

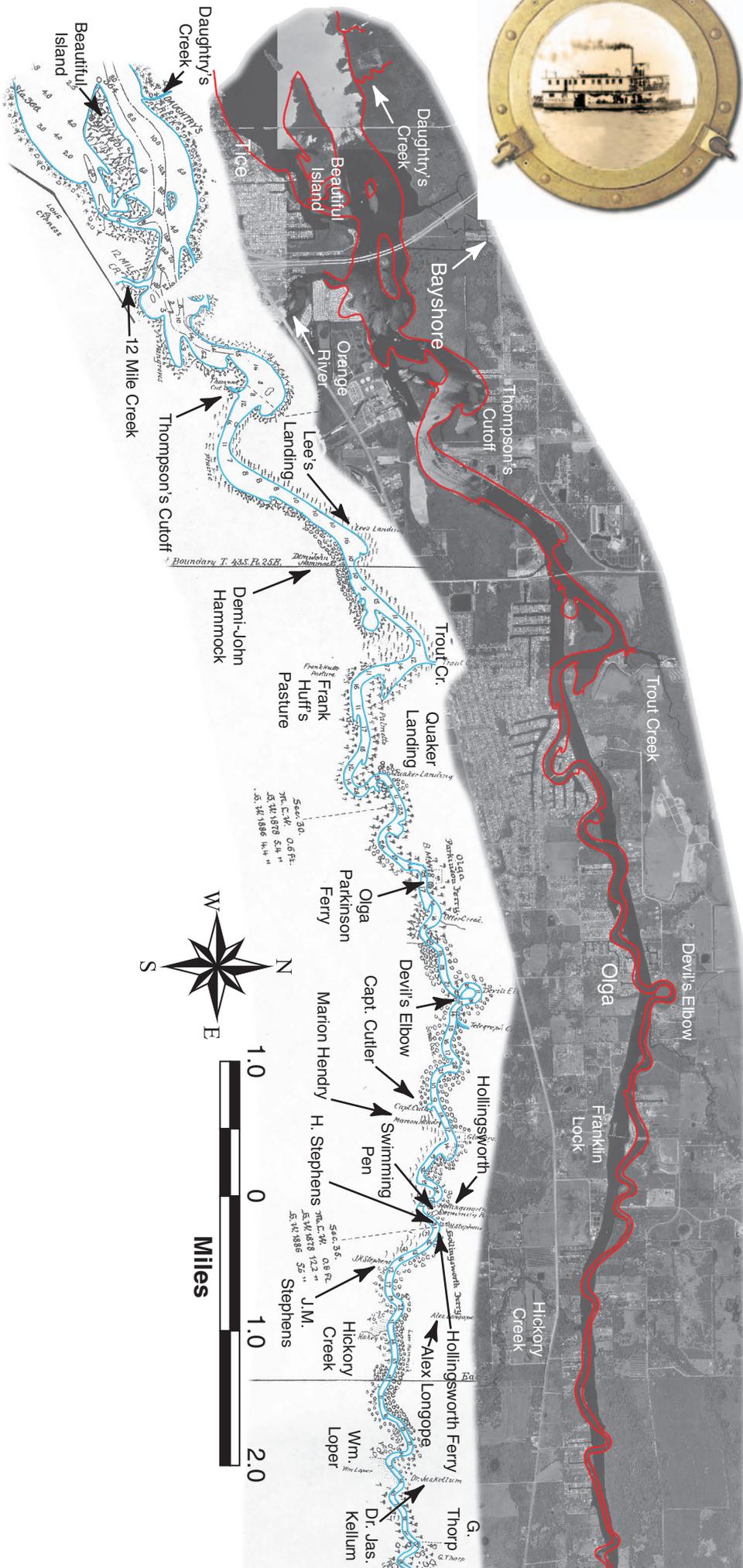
ALTERING THE CALOOSAHATCHEE FOR LAND AND WATER DEVELOPMENT

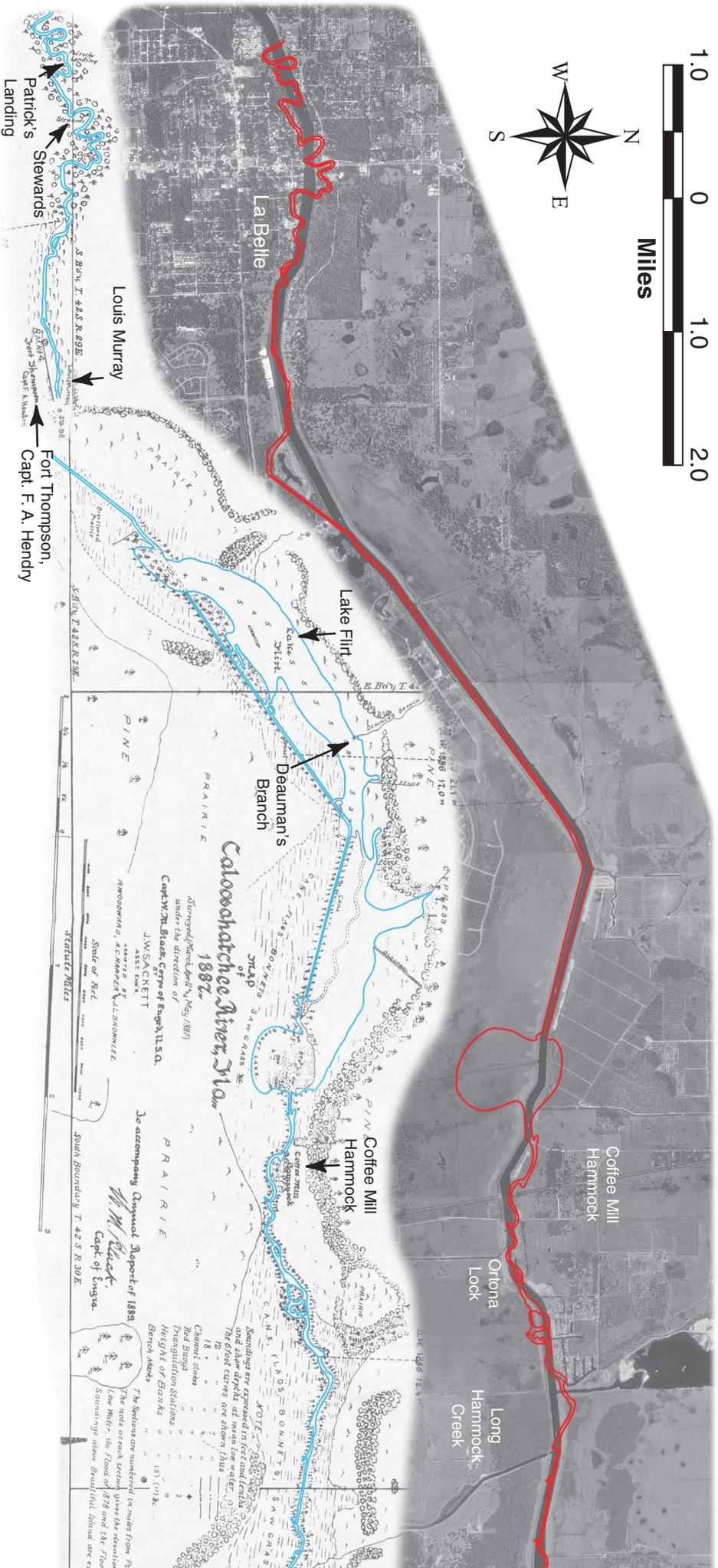


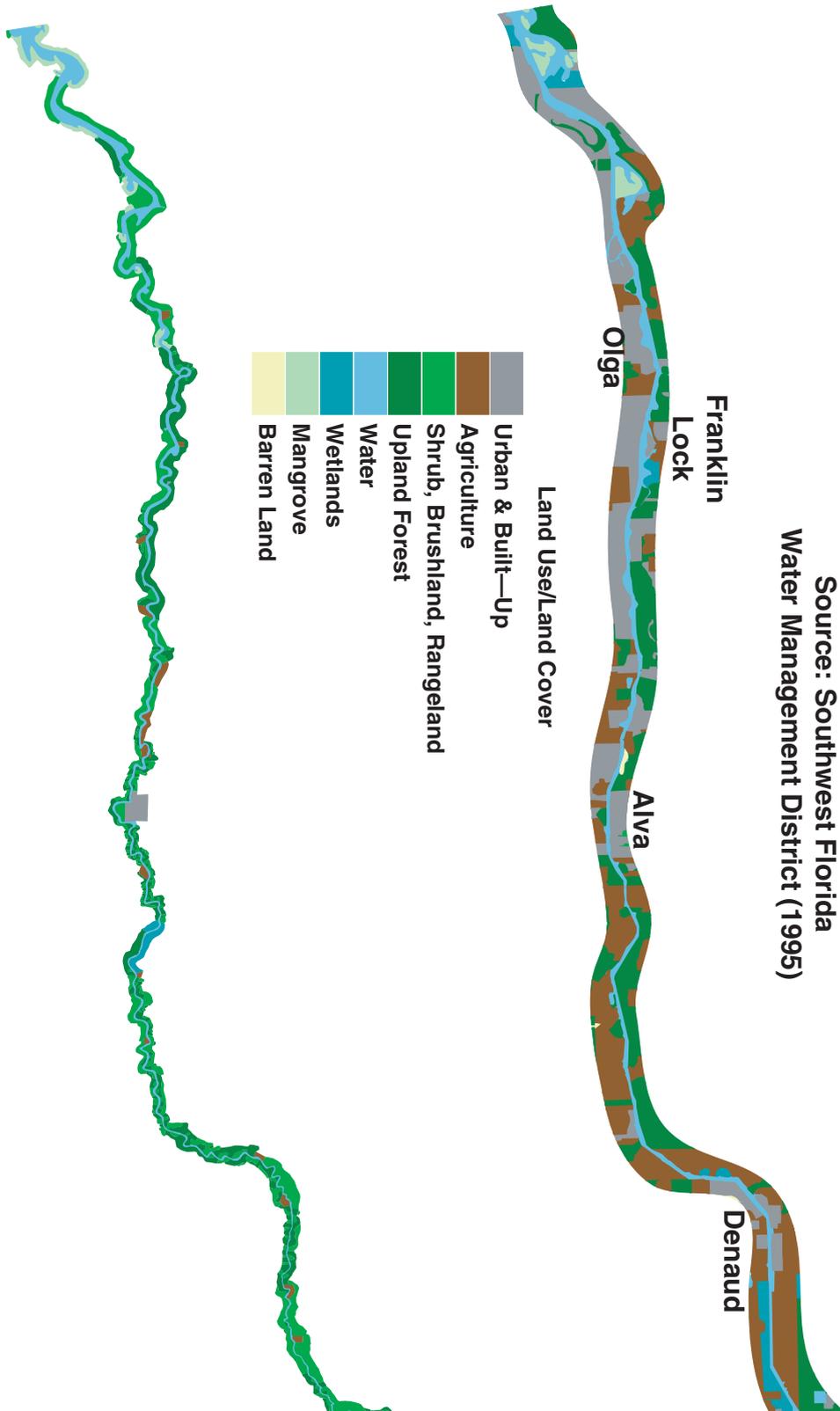
The Caloosahatchee [Caloosa = indigenous Native Americans who inhabited Southwest Florida, Hatchee = Seminole for 'river'] is a microcosm of Southwest Florida's waterways, in which multiple interests — striving to develop waterfront real estate, to create new land from formerly overflowed swamplands, and to increase and improve the navigable waterways — have propelled development in many profound ways. The river between Lake Okeechobee (on the east) and Beautiful Island (on the west) has been selected to illustrate the effects, both latent and direct, of land drainage and waterway construction policies on waterfront and waterway uses.

