Corkscrew Watershed Initiative

Deliverable 7.1.2: Final Future Conditions Model Report

Prepared for

South Florida Water Management District

April 2, 2026

Prepared by

Collective Water Resources

With

J-Tech, an Alliance between Jacobs Engineering and Tetra Tech, Inc.

Table of Contents

List of Figures

List of Tables

Abbreviations and Acronyms

APT	aquifer performance test
Ac-ft	acre-feet
AHED	Arc Hydro Enhanced Database
BCB	Big Cypress Basin
CFD	Computational Fluid Dynamics
cfs	cubic feet per second
CREW	Corkscrew Regional Ecosystem Watershed
CSS	Corkscrew Swamp Sanctuary
CWI	Corkscrew Watershed Initiative
CWI RM	CWI Refined Model
ECM	Existing Conditions Model
DEM	digital elevation model
ERP	Environmental Resource Permit
ET	evapotranspiration
FCM	Future Conditions Model
FPLOS	Flood Protection Level of Service
ft	foot/feet
LiDAR	light detection and ranging
LTS	Long Term Simulation
LWCSIM	Lower West Coast MODFLOW
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
PM	performance measure
SFWMD	South Florida Water Management District
SLCWP	South Lee County Watershed Plan
SLR	Sea Level Rise

USGS	U.S. Geological Survey
WY	Water Year
1D	one-dimensional
2D	two-dimensional
3D	three-dimensional

1.0 Background/Introduction

1.1 Project Purpose

J-Tech was selected for the completion and delivery of the Corkscrew Watershed Initiative (CWI) Project. The Notice to Proceed was established for this project on March 1, 2024. The objective of the CWI Project is to develop a comprehensive strategy to achieve ecological restoration of the Corkscrew Watershed by improving wetland hydroperiods and natural flows, without increasing flood risk in nearby flood-prone areas and without adversely impacting the water supply and water management needs of the Corkscrew Watershed. The objective will be accomplished through a public planning process that engages and involves key partners, stakeholders, and the public. The project will identify viable short-term and long-term strategies to achieve the CWI Project objectives. The proposed restoration alternatives will be cost-effective, feasible, and resilient. The CWI Project will consider population growth, land development, and climate change, including sea level rise and future rainfall. This project aligns with the mission of the South Florida Water Management District's (SFWMD) Big Cypress Basin (BCB) 2023–2028 Strategic Plan and will contribute to the resiliency of the Big Cypress Watershed.

1.2 Project Background and Scope of Work

The CWI Project boundary encompasses southern Hendry County, northern Collier County, and southern Lee County as shown in Figure 1-1. The project area is comprised of rivers (Imperial and Estero), creeks (Halfway and Spring), and wetland sloughs/swamps (Flint Pen Strand and Upper Corkscrew Swamp) within the Estero Bay Basin Watershed in southern Lee County and the Cocohatchee Canal/River Basin and Golden Gate/Naples Bay Watershed in northern Collier County. The initial project planning area was broadened beyond what may be considered an effective area to ensure thorough consideration of vulnerable communities and ecosystems.

Previous studies and monitoring documented reduced hydroperiods and increased water level recession rates in Audubon's Corkscrew Swamp Sanctuary (CSS; owned and managed by National Audubon Society), a critically important ecosystem, within the past 60 years (Clem and Duever, 2019). This three-year planning CWI Project (2024–2027) is funded by the BCB and builds upon previous efforts to determine potential causes of the shortened hydroperiod documented at the CSS. The CWI PROJECT will develop and evaluate restoration alternatives that address the purpose and needs of the CSS. The Technical Working Group (TWG) is the project planning team, and is comprised of SFWMD staff, representatives of local governments in the region, and others with responsibility for the management of the Corkscrew Watershed. TWG participants are those with expertise in the Corkscrew Watershed and the ability to fund and implement projects in the CWI Project area. Collectively, representatives of the City of Bonita Springs, Collier County, CSS, Corkscrew Regional Ecosystem Watershed (CREW) Land & Water Trust, Lee County, SFWMD, and Village of Estero make up the TWG. The TWG will provide guidance to the SFWMD Project Manager responsible for administering the contract and acting as the liaison between the TWG, the CWI Project Consultant (J-Tech), and the SFWMD Project Development Team (PDT).

The CWI Project work plan was finalized on July 1, 2024, and includes a detailed history of work on the project that has been completed to date by the SFWMD and TWG member organizations (*Deliverable 1.2.2: Final CWI Work Plan July, 1, 2024*).

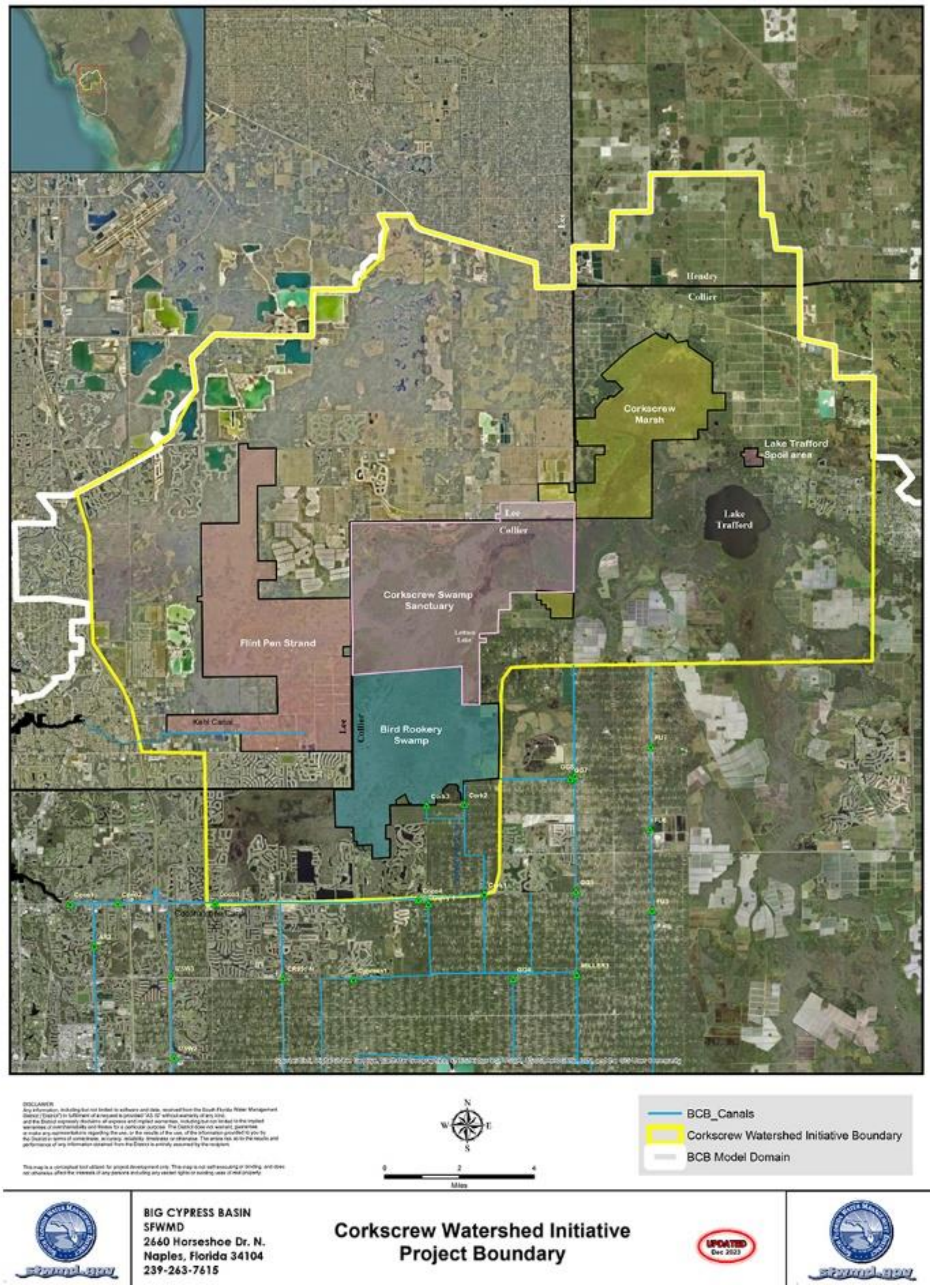

Figure 1-1. Corkscrew Watershed Initiative Project Area

The work plan also identifies the various tasks and deliverables that will be completed as part of the CWI Project. In summary, the CWI Project tasks include the following:

Task 1 – Project Coordination (on going)

Task 2 – Information Collection and Review and Site Reconnaissance (completed)

Task 3 – Develop Performance Measures and Metrics (completed)

Task 4 – Refine Project Area (completed)

Task 5 – BCB Model Refinement (completed) and Existing Conditions Model (completed)

Task 6 – Develop Initial List of Potential Ecologic and Hydrologic Restoration Projects (completed)

Task 7 – Future Baseline and Alternative Conditions Models Development/Evaluation (in progress)

Task 8 – Develop Final Project Matrix Including Project Goals, Cost and Regulatory Requirements

Task 9 – CWI Public Planning Project Report, Conceptual Plan(s) and Funding Summary Memo

1.3 Document Structure

This Draft Future Conditions Model Report meets the deliverable requirements of Task 7.1.2. This document includes the following technical sections:

- 2.0 – Overview and Objective of the Future Conditions Model (FCM)
- 3.0 – FCM Model Development
- 4.0 – Overview of Performance Measures and FCM Results
- 5.0 – Summary and Discussion

2.0 Overview and Objective of the Future Conditions Model

2.1 Overview of the BCB Model Refined for CWI and the Existing Conditions Model

The BCB Refined Model for CWI (CWI RM) is a coupled MIKE SHE/MIKE HYDRO model that includes the western watersheds of Collier County (including the Cocohatchee, Golden Gate Main, Faka Union, Henderson-Belle Meade, and Fakahatchee watersheds), the southeastern portion of Lee County that includes portions of Corkscrew, Flint Pen, and the Imperial River Basin sub-watersheds, and a small portion of Hendry County that is part of the Corkscrew East sub-watershed (Figure 2-1).

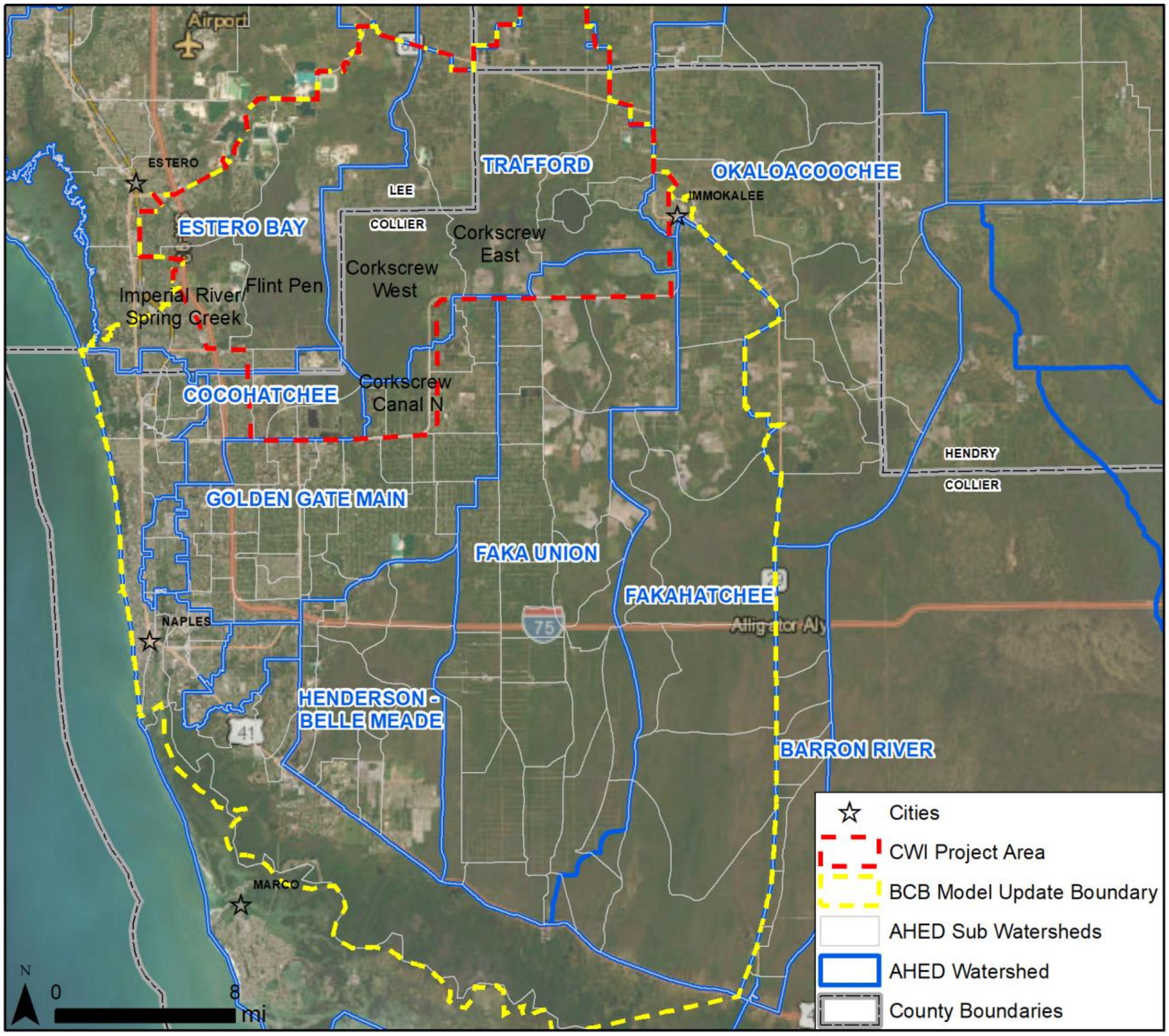

Figure 2-1. BCB Updated Model Domain, Counties, SFWMD AHED Watersheds and Sub-Watersheds

MIKE SHE is an integrated model that simulates 3D saturated groundwater flow, 2D overland flow, 1D unsaturated flow and hydrological and water use processes (i.e., rainfall, land use-based evapotranspiration (ET), drainage, irrigation, pumping). MIKE HYDRO is a 1D surface water model that simulates open channel flow dynamics and hydraulic operable and non-operable structures. The CWI RM has a grid cell size of 500 feet, which is applied to all components in MIKE SHE and includes a 5-layer groundwater model that includes the Surficial Aquifer System and the upper portion of the Intermediate Aquifer System. The model layers are the hydrogeologic units shown in Table 2-1, with the three Sandstone Aquifer units represented as one layer.

Table 2-1. Hydrogeologic Units included in the BCB Model (Adapted from Zumbro et al., 2023)

<table>
<tr><th>System</th><th colspan="2">Hydrogeologic Unit</th><th colspan="2">Lithographic Unit</th></tr>
<tr><td rowspan="3">Surficial Aquifer</td><td colspan="2">Water Table Aquifer</td><td colspan="2">Undifferentiated Sediments Holocene / Pleistocene</td></tr>
<tr><td colspan="2">Tamiami Confining Unit</td><td rowspan="2">Tamiami Formation</td><td>Bonita Springs Marl / Caloosahatchee Clay Member</td></tr>
<tr><td colspan="2">Lower Tamiami Aquifer</td><td>Ochopee Limestone Member</td></tr>
<tr><td rowspan="4">Intermediate Aquifer</td><td colspan="2">Upper Hawthorn Confining Unit</td><td rowspan="4">Hawthorn Group</td><td rowspan="4">Peace River Formation</td></tr>
<tr><td rowspan="3">Sandstone Aquifer</td><td>Clastic Zone</td></tr>
<tr><td>Interconfining Unit</td></tr>
<tr><td>Carbonate Zone</td></tr>
</table>

The CWI RM was refined from the previous model version, the BCB Model Update (Hazen and Sawyer, 2025), in which the BCB Flood Protection Level of Service (FPLOS) model was extended, updated, and calibrated for the period of 2017 to 2020. The main objective of the CWI RM modifications conducted during the initial phases of the CWI project, was to improve the prediction of performance measures (PM) for proposed project alternatives impacting Corkscrew and adjacent basins. Model output for development of PMs includes:

- Hydroperiods and depth targets in the Corkscrew wetland areas
- Dry season groundwater levels and recession rates
- Wetland sheet flow across barriers
- Flood risk measures – stages and flows in the primary system and flood depth mapping
- Flows to estuaries, which will be tied to potential impacts in salinity
- Predicted impacts on water supply

The details that were added to the model considered the above outputs as well as potential project types that would be evaluated with the model. For example, to evaluate the potential benefit of removing flow barriers and uncontrolled drainages, features that represent blockages and drainage under existing conditions need to be included in the baseline model. A detailed description of the model refinements are provided in *Deliverable 5.1.3: Final Refined Model Report, July 11, 2025*.

Following Deliverable 5.1.3, an Existing Conditions Model (ECM) was developed. The ECM is based on the CWI RM with the main difference being that instead of the use of historical gate levels to operate the control structures, the ECM structure operations are rule-based protocols. The main objectives of the ECM were to identify areas of flooding under design storm conditions, and Corkscrew wetland hydrology and water supply volumes under long-term conditions. The ECM model also provides a means to help evaluators understand the evaluation tool performance relative to their knowledge of current system behaviors, thereby providing context to explore relative future system changes in behavior. The ECM development and results are provided in *Deliverable 5.2.2: Final Existing Conditions Model, November 14, 2025*.

2.2 Objectives of the Future Conditions Model

The Future Conditions Model (FCM) will serve as the baseline model for alternative evaluation. The FCM is representative of the 2040 future planning horizon, which includes land use, water use, climate change, and drainage infrastructure changes from current conditions up to the 2040 timeframe.

A summary of the FCM changes from the ECM are listed below.

1. Future land use map changes based on sources from various municipalities, counties, and SFWMD
2. Drainage infrastructure associated with the recently permitted residential developments.
3. Recent or future changes in the primary surface water canal system and structures, including the incorporation of the full Picayune Strand Restoration Project (PSRP)
4. Lee County Kiker Preserve Project
5. Future water use changes based on the Lower West Coast Water Supply Plan (SFWMD, 2022).
6. Future climate change (sea level rise and rainfall)

3.0 FCM Development

3.1 Future Land Use Changes

Land use changes in the model involve changes in parameterization of various hydraulic and hydrologic model components. This section describes the changes specific to the land use map, and other sections below describe changes to model components that are related to land use changes. The land use map input to the model is used specifically for defining parameters that the model uses to calculate potential evapotranspiration, however, other model parameters (e.g., overland flow Manning's M (the M coefficient is the input in MIKE SHE and is equal to 1/n, where n is the better known Manning's roughness coefficient), detention storage, irrigation and drainage parameters) are also associated to the land use map.

The land use map that was incorporated into the BCB Model Update (Hazen and Sawyer, 2025) is SFWMD's Land Cover and Land Use for 2014-2016 (SFWMD, 2018a), which was the latest dataset available during the model BCB Model Update development. The CWI scope of work did not include updates to the land use map for the CWI RM nor the ECM. Thus, the first step in creating a future conditions land use map was to update the existing conditions land use with the latest available land use map, which is for the period of 2021-2023 (SFWMD, 2025).

Information for new permit applications for residential developments in various phases of planning and construction was obtained from the SFWMD's Environmental Resources Permit (ERP) database and from SFWMD staff. Details of the plans' layouts (i.e., residential areas, stormwater ponds, and wetlands) were digitized and added to the future land use map.

Finally, future land use projections for the planning horizon from various sources were obtained, reviewed and incorporated into the future land use map. It should be noted that the data in some of these sources was coarse, and thus had to be carefully interpreted to maintain the level of detail in the existing land use map. Changes from these sources were incorporated into the future land use map if they had not already been incorporated in prior steps. The sources for future land use are listed below:

1. Future 2040 land use created by SFWMD staff
2. Land use county comprehensive plans and local government data
    a. Collier County 2024–2050 future land use data
    b. Lee County 2045 future land use data
    c. City of Bonita Springs 2040 future land use data
    d. Village of Estero 2040 future land use data

The existing land use in the ECM and future land use in the FCM are shown grouped into general land use categories in Figure 3-1. The changes in land use in the model from ECM to FCM are shown in Figure 3-2 with an inset of the Lake Trafford area where much of the new development has taken place. The specific sources used for those land use changes are shown in Figure 3-3. Table 3-1 shows the total area by land use type in existing conditions model and the future conditions model.

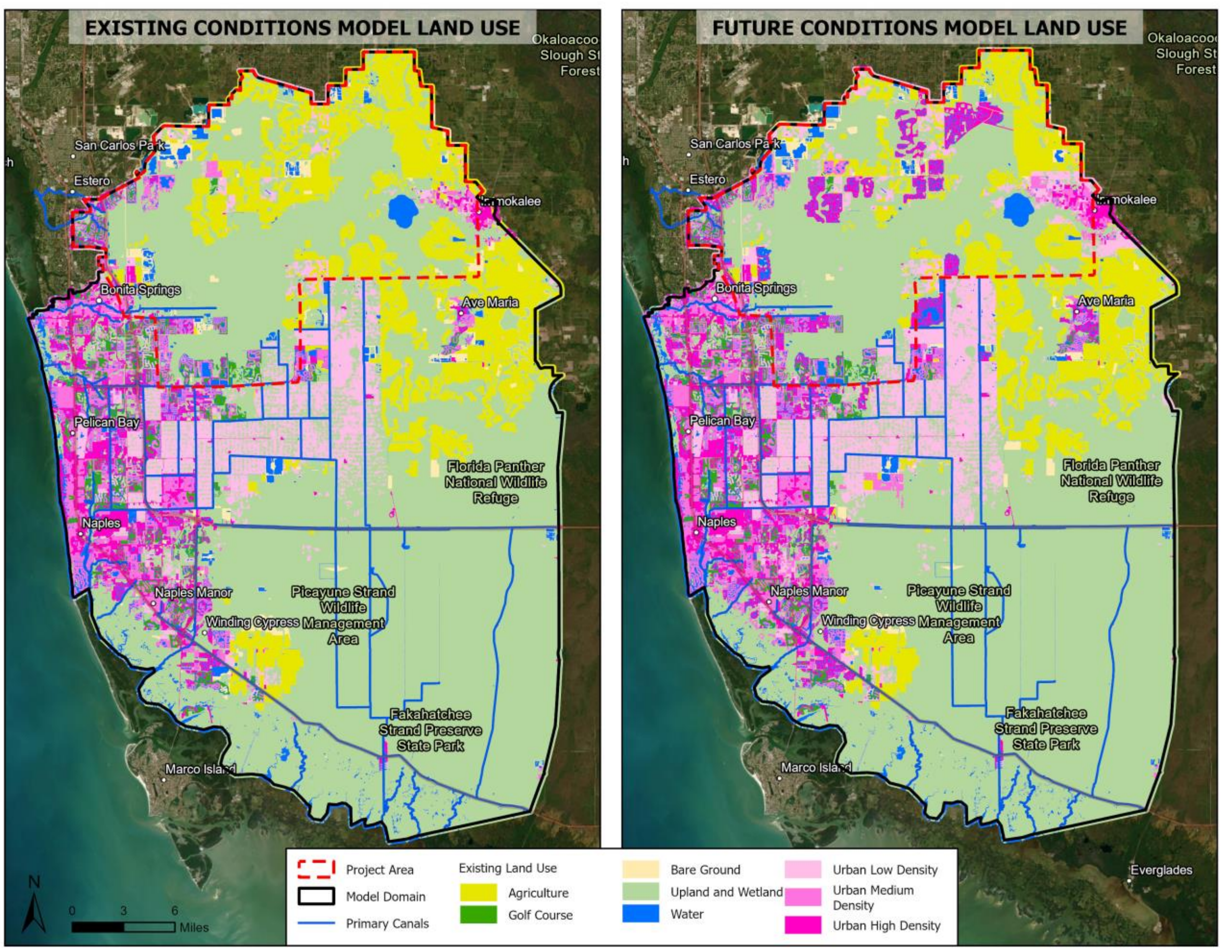

Figure 3-1. Existing Conditions Model Land Use and Future Conditions Model Land Use Shown Grouped Into General Land Use Categories

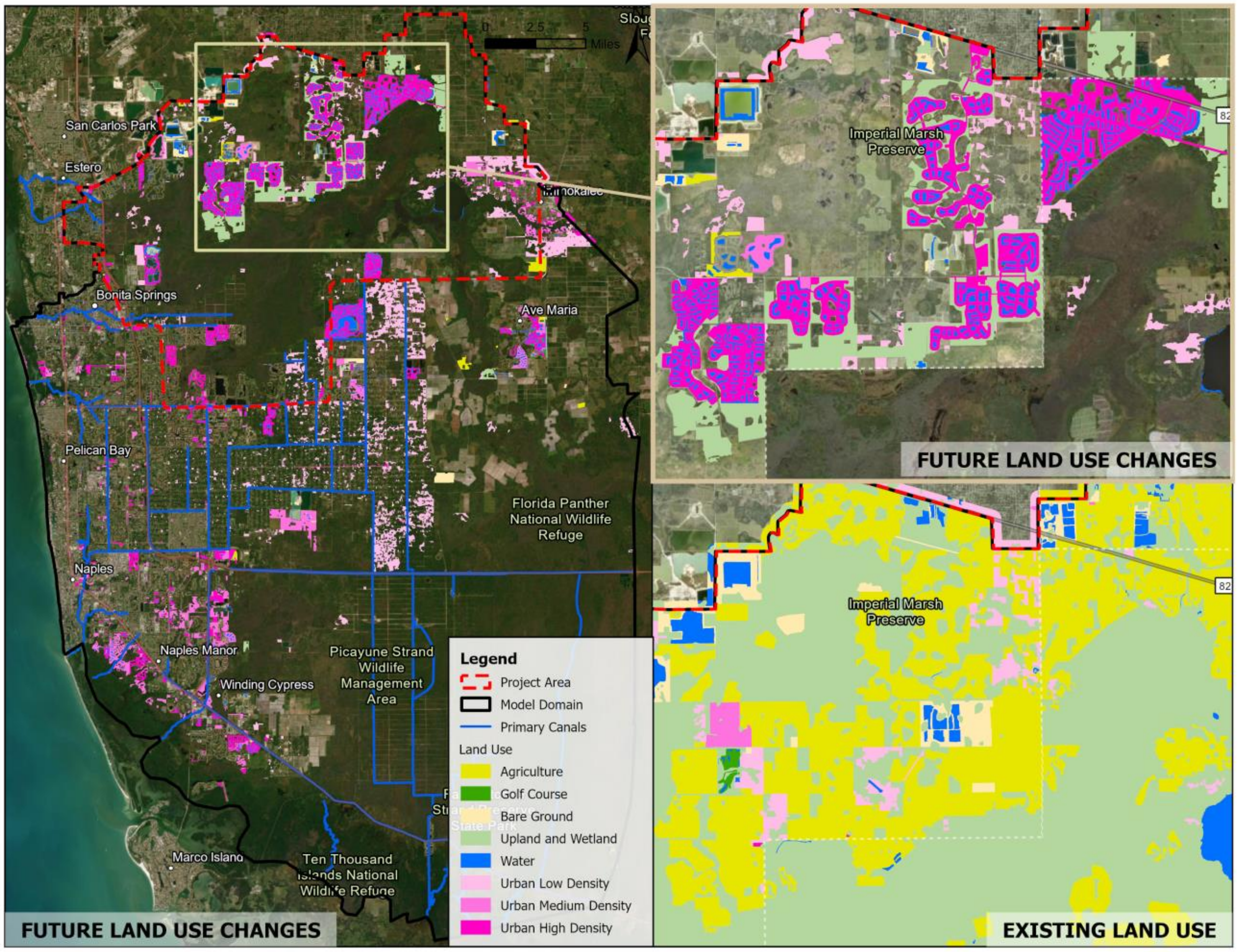

Figure 3-2. Areas of Future Land Use Changes and Future Land Use Types

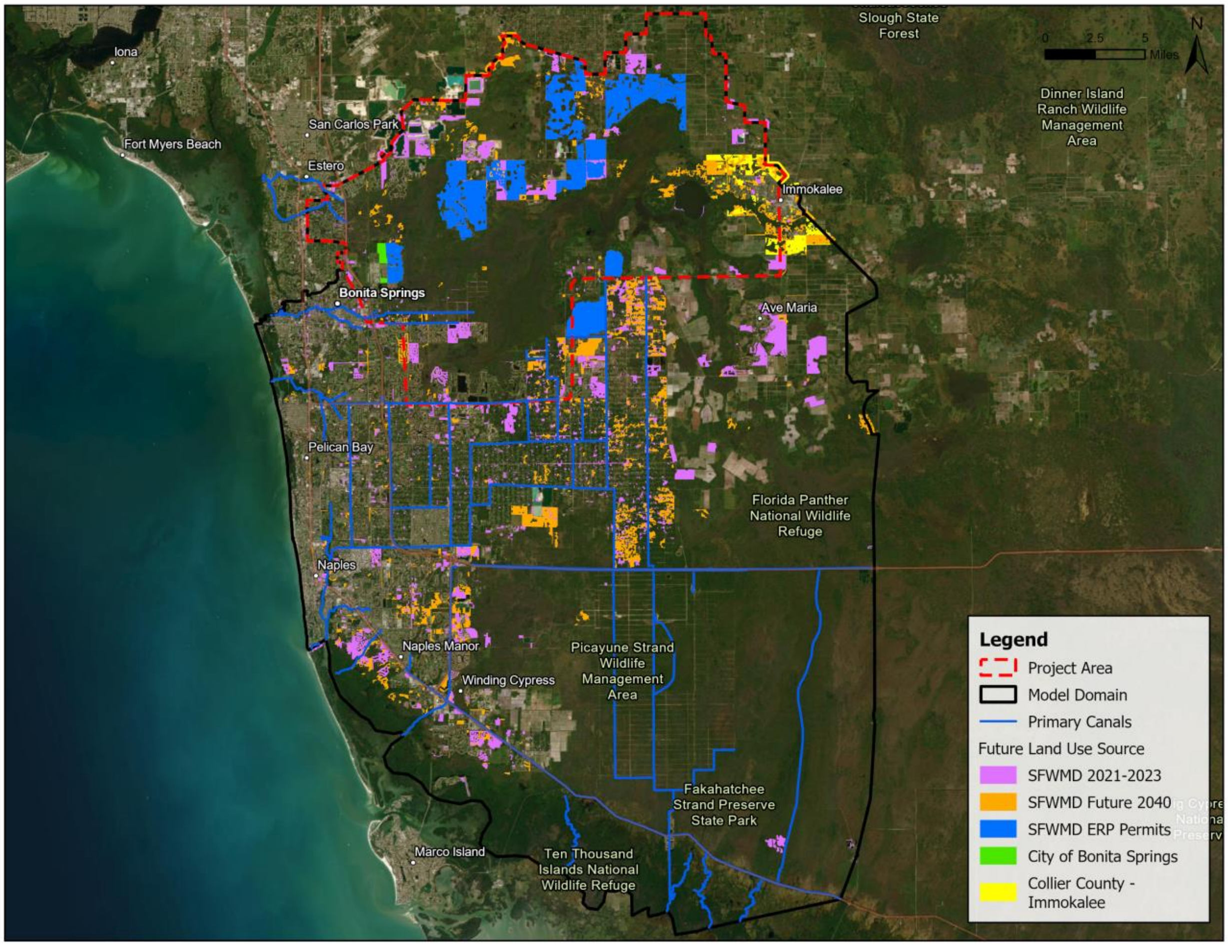

Figure 3-3. Sources for Future Land Use Changes

Table 3-1. Total Area by Land Use Type in the Existing and Future Conditions the Total Change in Area shown as Future Minus Existing in Acres.

Land Use	Existing (acres)	Future (acres)	Change (Future - Existing) (acres)
Agriculture	94,494	72,001	-22,492
Golf Course	14,026	14,072	46
Bare Ground	10,950	8,223	-2,727
Upland and Wetlands	427,618	408,611	-19,007
Water	31,274	35,398	4,124
Urban Low Density	48,433	65,785	17,352
Urban Medium Density	34,757	41,443	6,686
Urban High Density	33,289	49,308	16,018
Total	694,840	694,840	0

3.2 Stormwater Drainage for Permitted Residential Developments

The permitted developments that were added to FCM are listed in Table 3-2 and shown on Figure 3-4.

Table 3-2. Recent ERP Applications for Residential Developments Included in the FCM

Project Name	Permittee(s)	Application No.	Permit No.	Status	Acres
FFD Corkscrew Road Property	G.L. Acquisitions Corporation; FFD Land Co, Inc	211005-7746	36-107777-P	Approved	5,209
Verdana Village	TPL Land Sub LLC; TP2 Land Sub, LLC; TP Com Land Sub, LLC	220125-32828	36-103223-P	Approved	2,138
Kingston	Cameratta Companies, LLC	230607-38984	36-109267-P	Approved	6,786
Immokalee Road Rural Village	27th Pico Blvd Limited Partnership; Brentwood Holdings Limited Partnership	211207-32383	11-106362-P	Approved	2,681
Corkscrew Grove Villages	Alico Land Development Company	250414-52144	11-113576-P	Pending	4,663
Brightshore Village	Hogan Farms, LLC Brightshore Community Development District	241107-47387	11-109367-P	Approved	737
Bonita Grande RPD	BG Mine LLC Bonita Grande 80, LLC	230510-38581	36-109420-P	Approved	1,343
The Place	Corkscrew Farms Community Development District c/o Meritus Corp	210614-6485	36-08561-P	Approved	1,356

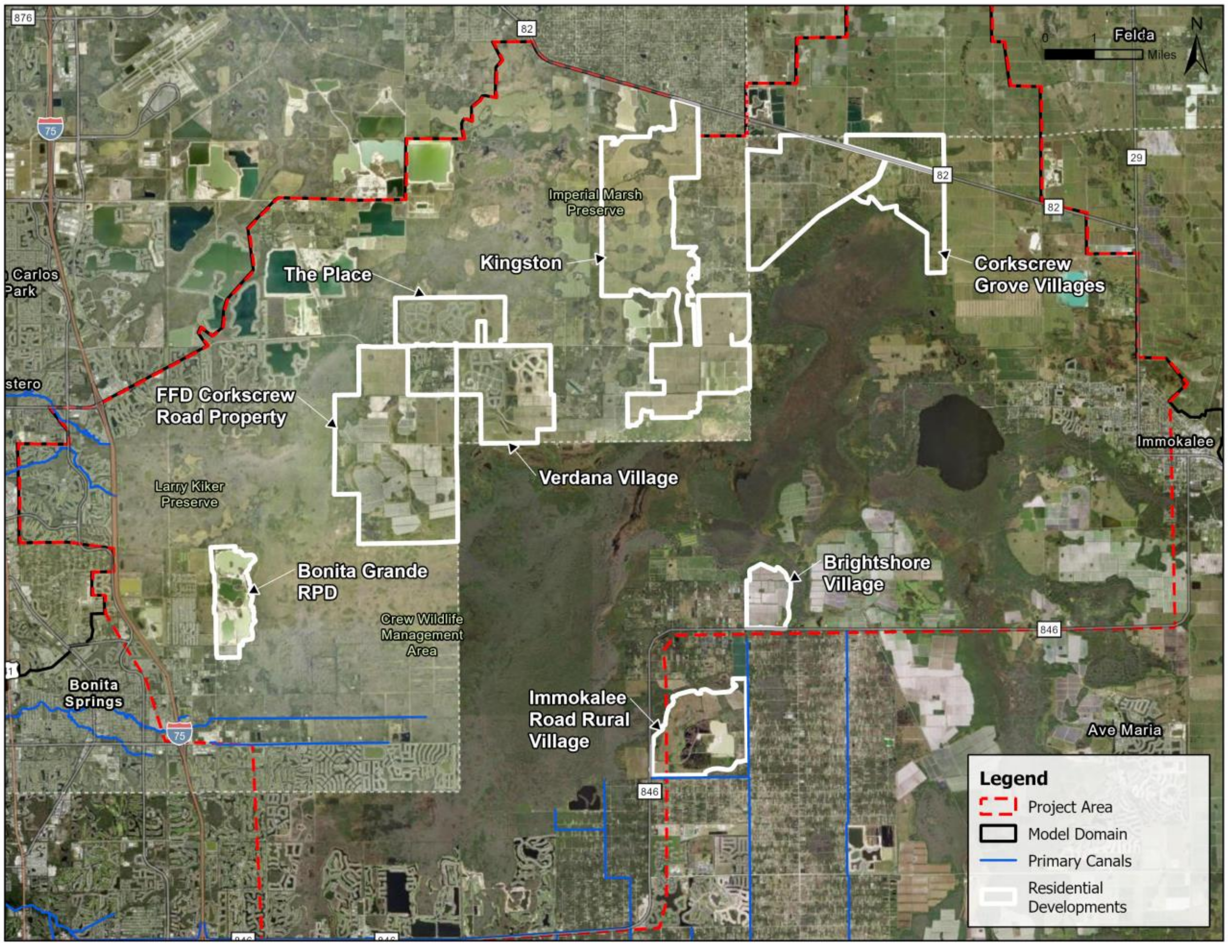

Figure 3-4. Recently Permitted Residential Developments added to the FCM model.

For each of these developments, land use and drainage information was extracted from plans that are submitted as part of the ERP application documents. Drainage structures, storage ponds, and hydraulic connections to Corkscrew or other basins in the model are represented as part of the surface water network. Several of the developments (particularly FFD Corkscrew Road Property, Verdana Village, Kingston, and Corkscrew Grove Villages) also include constructed wetland areas that the developed areas discharge to before stormwater is discharged to Corkscrew. The wetland storage, drainage structures, and hydraulic connections are also represented as part of the surface water network. Stormwater drainage from impervious residential areas is routed to the storage ponds and wetlands where is controlled by the basin outlet structures before discharging to Corkscrew. Basin hydrology and routing is represented via a number of parameters in the Ponded Drainage component in MIKE SHE. Stormwater ponds are also mapped in MIKE SHE and are connected to the surface water network (MIKE HYDRO) storage cross sections via flood codes, which allows for ET, infiltration and seepage. A more detailed description of the urban basin approach is described in Deliverable 5.1.3, Section 7.

Since the available LiDAR is for the 2018 timeframe and does not include the new developments, the topography was adjusted in the new residential areas to a higher elevation based off of an area weighted average of the finish floor elevation, road elevation, and average ground elevation in open spaces from the permit documents. Note that elevation changes are applied at the 500-ft resolution in the model and to the areas that are classified as residential within the development, thus, raising the roads and the buildings to the same elevation, which neglects the slope that exists between these features. However, stormwater drainage is conceptually represented in the model via the Ponded Drainage component, which simply routes the impervious fraction runoff and the specified rate to the receiving water body if storage is available. Thus, this conceptual approach simplifies the hydraulics of the stormwater drainage system, neglecting the finer topographic elements within the stormwater drainage system. Raising the topography in these developments has an impact in the overland and groundwater flow between the cells classified as residential and the surrounding cells classified as ponds and wetlands.

3.3 Changes in the SFWMD Primary Canal System

Recent changes to the primary canal system, and those that are planned in the near future, were incorporated into the FCM as described below. Figure 3-5 show the primary system and highlights the areas where changes were made.

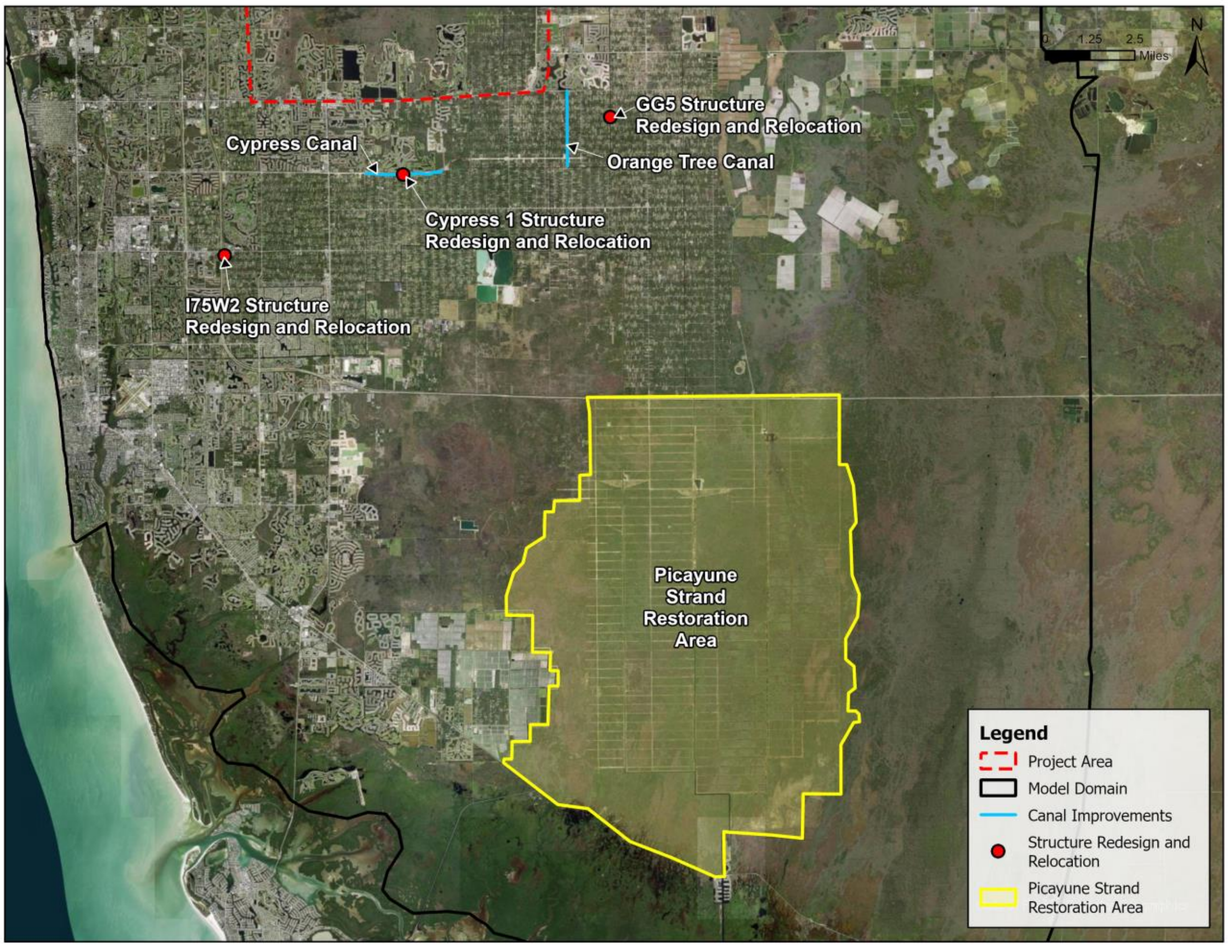

Figure 3-5. SFWMD Primary System and Changes Added to the FCM

3.3.1 I-75 Canal Geometry and Structures Changes

The I-75 canal begins unconnected just south of the Cocohatchee Canal, is aligned mostly parallel east of I-75, and drains into the Golden Gate Main Canal. The canal has three primary structures: I75W1 (southernmost), I75W2, and I75W3 (northernmost). The I75W1 was removed in early 2026. The I75W2 structure, along with the I75W2 pump, are to be removed in the near future. The I75W2 structure is located ~680 feet north of Pine Ridge Road and will be replaced with a newly designed structure ~740 feet south of Pine Ridge Road.

The old structures were removed and the new I75W2 structure was added to the FCM model according to design plans provided by SFWMD BCB staff and the design engineer (Figure 3-6). The new structure is a three-barrel concrete box gated culvert. Each of the gates is 7.5' W × 9.5' H. The new I75W2 structure does not include a pump.

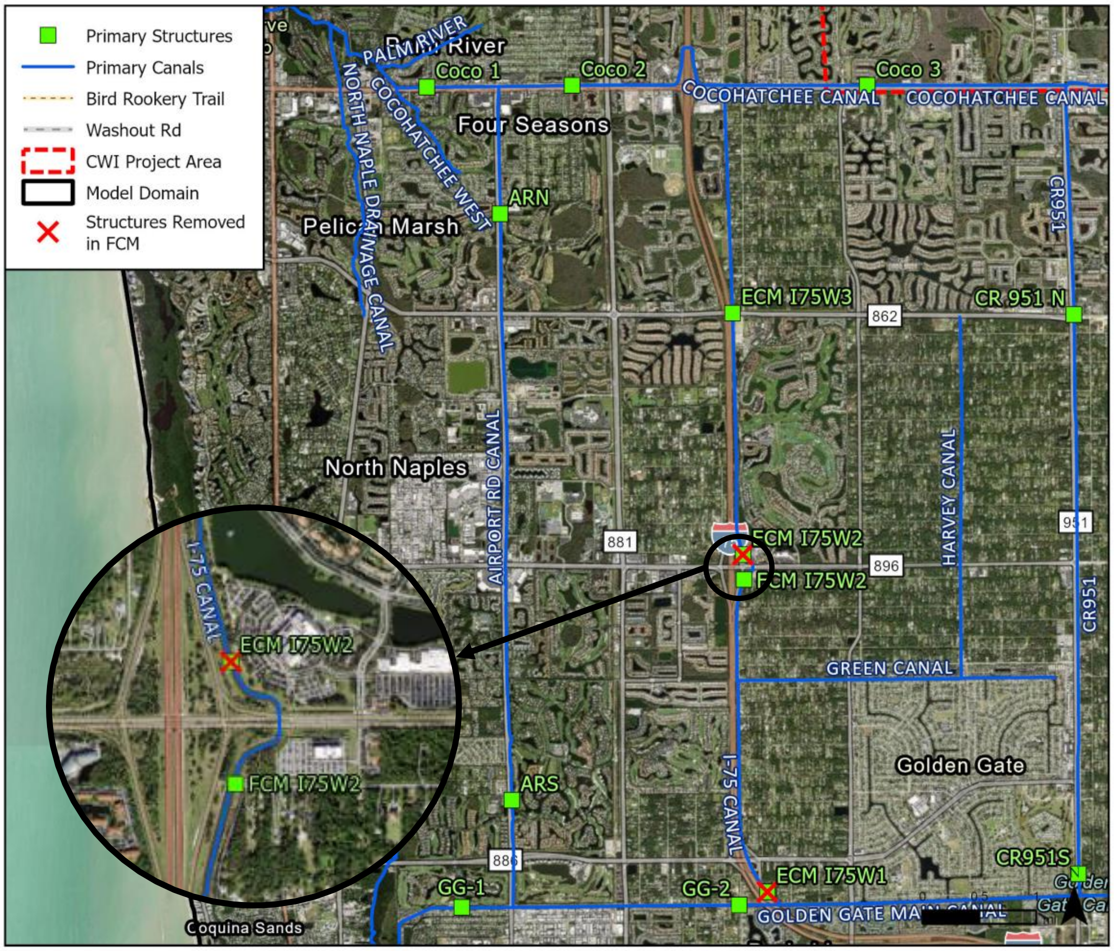

Figure 3-6. Changes in I-75 Canal Structures.

The structure operations were modified according to information obtained from BCB staff and from a model provided by Lago Consulting (via email communication), which was used to evaluate the I-75 project. The operations implemented in the FCM are based on one of the scenarios (scenario 3) that was simulated by Lago Consulting under a separate project with the District that included an analysis of proposed projects within the I-75 canal. One of the gates is operated at lower control elevations than the other two gates. Thus, a set of rules was coded for one of the gates and another set for the other two gates. The operation protocols as coded in the model are shown in Table 3-3. The operations from the Lago model were combined with the storm protocols and gate opening methods used for the other structures in the CWI model.

Table 3-3. New operation for the I75W2 Future Structure

Gate	Priority	Condition	Operation
1	1	Tailwater stages > headwater stages	Close
	2	Headwater stages <= 6.24 ft-NAVD [1]	Close 1 foot / 6 hours
	3	Storm Conditions[2]	Open 1 foot / 6 hours
	4	Wet season, headwater stages > 7.24 ft-NAVD	Open ½ foot / 6 hours
	5	Dry season, headwater stages > 8.24 ft-NAVD	Open ½ foot / 6 hours
	6	Wet season, headwater stages <= 6.24 ft-NAVD	Close ½ foot / 6 hours
	7	Dry season, headwater stages <= 7.24 ft-NAVD	Close ½ foot / 6 hours
	8	None of the conditions above are true	Gate level is unchanged
2, 3	1	Tailwater stages > headwater stages	Close
	2	Headwater stages <= 6.24 ft-NAVD	Close 1 foot / 6 hours
	3	Storm Conditions	Open 1 foot / 6 hours
	4	Wet season, headwater stages > 8.24 ft-NAVD	Open ½ foot / 6 hours
	5	Dry season, headwater stages > 9.24 ft-NAVD	Open ½ foot / 6 hours
	6	Wet season, headwater stages <= 6.24 ft-NAVD	Close ½ foot / 6 hours
	7	Dry season, headwater stages <= 7.24 ft-NAVD	Close ½ foot / 6 hours
	8	None of the conditions above are true	Gate level is unchanged

[1] Minimum operational level for storm conditions.
[2] Storm conditions are defined in Deliverable 5.2.2.

The I-75 Canal geometry was also modified in the FCM. The new cross sections were extracted from a model provided by Lago Consulting, which was used to evaluate the I-75 project. It should be noted that these cross sections are not representative of proposed grading for the canal but they are more accurate survey data than the cross sections in the original ECM. Cross sections included as part of the ECM were assumed based on LiDAR data and were from the BCB updated and calibrated model (Hazen and Sawyer, 2025), while those provided by Lago Consulting were reported by Lago Consulting to have been based on survey data. Figure 3-7 shows the previously delivered ECM versus the FCM canal bottom elevation profile and cross sections at the headwater and tailwater of the I75W2. Note that since ECM Deliverable 5.2.2, a few modifications were incorporated to the ECM to account for some modifications in the FCM that should also apply the ECM time period, such as this one. Section 3.8 summarizes the changes recently incorporated to the ECM. This updated ECM model will be redelivered with the FCM model files.

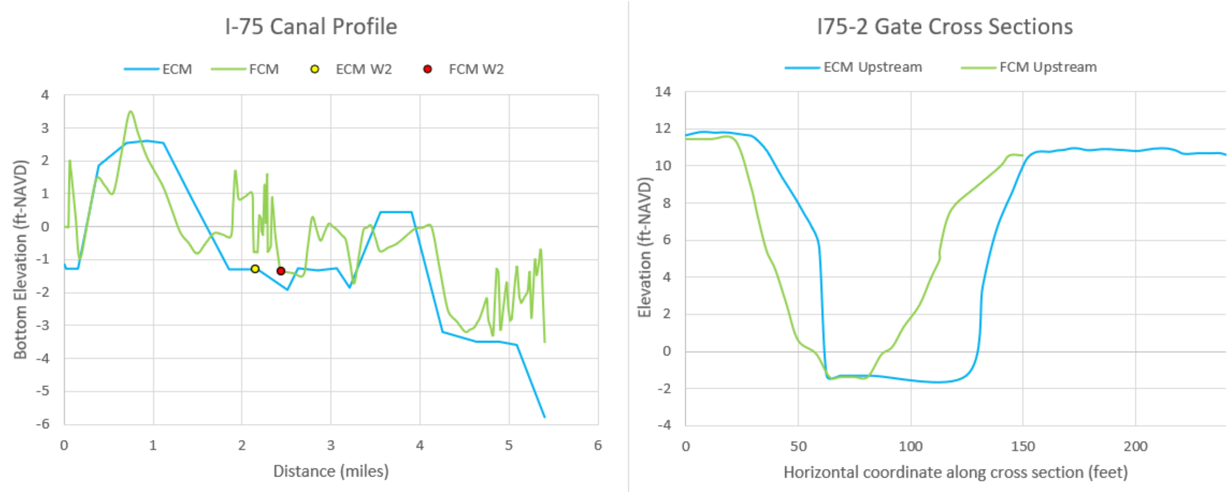

Figure 3-7. Changes in I-75 Canal Cross Sections Based on New Survey Information

3.3.2 Cypress Canal Geometry and CYP1 Structure Changes

The Cypress Canal alignment is being reconfigured and the CYP1 structure redesigned and relocated as part of the Vanderbilt Beach Road Extension Project (Figure 3-8). The existing structure, also known as GOLD4A, is a fixed weir (crest elevation of 8.2 ft-NAVD) with two sluice gates on each side (SFWMD, 2020). Information for this new cross section and structure information has been provided by the BCB staff and has been incorporated into the FCM. The new structure is a three-barrel concrete box gated culvert. The gates are 7.5’W x 8.0’H with the sill elevation at 1.2 ft-NAVD.

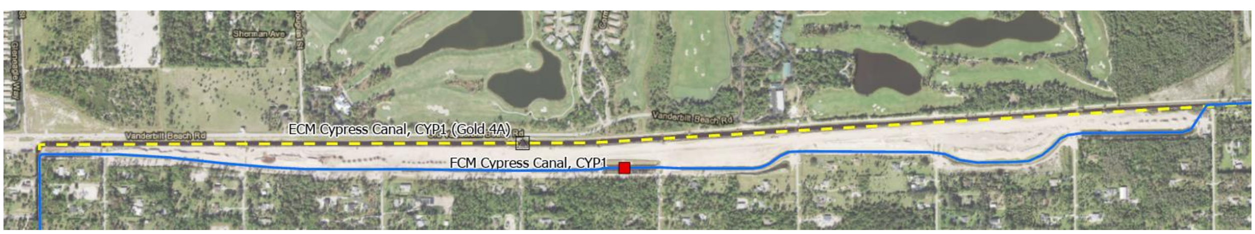

Figure 3-8. Revised Cypress Canal Alignment and Structure Location

The structure operations were modified according to information obtained from BCB staff. The operation protocols as coded in the model are shown in Table 3-4.

Table 3-4. New operation for the CYP1 Future Structure

Priority	Condition	Operation
1	Headwater stages <= 7.7 ft-NAVD[1]	Close 1 foot / hour
2	Storm Conditions[2]	Open 1 foot / hour
3	Wet season, headwater stages > 8.7 ft-NAVD[3]	Open ½ foot / hour
4	Dry season, headwater stages > 9.7 ft-NAVD	Open ½ foot / hour
5	Wet season, headwater stages <= 7.7 ft-NAVD	Close ½ foot / hour
6	Dry season, headwater stages <= 8.7 ft-NAVD	Close ½ foot / hour
7	None of the conditions above are true	Gate level is unchanged

[1] Minimum operational level for storm conditions.
[2] Storm conditions are defined in Deliverable 5.2.2.
[3] Priorities 3 to 6 are optimal operations for normal conditions.

3.3.3 GG5 Structure Changes

The GG5 structure will be relocated from current location, just north of Randall Blvd., to 4300 ft south at 20th Ave NE. The existing structure, also known as GOLDW5, is a fixed weir (crest elevation of 9.2 ft-NAVD) with two sluice gates on each side (SFWMD, 2020). Information for this new cross section and structure information has been provided by the BCB staff and has been incorporated into the FCM. The new structure is a three-barrel concrete box gated culvert. The gates are 10.0'W x 9.0'H with sill elevation at 2.2 ft-NAVD.

The structure operations were modified according to information obtained from BCB staff. The operation protocols as coded in the model are shown in Table 3-5.

Table 3-5. New operation for the GG5 Future Structure

Priority	Condition	Operation
1	Headwater stages <= 8.18 ft-NAVD[1]	Close 1 foot / 6 hours
2	Storm Conditions[2]	Open 1 foot / 6 hours
3	Wet season, headwater stages > 9.68 ft-NAVD[3]	Open ½ foot / 6 hours
4	Dry season, headwater stages > 11.68 ft-NAVD	Open ½ foot / 6 hours
5	Wet season, headwater stages <= 8.18 ft-NAVD	Close ½ foot / 6 hours
6	Dry season, headwater stages <= 10.68 ft-NAVD	Close ½ foot / 6 hours
7	None of the conditions above are true	Gate level is unchanged

[1] Minimum operational level for storm conditions.
[2] Storm conditions are defined in Deliverable 5.2.2.
[3] Priorities 3 to 6 are optimal operations for normal conditions.

3.3.4 Orange Tree Canal Geometry Changes

The Orange Tree Canal is a tributary of the Golden Gate Main Canal, located just south of Randall Blvd. Surveyed cross sections for recent modifications were provided by the BCB staff and incorporated into the model.

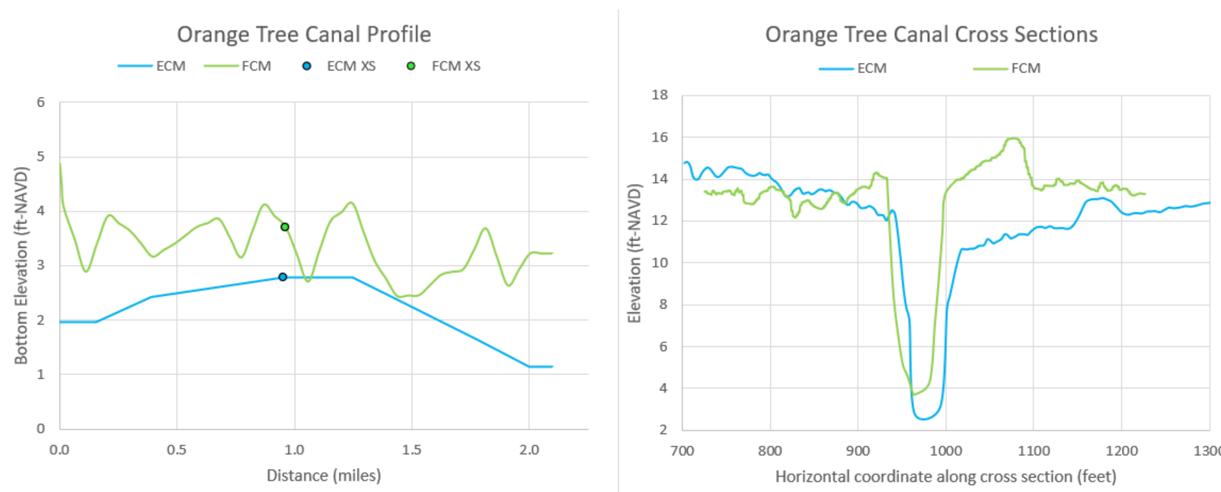

Figure 3-9. Changes in Orage Tree Canal Cross Sections

3.3.5 Picayune Strand Restoration Project (PSRP)

As part of the ECM a portion of the PSRP project was added to reflect the changes that were in place by the end of 2020. These changes include:

1. Removal of the LuckyLake Weir
2. Addition of the new Merritt pump, S-488,
3. Removal of the Merritt Canal downstream of the S-488 pump.
4. The addition of the tieback levees east and west of the pump, and
5. Connection of the pump discharge to the downstream wetland system.

The fully implemented Picayune Strand Restoration Project (USACE, 2024) was added to the FCM. In addition to the changes above, this includes:

1. Addition of the new FakaUnion Canal and Miller Canal pumps, S-487 and S-486, respectively.
2. Removal of FakaUnion and Miller canals downstream of the S-487 and S-486 pumps, respectively.
3. Addition of the tieback levees east and west of the pumps.
4. Connection of the pumps to the downstream wetland system.
5. Removal of the existing structures: FU-3, FU-2, Miller-1 and Miller-2.
6. Addition of the Southwestern Protection Feature (SWPF) Levee and connecting structures

The PSRP features are shown in Figure 3-10.

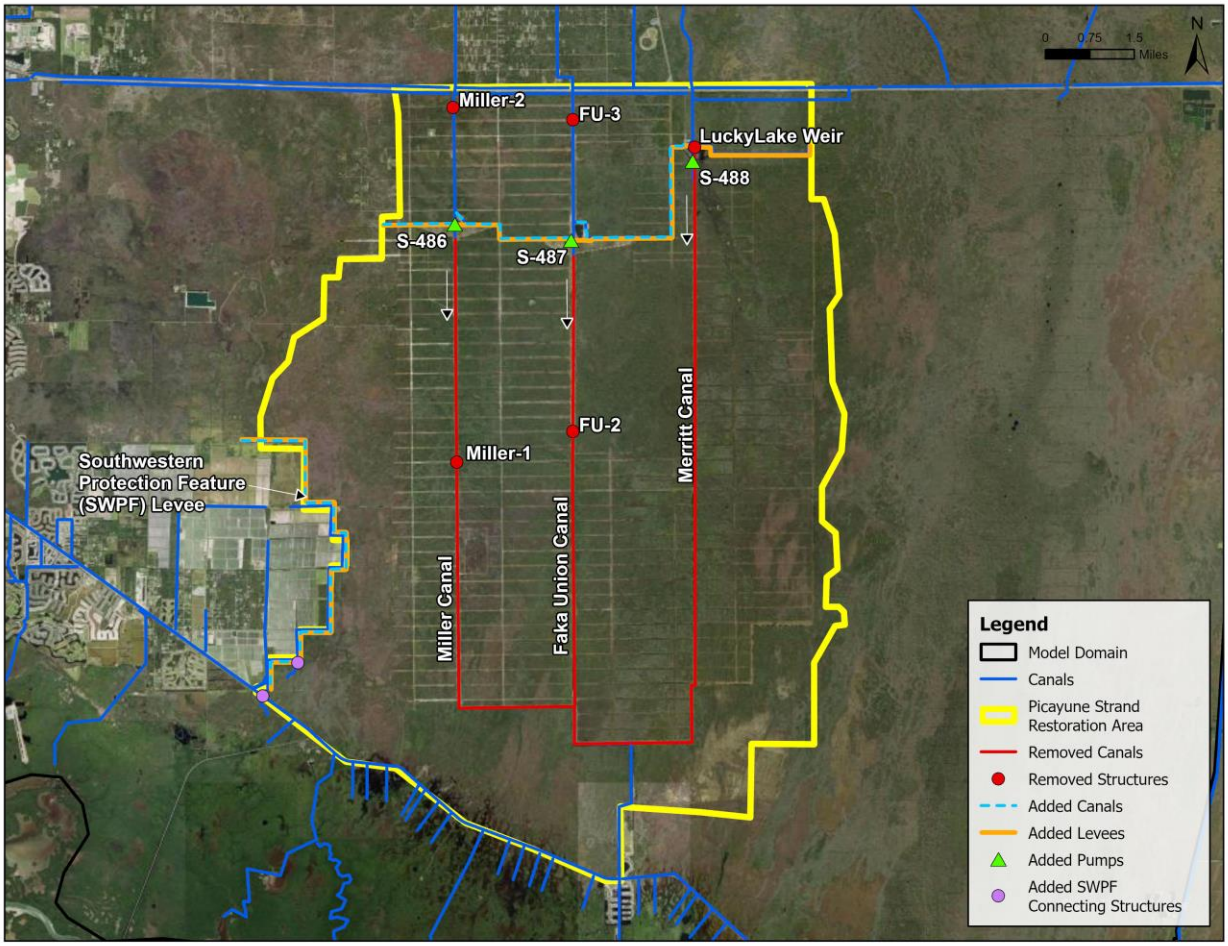

Figure 3-10. PSRP Features

Information for the PSRP features was obtained from the FDEP permit (FDEP, 2023) and USACE Operating Manual document (USACE, 2024). The three pump stations consist of the following pump capacities (excluding the backup pumps):

1. S-488 (Merritt Canal): Total capacity of 810 cfs, 2-75 cfs electric, 3-220 cfs diesel.
2. S-487 (Faka Union Canal): Total capacity of 2,650 cfs, 3-100 cfs electric, 5-470 cfs diesel.
3. S-486 (Miller Canal): Total capacity of 1,250 cfs, 1-75 cfs electric, 5-235 cfs diesel.

Operation of the structures in the model are based on communications with the BCB staff. The operation of the pumps are based on seasonal target stages (Figure 3-11). The rule based operations are described in Table 3-6.

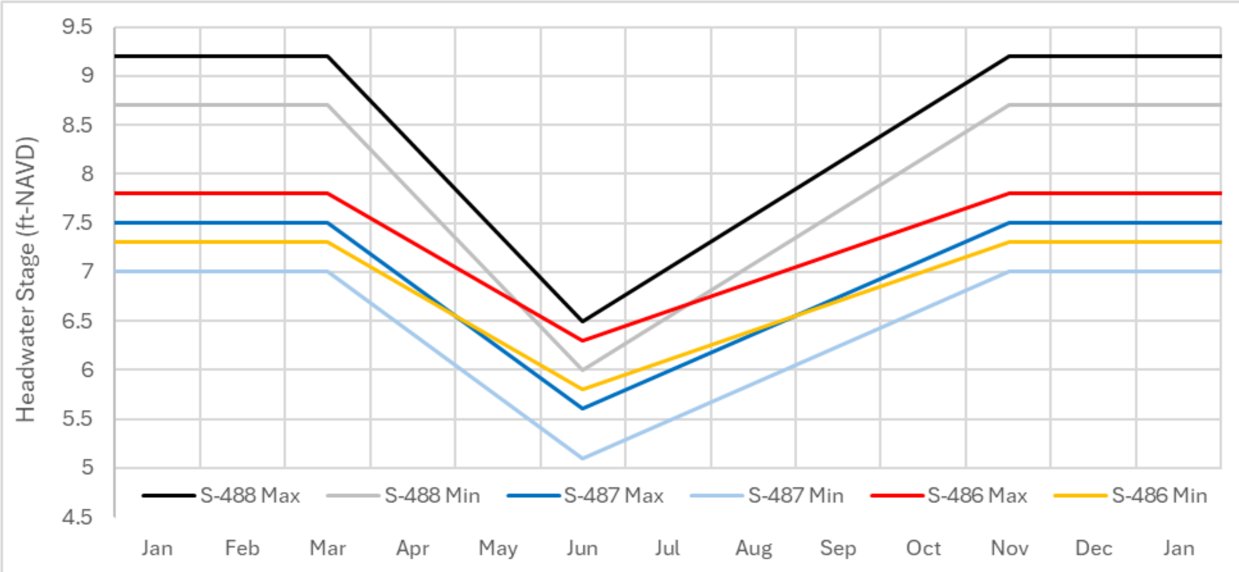

Figure 3-11. Seasonal Target Stages for the PSRP pumps

Table 3-6. Operation of the PSRP Pumps (S-486, S-487, S-488)

Priority	Condition	Operation[1]
1	Headwater stages < = lowest operating level[2]	Turn off pumps one at a time
2	Storm conditions and HW > storm operating level ft-NAVD[3]	Turn on pumps one at a time[4]
3	Headwater stages > optimal maximum (Figure 3-11)	Turn on pumps one at a time
4	Headwater stages < optimal minimum (Figure 3-11)	Turn off pumps one at a time
5	None of the conditions above are true	Discharge is unchanged

[1] All pumps operations are changed at hour frequencies.

[2] Lowest operating level was assumed to be 4.9 ft-NAVD for pumps S-486 and S-487 and 5.2 ft-NAVD for pump S-488, based on communications with BCB staff.

[3] Storm conditions are triggered by rainfall above the 5-yr storm depth (7.5 inches). Operations apply a pre-storm drawdown 72 hours ahead of rainfall accumulation exceeding this depth, as defined in Deliverable 5.2.2. Per communications with BCB staff, it was assumed that during this condition the headwater control stage is 5.4 ft-NAVD, for pumps S-486 and S-487 and 5.7 ft-NAVD for pump S-488, which is 6 inches above the lowest operating level.

[4] Starting with the electric pumps and then diesel pumps until the total pump station capacity is reached.

The tieback levees with the corresponding northern and western swales (or channels) along the levees were added as branches in the 1D (MIKE HYDRO) model. The height of the levee is included in the southern or eastern bank of the cross section and thus, it acts like a flow barrier since no overland flow lower than the levee height can flow from the southern or eastern side of the cross section. These levees are designed to prevent flood damage in areas north of I-75 and other adjacent private properties. The discharges from the pumps are connected to the southern wetlands via flood codes, which are model features that allow flooding from the 1D component to the MIKE SHE overland flow component (flood codes are described in Deliverable 5.1.3, Section 4.3 Flow Way Exchange with MIKE SHE).

The Southwest Protection Feature (SWPF) levee and canal were added as branches in the 1D (MIKE HYDRO) model, with the levee included in the eastern bank of the cross section. This also acts to prevent flood damage to the residential and agricultural areas to the west. Two culverts connecting the SWPF canal to the Picayune wetlands to the south and flowing under the Tamiami Trail to the south were also added to the model.

3.4 Lee County Kiker Preserve Project

The Lee County Larry Kiker Preserve Project (Kiker Preserve) is approximately 4,000 acres of natural habitat land acquisition by Lee County as part of the Conservation 20/20 program. It is located south of Corkscrew Road, west of the CREW Wildlife Management Area and part of the CWI project area (Figure 3-12). This project consists of constructing a berm and control structures between the Kiker Preserve and the urban areas to the west and south. The main purpose of this project is to hold excess stormwater in the Kiker Preserve until the developed areas downstream have receded after the storm event. This serves the dual purpose of flood protection and reduction of over drainage of the wetland areas. The project is divided into three phases consisting of three berm extensions:

1. The berm starts just east of I-75 and south of the Stoneybrook subdivision (south of Corkscrew Rd.), then goes south parallel to I-75 and then east, just south of the Hidden Cypress Preserve, up to the Bonita Grande Mine.
2. The berm wraps around the north and east sides of the Bonita Grande Mine, which is to be converted into a residential development.
3. The berm continues from the south of the Bonita Grand Mine wrapping around the urban developments to the west and then parallel to the Kehl Canal.

The first two phases have been incorporated in the baseline FCM. Phase 3 is not incorporated in the baseline FCM due to the need for land acquisition of properties located to the north of the proposed berm. However, it will be incorporated into at least one of the project alternatives.

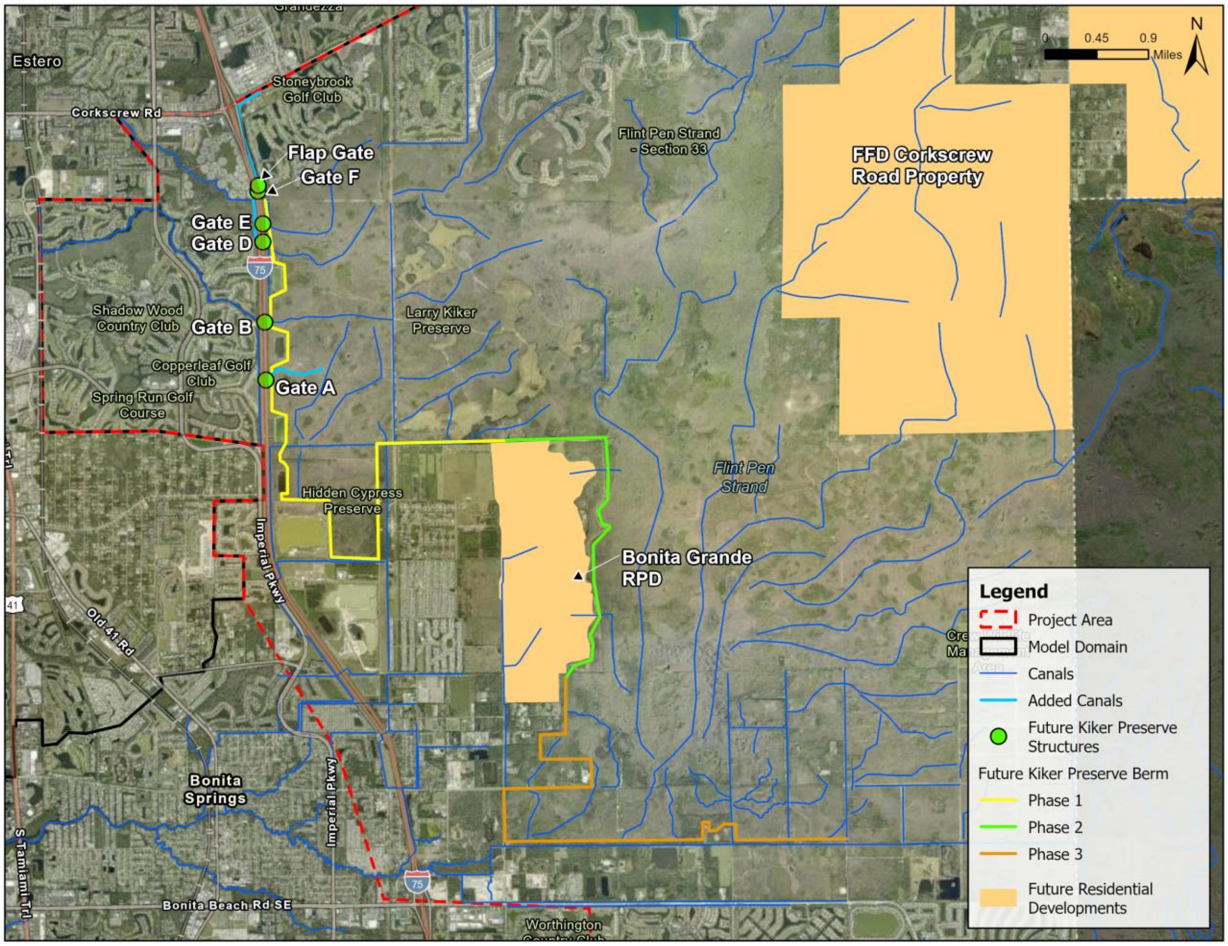

Figure 3-12. Lee County Kiker Preserve Project Features

Since the berms for phases 1 and 2 are mostly along existing high feature areas (existing roads and berms), and these features were already conceptually represented in the ECM via the Separated Overland Flow component, no further addition of a berm had to be added to the FCM. Thus, the incorporation of the project in the FCM consists of adding the control structures that serve to block the previously uncontrolled discharges via I-75 to the west. The structure information for the Kiker Preserve project was obtained from the ICPR model that was developed as part of the alternative evaluation (Kimley-Horn and Singhofen & Associates, 2024). The structures included in the model are described below. The operable gates are assumed to be underflow gates because they are operated with "top clips" in the ICPR model.

1. Kiker Structure A: Single underflow gate, width = 2.5 ft, sill elevation = 14.5 ft-NAVD, maximum gate level = 16.4 ft.
2. Kiker Structure B:
    a. Fixed weir, width = 40 ft, crest elevation = 16.6 ft-NAVD
    b. Three underflow gates, width = 2.0 ft, sill elevation = 13.5 ft-NAVD, maximum gate level = 16.5 ft-NAVD.
    c. Three underflow gates, width = 6.0 ft, sill elevation = 13.5 ft-NAVD, maximum gate level = 14.5 ft-NAVD.

3. Kiker Structure D: Single underflow gate, width = 6.0 ft, sill elevation = 11.0 ft-NAVD, maximum gate level = 12.0 ft.
4. Kiker Structure E:
    a. Fixed weir, width = 40 ft, crest elevation = 16.6 ft-NAVD
    b. Two underflow gates, width = 6.0 ft, sill elevation = 11.0 ft-NAVD, maximum gate level = 12.0 ft-NAVD.
5. Kiker Structure F:
    a. Fixed weir, width = 40 ft, crest elevation = 16.6 ft-NAVD
    b. One underflow gate, width = 6.0 ft, sill elevation = 11.0 ft-NAVD, maximum gate level = 12.0 ft-NAVD.

The gate operations are shown in Table 3-7 and Table 3-8. The operations are based on the description provided in Kimley-Horn and Singhofen & Associates (2024) for storm conditions and to maintain stages east of the structure around 14.5 ft-NAVD.

Table 3-7. Operation of the Kiker Preserve Gates A, B, D, E, F

Priority	Condition	Operation
1	TW > HW	Close
2	First 92 hours of a storm event	Close
3	Between 92 and 128 hours of a storm event	Open halfway
4	Between 128 and 152 hours of a storm event	Fully Open
5	HW > 14.6 ft-NAVD	Open
6	HW < 14.4 ft-NAVD	Close
7	None of the conditions above are true	Gate levels are unchanged

Table 3-8. Operation of the Kiker Preserve Recovery Gates B, E

Priority	Condition	Operation
1	TW > HW	Close
2	First 312 hours of a storm event	Close
3	HW > 14.6 ft-NAVD	Open
4	HW < 14.4 ft-NAVD	Close
5	None of the conditions above are true	Gate levels are unchanged

3.5 Future Water Use Changes

Future water use changes are represented in the irrigation and groundwater pumping modules. The irrigation module applies water to urban or agriculture model cells where the soil moisture content falls below the field capacity. The irrigation command areas (ICAs) is a model input map that tells the model which cell is irrigated and the types of irrigation sources for each unique cell identifier. A description of the irrigation module setup and assumptions can be found in the BCB model development and calibration report (Hazen and Sawyer, 2025). Since the ICA sources are defined according to the type of land use, the map was changed to reflect the changes in future land use.

The FCM groundwater pumping module was modified according to the following methods:

1. Pumping wells that correspond to agricultural land uses that were converted to urban or natural cells were removed from the model (Figure 3-13).
2. Since no information on future wells was available, the pumping wells associated with public water supply (PWS) uses remained as they were in the ECM but the volumes were increased according to water use projections in the Lower West Coast Water Supply Plan Water Supply Plan (SFWMD, 2022). Projections were converted to a volume fraction by County (Table 3-9) and applied as a multiplier to the ECM volumes.
3. Pumping wells associated with domestic self-supply (DSS) uses remained as they were in the ECM but the volumes were increased according to the population increases in the Lower West Coast Water Supply Plan (SFWMD, 2022). Population increases were converted to a volume fraction by County (Table 3-9) and applied as a multiplier to the ECM volumes.

Table 3-9. Pumping Volume Fractions Applied based on LWC projections

County	DSS	PWS
Lee	1.3	1.4
Collier	1.3	1.2

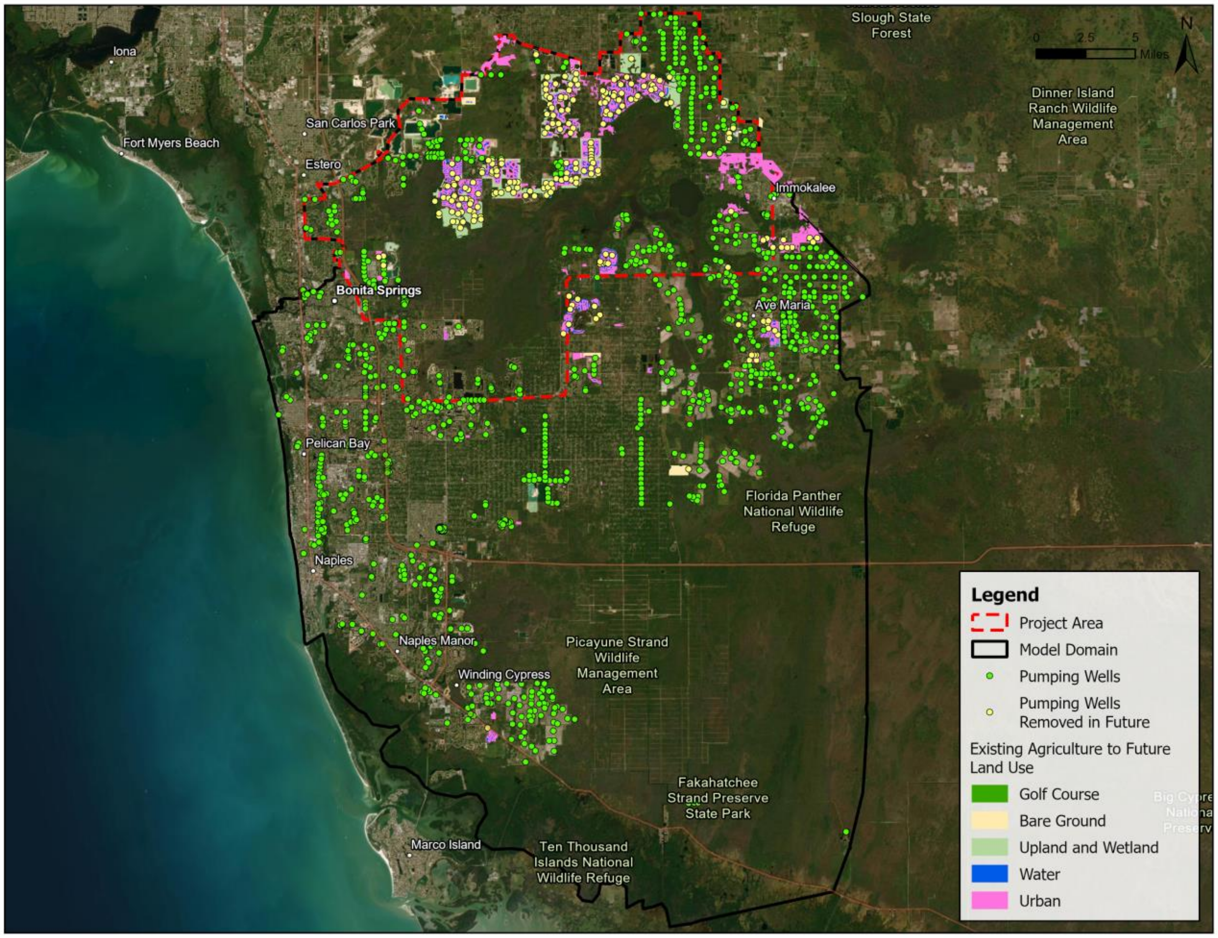

Figure 3-13. Removed Agricultural Pumps for Farm Fields Converted to Residential Uses or Natural Areas

3.6 Future Climate Change

Coordination with the SFWMD's Resiliency group was conducted to determine the information necessary to develop a climate scenario in accordance with the SFWMD planning projects.

3.6.1 Sea Level Rise (SLR)

The NOAA 2025 SLR calculator (https://coast.noaa.gov/sealevelcalculator/) values for the Naples Station for various years and climate scenarios are shown in Table 3-10. The recommendation from the Resiliency group was to use the Intermediate scenario for the planning horizon of 2040. The values shown in Table 3-10 are relative to 1992, therefore, to calculate an offset relative to 2020, the sea level rise in 2020 must be removed from the sea level rise in 2040. Thus, the offset applied to the Naples Station values was 0.92 – 0.46 = 0.46 feet.

Table 3-10. NOAA 2025 Projected Mean Sea Level Rise

Climate Change Scenario	Mean Sea Level Rise Relative to the Year 1992 (feet)						
	2020	2030	2040	2050	2060	2070	2080
Low	0.43	0.59	0.79	0.95	1.08	1.21	1.35
Intermediate Low	0.46	0.66	0.85	1.08	1.31	1.54	1.74

Climate Change Scenario	Mean Sea Level Rise Relative to the Year 1992 (feet)						
	2020	2030	2040	2050	2060	2070	2080
Intermediate	0.46	0.66	0.92	1.21	1.54	1.94	2.43
Intermediate High	0.46	0.69	1.02	1.41	1.97	2.69	3.48
High	0.46	0.72	1.12	1.64	2.4	3.35	4.53

3.6.2 Rainfall

Future rainfall change factor for the design storm simulations were obtained from the Resilience Metrics Hub (Future Extreme Rainfall Change Factors for Flood Resiliency Planning in South Florida Web Application | Resilience Metrics Hub). A rainfall factor was selected for each storm frequency based on the Resilience Metrics Hub Web Application values generated for the 3-day storm duration, for the Southwest Coast Rainfall Area, and the 2020 to 2059 planning horizon. The 50 percentile values were selected based on the recommendation of the Resiliency group, which is consistent with the SFWMD's FPLOS projects. This rainfall change factor was applied to the rainfall depths from the ECM described in Deliverable 5.2.2. Table 3-11 shows the change factors for each design storm and the total rainfall depth after the factor was applied averaged over the model domain. Note that the depths are spatially distributed in the model according to NOAA Atlas 14 gridded datasets. Figure 3-14 through Figure 3-17 show the temporal distribution of the rainfall depth relative to the simulation period for the each of the design storms.

Table 3-11. Future Rainfall Factors Applied to Design Storm Events

Design Storm Event	Rainfall Factor	Total Depth (in)
5-yr	1.08	7.95
10-yr	1.10	9.70
25-yr	1.14	12.48
100-yr	1.19	17.41

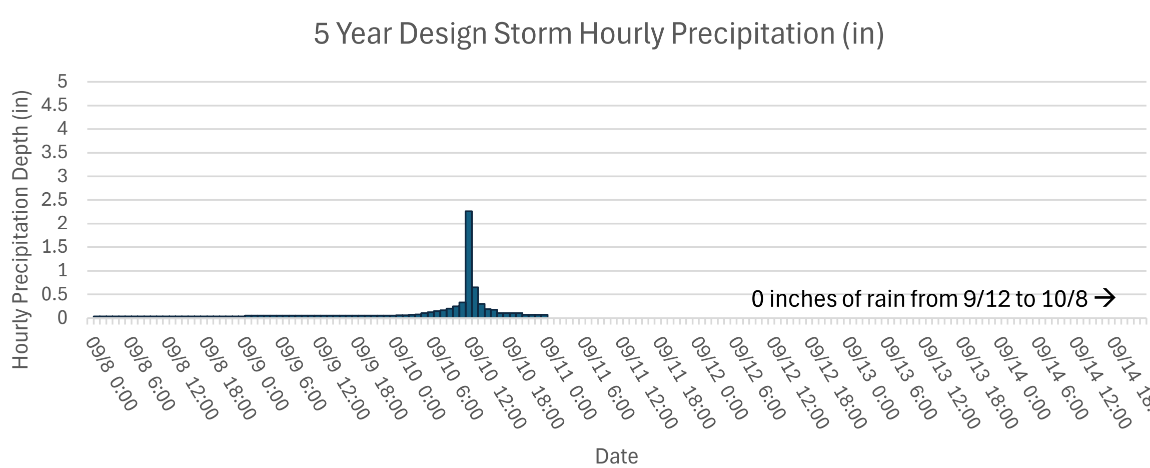

Figure 3-14. Five-Year Design Storm Rainfall Averaged Over the Model Domain

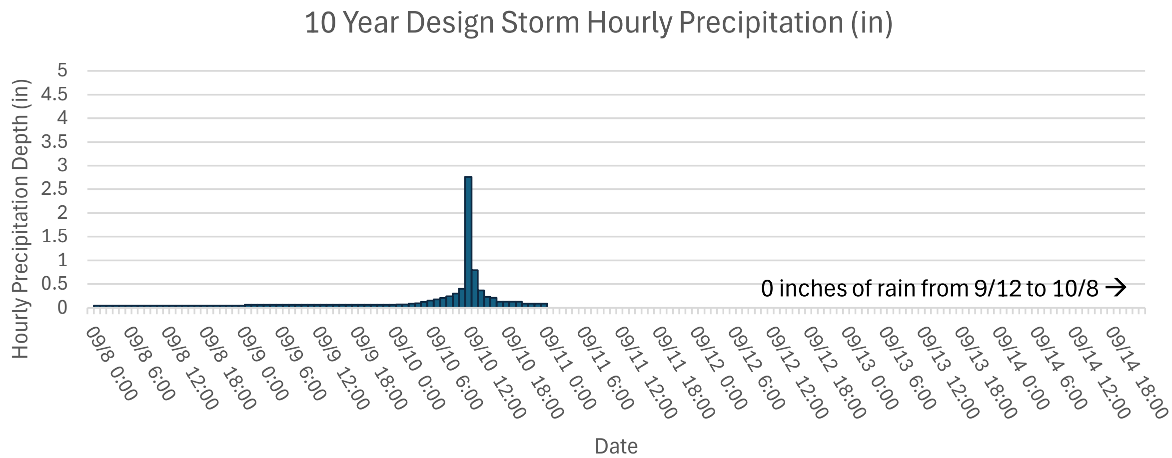

Figure 3-15. Ten-Year Design Storm Rainfall Averaged Over the Model Domain

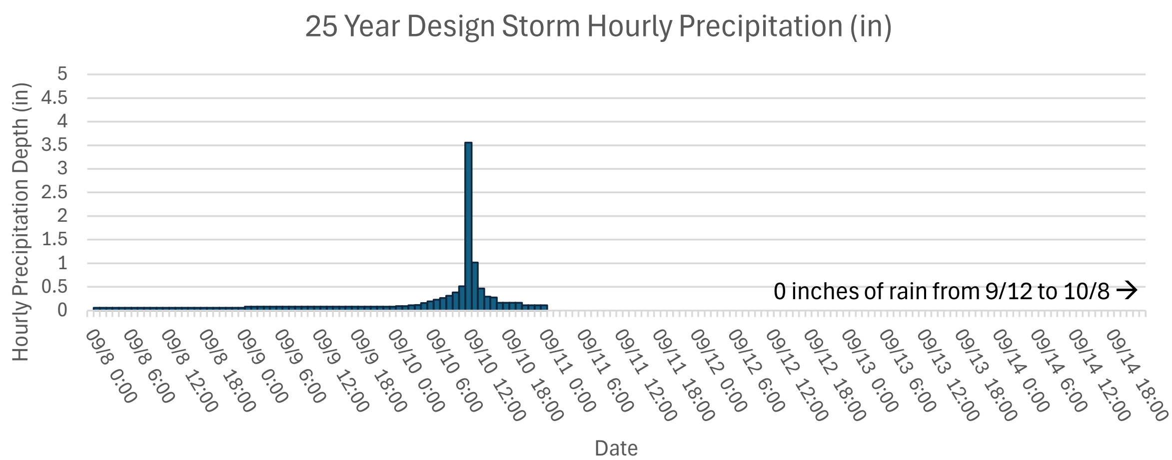

Figure 3-16. Twenty-Five Year Design Storm Rainfall Averaged Over the Model Domain

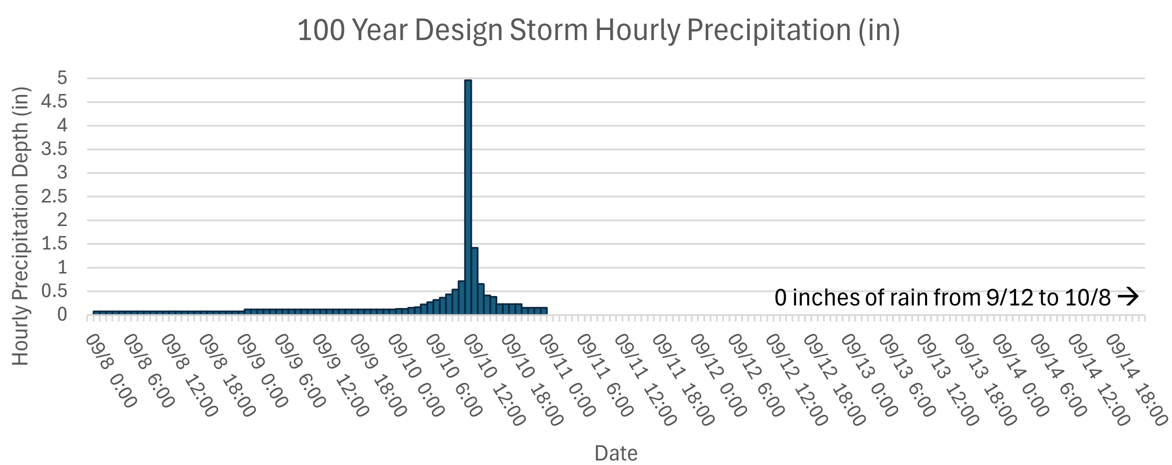

Figure 3-17. Hundred-Year Design Storm Rainfall Averaged Over the Model Domain

Meetings with SFWMD's Resiliency and Modeling groups were also held to determine if an appropriate method was feasible to adjust for the Long-Term Simulation (LTS) rainfall and ET. After considering the options available, the team agreed that for the FCM baseline and alternatives, the same temporal and spatial distribution of rainfall and ET as the ECM will be used for the LTS. However, a sensitivity run will be added to the final selected alternative using rainfall and ET data that results in drier conditions than the ECM period.

To develop these datasets two options were suggested:

1. Select a known historical drought period: 1971-1975 for both rainfall and ET, based on the historical period climate analysis performed by SFWMD.
2. Use the datasets that the Resiliency and Modeling groups are developing based on the recent climate models.

The final approach for the sensitivity analysis will be further discussed and determined in subsequent meetings.

3.7 Changes in Initial and Boundary Conditions from ECM

Initial and Boundary Conditions for the ECM are described in Deliverable 5.2.2. The SLR offset was incorporated in the tidal boundary conditions in both MIKE SHE (groundwater component) and MIKE HYDRO (surface water component). Non tidal boundaries for the design storms are set as uniform values which are the same as the initial values, which are based on the average wet season water table and for the LTS the boundaries are based on observed data for the historical time period being used.

Initial conditions in the LTS were not changed from the ECM. Initial conditions for the FCM design storms use a hotstart file from the FCM long term simulation, following a similar approach as the ECM. The day of the hotstart is the same as in the ECM, representing conditions right before Hurricane Irma in September of 2017.

3.8 Refinements to ECM after Deliverable 5.2.2

Recent site visits to the proposed project areas provided insight regarding hydraulic features that should be added or adjusted to improve the representation of the area in the model. Furthermore, new data regarding existing features were obtained during the FCM development. Thus, adjustments to the FCM that are representative of the existing conditions time period where also incorporated to the ECM. A summary of the recent changes to the ECM after the Deliverable 5.2.2.

1. Washout Road – The site visit illustrated a lot of ponding and water movement along the road swales, particularly along the western swale. Thus, the western swale was added to the model. The eastern swale was excluded since due to the close proximity in relation to the cell size both swales cannot be linked to MIKE SHE. The separated overland area along the road was removed and instead the height of the road was incorporated into the added swale cross sections. Thus, overland flow can cross from east to west either through the culvert crossings or by overtopping the road levee.
2. Fish Farm Road – The site visit illustrated how water can move across the culverts under the Farm Fish road, which connects to Rookery Lane going towards the Audubon Corkscrew Swamp Sanctuary. The previous version of the model was missing some of the southern culverts along the road. Thus, the missing connections were added, including addition and extension of flow ways to connect the culverts.

3. Bird Rookery – The berm/road between the northeast of the Bird Rookery Trail and the rural residential areas west of Immokalee road shows a lower elevation in the LiDAR along the western side. The entire area is blocked by a separated overland area. Thus, an extension of the flow way south of the berm to link north side of the berm with a weir with the corrected LiDAR elevations to allow flow south east of Bird Rookery.
4. Saddlebrook Lake – Information regarding the Saddlebrook Lake approximate depths and outlet structure and control elevation was received after Deliverable 5.2.2. Revision of cross sections and the MIKE SHE topography was conducted to represent the depth of the lake based on this information. The outlet structure and the connection to Corkscrew Canal was added.
5. I-75 Canal – The I-75 Canal cross sections were replaced to incorporate data from survey (refer to Section 3.3.1).
6. Picayune Operations – Operation of Merrit pump (S-486) to be compatible with the changes in FCM and minimum operation level corrected by BCB staff.

4.0 Performance Measures and FCM Results

4.1 Overview of Performance Measures for Alternative Evaluation

The document *Corkscrew Watershed Initiative Deliverable 3.2: Final Project Performance Measures and Metrics Technical Memorandum* provides a summary of the measures that will be used to evaluate alternatives. Some measures related to habitat restoration and project implementation will not be based on model output. The measures discussed in this section are those that are based on the model output, which are those related to hydrologic restoration of wetlands, flood protection, and water supply.

For the flood protection metrics, three out of the six performance measures that are used in the SFWMD's FPLOS program were applied. These are: FPLOS PM1 – maximum canal stage profiles, PM 5 – peak flood depths, and PM 6 – flood duration. The other FPLOS PMs are not used because they have to do with assessing structure capacities and system drainage which are not relevant to the alternative evaluation for CWI. Nevertheless, flow hydrographs and headwater and tailwater stages were also plotted to provide a qualitative baseline of existing conditions at the primary structures. To calculate PM 1, PM 5 and PM 6, the model output from the four design storm simulations is used.

For the wetland hydrologic restoration and water supply metrics, six performance measures were quantified using output from the LTS model:

1. Saltwater intrusion – changes in flow volumes at the tidal structures/outlets closest to the project area (Kehl Canal, Imperial River, COCO1, and GG1) as well as changes to dry season groundwater levels.
2. Sheet flow – changes in overland flow across man-made barriers.
3. Average wet season water depth, from July 1 to September 30.
4. The tenth percentile dry season water levels, from March 1 to June 30. Note this metric replaces the minimum dry season water level originally described in Deliverable 3.2.
5. Hydroperiods – number of months the water level is above ground for the water year, from June 1 to May 31.

6. Water supply – changes in the groundwater levels and fluxes in the vicinity of public supply wellfields.

Section 4.2 summarizes the flood protection results and measures, Section 4.3 summarizes the wetland hydrologic restoration measures and LTS results, and Section 4.4 shows the water supply output from the LTS that will be used to perform relative comparisons with the FCM baseline and alternatives.

In addition to the performance metrics listed above, additional output from the long term simulation was included in **Appendix C**: FCM Long Term Simulation Stage and Flow Hydrographs and Gate Levels. This output includes:

1. The headwater and tailwater stages, gate opening, and flow at key structures: Kehl Canal Weir, Cork3, Cork2, Cork1, Curry1, CR951N, GG1, and Miller3.
2. The stage and flow at the Bird Rookery north trail bridge and at the I-75 bridges crossing Miller Canal, Faka Union Canal, and Merrit Canal.
3. Surface water discharges and stages to the Cocohatchee Canal from the north between COCO4 to COCO3. This includes flow from the developments that are north of the canal in the southern part of Corkscrew and from the southern portions of Corkscrew, southwest of Cork1 and Cork2.

4.2 Flood Protection Performance Measures and Design Storm Results

4.2.1.1 Maximum Canal Stage Profiles

The maximum canal stage profiles can be used to assess where peak stages exceed the canal banks. Four canal reaches within the project area were assessed under this performance metric (Figure 4-1). Maximum simulated canal stages were plotted with the canal bottom elevation and canal left and right top of bank extracted from the model canal cross sections. Modeled structures and canal junctions are also included on the profiles for reference.

The sections of the Corkscrew Canal between Cork 2 and Cypress Canal and the south of Cork 3 flow through rural residential and single family residential land use areas. The Cocohatchee canal flows through highly urbanized areas including residential and commercial land uses. The Kehl Canal upstream of the Kehl Canal Weir is non-urban land use (mostly wetlands) but downstream of the Kehl Canal Weir, there are some residential land uses adjacent to the canal system.

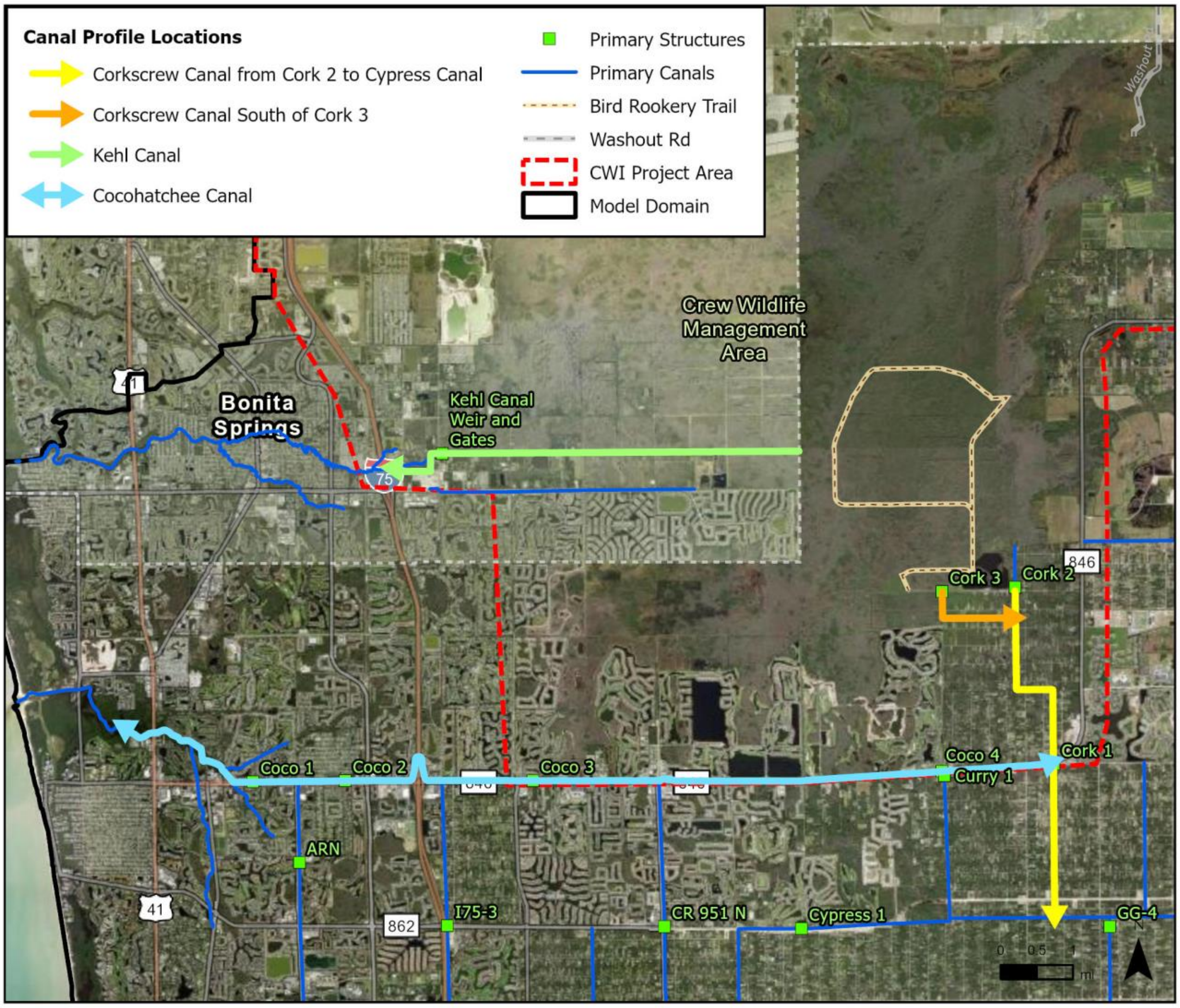

Figure 4-1. Locations of Maximum Canal Stage Profiles.

The section of the Corkscrew Canal between Cork 2 and the Cypress Canal structures (Figure 4-2) flows through rural residential and mixed non-urban land uses. Simulated maximum water surface elevations from all future storm events (100-yr, 25-yr, 10-yr, and 5-yr design events) exceed portions of the banks in this section of canal. Simulated flows from the Bird Rookery area upstream of Cork 2 and additional simulated flows from the Canal Junction between 41st and 39th along with the simulated head losses at Cork 1 and multiple culverts within the reach contribute to the high simulated maximum water surface profiles in the canal. When compared with the existing conditions simulated results for the 100-year design event (**Appendix A**: Design Storm Stage Canal Profiles, FCM vs ECM), the maximum canal stages simulated in future conditions are slightly higher than existing conditions (0.3 ft higher on average along the profile for the 100-year design event), but even a small change in stages can increase the overtopping length by hundreds of feet.

