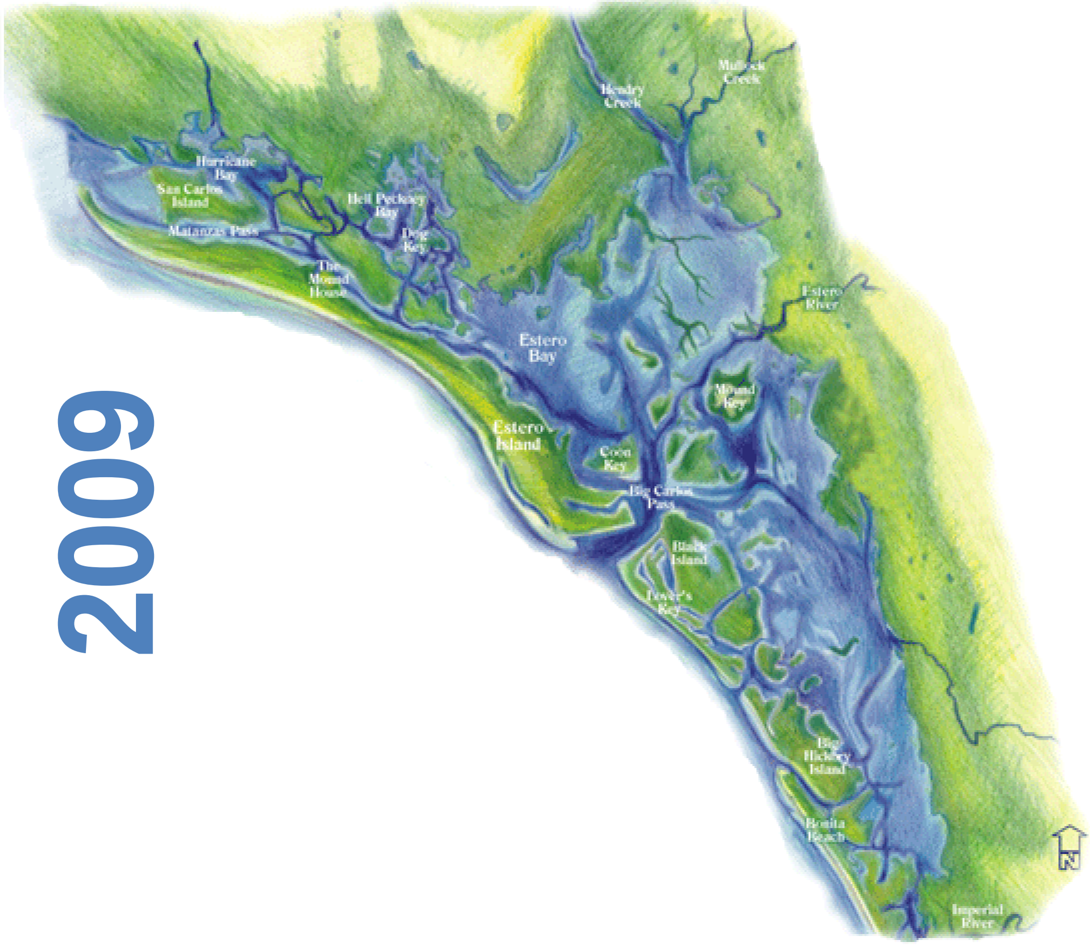
# State of the Bay Update

Estero Bay Agency on Bay Management

# 2009




**Southwest Florida Regional Planning Council**
**1926 Victoria Avenue, Fort Myers, Florida**

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Estero Bay

## Acknowledgements

This project has benefited from numerous agencies and individuals that have contributed information, time, and opinion to the contents and recommendations. Special thanks go to Judy Ott, Program Scientist, Charlotte Harbor National Estuary Program; Keith Kibbey, Environmental Laboratory Manager, Lee County Environmental Laboratory; and Karen Bickford, TMDL Coordinator, Lee County Division of Natural Resources for assistance with the water quality section. Assistance in the wildlife section was provided by: Nancy Douglass, Nongame Biologist, FWC; Heather Rigney, Species Conservation Planning Section, FWC; Craig Faulhaber, Florida Scrub-Jay Conservation Coordinator, FWC; Jake M. Gipson, FWRI Bald Eagle Nest Data Coordinator, FWC; Ulgonda Kirkpatrick, Eagle Plan Coordinator, FWC; Kristina Jackson, Red-cockaded woodpeckers Safe Harbor Coordinator, FWC; Win Everham, FGCU; Nora Demers, FGCU; Katy NeSmith, Zoologist, Florida Natural Areas Inventory; Cheryl Clark, FDEP/Estero Bay Aquatic Preserve; and Erin Rasnake, FDEP.

FUNDING FOR THIS REPORT WAS PROVIDED BY LEE COUNTY SMART GROWTH. Special assistance was received from Mr. Wayne Daltry, Smart Growth Director.

The Charlotte Harbor National Estuary Program and the Southwest Florida Regional Planning Council have provided the venue and support for the entire project and regular input in the structure and function of the plan.

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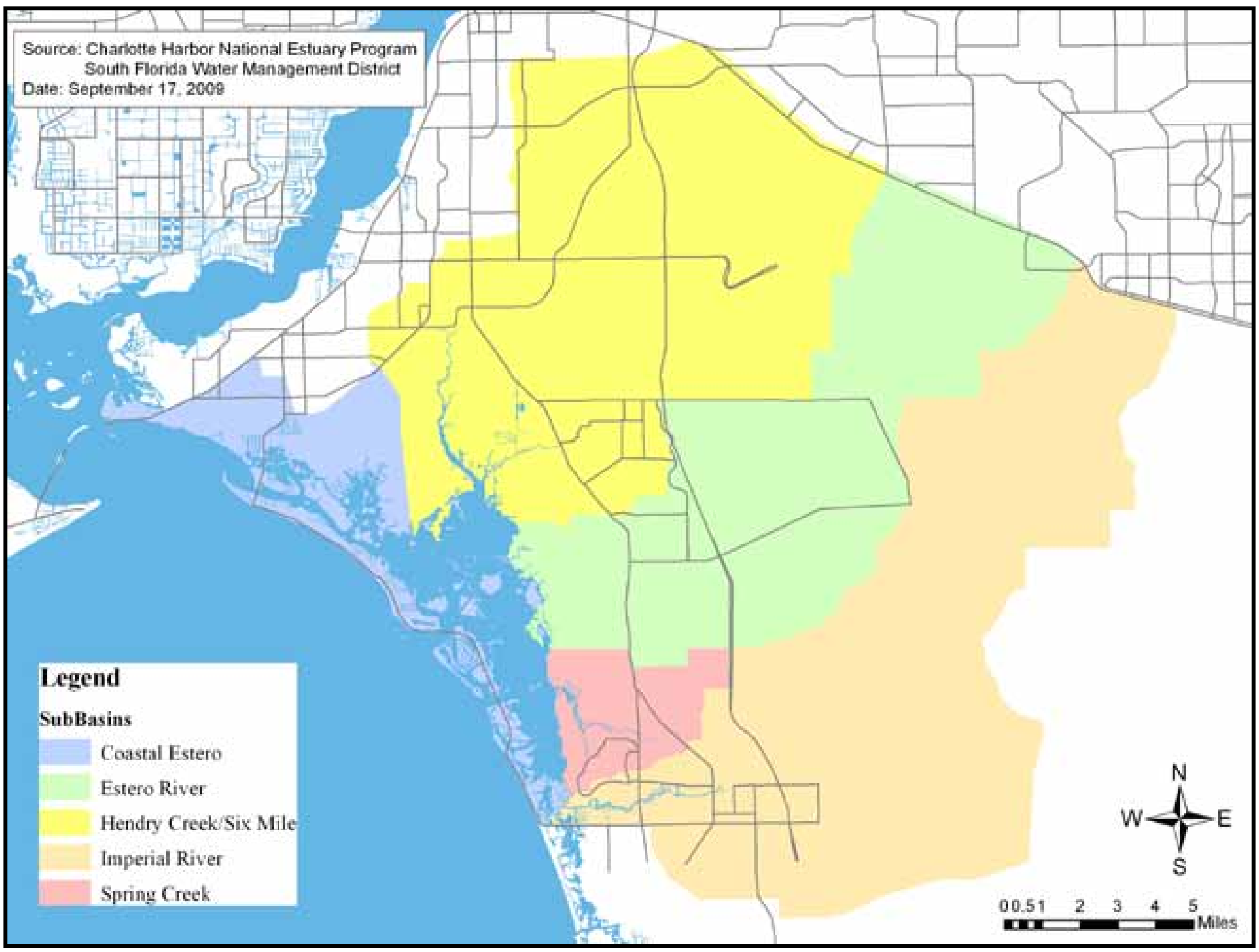
## Introduction

The Estero Bay Agency on Bay Management (ABM) was established in 1996 in accordance with the settlement agreement for the completion of permitting for Florida Gulf Coast University (FGCU), after the completion of the Arnold Committee study process. The ABM membership consists of, but is not limited to, representatives from the following: local chambers of commerce, citizen and civic associations, Lee County government, the South Florida Water Management District (SFWMD), the Florida Department of Environmental Protection (FDEP), the Florida Fish and Wildlife Conservation Commission (FWC), FGCU, the Southwest Florida Regional Planning Council (SWFRPC), commercial and recreational fishing interests, environmental and conservation organizations, the Responsible Growth Management Coalition (RGMC), the Town of Fort Myers Beach, the City of Sanibel, scientists, affected property owners and the land development community. The ABM is a non-regulatory, advisory body whose directive is to make recommendations to the SWFRPC for the management of Estero Bay and its watershed (Estero Bay Agency on Bay Management 2004). The waters of Estero Bay provide a tremendous resource for local residents and tourists who enjoy fishing and appreciate the local vegetation and wildlife. It is also important to note that Estero Bay is Florida's first aquatic preserve (Estero Bay Agency on Bay Management 2002).



## Principles of the Estero Bay Agency on Bay Management

### I. General

I. A. The ABM will be cognizant of the "big picture" and to the concept of "ecosystem management" and sustainable development.
I. B. Water conservation practices and wastewater reuse will be encouraged throughout the watershed to protect potable water supplies."
I.C. All re-zoning requests within the Estero Bay watershed will be critically evaluated to ensure protection of water quality, rare and unique habitats, listed wildlife, and ecosystem functions.
I.D. Variances from environmental regulations and deviations from development standards will be the exception, not the rule.
I.E. Environmental protection and long-term quality of life will not suffer based on short-term economic impacts or political pressures.
I.F. Zoning resolutions that are required as a part of the approval for re-zoning must be tracked for future compliance and enforcement.
I.G. Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.
I.H. Additional staff will be hired to assist in the compliance and enforcement of zoning resolutions related to environmental issues.
I.I. Agency staffing will keep pace with increased demand on services, especially environmental protection issues. Trained and experienced wildlife biologists and environmental scientists will be hired to ensure adequate development review.
I.J. Activities in the watershed by any regulatory agency shall provide the opportunity for public participation.

### II. Uplands, Headwaters and Isolated Wetlands

**II. A. Land Management and Acquisition**
II. A. (1) Lands identified as critical for listed species shall be targeted for public purchase and managed to maintain their environmental value.
II. A. (2) The Lee County Conservation Land Acquisition and Stewardship Advisory Committee will consider priorities for land purchases adopted by the "Arnold Committee" and the ABM.
II. A. (3) The Lee County Conservation Land Acquisition and Stewardship Advisory Committee will use proactive approaches to investigate the willingness of landowners to be voluntary sellers, as specified in the requirements of the ordinance that established the land acquisition program.
II. A. (4) Regulations within the existing "Notice of Clearing" process by Lee County will be developed that require wildlife surveys, habitat assessments, and a development plan for the agricultural operations so that critical habitats for state and federal listed species can be preserved.
II. A. (5) Conservation easements will be used as an option to protect critical habitats.
II. A. (6) Programs such as the "Keep It Clean" and "Florida Yards and Neighborhoods" programs should be promoted, to minimize inputs of storm water pollutants into the bay.
II. A. (7) Before off-site mitigation for wetland and listed-species upland impacts is considered, opportunities for avoidance, minimization, and on-site mitigation must be exhausted.
II. A. (8) Off-site mitigation projects should be within watershed and within habitat type wherever possible.

**II. B. Vegetation**
II. B. (1) Natural, native vegetation within natural systems will be retained to the greatest extent possible.

II. B. (2) Physical removal of invasive vegetation will be utilized for control rather than widespread chemical treatment.
II. B. (3) Limited application of herbicides that rapidly degrade may be used, according to the product label, on a case by case basis for the control of nuisance and invasive non-native vegetation and to maintain native plant communities.
II. B. (4) Promote, whenever possible, the active and aggressive removal of invasive non-native plants from all common areas, conservation easements, preserves and natural areas within the Estero Bay watershed.
II. B. (5) Isolated and seasonal wetlands are recognized for their importance for flood protection, unique fish and wildlife habitat, water quality, and water quantity. These wetlands should be preserved to the greatest extent possible.

**II. C. Physiographic**
II. C. (1) Consideration will be given to the ancient relief of the watershed by: preserving vegetation that provide the characteristic habitat and canopy; retaining the relic natural features; and reconnecting historic natural flow ways that have been diverted or severed.

**II. D. New Construction**
II. D. (1) Construction within flood plains shall be avoided wherever possible.
II. D. (2) For construction that must occur within flood plains, utilize techniques that do not adversely impact the capacity of the floodplain (e.g. use of pilings to raise living floor elevations versus use of fill).
II. D. (3) Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood) within flood plains.

**II. E. Hazardous Materials**
II. E. (1) Specifically placed larvicides and biological controls are the preferred methods for mosquito control. Adulticides should only be used in compliance with Section 388.011(1) Florida Statutes.

**II. F. Agriculture**
II. F. (1) Tax incentives should be created so that landowners may continue land use practices that maintain ecologically important habitat.
II. F. (2) Adequate staff at Property Appraisers Offices within the watershed will be provided to review the high number of applications and strictly enforce the rules for Bona fide agricultural tax exemptions.
II. F. (3) The minimum time period for re-zoning of agricultural land should be increased from three years to ten years to reduce the speculative clearing of agricultural land for "higher use" which results in the loss of natural habitat and the loss of tax revenue.
II. F. (4) Legislation should be implemented that provides inheritance tax, real estate tax and estate tax relief for agriculture landowners and their heirs, who will maintain their land in agriculture.
II. F. (5) Legislation should be implemented that provides inheritance tax, real estate tax and estate tax relief for landowners and their heirs, who provide permanent conservation easements on their property.

**II. G. Urban**
II. G. (1) Old surface water management (SWM) systems built before current regulations will be retrofitted, using best available management practices, to meet current SWM standards.
II. G. (2) Permitting must address cumulative impacts to the water storage capacity of the watershed.
II. G. (3) Grants or incentives should be provided for retrofitting old surface water management systems that are not effectively managing water volume or flow, or removing nutrients and other pollutants.
II. G. (4) Proposals that reduce impacts to Estero Bay and its watershed, that might include: rural village concepts, urban infill, redevelopment sites, greenways; should be encouraged.

**II. H. Roadways**

II. H. (1) All future roadways to be located in the floodplain within the Estero Bay watershed will be designed and constructed to not impede flows from a 25-year, 3 day, storm event.

II. H. (2) Transportation planning shall be undertaken with goals of increasing public transportation and enhancing new and existing roads with walkable, bikeable passageways that are connected and landscaped.

## III. Water Courses

**III. A. Physiographic**

III. A. (1) Non-structural approaches versus structural approaches will be used for water resource management solutions.

III. A. (2) No further canalization or dredging of remaining natural watercourses will occur.

III. A. (3) A better balance of ecological needs versus water flow will be used for water resource management decisions.

III. A. (4) Establish and restore the historic basin flood plains to the maximum extent possible.

III. A. (5) The ancient relief of the upper tributary reaches will be maintained by: preserving vegetation that provide the characteristic riparian habitat and canopy, retaining the relic natural features of the tributary bank contours, and reconnecting historic natural flow ways that have been diverted or severed.

**III. B. Vegetation**

III. B. (1) Natural, native vegetation versus non-native invasive vegetation within flow ways and natural systems will be retained to the greatest extent possible.

III. B. (2) Physical removal of invasive vegetation versus widespread chemical treatment will be utilized for control.

III. B. (3) Limited application of herbicides that rapidly degrade may be used on a case-by-case basis, under the supervision of certified personnel, for control of nuisance and invasive nonnative vegetation and to maintain native plant communities.

III. B. (4) Promote, whenever possible, the active and aggressive removal of invasive non-native plants from all common areas, conservation easements, preserves and natural areas within the Estero Bay watershed.

**III. C. New Construction**

III. C (1) New setback criteria will be developed and implemented along watercourses to provide construction setbacks to the maximum extent possible. These setback criteria will be based on the best available scientific data.

III. C. (2) Construction within tributary flood plains shall be avoided wherever possible.

III. C. (3) For construction that must occur within flood plains, utilize techniques that do not adversely impact the capacity of the floodplain (e.g. pilings to raise living floor elevations versus fill).

III. C. (4) Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood) within flood plains.

**III. D. Hazardous Materials**

III. D. (1) Specifically placed larvicides and biological controls are the preferred methods for mosquito control. Adulticides should only be used in compliance with Section 388.011(1) Florida Statutes.

**III. E. Boating**
III. E. (1) No special accommodations will be made for boats (e.g. no cutting of over story vegetation, no removal of oxbows, no dredging or filling except for permitted maintenance of navigation channels).

## IV. Bay Waters

**IV. A. Water Quality**
IV. A. (1) Regulatory agencies will adopt requirements for "Best Management Practices." IV. A. (2) Operation of overloaded and outdated package wastewater treatment plants will be discontinued.
IV. A. (3) All urbanization will be served by centralized sewage systems.
IV. A. (4) There should be uniform application of water quality protection measures by regulatory agencies. A holistic management scheme should be implemented that takes into consideration ecological impacts of regulated activities.
IV. A. (5) Compliance and enforcement of existing regulations are needed to protect water quality and biological integrity.
IV. A. (6) There shall be no discharge of hazardous materials into Estero Bay.
IV. A. (7) Surface water management systems in new developments will be required to utilize state-of-the-art best management practices and increased BMP's.
IV. A. (8) Grants and other incentives for retrofitting old or ineffective storm water systems should be encouraged.
IV. A. (9) The State of Florida will actively investigate and prosecute water quality violators.
IV. A. (10) Retrofitting existing shorelines hardened with vertical seawalls to sloping lime rock revetments or native, salt tolerant vegetation, should be encouraged wherever possible.
IV. A. (11) Compliance and enforcement of existing environmental regulations will be a top priority for regulatory agencies.

**IV. B. Habitat Alteration**
IV. B. (1) No further alteration of Estero Bay bottom shall occur, except as proven necessary for the health, safety and welfare of the natural resources of Estero Bay and of the people in the watershed.

**IV. C. New Construction**
IV. C. (1) New construction projects should utilize best management practices to minimize negative impacts to the bay to the greatest extent possible; and in addition, the project as a whole, including mitigation, should be necessary to protect the public health, safety, or welfare, or the property of others, and should improve the current condition and relative value of functions being performed by the areas affected by the project.
IV.C.(2) Utilize non-polluting construction materials (e.g. concrete pilings versus treated wood).

**IV. D. Wildlife**
IV. D. (1) A manatee protection plan will be adopted to reduce the number of boat-related manatee mortalities and that respects the rights of other users of the bay; to achieve a sustainable manatee population (the goal of the Marine Mammal Protection Act); to protect manatee habitat; to promote boating safety; and to increase public awareness of the need to protect manatees and their environment.
IV. D. (2) Efforts by wildlife protection agencies will be accelerated to reduce other non-boat related manatee mortalities.
IV. D. (3) Maintain and improve the overall ecology of the bay and its watershed.
IV. D. (4) Wildlife resources such as rookeries, sea grass beds and fisheries are under increasing threat from human activity. Greater efforts are required by regulatory and other agencies and groups to insure the sustained productivity of these resources.

IV. D. (5) Additional manatee research funding should be provided.

**IV. E. Recreation**

IV. E. (1) Regulatory agencies and boaters will make special effort to maintain the bay as a major natural resource for fishing and appreciation of vegetation and wildlife.

IV. E. (2) Safe operation of vessels is mandatory.

IV. E. (3) Respect for wildlife, its habitat, and other bay users are particularly important in a crowded bay.

IV. E. (4) Use of non-motorized boats, such as kayaks and canoes, is encouraged and supported. (Estero Bay Agency on Bay Management 2002)


Bunche Beach

## Human History of Estero Bay

**Calusa Period**

As new archeological data are analyzed, the date of the first human habitation of Florida is pushed earlier and earlier. It is currently estimated that the first human habitation of Lower Charlotte Harbor and the Estero Bay region occurred approximately 10,000 years ago. These first inhabitants were nomadic people who used stone tools and hunted large mammals in the interior plains. Coastal villages developed as climate changed, sea levels rose and fishing skills increased. Farming, pottery skills, and trade with people outside of Florida developed between 3,000 and 500 years ago. Archeological records indicate that copper, iron ore and maize seeds were prized imports, while pearls, shells, and fish bones were the primary exports. During this period, mound building began and ceramic pottery was used to store goods. There is debate over whether the Estero Bay area was more dominated by the Mississippian culture or by contacts with Central and South American civilizations, with which contact existed through marine trade.

The Calusa Period spanned from 4,000 BC to 1710 AD. The Estero Bay and the Lower Charlotte Harbor area was the center of the Kingdom of the Calusa. It is thought that this tribe came from Caribbean islands. The Calusas fished the Gulf of Mexico, established settlements near fresh water tributaries, and paddled cypress canoes to colonies in other areas. Archeologists believe nearby Mound Key in Estero Bay may have been the tribe's regional center. The 125-acre island is approximately 33 feet high and covered with massive middens - refuse heaps composed of discarded shells. As had other Indian civilizations living on the Gulf of Mexico, the Calusa built large structural mounds from mollusk shells on which important buildings were constructed. Structures on the mounds ranged from the residence of the Chief to temple-like buildings. The Calusa built small canals that served as access to Lake Okeechobee and the Kissimmee River from the Caloosahatchee.

The Calusa tribal area covered most of southwest Florida and parts of southeast Florida. Population estimates vary, but the natural ecology may have maintained a native Calusa population of up to 40,000 at the time of Columbus. A population of this size was not again achieved for the same area until after World War I.

**Spanish Exploration Period**

The first documented Europeans to visit southwest Florida were members of the Juan Ponce de León expedition. In 1493 Juan Ponce de León sailed with Columbus on his second voyage to the Americas. He landed at St. Augustine in late March of 1513, after looking for gold and the Fountain of Youth in the Bahamas and Bimini. He named the place La Florida. It was during the final phase of his first voyage that Ponce de León led the first documented Spanish landing party ashore near Lovers Key on June 4, 1513 and first encountered the Calusa Indians. As Ponce de León and his men explored inland for wood and fresh water, they saw the Calusa tribal village at Mound Key. They encountered the Calusa and discovered that they were an unfriendly tribe. The explorers fled back to their ships and decided to leave the area, sailing back to Puerto Rico.
In 1521, Ponce de León returned to the Southwest coast of Florida to colonize. He landed on the gulf beaches near Lovers Key in Estero Bay with over 200 settlers, 50 horses, numerous beasts of burden, tools, and seeds. The plan was to set up a farming colony. As they went inland for fresh water, the Calusa ambushed

them.  Ponce de León was shot in the thigh by an arrow and was seriously wounded.  The settlers decided to abandon the settlement and sail back to Cuba. As a result of his wound, Ponce de León died at the age of 61 in Cuba.

Throughout the 1500s, other Spanish explorers and enterprising pirates sailed southwest Florida's coastal waters. Treasure-laden galleons from Mexico and Central America sailed past Estero Bay. Map-makers named the bay "Estero," the Spanish word for estuary.

A tenuous alliance was later formed between the Calusa and the Spanish in 1567.  Mound Key was also the site of the first Jesuit mission in North America.  However, the Spanish did not want to help the Calusa against their enemy the Tocobaga and the Calusa were disinterested in Christianity, so the alliance dissolved.  Other Spaniards followed, and the Calusa were eventually conquered—but by disease, not warfare. Although the Calusa eventually died out in Florida due principally to the introduction of common European illnesses such as smallpox and influenza for which they had no natural immunities, they succeeded in keeping their would-be Spanish conquerors at bay for over a 250-year period.  The last known documented Calusa in southwest Florida died in the late 1700s.  Slavery, indenture, or conversion led to the transfer of the majority of the last remnants of the tribe by the 1800's remaining population to Cuba and other Caribbean lands where descendants can be found today.

**Cuban Period**

The Cuban Period spanned from 1710 to 1836. Southern Florida became lightly repopulated through migration of the southern Creek Indians from Alabama and Georgia, who likely intermarried or absorbed very small numbers of remnant native peoples, and became known as Seminoles. The name Seminole is from the Creek word 'semino le', interpreted to translate as 'runaway.'  Another, better description of the meaning can be "emigrants who left the main body and settled elsewhere." The term was first applied to the tribe about 1778.

Southwest Florida, while it remained under Spanish control, was not a center for major settlement.  Fishing camps were established by people of direct Spanish and Cuban descent who harvested the bounty of the estuary and brought salted and smoked fish to the urban centers of Cuba and the Spanish Caribbean.  Beyond fishing camps, the interior was visited only for hunting trips. Here the Cubans made contact with the Seminoles.  The Cuban populations did not desire to settle in the interior of southwest Florida so conflict with the Seminoles was minimal.

The settlement history of southwest Florida by Americans was driven by military decisions associated with the series of Seminole Wars generated by the southward movement of American settlers from Georgia and elsewhere in the southeastern United States immigrating into Florida even when it was still a Spanish possession.  There were three Seminole Wars in Florida; the first Seminole War started in 1817 and shortly thereafter Spain ceded Florida to the United States. The series of wars, ending finally in 1858, led to the Seminoles moving further southward and residing in southwestern Florida, including family groups in the Estero basin.

**American Period**

The American Period spans from 1817, when Florida became a territory of the United States, to the present. The Treaty of Camp Moultrie was signed in 1823, legally establishing large parts of Lower Charlotte Harbor south of the Peace River as the promised Seminole territory. By 1840, the Lower Charlotte Harbor area had several forts: Fort Dulany, Fort Denaud, Fort Adams, and Fort Thompson. The last Seminole War ended in 1842 with an agreement that the Seminoles could remain in Florida but were forced further south into the Big Cypress Swamp and the Everglades.

By the mid 1800s, settler families headed south, settling on the high ground created by the Calusas and scrub lands along rivers. Estero's first American homesteader arrived in 1882. He was followed by others who farmed citrus along the river, ranched cattle and commercial fished and then used the waterway to ship harvests north via the Gulf. Frank Johnson, one of Lee County's early pioneers, settled on Mound Key and began excavating the historic site, gathering Calusa artifacts and gold and items left behind by the Spanish and Cubans.

The early settlements in the Estero Bay watershed of town size all occurred after the Civil War and were isolated pods created by land-hungry pioneers, or by visionaries in pursuit of dreams. Through the late 19$^{th}$ and early 20$^{th}$ centuries, the Estero Bay towns and area depended principally upon agriculture (citrus and cattle), commercial fishing, recreational fishing and tourism. Estero River Groves was renowned for its wonderful citrus.

Bonita Springs' history begins in 1888 when Alabama cotton farmer B.B. Coomer moved there and purchased 6,000 acres to start a plantation of pineapples, coconut and bananas. Coomer subsequently saw his entire crop wiped out by a freeze in 1893.

Estero was established and incorporated by the followers of Dr. Cyrus Teed, who proposed a theory that we live on the inside of the Earth's outer skin, and that celestial bodies are all contained inside the hollow Earth. This theory, which he called Koreshan Unity, drew followers to purchase and occupy a 320-acre tract in 1894. They were business-oriented and lived communally, prospering enough to found its own political party ("The Progressive Liberty Party") and be considered among San Carlos Island's first developers. In 1904, the Koreshans, a celibate Utopian society, built a post office at their settlement and Estero officially became a town. But three years later, other local citizens protested the incorporation, the neophyte city was dissolved and once again part of unincorporated Lee County.

As coastal settlements were few and far between south of San Carlos Bay, there was no incentive for the federal government to conduct bathymetric surveys and compile charts. Eventually, when the US Army Corps of Engineers (USACOE) surveyed Estero Bay in 1908, they could not locate an inland water route from Matanzas Pass to Naples, even though the Coast Survey chart seemed to indicate an interior waterway as far south as Clam Pass. At the time, there were three very small gasoline freight launches running between Ft. Myers and the Estero River, one twice weekly and two three-times weekly. Also, a mail steamer provided service from Ft. Myers to Carlos. As many as 36 fishing shacks were counted on the bay during the fishing season, when one carload of fish could be taken every two days to Punta Gorda for shipment by railroad. The USACOE recommended dredging a 5-foot-deep by 60-foot-wide channel from the mouth of Matanzas Pass to Surveyor's Creek (Imperial River) in 1908. This proposed project was not implemented.

By the 1920 Census, Bonita Springs and Estero were named and settled farming and fishing villages, as was Bayview (a.k.a. Crescent Beach or Estero Island, now as the Town of Fort Myers Beach). The creation of the Tamiami Trail in the late 1920s opened up most of the Estero Bay coastal watershed, becoming motor court and trailer park destinations, and the construction of a toll bridge to Estero Island (54 cents in 1921) inspired further development of the island. The coastal component of the basin endured the same boom and bust phenomenon Florida had during the 1920s, with its own promoters engaged in the same land sales schemes depicted by the Marx Brothers in the movie *Coconuts.*

Development has changed the historic boundaries and extent of the Estero Bay watershed. The boundaries were increased when 10-Mile Canal was dredged in the 1920's thereby connecting areas that formerly flowed north to the Caloosahatchee. The dredging began as a source of fill to create a dike to prevent parts of Fort Myers from flooding with seasonal sheetflow from undeveloped lands to the east of the city boundary. The boundaries were also reduced by drainage projects associated with the development of Lehigh Acres.

World War II brought the area out of the Depression, and Fort Myers Beach was used as a rest and recreation site for trainees at the military bases, Page Field and Buckingham Field, only briefly discomfited by the 1944 hurricane.

Estero remained a quiet, sleepy citrus and fishing community for the next 50 to 60 years, harboring small retirement communities and mobile home parks. Estero River Heights, the area's first major development, was built along the river during the late 1960s; today, the neighborhood is filled with mature landscaping and trees, and renovated homes.

A set of technological innovations associated with working in the tropics developed by the U.S. military during World War II including air-conditioning, chemical mosquito control, quick land clearing and wetland filling, and the interstate highway system opened up southwest Florida to easier habitation by visitors and immigrants from the midwest and northeast. Following World War II, many of the servicemen who had trained on bases in southwest Florida and had experienced the region's environment either immediately returned to the area with their families after the war or, after working in other areas of the country, began retiring to this area. This trend created a one-way population influx beginning in the 1960s and 1970s. This population increase caused areas in the western corridor of the Estero Bay watershed, including San Carlos Park, Estero, San Carlos Estates, Estero Bay Shores, Spring Creek Village, Bonita Springs, and Bonita Beach to expand. Agricultural subsequently moved eastward to less expensive lands converted from former native range.

This post World War II boom came to the Estero Watershed later than other parts of the west coast of Florida, but ultimately with similar results. Large amounts of land were committed to residential urban/suburban purposes without commitments to urban services and infrastructure, viable higher income employment for the working age population, a functional transportation network. The new developments either grew around or bypassed the older villages, creating new named communities from raw land, and increasing the density and intensity of development within the watershed. Fort Myers Beach and Bonita Beach went condo and high rise. San Carlos Island and San Carlos Park became intensely developed.

The first attempt to incorporate Fort Myers Beach occurred in the mid 1940's and failed by a margin of six or seven votes. A second try in the late 40's lost by a larger number, and an attempt in November, 1953 was a total failure.

In 1955, private developer Walter Mack, with contributions from the Bonita (town) Chamber of Commerce, dredged a channel, 4-feet-deep by 50-feet-wide, from Big Hickory Pass south to the Cocohatchee, thereby providing boat access between Estero Bay and Wiggins Pass.

The Matanzas Harbor became a reliably accessible fishing port after maintenance dredging of Matanzas Pass. Reflecting this use, 1956 records listed 280 shrimp boats using the facilities at Fort Myers Beach. That year shrimp boats delivered 3,800 tons of shrimp. By 1960, waterborne commerce consisted principally of diesel fuel, fish, shrimp and ice, with tanker barges delivering the fuel. The commercial facilities - included two shrimp and several fish packinghouses, fuel and ice distribution points, and two marine railways. Much of the land development - construction of an ice plant and diesel fuel terminal - were for the support of the shrimp and fishing activity. The local fleet required a supply of fuel and ice in order to operate. From 1963 to 1966, the shrimp harvest increased from 1,294 to 1,713 short tons. The need for vessel facilities was strong during this period, enabling the justification for a channel extension that created a 5-foot-deep by 60-foot-wide channel from the mouth of Matanzas Pass to the Imperial River and improved the Matanzas Pass Channel from the Gulf to a turning basin off San Carlos Island. Prospects for continued commercial growth were good.

In 1958 Barry C. Williams and Investors purchased 5,500 acres along the northern and eastern coast of Estero Bay for $1.6 million. Robert Troutman, an Atlanta attorney representing investors, drew up a plan to expand a seawall deep into Estero Bay along 18 miles of this coastline. The seawall, called a bulkhead, would straighten out the jagged coastline by using 17 million cubic yards of fill. Along the way it would swallow up submerged lands and islands, creating 1,100 upland acres that previously were under water. For fill, Troutman proposed dredging a 12-foot channel through the seagrass beds around his bulkhead. The same technique had been employed along the east coast and in areas to the north, such as Tampa, St. Petersburg and Sarasota.

Determined to keep Estero Bay from the loss of habitat and degraded water quality when developers removed the mangroves and seagrass beds that served as a nursery for fish, shrimp, mammals and birds, local residents and fishermen formed the Lee County Conservation Association. At one point during the mid-1960s, it’s estimated that about 50 percent of the registered voters in Lee County belonged to the association.

The members of the association wrote letters, engaged politicians and used their voting bloc to change leadership in Lee County. They argued that submerged lands belonged to the state and tried to create the Estero Bay State Park. Florida law clearly states that any land above the high tide mark can be owned privately but property below it belongs to the state. Their efforts led to the creation of the Estero Bay Aquatic Preserve which was the first aquatic preserve designated under Florida Statutes, in 1966, and today the Department of Environmental Protection, Office of Coastal and Aquatic Managed Areas (CAMA) manages the aquatic preserves. The state eventually would use the preserve as a model to create 41 others along Florida's coastal waters.

The 10-Mile Canal was extended in the 1970s, dredging through uplands and wetlands and blasting through rock to connect it to Mullock Creek, cutting off the connection of the Six-Mile Cypress Slough to the headwaters of Hendry Creek.

From 1973 to 1976, a group of Lee County students from each of the high schools studying the role of forested wetlands in Florida's ecology became alarmed at how fast these environmental treasures were disappearing to private interests. The students, known as "the Monday Group," envisioned a place where visitors could stroll among majestic cypress trees and catch the whisper of Florida's primordial past. In such pristine surroundings, they hoped that people could begin to learn how wetlands provide priceless but often hidden benefits, such as water purification and storage, natural flood control and wildlife habitat. Knowing that Six Mile Cypress Slough was under imminent threat from logging and the channeling, the Monday Group launched a daring campaign to save the area for future generations. Lee County voters responded overwhelmingly by referendum to increase their own taxes to purchase and convert the Slough into a preserve.

Beginning in 1974, Regional Planning Councils were charged with coordination of the review of any large-scale development project which, because of its character, magnitude, or location, could have a substantial effect upon the health, safety, or welfare of the citizens of more than one county. Such a project, known as a Development of Regional Impact (DRI) is typically complex and requires input from many reviewing agencies. Demand for the southwest Florida lifestyle, the livability of the environment, the increased use of air conditioning and the control of mosquitoes, which in a large part has been due to the ongoing development, kept the land use conversions growing.

In the mid 1980s, the growth-impacted counties containing the Estero Bay basin amended their comprehensive plans in an attempt to control the location and intensity of urban land use changes. The comprehensive plans attempted to contain the urban growth to the western portion of the basin (located near US 41 and the railroads) while protecting the major wetlands systems existing in the eastern part of the basin and the state buffer preserves surrounding the Bay. The result was that, south of State Road 82 and east of 1-75, the greater part of the wetland system that was present in 1900 is now mostly identified as Density Reduction/ Groundwater Recharge (DR/GR). For a time it looked as though this area would be protected through a combination of regulations by the United States Army Corps of Engineers (USACOE), State of Florida, the South Florida Water Management District (SFWMD), and county regulations. State wetland regulations and Federal wetland permitting practices have allowed the reduction of wetland protection (Beever 2007).