Pre-development Geography

It is hard to recognize from today's Okeechobee Waterway — with its abruptly cut banks and straight-lined, flood-controlled, navigation-optimized, dredged channel — the once meandering, shifting, rope-bending, snag-laden course of the Caloosahatchee. Today, the Caloosahatchee is the western portion of the Okeechobee Waterway, which stretches from Stuart, on the Atlantic Ocean, to San Carlos Bay and the Gulf of Mexico. The route crosses the state via the St. Lucie River and Canal, Lake Okeechobee, and the Caloosahatchee (see Map 1 in the Dredging History chapter). Map 1 in the present chapter shows the antecedent river course superimposed on the present waterway.

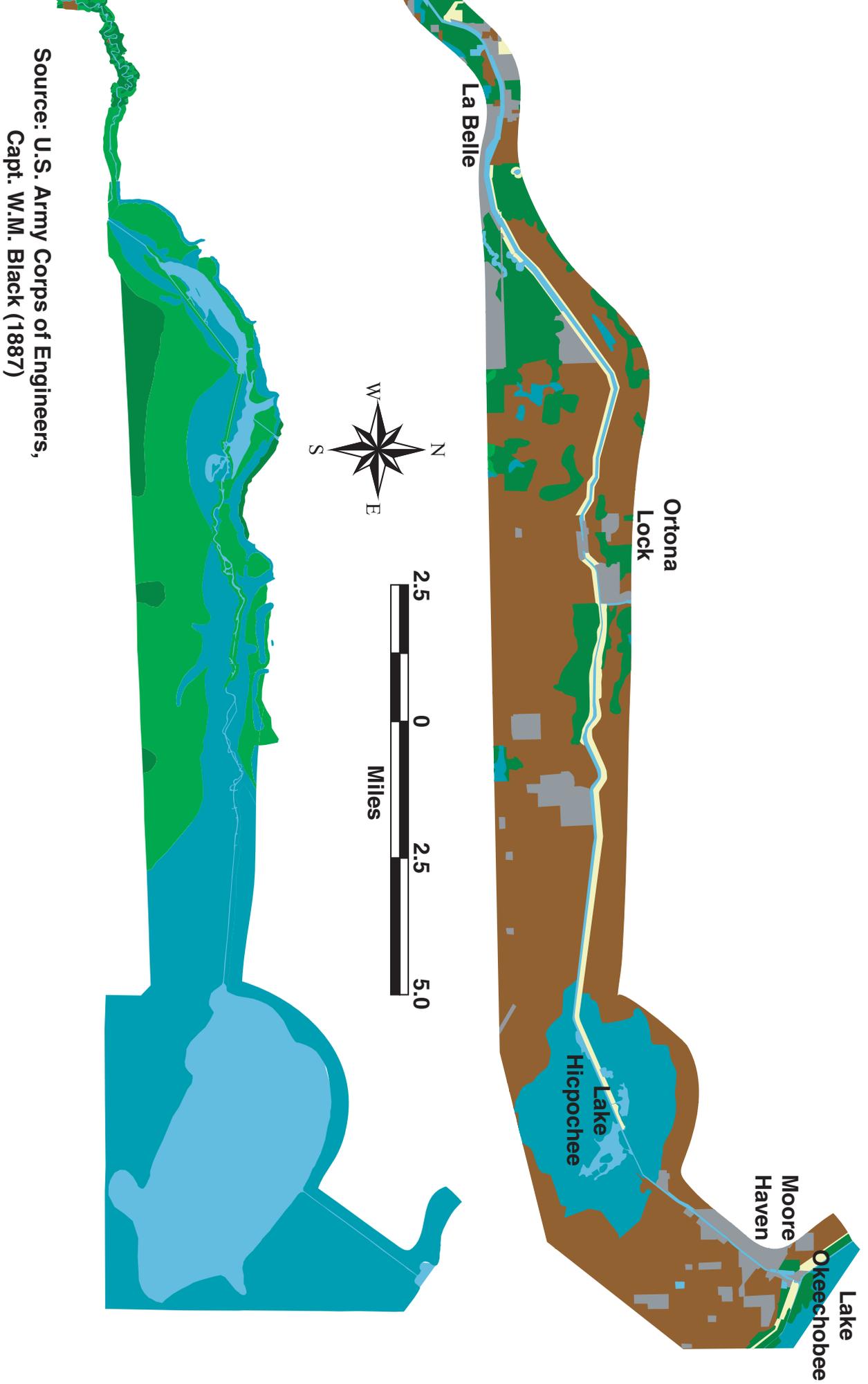






Before human intervention, the Caloosahatchee originated in a geologic basin known as Lake Flirt, located at Ft. Thompson, approximately 2 miles east of La Belle. The formation was perched 4–10 feet (varying with seasonal water levels) above the western Caloosahatchee valley, creating 0.9-mile-long rapids that fed the Caloosahatchee. To the east, ephemeral marshes seasonally connected a series of lakes. In the wet season (May–October), high water would spill out of the shallow boundary of Lake Okeechobee and sheet flow through the ephemeral marshes and swamp forest to collect in several smaller lakes—Hicpochee (9,000 acres), Bonnet (500 acres) and Flirt (1,000 acres)—before spilling over the rapids and flowing into the Caloosahatchee and to the Gulf of Mexico. The Ft. Thompson Rapids set the head of navigation. The lower portion of Map 2, from the Black survey of 1887, shows land use and land cover before major development occurred.

During the dry season (November–April), the region of marshes surrounding Lake Hicpochee and the riverbed from that lake to the foot of Ft. Thompson Rapids would dry up so much that a horse could be ridden in the channel. Normal high water would raise the water level downstream by 2 feet at Ft. Thompson, 3 feet at Ft. Denaud (La Belle) and Alva, 2 feet at Olga and 1 foot at Ft. Myers. Freshets caused by continuous heavy precipitation increased the water level to historic heights above mean water of as much as 12 feet at Ft. Thompson, 17 feet at Ft. Denaud, 14 feet at La Belle, 13 feet at Alva, and 6 feet at Ft. Myers.



Map 2.
Land use/land cover along the Caloosahatchee, 1887 and 1995.

Source: U.S. Army Corps of Engineers,
Capt. W.M. Black (1887)

Distance and number of river bends between pre–development and contemporary conditions along the Caloosahatchee/Okeechobee waterway.

	Beautiful Island/Olga		Olga/Alva		Alva/La Belle		La Belle/Moore Haven		Total	
	Miles	River-Bends	Miles	River-Bends	Miles	River-Bends	Miles	River-Bends	Miles	River-Bends
Pre–development River	9.5	5	8.7	19	19.0	58	26.7	20	63.9	102
Okeechobee Waterway	7.7	3	7.0	2	14.0	10	27.0	11	55.7	26
Difference	-1.7	-2	-1.7	-17	-2.0	-48	+0.3	-9	-8.2	-76

Table 1.



Figure 1. Four-point rope bend.