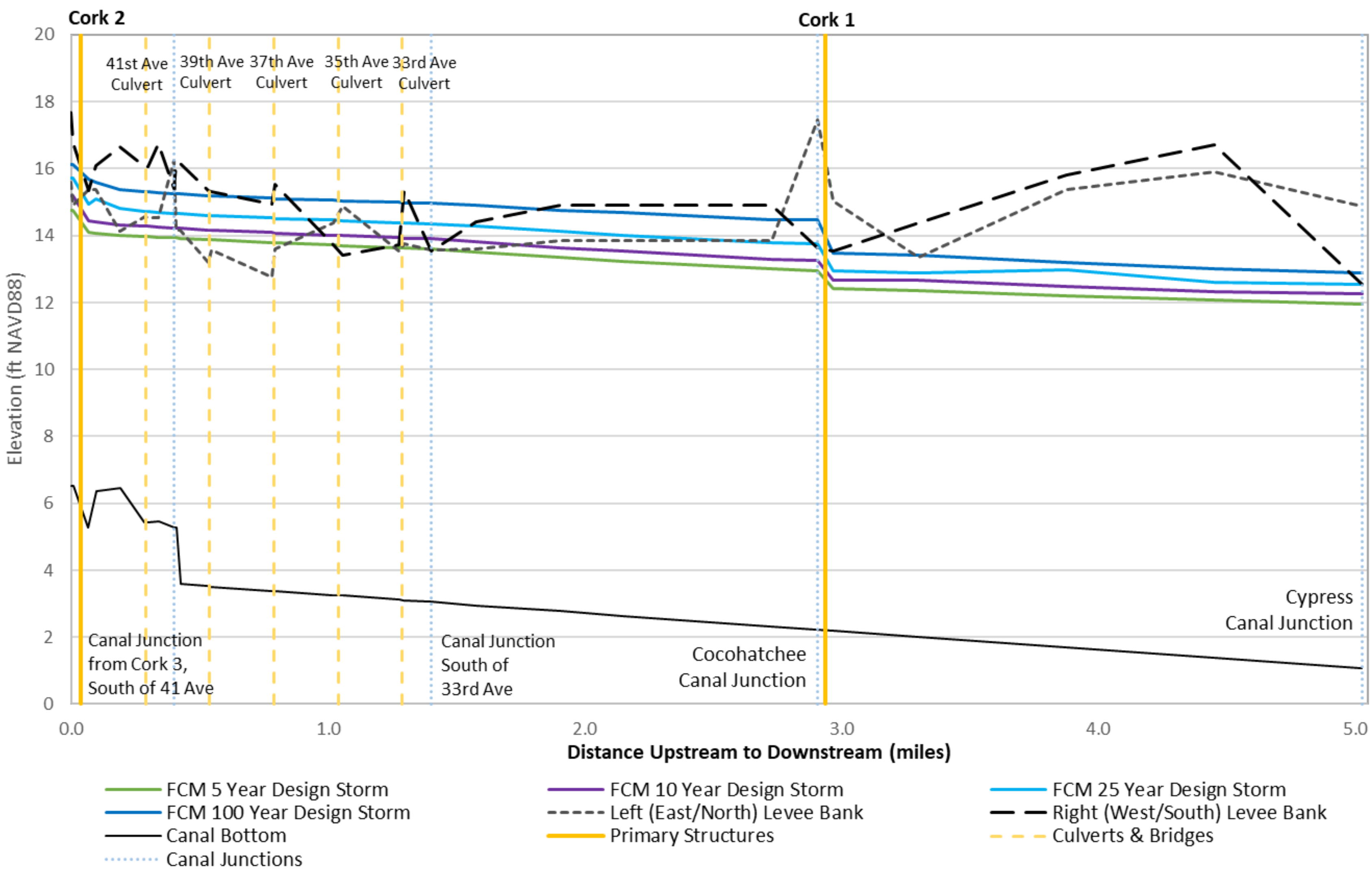

Figure 4-2. FCM Simulated Maximum Water Surface Elevation for the Section of Corkscrew Canal Between Cork 2 and the Cypress Canal.

The section of the Corkscrew Canal south of Cork 3 (Figure 4-3) flows through rural residential, single family residential, and mixed non-urban land uses. Simulated maximum water surface elevations from all future conditions storm events (100-yr, 25-yr, 10-yr, and 5-yr design events) exceed portions of the banks in the upstream area of this canal section. Simulated head loss through the 41st Ave culvert contributes to higher simulated maximum stages in this area. Land use to the west of the canal (right bank) upstream of 41st Ave culvert is wetland, while land use to the east of the canal (left bank) is rural residential. The rural residential area to the east has additional natural area converted to rural residential in the future conditions model. Downstream of the 41st Ave culvert, all design storm events simulated maximum stages that exceed the right bank and some portions of the left bank in an area of rural residential land use. When compared with the existing conditions simulated results for the 100-year design event (**Appendix A**: Design Storm Stage Canal Profiles, FCM vs ECM), the maximum canal stages simulated in future conditions are slightly higher than existing conditions (approximately 0.3 ft higher on average along the profile for the 100-year design event).

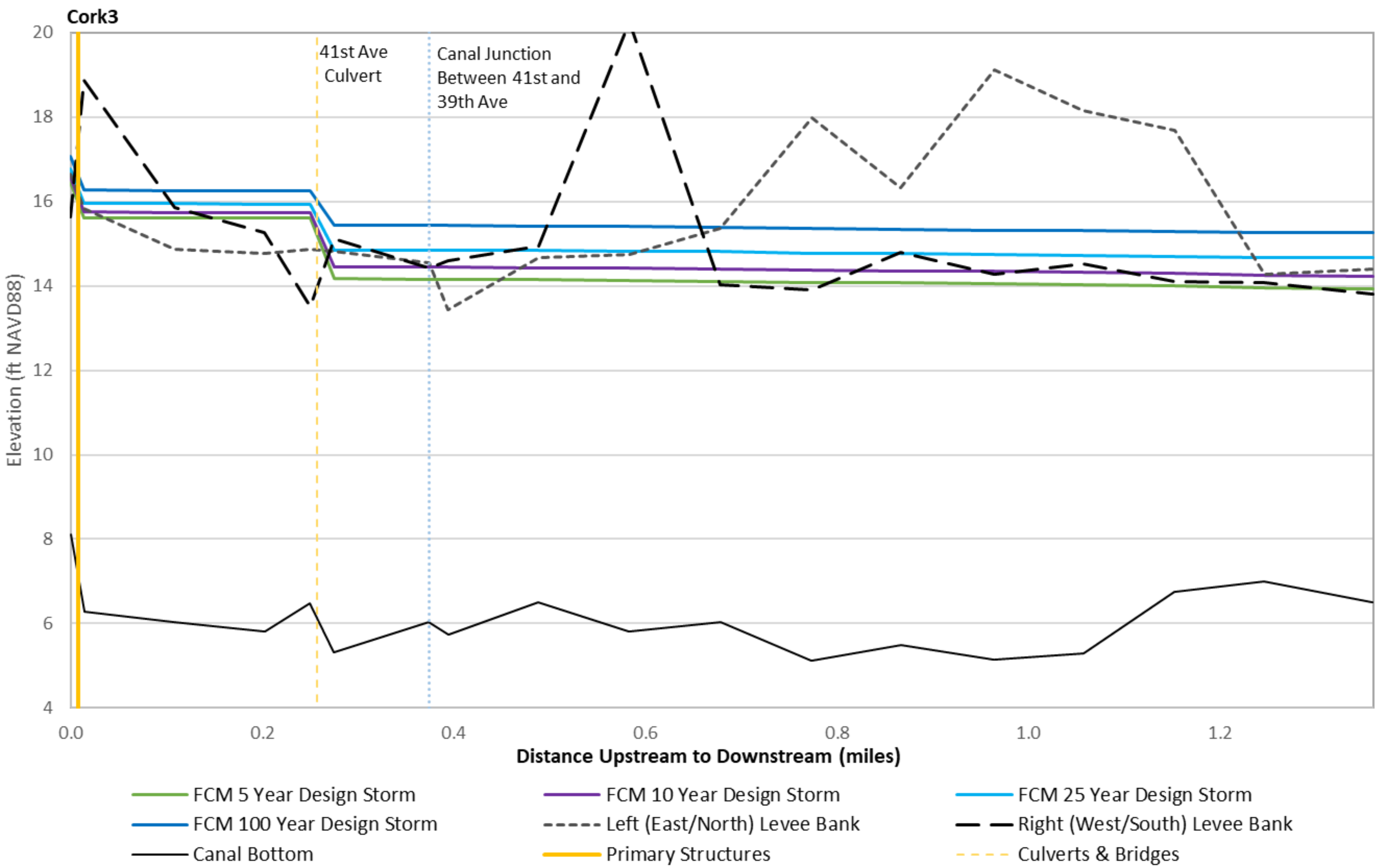

Figure 4-3. FCM Simulated Maximum Water Surface Elevation for the Section of the Corkscrew Canal South of Cork 3.

The Kehl Canal (Figure 4-4) flows through mostly wetland and other non-urban land uses. Downstream of the Kehl Canal Weir and Gate, there is some residential land use adjacent to the canal system. Simulated maximum water surface elevations from all future conditions storm events

(100-yr, 25-yr, 10-yr, and 5-yr design events) exceed the banks in multiple locations along the Kehl canal. The Kehl canal collects flows from a large area within the Corkscrew wetlands area, which contributes to high simulated stages in the canal during simulated design storm events. Simulated head loss through the culverts and Kehl Canal Weir and Gate also contribute to higher simulated stages in the upstream portion of the canal. When compared with the existing conditions simulated results for the 100-year design event (**Appendix A**: Design Storm Stage Canal Profiles, FCM vs ECM), the maximum canal stages simulated in future conditions are slightly higher than existing conditions (approximately 0.4 ft higher on average along the profile for the 100-year design event).

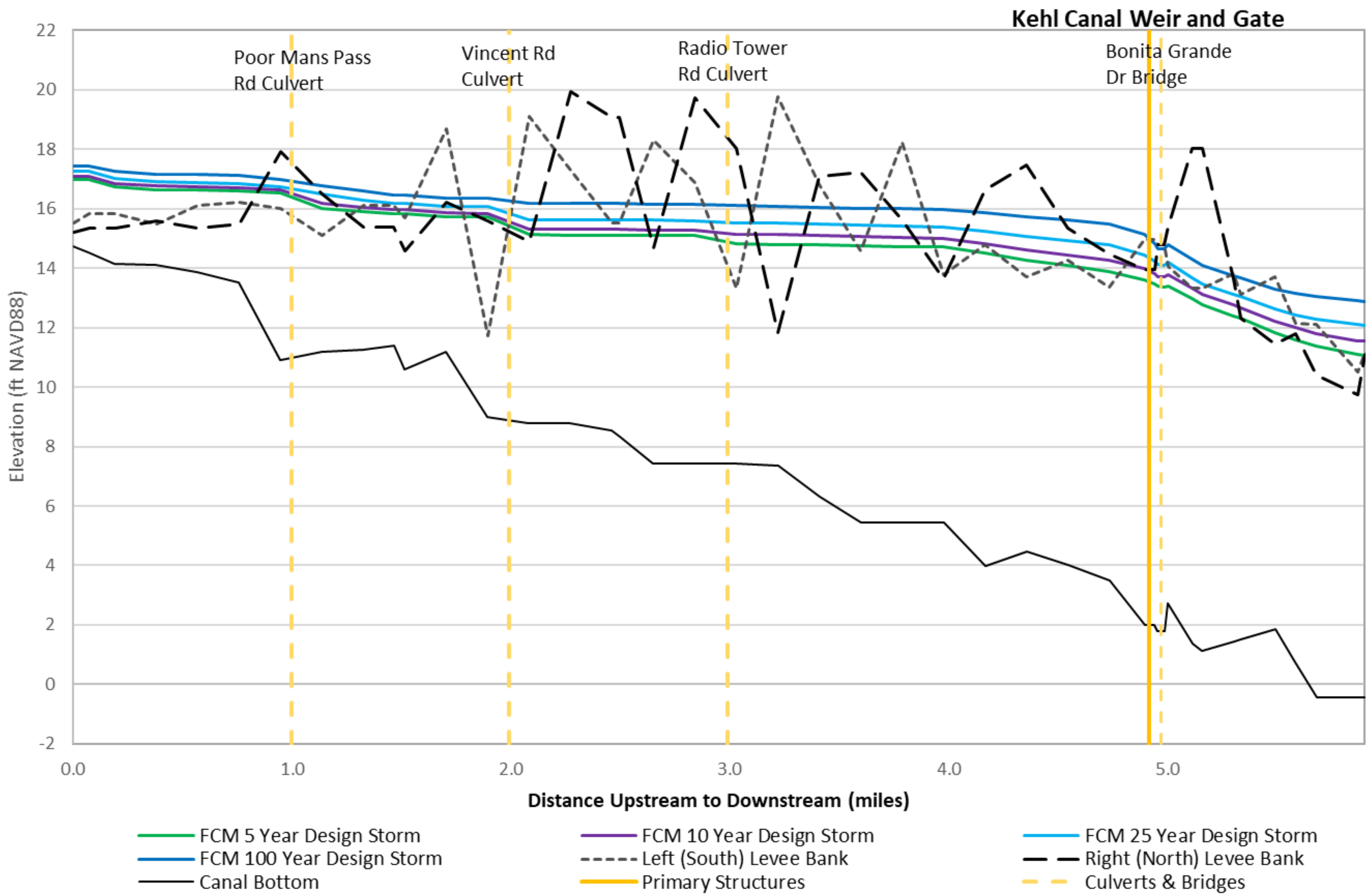

Figure 4-4. FCM Simulated Maximum Water Surface Elevation for the Kehl Canal.

The Cocohatchee canal (Figure 4-5.) flows through highly urbanized areas including residential and commercial land uses. Simulated maximum water surface elevations from all future conditions storm events (100-yr, 25-yr, 10-yr, and 5-yr design events) exceed portions of the right bank between mile 6 and 8, upstream of COCO3, which is a wetland area that discharges to the Cocohatchee Canal. Other simulated maximum water surface elevations from the 25-yr and 100-yr design events that exceed the right bank near the COCO4 structure are in rural residential and single family residential areas. Downstream of COCO1, simulated maximum water surface elevations from all future conditions storm events (100-yr, 25-yr, 10-yr, and 5-yr design events) exceed the banks in the mangrove swamp land use areas. When compared with the existing conditions simulated results for the 100-year design event (**Appendix A**: Design Storm Stage Canal Profiles, FCM vs ECM), the maximum canal stages simulated in future conditions are higher than existing conditions (approximately 0.3, 0.5, 0.8, and 0.6 ft higher at COCO4, COCO3, COCO2, and COCO1 headwater respectively for the 100-year design event).

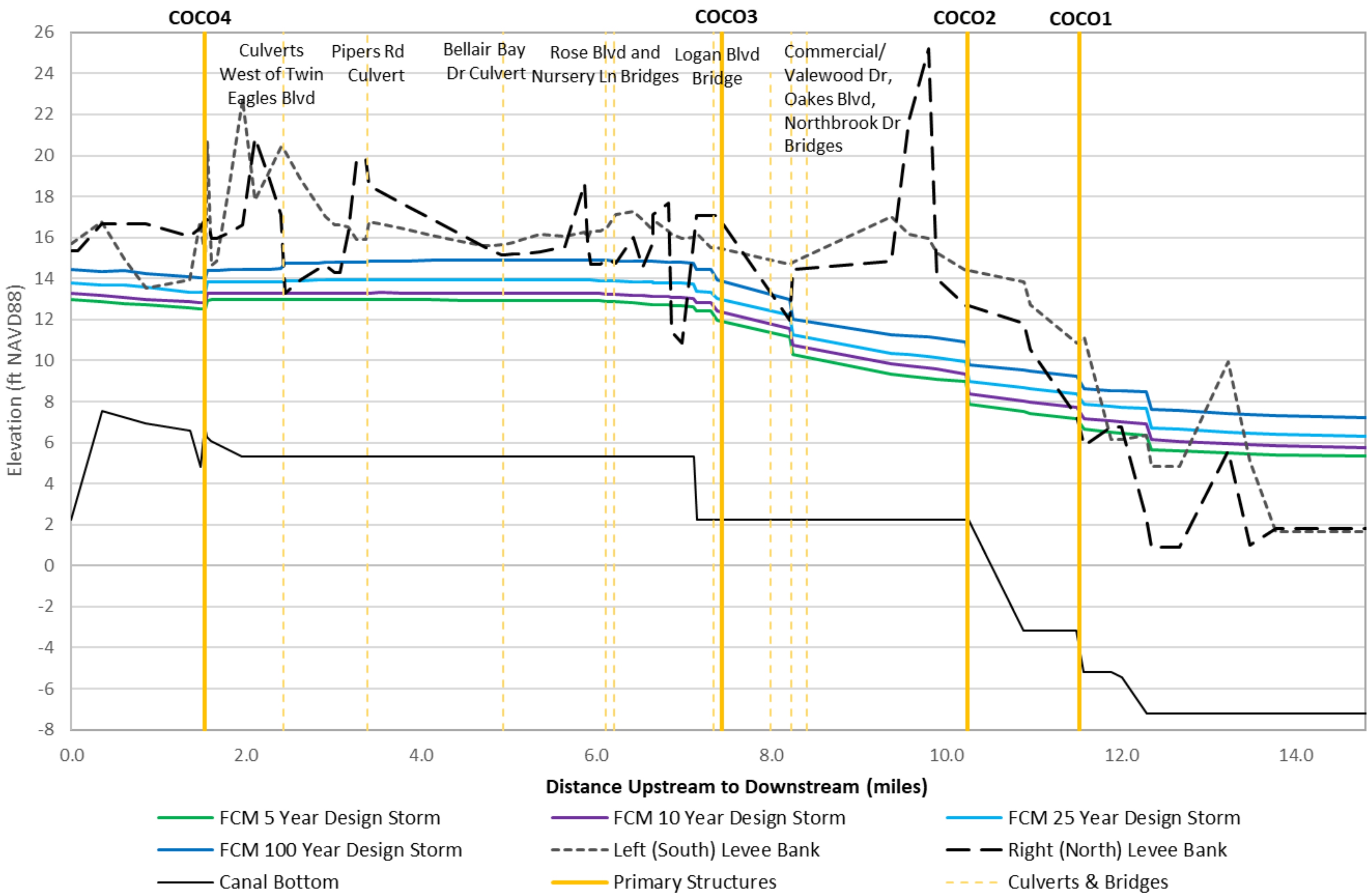

Figure 4-5. Simulated Maximum Water Surface Elevation for the Cocohatchee Canal.

4.2.2 Flow and Stage Hydrographs

The simulated flow and stage hydrographs resulting from the FCM design storm simulations are presented below. The results for each design storm are presented by structure. The following structures are presented in this section: Cork 3, Cork 2, Cork 1, Curry 1, COCO4, COCO3, COCO2, COCO1, the Kehl Canal Weir and Gate, CR951N, GG1, Miller Canal Bridge at I-75, and Bird Rookery North Bridge. **Appendix B**: Design Storm Simulation Stage and Flow Hydrographs, ECM vs FCM shows a comparison between the FCM and ECM for the plots below.

4.2.2.1 Cork 3

The results for the Cork 3 structure simulated flow and stage hydrographs with simulated gate levels for each design storm are presented in Figure 4-6 through Figure 4-9. The Cork3 structure simulated gate levels are open for the entire design storm simulation for all simulated design storms because the Cork 3 simulated headwater initial condition starts above the Cork 3 wet season optimal control elevation and does not recede below that level before the simulation ends.

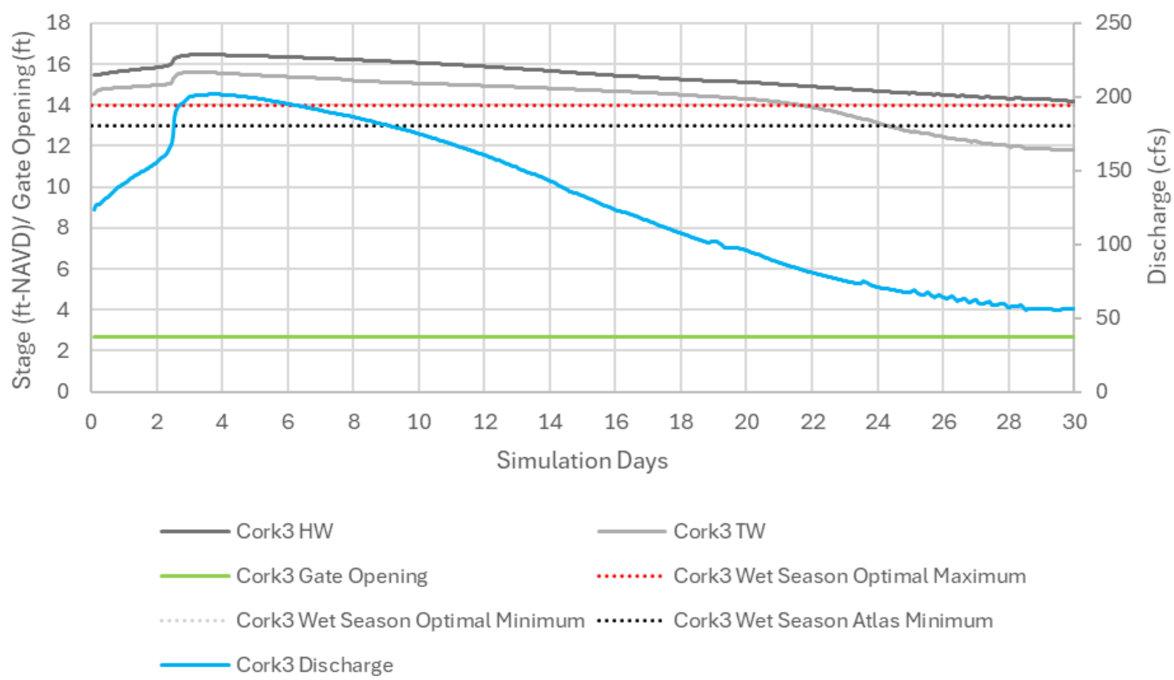

Figure 4-6. 5-year Design Storm Simulated Flow and Stage Hydrographs for Cork 3

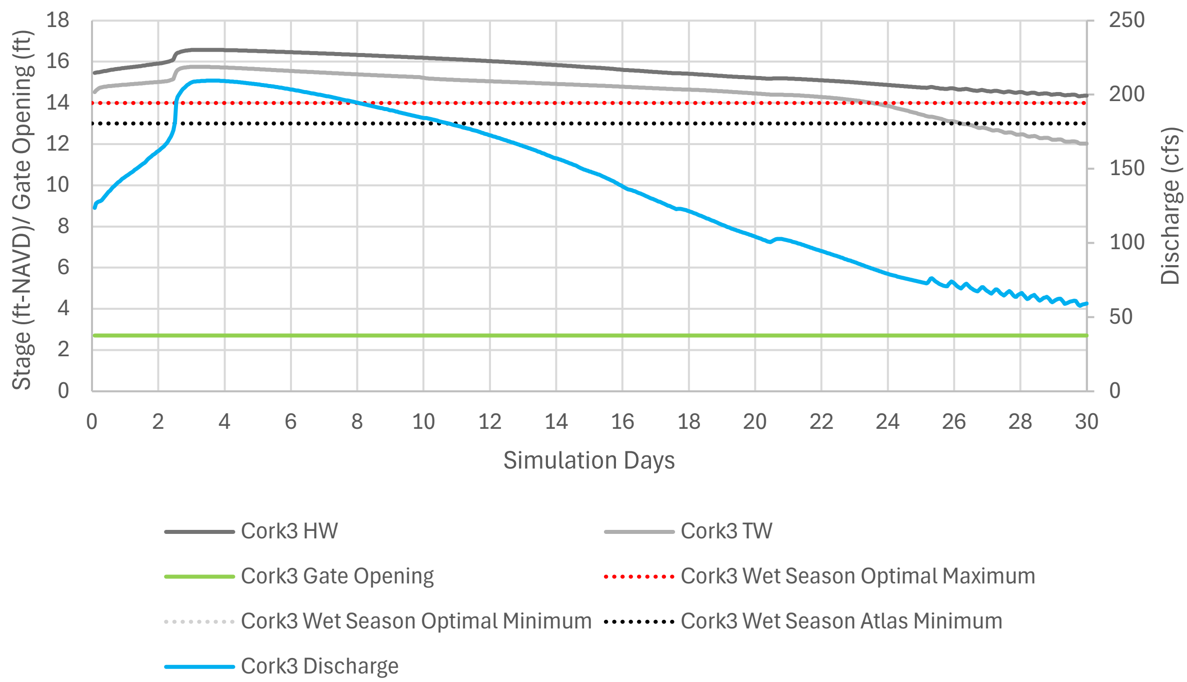

Figure 4-7. 10-year Design Storm Simulated Flow and Stage Hydrographs for Cork 3

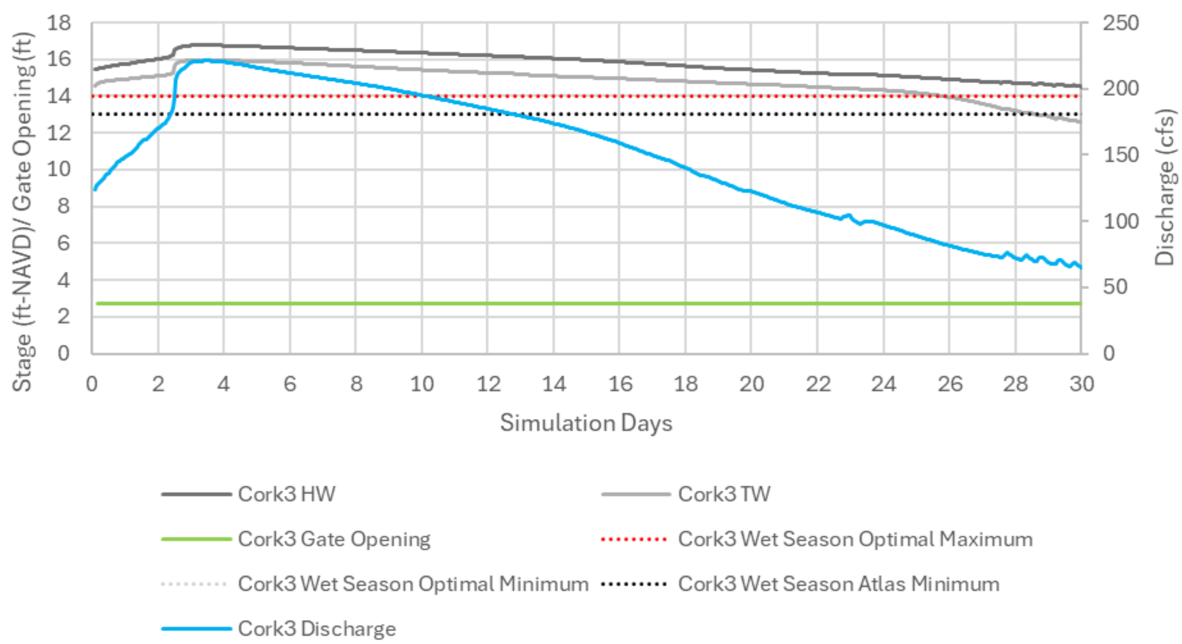

Figure 4-8. 25-year Design Storm Simulated Flow and Stage Hydrographs for Cork 3

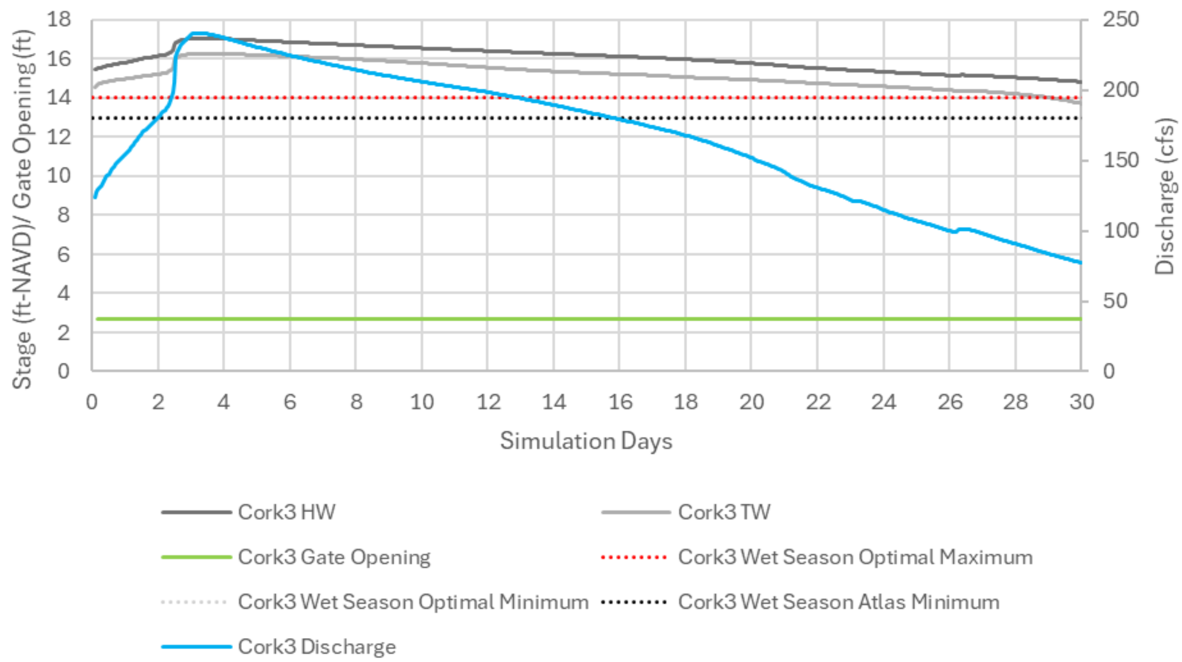

Figure 4-9. 100-year Design Storm Simulated Flow and Stage Hydrographs for Cork 3

4.2.2.2 Cork 2

The results for the Cork 2 structure simulated flow and stage hydrographs with simulated gate levels for each design storm are presented in Figure 4-10 through Figure 4-13. The Cork 2 structure simulated gate levels open fully at the beginning of the simulation and remain fully open until the simulated headwater levels reach the wet season optimal control elevation, at which time gates begin to close to maintain the headwater within the Cork 2 wet season optimal range.

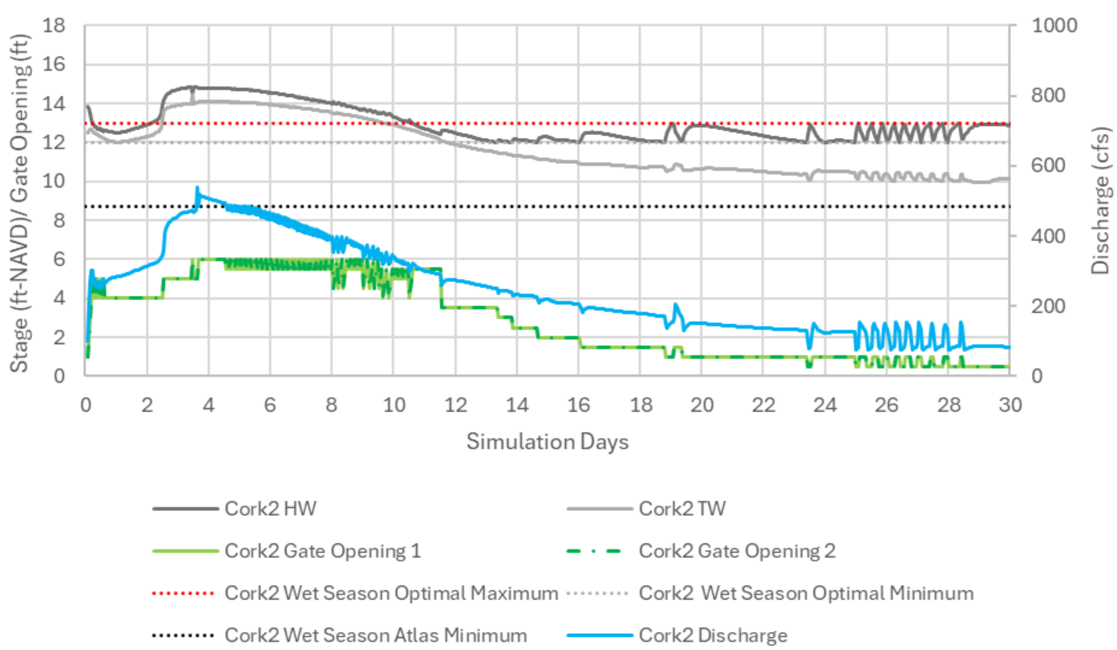

Figure 4-10. 5-year Design Storm Simulated Flow and Stage Hydrographs for Cork 2

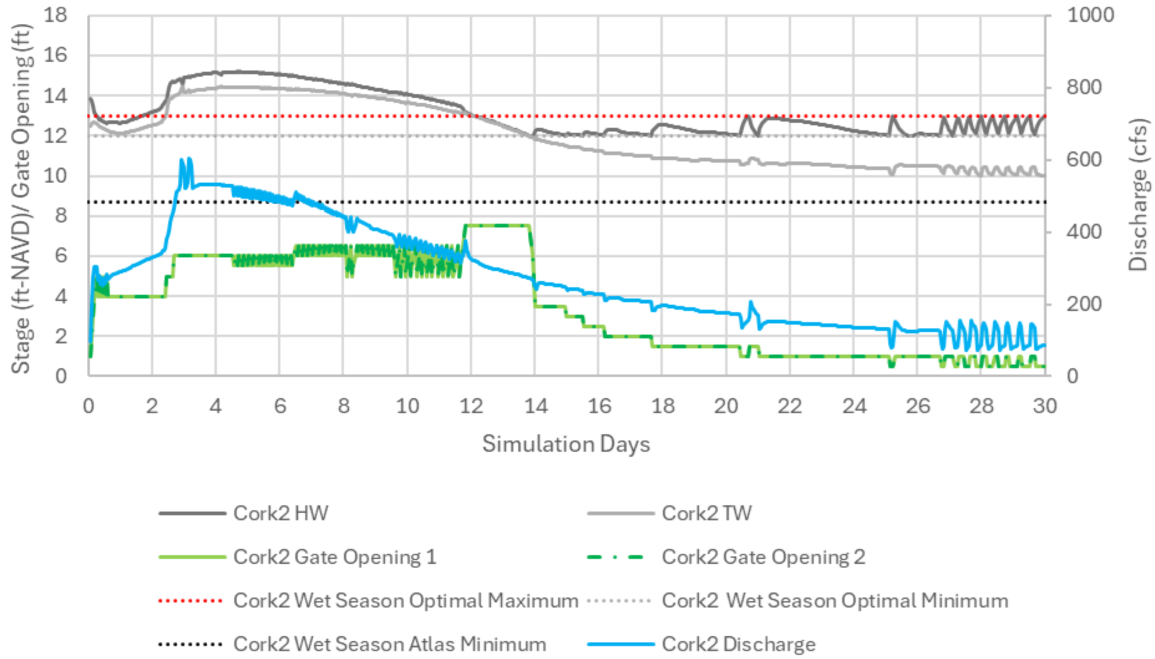

Figure 4-11. 10-year Design Storm Simulated Flow and Stage Hydrographs for Cork 2

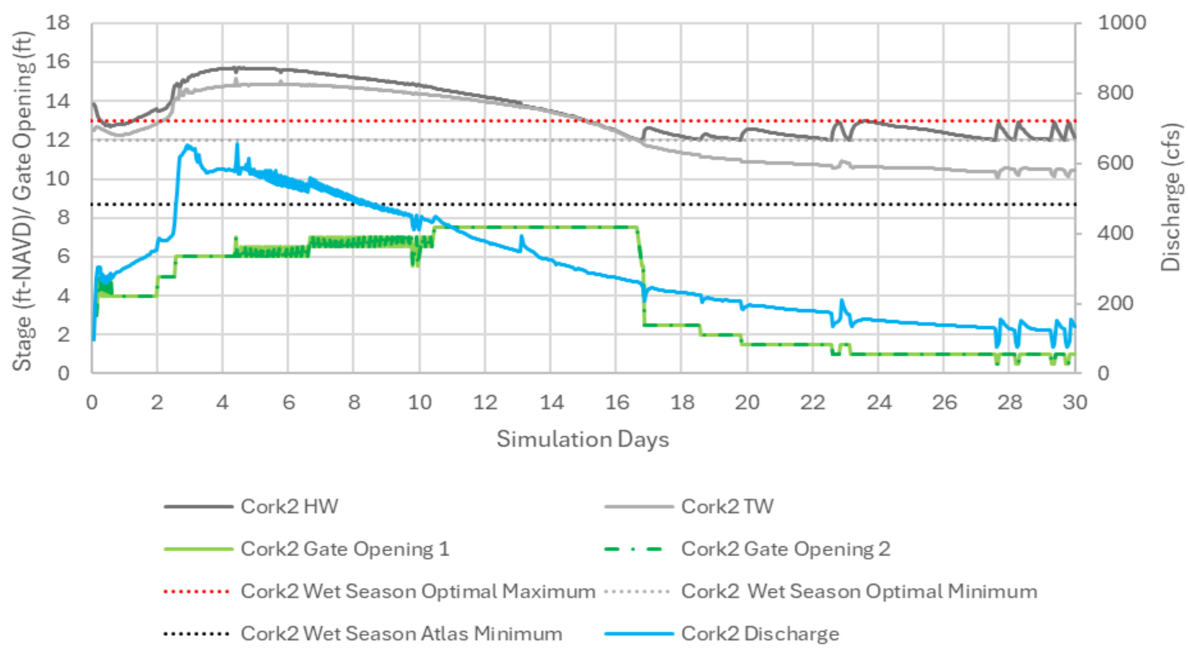

Figure 4-12. 25-year Design Storm Simulated Flow and Stage Hydrographs for Cork 2

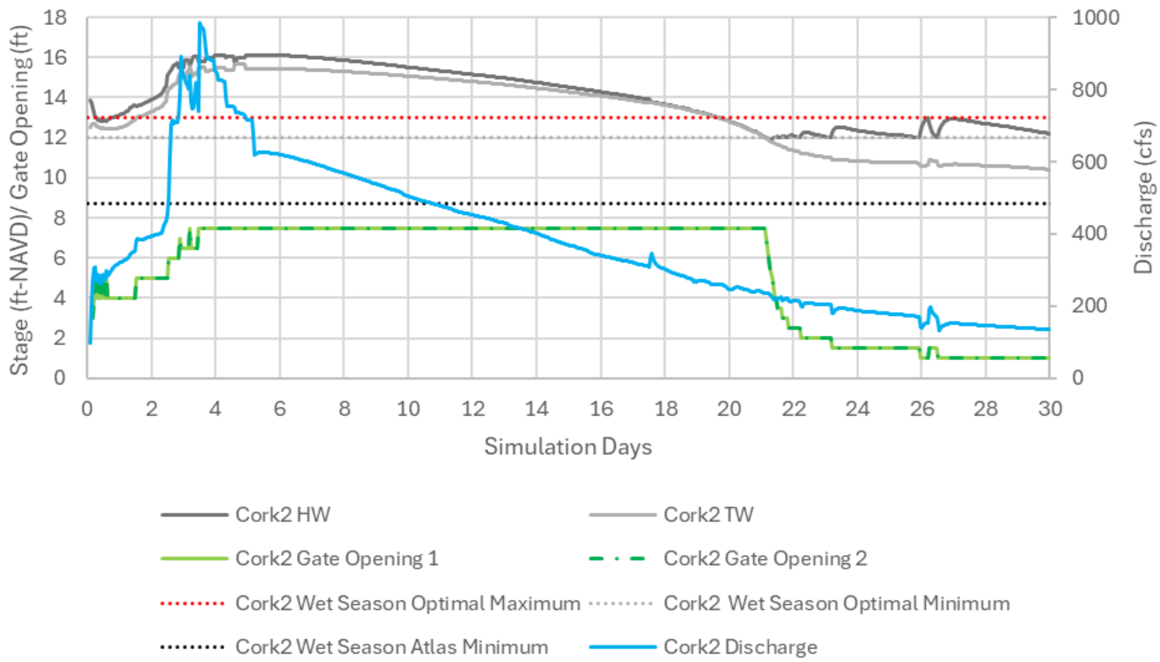

Figure 4-13. 100-year Design Storm Simulated Flow and Stage Hydrographs for Cork 2

4.2.2.3 Cork 1

The results for the Cork 1 structure simulated flow and stage hydrographs with simulated gate levels for each design storm are presented in Figure 4-14 through Figure 4-17. The Cork 1 structure simulated gate levels open fully at the beginning of the simulation and remain fully open until the simulated headwater levels reach the wet season optimal control elevation, at which time gates begin to close to maintain the headwater within the Cork 1 wet season optimal range. The sudden decrease in simulated discharge through the Cork 1 structure within the first 5 days of the simulation is correlated with the time at which the simulated gate levels at COCO4 structure, which discharges towards the Cork 1 structure, close because the COCO4 simulated tailwater is higher than the COCO4 simulated headwater in the wet season. The 100-year event shows a lower discharge peak than the 25-year event due to a higher tailwater level, but the flow volume is larger, taking longer to recede.

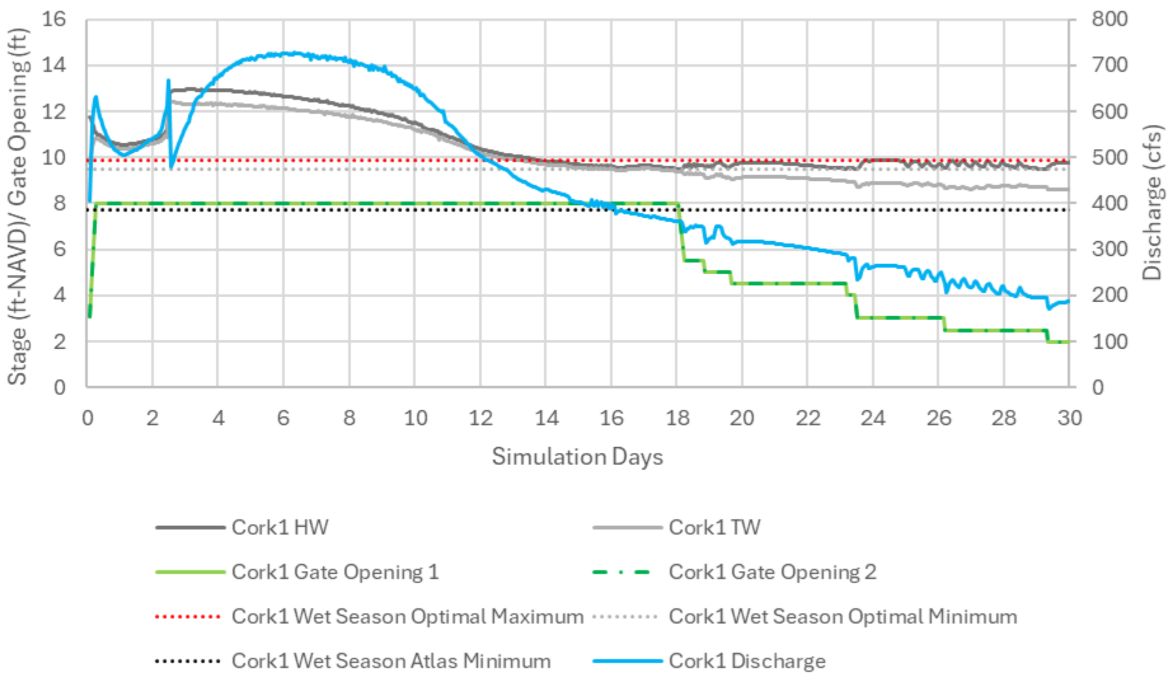

Figure 4-14. 5-year Design Storm Simulated Flow and Stage Hydrographs for Cork 1

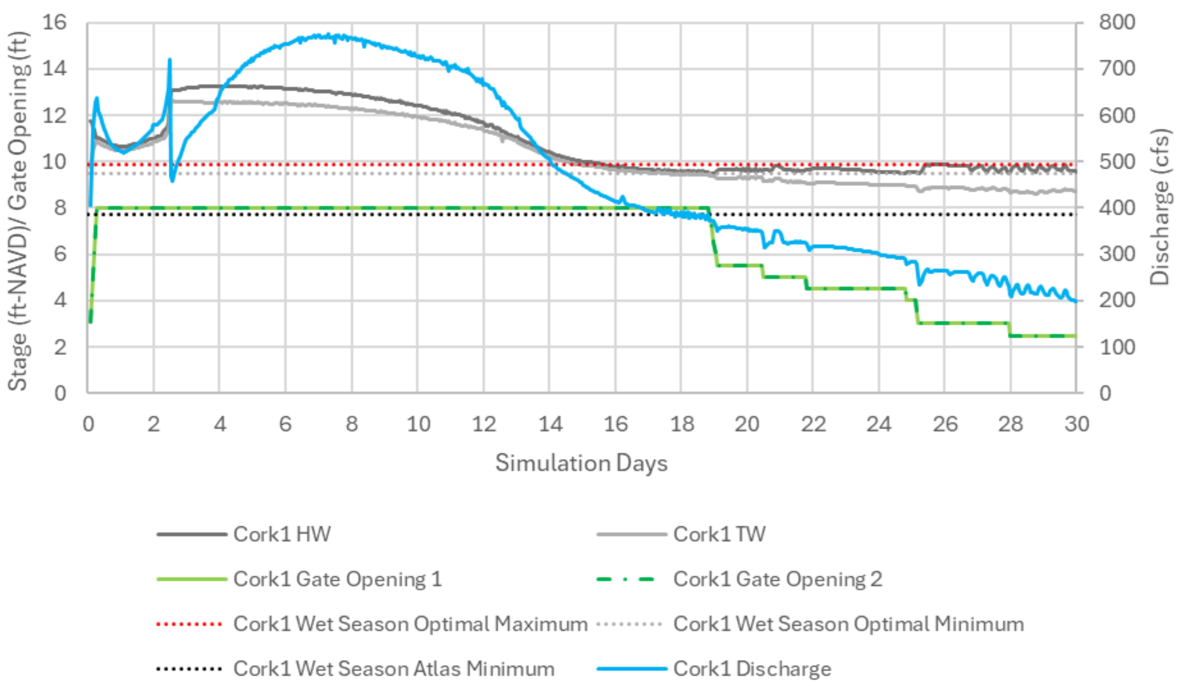

Figure 4-15. 10-year Design Storm Simulated Flow and Stage Hydrographs for Cork 1

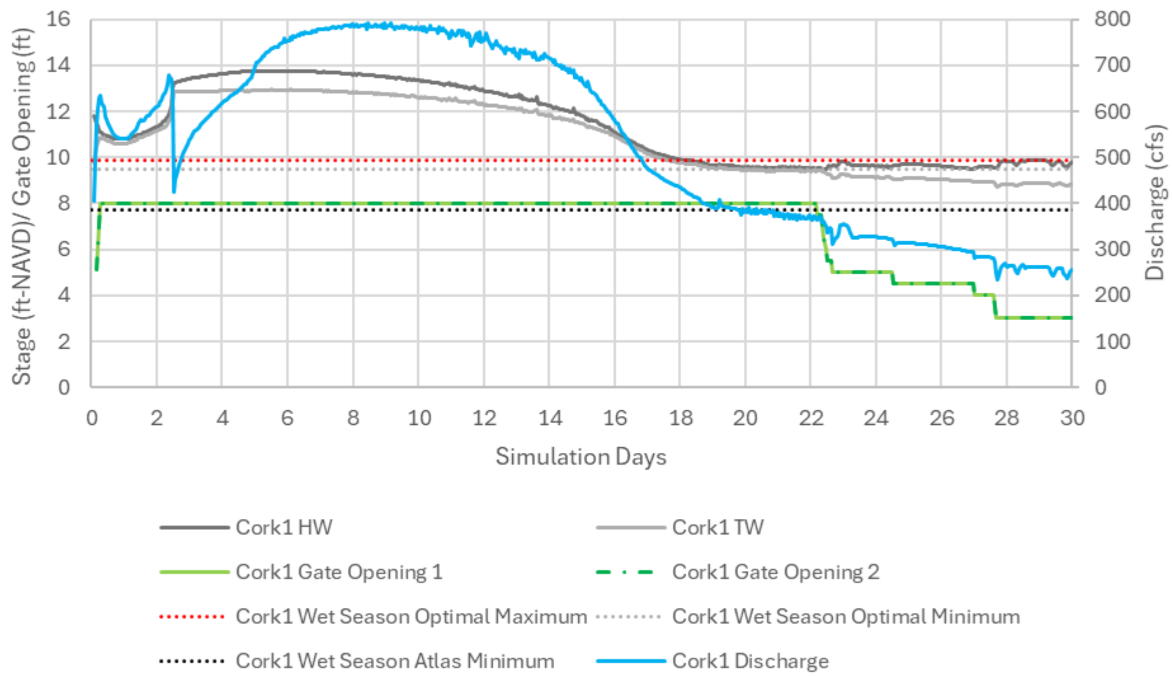

Figure 4-16. 25-year Design Storm Simulated Flow and Stage Hydrographs for Cork 1

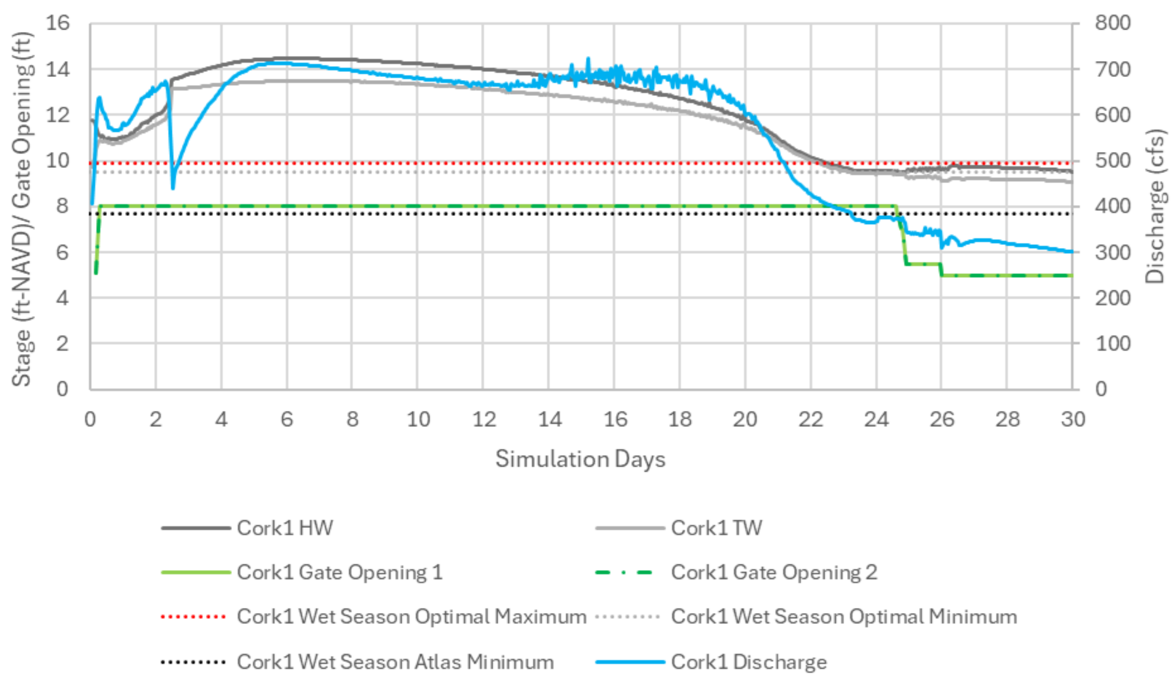

Figure 4-17. 100-year Design Storm Simulated Flow and Stage Hydrographs for Cork 1

4.2.2.4 Curry 1

The results for the Curry 1 structure simulated flow and stage hydrographs with simulated gate levels for each design storm are presented in Figure 4-18 through Figure 4-21. The Curry 1 structure simulated gate levels open fully at the beginning of the simulation and remain fully open until the simulated headwater levels reach the wet season optimal control elevation, at which time simulated gate levels vary to maintain the headwater within the Curry 1 wet season optimal range.

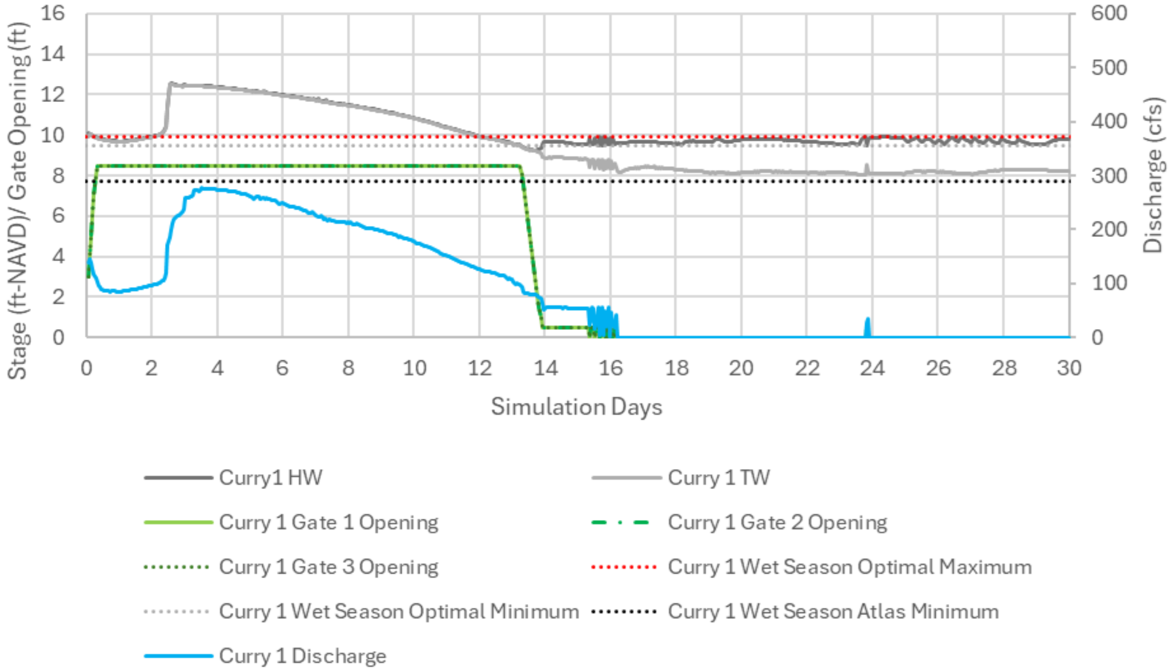

Figure 4-18. 5-year Design Storm Simulated Flow and Stage Hydrographs for Curry 1

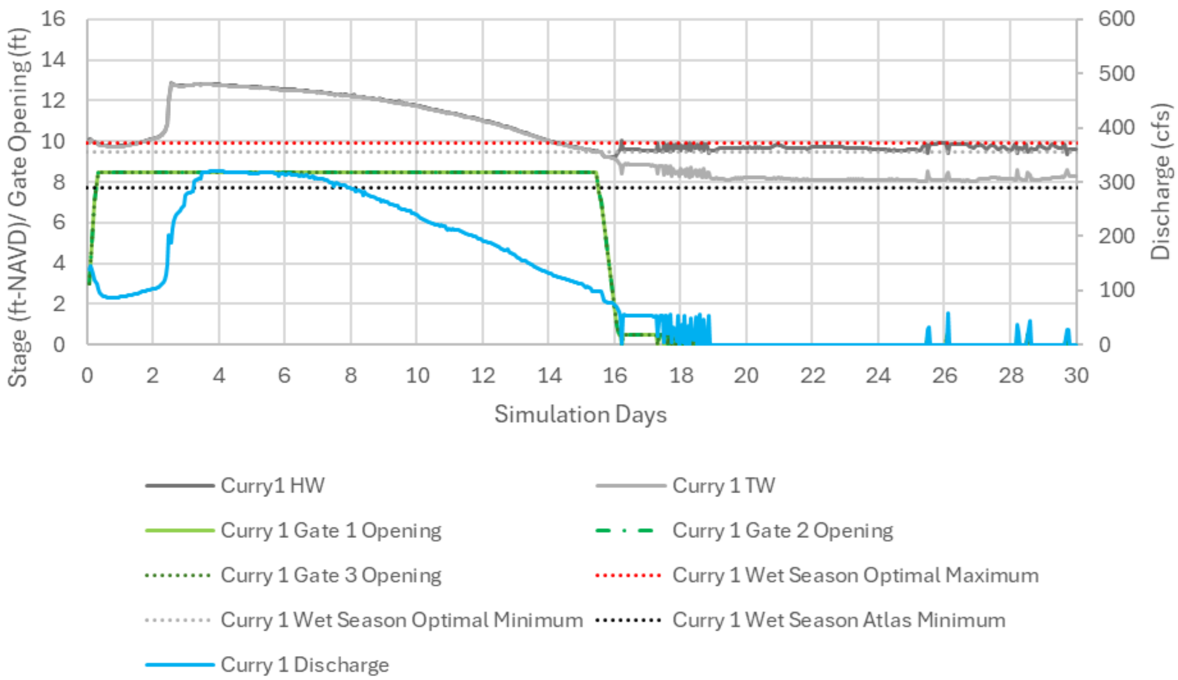

Figure 4-19. 10-year Design Storm Simulated Flow and Stage Hydrographs for Curry 1

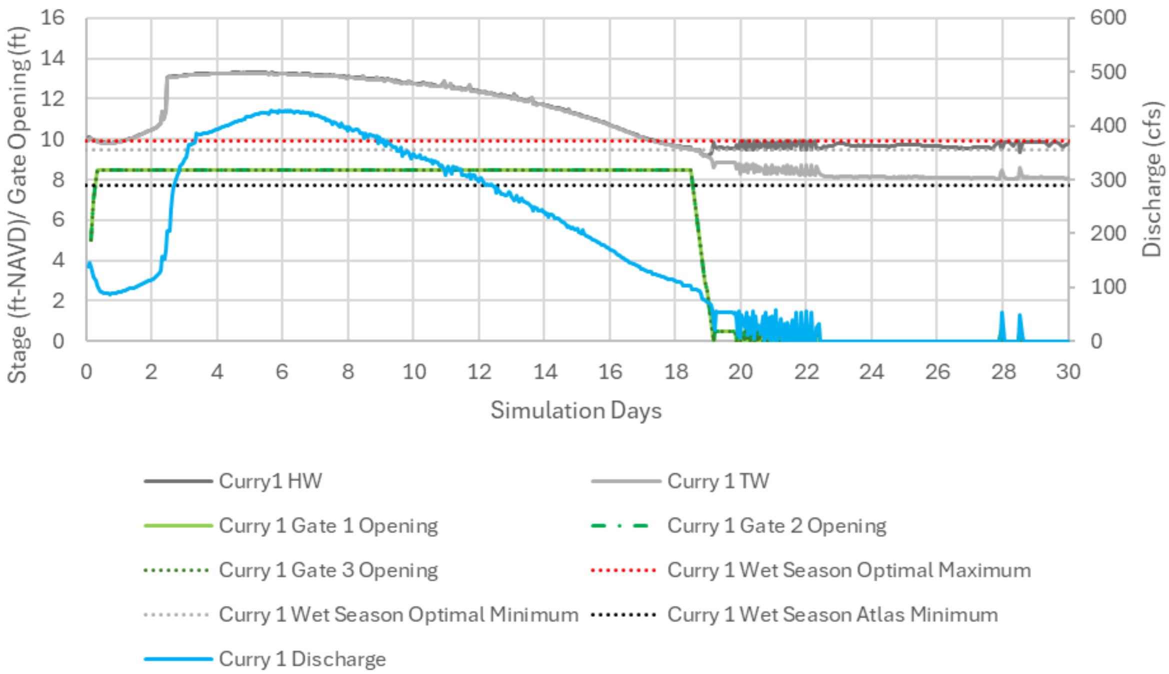

Figure 4-20. 25-year Design Storm Simulated Flow and Stage Hydrographs for Curry 1

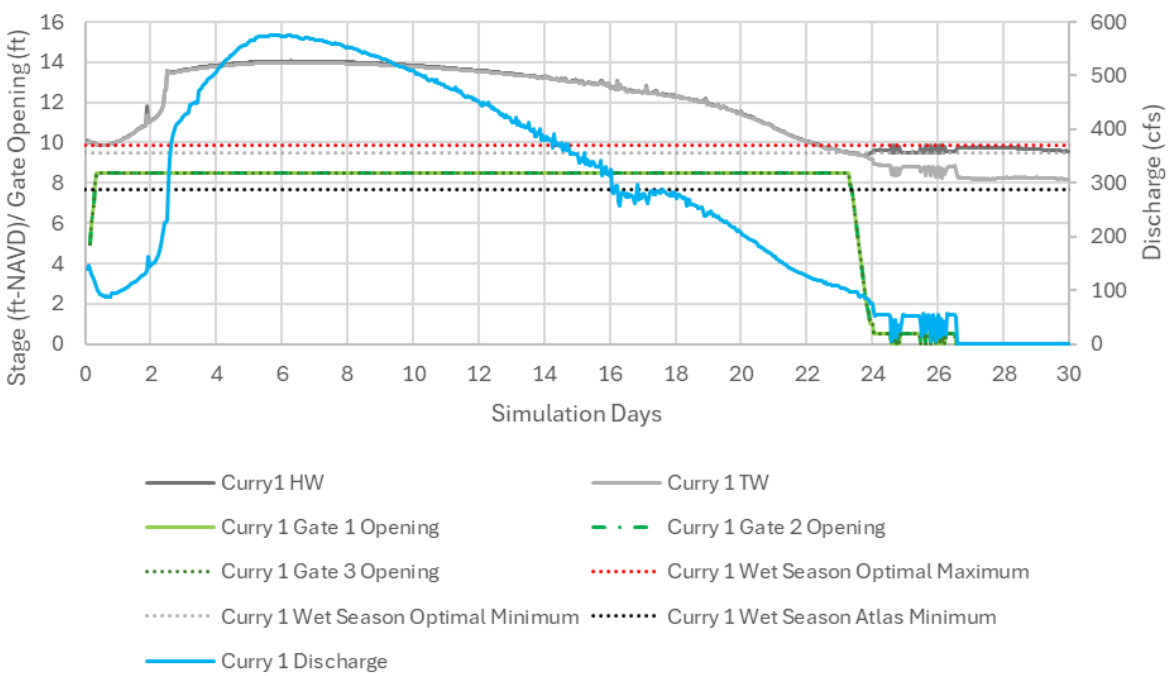

Figure 4-21. 100-year Design Storm Simulated Flow and Stage Hydrographs for Curry 1

4.2.2.5 COCO4

The results for the COCO4 structure simulated flow and stage hydrographs with simulated gate levels for each design storm are presented in Figure 4-22 through Figure 4-25. The COCO4 structure simulated gate levels open at the beginning of the simulation but close when simulated headwater levels drop below the wet season optimal minimum control elevation. The simulated gate levels close again before the peak to prevent reverse flow when the COCO4 simulated tailwater is higher than the COCO4 simulated headwater. Because the COCO4 structure is manually operated, the simulated levels are coded to only change every 6 hours. Therefore, the simulated gate levels take approximately 24 hours to fully open from closed level when opening 1 ft every 6 hours in storm conditions and take 48 hours to fully open from closed level when opening 0.5 ft every 6 hours outside of storm conditions.

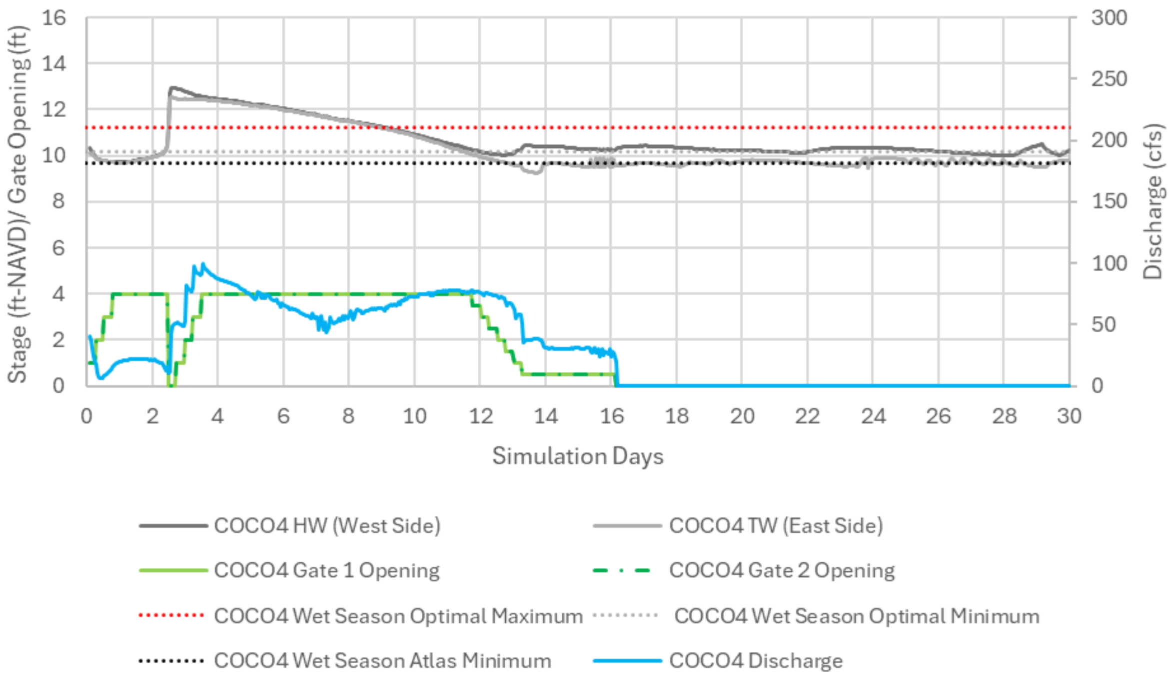

Figure 4-22. 5-year Design Storm Simulated Flow and Stage Hydrographs for COCO4

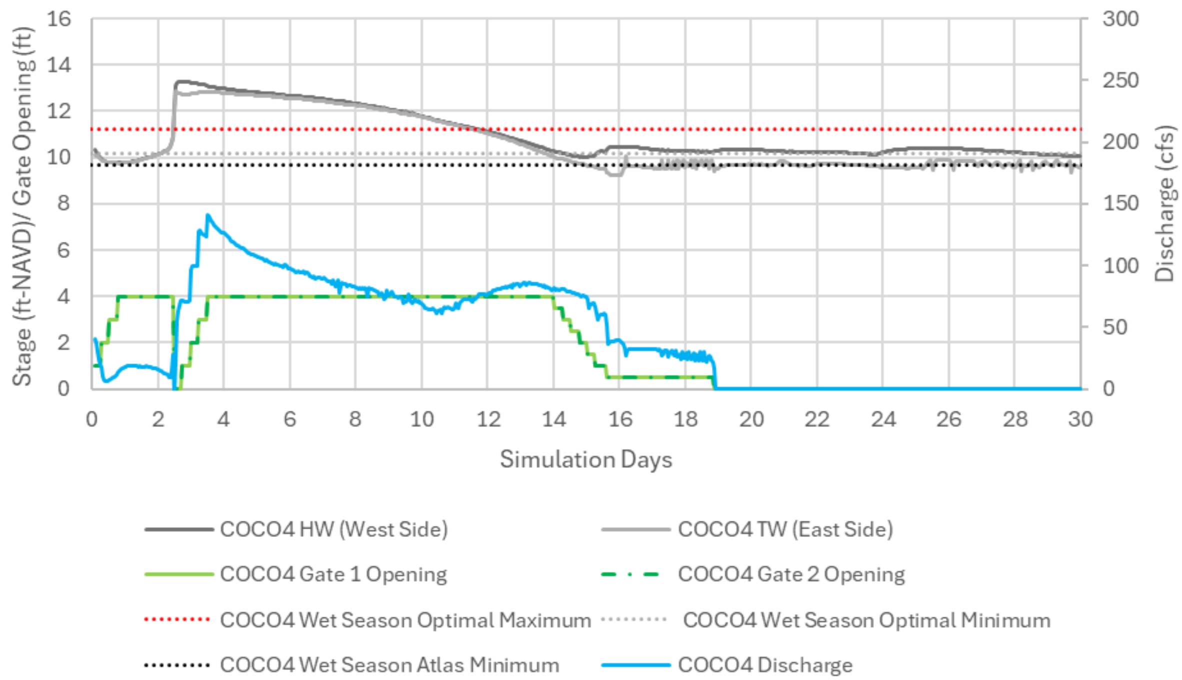

Figure 4-23. 10-year Design Storm Simulated Flow and Stage Hydrographs for COCO4

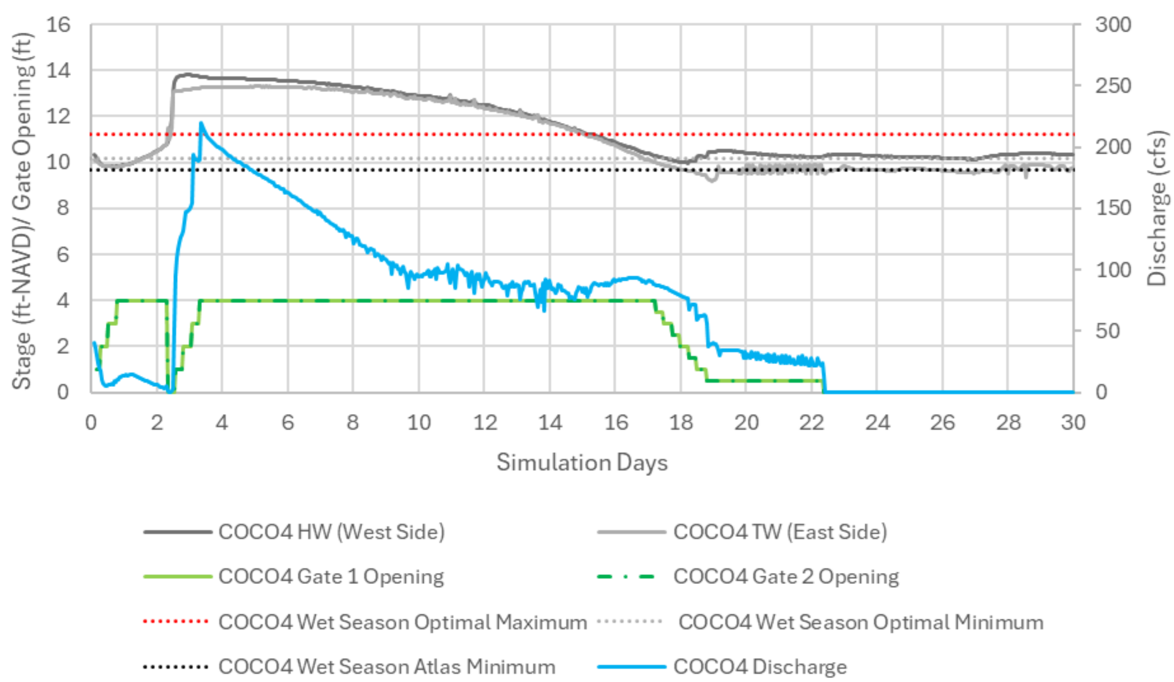

Figure 4-24. 25-year Design Storm Simulated Flow and Stage Hydrographs for COCO4

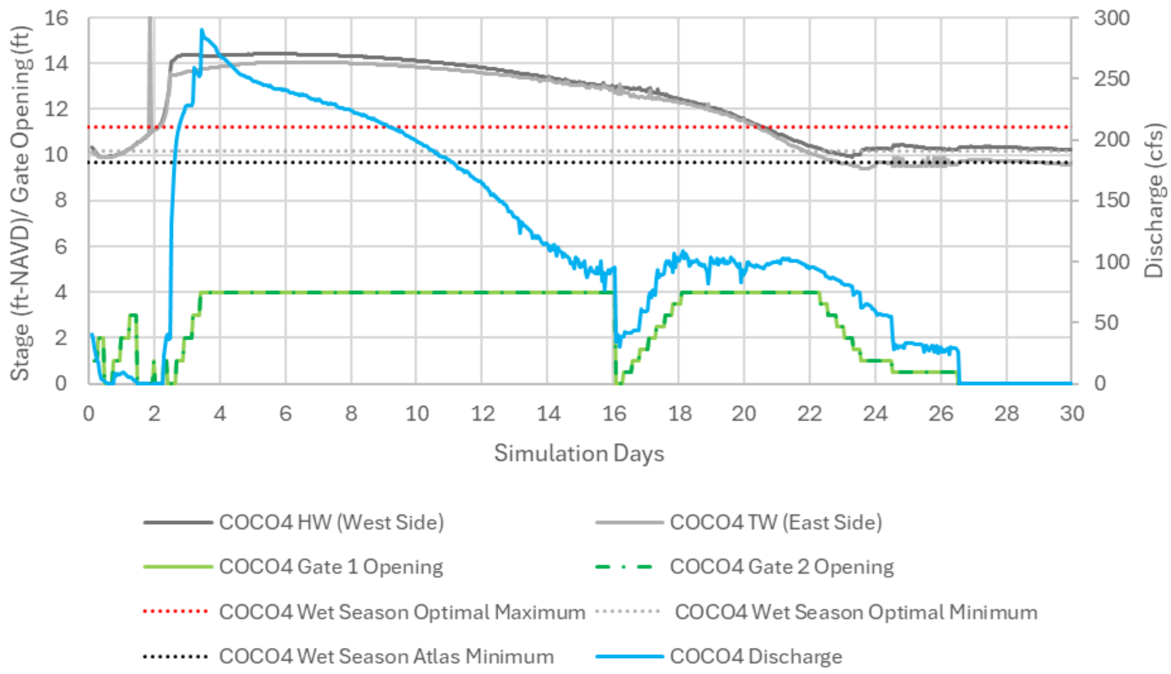

Figure 4-25. 100-year Design Storm Simulated Flow and Stage Hydrographs for COCO4

4.2.2.6 COCO3

The results for the COCO3 simulated flow and stage hydrographs with simulated gate levels structure for each design storm are presented in Figure 4-26 through Figure 4-29. The COCO3 structure simulated gate levels open fully at the beginning of the simulation and remain fully open until the simulated headwater levels reach the wet season optimal control elevation, at which time gates begin to close to maintain the headwater within the COCO3 wet season optimal range.

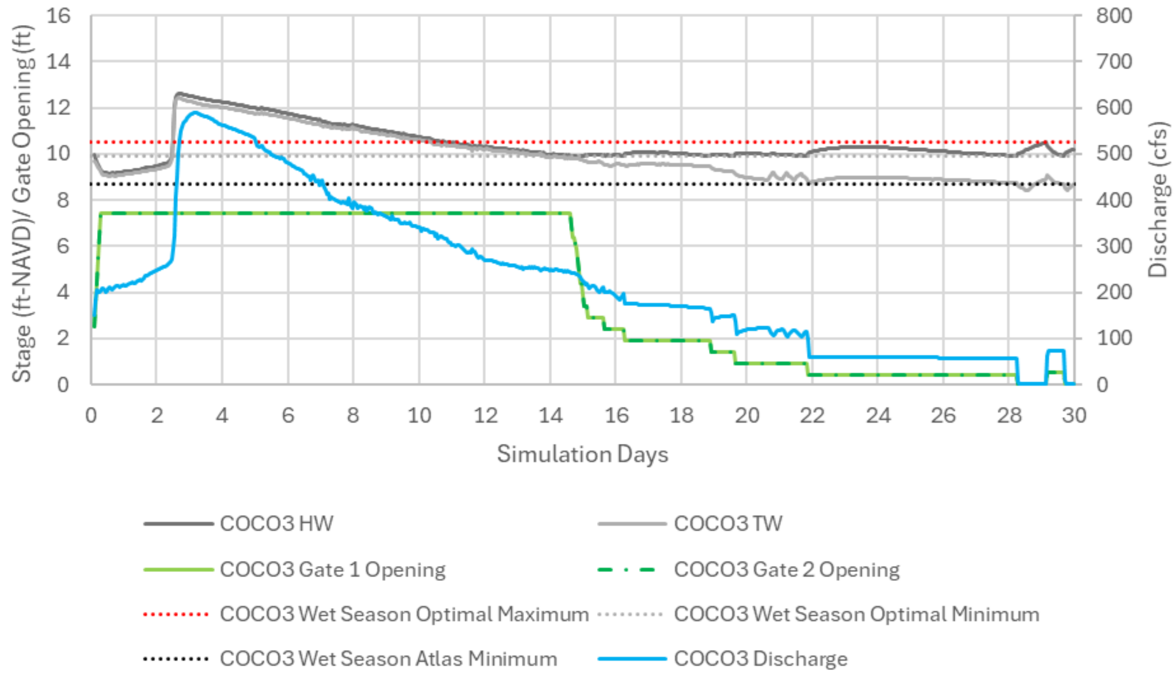

Figure 4-26. 5-year Design Storm Simulated Flow and Stage Hydrographs for COCO3

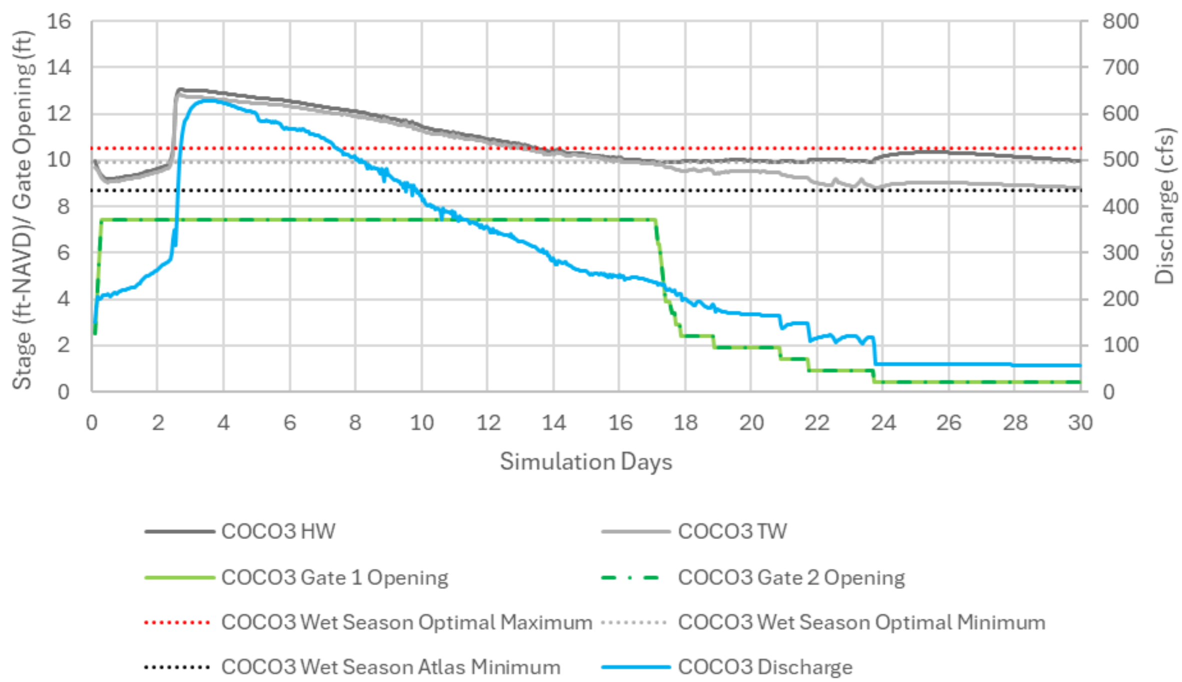

Figure 4-27. 10-year Design Storm Simulated Flow and Stage Hydrographs for COCO3

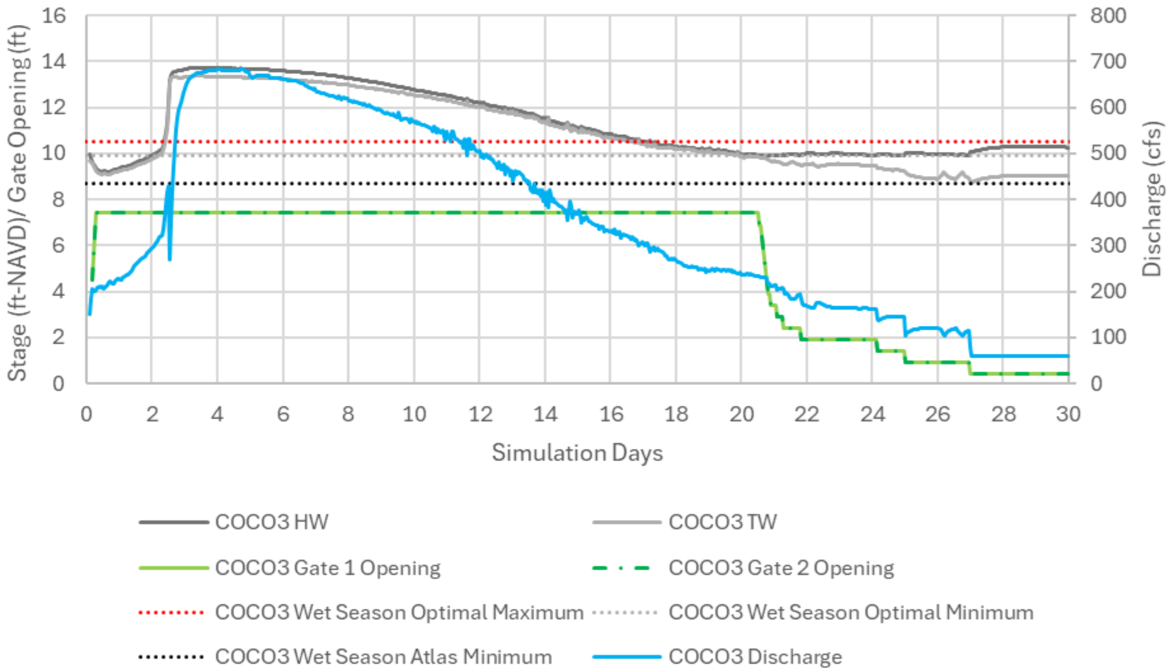

Figure 4-28. 25-year Design Storm Simulated Flow and Stage Hydrographs for COCO3

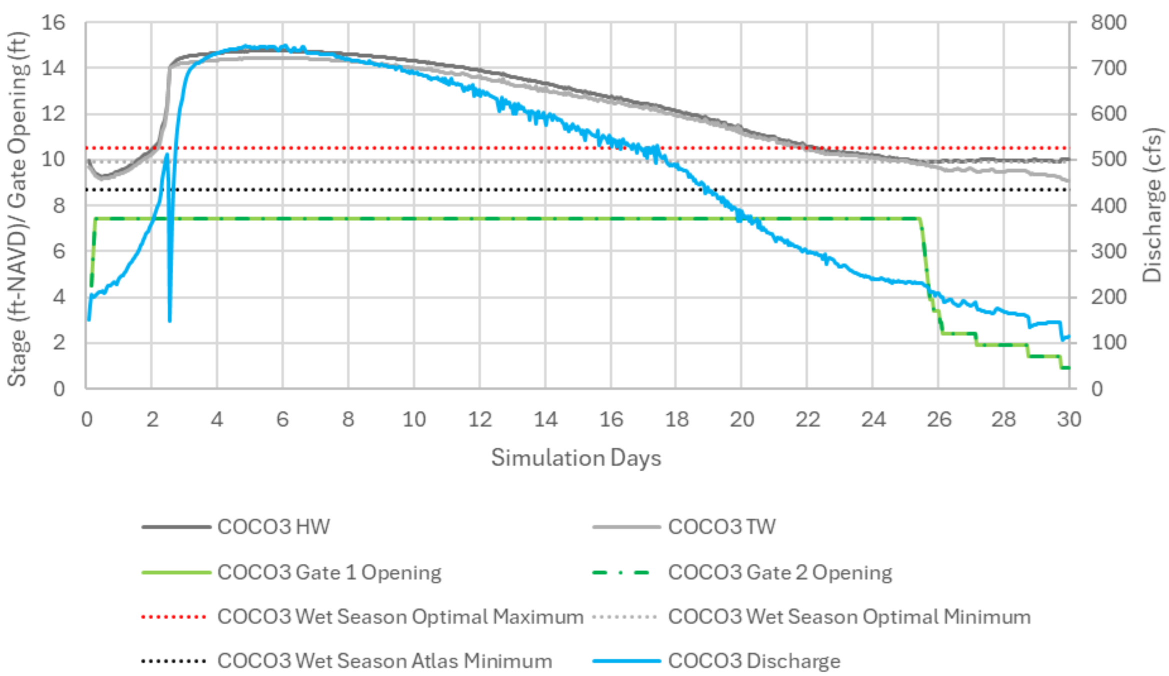

Figure 4-29. 100-year Design Storm Simulated Flow and Stage Hydrographs for COCO3

4.2.2.7 COCO2

The results for the COCO2 simulated flow and stage hydrographs with simulated gate levels structure for each design storm are presented in Figure 4-30 through Figure 4-33. The COCO2 structure simulated gate levels lower multiple times at the beginning of the simulations because the simulated headwater levels drop below the wet season optimal minimum control elevation at the COCO2 structure. A 1 ft gate opening at this structure results in a larger fluctuation in headwater stage and flow than upstream structures, COCO3 and COCO4, due to a larger difference in headwater and tailwater at this structure. The COCO2 structure is at a location where the modeled canal slope and water surface elevation slope increases (see Cocohatchee Canal profile in Figure 4-5.).

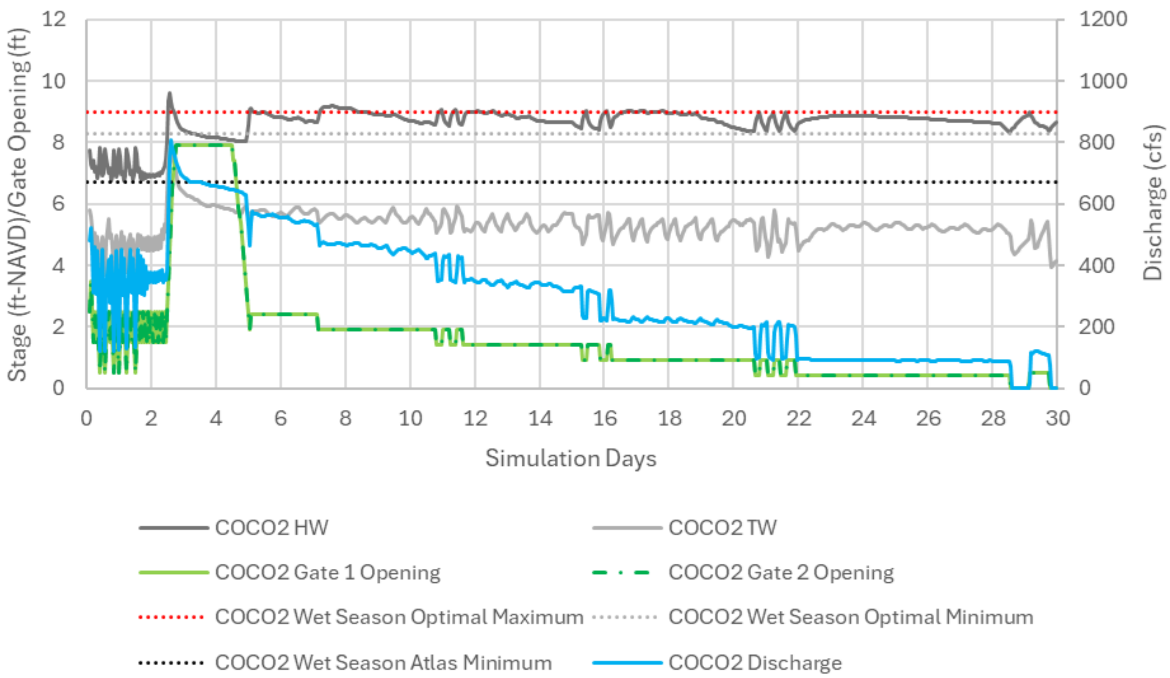

Figure 4-30. 5-year Design Storm Simulated Flow and Stage Hydrographs for COCO2

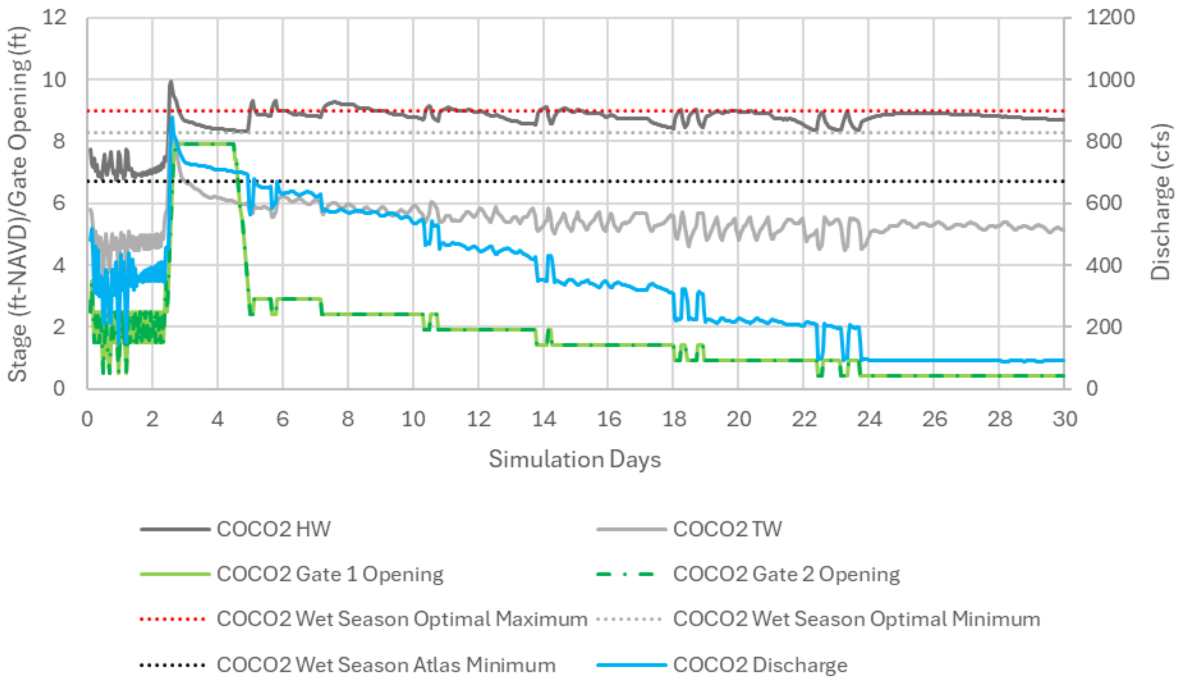

Figure 4-31. 10-year Design Storm Simulated Flow and Stage Hydrographs for COCO2

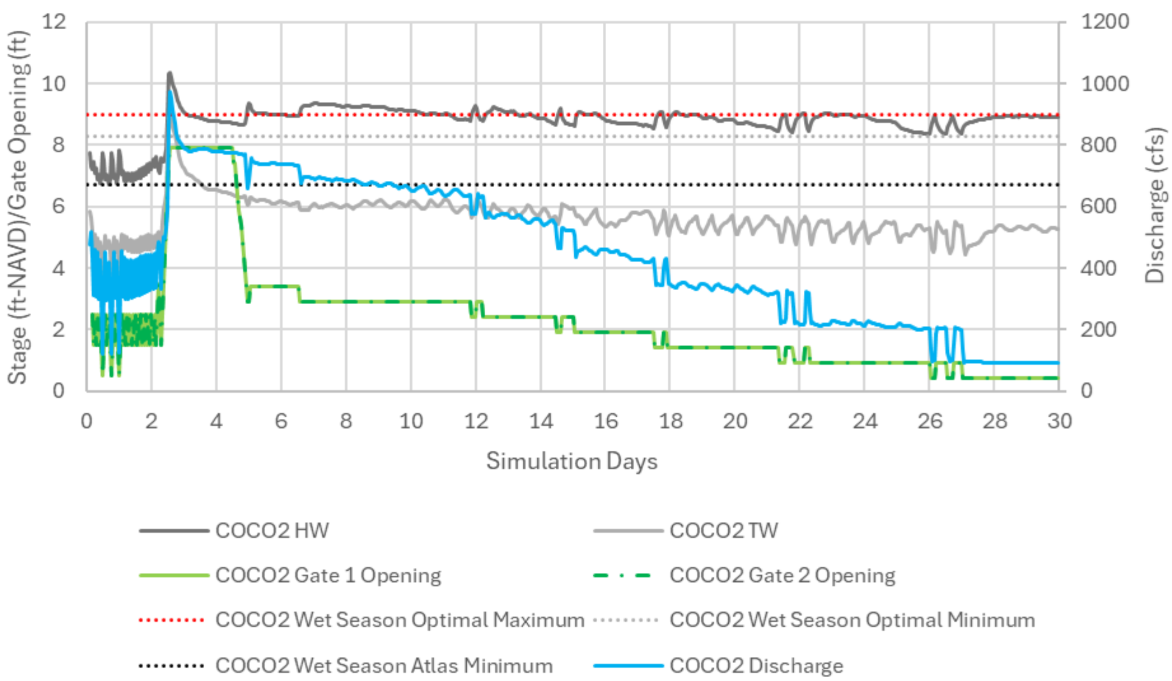

Figure 4-32. 25-year Design Storm Simulated Flow and Stage Hydrographs for COCO2

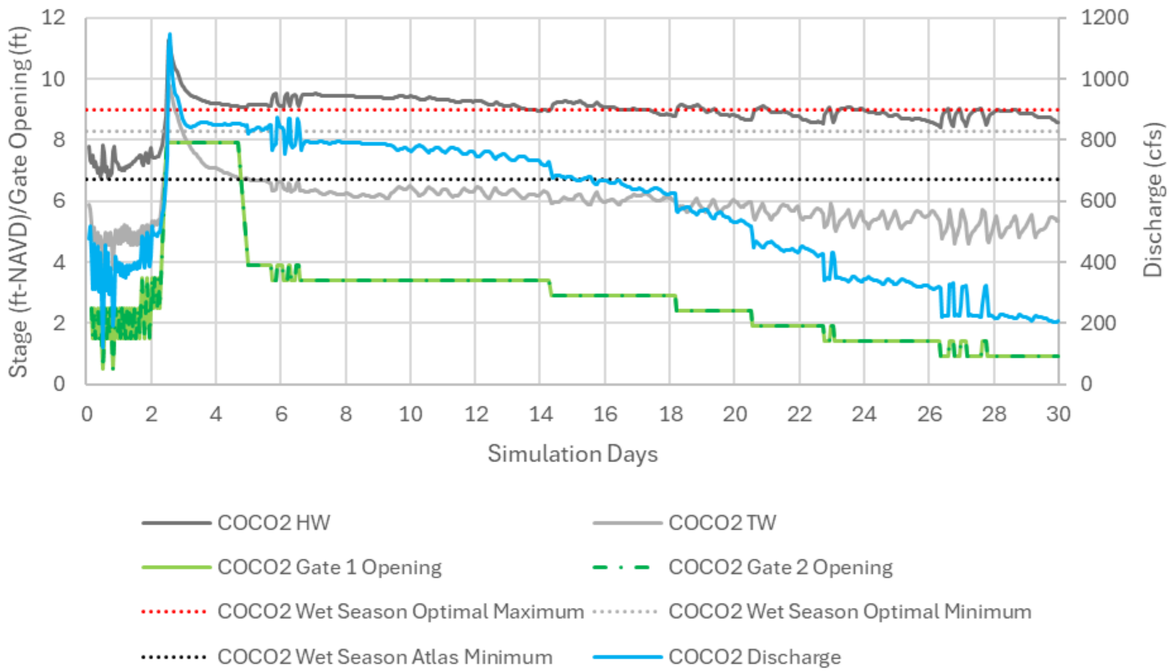

Figure 4-33. 100-year Design Storm Simulated Flow and Stage Hydrographs for COCO2

4.2.2.8 COCO1

The results for the COCO1 structure simulated flow and stage hydrographs with simulated gate levels for each design storm are presented in Figure 4-34 through Figure 4-37. The COCO1 structure simulated gate levels lower multiple times at the beginning of the simulations because the simulated headwater levels drop below the wet season optimal minimum control elevation at the COCO1 structure. A 1-ft gate opening at this structure results in a larger fluctuation in headwater stage and flow than upstream structures, COCO3 and COCO4, due to a larger difference in headwater and tailwater at this structure. The COCO1 tailwater is in the tidal portion of the Cocohatchee Canal.

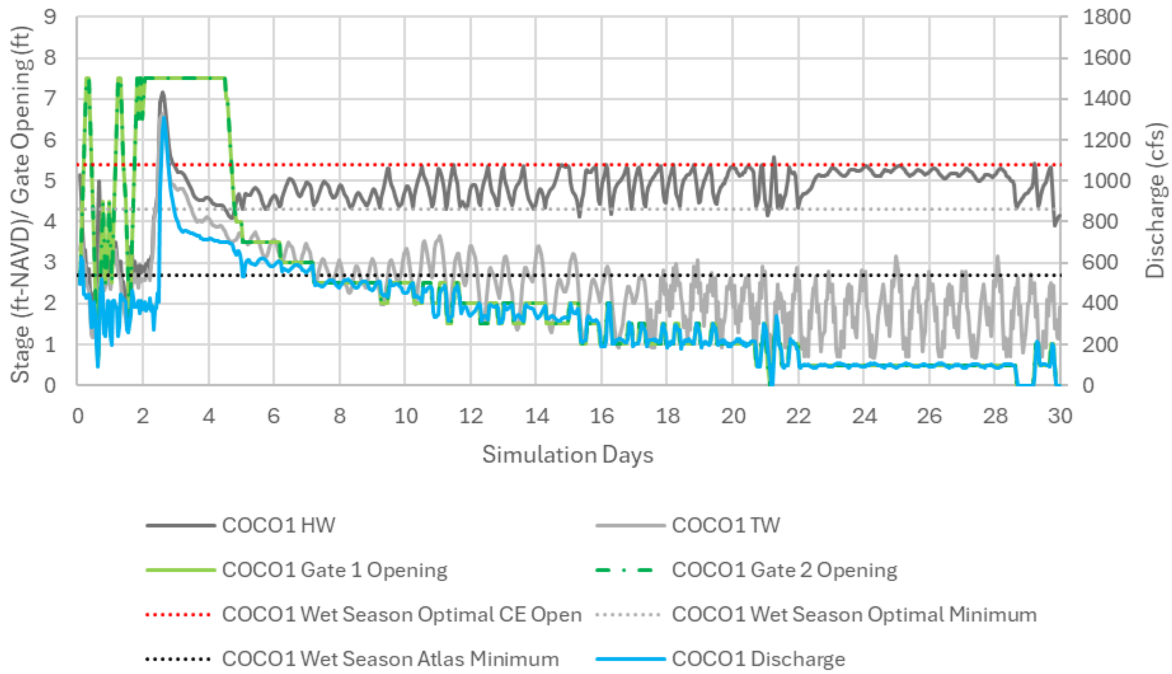

Figure 4-34. 5-year Design Storm Simulated Flow and Stage Hydrographs for COCO1

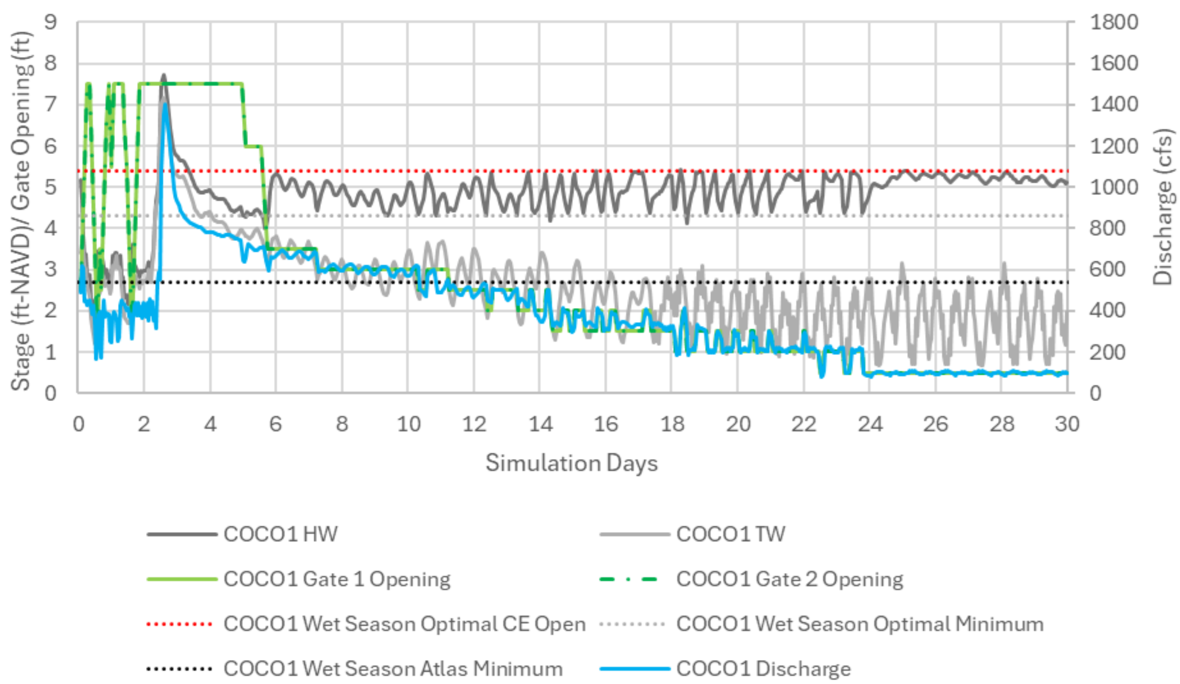

Figure 4-35. 10-year Design Storm Simulated Flow and Stage Hydrographs for COCO1

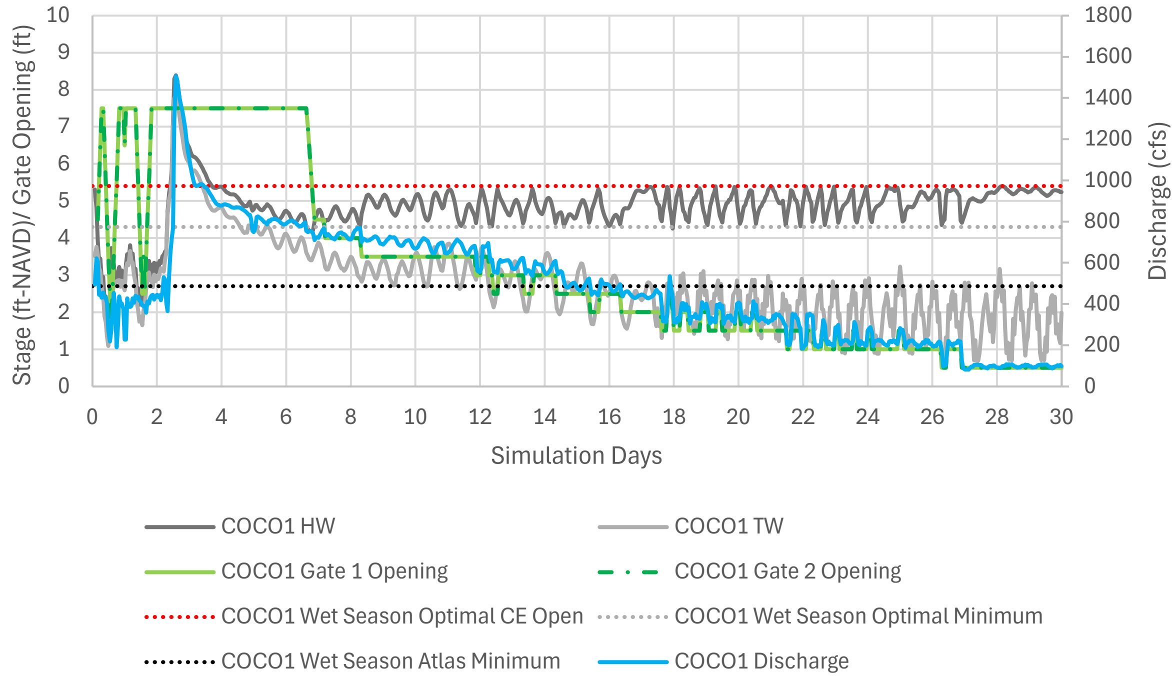

Figure 4-36. 25-year Design Storm Simulated Flow and Stage Hydrographs for COCO1

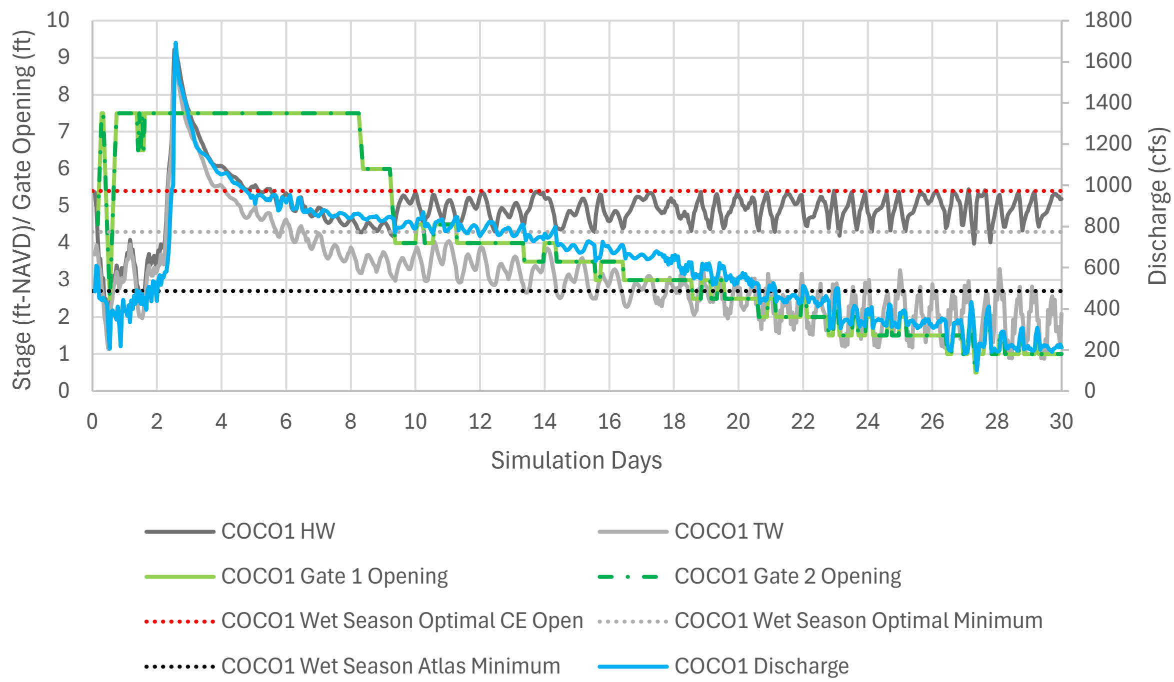

Figure 4-37. 100-year Design Storm Simulated Flow and Stage Hydrographs for COCO1

4.2.2.9 Kehl Canal Weir and Gates

The Kehl Canal Fixed Weir and Gated structure simulated flow and stage hydrographs and gate levels for each design storm are presented in Figure 4-38 through Figure 4-41. The Kehl Canal structure simulated gate levels open fully at the beginning of the simulation and remain fully open until the simulated headwater levels reach the fixed weir elevation of 8.65 ft NAVD, at which time simulated gate levels begin to close. The Kehl Canal Gate 3 does not start to open until Gate 1 and 2 are 1 ft less than fully open, as intended in the model coded rules.

