

Blackwater River Watershed Master Plan

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INTRODUCTION

Overview of Blackwater River Watershed

(Adapted from Thorpe et al. 1997)

Originating in Bradely, Alabama, the Blackwater River travels south approximately 62 miles prior to discharging into Escambia Bay (figure 5). The river drains approximately 860 square miles, approximately 700 of which are within Florida. Average depths are between two and 15 feet, and widths tend to vary between 110-300 feet. The major source of flow is groundwater discharge, with a smaller contribution from surface runoff. Lower portions of the river have a tidal range of approximately two feet, and saltwater intrusion has been identified six miles upstream. Principal tributaries of the river include Big Juniper Creek, Big Coldwater Creek, and Pond Creek. Primary land uses within the basin include forestry (76.6%) and agriculture (18.8%). The Blackwater River is designated as an Outstanding Florida Water (OFW), and is among the most popular waterbodies in the state for canoeing and other recreational activities.

The Blackwater River and its tributaries drain acidic flatwoods and other wetlands, as well as being influenced by discharge from the Sand and Gravel Aquifer. The river tends to exhibit a reddish color, due primarily to the presence of tannic and organic acids. The upper Blackwater River and its tributaries Big Juniper Creek, Sweetwater Creek, and Big Coldwater Creek have been described as swift, relatively shallow, and sand-bottomed.

Aquatic vegetation is sparse, and some habitat cover is provided by snags, fallen trees, and undercuts. In the 1970s, only the upper reaches of this system were assessed as having adequate cover for fish habitat. The lower Blackwater River is tidally influenced with moderate currents. Substrates are more fine and organic, and emergent and submergent species of vegetation are more common. Pond Creek is similar to the lower Blackwater River, with lower reaches tidally-influenced. Currents are moderate, substrates range from sand to mud, and emergent and submergent species of vegetation are common. FWCC scientist further describes a series of lake-like freshwater and brackish basins along the lower river. Aquatic vegetation is abundant in these basins, substrates tend to be rich and organic with sand along some shorelines, and currents are nonexistent except when associated with tidal fluctuation.

Characteristic fish species include spotted bass, sailfin shiner, chain pickerel, and largemouth bass. The Blackwater River system supports the endangered blackmouth shiner. Among the sensitive species living in the watershed are the red cockaded woodpecker, Florida pine snake, eastern indigo snake, osprey, Florida black bear, and the white-topped pitcher plant.

The lower Blackwater River system receives discharges from domestic wastewater treatment facilities, and portions of the system are subject to impacts from nonpoint source pollution. Water quality in general has been characterized as excellent and much of the river basin is protected by conservation lands.

History of the Watershed

Logging has played a key role in the history of the Blackwater River watershed. Beginning in the 1830s, lumbermen harvested pine, cypress and juniper from the lands surrounding the Blackwater River. By the late 1800s, the sawmills around Blackwater Bay were the largest in Florida, producing millions of board feet of lumber for the world market.

Before logging railroads arrived in northwest Florida in the 1880s, all logs were floated down the river to mills in Milton and Bagdad. Some of the logs, called sinkers or deadheads, sank in the river on the way to the mills and are still there. To make way for the logs to float down the river, loggers removed most of the natural woody material from the river. Today, the deadhead logs provide important structure and habitat that was lost when the river was de-snagged. Logging continued until the timber supply was exhausted in the early 1900s. At this point, logging had left the watershed denuded of trees and some of the watershed's streams channelized.

When much of the Blackwater River watershed came into public ownership in the 1930s, replanting the forests became a top priority. In 1936, the area surrounding the headwaters of the Blackwater river in Alabama became the Conecuh National Forest. The federal government acquired land around the Blackwater River in Florida in the early 1930s for a land-use project. In 1938, the Florida Board of Forestry and the U.S. Department of Agriculture executed an agreement for cooperative land management. Later, in 1955, the government deeded the forest to the Florida Board of Forestry (now the Florida Division of Forestry), establishing the Blackwater River State Forest.

These public lands are currently managed for multiple uses, including recreation, timber production, watershed protection, wildlife management, and recovery of endangered plant and animal species. Many private landowners have also been good land stewards and have re-grown extensive bottomland hardwood and upland pine forests. Continued land management on these private lands is the best investment possible for the future health of the Blackwater River watershed.

Map of the Blackwater River Watershed



Gulf Coastal Plain Ecosystem Partnership Major Watershed

Northwestern Florida and Southern Alabama

Note: Because of map scale, map does not indicate all private property. GCPEP partners recognize the full rights of individual land managers & neighboring private property owners to pursue their own interests and objectives on their own land.

EXISTING CONDITIONS

Geographic Area

The Blackwater River watershed is one of the last remaining shifting white sand bottom river systems in its natural state in the world. With sections of the river designated as an Outstanding Florida Water (O.F.W.) and as a Florida Canoe Trail, the Blackwater River watershed provides an opportunity to protect a valuable natural resource for the benefit of society and ecology alike. The Blackwater River watershed is located in the southeastern United States, with its geographic boundaries crossing two states and four counties. The watershed encompasses parts of Alabama's south central region and Florida's northwestern panhandle and is encompassed by the larger Pensacola Bay watershed. The headwaters of the watershed are located in Alabama's Escambia and Covington counties, however the majority of its approximate 719 square mile area occupies Florida's Santa Rosa and Okaloosa counties (F.G.D.L. 2009). The Blackwater River flows from the Conecuh National Forest through the Yellow River Water Management Area and the Blackwater River State Forest before flowing into the Blackwater Bay and Garcon Point Water Management Area (Refer to Figure 1 for a map of the watershed geographic layout as well as its spatial extent of open waters and riparian wetlands).



Climate

The Blackwater watershed has a humid subtropical climate characterized by mild winters and hot summers. The average annual temperature is approximately 64°F with an average annual precipitation of approximately 64 inches (G.S.A. 2009, R.S.S.Weather.com 2009). Summer is

the wet season with one-third to one-half of all precipitation in the basin falling during this time. Fall is the driest season receiving less than 20% of the annual precipitation.

Hydrology

In Alabama the Blackwater River watershed is 145 square miles and is composed of 6 smaller sub-watersheds; the Blackwater River, Panther Creek, Big Juniper Creek, Sweetwater Creek, East Fork Big Coldwater Creek, and West Fork Big Coldwater Creek (G.S.A. 2009). The main river stretch has 3 major tributaries: Sweetwater Creek, Juniper Creek, and Coldwater Creek.

The stream gauge outside of Bradley, Alabama, measures an average discharge of 146 cfs with a lowest value of 17 cfs and a flood stage value at 16,000 cfs, based on 34 years of record (G.S.A. 2009). Near Baker, FL, the United States Geologic Service (U.S.G.S.) has a stream gauge that has been measuring river depth and discharge since 1952 (Figure 2 and 3).

The depth of the river averages 3.5-4 feet deep, but flooding is not uncommon along the river. Although only qualitative, it could be speculated from the gauge height at Baker, FL, that the river's depth has decreased slightly after 1994, and there have been fewer flooding events. Along with flooding events there have also been a few very low flow events, as seen from the stream discharge measurements. There is a great deal of discharge variability from below 25 cfs to over 20,000 cfs. Using this data from the U.S.G.S., it could be concluded that there has been fewer high flow events since 1994.

Tidal Influence

The gauge at Milton, FL, near the point where the Blackwater River flows into the Blackwater Bay the tide is diurnal and varies from an approximated 2-foot increase during high tide to about a foot decrease during low tide (Mobile Geographics).

Geology

The geology of this watershed is primarily composed of the Citronelle Formation and Terrace and Alluvial deposits. The lithology is distinguished primarily by the elevations above stream levels. High terrace deposits represent former flood plains when streams were at higher elevations. Low terrace or alluvial deposits occur in stream valleys and along banks of current streams. The terrace and alluvium deposits consist principally of unconsolidated silt, sand, gravel, and clay, and various mixtures of these sediments (G.S.A. 2009). The Citronelle Formation is primarily composed of deeply weathered fine to coarse quartz sand with scattered limonite pellets and some gravel content and can be 50-200 ft thick (Otvos 1998).

Mineral resources present within the state forest include; oil, natural gas, sand, gravel, and clay. Sand, clay and gravel have been excavated from borrow pits for the exclusive use of

improvements or construction of roads in the forest. Management plans within the state park require that these pits be reclaimed when no longer needed by returning the area to as close to its natural state as possible (Fl-D.O.F. 2000). The aquifer underlying the watershed could be classified as the Eocene-Pleistocene undifferentiated aquifer. It is composed of a number of different formations of this age and the sediments are primarily sands, clays, gravels, unconsolidated silts, and some soft limestones that are unconfined. Yields of water to individual wells are generally less than 200 gallons per minute (gpm)(G.S.A. 2009).

The geology of the watershed has proved to be a management hurdle due to the highly erodible sandy lithology that composes the riverbanks. Excessive sedimentation due to bank erosion is a stakeholder concern and a number of studies conducted by the F.D.E.P. have quantified the effects of this bank erosion. Excess sediment into the river can have a negative impact on fish and wildlife communities, and in some cases smother fish eggs and lead to habitat destruction (Ray 1999). It has been shown from a few studies that one of the 6 contributing factors of excess sediment to the river are roads adjacent to, or that cross over the river (Ray 1996, 2003, 2005a and 2005b). At each of the sampling locations it was determined that sediment delivery was increased due to road run-off and in one case from sand mining. In many of the studies B.M.P.s were implemented to reduce the sediment input. These included elevating roads, proposing buffers, and in some cases paving the roads or bridges.

Blackwater River Chemistry

The Blackwater River has a unique water chemistry that is generally referred to as 'black water'. The inherently low nutrient and dissolved oxygen levels of black water make it particularly susceptible to undergoing changes when contaminated with nutrients or chemicals. The sandy materials comprising much of the geology and soils in the area do not retain organic materials well and nutrient pollutants move through them easily. The result is a rapid movement of nutrients from their source to nearby ground or river waters. Nutrients entering the river can drive a proliferation of algal growth increasing the biological oxygen demand, resulting in a decrease of the already low dissolved oxygen levels.

Currently, there is a lack of knowledge as to what extent the native ecosystem can tolerate nutrient and dissolved oxygen fluctuations. The hypothesis that low dissolved oxygen levels are a natural occurrence in the river should not slow down research geared at determining whether there are also anthropogenic factors that have contributed to this level. Managers must have the foresight to understand that although past human action may not have led to the low dissolved oxygen levels, the sensitive nature of this black water river will require stringent monitoring of even minor future activities that could impact the dissolved oxygen levels.

Ecology

The forested lands of the Blackwater River watershed host a large diversity of intact ecosystems that provide habitat for numerous plant and animal species. The longleaf pine and wiregrass

ecosystem which runs from the Conecuh National Forest and down into the Blackwater River State Forest in Florida is the largest continuous longleaf/ wiregrass ecosystem in the world. The longleaf pine/wiregrass ecosystems once covered 60 million acres of the southeastern United States. Now much of the remaining 3 million acres of this highly diverse ecosystem exists within the Blackwater River watershed (F.D.A.C.S. 2009). Within the forest there are small ponds and pitcher plant bogs that combined with riparian wetlands account for 20% of the watershed. Collectively the Blackwater River watershed ecosystem provides habitat for a wide diversity of plants and animals, many of which are listed as endangered or threatened including the endangered red-cockaded woodpecker, gopher tortoise and Sherman's Fox squirrel (Fl-D.O.F. 2000, U.S.F.W.S. 2009). The most common tree species growing in the watershed are the loblolly pine, Atlantic white cedar, sweet gum, red maple, and sweet bay (Fl-D.O.F. 2000). Game species also thrive in the watershed and include the white tailed deer, wild turkey and gray squirrel, while non-game species include red and gray fox, bobcat, eastern tiger salamander, bald eagle, and the eastern diamondback rattlesnake. The rivers of the watershed provide habitat for a diversity of fish species including largemouth bass, long nose gar, channel catfish and the blackmouth shiner (Fl-D.O.F. 2000). In the river itself the sediment types vary slightly allowing for a number of different habitats within the river. Much of the river sediment is shifting white quartz sand, where the water depth can range from 1 to 15 feet. This sediment type provides habitat for a low diversity of flora or fauna due to its constant movement. On the banks of the river and in water depths of a few inches to less than a foot, the packed sand is covered with a thin layer of silt. There is generally a large amount of debris, including downed trees and leaf litter, creating little or no current. This area has a larger diversity of fauna, including some burrowing insect and marine species as well as some submerged vegetation. Along the river there are also backwaters or swamps which provide yet another very important habitat for both flora and fauna. The bottoms of these wetland features have a much higher silt and organic sediment content than along the river flow path. The water is generally a foot deep with little or no movement. All of these different portions of the river provide important refugia and habitat for flora and fauna, especially for young fishes.

Seepage Slopes

Seepage slopes are a very unique ecological feature only found in this part of the southeast United States. Seepage slope communities are sloping wetlands of shrub thickets or wet prairies in upland pine communities. The loamy sand soils are nutrient poor and generally saturated, but seldom inundated. The saturation is sustained by downslope seepage of groundwater above an impermeable layer of clay, organic matter or rock. The impermeable layer prohibits groundwater penetration and results in a perched water table. Water that seeps from the slopes generally flows into a stream. These wetlands may dry out in times of drought due to their dependence on groundwater (F.N.A.I. 1990). Seepage slope communities are savannah-like, with open overstories of longleaf pine (*Pinus palustris*) or slash pine (*Pinus elliottii*). The open canopy is maintained by low intensity fire with a frequency of around five years or less. Common shrubs include wax myrtle (*Myrica cerifera*), titi (*Cyrilla racemiflora*), gallberry (*Ilex coriacea*), inkberry (*Ilex glabra*), sweetbay magnolia (*Magnolia virginiana*) and red-bay (*Persea borbonia*). Shrubs become more dominate in the absence of frequent fire and the seepage slope eventually becomes a wooded baygall. The open overstory allows plenty of light for many herbaceous

species including rare insectivorous plants. The dominant herbaceous plants include beak-rushes (*Rhychospora* spp.), wiregrass (*Aristida beyrichiana*), toothache grass (*Ctenium aromaticum*), bluestem (*Schizachyrium* spp.), pitcher plants (*Sarracenia* spp.), sphagnum moss (*Sphagnum* spp.), milkworts (*Polygala* spp.), yellow-eyed grasses (*Xyris* spp.), hat-pins (*Eriocaulon* spp.), meadowbeauty (*Rhexia alifanus*), sundews (*Drosera* spp.) and orchids (*Orchidaceae*) (F.N.A.I. 1990). Approximately 1% of seepage slopes that originally existed along the Gulf Coastal Plain are still intact. These areas have been either encroached by woody species in the absence of fire, lost to development and road construction, converted into private ponds, or drained for pine plantations. Yet, these increasingly rare communities provide habitat for many rare, endemic or endangered plant species including pitcher plants, orchids and other wildflowers (F.N.A.I. 1990).

Feral hogs (*Sus scrofa*), an exotic species in Florida, pose a serious threat to these imperiled communities. Hogs forage underground for food by rooting or using their snout to overturn soil (Bratton et al. 1982, Simberloff et al. 1997). This destructive foraging activity can bring about three key environmental changes. First, hog rooting reduces vegetative cover and exposes bare soil (Bratton 1974, Engeman et al. 2007, Howe et al. 198, Howe and Bratton 1976, Kotanen 1995 & 1997, Ralph and Maxwell 1984). Reduced cover changes micro-site conditions by increasing soil surface temperatures and decreasing soil moisture (Kotanen 1997). The exposed soil leads to accelerated erosion, soil compaction, stream siltation, decomposition and nutrient loss (Howe and Bratton 1976, Singer et al., 1984).

Second, feeding and rooting behavior can contribute to changes in plant species composition (Howe et al. 1981, Singer et al. 1984). Hogs feed directly on vegetation with bulbs, tubers, rhizomes and corms. These plant species may be more heavily selected and impacted than other less sensitive plant species (Howe and Bratton 1976). Plant species not fed on directly may be inadvertently affected during rooting for earthworms or other food (Hobbs and Huenneke 1992). Lastly, disturbance can cause loss of species or biodiversity. It is especially common for plant species to be unable to recover between frequent or intense disturbances in systems with low nutrient availability and thus reduced growth rates (Huston 1979, Walker and Peet 1983). Frequent or heavy disturbance of seepage slopes by hogs favors succession of more common species rather than the sensitive and rare species that exist under natural conditions. Not only can hog disturbance act to set back succession, but it can also facilitate invasion of exotic plants (Aplet et al. 1991, Howe and Bratton 1976, Medeiros et al. 1991). Hog foraging can also deleteriously affect animal populations. In addition to plants, hogs feed on ground nesting birds, reptiles, amphibians and small mammals (Stegeman 1938, Singer et al. 1984, Taylor and Hellgren 1997).

Streams & Rivers

The American Fisheries Society's (A.F.S.) Endangered Species Committee has monitored imperiled freshwater organisms of North America since 1972 (U.S.G.S 2009). Each year their findings are published in the A.F.S.'s Fisheries Journal. The Committee categorizes fish species that are Vulnerable, Threatened, Endangered or Extinct. A Vulnerable (V) categorization indicates that the taxon is in imminent danger of becoming threatened or endangered. A Threatened (T) categorization indicates that the taxon is in imminent danger of becoming

endangered throughout all or significant portions of its range. An Endangered (E) categorization indicates that the taxon is in imminent danger of extinction throughout all or significant portions of its range. An Extinct (X) categorization indicates that the taxon either: no longer lives outside of captivity (Xn); has not been observed in less than 50 years (Xp); or has not been observed in more than 50 years (X). Fish taxon that have been categorized as Vulnerable within the Blackwater River watershed include the alligator gar (*Atractosteus spatula*), the Florida chub (*Macrhybopsis* sp. cf. *aestivalis*), the iron color shiner (*Notropis chalybaeus*), the bluenose shiner (*Pteronotropis welaka*) and the striped bass (*Morone saxatilis*). Fish taxon that have been categorized as Threatened within the Blackwater River watershed include the Gulf sturgeon (*Acipenser oxyrinchus desotoi*), the Alabama shad (*Alosa alabamae*) and the blackmouth shiner (*Notropis melanostomus*) (Figure X in Appendix B depicts the habitat of the eight imperiled fishes within the Blackwater River watershed). According to this classification system no fish species is categorized as Endangered or Extinct within the Blackwater River watershed (Jelks 2009).

Blackwater Bay

The Blackwater Bay is one of five waterbodies making up the Pensacola Bay System. Both the Blackwater and Yellow Rivers flow into the Blackwater Bay, which widens into East Bay then into Pensacola Bay before flowing into the Gulf of Mexico (refer to Figure 4 for the geographic location of the Blackwater Bay relative to Pensacola Bay). The Blackwater Bay is bordered by Eglin Air Force Base on the east side and by residential areas to the north and west sides. The Blackwater Bay is a coastal plain river dominated estuarine system characterized as a drowned river valley that flows into the Gulf of Mexico (Macauley et al. 2009). The average depth of the Blackwater Bay is approximately six feet and during periods of low water flow salt water enters the system. The Blackwater Bay historically contributed to the general health of the Pensacola estuarine system by harboring wetlands, marshes and submerged aquatic vegetation that aided in filtering nutrient, sediment and chemical contaminants from the water. A 1992 seagrass assessment determined the majority of seagrass beds in the Blackwater Bay to be patchy (Macauley et al. 2005). Management of the vegetation within the Blackwater Bay is an integral part in maintaining the health of the Pensacola Bay (refer to Figure 1 in Appendix B for locations of seagrass beds in the Blackwater Bay). While shell fishing is prohibited in the Blackwater Bay restoration and maintenance of the oyster beds, seagrasses and wetland areas will aid to filter nutrients, sediments and chemical pollutants from the water before it reaches the shell fishing areas of the southern portion of the bay (refer to Figure 2 in Appendix B for a shellfish harvesting area map of the Pensacola Bay) (F.D.A.C.S. Division of Aquaculture 2009).

LAND USE

Land Cover

As of 2004, land cover in the Blackwater River watershed was dominated by coniferous upland forests (24%), cropland & pastureland (17%) and coniferous plantations (15%) (F.G.D.L. 2009). Less dominant but other prevailing land cover types include regeneration forests (9%), mixed coniferous/hardwood forests (8%), mixed wetland forests (7%) and coniferous wetland forests (5%). As of 2004, residential areas covered only 4% of the watershed land (refer to Figure 5 for land cover proportions for 1995 and 2004). Overall, the land cover in the watershed is diverse and includes a variety of wild and urbanized spaces.

Between 1995 and 2004, the land cover pattern in the watershed evolved. In 1995 the predominant land covers in the watershed were coniferous upland forests (36%), coniferous plantations (15%), cropland & pastureland (19%), mixed wetland forest (9%), forest regeneration areas (8%), coniferous/hardwood mixed forests (5%) and medium density residential areas (2%) (F.G.D.L. 2009). While a slightly different land cover categorization was used in 1995 than in 2004, it is possible to determine some trends in land cover change (Refer to Table 2 Appendix A for a full comparison of land cover and land cover change in the Blackwater River watershed between 1995 and 2004). The major declines in land cover types between 1995 and 2004 include: coniferous plantations (loss of 24,376 acres), cropland & pastureland (loss of 5,662 acres), coniferous upland forest (loss of 45,803 acres), medium density residential areas (loss of 5,971 acres) and hardwood wetland forest (loss of 6,204 acres).

For this analysis land cover changes of more than 1,000 acres between 1995 and 2004 are considered to be major gains or losses of the relevant land cover type. The major gains in land cover types between 1995 and 2004 include: disturbed land (gain of 1,403 acres), conifer/hardwood mixed forest (gain of 14,378 acres), hardwood upland forest (gain of 4,160 acres), forest regeneration areas (gain of 5,542 acres), mixed rangeland (gain of 8,921 acres), high density residential (gain of 9,363 acres), low density residential (gain of 5,283 acres) and shrub & brush land (gain of 3,064 acres).

The major losses in land cover types between 1995 and 2004 include: coniferous plantations (loss of 24,376 acres), cropland & pastureland (loss of 5,662 acres), coniferous upland forests (loss of 45,803 acres), wetland hardwood forests (loss of 2,615 acres) and mixed wetland forests (loss of 6,204 acres) (refer to Figure 3 Appendix B for a comparison of land cover change in acres between 1995 and 2004). Major land cover changes indicate that the Blackwater River watershed is gaining mixed conifer/hardwood, upland hardwood and regenerating forest land but losing upland coniferous, hardwood wetland and mixed wetland forestland. Additionally, rangeland, high-density residential and disturbed land cover areas are increasing while coniferous plantation and cropland & pastureland cover is decreasing. General land cover trends include an increase in the density of urban areas, and a decrease in coniferous upland and wetland forests as well as cropland & pastureland areas.

Stakeholders

The major stakeholders associated with the Blackwater River watershed are the general public who own the majority of the land in the form of private land holdings and a state park, a state forest, a national forest and an air force base. The silviculture and ecotourism industries and wildlife, river and ecology advocates are also key stakeholders in the Blackwater River watershed. One of the largest uses of this watershed is eco-tourism, including water sports on lakes and rivers, fishing, hunting, camping, bicycling, and hiking.

The natural resources utilized in this watershed include timber, timber and wood product lands, sand and gravel quarrying, fertile soils utilized for agriculture, and water supplies. Private landowners in the watershed are primarily using their land for residential, silviculture and rangeland activities. The publicly owned land is generally managed for ecotourism and for conservation of the native ecology.