Spanish Wells was Bonita Springs' first gated community, founded in 1979, and within 20 years, many upscale gated communities followed, including Bonita Bay, Pelican Landing, Worthington and Hunter's Ridge**.**

In 1980, the Coast Guard established a search and rescue station on San Carlos Island at Matanzas Pass, which is reportedly the fourth busiest station in the United States. The station handles over 600 search and rescue missions a year including Cuban refugees' interdiction and drug enforcement duty. The Coast Guard station covers a coastline of about 60 miles from Sarasota Beach to Cape Romano.

Southwest Florida Regional Airport (RSW) opened on May 14, 1983.The original terminal was located off of Daniels Parkway. On May 14, 1993, ten years after opening, the airport was renamed Southwest Florida International Airport. Southwest Florida International Airport's new terminal, accessed from Ben Hill Griffin Parkway, opened in 2005 to accommodate record numbers of travelers. It is one of the newest terminals in the nation and was the largest public works project in Lee County history. A recent economic impact study showed the airport's annual contribution to the region's economy is$3.6 billion. Southwest Florida International Airport served over 8 million passengers in 2007 and is one of the top 50 busiest airports in the nation.

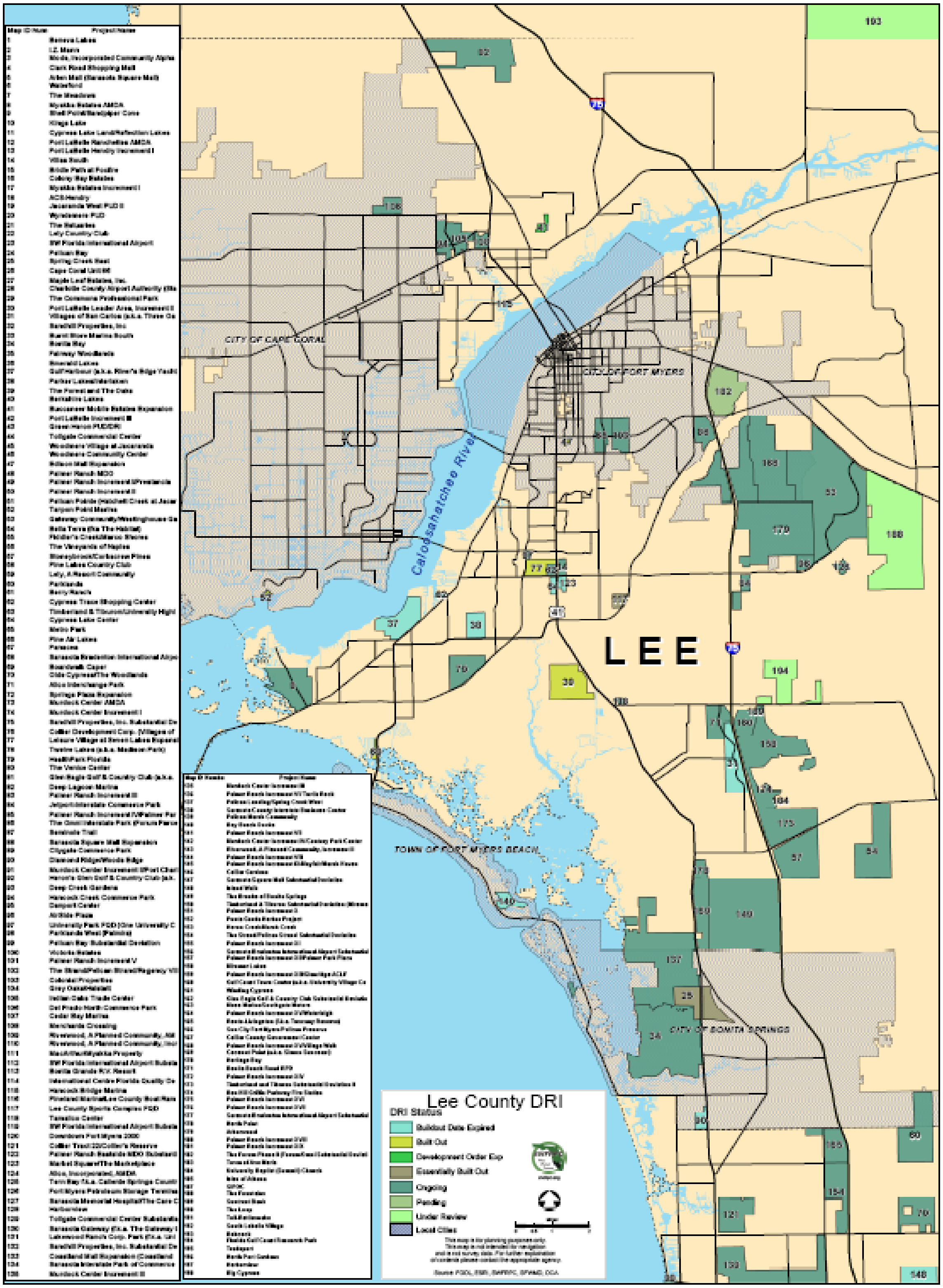
The 7,000-acre Mitigation Park, located four miles southeast of Southwest Florida International Airport, was established to compensate for the impact of long-term development and expansion of the airport. The lands are among the most pristine and environmentally sensitive in the region. Site surveys resulted in identifying eight plant and eleven wildlife species listed as protected by State and Federal agencies. The site includes the Imperial Marsh, the largest freshwater marsh in Lee County, and extends from the headwaters of the Imperial and Estero river watersheds through the Flint Pen Strand, ultimately connecting to the Estero Bay. The Port Authority has been recognized and has won several industry environmental awards for this project. The total budget for the project was $30 million, which included land acquisition and restoration costs. The Lee County Port Authority maintains this property for approximately $500,000 per year. No ad valorem (property) taxes are used for airport operation or construction. Although it is called a park, this mitigation land is not a public area.

The siting of Florida Gulf Coast University, Florida's newest higher education facility, in the DR/GR, led to serious opposition, because of the possible threat to Lee County's domestic water supply, wildlife habitats, wetlands, and the cost of the infrastructure for such an inaccessible site. The formation of the Estero Bay Agency for Bay Management in 1995 was a direct result of the settlement agreement to address that opposition. Within the first two years after the FGCU founding much residential and commercial development was approved for the area, including three Developments of Regional Impact (DRIs). The Southwest Florida International Airport reconfigured and expanded, and Lee County's largest. The Lee County Metropolitan Planning Organization (MPO) has also considered the possibility of new roads bisecting the area in several directions.

In 1997, Southwest Florida's only four-year university, Florida Gulf Coast University, opened in the middle of the watershed east of Estero and I -75. Then, as predicted, Germain Arena and Miromar Outlets opened in Estero in 1998, and growth exploded both east of Interstate 75 extending to the Collier County Line along Bonita Beach Road, and into the areas flanking US 41, Ben Hill Griffin Parkway and Three Oaks Parkway. The most dramatic of these changes in the land uses is the reduction in wetlands, the increases and then the decreases in agricultural areas, and the continued increasing of urbanization in a six- to eight-mile wide corridor between the Bay on the west and 1-75 to the east.

In 1997 the voters of Lee County demonstrated their concern for preservation by voting for Conservation 2020, a plan for citizens to tax themselves in order to set up a fund for purchase of sensitive lands from willing sellers.

According to the 2000 census, the Estero Bay basin population totaled nearly 145,000 people.



## Water Quality

### 2008 Water Quality Status

| | Chlorophyll-a | Copper | DO | Fecal Coliform | Total Nitrogen | Total Phosphorus | Turbidity | Total Met |
|---|---|---|---|---|---|---|---|---|
| **Estuarine** | | | | | | | | |
| Estero Bay | | | | | | | | **7** |
| Mullock Creek | | | | | | | | **7** |
| Hendry Creek | | | V | V | | | | **5** |
| Estero River | | | V | V | | | | **5** |
| Spring Creek | | | | | | | | **5** |
| Imperial River | | | V | V | | | | **5** |
| **Fresh** | | | | | | | | |
| Mullock Creek | | | V | V | | | | **5** |
| 10-Mile Canal | | | V | | | | | **6** |
| Hendry Creek | | | V | | | | | **6** |
| Spring Creek | | | | | | | | **6** |
| Imperial River | V | | V | V | | | | **4** |
| **Total Met** | **11** | **11** | **6** | **4** | **11** | **11** | **11** | |

| | |
|---|---|
| | Water Quality Standard not met for average in 2008 |
| V | On the FDEP Verified List for Water Quality Impairments |

(Florida Department of Environmental Protection 2009; Lee County Environmental Lab 2009)

In the past, the state of Florida has not provided quantitative standards for nutrients such as nitrogen and phosphorus. These nutrients are often cited as the cause of low dissolved oxygen levels, a factor in the health of fish and wildlife resources in the Estero Bay watershed. However, on January 14, 2009, the US Environmental Protection Agency (USEPA) issued a determination letter requiring the state to determine and adopt numeric nutrient standards for nitrogen and phosphorus in water bodies. At the time of this report, this effort was ongoing.

## Comparison of Water Quality Standards

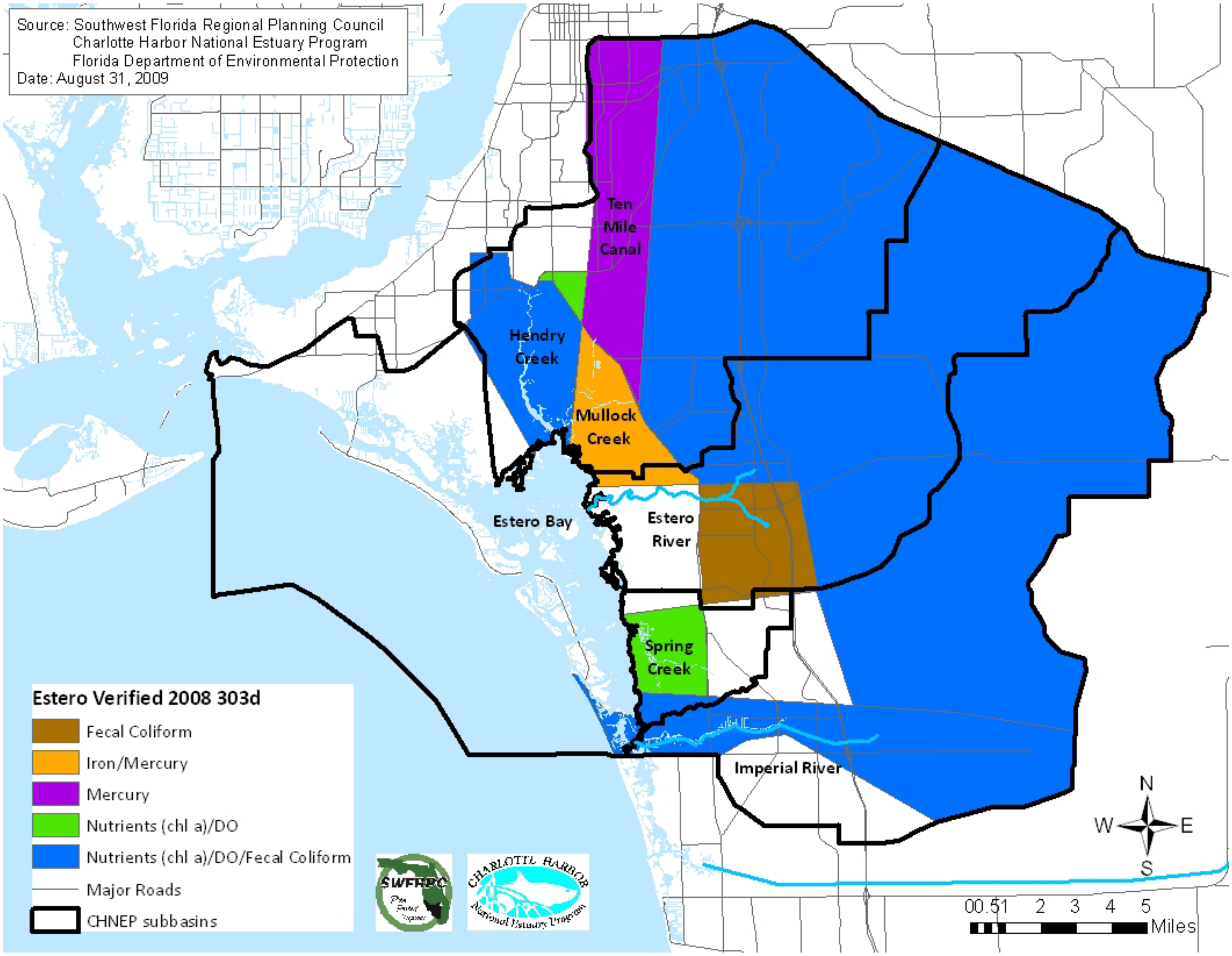
Some water quality standards have changed since the last State of the Bay Update in 2004. Below is a comparison of past and present standards, as well as state and federal standards. In many cases, standards have become more stringent; however, state standards continue to be less stringent than federal standards. It should be noted that chlorophyll-a does not have a state standard, but continues to be defined as an impairment at certain levels.

| **Parameter** | **State Standards** | | **EPA** | |
|---|---|---|---|---|
| | **2004** | **2009** | **2004** | **2009** |
| Chlorophyll-a | 11 mg/mL3 estuarine | 11 mg/mL3 estuarine | 0.4 ug/L rivers/streams | 0.4 ug/L rivers/streams |
| | 20 mg/mL3 streams | 20 mg/mL3 streams | | |
| Copper | 3.7 mg/mL3 marine | 3.7 ug/L estuarine | 0.125 mg/L estuarine | 3.1 ug/L estuarine |
| | 3.7 mg/mL3 fresh | | 0.125 mg/L fresh | 9.0 ug/L fresh |
| Dissolved oxygen | 4.0 mg/L estuarine | 5.0 mg/L estuarine | 5.0 mg/L estuarine | 5.0 mg/L estuarine |
| | 4.0 mg/L fresh | 5.0 mg/L fresh | 5.0 mg/L fresh | 5.0 mg/L fresh |
| Fecal coliform | 200 count/100 mL estuarine (2004 SOB) *400 count/100 mL (Impaired Waters Rule in 2002)* | 200 count/100 mL | | |
| | 200 count/100 mL estuarine (2004 SOB) 400 count/100 mL (Impaired Waters Rule in 2002) | 200 count/100 mL | | |
| Total nitrogen | Narrative | In development | 0.7-3.5 mg/L estuarine = caution >3.5 mg/L = impaired (2004 SOB) *0.9 mg/L (Summary Table for Nutrient Criteria in 2002)* | 0.9 mg/L |
| Total phosphorus | Narrative | In development | 0.1-0.5 mg/L estuarine = caution >0.5 = impaired (2004 SOB) *40 ug/L (Summary Table in 2002)* | 40 ug/L |
| Turbidity | No mention | No mention | 25-100 NTU estuarine = caution >100 = impaired (*Summary Table in 2002*) | 1.9 NTU rivers/streams |

Note: mg/mL3 = ug/L (micrograms/Liter)

62-302 = Surface Water Quality Standards (FDEP 2008)
62-303 = Impaired Waters Rule (FDEP 2002)
Summary Table for Nutrient Criteria (USEPA 2002)
Gold Book (USEPA 1986)
National Recommended Water Quality Criteria (USEPA 2009)

## Impaired Waters




The Florida Department of Environmental Protection establishes a list of water quality impairments. The map above illustrates the locations of these impairments in the Estero Bay watershed and surroundings. The verified list does not conform entirely to the 2008 water quality assessment above. As is evident from the following data, water quality varies each year. The 2008 assessment provides a snapshot in time, whereas the FDEP information shown above illustrates areas of chronic water quality problems.

### Parameter: Chlorophyll-a

Chlorophyll-a is a measure of phytoplankton activity in the water column based on the primary photosynthetic pigment of green and other algae. It is a resultant parameter that synthesizes many environmental factors including nutrients, temperature, salinity, trace elements, toxics, tides and relative dilution, including water flows. It is proposed as a presumptive measure of estuarine health for the purpose of determining impaired waters. According the Florida Impaired Waters Rule (62-303), an annual average measurement greater than 11 $mg/m^3$ in estuarine conditions is considered impaired. An annual average exceeding 20 $mg/m^3$ in freshwater streams is considered impaired. There is state no water quality standard for chlorophyll-a at this writing.

The Lee County Environmental Laboratory provided the data for all chlorophyll-a analysis.

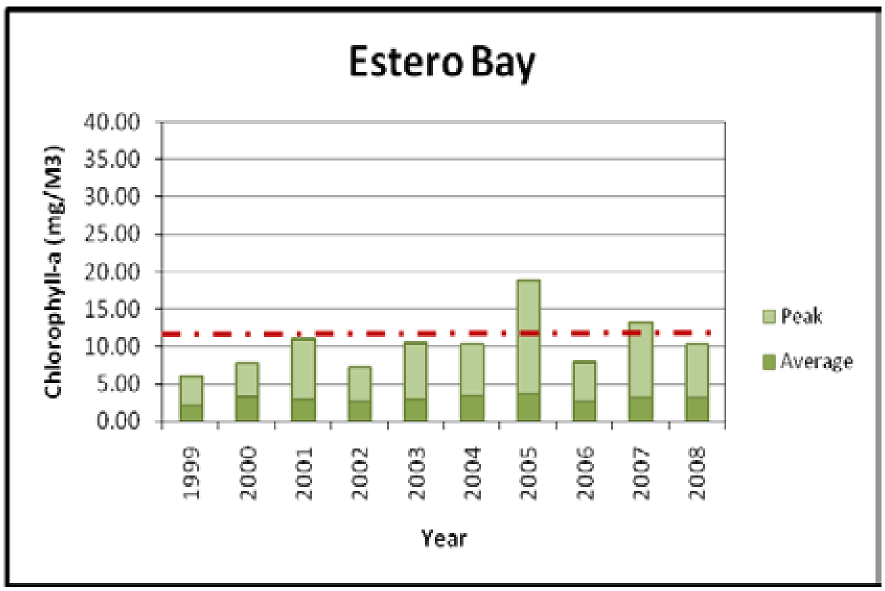
**Chlorophyll-a in Estuarine Systems**

**2006-2008 change**

average +20%

peak +30%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.72 | 7.95 | April |
| **2007** | 3.16 | 13.35 | August |
| **2008** | 3.26 | 10.35 | September |

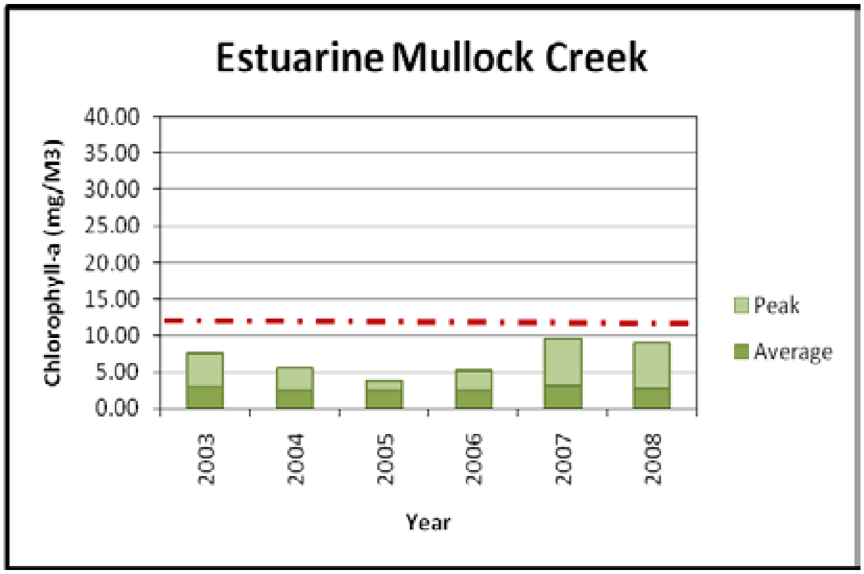


**2006-2008 change**

average +13%

peak +72%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.58 | 5.25 | March |
| **2007** | 3.24 | 9.65 | July |
| **2008** | 2.92 | 9.05 | June |

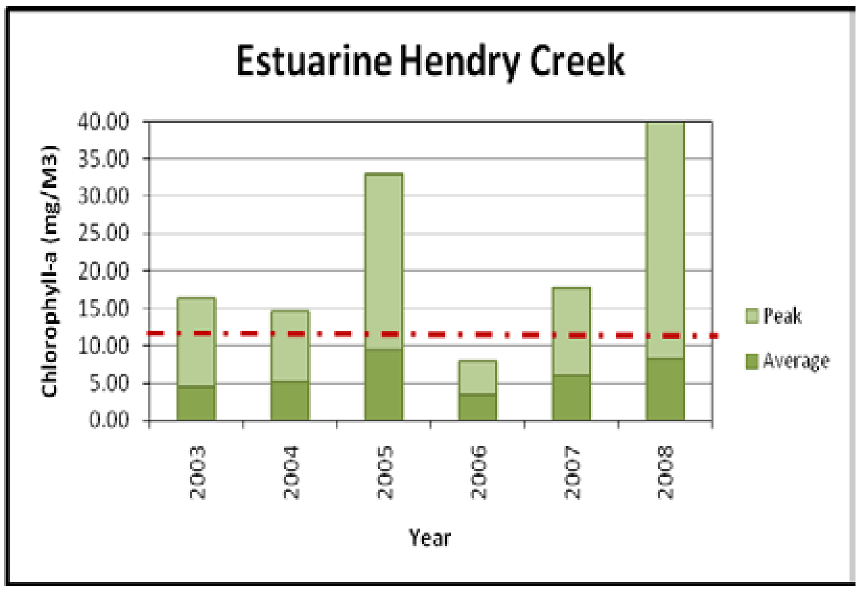



**2006-2008 change**

average +139%

peak +1282%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 3.49 | 8.00 | April |
| **2007** | 6.02 | 17.75 | July |
| **2008** | 8.36 | 110.53 | February |

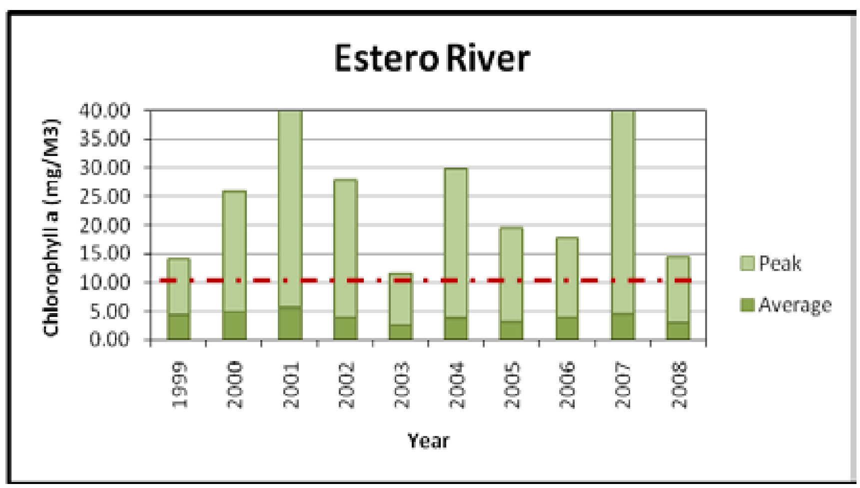



**2006-2008 Change**

average -25%

peak -18%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 4.06 | 17.75 | February |
| **2007** | 4.64 | 74.25 | June |
| **2008** | 3.05 | 14.48 | April |

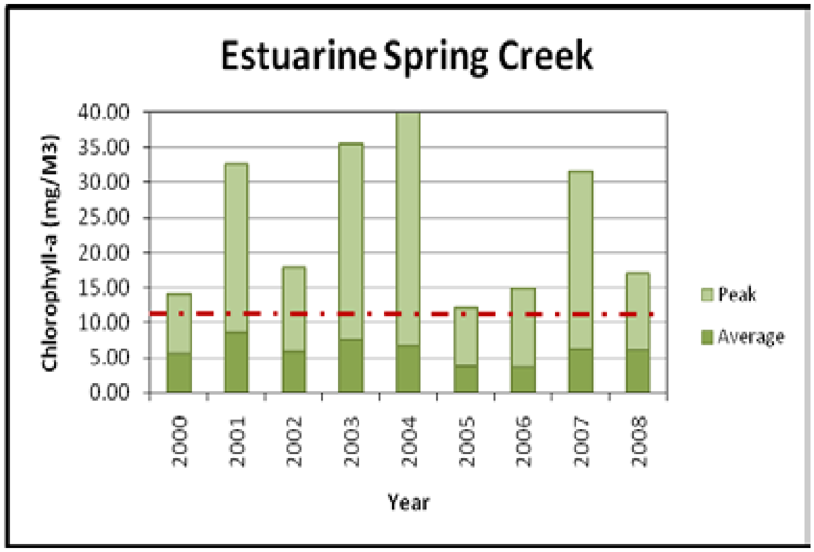


**2006-2008 change**

average +67%

peak +14%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 3.68 | 15.00 | December |
| **2007** | 6.34 | 31.70 | July |
| **2008** | 6.14 | 17.10 | April |

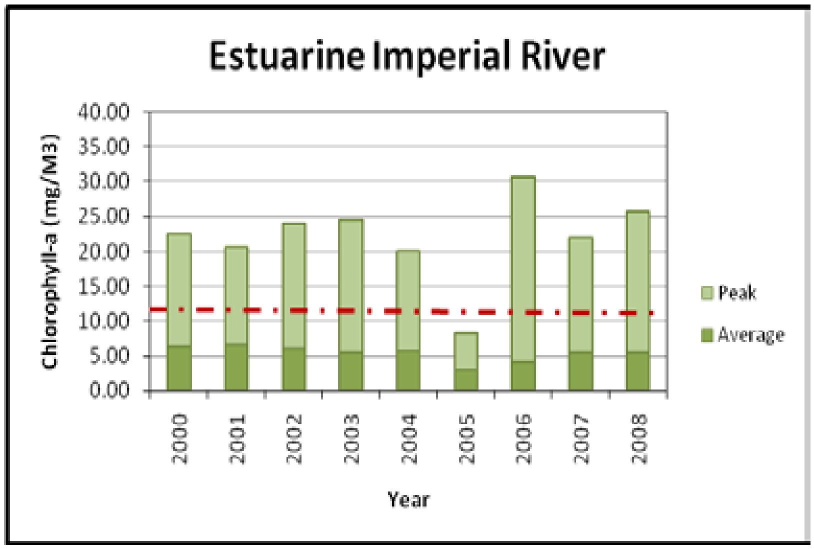


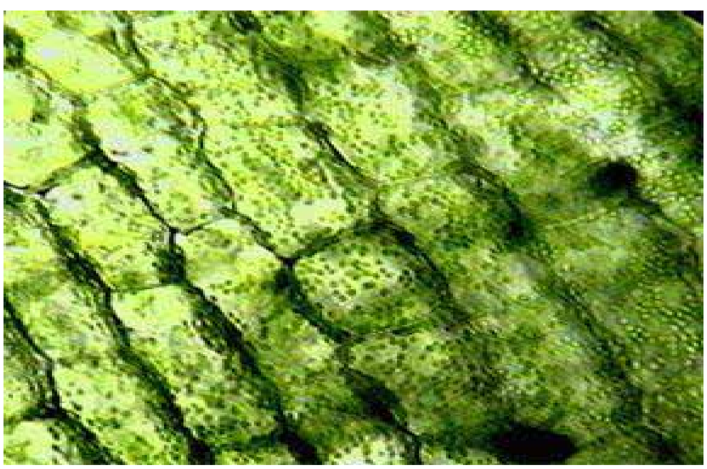

**2006-2008 change**

average +34%

peak -16%

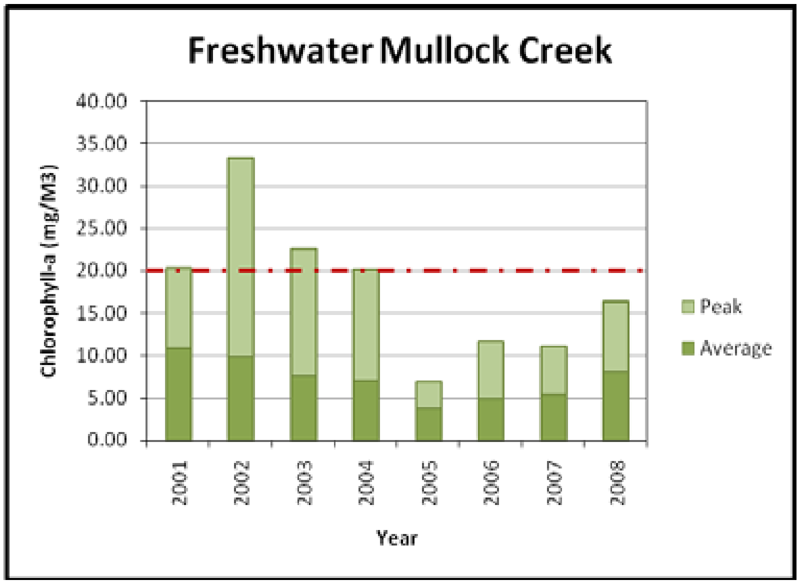
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 4.18 | 30.70 | March |
| **2007** | 5.60 | 21.98 | June |
| **2008** | 5.62 | 25.78 | December |



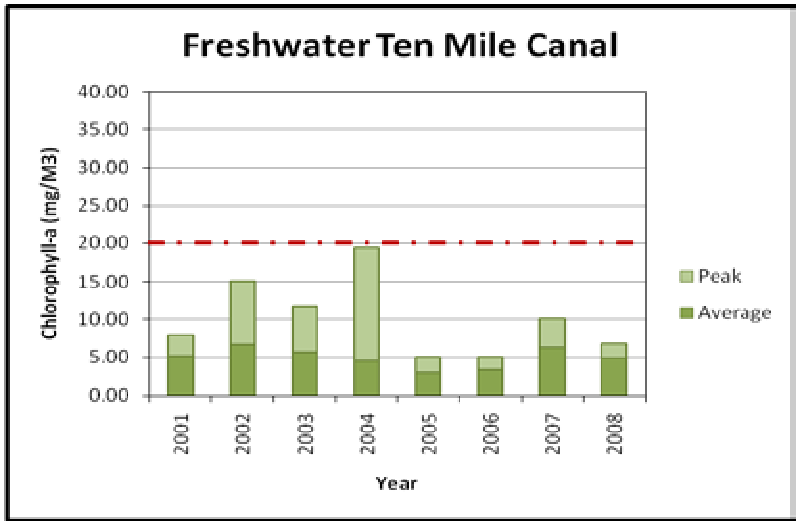
**2006-2008 change**
average +65%
peak +17%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 4.92 | 43.35 | December (05) |
| 2007 | 5.35 | 39.15 | April |
| 2008 | 8.11 | 50.53 | September (07) |



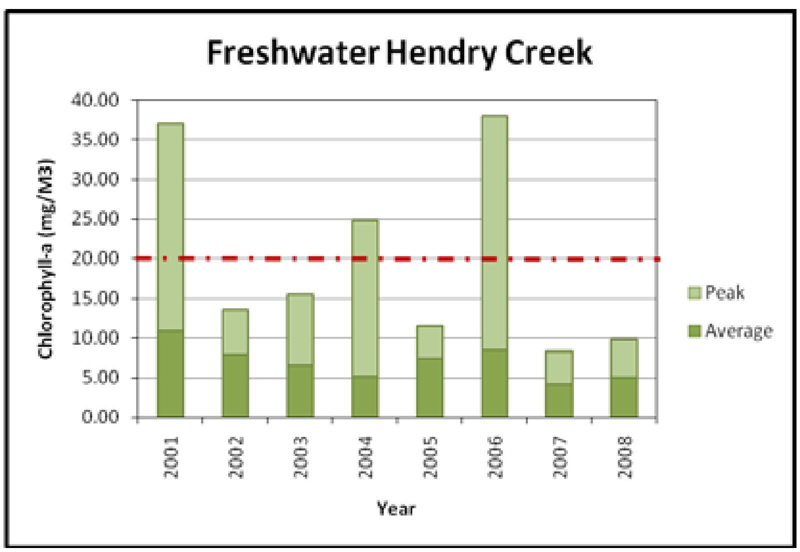

**2006-2008 change**
average +43%
peak +18%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 3.46 | 15.43 | March |
| 2007 | 6.29 | 51.58 | April |
| 2008 | 4.93 | 18.20 | January |



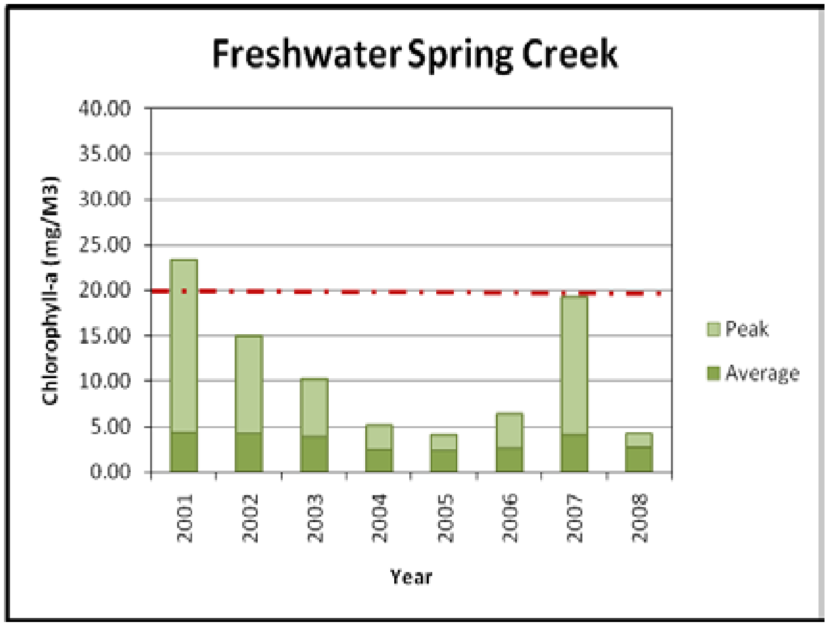

**2006-2008 change**
average -41%
peak -82%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 8.52 | 68.40 | October (05) |
| 2007 | 4.08 | 14.68 | April |
| 2008 | 5.06 | 12.40 | February |



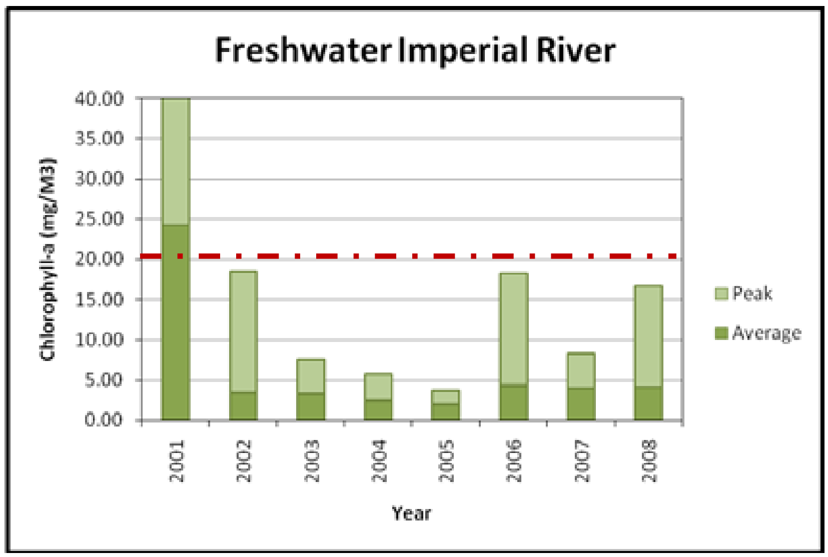
**2006-2008 change**
average 4%
peak -33%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.58 | 6.40 | June |
| **2007** | 4.19 | 19.35 | June |
| **2008** | 2.70 | 4.30 | February |




**2006-2008 change**
average -3%
peak -36%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 4.24 | 50.85 | October (05) |
| **2007** | 3.99 | 14.88 | July |
| **2008** | 4.10 | 32.40 | February |




## Parameter: Copper

Copper (Cu) is a measure of all dissolved copper in the water column, including hexavalent, bivalent, and trivalent ions. It is a resultant parameter that synthesizes many environmental inputs of copper including: dissolved copper from roadways; antifouling paints for marine applications; treated wood, such as pilings; aquatic algaecides and lake treatments; architectural sources; marine cathodes; human debris; and natural sources.

In December 2008, the City of Naples, just outside the Estero Bay watershed, enacted a ban on copper-containing herbicides commonly used in city lakes for control of aquatic plants. The ordinance states that, "…amending the existing Code to prohibit the use of copper sulfate or any other copper-containing herbicide in City lakes is likely to provide enhanced environmental protection to Naples Bay, decrease the amount of copper entering the City's lakes and natural waterways, including Naples Bay, thus improving water quality…" (City of Naples 2008). At the time of this writing, the Florida Department of Agriculture and Consumer Services has restricted the City of Naples from enforcing this ban.