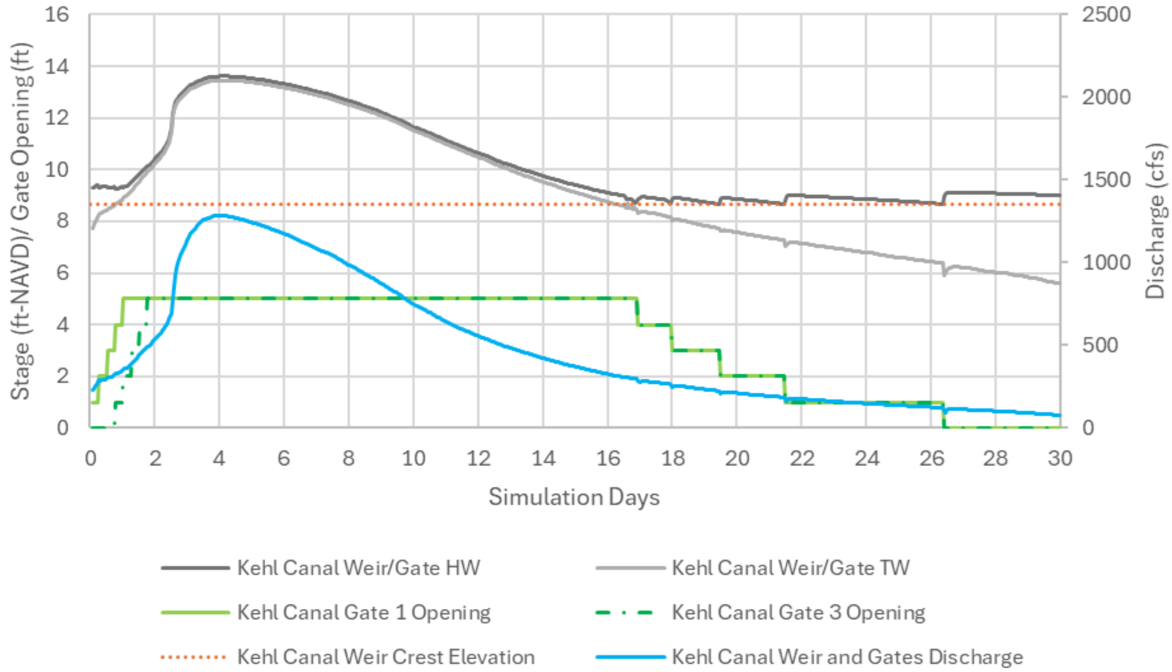

Figure 4-38. 5-year Design Storm Simulated Flow and Stage Hydrographs for Kehl Canal Weir and Gates

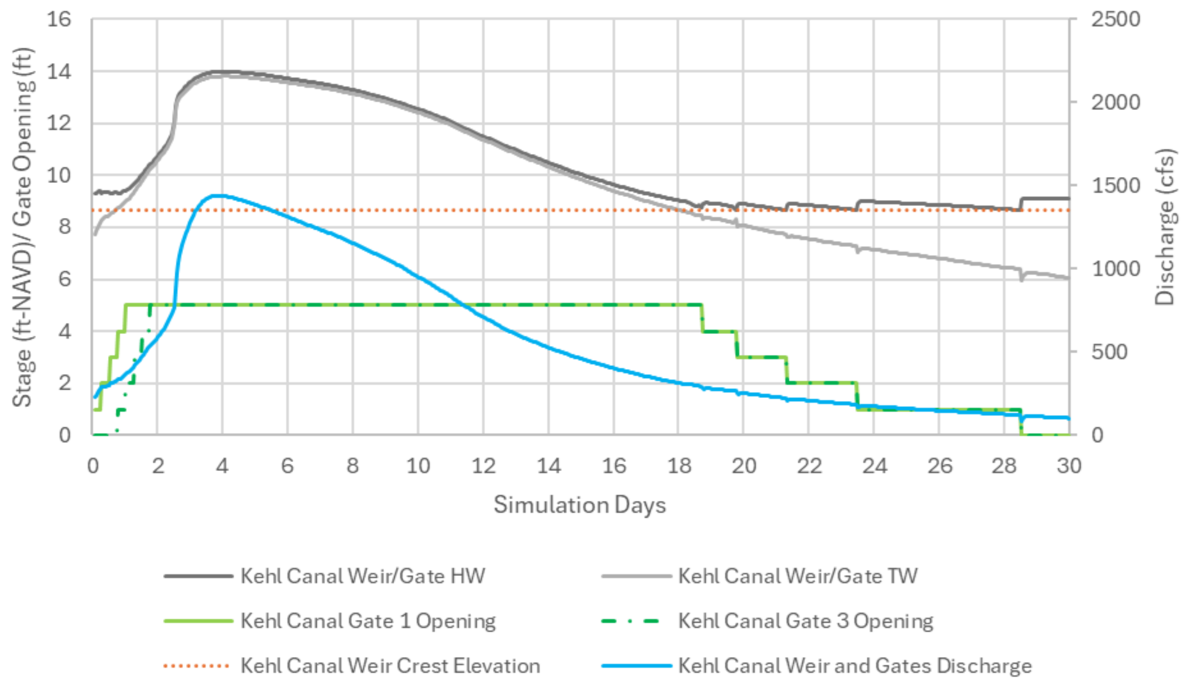

Figure 4-39. 10-year Design Storm Simulated Flow and Stage Hydrographs for Kehl Canal Weir and Gates

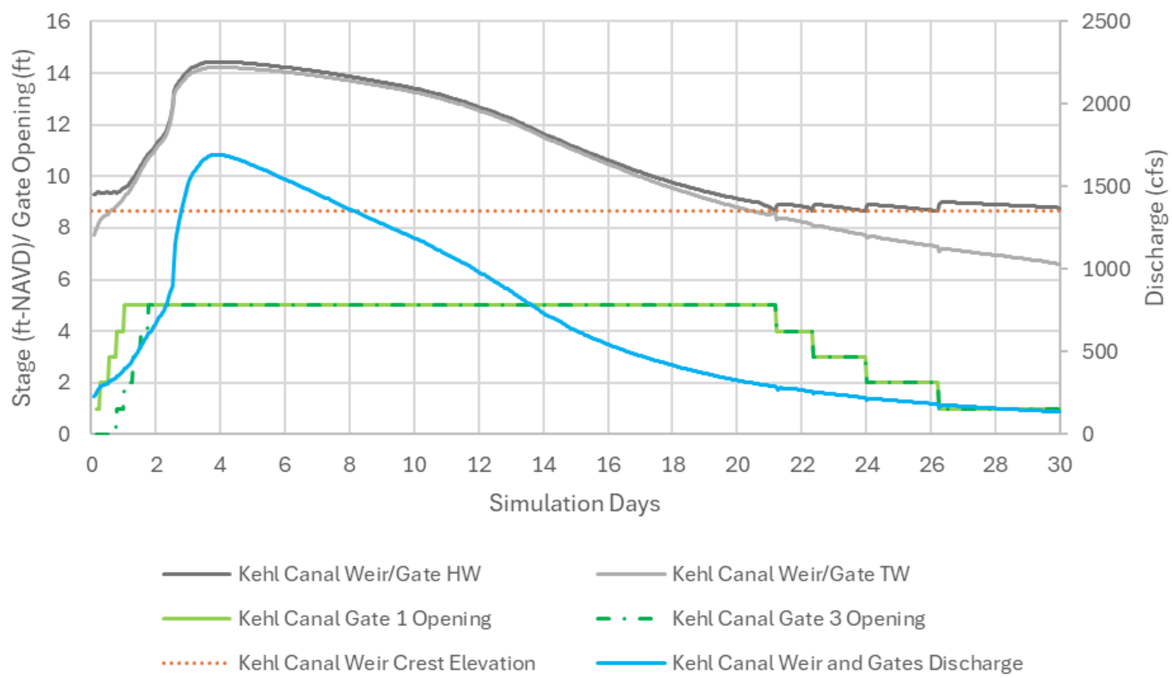

Figure 4-40. 25-year Design Storm Simulated Flow and Stage Hydrographs for Kehl Canal Weir and Gates

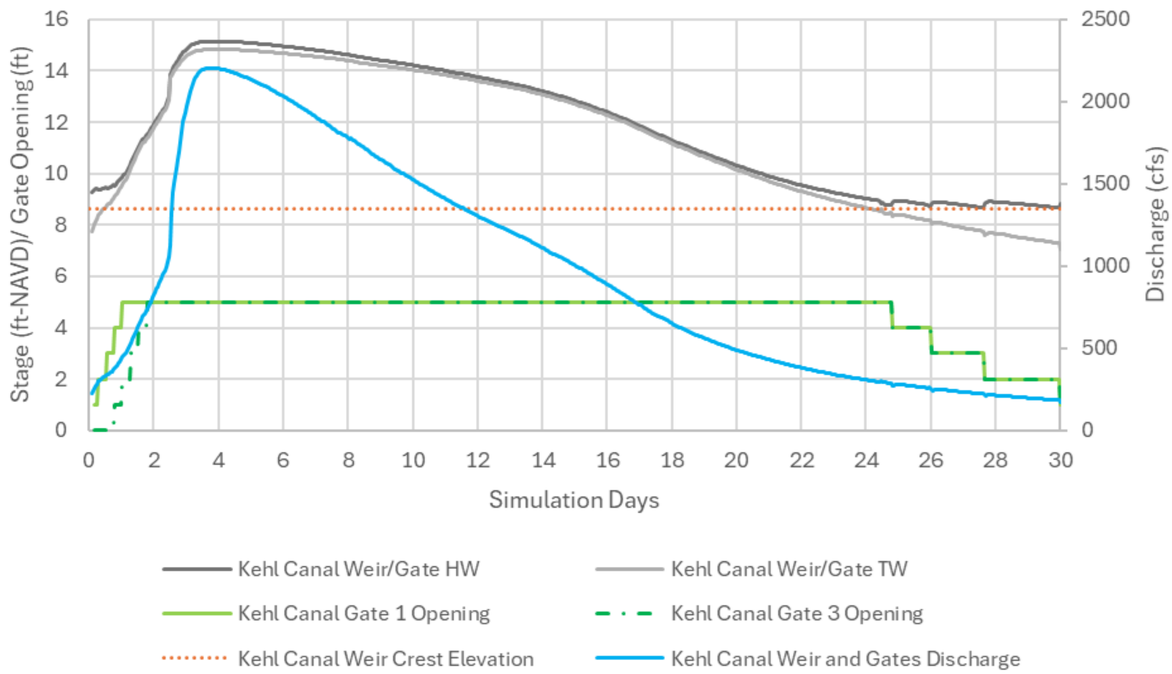

Figure 4-41. 100-year Design Storm Simulated Flow and Stage Hydrographs for Kehl Canal Weir and Gates

4.2.2.10 CR951N

The CR951N structure simulated flow and stage hydrographs and gate levels for each design storm are presented in Figure 4-42 through Figure 4-45. The CR951N structure simulated gate levels lower multiple times at the beginning of the simulations because the simulated headwater levels drop below the wet season optimal minimum control elevation at the CR951N structure. The CR951N structure has additional optimal levels for the tailwater during the wet season as shown in the CR951N control rules described in Deliverable 5.2.2. While the headwater optimal levels take precedence, if the headwater is within the optimal range and the tailwater is below the optimal range, the gates will open to increase the tailwater stage. During the days after the storm (between 7 to 12), the gates open and close at an hour frequency when the headwater levels are between the wet season optimal minimum and maximum. Once the levels fall below the optimal minimum, the gates close for the remaining of the simulation.

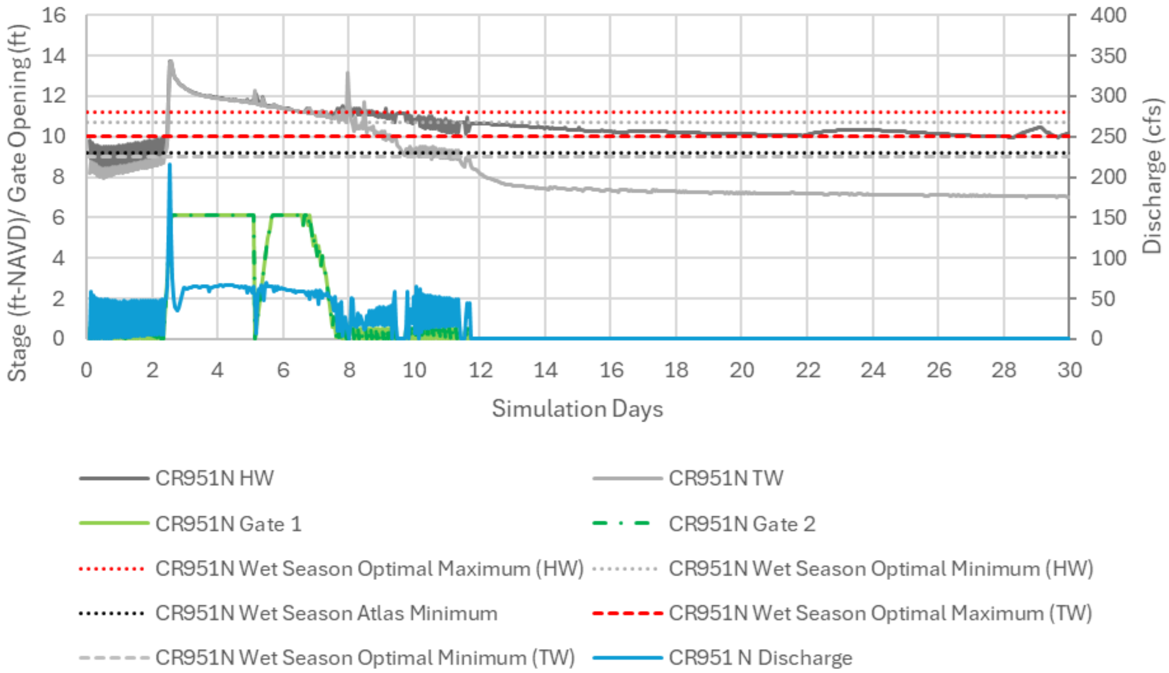

Figure 4-42. 5-year Design Storm Simulated Flow and Stage Hydrographs for CR951N

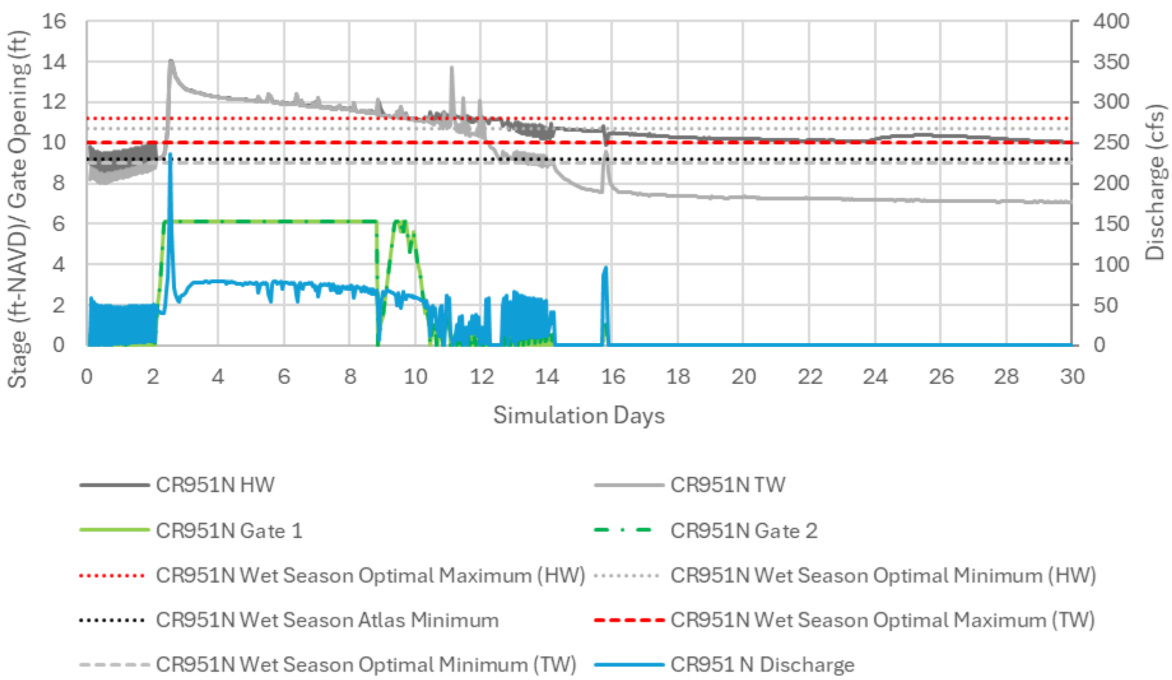

Figure 4-43. 10-year Design Storm Simulated Flow and Stage Hydrographs for CR951N

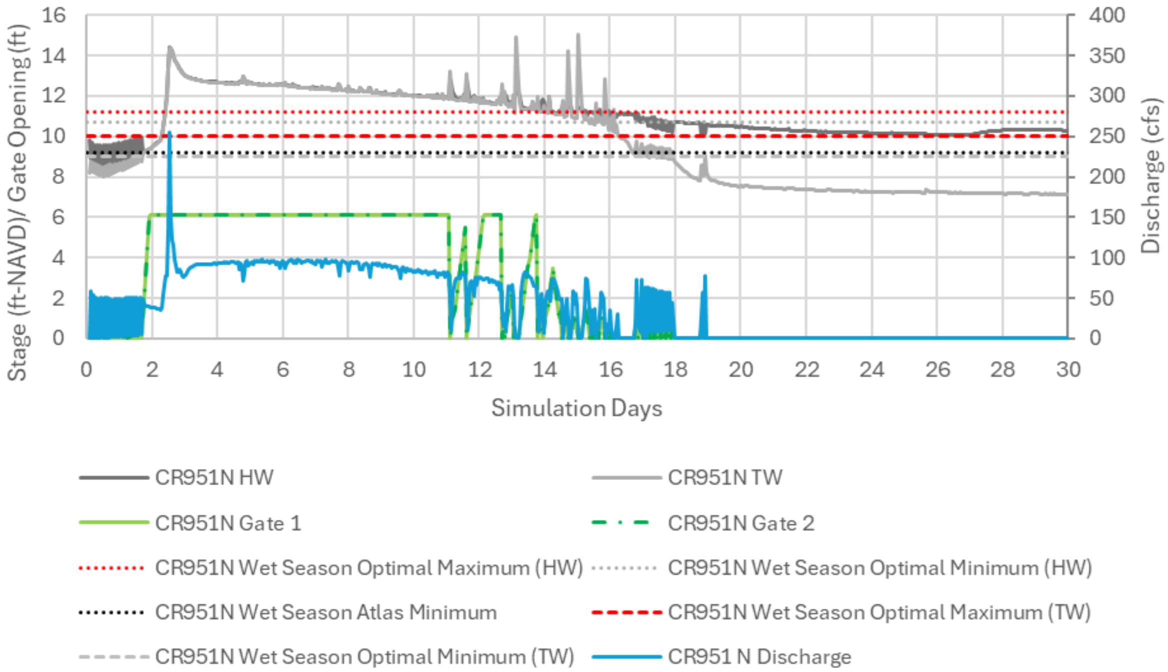

Figure 4-44. 25-year Design Storm Simulated Flow and Stage Hydrographs for CR951N

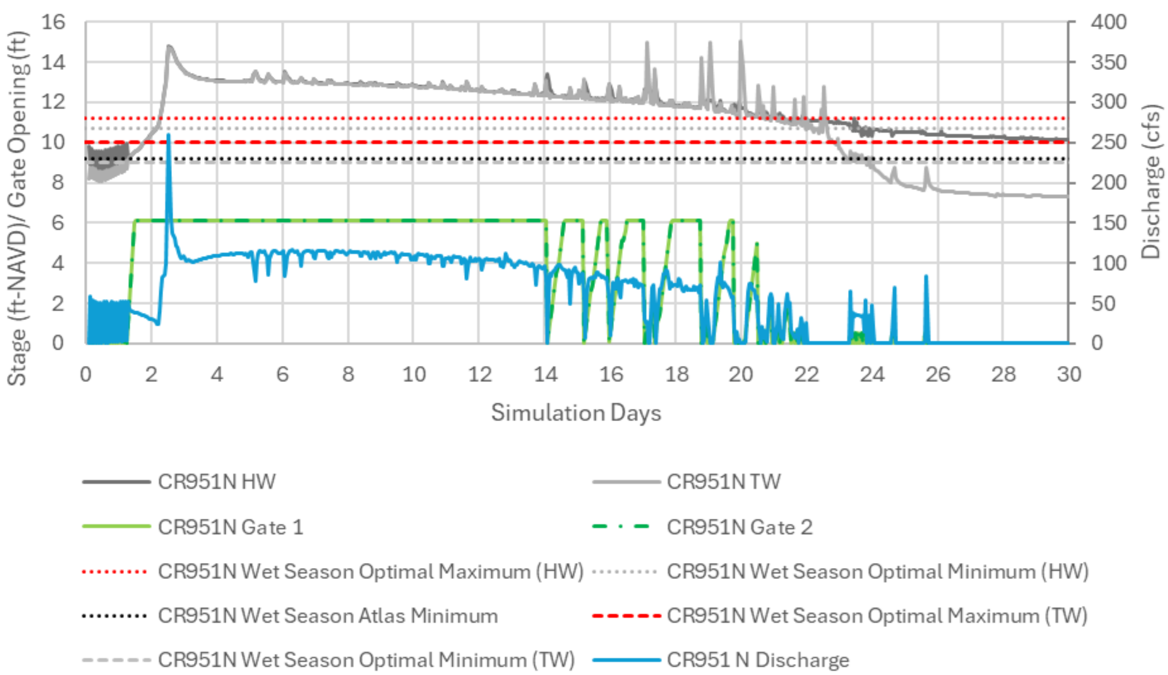

Figure 4-45. 100-year Design Storm Simulated Flow and Stage Hydrographs for CR951N

4.2.2.11 GG1

The GG1 structure simulated flow and stage hydrographs and varying weir levels for each design storm are presented in Figure 4-46 through Figure 4-49. The GG1 structure is a weir overflow structure so simulated weir levels are shown in Figure 4-46 through Figure 4-49 instead of simulated gate opening. The GG1 structure simulated weir levels fluctuate multiple times at the beginning of the simulations because the simulated headwater levels drop below the wet season optimal minimum control elevation at the GG1 structure. During the peak of the storm the weir remains fully open until the simulated headwater levels reach the wet season optimal control elevation, at which time simulated weir levels vary to maintain the headwater within the GG1 wet season optimal range.

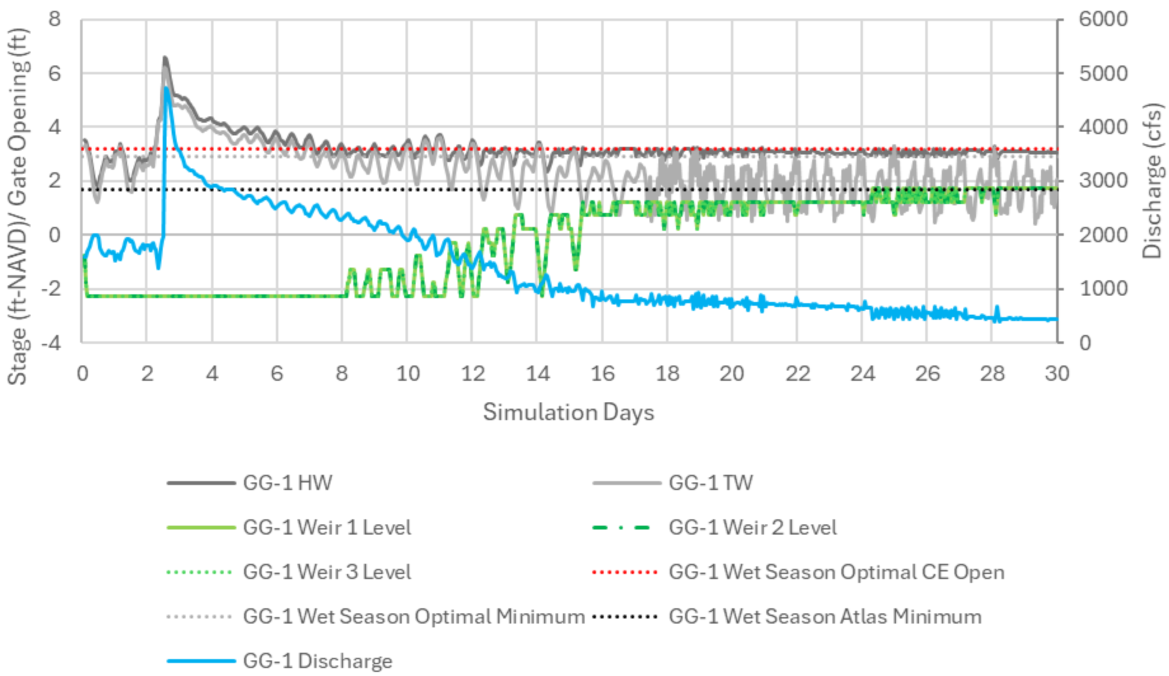

Figure 4-46. 5-year Design Storm Simulated Flow and Stage Hydrographs for GG1

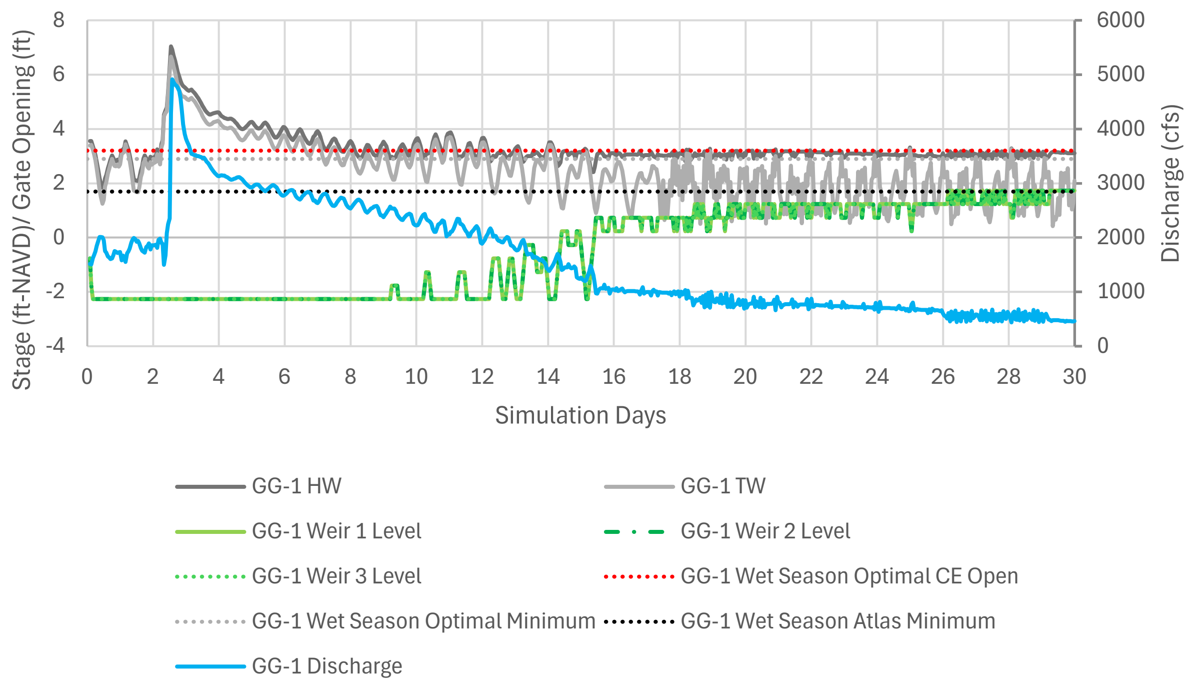

Figure 4-47. 10-year Design Storm Simulated Flow and Stage Hydrographs for GG1

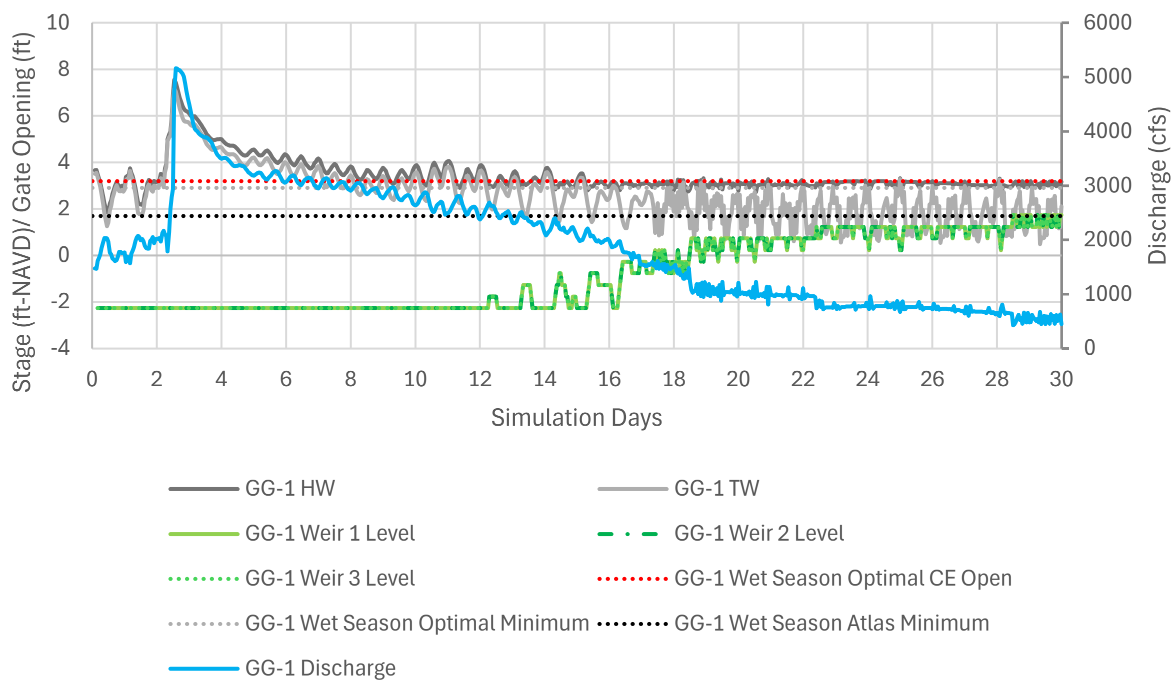

Figure 4-48. 25-year Design Storm Simulated Flow and Stage Hydrographs for GG1

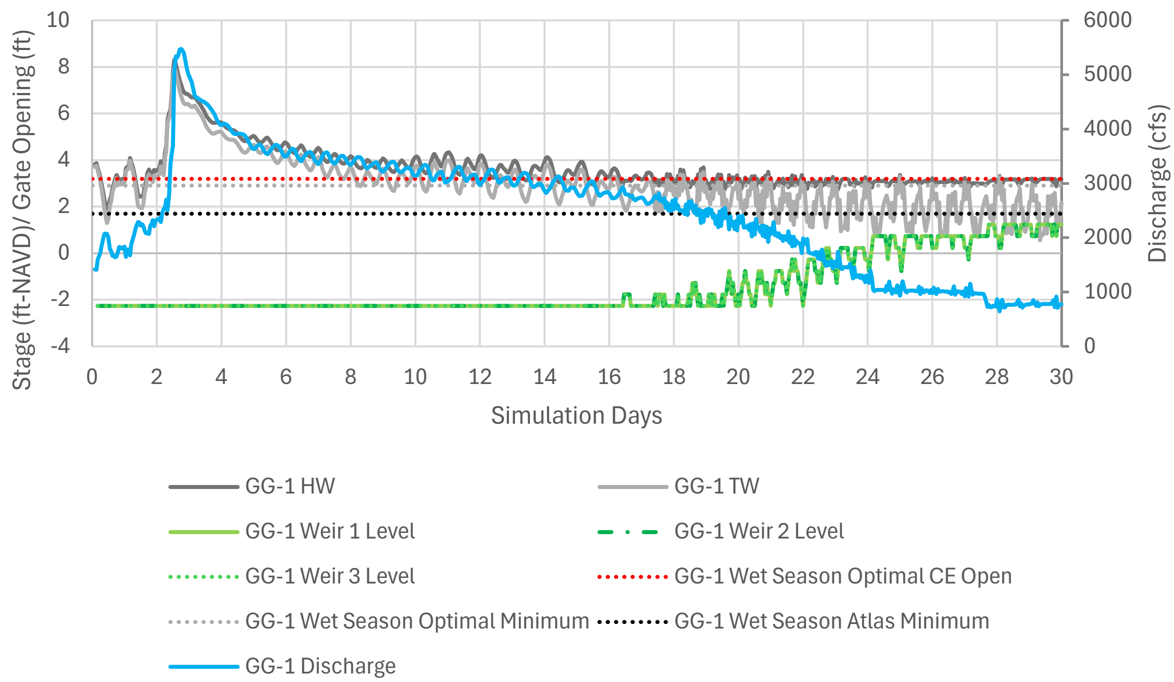

Figure 4-49. 100-year Design Storm Simulated Flow and Stage Hydrographs for GG1.

4.2.2.12 Miller Canal Bridge at I-75

The Miller Canal Bridge at I-75 simulated flow and stage hydrographs for each design storm are presented in Figure 4-50 through Figure 4-53.

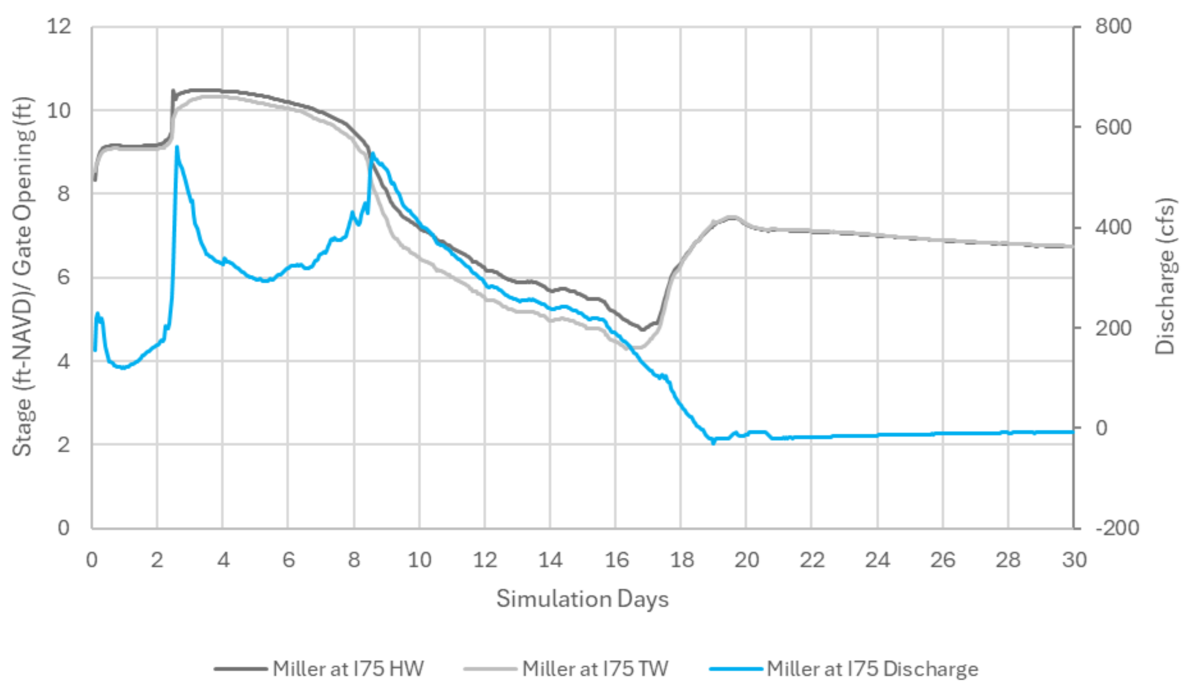

Figure 4-50. 5-year Design Storm Simulated Flow and Stage Hydrographs for the Miller Canal Bridge at I-75.

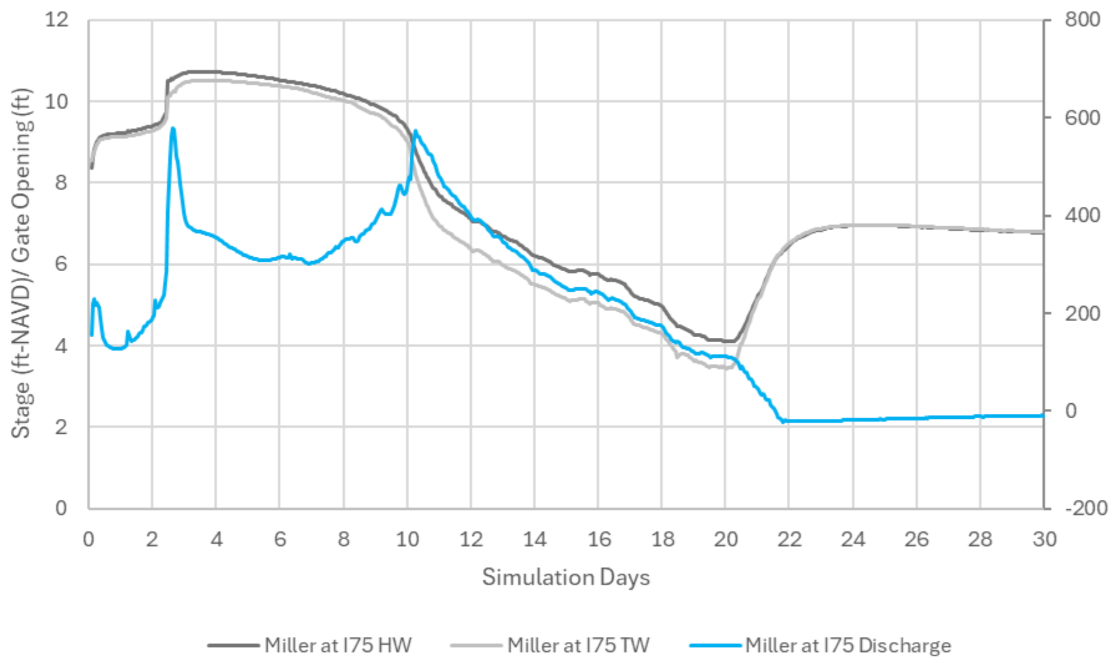

Figure 4-51. 10-year Design Storm Simulated Flow and Stage Hydrographs for the Miller Canal Bridge at I-75.

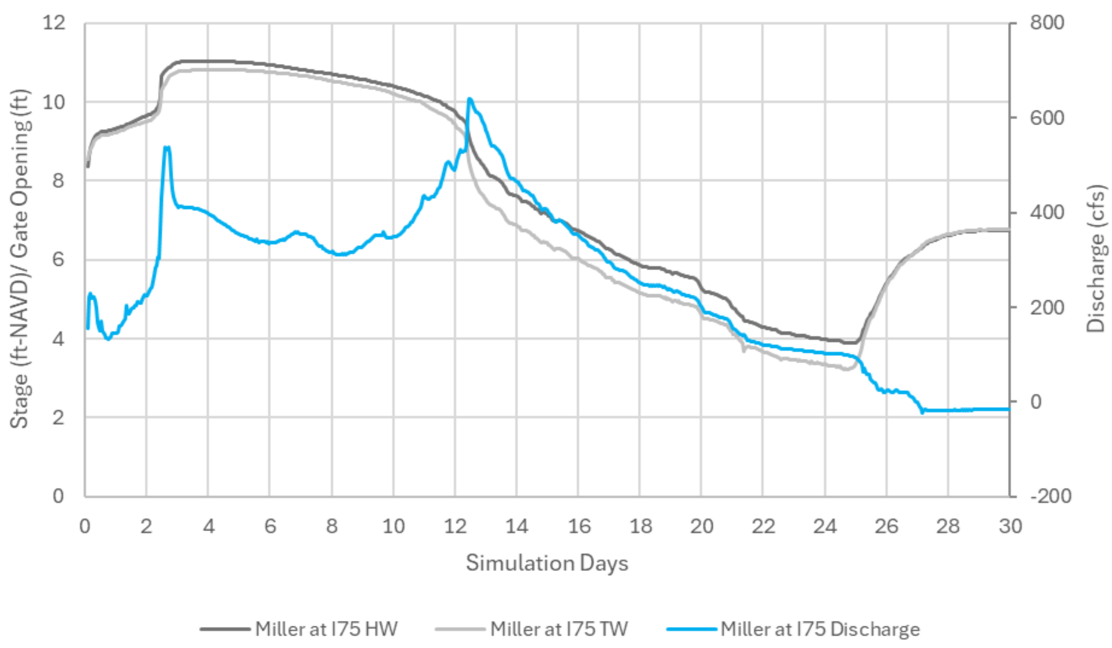

Figure 4-52. 25-year Design Storm Simulated Flow and Stage Hydrographs for the Miller Canal Bridge at I-75.

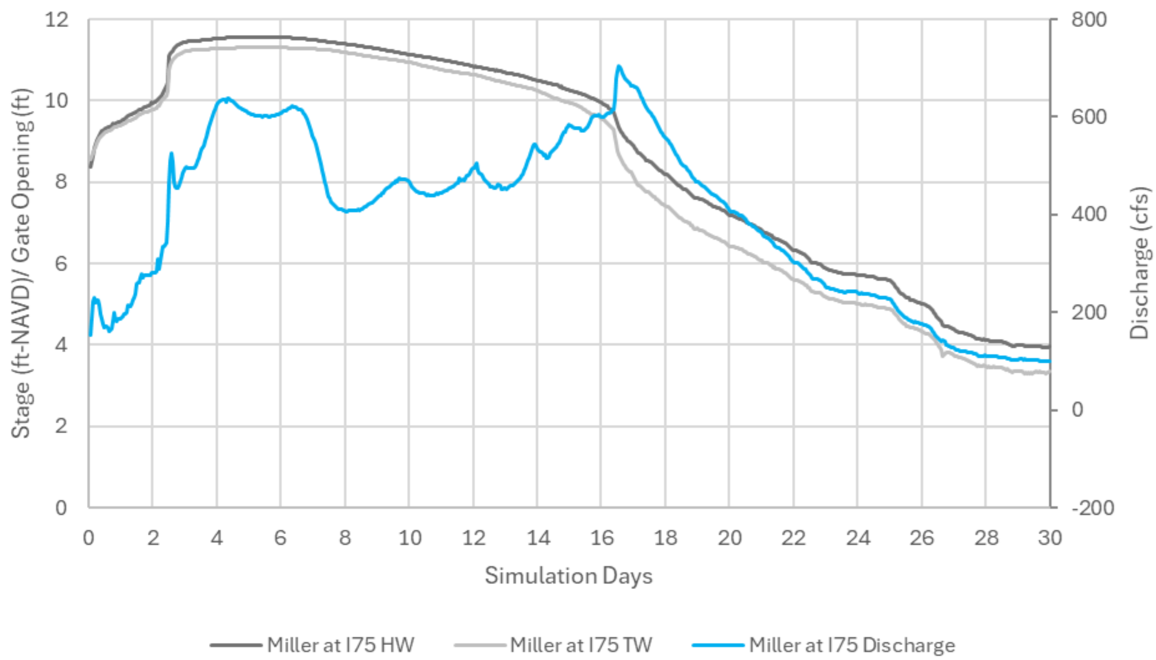

Figure 4-53. 100-year Design Storm Simulated Flow and Stage Hydrographs for the Miller Canal Bridge at I-75.

4.2.2.13 Bird Rookery North Bridge

The Bird Rookery North Bridge simulated flow and stage hydrographs for each design storm are presented in Figure 4-54 through Figure 4-57.

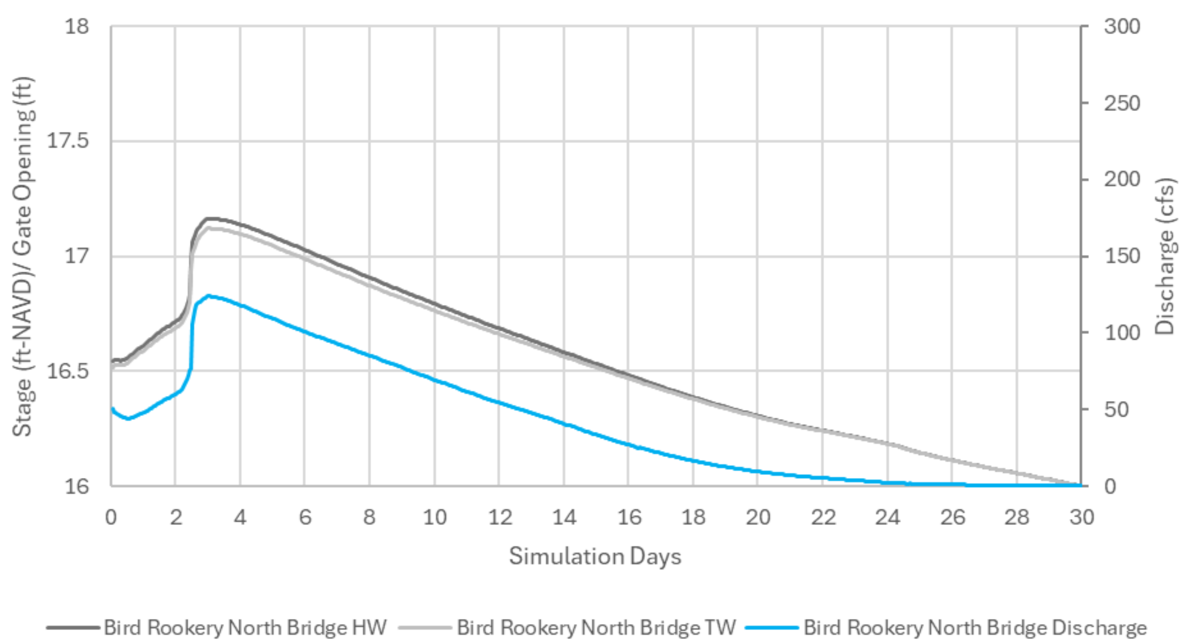

Figure 4-54. 5-year Design Storm Simulated Flow and Stage Hydrographs for the Bird Rookery North Bridge.

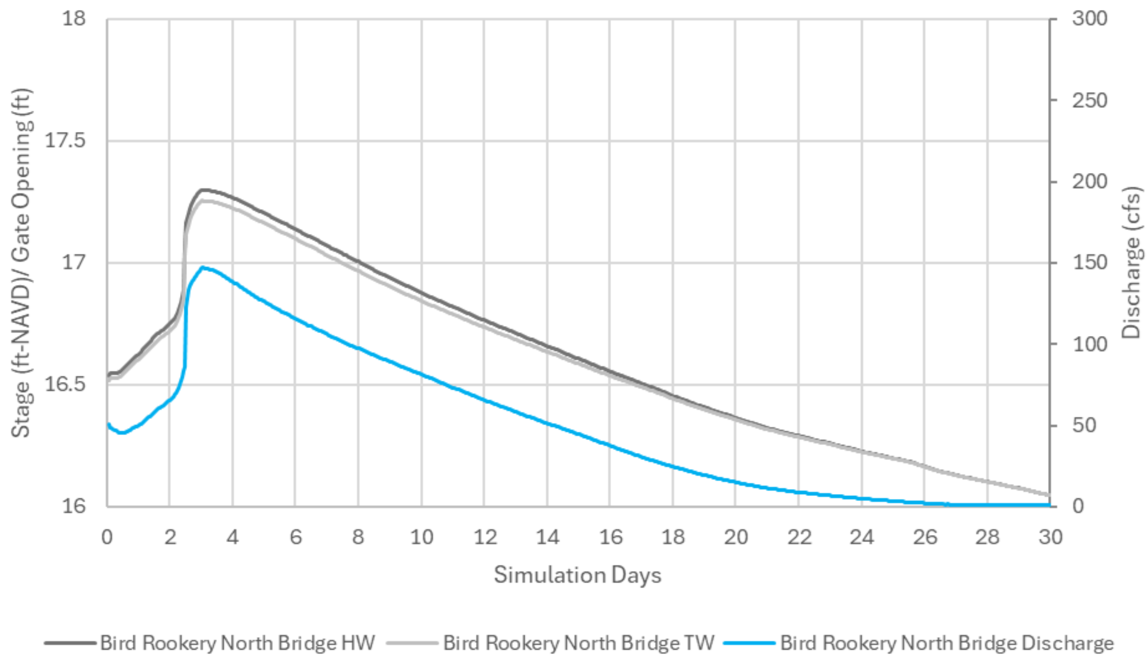

Figure 4-55. 10-year Design Storm Simulated Flow and Stage Hydrographs for the Bird Rookery North Bridge.

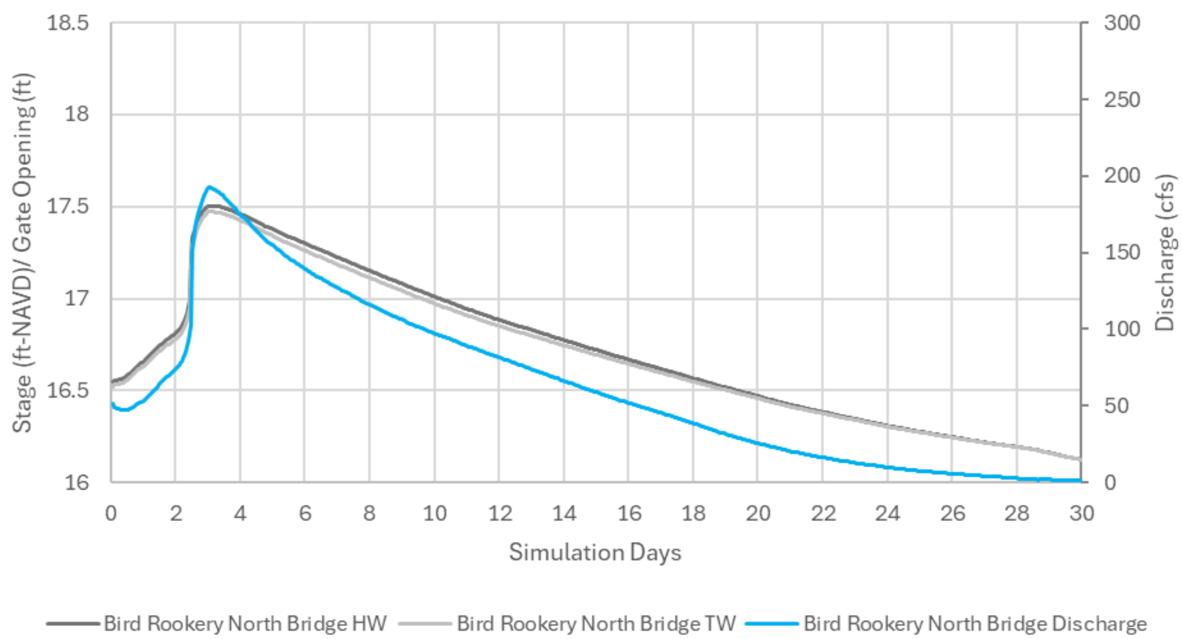

Figure 4-56. 25-year Design Storm Simulated Flow and Stage Hydrographs for the Bird Rookery North Bridge.

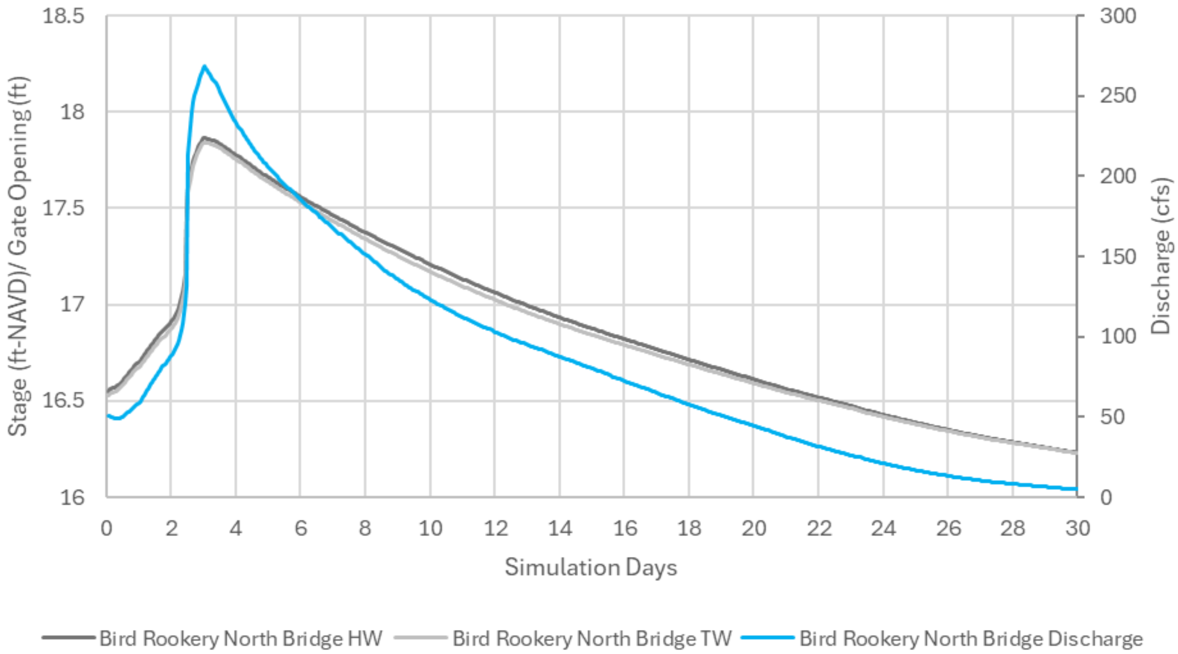

Figure 4-57. 100-year Design Storm Simulated Flow and Stage Hydrographs for the Bird Rookery North Bridge.

4.2.2.14 Faka Union 1

The Faka Union 1 simulated flow and stage hydrographs for each design storm are presented in Figure 4-58 through Figure 4-61.

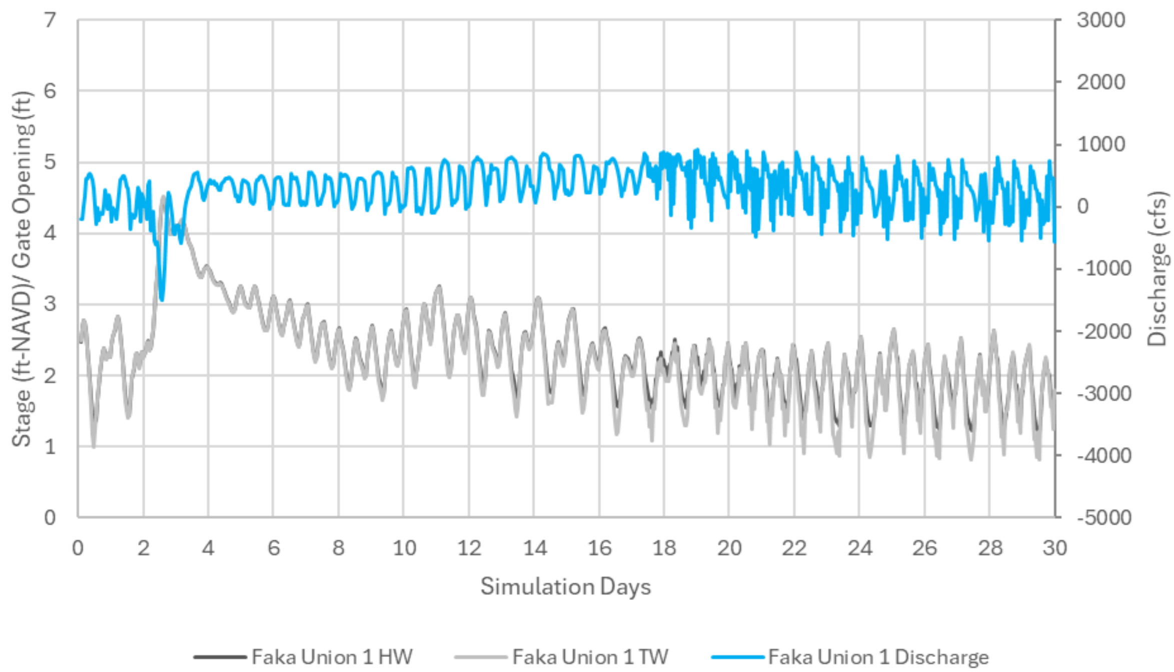

Figure 4-58. 5-year Design Storm Simulated Flow and Stage Hydrographs for Faka Union 1

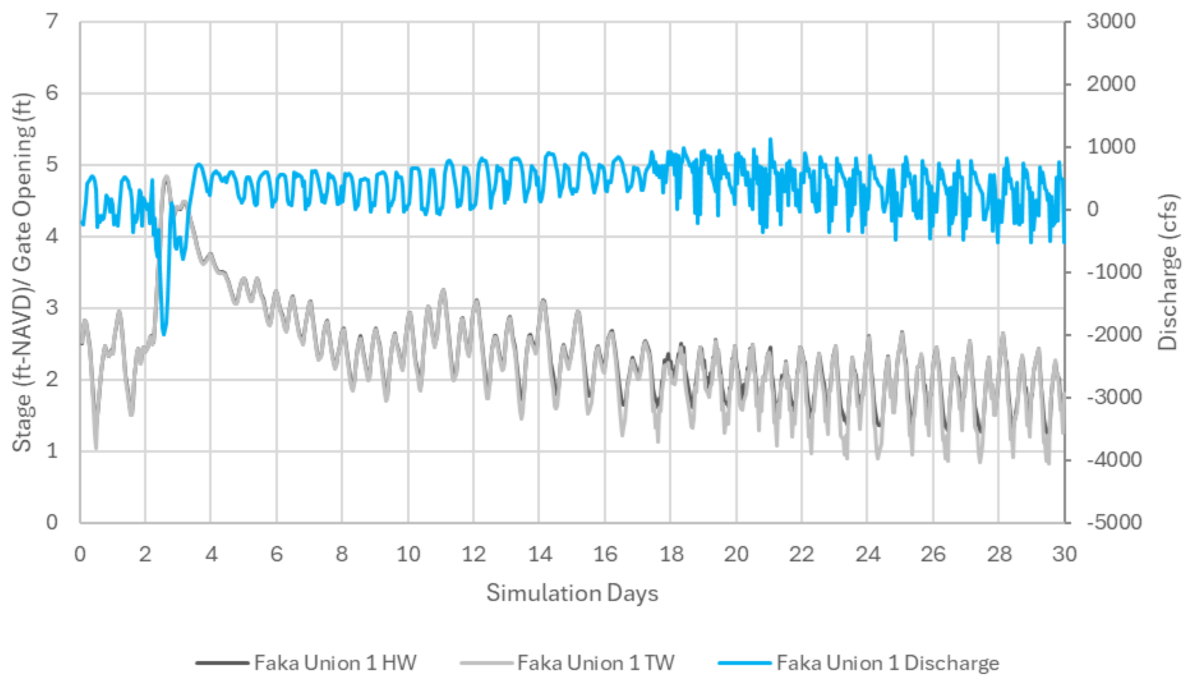

Figure 4-59. 10-year Design Storm Simulated Flow and Stage Hydrographs for Faka Union 1

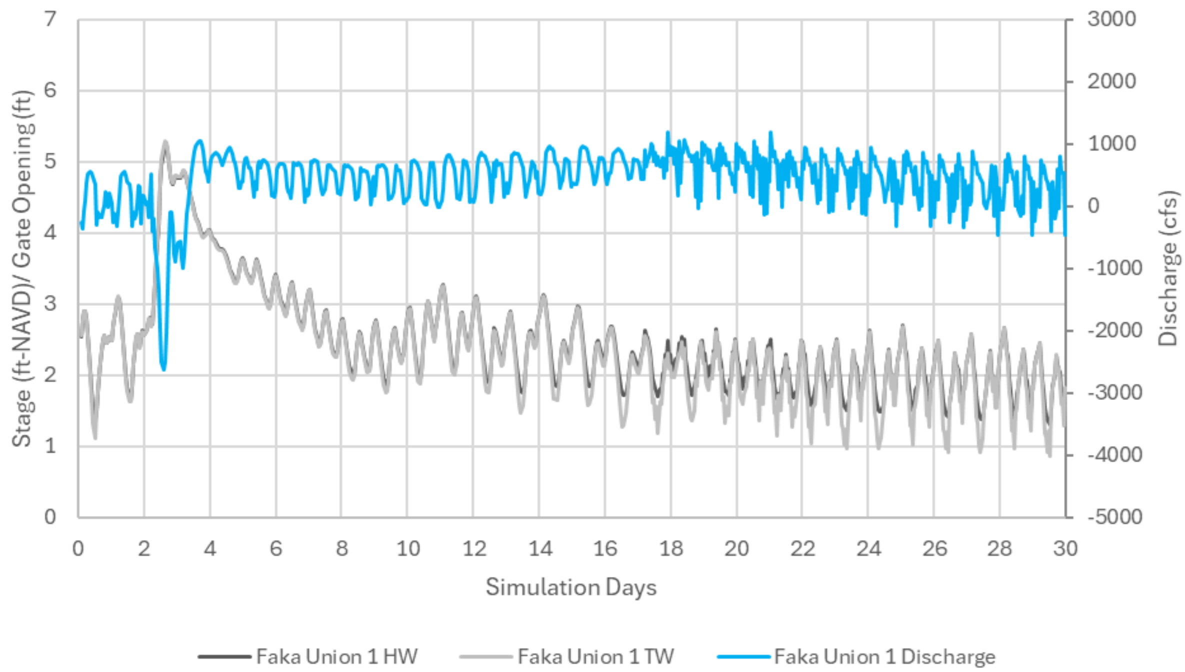

Figure 4-60. 25-year Design Storm Simulated Flow and Stage Hydrographs for Faka Union 1

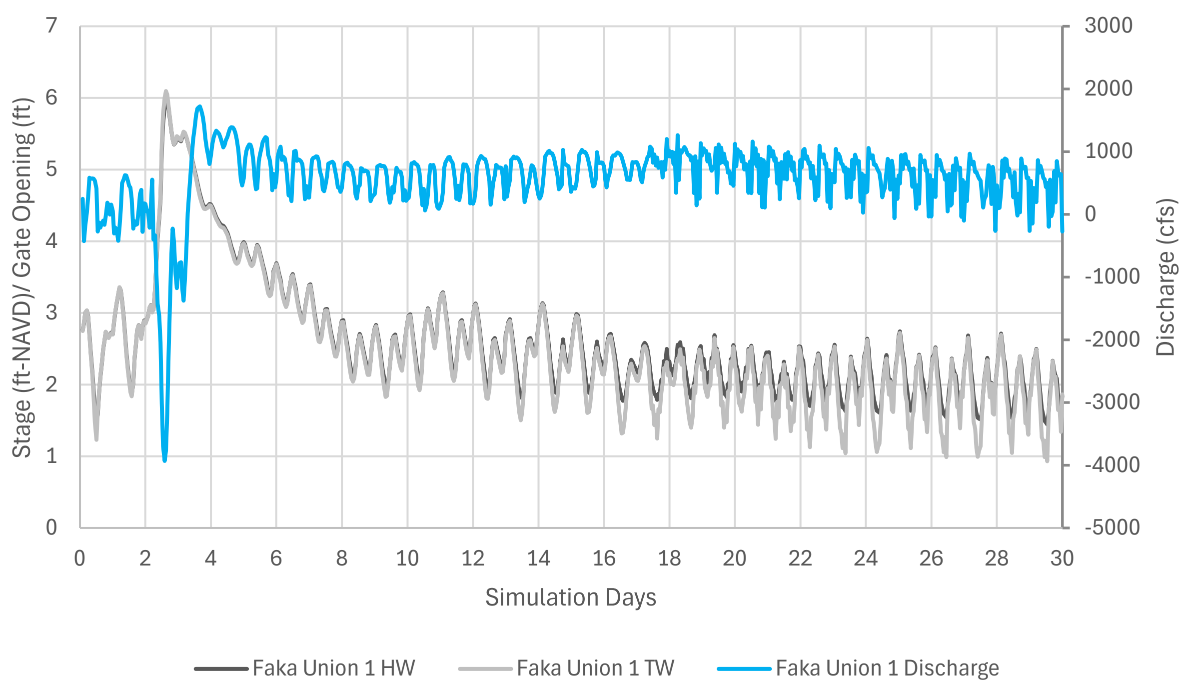

Figure 4-61. 100-year Design Storm Simulated Flow and Stage Hydrographs for Faka Union 1

4.2.3 Peak Stage and Discharge

The simulated peak flow and stage hydrographs resulting from the FCM design storm simulations are presented below. The results for each design storm are presented by structure. The peak was calculated from a 1 hour results output interval, excluding the first day of the simulation to ensure the reported peak is due to the storm peak and not initial instabilities that may occur. Table 4-1 shows the peak stages and discharge for the four design storm events simulated by the FCM. Table 4-2 shows the differences in peak stages and discharges between the FCM and the ECM (FCM minus ECM).

Table 4-1. FCM Design Storm Simulated Peak Stage and Peak Discharge Summary

Structure	Peak Stage (ft NAVD)				Peak Discharge (cfs)			
	5-yr	10-yr	25-yr	100-yr	5-yr	10-yr	25-yr	100-yr
Cocohatchee Watershed								
COCO1	7.2	7.7	8.4	9.2	1296	1388	1505	1692
COCO2	9.3	9.8	10.4	11.3	783	861	976	1147
COCO3	12.6	13.0	13.7	14.8	591	629	683	751
COCO4	13.0	13.3	13.8	14.4	100	142	220	289
AR2 (North)	10.4	10.9	11.5	12.1	264	253	231[1]	237[1]
Golden Gate Main								
AR1 (South)	10.2	10.6	11.0	11.4	916	958	1006	1045
GG1	6.6	7.0	7.6	8.3	4727	4914	5163	5473
GG2	8.4	8.7	9.3	9.9	3297	3546	3737	3929
GG3	10.3	10.8	11.3	11.8	2314	2409	2526	2703
GG4	11.8	12.2	12.5	12.9	1342	1275	1292	1490
GOLDW5 (GG5)	12.5	13.1	13.5	14.2	1637	1872	2307	2773
GG6	15.9	16.3	16.9	17.5	285	368	501	705
GG7	14.3	14.7	15.2	15.7	290	315	433	499
I75W1	9.1	9.6	10.3	10.8	1445	1467	1449	1561
I75W2	12.1	12.3	12.7	13.0	437	466	589	789
I75W3	12.2	12.4	12.8	13.2	193	223	262	312
CYP1	11.9	12.2	12.4	12.8	444	500	530	645
CUR1	12.5	12.9	13.3	14.1	279	320	427	575
CR951N	13.7	14.0	14.4	14.8	216	236	254	260
CR951S	10.6	11.0	11.3	11.7	802	810	778[2]	763[2]
CORK1	13.0	13.3	13.8	14.5	728	774	793	713
CORK2	14.7	15.2	15.7	16.1	497	600	647	973
CORK3	16.5	16.6	16.8	17.1	202	209	221	241
Faka Union Watershed								
FU1	4.5	4.8	5.2	6.0	-1512[3]	-1984[3]	-2625[3]	-3928[3]
FU3	11.5	11.7	12.0	12.4	1488	1698	1957	2148
FU4S	12.8	13.0	13.1	13.4	1601	1643	1675	1698

Structure	Peak Stage (ft NAVD)				Peak Discharge (cfs)			
	5-yr	10-yr	25-yr	100-yr	5-yr	10-yr	25-yr	100-yr
FU5	15.6	15.9	16.3	16.8	1449	1553	1654	1776
FU6	17.2	17.7	18.0	18.4	1710	1898	2037	2176
FU7	19.9	20.4	20.9	21.4	1130	1289	1432	1581
MILLER3	11.9	12.3	12.7	13.0	204	326	454	582
Henderson Creek								
HC1	5.4	5.7	6.0	6.5	572	618	694	849
HC2	9.5	9.6	9.8	10.0	318	329	344	353
Estero Bay								
Kehl Canal Weir and Gate	13.6	14.0	14.4	15.2	1285	1440	1695	2206

[1] The peak discharges are lower at AR2 (North) for the 25-yr and 100-yr storm events than for the 5-yr and 10-yr events because the tailwater exceeds the headwater and the gates start to close, which does not occur in the 5-yr and 10-yr events.

[2] The peak discharges are lower at CR951S for the 25-yr and 100-yr storm than in the 5-yr and 10-yr events. This is due to a bridge which is causing a flow restriction in the Golden Gate Main canal downstream of the location at which CR951S discharges into the Golden Gate Main canal. This flow restriction is exacerbated in the 100-year where the bridge causes a higher head loss and causes a flow reversal in the Golden Gate main canal near the CR951S discharge point and raising the tailwater at CR951S structure. This higher tailwater limits the discharge from the CR951S during the higher storm events

[3] Peak flows are negative due to the tidal surge at the peak of the storm (Figure 4-58 - Figure 4-61).

Table 4-2. Comparison Between the FCM and ECM Design Storm Simulated Peak Stage and Peak Discharge Summary

Structure	Peak Stage (ft NAVD)				Peak Discharge (cfs)			
	5-yr	10-yr	25-yr	100-yr	5-yr	10-yr	25-yr	100-yr
Cocohatchee Watershed								
COCO1	0.7	0.8	0.8	0.7	141	135	139	184
COCO2	-0.1	0.6	0.8	0.9	63	135	155	180
COCO3	0.6	0.6	0.7	0.9	53	45	54	49
COCO4	0.4	0.4	0.6	0.5	45	73	104	83
AR2 (North)	0.4	0.4	0.4	0.3	18	-12	-37	-33
Golden Gate Main								
AR1 (South)	0.3	0.3	0.3	0.3	-16	-6	7	-10
GG1	0.5	0.5	0.4	0.5	384	163	234	282
GG2	0.5	0.3	0.5	0.5	73	191	60	123
GG3	0.6	0.5	0.5	0.4	207	136	115	191
GG4	0.4	0.4	0.3	0.3	3	-171	-72	113
GOLDW5 (GG5)	0.7	0.7	0.6	0.6	223	77	245	334
GG6	0.6	1.2	0.8	0.9	24	106	156	221

Structure	Peak Stage (ft NAVD)				Peak Discharge (cfs)			
	5-yr	10-yr	25-yr	100-yr	5-yr	10-yr	25-yr	100-yr
GG7	0.1	0.3	0.4	0.5	109	53	91	50
I75W1	0.1	0.3	0.5	0.4	-60	-165	-147	50
I75W2	1.1	0.9	0.7	0.6	-261	-328	-331	-245
I75W3	0.5	0.4	0.4	0.4	-20	11	29	6
CYP1	0.3	0.2	0.2	0.3	432	488	518	632
CUR1	0.2	0.3	0.4	0.5	57	57	105	111
CR951N	0.3	0.2	0.3	0.3	36	32	26	11
CR951S	0.4	0.4	0.2	0.3	-79	-41	-62	-31
CORK1	0.2	0.2	0.4	0.4	35	41	14	-67
CORK2	0.1	0.2	0.3	0.2	47	93	109	234
CORK3	0.1	0.1	0.1	0.2	4	5	8	13
Faka Union Watershed								
FU1	0.4	0.4	0.4	0.5	-588	-598	-684	-988
FU3	2.3	2.0	1.7	-3.4	-322	-272	-242	-250
FU4S	1.1	0.9	0.9	0.2	-45	-88	-120	-120
FU5	0.8	0.9	0.8	0.8	258	251	217	243
FU6	1.2	1.1	1.0	0.8	732	662	522	401
FU7	1.4	1.7	1.6	1.3	683	661	605	451
MILLER3	0.5	0.4	0.3	0.3	-8	108	133	108
Henderson Creek								
HC1	0.2	0.2	0.2	0.2	38	34	58	152
HC2	0.5	0.3	0.1	0.1	25	24	24	27
Estero Bay								
Kehl Canal Weir and Gate	0.4	0.4	0.4	0.5	117	117	138	240

Higher peak stages are shown in all locations, most likely due to the higher rainfall in the FCM than in the ECM design storms. Higher discharges are also shown in most locations, except for locations where some of the infrastructure changes occurred, such as the I-75 Canal geometry, which lower the canal conveyance in the FCM model, and FU1 station, which is downstream of the PSRP removed canals.

4.2.4 Peak Flood Depth Maps and Flooded Areas

The peak flood depths for the FCM design storm simulations and comparison to the ECM are presented in this section. The peak flood depths were calculated based on the simulated maximum overland depth. The results are presented by design storm across the study area in tables and figures.

Figure 4-62, Figure 4-65, Figure 4-68, and Figure 4-71 provide a visual depiction of the simulated peak flood depths in urban and agricultural land use areas for the 5-, 10-, 25-, and 100-yr design events, respectively. Note that the figures zoom into the project area, but the total flooded areas were added for the entire basins. Figure 4-63, Figure 4-66, Figure 4-69, and Figure 4-72 show a comparison of the FCM and ECM inundation depths (FCM minus ECM) for the 5-, 10-, 25-, and 100-yr design events, respectively. Figure 4-64, Figure 4-67, Figure 4-70, and Figure 4-73 show areas where ponding changed not flooded in the ECM to flooded in the FCM in the Urban and Agricultural Future Land Uses for the 5-, 10-, 25-, and 100-yr design events, respectively. The FCM flood depth is shown where flood depths were less than or equal to 0.25 ft (no flooding) in the ECM and were greater than 0.25 ft (flooded) in the FCM for future urban and agricultural land uses only.

Table 4-3, Table 4-5, Table 4-7, and Table 4-9 show the FCM simulated area of inundation in urban and agricultural land use areas for the peak flood depths for the basins in and adjacent to the project area for the 5-, 10-, 25-, and 100-yr design events, respectively. The basins are based on the SFWMD AHED Watershed delineations. Table 4-4, Table 4-6, Table 4-8, and Table 4-10 show a comparison between the FCM and ECM inundation areas (FCM minus ECM) for the 5-, 10-, 25-, and 100-yr design events, respectively.

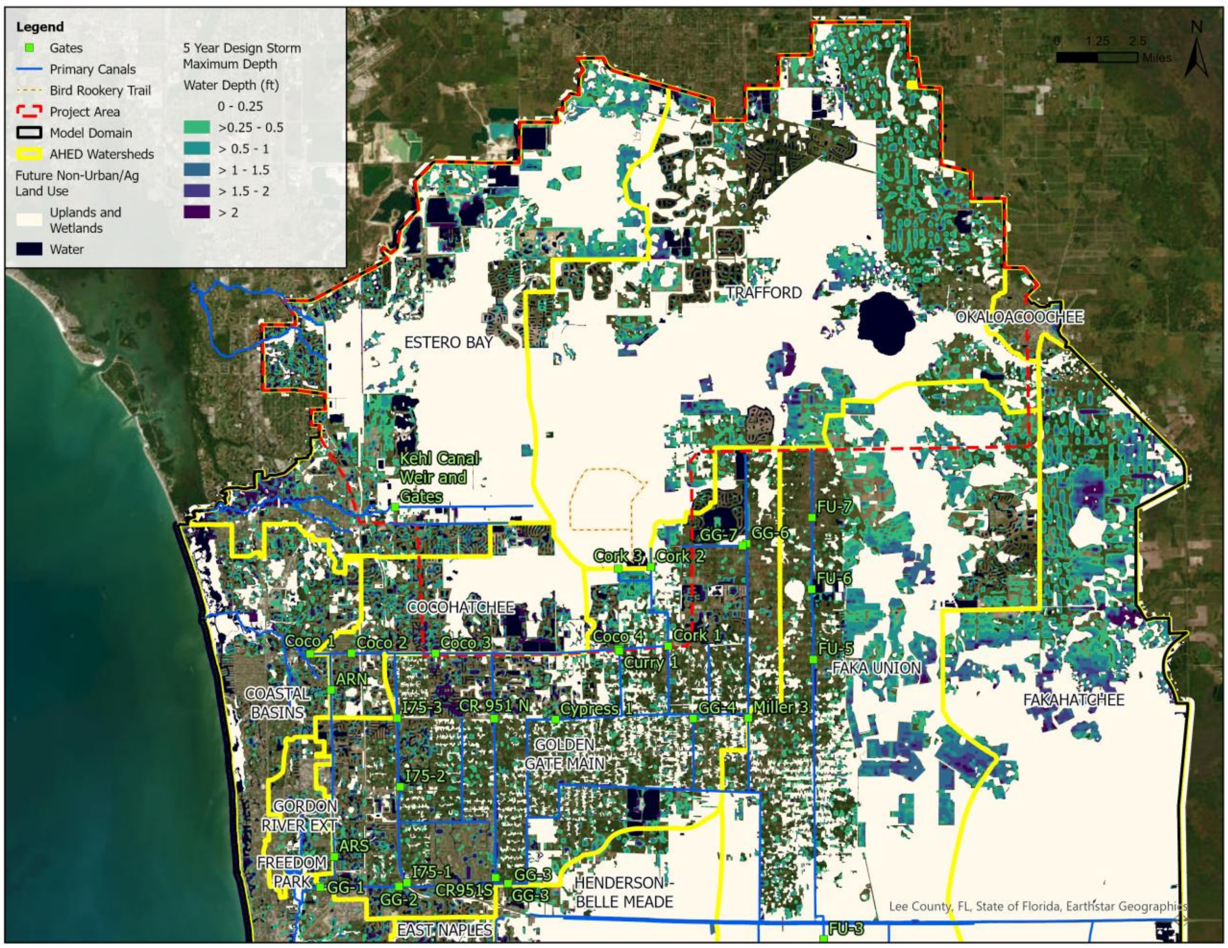

Figure 4-62. FCM Five-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

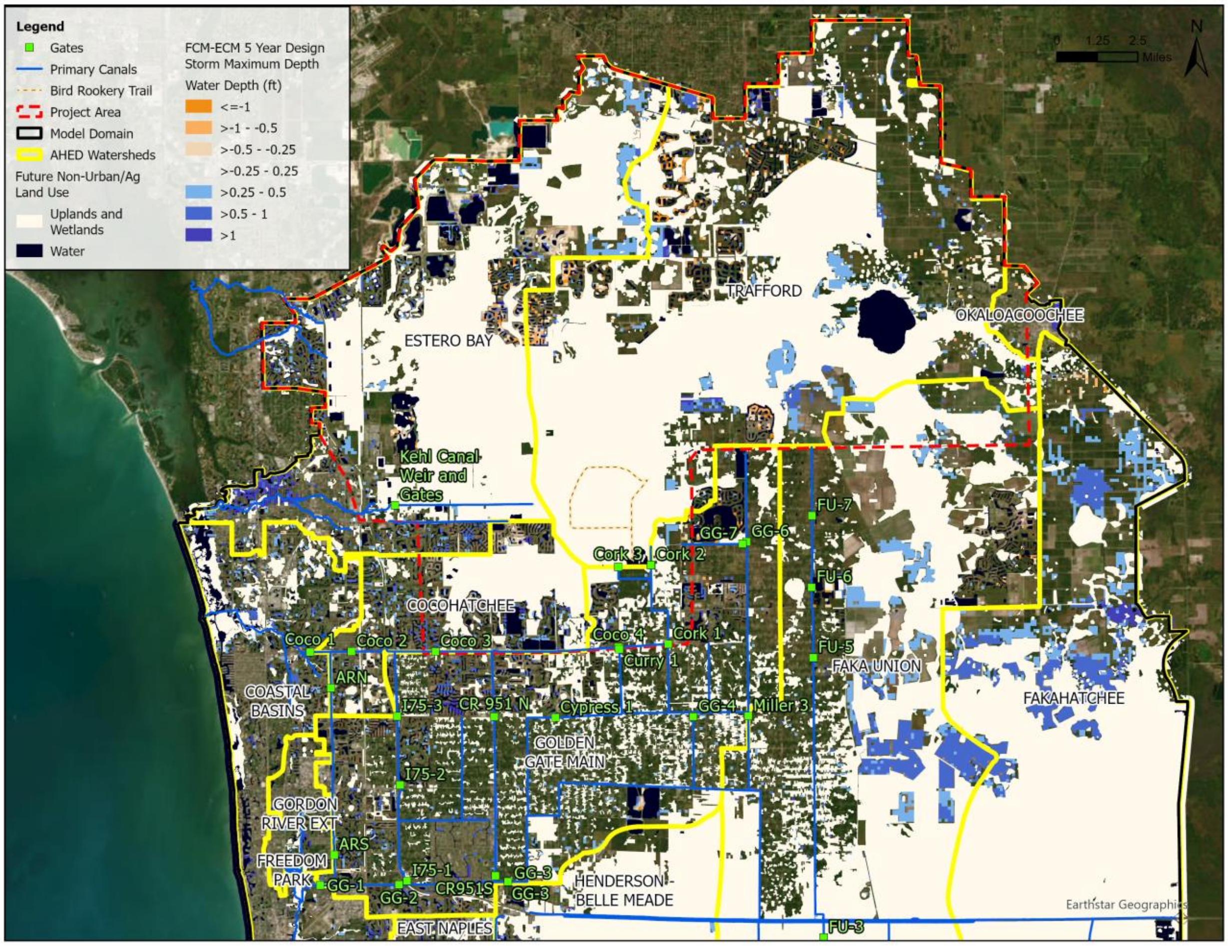

Figure 4-63. Comparison Between the FCM and ECM Five-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

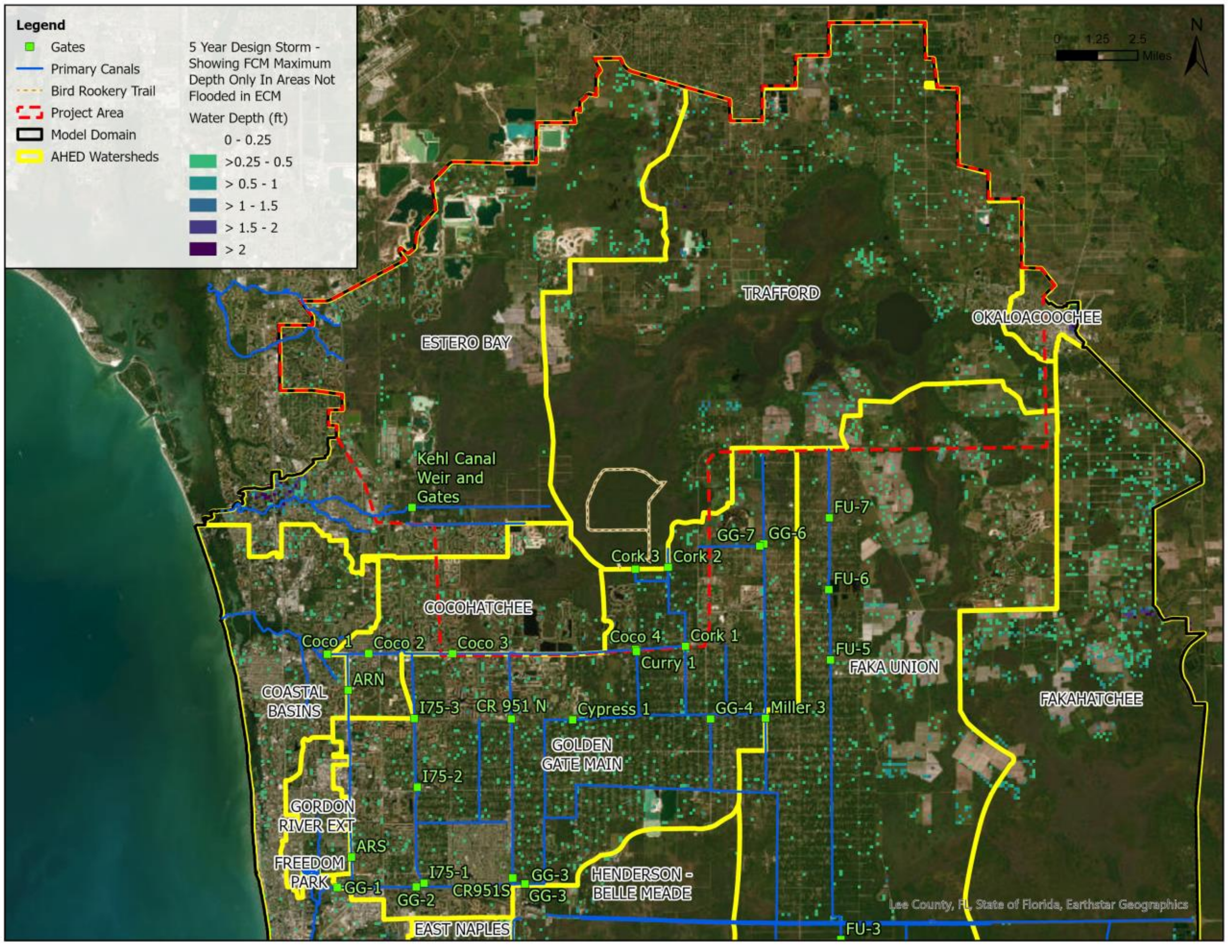

Figure 4-64. FCM Five-Year Design Storm Peak Flood Depths shown for areas where ponding changed not flooded in the ECM to flooded in the FCM in the Urban and Agricultural Future Land Uses.

Table 4-3. FCM Five-Year Design Storm Urban and Agricultural Flooded Areas per Basin

Depth (ft)	5-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	3111	597	5320	4654	4970
0.5 - 1 ft	3576	436	5137	1555	4081
1 - 1.5 ft	1877	275	3524	568	1882
1.5 - 2 ft	769	224	1441	379	1154
≥ 2 ft	1670	735	1257	2118	1366

Table 4-4. Comparison of between the FCM and ECM Five-Year Design Storm Urban and Agricultural Flooded Areas per Basin (FCM minus ECM)

Depth (ft)	5-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	-316	149	-149	1940	-1498
0.5 - 1 ft	-241	-57	178	482	-872
1 - 1.5 ft	769	46	1963	103	-419
1.5 - 2 ft	69	17	981	-98	69
≥ 2 ft	987	195	517	568	436

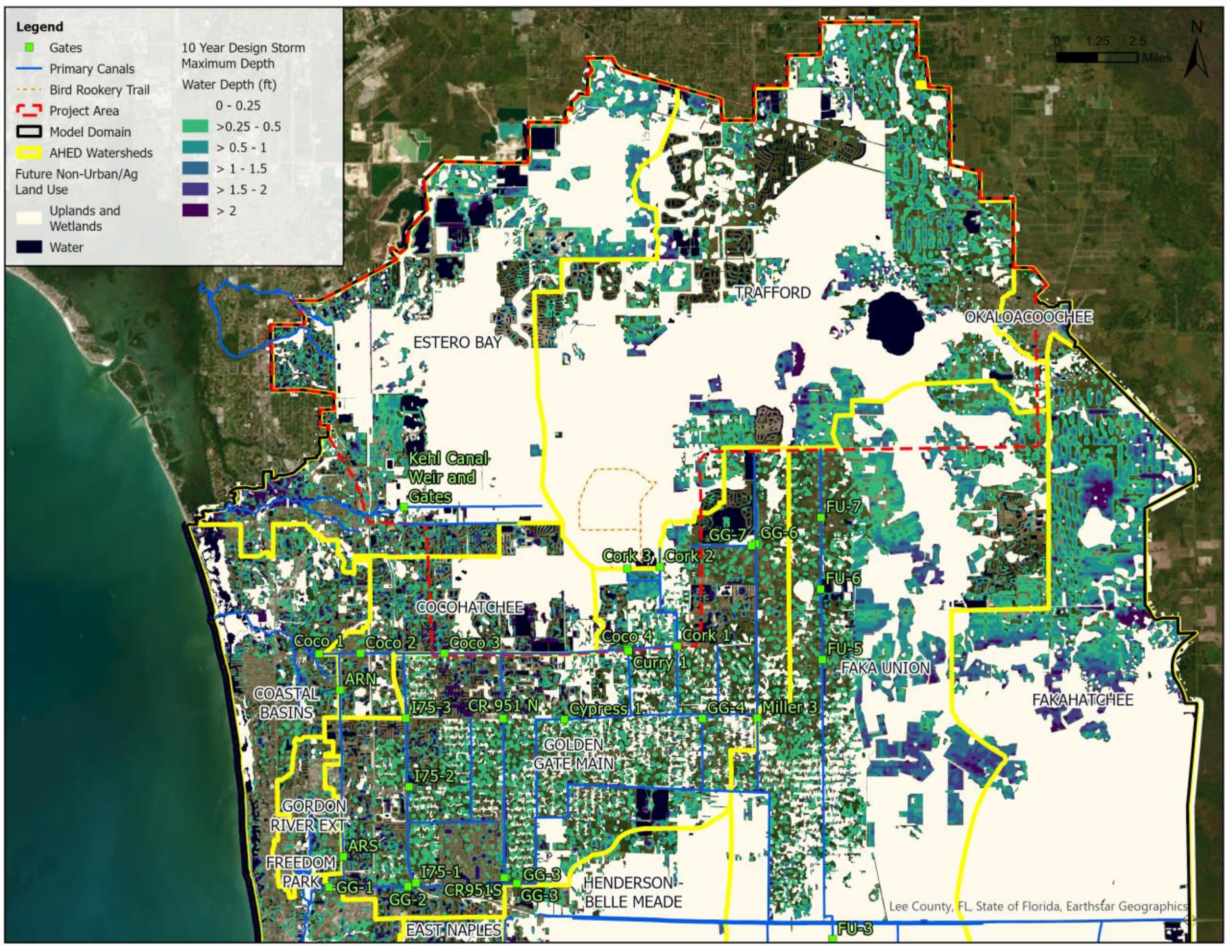

Figure 4-65. FCM Ten-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

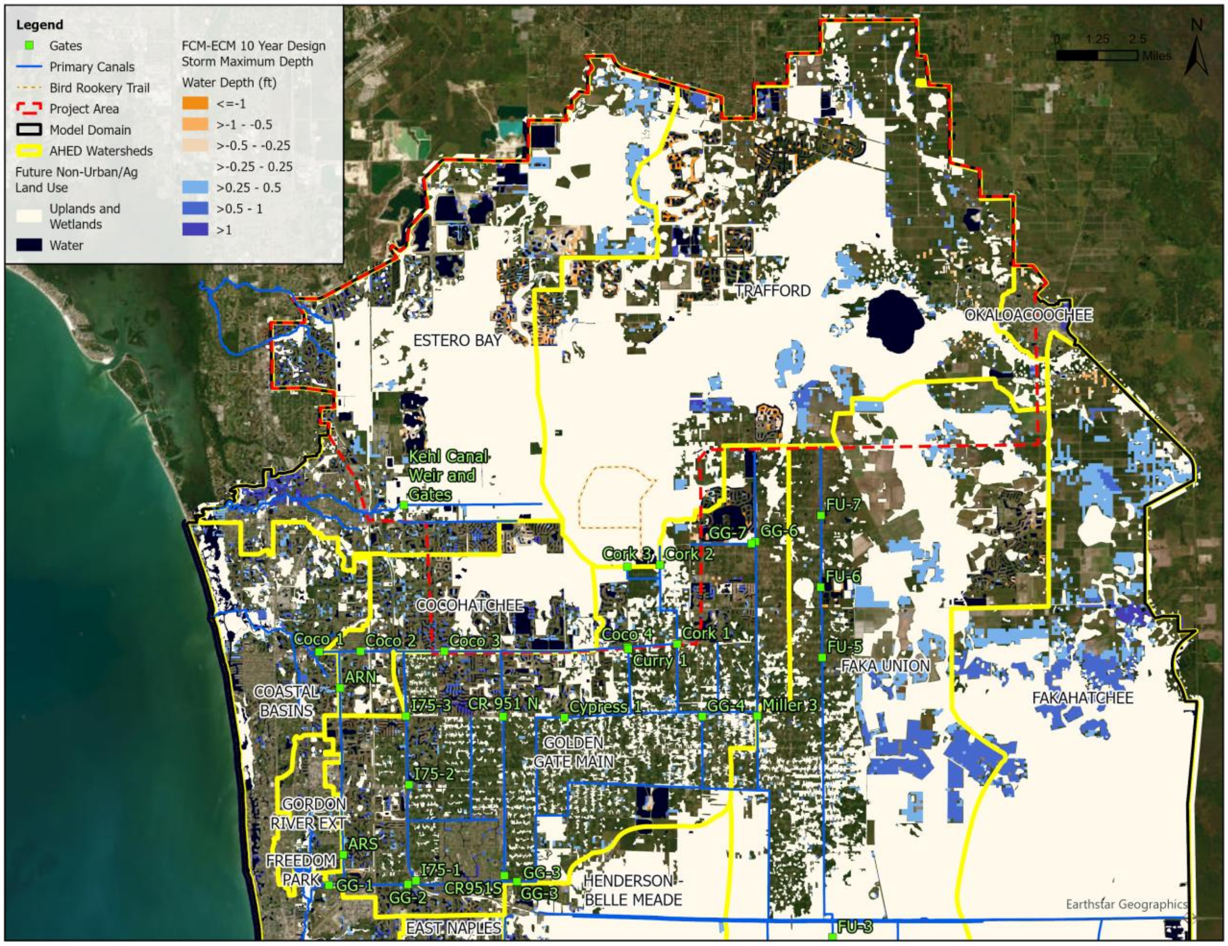

Figure 4-66. Comparison Between the FCM and ECM Ten-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

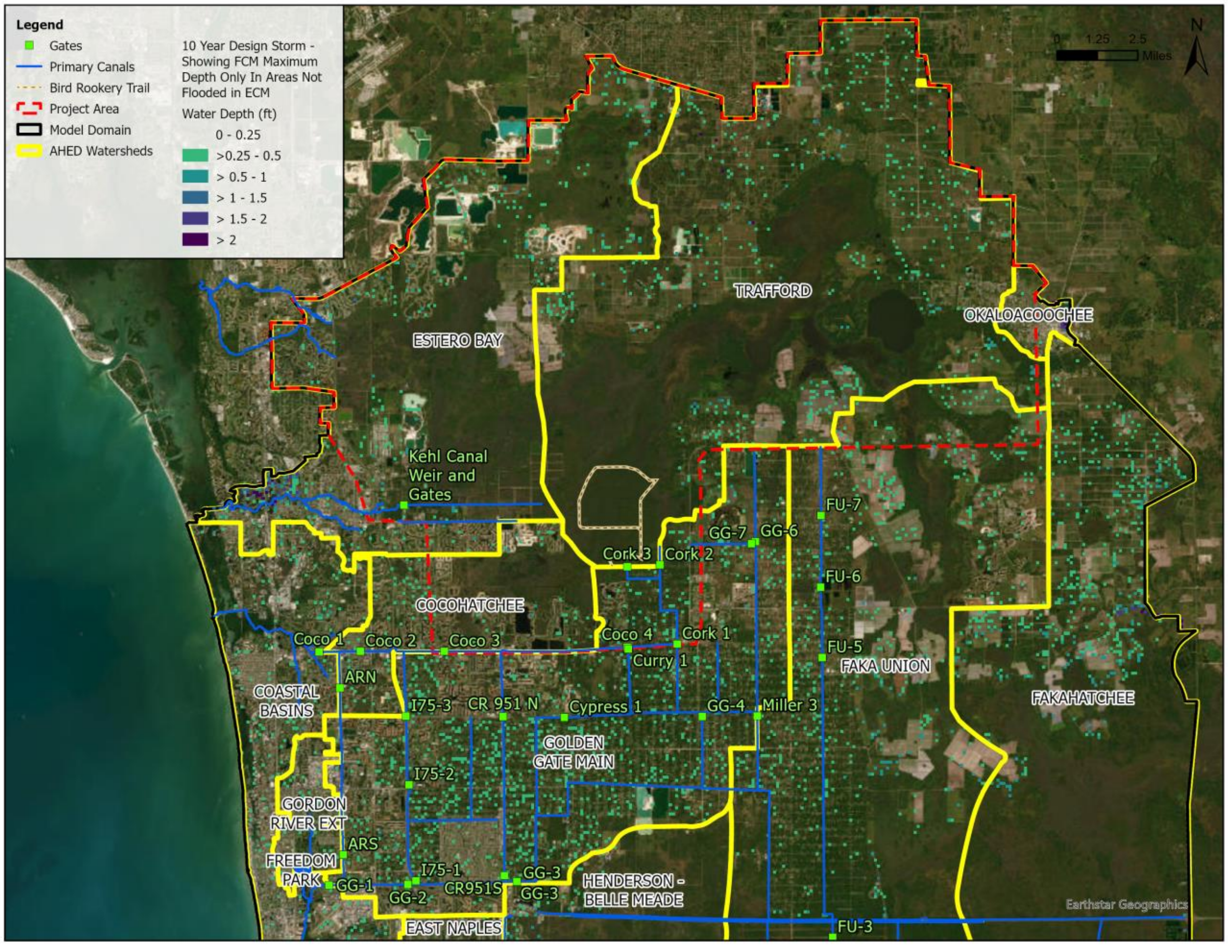

Figure 4-67. FCM Ten-Year Design Storm Peak Flood Depths shown for areas where ponding changed not flooded in the ECM to flooded in the FCM in the Urban and Agricultural Future Land Uses.

Table 4-5. FCM Ten-Year Design Storm Urban and Agricultural Flooded Areas per Basin

Depth (ft)	10-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	3748	1050	8264	10991	6543
0.5 - 1 ft	3759	425	5647	2634	4712
1 - 1.5 ft	2468	362	3834	775	2405
1.5 - 2 ft	976	212	2284	511	1377
≥ 2 ft	1837	855	1446	2319	1745

Table 4-6. Comparison between the FCM and ECM Ten-Year Design Storm Urban and Agricultural Flooded Areas per Basin (FCM minus ECM)

Depth (ft)	10-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	178	385	1532	4838	-1733
0.5 - 1 ft	-717	-75	-264	958	-1400
1 - 1.5 ft	815	109	1504	212	-362
1.5 - 2 ft	195	-40	1733	6	63
≥ 2 ft	976	241	562	580	367

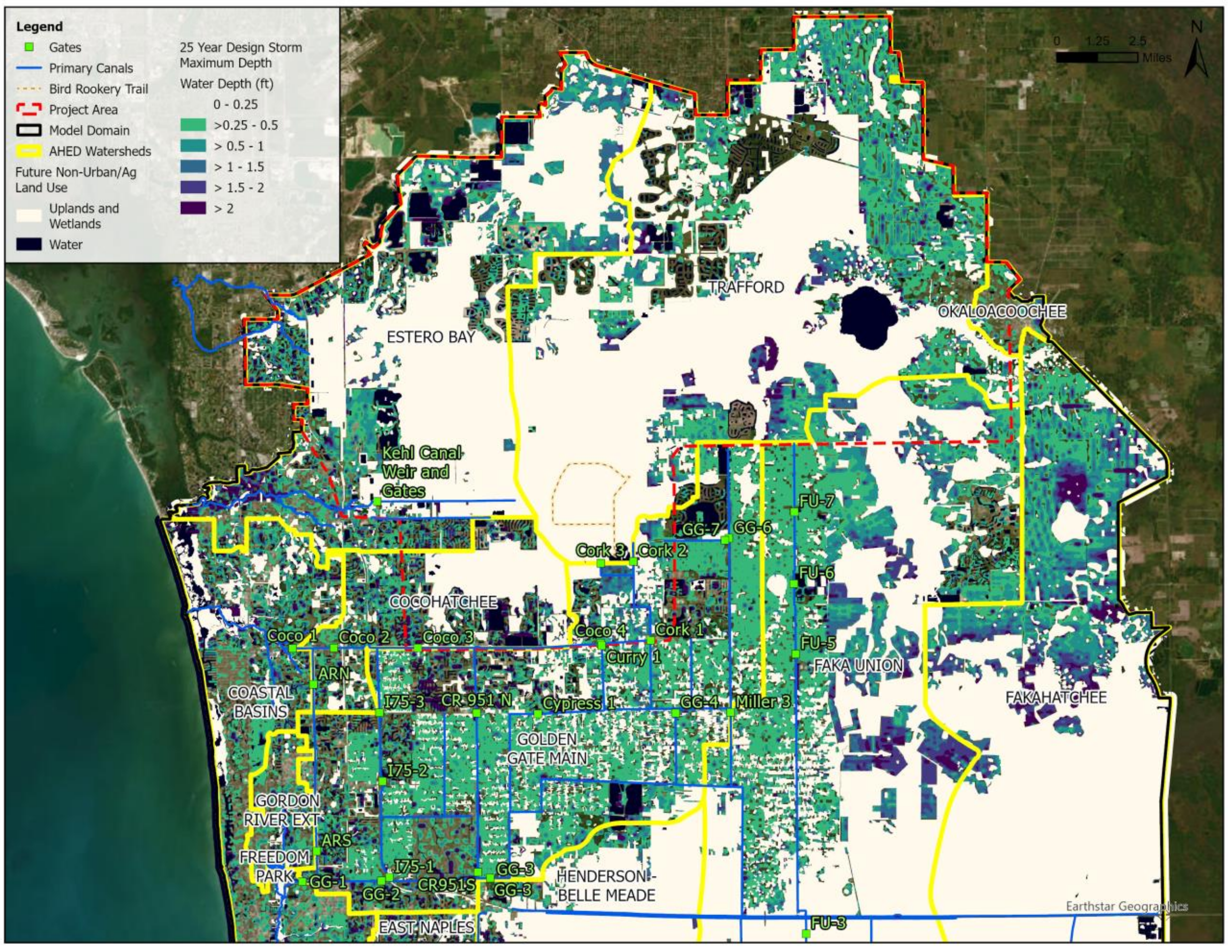

Figure 4-68. FCM Twenty Five-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

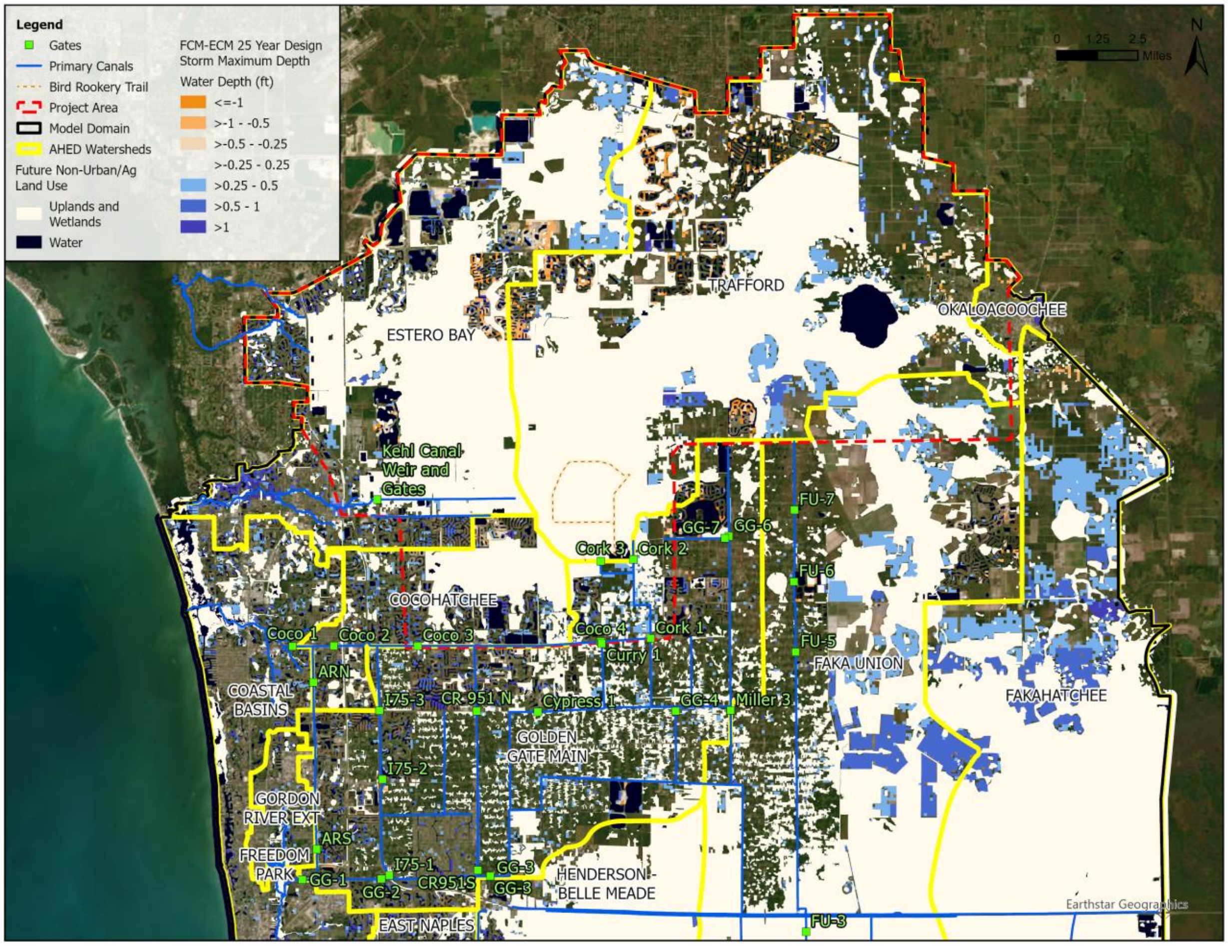

Figure 4-69. Comparison between the FCM and ECM Twenty Five-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

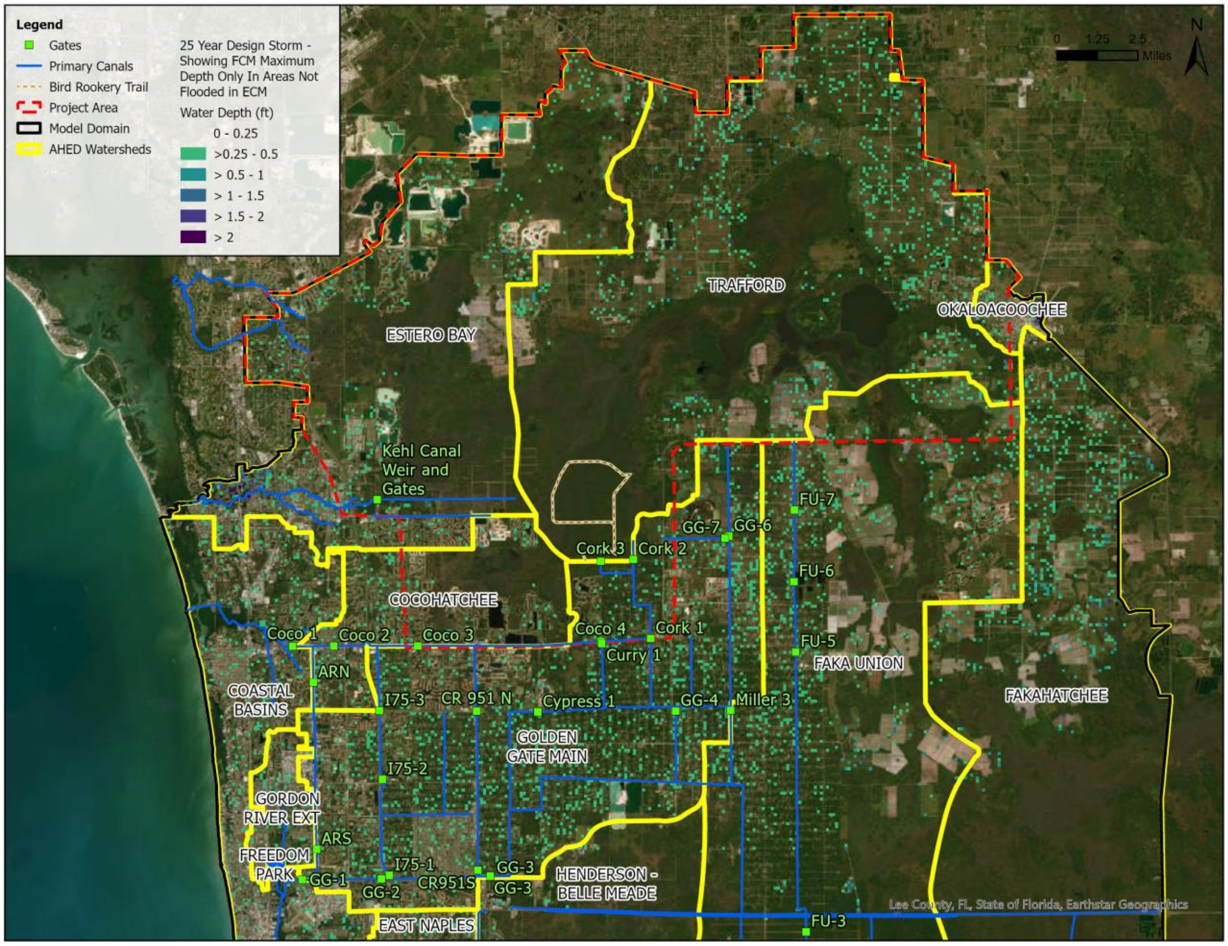

Figure 4-70. FCM Twenty Five-Year Design Storm Peak Flood Depths shown for areas where ponding changed not flooded in the ECM to flooded in the FCM in the Urban and Agricultural Future Land Uses.

