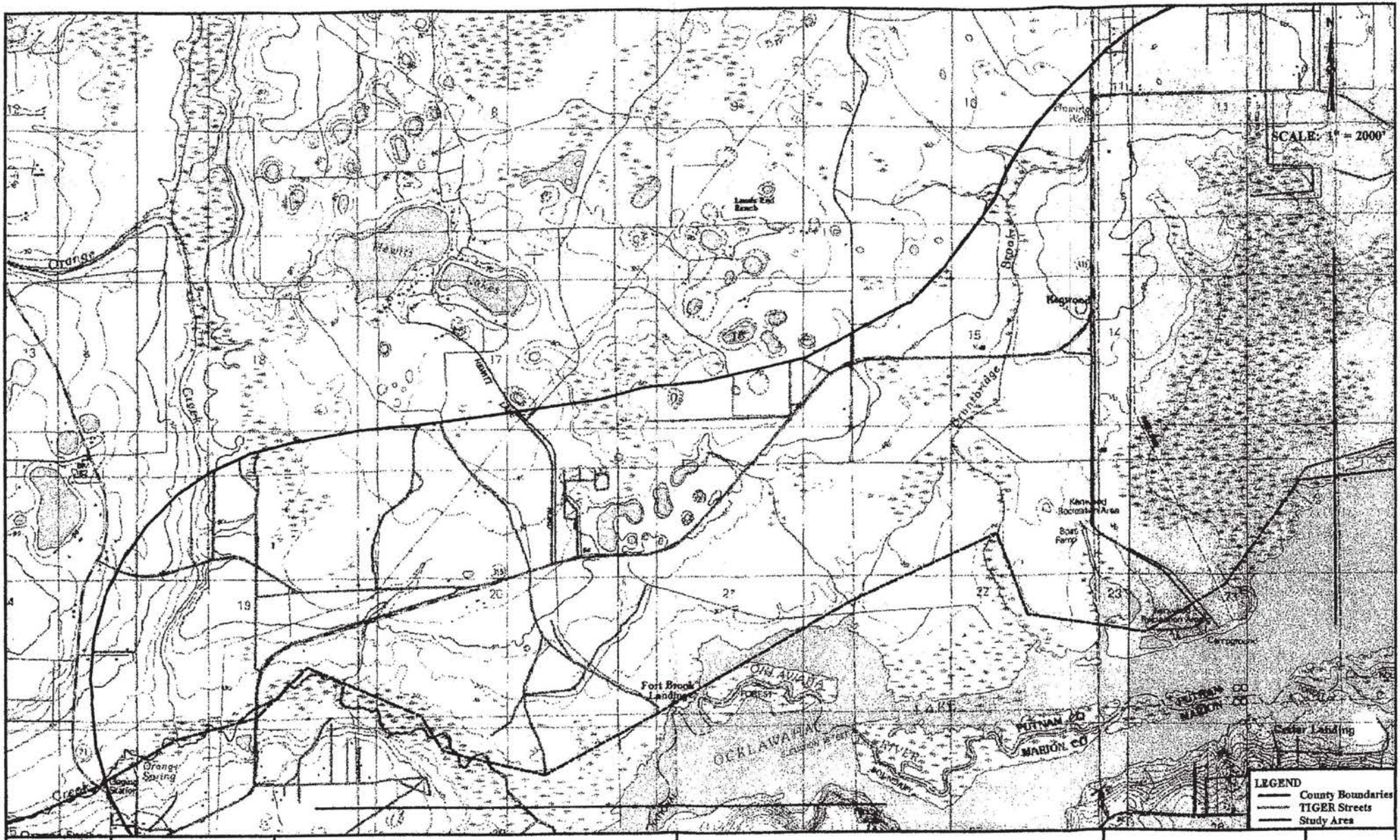
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Topography

Source: U.S.G.S. 7.5 Min. Quadrangle

FIGURE 4-3d



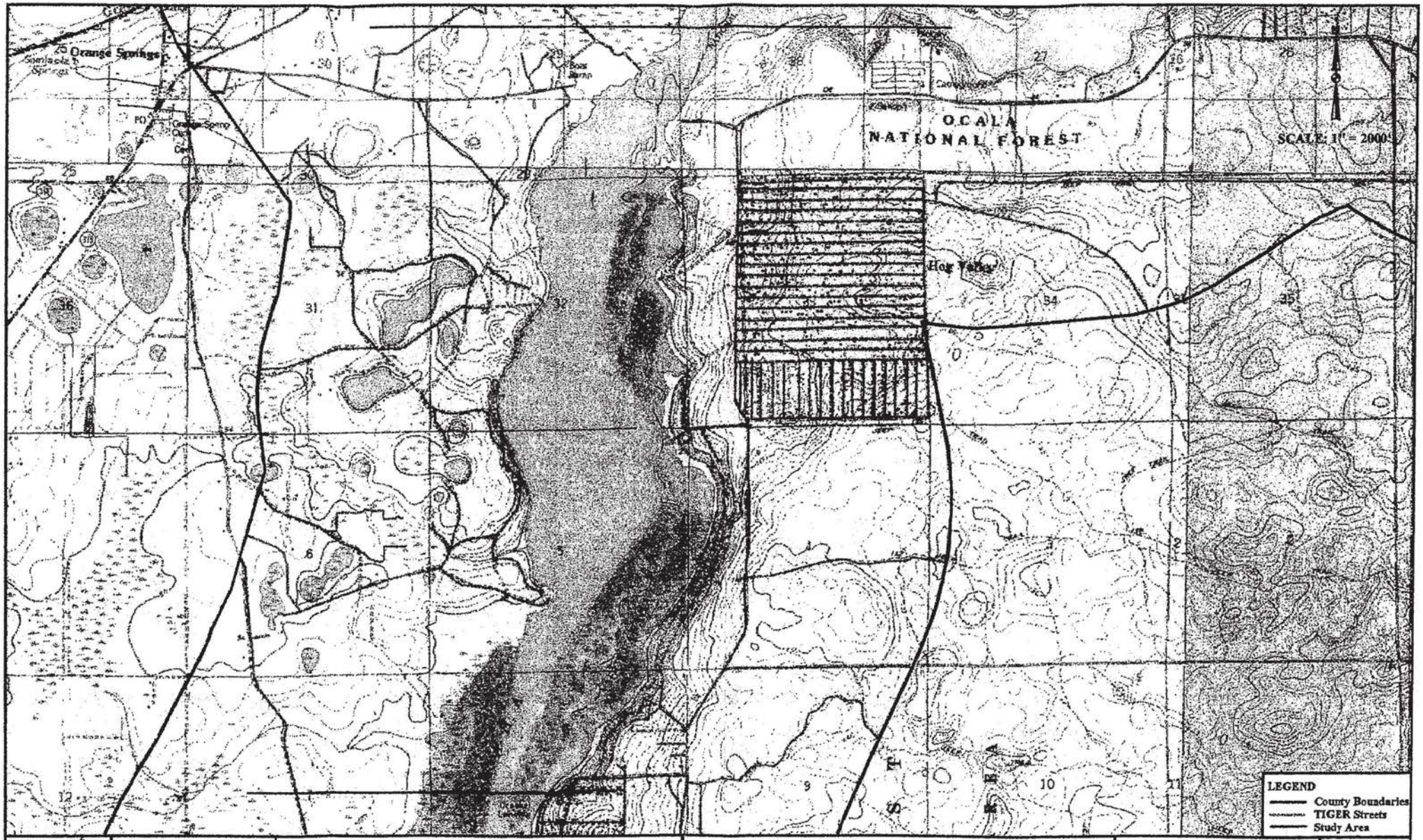
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