A brief discussion of the management of the publicly held land in the Blackwater River watershed follows. The Blackwater River State Park manages 590 acres of the Blackwater River watershed. This land is comprised of upland pine forests, swamps and award winning Atlantic cedar lined rivers. The picturesque white sand bottomed rivers are a favorite destination for hikers and boaters and the Blackwater River State Park provides the infrastructure for eco-tourists to swim, fish, camp, paddle and stroll along trails through managed wildlands. The park has also been recognized as an official Registered State Natural Feature in 1980 for possessing “exceptional value in illustrating the natural history of Florida” (Blackwater River State Park 2009). The Blackwater River State Forest manages 206,350 acres of the Blackwater River watershed within the Florida panhandle.

This land constitutes a substantial portion of the largest contiguous longleaf pine/wiregrass ecosystem remaining in the world. The State Forest is threaded by clear flowing waterways are host an abundance of eco-tourism activities. The Forest is managed for multiple uses and aims to balance the needs of environment with societies needs for recreation and resources (F.D.A.C.S. 2009). Within the Alabama portion of the watershed, Conecuh National Forest is comprised of longleaf pine/wire grass communities as well and hardwood bottoms. It is managed for recreational activities including hunting, hiking, camping and day use (U.S.D.A. Forest Service 2009). Eglin Air Force Base manages approximately 2000,000 acres of longleaf pine forest, approximately 7,000 acres of which make up the most extensive remaining old growth longleaf pine forests. The Air Force Base employs a team of natural resource management specialists who monitor the abundance of important species within the forests on the Base (Eglin Air Force Base 2009).

In general these public land holders aid in conservation efforts in the Blackwater River watershed by actively protecting, monitoring and restoring the valuable ecosystems within their boundaries.

WATER USE

Designated Use

In Florida water quality standards use water quality criteria to define designated uses of the States water bodies (F.D.E.P. 2007). Under the Florida classification scheme, the Blackwater River is designated a Class III water body which means that the River must be “suitable for recreation, propagation & maintenance of a healthy, well-balanced population of fish and wildlife” to meet its designated use. In Alabama the Blackwater River as well as the 5 other associated streams in the watershed are classified as Fish and Wildlife usage (G.S.A. 2009). This is equivalent to both the fishable/swimmable uses designated by the Clean Water Act and to the Class III waters designation assigned by the State of Florida.

Water Consumption

The quantity of water extracted from the Blackwater River watershed for 12 consumption does not appear to be well documented. The last data from the Alabama portion of the watershed was from 1995 (Table 1). In 1995, water was primarily used for public water supply, 3.37 million gallons per day (mg/d), which is controlled by county water authorities and its sole source is groundwater. Self-supplied domestic used (SS Dom.) is the withdrawal of water from private groundwater wells, at 0.69 mg/d. Self-supplied industrial and commercial (SS Ind./Comm.) utilizes both groundwater and surface water, with 0.79 mg/d from groundwater and 35.52 mg/d from surface water. Agricultural water use includes both water for irrigation and livestock sourced from both groundwater and surface water, with 0.13 mg/d from groundwater and 1.18 mg/d from surface water. In this portion of the watershed surface or groundwater is not used from hydroelectric power.

Table 1. Water use in million gallons per day (1995) in the Alabama Blackwater River Hydrologic Unit (03140304).

WATER QUALITY

Alabama Assessment of Water Quality

According to the Alabama Management Plan, the Blackwater River, from its source to the Florida-Georgia state line is not impaired and therefore has no established T.M.D.L.s. However, the major threats to water quality in the adjacent Conecuh River watershed include excessive nutrients (ammonia, nitrate, and phosphorous), high bacteria counts, excessive sedimentation, and excessive concentrations of metals and organic compounds. This watershed has similar land-use delineation as well as physical characteristics to that of the Blackwater.

Florida Impaired Waters

In 1998 Florida's Department of Environmental Protection (F.D.E.P.) completed a partial assessment of water quality in the 104 water body segments making up the Blackwater River watershed (F.D.E.P. 2007). That same year several Blackwater River water body segments were added to the 303(d) List of Parameters of Concern (refer to Figure 4 Appendix B for a map of the results of the 1998 water quality assessment in the Blackwater River watershed). These water body segments and parameters of concern are as follows: Big Coldwater Creek (listed for Coliforms and Total Suspended Solids (T.S.S.)), Big Juniper Creek (listed for Coliforms and Turbidity), Mare Creek (listed for Dissolved Oxygen (D.O.) and Turbidity), Manning Creek (listed for Coliforms, T.S.S. and Turbidity), Bucket Branch (listed for a Nonpoint Source), West Fork (listed for Nutrients and Coliforms), East Fork (listed for Coliforms and T.S.S.), Blackwater River (listed for Coliforms, Mercury in Fish and T.S.S.) (F.D.E.P. 2007). The water bodies put on the 1998 List of Parameters of Concern became the focus of management and a 2007 water quality verification process (F.D.E.P. 2007).

As of 2007, the water quality assessments found: 7 water body segments to be verified from impairment, 13 water body segments to be potentially impaired and put on the Planning List, 19 water body segments met standards while attaining only some of the designated uses and 57 water body segments to lack sufficient data for assessment. Those water bodies on the Planning List are potentially impaired due to high T.S.S. loads (F.D.E.P. 2007). High T.S.S. loads are thought to stem from land use activities such as land clearing, agriculture, silviculture, dirt road erosion and recreation that accelerate sedimentation, causing habitat smothering in streams (F.D.E.P. 2007). None of the assessed Blackwater River watershed's water body segments attain all designated uses. The water bodies requiring Total Maximum Daily Load (T.M.D.L.) establishment are impaired due to high coliform concentrations in water and high mercury concentrations in fish (F.G.D.L. 2009, F.D.E.P. 2007). In 2001, T.M.D.Ls were established for fecal coliforms in 7 water bodies: Downstream Segment, Big Cold Water Creek, Big Juniper Creek, Blackwater River, East Fork Big Cold Water Creek, Manning Creek, and West Fork Big Cold Water Creek (USEPA 2001a and 2001b). In all cases, the T.M.D.L. concentration for fecal coliform is 200 colonies per 100ml of water, while the load of coliforms varies for each river segment (USEPA 2001a and 2001b). The Pond Creek tributary of the Blackwater River is on the 303(d) list of impaired waters due to high concentration of fecal coliforms, however it does not seem that T.M.D.Ls have been established. Segments of the Blackwater River and its Rock Creek tributary are on the 303(d) list due to high levels of mercury concentrations in fish tissue (see Figure 6 for the geographic layout of these impairments). Assessment of water quality in the Blackwater River watershed continues.

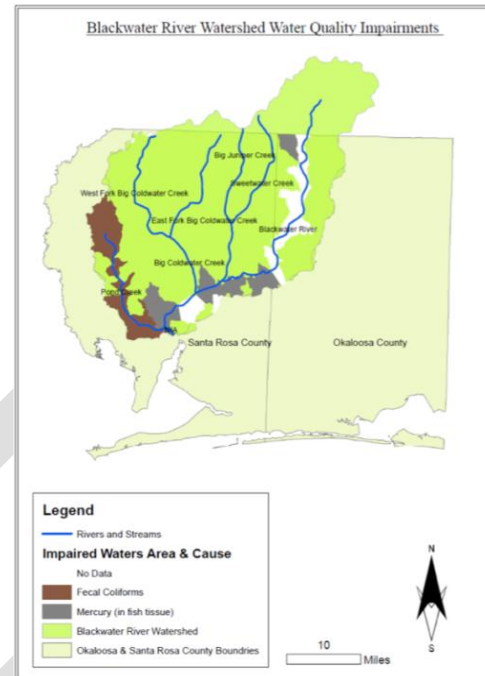


Figure 6. Water quality assessment results for the Blackwater River watershed as of 2006. The color brown indicates water body segments found to be impaired due to fecal coliform levels. The color grey indicates water body segments found to be impaired due to mercury levels in fish. The color white indicates a lack of sufficient data to make an assessment (data from FGDL 2009).

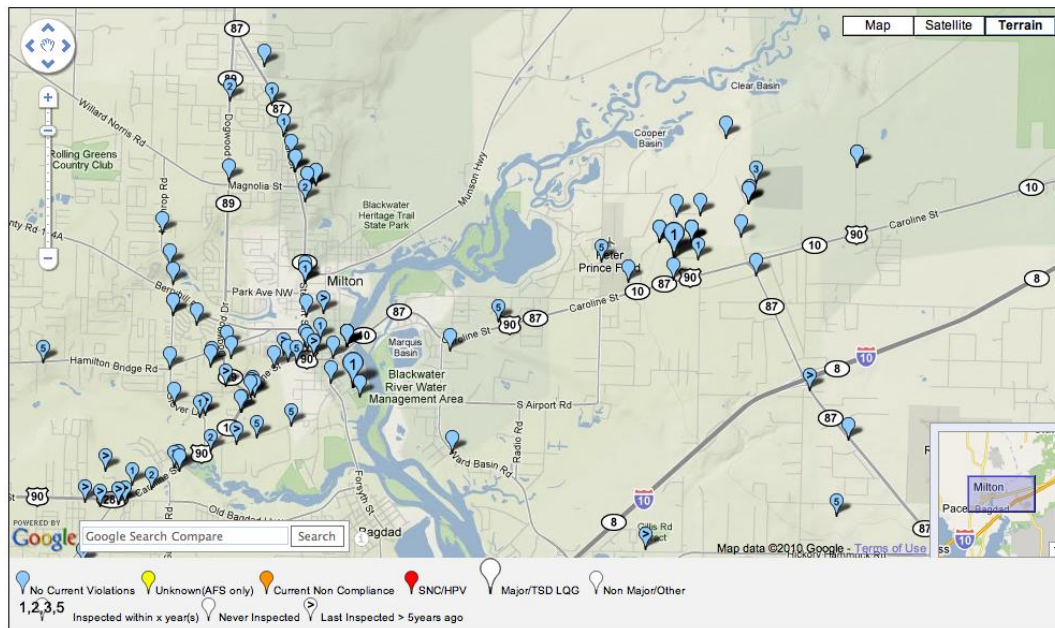


Figure 7. Location of Waste Water and Hazardous Waste Permits around Milton, Florida and within the Blackwater River Watershed (USEPA, 2010).

Point Sources of Pollution

There are 5 N.P.D.E.S. permitted sites along the Blackwater in Alabama, and as of 2000 there were no violations (G.S.A. 2009). In Florida a search was conducted on the E.P.A. water permitting website to determine the N.P.D.E.S. and hazardous waste use permits in the watershed. This assessment was focused around the town of Milton FL, which has the highest concentration of these permits (Figure 7). Milton is located near the mouth of the Blackwater River and has a population of approximately 7,000 people (Macauley et al. 2009). The symbols on the figure indicate if the sites are within compliance and the number of years since the last inspection. This data source suggests that as of April 2010, there are many sites that are not up to date with but there are no sites that are currently non-compliant. There is some concern from stakeholders that the town of Milton Wastewater Treatment facility could be a potential source of contaminants, including bacteria to the river. Although there were upgrades to the plant in 2006 (City of Milton, 2010), there are portions of the plant that are much older and under high flow conditions could leak or overflow.

Nonpoint Sources of Pollution

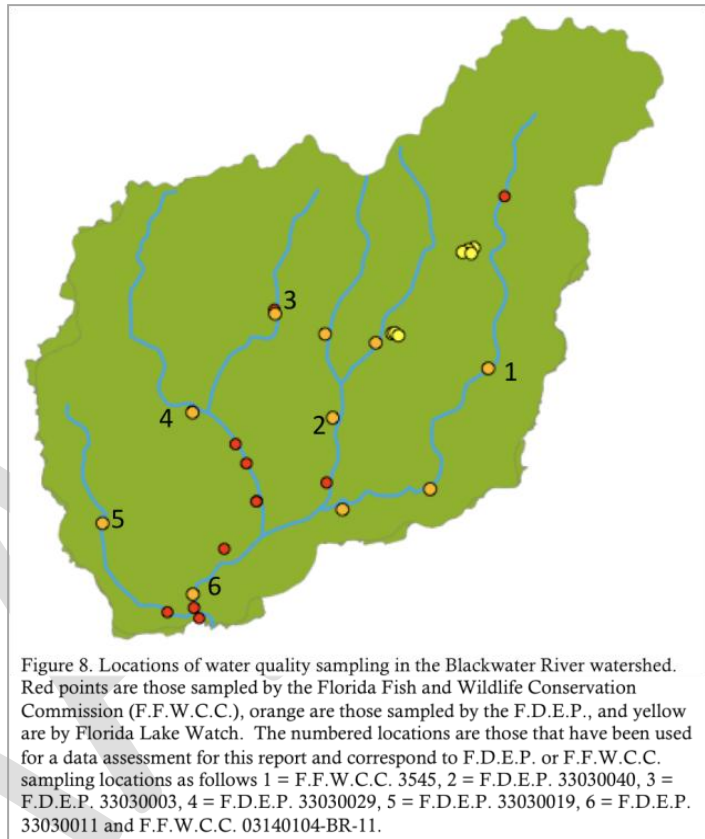
Nonpoint sources of pollution are much harder to determine in a watershed, as they can be the product of a number of land-uses as well as anthropogenic activities. Nonpoint sources can include, but are not limited to, agricultural run-off, septic tank contamination, and development activities such as road building or shoreline stabilization. In attempts to characterize this pollution, long-term data sets from the E.P.A. were assessed and discussed below.

Environmental Protection Agencies S.T.O.R.E.T. Data

The E.P.A. S.T.O.R.E.T. database contains a large water quality data set reported by the F.D.E.P., the Florida Fish and Wildlife Commission and Florida Lake Watch (Appendix A, Table 1 shows the water quality characteristic measured and the method used to measure each constituent of water quality). Figure 8 shows the sampling locations of these agencies within the watershed. Although there seems to be a good distribution of locations in the watershed, Florida Fish and Wildlife ceased sampling along the river in 2000. Only the orange symbols in Figure 8 represent current sampling locations. The methods utilized are approved by the U.S.E.P.A., including those analytical procedures beginning with ESEPA and APHA. Although some non-E.P.A. approved methods have been used early in the sampling, it seems that the current procedures being conducted by the F.D.E.P. are approved methodologies.

It is, however, important to keep in mind that when looking at historical data, some of the reported values may not be reliable due to the methods that were utilized, especially when pertaining to Enterococcus Group Bacteria and Fecal Coliform.

The data available on the S.T.O.R.E.T. database for the Blackwater River ranges from 1977 to present. In most cases the samples have been collected regularly, from monthly to at least 3 times a year, since 1999. The available data on the S.T.O.R.E.T. database was analyzed for any long-term trends for a more complete picture of the watershed. Although a number of analytical techniques were examined, only a few are reported here. For this discussion six sampling locations were chosen, one from each of the main tributaries (Figure 8). These data sets were used because the data spans the longest range of time. Sample 1 is from the Route 4 bridge east of Martin Mill Road, 2 from Indian Ford Road bridge, 3 from Highway 4 Bridge east of MacDaniels Rd, 4 from Highway 87 N bridge south of Neal Kennington Road, 5 from Highway 90 bridge north of Old Bagdad Road, and sample 6 is taken from the Highway 90 bridge just east of Milton.



Dissolved Oxygen

Low dissolved oxygen (D.O.) can be a very large problem for fish populations and production in a river system. The F.D.E.P. rule for Class III waterways is that D.O. should not be below 5 mg/L. For sampling locations 1, 2, 3, and 4 all sampling points fall between 6 and 12 mg/L (Figure 5 Appendix B). For sampling sites 5 and 6 (Figure 9) there are many times that D.O. fell below 5 mg/L. This occurs mostly after 2000; however in the last year there have been no low D.O. readings. It is important to remember that D.O. can be affected by a number of variables such as: the time of day that sample was taken, the depth of the sample in the water, and the weather on the sampling day. The data presented do not necessarily indicate a problem, but the trend should continue to be examined. These two sampling locations are closest to the estuary and salt content can decrease the D.O. concentration.

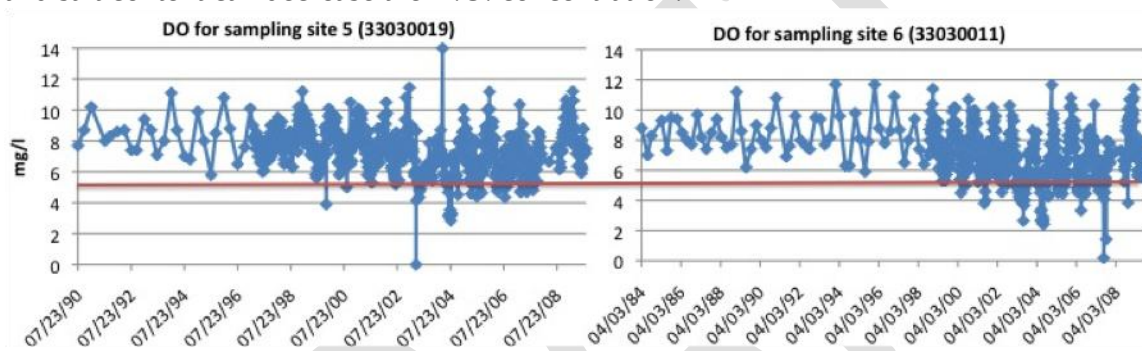


Figure 9. Dissolved oxygen trends for sampling sites 5 and 6. The red line indicates 5mg/l. The F.D.E.P. rule for Class III water indicates impairment if levels fall below this level.

Nutrients

Nutrient pollution is a nationwide concern for many inland waterways. The main sources of nutrient pollution are agricultural run-off due to excessive fertilizer use and run-off from pasturelands. As of 2004, about 17% of the land use in the watershed was cropland or pasturelands. The F.D.E.P. is working on developing nutrient criteria for the state of Florida, but currently nutrient pollution is defined as altering the background nutrient concentrations as to cause an imbalance of natural populations of aquatic flora or fauna (F.D.E.P., Criteria for Surface Water Quality Classifications).

Using data collected from the S.T.O.R.E.T. database, the long-term trends of both phosphorous and nitrogen were examined. Any increase in either phosphorous and nitrogen should be detectable by examining the long-term trends. There seems to be no increasing Phosphorous (P) trend at the six sampling locations identified. At sampling sites 1-5, P values range between 0 and 40 ppb (Figure 6 Appendix B). Sampling location 6, the longest record, has P values before 2000 which average around 35-40 ppb and seemed to have dropped to values around 10 ppb from 2000 to present, which is similar to the values of the other sites over this more recent timescale. Phosphorus concentrations are quite consistent between the sites as well as over these

long-term trends. Nitrogen was also examined at the same locations, but the sampling was only initiated in 1998 (Figure 7 Appendix B). Most values are at or around 500 ppb, however there are some values that spike to above 600 ppb. At sample locations 2, 3, 4, and 5 after 2007 there are distinct increases in the nitrogen concentrations. The highest concentrations of nitrogen are seen at 5 of the 6 locations after 2007.

Overall, the concentrations of nutrients are quite low along the river, which is to be expected due to the nutrient poor sandy lithology. However it is important to continue observing concentrations, especially nitrogen across the watershed. According to the F.D.E.P. Criteria for Surface Water Quality, water bodies must be protected from further enrichment if they have P concentrations less than 0.04 mg/L (40 ppb) and nitrogen concentrations below 0.3 mg/l (300 ppb).

Sedimentation

Sedimentation has been identified as a stakeholder concern in this watershed. Due to the local geology of easily erodible soils as well as a sand dominated riverbank lithology, excess sedimentation into the river is a large problem. This can either be local erosion of the riverbanks or can be characterized by the transport of upstream sediment at higher elevations to lower downstream locations. This is an innate problem to this region, but it can be exacerbated by anthropogenic activities, including some land-use practices (agriculture or timber harvesting), road construction and use, as well as development along the riverbanks. There are a number of unpaved roads as well as small tributaries in this watershed. In previous practice of road maintenance, the goal was to remove water from road surfaces. Unfortunately, this practice greatly increased the amount of sediment that was moved from the land surface into the streams.

There are a number of ill effects associated with sedimentation, both physical and biological. The physical effects include change in water quality, the reduction of storage capacity in water impoundments (both natural and man-made), decreased usability of recreational areas, the disruption of natural stream order and flow, and the destruction of structures along the river banks. Excess sediment can also have negative effects on the biology of the watershed, including the destruction of both marine and terrestrial animal habitat, the breakdown in the aquatic food chain as sediment suffocates small organisms living in the streambed, decrease in spawning areas caused by sediment infilling, and possible damage to fish species through direct abrasion to bodies and gills (G.S.A. 2009).

Three criteria measured by the F.D.E.P. could be used as indicators of increased sediment delivery to the river: turbidity, total suspended solids (T.S.S.), and specific conductance. Turbidity is a measurement of water clarity. Total suspended solids are a measure of the non-filterable component of the water, or the sediment trapped as the water is filtered. Specific conductance is a measure of how well water can conduct an electrical current, which is controlled by specific ions in the water that can be contributed by soil erosion, specific types of pollution, or increased salt concentration. As discussed above, some water body segments have contaminated with T.S.S. and/or turbidity, though these segments are quite small. The long-term trends of each of these components were examined at the six sampling locations to determine if there was an increase over time, and these results may represent larger portions of the river

(Figures 8-10 Appendix B).

Turbidity has been measured at 2 of the 6 sites from 1994 to present and from 1999 to present at the other 4 sites. There are some samples that record higher turbidity, but overall the water is very clear and turbidity is not a problem. Total suspended solids measured at the six sampling locations also have very low concentrations. Like turbidity, this is to be expected due to sandy sediments along the riverbanks. This type of sediment does not become suspended in the water column, and therefore does not contribute to turbidity or T.S.S. Total suspended solids were identified as a concern and are currently on the planning list for possible impairment along the river. The lack of high values in this data assessment may be due to the specific conditions at each specific sampling location. The creeks on the planning list are mainly minor waterways, where sedimentation could have more severe effects. This inconsistency in data further emphasizes the need for increased spatial distribution in sampling and assessment of all water bodies in the river.

Specific conductance at site 1-4 measures at or about 50 umho/cm. As a reference, the conductance of seawater is about 50,000 umho/cm (mS/cm). The very low values seen at these four sites indicate that there is probably little to no addition of excess sediment or soil to the river. At sites 5 and 6 the specific conductance values jump to above 10,000 after 1999. At site 6, the closest site to the estuary, some of these high values could be contributed to saltwater; however, the values seem rather high and should be seen throughout the record, not just after 1999. As discussed below, site 5 is listed as contaminated with Fecal Coliform and site 6 is located in a much more populated area of the watershed. This increase in specific conductance could be due to increased erosion around populated areas, contamination from septic tanks, or other pollutants. More research will need to be conducted to determine the cause; however, there does seem to be the addition or change in land-use around 1999 that contributes to this change.

