Inventory and Assessment of Hydrologic Alterations in the Myakka River Watershed

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Abstract:

The Myakka River and it's associated watershed encompasses approximately 600 square miles and spans across four Counties in southwest Florida; Charlotte, Sarasota, Manatee and Hardee. The Myakka River is designated as a Wild and Scenic River from Charlotte through Sarasota County and the entire watershed is located in the Charlotte Harbor National Estuary Program (CHNEP).

Since Florida became a State in 1845, a number of hydrologic alterations in the form man-made drainage ditches, dams, dikes and flow diversions have occurred in the Myakka River watershed. These hydrologic alterations along with the introduction of irrigation sources from outside or beneath the watershed have all been identified as potentially altering the historical hydrology of the river and the water budget from the watershed.

These hydrologic alterations are a focus of several objectives in the CHNEP Comprehensive Conservation Management Plan (CCMP). To restore a more natural hydrologic flow regime for the Myakka River and develop a more natural water budget to the bays and estuaries, it is essential to first understand what hydrologic alterations have occurred in the watershed. With a common understanding, water managers including hydrologists, biologists, and chemists can better plan and implement a watershed management plan that protects and to the extent possible, restores the river.

It is within this context that thirteen (13) hydrologic alterations were preliminarily evaluated relative to their effects on the water budget of the Myakka River watershed. From these preliminary evaluations, it is concluded that consideration be given to managing the Myakka River watershed in four distinct segments: (1) the Upper Myakka River, upstream of Flatford Swamp where the historical water budget appears to have been consistently increased; (2) the Myakka River, between State Road 72 and Flatford Swamp where the historical water budget appears to have been consistently increased; (3) the Myakka River, between U.S. 41 and State Road 72 where the historical water budget appears to have been consistently reduced; and (4) the lower Myakka River downstream of U.S. 41 and the Big Slough watershed, where the historical water budget appears to have been consistently increased. Exhibits 1 through 4 present reference maps for the 13 hydrologic alterations considered.

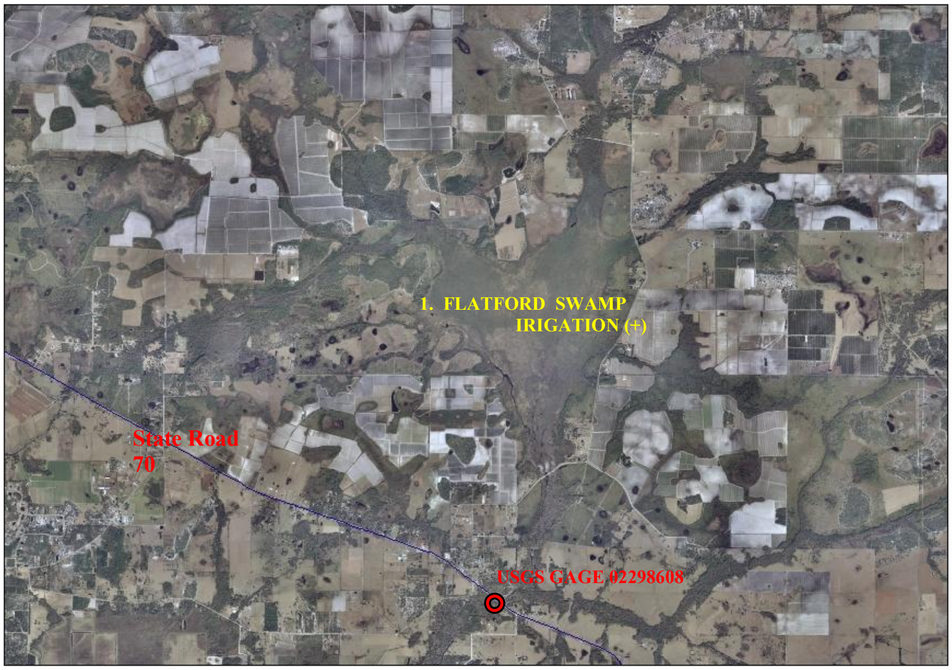

1. FLATFORD SWAMP
IRIGATION (+)
State Road
70
USGS GAGE 02298608

EXHIBIT 1

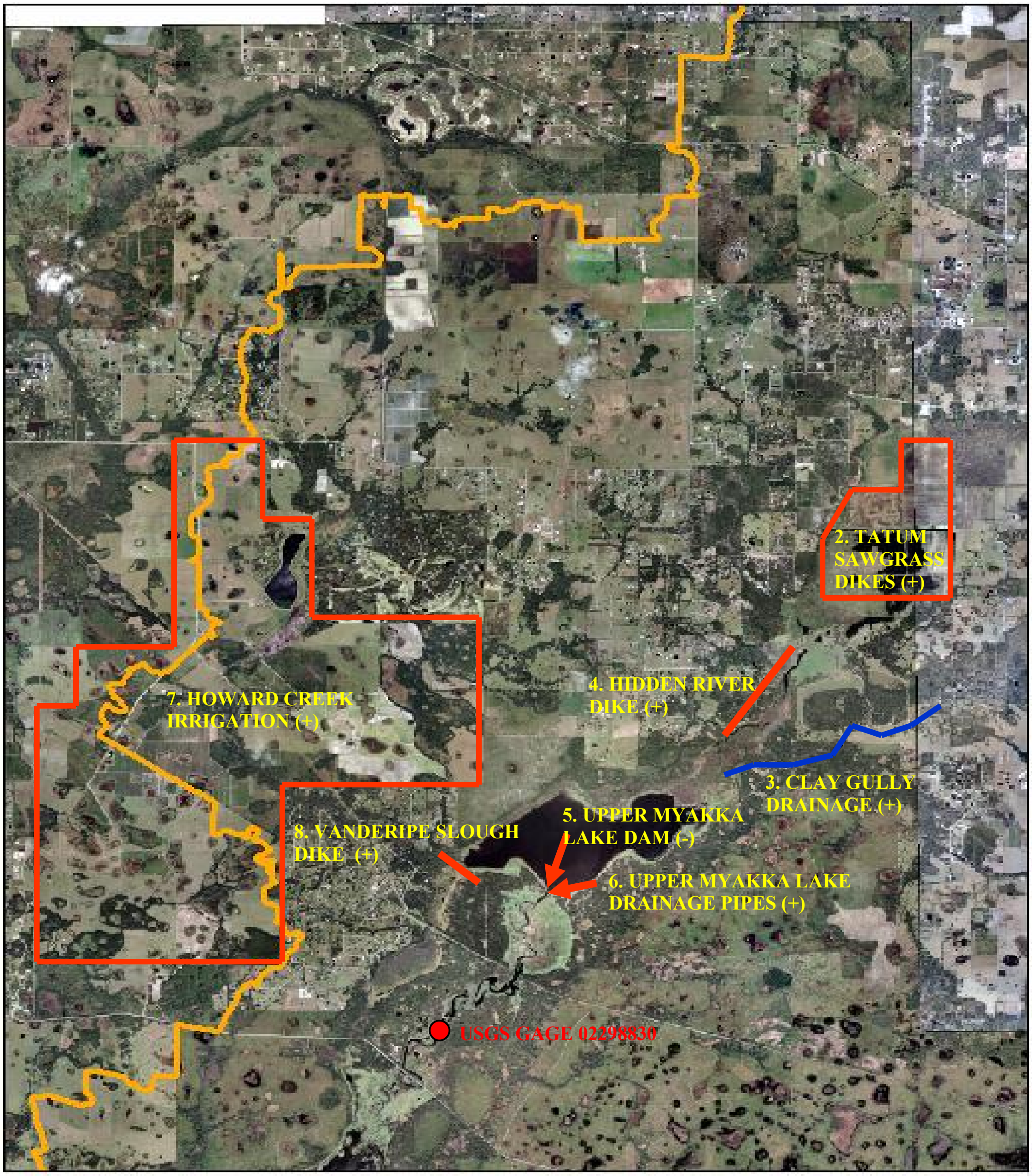

2. TATUM SAWGRASS DIKES (+)
4. HIDDEN RIVER DIKE (+)
7. HOWARD CREEK IRRIGATION (+)
3. CLAY GULLY DRAINAGE (+)
5. UPPER MYAKKA LAKE DAM (-)
8. VANDERIPE SLOUGH DIKE (+)
6. UPPER MYAKKA LAKE DRAINAGE PIPES (+)
USGS GAGE 02298830