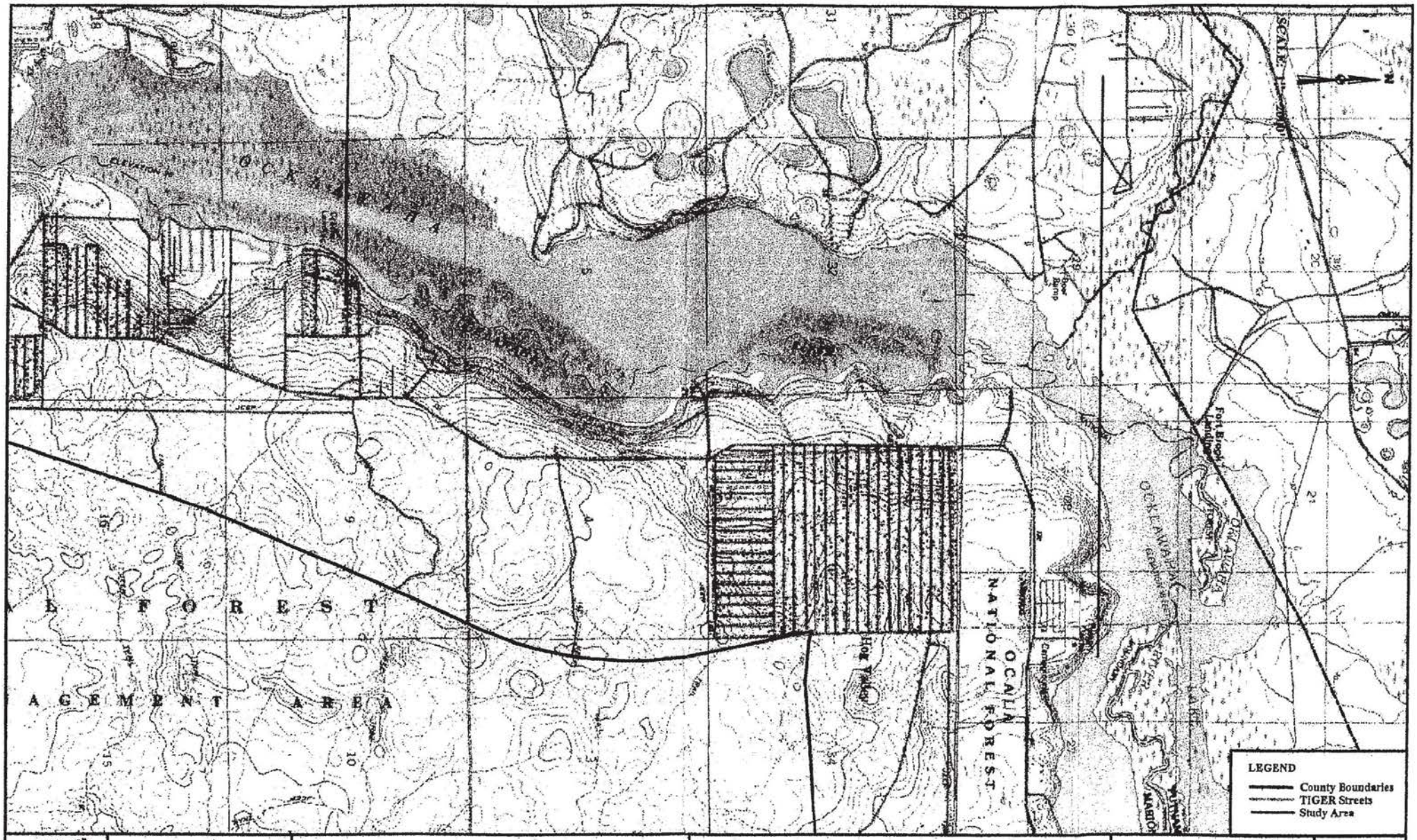
Project Area Topography

Source: U.S.G.S. 7.5 Min. Quadrangle

FIGURE 4-3e



	PBSJ Post, Buckley, Schuh & Jernigan, Inc.	**Ocklawaha River Restoration**	**Project Area Topography**	Source: U.S.G.S. 7.5 Min. Quadrangle	FIGURE 4-3f



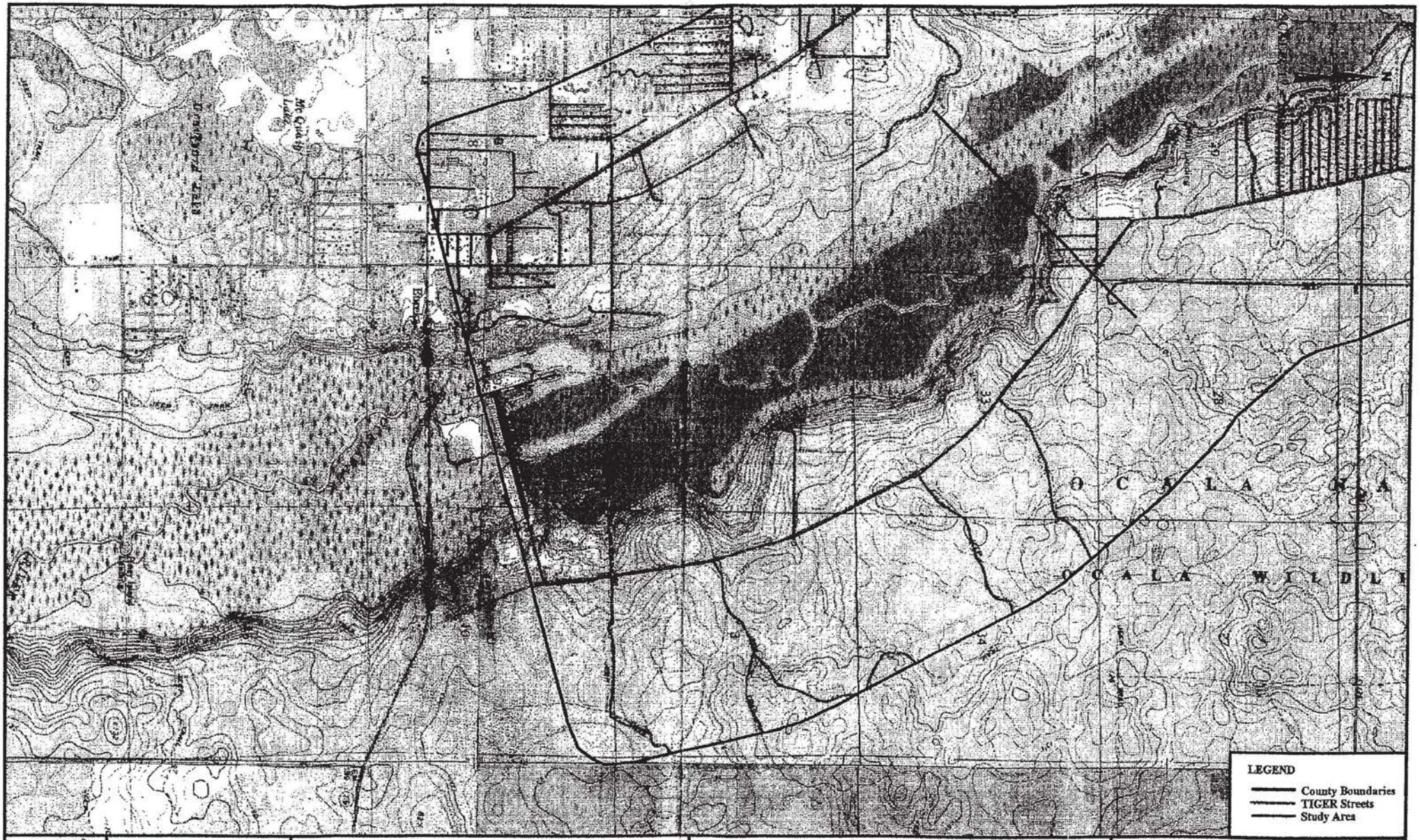
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ockalwaha River Restoration