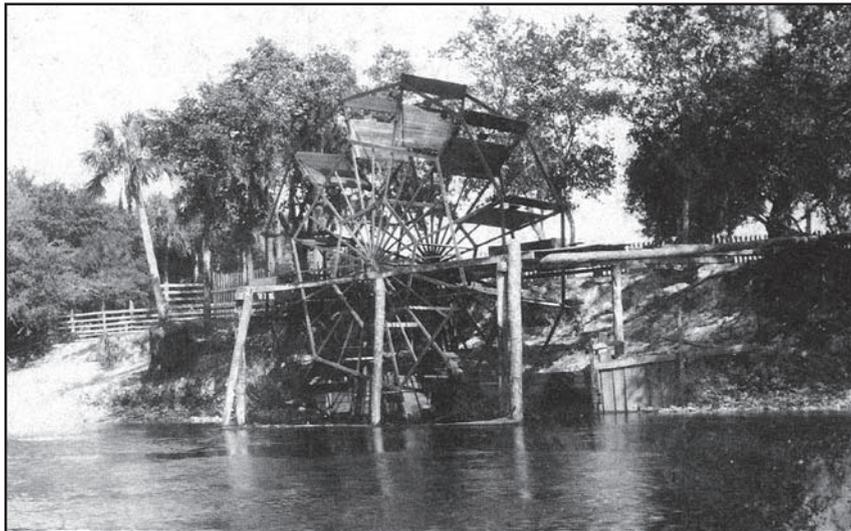


Figure 2. Water wheel irrigation.

These extreme, cyclical variations in stream flow contributed to the Caloosahatchee's meandering course. There were 102 river-bends in the 64-mile stretch from Beautiful Island to Lake Okeechobee in the pre–development period (Table 1). Navigating the river was especially difficult at the low-water stage. Some of the sharper meanders required the larger vessels to “warp-around,” that is, to run their bow up on shore, attach a spring line to trees, back down to a second point, swing around and go ahead at the next point, and so on until the bends were passed (Figure 1).

Torrential rains during the wet season dramatically increased the volume of discharge and sediment load, leading to channel scouring and flooding of adjacent lowlands. During this period, coarser-textured sediments were deposited both as point-bars on the inside of the meanders and along the banks of the natural levees. Channel deepening occurred on the outer bends, and fresh, fine-textured alluvium was deposited on the adjoining floodplain. At these high water stages, the meandering Caloosahatchee in places cut across the necks of the meander spurs, shortened its course, and created abandoned meanders or oxbows.

Land and waterway developments were slow to occur during the 19th century. The Seminole Wars and the Civil War were major deterrents to settlement expansion. Extensive cattle grazing was a common land use. Small settlements did evolve along the river, usually occupying former military outposts. Ft. Thompson was an important up-river location because of the ford where cattle drives crossed the rapids en route to the shipping pier at Punta Rassa. The land cover along much of the river's course south of Ft. Thompson was in upland forest, scrub, grassland, and some homesteads with small agricultural farms (Map 2). The lower portion of Map 1 highlights the names of some of the homesteaders. Rudimentary waterwheel-type irrigation systems permitted farming during the dry season (Figure 2).

The winter freezes of 1892 and 1899 prompted North Florida citrus growers to reestablish their groves south of the freeze line and in the Caloosahatchee Valley. Citrus production increased rapidly in subsequent years and the transport of fruits and shipment of supplies became dependent on riverboat transport (Figure 3). Large catches of fish were brought down the river from Lake Okeechobee, although the business did not become extensive until after the railroad entered Ft. Myers, in 1904.

The 1880-90s was a period wherein the upper river valley represented the backbone of potential growth that resided in its agricultural resources, but communities there depended on the lower river course for transport and communication with service centers downstream. The key to sustainable regional growth rested on creating a scheme to manage the floods, which drove the early settlers from their homes, damaged farmlands, and discouraged agricultural development.



Figure 3. SS *City of Athens*, 1910.

Land Reclamation or River Navigation?

The development history of the Caloosahatchee is a record of competing and conflicting interests, some wanting to control flooding by upland drainage and others striving to build an inland waterway for pleasure boating and commercial use.

The record of government intervention by the State of Florida and federal agencies had its origins in the 1880s, with attempts to drain the overflowed lands adjoining Lake Okeechobee and to reduce and maintain water lev-

The net incidental result of Disston's dredging operation was to open up a water route for steamers some 300 miles long from the Gulf of Mexico to the interior of Florida via the Caloosahatchee and Lake Okeechobee to Kissimmee (Figure 5). But the dredged channel between Ft. Thompson and Lake Okeechobee was not maintained and shoals quickly appeared; boats drawing a mere 4 to 6 inches grounded repeatedly in Bonnet Lake and Lake Flirt. More significantly, during the wet season, floodwaters from Lake Okeechobee rushed unrestricted down the channel and caused severe flooding of the farms and citrus groves in the lower valley.

The dilemma facing the Caloosahatchee Valley at that time, much as it is today, was to devise a scheme that would coordinate land drainage with river navigation. Residents in 1913, for example, believed that floodwaters could be mitigated by straightening the river's course and navigation could be improved by deepening the channel, though attempts to straighten the river above Alva would probably require building levees well back from the river banks which would deprive a greater part of the citrus groves along the river from protection. The heated battle between land drainage and river navigation sometimes raged beyond the rule of law. Makeshift dams built by private interests across the canal between Lake Hicpochee and Bonnet Lake were blown up by unknown parties. In 1902, the state approved an application to close the canal but held Lee County responsible for all damages. The Army Engineers, at that time, agreed with local and state government that navigation interests were insufficient to warrant federal waterway improvements.

By 1913, however, drainage operations by the state elsewhere in central Florida had lowered the water level in Lake Okeechobee so much that navigation in the upper Caloosahatchee was seriously impaired and settlements were being abandoned. In 1914, the river at its junction with the lake dried out and at La Belle there was only 1.5 feet of water, not enough to allow the passage of commercial river traffic. The State of Florida dredged a 5-foot-deep by 40-foot-wide channel from Lake Okeechobee to La Belle. The seesawing of natural events—flooding of river lowlands followed by shoaling of navigation chan-

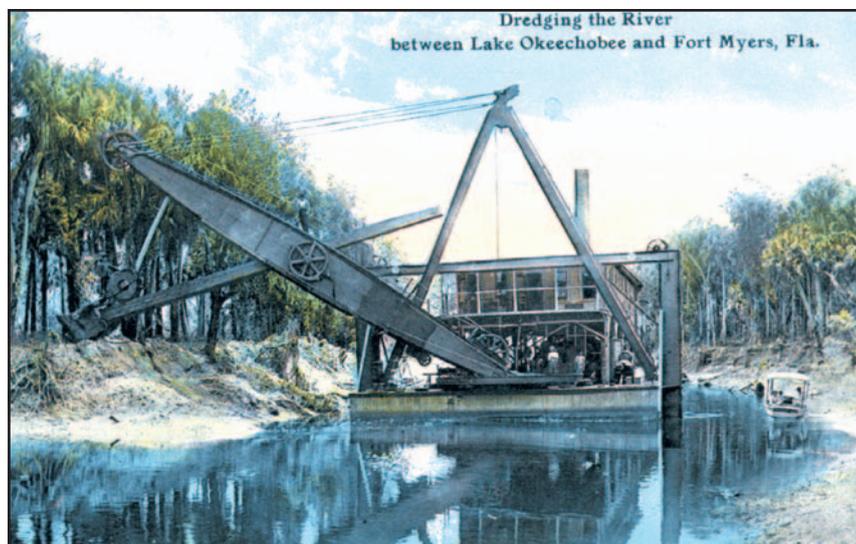


Figure 4. River dredge.

els in the river. By 1887, the Atlantic and Gulf Coast Canal and Okeechobee Land Company of Hamilton Disston had opened a channel, with a minimum cross-section of 22 feet by 5 feet, from Lake Okeechobee to the headwaters of the Caloosahatchee at the western end of Lake Flirt. The Disston dredges were brought up-river from Ft. Myers. Four of the most severe river bends west of Ft. Thompson were straightened in order to move the dredges upstream. The 4-mile stretch of rock-floored outcrops, including the Ft. Thompson Rapids west of Lake Flirt, was dynamited in order to deepen the channel. A provisional dam was built every few miles to the rear of the dredge to obtain sufficient water to float the equipment (Figure 4). Disston's work was not intended to benefit navigation. Indeed, since the contract with the state included the drainage of the Caloosahatchee Valley and confining the river to its banks, the dredged channel was to have been closed and a levee extended north-south just west of Lake Hicpochee. Nearly 2 miles of this levee was constructed when the company ceased operations and the channel was never closed.

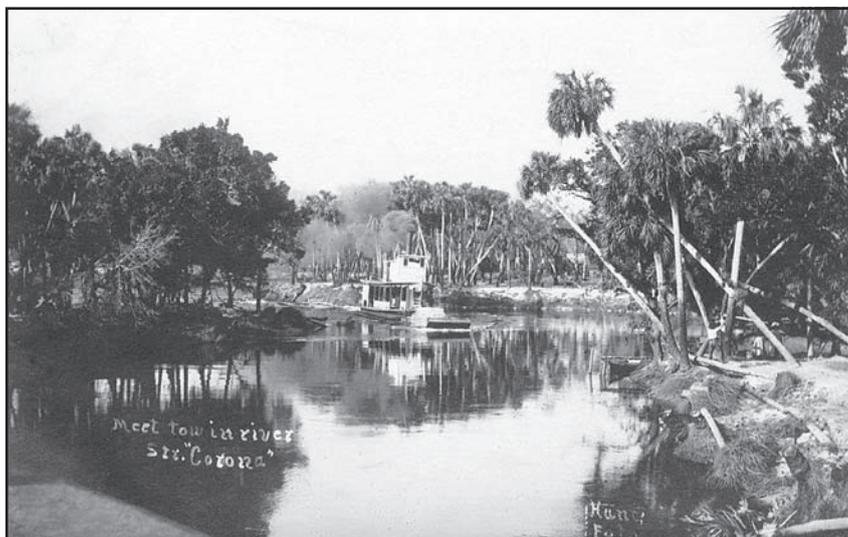
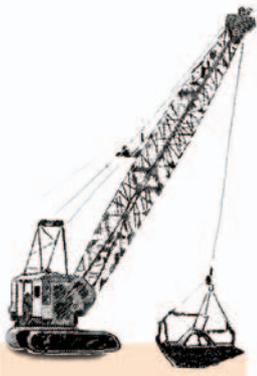


Figure 5. Tow steamer *Corona*.



