

APPENDIX A

HEC-RAS MODEL DEVELOPMENT

STEINHATCHEE RIVER, FLORIDA

SUWANNEE RIVER WATER MANAGEMENT DISTRICT
9225 CR 49
LIVE OAK FLORIDA 32060

MAY 2018



APPLIED TECHNOLOGY AND MANAGEMENT, INC.
2201 NW 40 TERRACE.
GAINESVILLE, FLORIDA 32605
386-256-1477

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
2.0	MODEL DATA DEVELOPMENT	2-1
3.0	HEC-RAS MODEL CONSTRUCTION	3-1
3.1	Bridges	3-2
3.2	Steady Flow Files	3-2
3.3	Steinhatchee River Sink and Rise	3-3
3.4	Boundary Conditions	3-6
4.0	MODEL CALIBRATION	4-1
5.0	CALIBRATION RESULTS	5-1
6.0	CONCLUSIONS	6-1
7.0	REFERENCE	7-1

LIST OF TABLES

Table 3-1. Steinhatchee flow distribution locations for HEC-RAS.	3-3
Table 3-2. Steady-state input percentile flows at the flow change locations: Steinhatchee River.	3-4

LIST OF FIGURES

Figure 1-1a. Extents of Steinhatchee River Watershed with sub watersheds outlined.	1-2
Figure 1-1b. Base model for the modified HEC-RAS model for the Steinhatchee River MFL.	1-3
Figure 3-1. Steinhatchee River shoals.....	3-1
Figure 3-2. Steinhatchee Falls.	3-2
Figure 3-3. Steinhatchee River Sink.	3-5
Figure 3-4. Steinhatchee River Rise (Photo by R. Means).....	3-5
Figure 5-1. Simulated stages from the Steinhatchee River HEC-RAS model as compared to the rating curve for USGS Gage 02324000.	5-2

1.0 INTRODUCTION

The Steinhatchee River watershed encompasses 562 square miles from its headwaters in Mallory Swamp in Lafayette County to its mouth at Deadman Bay in Dixie/Taylor County. It is located near the center of the Big Bend region of Florida. The majority of the watershed falls within the Gulf Coast Lowlands. Further downstream, it crosses into the Coastal Swamp Region.

The Steinhatchee River headwaters begin in the swampy hammocks of Lafayette County and flow southwestward in a narrow incised valley, generally lying 10 feet or less above mean sea level (msl). It forms the southern county boundary between Taylor and Dixie Counties. The Steinhatchee River flows in a narrow channel cut in Eocene carbonates, which commonly crop out along the lower portion of the river. The river flows underground for a 1-mile stretch near the community of Tennille and emerges about 0.3 mile west of U.S. Highway 19 (US 19). The underground portion of the river's route is mirrored at the surface by a topographic valley containing only intermittent flow. The Steinhatchee River is a sluggish, generally tannic stream, widening near the coast as it enters the coastal salt marshes. The lowlands adjacent to the river are typically very narrow, widening significantly in one area northeast of the Town of Steinhatchee.

A modified steady-state Hydrologic Engineering Centers River Analysis System (HEC-RAS) model was developed for the Steinhatchee River to support Minimum Flows and Levels (MFL) development and ecological modeling. The Steinhatchee River is defined in this report as the 20-mile-long stretch of river that begins in Lafayette County and extends to the Gulf of Mexico. Figure 1-1a shows the extents of the Steinhatchee River watershed along with the sub-watershed breakdown. The Steinhatchee River was modeled in 1981 for the Federal Emergency Management Agency's (FEMA) flood insurance rate map (FIRM) development by Gee and Jenson for the 1983 Dixie County Flood Insurance Study (FIS). Updated hydrological and hydraulic analyses were completed by Dewberry and Davis as a sub-Consultant to URS Corporation for the 2006 Dixie County FIS update. Currently, Taylor Engineering is converting the existing HEC-2 model to a HEC-RAS model for FEMA as part of an updated FIS. The current HEC-RAS model, still under development by Taylor Engineering, was utilized as the base model for the Steinhatchee MFL HEC-RAS model. Figure 1-1b shows the extents of the area modeled in HEC-RAS along with the locations of the cross-sections utilized in the HEC-RAS model.



Figure 1-1a. Extents of Steinhatree River Watershed with sub watersheds outlined.