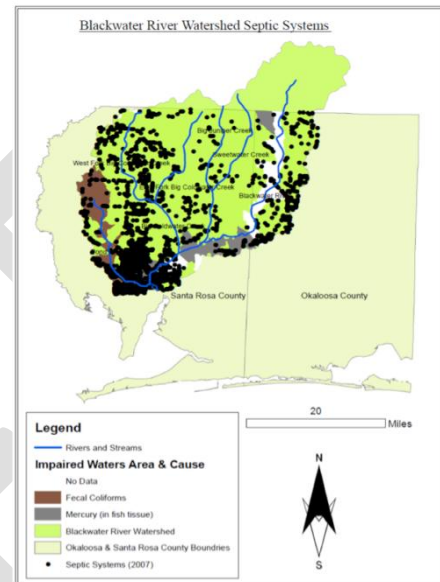


Figure 11. A number of septic systems exist within the Blackwater River watershed. To reduce the possibility of septic system contribution of fecal coliforms and nutrients to water it is recommended that a basin wide approach to maintain and replace septic systems be enacted.

Septic Systems

Within the Alabama portion of the Blackwater River watershed there are an estimated 365 septic tanks. The Geological Survey of Alabama estimates that 6% (~21 septic systems) of the septic systems in the Alabama portion of the Blackwater River watershed are failing (G.S.A. 2009). There are also a number of septic systems in the Florida portion of the Blackwater River watershed, especially along the western and eastern edges, and near the mouth of the river (Figure 11). Nutrients and coliforms originating from septic systems are considered a non-point source of pollution. Degradation of water quality due to septic systems is a major stakeholder concern in the Blackwater River watershed.

Septic systems provide small-scale sewage treatment in rural areas that are not connected to municipal sewer systems. Septic systems consist of a tank and a drainage field as shown in Figure 10. Household wastewater flows into the septic tank where the solids sink, the scum floats and anaerobic bacteria begin the decomposition process. When the volume of the septic system reaches capacity the liquid waste flows out of the tank and into the drainage field via porous piping. Complete treatment of wastewater depends on in-tank processing and dispersal of effluent to the leach field. If not properly maintained, septic systems can become a source of organic matter, nutrients, oxygen demanding bacteria and pathogens to the environment. Proper functioning of the septic tank depends on the maintenance of tank volume and drain field function to allow for sufficient decomposition of waste. Maintenance requires the removal of accumulated partially decomposed solid waste from the septic tank every 3 to 5 years. If sufficient septic tank volume is not maintained, sufficient decomposition of waste is not achieved, and the leach field will become clogged and fail, releasing organic matter, nutrients, oxygen demanding bacteria and pathogens into the environment (Cogger, 2009).

Bacterial Indicators of Fecal Contamination

Recreational activities and human health are put at risk in river systems having elevated levels of coliform bacteria.

Management efforts to reduce bacterial populations may be hindered by misidentification the source of bacteria. It is important to appropriately identify the source of bacteria to allow

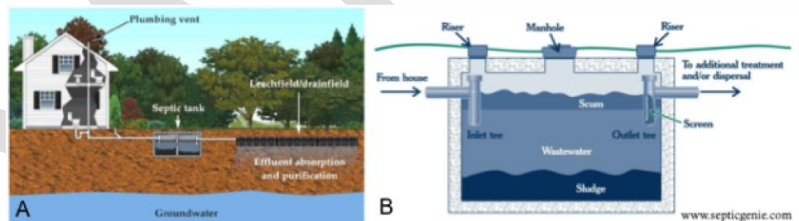


Figure 10. Diagram of septic system relation to house (A) and design (B).

for targeted management and reduction of bacterial populations in river systems. Commonly quantification of fecal coliform, enterococci or the bacterial species *e. coli* are used to indicate the presence of human feces in water. However the management implications and source information varies greatly depending on which bacterial group is utilized. With a clearer understanding of the fate of these different indicator organisms, a more accurate risk assessment can be implemented. Following is a discussion of the differences in origin between fecal coliform, enterococci and *E. coli*.

Fecal Coliform

Fecal coliforms are the thermotolerant subset of total coliform that are commonly found in the feces of humans and other warm-blooded animals (Elmund et al 1999, USEPA 2009).

Quantification of fecal coliforms is frequently used to indicate the potential presence of bacteria from human feces that may threat human health (Elmund et al 1999, USEPA 2009). However the standard fecal coliform test has been found to falsely identify up to 90 percent of non-fecal source bacteria as fecal source bacteria (Caplenas and Kanarek 1984). Fecal coliform tests quantify the total quantity of thermotolerant bacteria as fecal coliforms including three coliform genera (*Klebsiella*, *Enterobacter*, and *Citrobacter*) that account for less than 3% of human fecal bacteria (Elmund et al 1999). Erroneous quantification of fecal sourced bacteria within the

fecal coliform group may misinform management strategies regarding the extent of fecal pollution in streams and/or rivers. Due to the lack of specificity in the currently used standard for fecal coliform evaluation, a more reliable health risk assessment for fecal coliform bacteria is recommended (Caplenas and Kanarek 1984, Elmund et al 1999).

Enterococcus

While the enterococci bacterial group is also frequently found in the feces of humans and other warm-blooded animals some strains are ubiquitous and not related to fecal pollution (USEPA 2009). The enterococci test is commonly used as a measure of the bacteriological quality of ambient fresh and marine recreational water. Epidemiological studies have led to the development of criteria that can be used to promulgate recreational water standards based on the established relationship between health effects and water quality. The significance of finding enterococci in recreational water samples is the direct relationship between the density of enterococci in the water and swimming-associated gastroenteritis studies of marine and fresh water bathing beaches (USEPA 2009).

Escherichia coli (E. coli)

E. coli bacteria is a natural inhabitant only of the intestinal tract of warm-blooded animals, its presence in water samples is an indication of fecal pollution and the possible presence of harmful enteric pathogens (USEPA 2009). In most cases E. coli might be the best indicator of fecal contamination in water because it accounts for more than 95% of the coliform genera in human feces (Elmund et al 1999). Based on reviewed research it is recommended that E. coli rather than the traditional fecal coliform or enterococci groups be used as an indicator of fecal contamination unless the water under examination has been influenced by effluent from pulp or paper processing mills (Beauchamp et al 2006; Elmund et al 1999). E. coli have the ability to survive in pulp and paper mill effluents (Beauchamp et al 2006). The use of E. coli as an indicator of fecal contamination in waters containing pulp or paper mill discharge is questionable (Beauchamp et al 2006). When identifying the source of bacterial populations in areas with a history of pulp or paper mill activity additional information will be required to clearly indicate contamination by feces (Beauchamp et al 2006). E. coli is considered a more specific indicator of fecal contamination in fresh water (U.S. EPA 2009).

Brackish Waters

In 2004, Enterococcus spp. took the place of fecal coliform as the new federal standard for water quality at public beaches. It is believed to provide a higher correlation than fecal coliform, with many of the human pathogens often found in city sewage (Jeng et al 2004). In brackish waters enterococci might be a more stable and hence a more conservative indicator for elevated microbial level concerns than E. coli or fecal coliform (Jeng et al 2004). For example recreational waters "could be permissible to swim in when fecal coliform is used as indicator, but not considered safe for swimming when enterococci are used. Therefore, it is important to determine which of the bacterial indicator organisms selected will best represent" the information that is being sought (Jeng et al 2004). Enterococci is considered the best indicator of

human sourced coliforms. The F.D.E.P. has been monitoring the Blackwater River for fecal coliforms and Enterococcus Group Bacteria since 1997 (Figures 11 and 12 Appendix B). Although it is important to measure both these constituents, it is critical to remember that presence of either of these bacteria does not mean for certain that septic tanks are responsible for the contamination. Both of these can be the result of animal waste and Fecal coliform can also be the result of rotting logs or debris in the river. According to current E.P.A. drinking water standards there can be no fecal coliforms in water, and it is generally held that over 200 colonies per 100ml of water can be hazardous to health.

The fecal coliform trends indicate that the addition of these bacteria seems to be during pulse events, in that there are spikes in the data where in one sampling point the value jumps from 0 to over 1000 #/100ml. At sampling sites 1 through 4 most counts are not above 2000 colonies per 100ml. The pulses of bacteria seem to spread evenly over the record, and for the most part there is little or no detection except for these spikes. The record at sampling site 5 also has this flashy nature, but the values here are in some cases 5 fold more than the other locations. This site is along the Pond Creek tributary that is 303(d) listed for high coliform values. From this record we can see that this is not a recent occurrence, but there have been problems since the late 90's. Also, since late 2008 the counts do not seem to be as high. Sampling site 6 has the most peaks in count values, but only one value is above 2500 colonies per 100ml.

The Enterococcus Group bacteria have been measured at these locations, but at sites 2, 3, and 4 this record only extends back about a year. Sampling site 1 has fairly low values, with only one sample above 1000 counts per 100ml. The highest measurements are seen at sampling site 5, which is the listed site for high bacteria counts. The highest values have been in the last 2 years, with values above 1000 counts per 100ml. Sampling site 6 also has a high frequency of samples with bacterial counts, and again the highest values are in the past 2 years.

Both of these bacterial counting methods give a much broader view of possible bacterial contamination, but only by measuring E. coli bacteria, which is a type of Enterococcus Group bacteria, can we directly determine the contamination is due to septic tanks. It is important to continue sampling all bacterial counts to document any trends or changes.

STAKEHOLDER DISCUSSION

Ecological

Improve and Maintain River & Stream Water Quality

To allow for the identification of degraded water quality, its improvement and ultimately maintenance of good water quality in the Blackwater River watershed, the following recommendations should be implemented:

First, the basin-wide water quality assessment must be completed. Currently, more than 1/2 of the water body segments in the watershed have not had a water quality assessment made (refer to Figure 12 for a comparison of the number of water body segments for each assessment category). Of those water body segments that have had water quality assessments- none meet all designated uses for the Class III waterbody. A completed water quality assessment will lay the foundation for identification of land use activities that have degraded water quality and the remediation of good water quality. Water quality monitoring will also allow for the establishment of baseline water quality data from which impairment can be verified and T.M.D.L.'s can be established. It is important to look at the long-term trends, where available, to aid in the establishment of these T.M.D.L.'s. It must be kept in mind that blackwater river systems have innate characteristics, such as low nutrient and low D.O. concentrations, and that a slight change in these can lead to drastic changes along the river. These and other pollutants must be watched closely. It is important that the fairly well established sampling strategy conducted by the F.D.E.P. be continued at regular intervals and over the whole extent of the watershed.

Assessment of basin water quality should continue indefinitely in the form of an organized water quality monitoring program that would include quantification of sedimentation rates.

Establishment and organization of the water quality monitoring program should include all major public landowners in the basin as well as state water quality agencies. Data resulting from the monitoring program should be uploaded, organized and available for public access via the Blackwater River Foundation webpage.

Second, the impaired water body segments must be closely scrutinized to identify potential and actual causes of impairment. There are a number of septic systems within the watershed. To reduce the possibility of these septic systems contributing fecal coliforms, other bacteria, and nutrients to the waters, a watershed scale approach should be established to help septic tank owners maintain and replace septic systems (see Figure 11 for the location of septic tanks within the basin). Many homeowners are unaware that septic tanks have to be inspected every 5 years

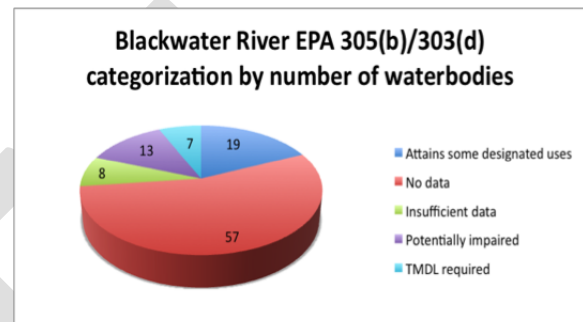


Figure 12. An examination of the total number of waterbody segments in the Blackwater River watershed and the water quality assessment status of them (data from F.D.E.P. 2007).

and have a lifespan of approximately 25 years. Annual mailers should be sent to homeowners as a reminder. Additionally, the counties should consider financial incentives for inspections and/or maintenance of septic tanks especially in areas that contribute to Pond Creek. Clearing of land in preparation for agricultural, development, recreational or transportation increases rates of erosion and sedimentation to near-by stream and river segments (F.D.E.P. 2009). To identify land use activities that accelerate sedimentation, baseline sediment rates should be characterized and monitoring of sedimentation rates adjacent to active land use activity is encouraged (refer to Figure 13 for a

comparison of the land use activities occurring adjacent to waters impaired due to fecal coliform levels).

Third, Best Management Practices (BMPs) must be established. Relevant landowners should be contacted to determine what is needed to

implement BMPs. Funding and outreach and education programs will be needed to aid in the development, establishment and monitoring of BMPs. Agencies such as the Natural Resource Conservation Service (N.R.C.S.), North West Florida Water Management District (N.W.F.W.M.D.), Florida Department of Environmental Protection (F.D.E.P.), and the Environmental Protection Agency (E.P.A.) may be able to offer support for these activities. Riparian setbacks are very important for protecting water quality from degradation due to nutrient, chemical and sediment inputs. Wildland buffering adjacent to rivers and streams allows for a wildlife corridor and aids to reduce the load of sediment entering the river. Buffers should be implemented to protect riverine ecosystems and water quality from degradation occurring due to land use activities such as cattle ranching, construction, traffic, silviculture, development and recreation. The F.D.E.P. has adopted a Basin Management Action Plan (B.M.A.P.) to address fecal coliform in the tributaries of the Lower St. Johns River, and perhaps it can offer guidance for establishment of septic tank management in the Blackwater River watershed (F.D.E.P. 2009).

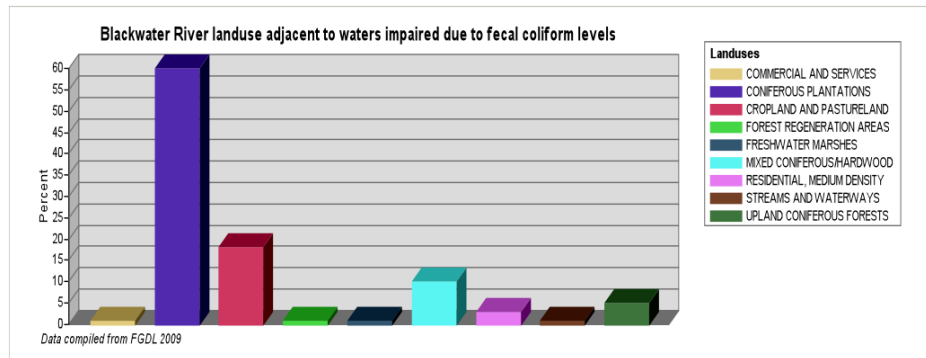


Figure 13. A proportional comparison of the land use activities occurring along Blackwater River waters impaired due to fecal coliform levels (F.G.D.L. 2009).

Improve Fish Habitat

River and stream management should in part focus on improving the habitat for fish species listed as Vulnerable or Threatened by the American Fisheries Society (see Table 2 for a full listing of A.F.S. categorized Vulnerable or Threatened fish species in the Blackwater River watershed). Such management efforts would include but not be limited to: reduction of impoundments to allow spawning, improve water quality to meet habitat needs, maintenance of flood plains along rivers, reduce harvest to allow population increases, protect the river, reduce sedimentation rates, stream and estuarine ecology to provide food and habitat for fishes at all trophic levels.

Table 2: Fish that are vulnerable or threatened in the Blackwater River.

Common Name	Species Name	AFS Categorization
Alabama Shad	<i>Alosa alabamae</i>	Threatened
Alligator Gar	<i>Atractosteus spatula</i>	Vulnerable
Black Mouth Shiner	<i>Notropis melanostomus</i>	Threatened
Blue Nose Shiner	<i>Pteronotropis welaka</i>	Vulnerable
Florida Chub	<i>Macrhybopsis</i> sp. cf. <i>aestivalis</i>	Vulnerable
Gulf Sturgeon	<i>Acipenser oxyrinchus desotoi</i>	Threatened
Iron Color Shiner	<i>Notropis chalybaeus</i>	Vulnerable
Striped Bass	<i>Morone saxatilis</i>	Vulnerable

One important consideration for improving fish habitat is to limit unnatural sedimentation into the river. It is important to continue surveying river sections that have adjacent roads or bridges to determine the extent of anthropogenically affected areas. Along with surveying these areas, it is important to continue with the BMPs that have been mentioned and implemented in the Ecosummary BioRecon Reports by Donald Ray. These BMPs include bridge elevations, bridge and road paving, and riverbank buffers. Buffers, along with maintaining the flood plain, are important considerations for dealing with the problem of excess sedimentation. Due to the innate sandy geology in this watershed, this river's natural course is to meander, which naturally erodes the banks. Many anthropogenic activities, including road building, some land use practices, and development, alter this natural course and add excesses of sediment as well as other pollutants. Buffers along the riverbank will help protect against these contaminants as well as maintain healthy ecosystem habitat.

Improve Seepage Slope Habitat

There are conservation actions that can be implemented to reduce threats to seepage slope communities. Incentives may be used to protect the conversion of these remaining wetlands to urban or commercial development. A less expensive option would be to develop partnerships with local landowners to implement wetland restoration and conservation projects on privately owned seepage slopes. Without adequate fire, even seepage slope communities protected from development will become baygalls and lose the herbaceous vegetation. An increased awareness of the importance of fire in maintaining seepage slopes and other natural communities can be achieved through education of the public. Programs can be created to improve existing Florida Fish and Wildlife Conservation Commission (F.W.C.) outreach that disseminates information to ranchers and landowners on the value of prescribed burning of natural areas. Increased public understanding of prescribed fire is crucial because it has been correlated with increased acceptance of such programs (Cortner et al. 1990). Additionally, trapping programs should be implemented to reduce exotic animal populations in areas where degradation is evident. Eglin Air Force Base (E.A.F.B.) works with the United States Department of Agriculture (U.S.D.A.) to trap feral hogs on the reservation. A study on E.A.F.B. assessed the effect



Sarracenia leucophylla
(white topped pitcher
plant) endangered species
found in seepage slope
communities of the
Blackwater River
watershed (photo by
Megan Brown).

of hog trapping on hog damage in seepage slopes. Researchers found damage to seepage slope plant communities declined after trapping of hogs began. The study included a cost-benefit analysis and demonstrated that hog removal was cost effective when compared to the economic valuation of the hog damage to the habitat (Engeman et al. 2007). Complementary research on seepage slope plant communities is currently being conducted at the University of Florida to further investigate: 1) the mechanisms driving shifts in plant composition in response to feral hog disturbance; and 2) possible monitoring and restoration methods for use by natural resource managers. Understanding these mechanisms will further guide management in the protection of these rare communities.

Woody Material Management Recommendations

There are several recommendations regarding woody material that will serve to enhance the river's productivity and stability while ensuring and promoting bridge safety. Currently, woody material that is caught under bridges is removed and taken off sight. The regular maintenance that is set in place is a good and proactive measure. However, if the material that is lodged under the bridges was simply dislodged and floated downstream then the channel forming function and habitat that it provides would not be lost. This would also save in maintenance costs as the material would not have to be transported off site. It is a possibility that the material may float downstream and lodge under the next bridge that it encounters. However, it may also be lodged against the stream bank and behind snags. With the regular maintenance that is already in place, it is likely that the cost benefit of this management practice will save in the long run.

Bridge design is also a factor in the degree to which woody material is trapped under bridges presenting safety issues. Narrow bridges block the floodplain and confine the river during high flow events. This bottleneck is likely to trap large woody material. Pilings in the middle of the bridge that provide support also trap material because they narrow the width available for transport. The Kennedy Bridge, on Kennedy Bridge Road in the Blackwater State Forest is a superb example of bridge design that facilitates woody material transport and safety. The bridge spans a portion of the floodplain and has no pilings preventing material transport. As bridges are replaced in the Blackwater River watershed designs that promote woody material transportation and structural integrity should be considered.

Social

Increase Stakeholder Education

To gain stakeholder support and involvement in conservation of the ecological health of the Blackwater River watershed it is recommended that community-based environmental education programs be expanded upon. Such programs include people of all ages and can include guided weekend walks in the watershed focused on plant and animal identification or activities focused on exposing participants to ecosystems in more depth using basic science. In developing community-based environmental education programs it is important to notice that the literacy rate for people living in Okaloosa and Santa Rosa counties is 16% (F.G.D.L. 2009). Therefore, outreach and education activities should rely upon the use of visual and audio technologies as well as hands on learning experiences (radio, TV, hands on activities, tours of watershed, etc.) to increase awareness and knowledge of watershed issues and activities. The Blackwater River

system provides recreational space for numerous eco-tourists. Targeting eco-tourists for education and outreach activities can greatly aid to increase the community's knowledge of important river issues.

The Blackwater River Foundation should work directly with the river recreation outfitters to educate the public and reduce trash around high impact recreation areas. Possible activities that would involve liveries and their customers in learning about and managing for important river issues could include:

1. Requiring classes for livery owners about eco-tourism and eco-friendly practices as a part of their permitting process for those receiving permits from the F.D.A.C.S. Division of Forestry for conducting business within the State Forest (F.D.A.C.S. Division of Forestry Policy & Procedures 2003).
2. The implementation of a county wide process for registration & permitting of river liveries not operating within the State Forest that is similar to the process already established by the State Forest. The funds from this process can be used to implement some of the other suggested activities. Permitting of all commercial water based eco-tourism activities in the watershed would allow for quantification of the number of people using the watershed's natural resources for business and pleasure.
3. Development of a healthy rivers program that would offer recognition to those liveries who voluntarily participate. Such a program could include features such as:
 - a. A logo with the program's name that liveries can use as part of their advertisement to attract eco-tourists.
 - b. Information kiosks at boat/ tube rental locations that educate eco-tourists about important river issues (such as the importance of woody material, fish and macro-invertebrate habitat, packing out trash, and pollutants in the river).
 - c. Liveries providing pre-departure educational talks to their customers about how to behave on the river.
 - d. Engagement of the liveries in reducing garbage in the river through:
 - i. The sponsorship of trash receptacles at the boat launch locations used by liveries, listed in Blackwater River Paddling Trail Guide or other high use locations (F.D.E.P. Greenways & Trails 2007). The installation and management of these receptacles could be sponsored by the liveries, the Blackwater River Foundation, or local businesses and could have advertisements or information signs on them.
 - ii. Liveries could educate customers and provide them incentives through a trash buy-back program. Liveries would provide renters with a garbage bag and those that bring it back full could receive a discount on their next rental.

Beyond direct engagement with the liveries there are many opportunities to increase the education of local stakeholders and river users. Steve Brown (NWF Water Management District) and Mary Gutierrez (BARC/WFRPC) have volunteered to provide assistance in cleanup and educational outreach activities in previous Blackwater River Foundation meetings. These two people might make ideal candidates to invite to be involved in the process of developing and implementing such activities (Blackwater River Foundation Inc. 2009). Educational activities for locals using the river could include:

1. The implementation of an anti-littering campaign that would include the installation and maintenance of trashcans at regularly used parking areas associated with sandbar recreation areas.
2. The installation of informative signage about the importance of woody material, littering, and ecosystem health along heavily trafficked areas.
3. A river cleanup that includes an educational component and free t-shirts.

Water Quantity Assessment

The extent to which both groundwater and surface water is used in the watershed is not very well monitored. The data from Alabama is from 2000 and it has proved difficult to determine water use in Florida. There is little doubt that water consumption is an important consideration in further protecting the river, so efforts should be made to develop a more complete water budget for the watershed.