Table 4-7. FCM Twenty Five-Year Design Storm Urban and Agricultural Flooded Areas per Basin

Depth (ft)	25-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	5326	1980	14767	22836	10514
0.5 - 1 ft	4132	654	6319	5096	5814
1 - 1.5 ft	2944	316	4362	1573	3065
1.5 - 2 ft	1509	339	3421	626	1842
≥ 2 ft	2152	976	2095	2646	2365

Table 4-8. Comparison between the FCM and ECM Twenty Five-Year Design Storm Urban and Agricultural Flooded Areas per Basin (FCM minus ECM)

Depth (ft)	25-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	654	425	4304	5665	-1716
0.5 - 1 ft	-585	184	-247	2192	-1710
1 - 1.5 ft	379	-63	786	683	-373
1.5 - 2 ft	821	115	2399	132	46
≥ 2 ft	729	218	987	562	373

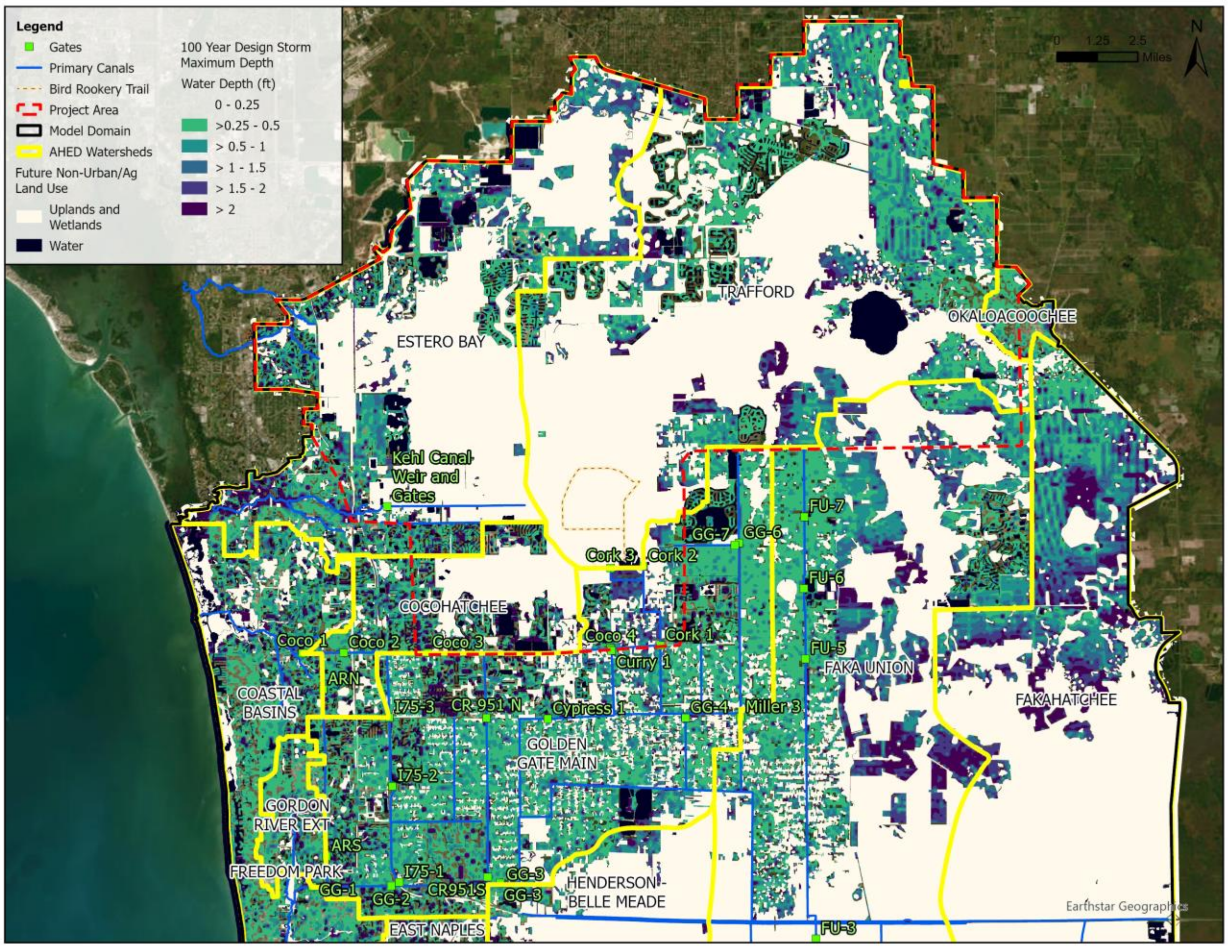

Figure 4-71. FCM Hundred-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

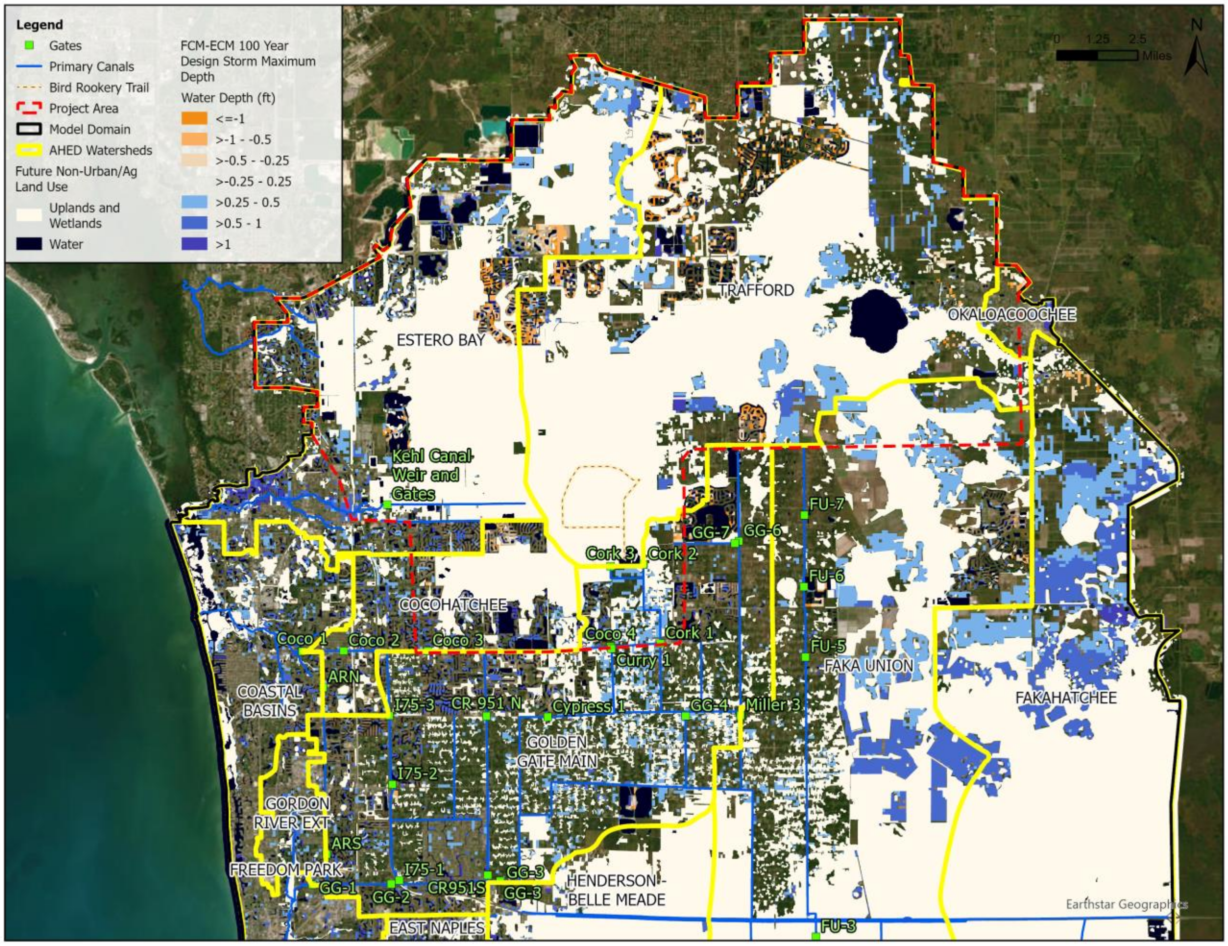

Figure 4-72. Comparison between the FCM and the ECM Hundred-Year Design Storm Peak Flood Depths for Urban and Agricultural Land Uses

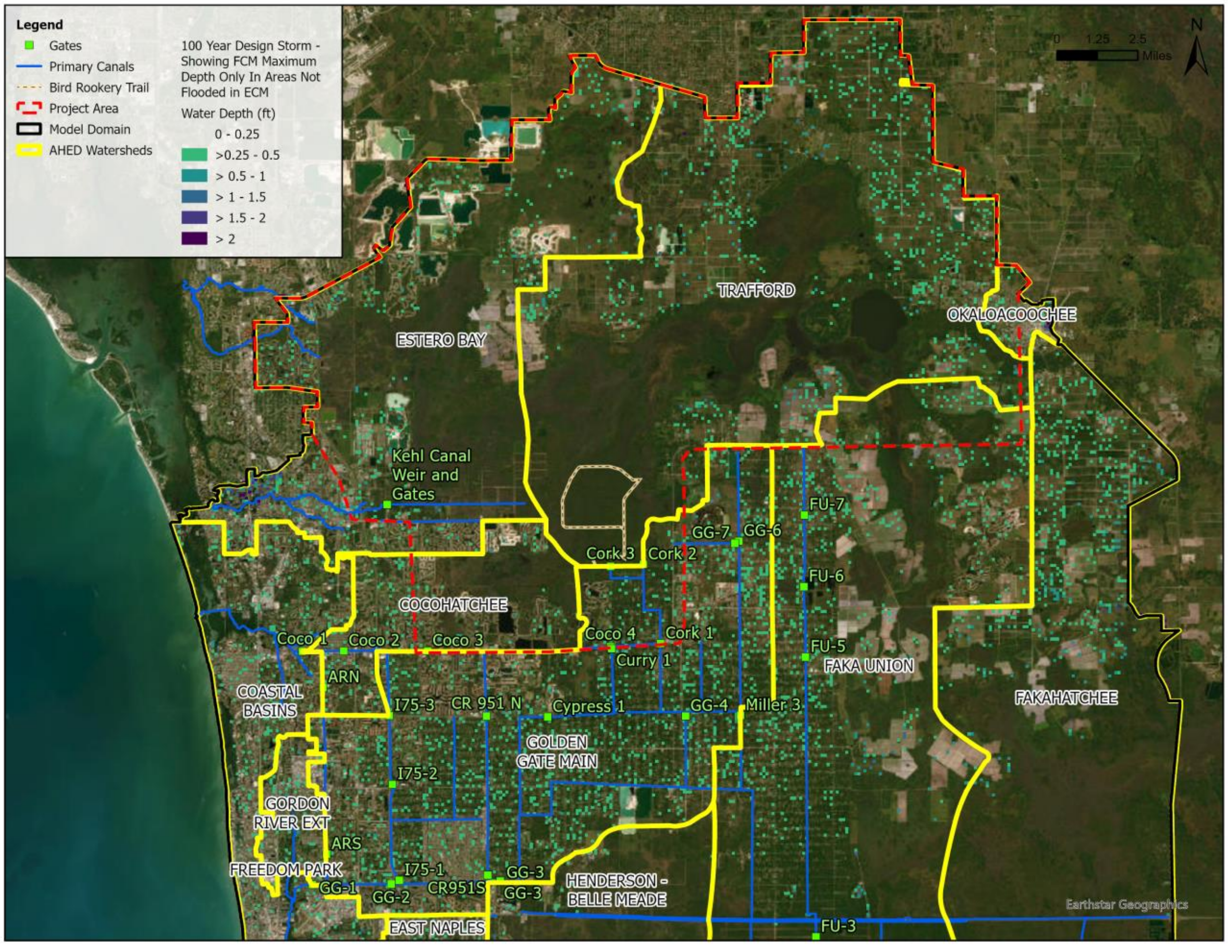

Figure 4-73. FCM Hundred-Year Design Storm Peak Flood Depths shown for areas where ponding changed not flooded in the ECM to flooded in the FCM in the Urban and Agricultural Future Land Uses.

Table 4-9. FCM Hundred-Year Design Storm Urban and Agricultural Flooded Areas per Basin

Depth (ft)	100-yr Design Storm Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	6841	2847	12982	24535	14371
0.5 - 1 ft	4276	981	8620	9912	7449
1 - 1.5 ft	3357	407	5160	3289	4000
1.5 - 2 ft	2399	298	3581	1584	2709
≥ 2 ft	3191	1360	4809	3329	3576

Table 4-10. Comparison between the FCM and ECM Hundred-Year Design Storm Urban and Agricultural Flooded Areas per Basin (ECM minus FCM)

Depth (ft)	100-yr Design Storm				
	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0.25 - 0.5 ft	821	207	1521	1314	-855
0.5 - 1 ft	-218	321	970	3495	-1630
1 - 1.5 ft	-373	98	155	1492	-947
1.5 - 2 ft	935	-23	1119	775	92
≥ 2 ft	1263	344	3157	821	448

In general, the peak flood depths are fairly low for most urban areas, less than 0.5 feet. Some of the agricultural fields have relatively high flood peaks, which is due to lack of storage features and to the assumed drainage infrastructure and operations of the fields.

Differences between the ECM and FCM are relatively small within the project area. These minor changes are due to the changes in land use which lead to changes in storage and drainage parameterization in the model. The largest differences are shown in the Faka Union, Golden Gate Main and Trafford Basins due to increased development and changes from agricultural to urban land uses. New developments include storage ponds that can hold at least a portion of the storm volumes before discharging downstream and were raised to a higher ground elevation based on permit information. This is likely the reason that the Trafford basin shows a lower flood inundation area in the FCM than in the ECM, even with higher rainfall depths. In other basins south of the project area, since some of the land use changes incorporated are based on future land use map projections and do not have permits, several of the developments added do not include the storage and drainage features that would be required by permits and thus drainage is conceptually assumed. Moreover, some of the structural changes in the FCM may have led to lower basin discharges than in the ECM (Table 4-2). For example, in the Golden Gate basin, the I-75 Canal structures show lower discharges; and in the Faka Union basin, the FU-1 weir, shows lower discharges due to the PSRP canal removal. In wetland areas south of the project, large areal increases from the ECM to the FCM are simulated in the PSRP area due to the removal of canals and near the coast due to the SLR boundary condition.

4.2.5 Flood Duration Maps and Areas

The flood duration for the FCM design storm simulations are presented in this section. The results are presented by design storm across the study area in tables and figures.

Figure 4-74, Figure 4-75, Figure 4-76, and Figure 4-77 provide a visual depiction of the simulated flood duration in urban and agricultural land use areas for the 5-, 10-, 25-, and 100-yr design events, respectively.

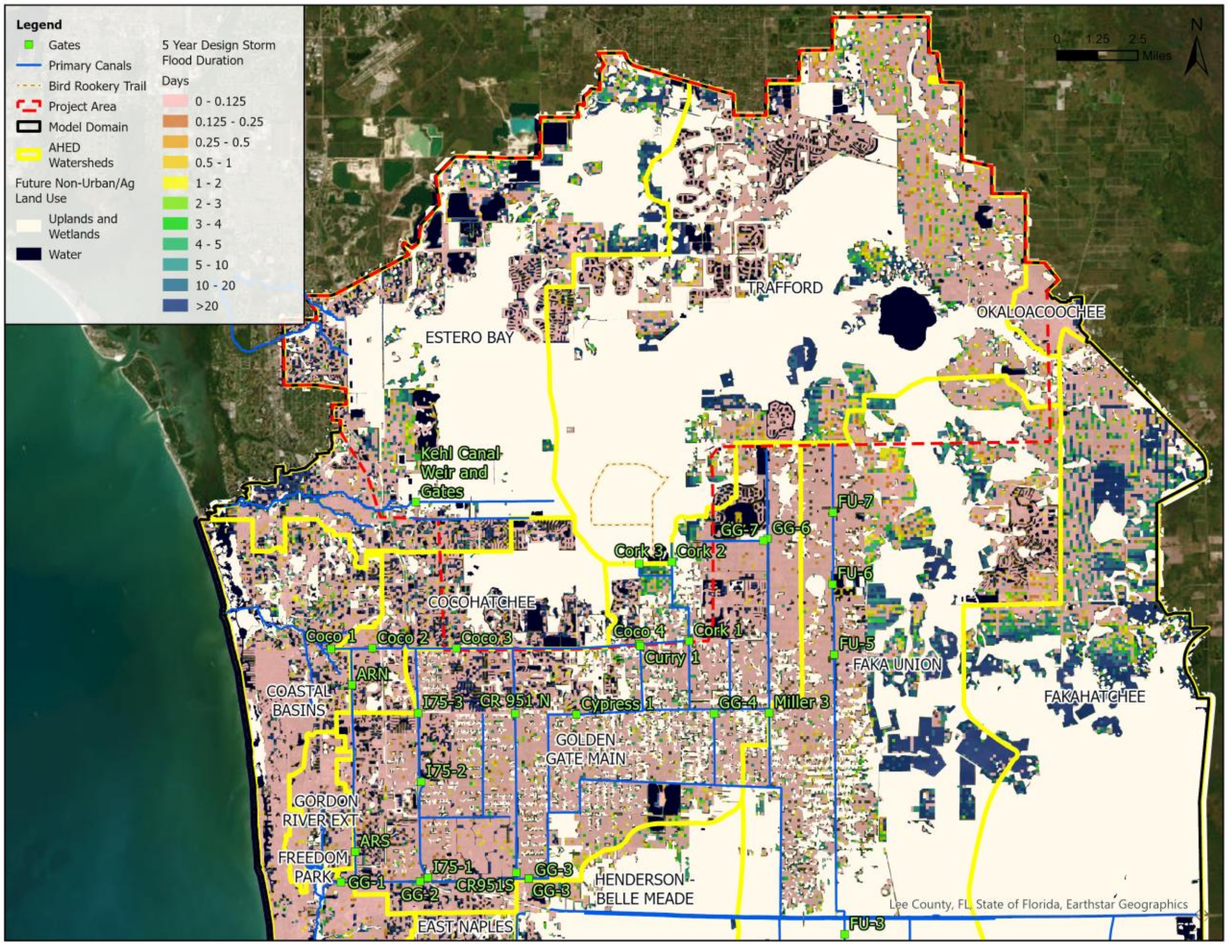

Figure 4-74. FCM Five-Year Design Storm Flood Duration (Days) for Urban and Agricultural Land Uses

Table 4-11, Table 4-13, Table 4-15, and Table 4-17 show the area of inundation in urban and agricultural land use areas based on the flood duration for the 5-, 10-, 25-, and 100-yr design events, respectively.

Table 4-11. FCM Five-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	459	149	1291	1819	1188
0.125 - 0.25	212	29	781	545	476
0.25 - 0.5	344	161	608	671	660
0.5 - 1	620	143	1073	729	1435
1 - 2	551	143	1240	781	1211
2 - 3	413	23	700	442	792
3 - 4	385	52	499	396	568
4 - 5	350	52	465	281	476
5 - 10	1263	121	1923	861	1504
10 - 20	1682	333	2204	373	1377
≥ 20	4723	1062	5917	2376	3765

Table 4-12, Table 4-14, Table 4-16, and Table 4-18 show a comparison between the FCM and ECM (FCM minus ECM) simulated area of inundation in urban and agricultural land use areas based on the flood duration for the 5-, 10-, 25-, and 100-yr design events, respectively.

Table 4-12. Comparison between the FCM and ECM Five-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	23	63	425	907	-155
0.125 - 0.25	0	0	218	115	-253
0.25 - 0.5	69	98	-126	184	-362
0.5 - 1	109	0	92	247	17
1 - 2	-121	6	316	264	-161
2 - 3	-57	-63	115	121	-126
3 - 4	-75	34	11	138	-126
4 - 5	-115	34	80	80	-57
5 - 10	-121	-40	654	551	-52
10 - 20	-34	86	138	178	-304
≥ 20	1590	132	1590	212	-712

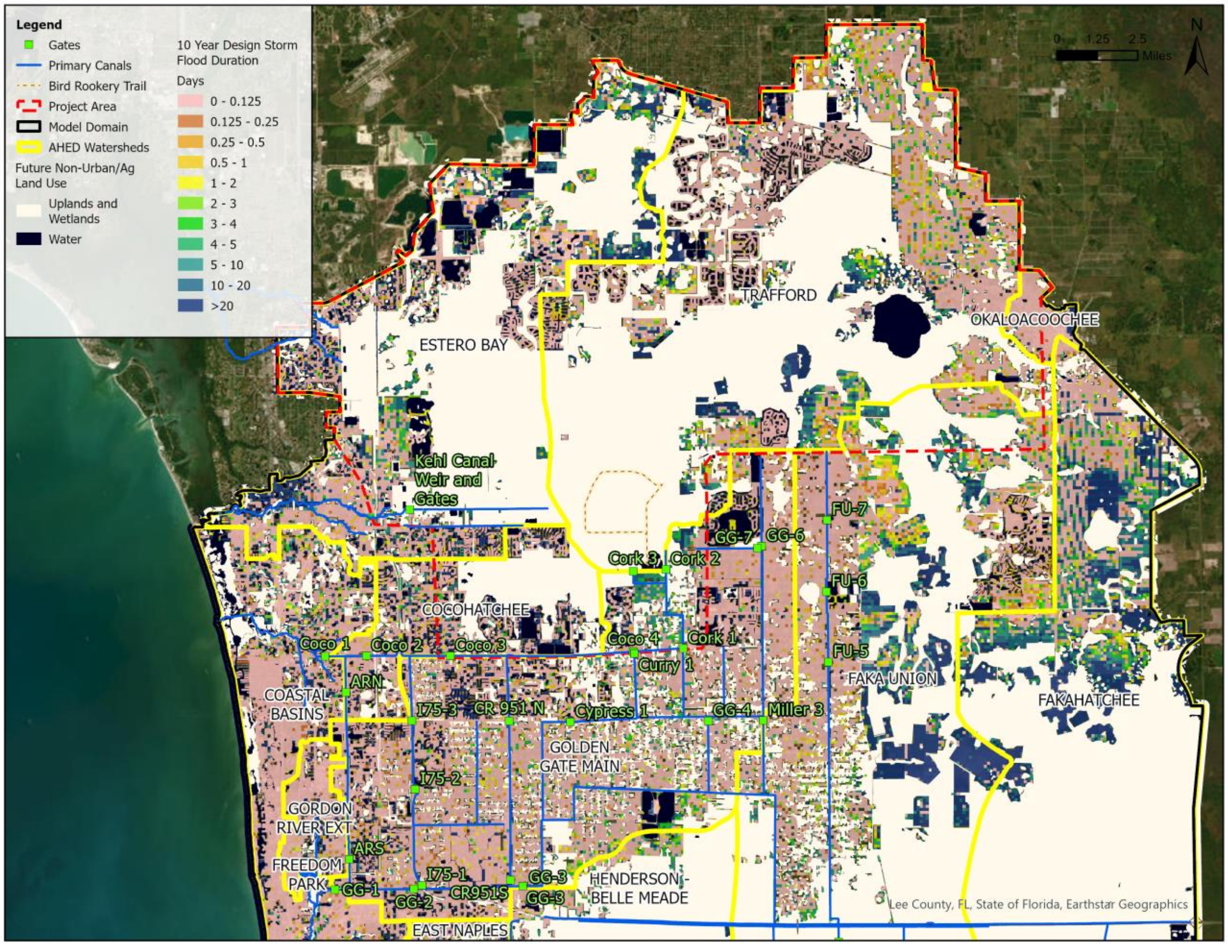

Figure 4-75. FCM Ten-Year Design Storm Flood Duration (Days) for Urban and Agricultural Land Uses

Table 4-13. FCM Ten-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	1154	476	3426	6336	2215
0.125 - 0.25	367	75	1050	1245	976
0.25 - 0.5	333	69	867	999	895
0.5 - 1	626	310	1567	1119	1446
1 - 2	735	161	1538	1257	1573
2 - 3	499	69	935	706	1016
3 - 4	419	69	671	649	666
4 - 5	350	63	511	402	585
5 - 10	1486	161	2146	1573	1745
10 - 20	1796	321	2399	511	1647
≥ 20	5022	1131	6376	2451	4035

Table 4-14. Comparison between the FCM and ECM Ten-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	298	253	1819	3271	-419
0.125 - 0.25	40	11	52	327	-92
0.25 - 0.5	103	-23	-132	201	-362
0.5 - 1	0	149	184	270	-189
1 - 2	-52	11	247	448	-212
2 - 3	6	6	275	184	-52
3 - 4	-155	-17	195	310	-178
4 - 5	-86	6	115	143	-115
5 - 10	-149	40	683	958	-321
10 - 20	-75	40	287	253	-224
≥ 20	1515	143	1354	247	-895

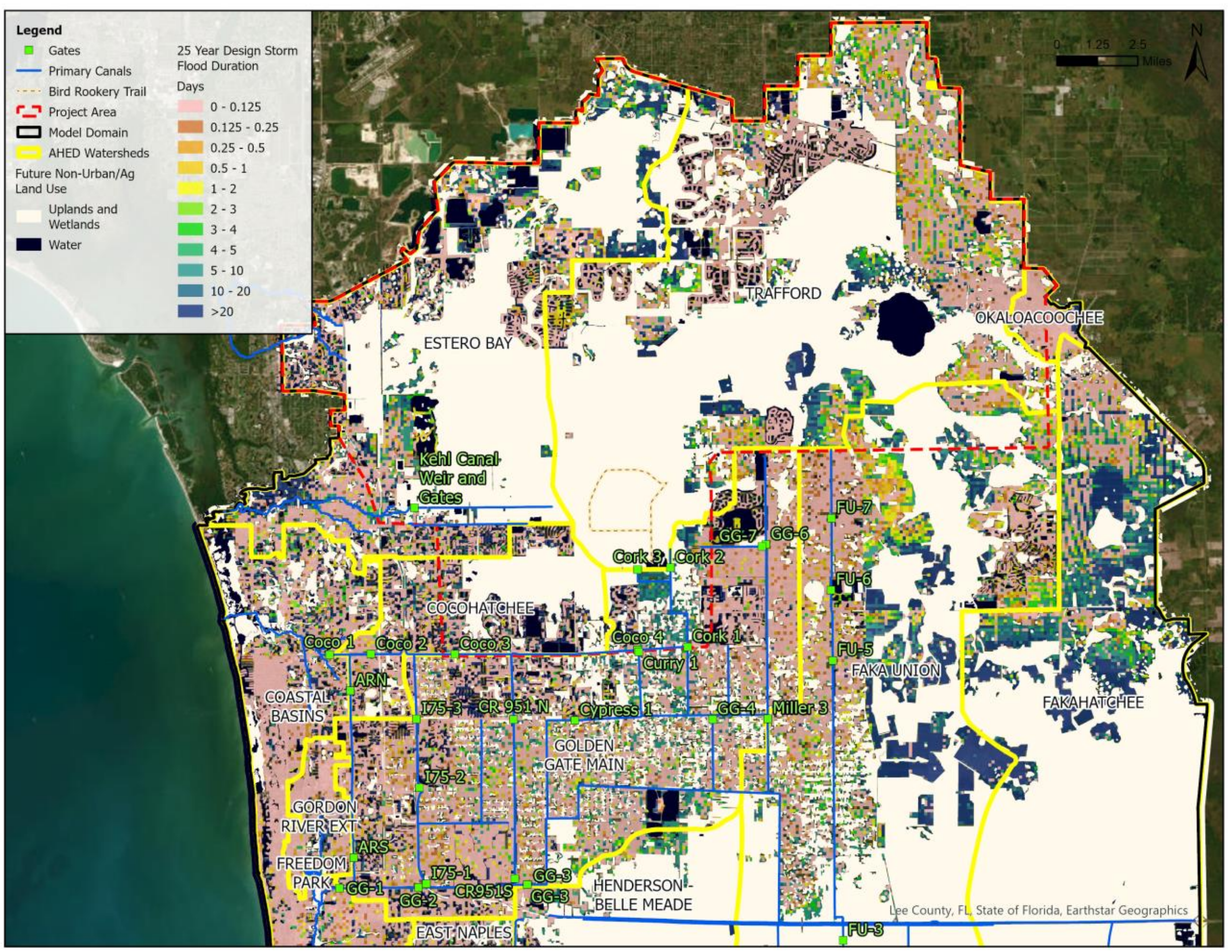

Figure 4-76. FCM Twenty Five-Year Design Storm Flood Duration (Days) for Urban and Agricultural Land Uses

Table 4-15. FCM Twenty Five-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	2709	1412	9275	16988	6129
0.125 - 0.25	580	195	1521	2112	1159
0.25 - 0.5	482	143	1096	1389	1205
0.5 - 1	844	218	1544	1532	1728
1 - 2	878	310	2192	1664	1888
2 - 3	545	103	1326	913	1205
3 - 4	499	52	999	706	1050
4 - 5	430	40	677	683	723
5 - 10	1618	184	2514	2646	2118
10 - 20	2014	327	2870	1624	2037
≥ 20	5475	1280	6962	2531	4356

Table 4-16. Comparison between the FCM and ECM Twenty Five-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	562	419	4058	4666	-143
0.125 - 0.25	40	69	385	344	-430
0.25 - 0.5	143	11	-109	270	-385
0.5 - 1	241	40	-281	327	-425
1 - 2	63	80	499	333	11
2 - 3	-17	0	402	109	-63
3 - 4	-40	23	367	103	149
4 - 5	-6	-29	270	201	-17
5 - 10	-396	17	763	1372	-614
10 - 20	-40	29	763	1245	-235
≥ 20	1446	218	1102	270	-1234

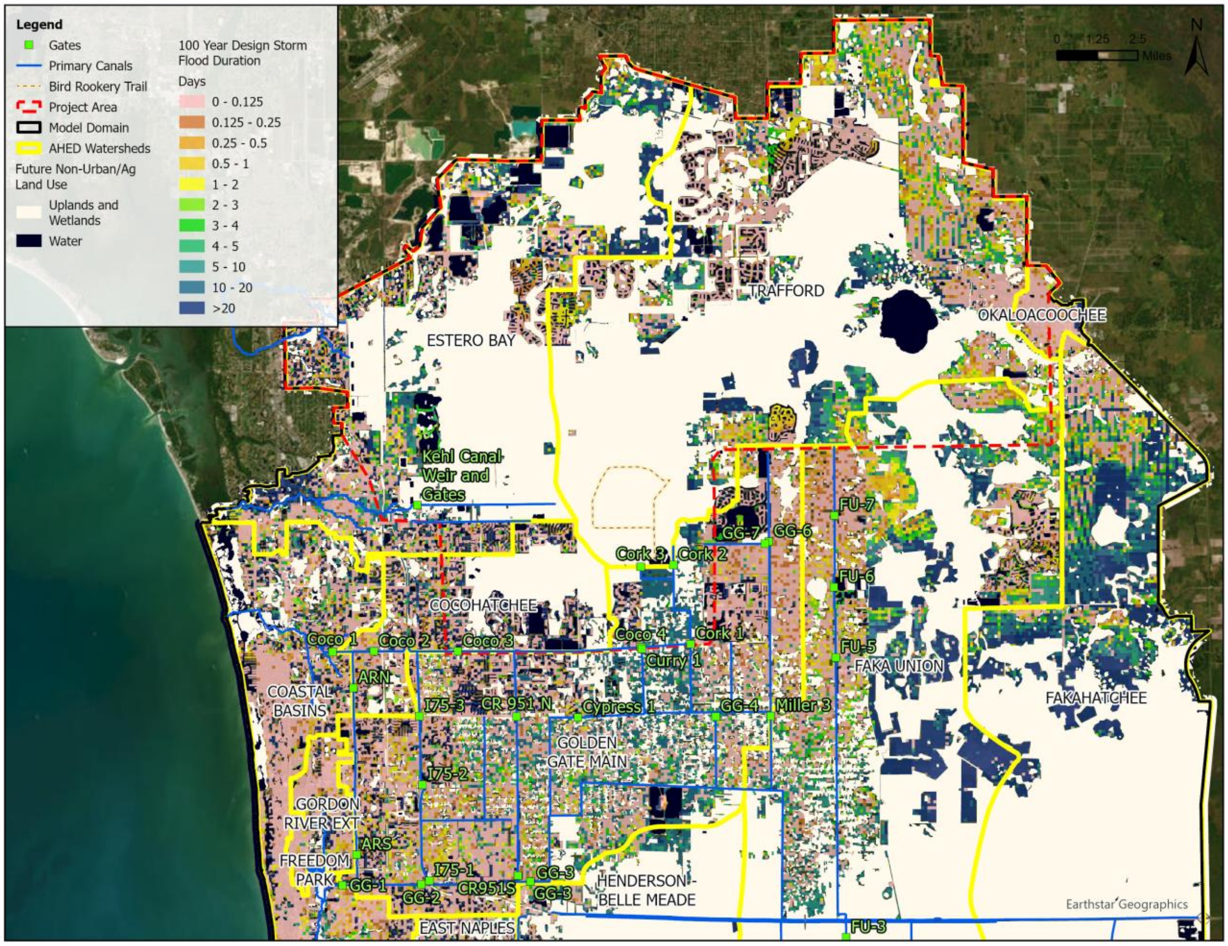

Figure 4-77. FCM Hundred-Year Design Storm Flood Duration (Days) for Urban and Agricultural Land Uses

Table 4-17. FCM Hundred-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	4620	2388	9487	19680	10216
0.125 - 0.25	803	333	1509	2594	1469
0.25 - 0.5	649	201	1188	1475	1234
0.5 - 1	849	258	1946	1905	2554
1 - 2	953	281	1900	1854	2588
2 - 3	660	212	1613	1360	1314
3 - 4	631	86	1165	832	1268
4 - 5	407	63	1010	735	999
5 - 10	2003	235	3759	3616	3099
10 - 20	2439	367	3776	5722	2456
≥ 20	6049	1469	7800	2887	4907

Table 4-18. Comparison between the FCM and ECM Hundred-Year Design Storm Flood Duration Areas for Urban and Agricultural Land Uses

Duration (Days)	Area of Inundation > 0.25 ft in Urban and Agricultural Land Use Area (Acres)				
	ESTERO BAY	COCOHATCHEE	FAKA UNION	GOLDEN GATE MAIN	TRAFFORD
0 - 0.125	895	367	2307	1791	958
0.125 - 0.25	235	103	367	350	-591
0.25 - 0.5	166	-46	-29	-362	-683
0.5 - 1	46	75	-63	57	-189
1 - 2	-46	-6	-241	29	46
2 - 3	11	52	52	241	-224
3 - 4	-17	23	241	-23	-29
4 - 5	-98	11	430	6	80
5 - 10	-92	75	1578	1016	-34
10 - 20	-63	63	1343	4287	-539
≥ 20	1389	230	930	505	-1693

In general, the durations are fairly low for most urban areas, less than 0.5 feet and 1 day, respectively. Some of the agricultural fields have relatively high flood durations due to the lack of storage features and low capacity drainage.

Differences between the ECM and FCM are relatively small within the project area. As described in the previous section, these minor changes are due to the changes in land use which leads to changes in storage and drainage parameterization in the model.

4.3 Wetland Hydrologic Restoration Performance Measures and LTS Results

In this section, maps and tables are presented in support of the wetland hydrologic restoration measures and metrics. Some of the PMs will be quantified and compared with the targets values described in the document *Corkscrew Watershed Initiative Deliverable 3.2: Final Project Performance Measures and Metrics Technical Memorandum*, which will provide an assessment of the existing performance, while some results are shown qualitatively to be compared with the FCM baseline and future alternatives.

In addition to water depths and hydroperiod maps, values are summarized for the different types of vegetation communities based on the District's land use map and for wetland hydrology indicators. Sixty-one wetland hydrology indicator locations for the various types of plant communities in Corkscrew were developed by BCB staff and Audubon's ecological consultant, Mike Duever. Note that some of the plant community categories described in the wetland hydrology indicator dataset differ from the model vegetation categories. The vegetation category classification in the model is based on the SFWMD Land Use Dataset and was conducted during the BCB update as described in the report by Hazen and Sawyer (Hazen, 2025). Two areas along Bird Rookery that were originally classified as Swamp Forest were changed to Marsh based on input from Audubon. Table 4-19 shows the relationship between the wetland vegetation categories in the model and the land use FLUCC codes and Figure 4-78 shows a map of the model vegetation spatial distribution.

Table 4-19. Model Vegetation Categories and SFWMD Land Use Dataset FLUCCS Codes

MIKE SHE Code	Category	FLUCCS Codes
8	Mesic Flatwood	3100, 3200, 3210, 3300, 4110, 4410
9	Mesic Hammock	4200, 4220, 4270, 4271, 4300, 4340, 4370
10	Xeric Flatwood	4130, 2240
11	Xeric Hammock	3220
12	Hydric Flatwood	6240, 6250, 6180
13	Hydric Hammock	4240, 4280, 6191
14	Wet Prairie	6430, 2540
16	Marsh	6400, 6410, 6440
17	Cypress	6200, 6210, 6215, 6216
18	Swamp Forest	6170, 6172, 6190, 6300
19	Mangrove	6120, 6420
20	Water	1660, 5110, 5120, 5200, 5300, 5410, 5420, 5430, 5720, 6510, 8360

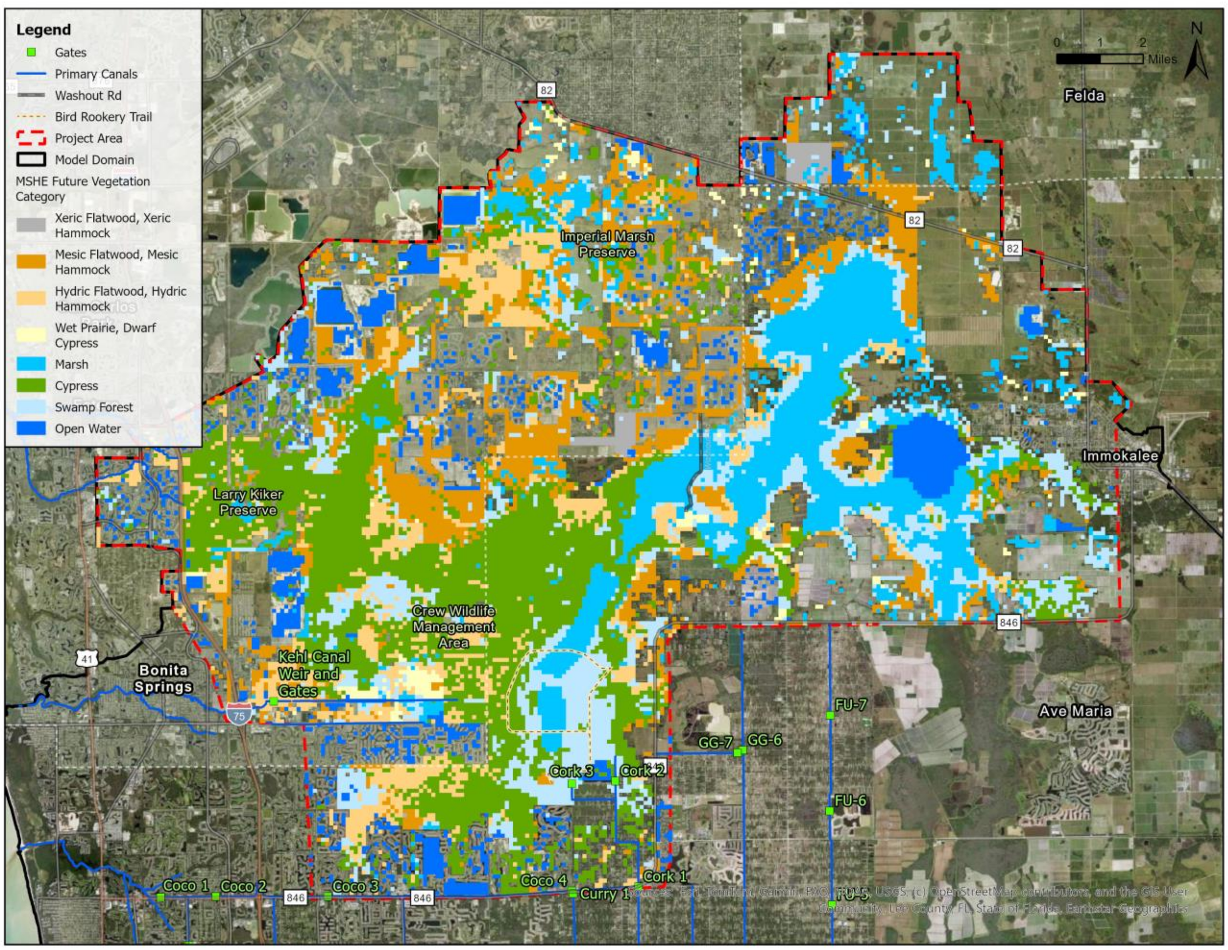

Figure 4-78. Model Wetland Vegetation Categories

Table 4-20 provides a reference for target values for the metrics for Southwest Florida plant communities provided by Mike Duever for the CWI project. Figure 4-79 shows a map of the wetland hydrology indicator locations with a unique indicator ID number for each location. If the description in the indicator point differs from the model vegetation category the point in the map shows the two classifications. Table 4-21 shows a list of all indicator IDs with their descriptions and model vegetation categories. The result averaging calculations for plant communities were conducted according to the model categories, but point values for each indicator location were also extracted and presented in the sections below.

Table 4-20. Hydrologic Regimes of Major Southwest Florida Plant Communities

Plant Community	Hydroperiod (months)	Seasonal Water Depth (inches)	
		Average Wet Season	Average Annual Minimum Depth
Xeric Flatwood and Hammock	0	≤-24	< -56
Mesic Flatwood and Hammock	≤1	≤2	-48 to -56
Hydric Flatwood and Hammock	1-2	2-6	-42 to -48
Wet Prairie and Dwarf Cypress	2-6	6-12	-38 to -42
Marsh	6-10	12-24	-26 to -38
Cypress	6-8	12-18	-31 to -38
Swamp Forest	8-10	18-24	-26 to -31
Open Water	>10	>24	> -26

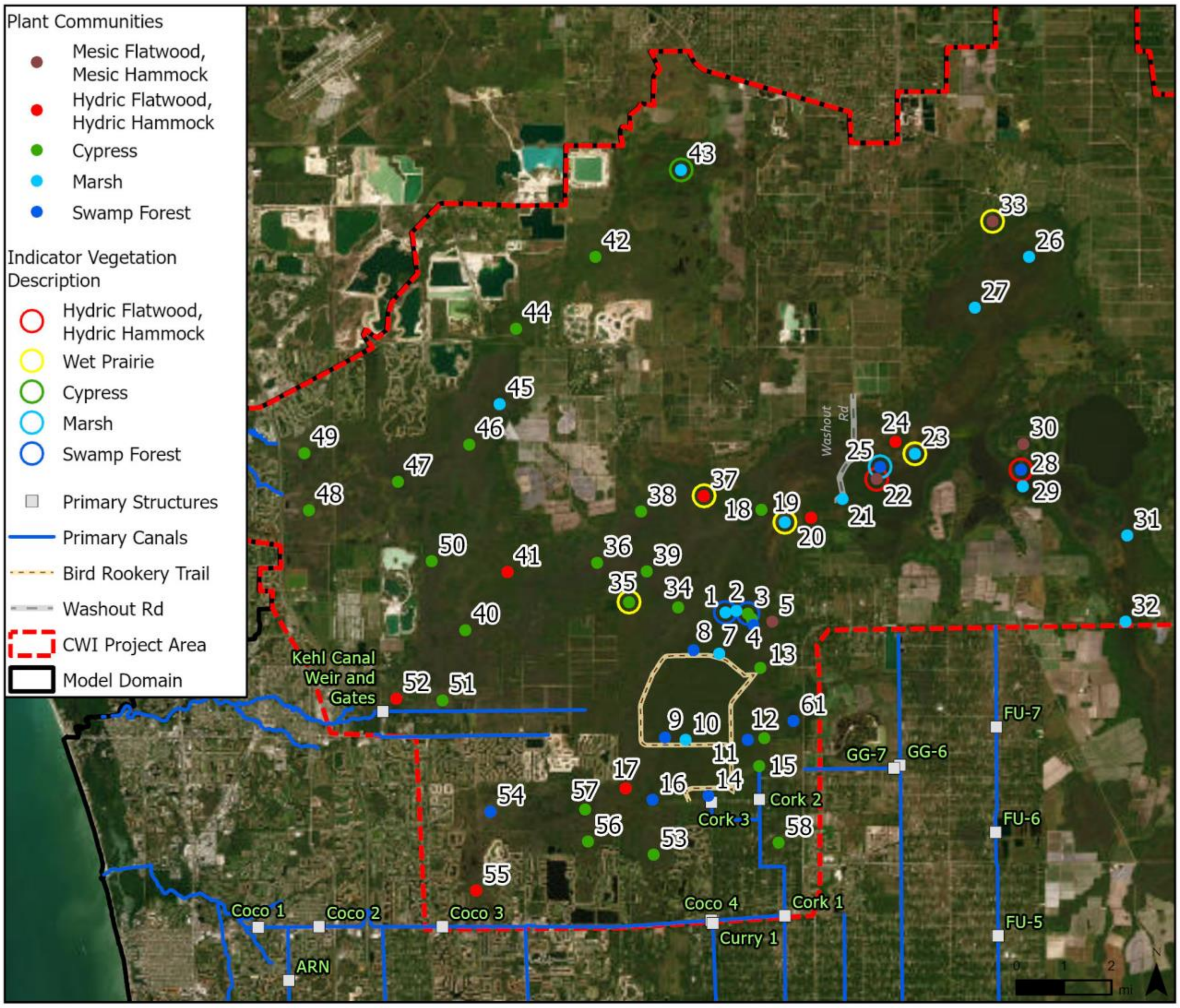

Figure 4-79. Wetland Hydrology Indicators for the Various Plant Communities in Corkscrew.

Table 4-21. Indicator IDs with the Indicator Description and Model Vegetation Category.

ID	Indicator Description	Model Vegetation Category
1*	Swamp Forest	Marsh
2	Marsh	Marsh
3*	Swamp Forest	Cypress
4	Cypress	Cypress
5	Pine	Mesic Flatwood and Hammock
6	Hammock	Swamp Forest
7	Marsh Upstream of South Dike	Marsh
8	Western Main Flow North of North Dike	Swamp Forest

ID	Indicator Description	Model Vegetation Category
32	Marsh	Marsh
33*	Wet Prairie	Marsh
34	Cypress	Cypress
35*	Wet Prairie	Cypress
36	Gordon Swamp	Cypress
37*	Wet Prairie	Hydric Flatwood and Hammock
38		Cypress
39	Cypress Flow Diversion to Lee	Cypress

ID	Indicator Description	Model Vegetation Category
9	Western Flowway Bird Rook Trail N side	Swamp Forest
10	Marsh	Marsh
11	Eastern Flowway	Swamp Forest
12	Cypress (shell bed)	Cypress
13	Eastern Flowway S Dike (Shell?)	Cypress
14	Cork 3 Indicator	Swamp Forest
15	Cork / GGE Indicator	Cypress
16		Swamp Forest
17		Hydric Flatwood and Hammock
18	Cypress	Cypress
19*	Wet Prairie	Marsh
20	Hydric Pine	Hydric Flatwood and Hammock
21	South smaller flowway (berm removal?)	Marsh
22*	Hydric Flatwoods	Mesic Flatwood and Hammock
23*	Wet Prairie	Marsh
24	Hydric Pine	Hydric Flatwood and Hammock
25*	Marsh	Swamp Forest
26	Marsh	Marsh
27	Marsh	Marsh
28*	Hydric Pine	Swamp Forest
29	Marsh	Marsh
30	Hammock Mesic	Mesic Flatwood and Hammock
31		Marsh

ID	Indicator Description	Model Vegetation Category
40	Cypress	Cypress
41	Pine/Cypress mix	Cypress
42		Cypress
43*	Cypress	Marsh
44	Cypress	Cypress
45		Marsh
46		Cypress
47		Cypress
48		Cypress
49	Cypress	Cypress
50	Cypress	Cypress
51	Cypress near Kehl	Cypress
52	Mix/Kehl WCS	Hydric Flatwood and Hammock
53	Bonita Bay Indicator	Cypress
54		Swamp Forest
55		Cypress
56	Quarry Cypress Indicator	Cypress
57		Cypress
58		Cypress
59		Mesic Flatwood and Hammock
60		Cypress
61		Marsh

Indicator ID with * show locations where descriptions differ from the model vegetation category. Not all indicators have a description.

4.3.1 Wet Season Water Depth

The purpose of the wet season depth metric is to assess the volume of surface water for the various plant communities so that aquatic fauna can build up their populations through the wet season. Wet season depths are averaged for the period of July 1 to September 30 to capture the wettest portion of the wet season after the raising water table in June and before the decline in October (Duever, 2024). Deliverable 3.2 specifically defines the average daily wet season PM as the median wet season water depth from July 1 to September 30 averaged over the five simulation years. To calculate the wet season water depths above ground, the higher resolution CWI corrected LiDAR was subtracted from the simulated median wet season water table for each year at the model resolution (500 feet). The CWI corrected LiDAR is described in Deliverable 5.1.3. The negative differences were set to zero, thus the minimum wet season water depth is zero.

Figure 4-80 shows the simulated median wet season water table elevation averaged over the 5-year simulation period. The wet season water table values range from high to low twenties in ft-NAVD in the northern portions of Corkscrew to around 10 ft-NAVD in the south central and western portions.

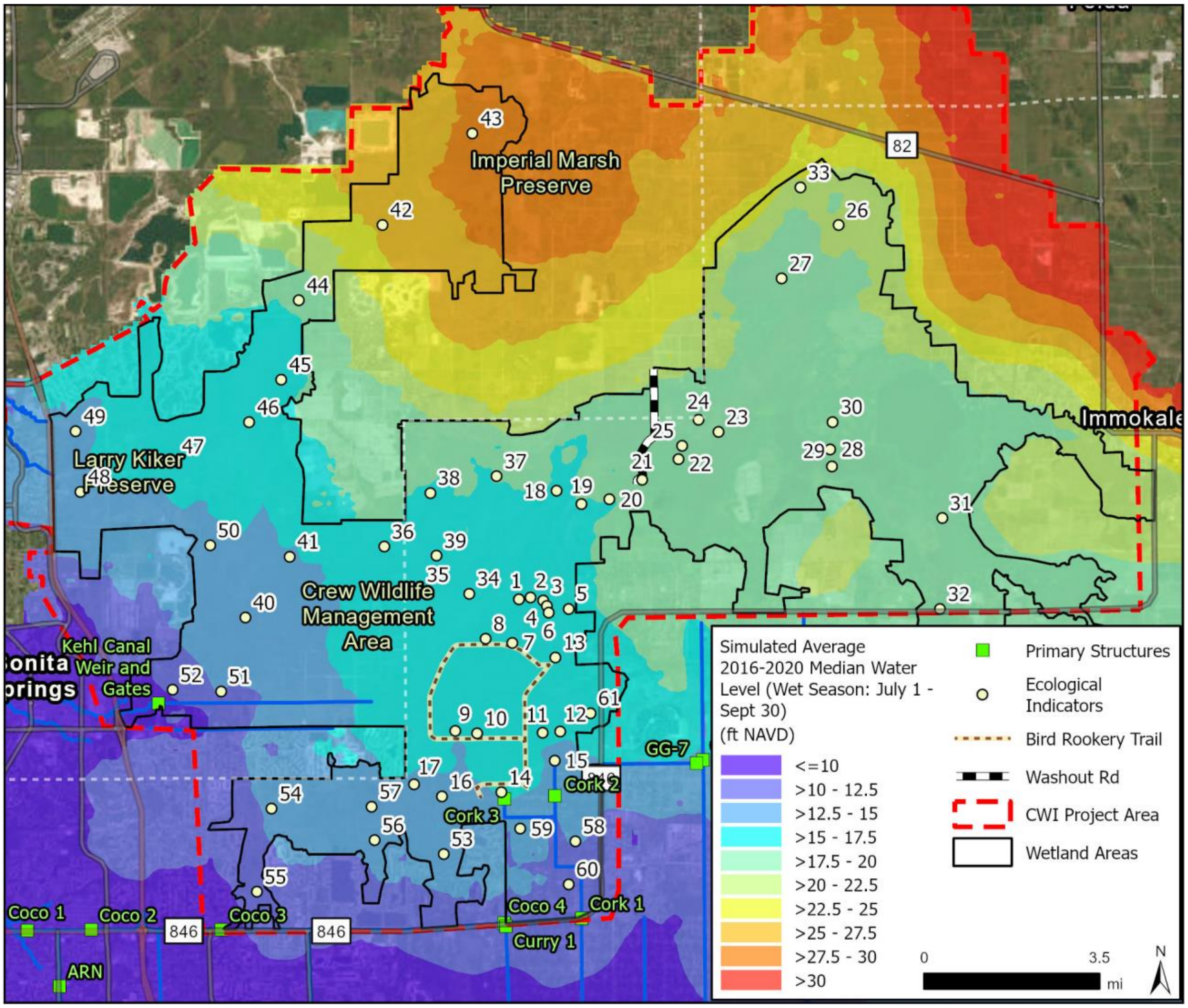

Figure 4-80. FCM Simulated Median Wet Season (July to end of September) Water Levels Averaged Over Five Years.

Figure 4-81 shows the simulated median wet season depths with negative differences set to zero averaged over the 5-year simulation period and Figure 4-82 shows a comparison between the FCM and the ECM simulated average wet season depths. The values for both figures are in inches. The comparison map shows the effect of added storage in the new developments increasing the wet season water table in those areas. While this increase is mostly within the development areas, the increased water table in the Corkscrew Grove Villages development seems to have some effect of increasing the water table downstream in the northern portions of the Corkscrew Marsh.

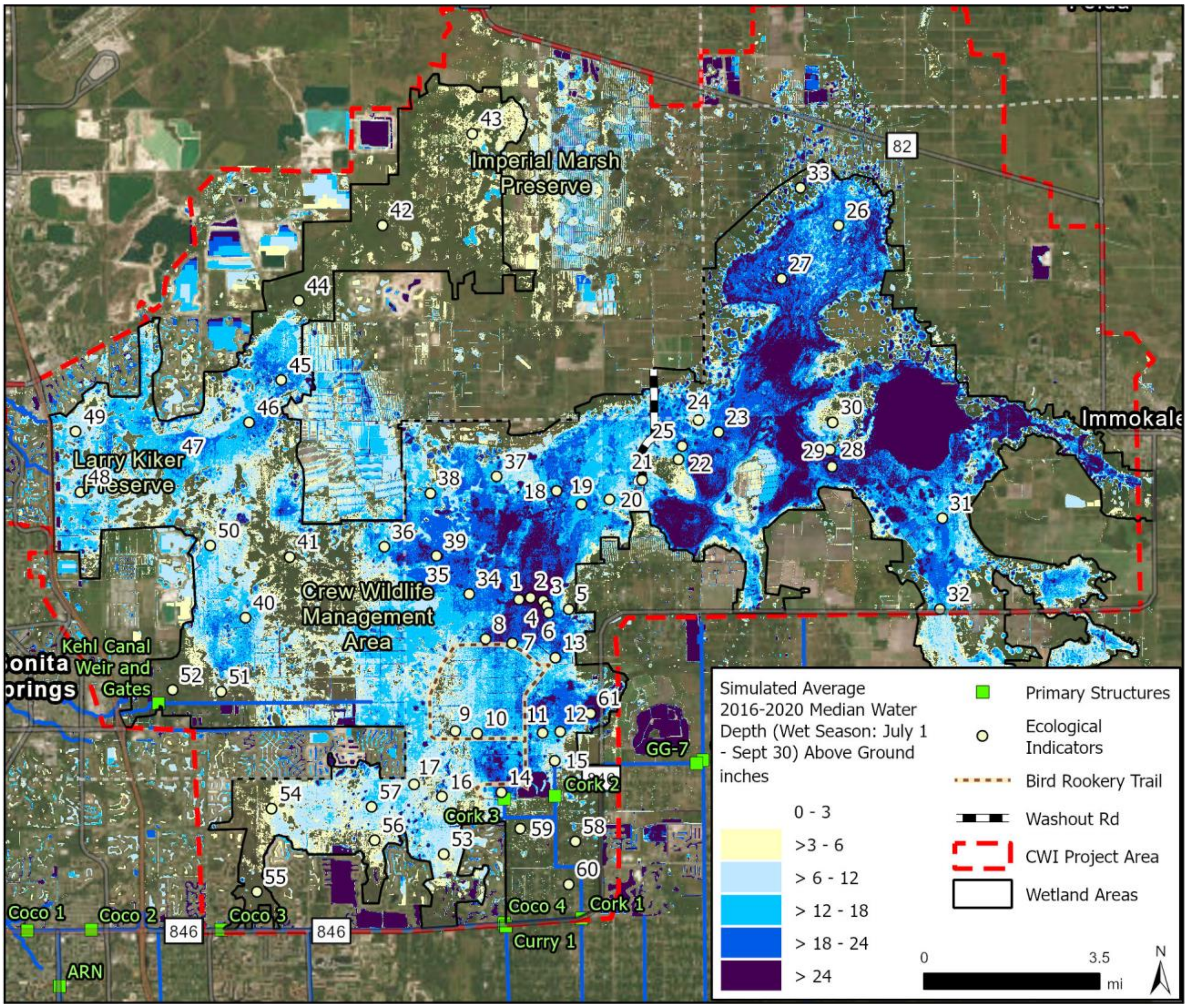

Figure 4-81. FCM Simulated Median Wet Season (July to end of September) Depths Averaged Over Five Years.

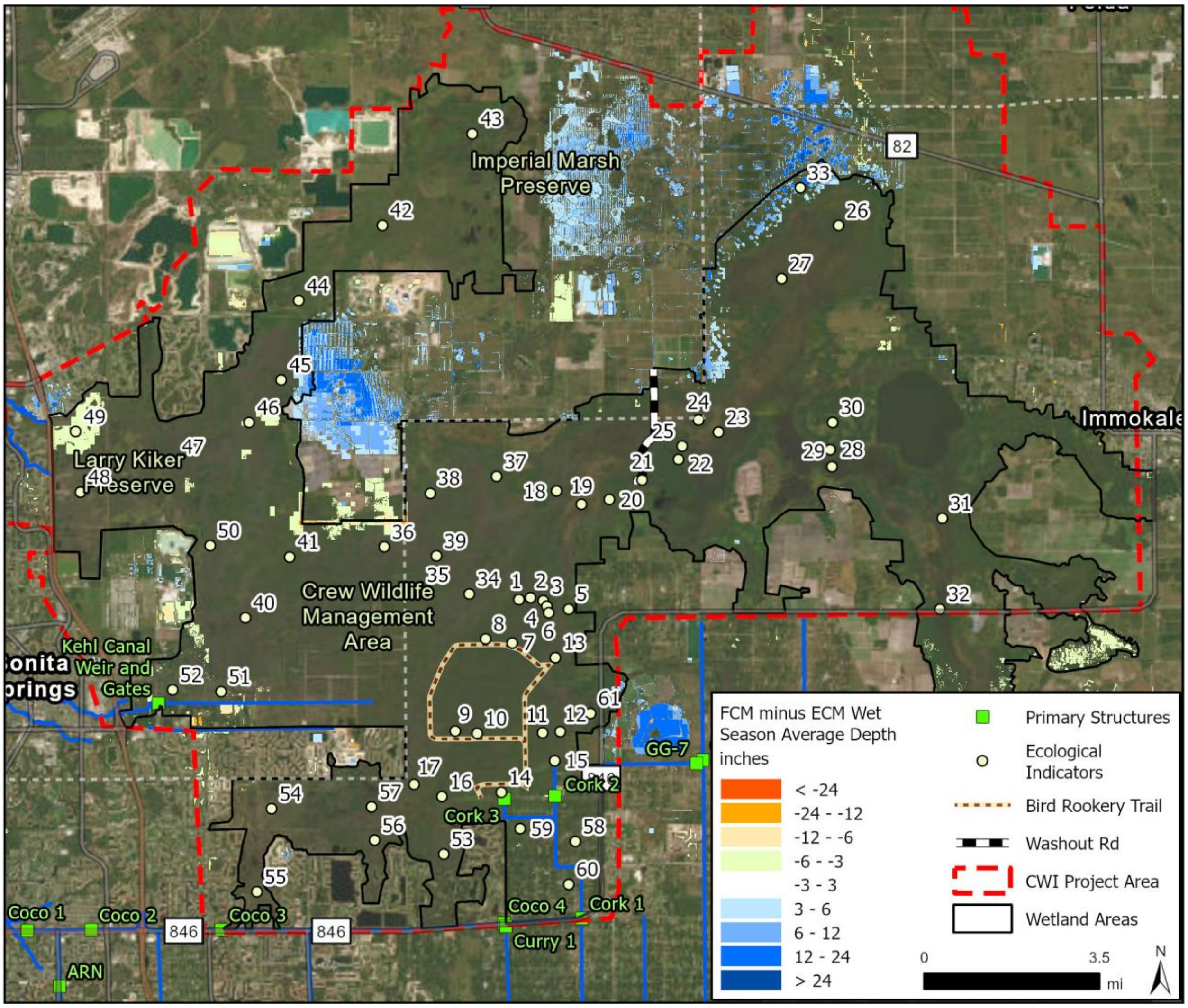

Figure 4-82. Comparison between FCM and ECM Wet Season Average Depths

Figure 4-83 shows the simulated average wet season depths compared against the reference target depths by plant community shown in Table 4-20 and the spatial definition of plant communities utilized in the model, as shown in Figure 4-78. The comparison to the reference target in Figure 4-83 is only shown within the Corkscrew wetland areas and the extents of the indicator locations (black outline). Areas in blue in Figure 4-83 are above the reference target range for the defined plant community in that area, areas in orange area below the reference target range, and areas with no color are within the target range. In general, the areas east of Washout Road and northcentral Corkscrew show above target depths and areas north of Corkscrew Road, Flint Pen, and south Corkscrew show below target depths.

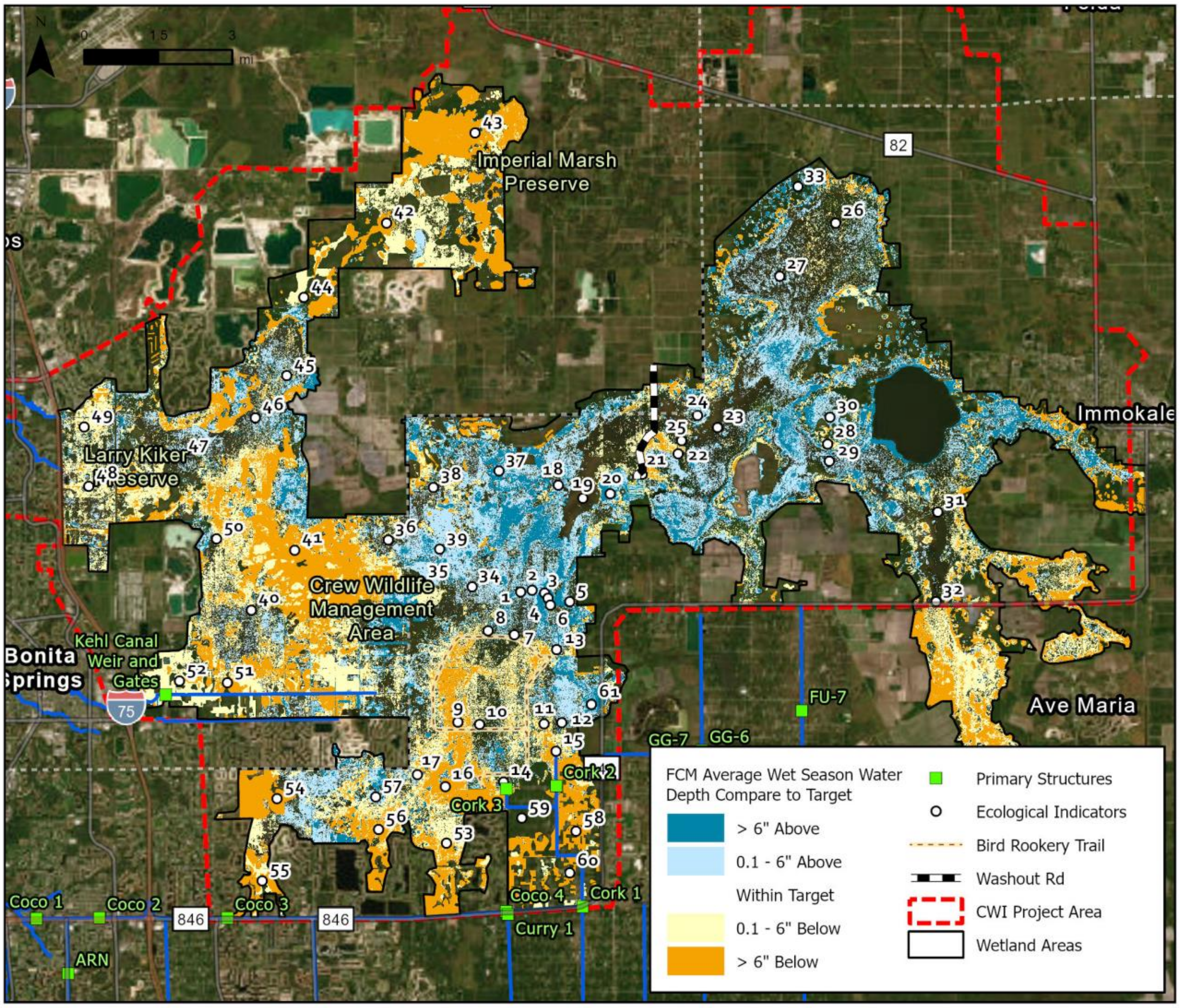

Figure 4-83. Comparison between FCM Average Wet Season and Wet Season Reference Target Ranges.

Table 4-22 shows the FCM median wet season depths in inches for each year averaged over each of the plant communities as classified in the model, that is, the average for the model cells that are in each plant category in the CWI project area (Figure 4-78, Table 4-19). The values are highlighted in blue if they are above the reference and in orange if they are below the reference. In general, the upland plant communities are above the target reference range and wet prairie, cypress, and swamp forests are below the target reference range.

Table 4-22. FCM Median Wet Season Depths for Plant Communities (inches)

Plant Community	2016	2017	2018	2019	2020	5yr Avg.	Reference Value[1] (in)
Xeric Flatwood, Xeric Hammock	6.4	7.0	3.3	4.7	2.5	4.8	≤-24
Mesic Flatwood, Mesic Hammock	4.8	5.7	3.0	3.7	2.3	3.9	≤2
Hydric Flatwood, Hydric Hammock	7.3	9.2	4.8	6.5	3.7	6.3	2-6
Wet Prairie, Dwarf Cypress	7.3	11.6	4.9	6.1	2.7	6.5	6-12
Marsh	19.9	20.9	16.5	17.1	14.6	17.8	12-24

Plant Community	2016	2017	2018	2019	2020	5yr Avg.	Reference Value[1] (in)
Cypress	13.7	15.4	10.0	12.5	8.9	12.1	12-18
Swamp Forest	14.6	16.2	11.0	12.4	9.2	12.7	18-24
Open Water	48.8	50.3	44.9	47.3	43.0	46.8	>24

[1] Reference values for wet season depths (Table 4-20)

Above reference

Below reference

Figure 4-84 shows a plot of the FCM and ECM median wet season depths averaged over the five simulation years for each of the wetland hydrologic indicators in inches and grouped by model vegetation categories. The plots include the wet season reference range minimum and maximum values for each plant community from Table 4-20. The indicator locations and plant community classifications are shown in Figure 4-79. Note that the Indicator IDs with an asterisk are in locations where the description for the indicator point differs from the model vegetation category. The indicators with descriptions that differ from the model vegetation categories are displayed again using their indicator description categories and corresponding targets in Figure 4-85. For example, indicator ID 19 (southwest of Washout Road) is classified as marsh in the model and as wet prairie in the indicator description. If classified as marsh, this area is within the wet season target range, but is classified as wet prairie, it is above the target range.

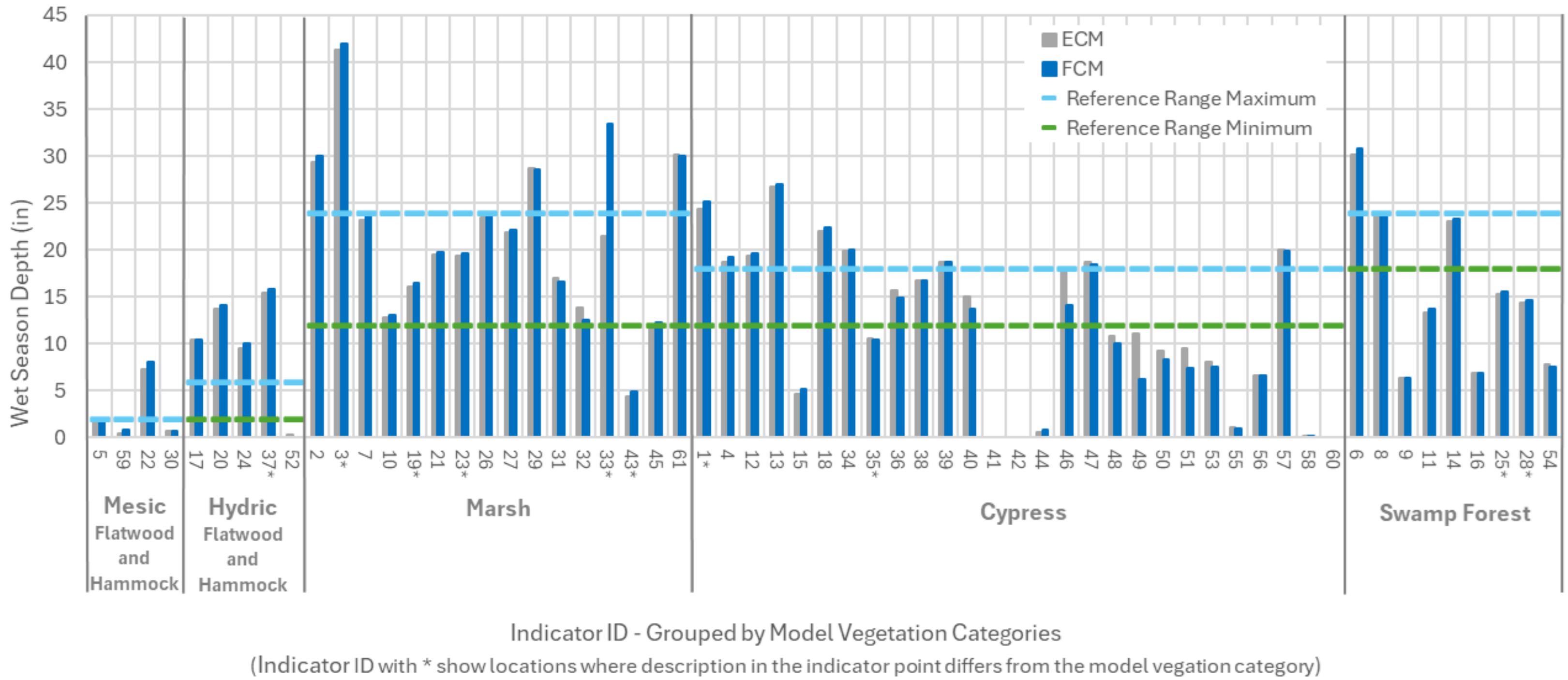

Figure 4-84. ECM and FCM Median Wet Season Water Depth for the Wetland Hydrology Indicators Averaged Over the Five Simulation Years and Grouped by Model Vegetation Category.

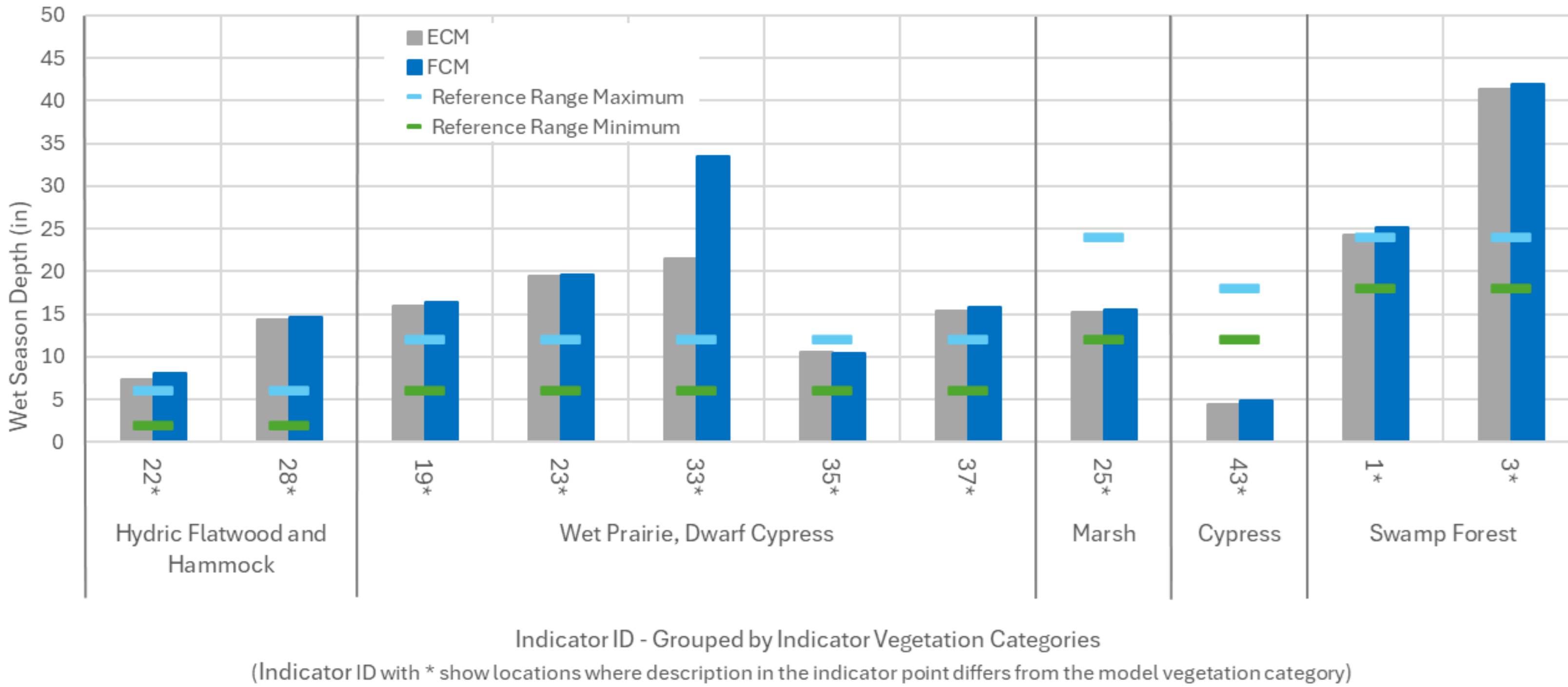

Figure 4-85. ECM and FCM Median Wet Season Water Depth for the Wetland Hydrology Indicators (where description in the indicator points differs from model vegetation category) Averaged Over the Five Simulation Years and Grouped by Indicator Vegetation Category.

Figure 4-86 and Figure 4-87 show the FCM wet season depths above and below the plant community reference range using the model vegetation classification and the indicator dataset classification where it differs, respectively. The indicators in the plots are grouped by location in the various Corkscrew areas. The plots show a similar spatial trend as the map in Figure 4-83 but provide a range of values above and below the targets within each of the areas. In general, the wettest areas in relation to the target references are in central Corkscrew, east and west of Washout Road. In the Bird Rookery area, the areas near the southern trail and closer to the downstream primary system drainage system are drier relative to the reference targets and those that are north of the northern trail are wetter. The area along the Flint Pen basin and near the Kehl Canal are drier than the reference target.

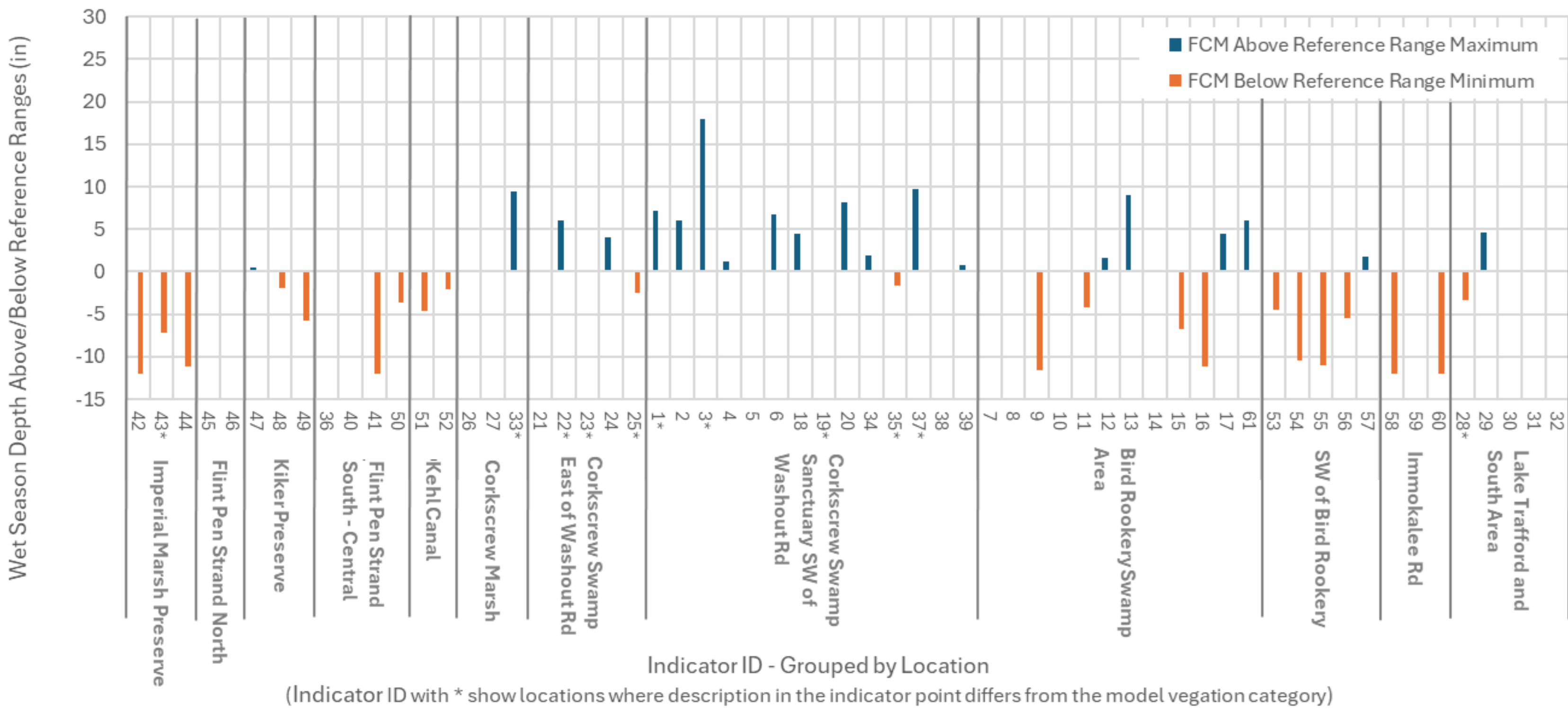

Figure 4-86. FCM Median Wet Season Water Depth for the Wetland Hydrology Indicators Averaged Over Five Years and Compared with the Wet Season Water Depth Reference Range Minimum and Maximum Values for their Respective Model Vegetation Categories and Grouped by Location.

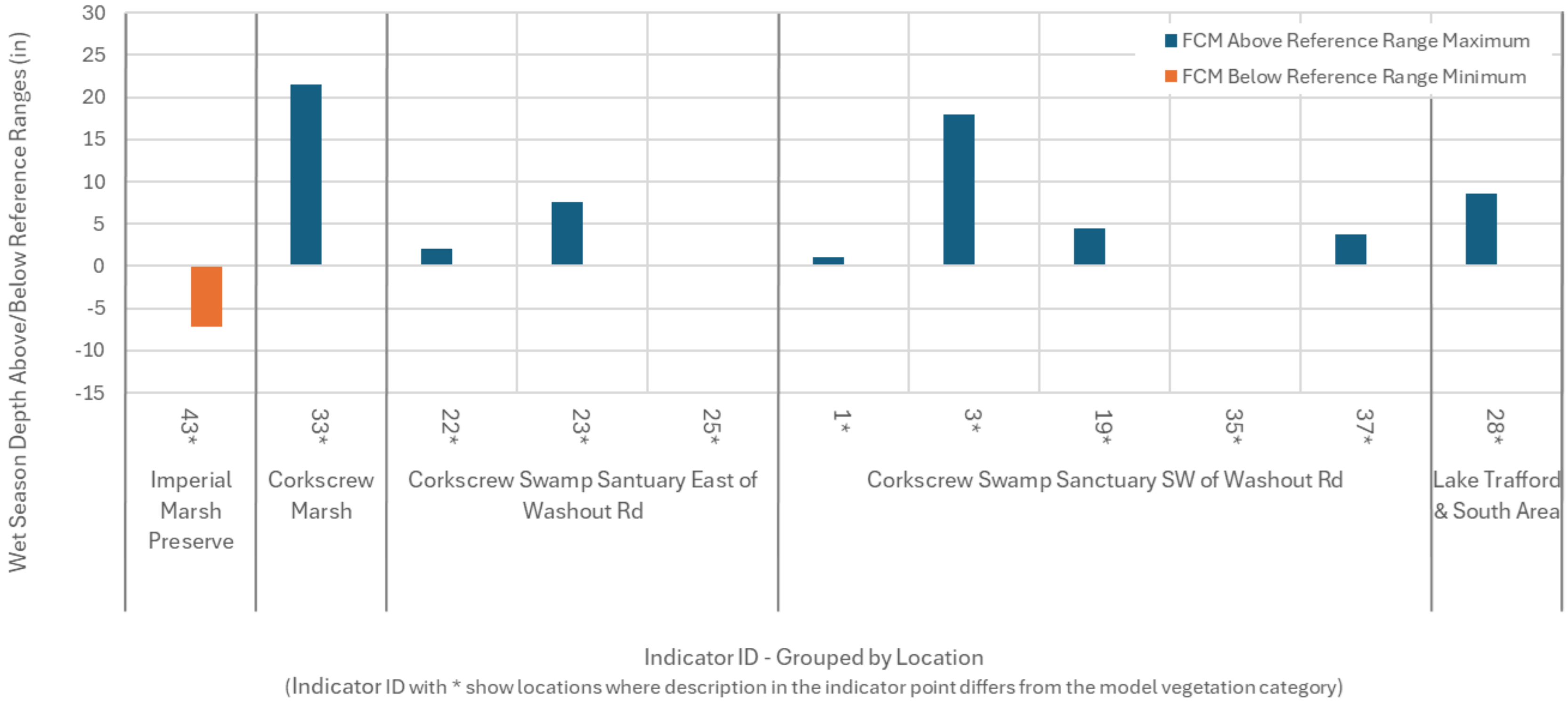

Figure 4-87. FCM Median Wet Season Water Depth for the Wetland Hydrology Indicators (where description in the indicator points differs from model vegetation category) Averaged Over Five Years and Compared with the Wet Season Water Depth Reference Range Minimum and Maximum Values for their Respective Indicator Vegetation Categories and Grouped by Location.

4.3.2 Dry Season Water Depth

This metric provides an assessment of dry conditions necessary for: "1) germination and survival of some important wetland plant species; 2) provide wetland foraging sites for numerous species of predators during their breeding season; 3) annual aeration of wetland substrates that can be critical to the survival of wetland plants; and 4) create appropriate fire conditions that maintain the diversity of natural southwest Florida plant communities" (Duever, 2024).

This metric was changed from the original definition Deliverable 3.2, which was the median water level during the dry season months, from November 1 - May 31. A change in the metric was recommended by TWG members after a recent analysis of the Picayune Strand Restoration Project data. It was argued that the minimum water elevation would better reflect the dry season low water levels than the dry season median (i.e., the 50th percentile). This dry season low is a critical value that can negatively impact the wetland communities, particularly with regard to the aquatic food web and in creating susceptibility to fire conditions. In addition, it was noted that often the dry season minimum occurs during June. Further discussions and analyses conducted by the TWG members and the project team led to a new definition of the dry season metric as the 10th percentile water depth during the period of March 1 to June 30. This statistic would better reflect the dry season low values than the median and would also provide a higher level of confidence than the minimum, which could be a short duration, low probability value or may result from a numerical glitch in the model. The analysis that led to this recommendation is summarized in the document *Evaluation of Dry Season Definitions and Low Water Level Statistics Technical Memorandum* prepared by Wetland Solutions and J-Tech.

To extract results for this metric, the 10th percentile water table elevation during the period of March 1 to June 30 was calculated for each simulation year and then the high resolution corrected CWI LiDAR was subtracted from the calculated water table.

Figure 4-88 shows the simulated 10th percentile dry season water table elevation averaged over the 5-year simulation period. The values range from mid-twenties (ft-NAVD) in the northern portions of the Imperial Marsh and the low twenties in the northern portions of the Corkscrew Marsh to as low as around 7.5 ft-NAVD in the southern portions of Flint Pen and Corkscrew.

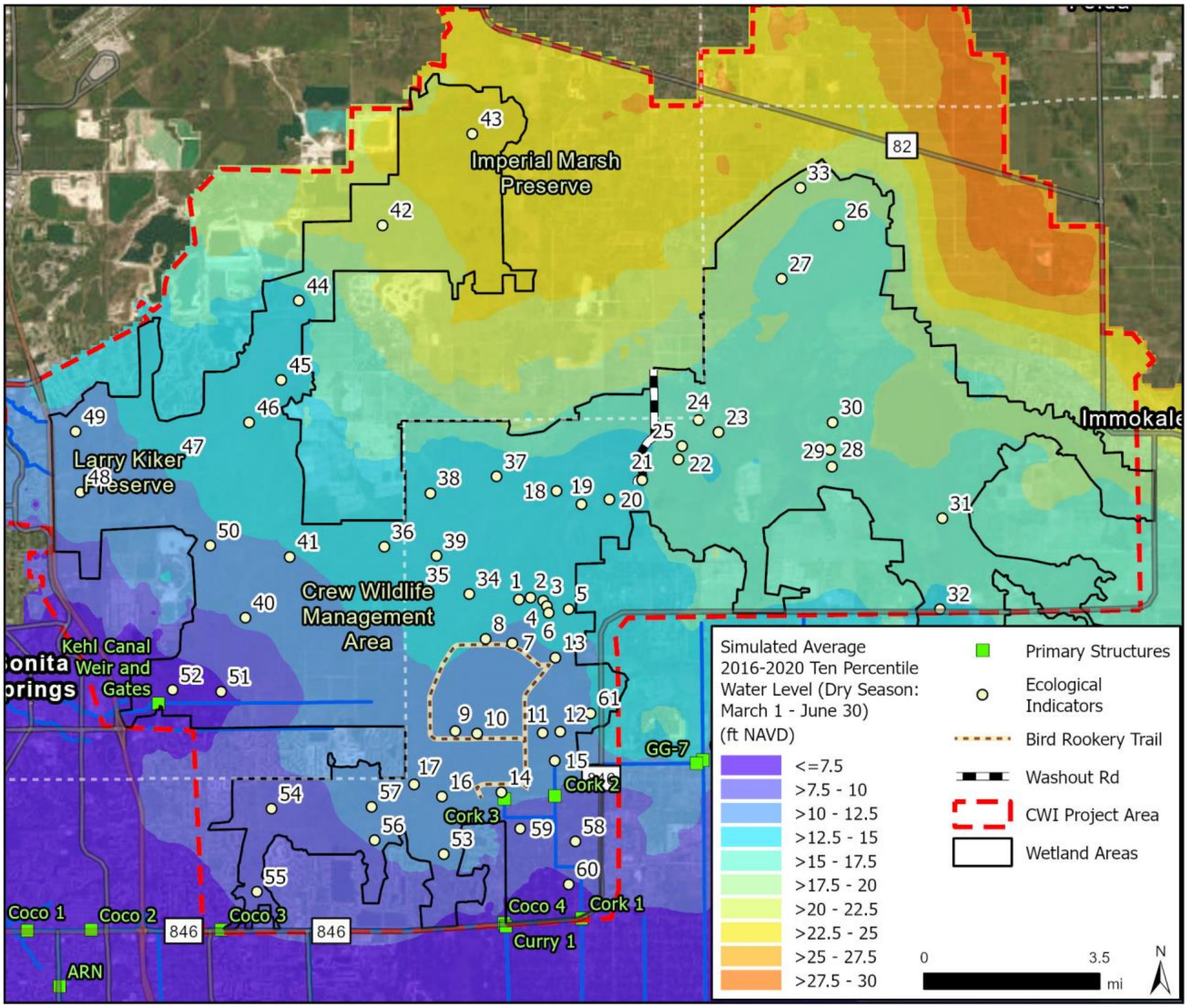

Figure 4-88. FCM Tenth Percentile Dry Season (March 1 to June 30) Water Levels Averaged over Five Years.

Figure 4-89 shows the FCM resulting average 10th percentile dry season depth over the 5 simulation years and Figure 4-90 shows the difference in the average between the FCM and the ECM. The values for both figures are in inches.

Figure 4-90 shows the effect of the increasing pumping rates in the PWS wells in the FCM based on future water use projections (such as in the northern Kiker Preserve area, areas near the Kehl Canal). In the areas north of Corkscrew where some of the land was converted from farmland to residential developments in the FCM, the dry season values increase due to the removal of agricultural wells and decrease in some of the agricultural excess discharges. The exception to this is the 6L Farms area that was converted to the FFD Corkscrew Road Property development (Figure 3-4) and the water table is lower in the FCM than in the ECM. In the ECM, the 6L Farms is represented without a drainage outlet in the southern portion of the property (water can only flow south if the levee is overtopped) and drainage is routed to the preserve areas in the southern portions of the property or out to the northwestern outlet. It should be noted that there is not ERP for the 6L Farms and thus, there is little information known about how this farm area was drained. In the FCM, the new development is represented according to the ERP information that includes two drainage outlets in the southern portion of the property at a lower elevation than the levee.

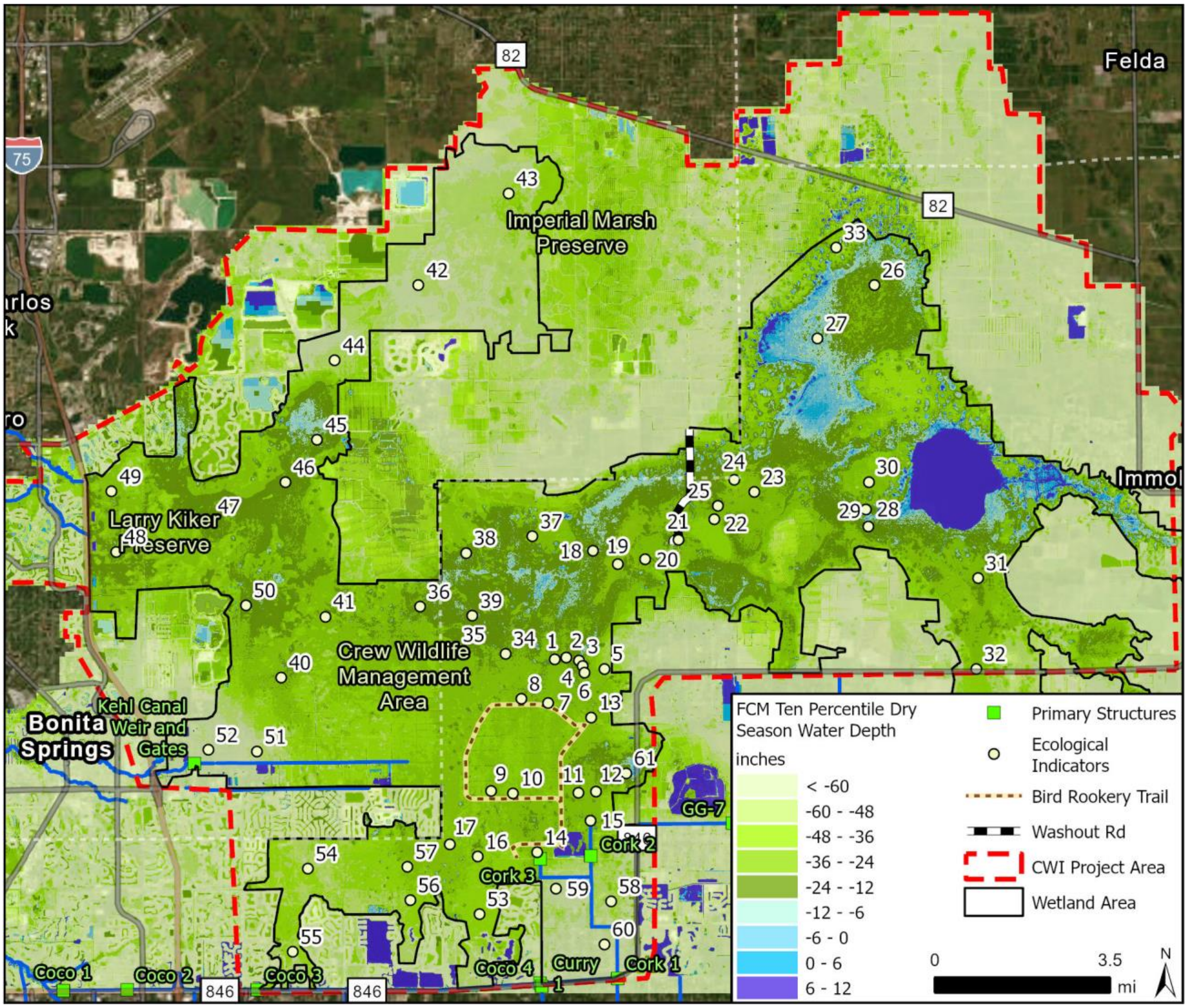

Figure 4-89. FCM Tenth Percentile Dry Season (March 1 to June 30) Water Depths Averaged over Five Years.

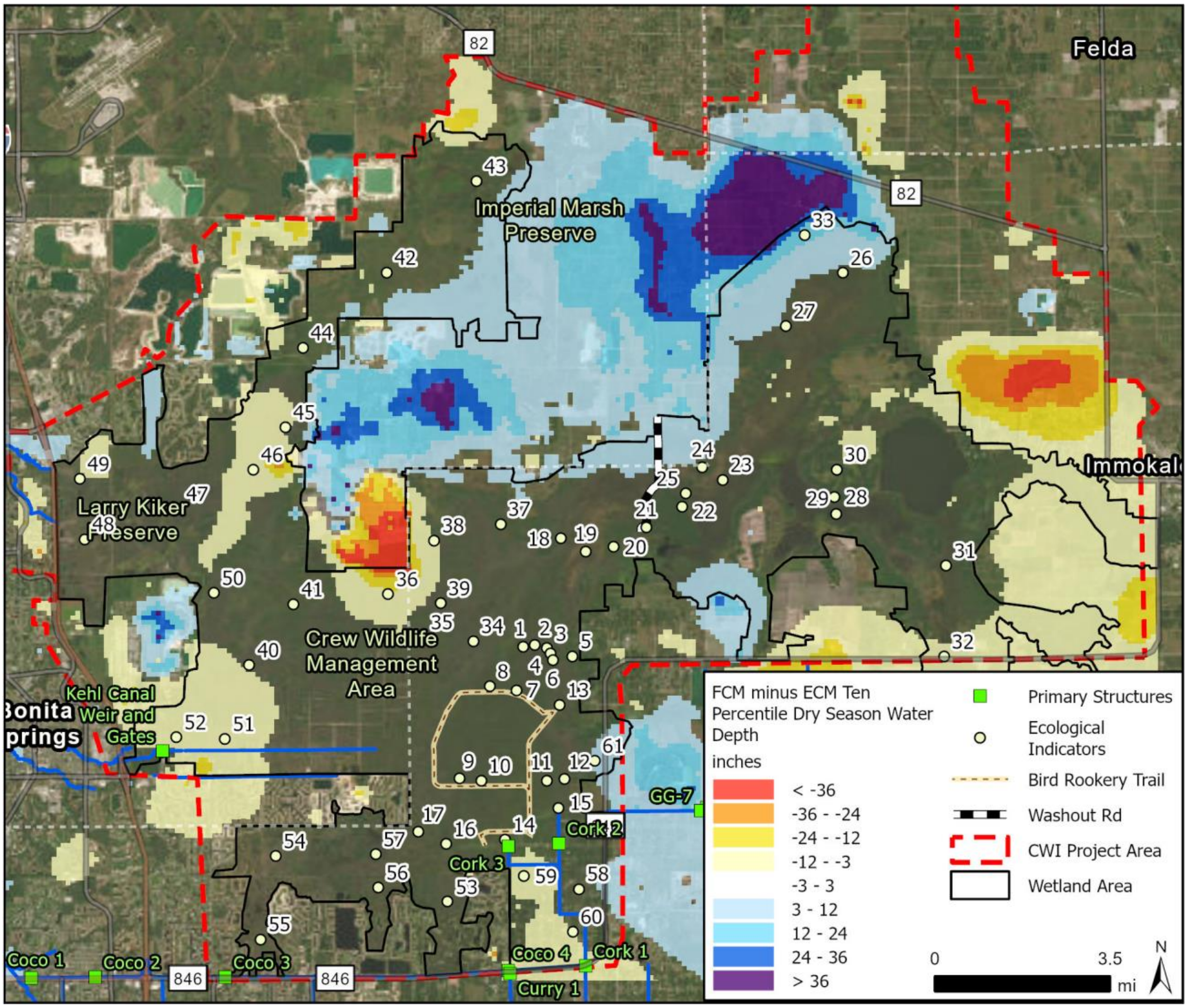

Figure 4-90. Comparison between FCM and ECM 10th Percentile Dry Season Depths Averaged over Five Years

Figure 4-91 shows the simulated average 10th percentile dry season depths compared against the reference target elevations by plant community shown in Table 4-20 and the spatial definition of plant communities utilized in the model and shown in Figure 4-78. The comparison to the reference target in is only shown within the Corkscrew wetland areas and the extents of the indicator locations (black outline). The areas in blue in the figure are above the reference target range for the defined plant community in that area, areas in orange area below the reference target range, and areas with no color are within the target range.