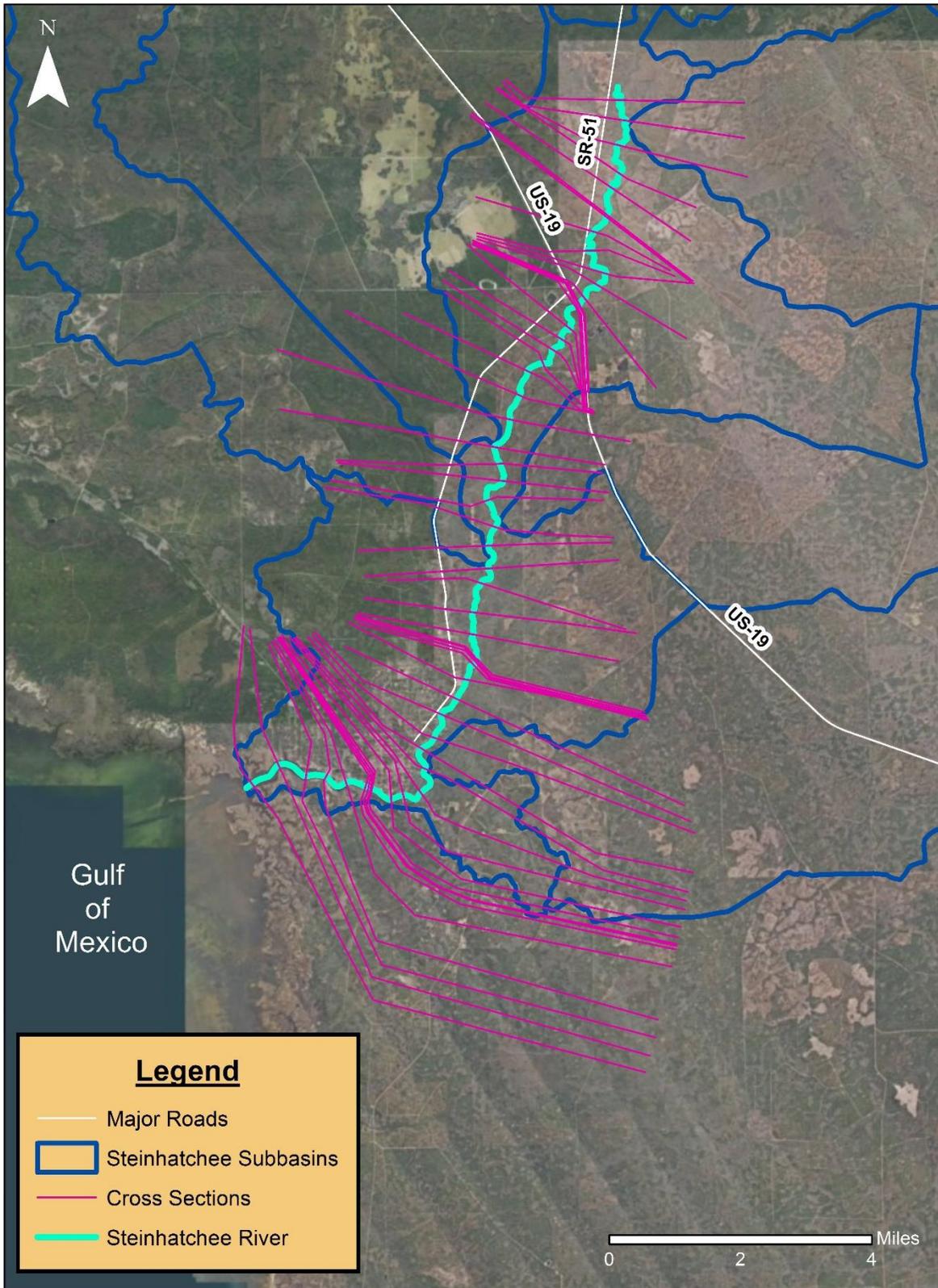


Figure 1-1b. Base model for the modified HEC-RAS model for the Steinhatchee River MFL.

The current modeling efforts utilized best available information from the existing HEC-RAS models of the Steinhatchee River and new survey data. Suwannee River Water Management District (SRWMD) provided digital elevation model (DEM) data that was combined with the existing and newly surveyed cross-sectional data to develop cross-sections for the HEC-RAS model. U.S. Geological Survey (USGS) flow and water level data were used in model development and calibration. The model was calibrated to observed stages and flows. HEC-RAS-simulated measurements of depths, velocities, water surface elevations, and other hydraulic output data were provided to SRWMD for use in the System of Environmental Flow Analysis (SEFA) model to simulate habitat conditions over a range of flow conditions. SRWMD ultimately utilized the results of SEFA in support of MFL development. All work was performed in North American Vertical Datum of 1988 (NAVD88).

2.0 MODEL DATA DEVELOPMENT

In support of MFL development, a steady-state HEC-RAS (HEC-RAS Version 5.0.1) model of the Steinhatchee River was developed for SRWMD. The model was constructed using best available data, including DEM, existing cross-sectional data, and new survey data.