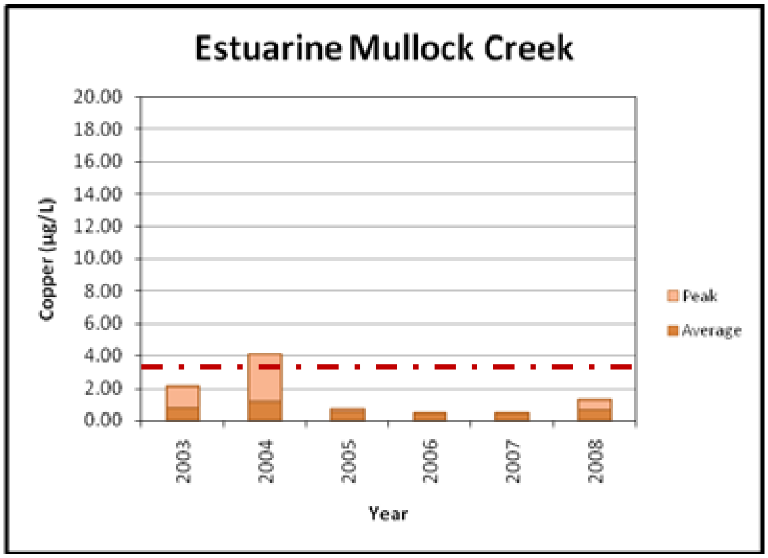
According to USEPA National Recommended Water Quality Criteria, the "Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect" (US Environmental Protection Agency 2009). For copper in marine or estuarine systems, the CCC is 3.1 µg/L and in freshwater systems, the CCC is 9.0 µg/L. This appears to be a tightening of the federal standards. The general state standard for copper is 3.7 µg/L in Class III marine and Class II fresh waters.

The Lee County Environmental Laboratory provided the data for all copper analysis.


Copper sulfate

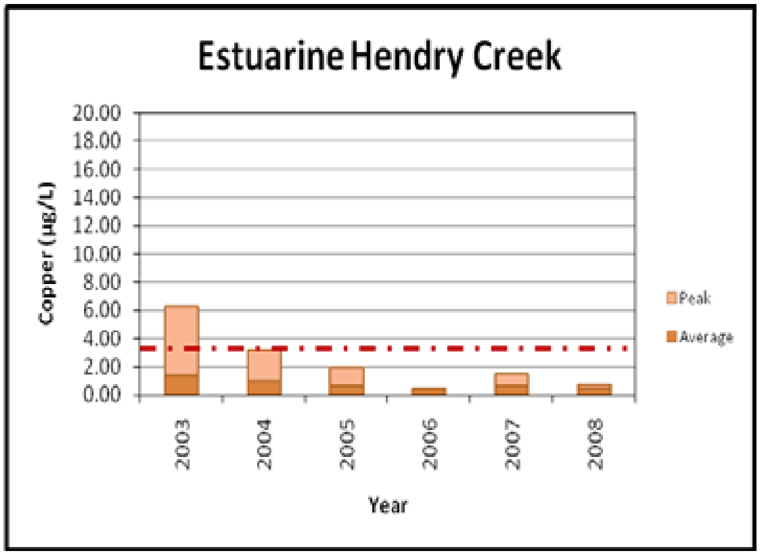
**2006-2008 change**
average +32%
peak +308%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.50 | 0.50 | |
| **2008** | 0.66 | 2.04 | September |



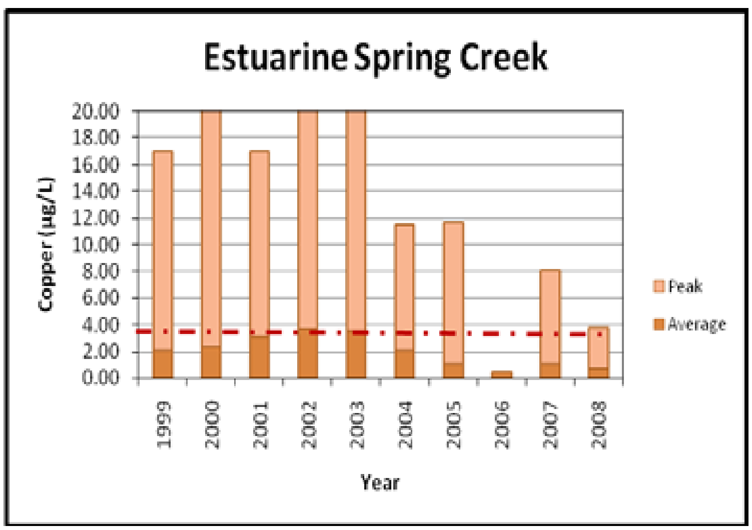

**2006-2008 change**
average -49%
peak -92%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.68 | 3.60 | September |
| **2008** | 0.53 | 1.25 | September |




**2006-2008 change**
average 0
peak -30%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 1.11 | 8.12 | June |
| **2008** | 0.70 | 3.82 | August |

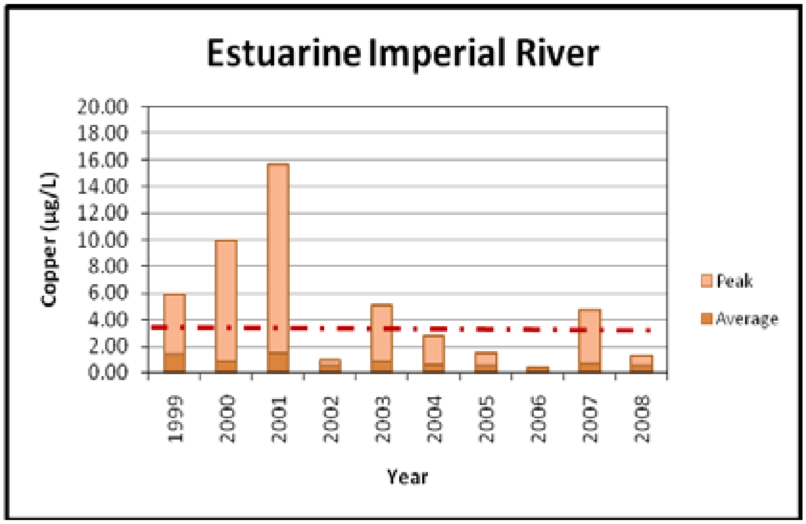


**2006-2008 change**

average +10%

peak -100%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.73 | 4.77 | June |
| **2008** | 0.55 | 1.37 | October |

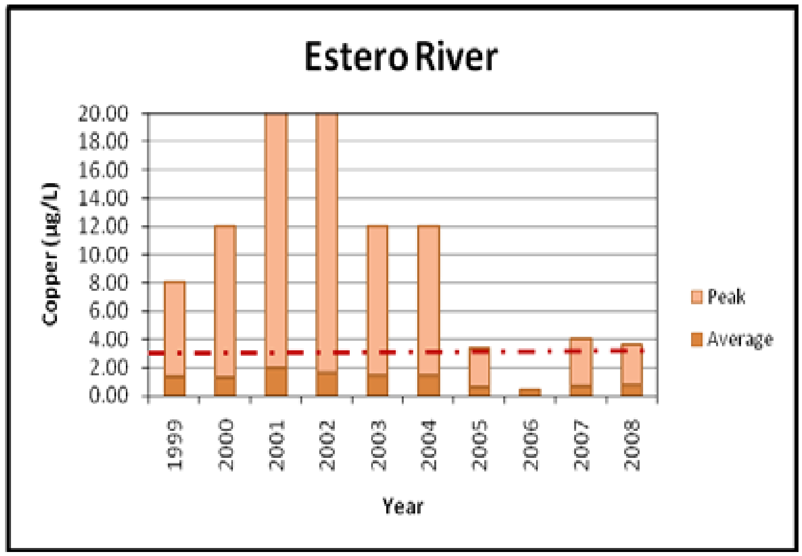



**2006-2008 change**

average +49%

peak +610%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.67 | 4.00 | September |
| **2008** | 0.74 | 3.55 | September |



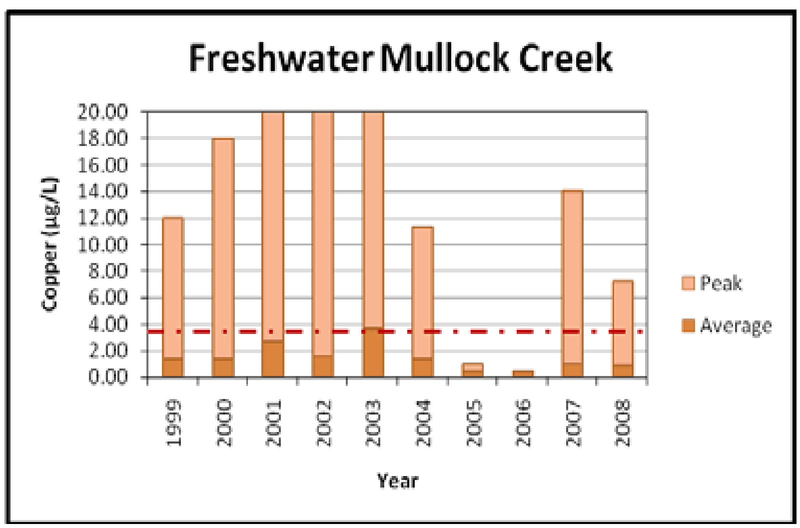

## Copper in Fresh Systems

**2006-2008 change**

average +75%

peak +1340%

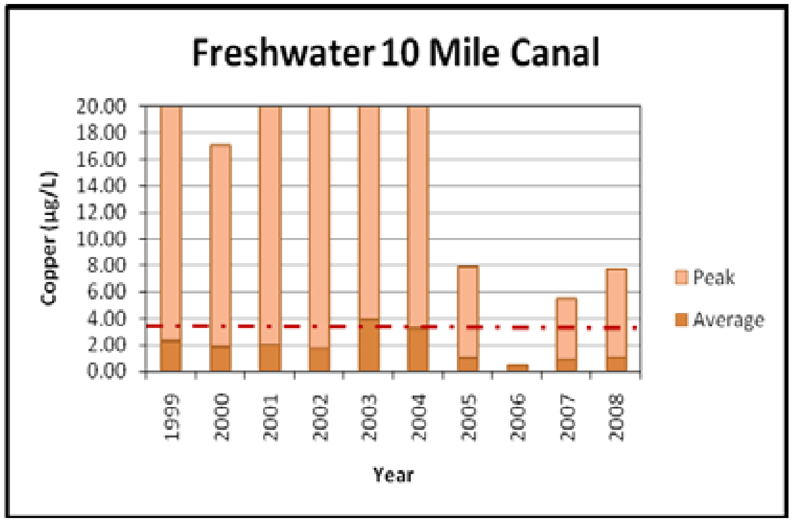
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.98 | 14.10 | August |
| **2008** | 0.88 | 7.20 | February |



**2006-2008 change**

| | |
|---|---|
| average | +111% |
| peak | +1434% |

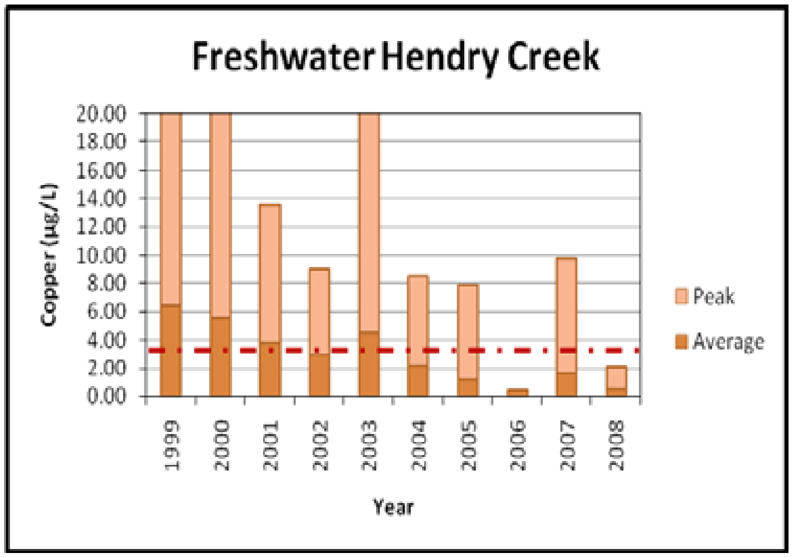
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.87 | 5.44 | August |
| **2008** | 1.05 | 7.67 | October |




**2006-2008 change**

| | |
|---|---|
| average | 15 |
| peak | 322 |

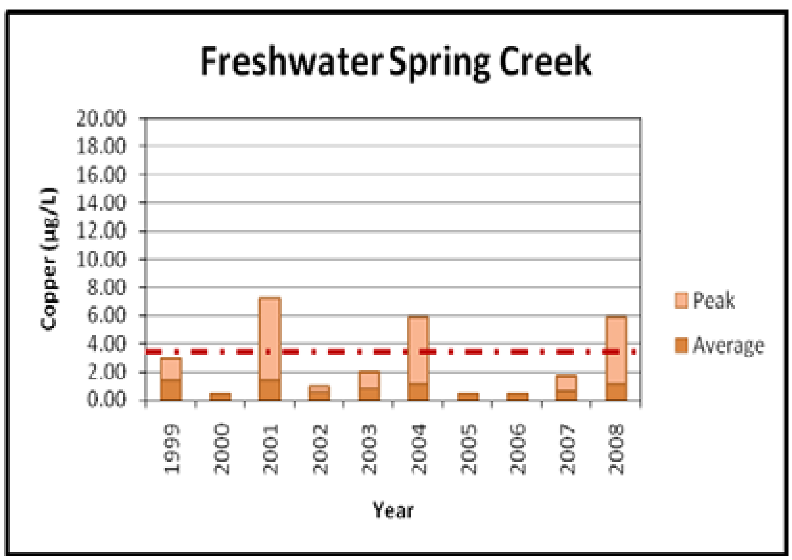
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 1.69 | 9.80 | February |
| **2008** | 0.57 | 2.11 | January |




**2006-2008 change**

| | |
|---|---|
| average | +140% |
| peak | +1084% |

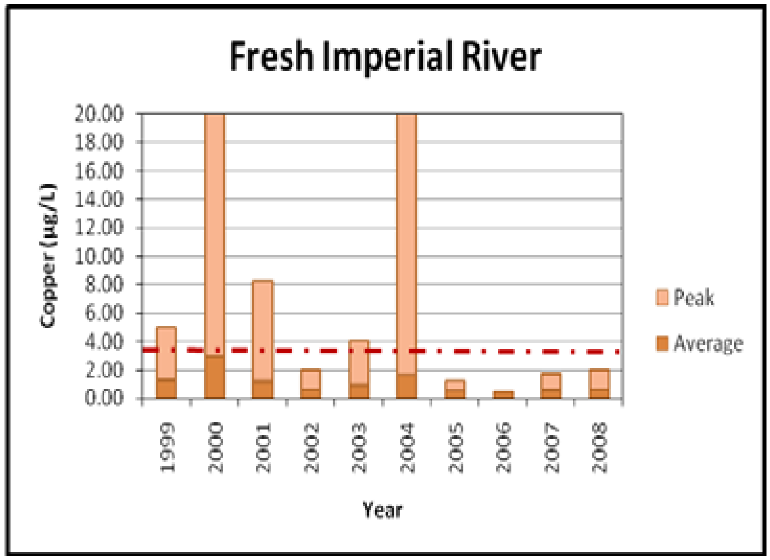
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.66 | 1.77 | June |
| **2008** | 1.20 | 5.92 | August |



**2006-2008 change**

| | |
|---|---|
| average | +28% |
| peak | +298% |

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.50 | 0.50 | |
| **2007** | 0.60 | 1.72 | June |
| **2008** | 0.64 | 1.99 | October |




## Parameter: Dissolved Oxygen

Dissolved oxygen (DO) is a measure of all dissolved oxygen in the water column. DO is vital to aerobic organisms in the aquatic ecosystem, and most higher taxa require higher DO levels for healthy life cycles and successful reproduction. Many factors affect DO including wind mixing, turbulence, flow volumes and rates, biochemical oxygen demand, algal blooms, photosynthesis and respiration, salinity and thermal stratification, anthropogenic eutrophication, and toxic spills.

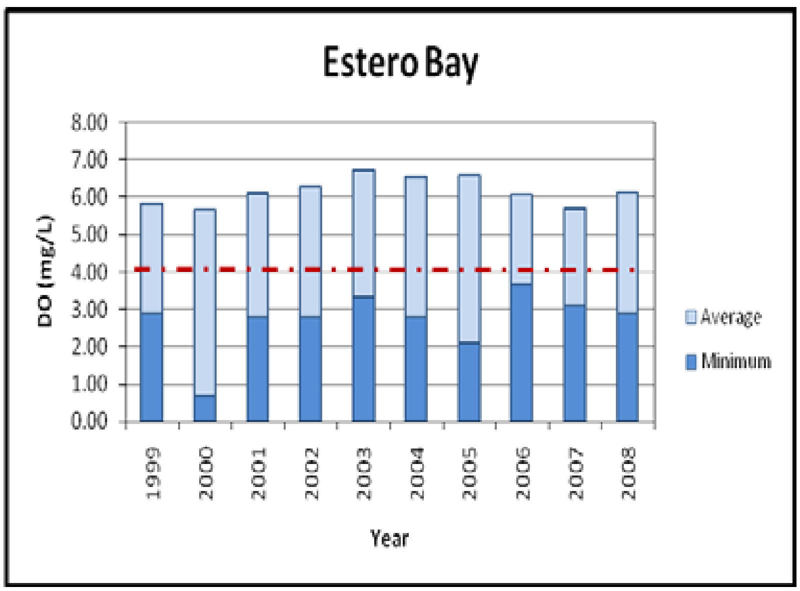
Florida's water quality standards state that dissolved oxygen in Class III freshwaters, "…shall not be less than 5.0 [mg/L]," and in Class III marine waters, "Shall not average less than 5.0 in a 24-hour period and shall never be less than 4.0." (Florida State Legislature 2008) Some natural estuaries will experience periods of low DO during the night due to community respiration exceeding the level of dissolved oxygen in the water column. This is rapidly recovered by community photosynthesis during the day. Prolonged periods of DO below 4.0 mg/L indicate problems. These may be transient, such as an algal bloom. However, prolonged systemic DO depression from anthropogenic inputs and other excess nutrient loading (such as atmospheric deposition) is not recoverable without source reduction efforts. Conditions below 2.0 mg/L are considered anoxic and can be fatal to most fishes and invertebrates.

The Lee County Environmental Laboratory provided the data for all dissolved oxygen analysis.

### Dissolved Oxygen in Estuarine Systems

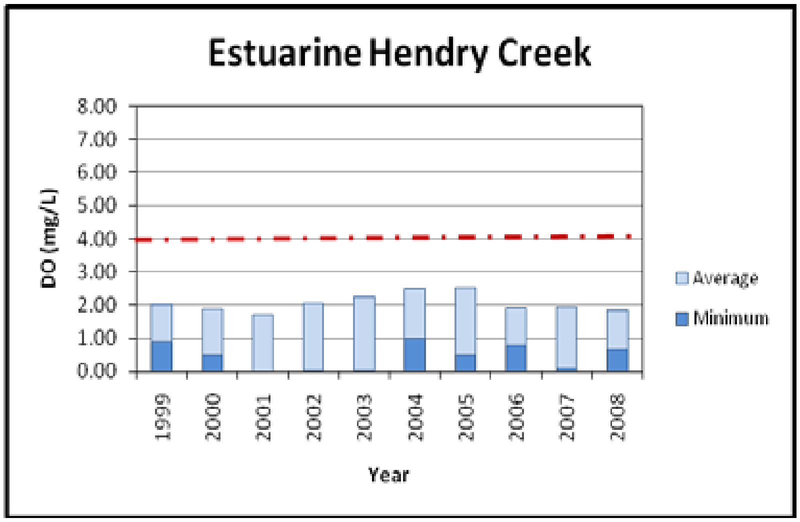
**2006-2008 change**
average +1.61%
minimum -21.62%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 6.07 | 3.70 | May |
| **2007** | 5.72 | 3.10 | September |
| **2008** | 6.16 | 2.90 | August |



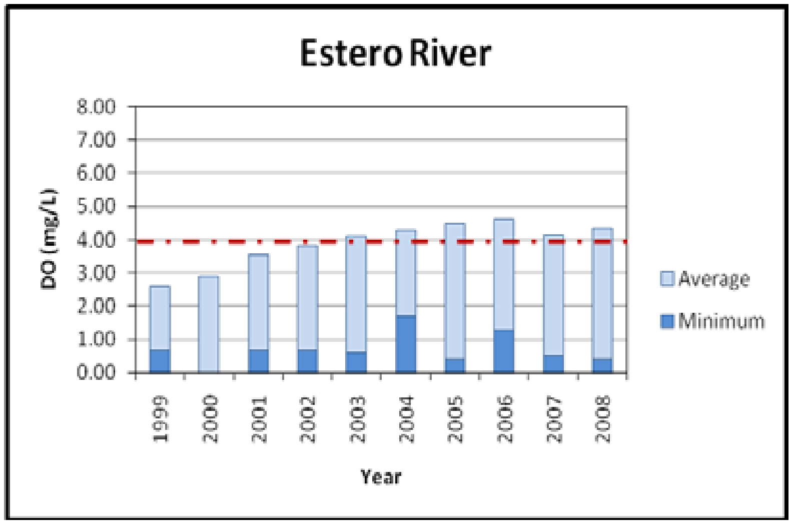
**2006-2008 change**
average -3.46%
minimum -12.50%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 1.93 | 0.80 | May |
| **2007** | 1.93 | 0.10 | July |
| **2008** | 1.86 | 0.70 | May |



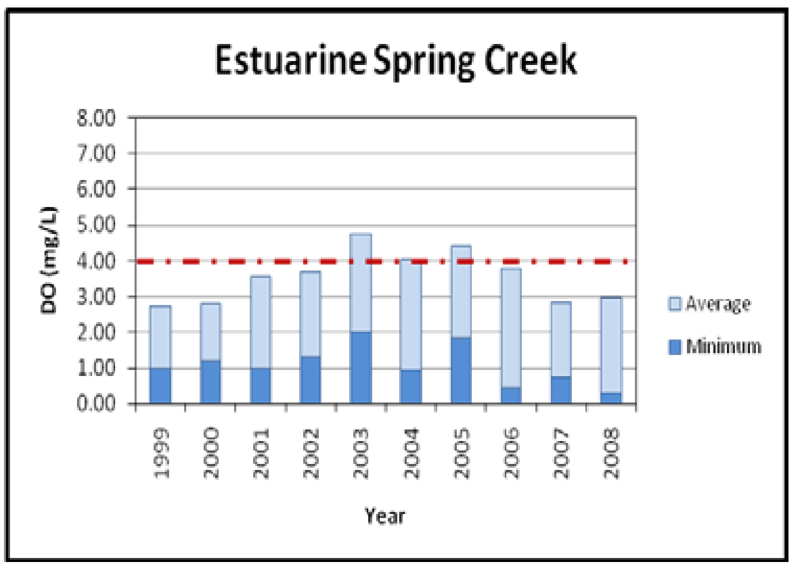

**2006-2008 change**
average -5.61%
minimum -69.23%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 1.93 | 1.30 | May |
| **2007** | 1.93 | 0.50 | July |
| **2008** | 1.86 | 0.40 | May |



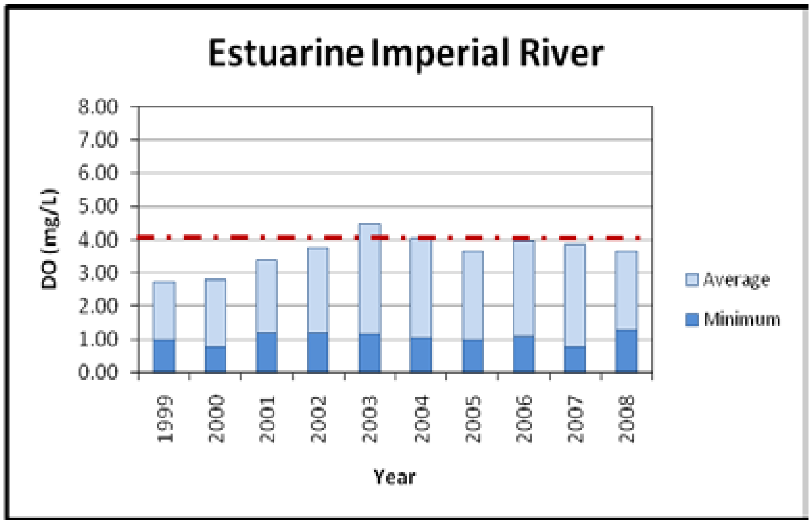

**2006-2008 change**
average -21.22%
minimum -33.33%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 3.79 | 0.45 | June |
| **2007** | 2.84 | 0.75 | June |
| **2008** | 2.99 | 0.30 | June |



**2006-2008 change**
average -7.94%
minimum +18.18%

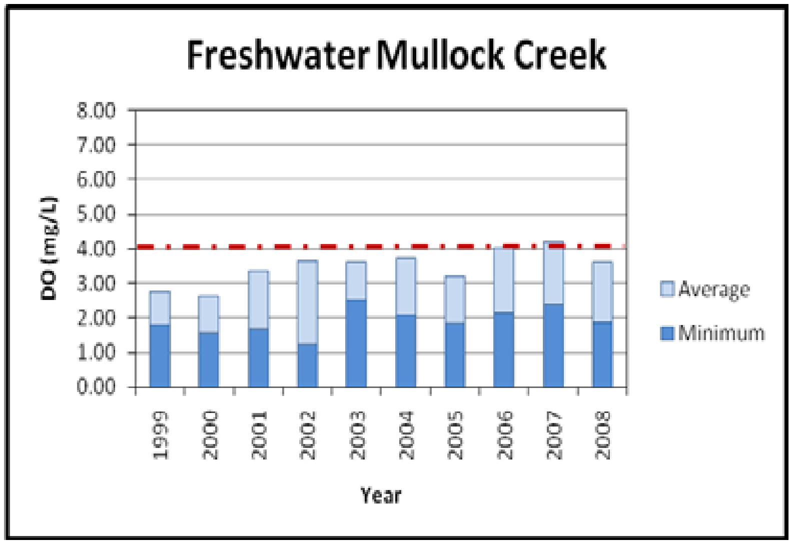
| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 3.96 | 1.10 | June |
| **2007** | 3.85 | 0.80 | September |
| **2008** | 3.65 | 1.30 | July |




## Dissolved Oxygen in Fresh Systems

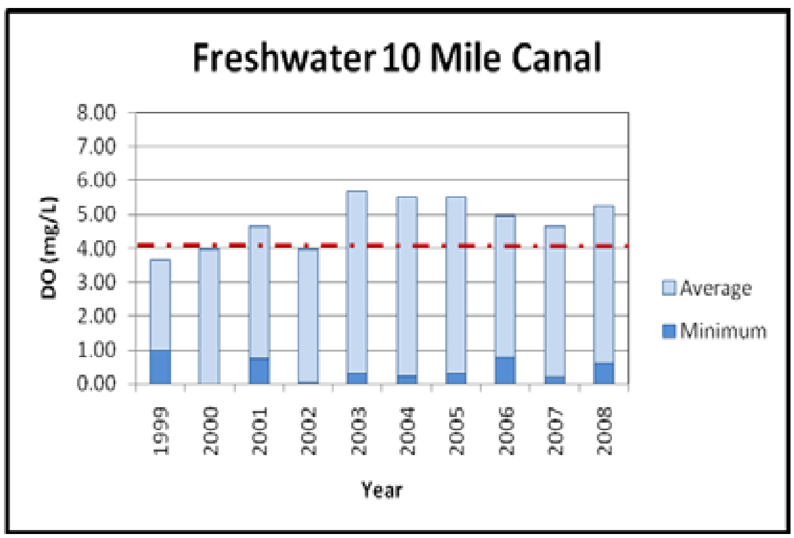
**2006-2008 change**
average -10.22%
minimum -13.18%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 3.96 | 2.38 | June |
| **2007** | 3.85 | 1.95 | September |
| **2008** | 3.65 | 2.05 | July |



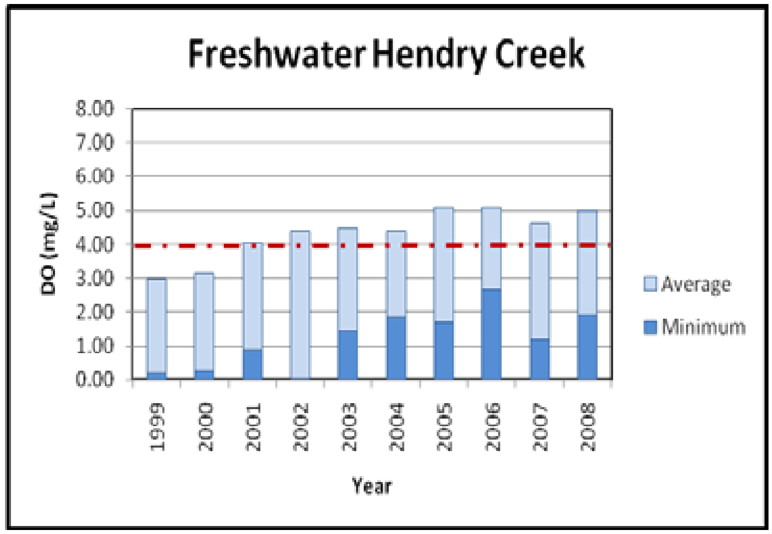

**2006-2008 change**
average +6.53%
minimum -25.00%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 4.95 | 3.86 | September |
| **2007** | 4.64 | 3.46 | August |
| **2008** | 5.27 | 3.96 | June |



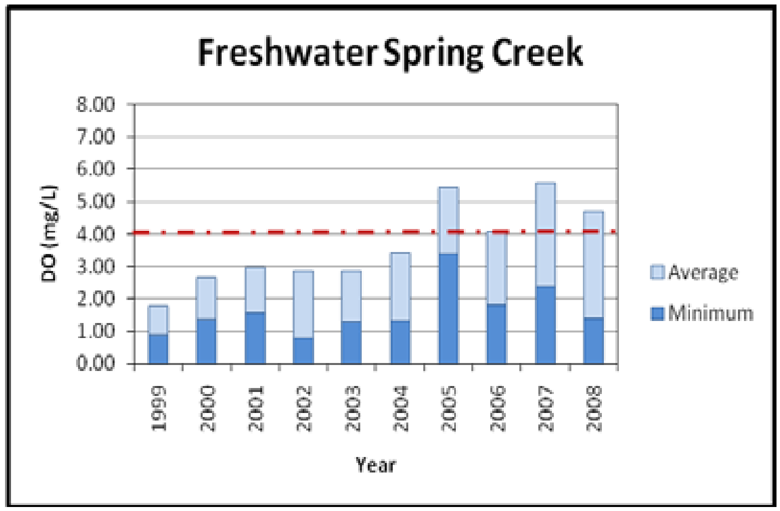
**2006-2008 change**
average -2.26%
minimum -28.76%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 5.10 | 2.67 | May |
| **2007** | 4.63 | 1.20 | December |
| **2008** | 4.99 | 1.90 | February |



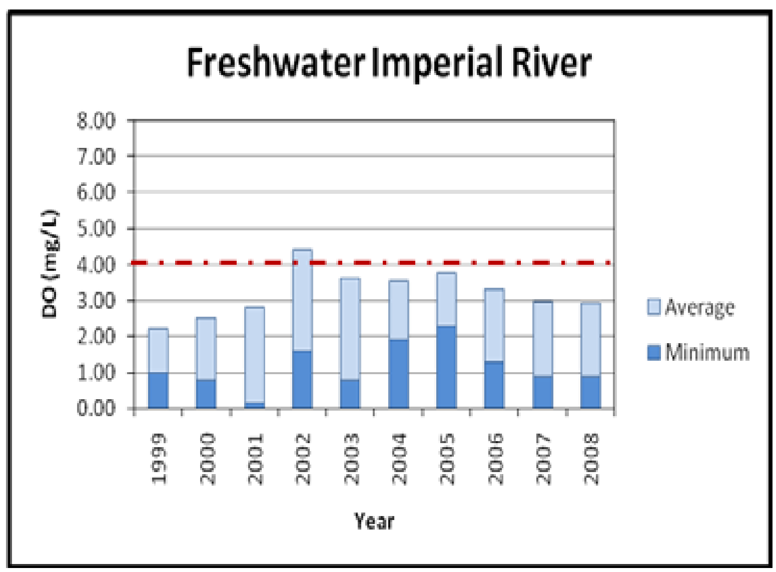

**2006-2008 change**
average +14.90%
minimum -22.22%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 4.08 | 1.80 | April |
| **2007** | 5.57 | 2.40 | June |
| **2008** | 4.69 | 1.40 | August |




**2006-2008 change**
average -11.34%
minimum -30.77%

| Year | Average | Minimum | Month of Minimum |
|---|---|---|---|
| **2006** | 3.31 | 1.30 | June |
| **2007** | 2.96 | 0.90 | July |
| **2008** | 2.93 | 0.90 | June |



## Parameter: Fecal Coliform

Fecal coliform is a measure of bacteriological contamination of the water column based on the activity of *Escheria coli*, commensal bacteria of higher vertebrates. It is a surrogate measure for other more harmful bacteriological and viral contaminants associated with waste material from human and vertebrate fecal discharges. This parameter includes inputs from many environmental inputs of fecal waste including human sewage (from vessel holding tanks, septic tanks, land sludge spreading, and package and other sewage treatment plants), waste from livestock (including cattle and chickens), and waste from wild and feral animals. Fecal coliform can also be naturally high in association with active bird rookeries; therefore, a healthy estuary with normal animal activity will have a natural background level.

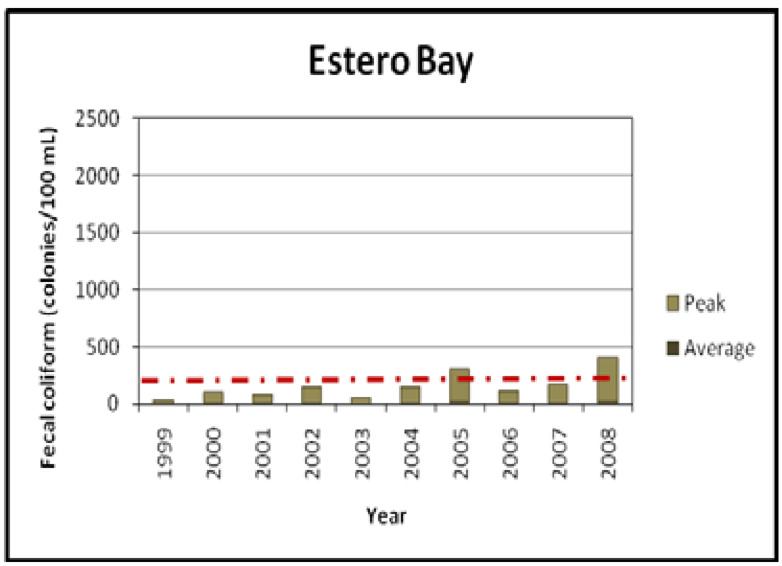
According to State of Florida standards, a measurement of more than 800 bacterial colonies per 100 mL on any single day of sampling or a monthly average of 200 colonies per 100 mL indicates impairment in Class III waters. In order to be classified as a Class II waterbody, appropriate for shellfish harvesting, the median measurement must be 14 counts/mL or less.

The Lee County Environmental Laboratory provided the data for all fecal coliform analysis.