Project Area Topography

Source: U.S.G.S. 7.5 Min. Quadrangle

FIGURE 4-3g



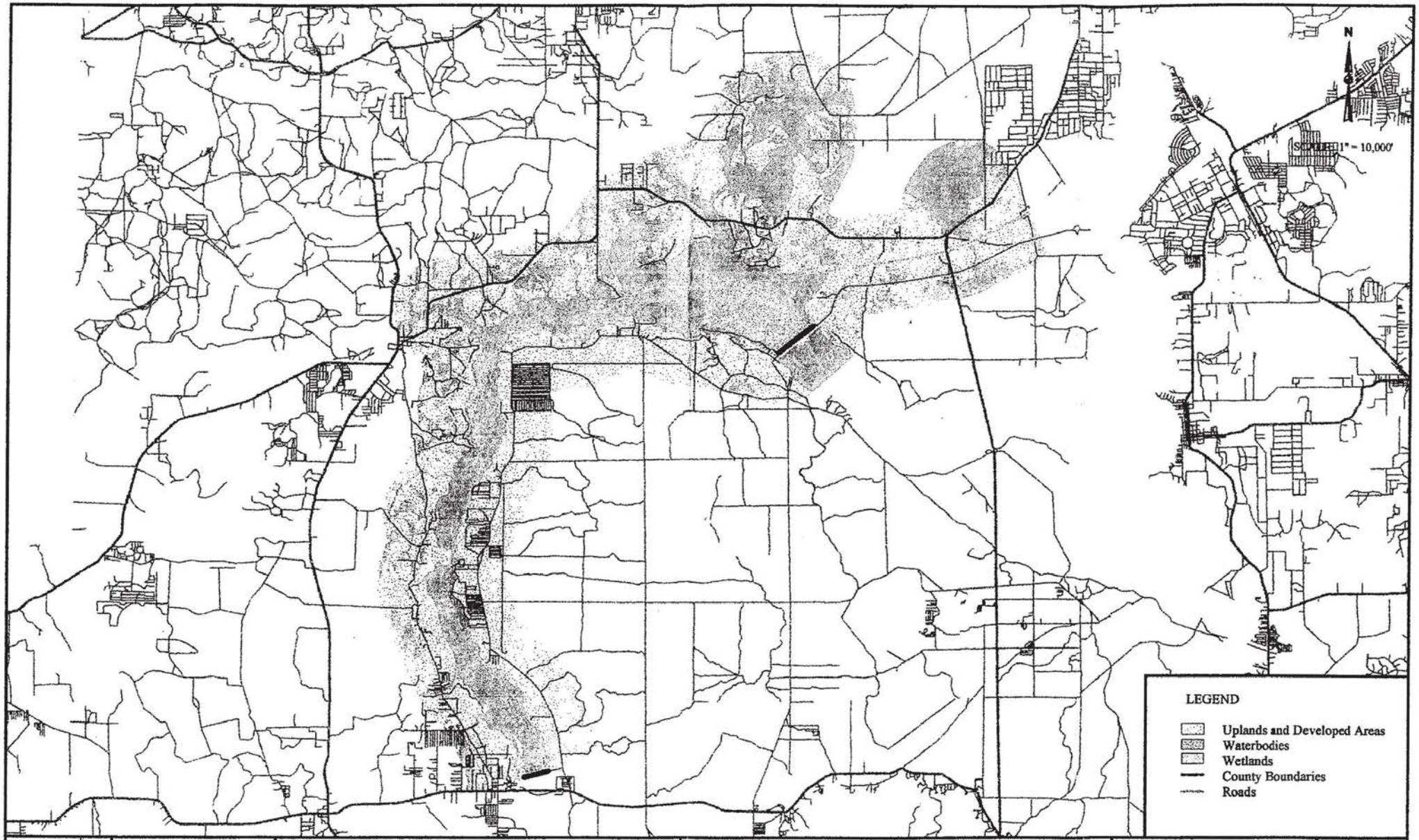
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Topography