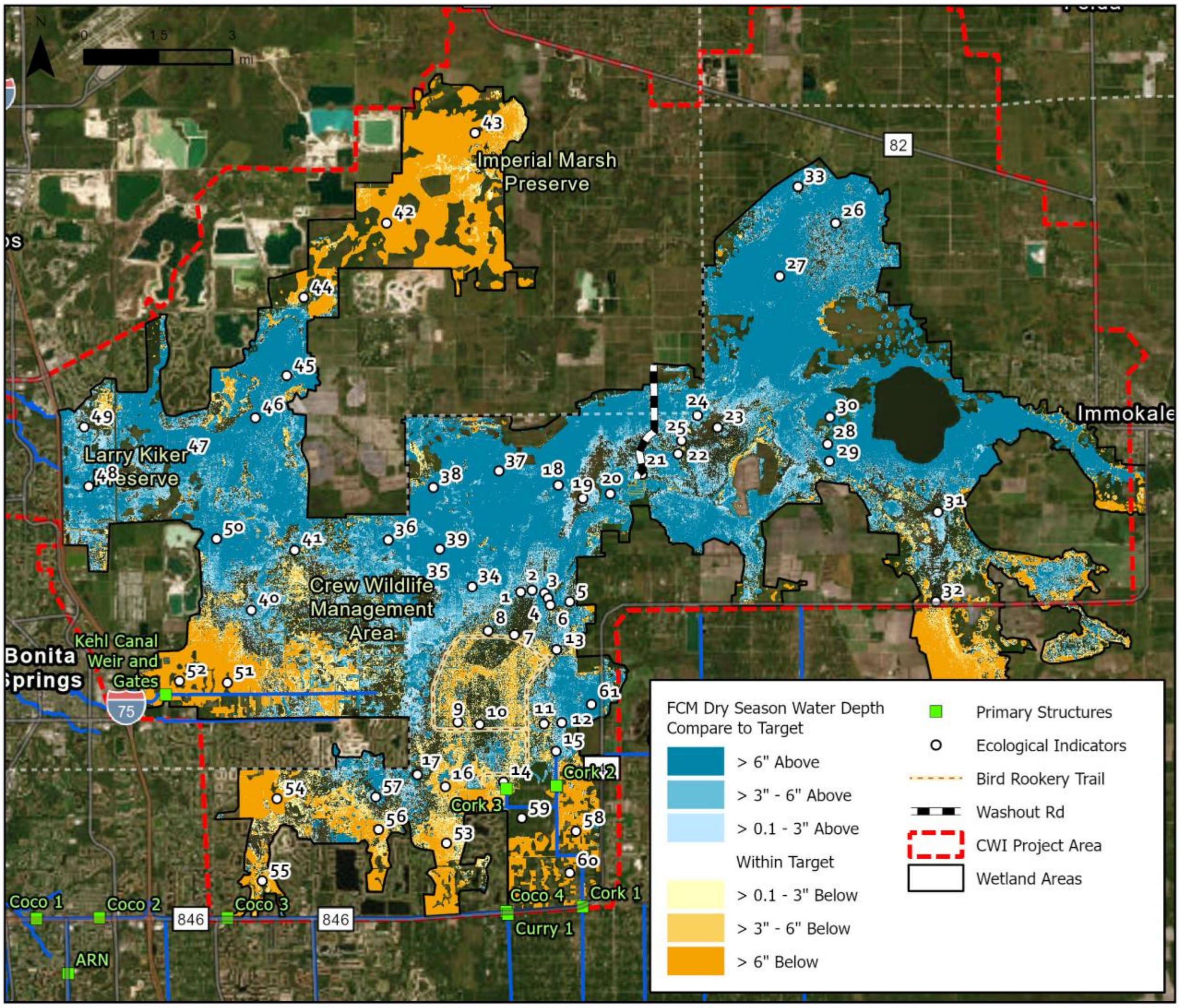

Figure 4-. Comparison between FCM 10th Percentile Dry Season Depths and Dry Season Reference Target Ranges.

Table 4-23 shows the simulated average dry season minimum depth in inches for the five simulation years averaged over the plant communities in the project area. The values are highlighted in blue if they are above the reference and in orange if they are below the reference. In general, the upland plant communities (xeric and mesic flatwood and hammock) and marsh are above the dry season reference range, whereas hydric flatwood and hammock, cypress, and swamp forests are above in some years and below in some years.

Table 4-23. Simulated Average Tenth Percentile Dry Season Depths for each Plant Community (inches)

Plant Community	2016	2017	2018	2019	2020	5-yr Average	Reference[1]
Xeric Flatwood, Xeric Hammock	-35.9	-55.2	-49.0	-38.1	-51.4	-45.9	< -56
Mesic Flatwood, Mesic Hammock	-34.5	-56.0	-51.1	-36.1	-51.1	-45.8	-48 to -56
Hydric Flatwood, Hydric Hammock	-32.5	-54.6	-49.1	-36.7	-48.2	-44.2	-42 to -48
Wet Prairie, Dwarf Cypress	-29.0	-49.1	-43.5	-33.9	-43.1	-39.7	-38 to -42
Marsh	-14.9	-34.2	-29.7	-12.6	-30.7	-24.4	-26 to -38
Cypress	-19.0	-40.0	-33.4	-22.7	-32.7	-29.6	-31 to -38

Plant Community	2016	2017	2018	2019	2020	5-yr Average	Reference[1]
Swamp Forest	-19.9	-41.4	-35.9	-22.7	-35.9	-31.2	-26 to -31
Open Water	27.7	8.6	13.7	26.9	13.5	18.1	> -26

[1] Reference values for dry season minimum depths (Table 4-20). Negative values = depth below ground.

Above reference

Below reference

Figure 4-91 shows the average dry season minimum depth for the five simulation years for each wetland hydrologic indicator location in inches and grouped by model vegetation categories with the dry season depth reference range minimum and maximum values for each plant community from Table 4-20. The locations and plant community classifications are shown in Figure 4-79. Note that the Indicator IDs with an asterisk are in locations where the description for the indicator point differs from the model vegetation category. The indicators with descriptions that differ from the model vegetation categories are displayed again using their indicator description categories and corresponding targets in Figure 4-92.

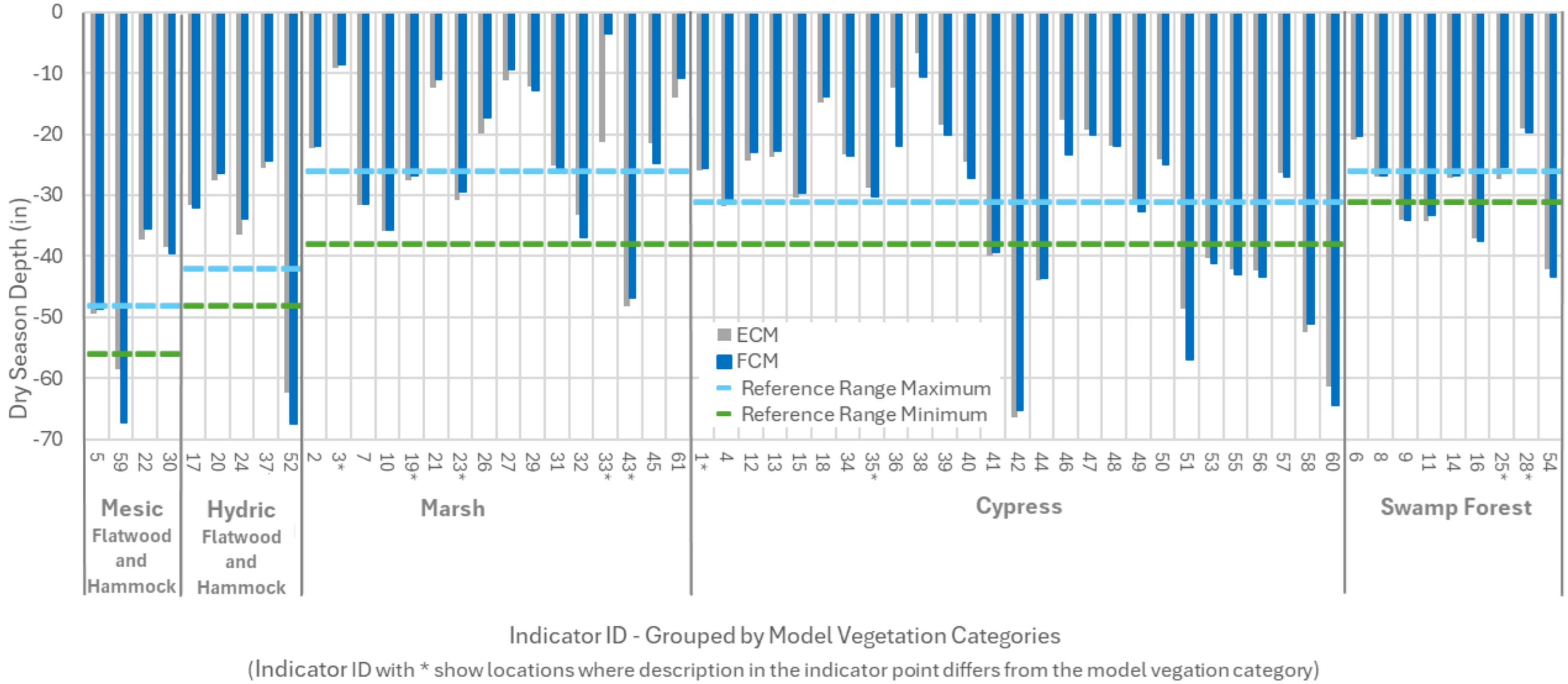

Figure 4-91. ECM and FCM Dry Season Tenth Percentile Depth for the Wetland Hydrology Indicators Averaged Over the Five Simulation Years and Grouped by Model Vegetation Category.

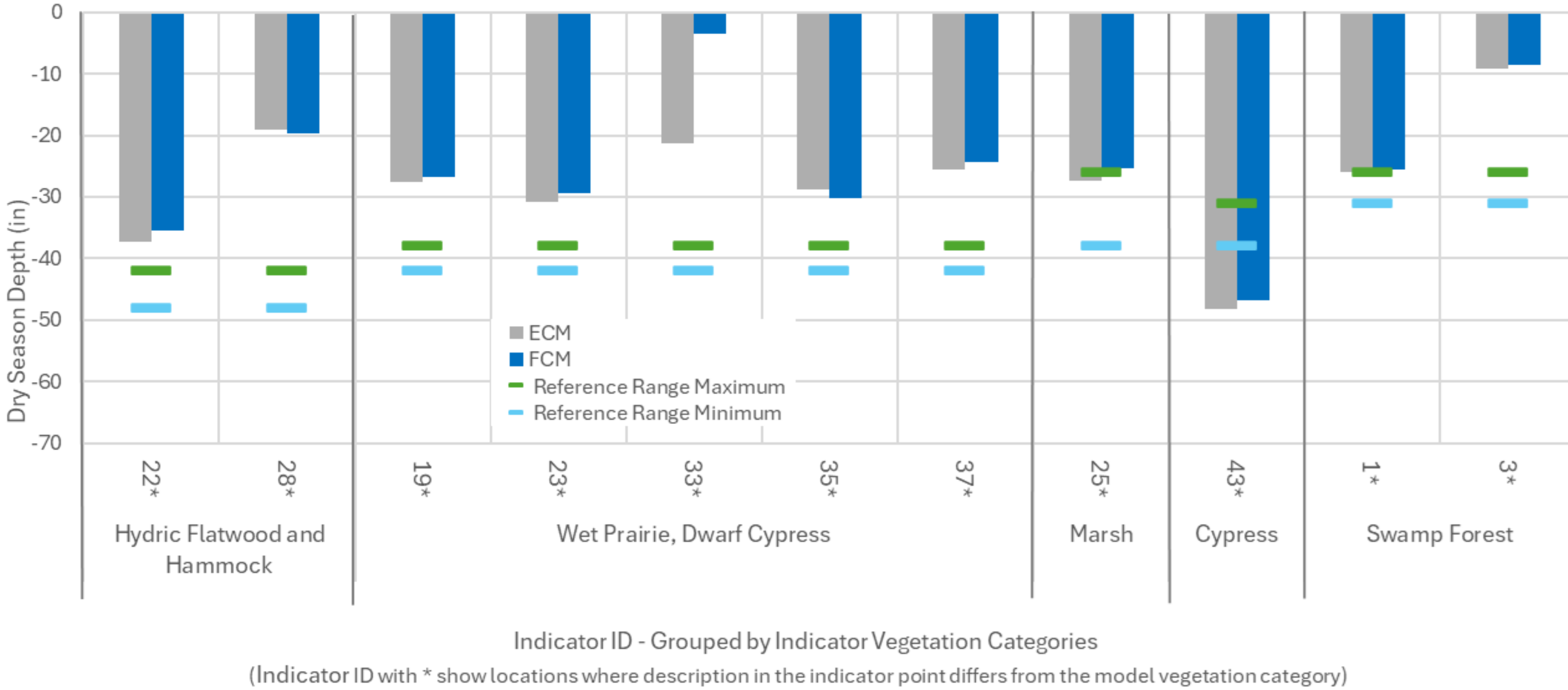

Figure 4-92. ECM and FCM Dry Season Tenth Percentile Depth for the Wetland Hydrology Indicators (where description in the indicator points differs from model vegetation category) Averaged Over the Five Simulation Years and Grouped by Indicator Vegetation Category.

Figure 4-93 and Figure 4-94 show the FCM dry season depths above and below the plant community reference range using the model vegetation classification and the indicator dataset classification where it differs, respectively. The indicators in the plots are grouped by location in the various Corkscrew areas. For most indicator locations, the dry season 10th percentile is above the dry season minimum target except for the Imperial Marsh area north of Corkscrew Road and the areas in south Flint Pen and Corkscrew, near the downstream canals. In general, most locations are above the minimum reference target. The locations that result in values below the reference minimum are those that are most proximate to the downstream drainage system and the area north of Corkscrew Road.

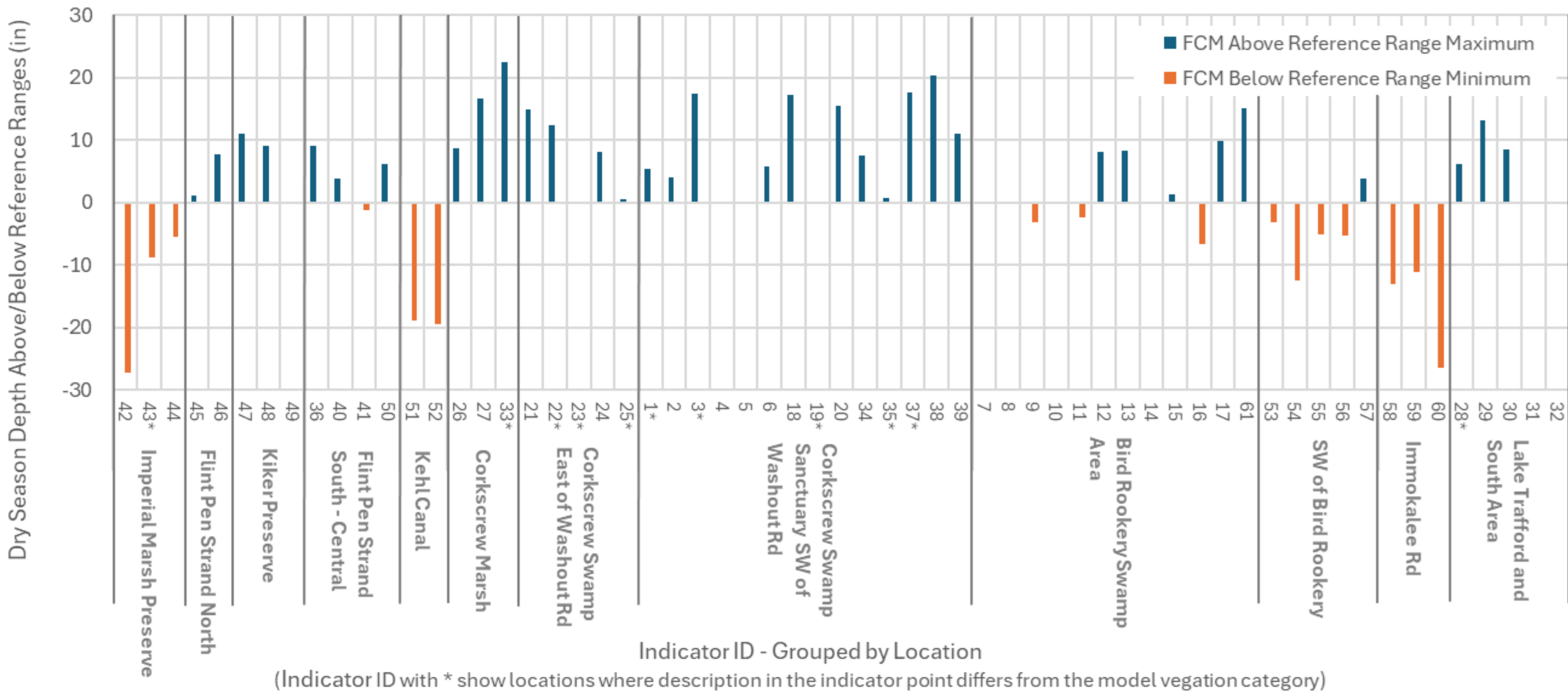

Figure 4-93. FCM Dry Season Tenth Percentile Depth for the Wetland Hydrology Indicators Averaged Over Five Years and Compared with the Wet Season Water Depth Reference Range Minimum and Maximum Values for their Respective Vegetation Categories and Grouped by Location.

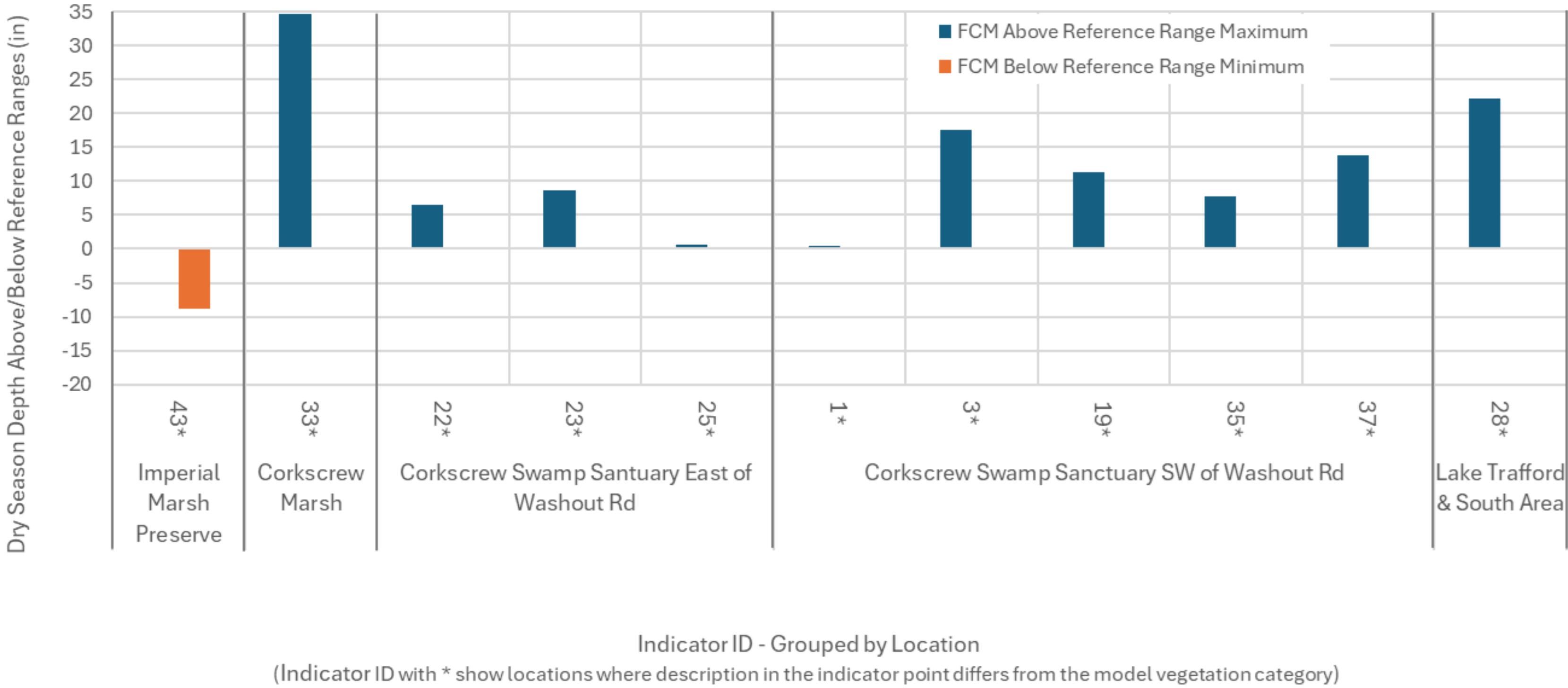

Figure 4-94. FCM Dry Season Tenth Percentile Depth for the Wetland Hydrology Indicators (where description in the indicator points differs from model vegetation category) Averaged Over Five Years and Compared with the Wet Season Water Depth Reference Range Minimum and Maximum Values for their Respective Vegetation Categories and Grouped by Location.

4.3.3 Hydroperiod

Hydroperiod in the context of this study is defined as the duration of time that water depths are above ground during a water year, which is defined from June 1 to May 31. This measure provides an assessment of the ability of the wetland system to "minimize colonization by upland vegetation, so that aquatic organisms have sufficient time to mature and build up their populations through the wet season. It is also significant for supporting a natural fire regime and minimizing wildfires" (Duever, 2024).

The hydroperiod for each water year in the simulation. The first water year in the simulation was excluded because the initial months of the simulation that would be needed for a full water year are considered part of the warmup period not to be included in the analysis. To calculate the hydroperiod, a tool was developed to read the water year water table output from the model and count the days above a higher resolution (10-foot) corrected Lidar for the CWI project area.

Figure 4-95 shows the simulated average annual hydroperiod for the four water years from June of 2016 to June of 2020. Figure 4-96 shows a comparison between the FCM and the ECM average hydroperiod.

The comparison map shows the effect of added storage in the new developments increasing the hydroperiod in those areas. While this increase is mostly within the development areas, the increased hydroperiod in the Corkscrew Grove Villages and Kingston developments seems to have the effect of increasing the water table downstream in the northern portions of the Corkscrew Marsh and the Corkscrew Swamp Sanctuary. As the dry season comparison map, the areas where the hydroperiod decreases reflects the increases in PWS pumping, particularly in the Flint Pen area, and the drainage changes in the 6L Farms.

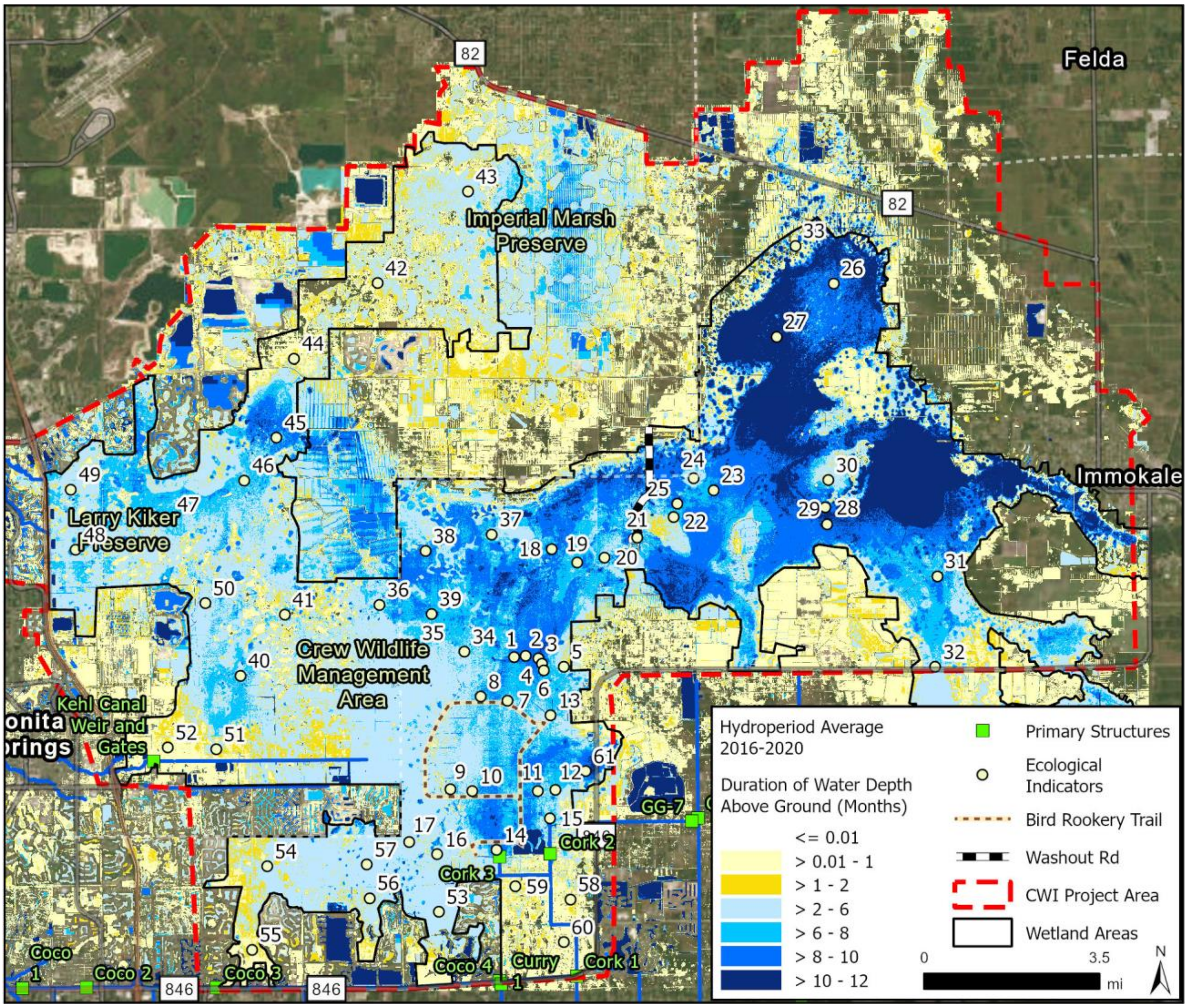

Figure 4-95. FCM Simulated Average Annual Hydroperiod.

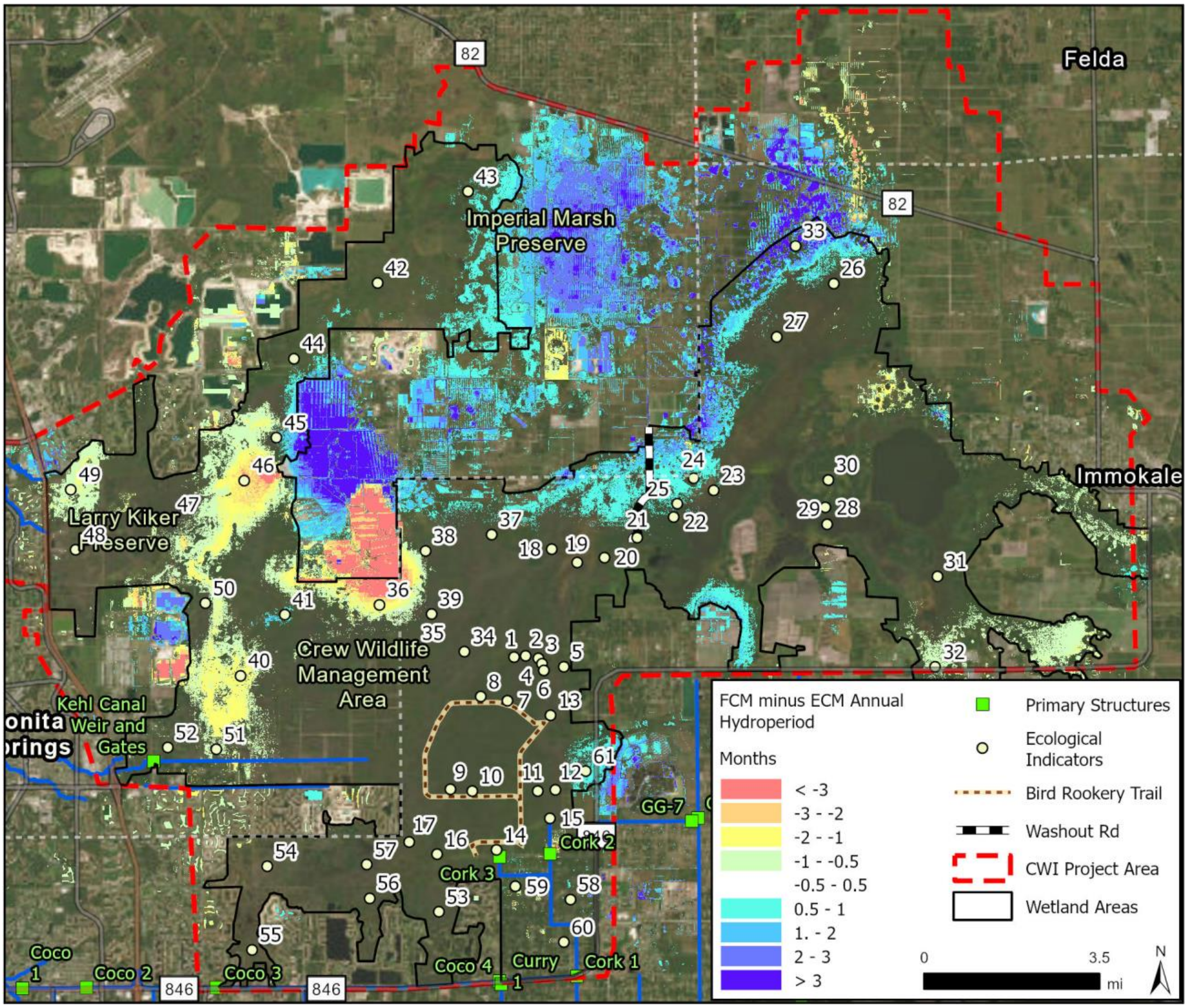

Figure 4-96. Comparison between FCM and ECM Average Hydroperiod.

Figure 4-97 shows the simulated average hydroperiod compared against the reference target elevations by plant community shown in Table 4-20 and the spatial definition of plant communities utilized in the model and shown in Figure 4-78. The comparison to the reference target in Figure 4-97 is only shown within the corkscrew wetland areas and the extents of the indicator locations (black outline). The areas in blue are above the reference target range for the defined plant community in that area, the areas in orange area below the reference target range, and the areas with no color are within the target range.

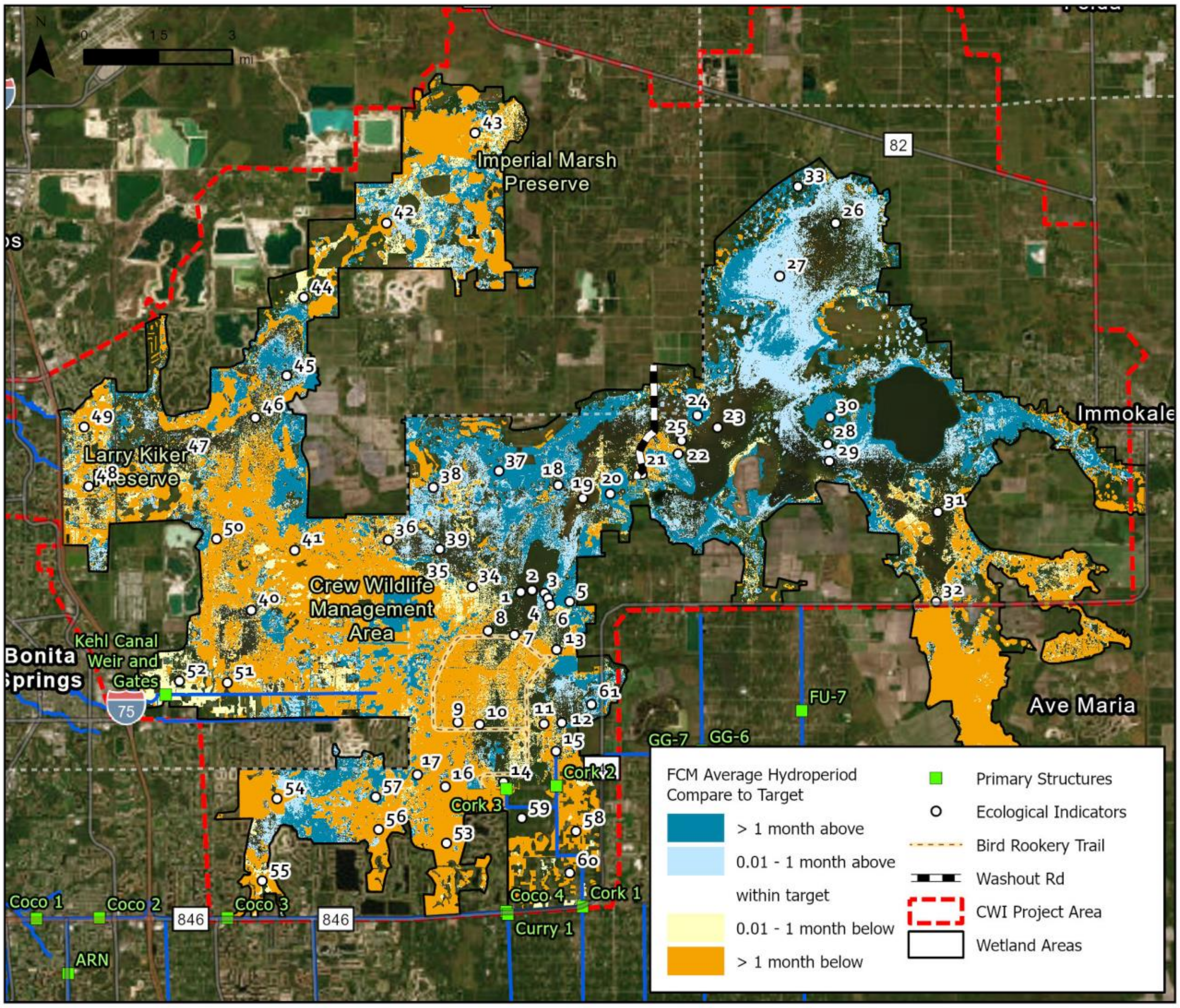

Figure 4-97. Comparison between Average Hydroperiod and the Hydroperiod Reference Target Ranges.

Table 4-24 shows the simulated average hydroperiod averaged over the various plant communities in the project area for each water year (WY) and the average over the four years. The values are highlighted in blue if they are above the reference and in orange if they are below the reference. In general, the xeric, mesic, and hydric flatwood and hammock plant communities are above the hydroperiod reference range, whereas cypress and swamp forest are below the reference.

Table 4-24. FCM Simulated Average Hydroperiod (months) for Plant Communities

Plant Community	WY 2016-2017	WY 2017-2018	WY 2018-2019	WY 2019-2020	Average	Ref.[1]
Xeric Flatwood, Xeric Hammock	2.5	3.5	3.5	1.7	2.4	0
Mesic Flatwood, Mesic Hammock	2.6	3.3	3.3	2.0	2.5	≤1
Hydric Flatwood, Hydric Hammock	3.2	4.1	4.1	2.6	3.2	1-2
Wet Prairie, Dwarf Cypress	3.3	4.4	4.4	3.1	3.5	2-6
Marsh	7.1	8.0	8.0	7.3	7.8	6-10
Cypress	4.8	5.8	5.8	4.7	5.2	6-8

Plant Community	WY 2016-2017	WY 2017-2018	WY 2018-2019	WY 2019-2020	Average	Ref.[1]
Swamp Forest	5.3	6.4	6.4	5.3	5.8	8-10
Open Water	10.4	10.6	10.6	10.4	10.5	>10

[1] Reference values for hydroperiod (Table 4-20)

Above reference

Below reference

Figure 4-98 shows a plot of the FCM and ECM simulated hydroperiod averaged over the five simulation years for each wetland hydrologic indicators in months and grouped by model vegetation categories with the hydroperiod reference range minimum and maximum values for each plant community from Table 4-20. The locations and plant community classifications are shown in Figure 4-79. Note that the Indicator IDs with an asterisk are in locations where the description for the indicator point differs from the model vegetation category. The indicators with descriptions that differ from the model vegetation categories are displayed separately again using their indicator description categories and corresponding targets in Figure 4-99.

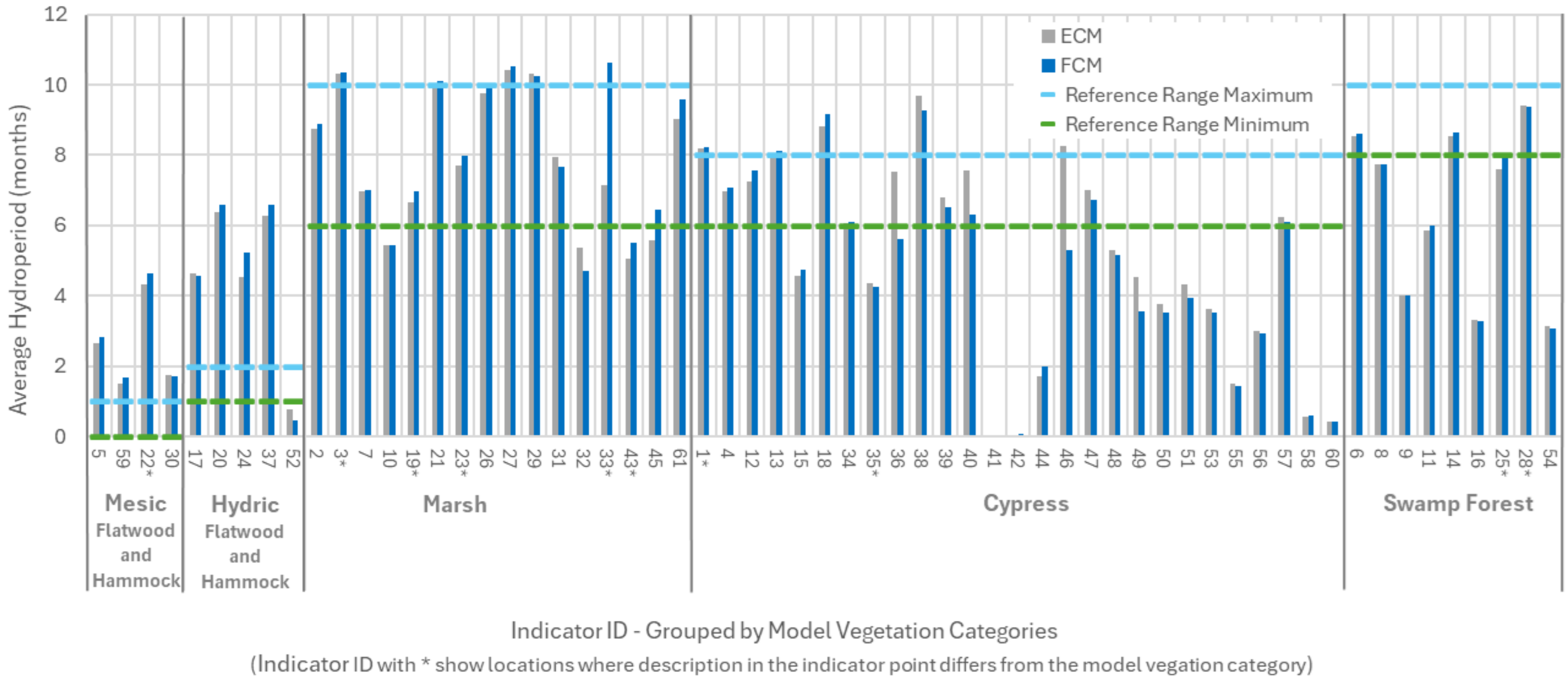

Figure 4-98. ECM and FCM Hydroperiods for the Wetland Hydrology Indicators Averaged Over the Five Simulation Years and Grouped by Model Vegetation Category.

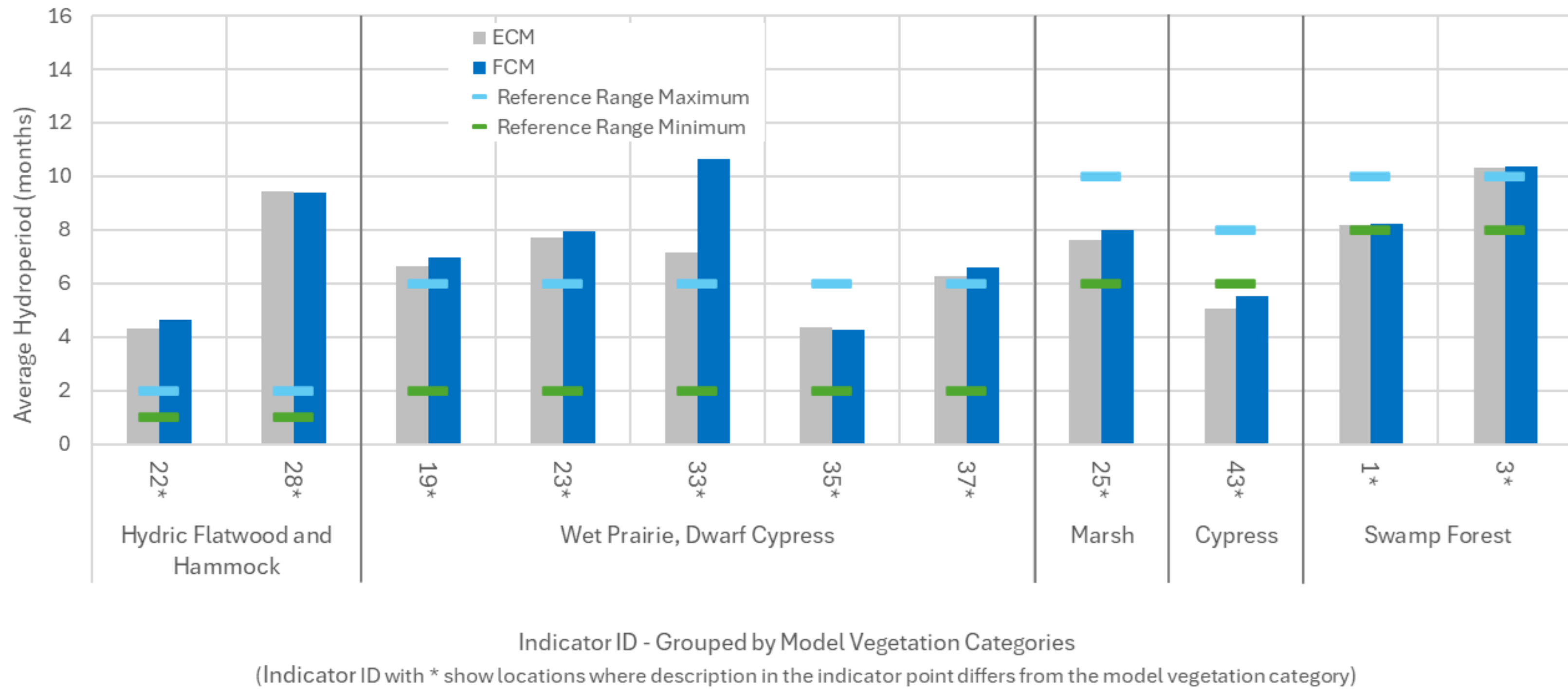

Figure 4-99. ECM and FCM Hydroperiods for the Wetland Hydrology Indicators (where description in the indicator points differs from model vegetation category) Averaged Over the Five Simulation Years and Grouped by Indicator Vegetation Category.

Figure 4-100 and Figure 4-101 show the FCM hydroperiod months above and below the plant community reference range using the model vegetation classification and the indicator dataset classification where it differs, respectively. The plots show approximately four months above the reference in the Corkscrew Marsh and the Corkscrew Swamp Sanctuary indicators and up to six months above the reference near Lake Trafford. In the southern areas of Corkscrew and Flint Pen, the plots show up to six months below the reference.

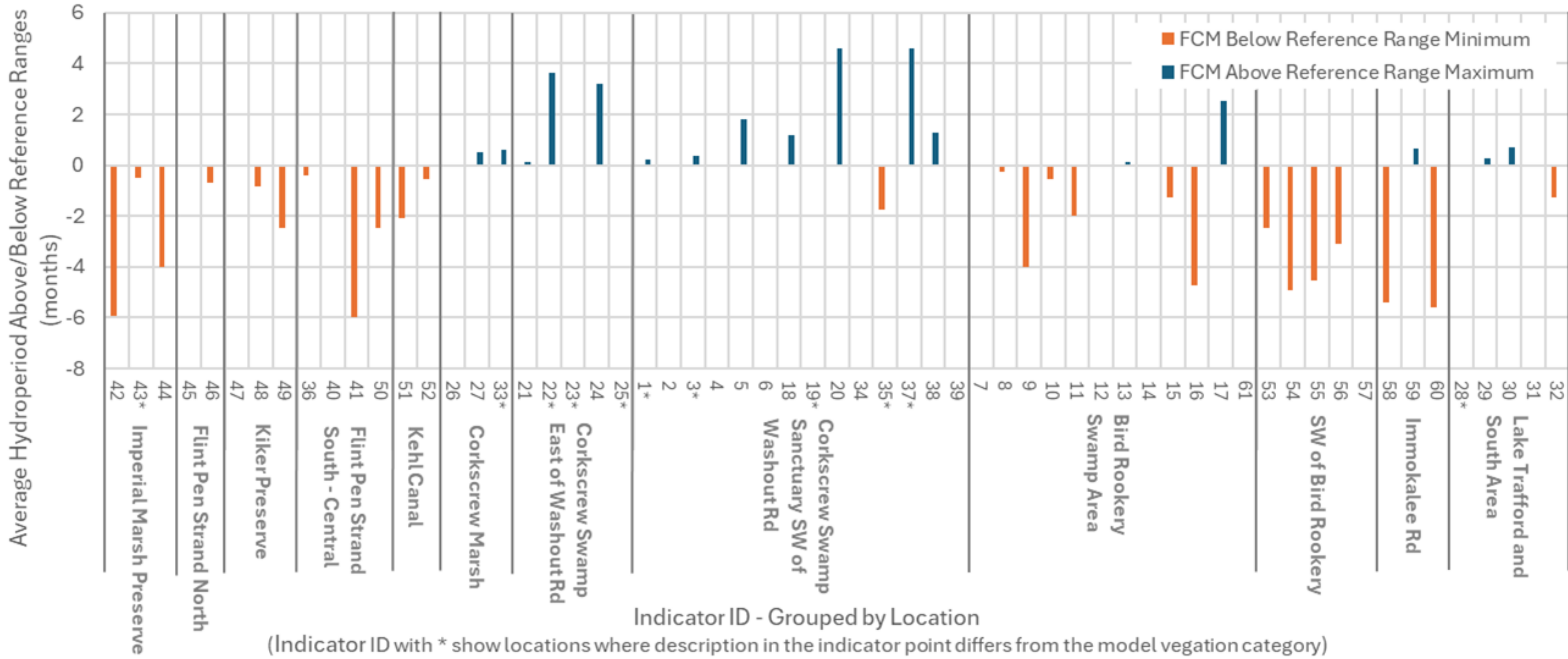

Figure 4-100. FCM Average Hydroperiod for the Wetland Hydrology Indicators Averaged Over Five Years and Compared with the Hydroperiod Reference Range Minimum and Maximum Values for their Respective Vegetation Categories and Grouped by Location.

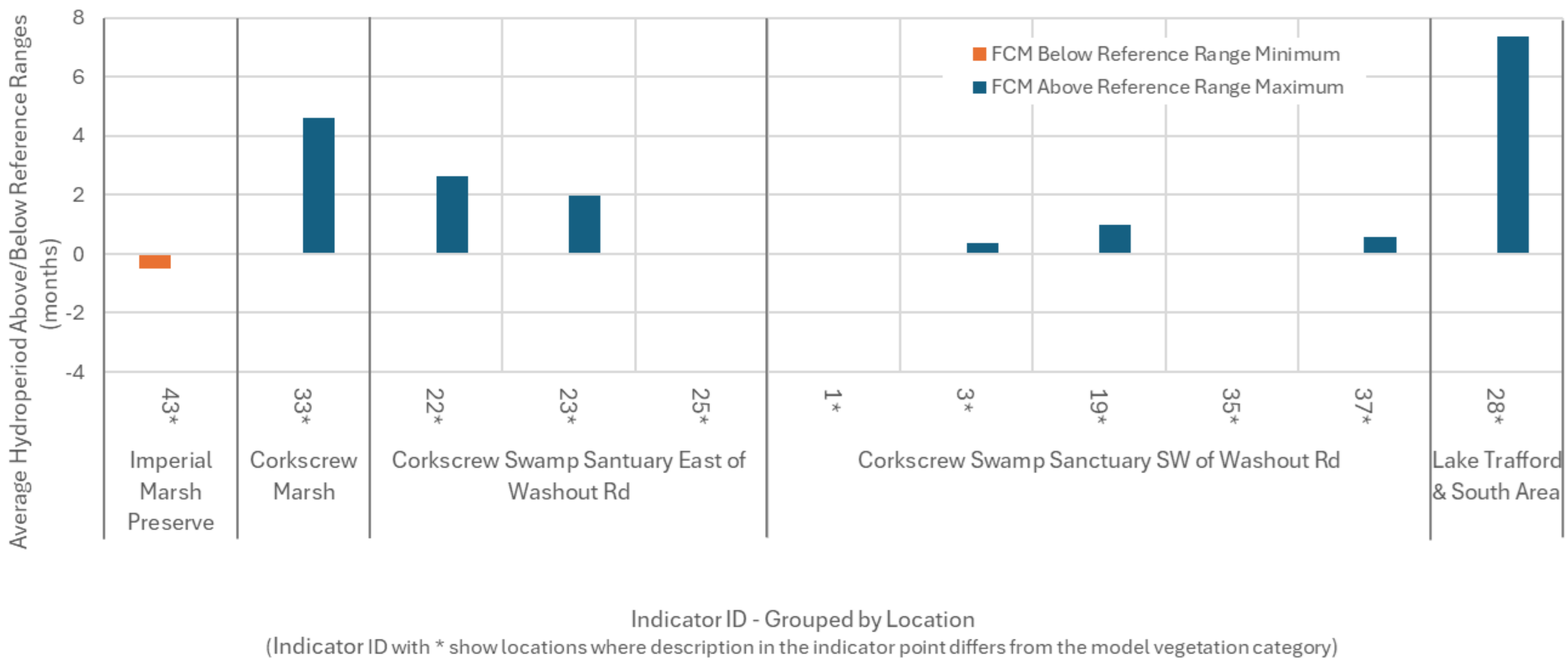

Figure 4-101. FCM Average Hydroperiod for the Wetland Hydrology Indicators (where description in the indicator points differs from model vegetation category) Averaged Over Five Years and Compared with the Hydroperiod Reference Range Minimum and Maximum Values for their Respective Vegetation Categories and Grouped by Location.

4.3.4 Groundwater Levels at Selected Locations and Wet Season to Dry Season Level Decrease at all Indicators

Restoration of the historical recession rates in Corkscrew is one of the critical goals of the CWI project. Groundwater level plots at selected indicators serve to provide a visual and qualitative representation to compare changes in recession rates with the FCM baseline and alternatives. Deliverable 5.2.2 shows groundwater plots at 15 selected locations. The plots shown below are the locations that resulted in the higher differences between the ECM and the FCM in the 10th percentile dry season water depth (i.e., > 0.5 feet or < -0.5 feet) or hydroperiods (i.e., > or < ~one week). Figure 4-102 to Figure 4-110 show the daily groundwater levels simulated by the ECM and FCM at these locations. The plots are displayed in spatial order from north to south and east to west (Figure 4-79) and they include the ground elevation, the range on wet season average and dry season minimum reference targets for the corresponding plant community (Table 4-20), converted to elevations at each location.

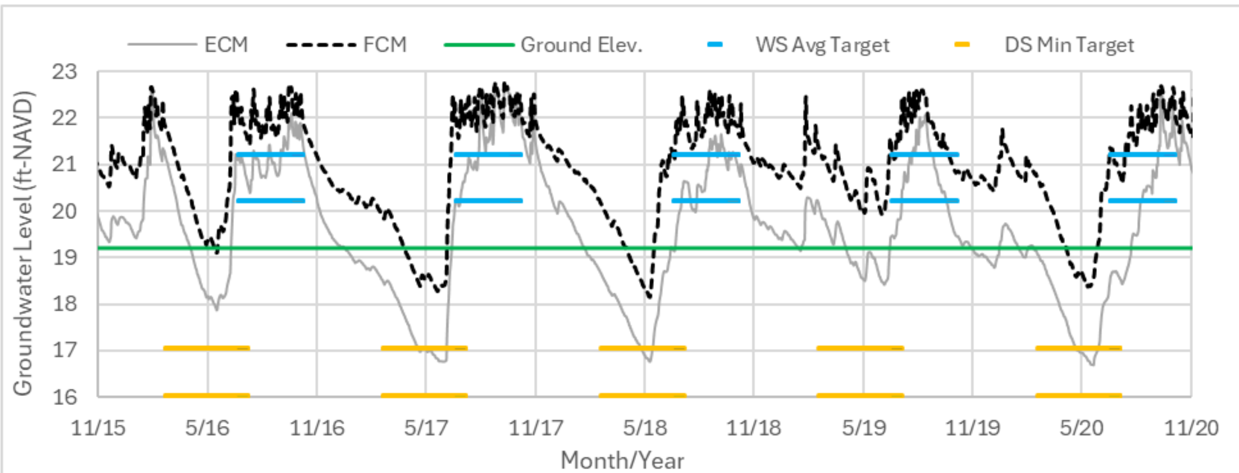

Figure 4-102. ECM and FCM Simulated Groundwater Levels for Indicator ID 33 – Marsh

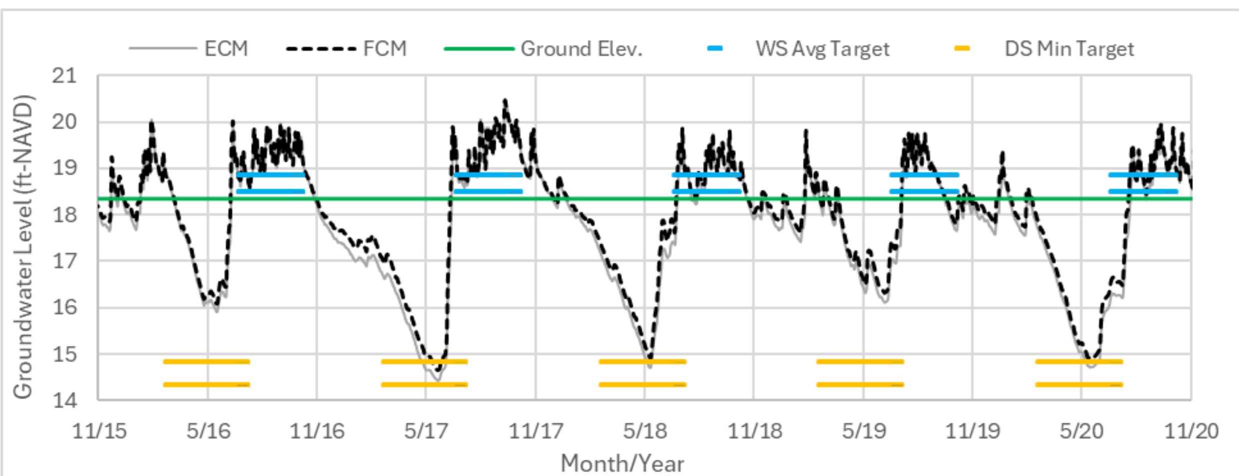

Figure 4-103. ECM and FCM Simulated Groundwater Levels for Indicator ID 24 – Hydric Flatwood

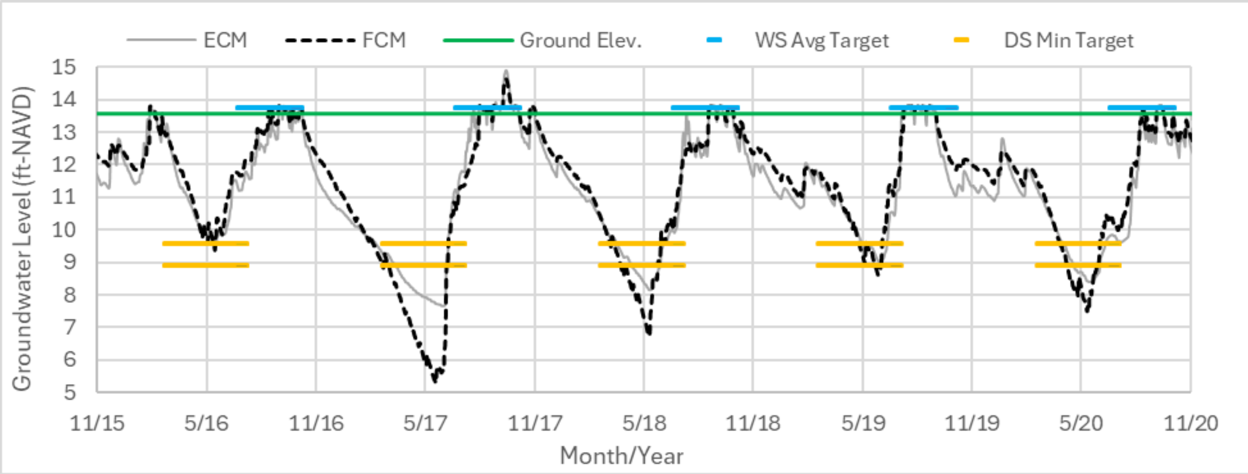

Figure 4-104. ECM and FCM Simulated Groundwater Levels for Indicator ID 59 – Mesic Flatwood

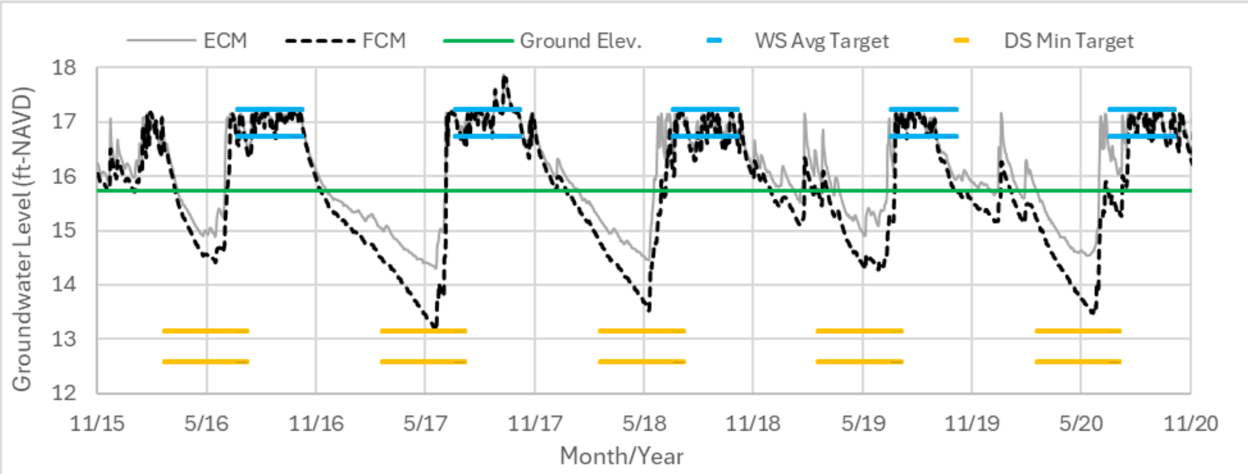

Figure 4-105. ECM and FCM Simulated Groundwater Levels for Indicator ID 36 – Cypress

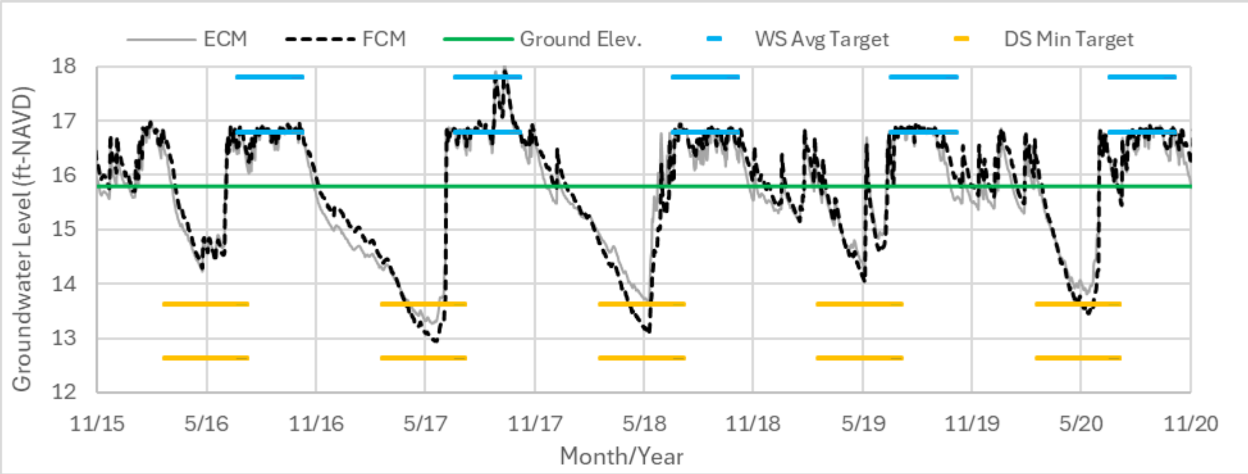

Figure 4-106. ECM and FCM Simulated Groundwater Levels for Indicator ID 45 – Marsh

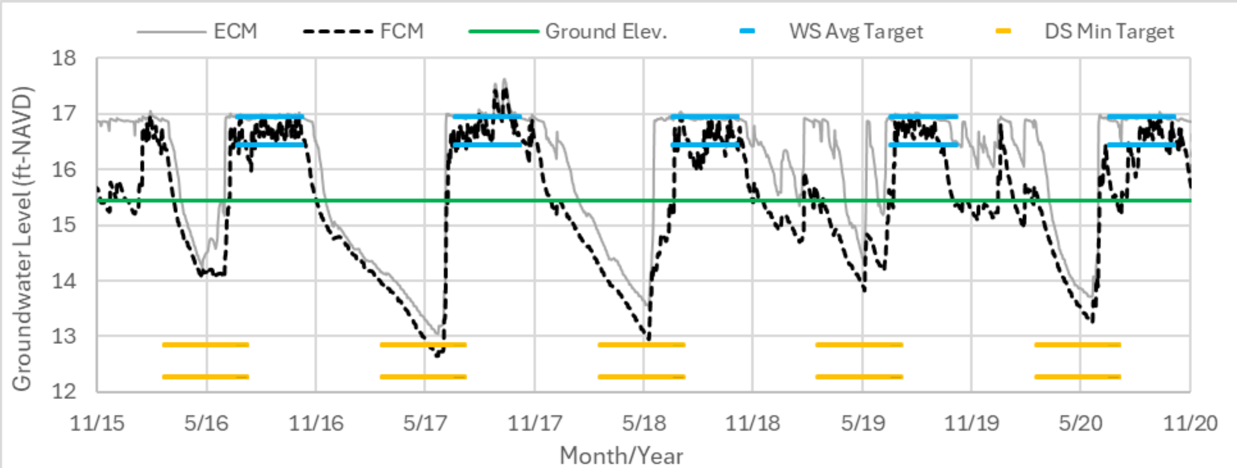

Figure 4-107. ECM and FCM Simulated Groundwater Levels for Indicator ID 46 – Cypress

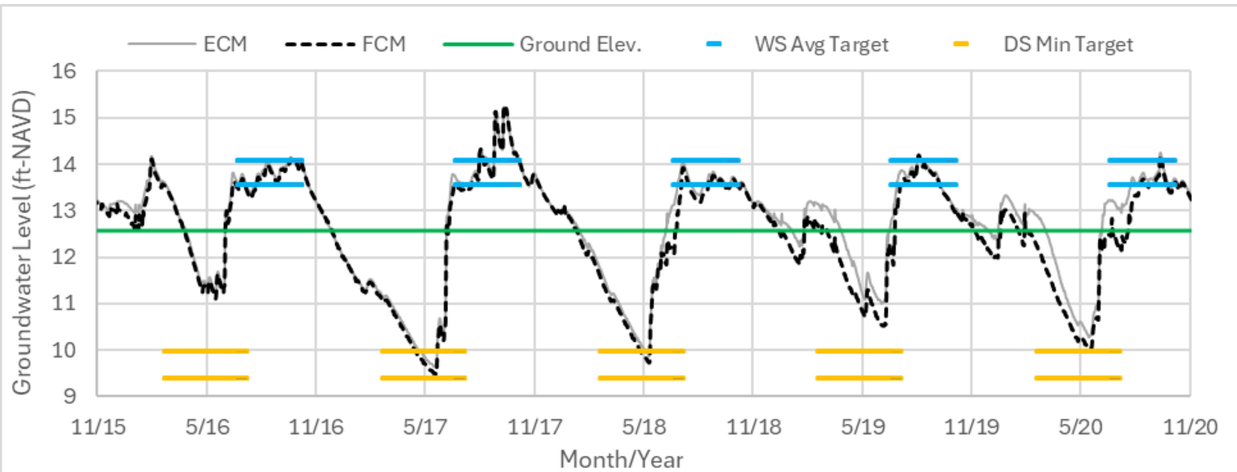

Figure 4-108. ECM and FCM Simulated Groundwater Levels for Indicator ID 40 – Cypress

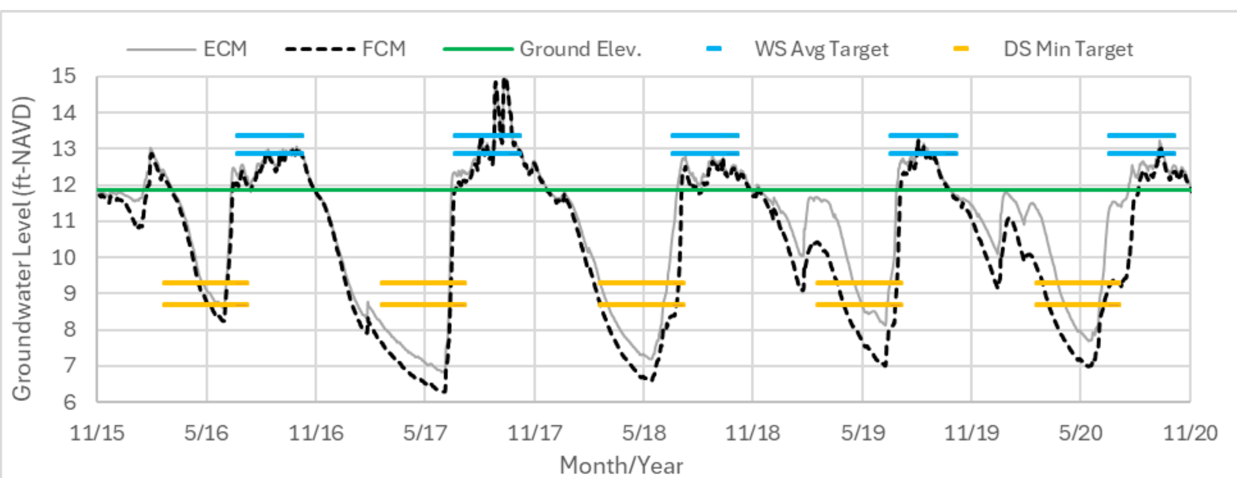

Figure 4-109. ECM and FCM Simulated Groundwater Levels for Indicator ID 51 – Cypress

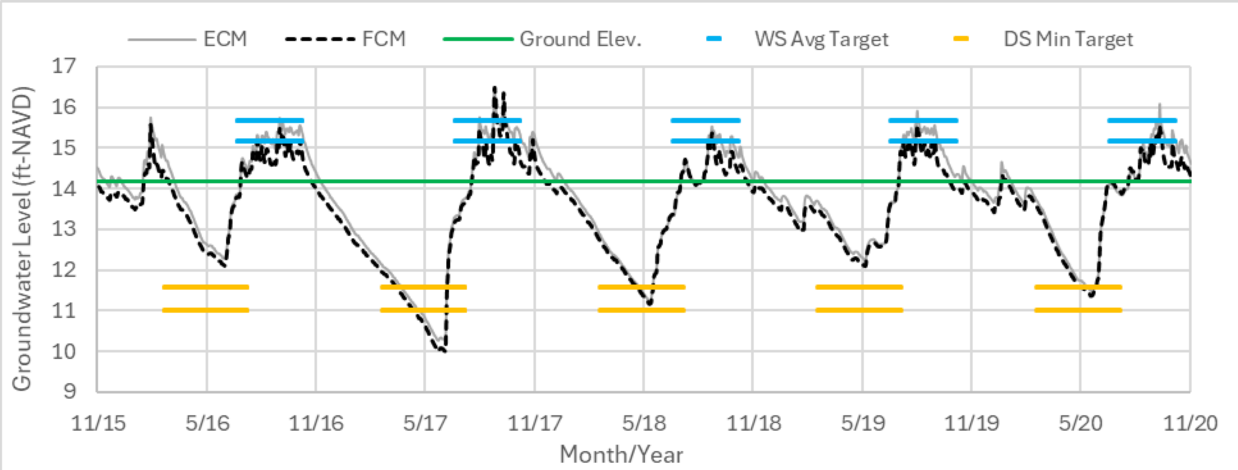

Figure 4-110. ECM and FCM Simulated Groundwater Levels for Indicator ID 49 – Cypress

Table 4-25 shows the decreased water table between the average wet season (from July 1 to September 30) and the 10th percentile dry season (March 1 to June 30 of the following year) for all indicator locations in inches. This provides a way to quantify the average recession magnitudes between locations. The larger decreases are due to proximity to pumping wells and/or to the primary drainage infrastructure. Most locations are similar (within a few inches) between the ECM and FCM, however, there are some locations (IDs 33, 36, and 51) when the absolute average differences are over 0.5 ft higher in the FCM. Plots for these locations, shown above.

Table 4-25. FCM Average Wet Season Average Minus Dry Season Tenth Percentile Water Levels (inches)

ID	WS16-DS17	WS17-DS18	WS18-DS19	WS19-DS20	Avg. Decrease	Avg. FCM - ECM
1	5.3	5.0	3.4	4.7	4.6	0.0
2	3.6	5.1	3.5	4.8	4.2	0.0
3	3.4	4.9	3.4	4.7	4.1	0.0
4	3.4	4.8	3.5	4.7	4.1	0.0
5	3.2	4.8	3.5	4.6	4.0	0.0
6	3.5	4.8	3.6	4.7	4.1	0.0
7	4.0	5.3	4.0	5.0	4.6	0.0
8	3.6	4.8	3.6	4.6	4.1	0.0
9	2.6	3.8	2.9	3.7	3.2	0.0
10	3.1	4.7	3.5	4.4	3.9	0.0
11	3.0	4.6	3.6	4.3	3.9	-0.1
12	2.6	4.0	3.3	3.8	3.4	-0.1
13	3.3	4.7	3.8	4.6	4.1	-0.1
14	3.1	4.8	3.4	4.4	3.9	-0.1
15	1.9	3.6	2.5	3.0	2.8	0.0
16	2.9	4.3	3.2	3.9	3.6	0.0
17	2.6	4.1	3.0	3.8	3.4	0.0
18	2.7	3.7	2.2	3.4	3.0	0.0
19	3.0	4.2	2.8	4.1	3.5	0.0
20	2.6	4.0	2.5	4.0	3.3	-0.1
21	2.0	3.3	1.7	3.0	2.5	-0.1
22	3.2	4.4	2.7	4.0	3.6	-0.1
23	3.5	4.6	3.2	4.6	4.0	-0.1
24	3.1	4.4	2.6	4.1	3.5	-0.2

ID	WS16-DS17	WS17-DS18	WS18-DS19	WS19-DS20	Avg. Decrease	Avg. FCM - ECM
25	2.6	4.2	2.6	3.9	3.3	-0.1
26	3.2	4.0	2.1	3.8	3.3	-0.2
27	2.3	3.3	1.2	3.1	2.5	-0.1
28	1.9	3.7	1.4	3.6	2.7	0.1
29	2.5	4.3	2.1	4.2	3.3	0.1
30	2.7	3.7	2.2	3.9	3.1	0.1
31	3.0	4.3	2.6	4.1	3.5	0.1
32	3.6	5.1	3.1	4.2	4.0	0.2
33	2.6	3.9	2.0	3.4	3.0	-0.6
34	3.1	3.9	3.1	3.9	3.5	0.0
35	2.9	3.7	2.8	3.7	3.3	0.1
36	2.5	3.4	2.5	3.4	2.9	0.7
37	2.7	4.0	2.5	3.7	3.2	-0.1
38	1.6	2.5	1.8	2.7	2.1	0.3
39	2.9	3.5	2.8	3.4	3.1	0.1
40	2.5	4.1	2.9	3.5	3.3	0.2
41	2.2	3.6	2.9	3.7	3.1	-0.1
42	4.1	6.1	4.5	6.0	5.2	-0.1
43	3.5	5.1	3.2	5.0	4.2	-0.1
44	3.2	4.3	2.9	3.9	3.6	0.0
45	2.3	3.6	2.4	3.3	2.9	0.3
46	2.5	3.7	2.4	3.3	3.0	0.2
47	2.7	3.7	2.5	3.3	3.1	0.0
48	2.1	3.2	1.7	2.8	2.5	-0.1
49	2.6	3.5	2.2	3.4	2.9	-0.3
50	2.4	3.4	2.1	3.2	2.8	0.0
51	4.1	6.3	5.1	5.4	5.2	0.6
52	4.5	6.0	5.6	5.7	5.4	0.4
53	3.3	4.7	3.1	4.5	3.9	0.0
54	3.5	5.1	3.4	4.6	4.1	0.1
55	2.6	4.3	3.0	3.6	3.4	0.0
56	3.2	4.8	3.3	4.6	4.0	0.0
57	3.0	4.5	3.3	4.2	3.7	0.0
58	2.9	4.6	3.6	4.3	3.8	-0.2
59	3.7	6.3	4.6	5.8	5.1	0.4
60	3.7	5.9	4.5	5.4	4.9	0.2
61	2.4	4.0	3.1	3.6	3.3	-0.3

4.3.5 Sheet Flow

Cumulative overland flow volumes were calculated at locations where obstructions to the natural wetland sheet flow occur due to man-made features, such as roads and berms. Overland flow is completely blocked in the model along these obstructions by way of the Separated Flow Area parameter, but flow can be simulated across them via structures (culverts and weirs) in the 1D surface water model and via the groundwater flow component.

Overland flow was extracted upstream and downstream of the flow blockages. The total flow across the four lines shown in Figure 4-111 are shown in Figure 4-112 to Figure 4-115. The plots show how overland flow is substantially reduced from the upstream to the downstream sides of these blockages. As flow goes across the blockages, it narrows through the 1D structures and travels through the preferential pathways represented by the 1D flow ways, which is where much of the difference in overland flow volume goes to.

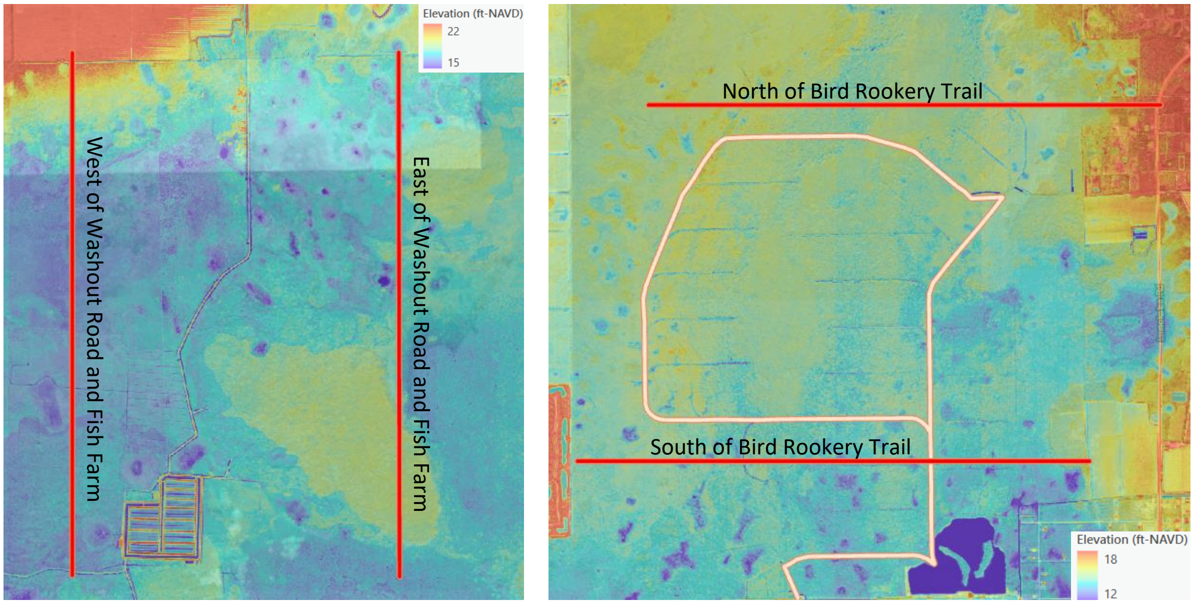

Figure 4-111. Locations where overland flow was extracted

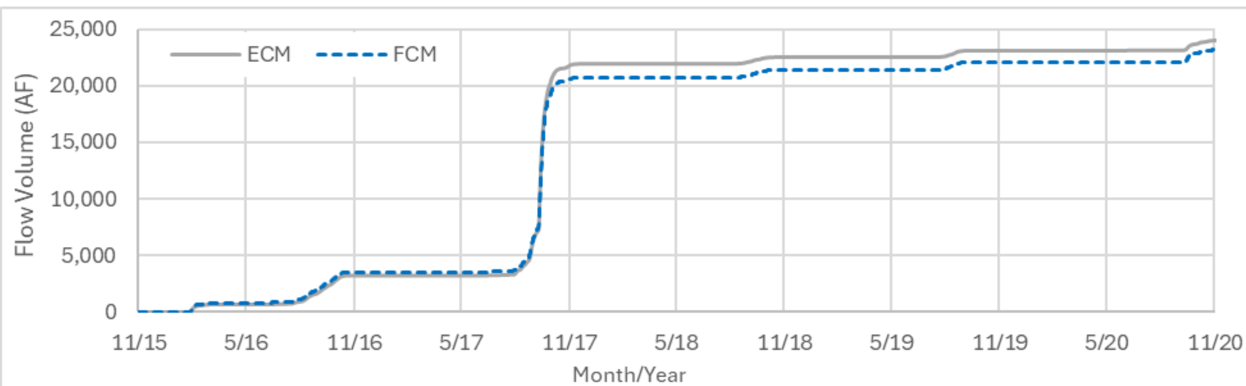

Figure 4-112. Simulated Cumulative Overland Flow Volume East of Washout Road and Fish Farm (acre-feet, AF)

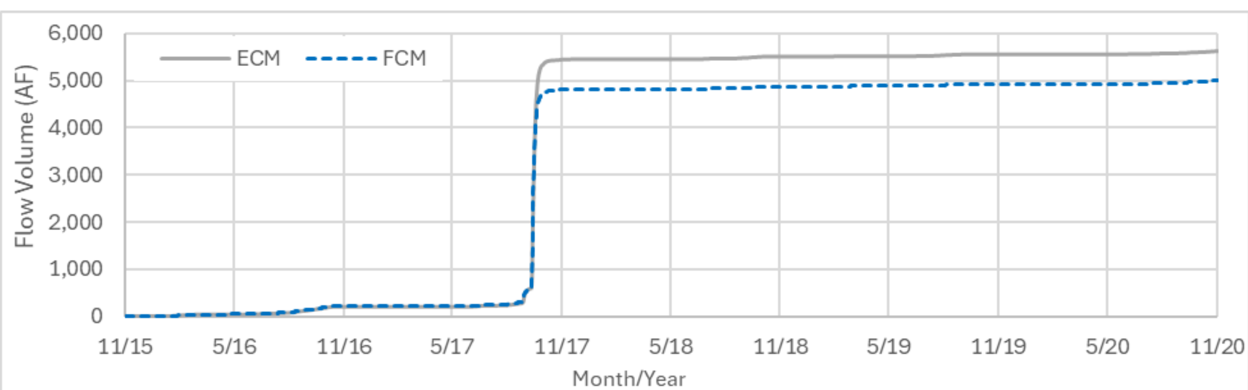

Figure 4-113. Simulated Cumulative Overland Flow Volume West of Washout Road and Fish Farm (acre-feet, AF)

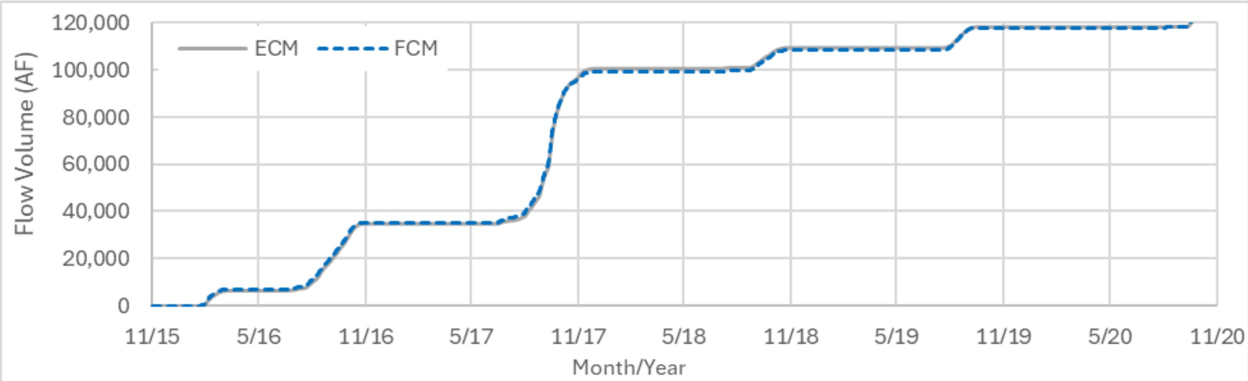

Figure 4-114. Simulated Cumulative Overland Flow Volume North of the Bird Rookery Trail (acre-feet, AF)

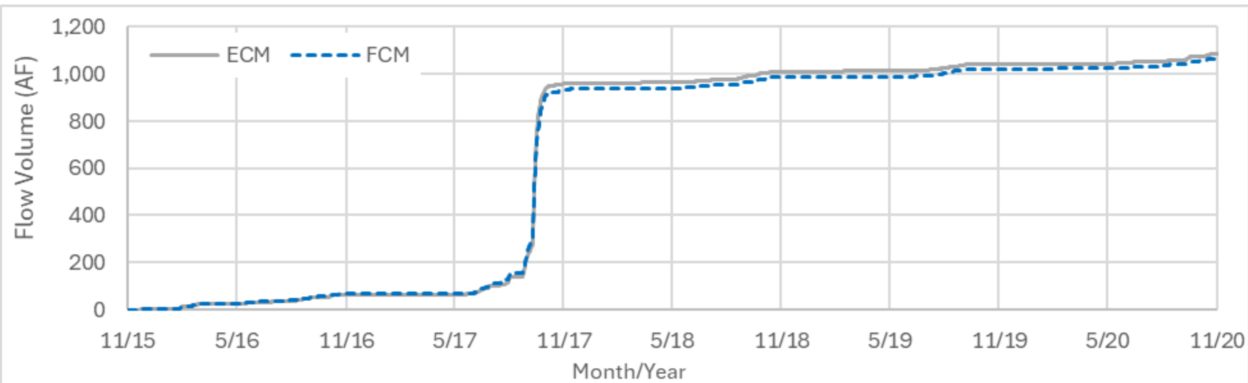

Figure 4-115. Simulated Cumulative Overland Flow Volume South of the Bird Rookery Trail (acre-feet, AF)

The FCM flows are somewhat lower than the ECM flow, which could be caused by the changes from agricultural to residential developments.

4.3.6 Flow Volumes at Tidal Structures

Changes in flow volumes at the tidal structures or drainage outlets serve as a measure of potential changes in susceptibility to saltwater intrusion. A reduction in flow from the baseline is considered an increased risk of saltwater intrusion. Figure 4-116 to Figure 4-119 show the cumulative flow volumes at the main outlets to tide near the project area for future and existing conditions.

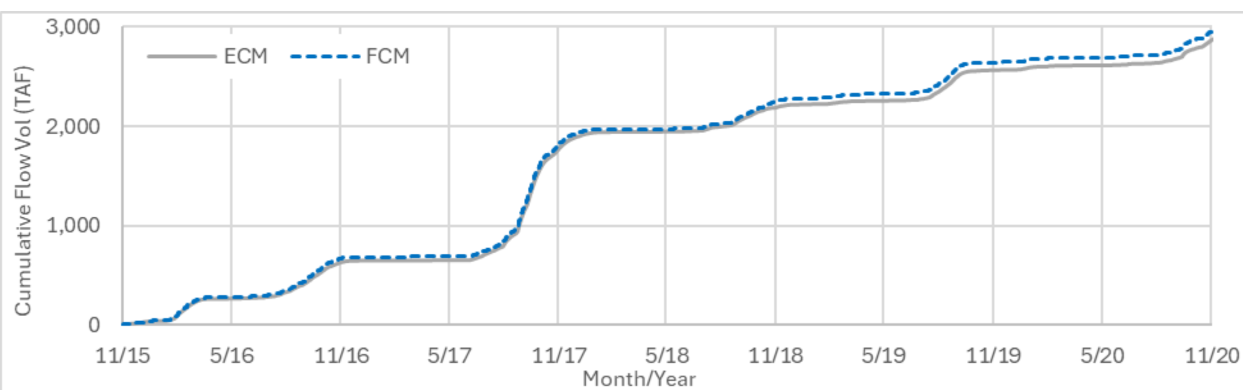

Figure 4-116. Simulated Cumulative Flow Volume at COCO1 (thousand acre-feet, TAF)

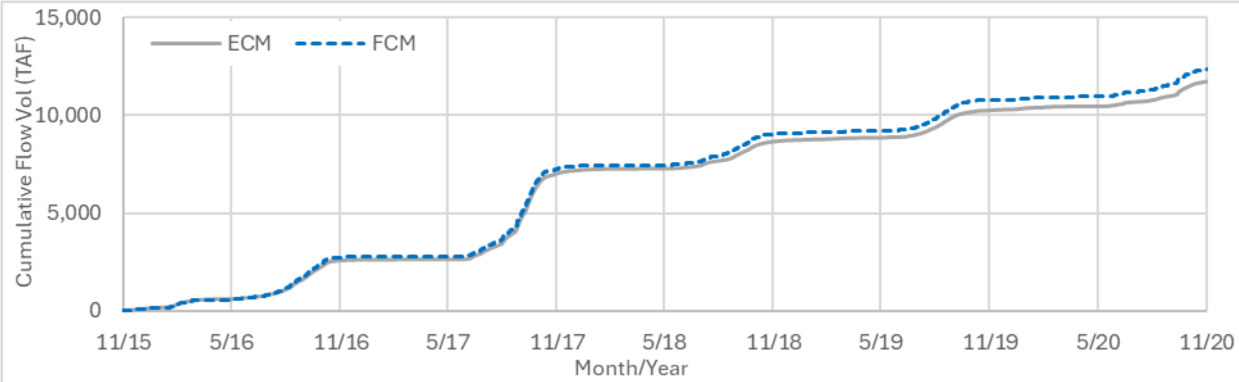

Figure 4-117. Simulated Cumulative Flow Volume at GG-1 (thousand acre-feet, TAF)

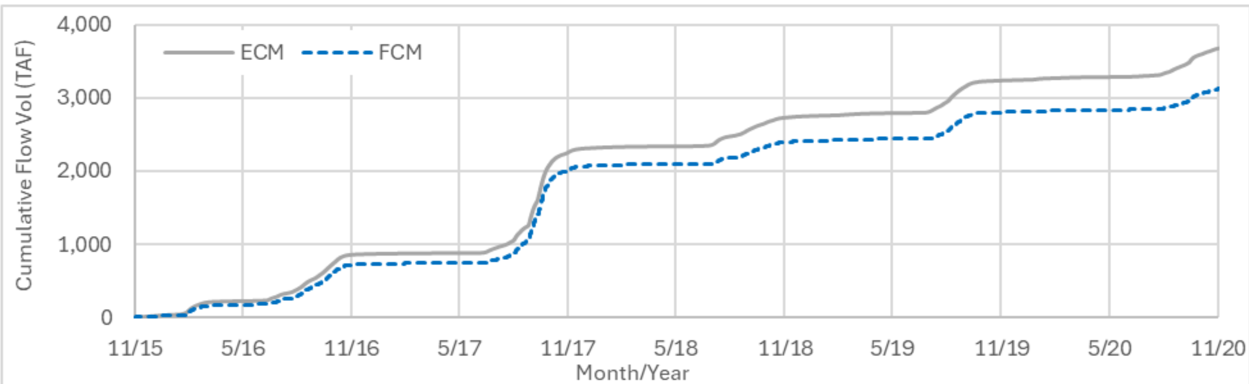

Figure 4-118. Simulated Cumulative Flow Volume at the Kehl Canal Weir (thousand acre-feet, TAF)

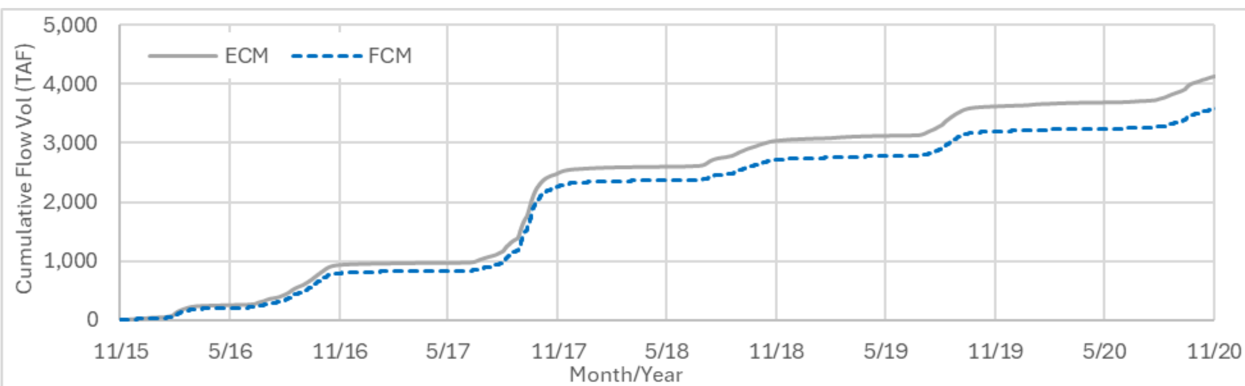

Figure 4-119. Simulated Cumulative Flow Volume at the Imperial River just east of I-75 (thousand acre-feet, TAF)

The lower volumes in Kehl Canal and Imperial River is likely due to a combination of increased stormwater storage in the residential developments added north of the Flint Pen basin and increased PWS pumping volumes.

4.4 Water Supply Performance Measures

One of the goals of the CWI project is to ensure that projects are not going to impact water supply. Groundwater levels and flows at selected locations near the larger public water supply wells were extracted to establish a comparison measure for the FCM baseline and alternatives. Sources for these well fields vary and include wells in the Surficial, Intermediate and Floridan Aquifers. Most have wells that pump from either the water table, the Lower Tamiami, and/or the Sandstone aquifer, which are the three aquifer units in the model. Thus, results for these three layers in the model were extracted.

Figure 4-120 shows selected locations that serve as indicators to changes in water supply nearby public water supply wells. The location of the selected flow extraction lines, i.e., the yellow circles labeled PM (performance measure) flow lines, were based on the groundwater flow vector field of the Lower Tamiami aquifer, is where the larger pumping volumes occur. At the selected locations, more pumping activity was evident from the higher flow magnitudes and directions towards the pumping wells.

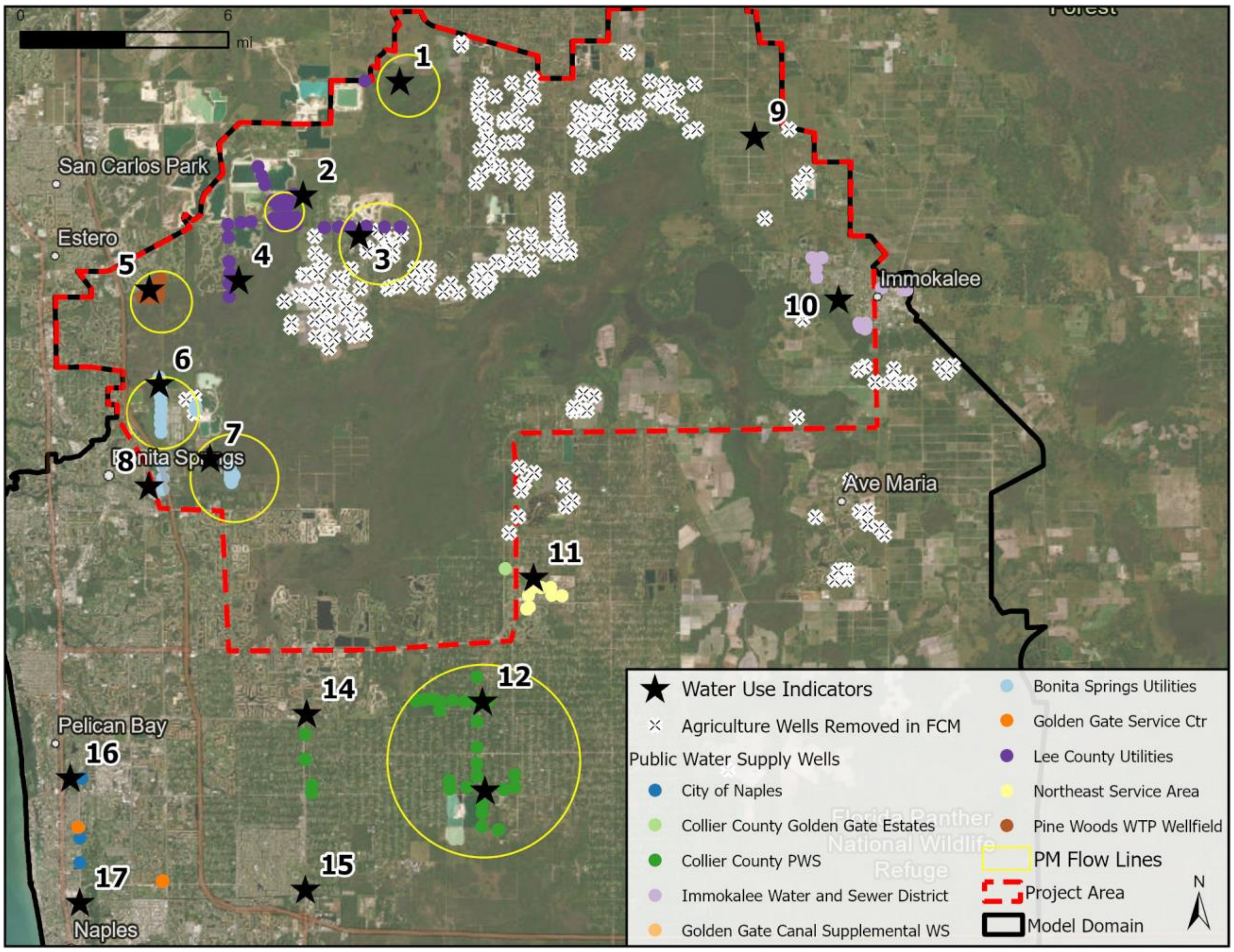

Figure 4-120. Water Level and Flow Indicator Locations for Changes to Water Supply

Figure 4-121 shows the source aquifers for the public supply wells and the removed agricultural wells and zoom views of flow vectors across the flow lines in the LTA.

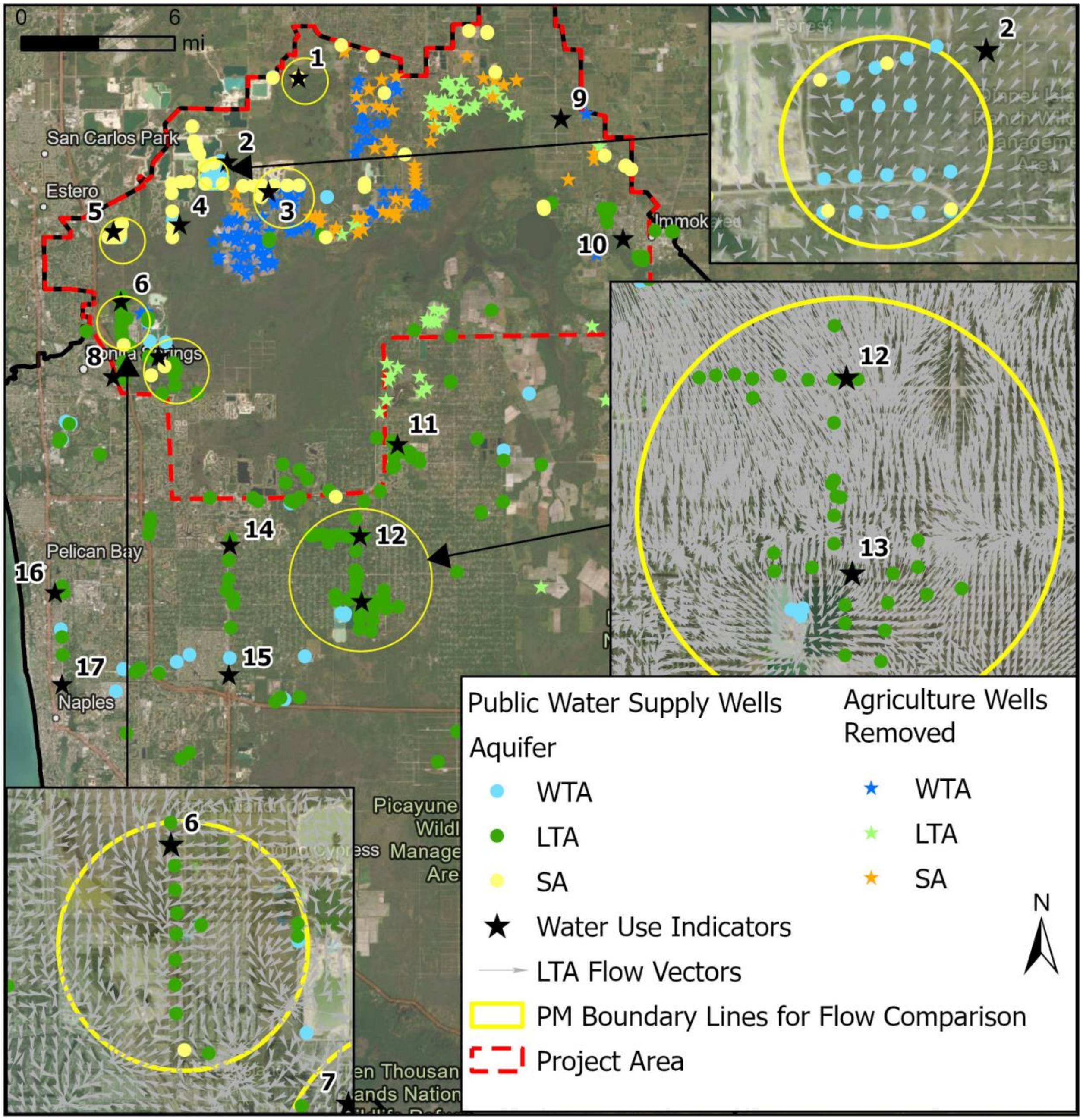

Figure 4-121. Aquifer Sources for Public Supply Well and Removed Agricultural Wells and Zoom Views with LTA Flow Vectors

Table 4-26 shows the average and minimum water levels for the three aquifer layers in the model during the months of January to May, which are the months with the lower groundwater levels. Table 4-27 shows a comparison between the FCM and the ECM average and minimum water levels at the same locations. As expected, most locations show lower water levels due to the increased in pumping applied in the FCM, as described in Section 3.5. Points 3 and 11 are an exception, where water levels are higher in the FCM than in the ECM. These locations are in areas closer to land use change from agricultural to residential and where the previous agricultural pumping wells were removed.

Table 4-26. FCM Dry Season Average and Minimum Water Levels (ft-NAVD) at Selected Locations Near Wellfields

Point ID[1]	Water Table Aquifer		Lower Tamiami Aquifer		Sandstone Aquifer	
	Average	Minimum	Average	Minimum	Average	Minimum
1	24.1	20.8	23.8	20.2	-1.1	-13.8
2	18.1	16.2	18.0	15.9	-13.7	-25.6
3	19.9	16.5	19.9	16.6	5.0	-2.7
4	14.2	12.1	14.3	12.2	-5.2	-14.5
5	12.3	9.5	11.8	8.9	1.7	-3.3
6	10.8	8.7	9.2	7.2	7.9	5.5
7	9.0	6.6	6.5	4.7	6.7	4.9
8	5.5	3.7	5.3	3.4	5.5	3.4
9	28.2	26.7	27.9	26.2	2.9	-4.5
10	19.3	16.7	19.3	16.7	8.7	2.0
11	10.9	8.7	10.8	7.8	8.4	3.7
12	6.8	3.2	5.2	1.9	5.4	2.2
13	6.3	3.5	3.2	0.4	3.7	1.0
14	7.3	4.8	6.6	4.1	6.7	4.2
15	5.5	4.1	5.4	3.6	5.4	3.6
16	3.0	-1.1	2.3	-0.5	0.7	-2.1
17	-0.8	-4.1	-0.8	-4.2	-2.8	-6.2

[1] Numbers correspond to locations in

Figure 4-120.

Table 4-27. FCM Minus ECM Dry Season Average and Minimum Water Levels (ft) at Selected Locations Near Wellfields

Point ID	Water Table Aquifer		Lower Tamiami Aquifer		Sandstone Aquifer	
	Average	Minimum	Average	Minimum	Average	Minimum
1	-0.1	-0.5	-0.2	-0.6	1.4	5
2	0	0	0	0.1	-2.2	-0.6
3	1.4	3.7	1.6	3.5	2	4.9
4	-0.2	-0.2	-0.2	-0.4	-1.9	-2
5	-0.4	-0.7	-0.5	-0.8	-0.4	-0.4
6	-0.1	-0.1	-0.4	-0.4	-0.3	-0.1
7	-0.4	-0.4	-0.8	-0.8	-0.8	-0.7
8	-0.1	-0.2	-0.3	-0.4	-0.3	-0.3
9	0	0	0	0	-0.3	0.3
10	-0.3	-0.7	-0.3	-0.7	0	0.8
11	1	0.2	0.2	0	0.3	4.3
12	-0.2	-0.6	-0.5	-0.9	-0.5	-0.8
13	-0.1	-0.2	-0.6	-0.8	-0.5	-0.7
14	-0.1	-0.3	-0.2	-0.4	-0.2	-0.4
15	0.1	0	0.1	0	0.1	0
16	-0.2	-0.2	-0.2	-0.3	-0.1	-0.2
17	-0.1	-0.1	-0.2	-0.4	-0.1	-0.1

Table 4-28 shows the sum of the flow volumes across the yellow circles in

Figure 4-120 and

Table 4-29 shows the difference in the sum of the flow volumes between the FCM and ECM (FCM minus ECM).

Table 4-28. FCM Total Groundwater Flow Volume (Ac-ft) Across the Selected Flow Lines (

Figure 4-120)

Month	Water Table Aquifer	Lower Tamiami Aquifer	Sandstone Aquifer
January	2,396	9,628	1,046
February	3,061	8,621	742
March	2,385	9,921	1,114
April	2,435	9,153	897
May	2,627	9,353	855
Total	12,903	46,675	4,654

Table 4-29. FCM Minus ECM Total Groundwater Flow Volume (Ac-ft) Across the Selected Flow Lines

Month	Water Table Aquifer	Lower Tamiami Aquifer	Sandstone Aquifer
January	1,114	1,660	374
February	1,215	1,265	296
March	864	1,048	330
April	495	881	160

Month	Water Table Aquifer	Lower Tamiami Aquifer	Sandstone Aquifer
May	233	882	148
Total	3,922	5,736	1,308

5.0 Summary and Discussion

This report provides a summary of the evolution (Section 2) and development (Section 3) of the FCM, which will serve as the baseline model for the CWI alternative evaluation. The results presented in Section 4 give an overview of the performance measures and metrics that will be used to compare and evaluate the project alternatives against this baseline model. The comparison between the FCM and the ECM (Deliverable 5.2.2), provides a measure of impact due to changes in land use and thus, changes in storage, drainage and water use result in spatial and temporal water level changes in Corkscrew and adjacent areas. In the next deliverable, these metrics will be further narrowed into quantities that will serve to output relative scores based on the weights and target values that have been defined in Deliverable 3.2 and refined during TWG meetings.