### Fecal Coliform in Estuarine Systems

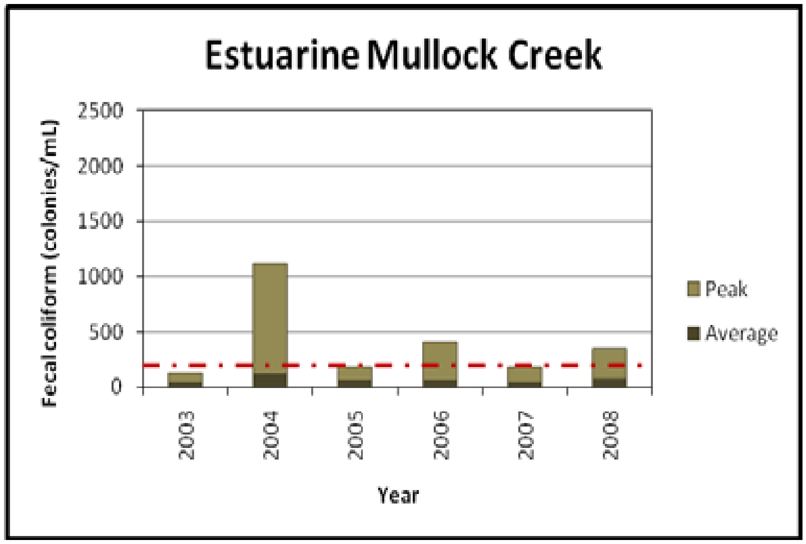
**2006-2008 change**
average +191.55%
peak +251.75%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 7 | 114 | September |
| **2007** | 7 | 176 | October |
| **2008** | 21 | 401 | November |



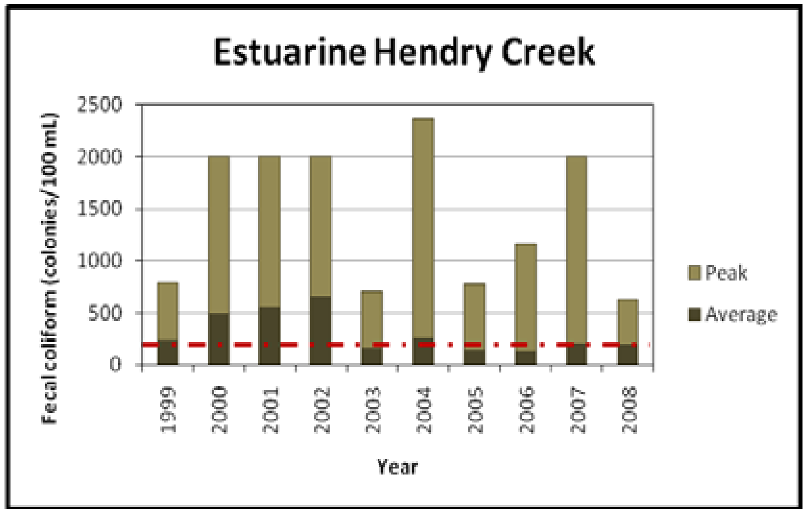
**2006-2008 change**
average +15.21%
peak -11.22%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 61 | 401 | August |
| **2007** | 41 | 182 | November |
| **2008** | 70 | 356 | January (09) |



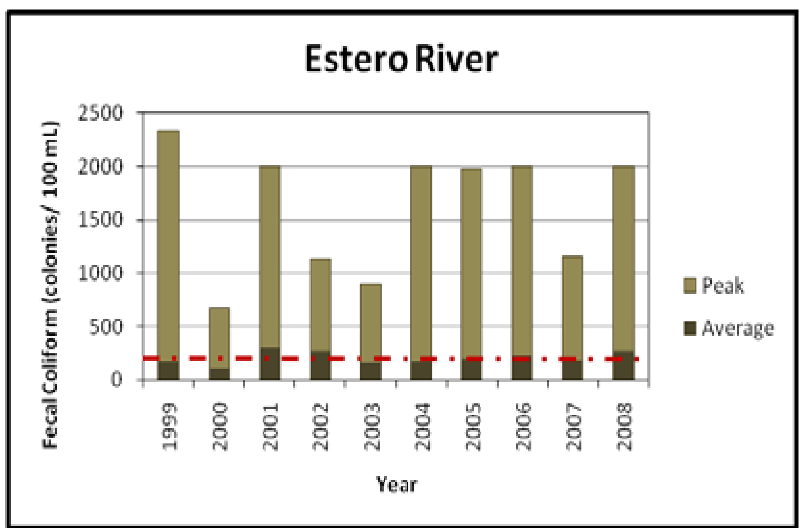

**2006-2008 change**
average +51.47%
peak -45.69%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 130 | 1160 | February |
| **2007** | 206 | 2000 | May |
| **2008** | 197 | 630 | April |



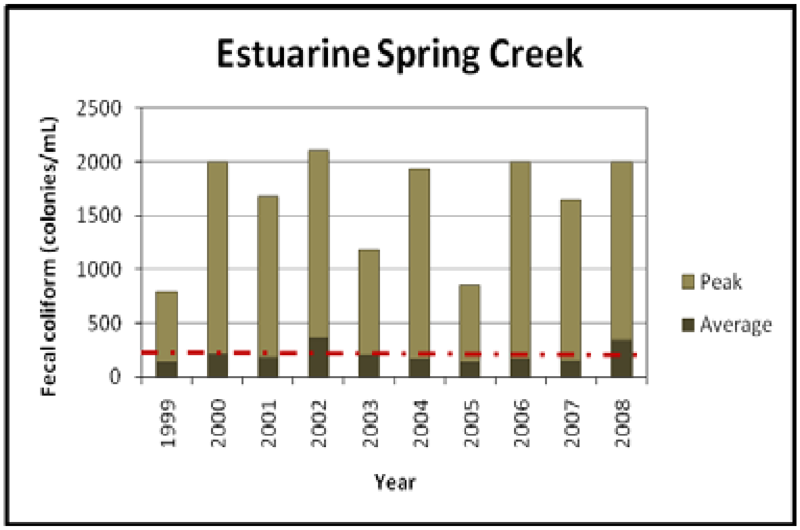

**2006-2008 change**
average +17.36%
peak 0.00

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 226 | 2001 | May |
| **2007** | 185 | 1150 | November |
| **2008** | 265 | 2001 | July |



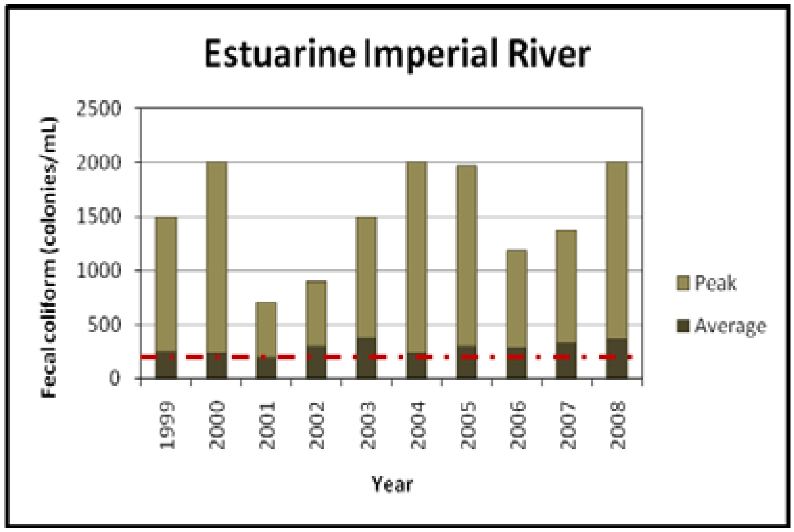
**2006-2008 change**
average +93.44%
peak 0.00

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 176 | 2001 | May |
| **2007** | 145 | 1650 | August |
| **2008** | 340 | 2001 | Feb/Sept |




**2006-2008 change**
average +25.52%
peak +68.15%

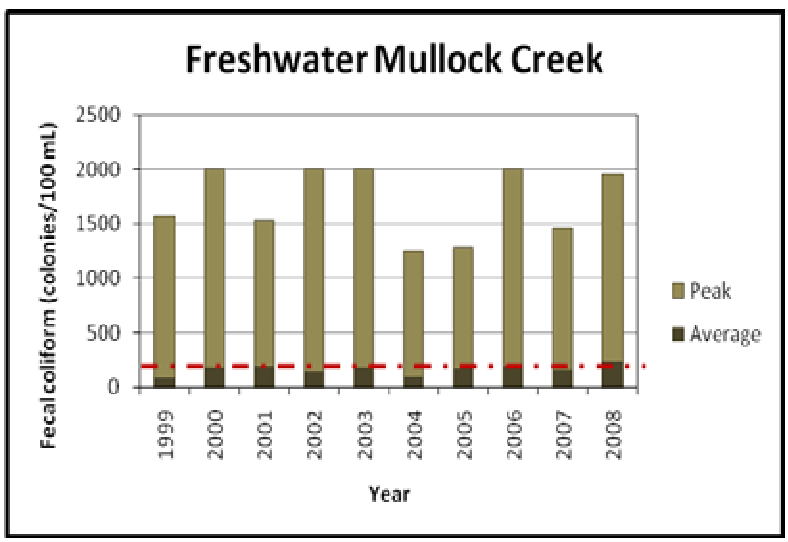
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 293 | 1190 | August |
| **2007** | 336 | 1370 | January |
| **2008** | 368 | 2001 | September |




## Fecal Coliform in Fresh Systems

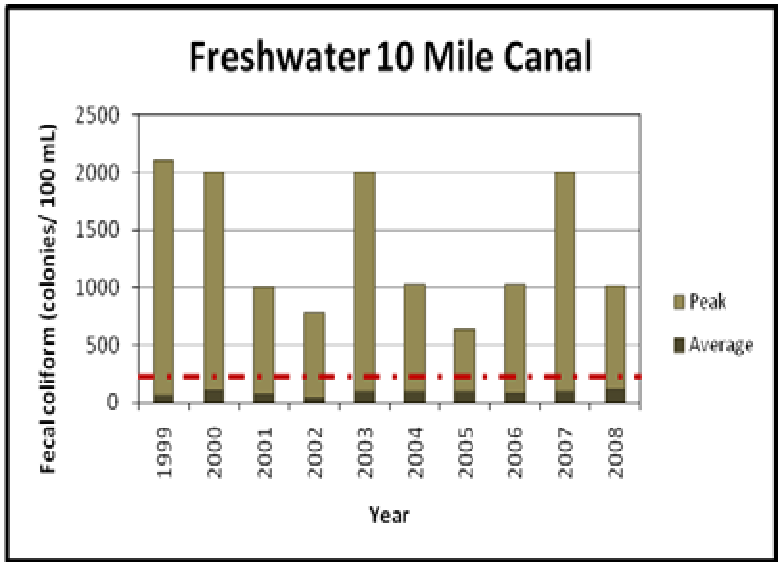
**2006-2008 change**
average +24.81%
peak -2.05%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 190 | 2001 | June |
| **2007** | 158 | 1460 | October |
| **2008** | 237 | 1960 | December |



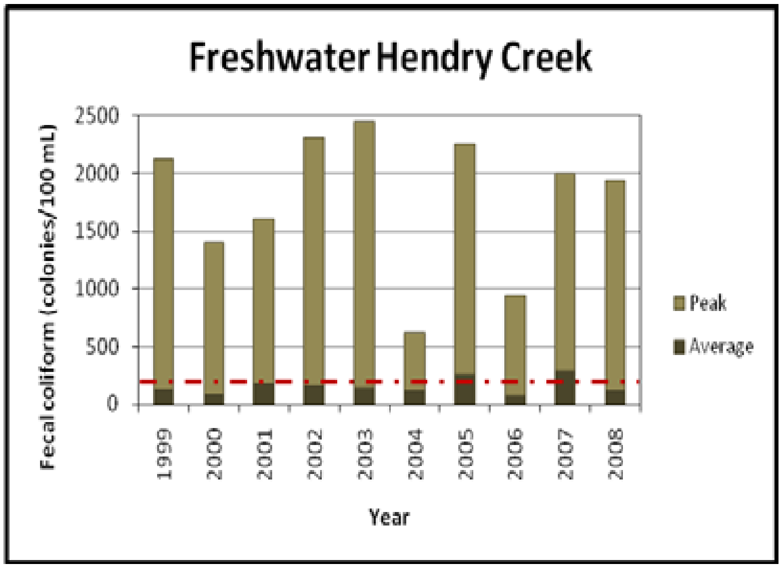
**2006-2008 change**
average +29.89%
peak -0.97%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 88 | 1030 | June |
| **2007** | 101 | 2001 | Aug/Oct |
| **2008** | 115 | 1020 | July |



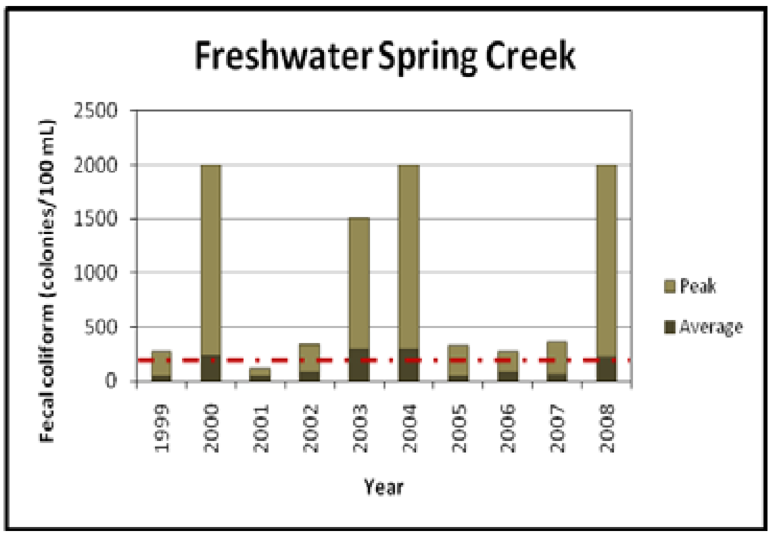

**2006-2008 change**
average +57.20%
peak +106.42%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 77 | 935 | August |
| **2007** | 285 | 2001 | December |
| **2008** | 122 | 1930 | February |



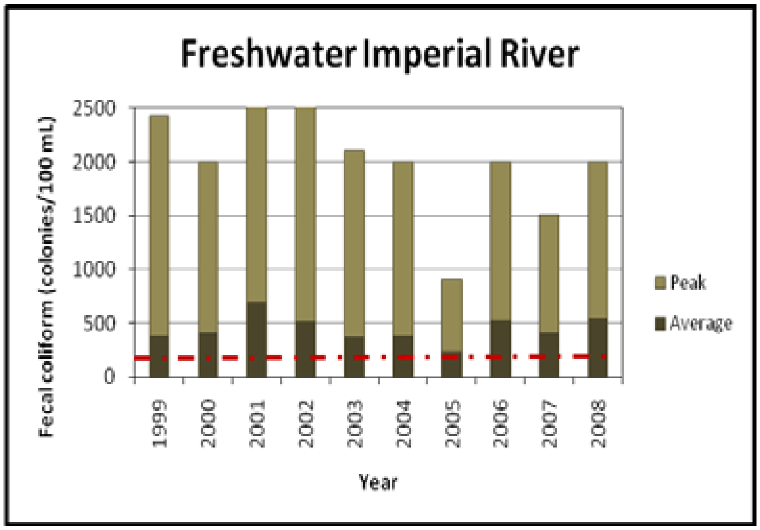

**2006-2008 change**
average +165.45%
peak +614.64%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 84 | 280 | April |
| **2007** | 65 | 360 | August |
| **2008** | 223 | 2001 | September |

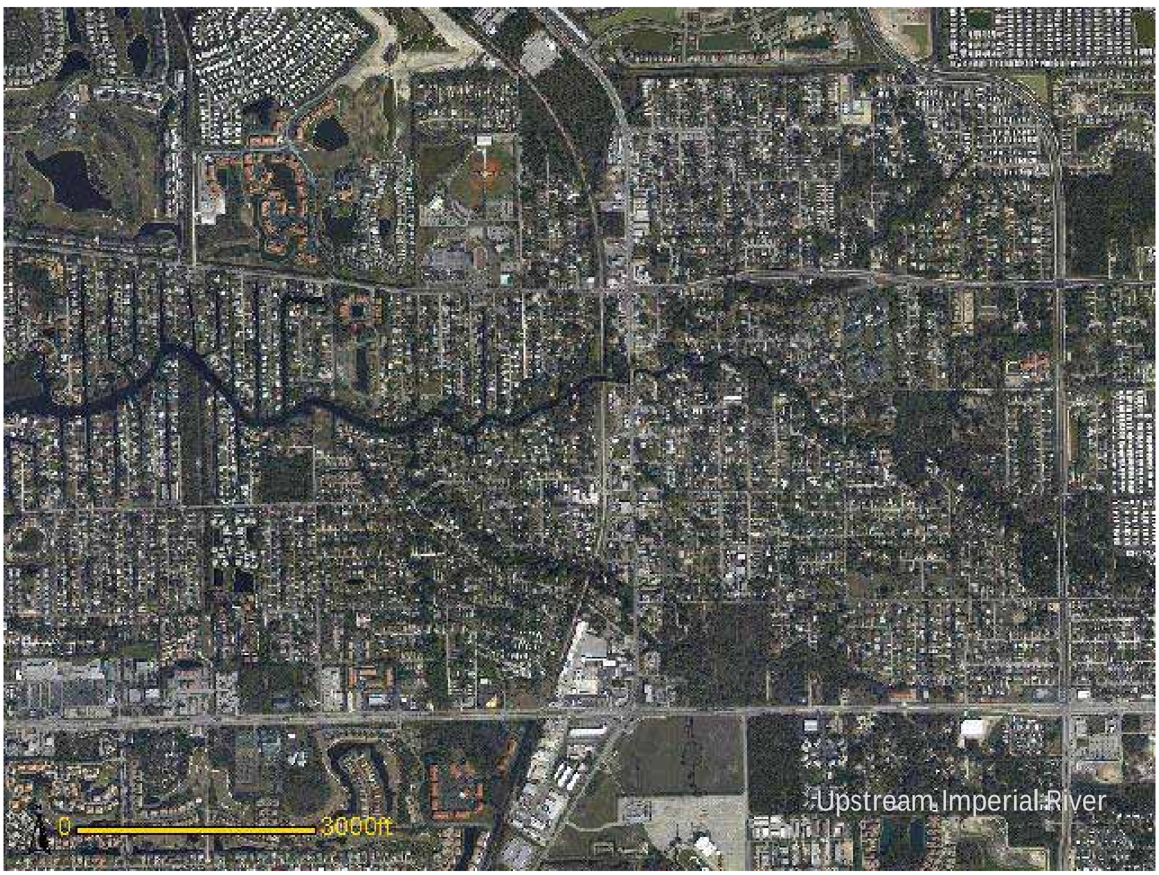


**2006-2008 change**

| | |
|---|---|
| average | +4.35% |
| peak | 0.00 |




| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 522 | 2001 | August |
| **2007** | 402 | 1500 | September |
| **2008** | 544 | 2001 | September |



## Parameter: Total Nitrogen

Total nitrogen (TN) is a measure of all dissolved nitrogen in the water column, including nitrates, nitrites and ammonia. It is a resultant parameter that synthesizes many environmental inputs of nitrogen, including the dissolved organics from algae, sea grass, mangrove, and phytoplankton productivity. Also included are anthropogenic inputs, such as from agriculture and fertilizer over-application, which may run off into water bodies.

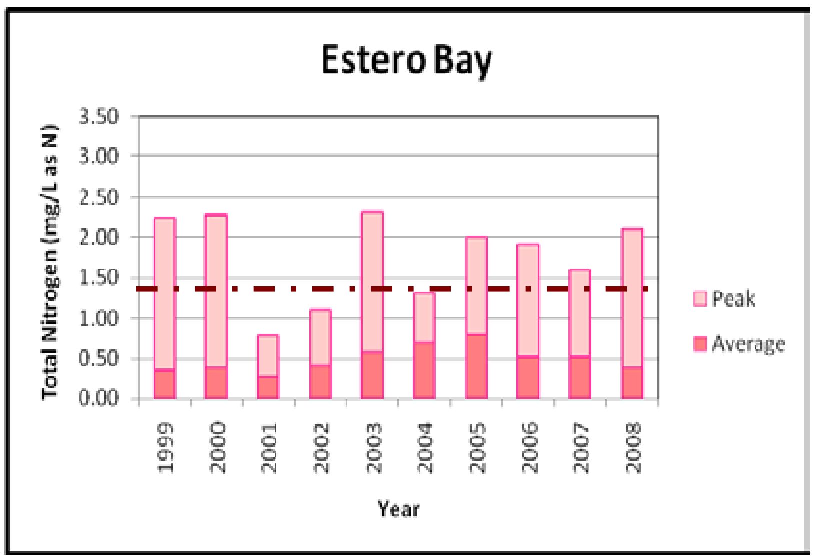
The USEPA Nutrient Criteria for this area, Aggregate Ecoregion XII, the Southeastern Coastal Plain, is 0.9 mg/L for rivers and streams (USEPA 2000). While the state of Florida has in the past had only narrative criteria for nutrients in water bodies, in response to a lawsuit by the Sierra Club, the Conservancy of Southwest Florida, the Florida Wildlife Federation, and others, USEPA recently issued a determination letter requiring the state to determine and adopt numeric nutrient standards for nitrogen and phosphorus in water bodies. USEPA has stated that the state must propose nutrient limits by January 14, 2010 and the resultant rule must be finalized by October of 2010.

The southwest Florida region has been proactive in addressing nutrient pollution at the local level. The Lower West Coast Watersheds Committee of the Southwest Florida Regional Planning Council developed a resolution regarding fertilizer regulation, which was adopted by Lee County as an ordinance in May of 2008. The ordinance regulates the nitrogen and phosphorus content of landscaping fertilizers, establishes a fertilizer black-out period during the rainy season, and establishes a 10-foot no-fertilizer buffer around waterbodies. Most municipalities in Lee County have followed suit, adopting the Lee County standards in whole, or some variation. The Lee County Environmental Laboratory provided the data for all total nitrogen analysis.

**Total Nitrogen in Estuarine Systems**

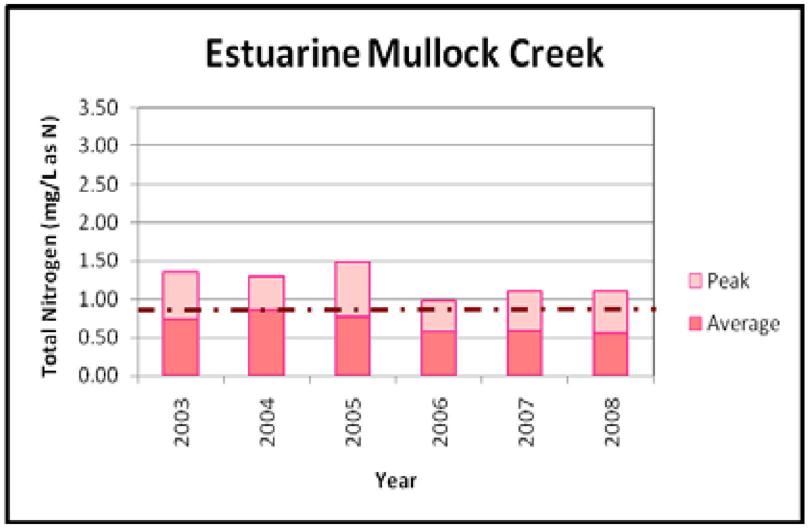
**2006-2008 change**
average -26.17%
peak +9.95%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.51 | 1.91 | April |
| **2007** | 0.51 | 1.60 | October |
| **2008** | 0.38 | 2.10 | December |



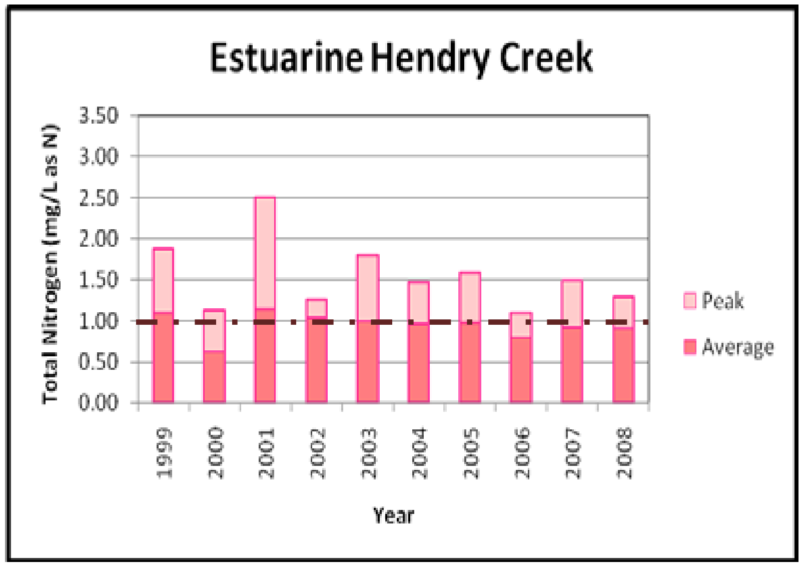
**2006-2008 change**
average -2.36%
peak +12.24%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.57 | 0.98 | July |
| **2007** | 0.60 | 1.10 | October |
| **2008** | 0.56 | 1.10 | July |



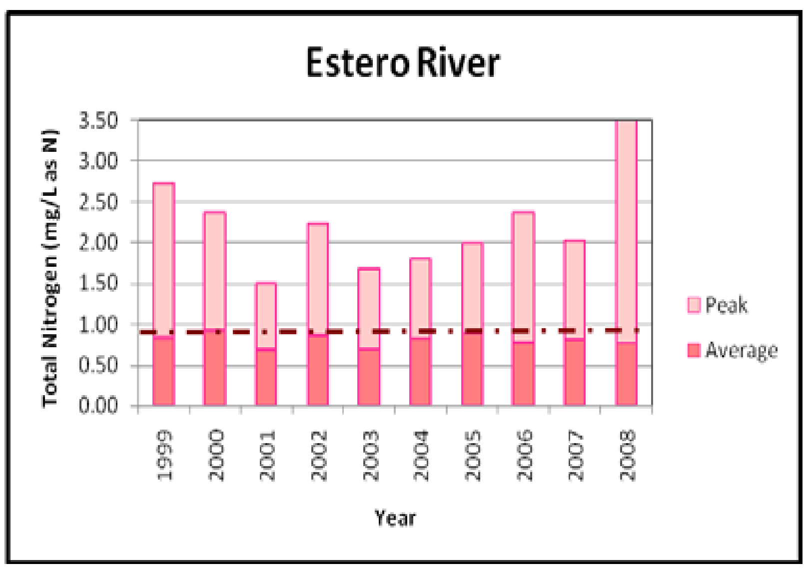

**2006-2008 change**
average +14.13%
peak +18.18%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.80 | 1.10 | Feb/May/Oct |
| **2007** | 0.93 | 1.50 | August |
| **2008** | 0.92 | 1.30 | Jan/Feb |



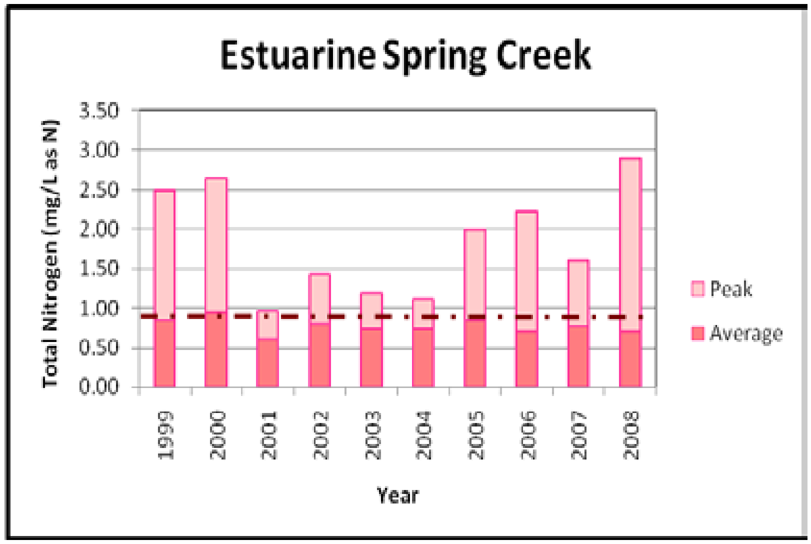

**2006-2008 change**
average -1.55%
peak +69.49%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.78 | 2.36 | October |
| **2007** | 0.81 | 2.03 | June |
| **2008** | 0.77 | 4.00 | September |



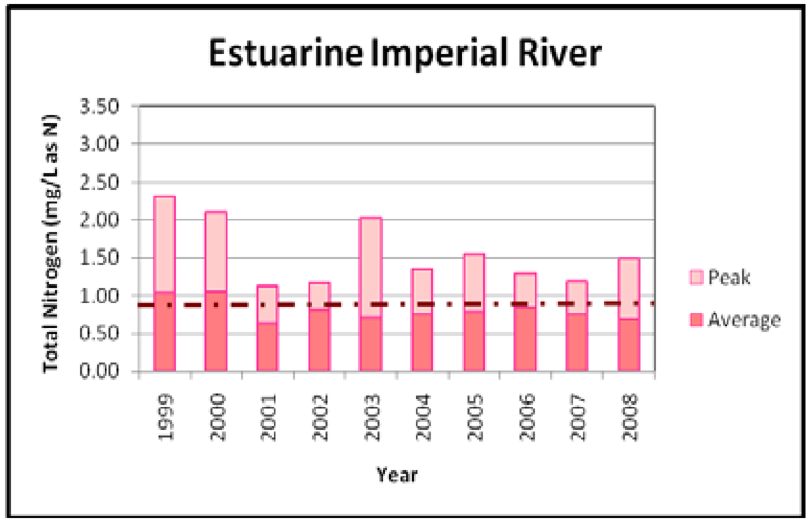
**2006-2008 change**
average +0.06%
peak +30.63%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 0.71 | 2.22 | May |
| 2007 | 0.78 | 1.62 | May |
| 2008 | 0.71 | 2.90 | May |




**2006-2008 change**
average -16.47%
peak +15.38%

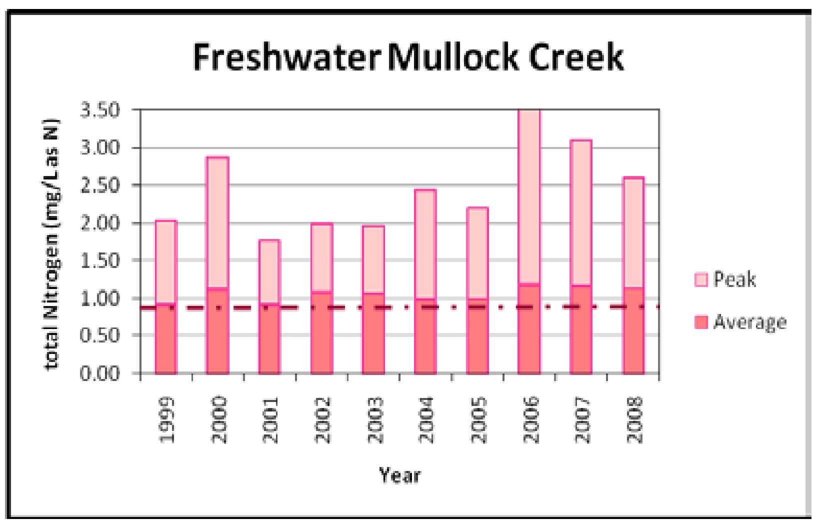
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 0.84 | 1.30 | January |
| 2007 | 0.75 | 1.20 | September |
| 2008 | 0.70 | 1.50 | July |




## Total Nitrogen in Fresh Systems

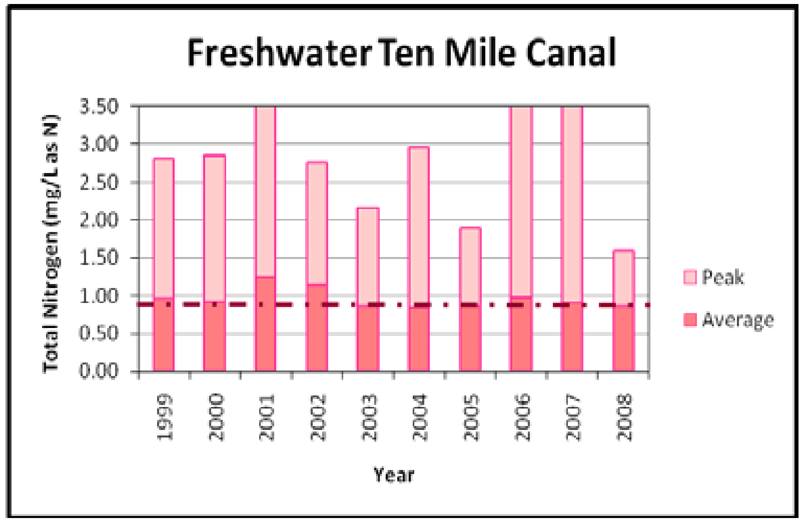
**2006-2008 change**
average -4.82%
peak -48.51%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 1.19 | 5.05 | April |
| 2007 | 1.17 | 3.1 | August |
| 2008 | 1.13 | 2.6 | February |



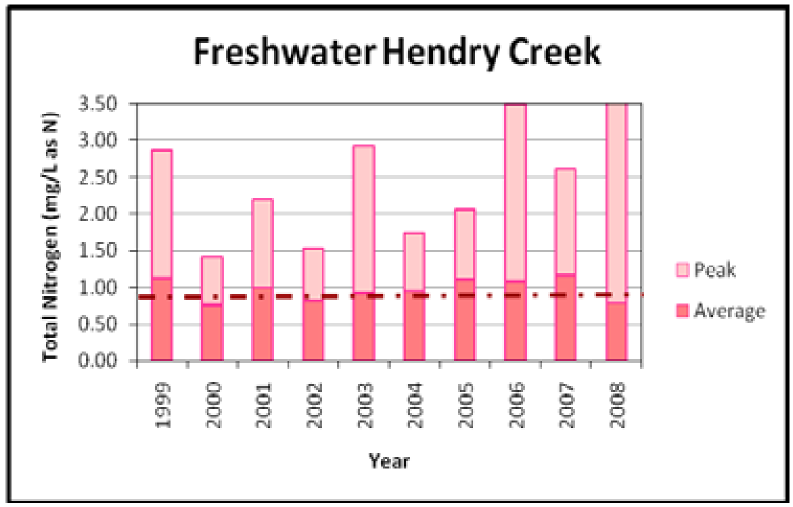
**2006-2008 change**
average -11.69%
peak -75.65%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.98 | 6.57 | June |
| **2007** | 0.91 | 5.21 | April |
| **2008** | 0.86 | 1.6 | June |



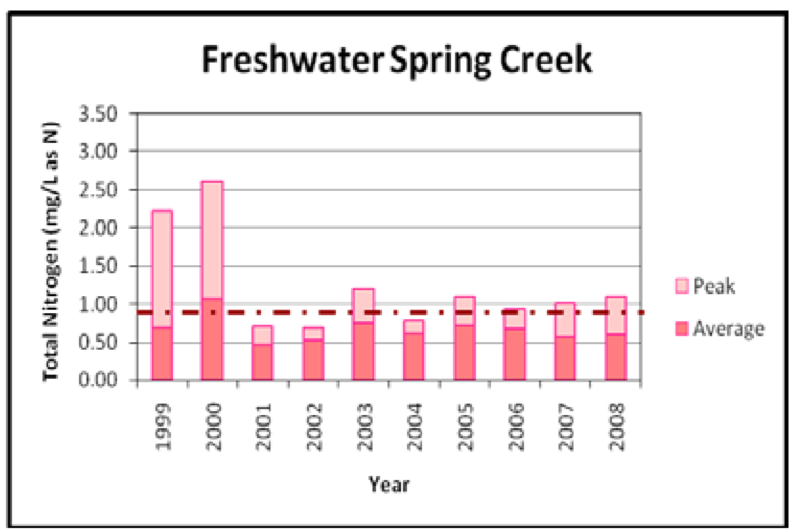

**2006-2008 change**
average -27.60%
peak +60.23%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 1.08 | 3.50 | May |
| **2007** | 1.17 | 2.60 | December |
| **2008** | 0.78 | 5.60 | January |




**2006-2008 change**
average -10.61%
peak +17.02%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.68 | 0.94 | January |
| **2007** | 0.58 | 1.01 | June |
| **2008** | 0.61 | 1.1 | July |

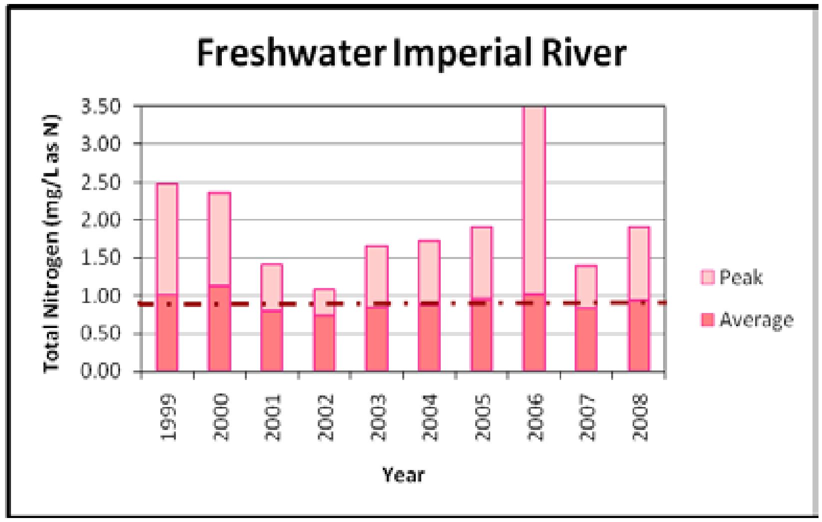


**2006-2008 change**

average -6.79%

peak -73.79%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 1.01 | 7.25 | October |
| **2007** | 0.83 | 1.4 | October |
| **2008** | 0.94 | 1.9 | July |




## Parameter: Total Phosphorus

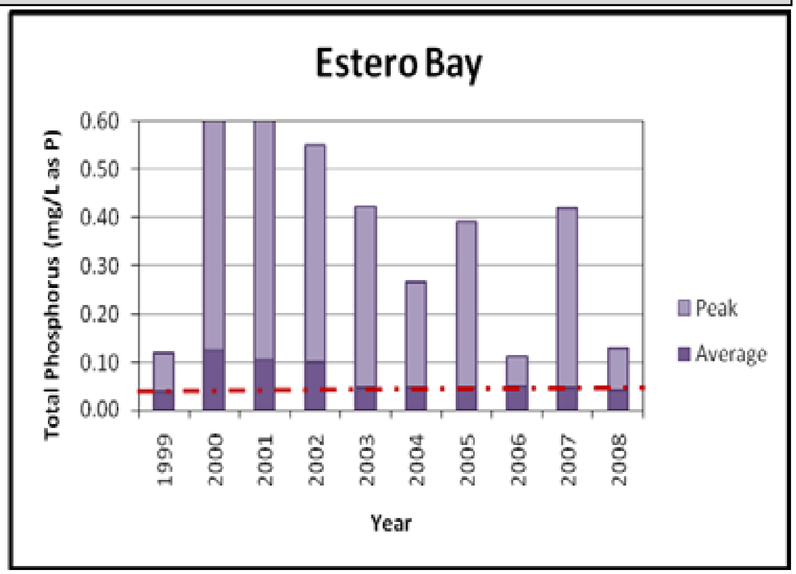
Total phosphorus (TP) is a measure of all dissolved phosphorus in the water column, including phosphates. It is a resultant parameter that synthesizes many environmental inputs of phosphates. The USEPA Nutrient Criteria for this area, Aggregate Ecoregion XII, the Southeastern Coastal Plain, is 40.0 µg/L for rivers and streams (USEPA 2000), which is equivilent to 0.04 mg/L. As discussed above, the state of Florida is in the process of developing numeric criteria for this nutrient.