A preliminary version of the HEC-RAS model being prepared by Taylor Engineering was provided and was used as the base model for the modified HEC-RAS model for the Steinhatchee River MFL (Figure 1-1b).

Taylor Engineering was converting the existing HEC-2 model to a geo-referenced HEC-RAS model and updating it by incorporating the following changes:

- Converted the non-georeferenced HEC-2 model to a geo-referenced HEC-RAS model.
- Used the HEC-2 as an input for flows and channel cross-section data, where available.
- Used LiDAR to define the overbank elevations and floodplain geometry of all cross-sections.
- Added a portion of the Steinhatchee River at the upstream end (within Lafayette County) that comes from a model AECOM previously constructed for SRWMD.
- Add ineffective or blocked areas – this had not been completed at the time of receipt of this version of the model.

3.0 HEC-RAS MODEL CONSTRUCTION

A total of 73 channel cross-sections and 6 bridges were included in the model received from Taylor Engineering. Of the 73 cross-sections, 28 had detailed in-channel survey. An additional 14 cross-sections were included between River Stations 76472 and 69743. SRWMD staff identified these cross-sections as appropriate for analysis using SEFA. This is in a section of the river that contains numerous shoals (Figure 3-1) and the long-term USGS gage (USGS 02324000). Deren Land Surveying surveyed these cross-sections to provide detailed topographic information of the channel portion of the section. LiDAR was used to define the floodplain for these sections. An additional cross-section was added to the model at River Station 51700 representing Steinhatchee Falls (Figure 3-2). Ineffective flow areas and blocked areas were added where appropriate.



Figure 3-1. Steinhatchee River shoals.



Figure 3-2. Steinhatchee Falls.

3.1 BRIDGES

There are six bridges in the model. The setup of the bridges was checked using information obtained during site reconnaissance and as-built plans, provided by the Structures and Facilities Department of the Florida Department of Transportation (FDOT) District 2 office.

3.2 STEADY FLOW FILES

SRWMD wanted to run predictive simulations for every incremental percentile flow, from the 1st percentile through the 99th percentile. Therefore, steady-state input percentile flows at every flow change location were generated for every percentile from the observed flow and stage conditions. Fifteen flow change locations were selected based on major sub-basins as provided by SRWMD (Figure 1-1a). The flow change locations are presented in Table 3-1. The distribution of flows was based on the contributing area to the Steinhatchee River in relation to the contributing area at the USGS gage 02324000. The flow percentiles were based on the USGS gage 02324000 flow record.

Table 3-1. Steinhatchee flow distribution locations for HEC-RAS.

Reach	Catchment	Area (mi ²)	Cumulative Area (mi ²)
101643.7	Owl Creek	20.945	117.214
97660.4	San Pedro Bay (Closed)	22.195	208.386
94796	Lafayette Wolf Creek	7.997	217.179
86138	Eight Mile Creek	65.943	301.256
76630.4	RR Steinhatchee	8.159	309.415
72694	USGS Gage Steinhatchee	3.924	313.339
65833	US19/98 Steinhatchee	7.335	320.674
50103	California Rocky Creek	76.101	405.92
42144	Hines Drain	27.241	434.18
38280	Boggy Creek	35.419	471.533
36481	Steinhatchee	5.489	477.022
29781.6	Steinhatchee	5.37	482.392
16250	Sandhill Creek	67.594	557.257
11630	Steinhatchee	2.214	559.471
544.725	Steinhatchee	2.455	561.926

For summary purposes, Table 3-2 shows steady-state input percentile flows at every flow change location for every 10th percentile and including the 95th and 99th percentile. Steady-state HEC-RAS input 10th percentile flow refers to the low flow or the flow that is exceeded 90 percent of the time.

3.3 STEINHATCHEE RIVER SINK AND RISE

One of the challenges of the HEC-RAS model was simulating interconnected karst formation known as the Steinhatchee River Sink and Rise, which was not modeled in the base HEC-RAS model. This feature begins north of US 19/98 and is characterized by numerous depressions and sink formations. It is located approximately 0.5 mile downstream of USGS Gage 02324000. The photos in Figure 3-3 characterize the area. USGS estimates that all flow in the Steinhatchee River below approximately 500 cubic feet per second (cfs) goes underground, reappearing at Steinhatchee River Rise south of US 19/98 (Figure 3-4). The aboveground channel remains dry most of the time, since 500 ft/s represents approximately an 80th percentile flow, or a flow that is exceeded approximately 20 percent of the time.

Table 3-2. Steady-state input percentile flows at the flow change locations: Steinhatchee River.