Source: U.S.G.S. 7.5 Min. Quadrangle

FIGURE 4-3h



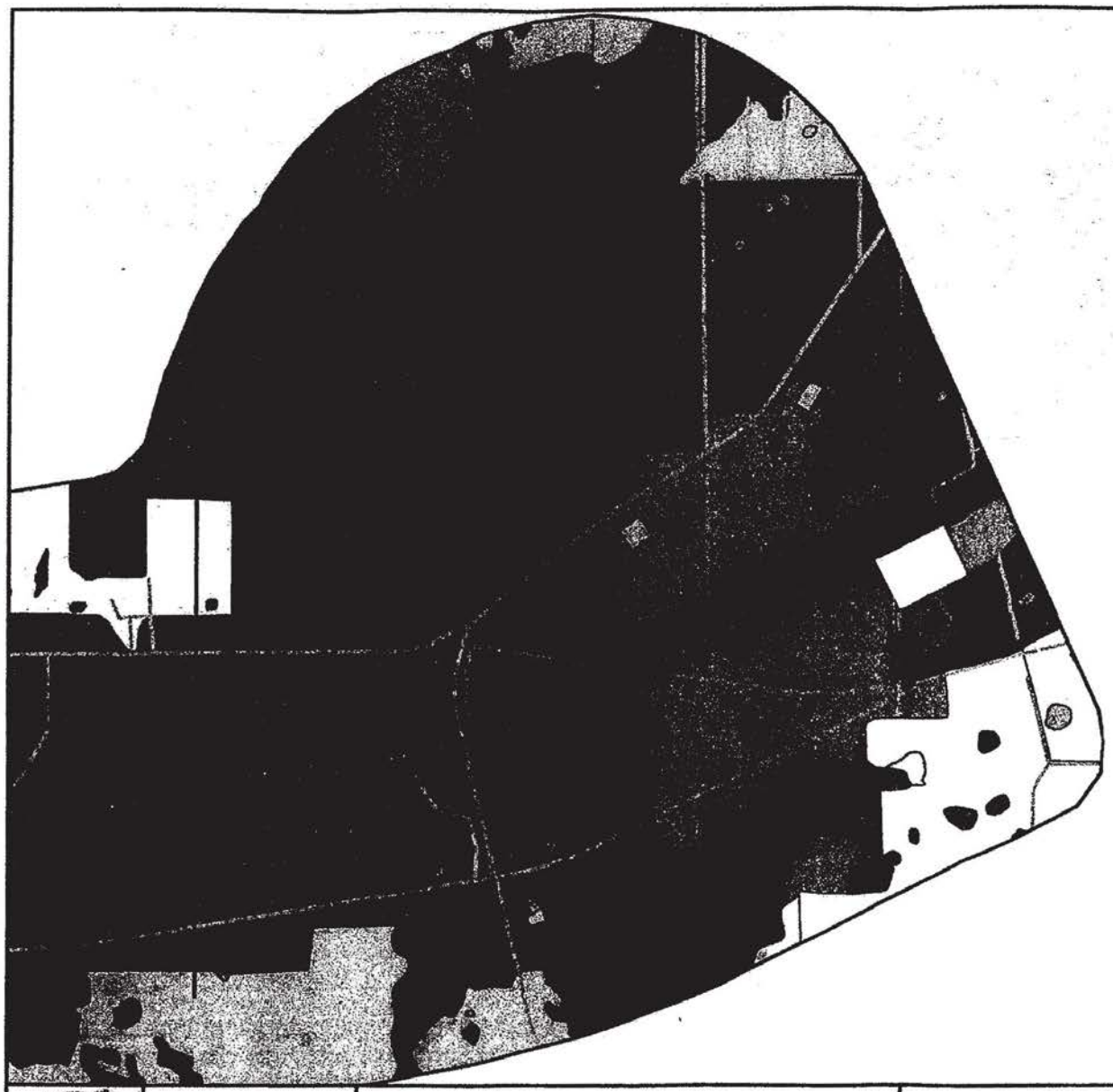
PBSJ Post, Beckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Wetlands

Source(s): SJRWMD; US Census Bureau

FIGURE 4-5



N

SCALE 1" = 2000'

LEGEND

- Low Density Residential
- Medium Density Residential
- Med./High Residential
- Commercial & Services
- Mixed Commercial & Services
- Clays
- Sand & Gravel Pits
- Recreational
- Open Land
- Inactive Land
- Improved Pastures
- Unimproved Pastures
- Row Crops
- Woodland Pastures
- Field Crops
- Mixed Crops
- Aquaculture
- Rural
- Fallow Cropland
- Herbaceous
- Shrub & Brushland
- Mixed Rangeland
- County Boundary
- Pine Flatwoods
- Longleaf Pine
- Sand Pine
- Upland Hardwoods
- Upland Mixed Coniferous
- Tree Plantations
- Forest Regeneration
- Streams & Waterways
- Lakes
- Reservoirs
- Bay Swamps
- River/Lake Swamp
- Wetland Coniferous Forest
- Cypress
- Wetland
- Freshwater Marshes
- Wet Praries
- Emergent Aquatic Vegetation
- Mixed Scrub
- Canals & Locks
- Communications
- Electrical Power Lines
- Roads

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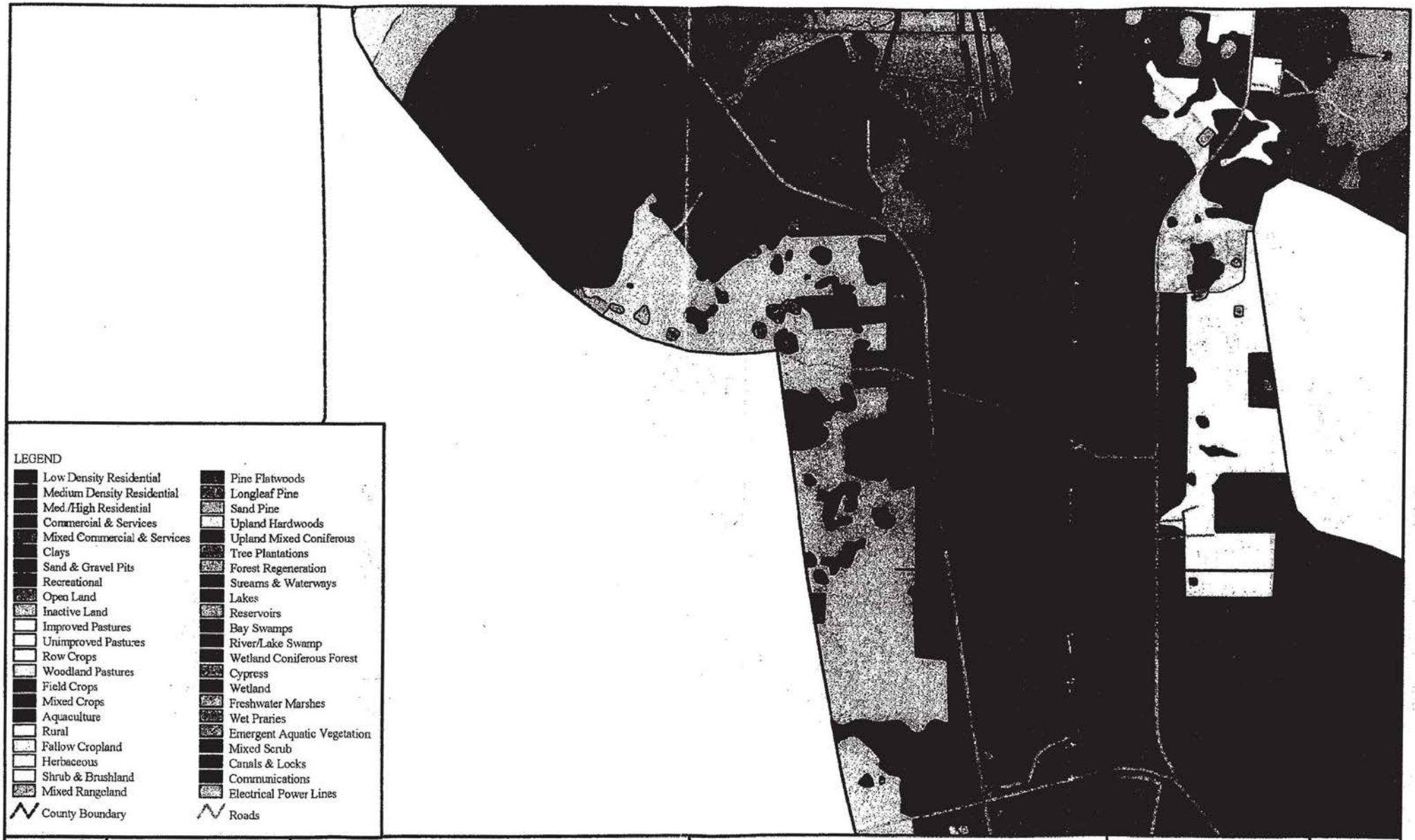
Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8a