TP, in and of itself, does not identify the source phosphorus in the water column. The main contributor is stormwater runoff containing excess fertilizer from residential and agricultural sources. The fertilizer regulations noted above are intended to help reduce these inputs. The Lee County Environmental Laboratory provided the data for all total phosphorus analysis.

**Total Phosphorus in Estuarine Systems**

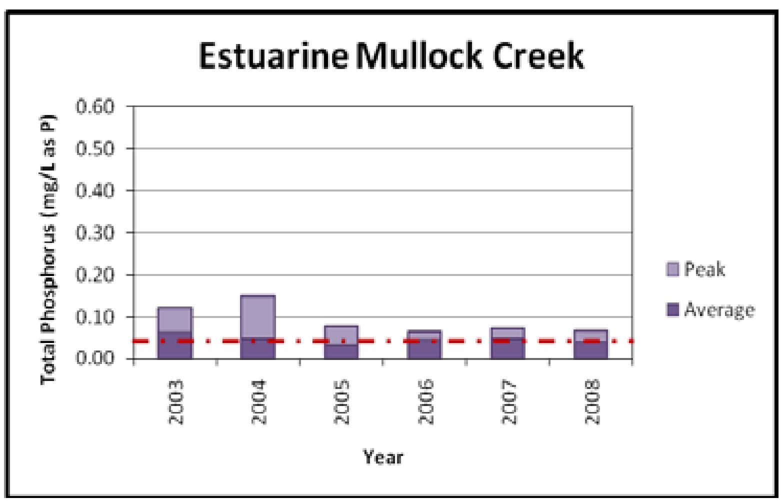
**2006-2008 change**
average -18.29%
peak +18.18%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.05 | 0.11 | September |
| **2007** | 0.05 | 0.42 | May |
| **2008** | 0.04 | 0.13 | January (09) |



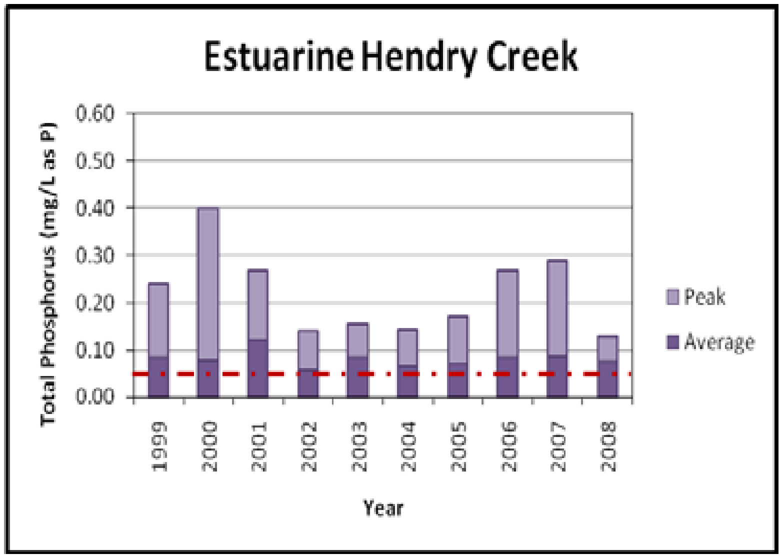

**2006-2008 change**
average -12.14%
peak +6.15%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.04 | 0.065 | June |
| **2007** | 0.05 | 0.073 | August |
| **2008** | 0.04 | 0.069 | August |



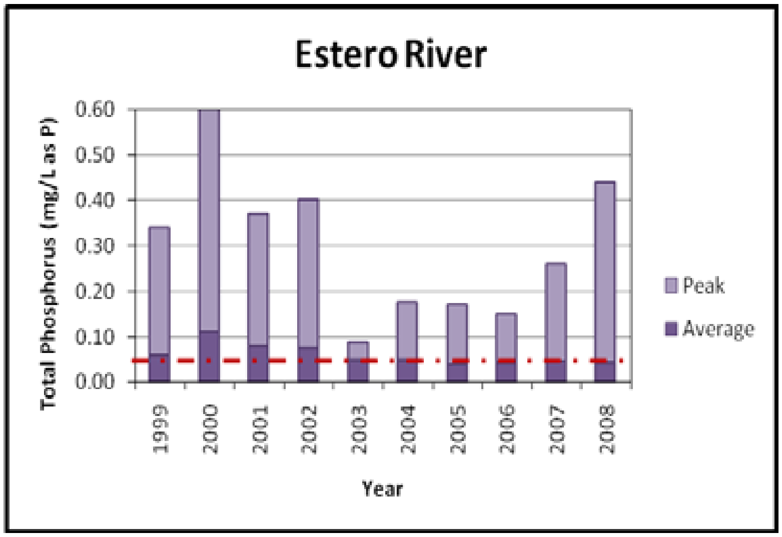
**2006-2008 change**
average -8.07%
peak -51.85%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.08 | 0.27 | February |
| **2007** | 0.09 | 0.29 | May |
| **2008** | 0.08 | 0.13 | May |



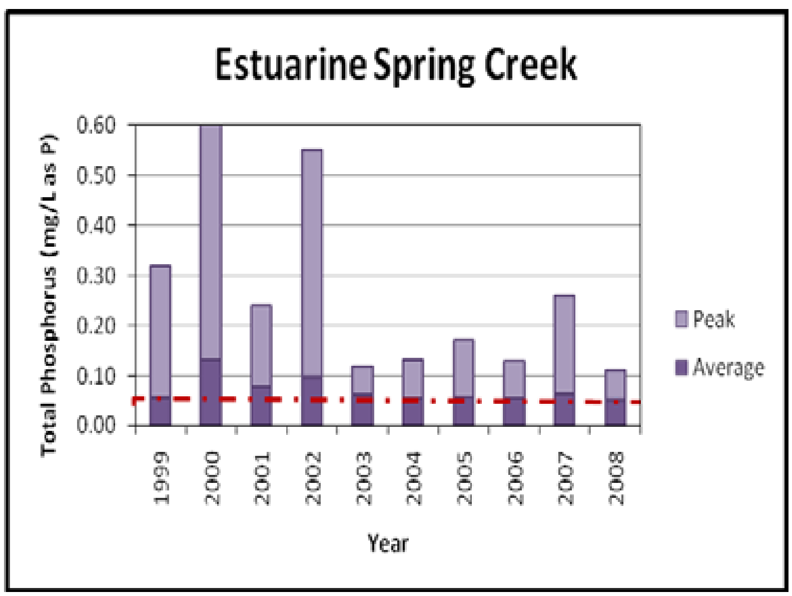

**2006-2008 change**
average +0.21%
peak +193.33%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.04 | 0.15 | June |
| **2007** | 0.05 | 0.26 | June |
| **2008** | 0.04 | 0.44 | September |



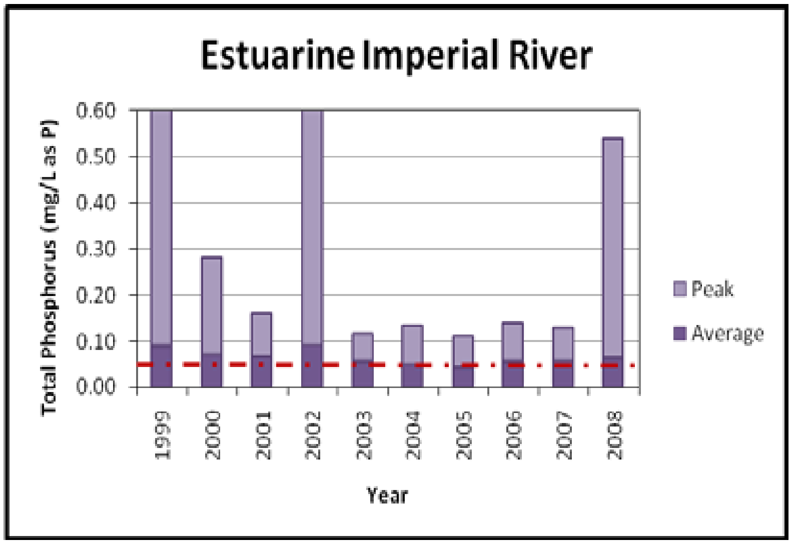

**2006-2008 change**
average -8.93%
peak -15.38%

| Year | Mean | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.06 | 0.13 | May |
| **2007** | 0.06 | 0.26 | May |
| **2008** | 0.05 | 0.11 | April |



**2006-2008 change**
average +13.27%
peak +285.71%

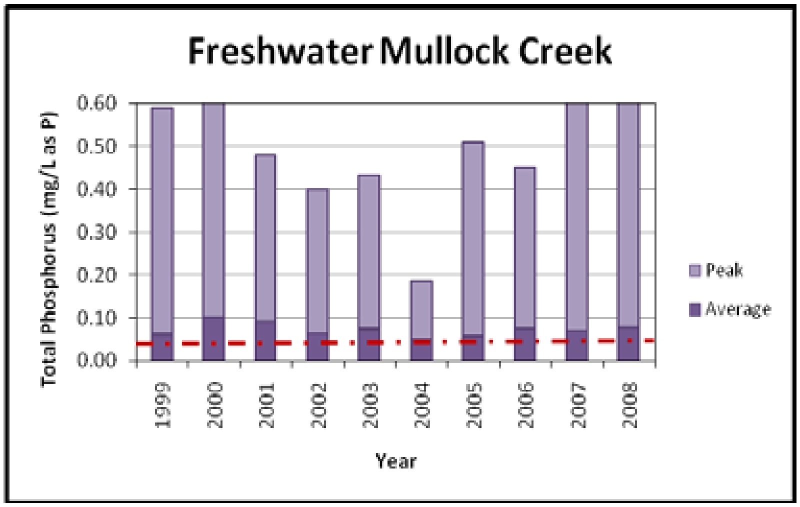
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.06 | 0.14 | June |
| **2007** | 0.06 | 0.13 | July |
| **2008** | 0.06 | 0.54 | July |




## Total Phosphorus in Fresh Systems

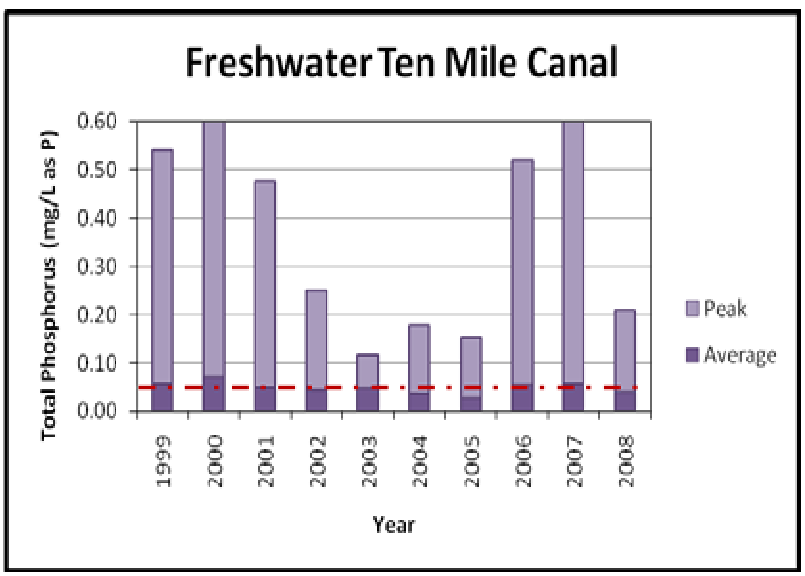
**2006-2008 change**
average +3.81%
peak +51.11%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.08 | 0.45 | April |
| **2007** | 0.07 | 0.69 | September |
| **2008** | 0.08 | 0.68 | July |




**2006-2008 change**
average -24.57%
peak -59.62%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.05 | 0.52 | June |
| **2007** | 0.06 | 0.78 | April |
| **2008** | 0.04 | 0.21 | February |

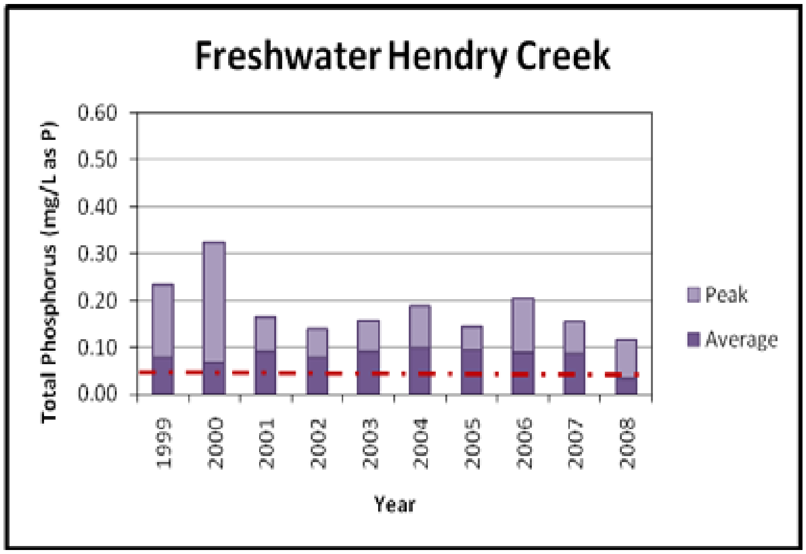


**2006-2008 change**

average -59.94%

peak -55.56%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.09 | 0.36 | May |
| **2007** | 0.09 | 0.27 | December |
| **2008** | 0.04 | 0.16 | February |

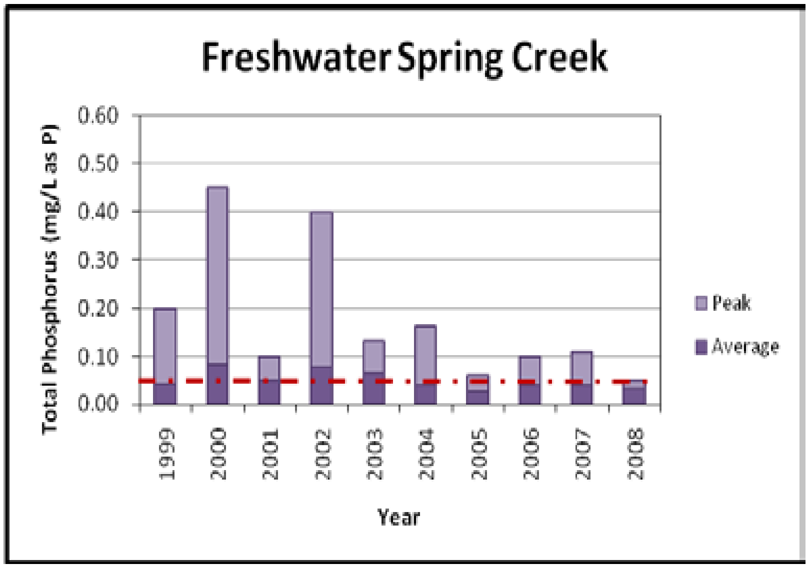



**2006-2008 change**

average -22.22%

peak -49.00%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.04 | 0.1 | June |
| **2007** | 0.04 | 0.11 | June |
| **2008** | 0.03 | 0.051 | August |

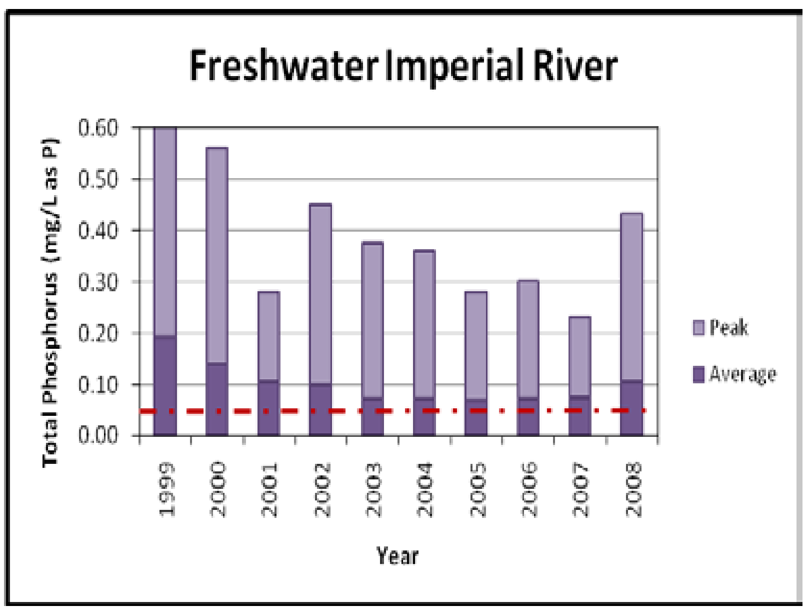



**2006-2008 change**

average +47.58%

peak +43.33%

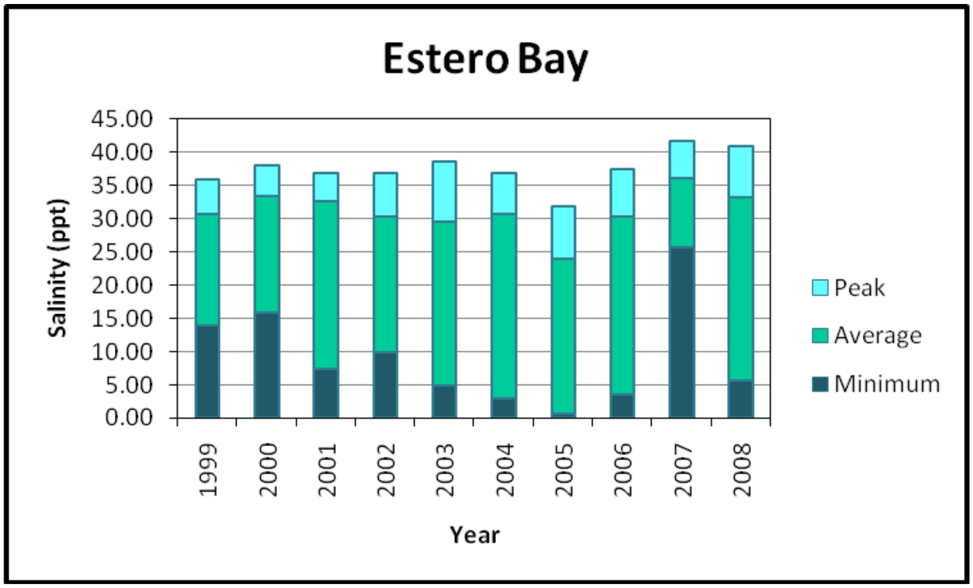
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 0.07 | 0.3 | October |
| **2007** | 0.07 | 0.23 | April |
| **2008** | 0.10 | 0.43 | July |



## Parameter: Salinity

Long term salinity changes in estuaries can reflect many changing factors. In Gulf of Mexico estuaries, landscape changes which alter the volume and periodicity of freshwater delivery to the estuaries can result in measureable changes. Examples include hypersalinity in lagoons and major freshwater dumping to bays at the receiving end of major canals. There is a rising trend of salinity for Estero Bay over the last decade. Of note is the contrast between annual minimums and annual peaks. 2005 had the lowest minimum and the lowest peak. 2007 had the highest minimum and the highest peak. While annual averages and peaks varied up to 30% between 2005 and 2007, minimums varied to a much greater degree. There was a 3,571% change in minimums between 2005 and 2007.

The Lee County Environmental Laboratory provided the data for all salinity analysis.




| **2006-2008 change** | |
|---|---|
| average | 9.31% |
| peak | 9.36% |
| minimum | 61.11% |

| **2005-2007 change** | |
|---|---|
| average | 50.79% |
| peak | 30.31% |
| minimum | 3571.43% |

| Year | Average | Peak | Month of Peak | Minimum | Month of Minimum |
|---|---|---|---|---|---|
| **2005** | 23.96 | 32.00 | April/May/Sept | 0.70 | July |
| **2006** | 30.46 | 37.40 | May | 3.60 | September |
| **2007** | 36.13 | 41.70 | November | 25.70 | Feb (08) |
| **2008** | 33.29 | 40.90 | October | 5.80 | September |

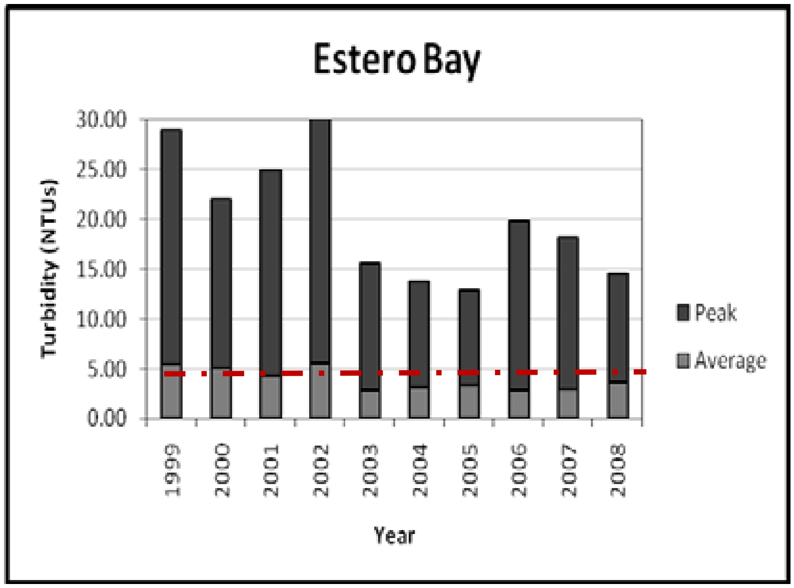
## Parameter: Turbidity

Turbidity is a measure of water clarity. It is a resultant parameter that synthesizes many environmental inputs of particles and dissolved materials, including the organics from detritus, plankton productivity, natural suspended particles and pollutants. The USEPA Nutrient Criteria for this area is 1.9 NTU, whereas the state standard is expressed as 29 or fewer NTUs above normal background levels.

**Turbidity in Estuarine Systems**

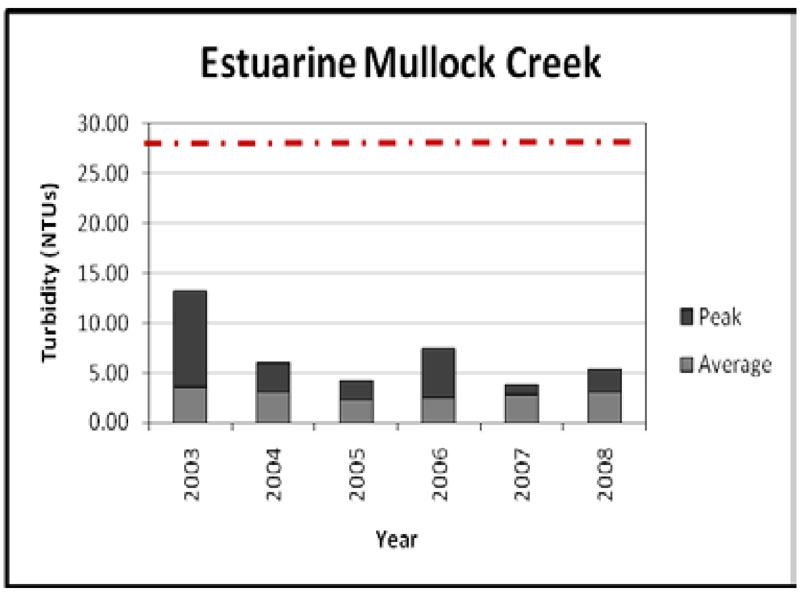
**2006-2008 change**
average +26.15%
peak -26.63%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.96 | 19.9 | December |
| **2007** | 3.06 | 18.2 | May |
| **2008** | 3.73 | 14.6 | January (09) |



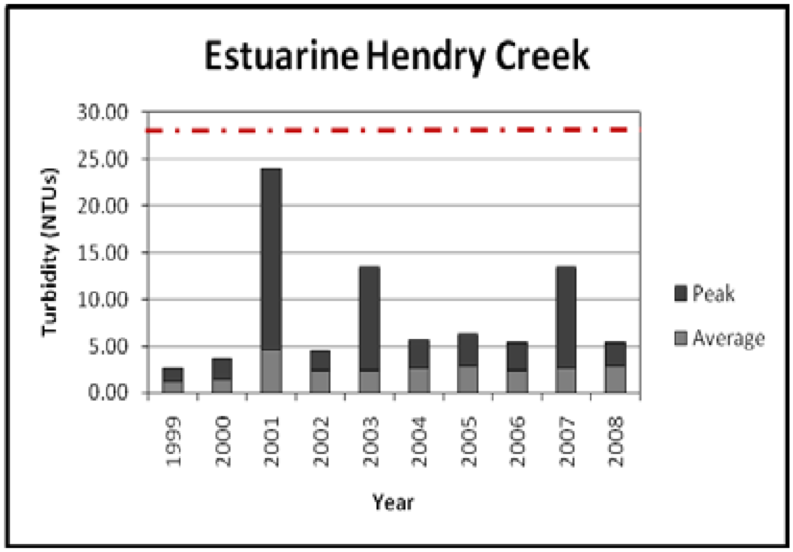

**2006-2008 change**
average +17.84%
peak -27.30%

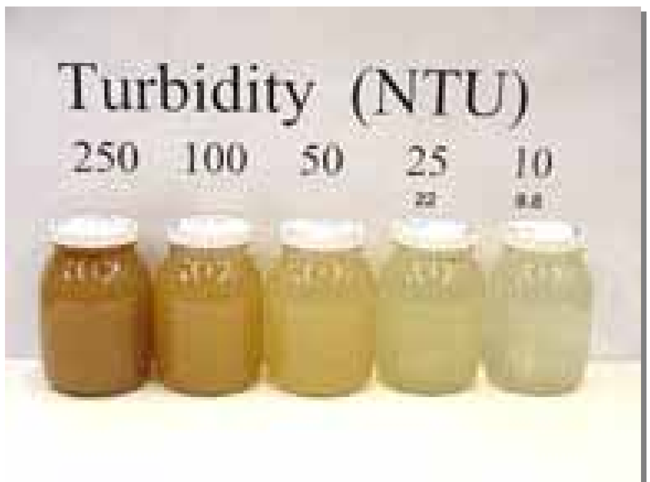
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.58 | 7.4 | August |
| **2007** | 2.85 | 3.91 | February (08) |
| **2008** | 3.04 | 5.38 | March |



**2006-2008 change**
average +22.47%
peak +0.74%

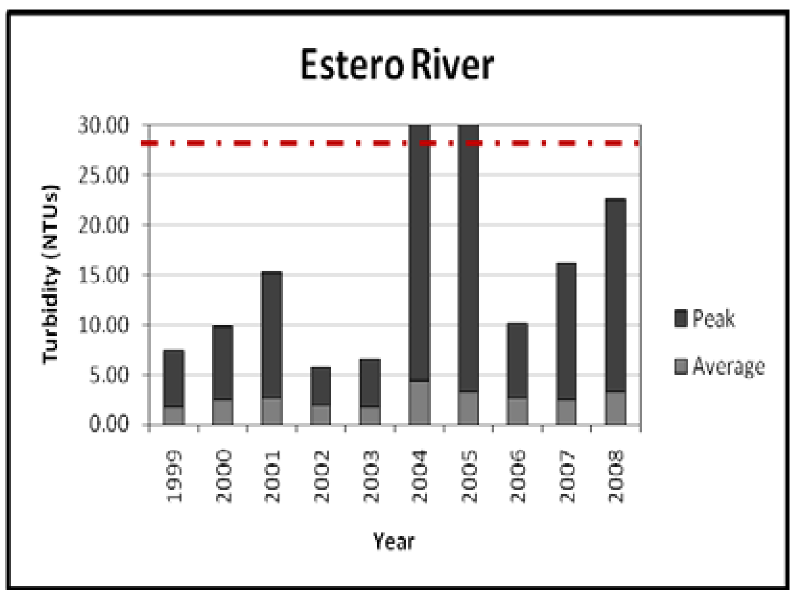
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.41 | 5.4 | January |
| **2007** | 2.68 | 13.5 | December |
| **2008** | 2.96 | 5.44 | July |



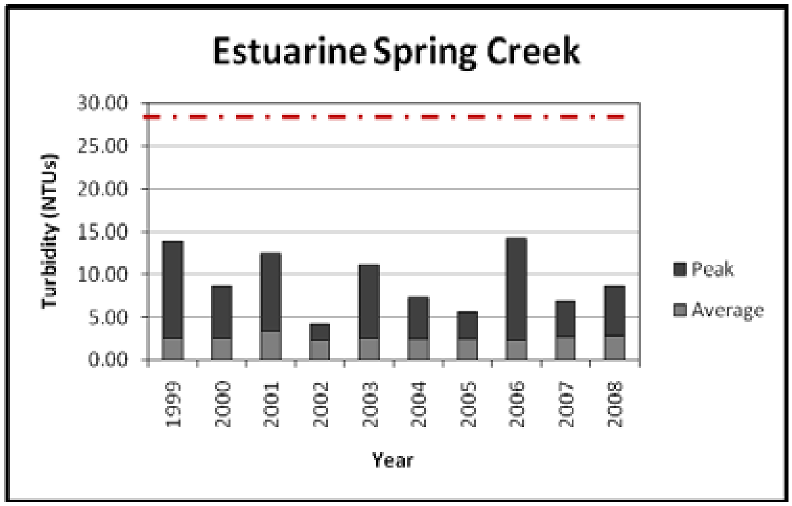

**2006-2008 change**
average +23.66%
peak +121.57%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 1.67 | 3.25 | July |
| **2007** | 1.84 | 4.82 | July |
| **2008** | 1.87 | 4.85 | June |



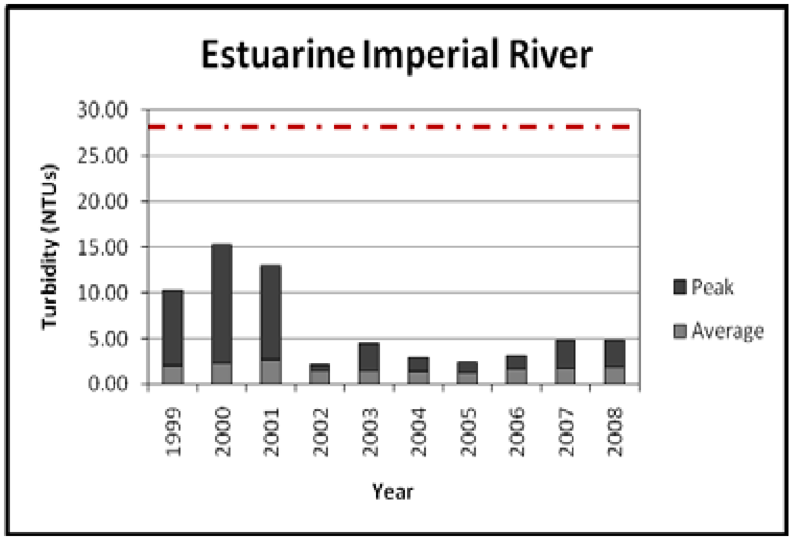
2006-2008 change
average +21.51%
peak -38.87%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 2.29 | 14.2 | May |
| 2007 | 2.67 | 6.86 | August |
| 2008 | 2.78 | 8.68 | May |




2006-2008 change
average +11.75%
peak +49.23%

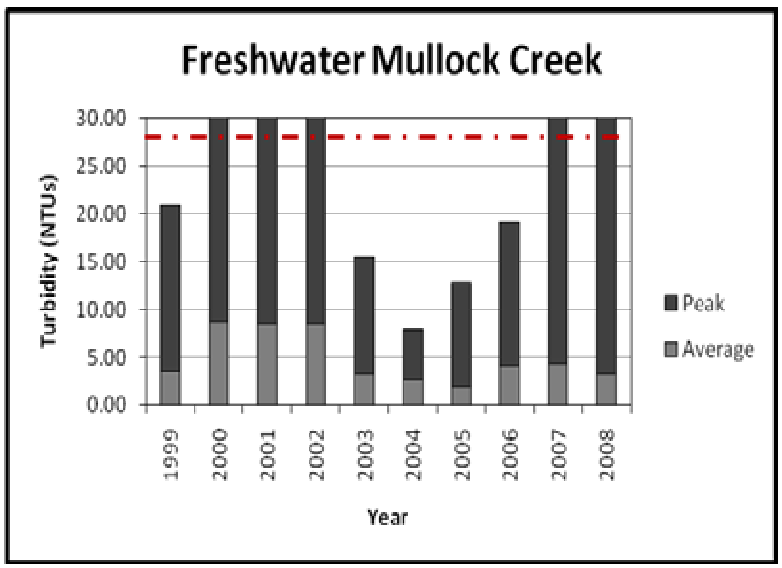
| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 1.67 | 3.25 | July |
| 2007 | 1.84 | 4.82 | July |
| 2008 | 1.87 | 4.85 | June |




## Turbidity in Fresh Systems

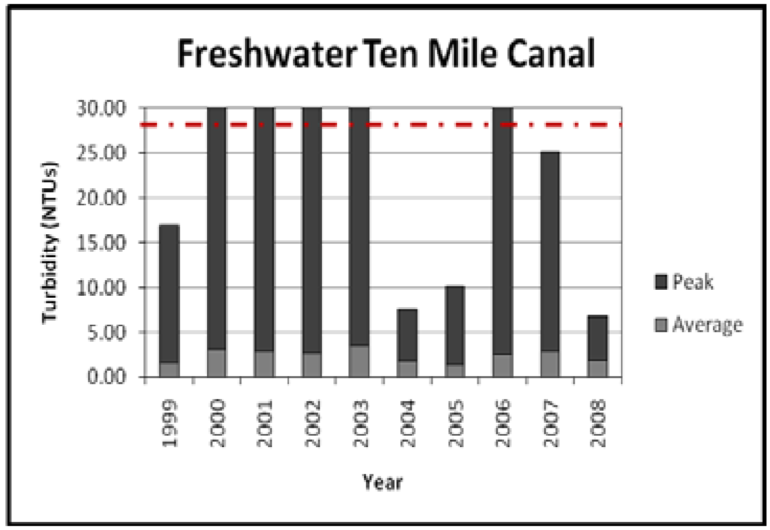
2006-2008 change
average -18.40%
peak +177.08%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| 2006 | 4.12 | 19.2 | May |
| 2007 | 4.34 | 52.9 | September |
| 2008 | 3.36 | 53.2 | June |



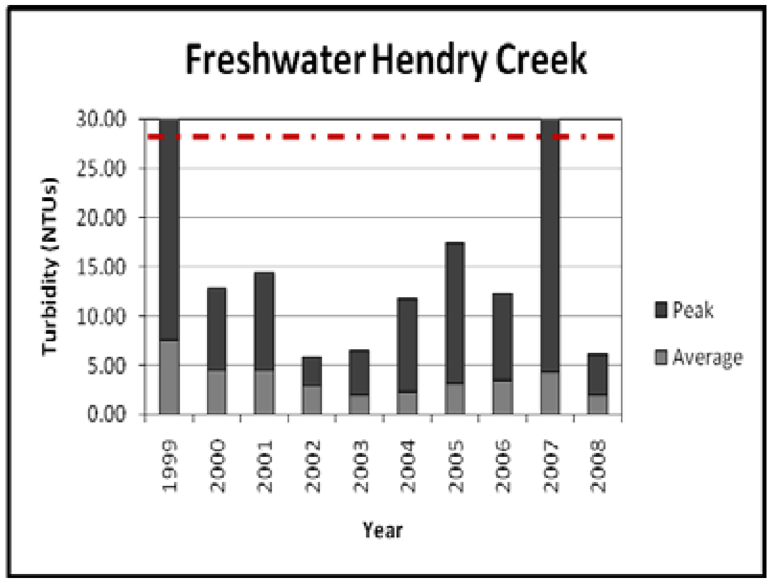
**2006-2008 change**
average -26.19%
peak -79.36%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 2.53 | 33.00 | June |
| **2007** | 2.92 | 25.20 | October |
| **2008** | 1.87 | 6.81 | April |