Reach	Percentile Flows (cfs)											
	99%	95%	90%	80%	70%	60%	50%	40%	30%	20%	10%	
101643.7	867.9	460.1	312.4	172.1	99.9	61.3	37.8	23.2	15.0	8.2	4.1	
97660.4	1,542.9	818.0	555.3	305.9	177.6	109.1	67.2	41.2	26.6	14.6	7.3	
94796	1,608.0	852.5	578.7	318.8	185.1	113.7	70.0	43.0	27.7	15.2	7.6	
86138	2,230.5	1,182.6	802.8	442.3	256.7	157.7	97.1	59.6	38.5	21.2	10.6	
76630.4	RR Bridge	2,290.9	1,214.6	824.5	454.2	263.7	161.9	99.7	61.2	39.5	21.7	10.9
72694	USGS Gage	2320	1230	835	460	267	164	101	62	40	22	11
65833	US19/98	2,374.3	1,258.8	854.5	470.8	273.3	167.8	103.4	63.5	40.9	22.5	11.3
50103		3,005.5	1,593.4	1,081.7	595.9	345.9	212.5	130.8	80.3	51.8	28.5	14.3
42144		3,214.7	1,704.4	1,157.0	637.4	370.0	227.2	140.0	85.9	55.4	30.5	15.2
38280		3,491.3	1,851.0	1,256.6	692.2	401.8	246.8	152.0	93.3	60.2	33.1	16.6
36481		3,531.9	1,872.5	1,271.2	700.3	406.5	249.7	153.8	94.4	60.9	33.5	16.7
29781.6		3,571.7	1,893.6	1,285.5	708.2	411.1	252.5	155.5	95.5	61.6	33.9	16.9
16250		4,126.0	2,187.5	1,485.0	818.1	474.8	291.7	179.6	110.3	71.1	39.1	19.6
11630		4,142.4	2,196.2	1,490.9	821.3	476.7	292.8	180.3	110.7	71.4	39.3	19.6
544.725		4,160.6	2,205.8	1,497.4	824.9	478.8	294.1	181.1	111.2	71.7	39.5	19.7



Figure 3-3. Steinhatchee River Sink.

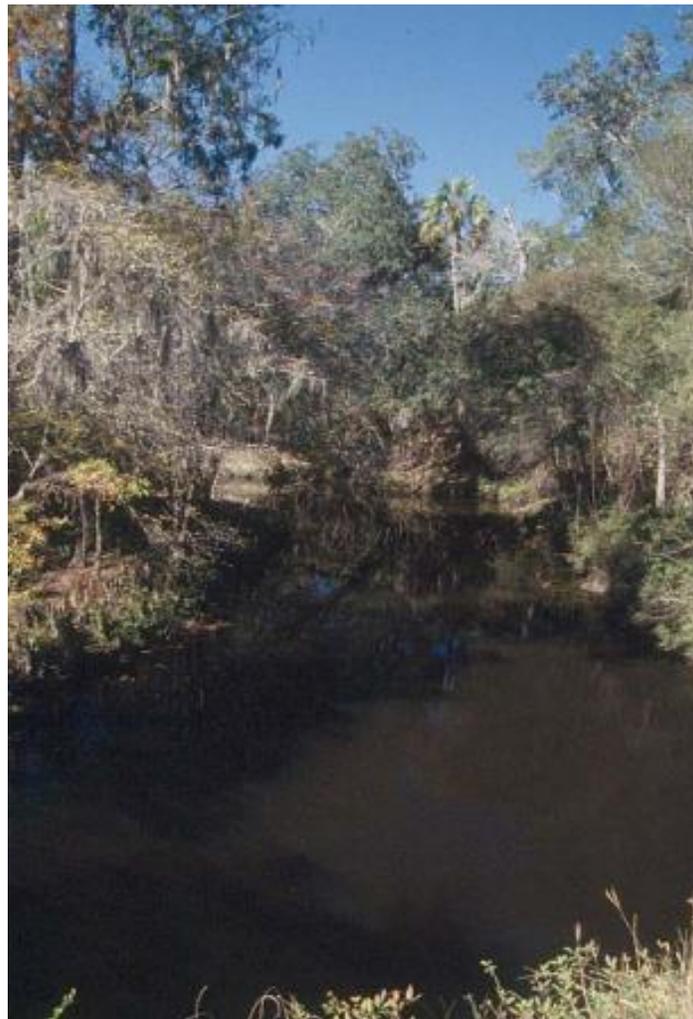


Figure 3-4. Steinhatchee River Rise (Photo by R. Means).