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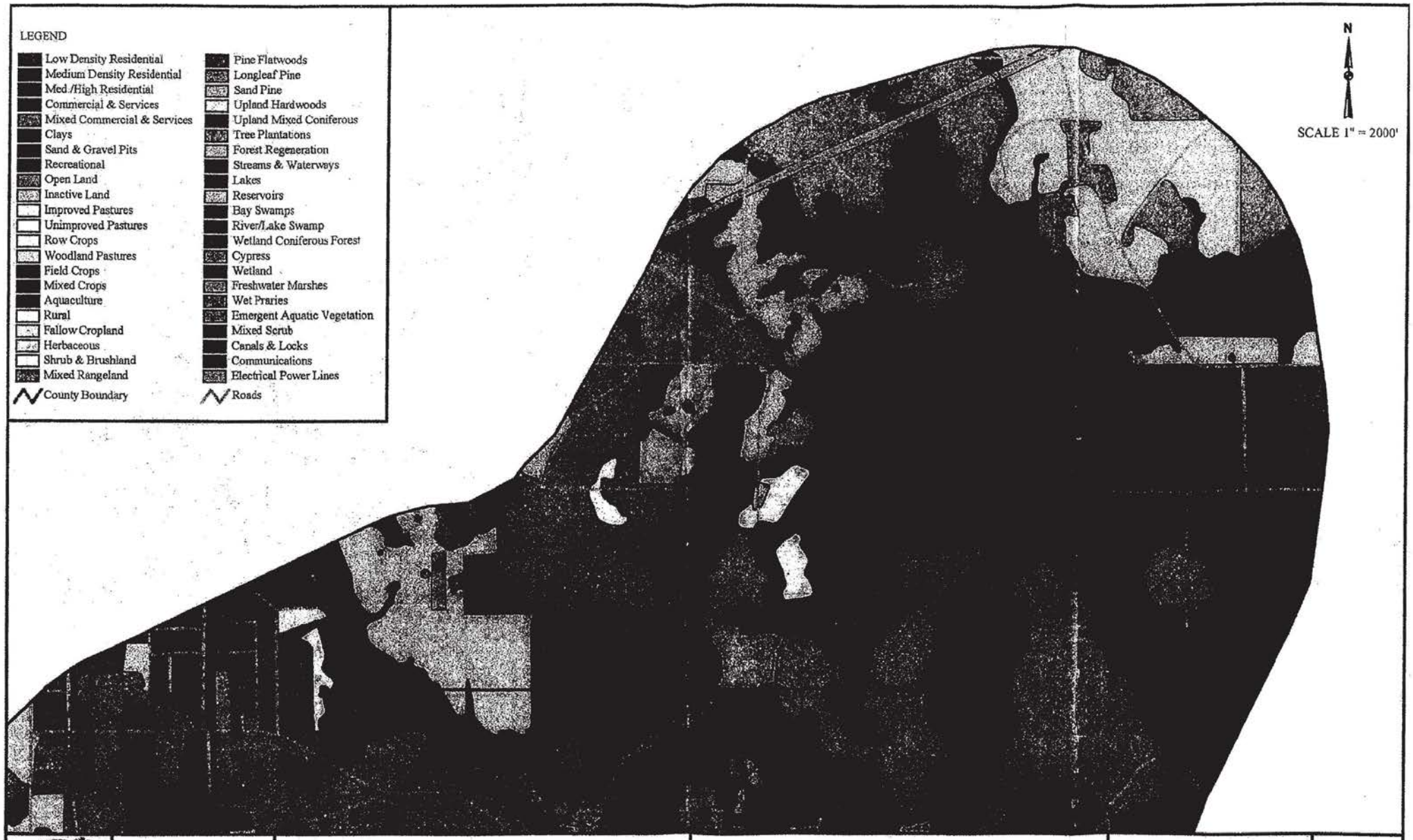
Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8b



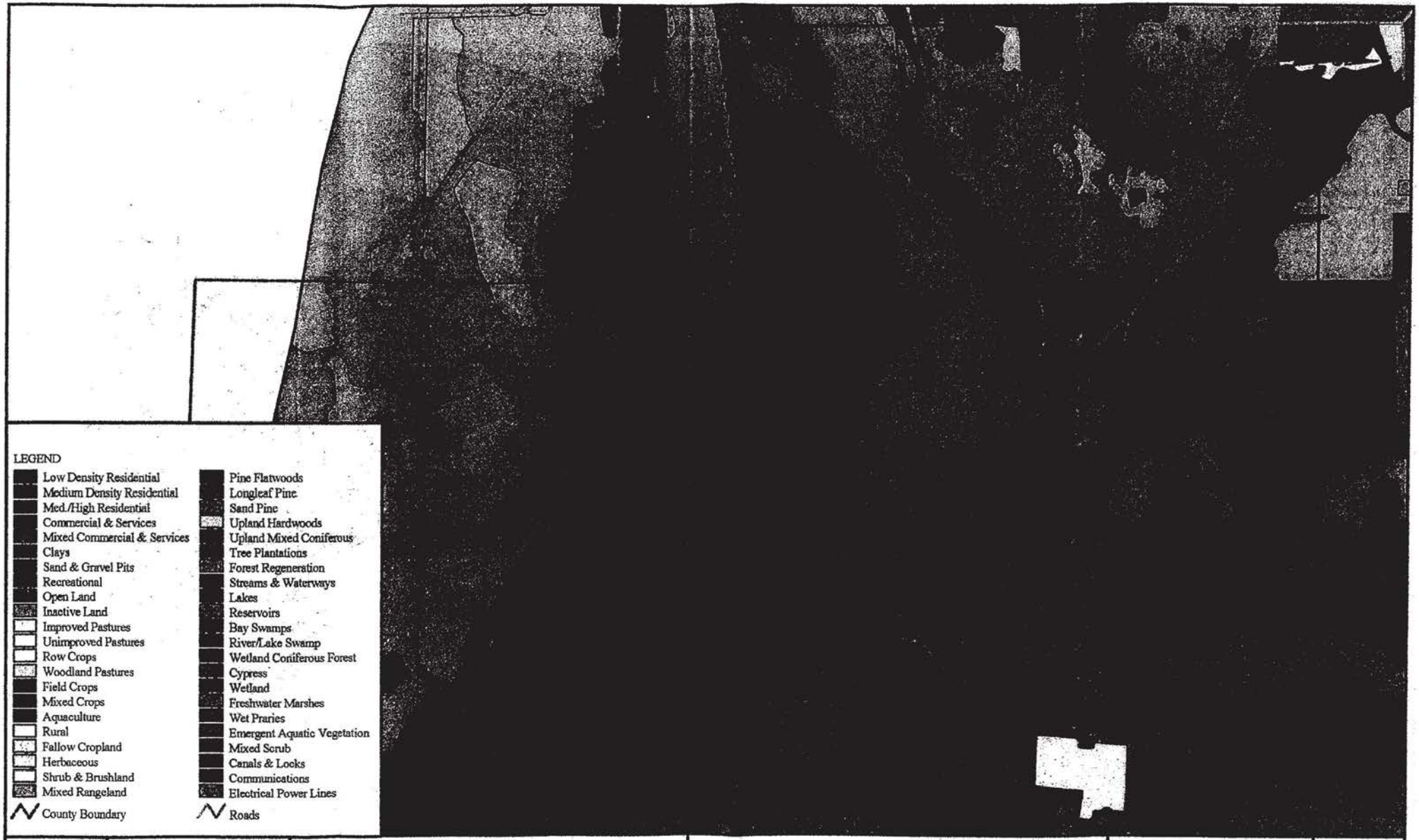
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8c