The FCM design storm simulations incorporated increases in the projected rainfall and SLR based factors and offsets provided and recommended by the SFWMD Resiliency group based on climate change research. These storm simulations are to assess the flood risk impact of the project alternatives in urban and agricultural communities adjacent to CWI. The design storm simulations show canal overtopping in the northern portions of the Corkscrew Canal (south of Cork 2 and Cork3), along some stretches of the Kehl Canal (where the berm is low or breached), and some portions of the Cocohatchee canal, but mostly where the top of bank is low adjacent to undeveloped land. Flood and duration maps show extensive flooding occurring in urban and agricultural areas increasing with the storm depth. In urban areas, however, the flood depths (< 0.5 ft) and durations are relatively low (< 3 hours), whereas some agricultural areas show higher flood depths and durations due to limited drainage in some of the farm basins. Hydrograph plots of the storms at key locations show that the Cork3 headwater stages stay above the wet season optimal maximum for the entire month duration of the storm simulations, even during the 5-yr storm. This illustrates the limited capacity of the structure and the canal, since tailwater stages are also high for a prolonged period of time. Other structures show the ability to return to the optimal stages within the month simulation period. As expected, these future conditions led to higher peak stages in canals and higher inundation areas and durations in some of the basins due to the higher storm depth and increased tailwater condition. In areas north of Corkscrew where previous agricultural basins were converted to urban developments, changes in storage and drainage resulted in a higher volume of water retained in the wet detention ponds and preserved areas of these developments and lower urban inundation in the Trafford and the Estero basins.

The FCM long term simulation incorporated the SLR in the tidal boundary, but no changes in rainfall or ET from the ECM were incorporated. Thus, the wetland hydrologic restoration results in Section 4.3 show the changes in water levels in Corkscrew due to the impact of changes in development storage and drainage features and water use. Agricultural water management is in many cases year round and crops need to be irrigated and drained during the dry season. Thus, excess drainage may occur from maintaining optimal water table conditions for crops during the dry season. When the excess drainage is discharged directly into Corkscrew, it may contribute to higher and longer hydration in the receiving wetlands than their natural hydroperiods. Moreover, the removal of the agricultural pumping wells removes a significant water table sink in areas that were converted from agricultural to urban uses. These factors in addition to the changes in storage requirements in new developments contribute to the changes in water levels seen in the areas near where these changes occur. Groundwater abstraction factors were applied to the public water supply wells based on future water use projections from the LWC Water Supply Plan. This additional pumping shows decreases in water levels in the vicinity of the well fields and increases in flow volumes towards the well fields. The decreases in water levels are lower in the surficial aquifer than in the Lower Tamiami and Sandstone aquifers.

The long term simulation water table was processed into wet season, dry season and hydroperiod metrics for each simulation year and compared to target references for the various plant communities in the CWI project area. In general, the resulting maps, vegetation community averages, and indicator plots show that the Corkscrew Marsh, Lake Trafford basin, and the northern portions of Corkscrew Swamp Sanctuary are too wet; whereas, the Imperial Marsh, southern Flint Pen, Bird Rookery and southern Corkscrew are too dry compared to the reference targets. These baseline results are reinforming the project definitions in order to better target the restoration solutions.

6.0 References

Coastal & Heartland National Estuary Partnership, 2021. South Lee County Watershed Initiative Hydrological Modeling Project Final Report, December 2021. Prepared by Coastal & Heartland National Estuary Partnership with Lago Consulting and Services.

Clem, S.E. and Duever, M.J., 2019. Hydrologic Changes over 60 Years (1959-2019) in an Old-Growth Bald Cypress Swamp on a Rapidly Developing Landscape. Wetland Science & Practice, October 2019.

Duever, 2024. Recommended Hydrologic Metrics for CWI Model. September 9, 2024.

Hazen and Sawyer, 2025. Big Cypress Basin Model Update. Task 4: Model Calibration. Submitted to SFWMD, March 18, 2024 with addendum on March 27, 2025

Kimley-Horn and Singhofen & Associates, 2024. Larry Kiker Preserve H&H Summary Report. Submitted to Lee County, March 2024.

SFWMD, 2018a. SFWMD Land Cover Land Use 2014-2016. Retrieved from: https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd::sfwmd-land-cover-land-use-2014-2016/about

SFWMD, 2018b. Flood Protection Level of Service provided by Existing District Infrastructure for Current (2015) Sea Level Conditions and Three Future (2065) Sea Level Scenarios for Golden Gate Watershed – Final Report, September 2018, South Florida Water Management District, Prepared by Parsons and Taylor Engineering.

SFWMD, 2020. Water Control Operations Atlas: Big Cypress Basin System Part 2: Structure Descriptions. Mary 23, 2020 (Working Version). South Florida Water Management District, Hydrology and Hydraulics Bureau and Big Cypress Basin Service Center.

SFWMD, 2022. Lower West Coast Water Supply Plan Update, Planning Document and Appendices. December, 2022.

SFWMD, 2025. SFWMD Land Cover Land Use 2021-2023. Published January 23, 2025. Retrieved from: SFWMD Land Cover Land Use 2021-2023 | South Florida Water Management District Open Data.

USACE, 2024. Comprehensive Everglades Restoration Plan, Picayune Strand Restoration Project. Final Operating Manual. Jacksonville District U.S. Army Corps of Engineers. July 2024.

Appendix A: Design Storm Stage Canal Profiles, FCM vs ECM

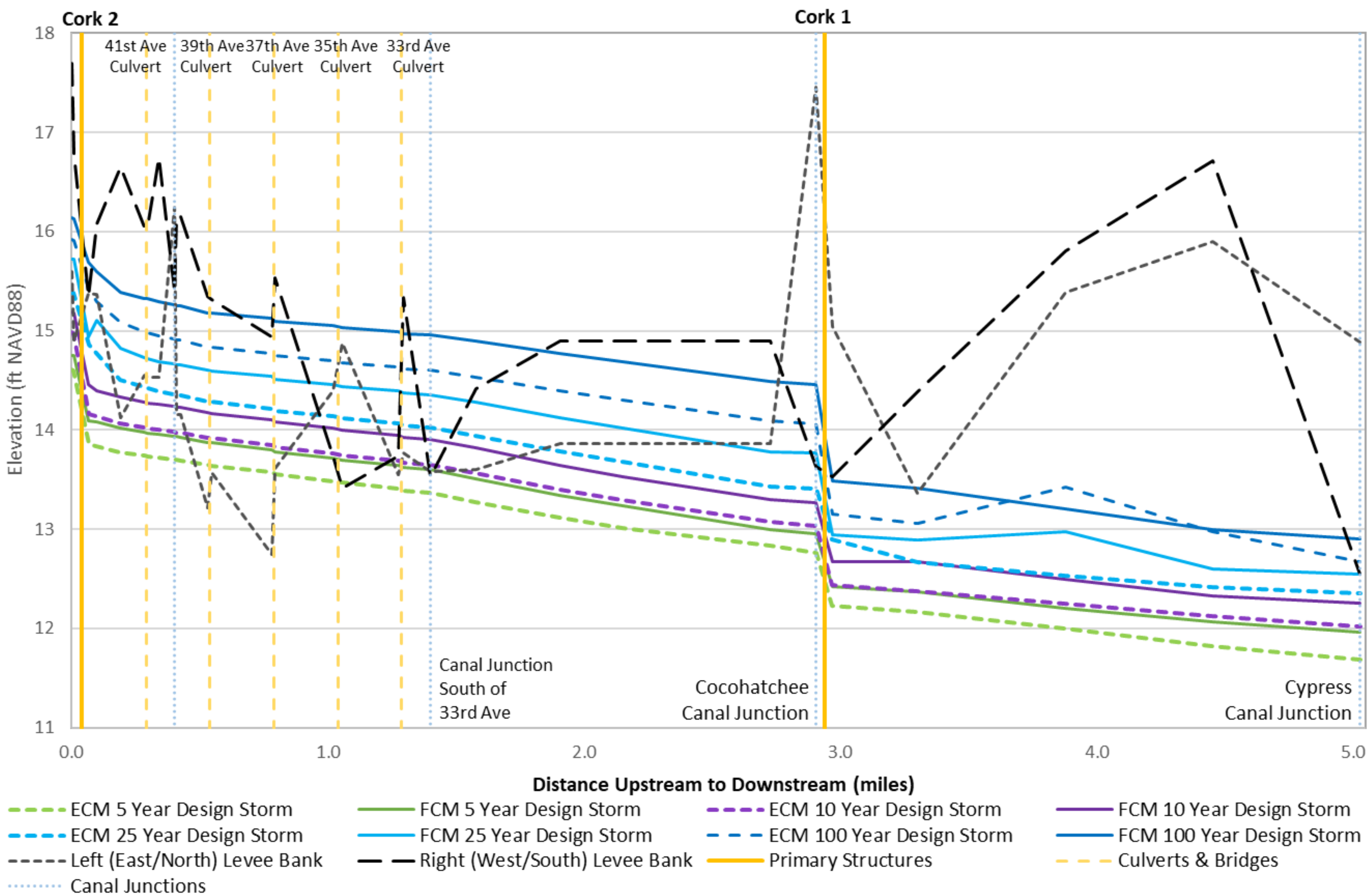

Figure A-1. Comparison between ECM and FCM Maximum Water Surface Elevation for All Design Storm Events for the Section of Corkscrew Canal Between Cork 2 and the Cypress Canal.

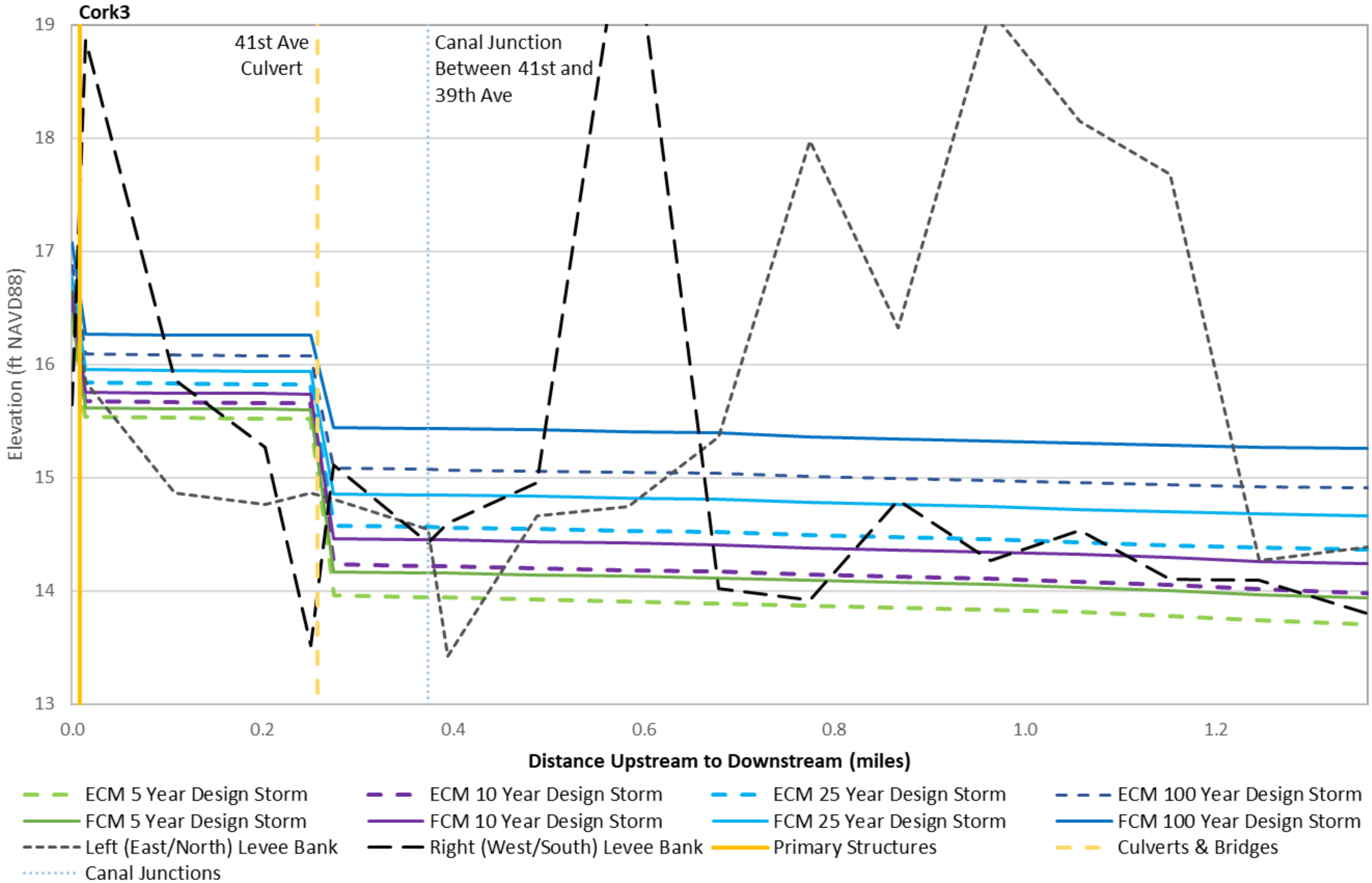

Figure A-2. Comparison between ECM and FCM Maximum Water Surface Elevation for All Design Storm Events for the Section of the Corkscrew Canal South of Cork 3.

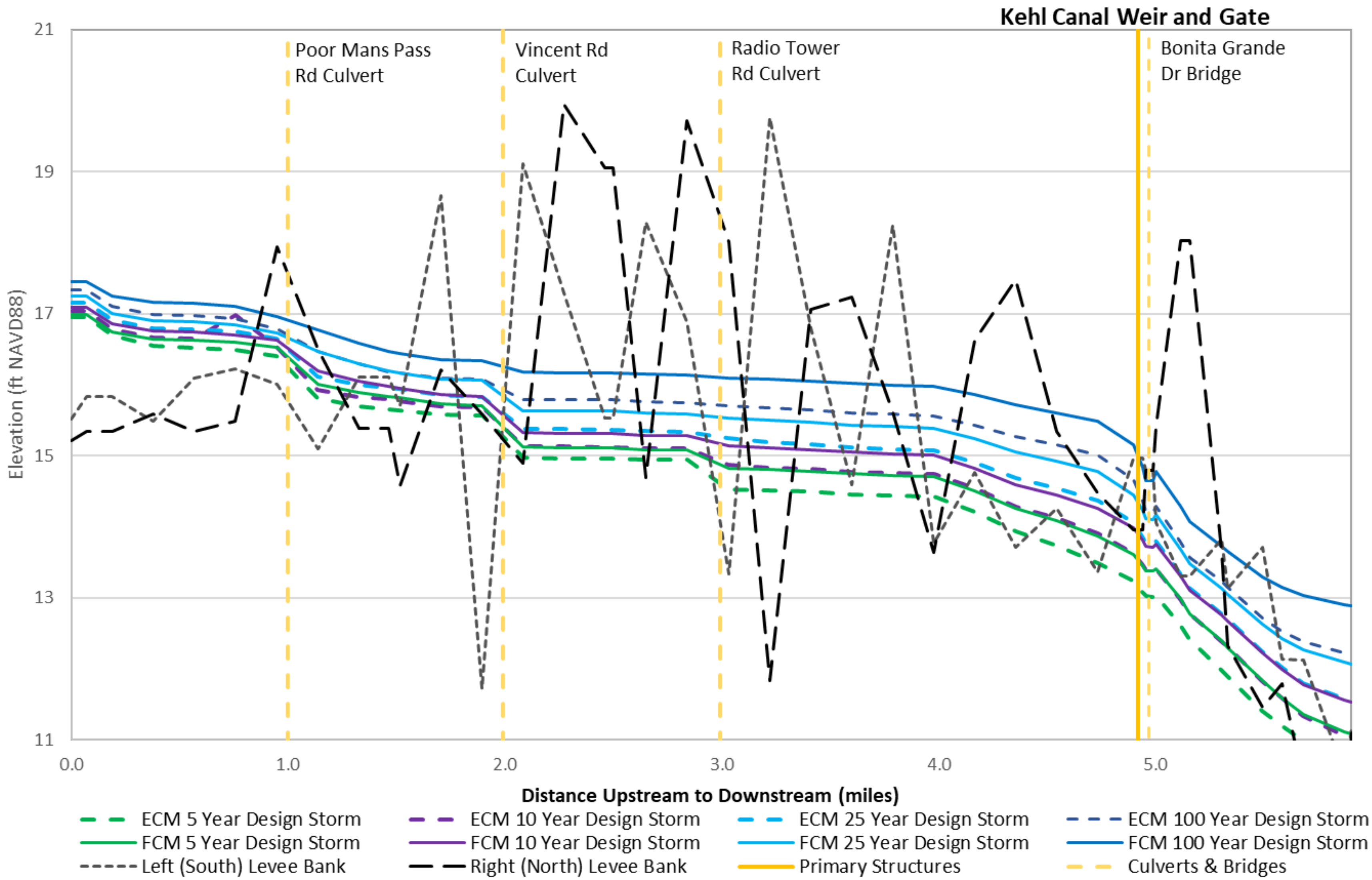

Figure A-3. Comparison between ECM and FCM Maximum Water Surface Elevation for All Design Storm Events for the Kehl Canal.

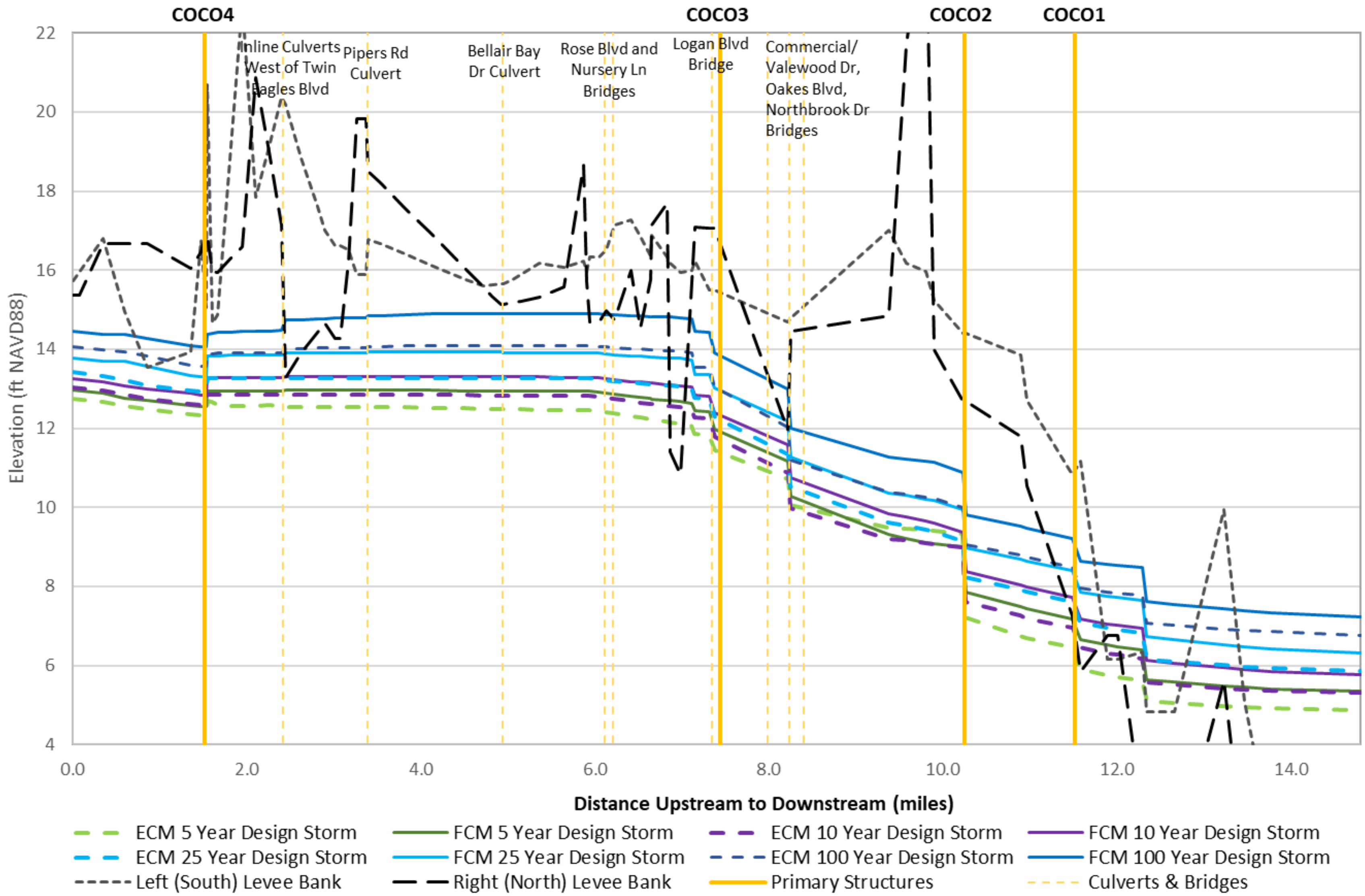

Figure A-4. Comparison between ECM and FCM Maximum Water Surface Elevation for All Design Storm Events for the Cocohatchee Canal.

Appendix B: Design Storm Simulation Stage and Flow Hydrographs, ECM vs FCM

Cork 3

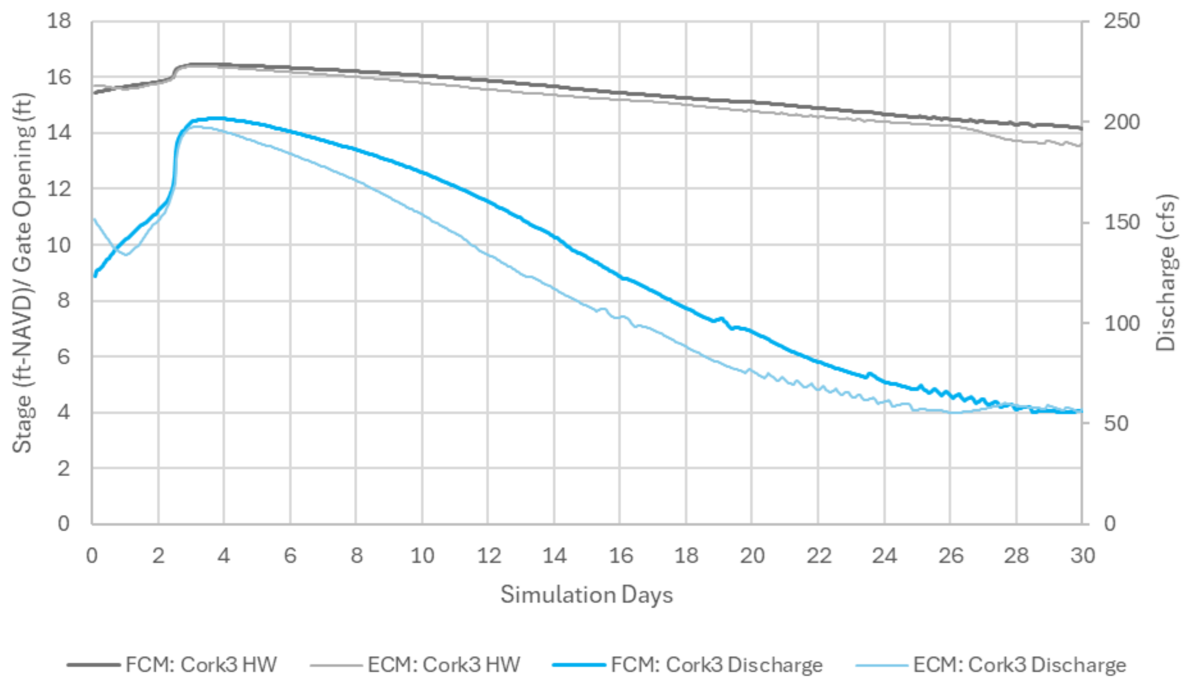

Figure B-1. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 3

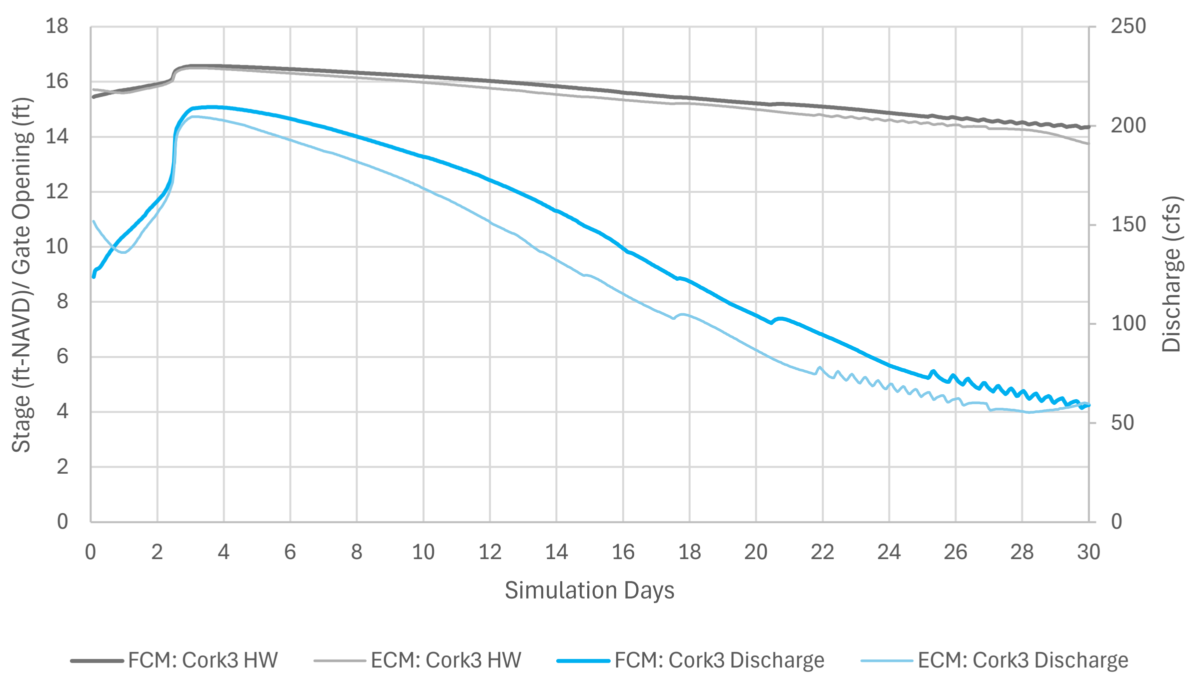

Figure B-2. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 3

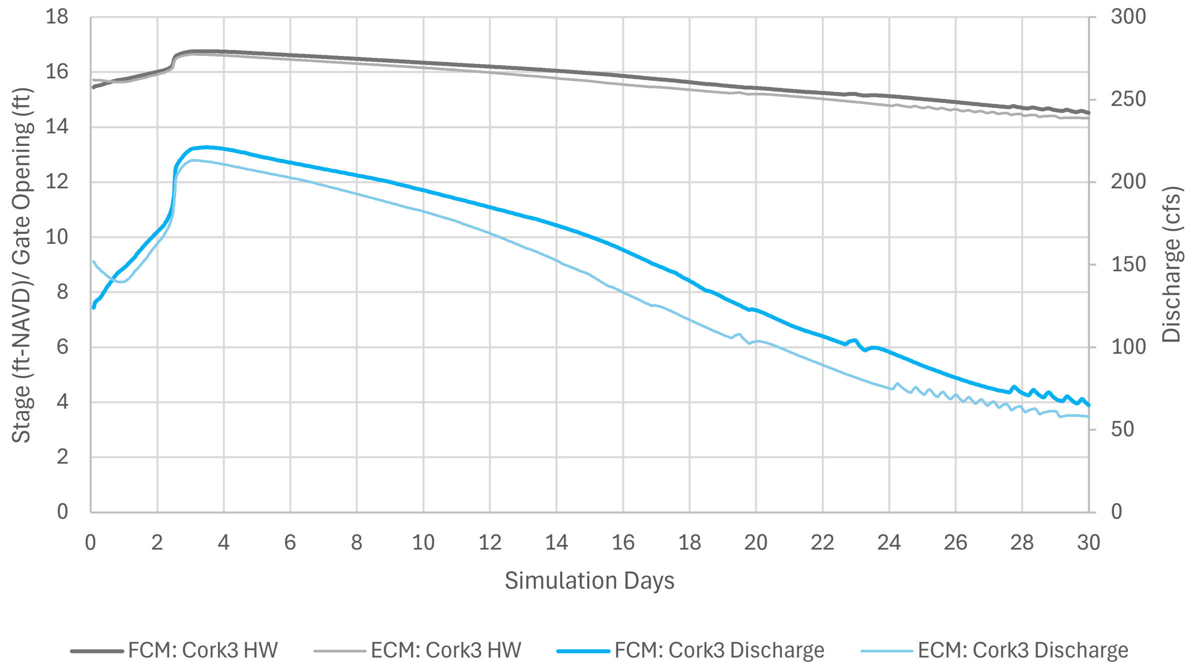

Figure B-3. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 3

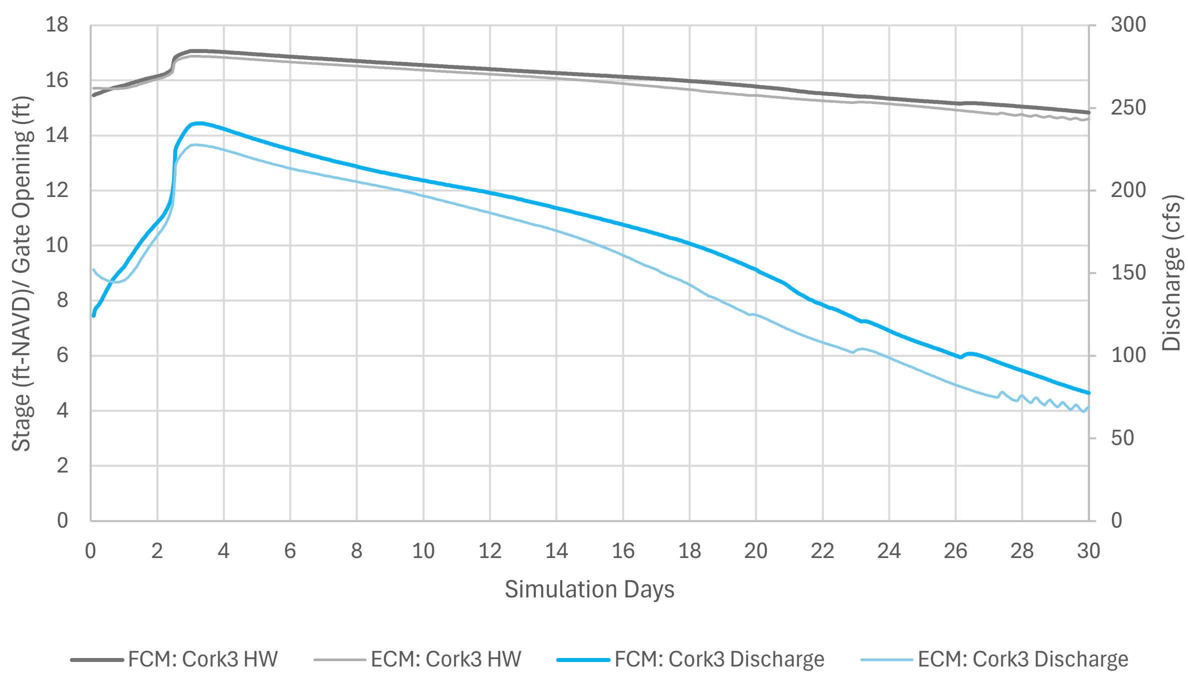

Figure B-4. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 3

Cork 2

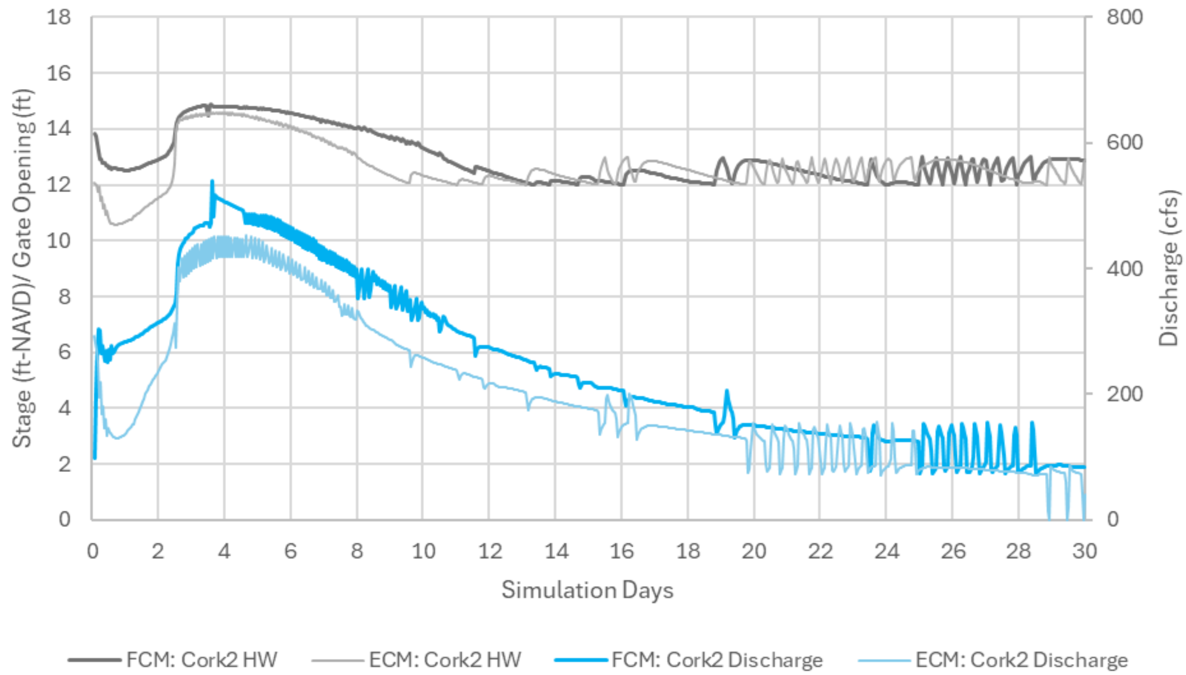

Figure B-5. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 2

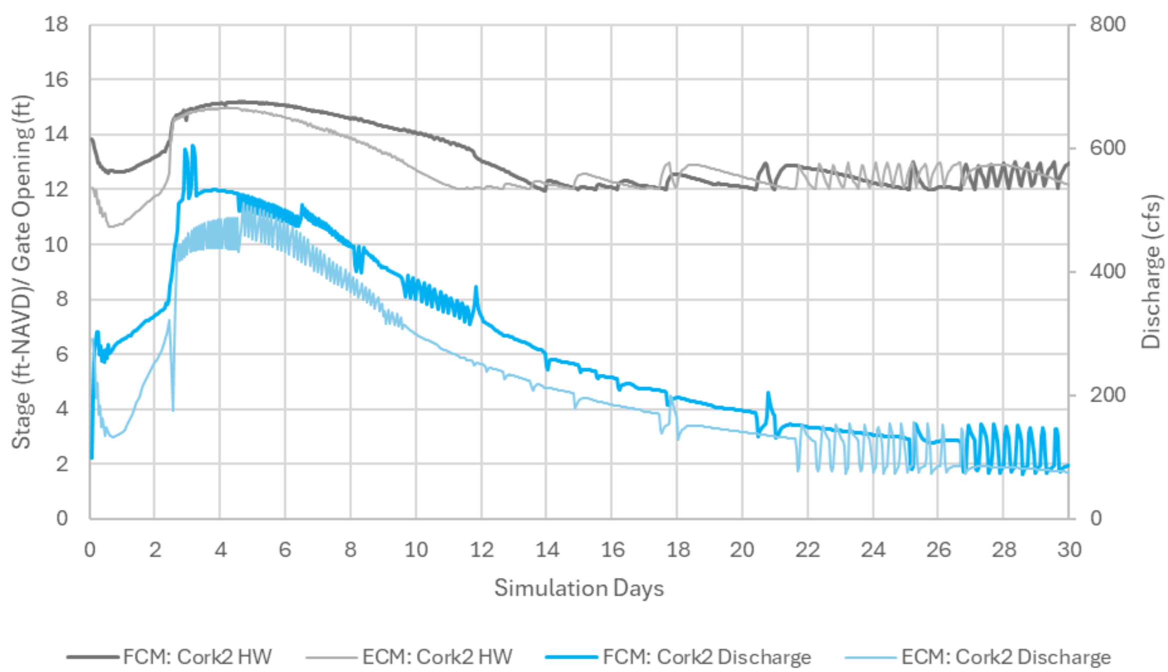

Figure B-6. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 2

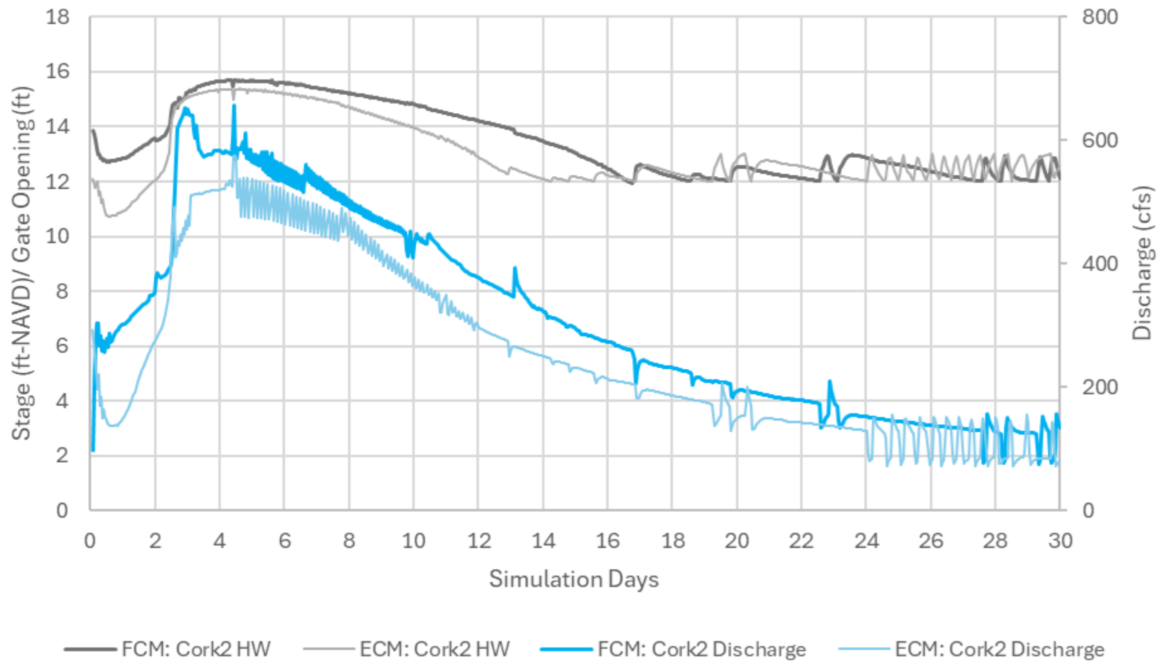

Figure B-7. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 2

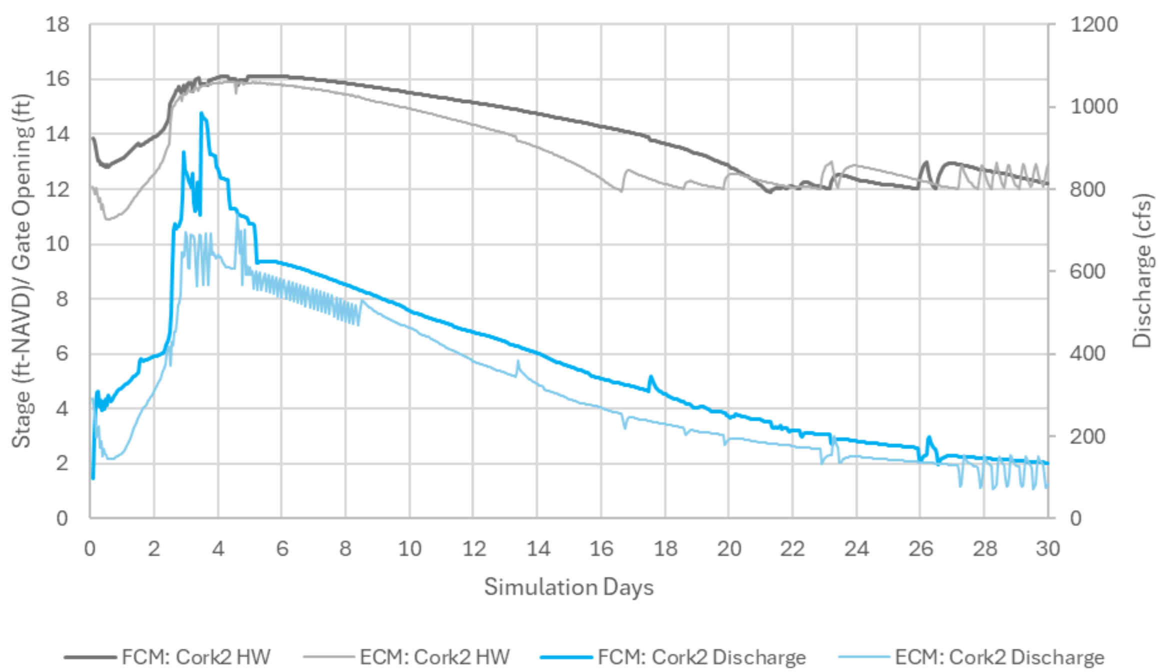

Figure B-8. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 2

Cork 1

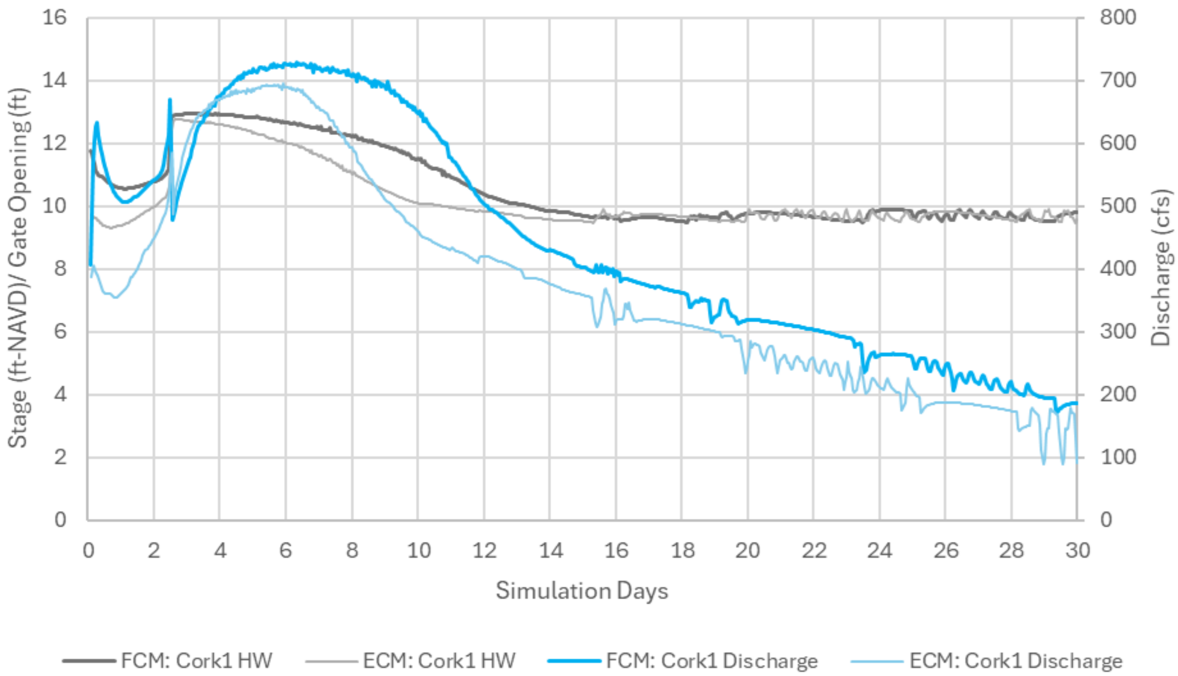

Figure B-9. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 1.

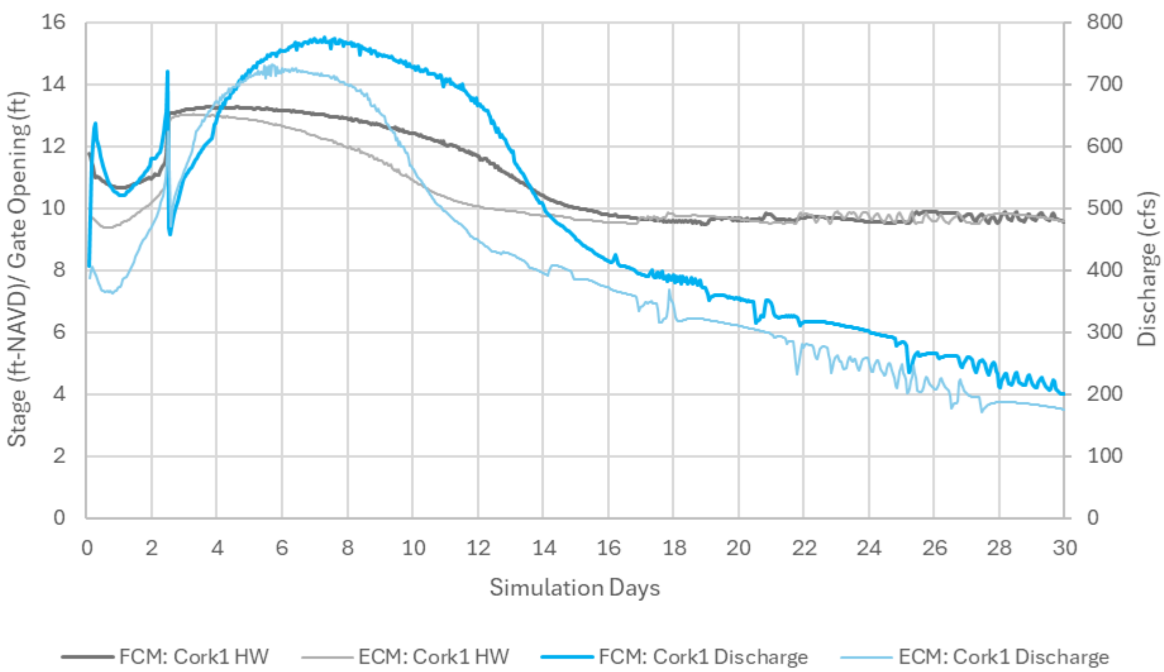

Figure B-10. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 1.

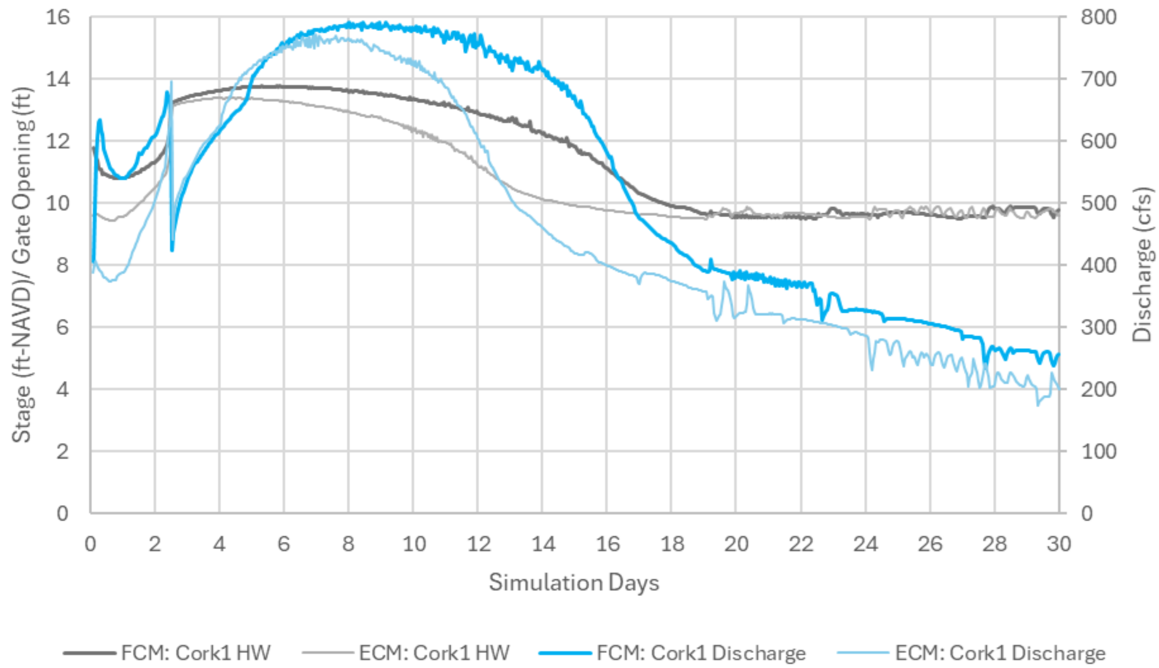

Figure B-11. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 1.

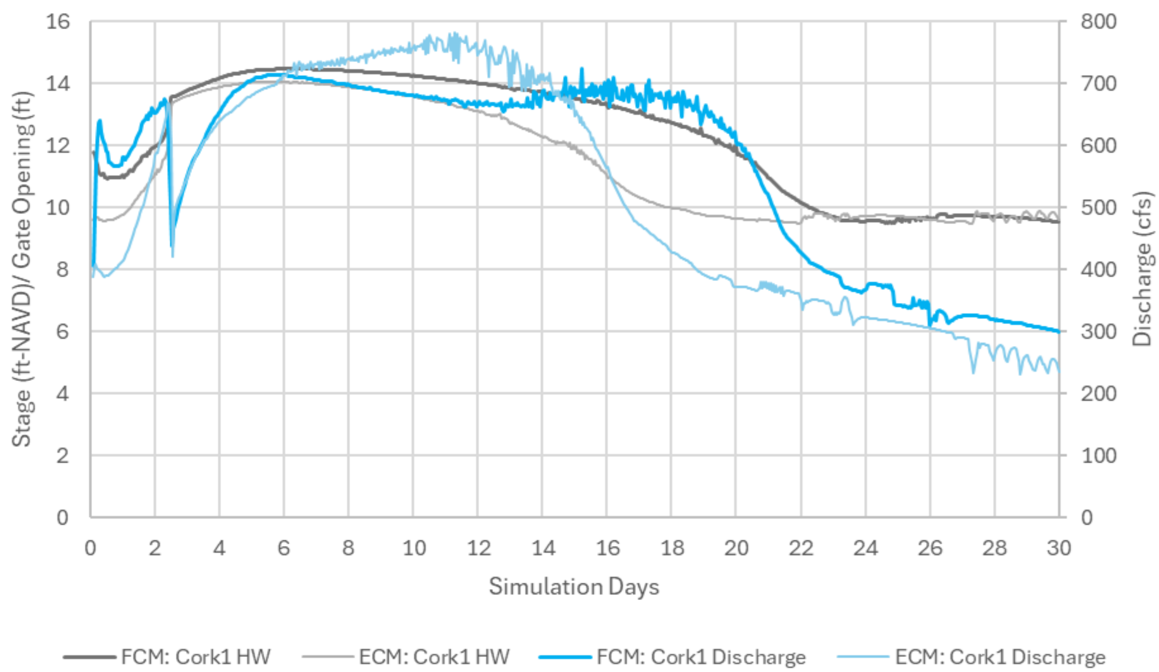

Figure B-12. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Cork 1.

Curry 1

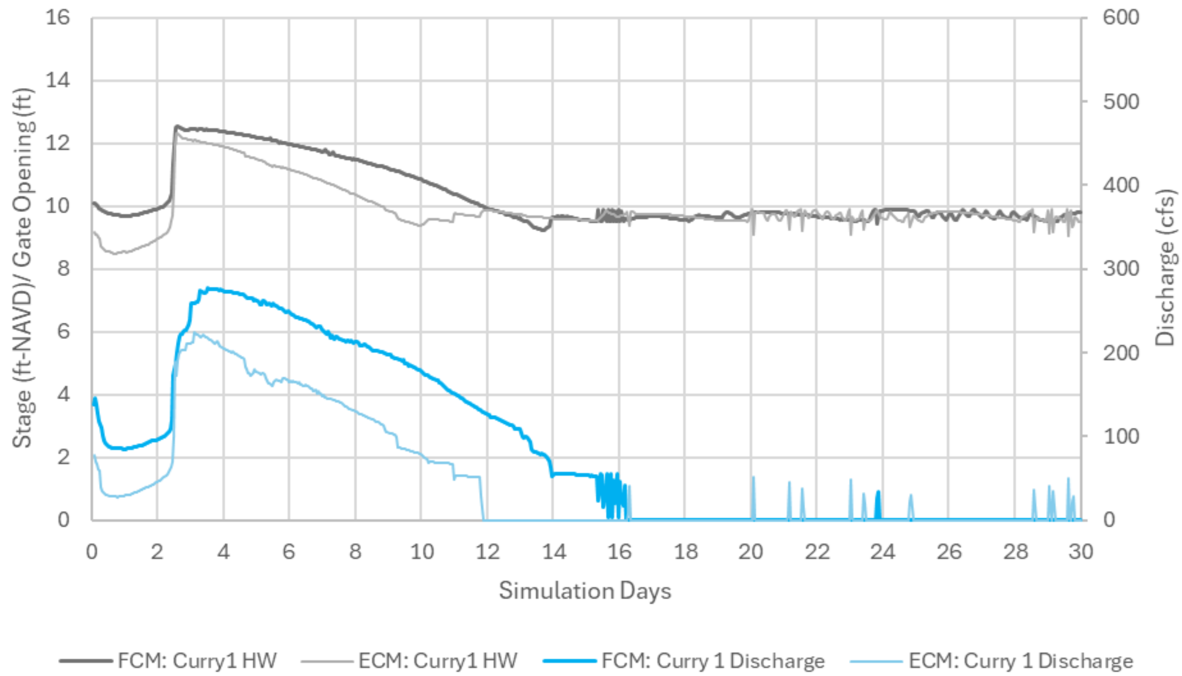

Figure B-13. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Curry 1.

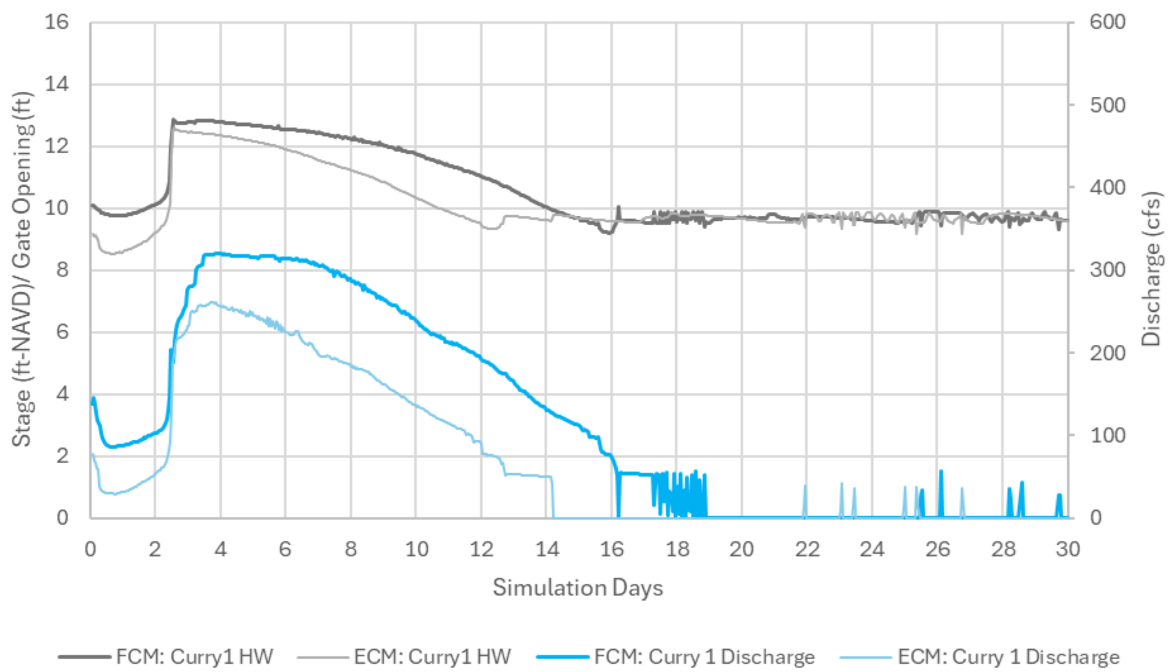

Figure B-14. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Curry 1.

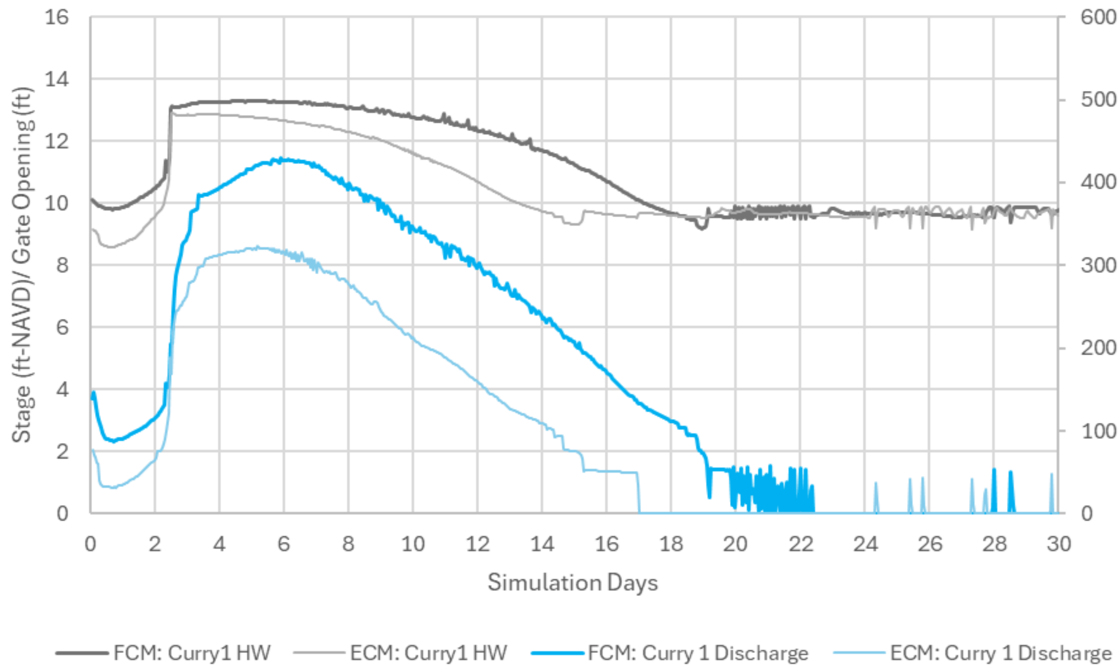

Figure B-15. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Curry 1.

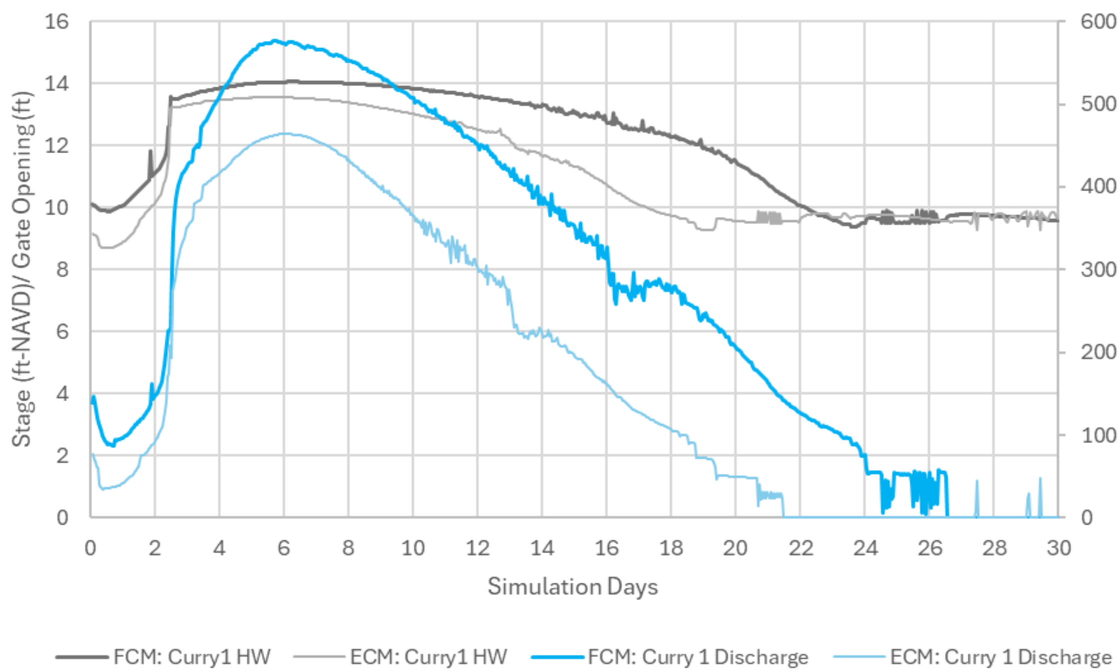

Figure B-16. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Curry 1.

COCO4

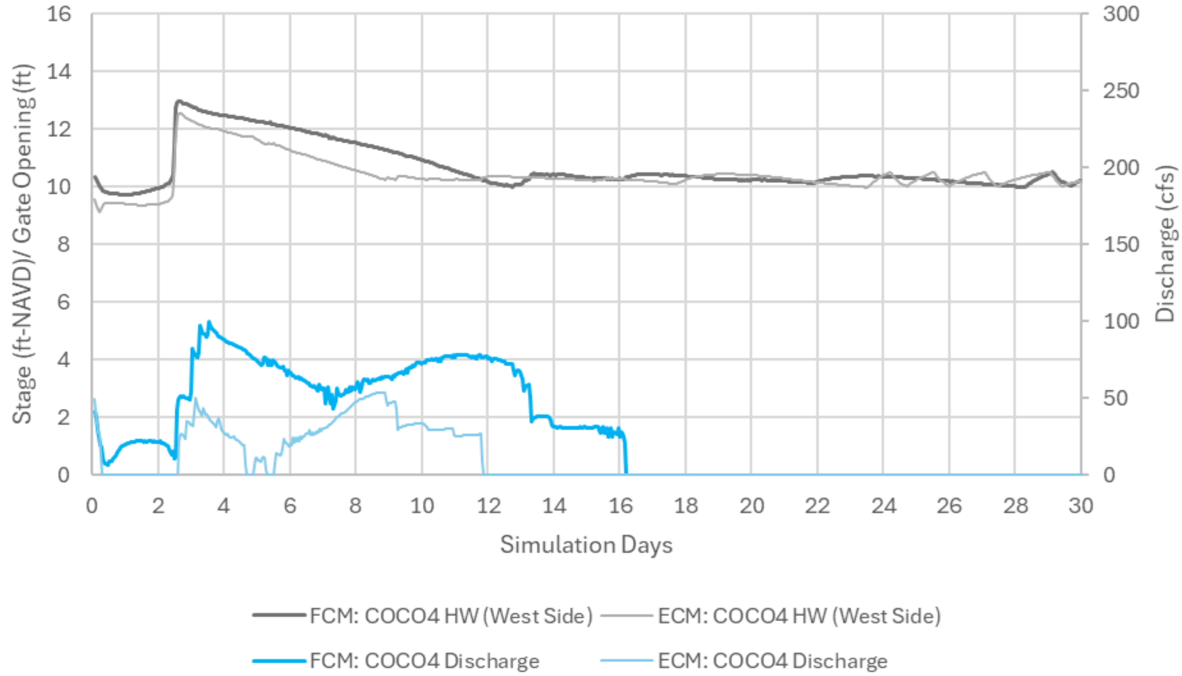

Figure B-17. 5-yr Design Storm Simulation Flow and Stage Hydrographs for COCO4.

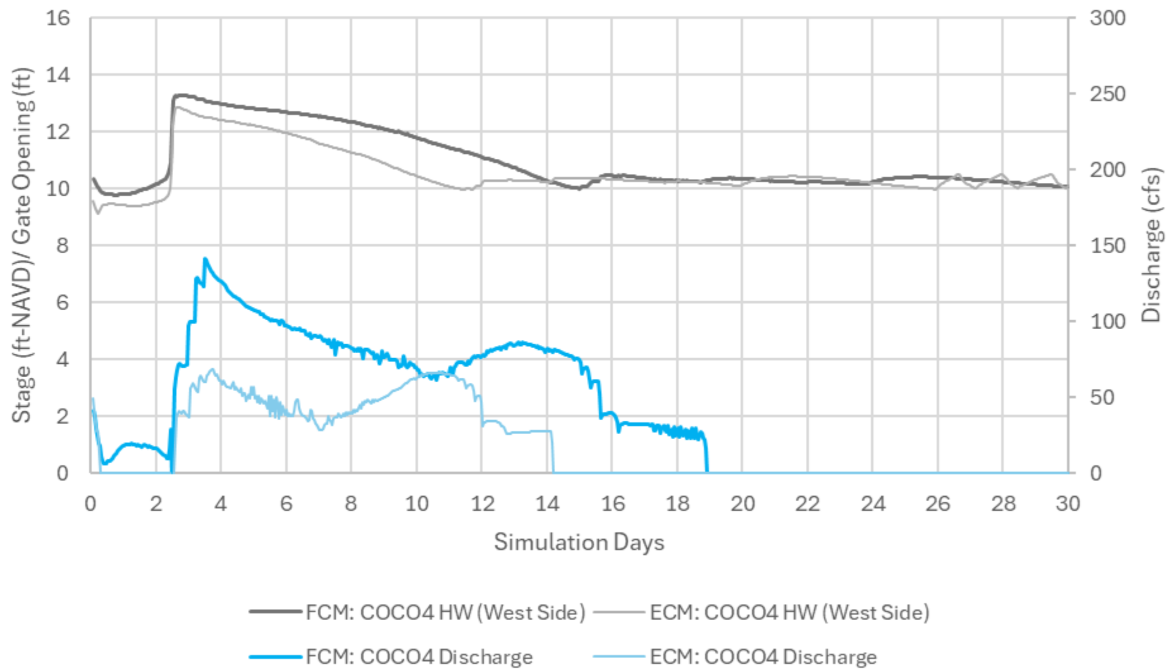

Figure B-18. 10-yr Design Storm Simulation Flow and Stage Hydrographs for COCO4.

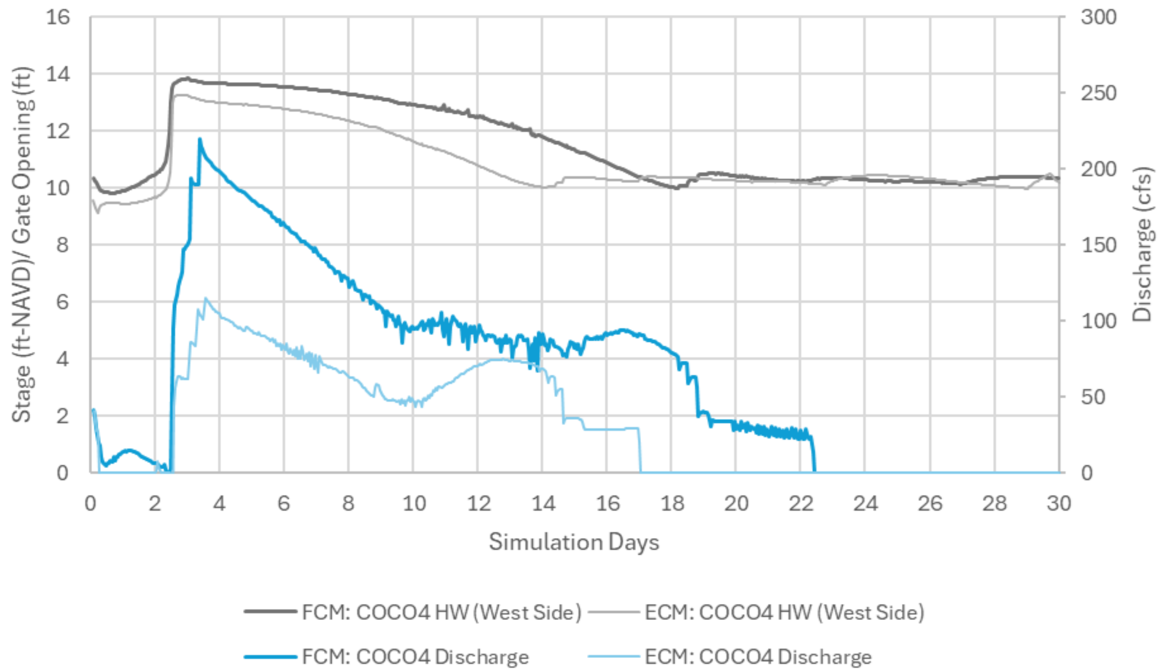

Figure B-19. 25-yr Design Storm Simulation Flow and Stage Hydrographs for COCO4.

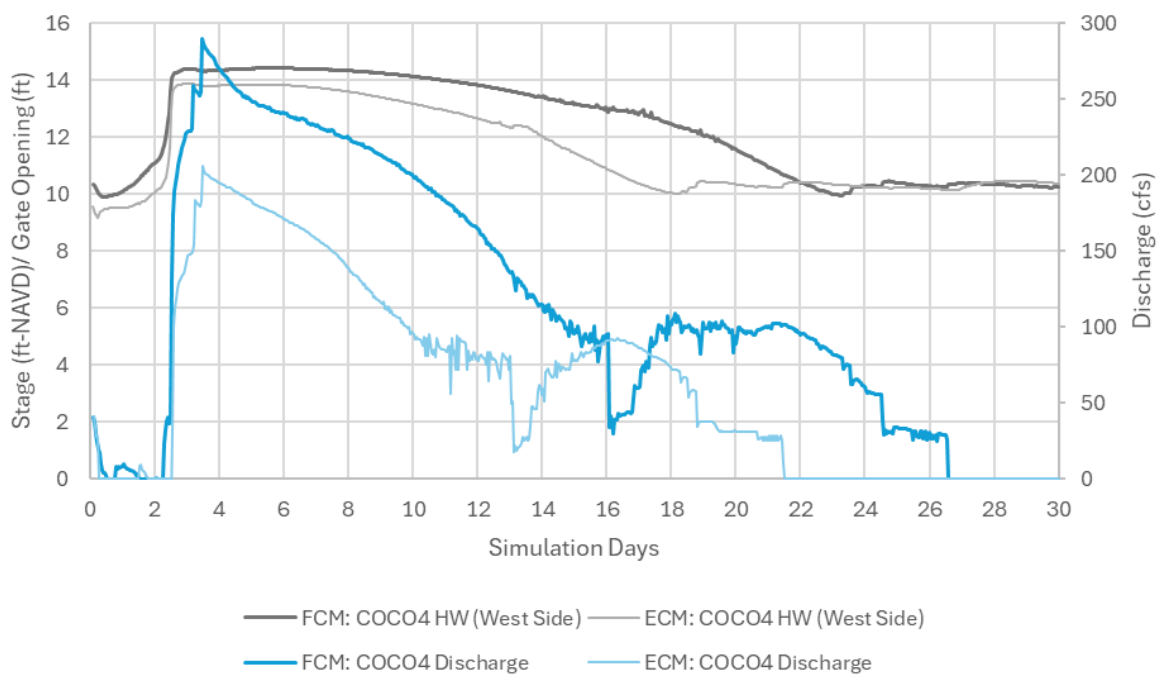

Figure B-20. 100-yr Design Storm Simulation Flow and Stage Hydrographs for COCO4.

COCO3

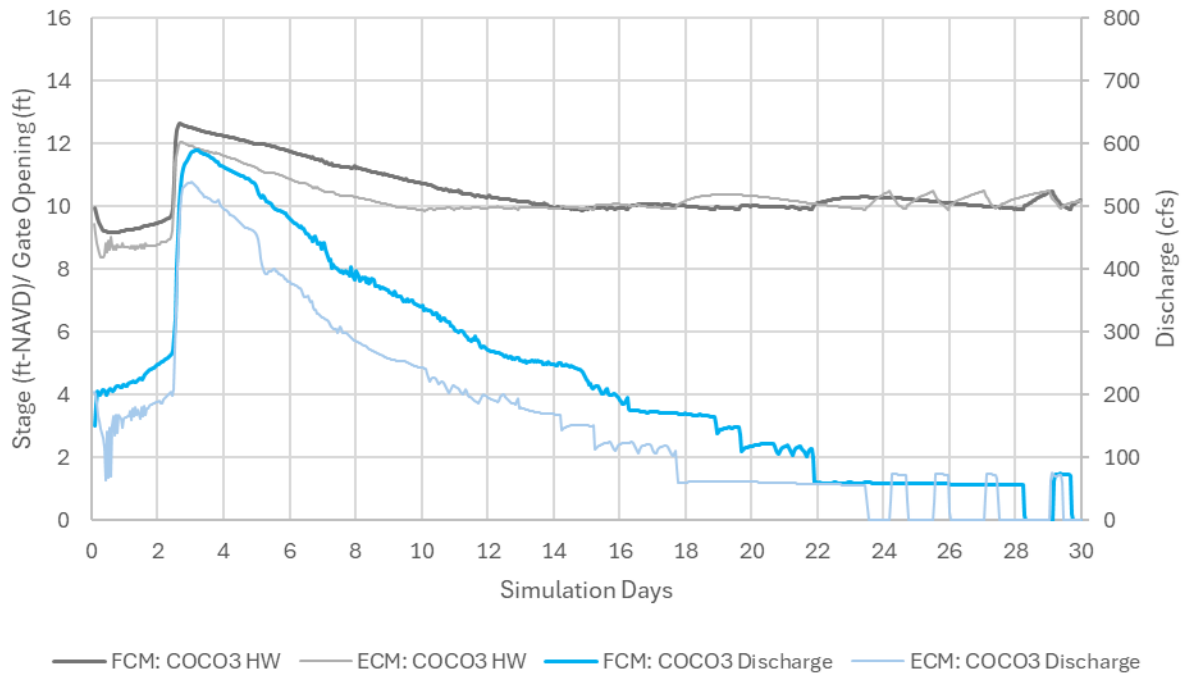

Figure B-21. 5-yr Design Storm Simulation Flow and Stage Hydrographs for COCO3.

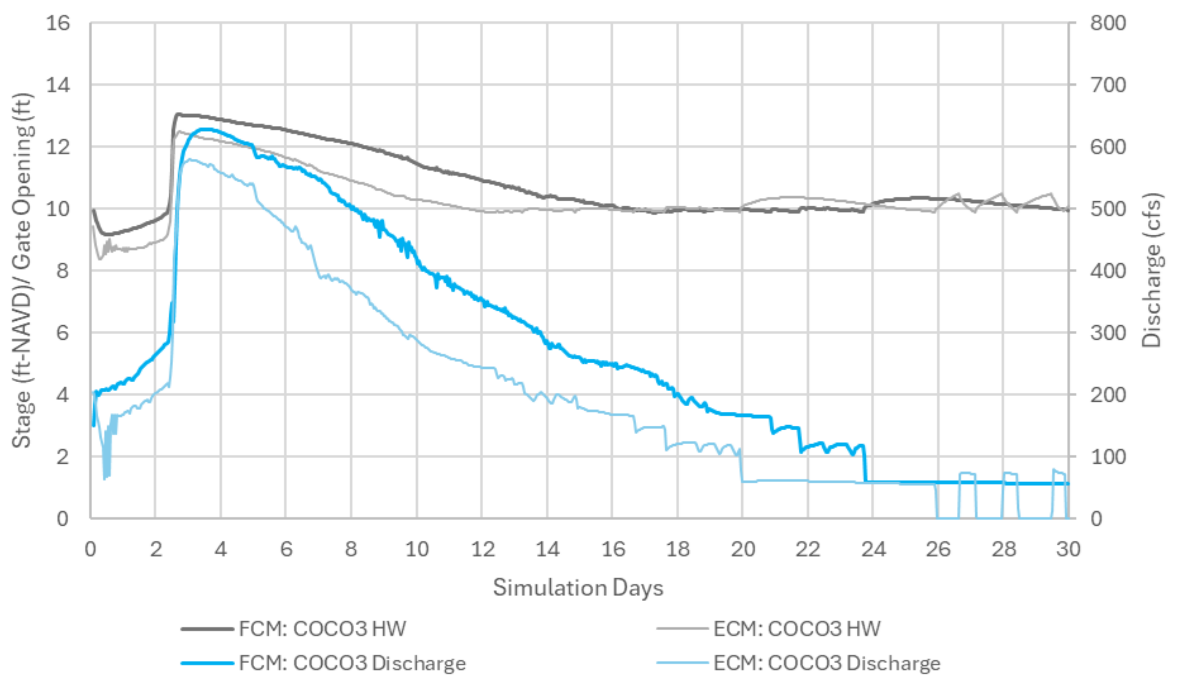

Figure B-22. 10-yr Design Storm Simulation Flow and Stage Hydrographs for COCO3.

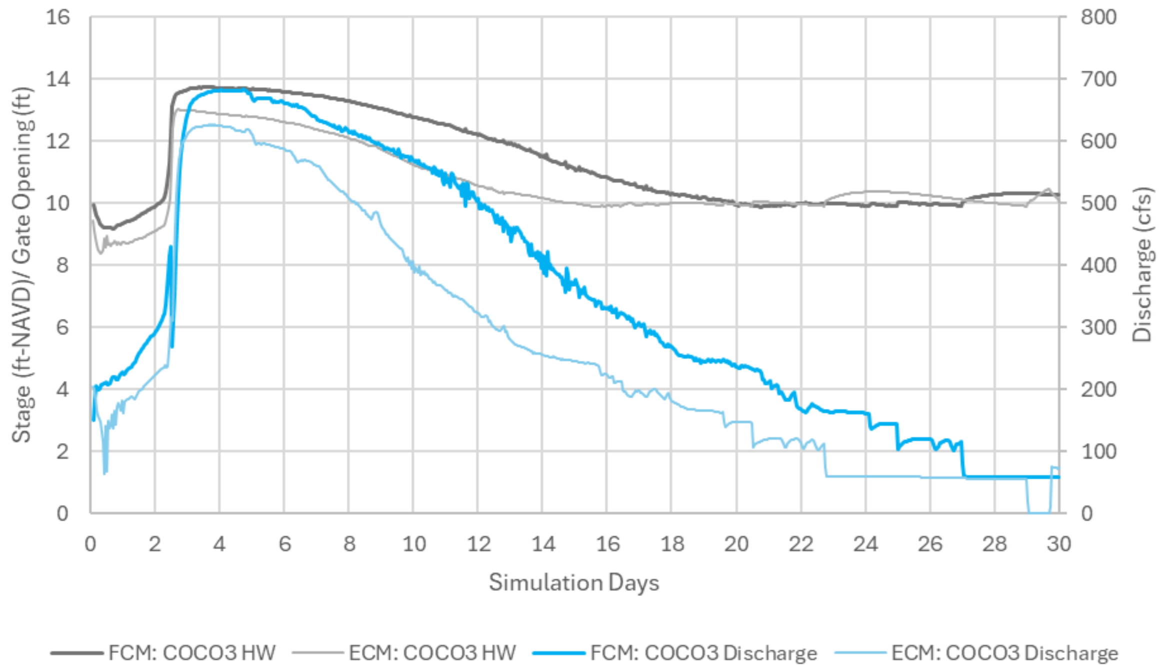

Figure B-23. 25-yr Design Storm Simulation Flow and Stage Hydrographs for COCO3.

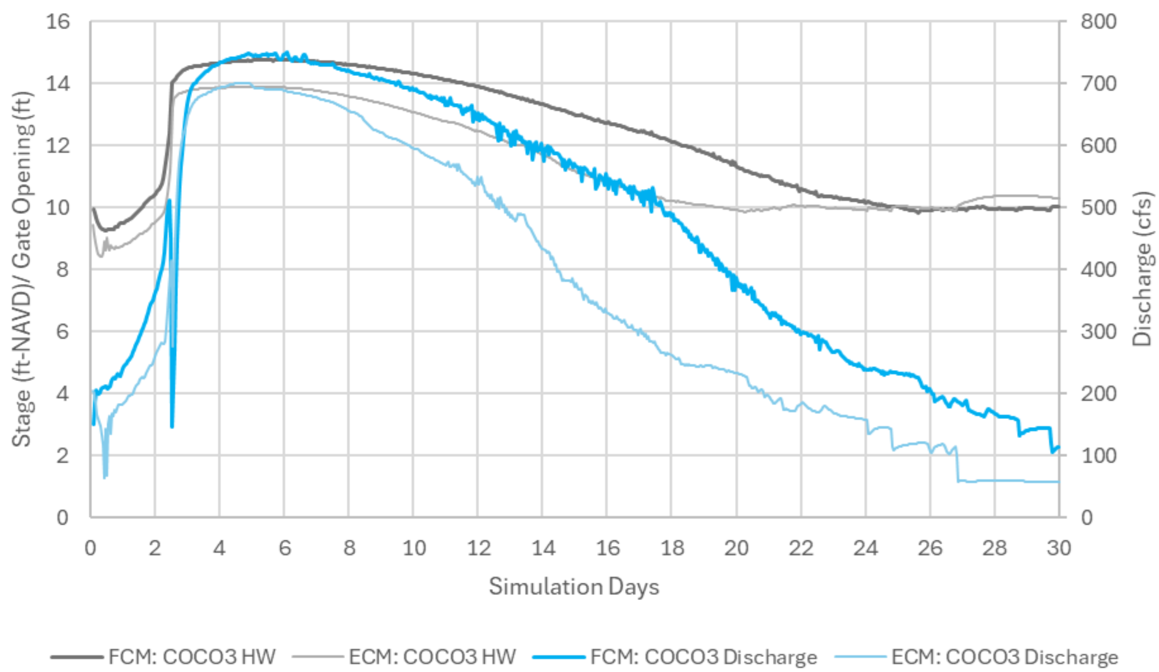

Figure B-24. 100-yr Design Storm Simulation Flow and Stage Hydrographs for COCO3.

COCO2

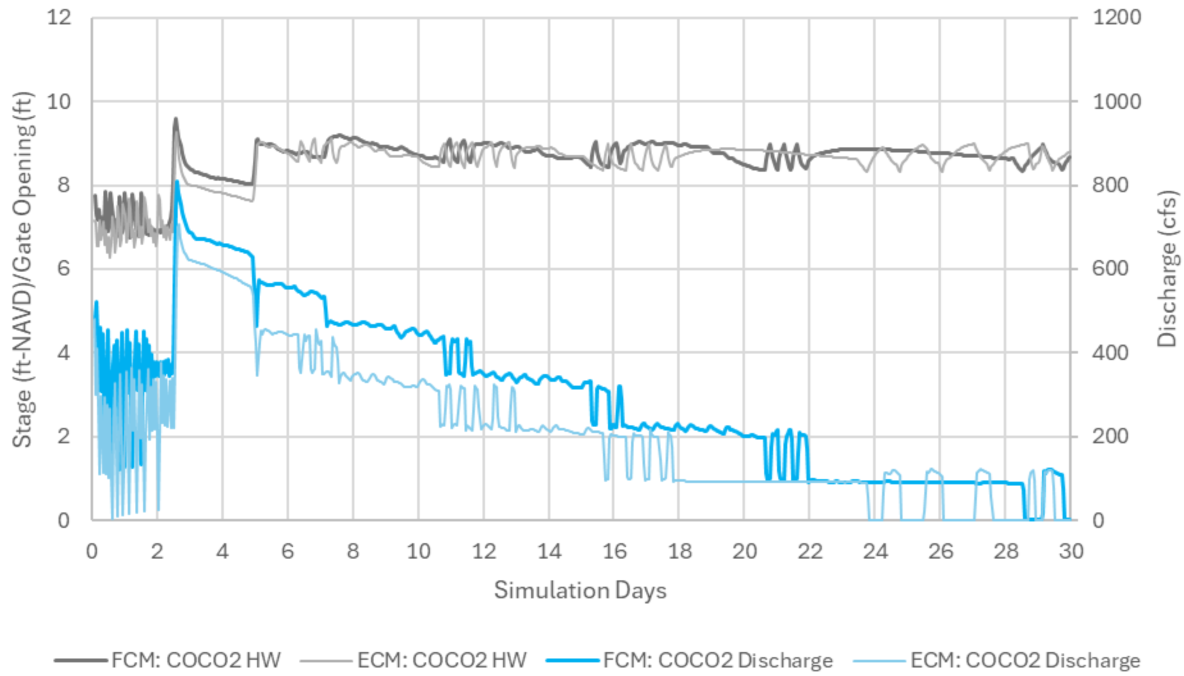

Figure B-25. 5-yr Design Storm Simulation Flow and Stage Hydrographs for COCO2.

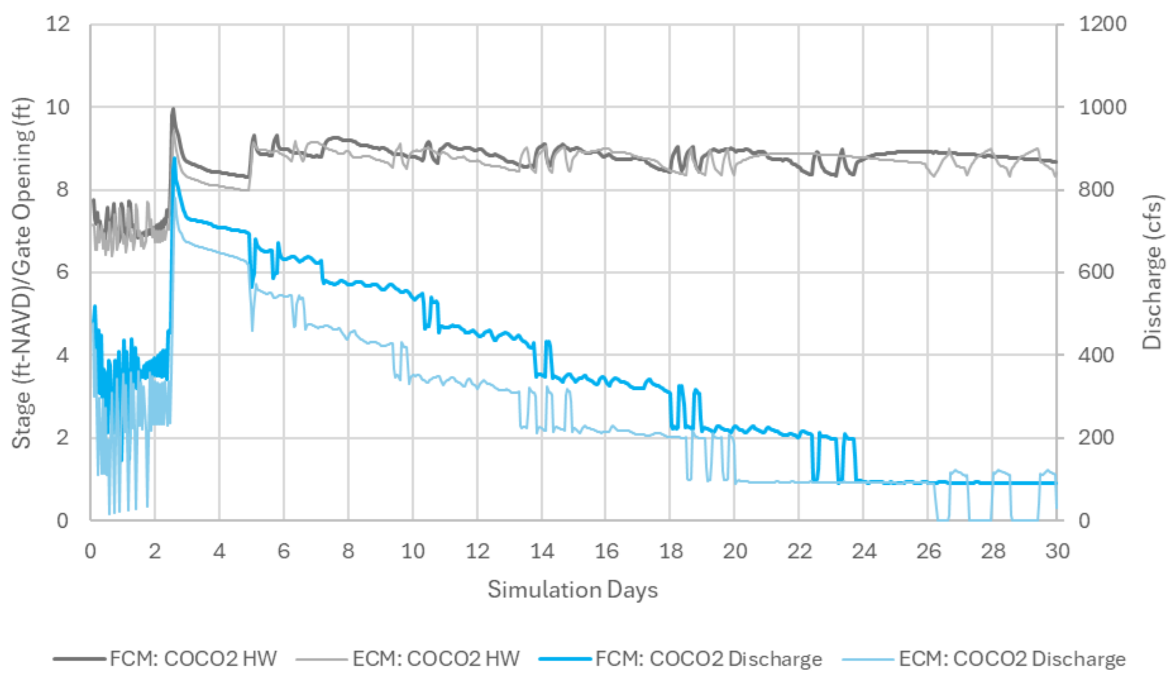

Figure B-26. 10-yr Design Storm Simulation Flow and Stage Hydrographs for COCO2.

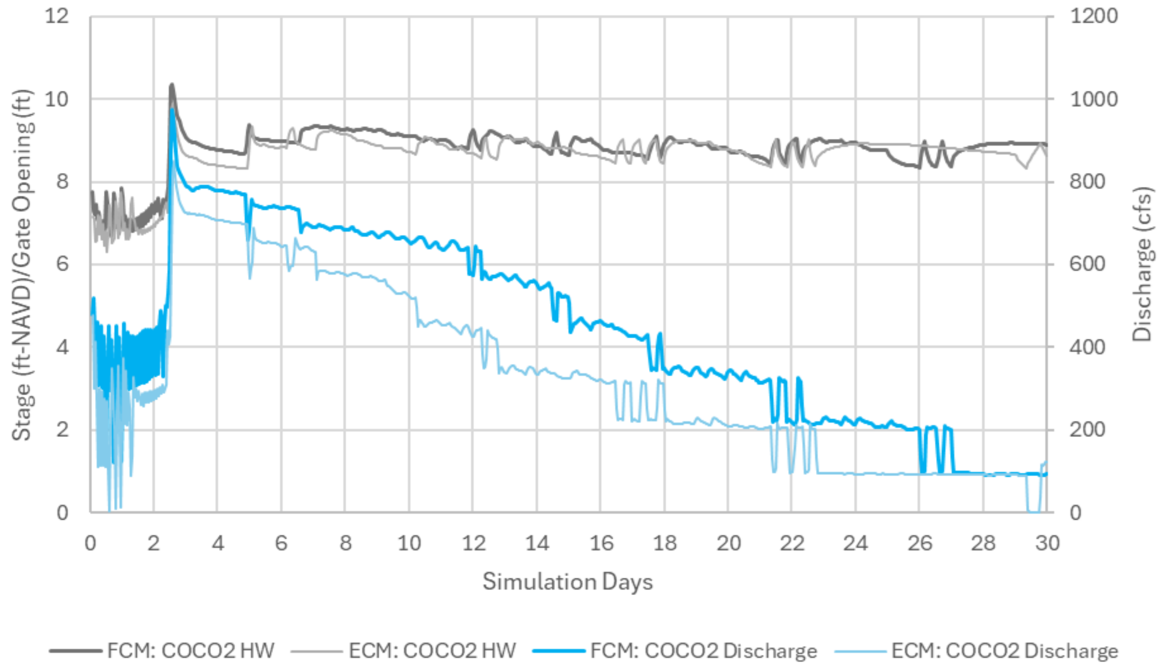

Figure B-27. 25-yr Design Storm Simulation Flow and Stage Hydrographs for COCO2.

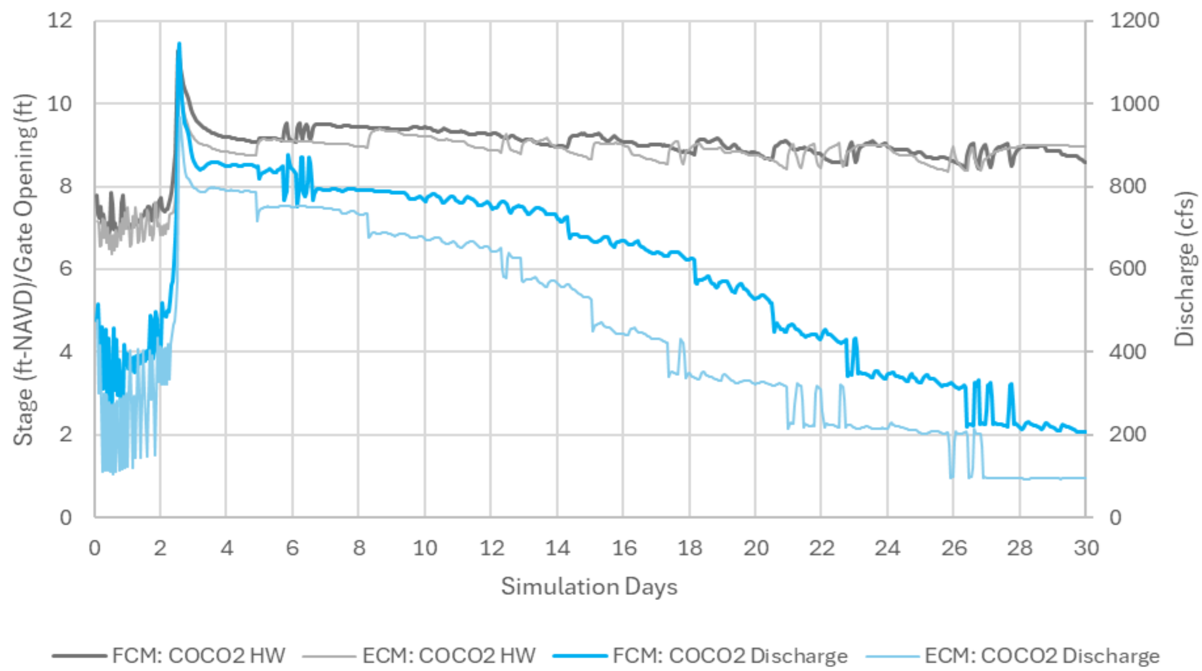

Figure B-28. 100-yr Design Storm Simulation Flow and Stage Hydrographs for COCO2.

COCO1

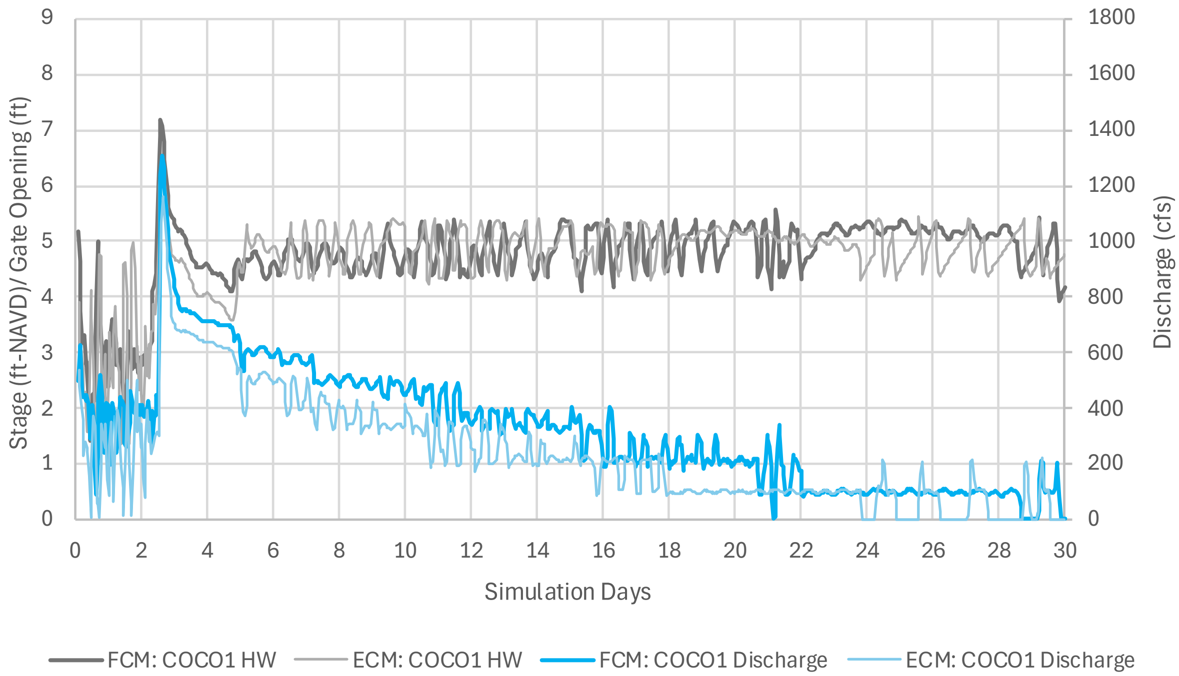

Figure B-29. 5-yr Design Storm Simulation Flow and Stage Hydrographs for COCO1.

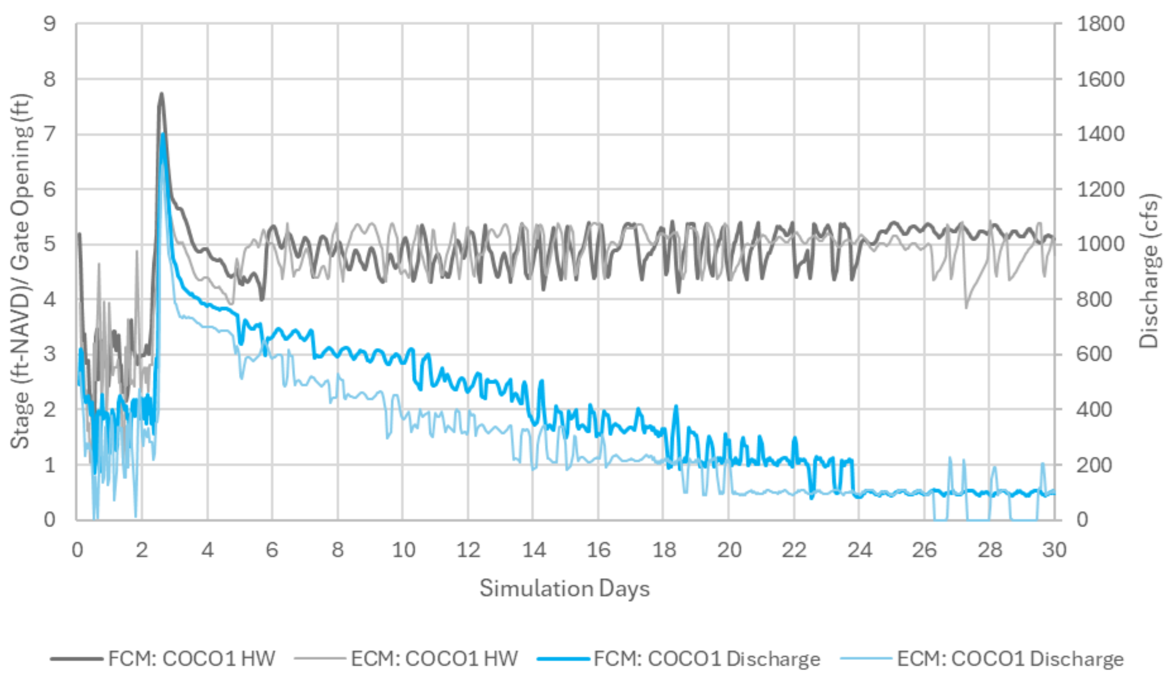

Figure B-30. 10-yr Design Storm Simulation Flow and Stage Hydrographs for COCO1.

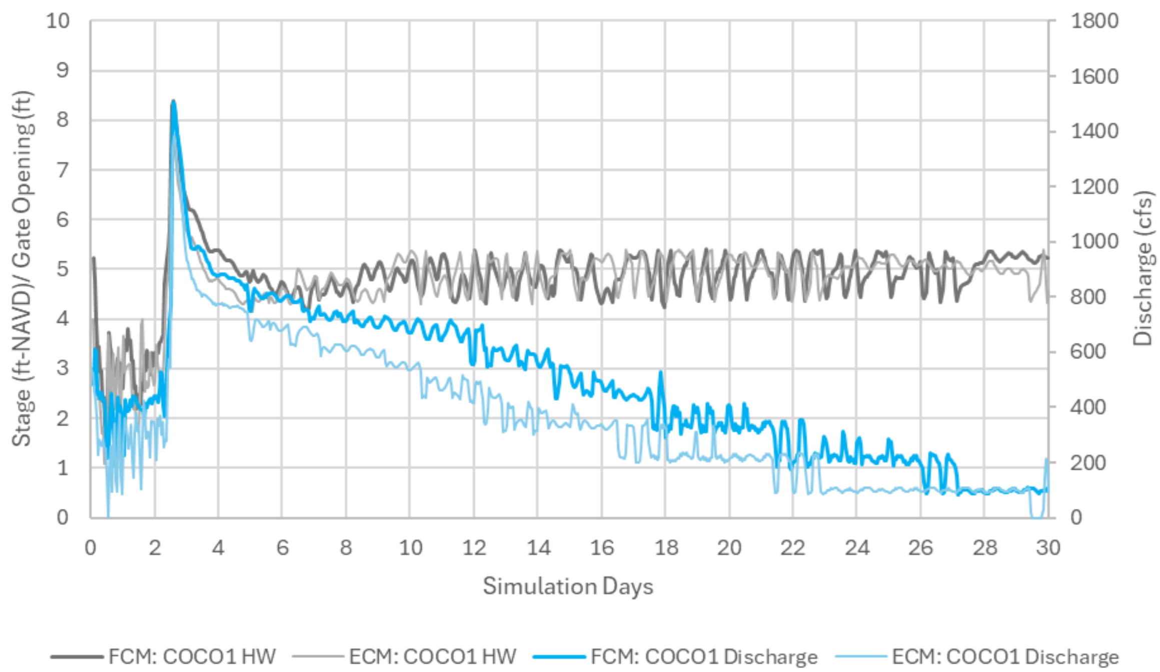

Figure B-31. 25-yr Design Storm Simulation Flow and Stage Hydrographs for COCO1.

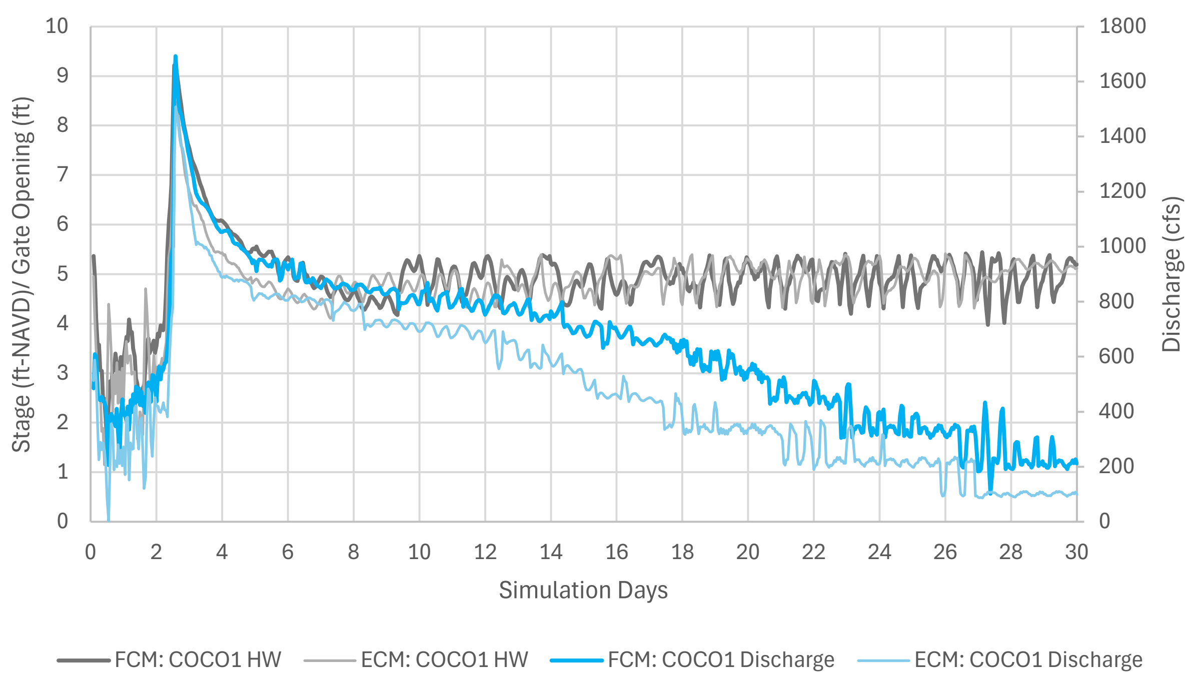

Figure B-32. 100-yr Design Storm Simulation Flow and Stage Hydrographs for COCO1.

Kehl Canal Weir and Gates

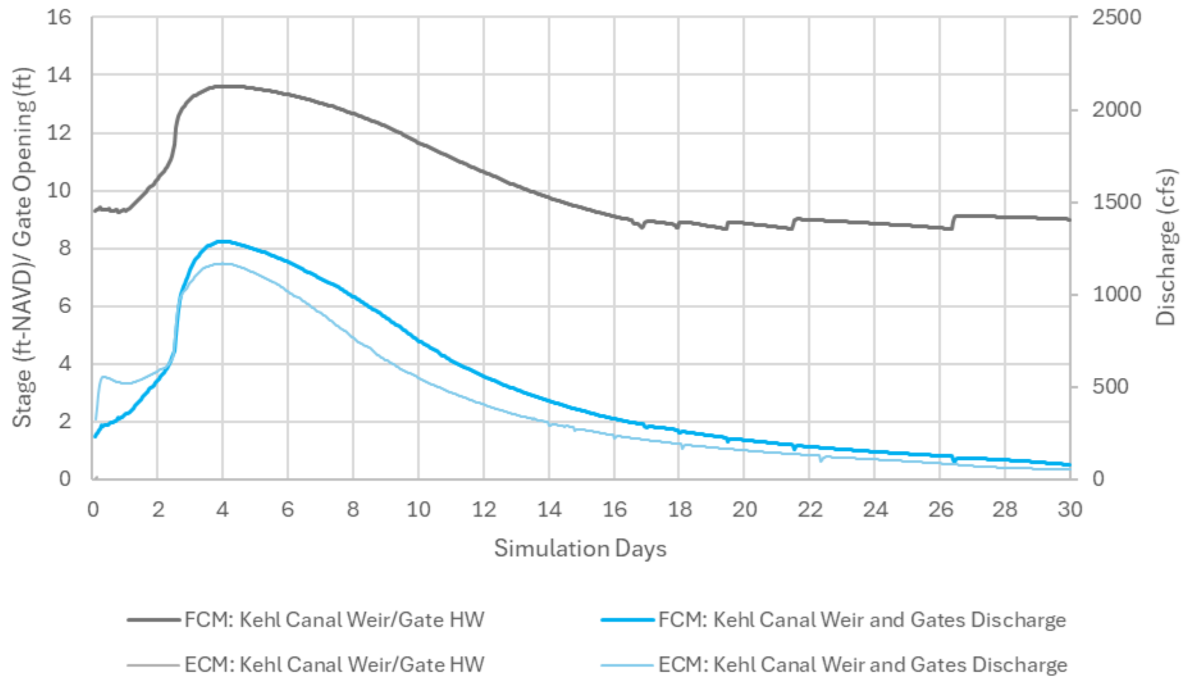

Figure B-33. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Kehl Canal Weir/Gate.