The Steinhatchee River Sink and Rise was modeled in HEC-RAS by increasing friction in the cross-sections in the sink area. The sink area contains a number of depressions where flow goes underground. It was not possible to determine the preferred sink that takes most of the flow since it appears to go underground in a more diffuse manner. Increasing the friction in this area allowed for matching hydraulic response up to the approximate 500 ft/s, when all river flow goes underground to reappear at Steinhatchee Rise. The Manning's n values are presented in Attachment 1.

3.4 BOUNDARY CONDITIONS

Boundary conditions of the Steinhatchee River HEC-RAS model consisted of a static boundary in Deadman Bay. A number of static water levels were tested and the HEC-RAS model was generally insensitive to this boundary in the river reach upstream of Steinhatchee Falls. The Steinhatchee River downstream of Steinhatchee Falls possesses a tidal signal based on measurements taken as part of a data collection effort to support development of a hydrodynamic model.

4.0 MODEL CALIBRATION

The model of the river was calibrated primarily by adjusting the friction. The model was calibrated to the observed stages and flows. The USGS flow and water level data at USGS Gage 02324000 were used for calibration. The HEC-RAS model was calibrated by adjusting the channel Manning's n friction factors. Consistency in the friction factors was maintained by avoiding point calibration and increasing the model's predictive capability. The HEC-RAS Hydraulic Reference Manual and Barnes (1967) were used as guidance for the selection of friction factors (Manning's n). A comparison of Manning's n values is presented in Attachment 1.

During the calibration phase, adjustments were made to some of the existing cross-sections that contained trapezoidal shaped channel geometry. The cross-sections selected for adjustment were those that were bounded by cross-sections that contained in-channel geometry developed from field survey. Conveyance characteristics of the cross-sections containing the trapezoidal in-channel geometry were compared with the conveyance characteristics of the cross-sections having field-surveyed in-channel geometry. The cross-section containing trapezoidal geometry was adjusted to better match the conveyance characteristics of the bounding cross-sections containing geometry developed from field survey. Four cross-sections were adjusted in this manner (86,482, 85,742.59, 83497.13, and 52,838.4). The conveyance needed to be reduced in these sections by 40 to 50 percent. To accomplish this required a combination of reduction in bottom width and an increase in Manning "n".

5.0 CALIBRATION RESULTS

Figure 5-1 presents the final simulated stages and flows as compared to the USGS rating at USGS gage 02324000. The results indicate a good match with the observed stage-flow relationship at the USGS gage. Additional data related to stage and flow at other locations in the model domain did not exist. However, there is a good level of confidence in the model calibration for the model reach above US 19 due to the presence of the USGS gage and the additional field survey that was obtained and incorporated into the model, particularly at the lower flows. The incorporation of shallow areas (shoals) upstream of US 19 provided important flow control points for model calibration and greatly increased the model's utility for performing MFL analyses. The Steinhatchee River Sink area, located just upstream of US 19, is another important feature that affects the stage-discharge rating relationship. The location of the gage 0.5 mile upstream of the sink area provides confidence that the hydraulic response in this reach was captured by the model.

There is less confidence in the model performance for the reach between Steinhatchee Falls and US 19 due to the lack of flow and stage data. Steinhatchee Falls is a significant feature and control point in this reach that provides confidence in the calibration. Additional data related to river flow at the gage and the magnitude of groundwater flow contributions from the springs, mainly Steinhatchee River Rise and Beaver Creek Springs, would provide a better definition of flow distribution along the river and, therefore, more confidence in the model predictions.