1966 -
*The Necessity to
Understand
the Sea*

"But the influence of the sea on man's daily life and on his future well-being is so great and still so poorly comprehended that the sea must be explored, studied, and understood so that it can be taken into account more intelligently whenever man is faced with any problem relating to his physical environment."

—H. B. Stewart,
"In Deep
Challenge,"
1966.

—Published by Van
Nostrand,
NJ. p. 17.

nels—fostered ambivalent public policies and created a laissez-faire attitude which resulted in little prescriptive action or long-term planning.

Disastrous floods in 1922, 1923, 1926, and 1928 caused the loss of many lives and considerable property damage in the Lake Okeechobee region. The federal government authorized the Army Engineers in 1927 to survey the Caloosahatchee drainage area and work with the state's Flood Control District (now the South Florida Water Management District) to improve both flood protection and navigation. This decision led to construction of the Hoover Dike around Lake Okeechobee as well as the dredging and channel straightening of the Caloosahatchee. The 1930s was a period of river dredging and construction of drainage canals, navigation locks at Moore Haven and Ortona and pumping stations to remove excess water from adjoining river bottomlands.

As a result of this work, the Caloosahatchee upstream from Beautiful Island was forever changed from the picturesque, meandering river which existed prior to 1881. It took on a new form, that of vertical-banked and straight-lined, flood-controlled, navigation-designed, dredged channel. It was also transformed into the federally authorized, Army Engineers-maintained Okeechobee Waterway (C-43 Canal), an intrinsic western component of the Cross-State Ship Channel that links the Gulf of Mexico to the Atlantic Ocean.

The Okeechobee Waterway was again modified in the mid-1950s. The channel was enlarged to an 8-foot depth and 250-foot width. Bridge crossings were modernized. An additional lock and dam structure was built in 1962 at Olga to assure a freshwater supply for Lee County and to prevent saltwater intrusion upstream.

In 1969, the structure was re-dedicated as the W.P. Franklin Lock in honor of Walter Prospect Franklin, a local entrepreneur and concerned member of the Okeechobee Waterway Association. This lock artificially sets the eastern limit of the Gulf's tidal influence for the

estuary, which historically extended to Ft. Denaud. The waterway was dredged again in the 1960s, but following passage of the Clean Water Act in 1972, the Army Engineers has restricted its functions to operation and annual maintenance of the locks at Moore Haven, Ortona, and Franklin.

The Caloosahatchee today is still in serious need of management and maintenance. It faces many of the same varied challenges of its past development and use, including competing demands for water by municipalities, agriculture, commercial and recreational boating activities, and the functional requirements of the natural aquatic system. In times of flooding, the Caloosahatchee is used as a conduit for discharge with little regard for the downstream impacts of water quality and water volumes. In times of drought, water releases from Lake Okeechobee often do not maintain minimum flows necessary to support the critical productive functions of natural systems nor do they retain necessary water depths in the federal navigation channel of Lake Okeechobee.

Resource managers with the South Florida Water Management District view and treat this waterway as a drainage and storage component of Lake Okeechobee and the multi-billion-dollar Comprehensive Everglades Restoration Project. Their concerns and program objectives are regional in scope and focus predominantly on water management functions, primarily flood control and water supply. Stakeholders and organizations concerned about the condition of the waterway have recently called for federal assistance from the Army Engineers to address its navigation and water-based eco-tourism needs by promoting coordinated management and sustainable use.

Does history repeat itself? Can we learn from past mistakes? Is there hope that both objectives—flood control and navigation—can be realized in the 21st century to provide for sustainable management that protects the resources and allows for use by all citizens who live, work and recreate along this waterway?

Contemporary Geography

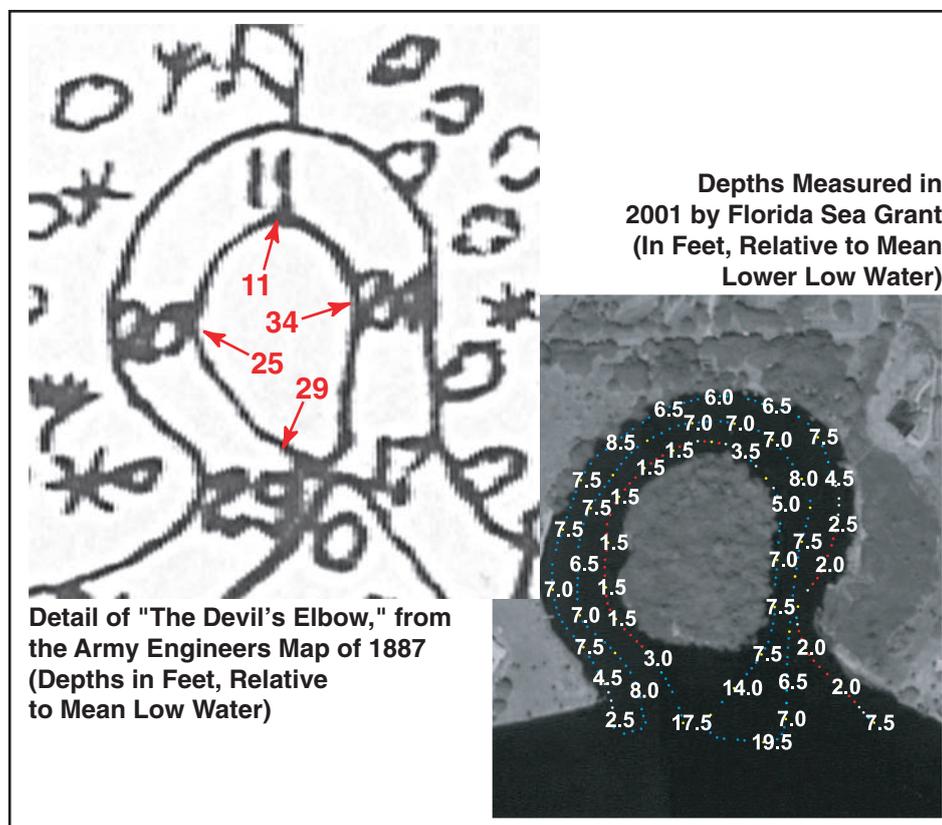
The scenic Caloosahatchee, the historic waterway that fostered settlement of interior Southwest Florida, functions today as a thoroughfare for transiting recreational boat traffic and a conduit for excess stormwater flows. Where once the river meandered, it is now a series of straight legs interrupted by 26 gentle bends (Map 1 and Table 1). Although one still, rarely, may encounter some tugs and barges, heavy commercial traffic of the past eras is gone. Both the form and function of the river have changed.

The Okeechobee Waterway and former vestiges of the Caloosahatchee lie side by side. About 35 abandoned meanders are situated between Olga and La Belle and another seven are in the estuarine portion of the river downstream from the Franklin Lock. The dichotomy of this landscape is striking: a straight-line, deep waterway with artificially configured banks, punctuated by intriguing side loops, heavily vegetated, shoaled, and snag-laden. A comparison of spot soundings from the years 1887 and 2002 shows the striking differences in water depths as channeled river discharge bypassed the meanders (Map 3). Today, nearly half of the meanders along the river are not fully navigable because of siltation caused by reduced water flow through the bends. Shoreline residences and boat docks are found on some, while others are quite pristine (see *Changes on the Waterway and Along the Waterfront*).

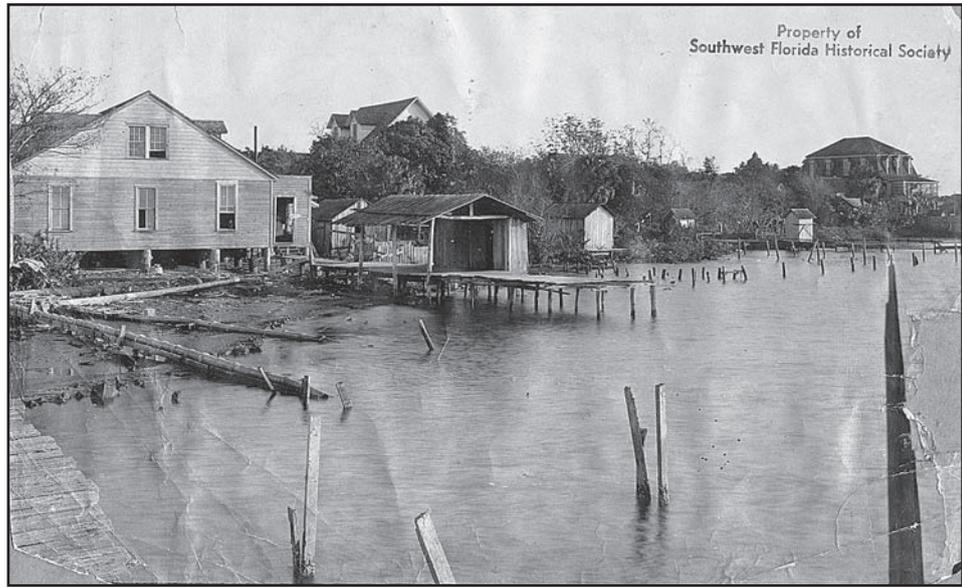
Lake Hicpochee, now approximately 215 acres of open water, is a mere relict of its past extent. Lake Flirt no longer exists, though the area is being studied to determine the feasibility of creating an above-ground reservoir with a total storage capacity of approximately 160,000 acre-feet (about 7 billion cubic feet). This proposed reservoir would be part of the Comprehensive Everglades Restoration Plan, a multi-billion dollar federal project to correct water flow problems created by dredging and channelizing the Okeechobee–Kissimmee–Everglades region.