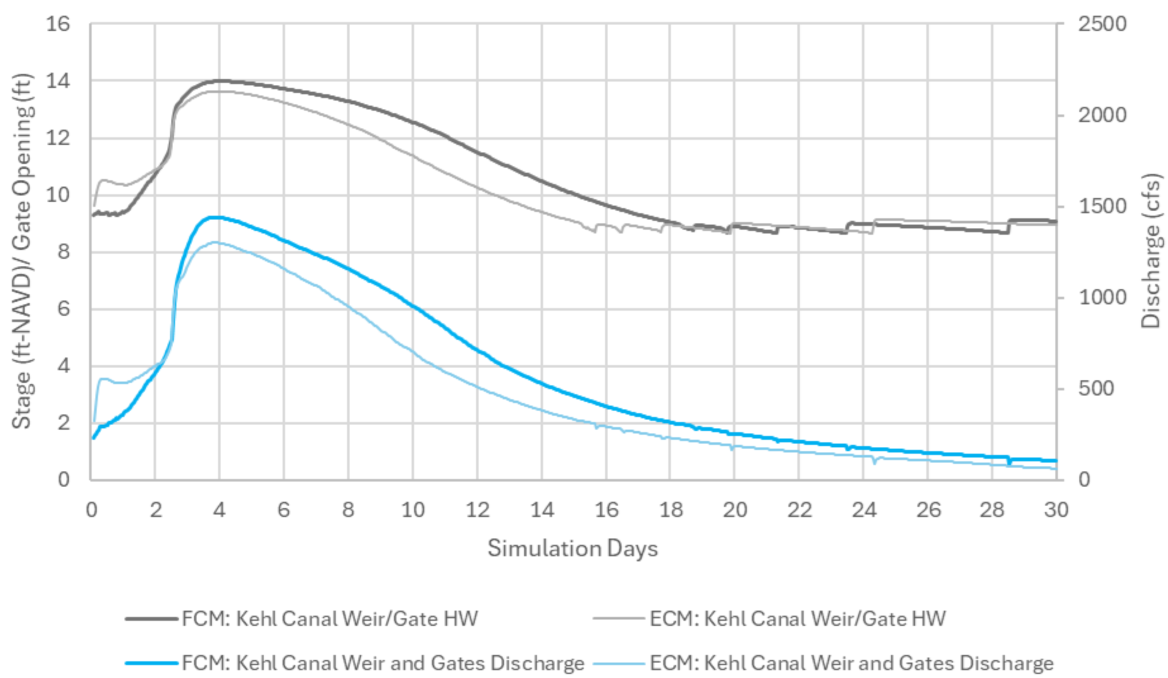

Figure B-34. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Kehl Canal Weir/Gate.

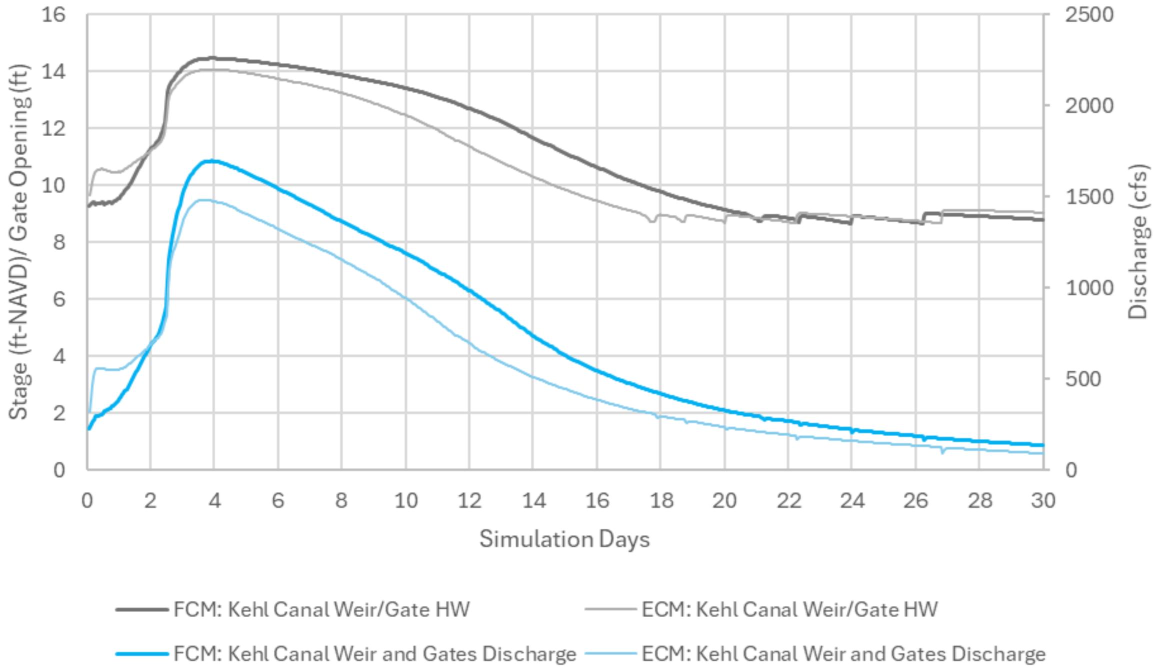

Figure B-35. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Kehl Canal Weir/Gate.

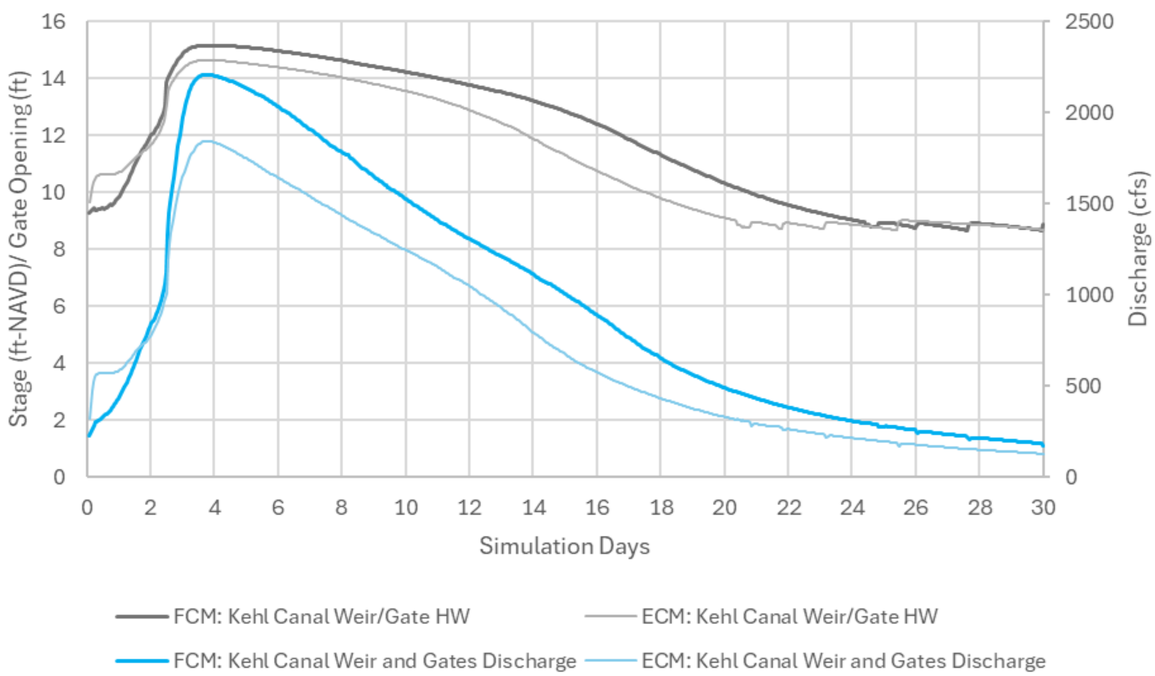

Figure B-36. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Kehl Canal Weir/Gate.

CR951N

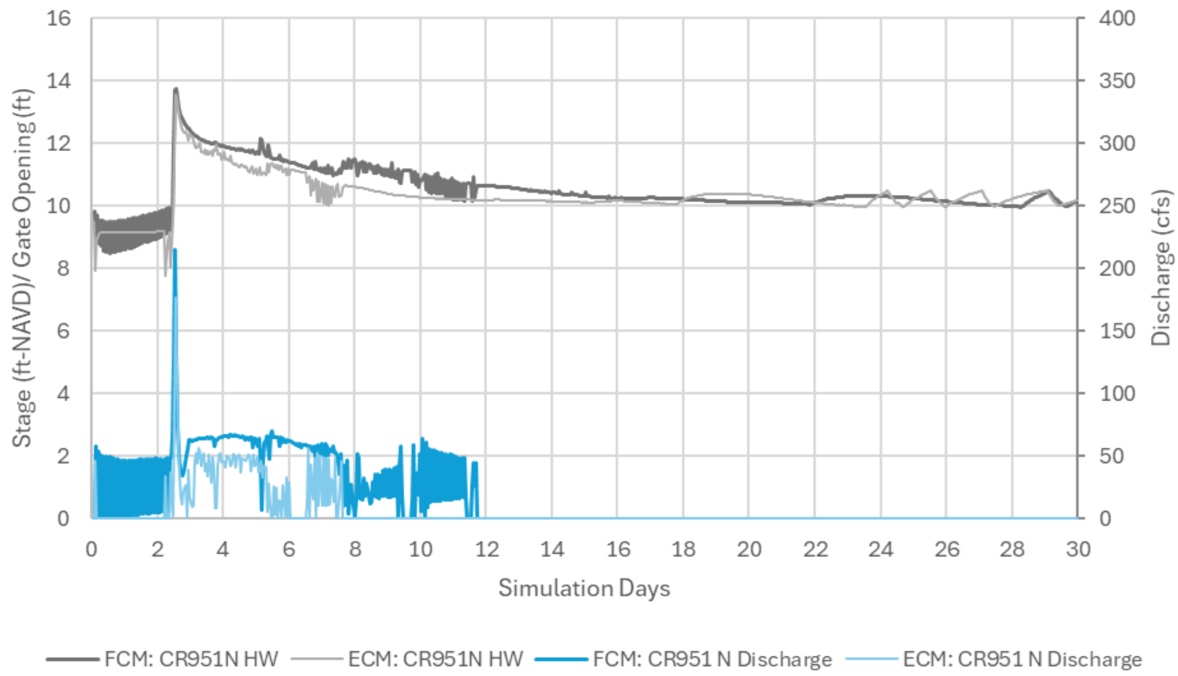

Figure B-37. 5-yr Design Storm Simulation Flow and Stage Hydrographs for CR951N

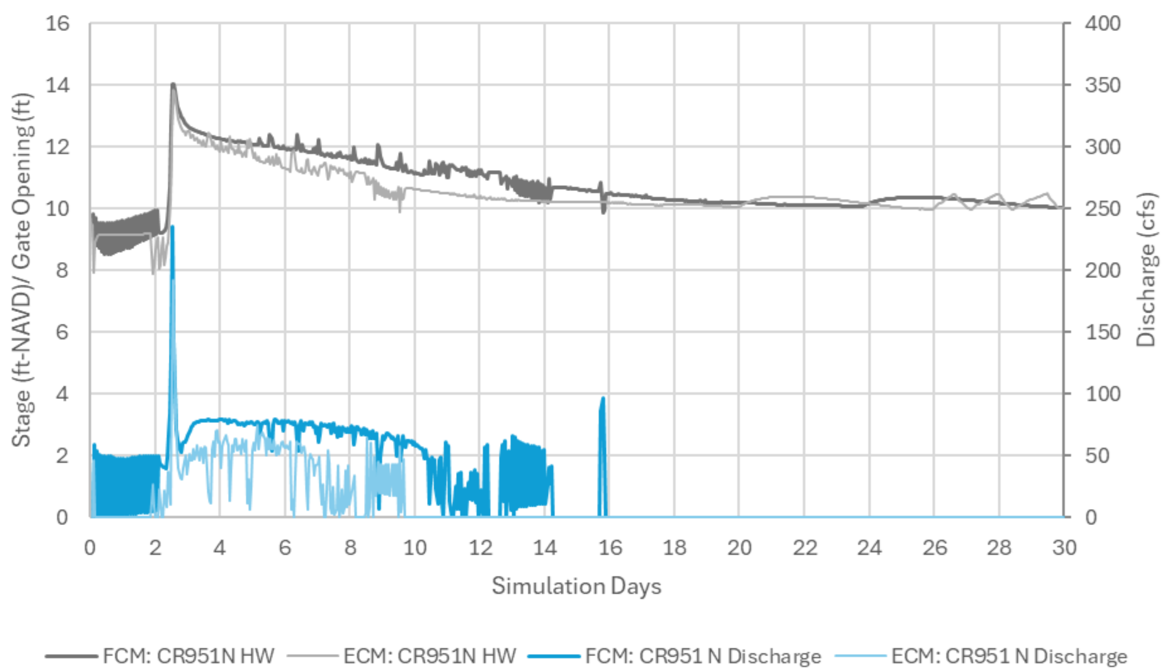

Figure B-38. 10-yr Design Storm Simulation Flow and Stage Hydrographs for CR951N

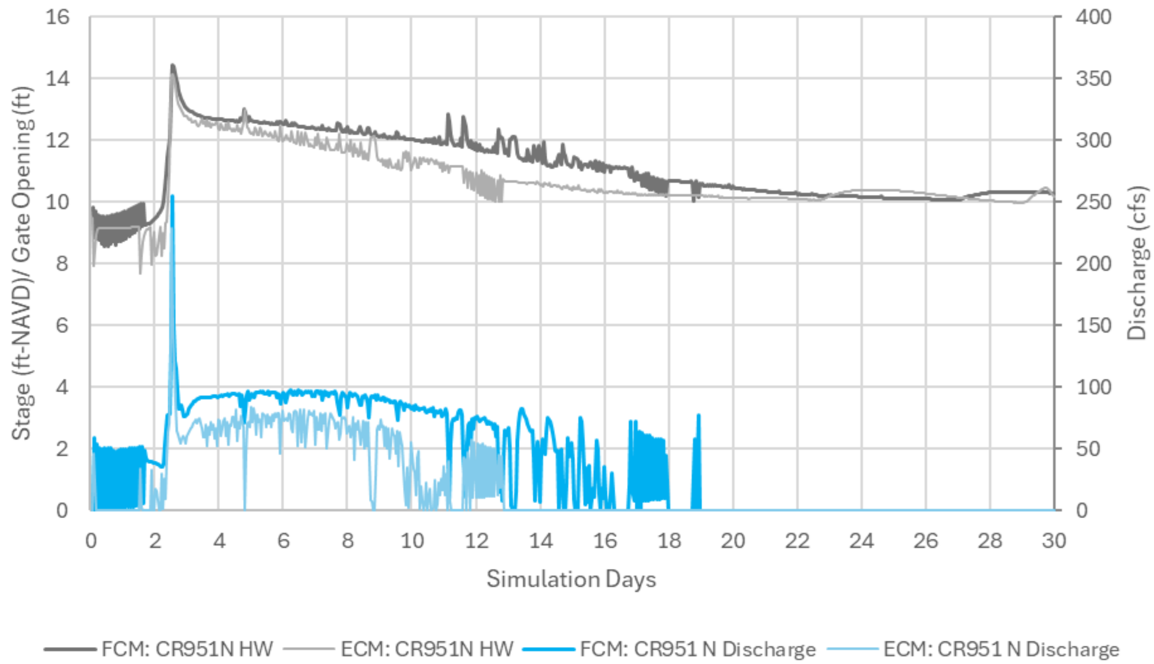

Figure B-39. 25-yr Design Storm Simulation Flow and Stage Hydrographs for CR951N

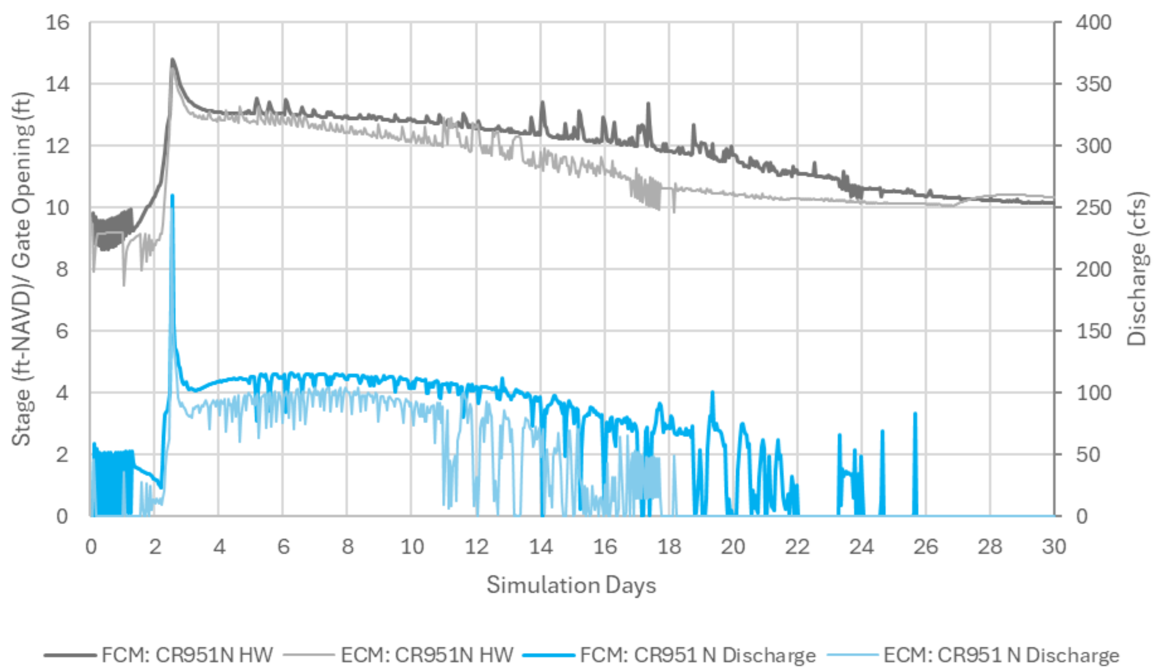

Figure B-40. 100-yr Design Storm Simulation Flow and Stage Hydrographs for CR951N

GG1

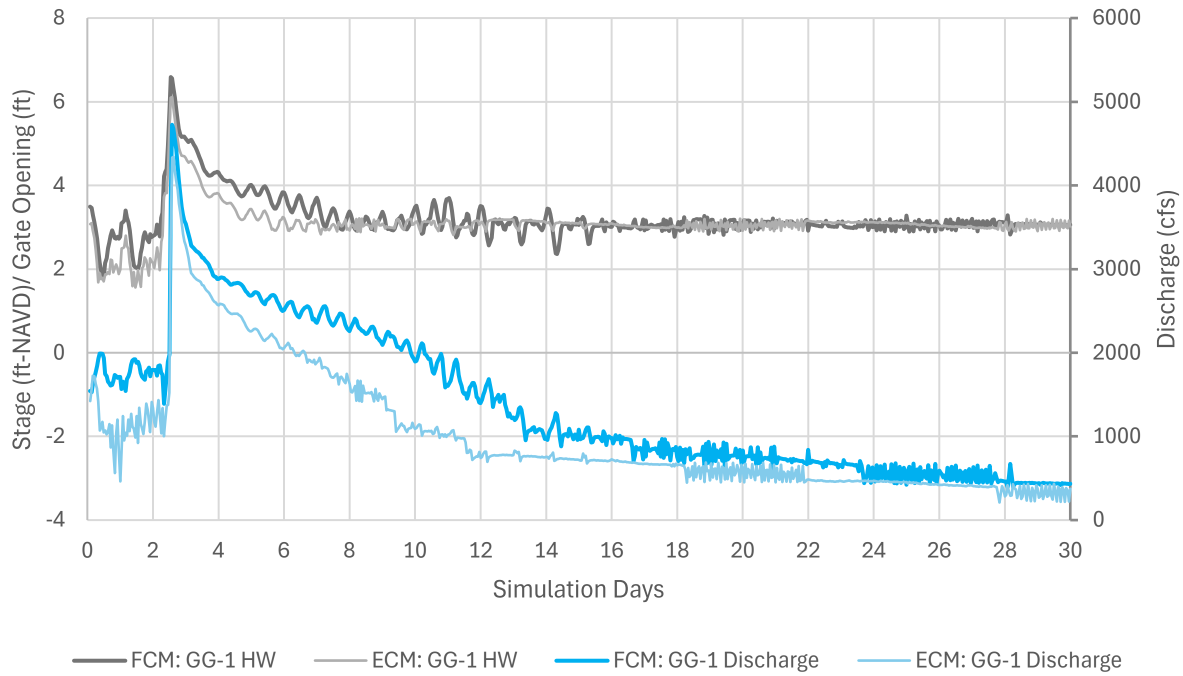

Figure B-41. 5-yr Design Storm Simulation Flow and Stage Hydrographs for GG1

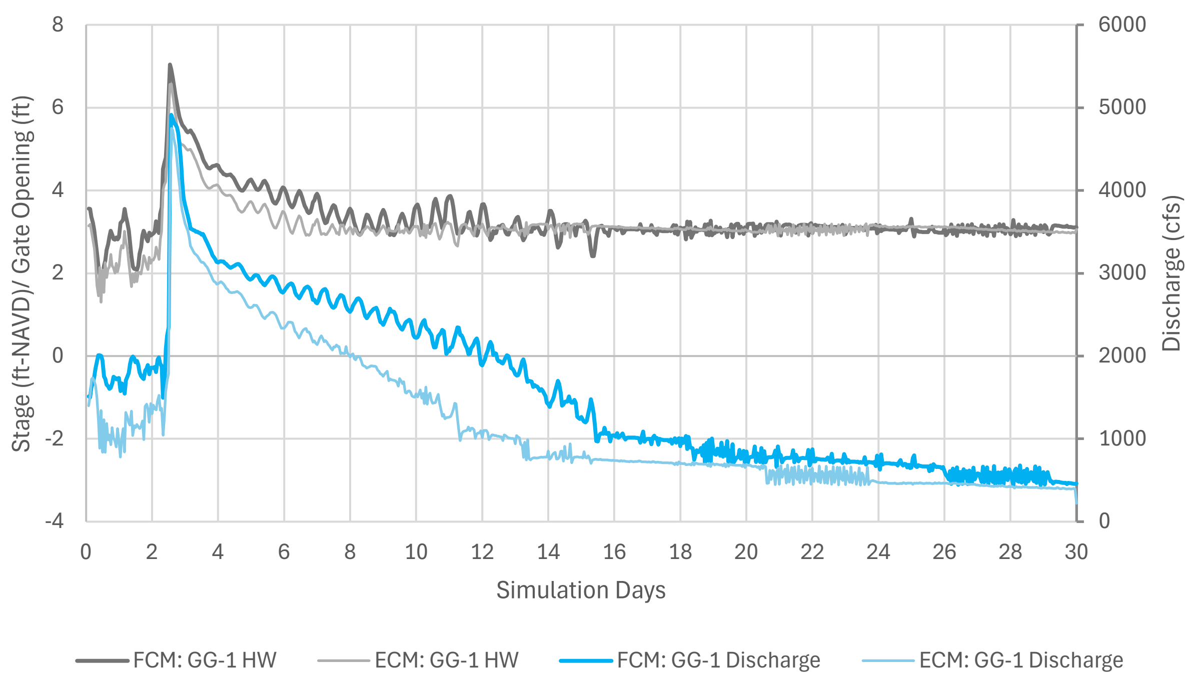

Figure B-42. 10-yr Design Storm Simulation Flow and Stage Hydrographs for GG1

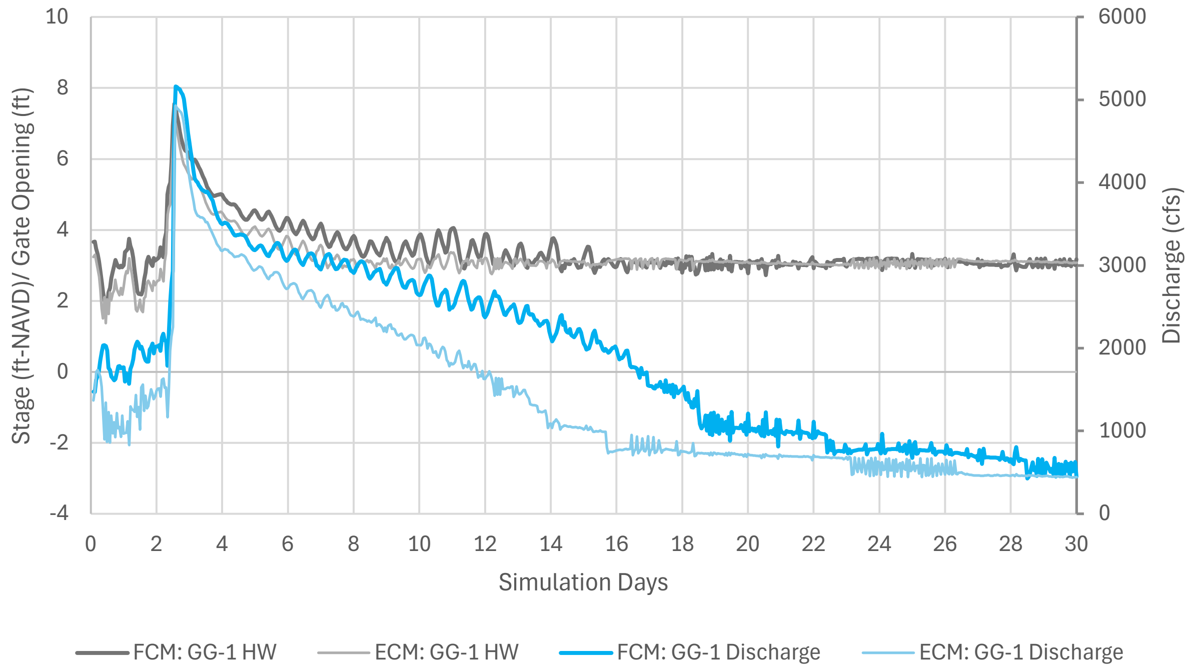

Figure B-43. 25-yr Design Storm Simulation Flow and Stage Hydrographs for GG1

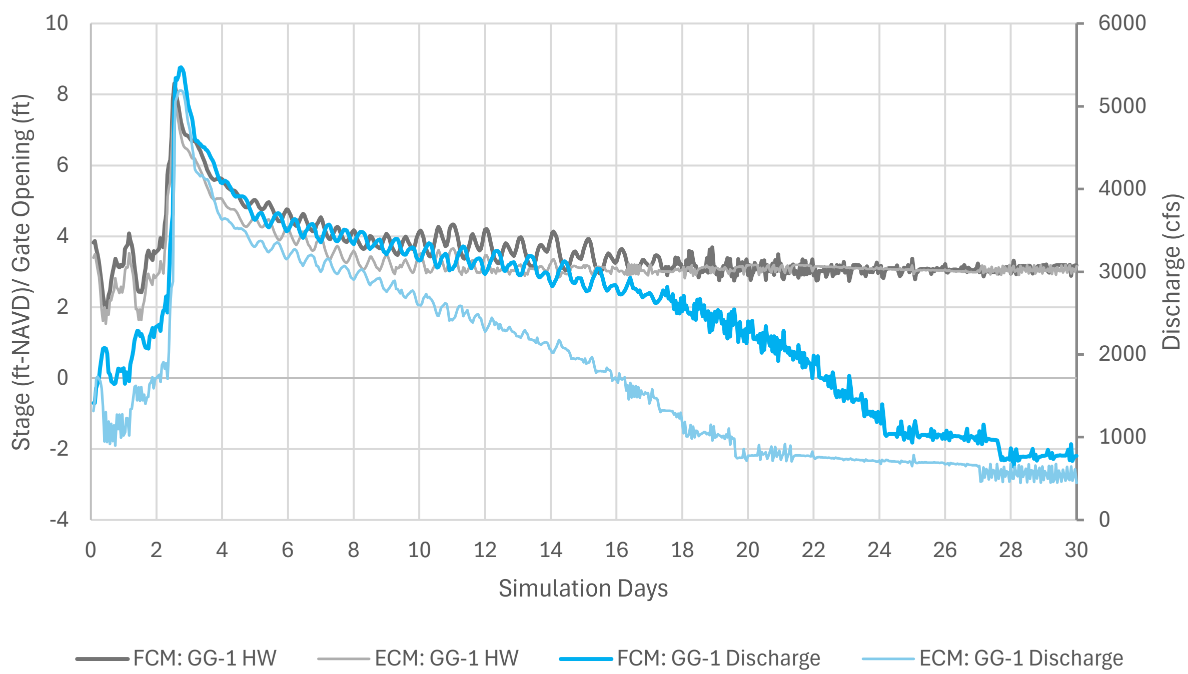

Figure B-44. 100-yr Design Storm Simulation Flow and Stage Hydrographs for GG1

Miller Canal Bridge at I-75

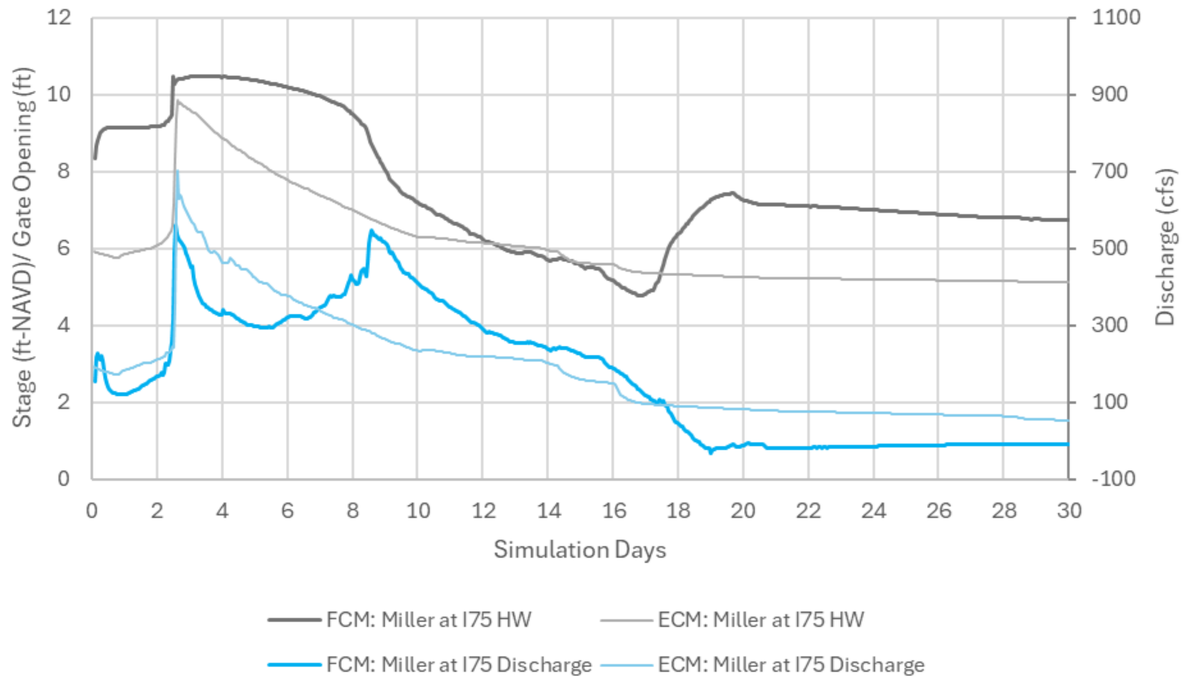

Figure B-45. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Miller Canal Bridge at I-75

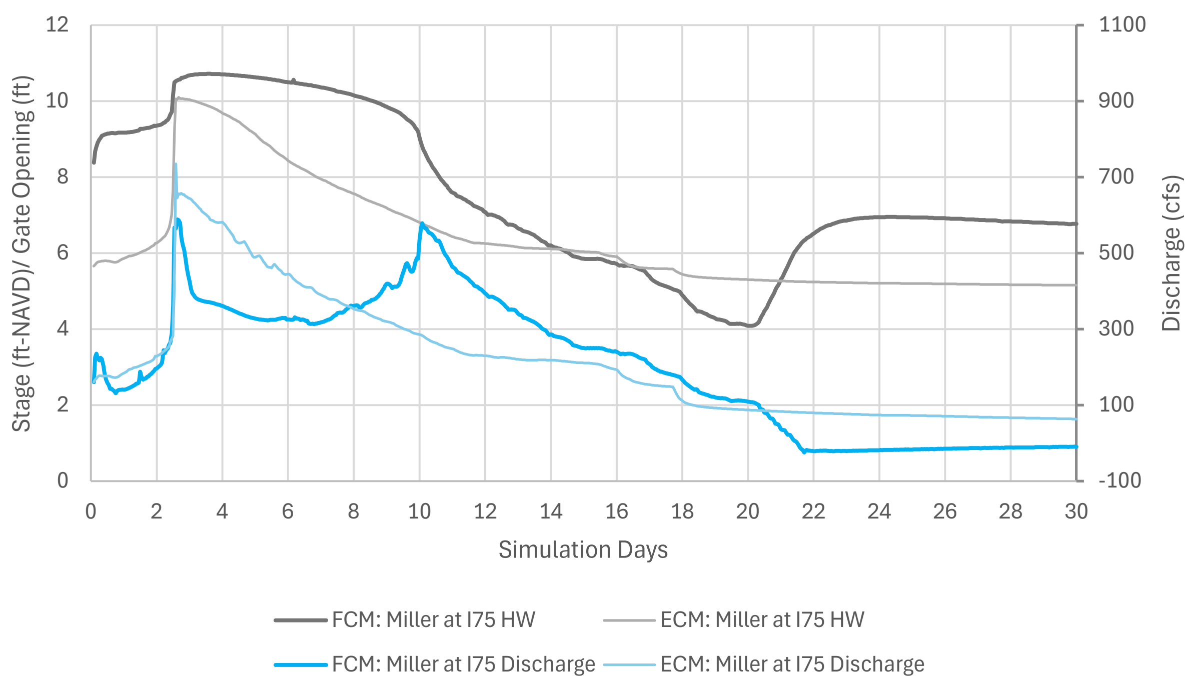

Figure B-46. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Miller Canal Bridge at I-75

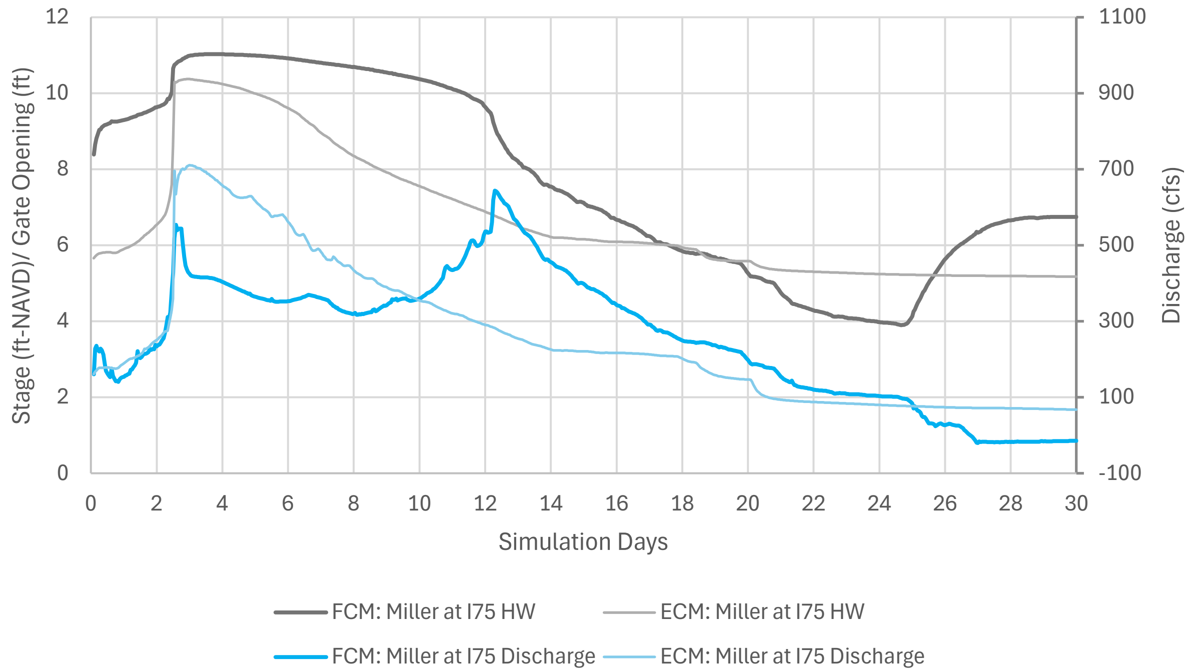

Figure B-47. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Miller Canal Bridge at I-75

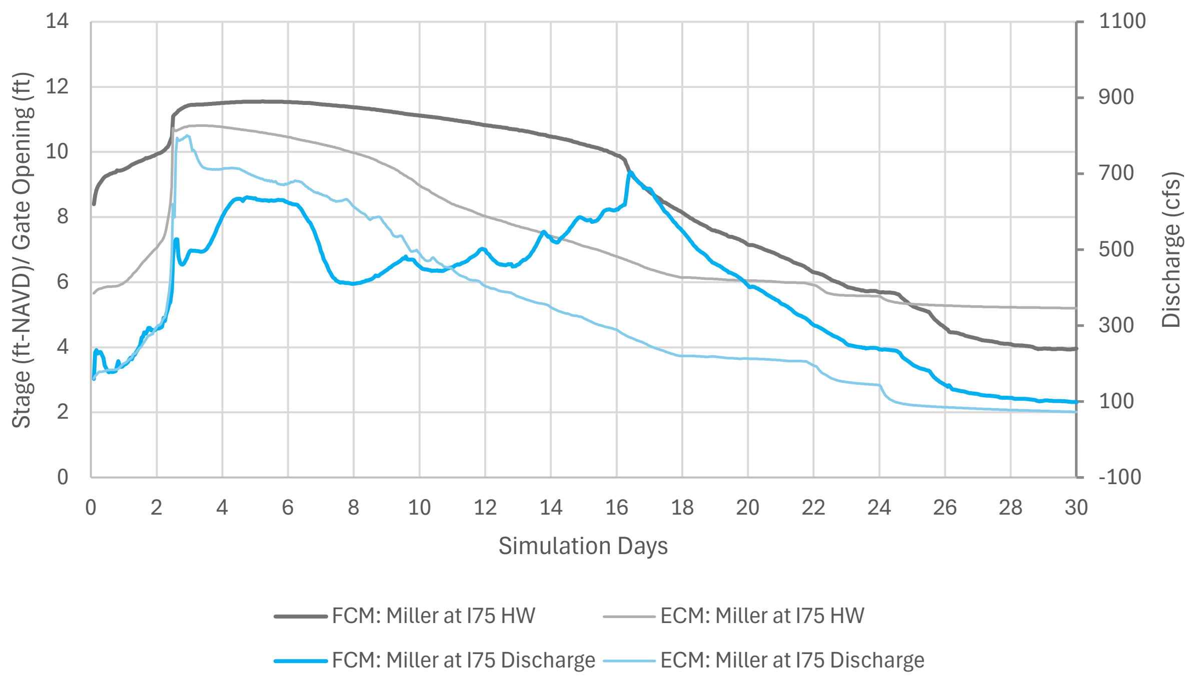

Figure B-48. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Miller Canal Bridge at I-75

Bird Rookery North Bridge

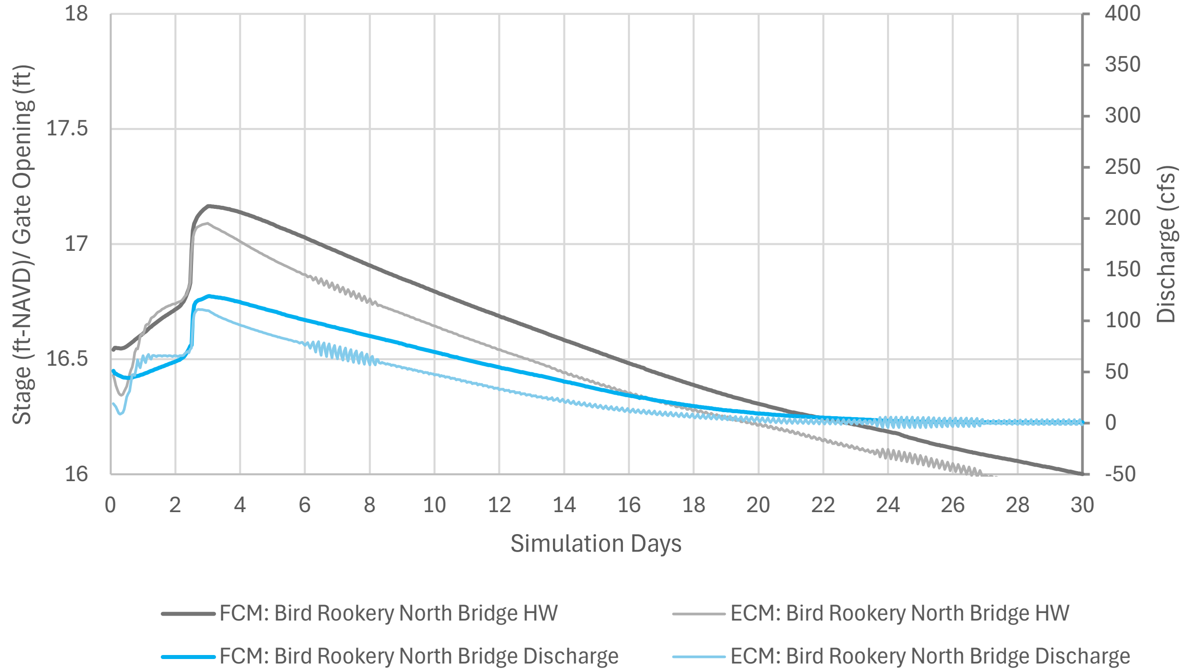

Figure B-49. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Bird Rookery North Bridge

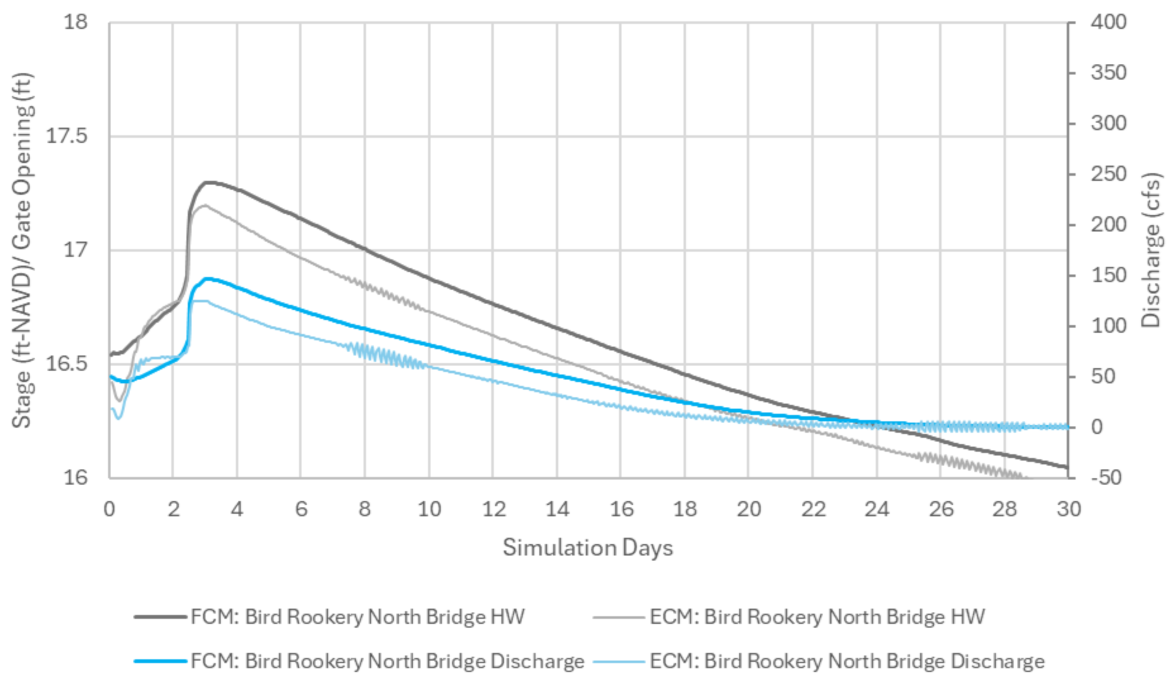

Figure B-50. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Bird Rookery North Bridge

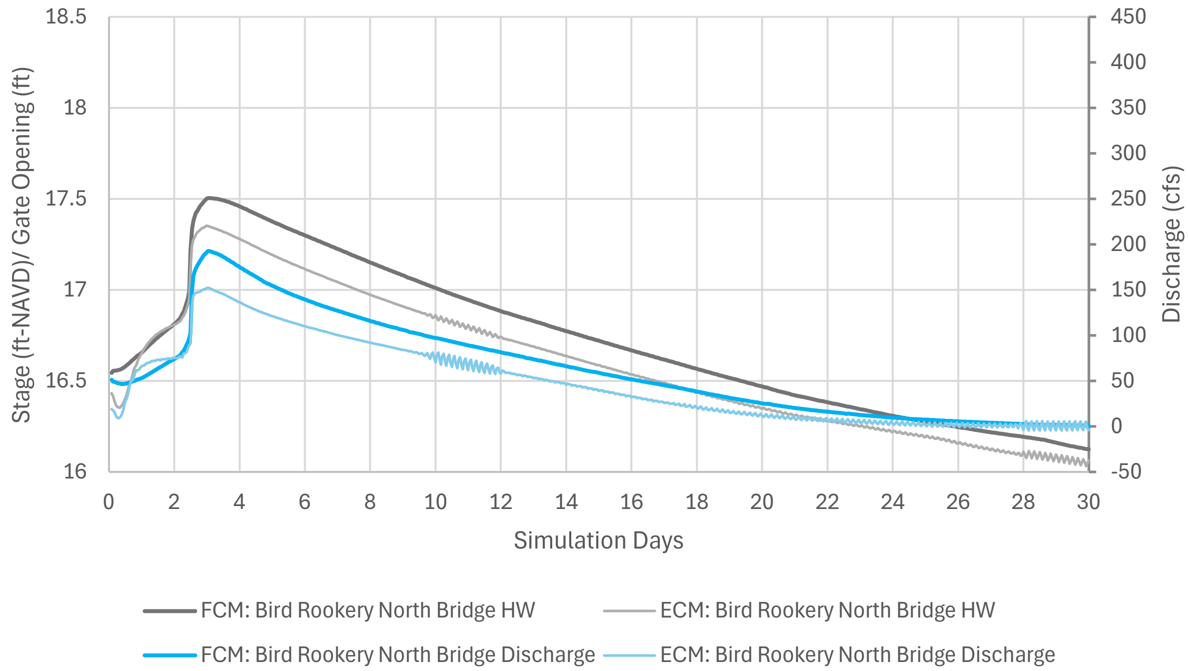

Figure B-51. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Bird Rookery North Bridge

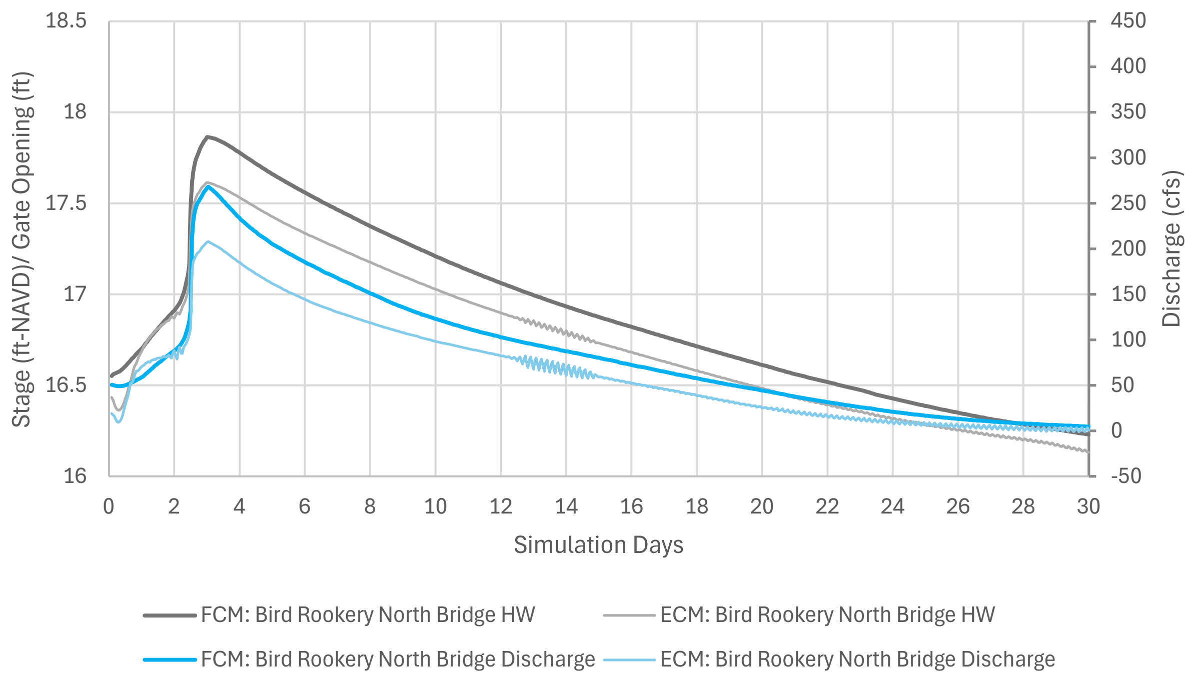

Figure B-52. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Bird Rookery North

Faka Union 1

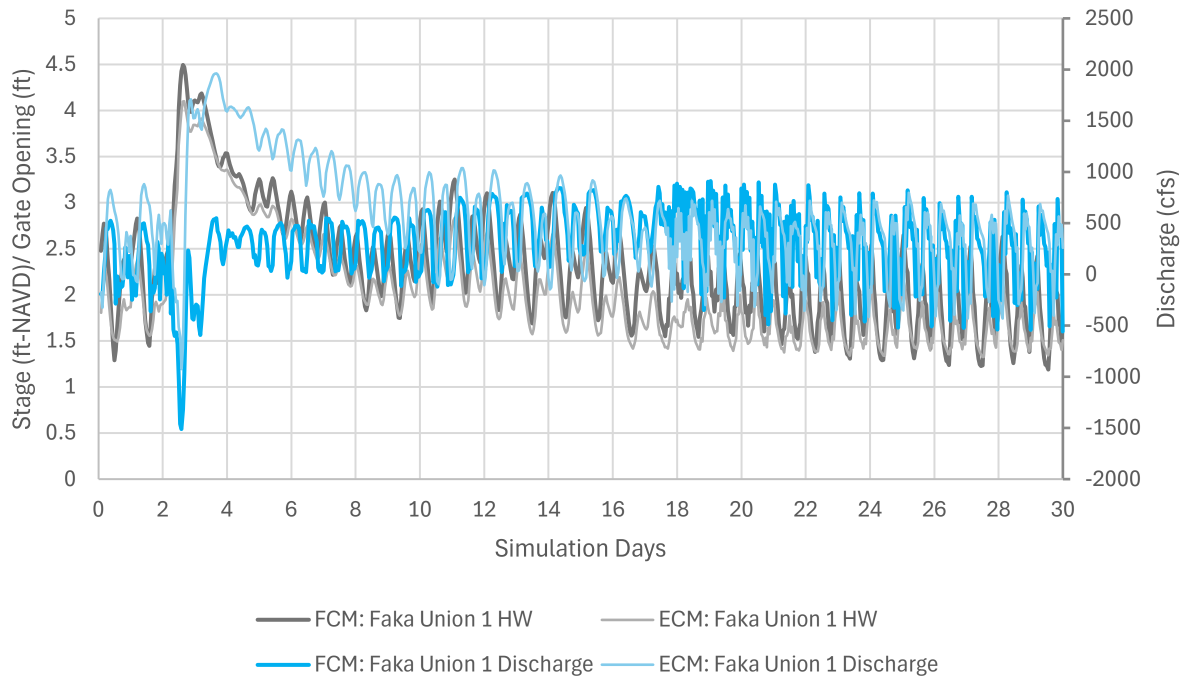

Figure B-53. 5-yr Design Storm Simulation Flow and Stage Hydrographs for Faka Union 1

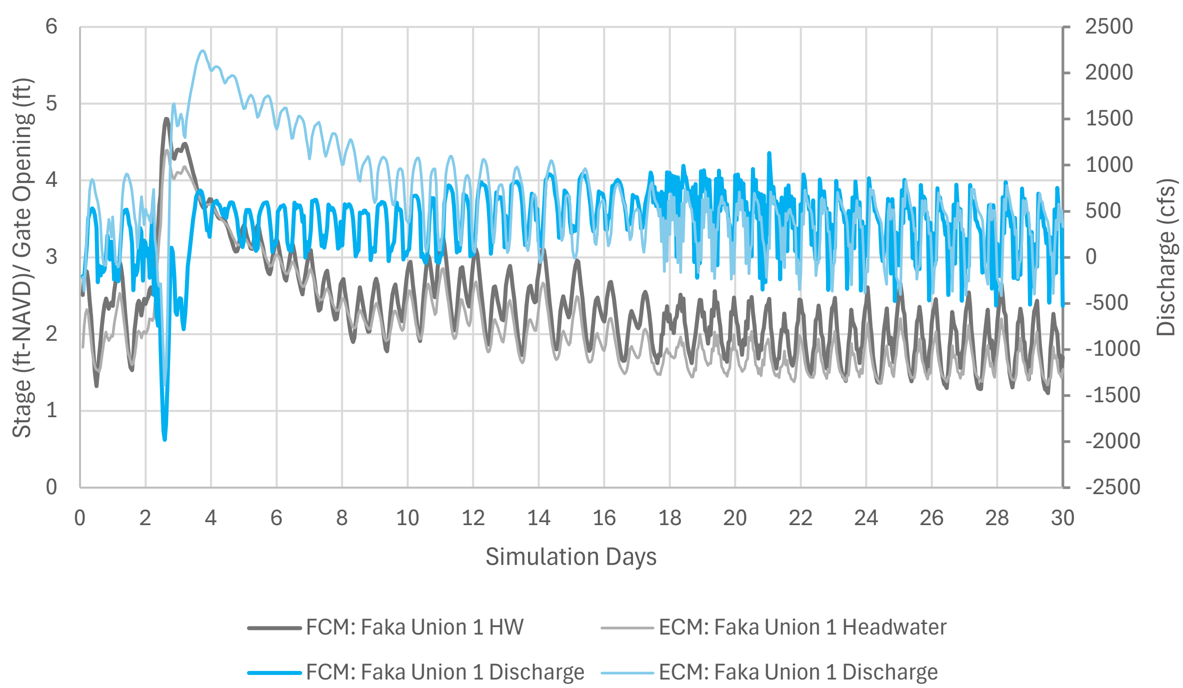

Figure B-54. 10-yr Design Storm Simulation Flow and Stage Hydrographs for Faka Union 1

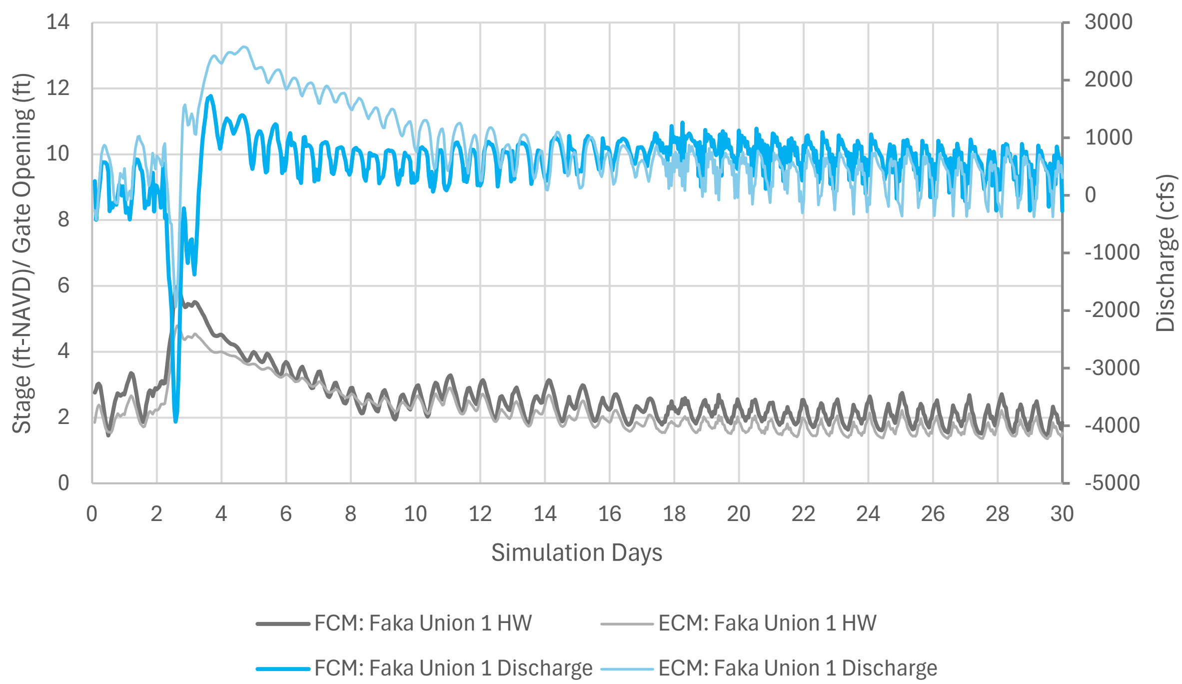

Figure B-55. 25-yr Design Storm Simulation Flow and Stage Hydrographs for Faka Union 1

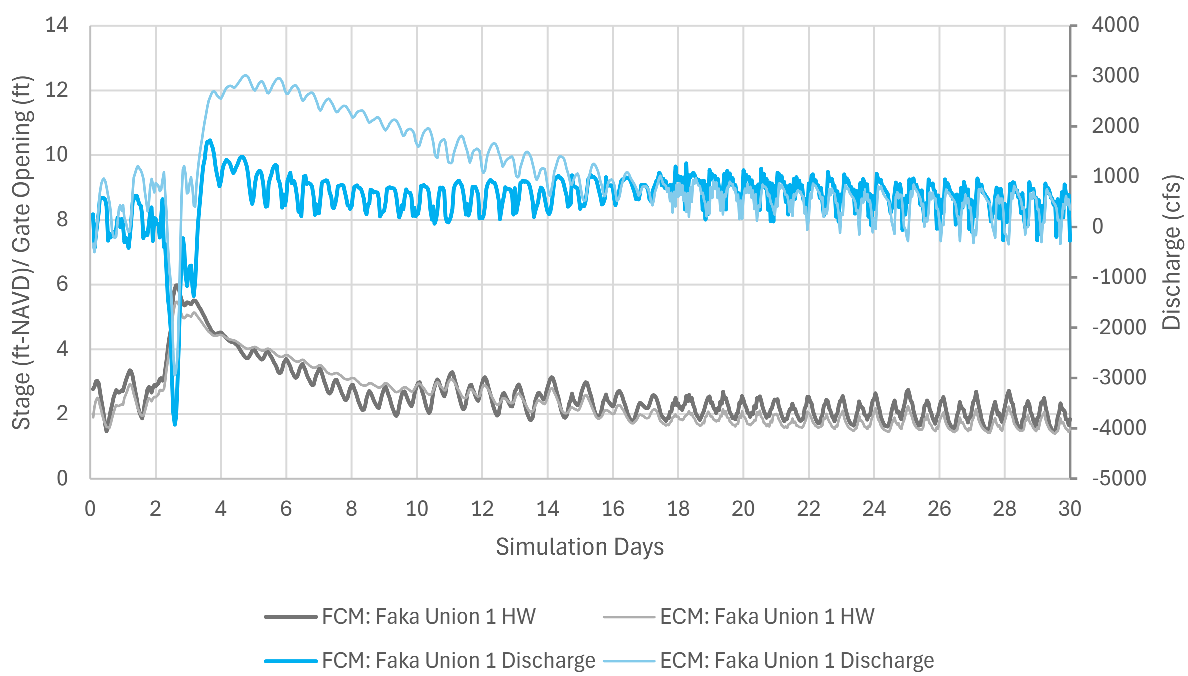

Figure B-56. 100-yr Design Storm Simulation Flow and Stage Hydrographs for Faka Union 1

Appendix C: FCM Long Term Simulation Stage and Flow Hydrographs and Gate Levels

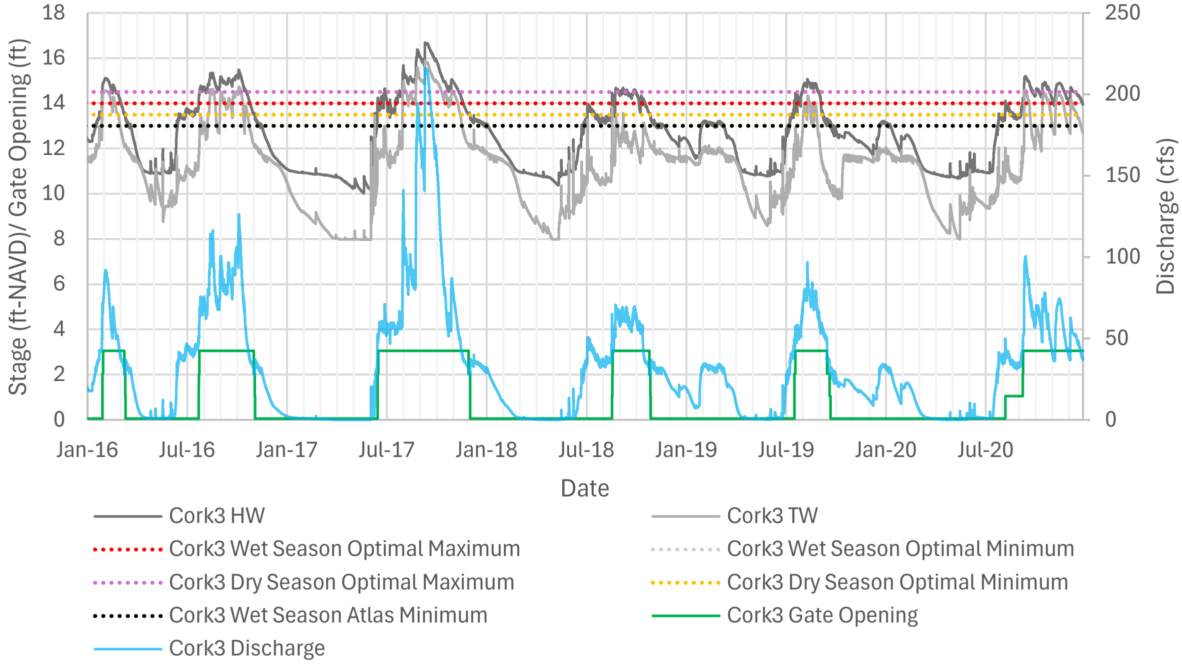

Figure C-1. Long Term Simulation Flow and Stage Hydrographs for Cork 3

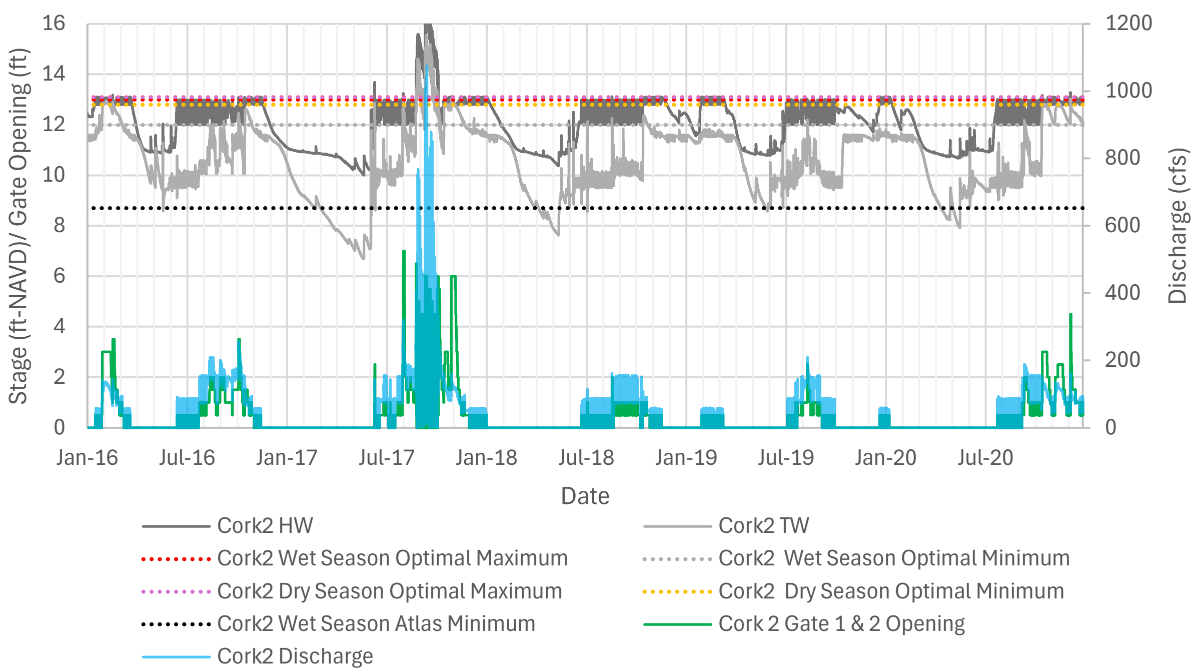

Figure C-2. Long Term Simulation Flow and Stage Hydrographs for Cork 2

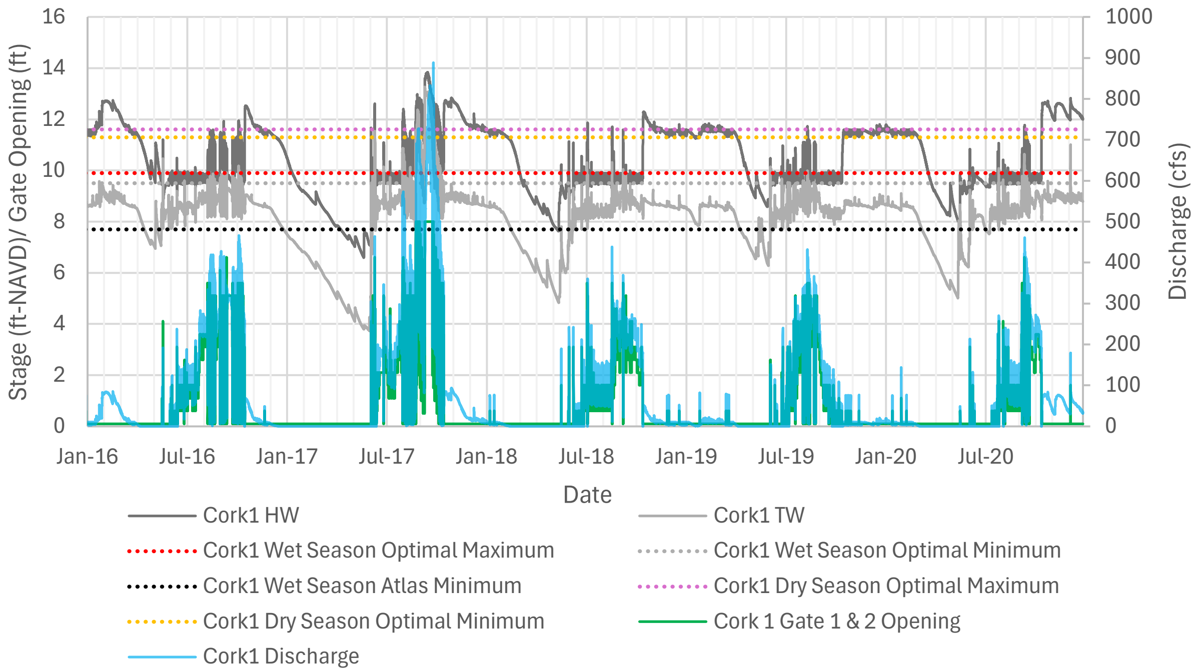

Figure C-3. Long Term Simulation Flow and Stage Hydrographs for Cork 1.

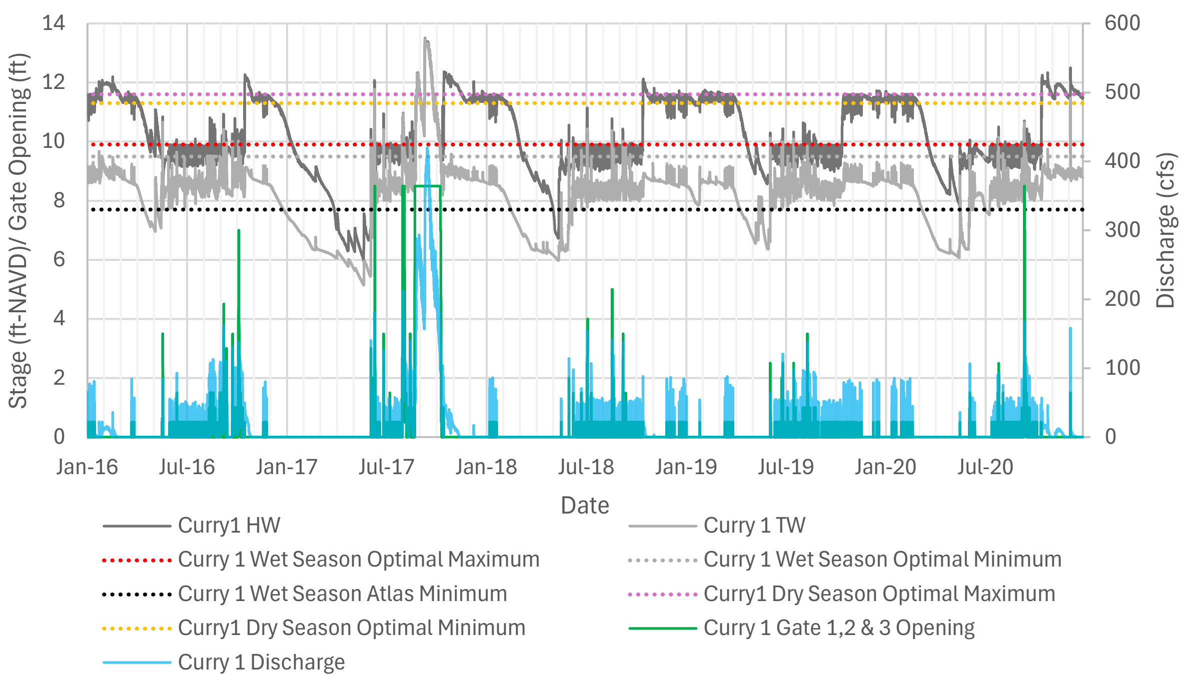

Figure C-4. Long Term Simulation Flow and Stage Hydrographs for Curry 1.

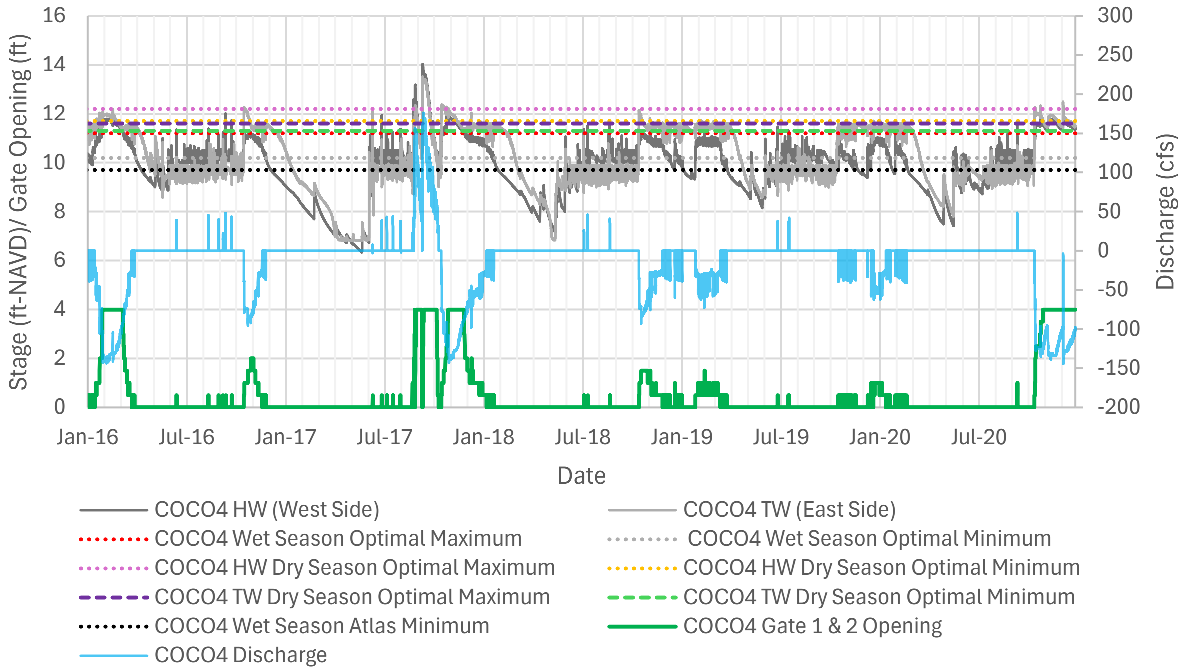

Figure C-5. Long Term Simulation Flow and Stage Hydrographs for COCO4.

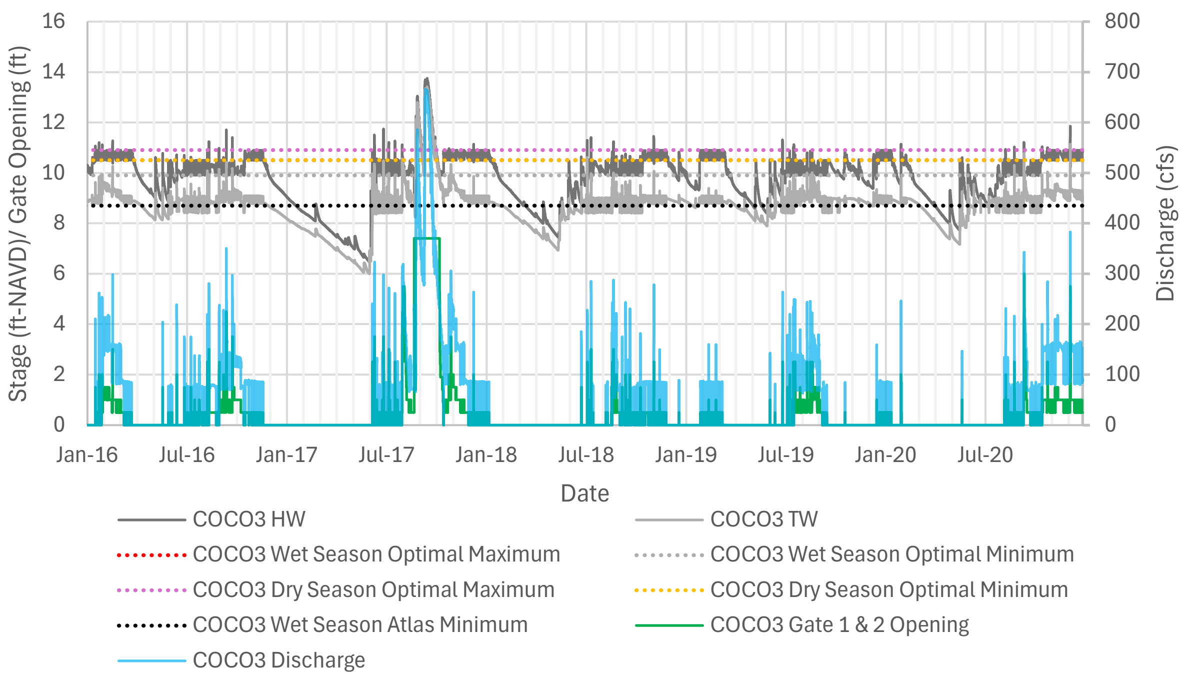

Figure C-6. Long Term Simulation Flow and Stage Hydrographs for COCO3.

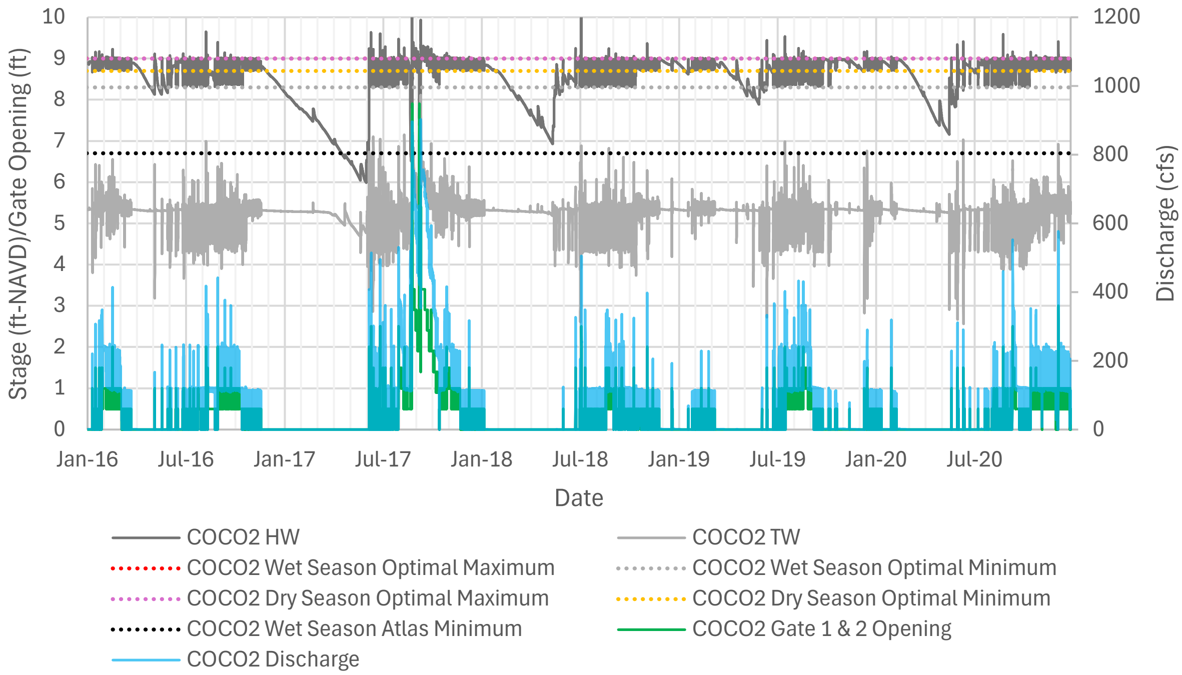

Figure C-7. Long Term Simulation Flow and Stage Hydrographs for COCO2.

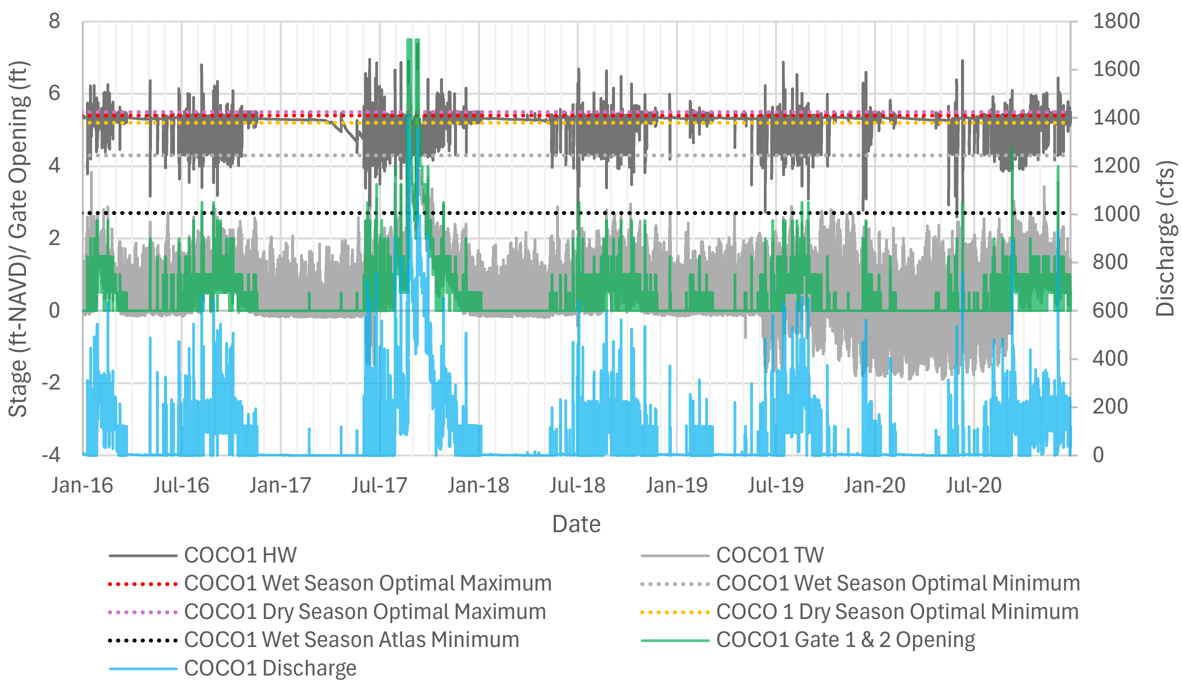

Figure C-8. Long Term Simulation Flow and Stage Hydrographs for COCO1.

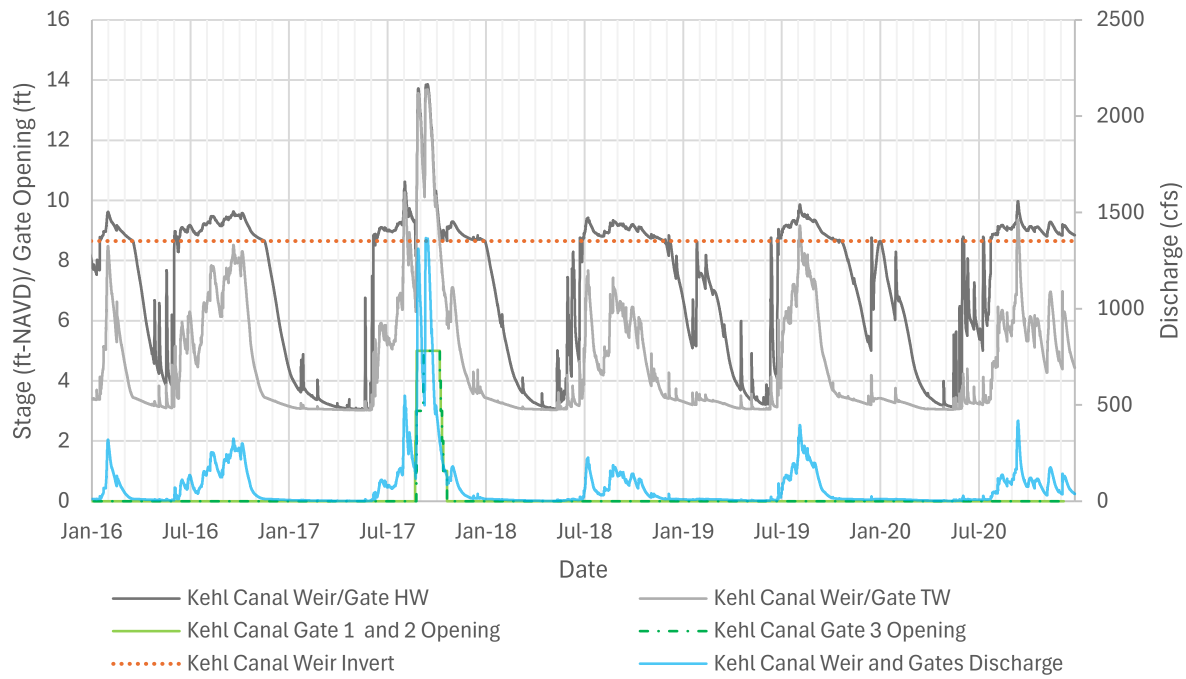

Figure C-9. Long Term Simulation Flow and Stage Hydrographs for Kehl Canal Weir/Gate.

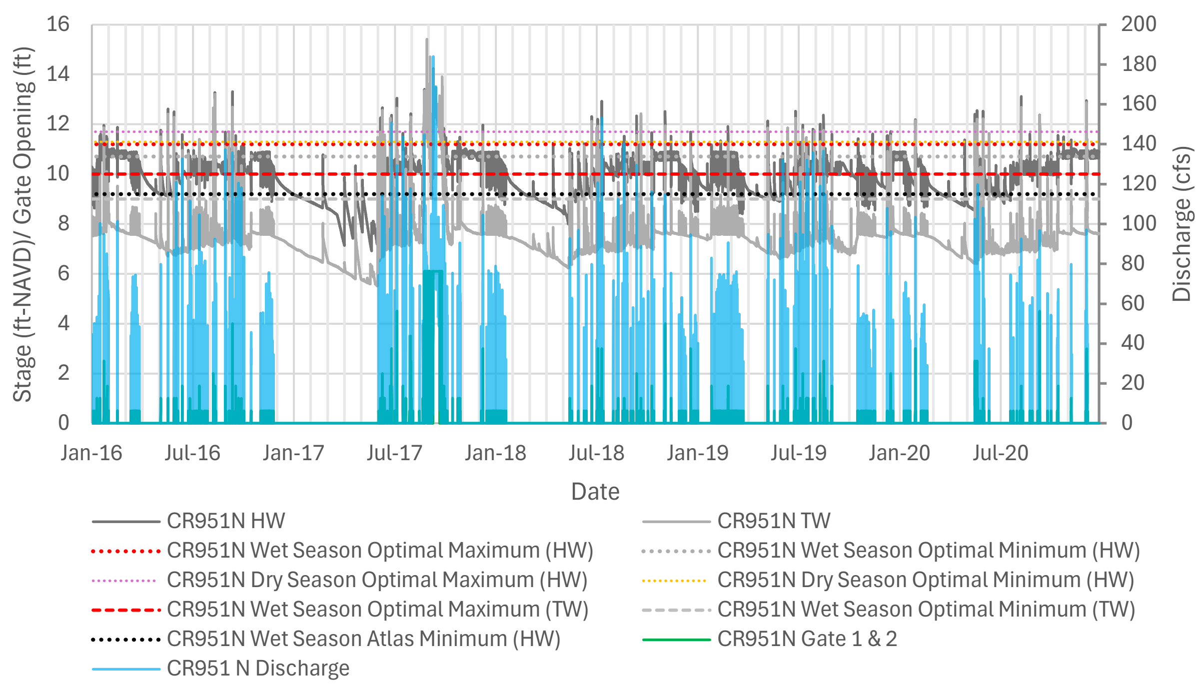

Figure C-10. Long Term Simulation Flow and Stage Hydrographs for CR951N

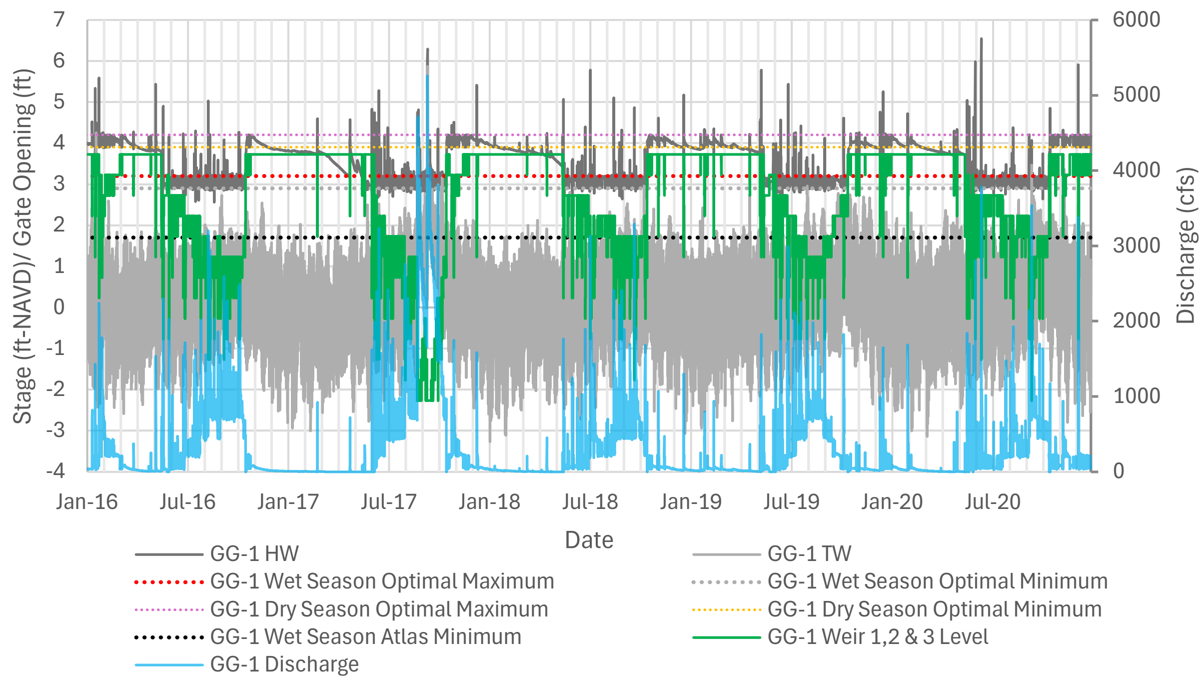

Figure C-11. Long Term Simulation Flow and Stage Hydrographs for GG1

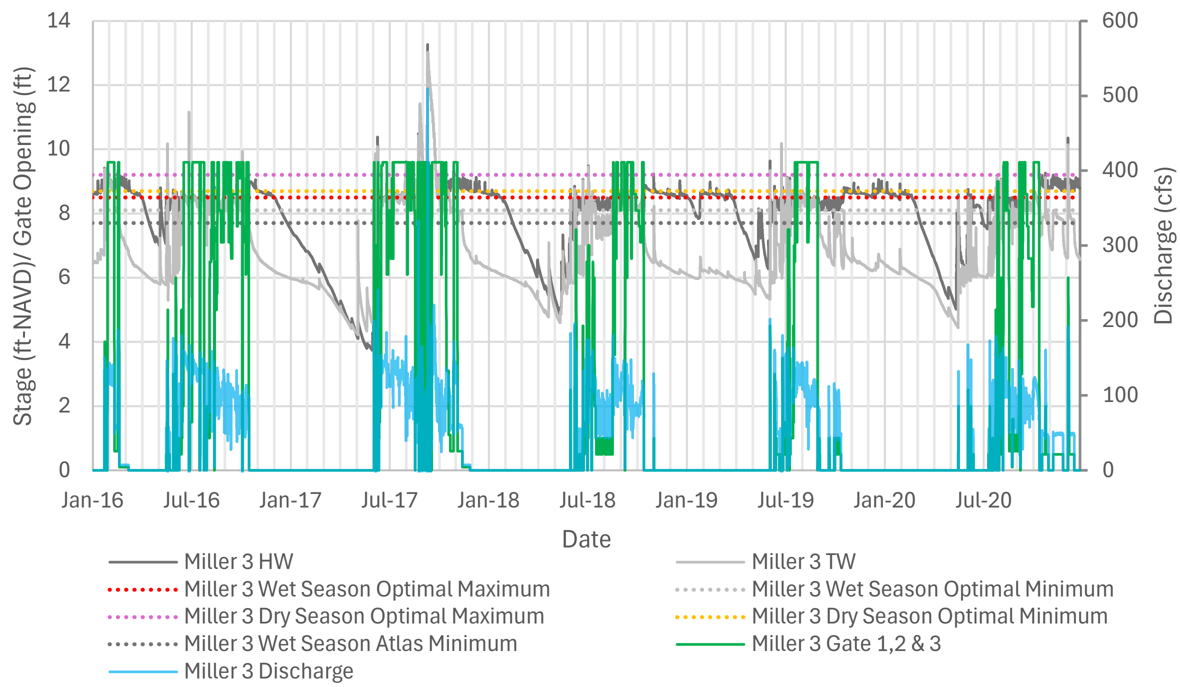

Figure C-12. Long Term Simulation Flow and Stage Hydrographs for Miller 3

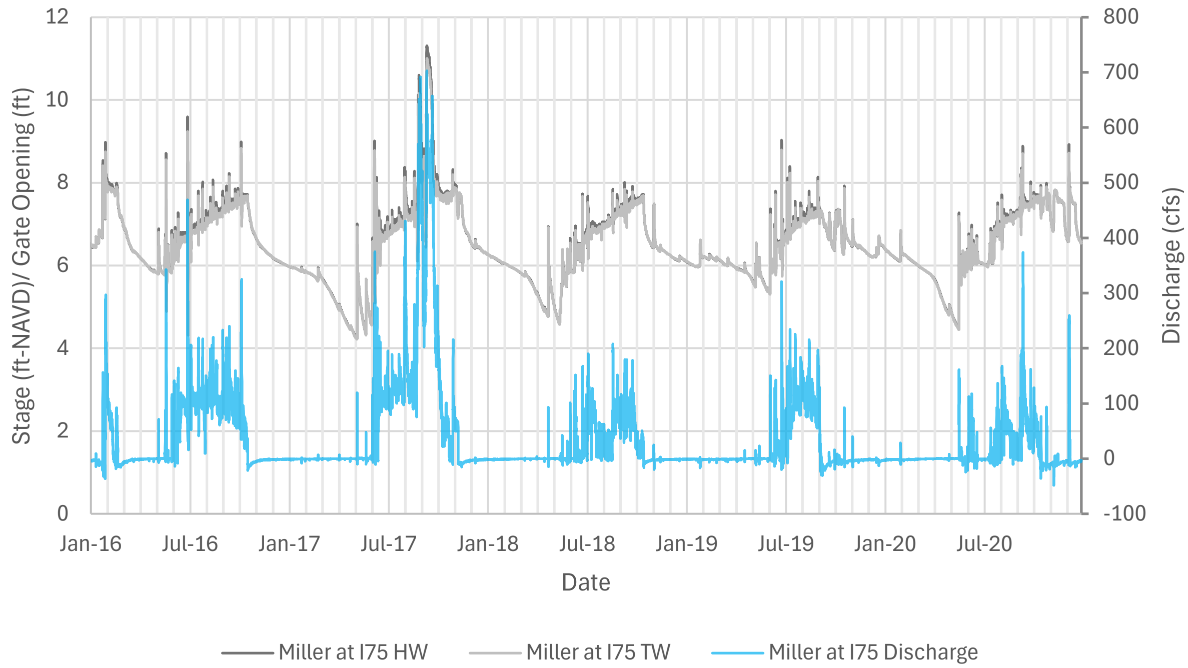

Figure C-13. Long Term Simulation Flow and Stage Hydrographs for Miller Canal Bridge at I-75

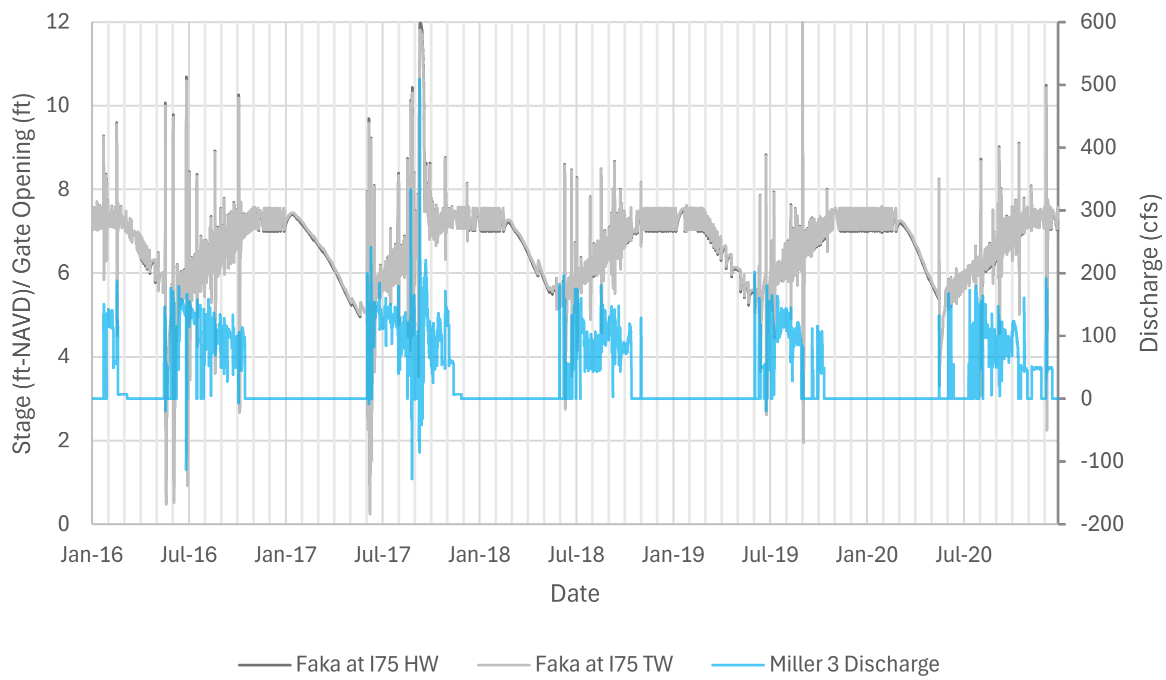

Figure C-14. Long Term Simulation Flow and Stage Hydrographs for Faka Union Canal Bridge at I-75

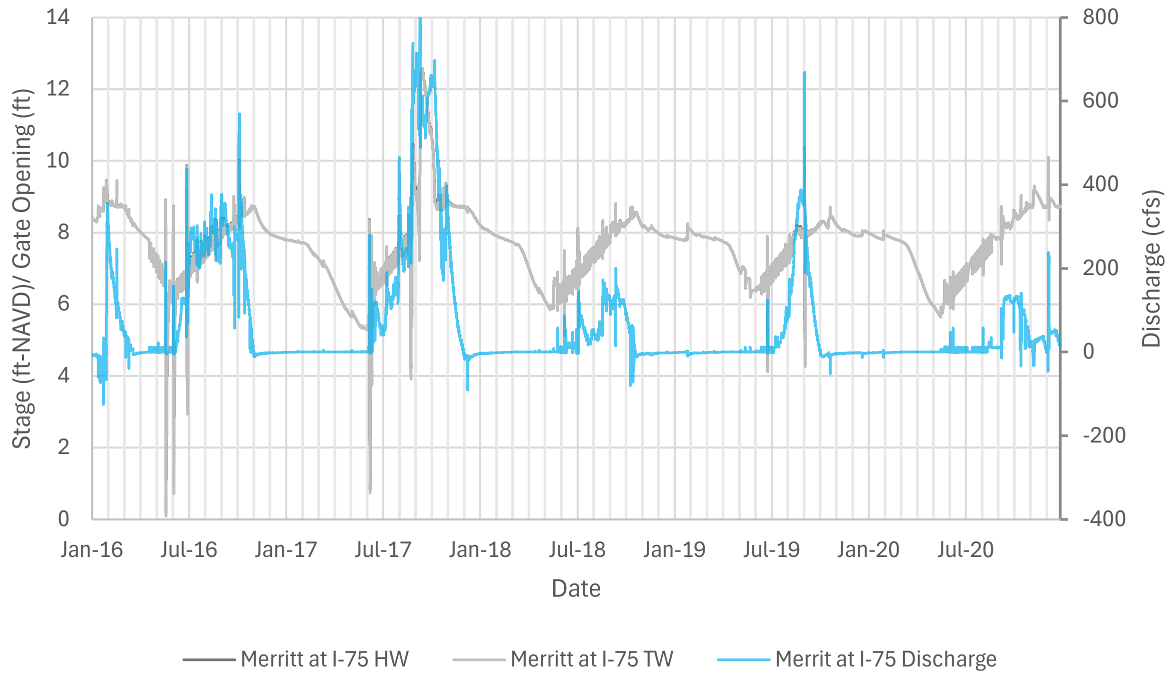

Figure C-15. Long Term Simulation Flow and Stage Hydrographs for Merrit Canal Bridge at I-75

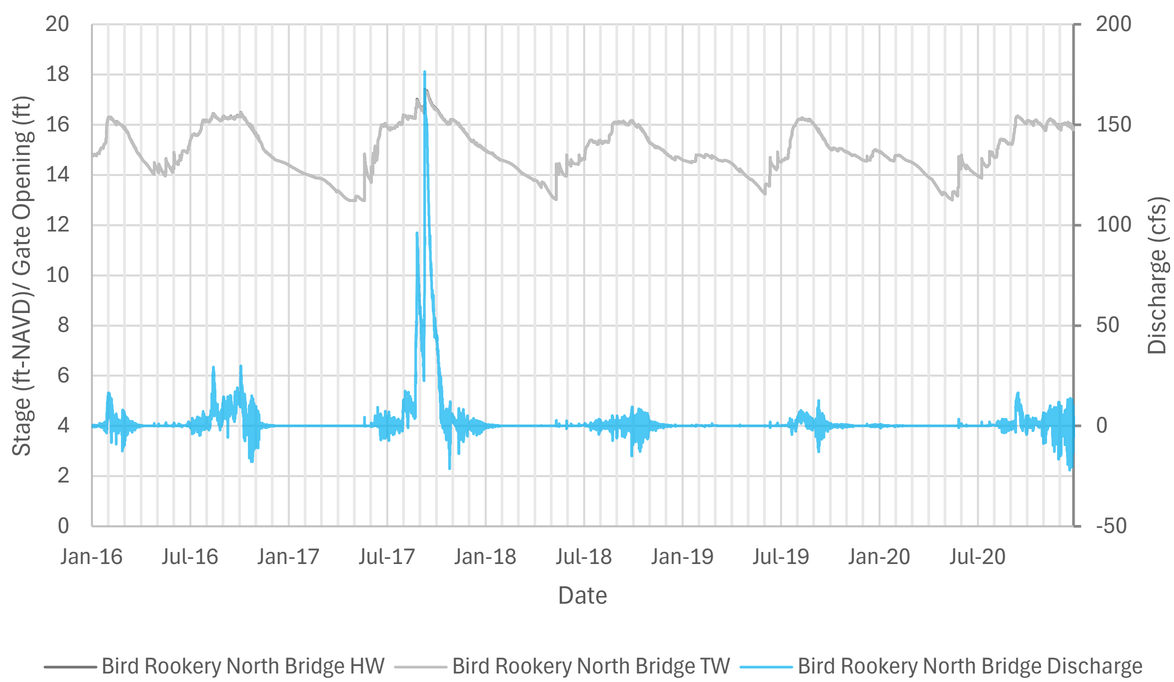

Figure C-16. Long Term Simulation Flow and Stage Hydrographs for Bird Rookery North Bridge

Stages and flow from the connections south of Shady Hollow Boulevard to the Corkscrew Canal downstream of Cork3 (Figure C-17) are shown in Figure C-18 and Figure C-19.