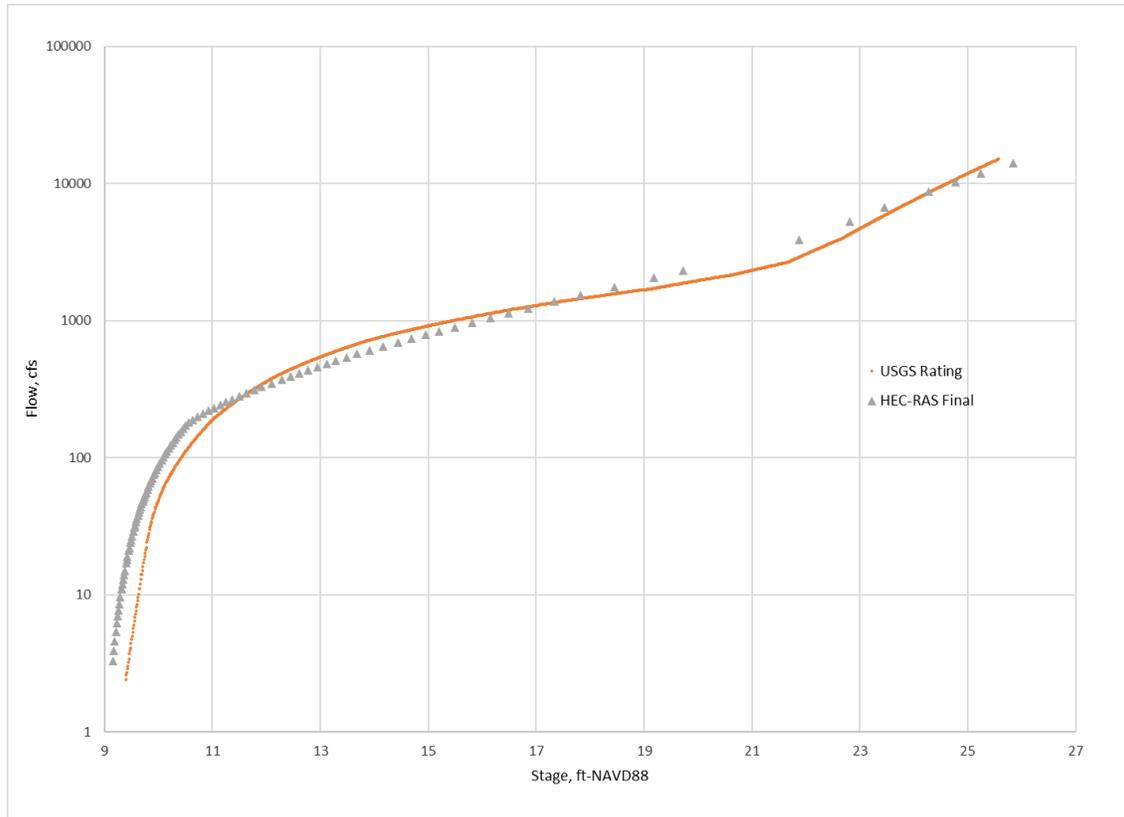


Figure 5-1. Simulated stages from the Steinhatchee River HEC-RAS model as compared to the rating curve for USGS Gage 02324000.

Detailed output from HEC-RAS was exported to an ASCII file for use in the ecological modeling of the Steinhatchee River. The detailed output defines the velocities, depths, wetted perimeter, and other hydraulic properties for each cross-section. These data were generated for every percentile from the observed flow and stage conditions. Each percentile flow condition was run within HEC-RAS. The detailed output for each steady-state run was exported to an ASCII output file. The steady-state output was exported to define the horizontal velocity distribution.

6.0 CONCLUSIONS

A modified steady-state HEC-RAS model was developed for the Steinhatchee River to support MFL development and ecological modeling. The current modeling efforts utilized best available information from the existing HEC-RAS models of the Steinhatchee River and new survey data. SRWMD provided the DEM data that were combined with the existing and newly surveyed cross-sectional data to develop cross-sections for the HEC-RAS model. USGS flow and water level data were used in model development and calibration. The model was calibrated to observed stages and flows by adjusting Manning's n values and flow-dependent friction factors. HEC-RAS-simulated measurements of depths, velocities, water surface elevations, and other hydraulic output data were provided to SRWMD for use in the SEFA model to simulate habitat conditions over a range of flow conditions. The detailed output for each steady-state run was exported to an ASCII output file to define a horizontal velocity distribution for ecological modeling and habitat suitability analysis. SRWMD utilized the results of the steady-state predictive simulations in support of MFL development.

7.0 REFERENCE

Barnes, H.H. 1967. Roughness Characteristics of Natural Channels. Water Supply Paper 1849. U.S. Geological Survey. Washington D.C.

Attachment 1

Manning's n Values

Manning's n Values in the
Taylor Engineering HEC-RAS Model
Being Prepared for FEMA

Manning's n Values in the
Steinhatchee MFL HEC-RAS Model

Manning's n Values
in the
Taylor Engineering HEC-RAS Model
Being Prepared for FEMA

HEC-RAS HEC-RAS 5.0.3 September 2016
 U.S. Army Corps of Engineers
 Hydrologic Engineering Center
 609 Second Street
 Davis, California

```

X      X  XXXXXXX  XXXX      XXXX      XX      XXXX
X      X  X        X      X      X  X      X      X
X      X  X        X      X      X  X      X      X
XXXXXXXX XXXX      X      XXX  XXXX      XXXXXXX  XXXX
X      X  X        X      X      X  X      X      X
X      X  X        X      X      X  X      X      X
X      X  XXXXXXX  XXXX      X      X      X      X
  
```

PROJECT DATA

Project Title: Steinhatchee
 Project File : Steinhatchee.prj
 Run Date and Time: 12/4/2015 12:08:44 PM