Land Use

Buffers

Buffers are needed to protect sensitive ecosystems and water bodies from land use activities such as land clearing, road building, and residential housing areas. In order to sustain the wildlife habitat, water quality/quantity, eco-tourism and scenic beauty in the Blackwater River watershed, minimum buffer widths should be implemented along the river and its tributaries throughout the watershed to prevent degradation due to increased development and land and water use activities. The Center for Watershed Protection has indicated that a minimum of a 100 ft buffer is essential to provide a water body with the protection it needs to maintain water quality (Shueler 2002). The Blackwater River watershed should follow the example of jurisdictions that have established plans for wildlife habitat corridors as well (Hillsborough County 2006). For example, in Hillsborough County they have established wildlife habitat corridors by utilizing the methodology established by UF's Center for Wetlands "Wekiva River Basin Buffer Study" (Brown 1989). This study suggested a science-based methodology focused on targeting significant species of animals and plants and then evaluating their buffer requirements to ensure their protection (Brown 1990). To protect the pristine nature of the Blackwater River watershed, it is recommended that the buffers established by the OFW designation be extended to protect the river from its headwaters through the Blackwater Bay.

Unify Management Across Jurisdictional Boundaries

Throughout the history of the United States there have been many legal battles fought over watersheds that cross state boundaries. Although the Blackwater River watershed is not in imminent threat of being a source of conflict between Alabama and Florida, the watershed will benefit from proactive establishment of unified management across state boundaries. The development of a management agreement now would avoid the possibility of future interventions by the Supreme Court or Congress to resolve conflict. By acting while the river remains

relatively healthy, Florida and Alabama may be able to develop an agreement that will dictate future management policy in a manner acceptable to both states.

Future Work: Pilot Study

Historic and current land use activities may act as drivers to accelerate the rate of erosion in riparian areas. The result of accelerated erosion is an increase in the volume of sediment moving off of the landscape, as compared to the processes occurring under natural conditions. In an effort to determine what the current sediment load of the system is, to what extent conservation and restoration efforts can reduce those loads, and to what extent improved stormwater infrastructure can reduce loads a pilot study is recommended. The following pilot study will provide needed information for taking the first step in understanding the erosion and sedimentation issues of the Blackwater River watershed as well as identify critical areas for restoration.

Sedimentation Model

Background

Land use activities such as timber harvesting, road building and urban expansion are commonly associated with an increase in river and stream sediment loads. This is due in part to the disruption of the ability of the wild landscape to store sediment. Wild landscapes serve to store sediment; this ecosystem service is most vulnerable to disruption on lands adjacent to and within riparian areas. While visual evidence of stream and river bank erosion is present throughout the Blackwater River system, it is not known what the baseline or 'normal' rates for erosion or quantities of sedimentation are for the system.

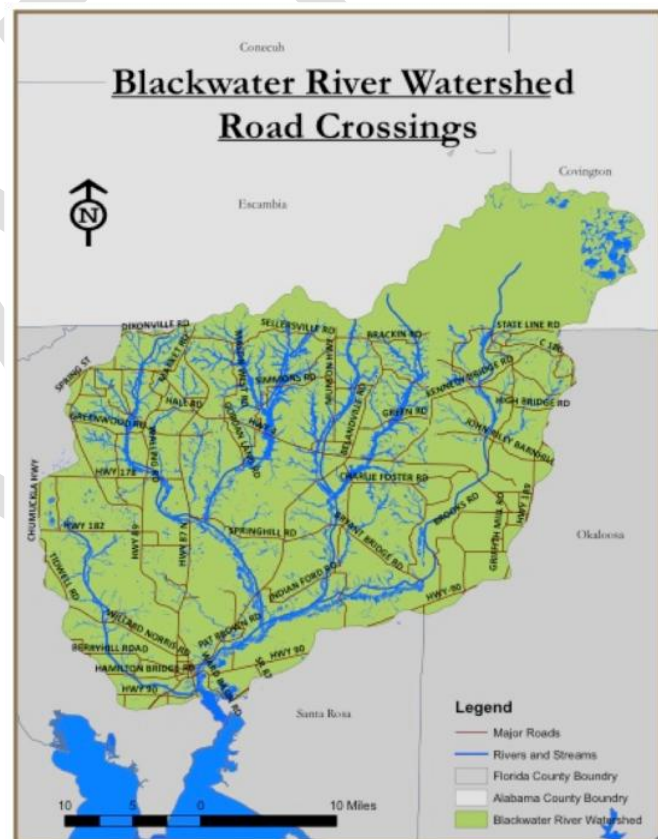


Figure 14. Florida roads in the Blackwater River watershed. Road crossings are known for acting as sources of sediment to the river due to accelerated erosion. River segments downstream from river road crossings with evidence of erosion will be examined by the sedimentation modeling pilot project.

Methods

The InVEST model's sediment retention module can be used to define the spatial extent and location of the watershed that have the greatest potential for storing sediment. This sediment module will also estimate the amount of sediment that can be kept from the river system through the restoration of specific portions of the landscape. The InVEST model synthesizes landscape information and quantifies the levels or values of sediment retention services provided across a watershed landscape and produces results in a map format that is easy to read, aiding users to better understand the spatial relationships between land use activities, erosion and sedimentation. A quantitative assessment and site specific identification of landscape features that are highly erodible will allow for the site specific protection of landscape features to best control erosion and sedimentation.

Using the InVEST sedimentation module an estimate of the average annual soil loss from each parcel of land within the watershed will be made. Special attention will be paid to erosional features associated with places where roads cross the river with an effort to identify the potential reduction of sediment to the river via restoration of these features (Refer to Figure 14 for a map of road crossings in the Florida portion of the Blackwater River watershed). The estimated ability of differing types of land cover to keep soil in place on a given parcel is calculated by comparing erosion rates for bare soil with those for the different types of vegetation. Vegetation does not only keep sediment from eroding where it grows. It also traps sediment that has eroded upstream. Additionally, the total sediment load exported from each main tributary of the Blackwater River will be determined. These estimates will be based on geomorphologic, climate, vegetation and management practices data. Calculations will be based the Revised Universal Soil Loss Equation (RUSLE). RUSLE integrates site specific information about rainfall erosivity, soil erodibility, slope length/gradient, Land Use/Land Cover (LULC) patterns and management practices (InVEST User's Guide 2010). Validation of the model would include visitation and sample collection from each significant tributary of the Blackwater River watershed (Refer to Figure 15 for potential validation sample locations).

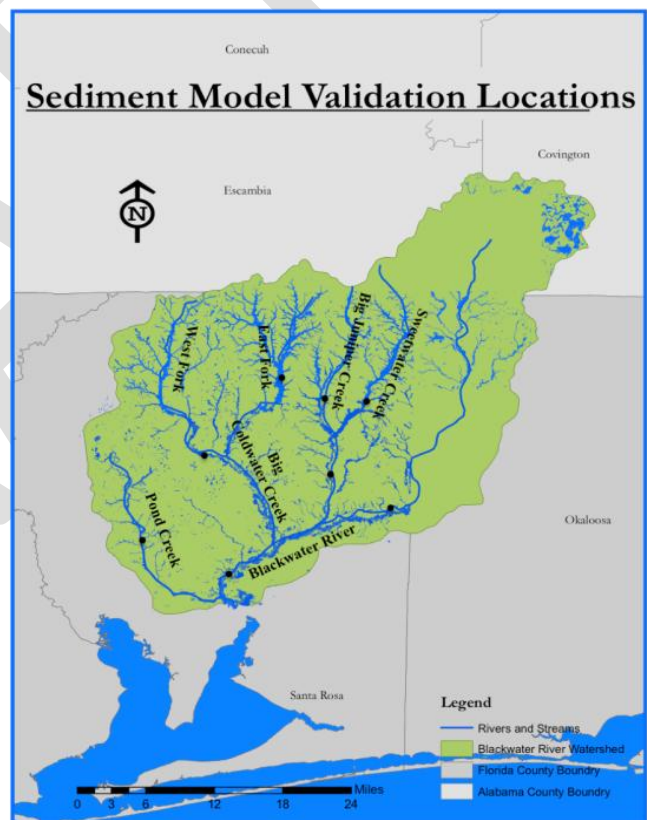


Figure 15. Main tributaries to the Blackwater River. Samples for validating model results will be collected at within each tributary prior to it flowing into the Blackwater River (approximate sample location marked by black dot). Validation sample locations will correspond with current Florida Fish & Wildlife Conservation Commission water quality monitoring locations.

Expected Results

Results from the sediment model will include:

1. Quantification of the sediment output for each tributary of the Blackwater River under current and projected land cover types.
2. The identification of landscape features that have the greatest potential to reduce sediment loads entering the river system.

City of Milton Storm Water Project

Background

The City of Milton, which lies right on the banks of the Blackwater River, has a population of around 7,000 people and does not currently have a storm water treatment system. There is evidence that in some cases around the city storm water flows directly from paved surfaces into the river. There are a number of small creeks around the city that also collect storm water and but these also flow into the river. Some residents have expressed concern that the lack of a proper storm water system has increased sedimentation flux into the river, changed the character of these small streams by deepening them, as well as increasing the flux of pollutants into the river. There are however, in Citizen's Park in Milton, storm water ponds that collect potentially contaminated water and sediment that runs off the adjacent road. The water passes through these highly vegetated ponds before it is discharged into the river. There is some concern that these ponds are filling with sediment very quickly and therefore calling into question their efficacy. To address these concerns this portion of the project is an attempt to assess the effectiveness of these ponds in collecting sediments and heavy metal pollutants that may be running into them from the city.

Vehicles are one of the major contributors of metals to our environment and much of the dust on the road is composed of these metal particulates (Revitt et al, 1990). During storm events storm water flushes this debris off of the pavement and into a storm water system, in this case a system of storm water ponds. Storm water ponds are designed to reduce flooding peaks as well as collect and slow water flow to allow for pollutants to settle and precipitate out of suspension (Baxter et al, 1985; Starzec et al, 2005). The removal efficiency for metals is 10 to 84% for metals and can range significantly between various types and characteristics of ponds (Farm, 2002, Hossain et al, 2005). While a number of metals are essential nutrients for plants and animals these can also be toxic at high concentrations (ie. Cu), others are toxic even at low concentrations (ie. Pb). Knowing the distribution of these metals in the environment is essential for a healthy ecosystem, so it is important to know the efficiency of storm water treatment systems.

Methods

To conduct this research a sampling trip will be necessary to Milton. First, a thorough site reconnaissance and a walking survey of the City of Milton to determine stream, creeks, and storm water discharge points into the river will be conducted. Focus will be paid especially to the creek or creeks that empty into the storm water ponds in Citizen's Park. Sediment samples will be taken from the banks of the creek to be compared to sediment taken within the ponds. Two sediment cores will be taken from the storm water ponds, one in the pond closest to the road and one closest to the river. Depending on initial concentrations in the storm water ponds two additional sediment cores will be taken upstream and downstream in the main stream of the Blackwater River where the water empties from these ponds. Additionally, equipment will be given to a member of the Blackwater River Foundation to collect water samples flowing from the pavement into the ponds during a storm event. Both the sediment and water samples will be processed and analyzed for heavy metals including Al, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sn, W, Y, Zn, Zr.

Expected Results

By comparing the concentration of these metals across the gradient above, in, and below the storm water ponds the effectiveness of the ponds will be determined. It is expected that much of the sediment that has been infilling the ponds originates from the stream channels that feed the ponds and that lack of a storm water system has exacerbated the erosion of the stream banks. Since the city of Milton is relatively small, the heavy metal concentrations in the ponds are not expected to be high, however it is expected that the storm water ponds will allow these metals to precipitate and not reach the Blackwater River.

Stream Restoration Pilot Study

Background

The Blackwater River has been influenced by anthropogenic activities including historic logging practices where logs were floated down the river causing bank erosion and sedimentation. The degree to which the river has changed as well as the stability and sustainability the current state of the river is largely unknown. The role that woody debris and riparian buffers have on stream stability is also poorly understood. It is important to understand the stability of the river channel and the main factors that influence its form and function in order to consider appropriate restoration techniques.

Methods

An in-stream assessment of the state of the river should be conducted to identify areas in need of restoration and resulting restoration projects. An in-stream assessment would involve a survey of the river coupled with bank erosion monitoring.

Surveying the river would involve mapping logjams, areas of erosion, and buffer widths using aerial photography and GPS. First, the watershed should be analyzed with aerial photography to identify reaches under silviculture, agriculture, and urban development that may be impacted and have minimal or no riparian buffer. Reference reaches should also be identified where the river is likely under pristine conditions. Three reaches of concern as well as three reference reaches should be identified for further investigation.

The reaches of concern and the reference reaches should be paddled in a canoe or walked while taking waypoints at logjams, areas of erosion, and impacted riparian buffers. Reach wide erosion rates should be assessed. A comparison between the locations of areas of evident erosion and narrow buffer widths should be performed. A comparison between the impacted and reference reaches should also be conducted and the role that woody material plays on stream bank erosion should be studied.

Erosion pin monitoring should also be conducted in the reference and impacted reaches. In this technique pins are placed horizontally into stream banks and the rate at which the bank erodes and the pin is exposed is measured over time. These sites should be visited annually to understand the erosion rates in impacted and reference.

Expected Results

This in-stream assessment will be used to understand the state of the river and the rate at which it is changing. This assessment will also identify what areas are most in need of restoration and what that restoration should look like. Stream restoration has traditionally been conducted in areas with more topography and rockier soils. The Blackwater River has a very different geomorphology and as a result techniques should be developed to specially meet the needs of this river. A study of the way that erosion, woody debris, and buffer widths impact the function of the river is essential for designing a successful restoration program.

CONCLUSIONS AND RECOMMENDATIONS

UNIVERSITY OF FLORIDA CONSERVATION CLINIC

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These conclusions and recommendations result from the research and observations of the authors and have been informed through stakeholder input. They are supported by two reports, a technical report which addresses the health of the watershed and a policy report which addresses the legal and institutional framework for watershed management. They are tailored to prioritize approaches that reflect the policy and economic context of the watershed and the priorities of the Blackwater River Foundation.

1. **WATER QUALITY ASSESSMENT**

The Blackwater River appears to enjoy relatively good water quality due to the predominance of public and private lands under management. However, only a limited number of stream sections in the Blackwater River watershed have been assessed to determine whether they meet the State of Florida's designated class 3 waterbody use criteria. All of the stream segments that have full assessments fail to meet the criteria (either for fecal coliforms or Mercury). Sources of fecal coliforms have not been identified.

Recommendations:

The Blackwater River Basin Water Quality Assessment should be completed so that the health of all river segments is known and priorities for restoration can be established.

An investigation into the sources of fecal coliforms should be undertaken.

Adequate development setbacks must be established and enforced. These will generally be site-specific, but a minimum for the watershed should be a development setback of 50 feet.

Blackwater River Foundation should encourage the end of direct discharge into the River from NPDES permit holders. Other effluent disposal options may be (1) public access reuse, (2) spray irrigation, (3) other land application methods.

2. **FECAL COLIFORM IMPAIRMENT REMEDIATION**

Pond Creek, in the western portion of the basin has been listed on the TMDL 303d list as impaired for fecal coliform. The source of this impairment is yet to be identified. Once identified, implementation of best management practices will aid to reduce non-point source fecal coliform in the river system.

Recommendations:

Targeted monitoring should be conducted to pinpoint sources of fecal coliform in impaired stream reaches. Potential non-point sources may include, but are not limited to, septic tanks and cattle farms.

A driving survey of landuse and farming practices in fecal coliform impaired stream reaches should be conducted to identify potential sources.

The Blackwater River Foundation should encourage the local governments within the watershed to provide financial incentives for replacement of failing septic systems. Priority in this program should be given to riparian landowners within stream segments that are identified as being impaired due to high fecal coliform levels through the TMDL process. Should septic systems be identified as the source of fecal coliform to the river, greater setback requirements should be explored.

3. **PUBLIC EDUCATION**

Public education and social marketing strategies are key components of any adaptive watershed plan. The Blackwater River Foundation has great resources to provide educational opportunities to residents within the basin.

Recommendations:

The Blackwater River Foundation should continue to develop programs that utilize property owned by the Foundation for school education programs.

The Blackwater River Foundation should promote an Adopt-A-Stream program for school aged children to promote watershed thinking, pollution awareness, and basic scientific discovery.

Such a program could also contribute to data collection and trend monitoring for water quality.

The Blackwater River Foundation should consider programs to educate the hunting public on proper disposal of carcasses, primarily through including more information about proper carcass disposal in the brochures and signage for the Wildlife Management Areas in the Blackwater River State Forest.

The Blackwater River Foundation should encourage the implementation of an anti-littering campaign that would include the installation and maintenance of trash receptacles at regularly used parking areas associated with sandbar recreation areas.

The Blackwater River Foundation should develop an educational program that includes the installation of informative signage about the importance of woody material, littering, and ecosystem health along heavily trafficked areas and a river cleanup that includes an educational component

4. ENGAGEMENT OF LIVERIES IN WATERSHED EDUCATION

There are a number of river and forest recreation outfitters and watercraft liveries that make use of the Blackwater River. Passive recreation such as canoeing, hiking, hunting, and fishing offers a relatively low-impact form of economic development in a forested watershed, and engagement of liveries in education can aid in the protection of natural resources. As ecological recreation specialists, liveries operating within the watershed ought to be targeted to aid in river education and management. The Blackwater River Foundation should work directly with the river recreation outfitters to educate the public. Possible activities that would involve liveries and their customers in learning about and managing for important river issues could include:

Recommendations:

The Blackwater River Foundation should promote the development and use of river-specific best management practices for river recreation outfitters.

Classes for livery owners about eco-tourism and eco-friendly practices should be developed and required as a part of their permitting process for those receiving permits from the (DACS) Division of Forestry for conducting business within the State Forest (DACS Division of Forestry Policy & Procedures 2003).

A watershed-wide process for registering and permitting river liveries not operating within the State Forest should be implemented, perhaps through an inter-local agreement or under the

auspices of the NFWMD. This could also be integrated with the process already established by the State Forest. Permitting of all commercial water based eco-tourism activities in the watershed would allow for quantification of the number of people using the watershed's natural resources for business and pleasure.

The Blackwater River Foundation should consider development of a healthy rivers social marketing program that would offer recognition to those liveries who participate. The Blackwater River Foundation should work directly with the river recreation outfitters to educate the public and reduce trash around high impact recreation areas. Possible activities could include:

1. Informational signs posted at boat/ tube rental locations to educate users about the importance of woody material, fish and macro-invertebrate habitat, riparian buffers and packing out trash from the river.
2. Liveries providing pre-departure educational talks to their customers.
3. A logo with the program name that liveries can use as part of their marketing to demonstrate social and environmental responsibility to customers.
4. Engagement of the liveries in reducing garbage in the river through:
 - a. The sponsorship of trash receptacles at the boat launch locations used by liveries, listed in Blackwater River Paddling Trail Guide or other high use locations (FDEP Greenways & Trails 2007). The installation and management of these receptacles could be sponsored by the liveries or Blackwater River Foundation and could have advertisements or informational signs on them.
 - b. Liveries could educate customers and provide them incentives through a trash buy-back program. Liveries could provide renters with a garbage bag and those that bring it back full could receive a discount on their next rental, or some other incentive.

5. **RIPARIAN BUFFER ESTABLISHMENT**

Riparian buffers serve three important functions: they help protect water quality, enhance and enable shoreline stability, and provide important wildlife habitat corridors. Riparian buffers on public lands and lands managed for silviculture tend to rely on the best management practices established by the Division of Forestry. In urbanized settings with intense land uses, and on agricultural lands, riparian buffers protect water quality and are especially important to maintain riparian corridors for wildlife migration and use. A review of local government riparian buffer regulations in the Blackwater River watershed suggests that many of the regulation buffer widths may be inadequate. Additionally, riparian areas associated with bridge crossings exhibit visual evidence of erosion due to a lack of vegetative cover.

Recommendations:

A Minimum buffer width of 50 feet should be implemented along the river and its tributaries throughout the watershed. Larger buffers may be necessary in certain areas (such as land near wetlands and to ensure habitat connectivity for wildlife).

Local governments should adopt comprehensive planning policies and land development regulations that require or encourage riparian buffers to be comprised of Florida Friendly Landscaping.

Except in cases of economic hardship and where soft stabilization techniques are not otherwise feasible, shoreline hardening should be prohibited in the watershed.

Living shorelines should be promoted as an alternative and as supplemental to shoreline hardening.

Bridge crossings with erosional features should be targeted and prioritized for restoration of native vegetative cover.

6. AGRICULTURAL BEST MANAGEMENT PRACTICES IMPLEMENTATION

BMPs are developed by rule for different forms of agriculture by the Florida Department of Agriculture and Consumer Services (FDACS). BMPs exist for vegetable crops, manure application, and cow/calf operations, as well as silviculture. Cattle are not required to be fenced out of streams and rivers. However, BMPs do recommend that watering troughs are placed in a manner that keeps cattle away from streams.

Recommendations:

The Blackwater River Foundation should conduct a review of cow/calf operations in the watershed, including the degree of access to streams and rivers. It is recommended that animals not be kept within 100 feet of a water body.

The Blackwater River Foundation should work with agricultural interests to expand BMPs in the watershed to increase riparian buffers.

7. SILVICULTURAL BEST MANAGEMENT PRACTICES

Silviculture is the predominant land use in the Blackwater River watershed, representing approximately 60% of its surface area. Silviculture also tends to be a relatively benign land use for watershed health when appropriate BMP's are used. Silviculture generally employs best management practices for stream protection that have been developed by the State of Florida

Division of Forestry. Although voluntary, these practices must be implemented in order to qualify for an exemption from stormwater management permitting. The BMPs for Outstanding Florida Waters (OFWs) such as the Blackwater River are more stringent than for non-OFWs. Silvicultural BMPs are tailored to protect water quality. .

Recommendations:

The Blackwater River Foundation should conduct a review of BMP adoption and compliance in the watershed and ensure that trend and targeted water quality monitoring provide the basis for demonstrating that silvicultural BMPs perform as intended.

The Blackwater River Foundation should work with silvicultural interests to expand BMPs in the watershed to increase riparian buffers for protection of wildlife habitat.

8. STEEPHEADS AND SEEPAGE SLOPES

The Blackwater River Watershed has both steepheads and seepage slopes, two unique and fragile features that are home to a number of threatened and/or endangered species.

Recommendations:

All steephead and seepage slope features should be surveyed within the watershed and special precautions should be taken to prevent these locations from excessive foot and motor vehicle traffic, as well as any construction projects.

It should be determined how these features are addressed in public lands management plans and within the ecosystem partnership.

Local government comprehensive plans should specifically address these to the extent they exist on lands not subject to public lands management.

9. OUTSTANDING FLORIDA WATERS

The Blackwater River is an Outstanding Florida Water (OFW), which creates a higher standard of water quality that must be met by some dischargers. Activities and discharges to OFWs must be clearly in the public interest and they cannot lower water quality below the ambient water quality at the time of designation. Among other attributes, OFW designation increases silvicultural buffers, stormwater retention, and limits dock exemptions from permitting.

Recommendation:

The Blackwater River Foundation should, to the extent data is available, determine the ambient water quality for the River at the time of designation to ensure that a baseline exists from which future determinations of water quality degradation can be made. This information should be made readily available to the public.