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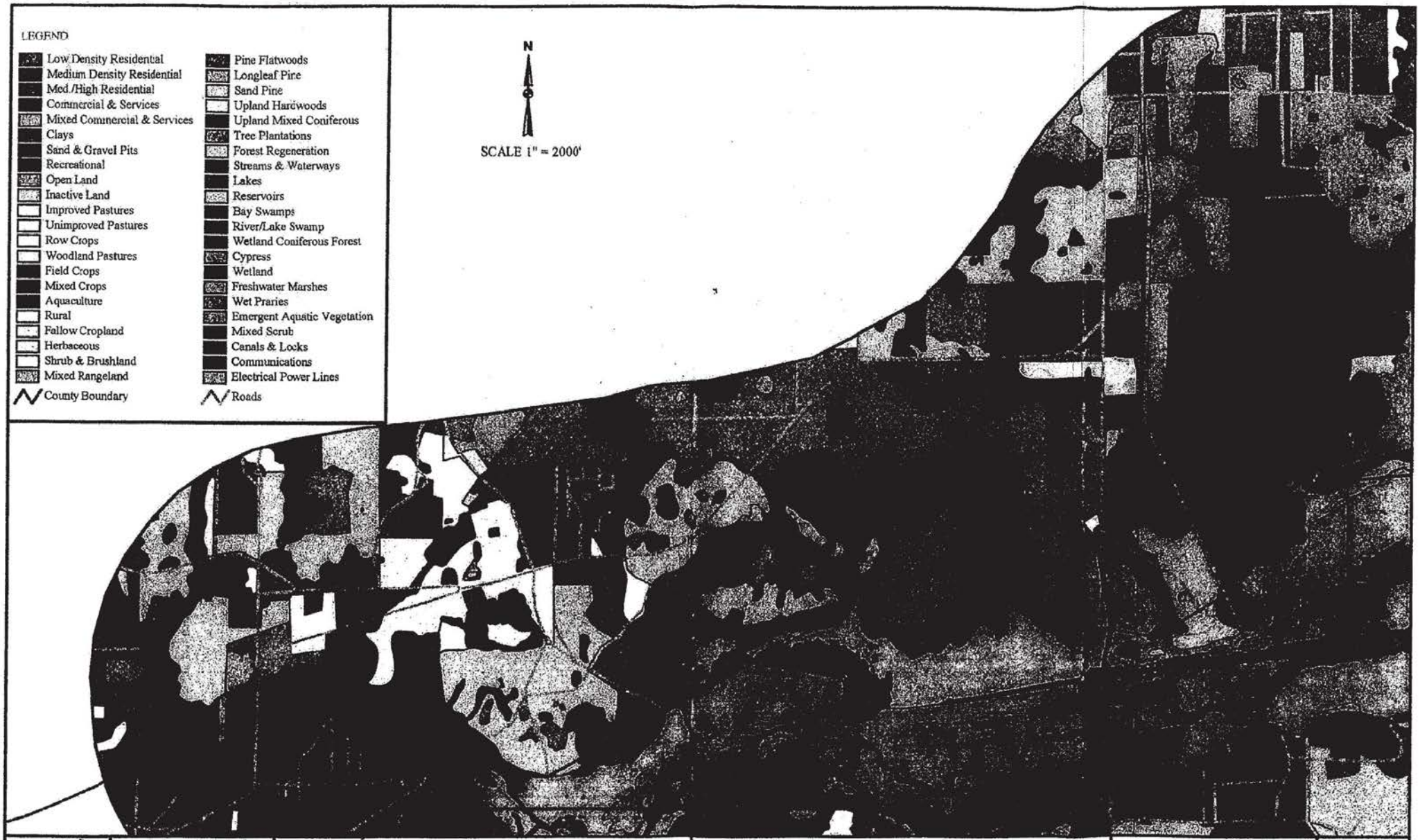
Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8d



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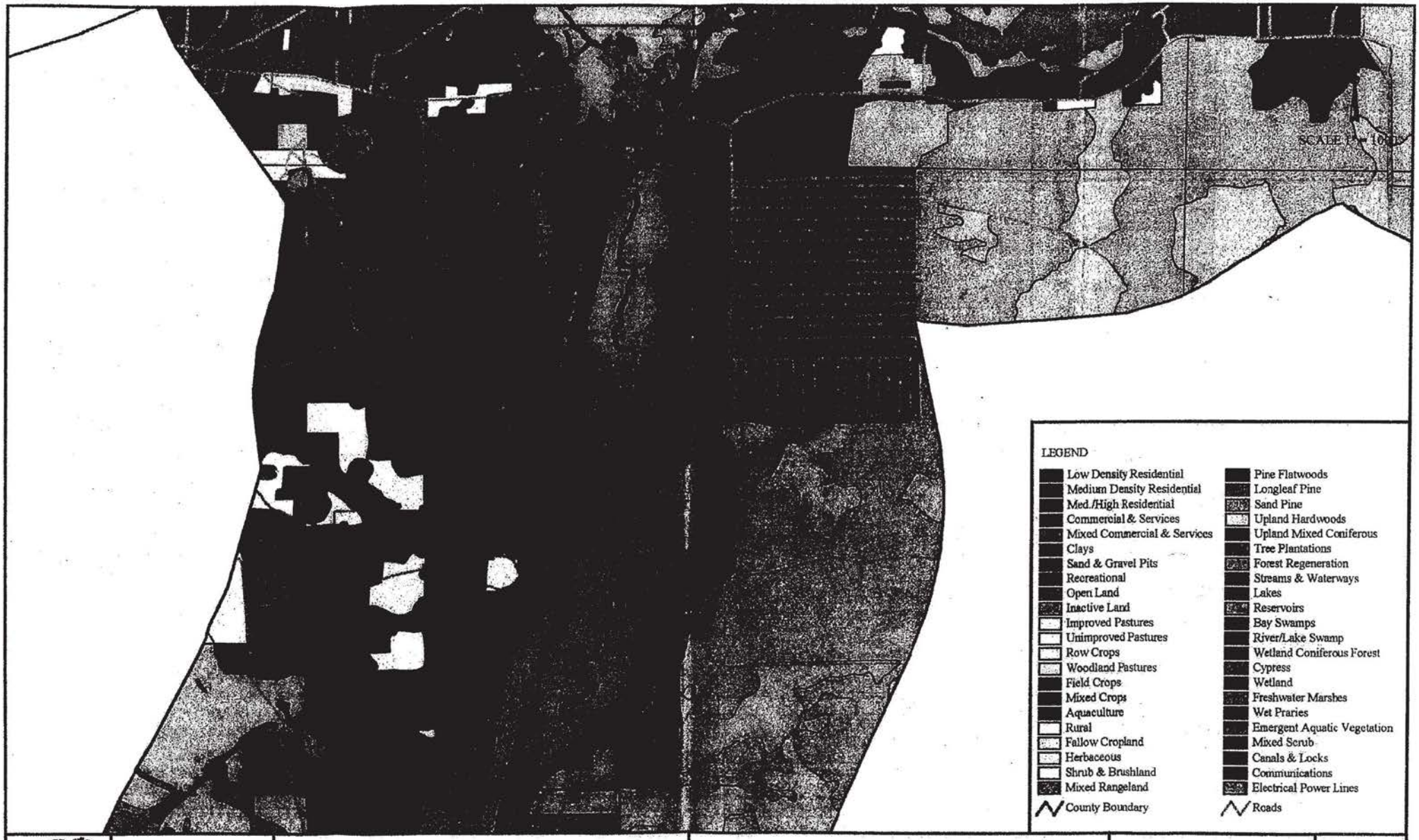
Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8e