EXHIBIT 2

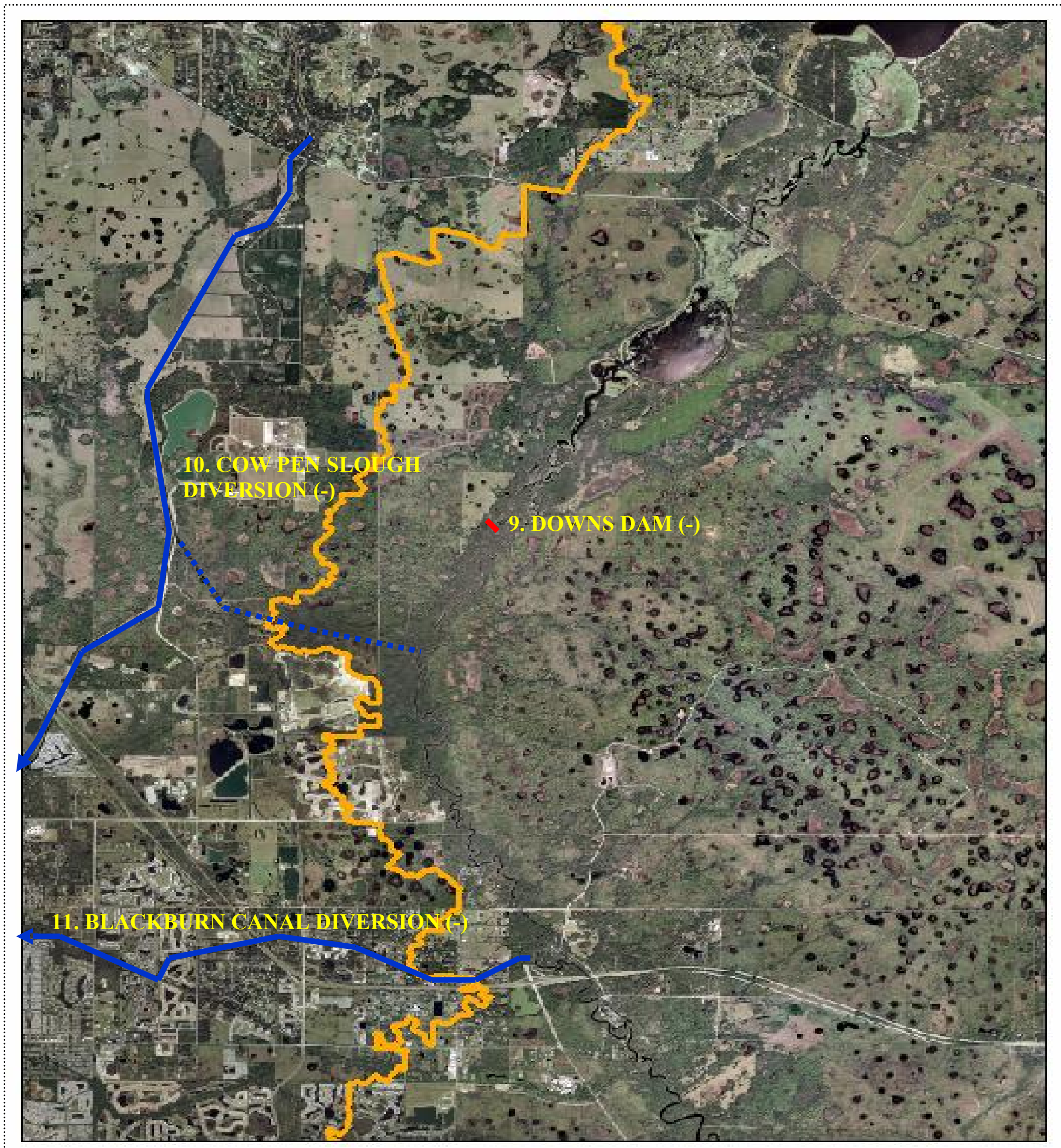

10. COW PEN SLOUGH
DIVERSION (-)
9. DOWNS DAM (-)
11. BLACKBURN CANAL DIVERSION (-)

EXHIBIT 3

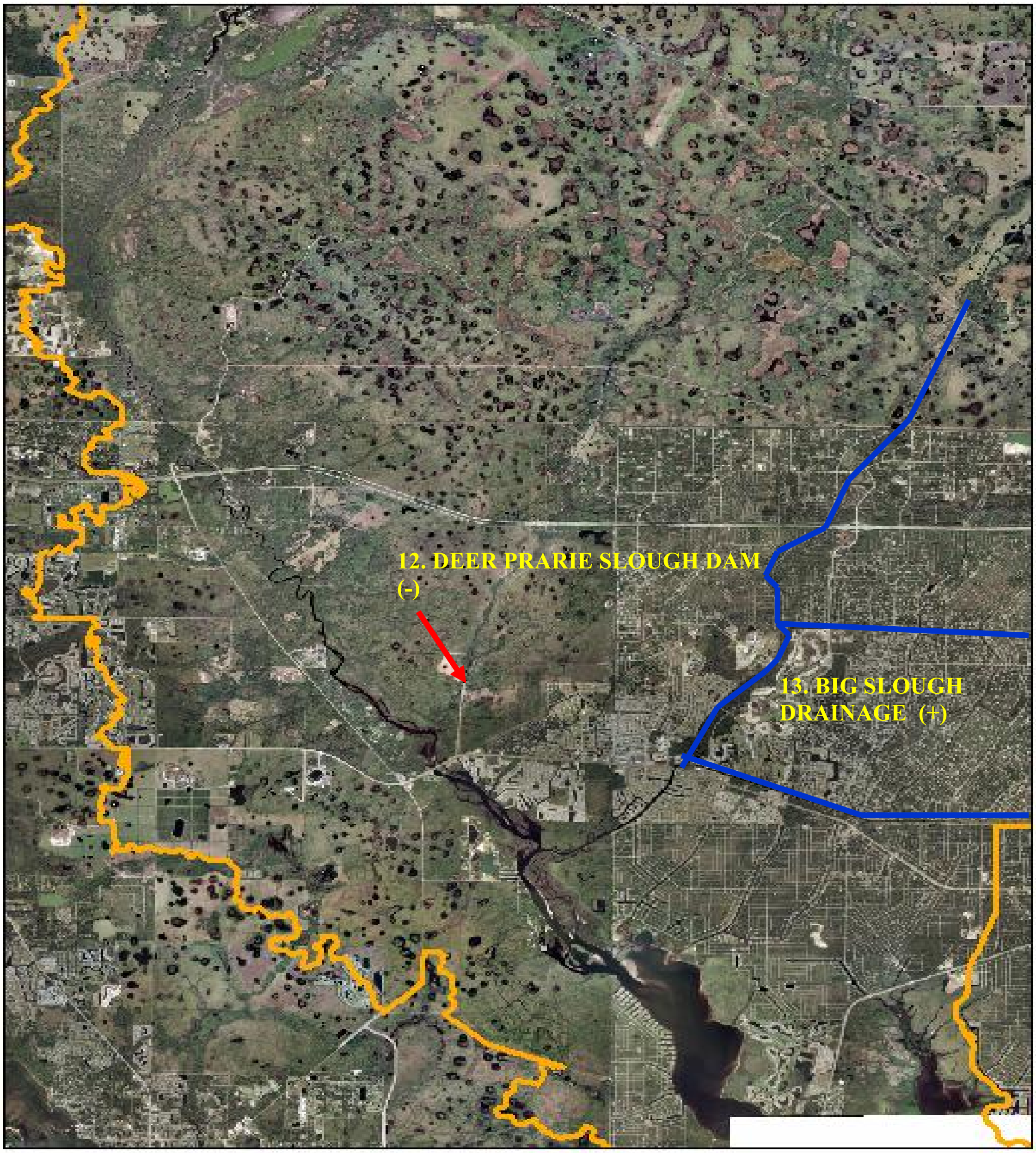


EXHIBIT 4

1. Flatford Swamp (Irrigation)

Flatford Swamp is located in the upper portion of the Myakka River watershed and is formed from the confluence of seven different tributaries: the Myakka River, Wingate Creek, Ogleby Creek, Long Creek, Maple Creek, Young's Creek, and Taylor Creek. Within the upper Myakka River watershed, excess water has resulted in abnormal tree stress and mortality in Flatford Swamp. A study sponsored by the Southwest Florida Water Management District (SWFWMD) determined that excess water in the system is the cause of the stressed and dying trees. Based upon information provided by SWFWMD, there are approximately 43.6 mgd and 66.8 mgd of permitted annual average ground water withdrawals upstream of Flatford Swamp and the Upper Myakka Lake, respectively.

A comparison by SWFWMD of median daily flows between 1940 to 1969 and 1970 to 1999 at the USGS Myakka River gage located downstream of the Upper Myakka Lake revealed an average annual excess of 24.51 mgd during the 135 day period between January 1 and May 15 for the recent 30 year period (refer to Figure 1.1).

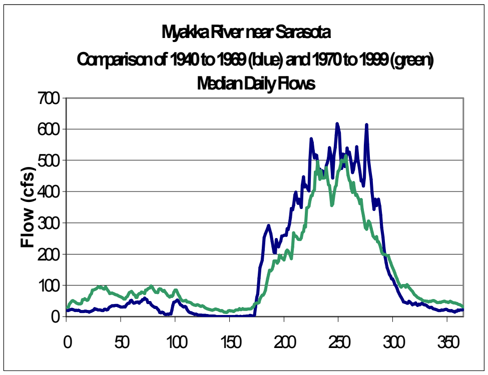
While the decline over the past 30 year in wet season flows was found to be a consistent phenomenon throughout Florida Rivers by SWFWMD, the increase in dry season flows in the Myakka River was unique. SWFWMD attributed the change in river flows throughout the District to a naturally occurring climatic change known as the Atlantic Multidecadal Oscillation (AMO). In addition, scientists recently discovered that tiny particles of dust blown across the Atlantic Ocean from the Sahara Desert have reduced the amount of rainfall reaching the surface of Florida.