Project in English units

SUMMARY OF MANNING'S N VALUES

River:Steinhatchee

Reach	River Sta.	n1	n2	n3
Reach	101643.7	.12	.035	.12
Reach	101259.9	.12	.035	.12
Reach	100989.2	.12	.035	.12
Reach	100951.3	Bridge		
Reach	100910.6	.12	.035	.12
Reach	100645.3	.12	.035	.12
Reach	99530.9	.12	.035	.12
Reach	98559.38	.12	.035	.12
Reach	97660.41	.12	.035	.12
Reach	96894.93	.12	.035	.12
Reach	95244.76	.12	.035	.12
Reach	94860.83	.12	.035	.12
Reach	94826.95	Bridge		
Reach	94796.63	.12	.035	.12
Reach	94200.81	.12	.035	.12
Reach	91879.88	.12	.035	.12
Reach	89806.97	.12	.035	.12
Reach	88286.26	.12	.035	.12
Reach	86482.68	.12	.035	.12
Reach	86138.8	.12	.035	.12
Reach	85742.59	.12	.035	.12
Reach	83497.13	.12	.035	.12
Reach	80707.97	.12	.035	.12
Reach	79065.02	.12	.035	.12
Reach	76630.41	.12	.035	.12
Reach	76548.21	Bridge		
Reach	76472.13	.12	.035	.12
Reach	74782.43	.12	.035	.12
Reach	72694.65	.12	.035	.12
Reach	69743.64	.12	.035	.12
Reach	68387.4	.12	.035	.12

Reach	66513.04	.12	.035	.12
Reach	65833.84	.12	.035	.12
Reach	65767.34	.12	.035	.12
Reach	65687.27	Bridge		
Reach	65612.23	.12	.035	.12
Reach	65474.14	.12	.035	.12
Reach	63031.55	.12	.035	.12
Reach	61676.07	.12	.035	.12
Reach	60356.9	.12	.035	.12
Reach	58669.24	.12	.035	.12
Reach	57221.52	.12	.035	.12
Reach	55018.72	.12	.035	.12
Reach	52838.4	.12	.035	.12
Reach	50103.08	.12	.035	.12
Reach	48663.15	.12	.035	.12
Reach	47201.82	.12	.035	.12
Reach	44643.07	.12	.035	.12
Reach	42144.57	.12	.035	.12
Reach	40479.34	.12	.035	.12
Reach	38280.25	.12	.035	.12
Reach	36481.11	.12	.035	.12
Reach	33879.9	.12	.035	.12
Reach	32043.8	.12	.035	.12
Reach	29781.59	.12	.035	.12
Reach	29608.89	.12	.035	.12
Reach	29556.54	Bridge		
Reach	29500.8	.12	.035	.12
Reach	29219.31	.12	.035	.12
Reach	27753.04	.12	.035	.12
Reach	25999	.12	.035	.12
Reach	24189.06	.12	.035	.12
Reach	22066.64	.12	.035	.12
Reach	20685.31	.12	.035	.12
Reach	18782.44	.12	.035	.12
Reach	16249.95	.12	.035	.12
Reach	14479.7	.12	.035	.12
Reach	13453.18	.12	.035	.12
Reach	11630.42	.12	.035	.12
Reach	11523.54	.12	.035	.12
Reach	11400.83	Bridge		
Reach	11342.99	.12	.035	.12
Reach	11080.55	.12	.035	.12
Reach	9429.195	.12	.035	.12
Reach	7409.675	.12	.035	.12
Reach	5795.768	.12	.035	.12
Reach	3251.439	.12	.035	.12
Reach	544.7247	.12	.035	.12

Manning's n values
in the
Steinhatchee MFL HEC-RAS model

HEC-RAS HEC-RAS 5.0.3 September 2016
 U.S. Army Corps of Engineers
 Hydrologic Engineering Center
 609 Second Street
 Davis, California

```

X      X  XXXXXXX  XXXX      XXXX      XX      XXXX
X      X  X        X      X      X  X      X
X      X  X        X      X      X  X      X
XXXXXXXX XXXX      X      XXX  XXXX      XXXXXXX  XXXX
X      X  X        X      X      X  X      X
X      X  X        X      X      X  X      X
X      X  XXXXXXX  XXXX      X      X      XXXXXX
  
```

PROJECT DATA

Project Title: Steinhatchee_MFL_HEC-RAS_SS
 Project File : Steinhatchee_MFL_HECRAS.prj
 Run Date and Time: 5/14/2018 9:21:42 AM