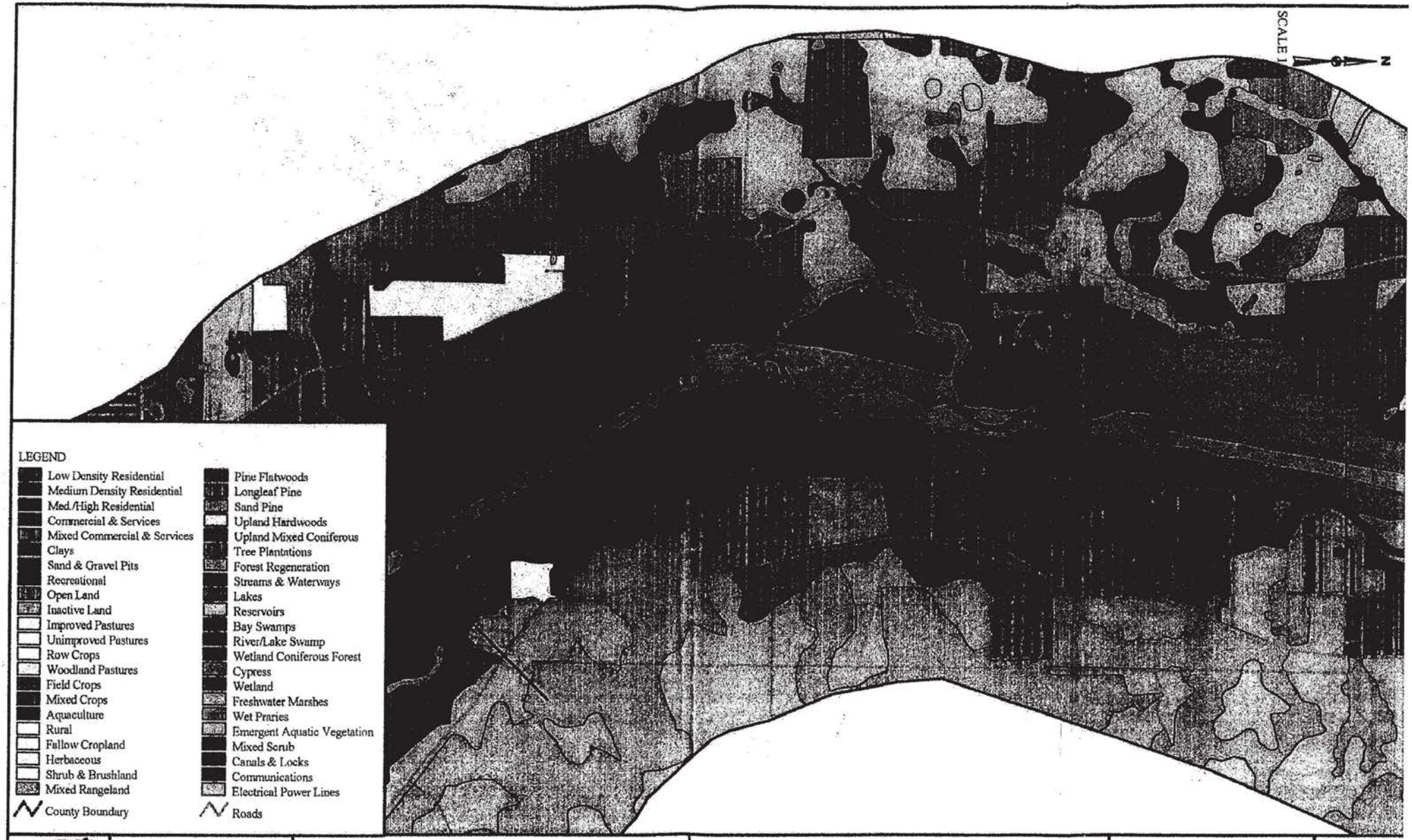
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8f