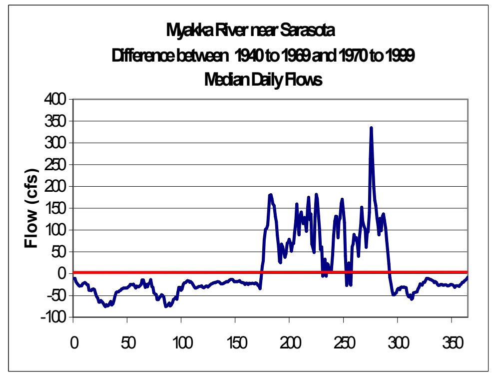
To further complicate the reported hydrology of the area, a dam was placed at the outlet to the Upper Myakka Lake between 1936 and 1941 which is upstream of the USGS gage. Then, in 1974, six, 60" diameter pipes with inverts approximately 4 feet below the dam spillway were placed adjacent to the dam. The timing and nature of these Upper Myakka Lake controls contribute to the 30-year river signature comparison shown in Figure 1.1. The introduction of ground water from upstream irrigation activities and the addition of "bleed-down" culverts in Upper Myakka Lake in the past 30 years help to explain the observed increase in dry season flows at the USGS site.

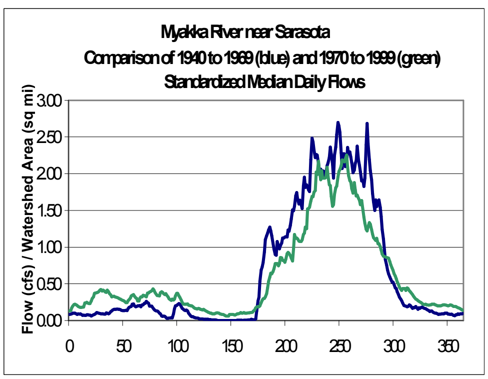
Figure 1.2 presents the days of zero flow for each year of record at the USGS gage located downstream of the Upper Myakka Lake. This information further verifies a change in low flow conditions in the past 25 to 30 years. Previous studies of low flows in the Myakka River seem to support a natural watershed wide trend for periods of no flow.

It should also be noted that SWFWMD and the agricultural community through the Florida Department of Agriculture and Consumer Services (FDACS) continue to develop and implement more efficient irrigation and conservation measures through the Facilitating Agriculture Resource Management Systems (FARMS) program. Since 1996, permitted annual average ground water withdrawals have declined by 3.4 mgd and 6.6 mgd upstream of Flatford Swamp and the Upper Myakka Lake, respectively. In addition, SWFWMD's Recovery Plan for the Southern Water use Caution Area (SWUCA) is aimed at continuing to reduce permitted groundwater withdrawals.

Figure 1.1 – Comparison of 30-yr river signatures downstream of Upper Myakka Lake (SWFWMD)







Period	Average of the Median Daily Flows (cfs)	
1940 to 1969	147.21	
1970 to 1999	138.12	
Difference for year	9.08	5.87 MGD
% Change for year	6.17%	
Difference for SRP Wet Season	79.36	51.27 MGD for 135 days 18.97 MGD for year
% Change for SRP Wet Season	22.51%	
Difference for NRP Wet Season	-37.94	-24.51 MGD for 135 days -9.07 MGD for year
% Change for NRP Wet Season	-150.73%	

Mean 40 to 69 Daily Median Flow (inches)	8.74
Change in inches between period medians	0.54
Mean of 40 to 69 Mean Daily Flow in inches	15.50
Mean of 70 to 99 Mean Daily Flow in inches	14.30
Change in inches	1.21
Percent Change between period means	7.79%

SRP Wet Season is June 14 to Oct 27 - total of 135 consecutive days
NRP Wet Season is Jan 1 to May 15 - total of 135 consecutive days
Wet seasons differences are the average daily difference for the respective 135 day periods
to extrapolate to a daily value per year multiply by 0.37 (i.e., 135 days / 365 days)

Watershed area (WA) upstream of the gage in square miles is:	229
Mean of POR Daily Mean Flow/WA:	1.10
Mean of POR Daily Median Flow/WA:	0.60
Mean of 40 to 69 Daily Median Flow/WA:	0.64
Mean of 70 to 99 Daily Median Flow/WA:	0.60
% Change in DFF/WA	6.17%

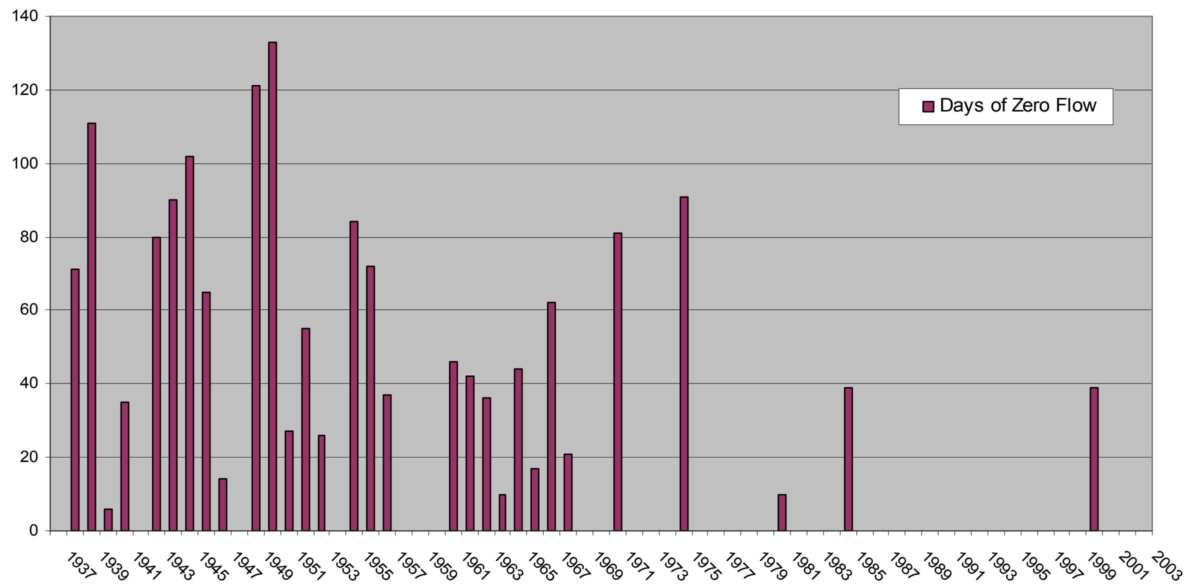


Figure 1.2 – Days of Zero Flow at Myakka River near Sarasota

2. <u>Tatum Sawgrass (Dikes)</u>

The historical Tatum Sawgrass area is approximately 4,300 acres in size. During major storm events, Tatum Sawgrass historically served as a backwater area for Myakka River flood waters. A drawing contained as part of the USGS flood study indicated that the top of the Tatum Sawgrass dikes ranged from elevation 18.7 to 19.7 msl, effectively isolating this area from the Myakka River system.

An evaluation of the effects on flooding of the Tatum Sawgrass dikes constructed in 1974 was conducted by the USGS in 1978. Flood stages determined by the USGS adjacent to Tatum Sawgrass are 19.0, 19.9, 20.4, 21.1, 21.5, 21.9, 22.5, and 23.2 feet above msl, for the 2, 5, 10, 25, 50, 100, 200, and 500 year frequency floods, respectively. This evaluation concluded that the loss in floodplain storage associated with the Tatum Sawgrass dikes resulted in increased flood stages and peak discharges up to and including the 25-year frequency. The USGS report also indicated that approximately 1,200 additional acres along the Myakka River main stem may be inundated during the 2-year flood as a result of the dikes. Therefore, these dikes affect all flow regimes with the exception of very extreme food events.

3. <u>Clay Gully (Drainage and Flow Diversion)</u>

Clay Gully intercepts the Myakka River approximately 2 miles northeast of the Upper Myakka Lake. From that point, it provides a more direct path for water to flow to the Upper Myakka Lake. In fact, from its' confluence with Clay Gully, the Myakka River turns northeast and meanders into the southwesterly portion of Tatum Sawgrass, where it then turns southwest and eventually finds its way to the same point of entry into the northeast corner of the Upper Myakka Lake as Clay Gully. However, the direct Clay

Gully route to the Upper Myakka Lake is less than half of the travel length of the Myakka River. Figure 3.1 presents the current configuration of Clay Gully.

From a historical interview of Clarence Summerall (CS) in January 1983 conducted by Park Ranger Paula Benshoff (PR), the following relevant excerpts are provided:

PR: How about Clay Gully, has it changed over the years?

CS: Well you know, at one time it was just a slough. But old man (Allen) Gus Crowley ploughed that gully from where it comes from the river down to Mossy Island Slough. Across that field there he ploughed it with a yolk of oxen.

PR: So there wasn't much to it then?

CS: Not even a good ditch.

PR: When do you (think) that happened?

CS: He ploughed that a whole lot longer than … well it was right close to 1900.