There are recreational boat facilities along the Okeechobee Waterway. Some towns, like Moore Haven and La Belle, provide downtown docking for transient vessels. In-the-water boat storage is available at various locations within the freshwater section of the waterway; boats from northern states are left here during the summer season protected from coastal storms.

The land use and cover that confronts the passing boater has been dramatically altered from the historic past. Major riverine forest tracts are gone, replaced by agriculture and urban built-up uses. High levees run parallel to the waterway from Lake Hicpochee to the historic Ft. Thompson area, just east of La Belle (Map 2).



Map 3.
Detailed plans showing water depths in the Devil's Elbow in 1887 and 2001.



Ft. Myers riverfront.



Stabilized Oxbow Slopes, Denaud.

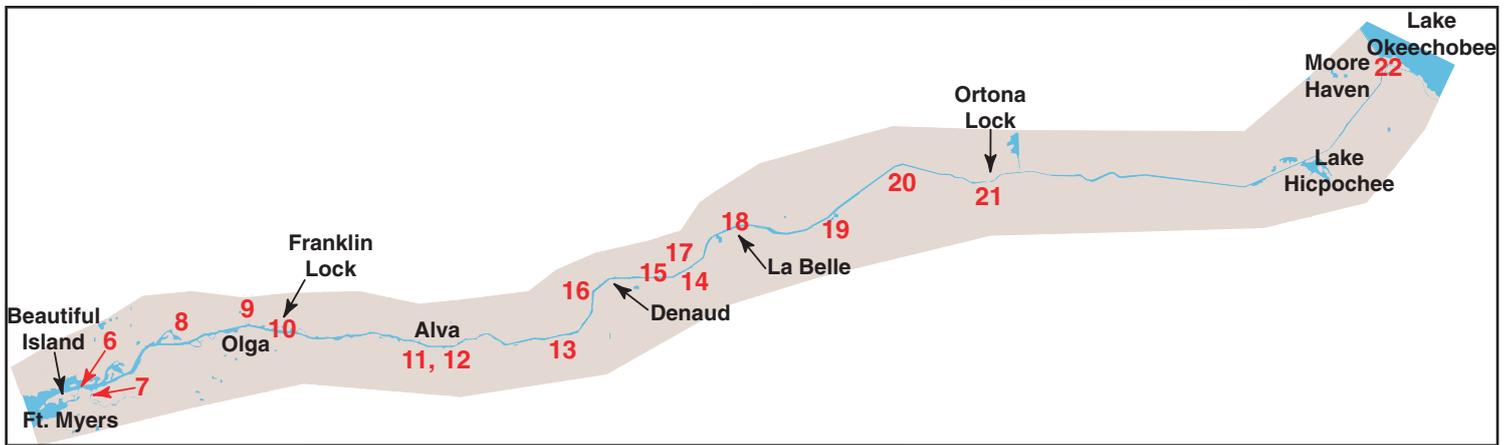


Orange grove, packing house and the Caloosahatchee at Alva in 1912.

Changes on the Waterway and Along the Waterfront

The history of waterway changes is reflected in a record of past and contemporary photographs referenced to specific sites along the stretch of the river from Beautiful Island to Moore Haven and the western rim of Lake Okeechobee (Map 4).

The view from the railroad trestle span at Beautiful Island is very much the same today as in yesteryears (Figures 6a, b). Shoreline land use on the Orange River, however, has changed dramatically from citrus groves to residential use (Figures 7a, b). Photo 8 shows the mouth of



Map 4.
Locations of photographs along the river.

Trout Creek and Figure 9 captures the Devil's Elbow on the north shore. Located opposite the historic settlement of Olga, the Devil's Elbow was an extremely tight river meander to navigate (thus its name), which required warping by larger vessels in order to pass through the tight

rope-bend. Water depths there, once 11-34 feet, have been reduced to 7-9 feet as a result of waterway channeling that bypassed this meander. Devil's Elbow today is a favored "hurricane hole" because of its relatively deep water, minimal fetch and protected location.



Figure 6a. Old railroad trestle at Beautiful Island.



Figure 6b. Contemporary trestle at Beautiful Island.



Figure 7a. Steamer on the Orange River.



Figure 7b. Contemporary Orange River shore.



Figure 8. A pre-development view of Trout Creek, a tributary of the Caloosahatchee.

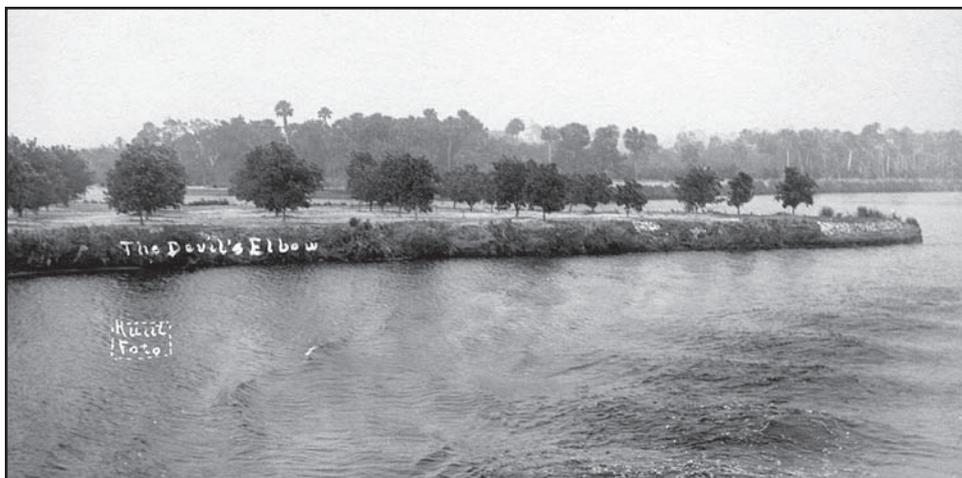


Photo 9. The Devil's Elbow, on the north shore, opposite Olga.

W. P. Franklin Lock is the western line of protection limiting storm surge from the Gulf and saltwater intrusion (Figure 10). The river scene looking west from Alva hasn't changed much (Figure 11a, b), though the

view years ago of the town with its historic swing bridge (Figure 12a) is different from its appearance today (Figure 12b).



Figure 10. W.P. Franklin Lock, 1968.

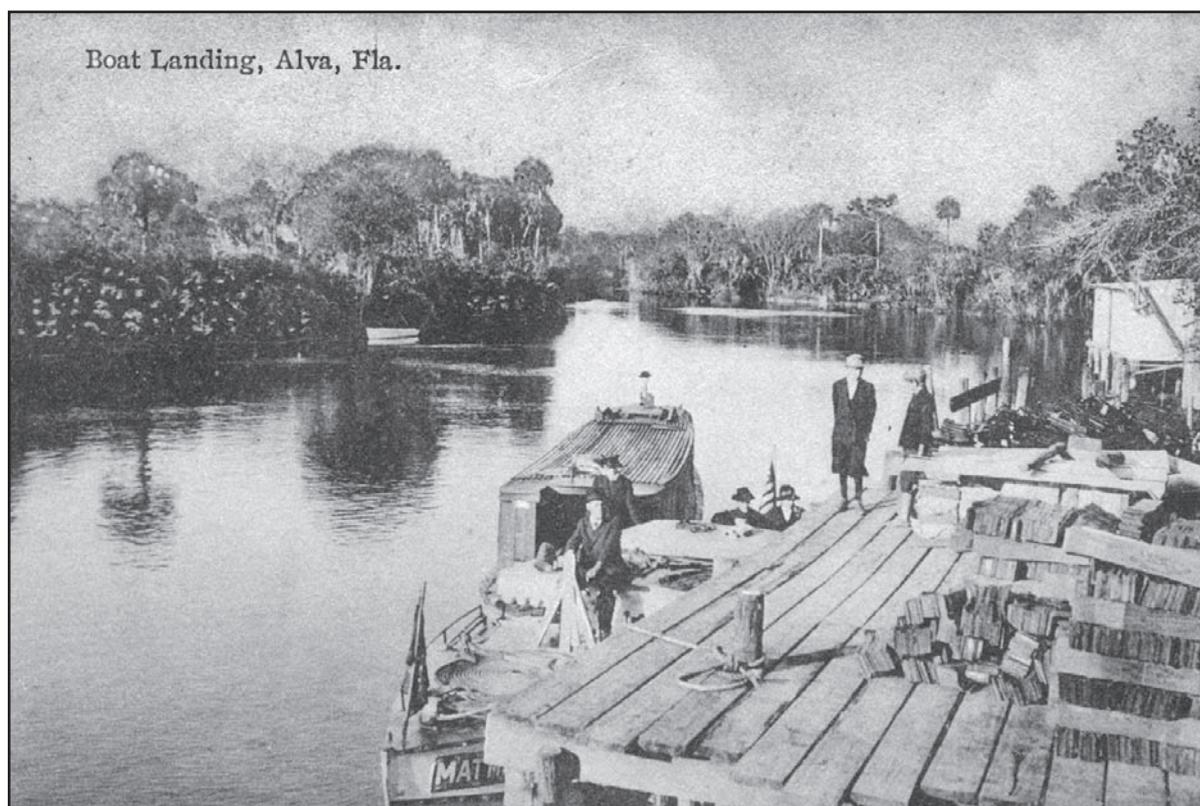


Figure 11a. Former boat landing at Alva.



Figure 11b. Today's contemporary boat landing at Alva.