10. WOODY MATERIAL MANAGEMENT

Woody material is an essential component of a healthy aquatic ecosystem. There is stakeholder concern that current bridge safety and flood control practices treat woody material as debris to be removed from the system. If the removal of woody material is an activity that is conducted within the navigable waters of the United States and in the Waters of the State of Florida, then it may be subject to concurrent permitting requirements. However, both federal law and state law provide for exemptions and categorical permits (nationwide permits and general permits respectively). These exemptions and categorical permits generally address “de minimus” and routine maintenance types of activities. Some require that advance notice of the activity be provided. The removal of woody material may fall into one of these categorical activities and may require advance notice as a result. There is no indication that this sort of notice is being provided in the watershed.

Recommendations:

The Blackwater River Foundation should promote the management of woody material as an important in-stream resource.

The Blackwater River Foundation should encourage ACOE, EPA, DEP and DOT to develop BMPs for the management of woody material for aquatic habitat, flood control and infrastructure protection. A segment of the Blackwater River should be considered for a woody material pilot study.

The Blackwater River Foundation should review the bridge and culvert replacement and maintenance schedule (if there is one) for such infrastructure within the watershed to encourage the use of technologies and techniques that promote the maintenance of diverse in-stream habitat structure.

The Blackwater River Foundation should consider stream restoration in impaired reaches and consider using woody material to stabilize stream banks and provide habitat diversity for macroinvertebrates and fishes.

11. ACTIVE RECREATION IMPACTS: BOAT WAKES & BOAT NOISE

Motor boats regularly use the Blackwater River, especially in the lower reaches. Some of these boats cause concerns over noise, safety, and river bank erosion. The Florida legislature has largely preempted local governments from regulating boat noise and boat wakes and limited the reasons for which these can be regulated. Currently, the Florida Fish and Wildlife Commission (FWC) has the sole authority to regulate boat wakes and the reasons for regulation are limited to “the protection of human life and limb, vessel traffic safety maritime property, and manatees.” Regulation is prohibited for the purposes of noise abatement, or the protection of shoreline, shore-based structures or upland property. Local governments can seek to establish boating restricted areas based on these limited purposes, but only through a rulemaking request to FWC. Vessel exclusion zones can be established to address user conflicts, such as those between non-motorized and motorized vessels, especially where there are designated canoe trails.

Recommendation:

An inventory should be conducted of current boating restricted areas in the Blackwater River Watershed, as well as those areas that stakeholders believe may qualify for boating restricted areas based on the statutory purposes, and draw conclusions as to whether these would provide ecological benefits in addition to the benefits provided by the statutory purposes.

12. IN-STREAM ISLANDS

Islands, especially shifting sandbars, within the banks of the Blackwater River are probably owned by the State of Florida, and subject to the public trust. Fencing and signage on islands owned by the state require a use authorization by the Board of Trustees of the Internal Improvement Trust Fund, unless exempted.

Recommendations:

The Blackwater River Foundation should support an inventory of islands to determine the extent and validity of any claims to ownership or use authorizations by private interests.

13. PUBLIC LANDS MANAGEMENT

A large portion of the Blackwater River watershed is held in public lands. Therefore public land management plans are important for determining the state of the river. Some of these plans have not been updated recently and hence may not reflect current thinking in adaptive watershed planning. Some of these plans are now in the process of being updated.

Recommendations:

The Yellow River/Blackwater Bay Aquatic Preserve Management Plan, adopted in 1991, should be updated.

The Yellow River/Blackwater Bay Aquatic Preserve Management Plan should include considerations of climate change and climate variability, especially the effects of sea level rise, on aquatic and riparian ecosystems.

Shoreline hardening should be prohibited along the shoreline of the aquatic preserve.

Consideration should be given to the promotion of living shorelines as an alternative to shoreline hardening. Additionally, the use of incentives to promote living shorelines in front of currently hardened shorelines to create riparian habitat shoreward of structures and to protect riparian property should be considered.

The Blackwater River State Forest Management Plan, adopted in 2004, should be reviewed and updated.

The Blackwater River Foundation should participate in the process of those plans that are currently being updated in order to ensure that the Foundation's interests in watershed health are adequately represented.

14. TRANSBOUNDARY COORDINATION

The Blackwater River is a transboundary watershed and management is shared between Alabama and Florida. Although a small portion of the watershed lies within Alabama, and the portion that is in Alabama lies largely within a National Forest, these headwaters are arguably the most important part of the watershed.

Recommendations:

Management of the watershed's resources should be coordinated between all agencies and stakeholders in Alabama and Florida.

Stakeholders from Alabama should be encouraged to attend meetings and events hosted by the Blackwater River Foundation.

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APPENDICES

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Appendix A: Tables

Table 1. Water Quality Analytical Data and Methological Procedures.

Characteristic Name	Units	Analytical Proc ID
Alkalinity, Carbonate as CaCO ₃	mg/l	APHA -2320
Biochemical oxygen demand, standard conditions	mg/l	APHA -5210-B
Calcium	mg/l	USE.P.A. -200.7(W)
Carbon, Total Organic (Toc)	mg/l	APHA -5310-B
Chloride	mg/l	USE.P.A. -300(A)
Chlorophyll a, corrected for pheophytin	ug/l	APHA -10200-H
Depth, bottom	m	-
Depth, Secchi Disk Depth	m	21FLPNS -FT_1700
Dissolved oxygen (DO)	mg/l	21FLPNS -FT_1500
Dissolved oxygen saturation	%	-
Enterococcus Group Bacteria	#/100ml	USE.P.A. -1600
		APH -9230-C
Fecal Coliform	#/100ml	APHA -9222-D
		21FLBFA -STANDARDMETH
		21FGW - 900456
		NIOSH -600
		21FLPNS -STANDMETH
Fluorides	mg/l	APHA -4500-F-C
Magnesium	mg/l	USE.P.A. -200.7(W)

Nitrogen, ammonia as N	mg/l	USE.P.A. -350.1
Nitrogen, ammonia (NH ₃) as NH ₃	mg/l	21FLGW -900456
Nitrogen, Kjeldahl	mg/l	USE.P.A. -351.2
Nitrogen, Nitrite (NO ₂) + Nitrate (NO ₃) as N	mg/l	USE.P.A. -353.2
pH	-	21FLPNS -FT_1100
Pheophytin-a	ug/l	APHA -10200-H
Phosphorus as P	mg/l	USE.P.A. -365.4
Phosphorus, orthophosphate as P	mg/l	USE.P.A. -365.1
Potassium	mg/l	USE.P.A. -200.7(W)
Salinity	ppth	21FLPNS -FT_1300
Sodium	mg/l	USE.P.A. -200.7(W)
Solids, Dissolved	mg/l	APHA -2540-C
Solids, Total Suspended (T.S.S.)	mg/l	APHA -2540-D
Specific conductance	umho/cm	21FLPNS -FT_1200
Sulfur, sulfate (SO ₄) as SO ₄	mg/l	USE.P.A. -300(A)
Temperature, water	deg C	21FLPNS -FT_1400
Total coliform	cfu/100ml	21FLGW -900456
		21FLBFA -STANDARDMETH
		21FLPNS -STANDMETH
Turbidity	NTU	USE.P.A. -180.1

Some data from 1977, rest of data sets span somewhere between 1984 - 2009

Table 2. Land Cover and Land Cover Change in the Blackwater River Watershed between 1995 and 2004.

Land Cover	1995 (acres)	2004 (acres)	Change 1995 - 2004
Airports	2623	2343	-280
Aquaculture	103	83	-21
Bays, Swamps & Estuaries	12	293	281
Burned Areas	71	36	-35
Cemeteries	124	110	-14
Coastal Scrub	6	0	-6
Commercial & Services	1226	1260	34
Community Recreational Facilities	24	316	292
Coniferous Plantations	98051	73676	-24376
Cropland & Pastureland	87638	81976	-5662
Cypress	218	1128	911
Disturbed Land	151	1554	1403
Electrical Power Facilities	44	27	-17
Electrical Power Transmission Lines	1314	1646	332
Emergent Aquatic Vegetation	12	98	86
Extractive	125	115	-10
Feeding Operations	136	10	-126
Forest Coniferous/Hardwood Mixed	22806	37184	14378
Forests Coniferous Upland	163970	118167	-45803
Forests Hardwood Upland	1547	5707	4160
Forest Regeneration Areas	36510	42052	5542
Freshwater Marshes	756	671	-85
Golf Courses	276	286	11
Holding Ponds	27	9	-18
Industrial	157	141	-16
Inland Ponds & Sloughs	486	0	-486
Institutional	1411	1796	385
Intermittent Ponds	19	0	-19
Junk Yards	14	23	8
Lakes	439	1023	585
Major Springs	1	2	0
Mixed Rangeland	31	8952	8921
Nurseries & Vineyards	365	426	61
Oil & Gas Fields	45	79	35
Oil, Water, or Gas Transmission Lines	292	415	123
Open Land (Rural)	151	569	418

Land Cover	1995 (acres)	2004 (acres)	Change 1995 - 2004
Open Land (Urban)	168	78	-90
Parks & Zoos	30	32	1
Race Tracks	69	0	-69
Recreational	92	24	-68
Reservoirs	1598	1235	-363
Residential, High Density	628	9991	9363
Residential, Low Density	7067	12350	5283
Residential, Medium Density	8792	2821	-5971
Riverine Sandbars	107	53	-54
Roads & Highways	1100	854	-246
Saltwater Marshes	121	195	74
Sand & Gravel Pits	862	421	-440
Sand other than Beaches	31	0	-31
Sand Pines	8	4	-5
Sewage Treatment	30	7	-23
Shrub & Brushland	5421	8485	3064
Slough Waters	1	1	1
Specialty Farms	7	0	-7
Streams & Waterways	1596	1902	305
Strip Mines	83	52	-31
Surface Water Collection Ponds	0	106	106
Tourist Services	71	0	-71
Transmission Towers	4	0	-4
Transportation, Communication & Utilities	29	309	280
Tree Crops	978	991	13
Tree Plantations	39	0	-39
Water Supply Plants	0	17	17
Wet Prairies	1	851	850
Wetland Forest Hardwood	5661	3046	-2615
Wetland Forest Coniferous	818	22332	21515
Wetland Forest Mixed	42669	36465	-6204
Wetland Scrub Shrub	1729	3721	1992
Wetlands Non-vegetated	0	25	25

Appendix B: Figures

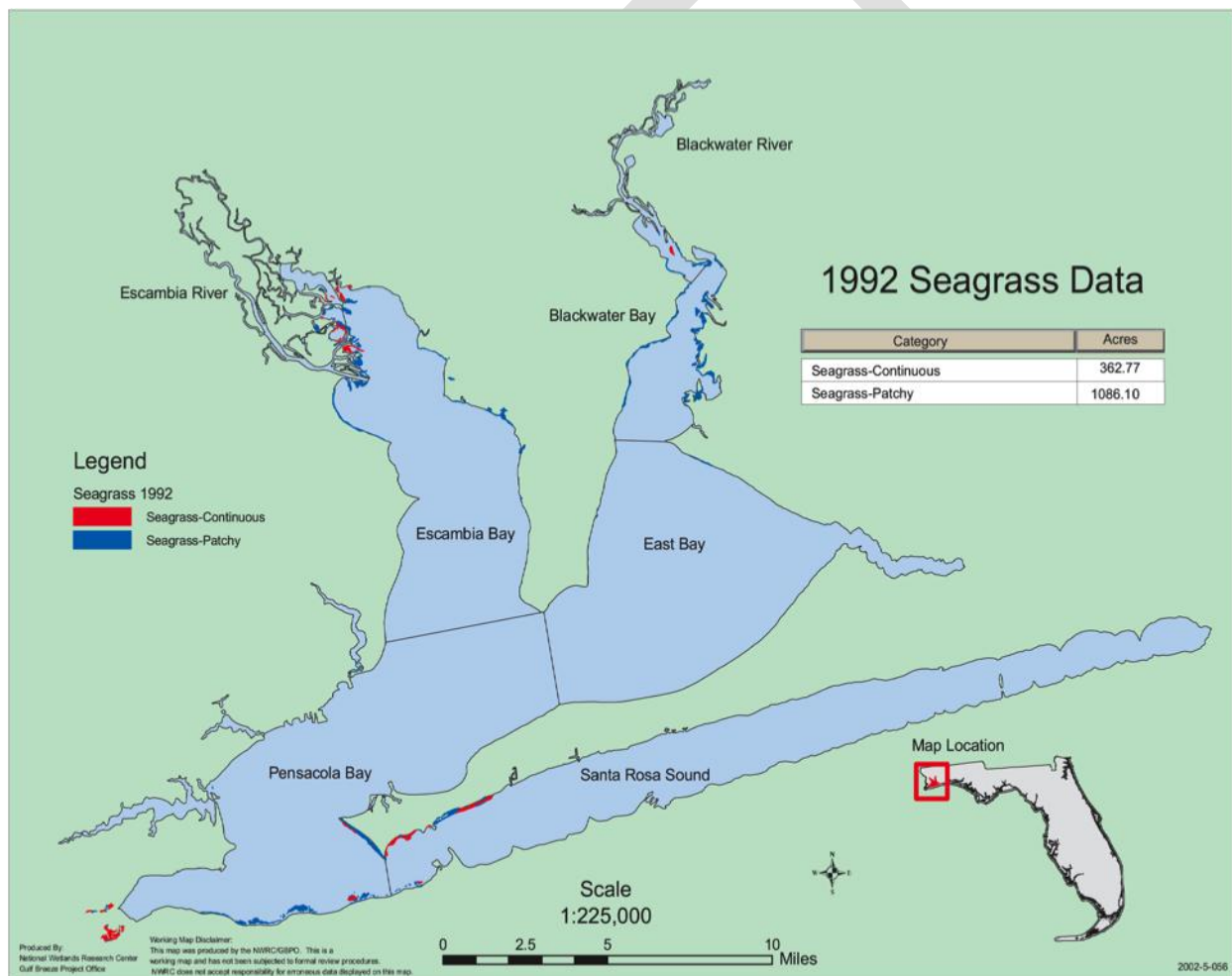


Figure 1. Map showing the seagrass beds of the Pensacola Bay. Within the Blackwater Bay the majority of existing seagrass beds are patchy, as shown in blue. Only on seagrass bed within the Blackwater Bay is continuous, as shown in red (Macauley et al. 2005).

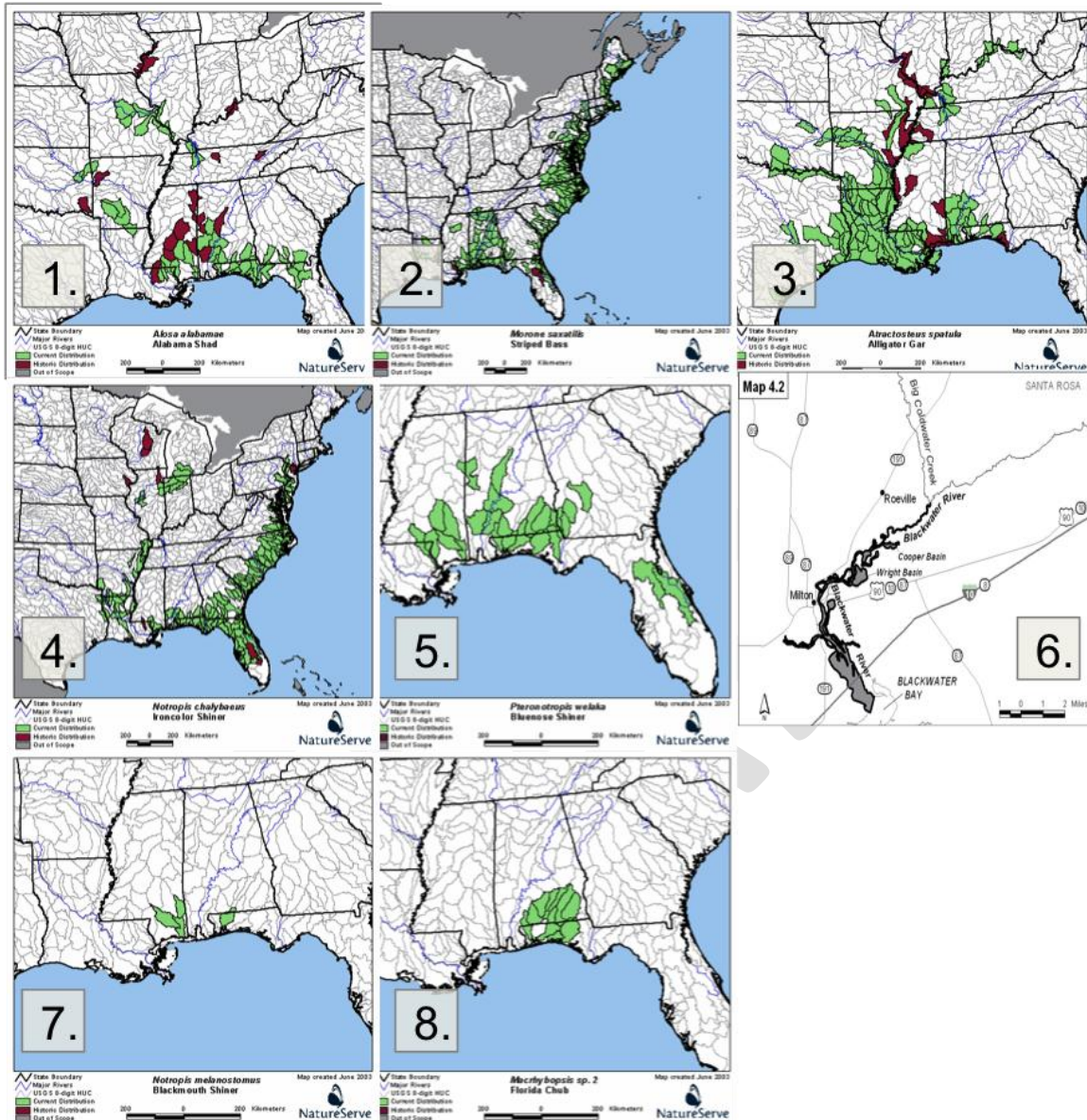


Table X. Maps depicting the current (in green) and historic (in red) habitat for Vulnerable or Threatened fish species within and adjacent to the Blackwater River watershed. (1) Alabama Shad Box (2) Striped Bass (3) Alligator Gar (4) Ironcolor Shiner (5) Bluenose Shiner (6) Gulf Sturgeon (7) Blackmouth Shiner (8) Florida Chub (Jelks 2009).

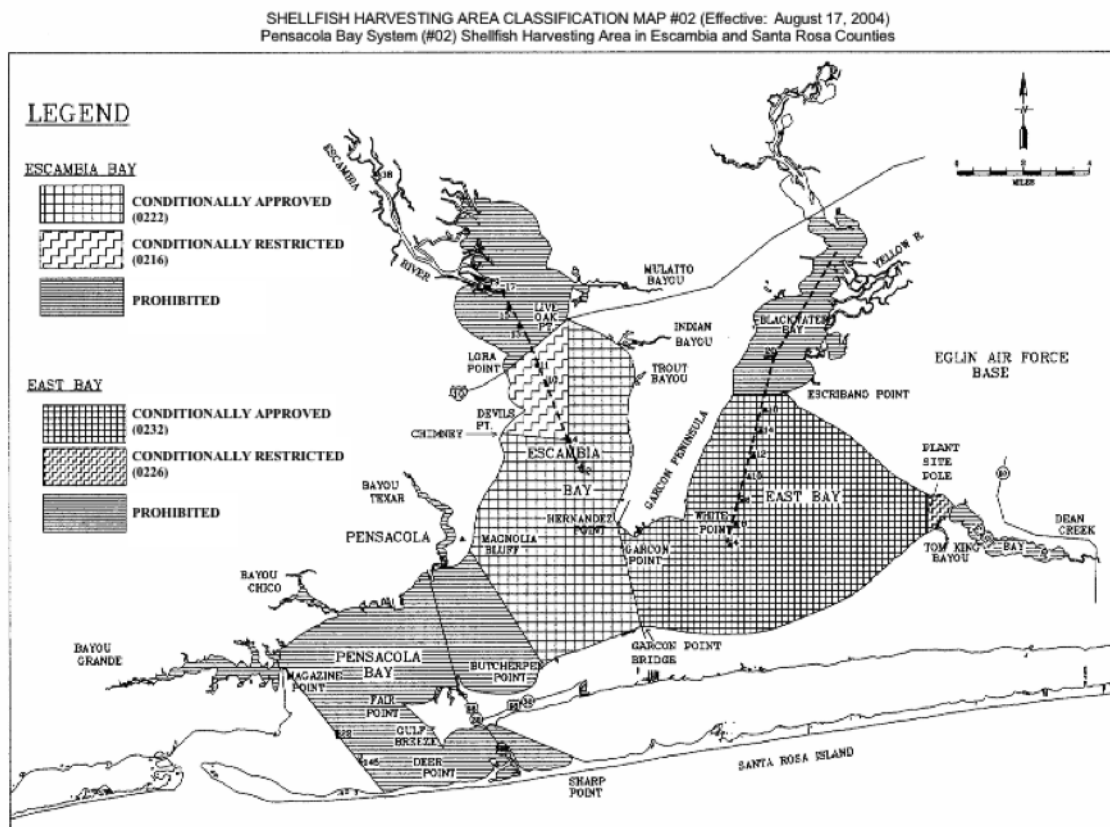
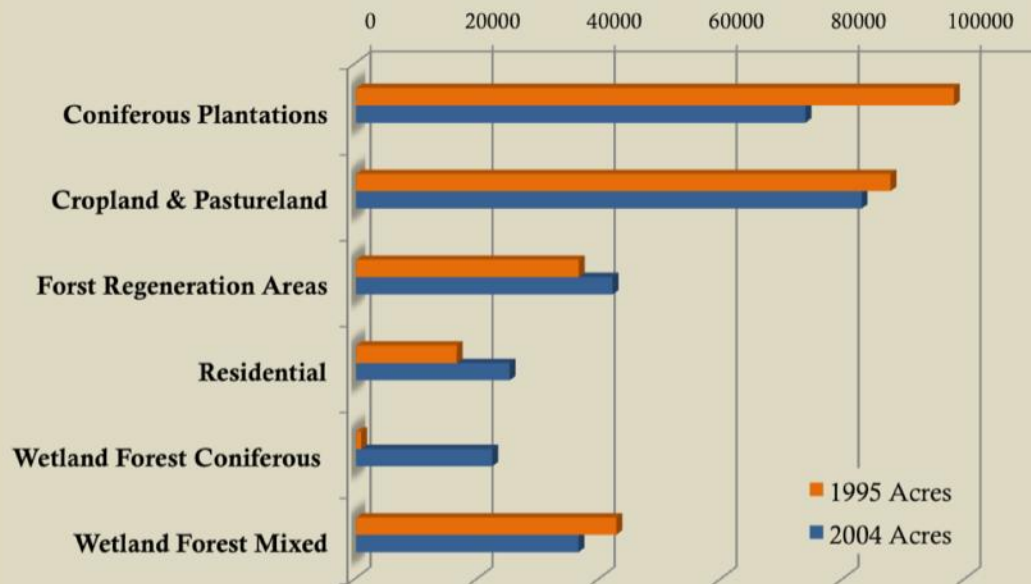


Figure 2. Shellfish harvesting area map of the Pensacola Bay. Shellfish harvesting is prohibited in the Blackwater Bay, however, restoration and maintenance of the seagrass beds, oyster beds and wetland areas of the Blackwater Bay will help in reducing the nutrient, chemical and sediment loads flowing from the Blackwater Bay to shellfishing areas in the southern Bay (F.D.A.C.S. Division of Aquaculture 2009).