Figure 3.1 – Clay Gully

In 1991, Paula Benshoff interviewed Allen Crowley's son, Joe Crowley who added that before his father ploughed out Clay Gully, it was only eight feet wide at the widest part and about 3 feet deep. He also added the gully was enlarged since then due to the flow of water.

The 1945 Robert Angus engineering report states that "a cutoff channel has, however, been formed … to the upper end of the Upper Myakka Lake, and this cut off is known as Clay Cully." This report also stated in part that flood elevations could be reduced "if Clay Gully were widened and a proper floodway constructed". In their subsequent 1978 flood study of the Myakka River, the USGS indicated that 35 percent of the Myakka River flow is shunted around the Tatum Sawgrass area through Clay Gully.

4. <u>Hidden River (Dike)</u>

In a 1991 interview, Joe Crowley remembered thousands of Ibis and other wading birds roosted at the big marsh on the Myakka River up by the Carlton pasture (Hidden River).

In 1957, Frank Smith, a land developer and designer of irrigation ditch digging equipment contracted with the Carlton family and Attorney John Early to purchase their adjacent properties, which became Hidden River. From the *History of Hidden River*:

"Mr. Smith's original intention was to raise cattle. Recognizing that a portion of the property was 'waterlogged', he contracted the Soil Conservation, who decided to put his property into their conservation program constructing the dike, by-pass canals and the drainage system throughout what is now Hidden River" (refer to Figure 4.1).

Figure 4.1 – Hidden River Dike w/Outfall

The cattle ranch "protected" by the dike was subsequently platted as a residential subdivision in 1966. A recent survey indicates a low point in the top elevation of the dike at 21.66 msl. Flood stages determined by the USGS adjacent to the Hidden River dike are 18.9, 19.5, 19.9, 20.6, 21.0, 21.4, 21.8, and 22.4 feet above msl, for the 2, 5, 10, 25, 50, 100, 200, and 500 year frequency floods, respectively. Therefore, this dike affects all flow regimes that would normally come out of bank along the north side of the river.

In June of 1992, the dike held during flood producing rains but the rise in the Myakka River caused water come around the dike. This resulted in some severe damage to the roads and other infrastructure in the Hidden River subdivision. Then on June 23, 2003, a record flood overtopped the dike, causing several breaches and the entire floodplain behind the dike was recaptured. From the *Sarasota Herald Tribune*:

"Flood waters continued to rise at a rate of 4 to 6 inches an hour well into the afternoon. Of approximately 90 homes in the subdivision, up to 40 had been affected by the rising water – some with water up to their rooflines…As of mid afternoon, about 300 acres had been affected by the flooding…On the east side of the complex, most homes were under up to eight feet of water."

5. <u>Upper Myakka Lake (Dam)</u>

The dam located at the main outfall to the Upper Myakka Lake was constructed in the spring of 1941 (refer to Figure 5.1), replacing a dam that had been constructed several years earlier by the Civilian Conservation Corps (CCC). The construction of this dam resulted in a backwater effect into both Howard Creek and Vanderipe Slough. A dike was therefore constructed along the north side of Vanderipe Slough. The construction of the dam precipitated an engineering study being conducted in 1945 by Robert Angas on behalf of the Florida Forest and Park Service to address flooding concerns expressed by upstream private property owners. This engineering study was to "determine the damage, if any, caused to the Carlton Pastures (subsequently Hidden River subdivision) by backwater from the dam at the outlet of the Upper Myakka Lake. In addition, the study was to determine what damage, if any, was being done to the pastures of Mrs. John Vanderipe, Sr. by the dam".

Although it was also noted that the actual length was somewhat shorter than the 200 foot length on the original design plans, this report concluded that the dam was probably not causing damage to the Carlton Pastures. However, the report recommended monitoring water levels upstream and downstream of the dam to determine if the water below the dam was falling more rapidly than water in the Upper Lake. If an appreciable difference in water levels above and below the dam existed above an upstream elevation of 14.5 msl, the report recommended providing for additional spillway opening. Subsequent monitoring by the Superintendent of the Park and the Park Ranger in September of 1945 indicated that the receding elevation difference in water levels was between 4 to 6 inches.

Figure 5.1

The crest of the dam is at 13.65 feet above msl. At this crest, approximately 2,935 acre-feet of storage are impounded in the Upper Lake. Based upon an upstream contributing drainage area of approximately 229 square miles, this volume would correspond to 0.24 inch of runoff over the contributing area.

Flood stages determined by the USGS for the Upper Myakka Lake are 17.4, 18.1, 18.6, 19.1, 19.5, 19.9, 20.3, and 20.8 feet above msl, for the 2, 5, 10, 25, 50, 100, 200, and 500 year frequency floods, respectively. Therefore, this dam is expected to affect low and possibly moderate flows, but have minimal effect on high flows.

From a historical perspective, very little information is available prior to the installation of the Upper Myakka Lake Dam. However, the interview of Clarence Summerall (CS) in January 1983 conducted by Park Ranger Paula Benshoff (PR) provides the following insights:

PR: Where there a lot of hyacinths in the lake back then?

CS: It was covered up.

PR: Was that in the early 1900's?

CS: Yeah and I seen the time out there that you couldn't see the water.

PR: Back then, did anyone have any speculation as to how they got into the lake?

CS: Reasoner brought that stuff from South America. He brought it up here and sold it for flowers…

PR: Do you know when the hyacinths were brought in?

CS: It was in the early 1900's somewhere.

PR: How early would you say the lake was covered with hyacinths?

CS: It would be maybe 1910 or better. But I've waded through the lake many times. 'Til they put the dam in there the lake never did get over pocket deep.

PR: Can you remember any changes that occurred after they put the dam in?

CS: Yes. The changes was amazing. They dammed all that water up and run it up and pushed it back to Howard Creek…

PR: So was it dryer before?

CS…I've crossed that lake with a car. And it didn't drown it out. Shep's Island was a big campground. That was where we'd camp. But now, there's no way to go out there… The only way you can get in there is to cross the dam. Used to be the lake was all sand. Now you go out there and bog down.

6. Upper Myakka Lake Pipes (Drainage)

As previously indicated, installation of the dam on the Upper Myakka Lake was somewhat controversial, causing the construction of the dike north of Vanderipe Slough. In following years, several other dikes were installed in the floodplain of the Myakka River, upstream of the Upper Myakka Lake. In 1974, coincidentally the same year that an extensive dike system was constructed in Tatum Sawgrass, six (6), 60" diameter pipes were constructed just southeast of the Upper Myakka Lake dam to allow for the drawdown of lake (refer to Figure 6.1).

The primary purpose for these culverts was to allow for the periodic drawdown of the lake to control hydrilla and other weeds that had become problematic in the Upper Myakka Lake. In fact, in 1976, Sarasota County adopted Ordinance No. 76-6 authorizing the annual draw down of Upper Myakka Lake by the Florida Department of Natural Resources for the purpose of eradication of hydrilla and other noxious and harmful weeds and plant growth.

The inverts of these pipes vary between 9.6 and 9.8 msl. There are approximately 2,935 acre-feet of storage in the Upper Myakka Lake between the crest of the spillway and the inverts of the pipes. Therefore, installation of the pipes would equate to an average discharge rate during the 135 day season (from January 1 to May 15) of approximately 7 mgd.

Figure 6.1 - Upper Myakka Lake Culvert Installation, November, 1974

7. <u>Howard Creek (Irrigation)</u>

Howard Creek is located in Sarasota County and enters the Upper Myakka Lake north of the Vanderipe Slough dike. Figure 7.1 provides a picture taken from the Vanderipe Slough dike, looking north where Howard Creek enters the Upper Myakka Lake. Before the construction of the Vanderipe Slough dike, Howard Creek may have drained, or at least contributed flows to, Vanderipe Slough. The watershed served by Howard Creek has been predominately in agricultural use since the 1950's. Since 1990, treated reclaimed wastewater has been used to irrigate agricultural operations totaling between 4,792 and 5,642 acres. Long term rainfall and stream gage information from the USGS and rainfall and wastewater irrigation quantities from Hi-Hat and the City of Sarasota were used to determine if the reclaimed irrigation water was having an effect on flows from Howard Creek to the Upper Myakka Lake.

The USGS operates a stream flow station in Howard Creek (02298760) which has reported continuously November of 1983, with the exception of October 1995 through September 2000. The reported contributing drainage area at the USGS station is 20 square miles. Average monthly rainfall and runoff between 1983 and February of 1990 (when Hi-Hat and the City of Sarasota began reporting reuse irrigation quantities) were compared to average monthly rainfall and runoff from March 1990 through December 2004. The relationship of runoff to rainfall was also considered in this comparison. The results are provided below in Table 7.1 and indicate that the period of reclaimed wastewater irrigation resulted in lower ratios of runoff to rainfall during the dry season with the exception of February, May, and November. This was also the case for all months during the dry season when total monthly irrigation quantities were conservatively subtracted from the post 1990 average monthly runoff totals, except in May.