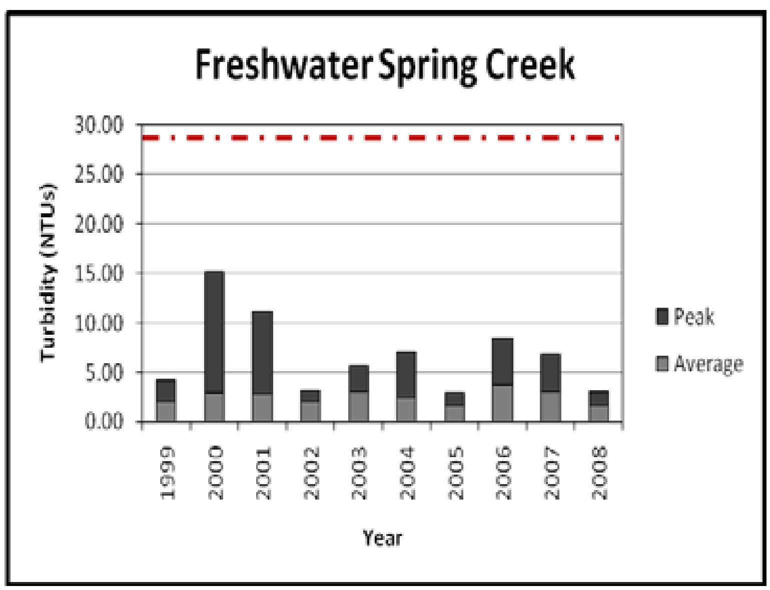

**2006-2008 change**
average -40.86%
peak -49.55%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 3.48 | 12.35 | May |
| **2007** | 4.37 | 40.80 | December |
| **2008** | 2.06 | 6.23 | January |



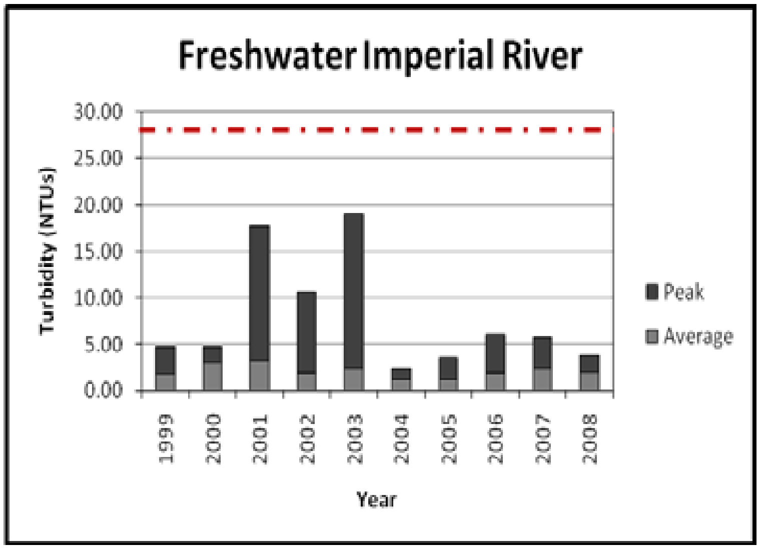

**2006-2008 change**
average -54.90%
peak -64.35%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 3.73 | 8.5 | September |
| **2007** | 3.01 | 6.76 | May |
| **2008** | 1.68 | 3.03 | March |



**2006-2008 change**
average +0.91%
peak -36.33%

| Year | Average | Peak | Month of Peak |
|---|---|---|---|
| **2006** | 1.97 | 6.00 | November |
| **2007** | 2.38 | 5.72 | October |
| **2008** | 1.99 | 3.82 | May |




## Charlotte Harbor NEP Status and Trends Assessment

The Charlotte Harbor National Estuary Program (CHNEP) completed a water quality status and trends assessment on July 27, 2007. Estero Bay was among the basins assessed. The report had the following findings and recommendations:

- Land use in the Estero Bay basin was reported to be primarily mixed wetlands (11%), upland forests (12%), pasture land (8%) and residential (4%).
- A statistically significant trend of < 5% per year was considered “shallow”. A statistically significant trend of ≥ 5% per year was considered “steep”. No steep increasing trends were found.
- A steep decreasing trend was found at 11 stations for specific conductivity (conductivity).
- Shallow increasing and decreasing trends were found for multiple parameters including ammonium, biological oxygen demand, chlorophyll-a, color, conductivity, dissolved oxygen, dissolved silica, enterococci bacteria, fecal coliform bacteria, nitrate, orthophosphate, salinity, total suspended solids, temperature, total nitrogen, total organic carbon, total phosphorus, turbidity, and pH at numerous stations.
- Shallow increasing trends for the Estero River were found for ammonium, conductivity, dissolved silica, nitrate, nitrite, orthophosphate, total suspended solids, total kjeldahl nitrogen and turbidity. Shallow decreasing trends were found for color, total suspended solids and pH at three or less stations.
- For Hendry Creek, shallow increasing trends were found for many parameters (ammonium, dissolved silica, nitrate, orthophosphate, total suspended solids, total kjeldahl nitrogen, total nitrogen and turbidity) at two or less stations for each parameter. Decreasing trends were found (chlorophyll a, color, dissolved oxygen, dissolved silica, and pH) at two or less stations for each parameter.
- For the Imperial River, shallow increasing trends were found for ammonium, fecal coliform bacteria, nitrate, nitrite and turbidity at two or less stations for each parameter. Decreasing trends were found for chlorophyll a, color, dissolved oxygen, enterococci bacteria, total suspended solids, temperature, and pH at three or less stations for each station.
- For Spring Creek, shallow increasing trends were found in surface waters for many parameters (ammonium, biological oxygen demand, conductivity, dissolved silica, fecal coliform, nitrate, nitrite, orthophosphate, total kjeldahl nitrogen, total nitrogen and turbidity) at three or less stations for each parameter. Shallow decreasing trends were found in surface water for color at three stations. Dissolved oxygen, enterococci bacteria, total suspended solids, and turbidity showed a shallow decrease at one station each.
- For Ten Mile Canal, a shallow increasing trend was found for ammonium at eight stations in surface waters. Biological oxygen demand had a shallow increasing trend at five stations in surface waters. Surface water concentrations of dissolved oxygen, dissolved silica, enterococci bacteria, nitrite plus nitrate, total nitrogen, and pH all had shallow increasing trends at two stations or less for each parameter. Fecal coliform bacteria, orthophosphate and total suspended solids had shallow increasing trends at eight, six, and five stations respectively in surface water stations. Turbidity had a shallow increasing trend at eleven stations. Shallow decreasing trends at two or less stations were found in surface waters for biological oxygen demand, chlorophyll

a, conductivity, dissolved silica, orthophosphate, total kjeldahl nitrogen, total nitrogen, and turbidity. Shallow decreasing trends for color, dissolved oxygen, temperature, and pH were found at seven, five, eleven and five stations respectively.

- The annual 1-day and 30-day flow maxima in Estero Bay appeared to be increasing, coincident with decreases in the number of low flow pulses. From these results, it may be concluded that changes to stream flow have been occurring at statistically significant rates for many streams over the period of record. Many of the strongest IHA stream flow changes were observed to occur in the Estero Bay watershed, and these locations were also locations where changes in water quality were detected. Many of the water quality changes in these areas indicated increased nutrients and suspended materials which tend to correlate with higher inflows and generally represent declining water quality condition. (Janicki Environmental, Inc. 2007)

**Number of Stations**

| Parameter | Estero Bay | Estero River | Hendry Creek | Imperial River | Spring Creek | Ten Mile Canal |
|---|---|---|---|---|---|---|
| BOD | 7 | | | | | 7 |
| Chl-a corr | 4 | | 1 | 1 | | 1 |
| Cl | | | | | | |
| Color | | 1 | | | | 2 |
| DO | 10 | 4 | 2 | 3 | 3 | 11 |
| F Coli | 1 | | | 1 | 1 | 2 |
| NH3 | 2 | | | 1 | | 3 |
| NO23 | 4 | 1 | 1 | 1 | 2 | 4 |
| NO3 | 3 | | 2 | 1 | 2 | 2 |
| pH | 3 | | | | 1 | 4 |
| PO4 | | 1 | 1 | 2 | 1 | 8 |
| Salinity | 9 | | | | | |
| SO4 | | | | | | |
| Temp | 9 | | | 3 | | 10 |
| TkN | 3 | | 1 | 1 | | 5 |
| TN | 5 | | 1 | 1 | 2 | 4 |
| TOC | | | | | | |
| TP | 3 | | | | | |
| TSS | 2 | 1 | 1 | 2 | | 4 |
| Turb | 6 | 2 | 1 | 3 | 1 | 7 |

**Percent of Station Improvements**

| Parameter | Estero Bay | Estero River | Hendry Creek | Imperial River | Spring Creek | Ten Mile Canal |
|---|---|---|---|---|---|---|
| BOD | 0% | | | | | 14% |
| Chl-a corr | 50% | | 0% | 0% | | 100% |
| Cl | | | | | | |
| Color | | 0% | | | | 100% |
| DO | 70% | 100% | 50% | 67% | 67% | 91% |
| F Coli | 0% | | | 100% | 0% | 0% |
| NH3 | 0% | | | 0% | | 0% |
| NO23 | 0% | 0% | 0% | 0% | 0% | 0% |
| NO3 | 0% | | 0% | 0% | 0% | 0% |
| pH | 0% | | | | 100% | 75% |
| PO4 | | 0% | 0% | 0% | 0% | 13% |
| Salinity | 100% | | | | | |
| SO4 | | | | | | |
| Temp | 22% | | | 0% | | 0% |
| TkN | 0% | | 0% | 0% | | 20% |
| TN | 0% | | 0% | 0% | 0% | 50% |
| TOC | | | | | | |
| TP | 33% | | | | | |
| TSS | 50% | 100% | 0% | 100% | | 25% |
| Turb | 83% | 250% | 0% | 33% | 0% | 14% |

**Percent of Station Degradations**

| Parameter | Estero Bay | Estero River | Hendry Creek | Imperial River | Spring Creek | Ten Mile Canal |
|---|---|---|---|---|---|---|
| BOD | 0% | | | | | 57% |
| Chl-a corr | 0% | | 100% | 0% | | 0% |
| Cl | | | | | | |
| Color | | 0% | | | | 0% |
| DO | 10% | 0% | 0% | 0% | 0% | 0% |
| F Coli | 0% | | | 0% | 0% | 0% |
| NH3 | 100% | | | 100% | | 100% |
| NO23 | 100% | 0% | 100% | 0% | 0% | 50% |
| NO3 | 67% | | 100% | 0% | 0% | 50% |
| pH | 0% | | | | 0% | 0% |
| PO4 | | 0% | 100% | 100% | 0% | 25% |
| Salinity | 0% | | | | | |
| SO4 | | | | | | |
| Temp | 33% | | | 0% | | 0% |
| TkN | 33% | | 100% | 100% | | 60% |
| TN | 40% | | 100% | 100% | 0% | 25% |
| TOC | | | | | | |
| TP | 0% | | | | | |
| TSS | 0% | 0% | 0% | 0% | | 0% |
| Turb | 0% | 0% | 0% | 0% | 0% | 14% |

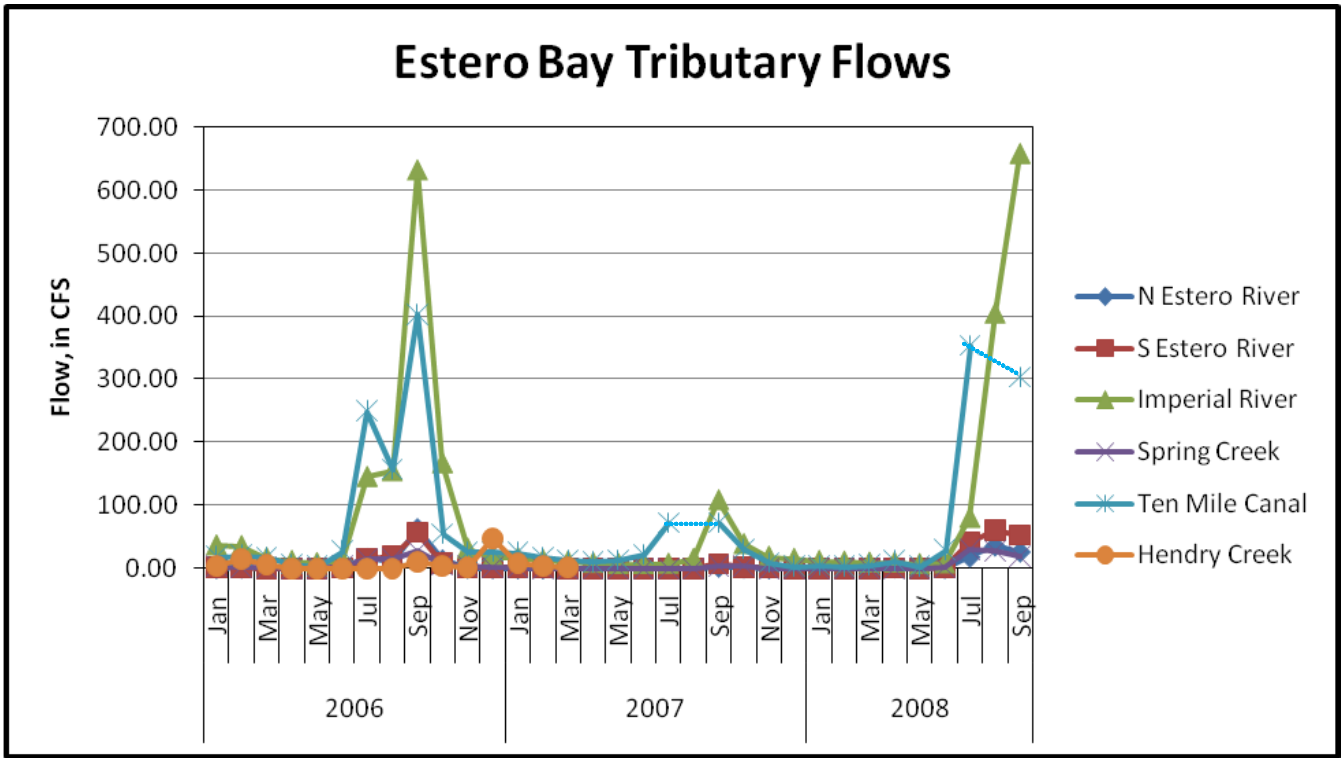
**Net Station Improvement and Degradation**

| Parameter | Estero Bay | Estero River | Hendry Creek | Imperial River | Spring Creek | Ten Mile Canal | Basin Net |
|---|---|---|---|---|---|---|---|
| BOD | 0 | | | | | -3 | **-3** |
| Chl-a corr | 2 | | -1 | 0 | | 1 | **2** |
| Cl | | | | | | | |
| Color | | 0 | | | | 2 | **2** |
| DO | 6 | 4 | 1 | 2 | 2 | 10 | **25** |
| F Coli | 0 | | | 1 | 0 | 0 | **1** |
| NH3 | -2 | | | -1 | | -3 | **-6** |
| NO23 | -4 | 0 | -1 | 0 | 0 | -2 | **-7** |
| NO3 | -2 | | -2 | 0 | 0 | -1 | **-5** |
| pH | 0 | | | | 1 | 3 | **4** |
| PO4 | | 0 | -1 | -2 | 0 | -1 | **-4** |
| Salinity | 9 | | | | | | **9** |
| SO4 | | | | | | | |
| Temp | -1 | | | 0 | | 0 | **-1** |
| TkN | -1 | | -1 | -1 | | -2 | **-5** |
| TN | -2 | | -1 | -1 | 0 | 1 | **-3** |
| TOC | | | | | | | |
| TP | 1 | | | | | | **1** |
| TSS | 1 | 1 | 0 | 2 | | 1 | **5** |
| Turb | 5 | 5 | 0 | 1 | 0 | 0 | **11** |

positive trend
neutral trend
negative trend

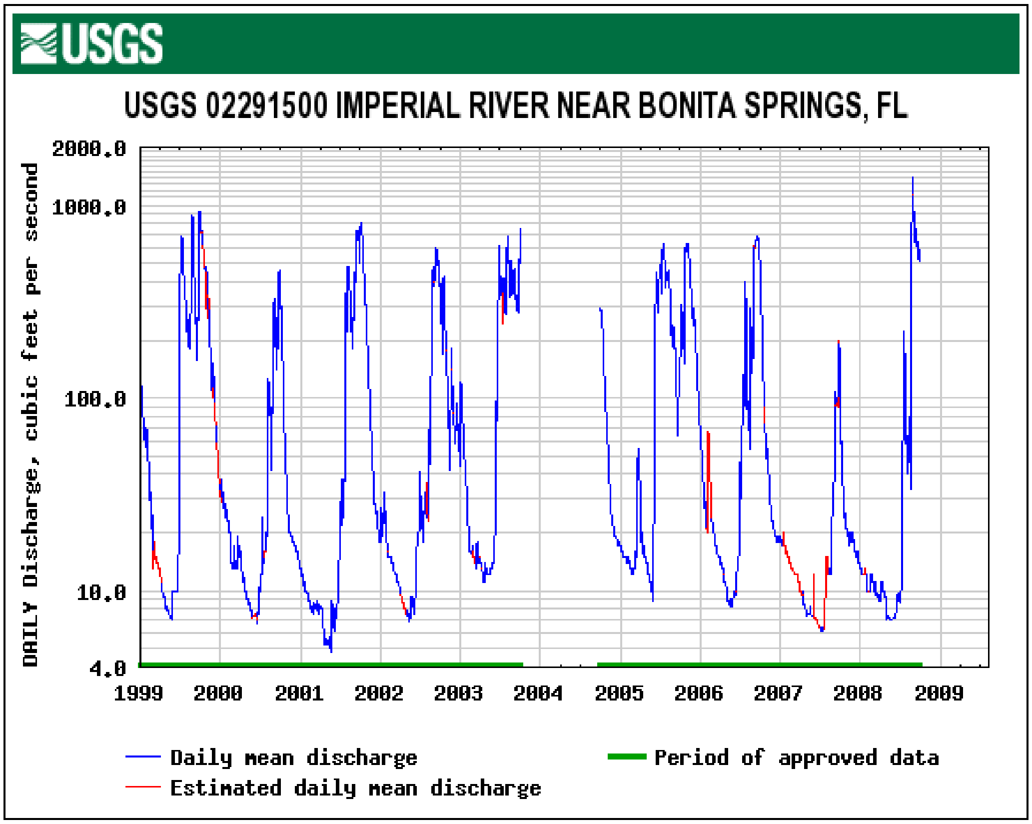
## Hydrology

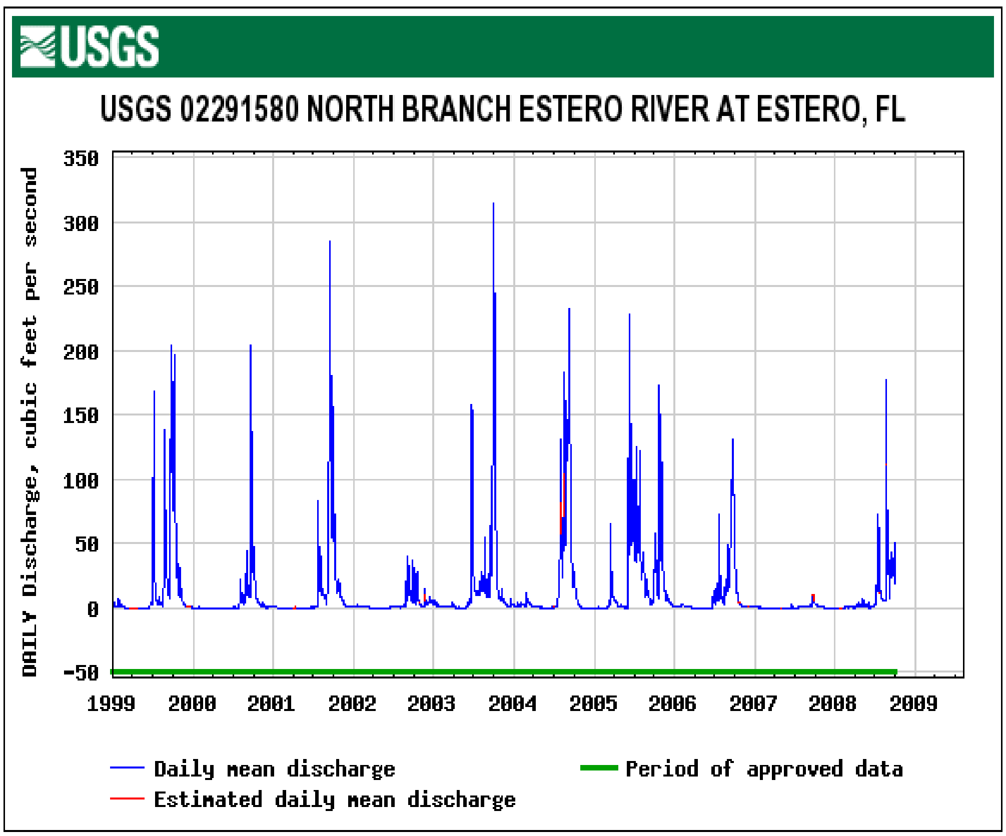
### Factor: Tributary Flows

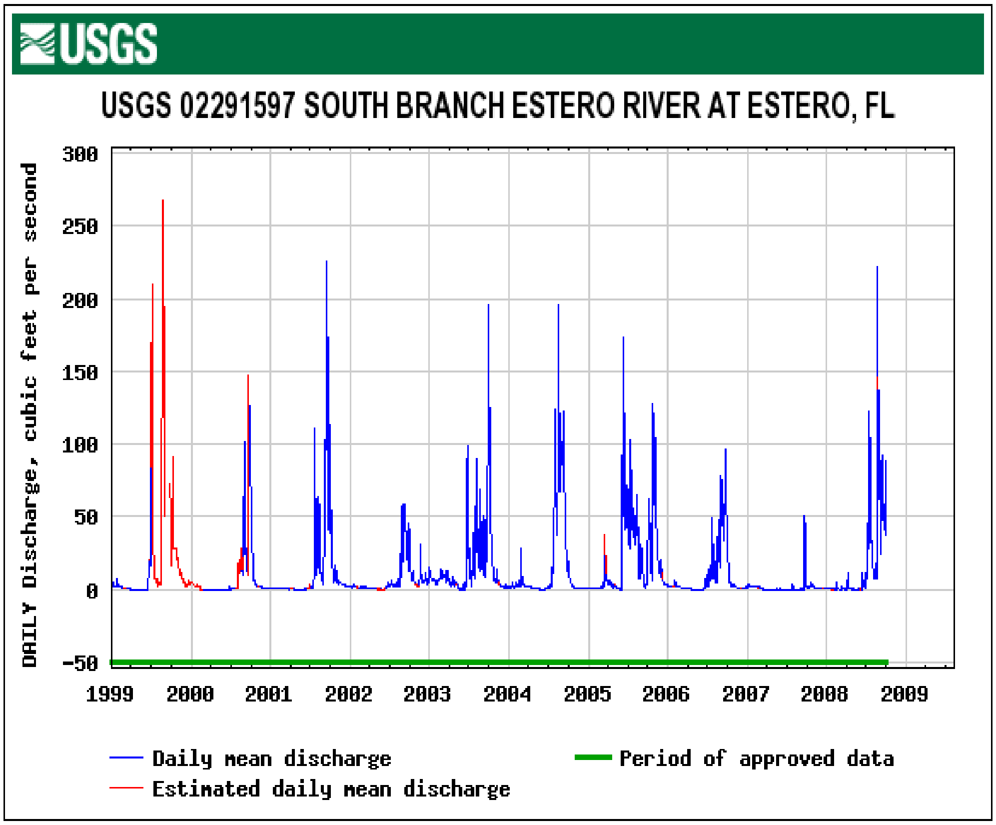


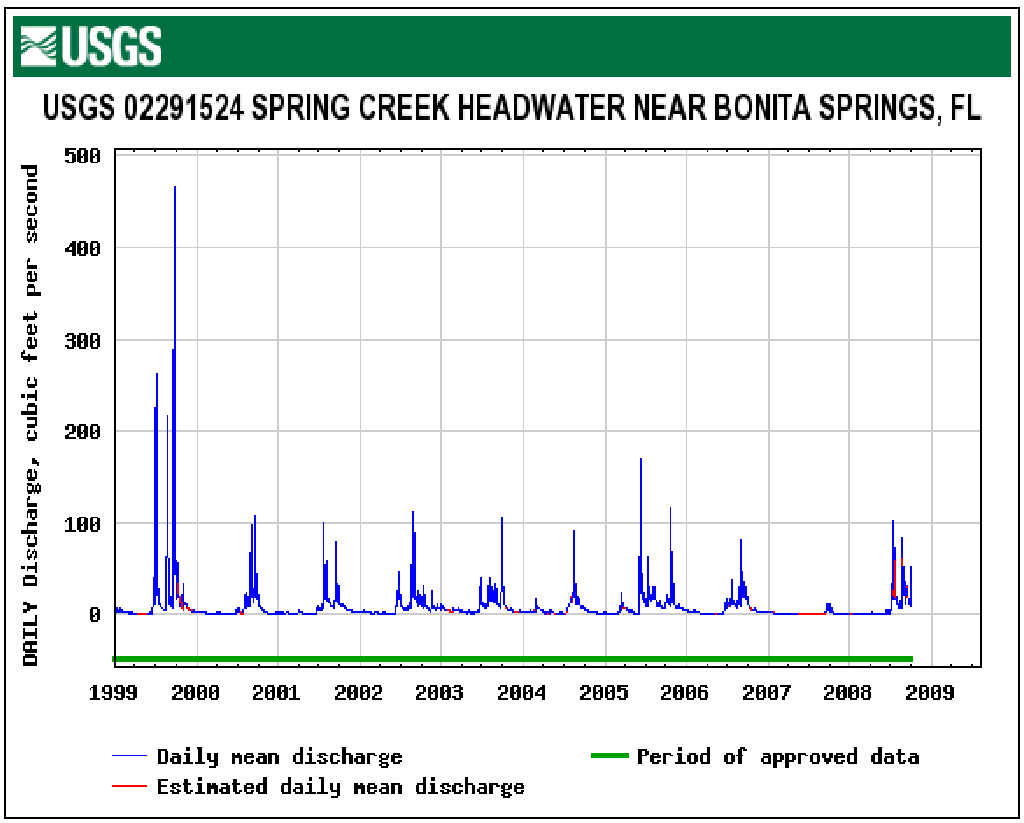

Tributary flows to Estero Bay have been altered by enhancements intended to drain land surfaces during the wet season and to retain water behind weirs and salinity barriers during the dry season. This continues to result in a spiked hydroperiod with little discharge of water during the dry season and sharp peaks during rain events, particularly when water control structures are opened. The lack of surface water retention on the landscape and the elimination of gradual sheetflow delivery to the estuary has shortened freshwater wetland hydroperiods. Surface water table elevations are rapidly lowered and drought conditions are accentuated, encouraging the invasion of exotic vegetation into wetlands and increasing the severity of fire season. Fisheries and wildlife that are dependent on depressional wetlands and riparian habitats lose valuable breeding periods and nursery habitats as the hydrologic system acts as a flush plumbing mechanism. In some areas, wading bird breeding is reduced and fails as wetlands drain too quickly and vital food concentration is lost. Amphibians, such as gopher frogs and tree frogs, are unable to complete reproductive life cycles. Under these conditions, exotic fish, amphibian and plant species fill in and flourish.

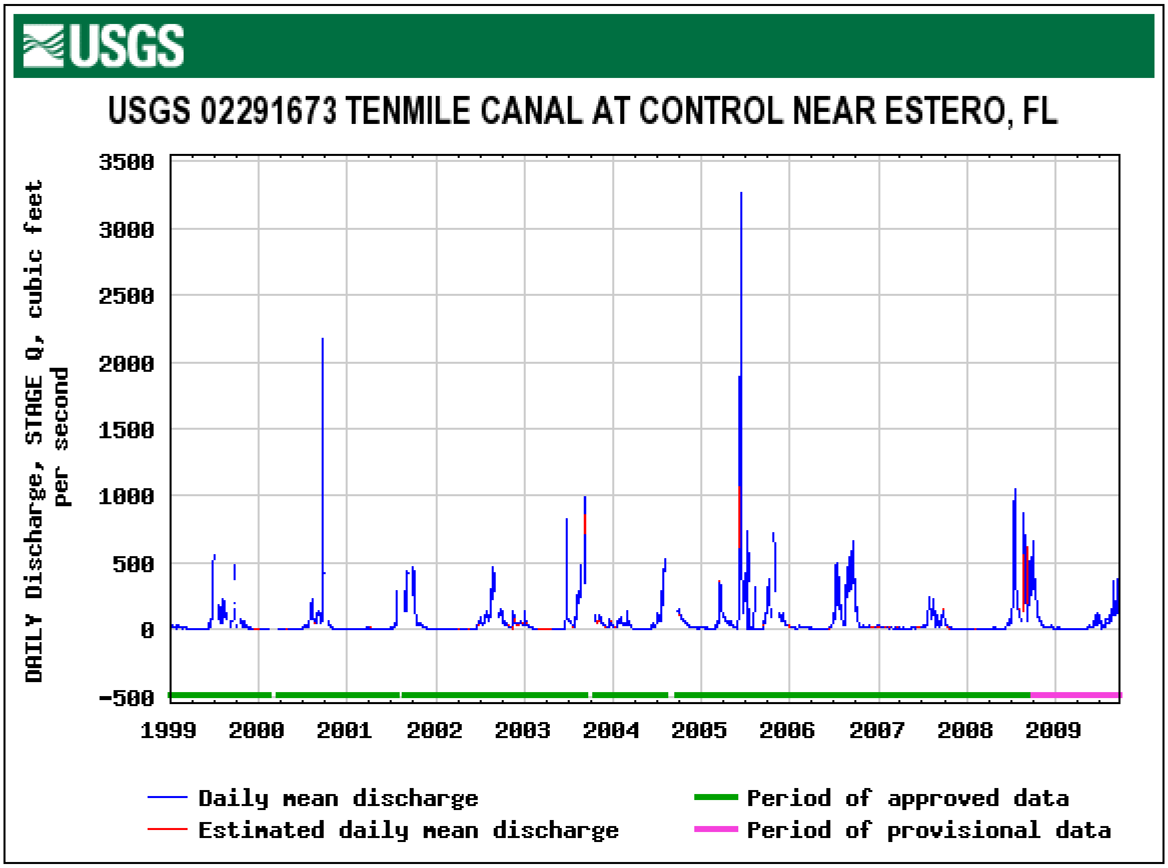
Data for analysis in this section is from the US Geological Survey (US Geological Survey 2009)


USGS
USGS 02291500 IMPERIAL RIVER NEAR BONITA SPRINGS, FL
DAILY Discharge, cubic feet per second
2000.0
1000.0
100.0
10.0
4.0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Daily mean discharge
Estimated daily mean discharge
Period of approved data


USGS
USGS 02291580 NORTH BRANCH ESTERO RIVER AT ESTERO, FL
DAILY Discharge, cubic feet per second
350
300
250
200
150
100
50
0
-50
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Daily mean discharge
Estimated daily mean discharge
Period of approved data


USGS
USGS 02291597 SOUTH BRANCH ESTERO RIVER AT ESTERO, FL
DAILY Discharge, cubic feet per second
300
250
200
150
100
50
0
-50
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Daily mean discharge
Estimated daily mean discharge
Period of approved data

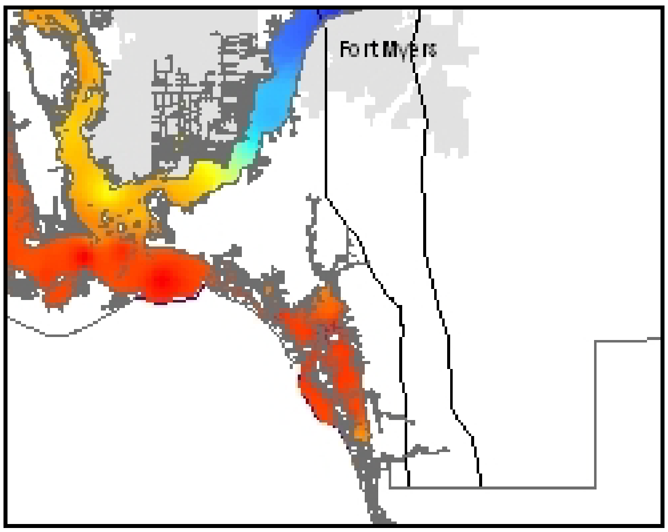

USGS
USGS 02291524 SPRING CREEK HEADWATER NEAR BONITA SPRINGS, FL
DAILY Discharge, cubic feet per second
500
400
300
200
100
0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Daily mean discharge
Estimated daily mean discharge
Period of approved data


USGS
USGS 02291673 TENMILE CANAL AT CONTROL NEAR ESTERO, FL
DAILY Discharge, STAGE Q, cubic feet per second
3500
3000
2500
2000
1500
1000
500
0
-500
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Daily mean discharge
Estimated daily mean discharge
Period of approved data
Period of provisional data

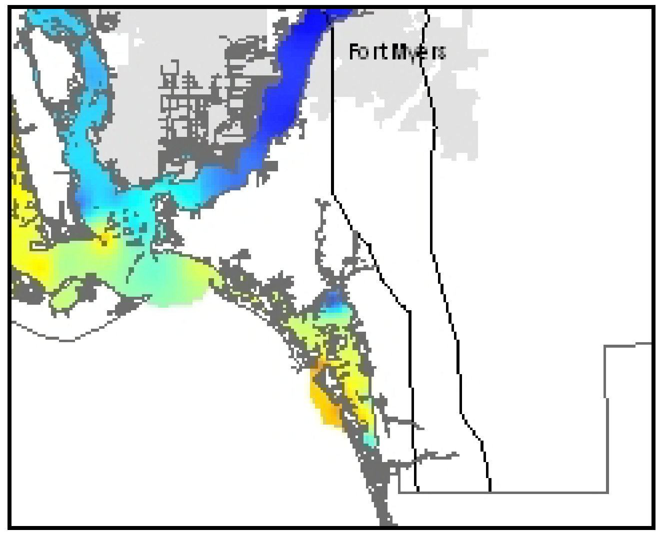
## Salinity Maps



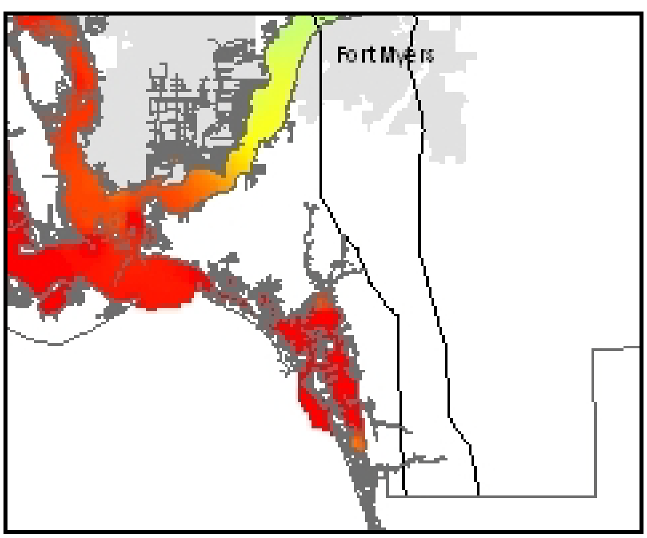
March, 2006



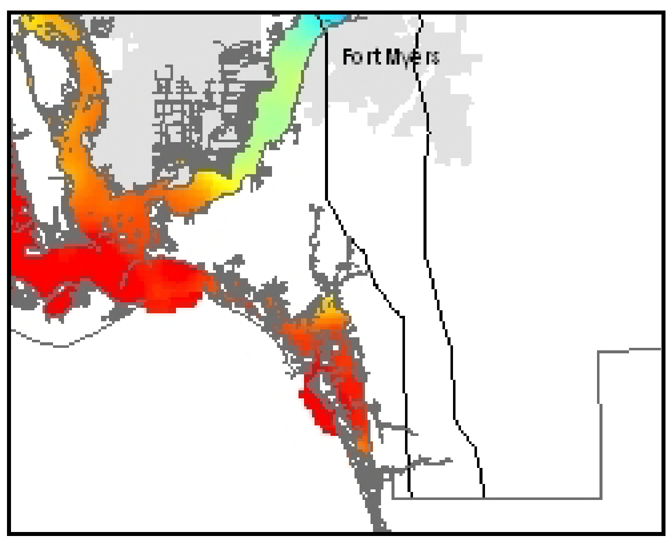

September, 2006




March, 2007

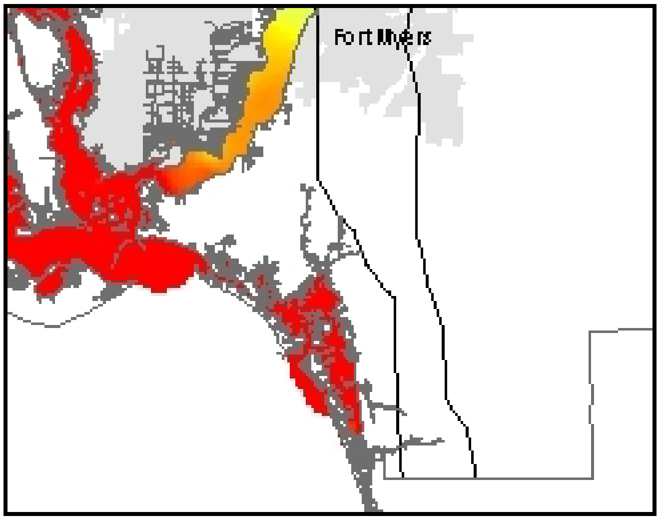



September, 2007

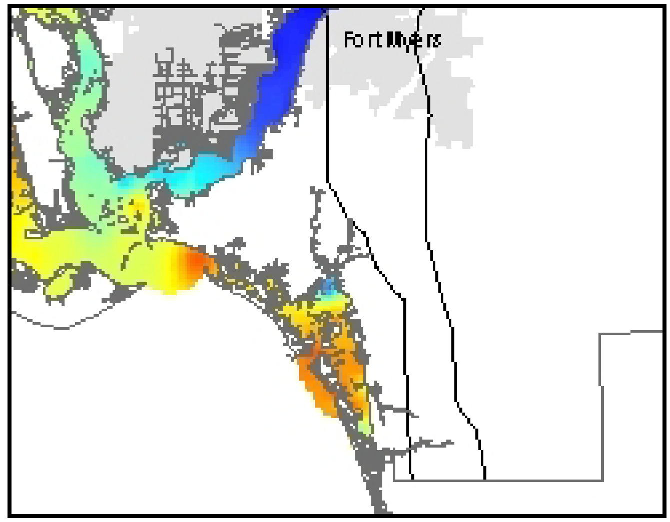




March, 2008




September, 2008




(Charlotte Harbor Environmental Center, Inc. 2006-2008)