Dominant Land Cover change:



Minor Land Cover Types:

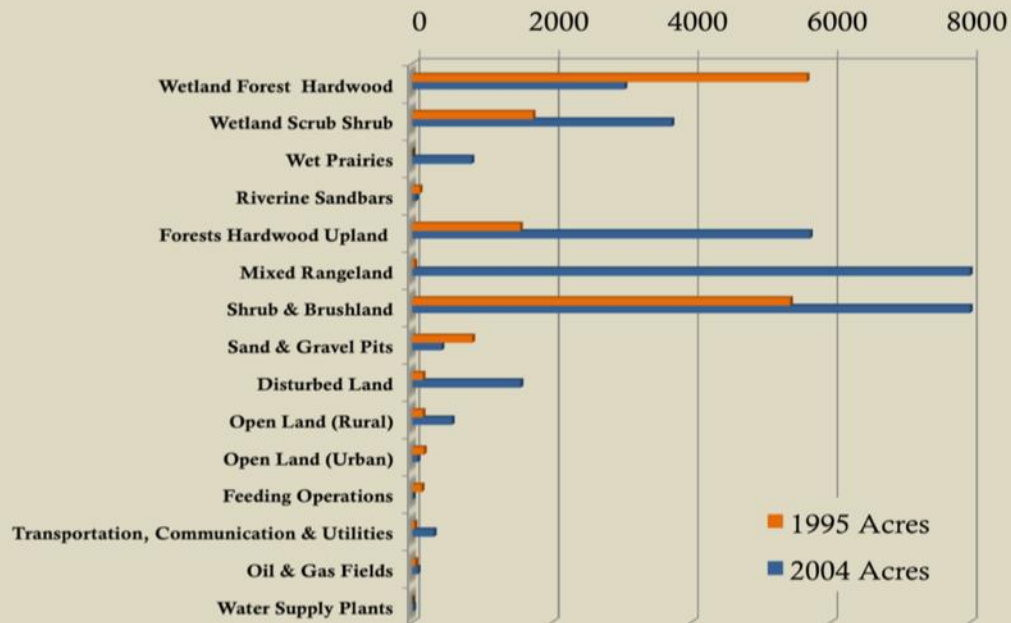


Figure 3. Major and minor land cover changes between 1995 and 2004 in the Blackwater River watershed (data from F.G.D.L. 2009).

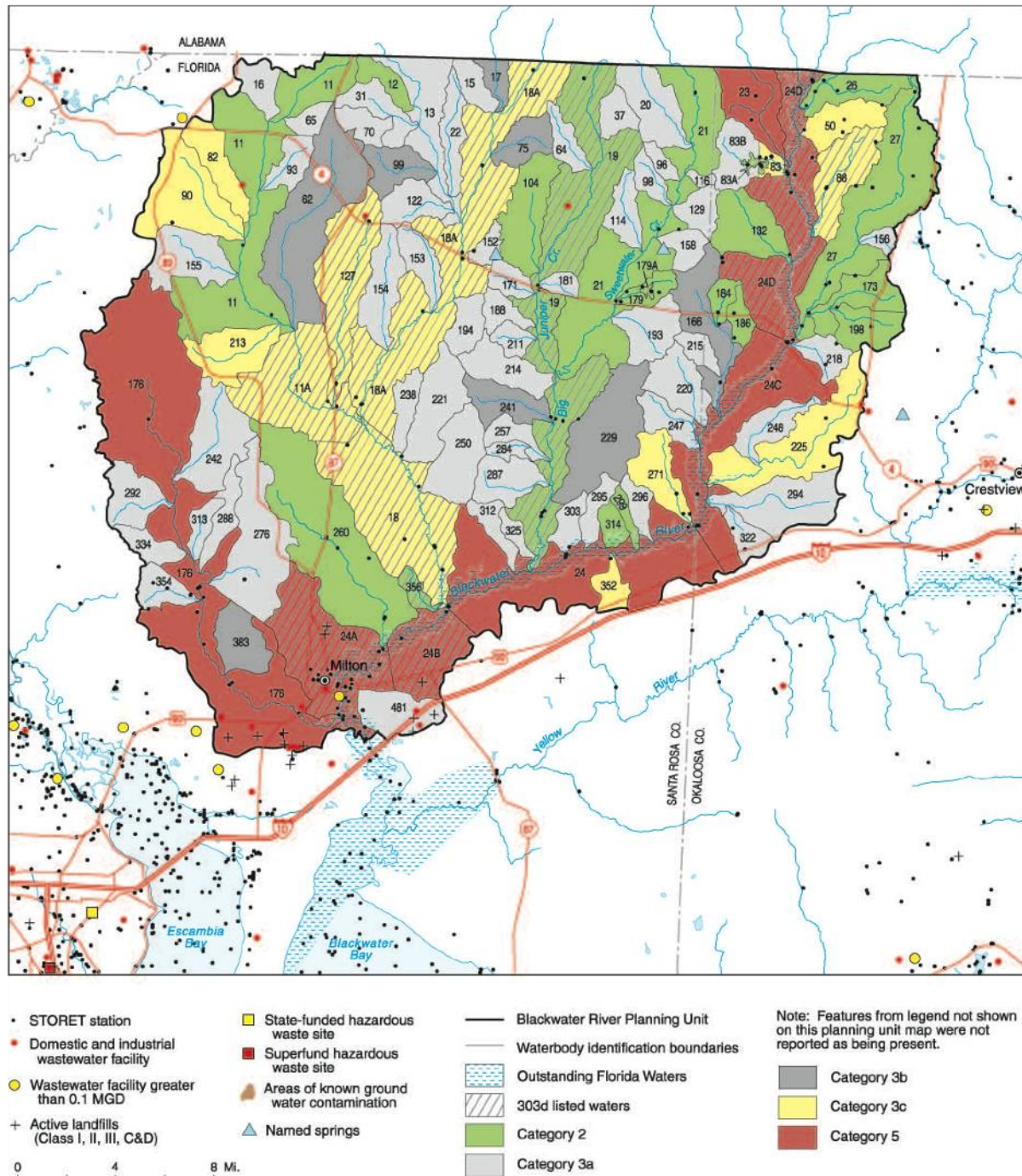


Figure 4. A composite map of the Blackwater river water quality assessment planning unit. Waters verified as impaired and on 1998 303(d) List are shown in red. Waters meeting planning list criteria due to potential impairments are shown in yellow. Waters with insufficient data to allow a water quality assessment are shown in grey (F.D.E.P. 2007).

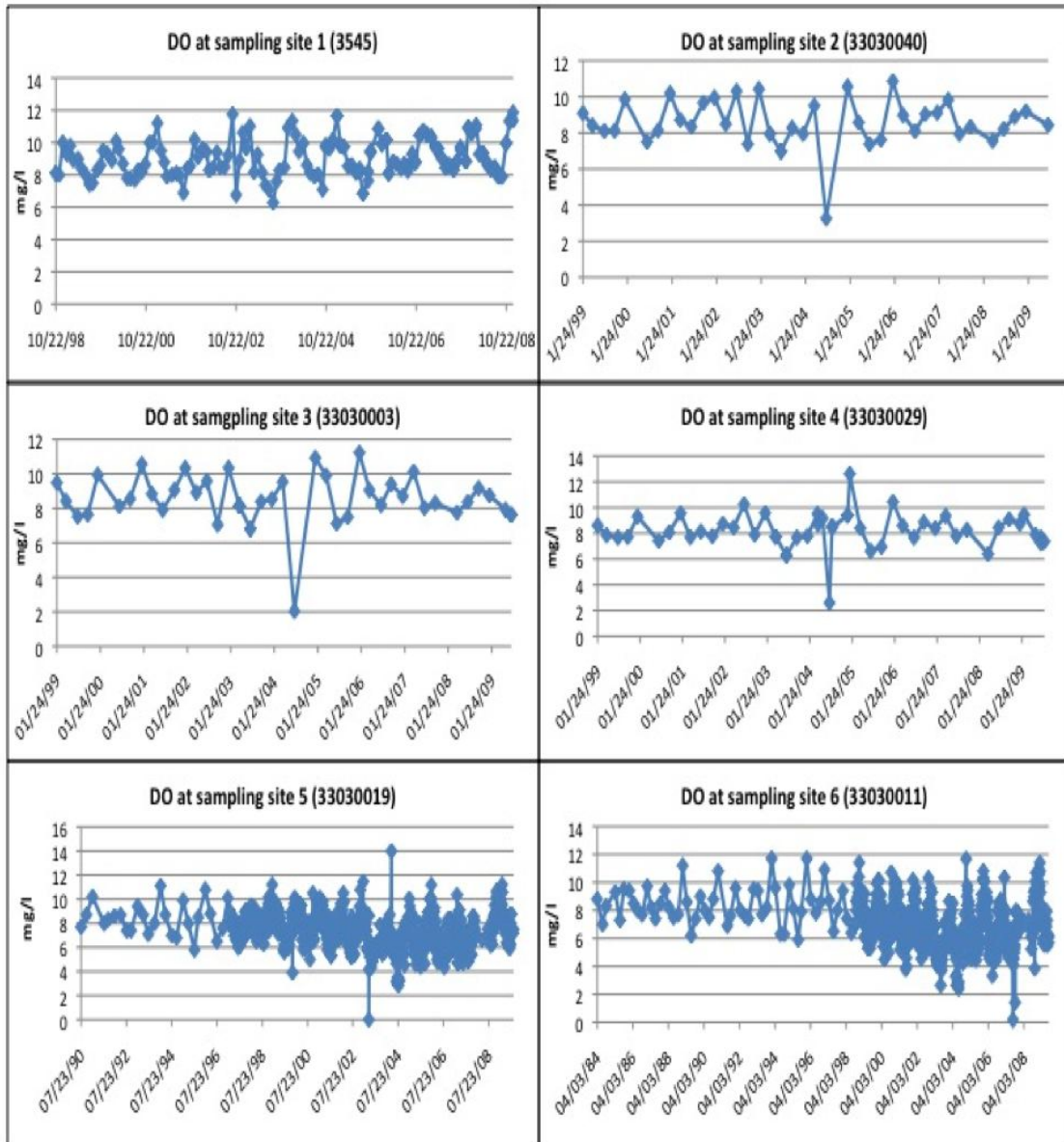


Figure 5. Water dissolve oxygen concentration trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

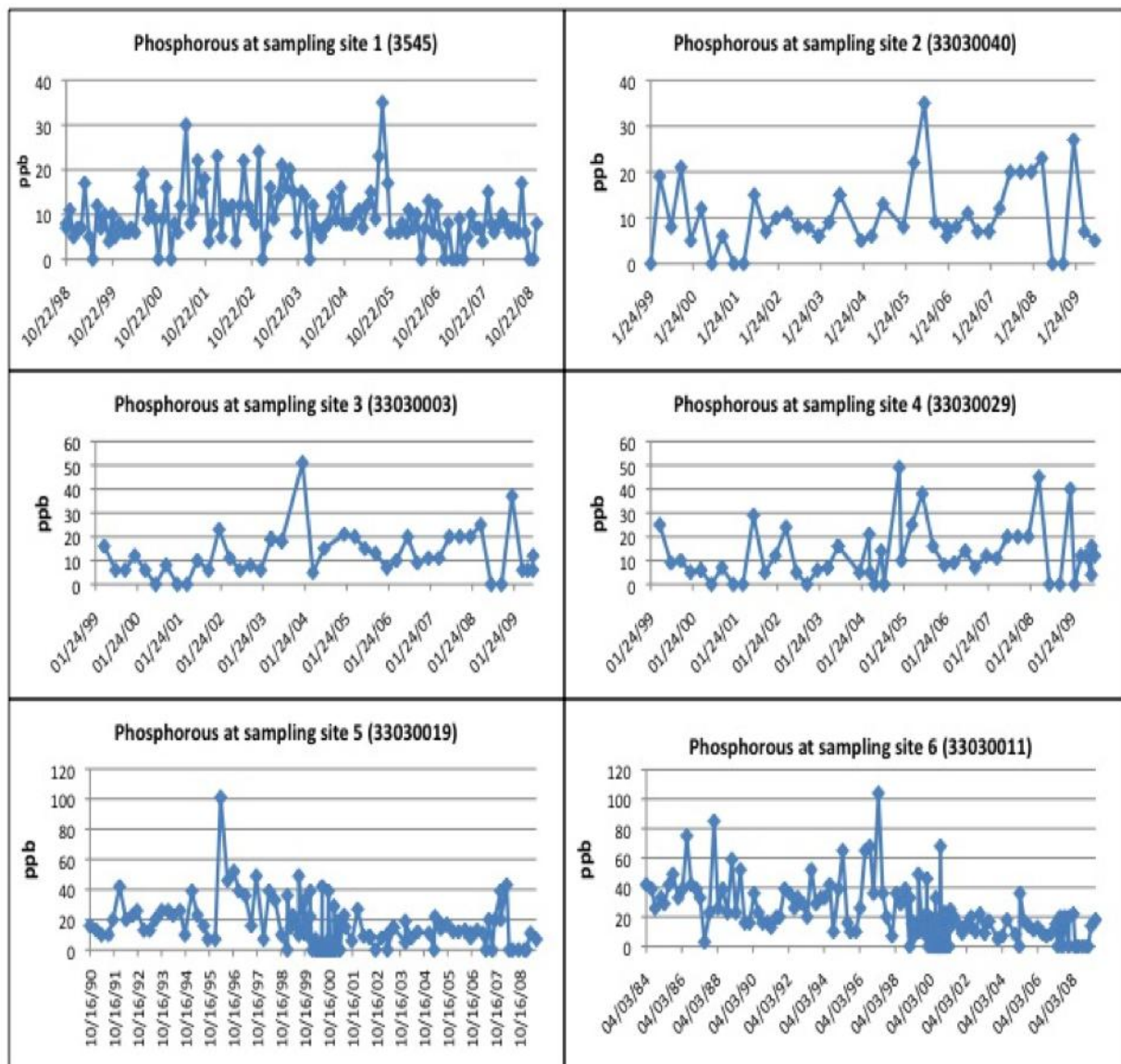


Figure 6. Water phosphorous concentration trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

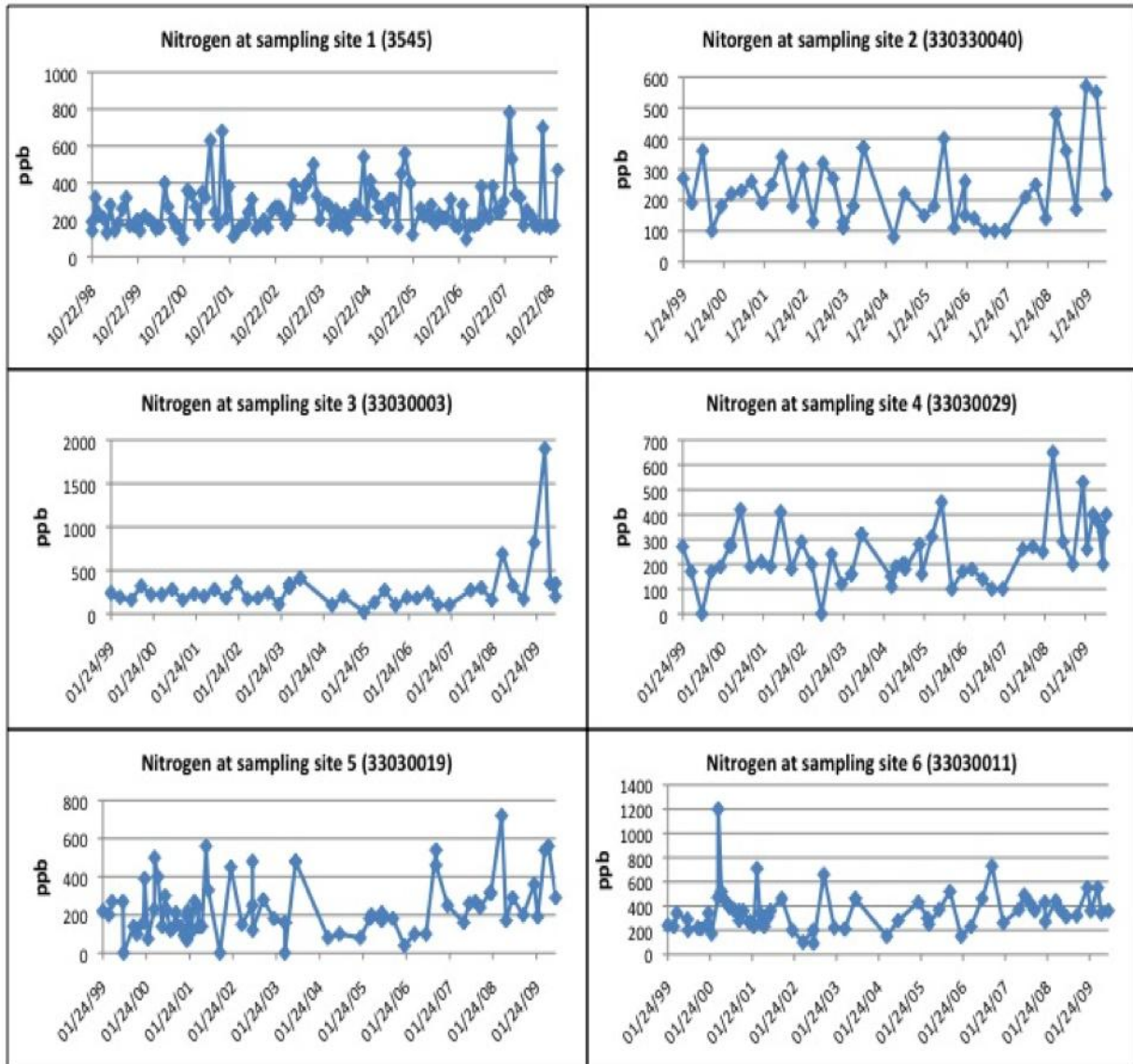


Figure 7. Water nitrogen concentration trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

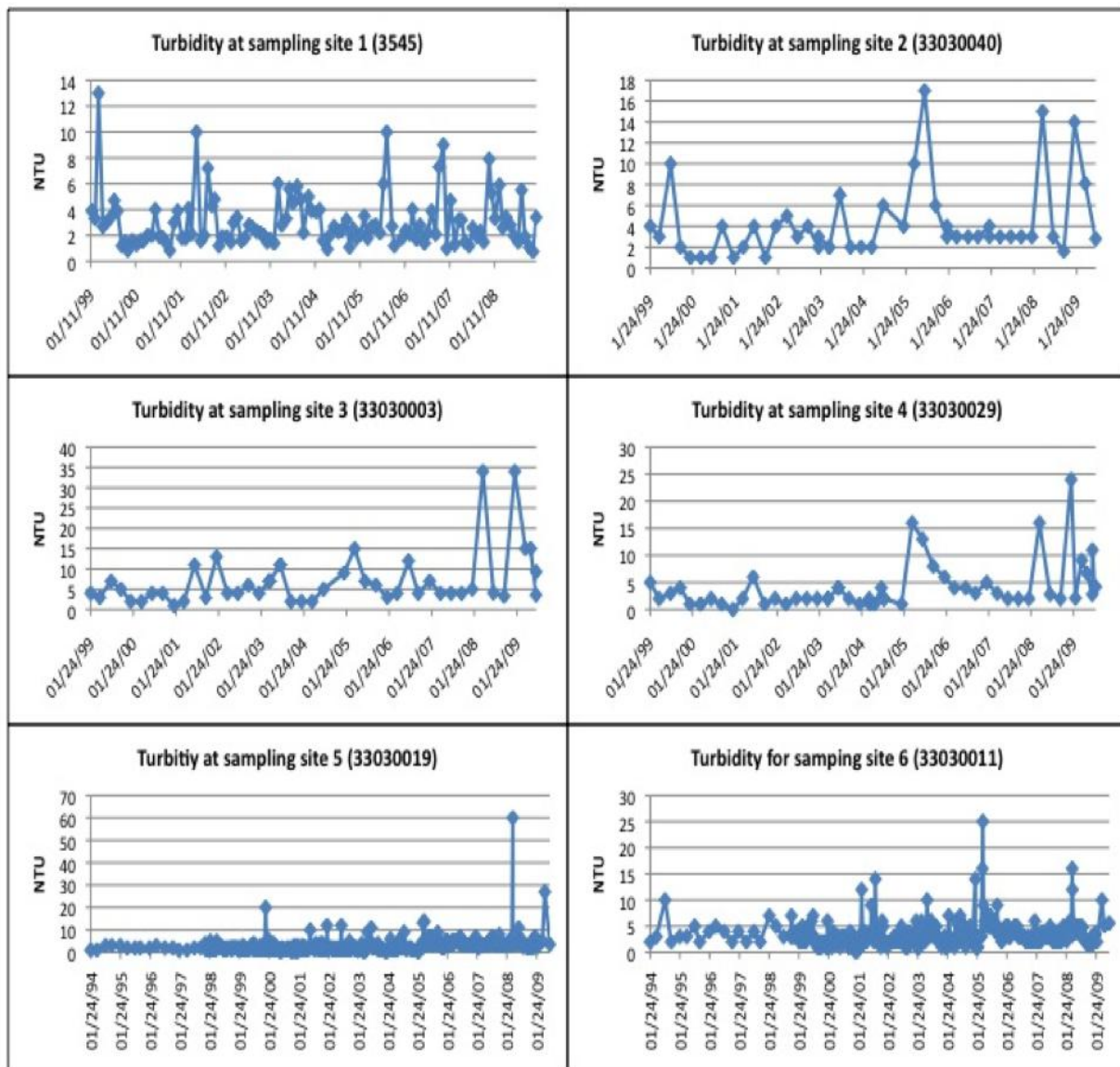


Figure 8. Water turbidity trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