Figure 7.1 – Upper Myakka Lake and Howard Creek from Vanderipe Slough Dike

Based upon this analysis, the 8 year period of record preceding the use of reclaimed irrigation generally resulted in higher dry season runoff volume conversion, even in dry season months that averaged less monthly rainfall (i.e. January, April, and December). Also, the 8 year period of record preceding the use of reclaimed irrigation averaged significantly less annual rainfall particularly in the wet season, which could also explain why post wet season months like October and November had lower runoff volume conversions. However, the month of May does appear to exhibit a trend of increased dry season runoff volumes following the use of reclaimed irrigation. It may also be the case that during the 8 year period preceding the use of reclaimed irrigation, that the Howard Creek dry season water budget was generally supplemented with greater quantities of ground water for irrigation.

	HOWARD CREEK		'83-'90	'90-'04			Adjusted	'90-'04
	1	2	3	4	5	6	7	8
	MEAN	MEAN	R/P	MEAN	MEAN	R/P	MEAN	R/P
	RAINFALL	RUNOFF		RAINFALL	RUNOFF		RUNOFF	
MONTH	inches	inches		inches	inches		inches	
JAN	1.64	0.32	0.20	2.85	0.49	0.17	0.40	0.14
FEB	1.60	0.18	0.12	2.40	0.35	0.15	0.23	0.10
MARCH	4.99	1.29	0.26	3.54	0.33	0.09	0.19	0.05
APRIL	1.54	0.40	0.26	3.54	0.59	0.17	0.43	0.12
MAY	2.24	0.19	0.09	2.72	0.51	0.19	0.35	0.13
JUNE	5.40	0.07	0.01	11.04	3.84	0.35	2.86	0.26
JULY	8.34	0.77	0.09	9.35	3.07	0.33	3.03	0.32
AUG	7.34	2.58	0.35	10.87	4.72	0.43	4.68	0.43
SEPT	5.79	3.25	0.56	8.04	4.68	0.58	4.63	0.58
OCT	2.88	0.29	0.10	2.89	0.72	0.25	0.60	0.21
NOV	2.06	0.22	0.11	1.34	0.18	0.13	0.07	0.05
DEC	2.06	0.58	0.28	2.68	0.54	0.20	0.45	0.17
	45.88	10.15	0.22	61.26	20.02	0.33	17.91	0.29

Table 7.1

Column 1 - average monthly rainfall based upon Myakka River station 194
Column 2 – average monthly runoff based upon USGS station 02298760
Column 3 – % of rainfall converted to runoff (column 2 / column 1)
Column 4 – average monthly rainfall based upon Hi-Hat irrigation report
Column 5 – average monthly rainfall based upon USGS station 02298760
Column 6 – % of rainfall converted to runoff (column 5 / column 4)
Column 7 – average monthly runoff less reported reuse quantities
Column 8 - % of rainfall converted to runoff (less reuse quantities)

8. <u>Vanderipe Slough (Dike)</u>

As previously discussed, the Upper Myakka Lake dam not only elevated low and normal water levels in the lake, but pushed water back up Howard Creek and into the north end of Vanderipe Slough. Figure 8.1 provides a view of Vanderipe Slough looking south from the dike. The Vanderipe Slough dike was reportedly installed in the late 1930's, early 1940's in association with the construction of the Upper Myakka Lake dam. In 1945 the Florida Forest and Park Service contracted a civil engineer, Robert Angus, to determine what damage, if any, was being done to the pastures of Mrs. John Vanderipe, Sr.

A survey map of Vanderipe Slough from this report indicates that the lowest elevation of the top of dike was around 14.5 msl. The same survey shows a high point in the Slough profile of 14.0 msl, about 1500 feet north of State Road 72. The report also states that flows through Vanderipe Slough cease when the Upper Myakka Lake drops to elevation 14.5. The report noted that the dike had been constructed across the upper end of Vanderipe Slough in an attempt to prevent the elevated lake water from entering the Slough. However, it was also noted that the dike was not long enough to prevent moderate high water from flowing around the north westerly end of the dike.

Flood stages determined by the USGS for the upper Myakka Lake are 17.4, 18.1, 18.6, 19.1, 19.5, 19.9, 20.3, and 20.8 feet above msl, for the 2, 5, 10, 25, 50, 100, 200, and 500 year frequency floods, respectively. Therefore, this dike is expected to affect low and normal flows, but have minimal effect on high flows.

Figure 8.1 – Vanderipe Slough, looking south from Dike

Mr. Angus also concluded in his report that:

"In my opinion the dike is doing no harm to the Vanderipe Pastures, as Vanderipe Slough was and still is a natural auxiliary flood channel for Myakka River. The river is still using the Slough as an auxiliary channel due to the dike being too short.

If the dike is lengthened, however, in order to keep the Lake and Howard Creek from flowing into the Slough over the low ground south of Howard Creek, the slough is still going to be inundated at times by Myakka River backwater from below the dam…

The lengthening of this dike at the entrance to Vanderipe Slough may necessitate the construction of the additional spillway at the Upper Myakka Lake dam. The reason for this is that the lengthening of this dike will prevent the river from using Vanderipe Slough as a high water floodway."

From a historical perspective, the interview of Clarence Summerall (CS) in January 1983 conducted by Park Ranger Paula Benshoff (PR) provides the following insights:

PR: Can you remember any changes that occurred after they put the (Upper Myakka Lake) dam in?

CS: Yes. The changes was amazing. They dammed all that water up and run it up and pushed it back to Howard Creek. Vanderipe Slough most of the time was just a slough – just a big old flat piece of ground. But when they put the dam in there and pushed that water back, it made it almost a river.

PR: So was it dryer before?

CS: It was just a little trickle of water down in there. Just like a rut in the road. You could go out to Vanderipe's and to go to the river we'd go right across Vanderipe Slough. ... You can't cross Vanderipe Slough anymore…

9. Downs (Dam)

Down's Dam was reportedly constructed in the 1930's (1983 Clarence Sumerall interview). This concrete dam has a 5 foot wide by 4 foot high notch that is operated by the underlying property owner. In the dry season a thick piece of plywood is placed on the upstream side of the structure and held in place by the water pressure (refer to Figure 9.1). The water level is controlled by the top of the structure elevation of 10.6 msl in the dry seasons. The plywood is removed in the wet season, allowing the upstream water levels to drop as much as four (4) feet and exposing the notch invert at 6.6 msl.

During the dry season, operation of this dam at 10.6 msl is effective in impounding water in the Lower Myakka Lake. In his 1945 engineering report to Florida Forest and Park Service, Robert Angus proposed that a dam with a spillway crest elevation of 10 msl be constructed at the outlet of the Lower Myakka Lake. At 10.6 msl, approximately 1000 acre-feet are stored in the Lower Myakka Lake.

Figure 9.1 – Downs Dam during Dry Season

Flood stages determined by the USGS in the vicinity of Downs Dam are 15.1, 16.2, 16.7, 17.3, 17.5, 17.8, 18.3, and 18.7 feet above msl, for the 2, 5, 10, 25, 50, 100, 200, and 500 year frequency floods, respectively. Therefore, this dam is expected to affect low and normal flows during the dry season, but have minimal effect on high flows.

From a historical perspective, the interview of Clarence Summerall (CS) in January 1983 conducted by Park Ranger Paula Benshoff (PR) provides the following insights:

PR: Did you ever go to Lower Lake?

CS: I've been down there a good many times. I've drove straight across that thing in dry weather.

PR: Across the middle of it?

CS: Across the whole thing. We start at deep hole and we'd go across there and it'd be dusty dry. Now that the hole had water in it but the lake would be dry…

PR: When the lake was dry, did grass grow across it?

CS: Yes. The cows would come right out on the lake bottom. In wet season it'd come back and be a lake again. But if we didn't have a dry spell, why it would hold water.

PR: In the wet season, how deep would the lake get?

CS: About waist deep.

PR: Was the bottom hard or mucky?

CS: Most of the lake was sand. Where the river comes into the lake was sand, but when you get past there, then you get the mud.

10. <u>Cow Pen Slough (Flow Diversion and Drainage)</u>

In a 1991 interview, Joe Crowley in discussing dramatic changes since his youth identified the canalization of Cow Pen Slough as one of the most severe impacts, indicating that there was a lot more swamp and marsh before it was dug out.

As reflected on the 1847 survey of Sarasota County, a large slough once dominated the landscape west of the Myakka River (refer to Figure 10.1). This slough ran from north to south and eventually turned eastward to the Myakka River. Being dependent upon the Myakka River for drainage, this large slough, like the Myakka River, receded very slowly. In fact, it likely became a large retention area at a certain elevation and only receded by evapotranspiration during the dry season.

Between 1916 and 1920, as part of the Sugar Bowl Drainage District, a drainage ditch was cut through this slough. This man-made ditch was then extended south of the slough where it was connected to a small tidal creek, known as Salt Creek. Salt Creek meandered southwest where it subsequently enters Shakett Creek and Dona Bay. This initiated the diversion of approximately 37,453 acres from the Myakka River watershed to Dona Bay. This drainage work, presumably performed for mosquito control and/or pastures conversion, effectively drained and diverted low and normal flows from the Myakka River to Dona Bay. However, due to the magnitude and relative lowness of this large slough system, it likely maintained a hydroperiod during the wet season that made it unsuitable for pasture or agriculture. Certainly, this area was still very prone to flooding following large storm events. Also in the 1920's, a well developed drainage system was constructed by the Pomello Park Drainage District in Manatee County to serve ranches in the upper reaches of what became the Cow Pen Slough basin.