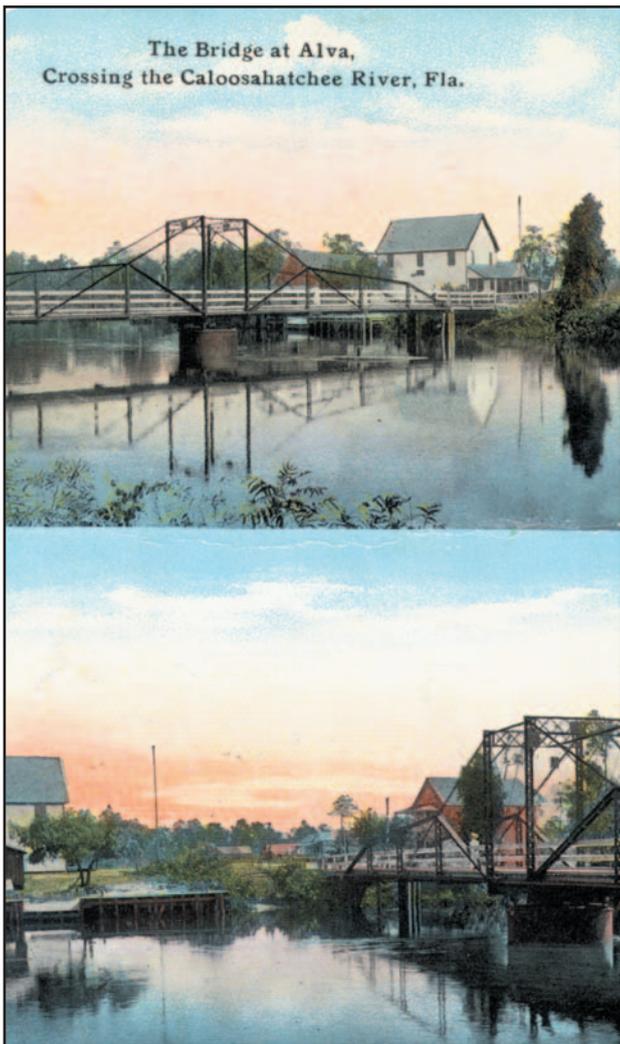


Figure 12a. Historic Alva bridge, view to west.

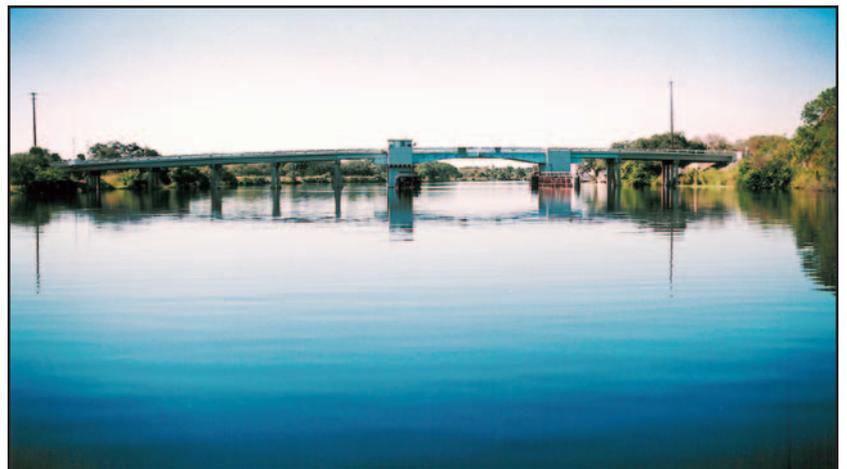


Figure 12b. Alva bridge, 2001.

A boat trip into segments of the old Caloosahatchee, where the old riverine forest has been retained (Figures 13a, b), or where old homes, such as the Terrell House at Turners' Landing have been preserved (Figures 14a, b), is a step back in time. In some cases, however, large homes

and boat docks line the former river bends (Figure 15) or the rim of the present waterway. Dredged spoil, side-cast on the north bank, appears near Rialto (Figure 16).

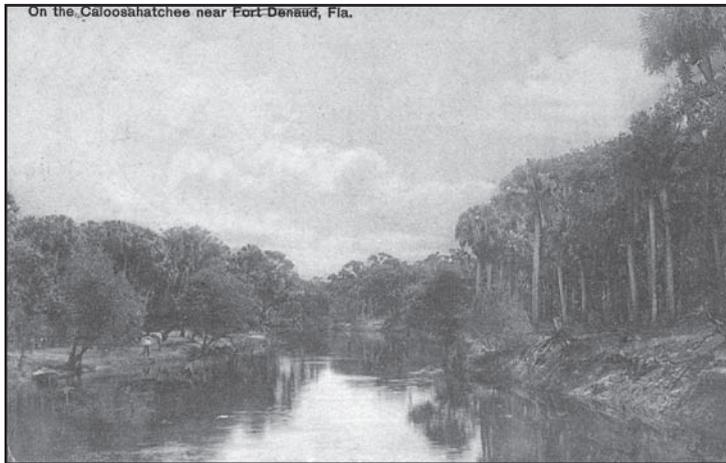


Figure 13a. Historic river near Ft. Denaud.



Figure 13b. Contemporary view of Oxbow, West of Denaud.



Figure 14a. Dr. Terrell house, Turners Landing today.



Figure 14b. Turners Landing in the early 1900s.



Figure 15. Rialto Oxbow (residential use).



Figure 16. Side cast spoil along waterway at Rialto.

La Belle, a historic river town, retains much of the character from bygone days especially along the waterfront (Figure 17a, b), though the old swing bridge has been replaced by a bascule bridge (Figure 17c, d). Nothing remains from Ft. Thompson although a historic marker has been erected at its location; Ft. Thompson was probably destroyed by

dredging and portions of the settlement buried under spoil along the south bank of the waterway. Figure 18a shows the flooded riverbanks years ago near Ft. Thompson, and Figure 18b is the cattle crossing at the Rapids. Lake Flirt no longer exists, but a number of dredged basins in that locale now harbor wet storage facilities (Figure 19).

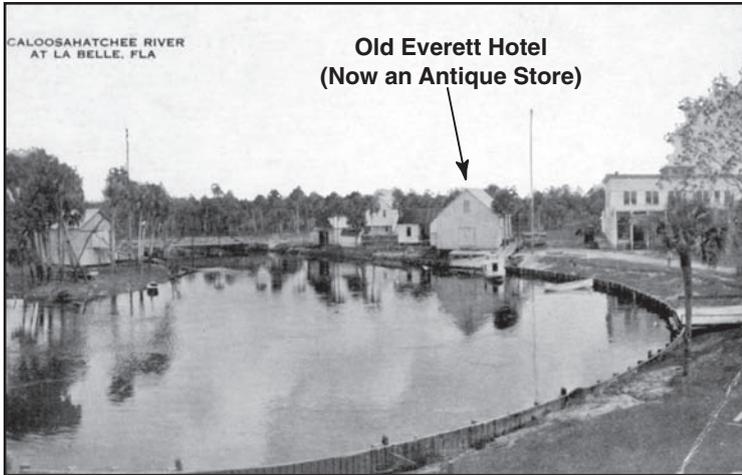


Figure 17a. La Belle riverfront (then).

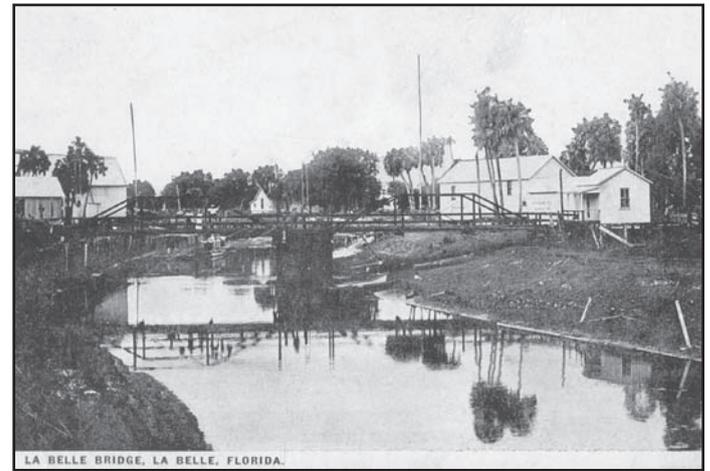


Figure 17c. La Belle swing bridge (then).



Figure 17b. La Belle Town dock (now).



Figure 17d. La Belle bridge (now).

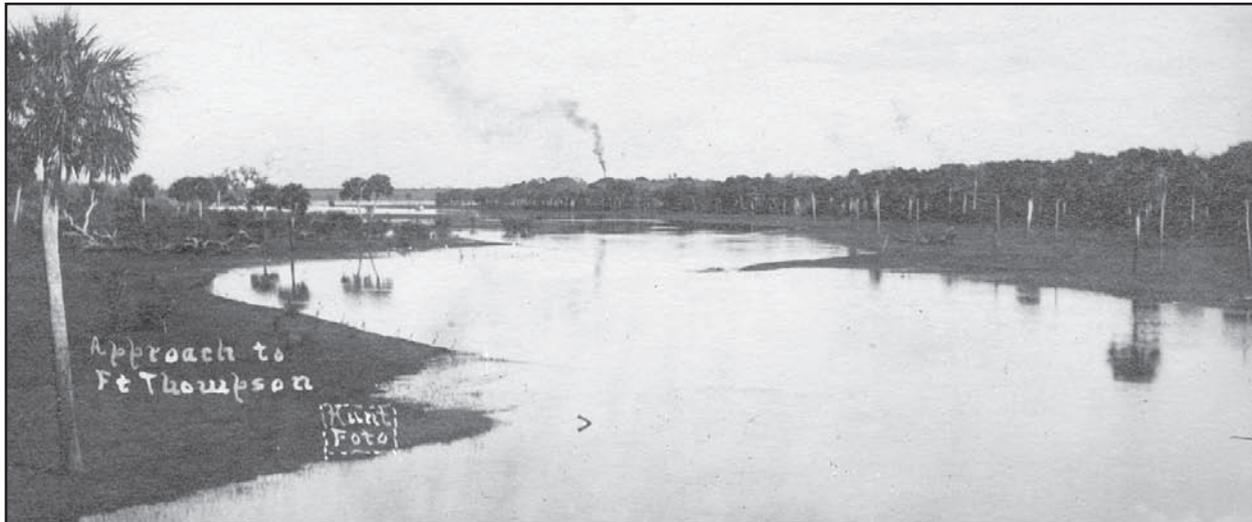


Figure 18a. River at Ft. Thompson.