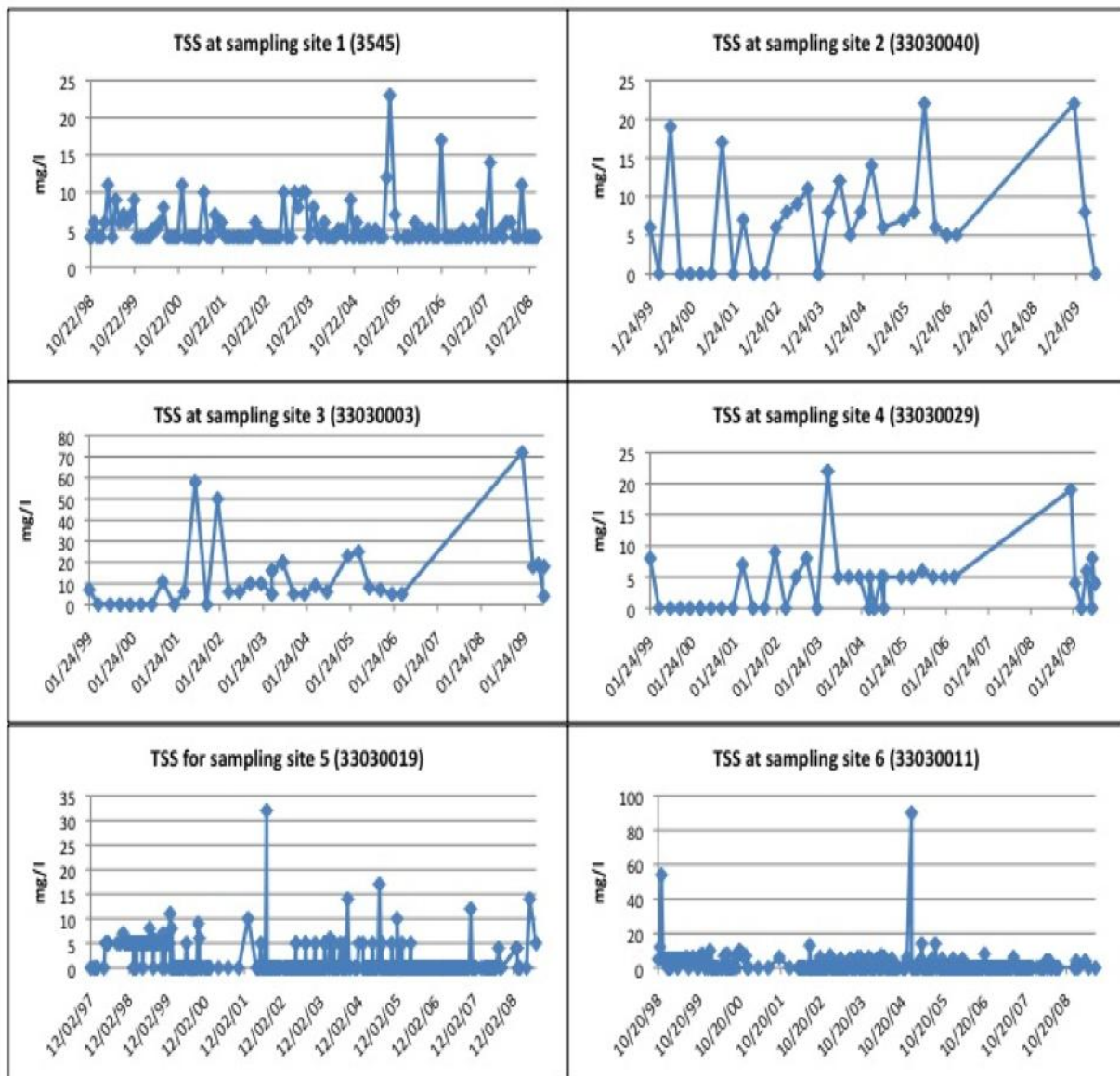
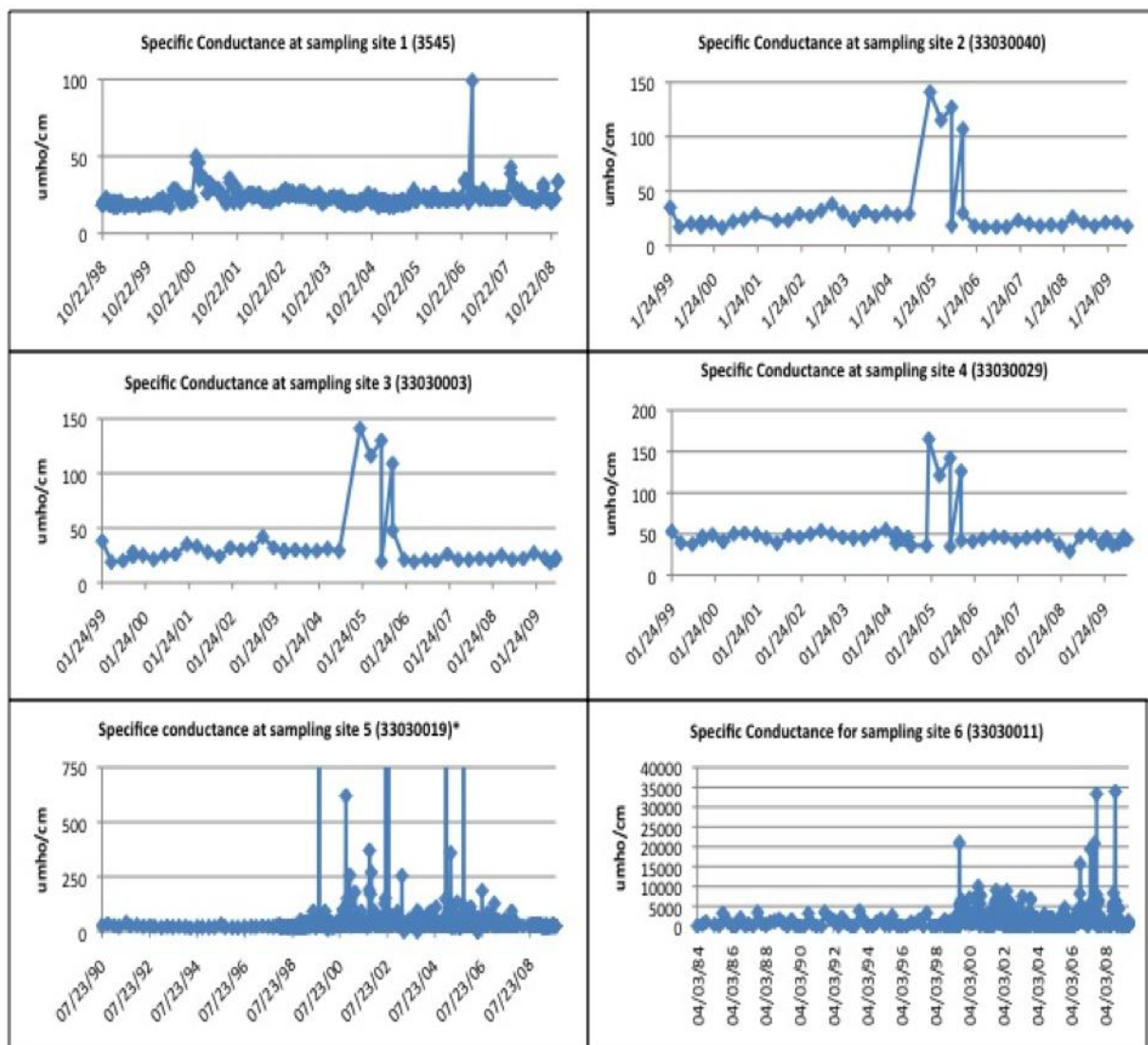


Figure 9. Water total suspended solids trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).



* Values at site 5 that are off the graph are >25,000 but <50,000 umho/cm.

Figure 10. Water specific conductivity trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

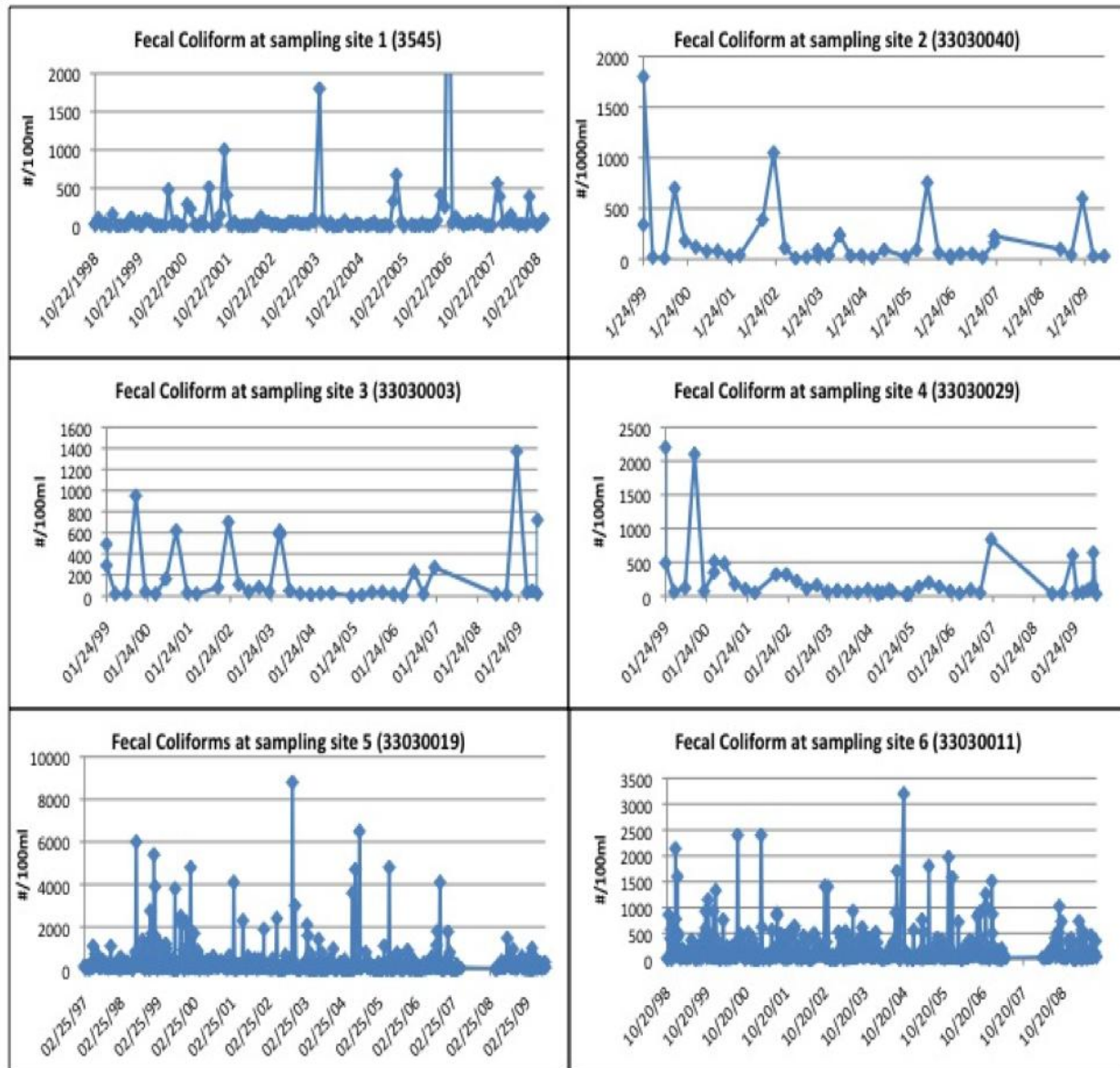


Figure 11. Water fecal coliform trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

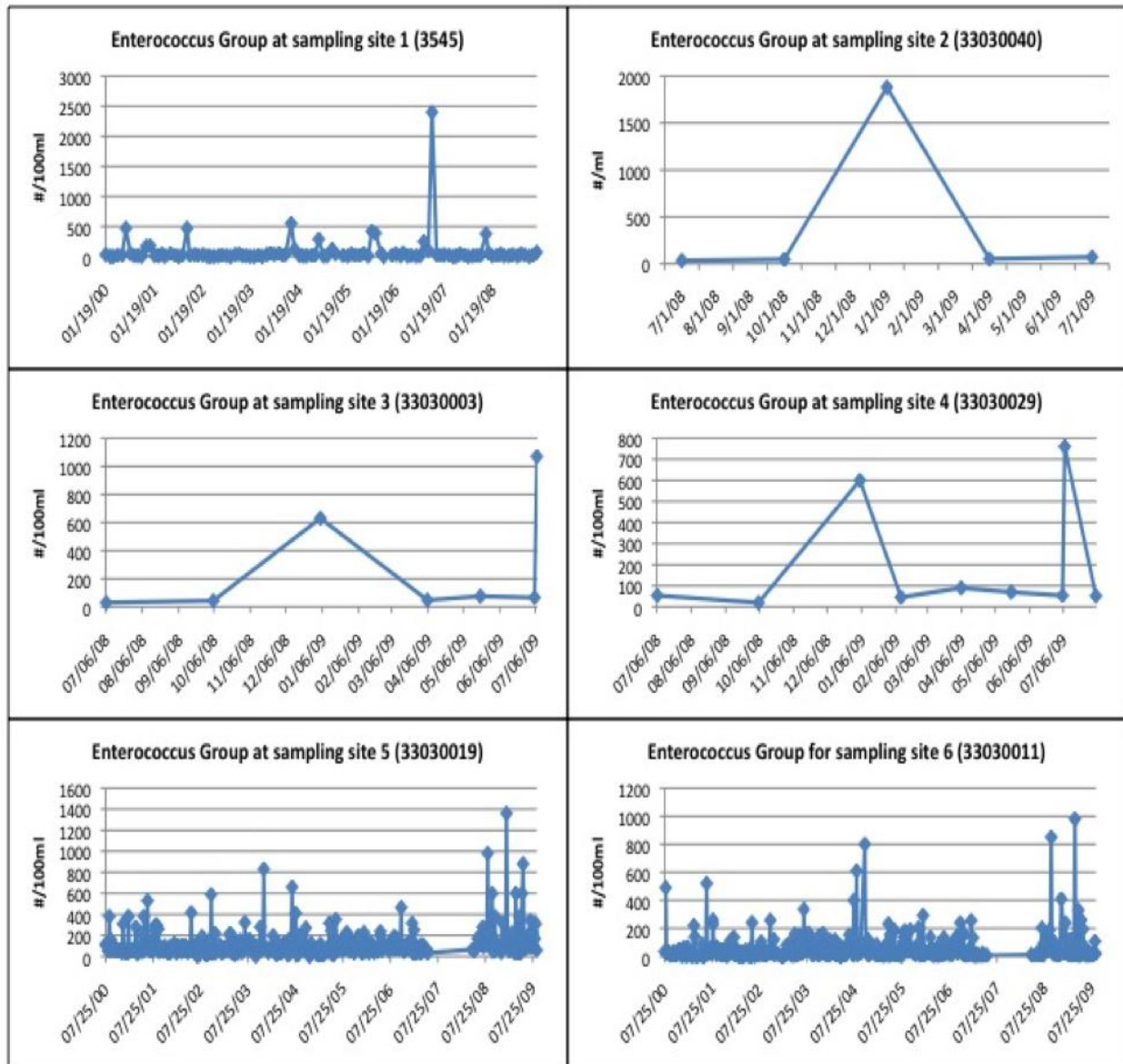


Figure 12. Water Enterococcus Group trends from six sampling locations in the Blackwater River watershed (data from E.P.A. S.T.O.R.E.T. 2009).

* Note for Figures 5-12 regarding sample site locations:

- Sample 1 – Route 4 bridge, east of Martin Mill Road
- Sample 2 – Indian Ford Road bridge
- Sample 3 – Highway 4 bridge, east of McDaniels Road
- Sample 4 – Highway 87 N bridge south of Neal Kennington Road
- Sample 5 – Highway 90 bridge, north of Old Bagdad Road
- Sample 6 – Highway 90 and Caroline Street bridge, Milton

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Appendix C: Blackwater River Watershed Stewardship Committee

Last Name	First Name	Affiliation	Phone	E-mail Address
Albrecht	Barbara	The Nature Conservancy (GCPEP)	850-623-0989	balbrecht@tnc.org
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Compton	Vernon	The Nature Conservancy (GCPEP)	850-623-0987	vcompton@tnc.org
Gutierrez	Mary	West Florida Regional Planning Council	850-332-7976	mary.gutierrez@wfrpc.org
Harper	Tristan	Moore, Hill & Westmoreland, P.A.	850-434-3541	tharper@mhw-law.com
Iversen	Craig	Blackwater River State Forest	850-957-6140	iversec@doacs.state.fl.us
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Hobbs	Chasidy	Emerald Coastkeeper	850-429-8422	info@emeraldcoastkeeper.org
Phillips	Pam	Gulf Alliance Community Engagement Project	850-370-0139	Pamela.King.Phillips@dep.state.fl.us
Ponsell	Ken	Blackwater Pyrates	850-529-3565	ken.ponsell@probuild.com
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Stanhope	Darliene	Santa Rosa County Planning and Zoning	850-981-7075	darlienes@santarosa.fl.gov
Snyder	Dick	University of West Florida	850-474-2806	rsnyder@uwf.edu
Szymoniak	Martha	West Florida Canoe and Kayak Club	850-623-9806	Zmaniacs@aol.com
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Appendix D: Goals of Blackwater River Stewardship Master Plan

Goal 1: Improve and Maintain River and Stream Water Quality

Goal 2: Protect Habitat throughout the Watershed by limited land-use impacts

Goal 3: Promote Woody Material as an essential component of a healthy aquatic ecosystem and an important in-stream resource

Goal 4: Reduce the channelization of river sections and small streams

Goal 5: Protect Steepheads and Seepage Slopes, two unique and fragile features that are home to a number of threatened and/or endangered species.

Goal 6: Implement Agricultural and Silvicultural Best Management Practices (BMPs)

Goal 7: Provide educational opportunities to residents and visitors within the River Basin

Goal 8: Create place-based education opportunities specific to the Blackwater River Watershed

Goal 9: Engage recreation outfitters and watercraft liveries in Watershed Education

Goal 10: Provide educational signage, websites, and printed publications about Watershed Stewardship

Goal 11: Reduce recreational impacts on river and streams.

Goal 12: Foster adaptive watershed planning for public lands management.

Goal 13: Unify Management and Coordination Across State Boundaries

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Appendix E: Implementation Plan

Goal 1: Improve and Maintain River and Stream Water Quality		Priority		
Objective	Task	High	Moderate	Low
1.1: Conduct a Blackwater River Basin-wide Water Quality Assessment so that the health of all river sections is known and priorities for restoration can be established.	1.1.1: Complete stream segment assessments	◆		
	1.1.2: Investigate the sources of fecal coliforms.			
	1.1.3: Identify critical areas			
	1.1.4: Identify data gaps and collect additional data needed.			
1.2: Determine baseline indicators for water quality standards	1.2.1: Determine the ambient water quality for the Blackwater River at the time of Outstanding Florida Water (OFW) designation to ensure that a baseline exists from which future determinations of water quality can be made.	◆		
	1.2.2: Partner with local schools and community groups to establish baseline water monitoring data for the river and its tributaries. Utilize volunteers to collect and analyze data currently not available.			
	1.2.3: Make water quality information readily available to the public.			
	1.2.4: Determine load reductions needed			
Reduce Fecal Coliform levels in	Establish a monitoring program to identify fecal coliform levels	◆		

rivers and streams	Establish target areas for monitoring.			
	Analyze septic tank reduction plans by local governments			
	Monitor the amounts of e-coli and fecal coliform at target areas.			
	Establish buffer/ setbacks for septic tanks			
Establish a Stormwater Pollution Prevention Plan for adoption by local governments.	Identify existing plans created by local governments and adapt as needed. *Santa Rosa County has a Stormwater Task Force who developed a stormwater management plan (2002) on its website. The City of Milton Stormwater Utility Plan/NPDES addresses stormwater management and is on its website.	◆		
Develop a water budget for the watershed	Develop an assessment technique for analyzing a water budget for the watershed.		◆	
	Assess human impacts on streamflow			
	Prioritize remediation based on assessment results			
	Educate & promote sustainable water use			
Establish MFLs (Minimum Flows and Levels)	Establish goals, impairments, problem statements, etc. for subwatersheds.		◆	

Conduct a subwatershed inventory of physical, biologic, habitat, and land use characteristics		◆	
Establish recommendations for streamside buffer habitat to reduce the amount of nutrients and pesticides that leads to the degradation of water quality.		◆	
Reduce anthropogenic contributions of sediment to the river		◆	
Delist fecal coliform impaired water segments	◆		

Goal 2: Protect Habitat throughout the Watershed by limited land-use impacts		Priority		
Objective	Task	High	Moderate	Low
2.1: Establish riparian buffers along waterways throughout watershed.	Establish criteria for riparian buffers along the river and its tributaries.		◆	
	Identify riparian buffers.			
Re-vegetate riparian buffers within watershed.	Set up a tree planting program to repair loss of riparian buffer along stream corridors.	◆		
	Educate landowners of the importance of good riparian habitat.			
Define larger buffers in areas such as wetlands to ensure wildlife habitat connectivity.		◆		
Investigate establishing or identify an organization to	Set guidelines and funding objectives to start the easement purchase program.		◆	

develop a Riparian Easement Purchase Program.				
Establish and adopt comprehensive planning polices and land development regulations that require or encourage riparian buffers to be comprised of Florida Friendly Landscaping.	Promote Living Shorelines as an alternative to shoreline hardening.	◆		
	Prohibit shoreline hardening in the watershed except in cases of economic hardship and where soft stabilization techniques are not otherwise feasible. *Living shorelines are typically less expensive than seawalls or placement of riprap.			
Bridge crossings with erosional features should be targeted and prioritized for restoration of native vegetative cover.	Identify and prioritize bridge crossings for restoration of native vegetative cover.	◆		
Develop a Habitat Conservation Plan (HCP) within development-prone areas near conservation and wildlife areas within watershed.	Select sites feasible to conduct a Habitat Conservation Plan (HCP)		◆	
	Partner with Florida Fish and Wildlife Conservation Commission and Santa Rosa County to create a HCP for selected site(s)			

Goal 3: Promote Woody Material as an essential component of a healthy aquatic ecosystem and an important in-stream resource		Priority		
Objective	Task	High	Moderate	Low

Encourage ACOE, EPA, DEP and DOT to develop BMPs for the management of woody material for aquatic habitat, flood control and infrastructure protection.	Establish a segment of the Blackwater River to be considered for a woody material pilot study.	◆		
	Review the bridge and culvert replacement and maintenance schedule (if there is one) for such infrastructure within the watershed to encourage the use of technologies and techniques that promote Woody Material maintenance as a diverse in-stream habitat structure.			
Restore streams in impaired reaches to stabilize banks and provide habitat diversity for macroinvertebrates and fishes.	Identify locations for stream restoration in impaired reaches and consider using woody material to stabilize stream banks and provide habitat diversity for macroinvertebrates and fishes.	◆		

Goal 4: Reduce the channelization of river sections and small streams		Priority		
Objective	Task	High	Moderate	Low
Update existing dredge permits and channelization to reflect current science	Create database of current dredge and channelization permits for waterbodies within watershed.	◆		
	Install a demonstration site of alternative sediment containment and collection to educate local governments on alternative methods other than channelization and dredging of small streams.			

Goal 5: Protect Steepheads and Seepage Slopes, two unique and fragile features that are home to a number of threatened and/or endangered species.		Priority		
Objective	Task	High	Moderate	Low
Further strategize on how to best protect steepheads and seepage slopes not subject to public lands management from excessive foot and motor vehicle traffic, as well as any construction projects. (i.e. through local comprehensive plans)	Survey all steephead and seepage slope features within the watershed.	◆		
	Determine how these features are addressed in public lands management plans and within the ecosystem partnership.			