Around 1950, a group of nine ranchers, with technical assistance from the Soil Conservation Service, constructed 7.5 miles of channel excavation along the lower reaches of Cow Pen Slough. Then in 1961, the Sarasota Soil Conservation District, Sarasota County and the Manatee River Soil Conservation District, with assistance from the Soils Conservation Service developed the "Watershed Work Plan for the Sarasota West Coast Watershed". Areas that once drained to the Myakka River via Cow Pen Slough had already been drained and diverted to Phillippi Creek by the Sarasota Fruitville Drainage District in the 1920's and put into vegetable production. However, these vegetable producing areas were still subject to flooding during large events. The objectives of the 1961 Plan were: (1) to reduce flood damage frequency in the vegetable producing area to about once in 10 years; and (2) to provide adequate drainage and flood protection in the pasture lands to permit the production of improved pastures in the lower-lying areas along the stream channels. As a result, a larger canal was excavated through the slough, extended west of the "old cow pen slough" ditch through an upland ridge, and connected directly to Shakett Creek. In addition to the canal work, three large water level control structures were constructed. Only two of these structures are still operational. Figure 10.2 presents the original Work Plan.

Due to environmental concerns relative to changes in freshwater volumes being diverted to Dona Bay, the 1961 Plan was not completed. The first and second phases of the Plan were completed in 1964 and 1966, respectively. The third phase which included the pumping station that would divert flows to Cow Pen Slough from Phillippi Creek was halted in 1972 due to concerns of project impacts on Dona Bay. The 1961 Plan was formally abandoned in 1979, and although the objective of reducing flood damage to the vegetable production areas was not accomplished, enough work had been completed to efficiently drain the historical slough. Since 1972, much of the historical slough has been converted and used for either pasture or citrus production.

Today, much of the historical slough signature still exists. Figure 10.3 presents the drainage system as it exists today in dark blue with the historical wetland and slough systems identified in light blue.