Figure 18b. Cattle crossing at Ft. Thompson.

Ortona Lock, near former Coffee Mill Hammock and west of the levee partially completed by Disston in the 1880s, is a major feature of the Okeechobee Waterway (Figure 20). For many years an important landmark

guiding mariners across Lake Okeechobee, a sentinel cypress, known as *The Lone Cypress*, marked the eastern entrance to the Caloosahatchee and became a fixture of Moore Haven at the lock's location (Figures 21a, b).



Figure 19. Boats near former Lake Flirt.



Figure 20. Ortona Lock.



Figure 21a. Lone cypress at the lake and canal junction.

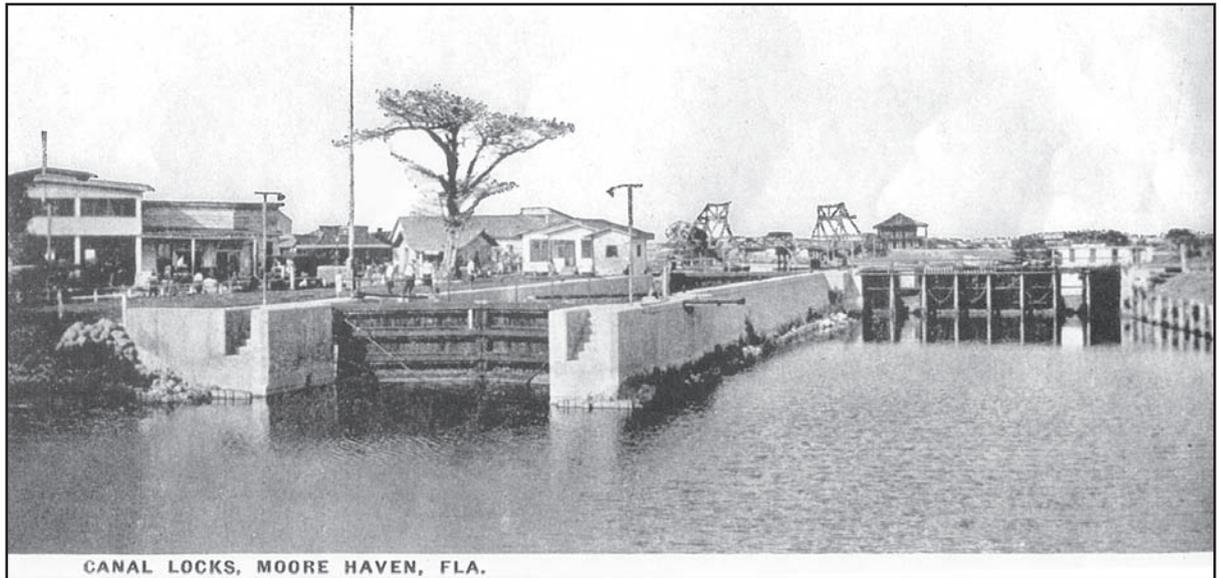
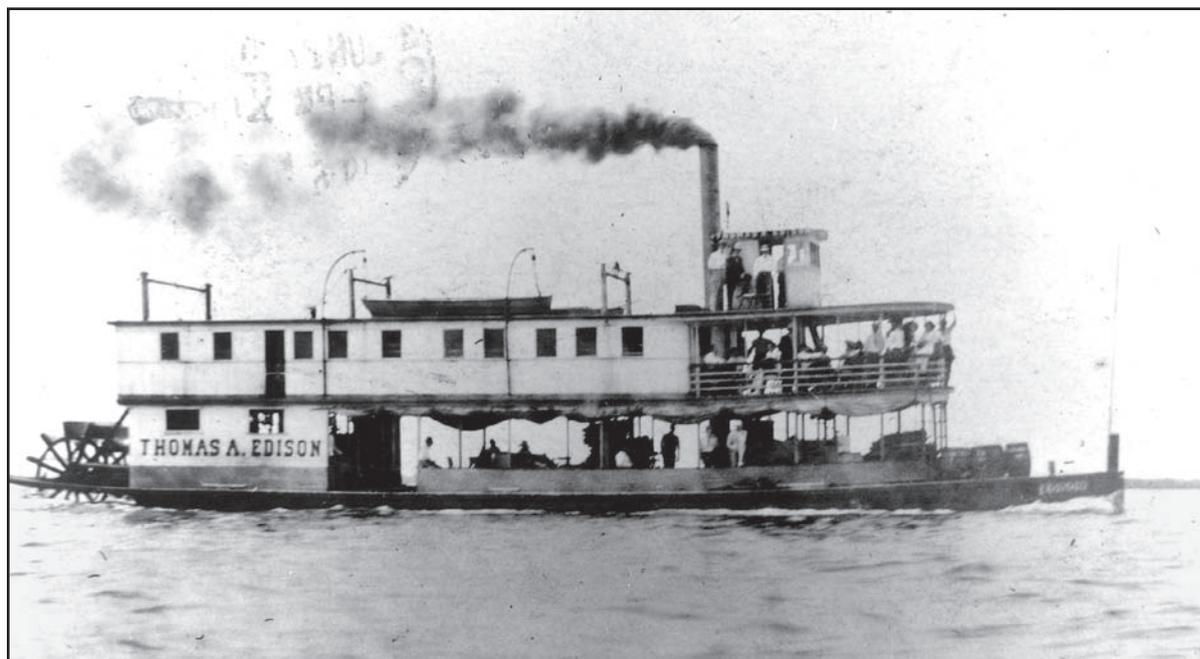


Figure 21b. Moore Haven lock.

Epilogue

Caloosahatchee history is the extreme case of altering land and water for coastal development in Southwest Florida. The river's form and function over the past 100 years have irrevocably changed. The historic river, which was relied upon by pioneers as a commercial artery for transporting goods and services, had a meandering, shifting course subjected to flood and drought conditions. Today, it is the straight-channel, dredged, Okeechobee Waterway, used by resource managers for flood control and by boaters transiting between the Eastern Seaboard

and Gulf Coast. Hidden behind the waterway's artificially configured banks are isolated remnants of the Caloosahatchee's meanders, some pristine, others altered by development pressures from residential, agricultural and recreational uses. The dichotomy of waterway and river remain coupled by geography and history. The question of how this historic river and its water will be managed and provided to sustain the rich historical and ecological balance, which drives our current coastal economy, is a vexing enigma to this day.



Steamer *Thomas A. Edison* on a run up the Caloosahatchee to Ft. Myers during the early 1900s.

References

Published Reports

Alperin, Lynn M., 1983, "History of the Gulf Intra-coastal Waterway," Navigation History NWS-83-9, National Waterways Study, U.S. Army Engineer Water Resources Support Center, Institute for Water Resources, U. S. Government Printing Office, Washington D.C., pp. 44-48.

U.S. House of Representatives, 1879, "Examination of Caloosahatchee River, Florida," Report of the Chief of Engineers, Vol. 2, Pt. 1, 46th Congress, 2nd Session, Doc. Vol. 2, No. 1, Pt. 2, pp. 863-869.

_____, 1907, "Report of Examination of Caloosahatchee and Orange Rivers, Florida," 60th Congress, 1st Session, Doc. No. 347, 7 pp.

_____, 1913, "Preliminary Examination of Caloosahatchee River, Fla.," 63rd Congress, 1st Session, Doc. No. 137, pp. 16-23.

_____, 1927, "Survey of Caloosahatchee River Drainage Area in Florida," 69th Congress, 2nd Session, Report No. 1888, 3 pp.

Unpublished Reports

Black, W.M., 1887, "Condition of Caloosahatchee Basin," letter to Chief of Engineers, U.S. Army, Washington, D.C., March 30, 1887, file copy, No. 1155, 2; pp. 126-129 and 214-217, Federal Records Center, Southeast Region (Atlanta).

Clausen, C.J. et. al., 1980, "Cultural Resource Survey of Portions of the Port La Belle Development Tract, Glades and Hendry Counties, Fla.," Survey Project 107 Prepared for General Development Corporation, Miami, Fla., by CCC Enterprises, Inc., North Port, Fla.

Newspaper Articles

Ft. Myers News-Press, "Application to Close Canal Granted!" April 17, 1902.

Ft. Myers News-Press, "Hicpochee Canal Not Government Water," May 8, 1902.

Newsletter Articles

Kimes, C.A., and L. C. Crocker, 1999, "A Historical Overview of the Caloosahatchee and its Watershed," in *Harbor Happenings*, Newsletter of the Charlotte Harbor National Estuary Program, Vol. 3, No. 1, Spring, pp. 8-13.

Scholle, Rae Ann, 1999, "Oxbows of the Caloosahatchee," in *Harbor Happenings*, Newsletter of Charlotte Harbor National Estuary Program, Vol. 3, No. 1, Spring, p. 17.