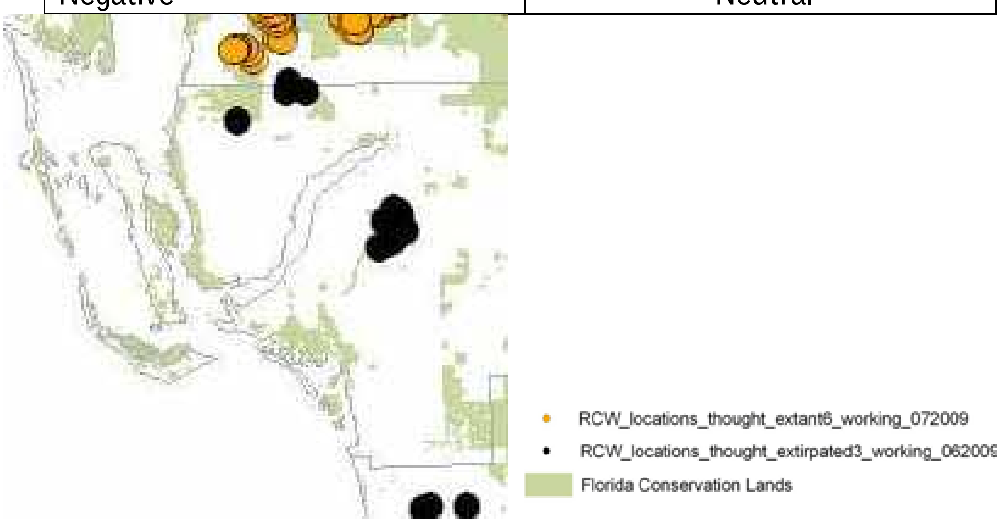
# Wildlife

## Factor: Red-Cockaded Woodpecker Presence

**Measure:** Number of Red-Cockaded Woodpecker Family Groups
**Time Frame:** 1991-2001
**Data Source:** FWC
**Level of Change:** -100% in EBABM area
**Meeting Recovery?** No

Significant loss of red cockaded woodpecker families and individuals have occurred in south and central Florida within the past eighteen years from catastrophic natural events (Hurricane Andrew), loss of foraging and nesting habitat to exotic invaders such as melaleuca and Brazilian pepper, direct violation takes, hydrologic change and land conversion from pine flatwoods to residential and agricultural landscapes lacking pines. This includes the apparent local extirpation of the red-cockaded woodpecker from in Lee County, 37% loss in Collier County west of the Big Cypress National Preserve, apparent local extinction from Sarasota, Manatee, Hillsborough, northern Hendry, and perhaps Hardee Counties in the last ten years. The average loss of clusters in the Southwest Florida Regional Planning Council Area on private lands in the past ten years is 44%.

| **2009** | X | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **% Change** | 100 | 90 | 80 | 70 | 60 | 50 | 40 | 30 | 20 | 10 | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| Negative | | | | | | | | | | | Neutral | | | | | | | Positive | | |




## Factor: Bald Eagle Nesting

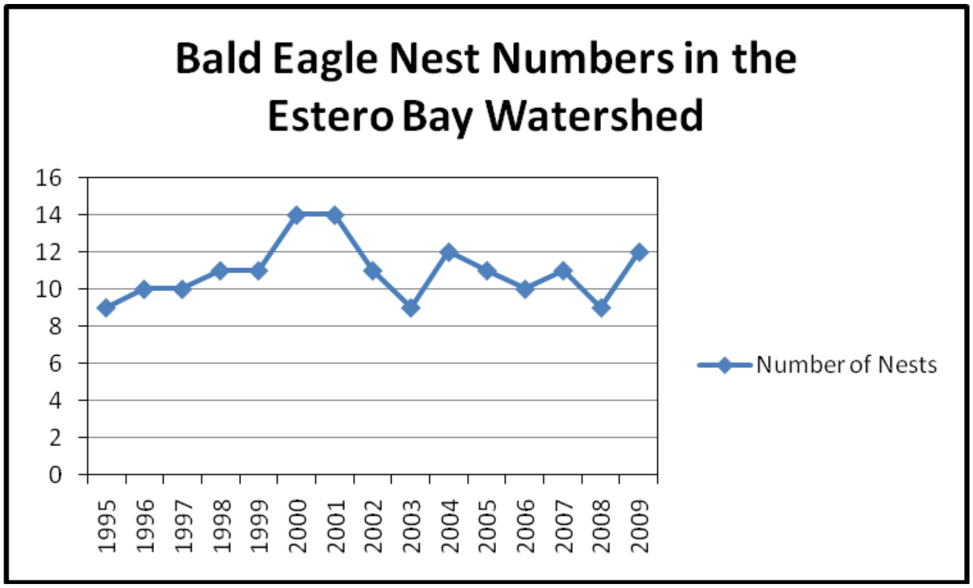
**Measure:** Number of Successful Bald Eagle Nests
**Time Frame:** 1995-2009
**Data Source:** FWC
**Level of Change:** + 33% in EBABM area
**Meeting Recovery?** Yes according to FWC

Changes in the nesting success of bald eagles have occurred in the Estero Bay Basin in response to land use changes and shifts in food resources. In 1995 there were nine bald eagle nests in the basin. By 1999 there were 11. In 2009, there were 12. The number of known nests has ranged from a low of nine in 1995, 2003, and 2008 to a peak of 14 in 2000 and 2001. In general, nests in interior locations depending on freshwater wetlands were less productive in fledging young than coastal nests. Since 2004, two new nest territories were established in the Estero Bay Basin.

In 2008, the statewide bald eagle nesting territory survey protocol changed. The protocol change reduces annual statewide survey effort and increases the amount of information gained from the nests that are visited during the survey season. Nest productivity is now determined for a sub-sample of the nests that are surveyed annually. Nest activity and productivity information are critical to determining if the goals and objectives of the Bald Eagle Management Plan are being met. A complete report of this year's survey will be available online October 1, 2009.

The information contained within the FWC database is current through the 2008-2009 nesting season; nests were surveyed by FWC from November 2008 to April 2009. Accuracy of the nest locations is estimated to be within 0.1 miles of the true location. Not all eagle nests in Florida have been documented by FWC. Non-documented nests receive the same level of protections as FWC documented nests.

| Year | Number of Nests | Success Rate |
|---|---|---|
| 1995 | 9 | 5 (55%) |
| 1996 | 10 | 6 (60%) |
| 1997 | 10 | 4 (40%) |
| 1998 | 11 | 7 (64 %) |
| 1999 | 11 | 6 (55 %) |
| 2000 | 14 | ? |
| 2001 | 14 | 10(71%) |
| 2002 | 11 | 2(18%) |
| 2003 | 9 | 2(22%) |
| 2004 | 12 | 6(50%) |
| 2005 | 11 | ? |
| 2006 | 10 | 7(70%) |
| 2007 | 11 | 4(37%) |
| 2008 | 9 | 6(67%) |
| 2009 | 12 | 5(42%) |


Bald Eagle Nest Numbers in the Estero Bay Watershed
16
14
12
10
8
6
4
2
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Number of Nests

## Factor: Florida Scrub Jay Nesting

**Measure:** Number of Successful Florida Scrub Jay Nests
**Time Frame:** 1995-2009
**Data Source**: FWC
**Level of Change:** -100% in EBABM area
**Meeting Recovery?** No

The Florida scrub jay became locally extinct in the Estero Bay Basin in the mid-1990's. At least one and perhaps two families of Florida scrub jays were found on the Chapel Ridge scrub system. Presence was confirmed during surveys by Estero Bay Aquatic Preserve biologists in 1989. The nest territories were within the proposed acquisition area for the Estero Bay Buffer Preserve CARL project. During site reviews for the development project now known as West Bay Club these jay families were no longer present. The last confirmed siting was in 1994. Unless a translocation is performed to some public land with improved scrub management there is no reasonable expectation that the Florida scrub jay will return to the Estero Bay Watershed. Since it is locally extinct future Estero Bay State of the Bay reviews will not include this species in the evaluation

| Year | Number of Nests | Success Rate |
|---|---|---|
| 1989 | 2 | 2 (100%) |
| 1993 | 1 | unknown |
| 1995 | 0 | 0 |
| 1999 | 0 | 0 |
| 2001 | 0 | 0 |
| 2009 | 0 | 0 |

## Factor: Gopher Tortoise Habitat

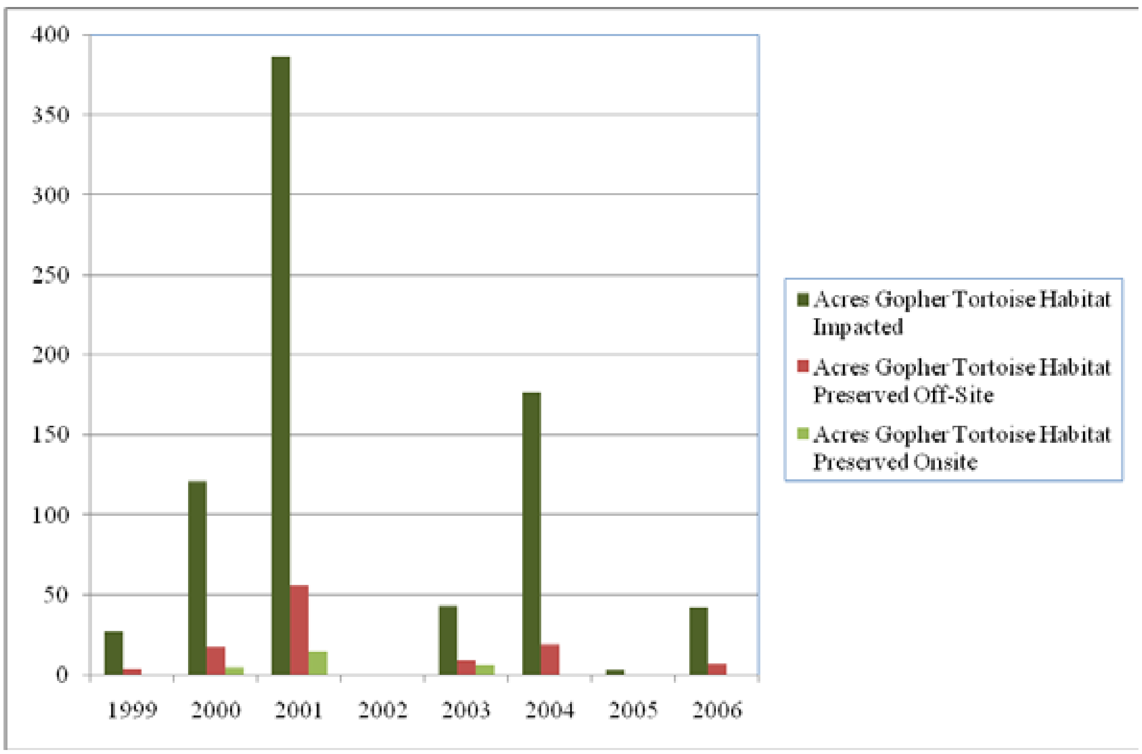
**Measure:** Acres of gopher tortoise habitat impacted
**Time Frame:** 1999-2009
**Data Source**: FWC?
**Level of Change:** -4% in EBABM area by 1999 to 2003
**Meeting Recovery?** No

The gopher tortoise utilizes dry, well-drained soils with areas of open herbaceous understory (Auffenberg 1978), including Unimproved Pastures (212), Woodland Pastures (213), Herbaceous (310), Shrub and Brushland (320), Palmetto Prairies (321), Coastal Scrub (322), Other Shrubs and Brush (329), Mixed Rangeland (330), Coniferous Forests (410), Pine Flatwoods (411),Longleaf - Xeric Oak (412), Sand Pine Scrub (413), Pine- Mesic Oak (414), Longleaf - Upland Oak (415), Other Pine (419), Upland Hardwood Forests (420), Xeric Oak (421), Brazilian Pepper (422), Oak - Pine - Hickory (423), Melaleuca (424), Temperate Hardwood Hammock(425), Tropical Hardwood Hammock (426), Live Oak Hammock (427), Cabbage Palm (428),Wax Myrtle - Willow (429), Beech - Magnolia (431), Sand Live Oak (432), Western Everglades Hardwoods (433), Hardwood - Conifer Mixed (434), Dead Trees (435), Australian Pines (437),Mixed Hardwoods (438), Other Hardwoods (439), Tree Plantations (440), Coniferous Tree Plantations (441), Hardwood (442), Forest Regeneration Area (443), Experimental Tree Plots(444), Seed Plantation (445), Beaches Other Than Swimming Beaches (710), Sand Other Than Beaches (720), Disturbed Lands (740), Rural Land in Transition Without Positive Indicators of Intended Activity (741), Borrow Areas (742), Spoil Areas (743), Fill Areas (744), and Burned Areas (745). In the year 2003, based upon FWC land cover mapping there was 40,198 acres of potential gopher tortoise habitat in the Estero Bay Watershed. Numbers in parentheses refer to FLUCCS codes.

In most of south Florida, perennially dry habitats exist as islands surrounded by a reticulation of hydric habitats. The gopher tortoise forages in both the upland and the adjacent hydric habitats when water levels recede and throughout the dry-season. The gopher tortoises that utilize natural hydric habitats construct dry-season burrows in hydric habitats, and wet-season burrows in dry, upland ridge islands. In drained Hydric Pine Flatwoods (624), gopher tortoises construct dry season burrows in the upper portions of the flatwoods.

During development review in the Estero Bay Basin, Lee County requires listed species surveys. These surveys reveal the presence of gopher tortoises and generate a measure of gopher tortoise habitat. In the course of conservation land acquisition and large scale land development, some areas are set aside as gopher tortoise habitat.

| Date | Acres Gopher Tortoise Habitat Impacted | Acres Gopher Tortoise Habitat Preserved Off-Site | Acres Gopher Tortoise Habitat Preserved Onsite | Net Gopher Tortoise Habitat Lost | Total Project Impact |
|---|---|---|---|---|---|
| **1999** | 27 | 4 | 0 | 23 | 76 |
| **2000** | 121 | 18 | 5 | 98 | 436 |
| **2001** | 387 | 56 | 15 | 316 | 1,108 |
| **2002** | 0 | 0 | 0 | 0 | 0 |
| **2003** | 43 | 9 | 6 | 28 | 88 |
| **2004** | 177 | 19 | 0 | 158 | 531 |
| **2005** | 3 | 0 | 0 | 3 | 3 |
| **2006** | 42 | 7 | 0 | 35 | 1,173 |
| **8-year total** | **800** | **113** | **26** | **661** | **3,415** |




The table and graph display the gopher tortoise incidental take permit activity for the Estero Bay Basin from 1999 through 2003. This does not include habitat losses accrued where off-site relocation or less-than-five on-site relocation permitting occurred. The effective mitigation ratio for the five year period was 1 acre of habitat preserved for every 5 acres impacted. Not all offsite mitigation occurs in the Estero Bay basin. A substantial part of this mitigation occurred at the Hickey Creek Gopher Tortoise Mitigation Park in the Caloosahatchee River basin.

## Factor: Wading Bird and Brown Pelican Rookeries

**Time Frame:** 1983-1989/1997-2001/2007-2009
**Data Source:** FWC, FDEP, Audubon
**Level of Change:** + 56% in EBABM area
**Meeting Recovery?** Not Yet

Changes in the nesting success of wading birds and brown pelicans have occurred in the Estero Bay Basin in response to land use changes, altered hydrology, and shifts in food resources. In 1986 there were nine wading bird or brown pelican rookeries in the basin. By 1999 there were six. Rookeries were lost from interior locations depending on freshwater wetlands.

There has been a significant increase in estuarine rookeries record in the FDEP monitoring of 2007- 2009. A total of 16 potential rookery sites exist and in 2009 fourteen of these were active.

The Estero Bay Colonial Water Bird Nest Monitoring and Protection Program is a cooperative effort of the Florida Department of Environmental Protection (DEP) Estero Bay Aquatic Preserves office, Audubon of Florida, Lee County, and volunteers.

Wading birds are an important indicator species for the health of the estuaries since they feed at such a high trophic level. Their indicator species status and dramatic decline since the 1930s makes their protection a necessity. Surveying and documenting trends in wading bird populations will help document the preservation of biodiversity in the Estero Bay Aquatic Preserves.

The program:
- Provides robust peak estimates of nesting efforts for each species found in the aquatic preserves, and
- Provides long term protection recommendations and monitoring techniques.

Data collected is analyzed and submitted to the South Florida Water Management District for publication in their annual *South Florida Wading Bird Report*. The report is used to follow trends in wading bird activity and to estimate the number of nesting wading birds in Florida.

Monitoring is done by visiting each island once a month during the nesting season starting as early as February and continuing as late as October. The methods used are direct counts of nesting pairs or nests on the islands by boat. Surveying is done while slowly circling the island and using high powered binoculars.

The colonial wading birds and diving birds observed nesting in the aquatic preserves are the anhinga, double-crested cormorant, brown pelican, great blue heron, little blue heron, great white heron, green heron, tricolored heron, black-crowned night-heron, yellow-crowned night heron, great egret, snowy egret, cattle egret, and reddish egret.

Volunteers play a vital role in the monitoring and protection program. With the help of volunteers the aquatic preserves staff are able to cover larger areas and monitor more islands. Volunteers are trained at the beginning of each nesting season so that everyone is consistent in their data collection techniques. Contact the Estero Bay Aquatic Preserve office at (239) 463-3240 for more information and volunteer opportunities.

In 2008 Estero Bay Aquatic Preserve's Colonial Waterbird and Nest Monitoring and Protection Program conducted bird surveys on islands within the aquatic preserve and state owned islands bordering the aquatic preserve. Islands were monitored for nesting birds monthly, starting in March and continuing through the end of nesting season in late summer. A total of 15 islands were surveyed including 13 historical nesting islands and two colonies that were initiated this season. Thirteen of the 15 islands had nesting colonies during the 2008 nesting season. The islands surveyed contained an average of 256 nests with a peak of 529 nests, between March and June.

In August several of the islands remained active with Brown Pelican, Great Egret and Double-crested Cormorant chicks still on nests. Data collected between March and June was analyzed and submitted for the first time to the South Florida Water Management District for publication in their annual *South Florida Wading Bird Report*. In the coming months while the birds are not nesting, staff and volunteers will continue with monofilament and fishing line cleanup.

| Year | Number of Active Rookeries (April) | Number of Active Rookeries(Feb-Aug) | April Nest Count | May Nest Count | Peak Nest Count (Feb-Aug) | May BRPE Count |
|---|---|---|---|---|---|---|
| 1977 | | | | | | 147 |
| 1978 | | | | | | 206 |
| 1979 | | | | | | 209 |
| 1980 | | | | | | 160 |
| 1981 | | | | | | 159 |
| 1982 | | | | | | 147 |
| 1983 | | | | 624 | | |
| 1984 | | | | 315 | | |
| 1985 | | | | 243 | | |
| 1986 | | | | 697 | | |
| 1987 | | | | 326 | | |
| 1989 | | | | 191 | | |
| 1997 | | | | | | 119 |
| 1998 | 6 | | 621 | | | |
| 2001 | 4 | | 195 | | | |
| 2007 | 13 | | 193 | | | |
| 2008 | 12 | 13 | 461 | 219 | 529 | 97 |
| 2009 | 10 | 14 | 280 | 241 | 449 | 60 |

- Species monitored 1998-2009 include: double crested cormorant (DCCO), brown pelican (BRPE), great blue heron (GBHE), great white heron (GWHE), great egret (GREG), snowy egret (SNEG), little blue heron (LBHE), tricolor heron (TRHE), reddish egret (REEG), anhinga (ANHI), black crowned night heron (BCNH), yellow crowned night heron (YCNH), green heron (GRHE), and cattle egret (CAEG).

- No Night-Herons or Green Herons were recorded during the May surveys 1983-1989. It is not clear if that was because observers did not see them or were not recording them.

- Ted Below, with Audubon and Rookery Bay, conducted surveys 1983-1987. Surveys were conducted by walking on the islands and counting nests.

**Peak numbers of nests found on Estero Bay Aquatic Preserve colonies between March and August 2008**

| Colony | DCCO | BRPE | GBHE | GWHE | GREG | SNEG | LBHE | TRHE | REEG | CAEG | BCNH | YCNH | GRHE | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Big Carlos Pass M-43 | 19 | 0 | 5 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 4 | 0 | 1 | 33 |
| Big Carlos Pass M-48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big Carlos Pass M-50&52 | 3 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 |
| Big Carlos Pass S of M-48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big Carlos Pass W of M-46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Big Carlos Pass W of M-52 | 0 | 28 | 2 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 |
| Big Hickory E of M-85 | 20 | 5 | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 36 |
| Big Hickory M-83 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 0 | 12 |
| Coconut Point East | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Coconut Point West | 8 | 33 | 1 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| Hogue Channel M-78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 3 | 10 |
| Matanzas Pass | 26 | 87 | 21 | 0 | 25 | 16 | 27 | 21 | 6 | 5 | 2 | 1 | 1 | 238 |
| New Pass M-21 | 0 | 0 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| New Pass M-9 | 13 | 28 | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| North Coconut M-4 | 7 | 0 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| Total | 97 | 207 | 63 | 3 | 53 | 16 | 27 | 23 | 6 | 5 | 9 | 15 | 5 | 529 |

**Peak numbers of nests found in Estero Bay Aquatic Preserve colonies between February and August 2009**

| Colony | DCCO | BRPE | GBHE | GWHE | GREG | SNEG | LBHE | TRHE | REEG | ANHI | BCNH | YCNH | GRHE | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Big Carlos Pass M-43 | 5 | 15 | 8 | 0 | 10 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 40 |
| Big Carlos Pass M-48 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| Big Carlos Pass M-50&52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Big Carlos Pass S of M-48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Big Carlos Pass W of M-46 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 4 |
| Big Carlos Pass W of M-52 | 10 | 11 | 1 | 0 | 12 | 0 | 0 | 3 | 0 | 1 | 2 | 0 | 0 | 40 |
| Big Hickory E of M-85 | 9 | 1 | 12 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| Big Hickory M-83 | 9 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 8 | 0 | 24 |
| Coconut Point East | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 9 |
| Coconut Point West | 13 | 26 | 5 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| Hogue Channel M-78 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 12 |
| Matanzas Pass* | 26 | 55 | 11 | 0 | 35 | 13 | 9 | 20 | 5 | 0 | 3 | 2 | 0 | 179 |
| New Pass M-21 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| New Pass M-9 | 7 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| North Coconut E of M-3 | 12 | 0 | 12 | 0 | 15 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 42 |
| North Coconut M-4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 94 | 108 | 76 | 0 | 84 | 15 | 10 | 25 | 5 | 1 | 12 | 17 | 2 | 449 |

* Surveys were not conducted at Matanzas Pass in February        Source: FDEP BAP 2009

## Factor: Amphibians

The worldwide decline in amphibians is a phenomenon that is poorly understood and may have significant implications for entire ecosystems. Amphibians have been identified as important indicators of ecosystem health due to their physiology and diversity of ecological requirements. The planetary decline in many species of amphibians has resulted in an increased level of research into their life histories. Scientists and conservation organizations all over the world have initiated monitoring projects to document the status of amphibian populations and to gain insight into why some species are declining.  In Southwest Florida very little information exists on amphibian diversity, distribution, abundance and ecology. This is unfortunate since this region is experiencing rapid land development that has led to significant loss of wetland communities on which amphibians depend. All but two species of amphibians in Southwest Florida are considered indicators of hydrologic change because they are dependent on water or wetland habitats for successful reproduction.


Eastern narrowmouth toad (*Gastrophryne carolinensis*)

The Southwest Florida Amphibian Monitoring Network represents a diverse group of citizen volunteers organized for the purpose of monitoring amphibians (mostly frogs) in southwest Florida. Early in 2000 several individuals began discussing the possibility of setting up an amphibian monitoring program in Southwest Florida based on the guidelines developed by the North American Amphibian Monitoring Program (NAAMP).  Subsequently it was decided to make an effort to launch a program and on April 15, 2000 a “kick off” workshop was held at the Calusa Nature Center and Planetarium. The project was co-sponsored by the Calusa Nature Center and Planetarium, Corkscrew Regional Ecosystem Watershed, Florida Gulf Coast University and the Audubon Society of Southwest Florida and the Charlotte Harbor National Estuary Program.


Florida cricket frog (*Acris gryllus dorsalis*)

The basic approach is to establish a route with 12 predetermined "stops" along a roadway. Volunteers monitor the "stops" at designated dates by listening for the frogs that are calling at each "stop". The information is sent to the network coordinator who summarizes the information from all routes and shares it with the NAAMP.

During 2000, eight routes were monitored on four dates during June, July, August and September. A total of 17 frog species were recorded during this period in Lee and Charlotte County.

An analysis of population trends from 2000 to 2004 was performed on the first five years of data and was presented at the CHNEP Charlotte Harbor Watershed Summit in 2005 and published in the *Florida Scientist* 69:117–126. (Both the presentation and article are available at www.CHNEP.org.) From this analysis it was determined that the calling intensity of the Cuban treefrog had increased and that there had been a shift to native frog species that require more permanent water. Permanent water habitats are less important to most anurans (frogs and toads), which have evolved to utilize ephemeral (seasonal) wetlands.

A key indicator species, the barking treefrog, appears to be declining. In 2007, seven of the nine occurrences of the barking treefrog were at just a single route near Corkscrew Swamp Sanctuary. Multiple factors including habitat loss combined with drought and declining water quality are likely responsible for this observation. The Corkscrew route is the only route representing an area with abundant wetlands that has maintained relatively stable frog diversity and abundance from 2000 to current (Southwest Florida Amphibian Monitoring Network 2008).

Frog paintings by Stephen Koury.

**Frog species observed by Frog Watch in Charlotte, Lee and Collier counties**

<u>Relatively common species:</u>
Oak toad, *Bufo quercicus*
Eastern narrowmouth toad, *Gastrophryne carolinensis*
Green treefrog, *Hyla cinerea*
Florida cricket frog, *Acris gryllus dorsalis*

<u>Rare species:</u>
Florida chorus frog, *Pseudacris nigrita verrucosa*
Florida gopher frog, *Rana areolata aesopus*

<u>“Indicator” species:</u>
Barking treefrog, *Hyla gratiosa*
Pinewoods treefrog, *Hyla femoralis*

<u>Nonnative species:</u>
Greenhouse frog, *Eleutherodactylus planirostris*
Cuban treefrog, *Osteopilus septentrionalis*
Giant toad, *Bufo marinus*
Bullfrog, *Rana catesbeiana*

During 2000, 297 monitoring events (total stops among all routes times the number of dates monitored) occurred as part of the seasonal project during the months of June through September. A total of 19 individuals participated in the monitoring network resulting in the detection of 17 species of frogs (Table 1).

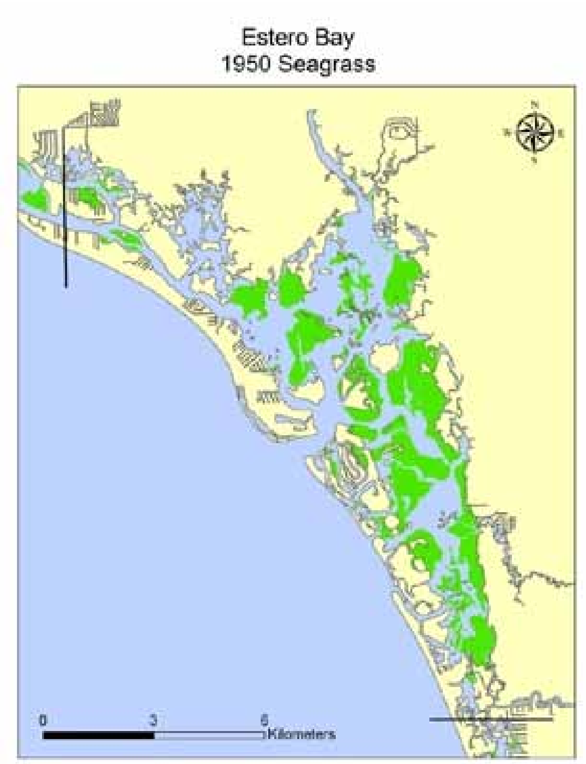
Table 1. Frog species detected and rank based on frequency of occurrence during the 2000 season. Based on 525 “detection events” (a).

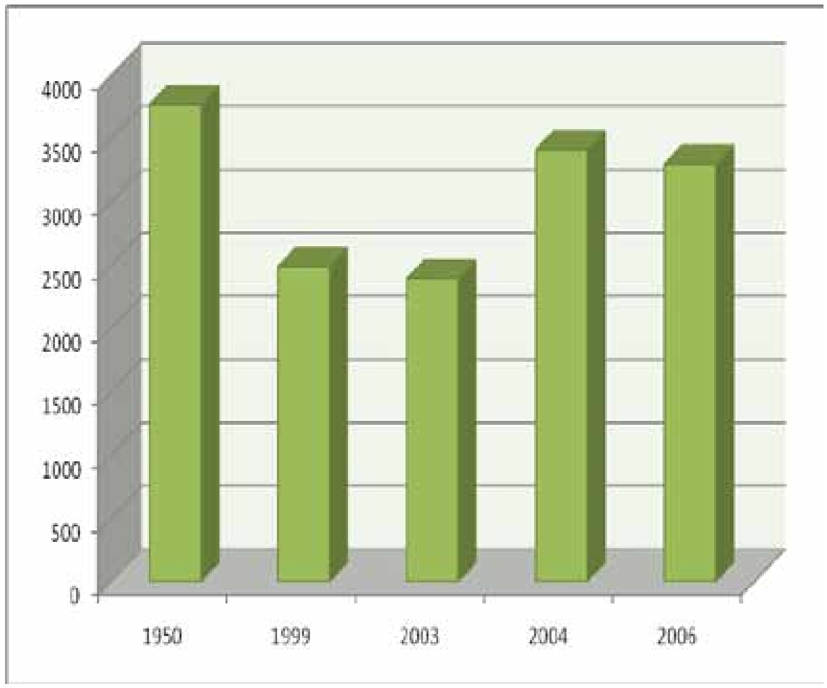
| Rank | Frog Species | % Occurrence |
|---|---|---|
| 1 | Oak toad, *Bufo quericus* | 17.1 |
| 2 | Southern toad, *Bufo terrestris* | 10.3 |
| 3 | Florida cricket frog, *Pseduacris nigrita verrucosa* | 9.0 |
| 4 | Green treefrog, *Hyla cinerea* | 8.8 |
| 5 | Squirrel treefrog, *Hyla squirella* | 7.6 |
| 6 | Greenhouse frog, *Eleutherodactylus planirostris* | 6.3 |
| 7 | Narrow-mouthed toad, *Gastrophryne carolinensis* | 5.7 |
| 8 | Pinewoods treefrog, *Hyla femoralis* | 4.8 |
| 9 | Pig frog, *Rana grylio* | 3.8 |
| 10 | Barking treefrog, *Hyla gratiosa* | 3.4 |
| 11 | Cuban treefrog, *Hyla septentrionalis* | 3.2 |
| 12 | Florida chorus frog, *Pseduacris nigrita verrucosa* | 2.9 |
| 13 | Southern leopard frog, *Rana sphenocephala* | 2.5 |
| 14 | Little grass frog, *Limnaoedus ocularis* | 0.6 |
| 15 | Eastern spadefoot toad, *Scaphiopus holbrooki* | 0.4 |
| 16 | Bull frog, *Rana catesbeiana* | 0.2 |
| 17 | Giant toad, *Bufo marinus* | 0.2 |
| 18 | none detected | 13.1 |

a=Any time a species was detected or not detected at any given stop or date.

## Factor: Seagrass Extents

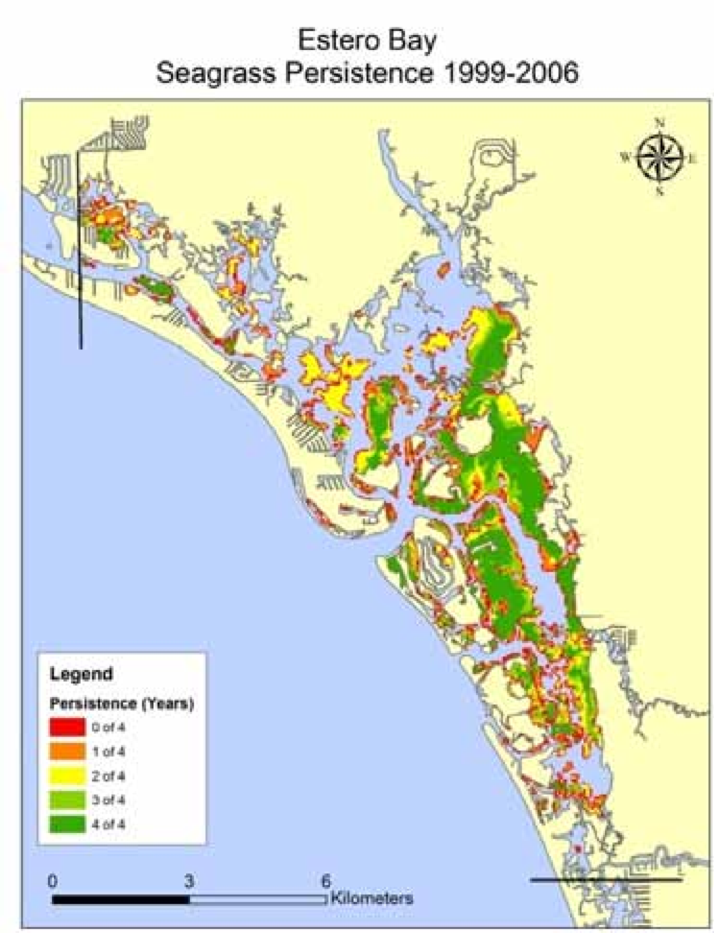
It is estimated that, in 1950, Estero Bay contained 3,769 acres of seagrasses. While seagrass acreage declined between 1950 and 1999, significant gains have been made since then. All figures and data for analysis in this section are from Janicki, Dema and Wessel (2006).




| Seagrass Acreages in SFWMD portion of the CHNEP | | | | |
|---|---|---|---|---|
| **Harbor Segment** | **1999** | **2003** | **2004** | **2006** |
| San Carlos Bay | 3,709 | 4,338 | 5,192 | 5,376 |
| Estero Bay | 2,488 | 2,393 | 3,409 | 3,298 |
| **TOTAL** | **6,197** | **6,731** | **8,601** | **8,674** |

Persistence of seagrass has also been tracked.  Persistence appears to be linked to water depth, with the most persistent areas being shallower and near-shore.





It is estimated that Estero Bay contains 107 acres of seagrasses that have been lost and are not restorable.