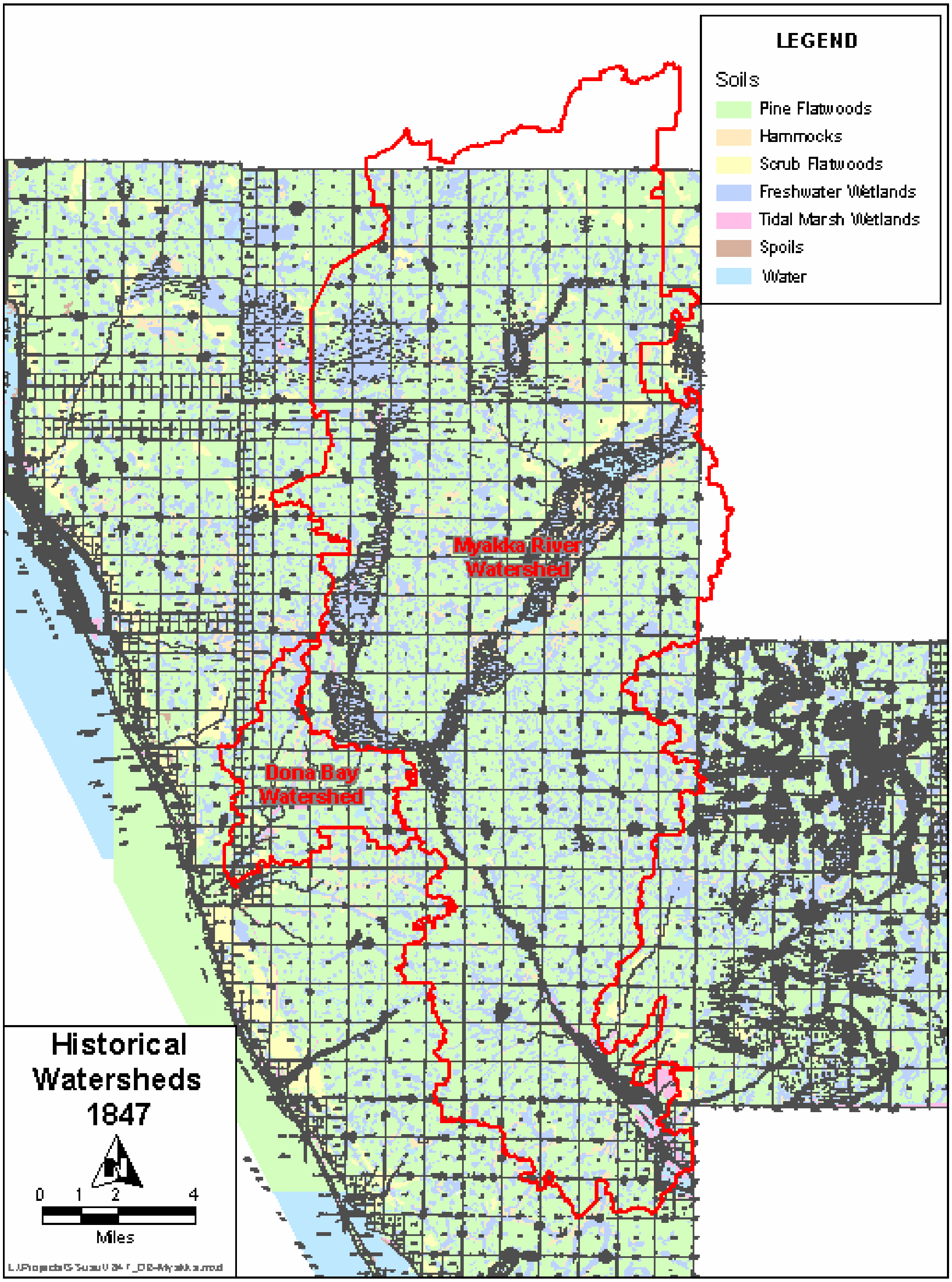


Figure 10.1 - 1947 Land Survey of Sarasota County

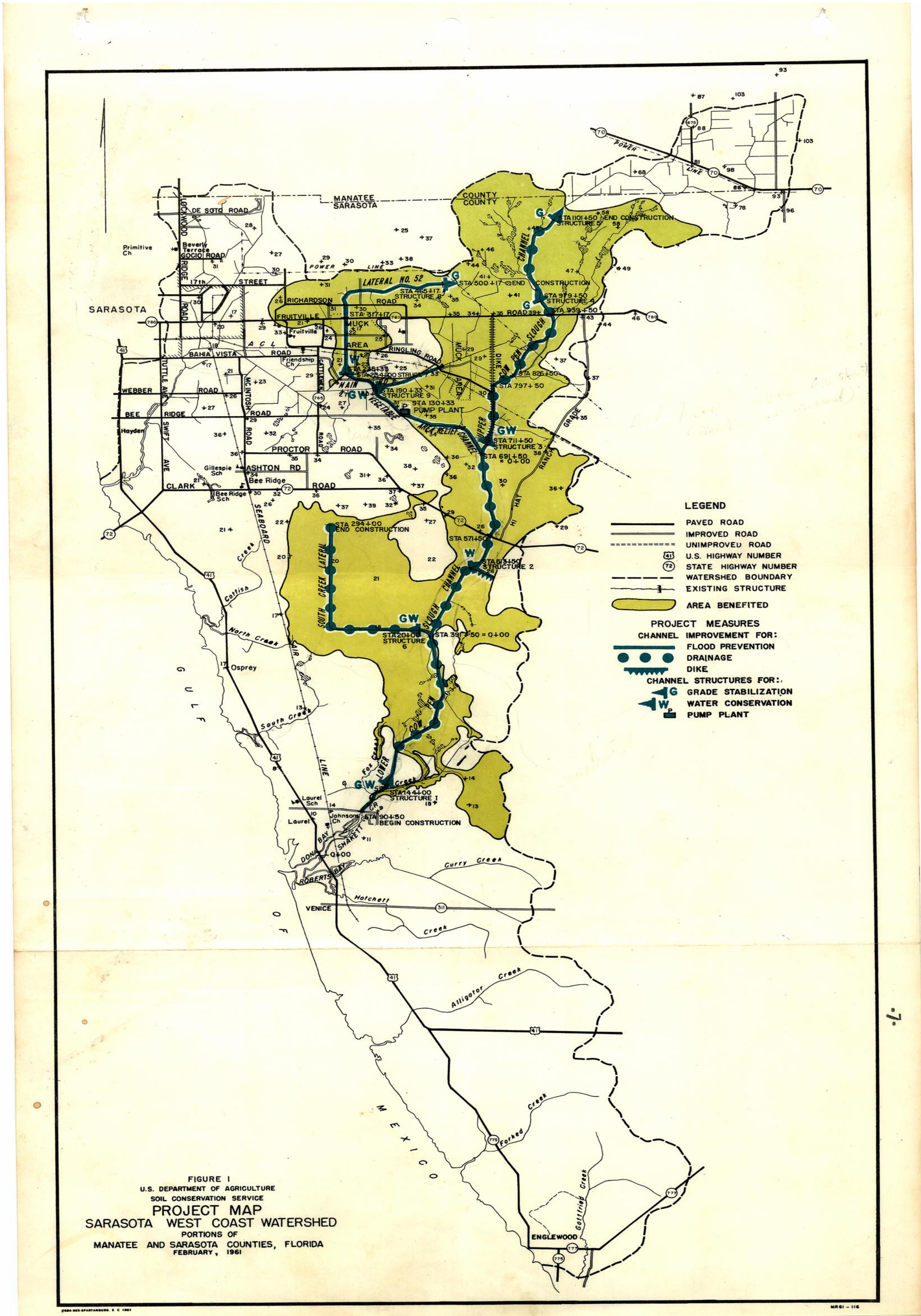


Figure 10.2 – 1961 Cow Pen Slough Work Plan

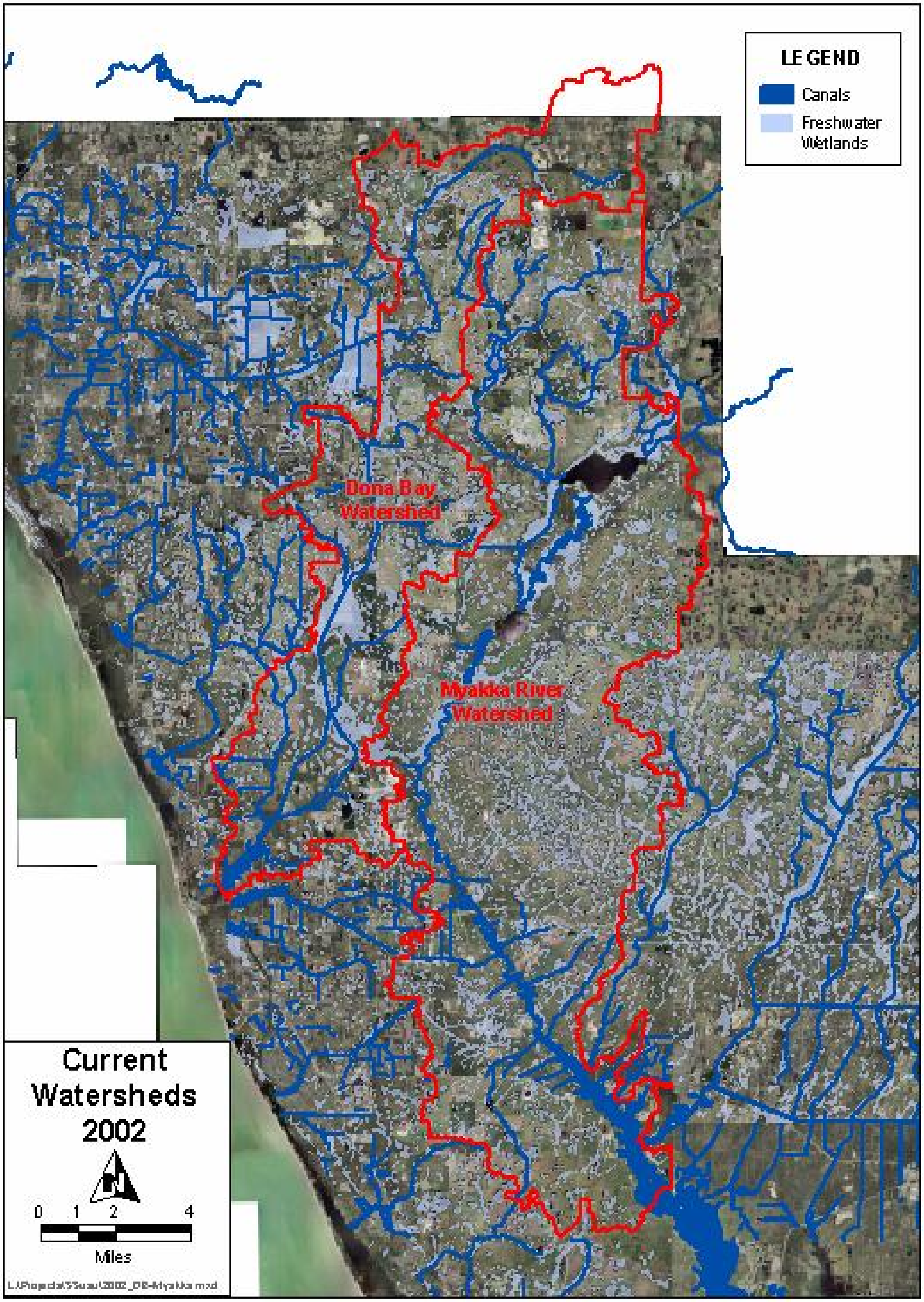


Figure 10.3 – Existing Drainage Network in Sarasota County

With the acquisition of the Pinelands Reserve and the Albritton tract, Sarasota County has put much of this historical slough under public ownership. Portions of it have been restored through re-hydration and Sarasota County is currently working with other watershed stakeholders to incorporate these public properties into a watershed management plan for Dona Bay. In addition, Sarasota County in cooperation with SWFWMD is monitoring stream stages and flows at both operable weirs on the canal. Preliminary rating curves have been established at both weirs and Sarasota County is currently reducing flow data from 2003 and 2004 to begin development of monthly and annual water budgets for this system.

Flood stages determined by the USGS at the historical confluence of the Cow Pen Slough with the Myakka River are 13.6, 14.7, 15.4, 16.0, 16.1, 16.4, 16.7, and 17.1 feet above msl, for the 2, 5, 10, 25, 50, 100, 200, and 500 year frequency floods, respectively. Therefore, the Cow Pen Slough diversion and drainage works are expected to affect all flow regimes.

Under current conditions, the Myakka River floodplain associated with a 5-year to 10-year frequency or greater will extend westward when flood stages exceed approximately elevation 14.6 to 15.3 msl to "old" Cow Pen Slough and ultimately, Dona Bay. There may also be a similar connection through the Pinelands Reserve when elevations exceed 16.2 msl.

11. Blackburn Canal (Flow Diversion and Drainage)

The Blackburn Canal extends approximately 6 miles from its confluence with the Myakka River to Roberts Bay and was designed to relieve flooding on the Myakka River on behalf of private property interests in 1959. According to the original engineering report prepared by DeLew, Cather and Brill, Blackburn Canal was designed to convey approximately 800 cfs for the 50-year frequency flood event. This canal was excavated at or below sea level from the Myakka River, west to Curry Creek. Curry Creek, once a relatively short, natural coastal creek, was straightened and deepened to provide for an adequate hydraulic connection with Blackburn Canal. Figure 11.1 shows the east end of Blackburn Canal at its confluence with the Myakka River.

The USGS has estimated flood stages at the confluence of the Myakka River and Blackburn Canal of 5.8, 7.9, 9.2, 10.4, 11.2, 11.9, 12.5, and 13.0 msl for the 2, 5, 10, 25, 50, 100, 200 and 500-year frequency flood, respectively. Since it is excavated at or below sea level for its entire length, this canal has the potential to impact all freshwater flows from the Myakka River.

Based upon stage-discharge relationships available for the Myakka River at its confluence with Blackburn Canal from the USGS and hydrodynamic modeling of a range of rainfall events and resulting hydrographs through the Blackburn Canal within the context of the Curry Creek watershed, it has been determined that approximately 7% of all freshwater flows are diverted from the Myakka River to Roberts Bay. With a contributing area of approximately 278.2 square miles and an average annual runoff of

15.26 inches, the estimated average annual volume of freshwater diverted to Roberts Bay from the Myakka River would be 15,851 acre-feet. However, as is the case with rainfall, this annual runoff volume will vary significantly from year to year. The USGS is currently monitoring flows on Blackburn Canal at Jackson Road. This information can be used to verify the actual flow volumes diverted by Blackburn Canal.

Figure 11.1 – Blackburn Canal at Confluence with Myakka River

12. <u>Deer Prairie Creek (Dam)</u>

Sometime in the 1950's a dam was placed in Deer Prairie Creek (refer to Figure 12.1). This dam is still in place and with a crest elevation of 3.31 msl, it essentially acts as a salinity barrier. It is estimated that this dam impounds approximately 8.25 acres. Assuming an artificial impoundment depth of 4 feet and a contributing drainage area of approximately 33,234.26 acres, this would equate to 13.24 acre-feet which corresponds to less than 0.01 inches of runoff over the contributing upstream drainage area. This dam probably effects low flows, but has a minimal effect on normal and high flows from the Deer Prairie Creek watershed.

Land acquisitions by Sarasota County and the Southwest Florida Water Management District have placed almost the entire Deer Prairie Creek watershed located within Sarasota County under public ownership. In addition, much of the drainage ditches constructed through the upstream slough system have recently been backfilled, thereby restoring much of this watershed to its natural, even historical condition. Removal of the Deer Prairie Creek damn would further restore Deer Prairie Creek watershed. This would also further restore the historical water budget from this watershed to Charlotte Harbor and provide for the historical upstream migration of salient and brackish dependent species. However, the aesthetic values of the freshwater impoundment upstream of the weir would be lost. From a hydrologic perspective, the Deer Prairie watershed provides the unique opportunity for a natural, baseline watershed.