Goal 6: Implement Agricultural and Silvicultural Best Management Practices (BMPs)		Priority		
Objective	Task	High	Moderate	Low
Conduct a review of cow/calf operations in the watershed, including the degree of access to streams and rivers.	Identify cow/calf operations in the watershed and locations to further strategize incentives for decrease water quality impairments.		◆	
Expand Best Management Practices (BMPs) within the watershed to increase riparian buffers.	Identify BMPs and strategize on expansion.		◆	

Conduct a review of silvicultural BMP adoption and compliance in the watershed	Ensure that trend and targeted water quality monitoring provide the basis for demonstrating that silvicultural BMPs perform as intended.		◆	
Work with silvicultural interests to expand BMPs in the watershed to increase riparian buffers for protection of wildlife habitat.	Investigate Habitat Conservation Plan (HCP) creation with silvicultural interests.		◆	

Goal 7: Provide educational opportunities to residents and visitors within the River Basin		Priority		
Objective	Task	High	Moderate	Low
Establish an “Adopt a Stream” program for school-aged children and other interested groups to promote watershed stewardship, pollution awareness, and basic scientific discovery.	Utilize an “Adopt a Stream” program to contribute to data collection and trend monitoring for water quality.	◆		
	Establish school participation in water quality monitoring within sections of watershed.			
Establish an education initiative for the hunting public on proper disposal of carcasses.	Identify means of information to educate hunting public about proper carcass disposal in brochures and signage within Wildlife Management Areas in the Blackwater River State Forest.	◆		
Further implement anti-littering campaign for roads near waterbodies such as through Santa Rosa’s Adopt-A-Spot	Install and maintain trash receptacles at regularly used parking areas associated with sandbar recreation areas. Community groups and/or scouts could adopt these locations.	◆		

program (SR Clean Community System).				
Continue annual Rivers Cleanup activities.	Establish River Cleanups that include educational components such as tours and outdoor classroom experiences.	◆		
	Establish watershed bus tours on a route highlighting stream conditions, drainage infrastructure, existing and proposed restoration projects, and cultural and historical features.			
Develop fact sheets about watershed and subwatersheds to distribute online and in print for the general public	Use fact sheet information to create education kiosk displays	◆		
Install informative signage about the importance of woody material, living shorelines, littering and ecosystem health along heavily trafficked areas.	Establish component through Santa Rosa Clean Community System's cleanup campaigns and educational signage at public access locations.	◆		

Goal 8: Create place-based education opportunities specific to the Blackwater River Watershed		Priority		
Objective	Task	High	Moderate	Low
Provide learning resources for educators	Develop electronic, web-based resource list		◆	
	Develop resource library			

Provide a center for educator professional development	Host workshops for teachers		◆	
Provide a center for place-based, hands-on learning	Determine type of desired programming		◆	
	Develop interdisciplinary, place-based curriculum			
	Develop financial resources to support place-based education program			

Goal 9: Engage recreation outfitters and watercraft liveries in Watershed Education		Priority		
Objective	Task	High	Moderate	Low
Establish a “Healthy River” social marketing program, offering recognition to those liveries who participate	Work directly with the river recreation outfitters to educate their customers and reduce trash around high impact recreation areas.		◆	
	Install informational signs posted at boat/ tube rental locations to educate users about the importance of woody material, fish and macro-invertebrate habitat, riparian buffers, and packing out trash from the river.			
	Encourage liveries to provide pre-departure educational talks to their customers.			
	Develop a logo with the program name that liveries can use as part of their marketing to demonstrate social and environmental responsibility to customers.			
	Provide sponsorships of trash receptacles at the launch locations			

	used by liveries, listed in Blackwater River Paddling Trail Guide or other high use locations (FDEP Greenways & Trails 2007). The installation and management of these receptacles could be sponsored by the liveries and other organizations, and could have advertisements or informational signs on them.			
	Establish a trash “buy-back” program that would provide users with a garbage bag and those that bring it back full could receive a discount on their next rental, or some other incentive.			
Develop and promote river-specific Best Management Practices (BMPs) for river recreation outfitters.	Host classes for livery owners about eco-tourism and eco-friendly practices.		◆	
Require educational component as part of permitting process within State Forest.	Require classes/training for livery owners in conjunction with their permitting process for those conducting business within the State Forest and receiving permits from the Division of Forestry.		◆	
Identify site specific locations for educational opportunities for students and general public	Establish a “Science Saturday” and/ or a “Summer Science Camp” or “Science Field Day” program specific to Watershed	◆		
Establish and maintain a regular Earth Day event within watershed	Partner with local schools to host Earth Day integrated with classroom activities.	◆		
Establish a Stewardship Training Program	Compile watershed educational resources and utilize T.W. Jones Education Center for location of Stewardship Training Program		◆	
Establish nonpoint source pollution education program	Continue to seek resources for updating Environmental Education curriculum in public schools specific to the Blackwater	◆		

within schools	River Watershed.			
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Goal 10: Provide educational signage, websites, and printed publications about Watershed Stewardship		Priority		
Objective	Task	High	Moderate	Low
Develop fact sheets about watershed and subwatersheds to distribute online and in print for the general public	Gather information about watershed and subwatersheds through basin-wide assessment.	◆		
Create and install informational kiosks about watershed characteristics at public access locations.	Identify locations for kiosk installation and include information about Rivers Cleanup.		◆	
Create subwatershed data sets to include goals, impairments, problem statements, etc.			◆	
Provide informational signage and displays at community events (such as fairs and festivals)			◆	
Develop a homeowners guide to the watershed that would educate homeowners on water quality protection	Identify resources specific to homeowners and residents related to water quality protection and sustainable water use.	◆		

Goal 11: Reduce recreational impacts on river and streams.		Priority		
Objective	Task	High	Moderate	Low
Create no-wake zones along river and tributaries, as defined within statutory limitations, where safety hazards are probable. (i.e. within certain distances of boat landings and bridge crossings)	Conduct an inventory of current boating restricted areas in the watershed.	◆		
	Identify user conflicts between motorized and non-motorized vessels along designated canoe trails.			
	Identify areas that stakeholders believe should be boating restricted areas based on statutory purposes.			
	Draw conclusions as to whether or not the stakeholder-identified areas would provide ecological benefits in addition to the benefits provided by the statutory purposes.			
Establish a no-fee permitting process for registering and permitting watercraft liveries, perhaps through an inter-local agreement or under the auspices of the NFWFMD and through the local tax collector's office to determine the number of vessels on area waters.			◆	

Goal 12: Foster adaptive watershed planning for public lands management.		Priority		
Objective	Task	High	Moderate	Low

Update the Yellow River/ Blackwater Bay Aquatic Preserve Management Plan to include considerations for climate change and sea level rise, on aquatic and riparian ecosystems.	Prohibit shoreline hardening along the shoreline of the aquatic preserve.		◆	
	Identify and work with local governments to provide incentives to living shorelines in front of currently hardened shorelines to create riparian habitat shoreward of structures and to protect riparian property should be considered.			
Update the Blackwater River State Forest Management Plan, adopted in 2004.	Review and identify needed revisions to the Blackwater River State Forest Management Plan, adopted in 2004.		◆	
Identify islands and shifting sandbars within the banks of the Blackwater River and its tributaries.	The Blackwater River Foundation should support an inventory of islands to determine the extent and validity of any claims to ownership or use authorizations by private interests.	◆		
Make management plan update processes available to the public, ensuring the interests in watershed health are adequately represented.	Identify plan updates and schedules.	◆		

Goal 13: Unify Management and Coordination Across State Boundaries		Priority		
Objective	Task	High	Moderate	Low
Provide the communication tools necessary for participation and	Provide Stewardship meeting notices and	◆		
	Maintain www.BlackwaterRiver.org with appropriate stakeholder			

coordination efforts between agencies and stakeholders in Florida and Alabama through means such as video-conferencing.	contact information and links to partners' websites			
	Provide an annual report of Stewardship activities within watershed to agencies and stakeholders within watershed.			
	Seek annual input on accomplishments and revisions of Stewardship Master Plan.			
Increase Stakeholder Involvement by inviting stakeholders in all jurisdictions to participate in watershed planning efforts.	Continue to identify and invite stakeholders within watershed to participate in stewardship planning efforts.	◆		
Identify means of facilitation of Watershed based coordination between political and geographic boundaries	Continue to recruit members for stewardship committee and reach out to other "stakeholders" for participation.	◆		

Appendix F: Environmental Education Strategic Plan

Blackwater River Stewardship Committee

Strategic Plan for Environmental
Place-Based Education

Developed March-June 2010

List of Participants

Table 1. List of Participants involved in Strategic Planning Process. Activities included meeting attendance, email correspondence, and completion of online survey.

Name	Affiliation
Charlene Kincaid	Coordinator of Mathematics and Science /Santa Rosa County
Chris Verlinde	University of Florida (UF)/Institute of Food and Agricultural Sciences Sea Grant and Blackwater River Foundation (BRF) Stewardship Committee
Barbara Albrecht	University of West Florida (UWF) Center for Watershed Excellence and BRF Stewardship Committee
Chasidy Hobbs	UWF and BRF Stewardship Committee
Debbie Holland	FL Department of Environmental Protection
Walt Reese	BRF and BRF Stewardship Committee
Mary Gutierrez	West Florida Regional Planning Council and BRF Stewardship Committee
Julie Smith	Santa Rosa County Schools
Sharon Henderson	Santa Rosa County Schools
Merrilee Currie	Santa Rosa County Schools
Kelly Marcilliat	Former teacher Navarre High School
Carole Tebay	Former early education specialist
Katie Tankersly	Former teacher- E-Ma-Chamee/ Eckerd Youth Alternatives
Beverly Saint John	Former teacher Milton High School
Debbie Miller	UF
Vickie Mullins	4-H
Barbara Furman	Former home school teacher

Amanda Carrigan-Grissom	Gulf Islands National Seashore
Michele Inkel	Santa Rosa County Schools
Stephanie Bondurant	Santa Rosa County Schools
Michelle Barlow	Santa Rosa County Schools
Susan Copeland	Santa Rosa County Schools
Debbie Wood	Santa Rosa County Schools
Alesia Gibbs	Santa Rosa County Schools
Janie Seal	Santa Rosa County Schools
Jennifer Baily	Santa Rosa County Schools
Sparrow Matthews	Eckerd Youth Alternatives
Dashean R Chavez	Santa Rosa County Schools
Kristy Sirmons	Santa Rosa County Schools
Faye Smith	Santa Rosa County Schools
Misty Meredith	Santa Rosa County Schools
Warren Bell	Santa Rosa County Schools
Diana Hayden	Santa Rosa County Schools
Sandra Porras	Escambia County Schools
Ian Turoff	Santa Rosa County Schools
Josh Wilks	BRF and BRF Stewardship Committee
Mack Thetford	BRF, UF, and BRF Stewardship Committee
Lindsey Wood	BRF- contractor and BRF Stewardship Committee

Introduction

Place-Based Education

Place-based education is an education strategy of that uses the local environment as a context for learning in multiple content areas¹. Place-based education is founded upon these tenets:

- The local environment is a logical place for learning to occur because it is accessible and relevant to learners, especially young learners
- Using the local environment as a context for learning may develop a deeper connection to place and ultimately a drive to better care for one's community
- Concepts from all disciplines can be integrated into one program, activity, or piece of curriculum

Strategic Plans: A Brief Overview

The purpose of a strategic plan is to provide an organization with a framework to for future action. Strategic plans are driven by the organizational mission and a desired state for the future, also referred to as a vision. Strategic plans are working documents aimed at moving an organization forward. Generally, action plans are accompanying documents, but actions are included in this strategic plan.

Background

Blackwater River Foundation (BRF) was established in 2002 by a group of local residents with a common goal: protecting the valuable natural and cultural resources of the Blackwater River watershed. BRF is involved in a variety of activities, including the development of the historic T.W. Jones House and property in Milton as a center for education.

Since 2009, BRF has facilitated a multi-stakeholder Stewardship Committee with the goal of developing a master plan for the Blackwater watershed. It was decided to develop an Ad-Hoc committee to assist with the development of a strategic plan for education activities as a part of the overall master plan. This strategic plan is the document resulting from the Ad-Hoc committee's work.

Process of Strategic Planning and Implementation

¹ Sobel, D. (2004). *Place-based education: Connecting Classrooms and Communities*. Great Barrington, MA: The Orion Society.

The development of this strategic plan involved:

- Identification of educators and stakeholders interested in education programming
- Development, distribution, and analysis of an online survey to determine existing conditions
- Meetings with educators and stakeholders to discuss existing conditions and options for the future
- Synthesis of results from the survey and meetings, which form the basis of the strategic plan, mission statement, and vision statements

Results of the survey and meeting minutes can be found in the Appendices.

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Place-Based Education Strategic Plan

Place-Based Education Program Mission

“provide resources for learning about local environment, history, and culture”

Vision for Place-Based Education

1. Provide learning resources for educators
2. Provide a center for educator professional development
3. Provide a center for place-based, hands-on learning at the T.W. Jones House Education Center

Vision Statement 1: “Provide learning resources for educators”

Strategy 1.1 Develop electronic, web-based resource list

Action 1.1.1 Conduct complete survey of existing programs
and curricula available to teachers

Action 1.1.2 Create web-page on Blackwater River
Foundation (BRF) website to house resource list

Action 1.1.3 Create a calendar of events of available
programs (BRF's and others) and post on website

Action 1.1.4 Present database to teachers

Strategy 1.2 Develop resource library at T.W. Jones House
Education Center

Action 1.2.1 Procure hard-copies of materials

Action 1.2.2 Develop check-out system

Action 1.2.3 Present resource library to teachers and provide
information to teachers regarding use of
materials

Action 1.2.4 Explore opportunities to integrate resource library
with the Santa Rosa County Professional
Development Center

Vision Statement 2: “Provide a center for educator professional development”

Strategy 2.1 Host workshops for teachers

Action 2.1.1 Work with partners to offer workshops from partners and outside entities (e.g., Project Wet curriculum or Florida Department of Environmental Protection)

Action 2.1.2 Work with school board to write components for professional development, in-service points and other benefits

Action 2.1.3 Promote workshops to teachers

Vision Statement 3: “Provide a center for place-based, hands-on learning at the T.W. Jones House Education Center”

Strategy 3.1 Determine type of programming BRF will offer

Action 3.1.1 Determine what programs are currently available in order to reduce redundancy in both content and age-group

Action 3.1.2 Determine the targeted audience (e.g., only Santa Rosa County teachers or regional; grades)

Action 3.1.3 Develop relationship with all Coordinators of Curriculum Content to ensure interdisciplinary nature of the program

Action 3.1.4 Develop, distribute, and analyze an all-teacher survey of programming that would help teachers meet goals and further the mission of Blackwater River Foundation

Strategy 3.2 Write interdisciplinary, place-based curriculum

Action 3.2.1 Develop curriculum based upon information gathered in Strategy 3.1

Action 3.2.2 Develop and procure materials that will be used for on-site components and/or off-site components

Action 3.2.3 Develop training program to coach teachers how to use curriculum materials and utilize on-components if applicable site

Action 3.2.4 Market program to teachers, offering professional development, in-service credits and other benefits if possible

Strategy 3.3 Develop master site plan for T.W. Jones House Education Center for education activities

Strategy 3.4 Develop financial resources to support place-based education program

Action 3.4.1 Develop grants database

Action 3.4.2 Explore opportunities for private funding

Action 3.4.3 Offer programs for a fee (e.g., weekend and/or summer programs)

Recommendations

Vision Statement 1

A resource list has been initiated by Blackwater River Foundation (BRF). This list will need to be updated and further investigated. In the May 27th meeting (See Appendix B), teachers felt that an online “storing house” where teachers could gather information would be easiest. BRF could potentially house this on its website. It would be helpful to work with county Content Area Curriculum Coordinators to distribute to all teachers and staff.

Vision Statement 2

Teachers have indicated they would like to have opportunities for professional development. They are often unaware of opportunities. Teachers like the format of Project Wild or Project Learning Tree, which usually include participation in a short training session in which teachers receive a book of activities divided by topic and grade. Better publicity for these programs is a key component for teacher participation, as is the timing of the event and the ability to earn professional development and in-service credits. BRF may work with Vickie Beagle and Content Area Curriculum Coordinators to develop professional development and in-service credit opportunities.

Vision Statement 3

In lieu of calling the education program “environmental education”, the term “place-based education” seems to fit with BRF’s mission and has more potential to reflect the interdisciplinary nature of the programming BRF would like to offer. This may be a key to drawing in teachers from all disciplines and focus on integration of subjects. Another key aspect of gaining teacher participation is to make sure all programming actually meets teachers’ needs and makes it easier for them to do their jobs. Creating and offering materials that teachers would use but do not currently have access is also an important component of developing the BRF education program.

Offering summer programming may be a good way to bring students to the Jones' Education Center, especially given that teachers are limited in field trip opportunities because of funding and time required for testing. During the May 27th meeting, teachers mentioned that summer programs often are looking for places to take their participants and often have the money to travel to the site. It may help to look at other programs as models, such as the Art Education summer program.

Community service opportunities for high school students are currently lacking and BRF's curriculum may want to include this component, especially for on-site work and for creating opportunities with other partnering agencies such as Northwest Florida Water Management District or Florida Division of Forestry. Some grants, such as the Department of Education "Learn to Serve" grant, may be a funding source.

Teachers in the May 27th meeting and in the survey indicated they would like materials about the local environment and community. For example, one teacher commented that they would like *"curriculum materials for local environment because students will be able to relate to this best."* Teachers also indicated they would like materials they can take with them and adapt to their lesson plans.

In the June 25th meeting, participants discussed programming at the T.W. Jones House. It may be helpful to have programming that offers a topic per year, so that multiple disciplines are captured and students have a chance to return to the site but perform different activities.

Appendix G: Environmental Education Survey Results

The following sections are the results of a survey sent to teachers and environmental educators in April, 2010.

I. Environmental Education Programs Available to Santa Rosa County Teachers

Table 2. Environmental Education Programs Available to Santa Rosa County Schools, Florida

Name of EE Program	Grades Served	Topic	Florida Next Generation Sunshine State Standards ²	Other
Navarre Beach Marine Science Station	K-12	Sea turtles, Estuaries, Florida Ecosystems (coastal, marine, estuarine), Sharks	Yes	Field trip to Station required
In Touch with the Sea	K-12	Marine animals, estuaries, oceanography, science experiments, water quality	Yes	Hands-on; fee; in class, home school, field trip, camps
4-H	K-12	Agriculture, communication skills, civics, public speaking, marine ecology, etc.		Student- driven projects, "learn by doing", clubs, in-school components,
I Love Science	5 th	Science	Yes	

² A blank in this box does not mean standards are not used in the program.

Resource Rangers/ Environmental Education Coordination Team	4-8	Various environmental issues		Group of educators in Escambia and Santa Rosa Counties coordinate events and field trips
University of Florida/Institute of Food & Agricultural Sciences/ Sea Grant	K-12	Marine, Coastal, Estuarine, Wetlands		
Gulf Islands National Seashore/ National Park Service	3-6	Coastal ecology, history		Field trip, in- class visits, traveling trunks, curriculum materials
Santa Rosa County Master Gardeners/ Garden Mosaics program	Pre-K, 7 th , Exceptio nal Student Educati on (ESE) (Middle)	Various environmental topics	Yes	Master Gardeners come to schools
Santa Rosa County Master Gardeners/Panhandle Butterfly House	Pre-K through 6th	Bugs, pond ecosystem, butterflies		Teachers request a visit
Gulf Power	K-12	Energy, Southeastern Forests,	Some	Curriculum materials, tours
Florida Department of Environmental Protection/ Northwest Florida Aquatic Preserves Office	K-12	Various environmental topics (marine, coastal, estuarine mostly)	Yes	Teachers schedule program with the provider
Florida Division of Forestry/Blackwater River State Forest				

Blackwater River State Park				
League of Women Voters				

Summary of Table 1:

- EE Programs are focused on marine, estuarine, and coastal habitats and agriculture/horticulture, with some focus on forests, history, and environmental issues/problems
- Less representation in Pre-K, High School, Higher Education (though teachers have ability to contact providers for programs)
- What are limitations, where are other gaps?

II. Environmental Education Curricula

Table 3. Curricula Available to Teachers in Santa Rosa County, Florida

Curriculum Material/ Date	Grades	Topic	Florida Next Generation Sunshine State Standards	Specific to Local Area	Other
Along the Blackwater River/ 1992	K-12	Endangered species, upland habitats, Blackwater River,	Yes (at time of publication)	Yes	Includes VHS video and print curriculum with activities
Florida Ag in the Classroom/ updated frequently	Pre K- 12	Florida Agriculture, Environment/Agriculture interactions,	Yes	Specific to FL, can be adapted to local environment	Available online, some activities at a cost

Project Wild, Project Wet, Project Learning Tree, etc.	K-12	Environmental	No, uses national standards	Can be adapted	Teachers attend workshop and receive curriculu m
Gulf Islands National Seashore Traveling Trunks	3-6	Coastal animals, Seafaring Sailor		Yes	Teachers check out trunk at Gulf Islands
Gulf Islands National Seashore Videos	3-6	History of National Park Service, Coastal habitats, Gulf Islands National Seashore, Civil War		Yes	Available at Gulf Islands
Resource Ranger/ Environment al Education Coordination Team Videos	4-8	Environmental Issues		Yes	Available online
Gulf Power Teacher's Stuff	K-12	Energy, Southern ecosystems	Gives topic headlines for adaptation	Regional	Available online

Summary of Table 2:

- Only one resource specific to Blackwater River, though dated.
- Hands-on resources and videos tailored to Elementary and Middle School
- Resources and activity guides such as Project Learning Tree or Project Wet are given to teacher who attends a workshop
- Limited resources
- Are teachers aware of existing resources? If so, are they using them? Why or why not?
- In survey, respondents use Project Wet (etc.) most frequently, why? (Question 3 on survey)

III. Targeted Grades for Santa Rosa County Environmental Education Programs

- All would use EE programs and Curricula (80-90% for all except Pre-K, K and Higher Education)
- What are the limiting factors?
- Which grades use EE most, or have programs available (survey shows late elementary & middle school)

IV. Topics covered in Environmental Education

Table 4. Environmental Topics Covered in Santa Rosa County, Florida

Representation	Topic
80 % or more	Coastal, Local habitats
50-70 %	Wetlands, Marine, Water Quality, Human/Environment Interactions, Local Environmental Issues, Global Environmental Issues, Solutions to Environmental Problems
Less than 50 %	Estuaries, Freshwater, Local Species, Gardening, Water Availability, Fire management, Invasive Non-native species, Environmental Health vs. Environmental Degradation, Local Environmental Problems, National Environmental Issues, Participation in Environmental Issues
0%	Uplands, Local Public/Private land management agencies, Job opportunities in natural resources

Summary of Table 3:

- Topics less than 50 % can be considered under-represented
- Is this true? Cross-reference with Tables 1 & 2, which show marine, coastal, and estuarine are most available
- Why are these topics under-represented?
- Would teachers use materials/programs for the under-represented topics?

V. Identification of Skill Sets to Target

- Critical Thinking and Analysis (understanding cause and effect, realization of how details factor into larger themes, problem solving)
- Scientific Method (understanding cause and effect, collecting data and analysis, data trends)

Other

- Inter-connections between cultural, social, environmental issues (personal responsibilities, community responsibilities, personal/ family's impact)
- Local opportunities in which to become involved

VI. Learning Opportunities

What teachers would use:

Curriculum Materials based on Local Topics (100%)

Lesson in a box (90.9%)

In-class visits from Environmental Educator (90.9%)

Visit to T.W. Jones Education Center (63.6%)

Other curricula (63.6%)

Selected quotes from survey:

- *"it is always good to have a first source person to discuss the issues and provide a lesson"*
- *"materials on local environment- because not all children are exposed to what we have"*
- *"I prefer lesson materials that are provided for me. It allows me the flexibility to integrate into my curriculum"*
- *"Because we are so limited in our field trip opportunities, in class visits are most desirable at this point"*
- *"lesson in a box- sounds easy, would have the materials all in one place without having to gather them"*
- *"curriculum materials for local environment because students will be able to relate to this best"*

VII. Major Themes from Survey

- There are gaps in programs and curricula for Pre-K, 1-2, 9-12, and Higher Education
- Programs are more available for coastal, marine, estuarine than other habitats
- Programs that offer materials teachers can adapt and use in the classroom (or visits from environmental educators) are most feasible and popular
- Curricula for local area limited and dated, teachers would use if available
- Funding for field trips is an issue (noted in several comments in the survey)