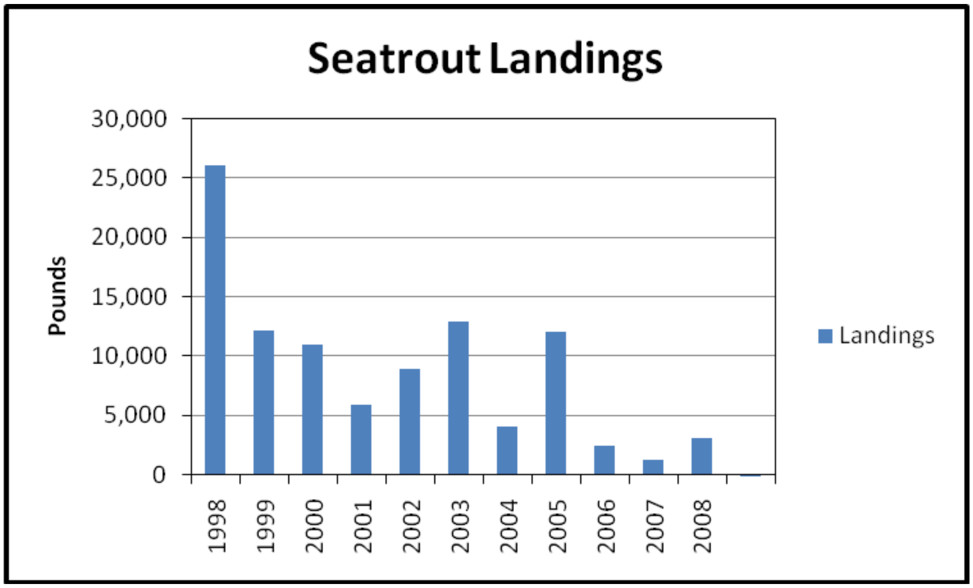
| **Baseline, non-restorable and adjusted baseline seagrass extents and potential seagrass targets (acres).** | | | |
|---|---|---|---|
| | **San Carlos Bay** | **Estero Bay** | **Total** |
| **Baseline** | 3,243 | 3,769 | 61,513 |
| **Non-restorable Areas** | 125 | 107 | 1,737 |
| **Adjusted Baseline** | 3,118 | 3,662 | 59,776 |
| **Maximum Annual Extent** | 5,376 | 3,409 | 67,415 |
| **Mean Annual Extent: all years** | 4,372 | 3,071 | 62,103 |
| **Mean Annual Extent: last 3 years** | 4,969 | 3,033 | 63,749 |
| **Most Recent Annual Extent** | 5,376 | 3,298 | 65,873 |

## Factor: Landings

Data on fisheries landings for all of Lee County were collected for Spotted Sea Trout, Mullet, and Blue Crab. Pounds (landings), number of trips and landings per trip are shown below for all three species. Landings for all three species have had a downward trend for the period between 1998 and 2008. In addition, the number of successful fishing trips for the three species has similarly declined.

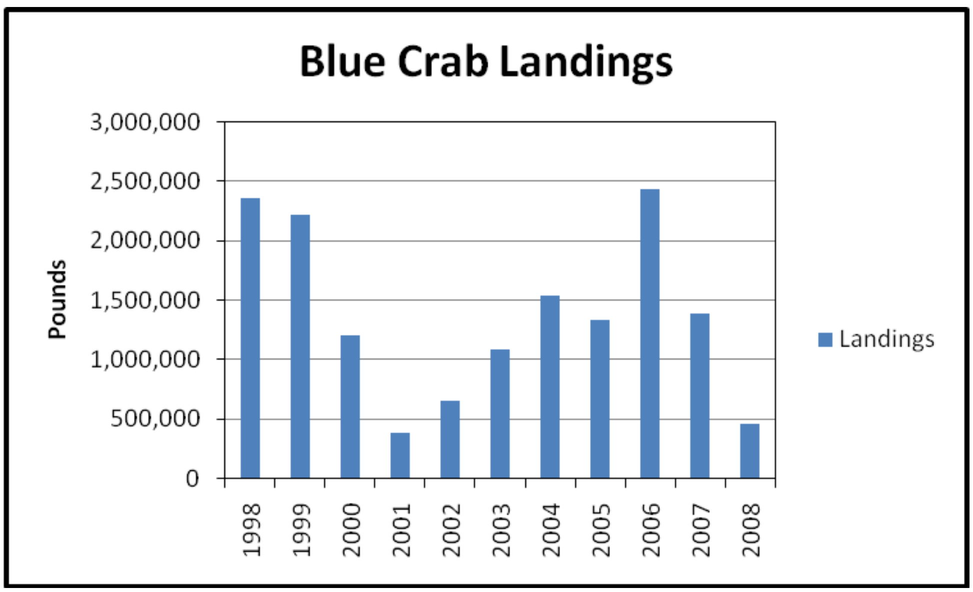
**Spotted Sea Trout**
1998-2008

| Year | Landings (pounds) | Trips | Landings/Trip |
|---|---|---|---|
| 1998 | 26,085 | 949 | 27 |
| 1999 | 12,224 | 566 | 22 |
| 2000 | 11,054 | 636 | 17 |
| 2001 | 5,975 | 369 | 16 |
| 2002 | 8,963 | 358 | 25 |
| 2003 | 12,985 | 392 | 33 |
| 2004 | 4,120 | 198 | 21 |
| 2005 | 12,113 | 359 | 34 |
| 2006 | 2,479 | 149 | 17 |
| 2007 | 1,248 | 95 | 13 |
| 2008 | 3,166 | 142 | 22 |
| **1998-2008 change** | **-88%** | **-85%** | **-19%** |



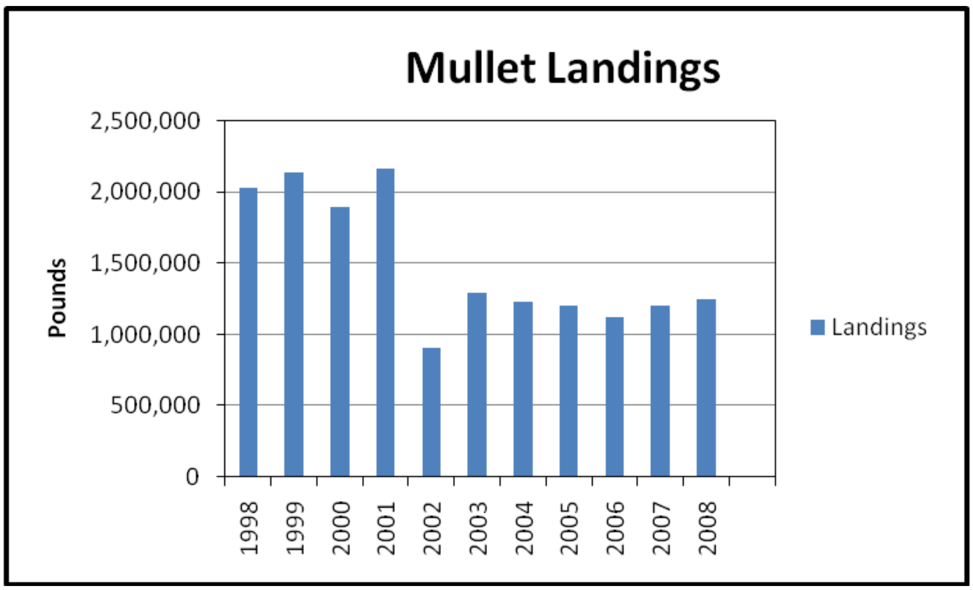
**Blue Crab**
1998-2008

| Year | Landings (pounds) | Trips | Landings/Trip |
|---|---|---|---|
| 1998 | 2,361,740 | 8,889 | 266 |
| 1999 | 2,217,971 | 8,549 | 259 |
| 2000 | 1,205,304 | 6,194 | 195 |
| 2001 | 384,724 | 3,075 | 125 |
| 2002 | 661,615 | 3,914 | 169 |
| 2003 | 1,092,288 | 4,967 | 220 |
| 2004 | 1,547,053 | 4,606 | 336 |
| 2005 | 1,338,285 | 4,708 | 284 |
| 2006 | 2,441,143 | 6,343 | 385 |
| 2007 | 1,390,276 | 5,087 | 273 |
| 2008 | 463,839 | 2,879 | 161 |
| **1998-2008 change** | **-80%** | **-68%** | **-39%** |



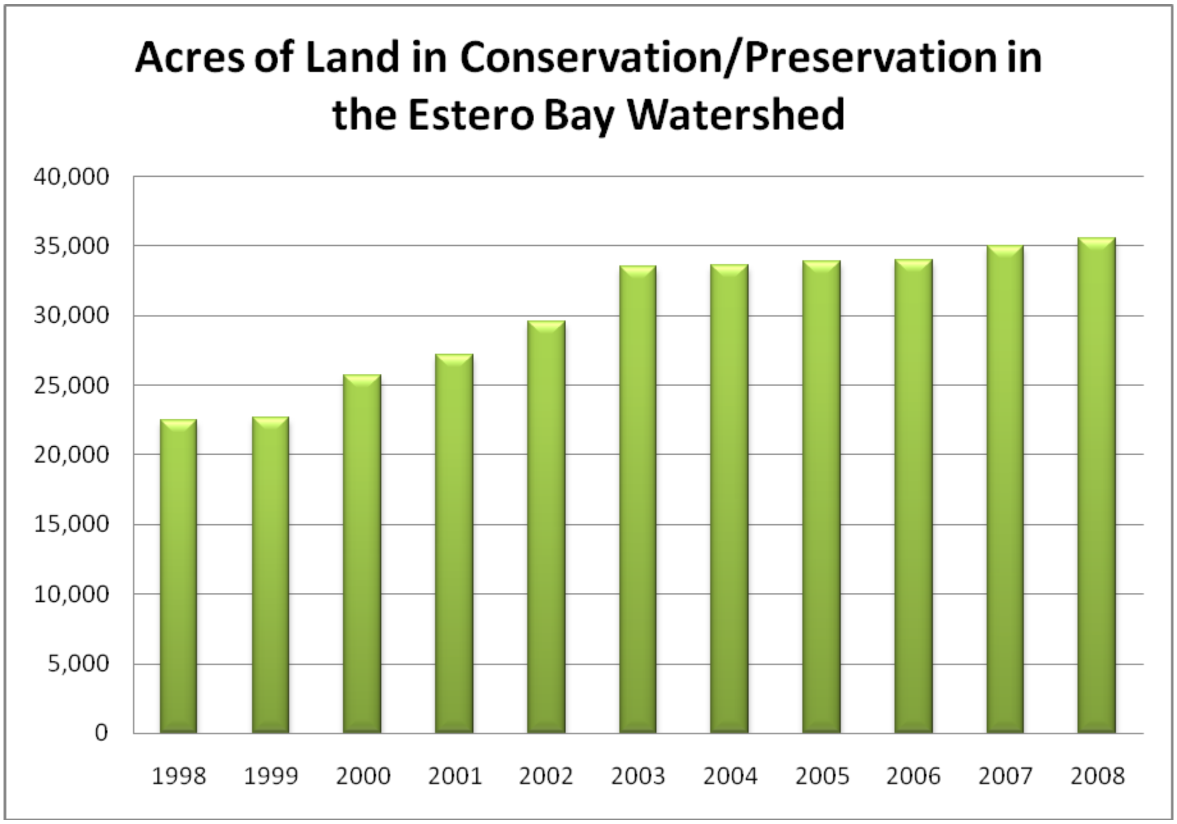
**Mullet**
1998-2008

| Year | Landings (pounds) | Trips | Landings/Trip |
|---|---|---|---|
| 1998 | 2,035,783.0 | 6,755.0 | 301.4 |
| 1999 | 2,141,311.0 | 5,904.0 | 362.7 |
| 2000 | 1,900,655.0 | 5,586.0 | 340.3 |
| 2001 | 2,168,389.0 | 5,045.0 | 429.8 |
| 2002 | 912,046.0 | 3,118.0 | 292.5 |
| 2003 | 1,296,915.0 | 3,828.0 | 338.8 |
| 2004 | 1,229,949.0 | 4,123.0 | 298.3 |
| 2005 | 1,202,347.0 | 3,888.0 | 309.2 |
| 2006 | 1,127,618.0 | 3,669.0 | 307.3 |
| 2007 | 1,202,984.0 | 3,643.0 | 330.2 |
| 2008 | 1,247,834.0 | 3,392.0 | 367.9 |
| **1998-2008 change** | **-39%** | **-50%** | **22%** |



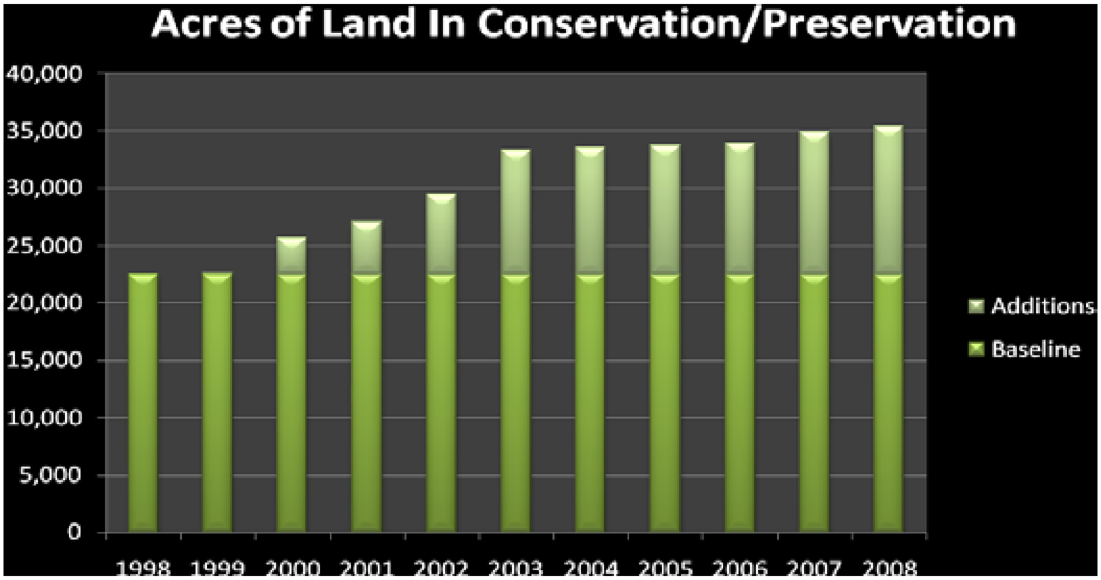
## Factor: Conservation Lands Extents

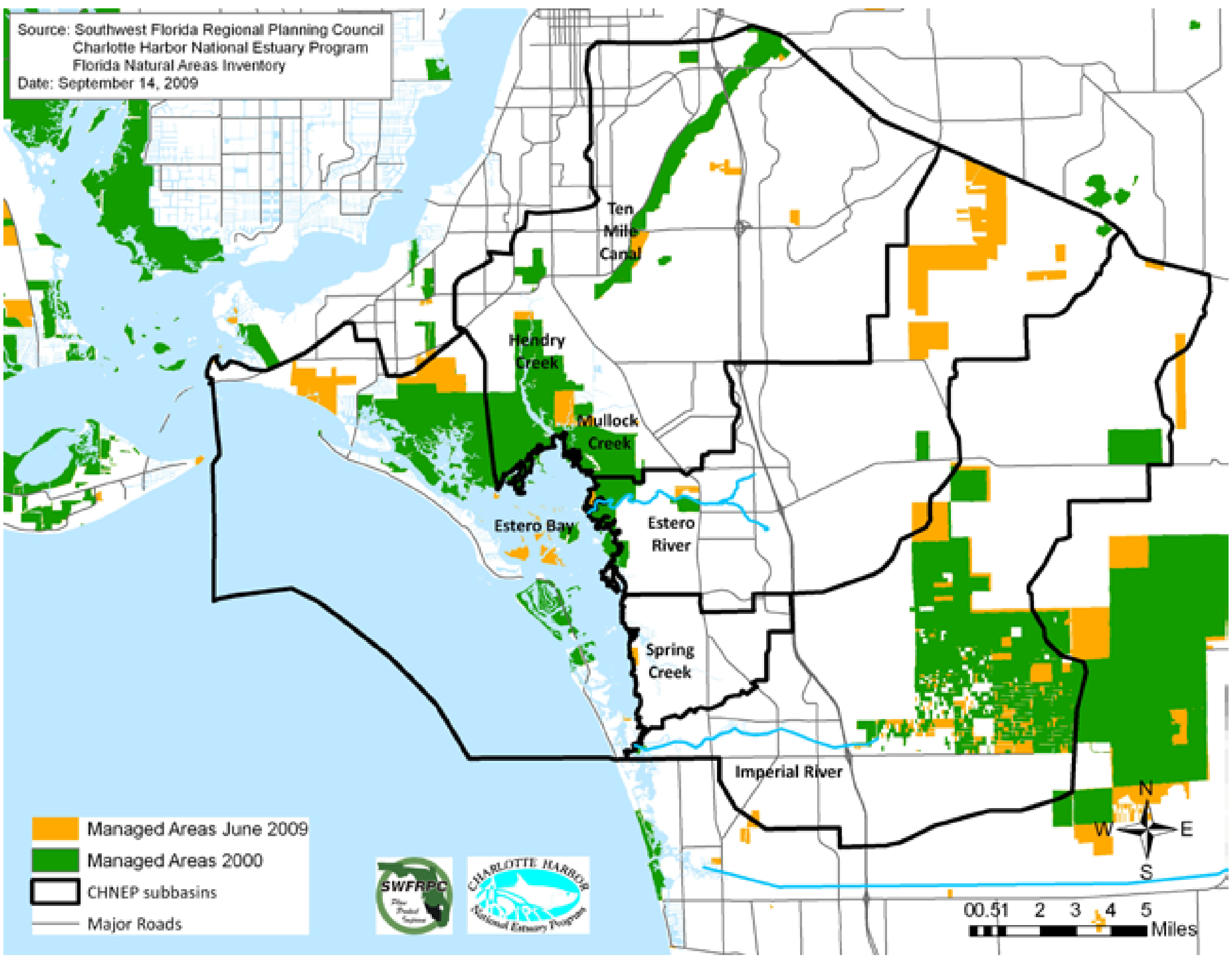
It is estimated that, in 1998, the Estero Bay watershed contained 22,502 acres of conservation lands. Significant gains (58% increase) have been made since then. All figures and data for analysis in this section are from CHNEP (2009).




| Year | Base (1998) | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acres | 22,502 | 122 | 3,032 | 1,491 | 2,429 | 3,887 | 167 | 238 | 109 | 1,042 | 511 |

| Original Target CCMP Acres | Total CCMP Additions in Acres | Total Acres | Percent Increase over Base |
|---|---|---|---|
| 5,626 (25%) | 13,027 | 35,529 | 58% |


Acres of Land In Conservation/Preservation
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Additions
Baseline

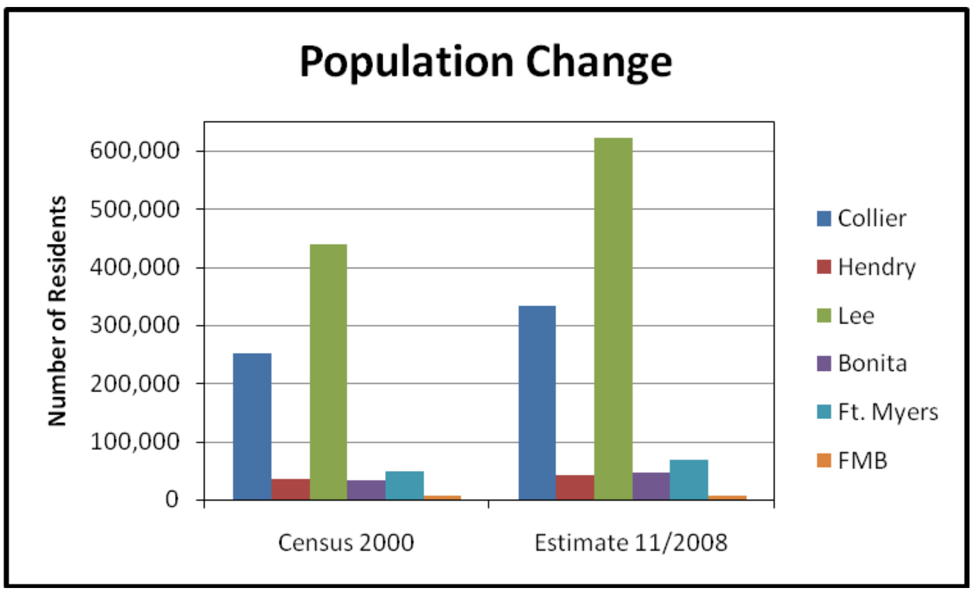

Source: Southwest Florida Regional Planning Council
Charlotte Harbor National Estuary Program
Florida Natural Areas Inventory
Date: September 14, 2009
Ten Mile Canal
Hendry Creek
Mullock Creek
Estero Bay
Estero River
Spring Creek
Imperial River
Managed Areas June 2009
Managed Areas 2000
CHNEP subbasins
Major Roads
SWFRPC
Charlotte Harbor National Estuary Program
N
W
E
S
0 0.5 1 2 3 4 5
Miles

## Social

### Factor: Population

At the time of the 2000 Census, the Estero Bay Basin had nearly 145,000 people living within its boundaries. Most of the population has been concentrated around Estero Bay itself. The presence of the Estero Bay state preserve has served as a buffer, keeping development back from the edges of the bay itself. Since the last State of the Bay report, there have been significant changes in population and development trends, most recently with a slight decline in population occurring as a result of the economic downturn of 2008-2009.

The figures below reflect population in the counties and cities that contribute to the Estero Bay Watershed. Most of the population within the watershed resides within Lee County.

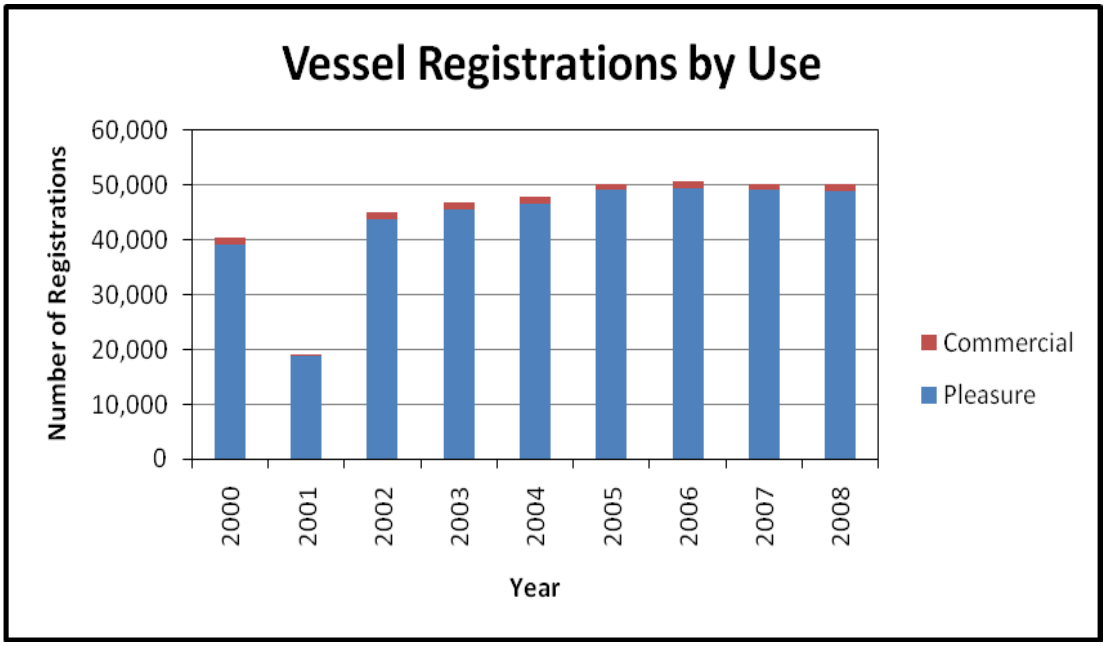


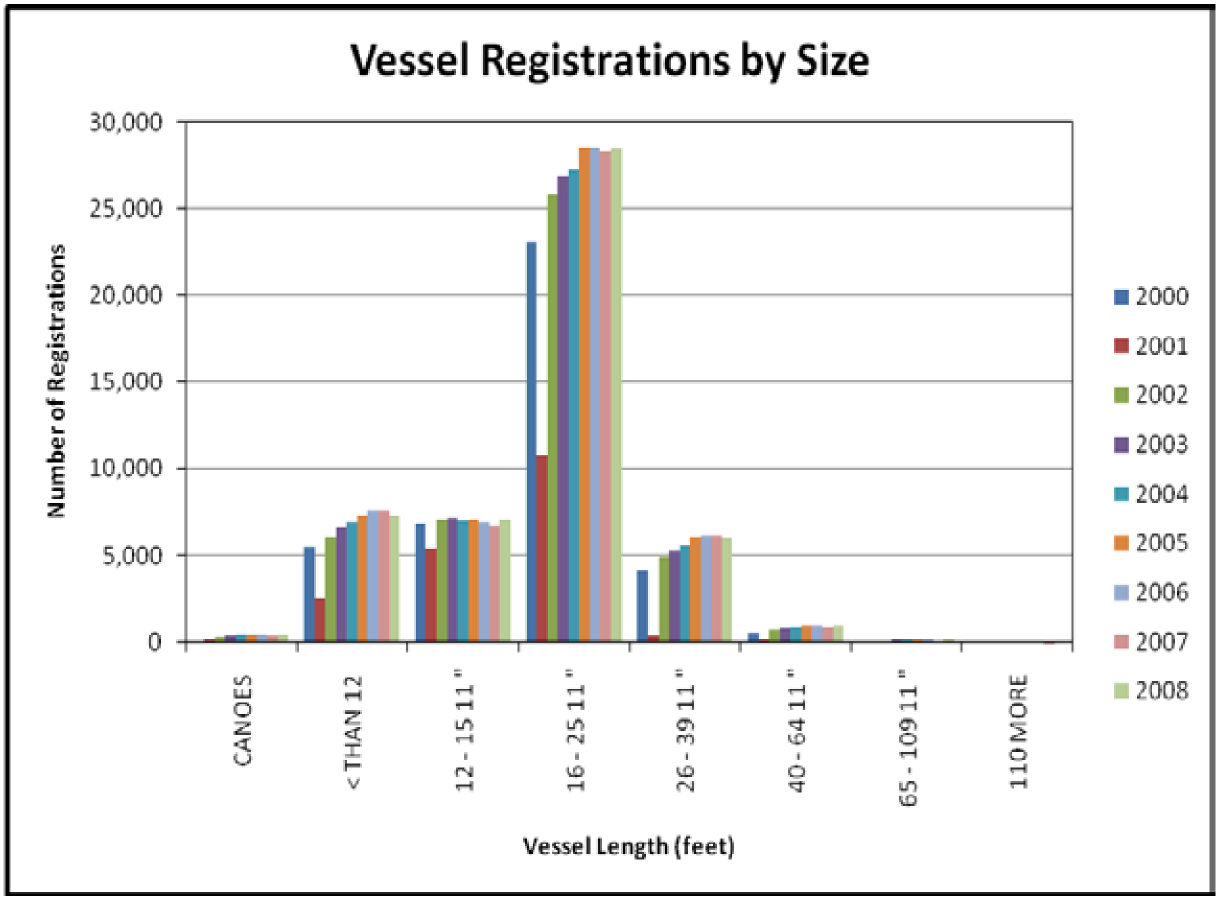

(Southwest Florida Regional Planning Council 2009)

## Factor: Boating

Vessel registrations in Lee County are dominated by recreational vessels that are less than 26 feet in length. Vessels from all over the region and from various parts of the US and Caribbean utilize and moor in the waters of Estero Bay, and many of these are not registered in Lee County, but in their home ports, so quantifying that level of utilization is very difficult. The figures below only reflect vessels that are registered in Lee County.

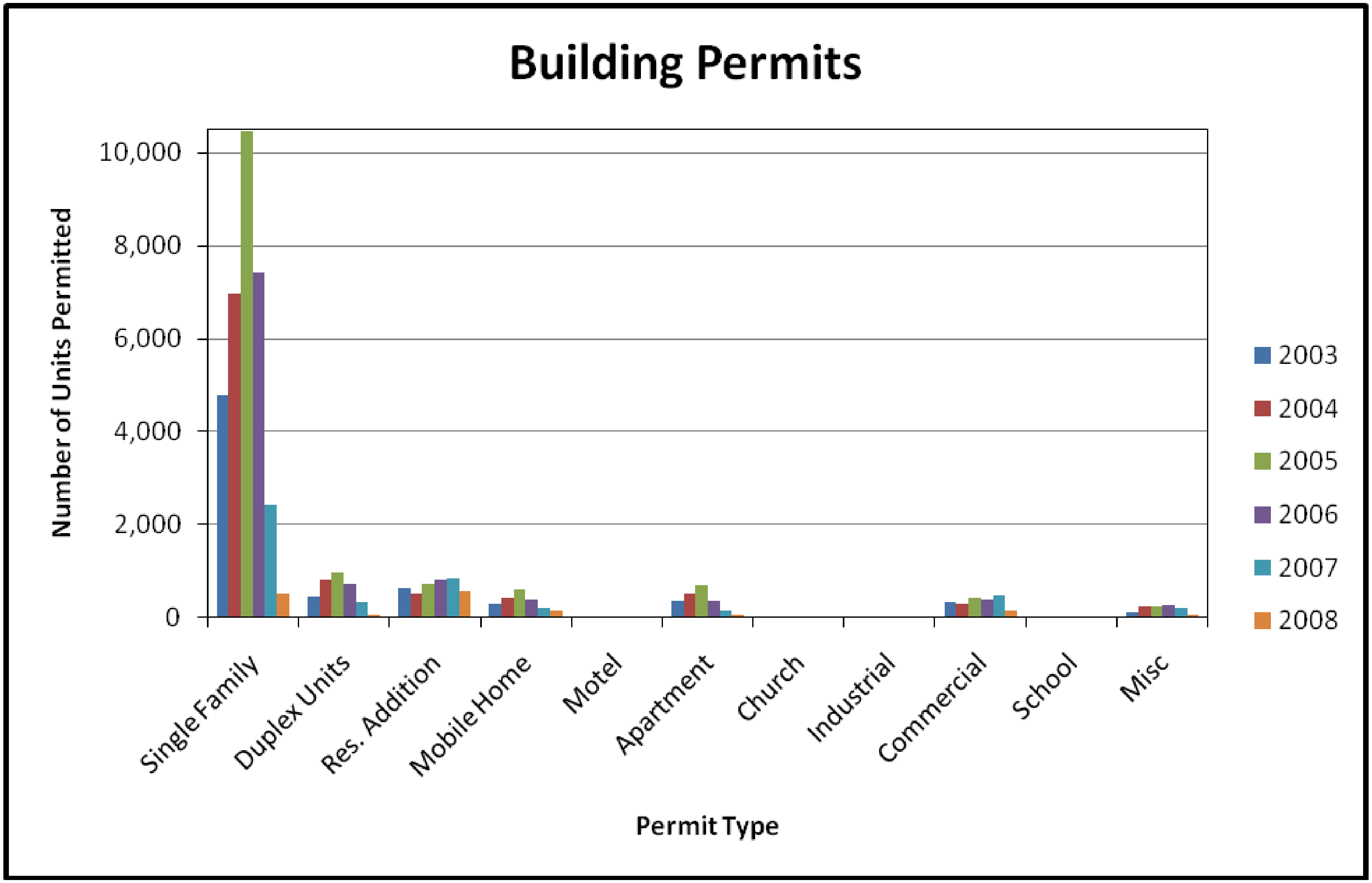
Trends in recreational vessel registrations generally reflect the state of the economy and available disposable income. While there was some growth during the beginning and middle of the period of study, the recent economic downturn may have contributed to the flattening of that trend over the last few years.




(Florida Department of Highway Safety and Motor Vehicles 2000-2008)

### Factor: Building Permits




(Lee County Department of Community Development 2003-2008)

## Discussion and Conclusions

By most measurements, growing human population continues to have an effect on Estero Bay and the natural environment of its watershed. There are many ongoing local initiatives to address indicators such as nutrients in surface waters and seagrass extent. Listed species continue to decrease in numbers and water quality, particularly with regard to nutrients, continues to degrade. Economic conditions that have flattened or reduced growth in construction and recreational boating are too recent and, likely, short-term, to have a long-term positive impact on recovery from environmental damage from expanding development. One bright exception is the increasing availability at reduced prices for conservation land acquisitions.

It is estimated that, in 1950, Estero Bay contained 3,769 acres of seagrasses. While seagrass acreage declined between 1950 and 1999, significant gains have been made since then. Persistence of seagrass has also been tracked. Persistence appears to be linked to water depth, with the most persistent areas being shallower and near-shore. It is estimated that Estero Bay contains 107 acres of seagrasses that have been lost and are not restorable. As of 2006, there were 3,298 acres of seagrasses of all species in Estero Bay.

Landings of economically important indicator species including spotted sea trout, mullet and blue crab have declined from 1998 to 2008. The number of trips taken to harvest these species has declined while landings per trip have declined for sea trout (-19%) and blue crab (-39%), but increased for mullet (22%).

Wildlife dependent upon interior habitats of the basin including xeric (dry) communities and pine forests has declined significantly. Florida scrub jays were extirpated from the basin sometime in the middle 1990's. Red-cockaded woodpeckers have declined 100% since 2001. Gopher tortoise habitat has been eliminated from the basin while being mitigated in the Caloosahatchee River basin. In contrast water dependent bird species display increases in nesting. The number of rookeries has increased, and success rates remain at 55%. Bald eagle nests have increased and success rates also remain roughly the same at 55%. Based on the work of the Southwest Florida Amphibian Monitoring Network, the calling intensity of the Cuban treefrog has increased, while a key indicator species, the barking treefrog, appears to be declining.

Existing water quality can be interpreted in many different ways and the trends vary by location and parameter. Our analysis of 2008 water quality data indicates that standards for chlorophyll-a are met in all tributaries and the bay, but Imperial River has an FDEP Water Quality Impairment. Standards for copper were met in the bay and all tributaries. For dissolved oxygen, standards were not met in estuarine reaches of Hendry and Spring Creeks and the Imperial River, and in the fresh reaches of Mullock Creek and the Imperial River. FDEP Water Quality Impairments for DO have been assigned to the fresh and estuarine reaches of Hendry Creek and the Imperial River, the Estero River, and the fresh reaches of Mullock Creek and Ten Mile Canal. Fecal coliform standards were exceeded in freshwater and estuarine Imperial River and Spring Creek, estuarine reaches of Hendry Creek and Estero River, and freshwater Mullock Creek. FDEP Water Quality Impairments for fecal Coliform have been assigned the totality of the Imperial River, the estuarine reaches of Hendry Creek and the Estero River, and the fresh reaches of Mullock Creek. USEPA standards for total nitrogen are exceeded in estuarine Hendry Creek, and the fresh reaches of Mullock Creek, Ten Mile Canal and the Imperial River. USEPA standards for total phosphorus are exceeded in Estero Bay and all reaches of all tributaries with the exception of fresh Spring Creek. State standards for turbidity were not exceeded in the Bay or any tributaries. The development of numeric state standards for nutrients will have an impact in the future on the "impaired" status of many of the state's water bodies.

The Charlotte Harbor National Estuary Program (CHNEP) completed a water quality status and trends assessment on July 27, 2007. Estero Bay was among the basins assessed. The status applied to 1995-2005. The study found no steep (≥ 5% per year) increasing trends. A steep decreasing trend was found for conductivity. Shallow (< 5% per year, but still statistically significant) increasing and decreasing trends were found for multiple parameters including ammonium, biological oxygen demand, chlorophyll a, color, conductivity, dissolved oxygen, dissolved silica, enterococci bacteria, fecal coliform bacteria, nitrate, orthophosphate, salinity, total suspended solids, temperature, total nitrogen, total organic carbon, total phosphorus, turbidity, and pH at numerous stations in Estero Bay. Continuing urban development has led to flashier hydrology. The Estero Bay basin has shown water quality degradation even though most of the area has been designated an Outstanding Florida Water during most of the trends period.

Solving problems with habitat loss, alterations in hydrology, and declines in fisheries and wildlife will require more than nutrient management. Although the recent economic downturn has slowed the rate of growth in the watershed, it is important to note that, during the period of this study, 43,892 residential building permits were issued, indicating a very high rate of growth and development across Lee County. The Lee County Mitigation Plan is the type of integrated restoration and acquisition plan that can address issues of biodiversity, hydrology, and water quality. The solution to pollution in the Estero Bay basin will occur on a landscape scale, requiring Smart Growth, and including areas without growth (such as the Density Reduction Groundwater Recharge (DRGR) area), that allow the Estero Bay ecosystem to provide the many invaluable natural functions and services that provide clean water, natural hydrology and fish and wildlife resources.

The Estero Bay Agency on Bay Management will continue participate in these important public private partnerships for nutrient management, biodiversity, hydrologic and water quality restoration. If these projects are successfully implemented, we anticipate an improved State of the Bay when the next report is issued in 2014.

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