Books

Grismer, Karl H., 1949, *The Story of Fort Myers: The History of the Land of the Caloosahatchee and Southwest Florida*, St. Petersburg Printing Company, Inc., Fla.

Internet

Comprehensive Everglades Restoration Plan, June 2002, http://www.evergladesplan.org/the_plan/2lev_restoration_plan.shtml

Dunn, Carl, 2002, "C-43 Basin Storage Reservoir, Part 1," in Comprehensive Everglades Restoration Plan (CERP), <http://www.evergladesplan.org/pm/projects/proj04.shtml>

Other Sources

Lee County Government, 2002, A Resolution Requesting the Support of the Southwest Florida Congressional Delegation in Securing Funding and Technical Assistance from the U.S. Army Corps of Engineers for a Reconnaissance Study of the Caloosahatchee From the Gulf of Mexico to Lake Okeechobee, Florida, Resolution No. 02-06-20, Ft. Myers, Fla.

For Your Information...

Physical Features of Southwest Florida Rivers and their Influence on Shoreline Use and Navigation

Rivers, such as the Caloosahatchee, Estero, Imperial, and Cocohatchee, share a number of common physical features that affect navigation and land use along their shorelines.

Viewed from the air, these streams display floodplains with a meandering river course. During the pre-development period, when flood-control structures were uncommon, overbank flooding occurred during the rainy season as the meandering river would leave its existing channel and inundate part or all of its floodplain. Early settlers described such events, wherein the increased flow kept the sediment load suspended, with the river channel oftentimes indistinguishable because of the floodwater's turbidity.

The meandering habit of these rivers alternately cuts and fills the valley floor, depositing sediments on the inside of bends and cutting away its banks on the outside, and in this process, the whole meander migrates down-valley. The Black map (1887) displays many of the Caloosahatchee's floodplain features of the pre-development period, downstream from Ft. Thompson (Figure 22). In time, the meanders develop narrow necks (Figure 22, a), and, in flood stages, the river may abandon, or cut-off, a meander loop (Figure

22, b). An oxbow lake forms (Figure 22, c) when the river deposits sediments across the ends of the abandoned channel.

In the active meanders, water pools along the outside bend because the river undercuts the bank, which results in caving that allows the meander radius to grow. Depths become shallow where the river crosses from one bend to the next and creates shifting sand bars known as riffles. Riverboat captains during the heydays of 20th century development were familiar with these channel characteristics as they navigated through the shifting shoals and sought the deepwater pools in the outer bends. Larger vessels were required to warp-around the tight rope-bends. Present day mariners seek out the remaining deepwater pools as storm havens or "hurricane holes."

Today, the lower Caloosahatchee, downstream from Beautiful Island, is an estuary (subject to tidal influence), but, in essence, it is a drowned river valley, inundated during the post-glacial rise in sea level. Many of its former river meanders are clearly visible along the shoreline (Figure 23, red dashed line).



Relict Meanders East of the Franklin Lock.



Figure 22. Meanders in the Caloosahatchee, 1887.

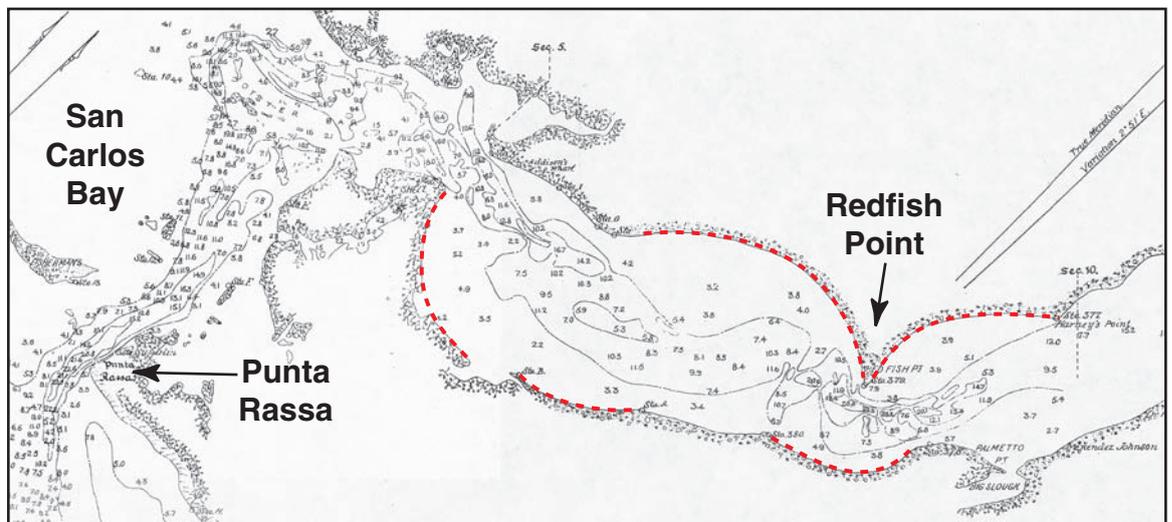


Figure 23. Drowned River Valley features.

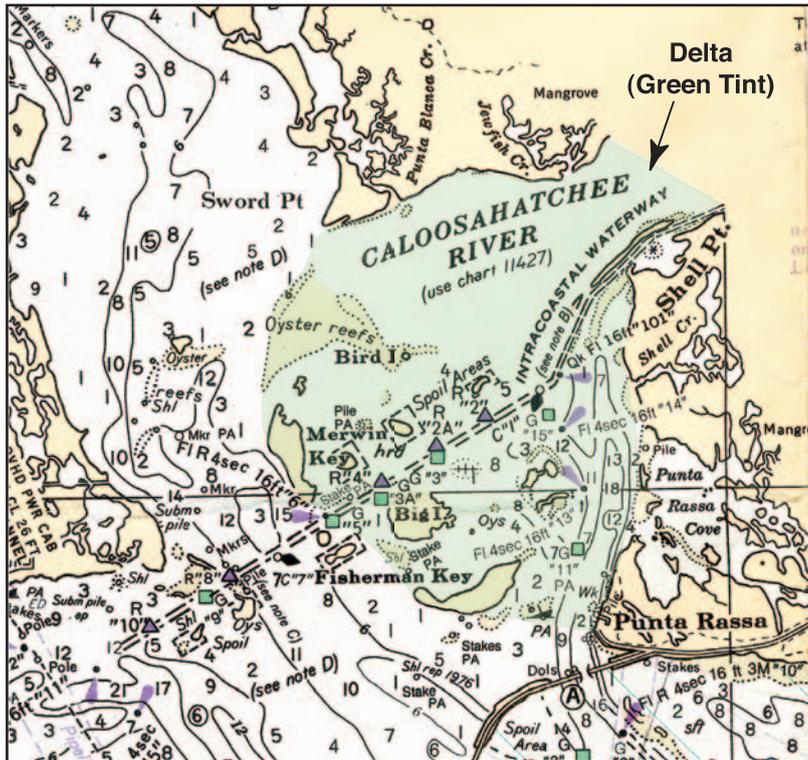


Figure 24. Chart of the Caloosahatchee delta.

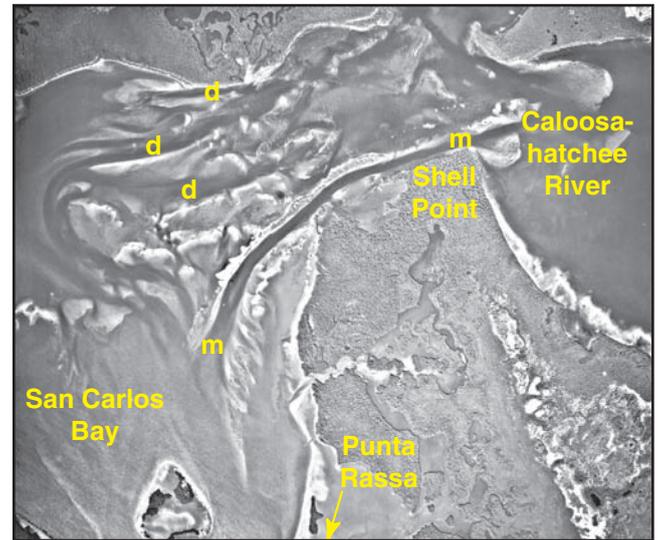


Figure 25. Caloosahatchee delta, 1944.



Figure 26. Imperial River delta, 1999.

Another feature of these rivers is the delta formed where the velocity of the stream rapidly decreases as it flows into a body of standing water. Distributary, intersecting, secondary channels form where the main river channel divides and pushes out into the bay. The configuration of the shoreline influences the shape of the delta. The Caloosahatchee delta, delineated by Shell Point at the apex (on the east) and a line drawn between Sword Point and Punta Rassa (on the west), has the characteristic *delta*-shape and is influenced by tidal currents flowing between Matlacha Pass and San Carlos Bay (Figure 24). Indeed, much of the shifting, shoaling character of the “Miserable Mile” segment of the Gulf Intracoastal Waterway through this area is attributable to tidal currents redistributing the river’s delta deposits. The aerial photograph in Figure 25 predates the Gulf Intracoastal Waterway and clearly shows the many distributary channels (“d”) in this area. The main, navigable channel through the delta (“m” in Figure 25) shows the side-cast spoil placed along the north bank of the channel. This is a federally-maintained channel that was first dredged by the Army Engineers in 1882.

The Imperial River’s delta (Figure 26) extends across lower Estero Bay and abuts the barrier island. This delta has proved to be an effective barrier to navigation. Shallow-draft coastal vessels used one of the distributary channels, the “Auger Hole,” during the early development period. In 1955, a private developer dredged a north-south channel across the delta in order to provide boat access between Estero Bay and Wiggins Pass.