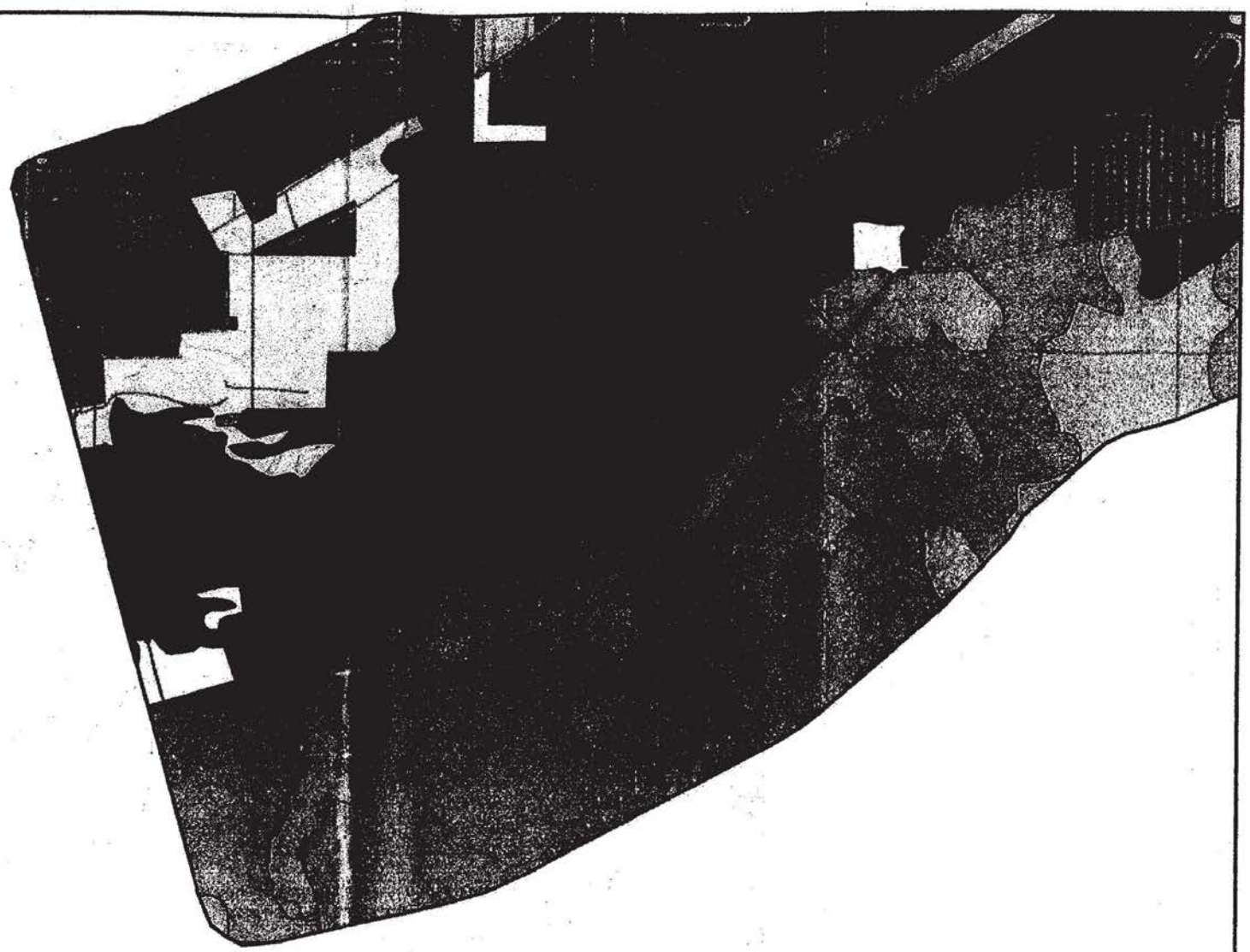
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8g



LEGEND

- Low Density Residential
- Medium Density Residential
- Med./High Residential
- Commercial & Services
- Mixed Commercial & Services
- Clays
- Sand & Gravel Pits
- Recreational
- Open Land
- Inactive Land
- Improved Pastures
- Unimproved Pastures
- Row Crops
- Woodland Pastures
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- Communications
- Electrical Power Lines
- Roads

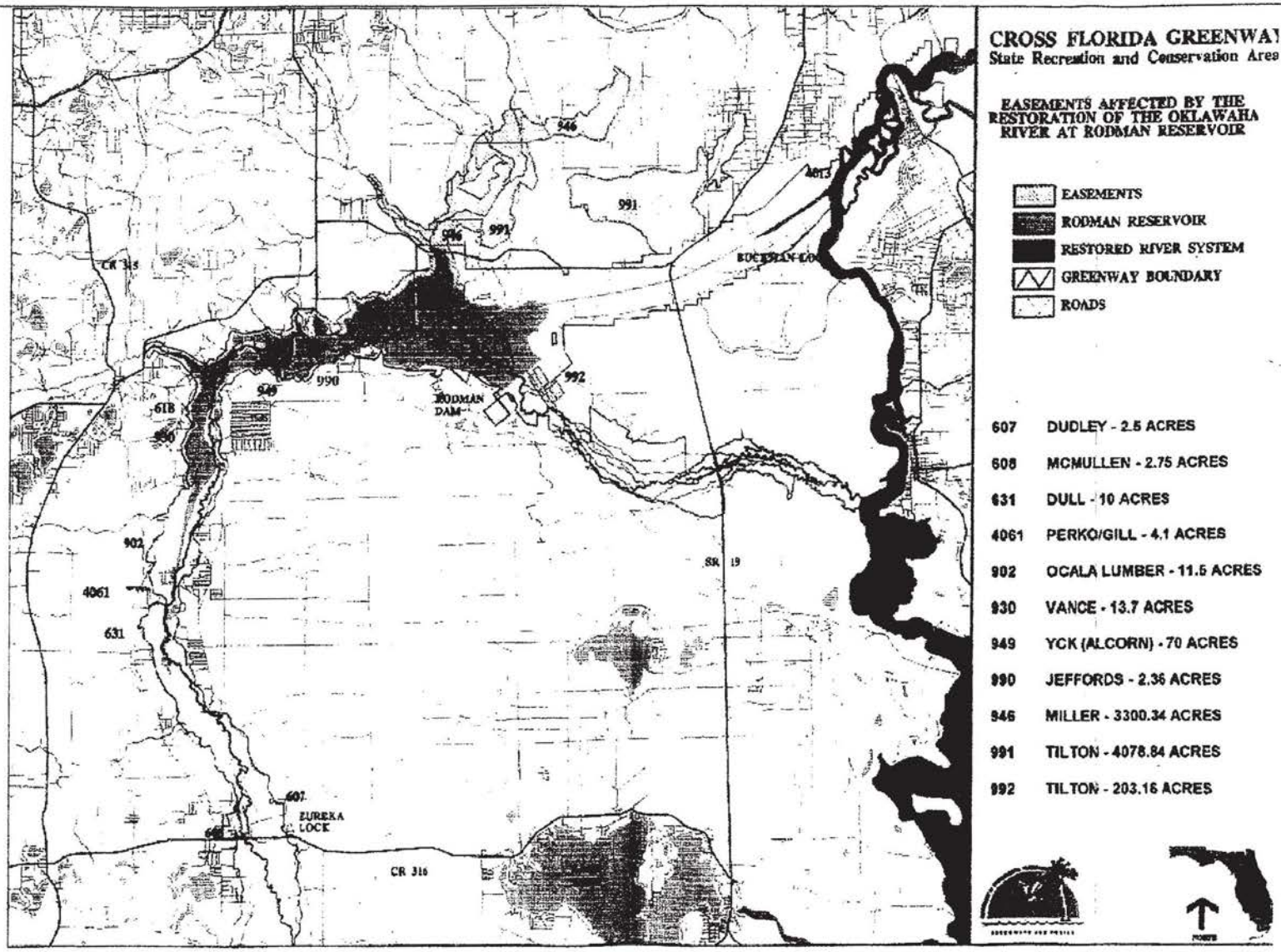
PBSJ Post, Buckley, Schuh & Jernigan, Inc.

Ocklawaha River Restoration

Project Area Land Use and Cover

Source(s): U.S. Census Bureau; SJRWMD

FIGURE 4-8h



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Easement Map

FIGURE 4-9