Project in English units

SUMMARY OF MANNING'S N VALUES

River:Steinhatchee

n5	Reach n6	River Sta. n7	n8	n1 n9	n2	n3	n4
	Reach	101643.7		.12	.045	.12	
	Reach	101259.9		.12	.045	.12	
	Reach	100989.2		.12	.045	.12	
	Reach	100951.3	Bridge				
	Reach	100910.6		.12	.045	.12	
	Reach	100645.3		.12	.045	.12	
	Reach	99530.9		.12	.045	.12	
	Reach	98559.38		.12	.035	.12	
	Reach	97660.41		.12	.035	.12	
	Reach	96894.93		.12	.035	.12	
	Reach	95244.76		.12	.035	.12	
	Reach	94860.83		.12	.035	.12	
	Reach	94826.95	Bridge				
	Reach	94796.63		.12	.035	.12	
	Reach	94200.81		.12	.035	.12	
	Reach	91879.88		.12	.035	.12	
	Reach	89806.97		.12	.035	.12	
	Reach	88286.26		.12	.035	.12	
	Reach	86482.68		.12	.035	.12	
	Reach	86138.8		.12	.035	.12	
	Reach	85742.59		.12	.035	.12	
	Reach	83497.13		.12	.035	.12	
	Reach	80707.97		.12	.035	.12	
	Reach	79065.02		.12	.035	.12	
	Reach	76630.41		.12	.035	.12	
	Reach	76548.21	Bridge				
	Reach	76472.13		.12	.045	.12	
	Reach	75471.16		.12	.045	.12	
	Reach	75397.01		.12	.045	.12	
	Reach	75235.03		.12	.045	.12	
	Reach	75212.79		.12	.045	.12	
	Reach	74782.43		.12	.045	.12	

Reach		74339.65		.12	.045	.12	
Reach		74133.68		.12	.045	.12	
Reach		74088.40		.12	.045	.12	
Reach		74028.63		.12	.045	.12	
Reach		73111.94		.12	.045	.12	
Reach		72959.44		.12	.045	.12	
Reach		72879.37		.12	.065	.12	
Reach		72694.65		.12	.065	.12	
Reach		72501.52		.12	.065	.12	
Reach		72448.75		.12	.065	.12	
Reach		72313.62		.12	.065	.12	
Reach		69743.64		.12	.15	.12	
Reach		68387.4		.12	.3	.12	.3
.12							
Reach		66513.04		.12	.3	.12	.3
.12	.3	.12					
Reach		65833.84		.12	.3	.12	.3
.12	.3	.12	.3	.12			
Reach		65767.34		.12	.045	.12	
Reach		65687.27	Bridge				
Reach		65612.23		.12	.035	.12	
Reach		65474.14		.12	.035	.12	
Reach		63031.55		.12	.035	.12	
Reach		61676.07		.12	.035	.12	
Reach		60356.9		.12	.035	.12	
Reach		58669.24		.12	.035	.12	
Reach		57221.52		.12	.035	.12	
Reach		55018.72		.12	.035	.12	
Reach		52838.4		.12	.035	.12	
Reach		51700		.12	.035	.12	
Reach		50103.08		.12	.035	.12	
Reach		48663.15		.12	.035	.12	
Reach		47201.82		.12	.035	.12	
Reach		44643.07		.12	.035	.12	
Reach		42144.57		.12	.035	.12	
Reach		40479.34		.12	.035	.12	
Reach		38280.25		.12	.035	.12	
Reach		36481.11		.12	.035	.12	
Reach		33879.9		.12	.035	.12	
Reach		32043.8		.12	.035	.12	
Reach		29781.59		.12	.035	.12	
Reach		29608.89		.12	.035	.12	
Reach		29556.54	Bridge				
Reach		29500.8		.12	.035	.12	
Reach		29219.31		.12	.035	.12	
Reach		27753.04		.12	.035	.12	
Reach		25999		.12	.035	.12	
Reach		24189.06		.12	.035	.12	
Reach		22066.64		.12	.035	.12	
Reach		20685.31		.12	.035	.12	
Reach		18782.44		.12	.035	.12	
Reach		16249.95		.12	.035	.12	
Reach		14479.7		.12	.035	.12	
Reach		13453.18		.12	.035	.12	
Reach		11630.42		.12	.035	.12	
Reach		11523.54		.12	.035	.12	
Reach		11400.83	Bridge				
Reach		11342.99		.12	.035	.12	
Reach		11080.55		.12	.035	.12	
Reach		9429.195		.12	.035	.12	
Reach		7409.675		.12	.035	.12	
Reach		5795.768		.12	.035	.12	
Reach		3251.439		.12	.035	.12	
Reach		544.7247		.12	.035	.12	