Figure 12.1 – Deer Prairie Creek Dam

13. Big Slough Canal

The Big Slough watershed is approximately 195 square miles and empties into the Myakka River near Charlotte Harbor. Man-made channels were originally built around 1930 by the Sugar Bowl Drainage District. As reflected on the 1847 survey of Sarasota County, the Myakkahatchee Creek (aka Big Slough) originally only extended approximately 4 miles into a very wet area (refer to Figure 10.1) that was subsequently ditched, drained, and platted as North Port Charlotte by General Development Corporation in the 1960's. General Development constructed an extensive network of canals, ditches and control structures to drain the initial 74.5 square mile incorporated area to Big Slough. The combined effect of all of the drainage work performed within the Big Slough watershed (refer to Figure 10.3) was to remove freshwater from the landscape to the Myakka River and Charlotte Harbor. A low head dam at approximately elevation 4 msl acts as a salinity barrier and is located approximately 4 miles from the mouth of Big Slough. Therefore, this dam is located at what appears to be the historical limit of the natural Myakkahatchee Creek (based upon the 1847 survey). It impounds some flow and is used by the City of North Port for public water supply. This dam is presented in Figure 13.1.

Figure 13.1 – Big Slough Dam

14. <u>Charlotte Harbor NEP Perspective:</u>

The Myakka River watershed is located within the Charlotte Harbor National Estuary Program (CHNEP). The CHNEP has developed a Comprehensive Conservation Management Plan (CCMP), with the following general goals: (1) increase aquatic/marine life productivity in the bays and estuaries; (2) increase habitat coverage and health in the bays and estuaries; (3) increase water quality in the bays and estuaries; and (4) address fresh water quantities to the bays and estuaries.

Of these four general goals, the greatest efforts have typically been expended to understand the first three. The last goal has been difficult to understand and attain. Yet it may be key in addressing the other three. In fact, the first three goals may actually be more symptomatic. For example, the first three goals are concerned with symptoms in the bay while the fourth goal is concerned about the cause or the source - what is being done to the landscape or watershed. It requires an understanding and management of the watershed.

To carry this symptom and cause relationship one step further, it is the volume of freshwater that is moved off of the watershed landscape that drives the loadings of pollutants that effect water quality in the bays, which in turn affects the habitat coverage and productivity in the bays, which in turn affects the marine life and productivity in the bay. Is it possible that addressing the quantity of freshwater flow through management of the watershed could result in increases in water quality, habitat coverage, and marine life production in the bay? While this relationship may not be completely linear, it does suggest the importance of addressing the impacts of hydrologic alterations within the watershed and the runoff component of the water budget.

The CCMP also currently contains four (4) specific hydrologic alterations objectives, as follows:

HA-1: Establish values for minimum seasonal flows by the year 2020.

HA-2: Identify, establish, and maintain a more natural seasonal variation in freshwater flows by the year 2010.

HA-3: Restore, enhance, and improve historical subbasin boundaries and natural hydrology by the year 2020.

HA-4: Enhance and improve by the year 2020 to more natural hydrologic conditions, water bodies affected by artificially created structures.

More recently, in May of 2004, the CHNEP hosted a Water Budget Workshop. The workshop identified three water budget objectives:

1. Quantify the existing water budget – existing monthly inflows and outflows

2. Estimate the "pre-development" or natural system's water budget – monthly inflows and outflows

3. Determine how to best enable the existing water budget to resemble the natural system's water budget

Future hydrologic restoration proposals could be evaluated based upon their ability to have the existing water budget resemble the historical or natural system water budget.

Average Monthly and Annual Water Budget

Using average long term rainfall records from SWFWMD for the Myakka River watershed and long term USGS monthly flow data, average monthly and annual water budgets can be estimated. Table 14 below summarizes the average monthly and annual water budgets for the Myakka River watershed.

	MYAKKA RIVER WATER BUDGET			
	1	2	3	4
	MEAN	MEAN	R/P	ET +
	RAINFALL	RUNOFF		STORAGE
MONTH	inches	inches		inches
JAN	2.25	0.60	0.27	1.65
FEB	2.62	0.58	0.22	2.04
MARCH	2.90	0.81	0.28	2.09
APRIL	2.42	0.46	0.19	1.96
MAY	3.30	0.21	0.06	3.09
JUNE	8.18	0.97	0.12	7.21
JULY	8.38	2.21	0.26	6.17
AUG	8.54	3.17	0.37	5.37
SEPT	7.80	3.37	0.43	4.43
OCT	3.29	1.92	0.58	1.37
NOV	1.85	0.53	0.29	1.32
DEC	1.96	0.43	0.22	1.53
	53.49	**15.26**	0.29	**38.23**

Table 14 – Myakka River, Average Annual and Monthly Water Budgets

Column 1 - Average rainfall amounts from SWFWMD for the Myakka River watershed
Column 2 - Average runoff amounts from USGS station 02298830
Column 3 – Percentage of Rainfall converted to Runoff (column 2 divided by column 1)
Column 4 – Average evapotranspiration plus delta storage (column 1 minus column 2)

With long term data, water budgets can be evaluated for different periods which correspond to known hydrologic changes to determine if changes in the water budget have occurred. Having a baseline "natural" watershed such as Deer Prairie Slough would be invaluable when trying to determine the impacts of hydrologic alterations in developing watersheds on the water budget. It is recommended that monthly or at least seasonal water budgets be compared as opposed to annual water budgets.

15. <u>Conclusions:</u>

Over the past 100 years, the landscape of the Myakka River watershed has changed to varying degrees. Drainage, dikes, dams, and flow diversions as well as importation of water from outside sources have resulted in the alteration of the timing and volume of freshwater flows to the Myakka River and ultimately Charlotte Harbor. These hydrologic alterations can also result in changes in water quality, habitat and aquatic life production in receiving waters. Meanwhile, other water management criteria have evolved for stormwater flood protection and quality as well as water supply development. Unfortunately, these criteria have not necessarily been coordinated with each other or the timing and volume needs of the natural systems. It has recently been recognized that a more holistic approach is needed to integrate and master plan the water needs of natural systems, water quality, water supply, and flood protection. The integration of these four water resource elements is considered Comprehensive Watershed Management. Watershed management also recognizes that our water resources are ultimately tied to what happens on the land. Connecting land to water is essential in providing sustainable water resources.

The water budget approach is consistent with holistic watershed management. It recognizes the freshwater balance needs of wetlands, creeks, rivers, bays and estuaries. While the water budget consists of numerous parameters, the most significant component from a receiving water standpoint is freshwater volumes. This can consist of surface water runoff, subsurface contributions from the surficial aquifer, outside imports such as irrigation and treated wastewater discharges, and exports from the watershed for water supply. Fortunately, the total amount of freshwater can be measured directly independent of other water budget parameters and almost 70 years of stream flow information are available at one strategic location in the Myakka River watershed.

Restoration of drained wetland systems that still exist within the watershed is a key strategy to natural systems hydrology that also could enhance water quality and floodplain management as well as provide more sustainable beneficial uses. Understanding what hydrologic alterations have occurred and their impact on the water budget in the Myakka River watershed is then an essential component of a watershed management plan. It is within this context that thirteen (13) hydrologic alterations were preliminarily evaluated relative to their effects on the water budget of the Myakka River watershed. The results of this effort are summarized in Table 15.

From these preliminary evaluations, it is concluded that consideration be given to managing the Myakka River watershed in four distinct segments: (1) the Upper Myakka

River, upstream of Flatford Swamp where the historical water budget appears to have been consistently increased; (2) the Myakka River, between State Road 72 and Flatford Swamp where the historical water budget appears to have been consistently increased; (3) the Myakka River, between U.S. 41 and State Road 72 where the historical water budget appears to have been consistently reduced; and (4) the lower Myakka River downstream of U.S. 41 and the Big Slough watershed, where the historical water budget appears to have been consistently increased.

Hydrologic Alteration	Type of Alteration	Date of Alteration	Control Elevation	Flow Regime Impact	Water Budget Impact
1. Flatford Swamp	Irrigation	1980	na	Low flow	+
2. Tatum Sawgrass	Dike	1974	19	Low flow	+
3. Clay Gulley	Drain & Diversion	1900	na	All flow	+
4. Hidden River	Dike	1958	21.66	All flow	+
5. Upper Lake Dam	Dam	1936/1941	13.65	Low to moderate flow	-
6. Upper Lake Pipes	Drain	1974	9.8	Low to moderate flow	+
7. Vanderipe Slough	Dike	1940	14.5	Low to moderate flow	+
8. Howard's Creek	Irrigation	1990	na	Low Flow	+
9. Downs Dam	Dam	1930's	6.6/10.6	Low flow	-
10. Cow Pen Slough	Diversion	1920s, 50's & 60s	16.2	All flow	-
11. Blackburn Canal	Diversion	1959	na	All flow	-
12. Deer Prairie	Dam	1950	3.31	Low flow	-
13. Big Slough Canal	Drainage	1930s & 1960s	na	All flow	+

Table 15 – Summary of Hydrologic Alterations in the Myakka River

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