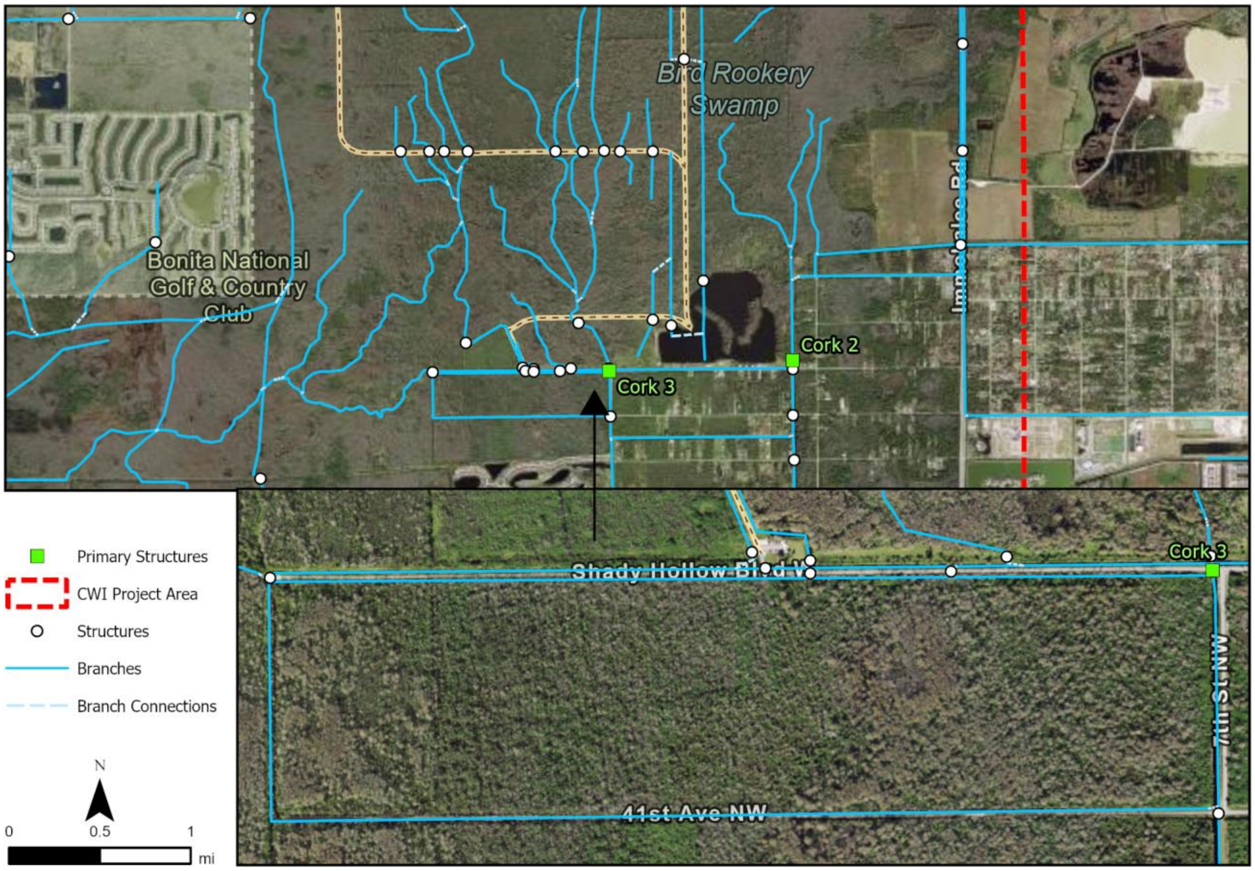

Figure C-17. Surface Water Discharge Locations to Corkscrew Canal, South of Cork3

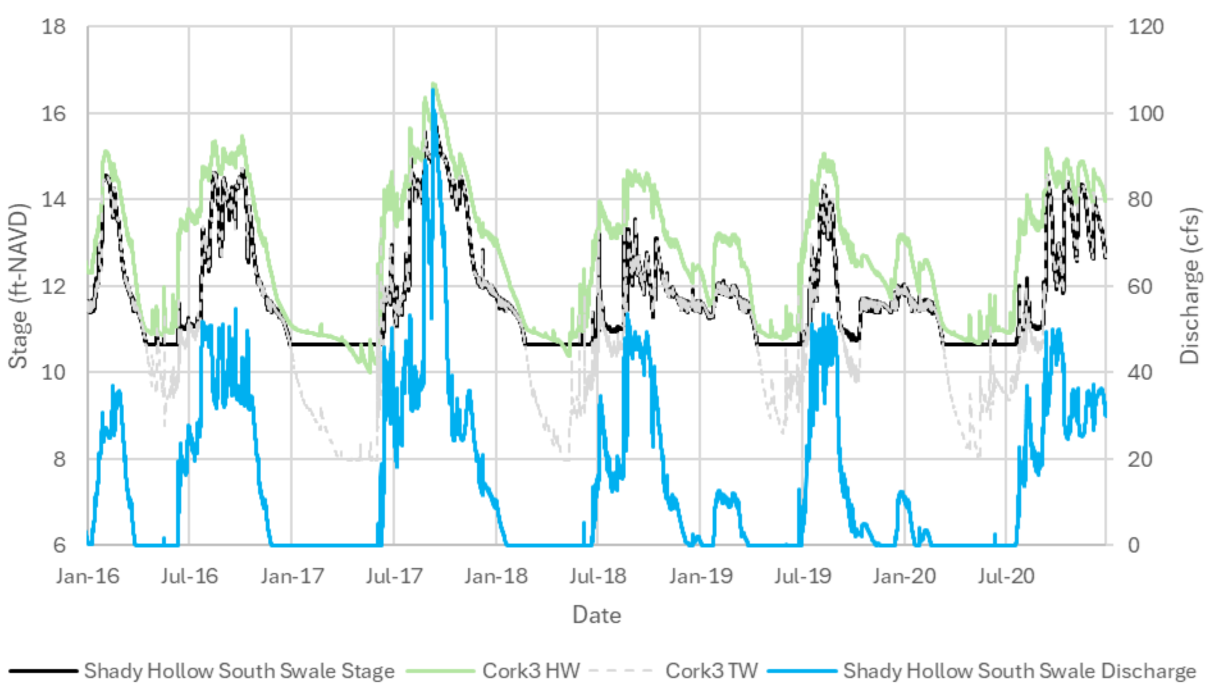

Figure C-18. Long Term Simulation Flow and Stage Hydrographs for Shady Hollow Boulevard South Swale

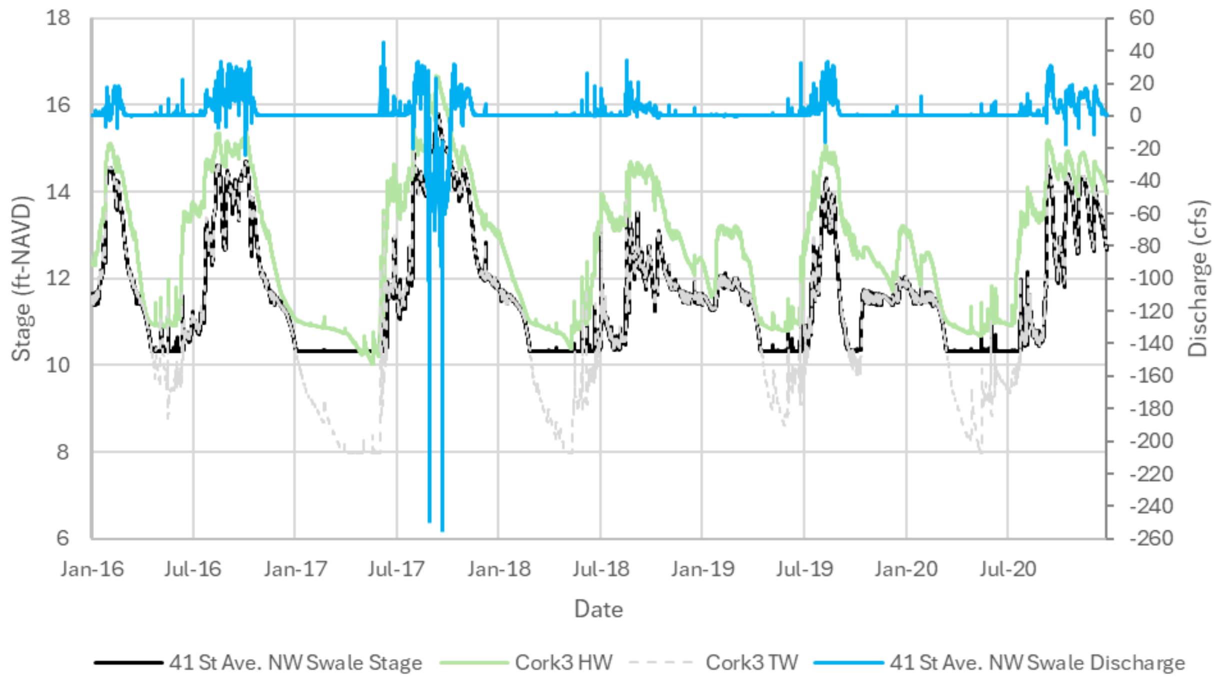

Figure C-19. Long Term Simulation Flow and Stage Hydrographs for the 41st Ave. NW North Swale

Stages and flow to the Cocohatchee Canal from the north are shown in the plots below. The locations are show in Figure C-20.

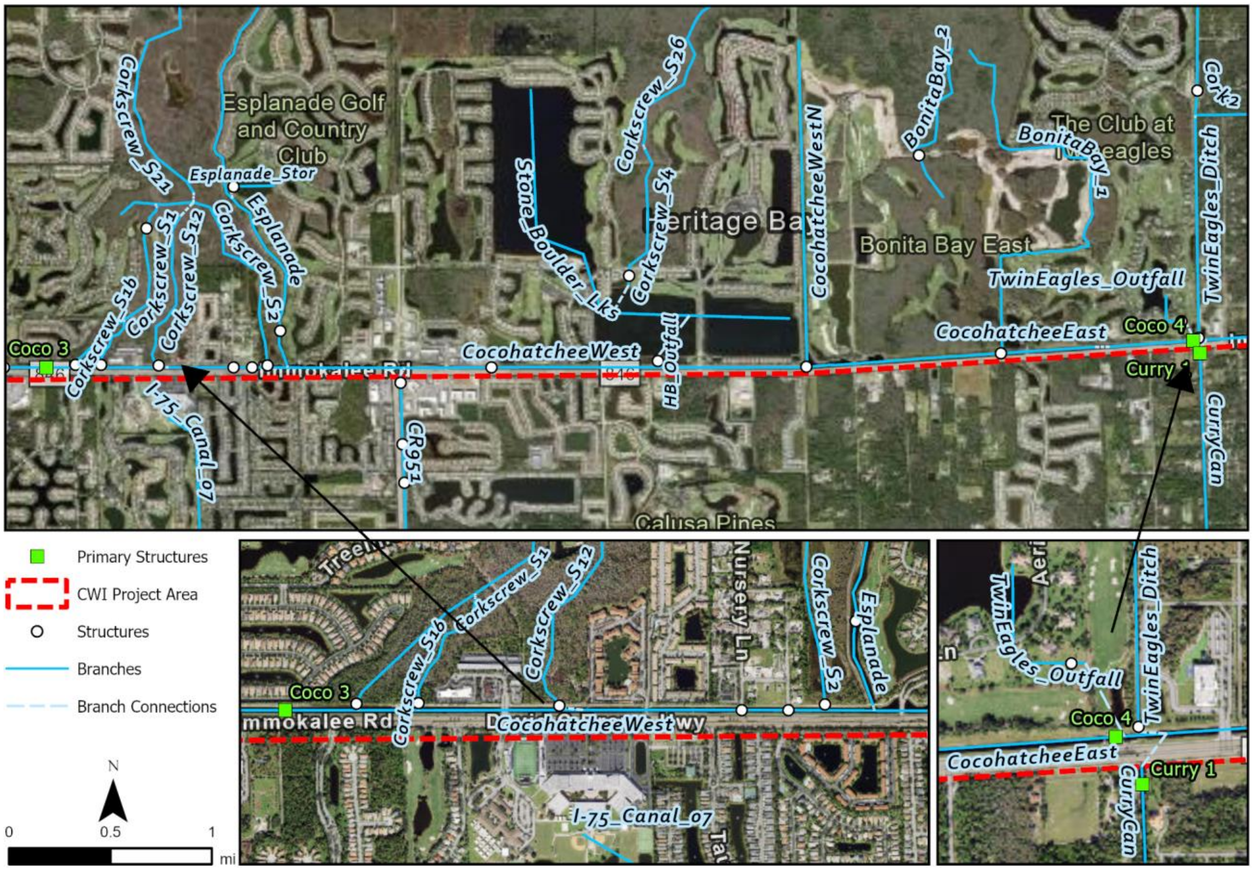

Figure C-20. Surface Water Discharge Locations to Cocohatchee Canal from COCO4 to COCO3

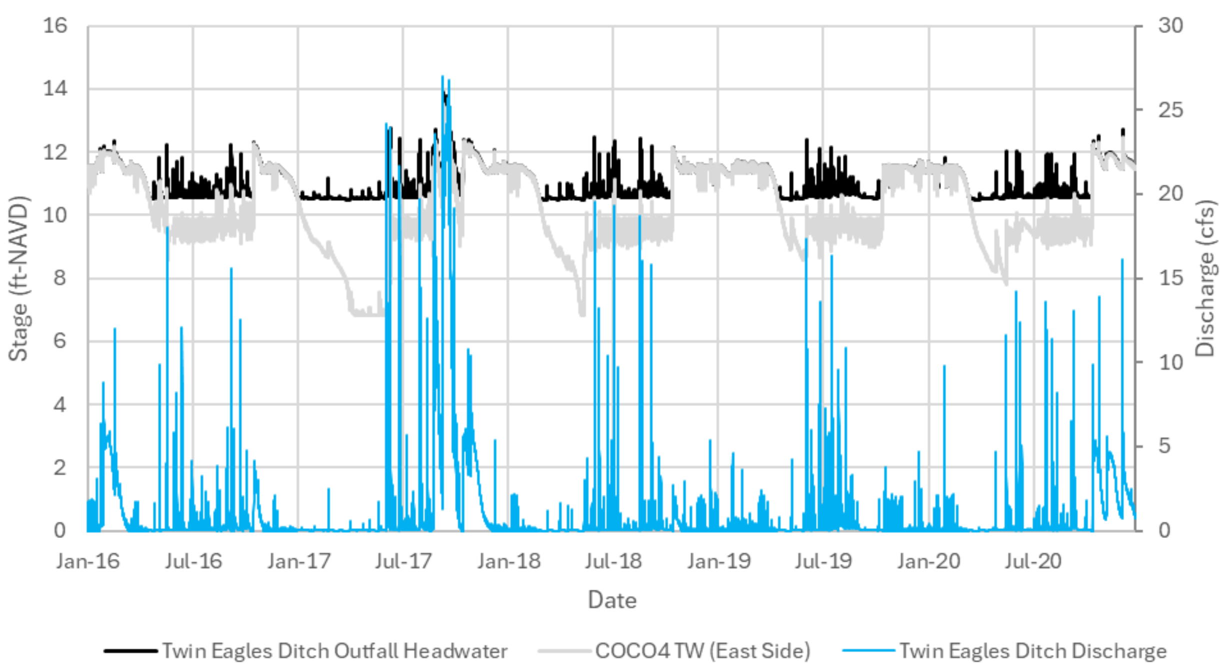

Figure C-21. Long Term Simulation Flow and Stage Hydrographs for Twin Eagles Ditch, East of COCO 4

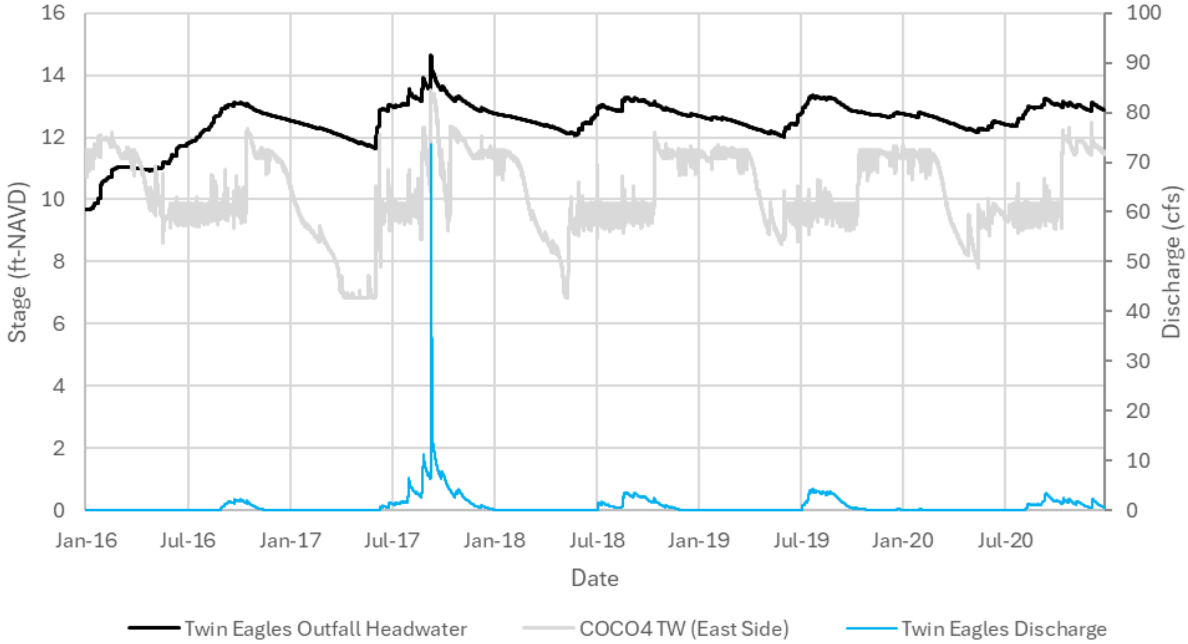

Figure C-22. Long Term Simulation Flow and Stage Hydrographs for Twin Eagles Outfall, East of COCO 4.

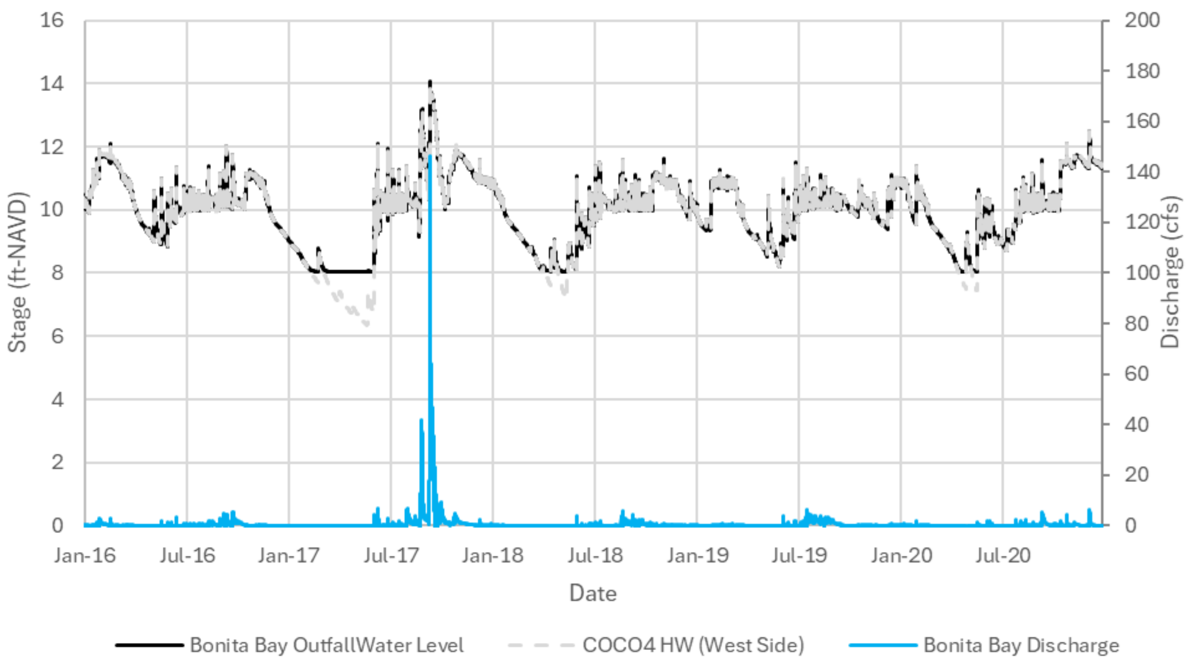

Figure C-23. Long Term Simulation Flow and Stage Hydrographs for Bonita Bay, West of COCO4

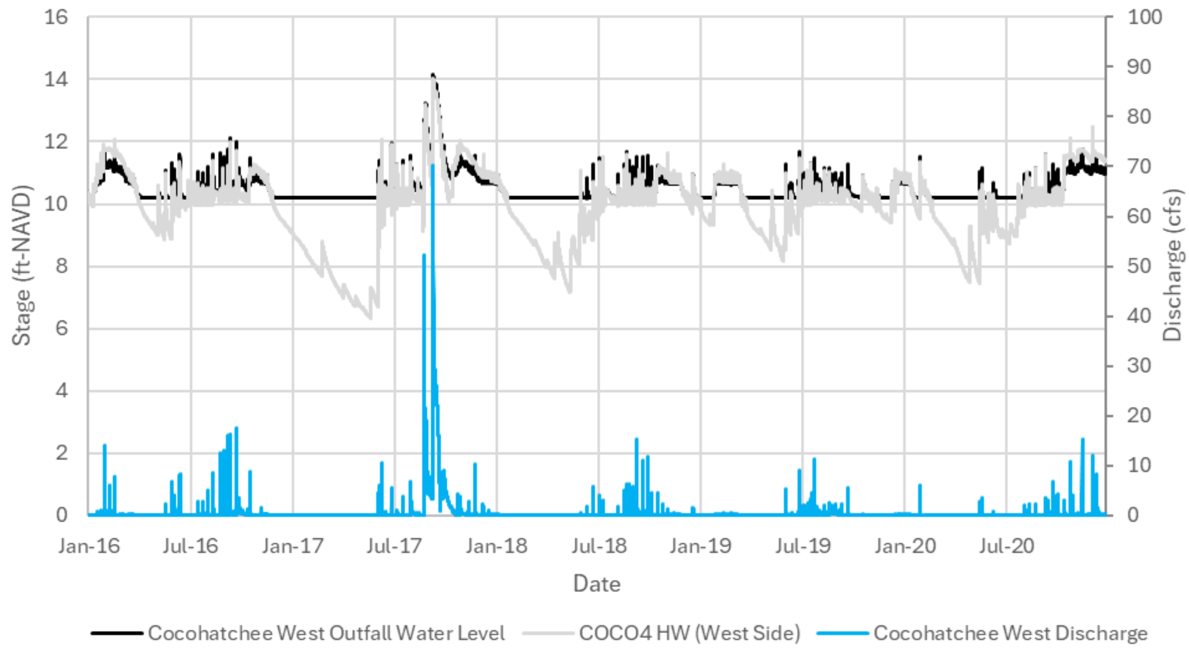

Figure C-24. Long Term Simulation Flow and Stage Hydrographs for Cocohatchee West N, West of COCO4

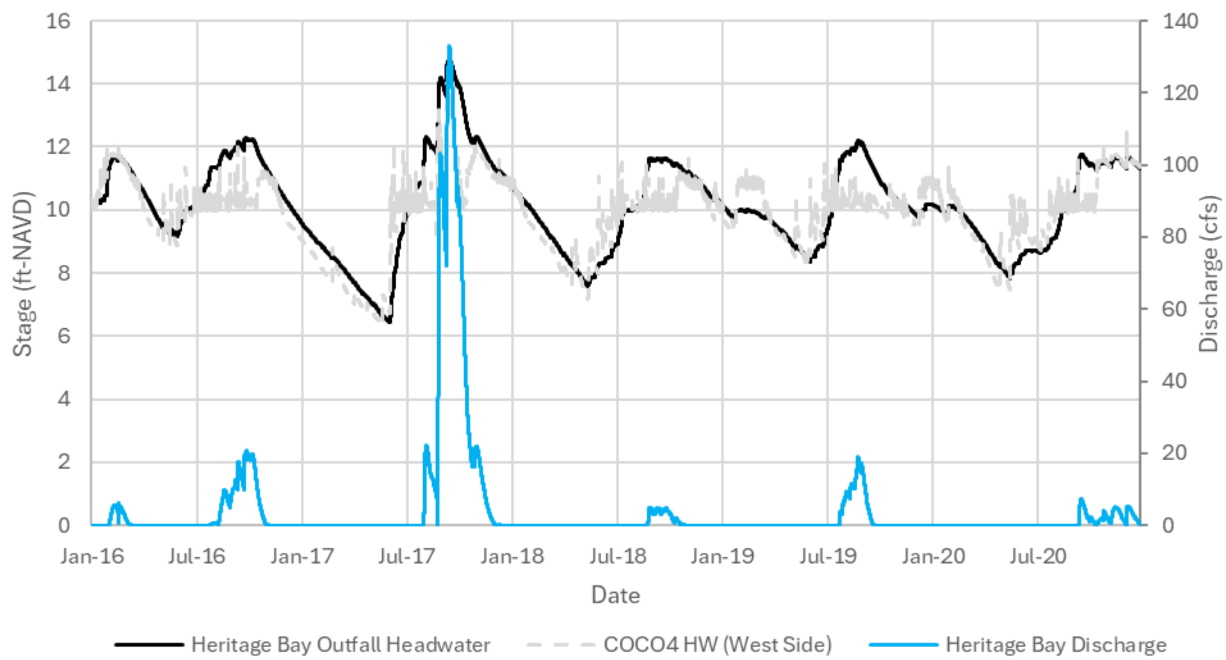

Figure C-25. Long Term Simulation Flow and Stage Hydrographs for Heritage Bay, West of COCO4

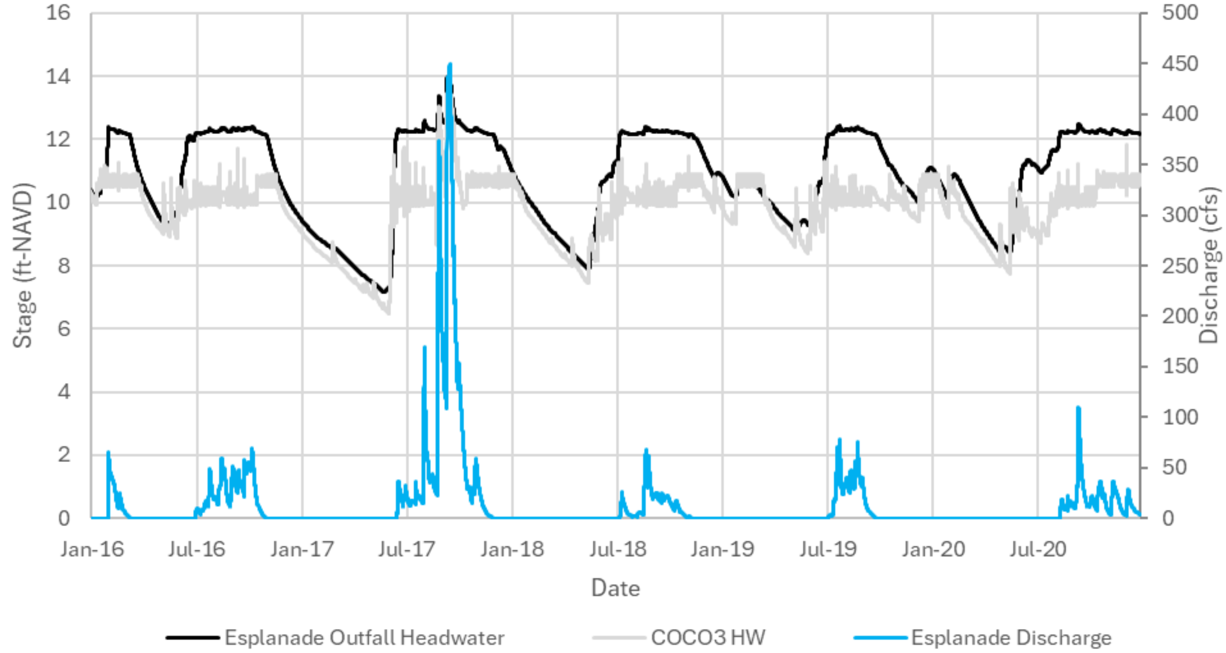

Figure C-26. Long Term Simulation Flow and Stage Hydrographs for Esplanade, East of COCO3.

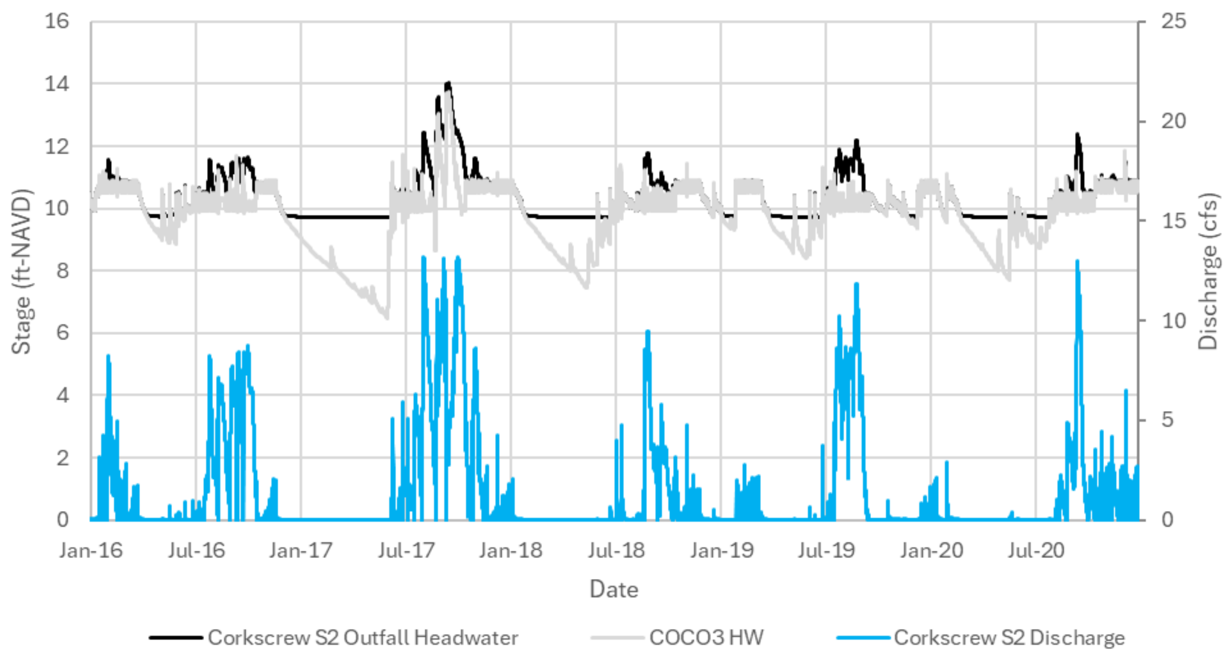

Figure C-27. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S2 Flow Way, East of COCO3.

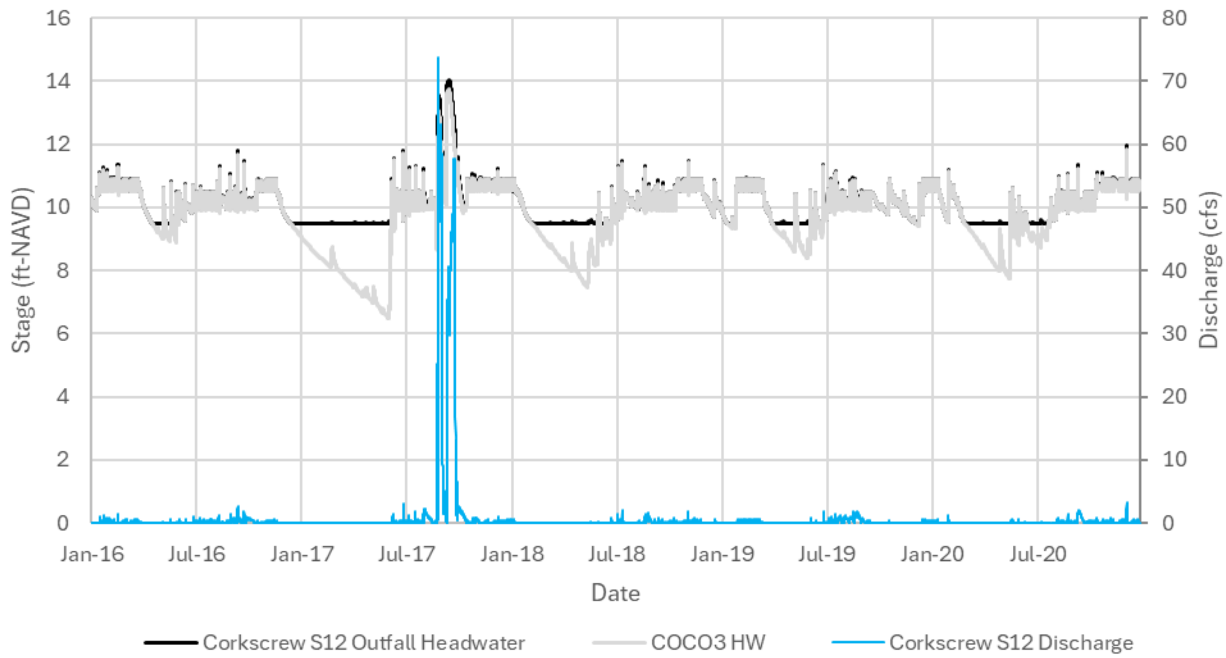

Figure C-28. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S12 Flow Way, East of COCO3.

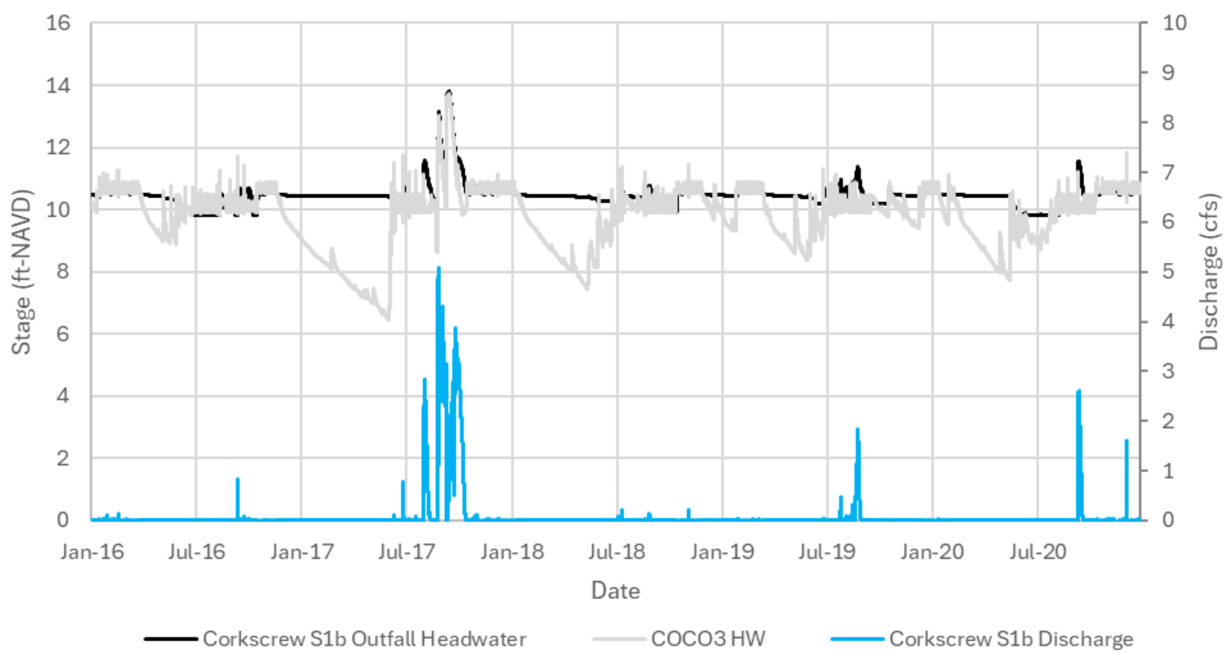

Figure C-29. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S1b Flow Way, East of COCO3.

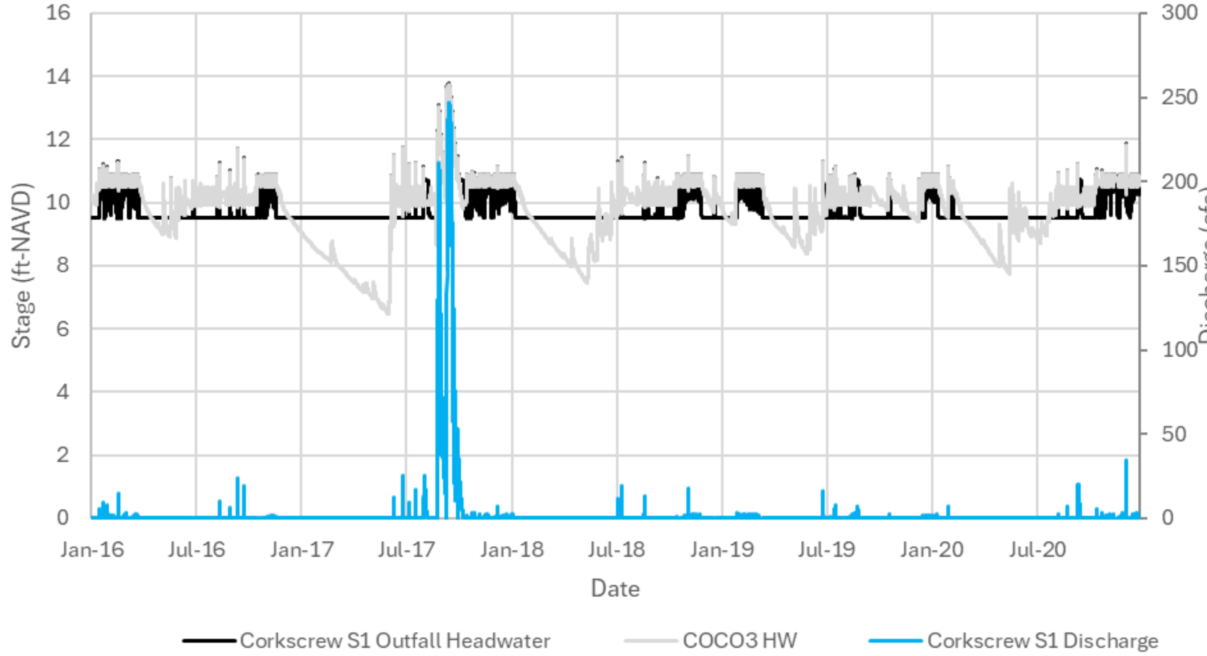

Figure C-30. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S1 Flow Way, East of COCO3.

Appendix D: Long Term Simulation Stage and Flow Hydrographs, ECM vs FCM

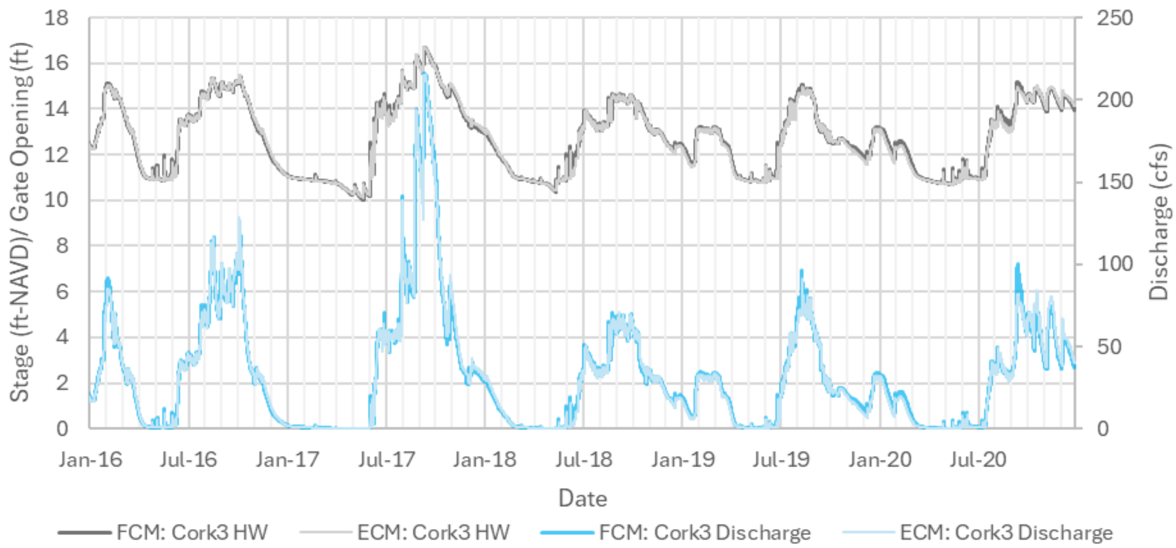

Figure D-1. Long Term Simulation Flow and Stage Hydrographs for Cork 3

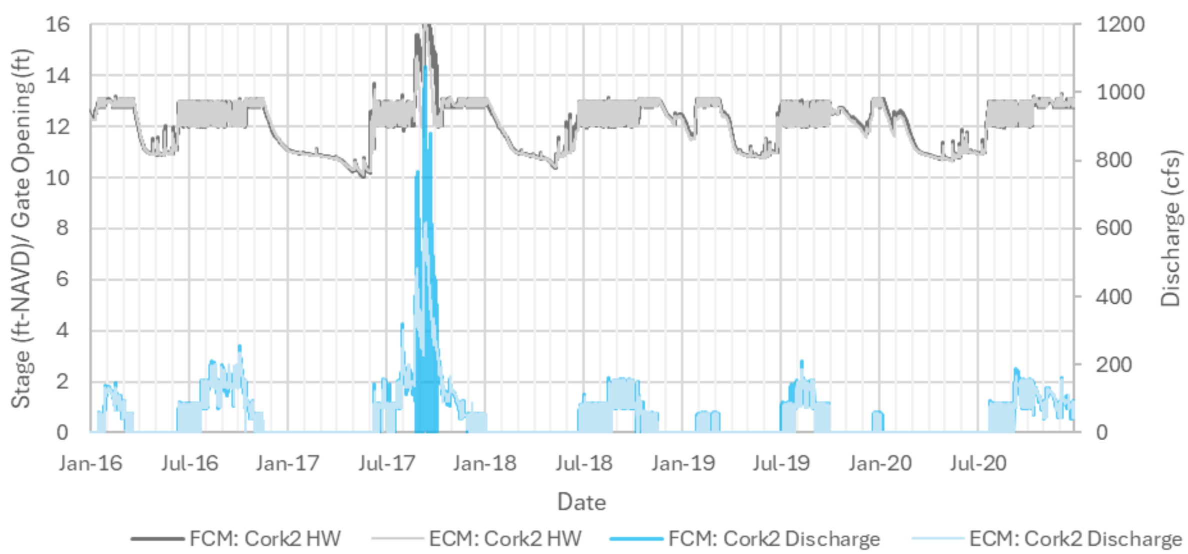

Figure D-2. Long Term Simulation Flow and Stage Hydrographs for Cork 2

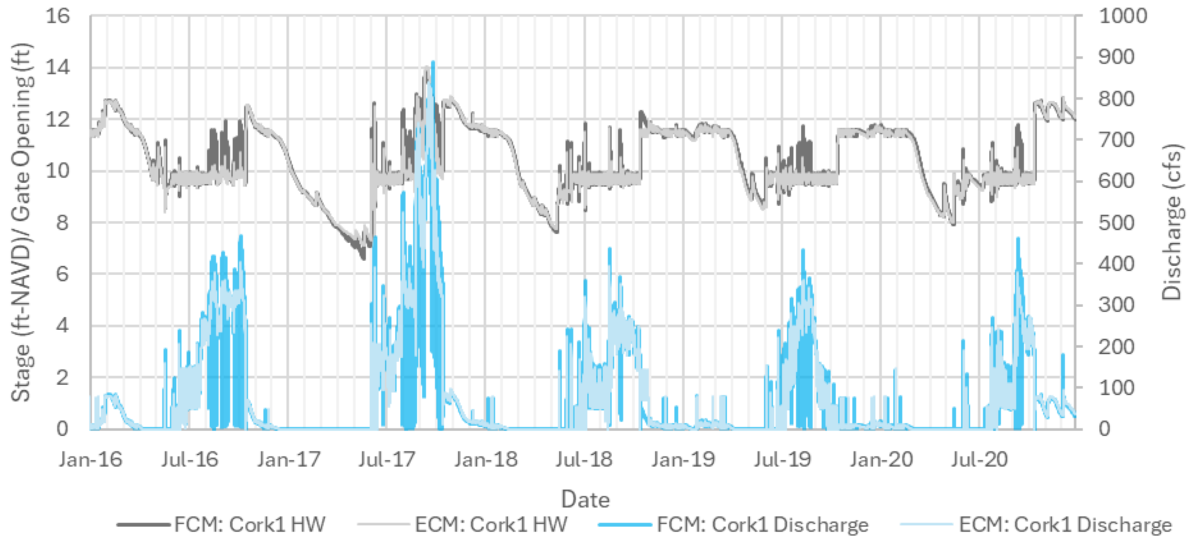

Figure D-3. Long Term Simulation Flow and Stage Hydrographs for Cork 1.

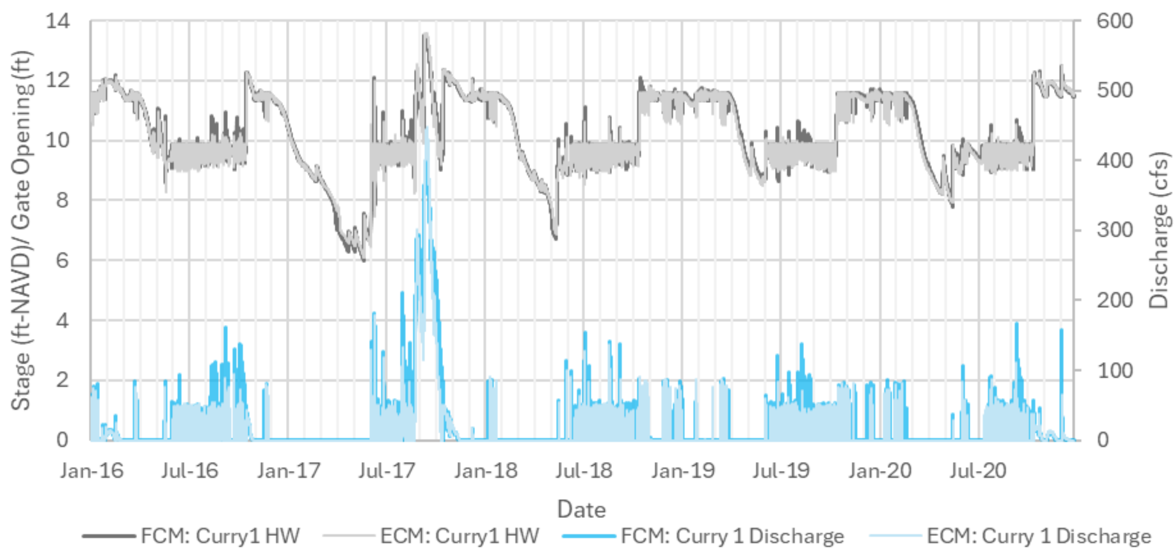

Figure D-4. Long Term Simulation Flow and Stage Hydrographs for Curry 1.

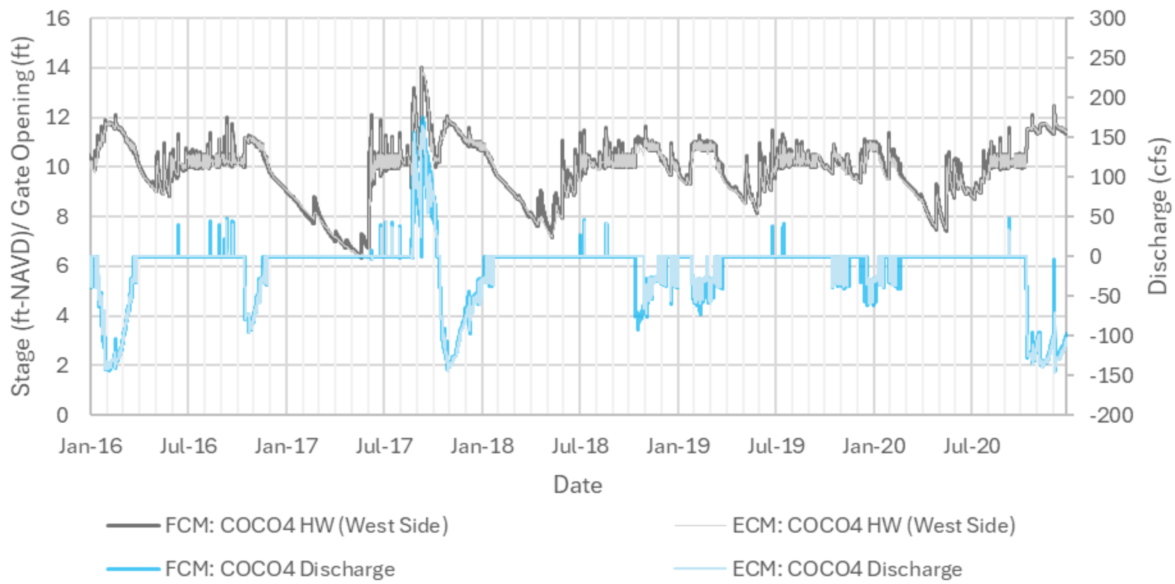

Figure D-5. Long Term Simulation Flow and Stage Hydrographs for COCO4.

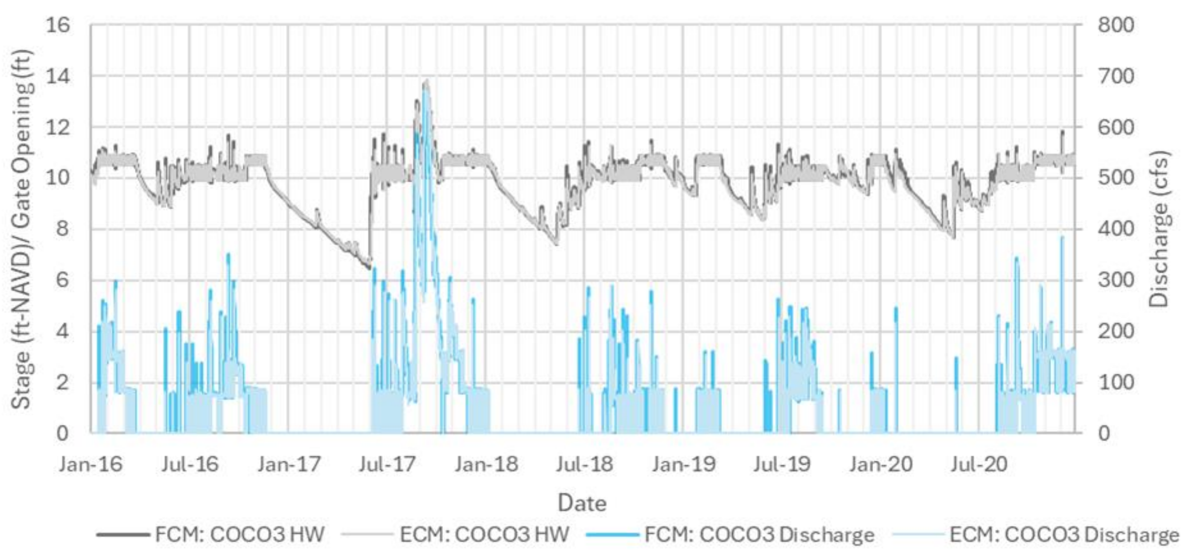

Figure D-6. Long Term Simulation Flow and Stage Hydrographs for COCO3.

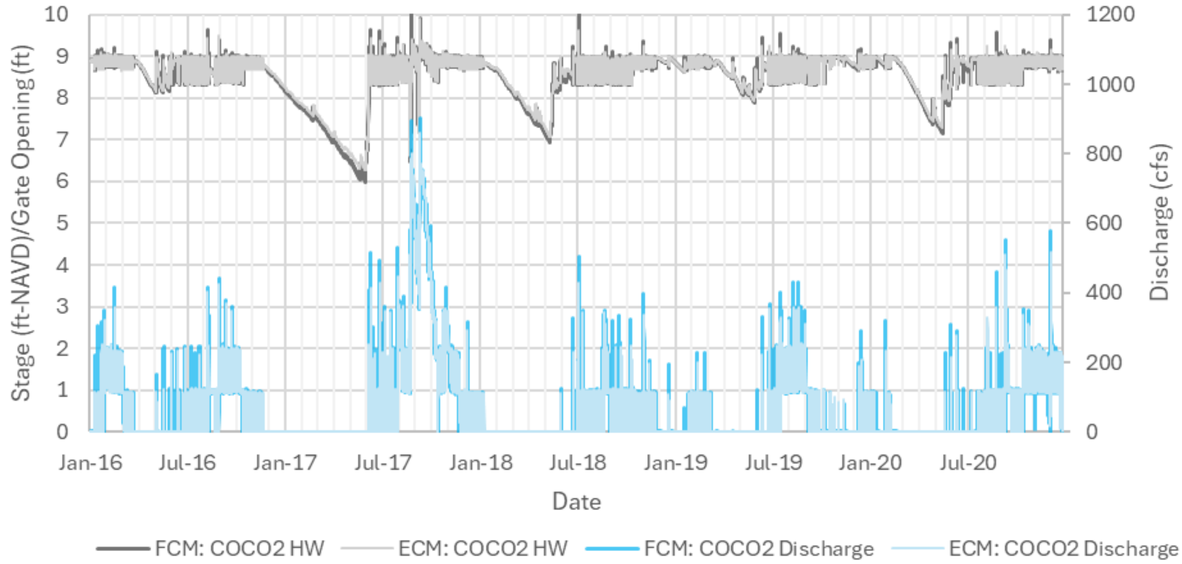

Figure D-7. Long Term Simulation Flow and Stage Hydrographs for COCO2.

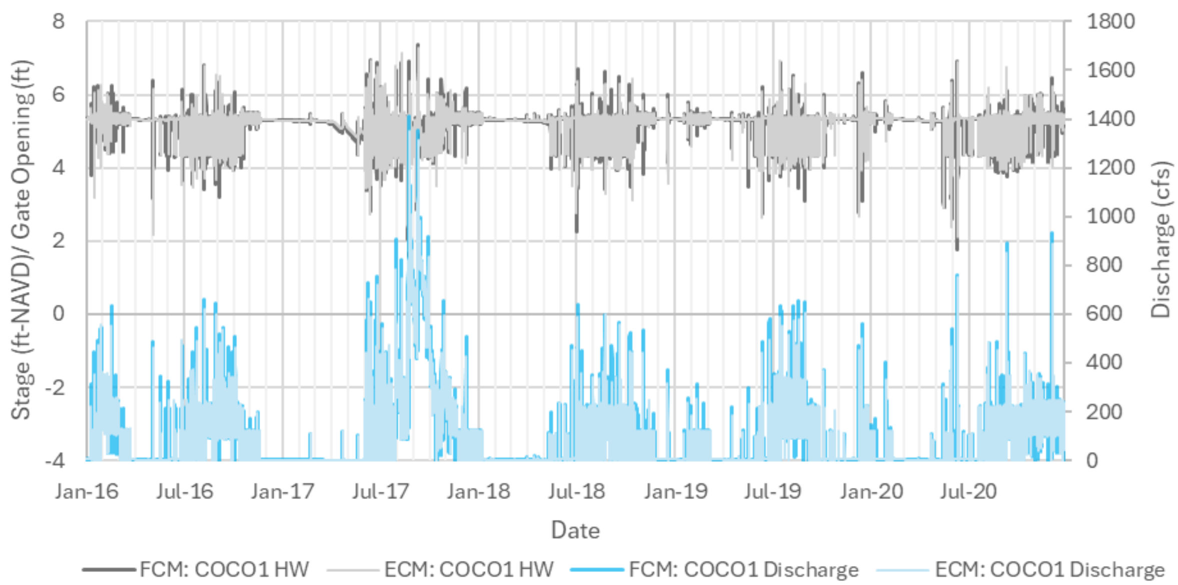

Figure D-8. Long Term Simulation Flow and Stage Hydrographs for COCO1.

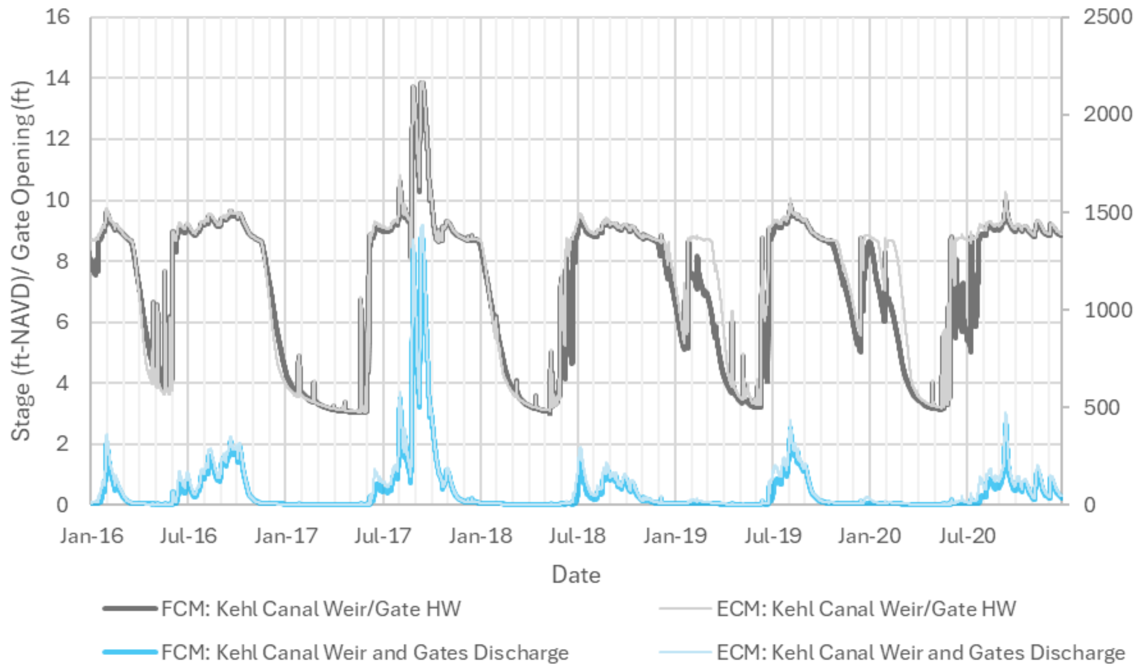

Figure D-9. Long Term Simulation Flow and Stage Hydrographs for Kehl Canal Weir/Gate.

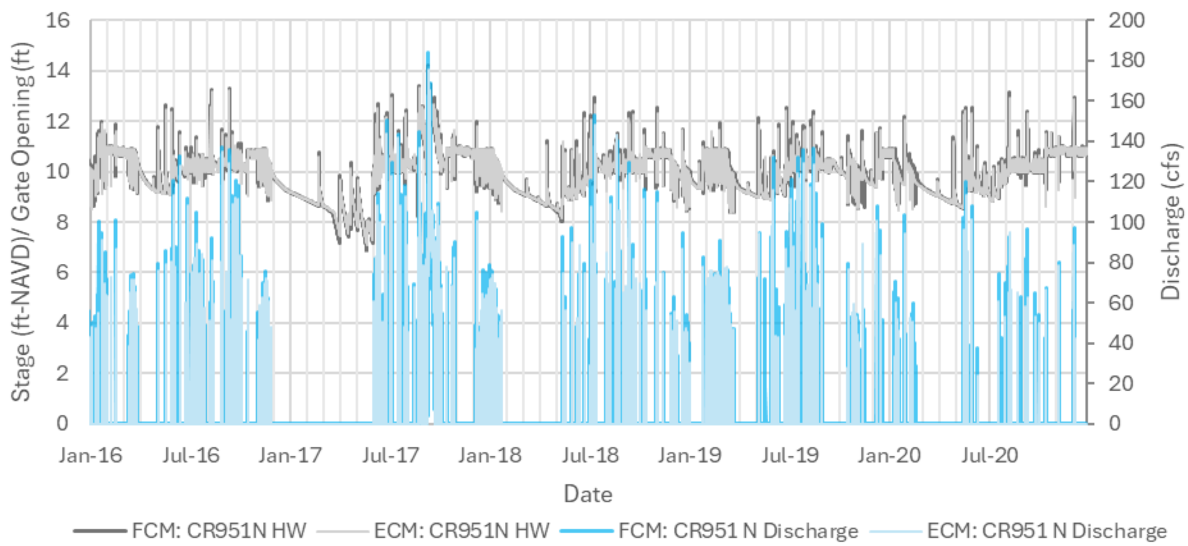

Figure D-10. Long Term Simulation Flow and Stage Hydrographs for CR951N

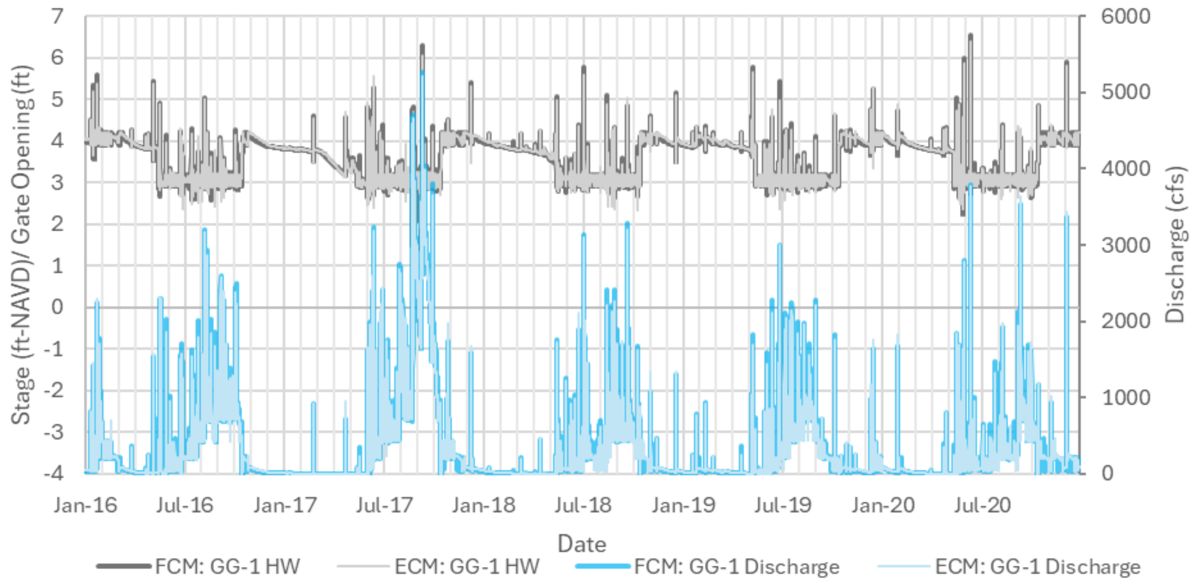

Figure D-11. Long Term Simulation Flow and Stage Hydrographs for GG1

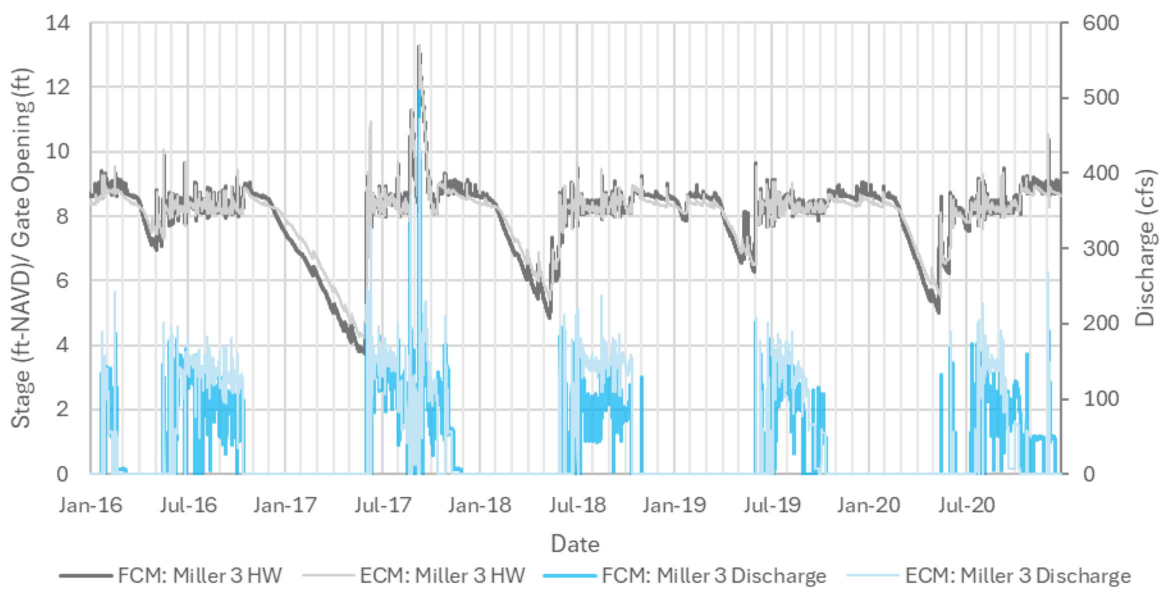

Figure D-12. Long Term Simulation Flow and Stage Hydrographs for Miller 3

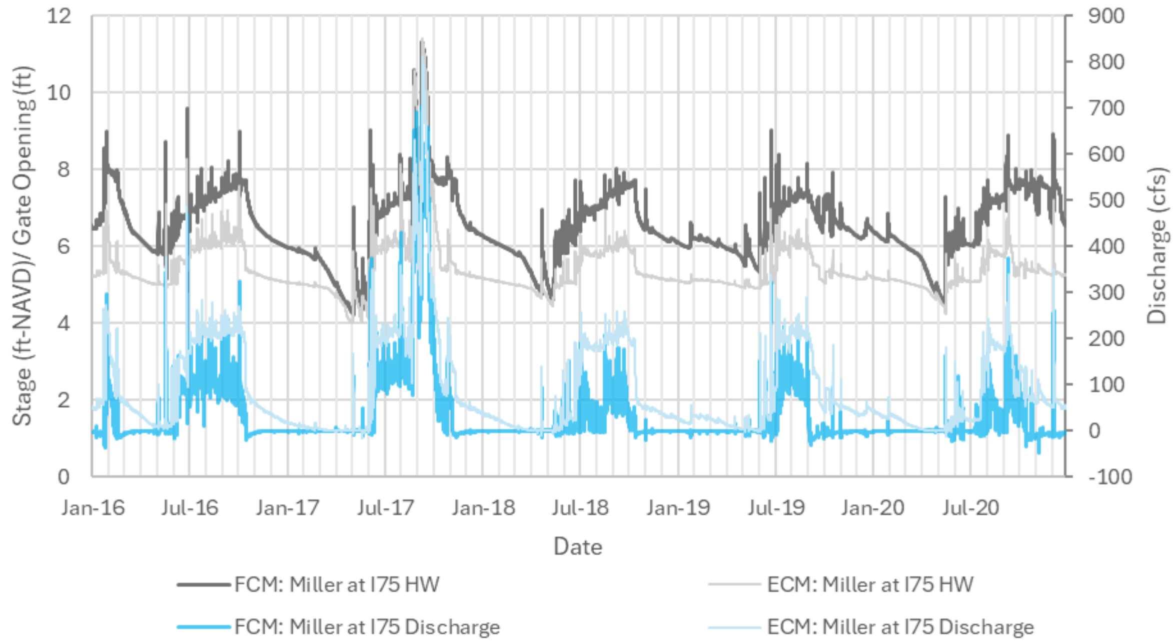

Figure D-13. Long Term Simulation Flow and Stage Hydrographs for Miller Canal Bridge at I-75

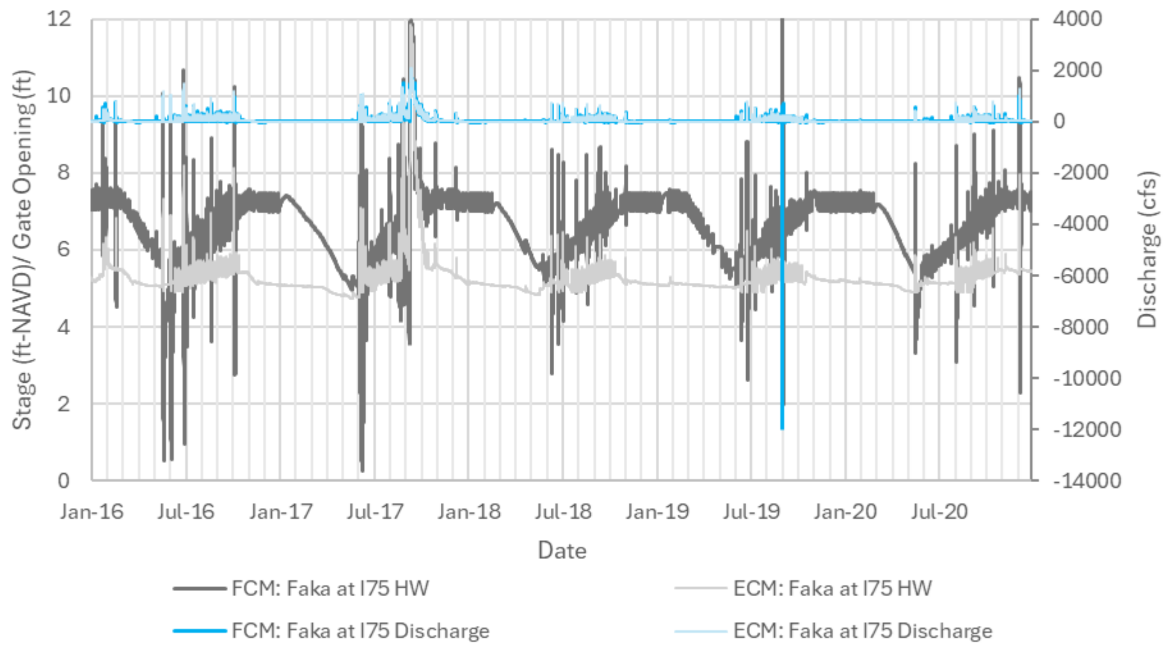

Figure D-14. Long Term Simulation Flow and Stage Hydrographs for Faka Union Canal Bridge at I-75

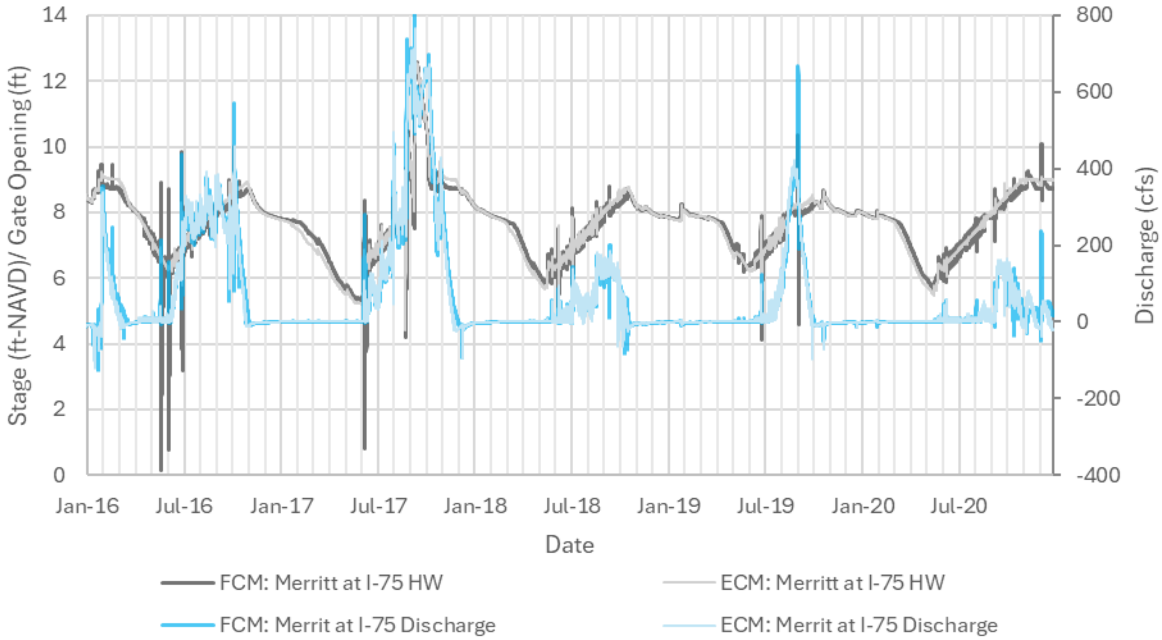

Figure D-15. Long Term Simulation Flow and Stage Hydrographs for Merrit Canal Bridge at I-75

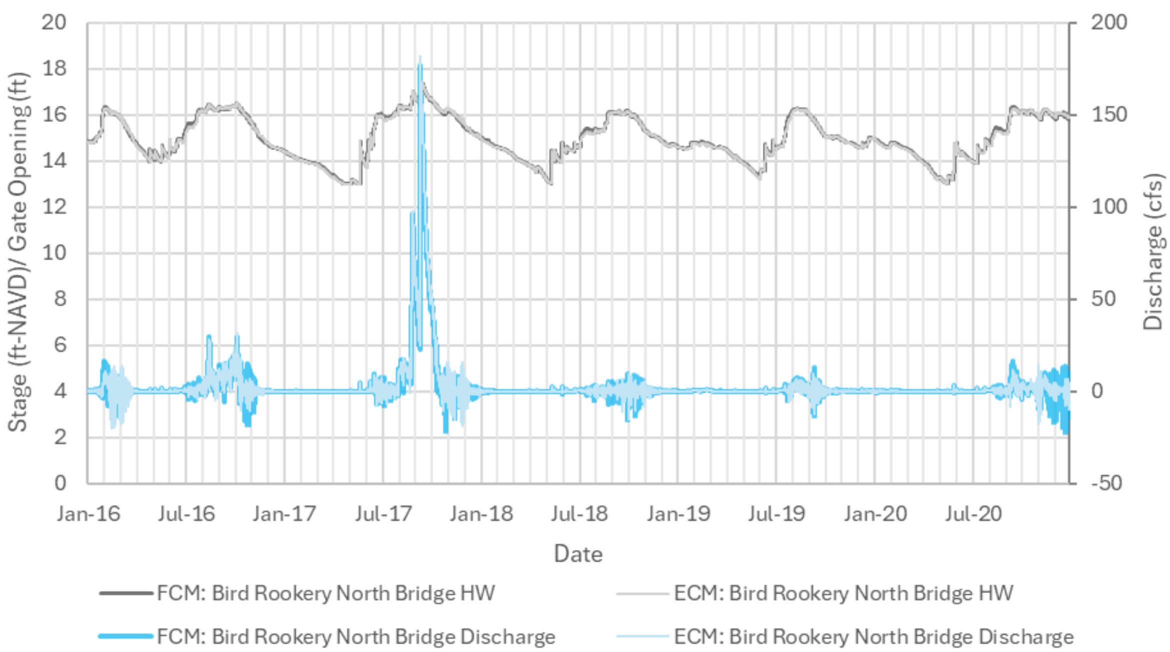

Figure D-16. Long Term Simulation Flow and Stage Hydrographs for Bird Rookery North Bridge

Stages and flow from the connections south of Shady Hollow Boulevard to the Corkscrew Canal downstream of Cork3 (Figure C-17) are shown in Figure C-18 and Figure C-19.

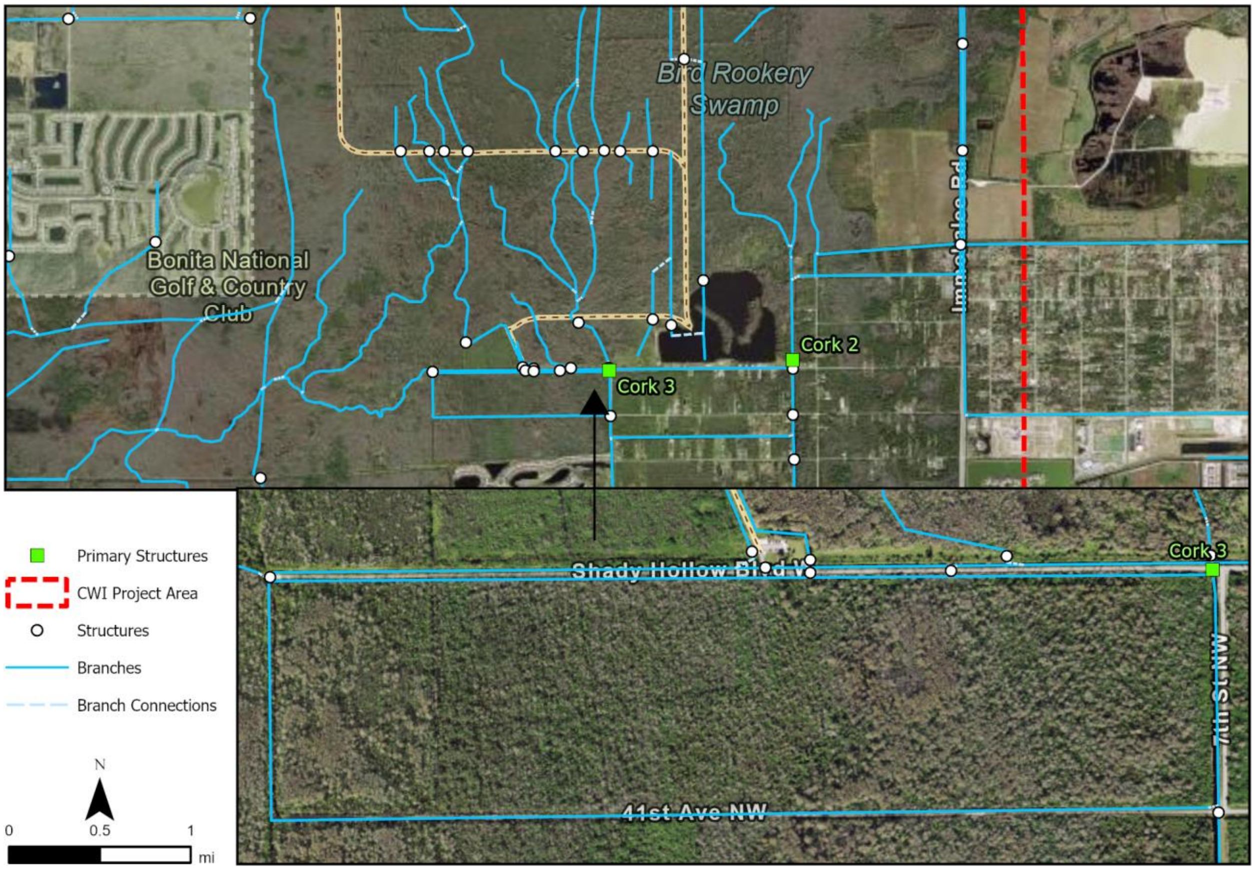

Figure D-17. Surface Water Discharge Locations to Corkscrew Canal, South of Cork3

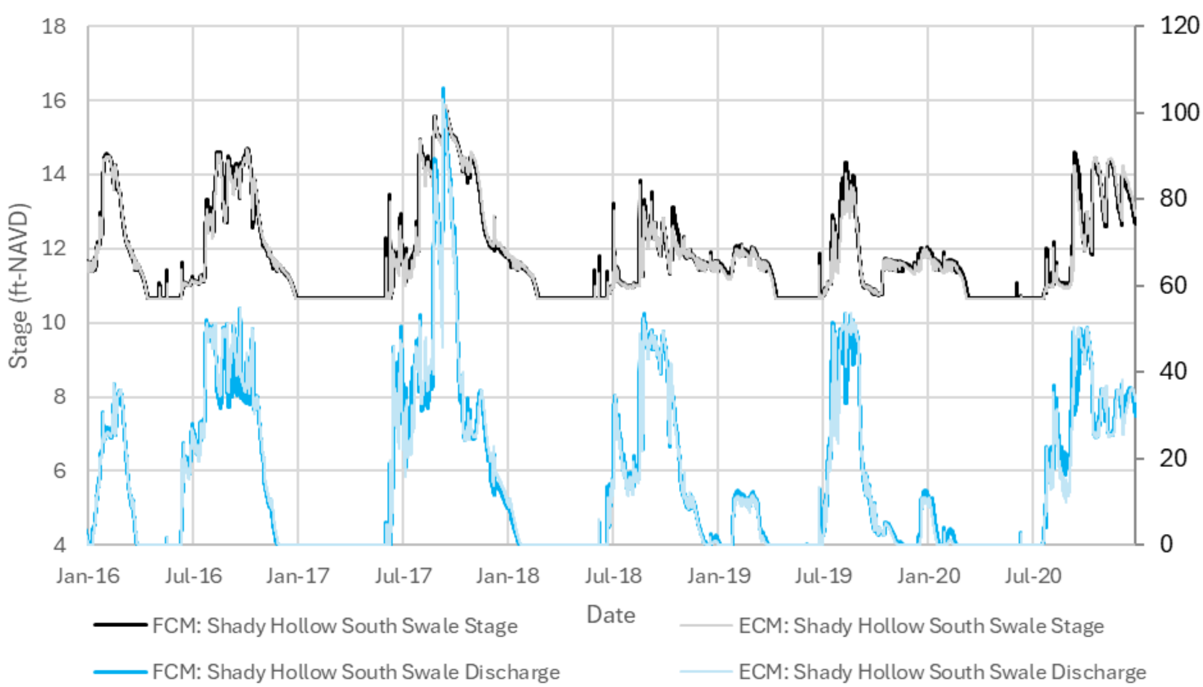

Figure D-18. Long Term Simulation Flow and Stage Hydrographs for Shady Hollow Boulevard South Swale

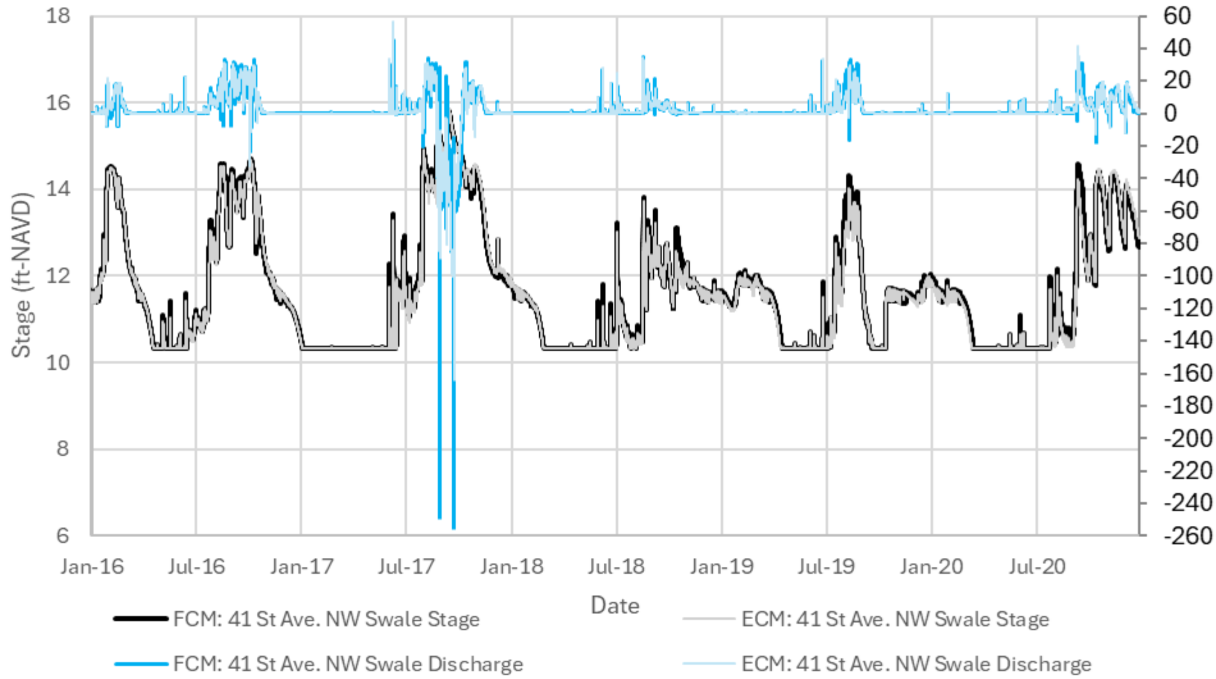

Figure D-19. Long Term Simulation Flow and Stage Hydrographs for the 41st Ave. NW North Swale

Stages and flow to the Cocohatchee Canal from the north are shown in the plots below. The locations are show in Figure C-20.

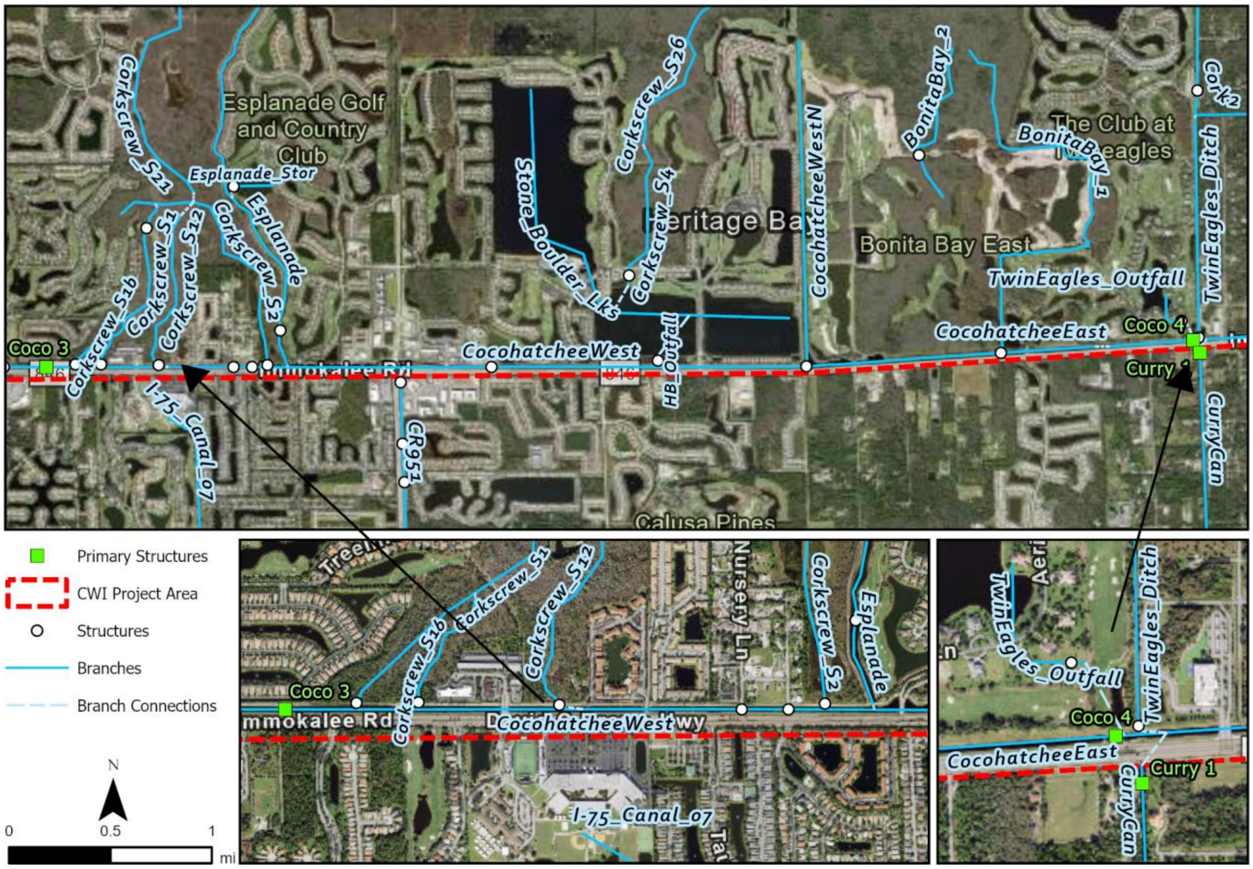

Figure D-20. Surface Water Discharge Locations to Cocohatchee Canal from COCO4 to COCO3

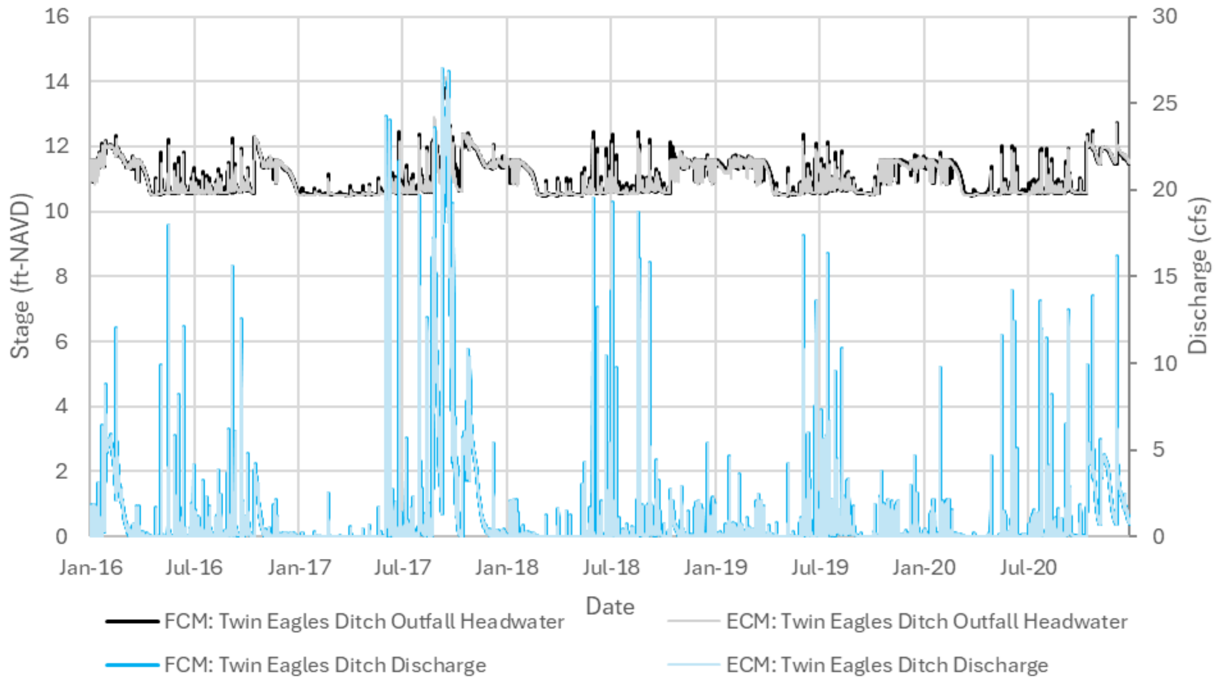

Figure D-21. Long Term Simulation Flow and Stage Hydrographs for Twin Eagles Ditch, East of COCO 4

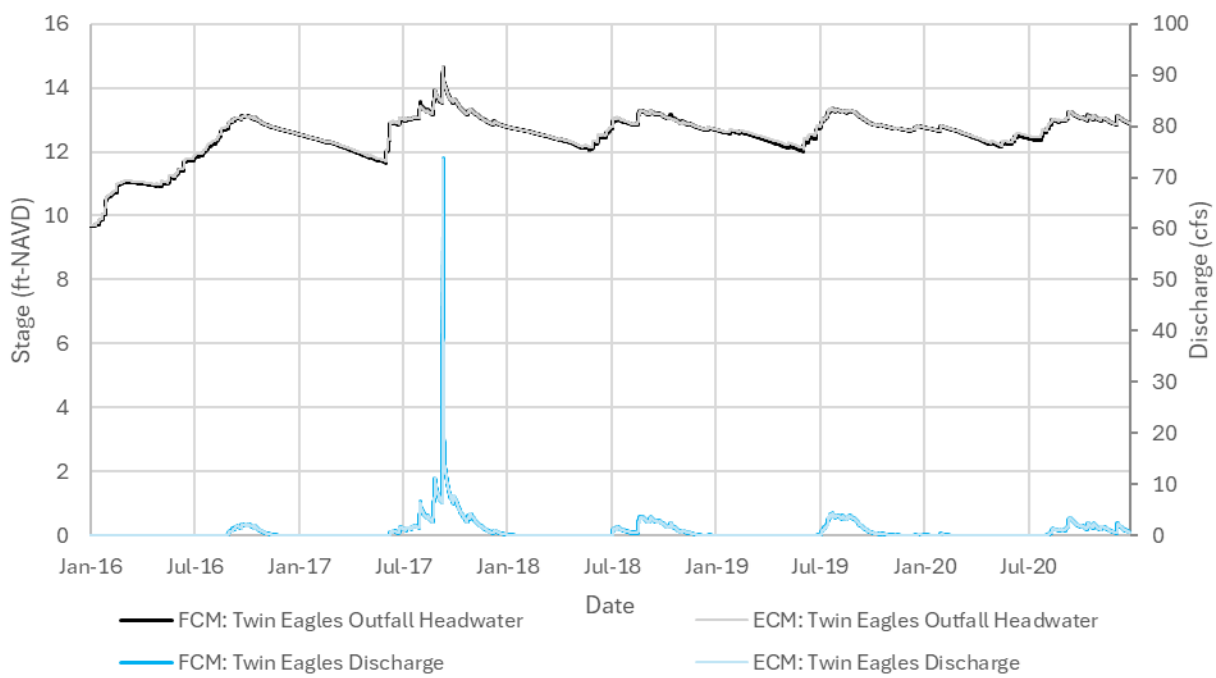

Figure D-22. Long Term Simulation Flow and Stage Hydrographs for Twin Eagles Outfall, East of COCO 4.

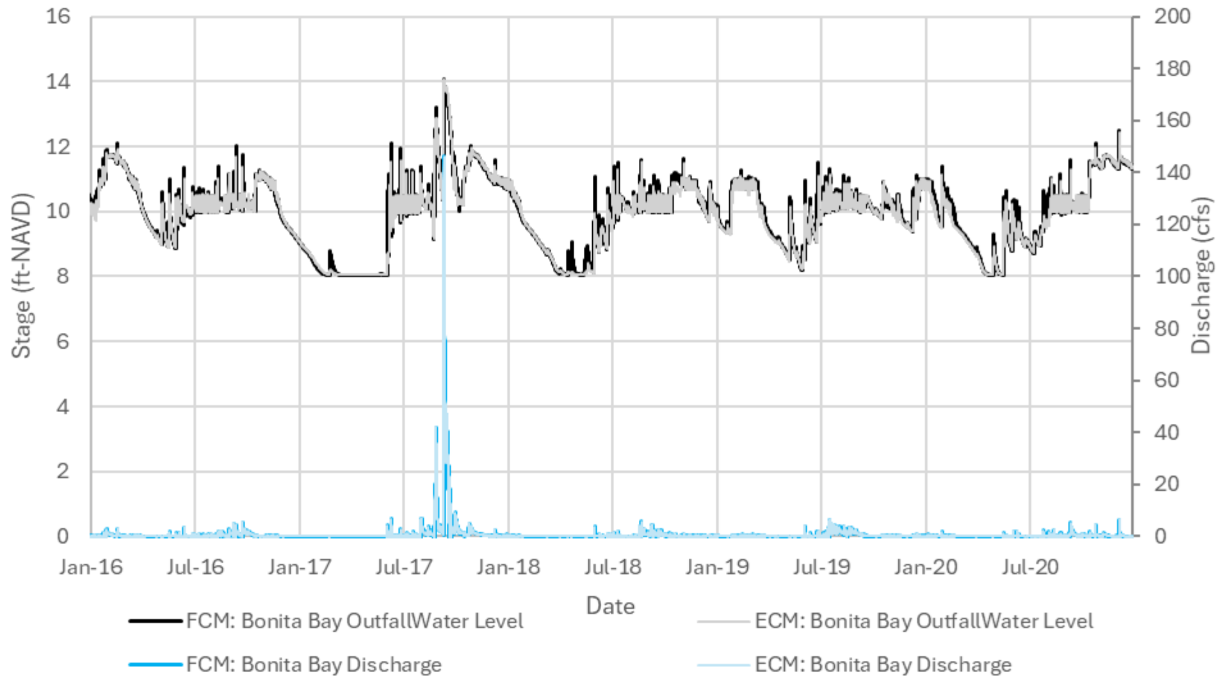

Figure D-23. Long Term Simulation Flow and Stage Hydrographs for Bonita Bay, West of COCO4

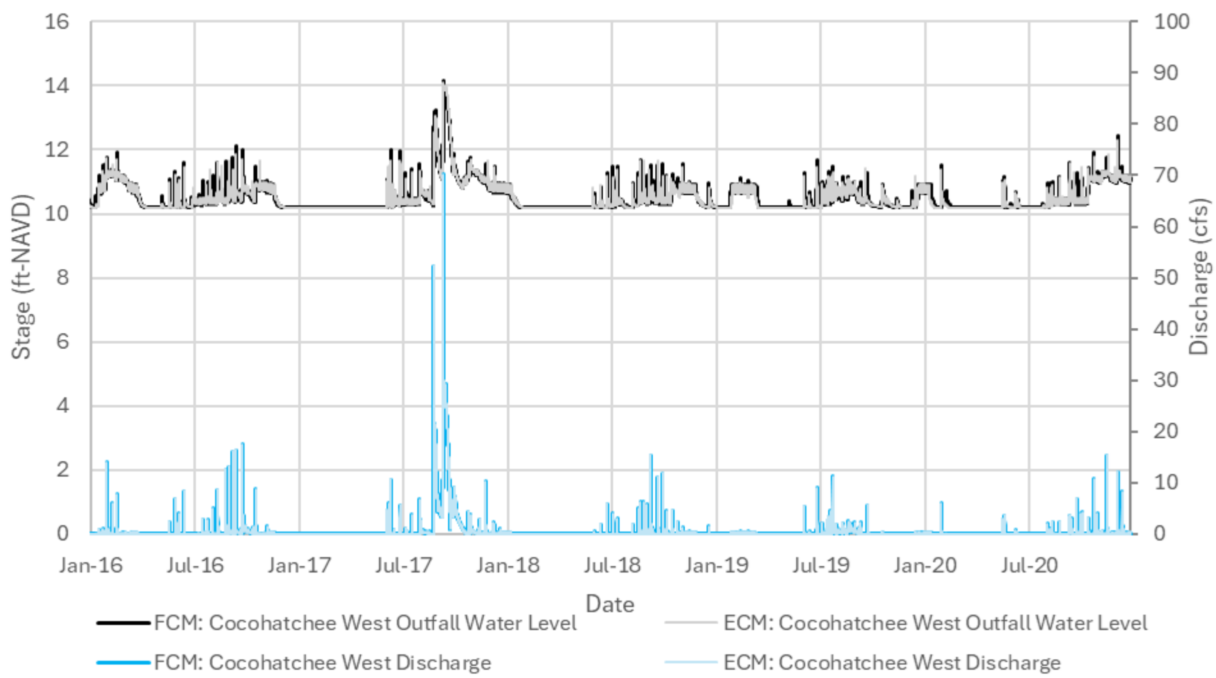

Figure D-24. Long Term Simulation Flow and Stage Hydrographs for Cocohatchee West N, West of COCO4

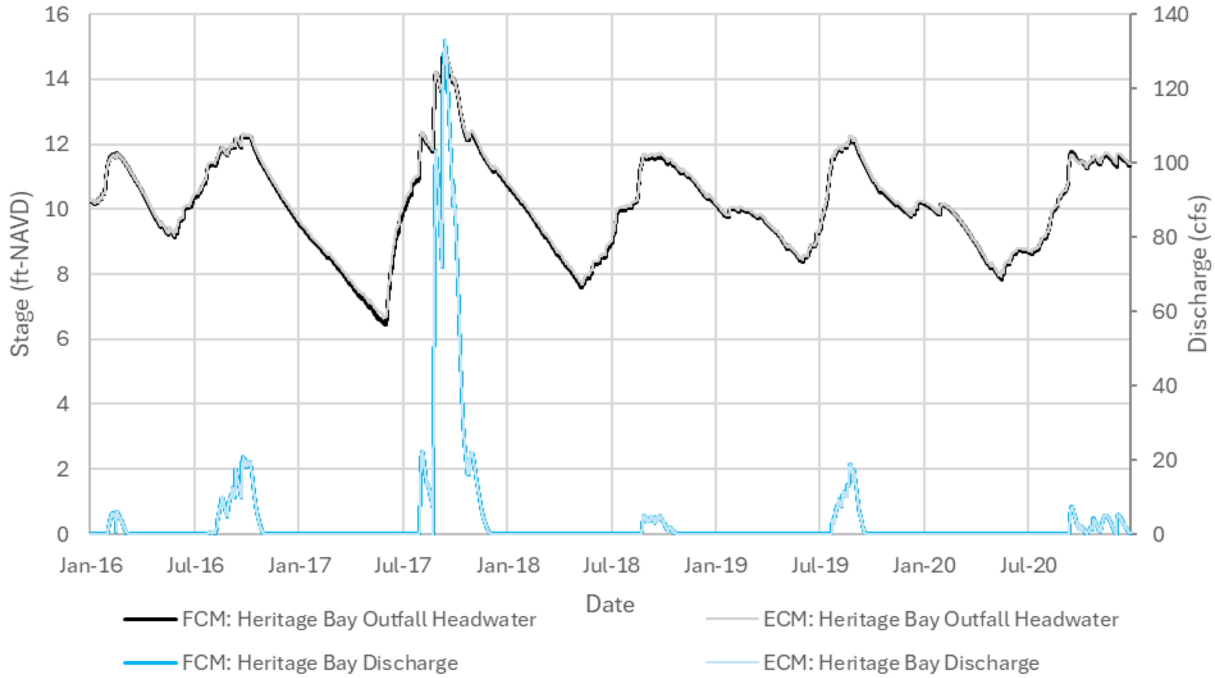

Figure D-25. Long Term Simulation Flow and Stage Hydrographs for Heritage Bay, West of COCO4

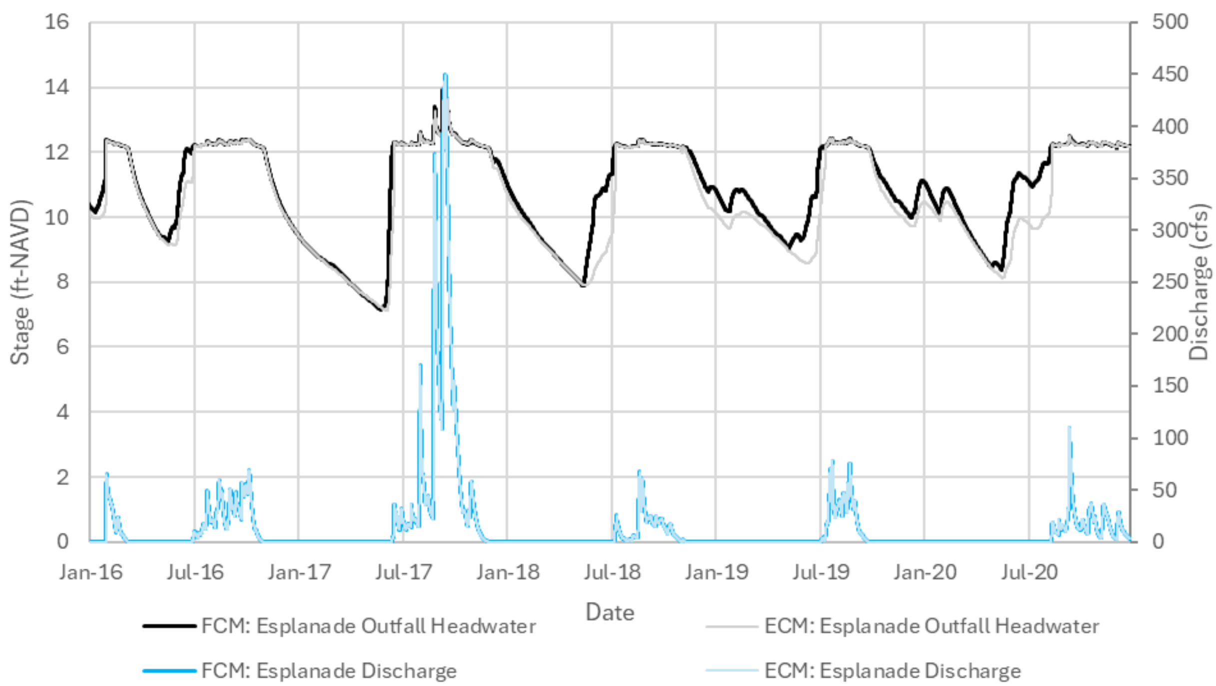

Figure D-26. Long Term Simulation Flow and Stage Hydrographs for Esplanade, East of COCO3.

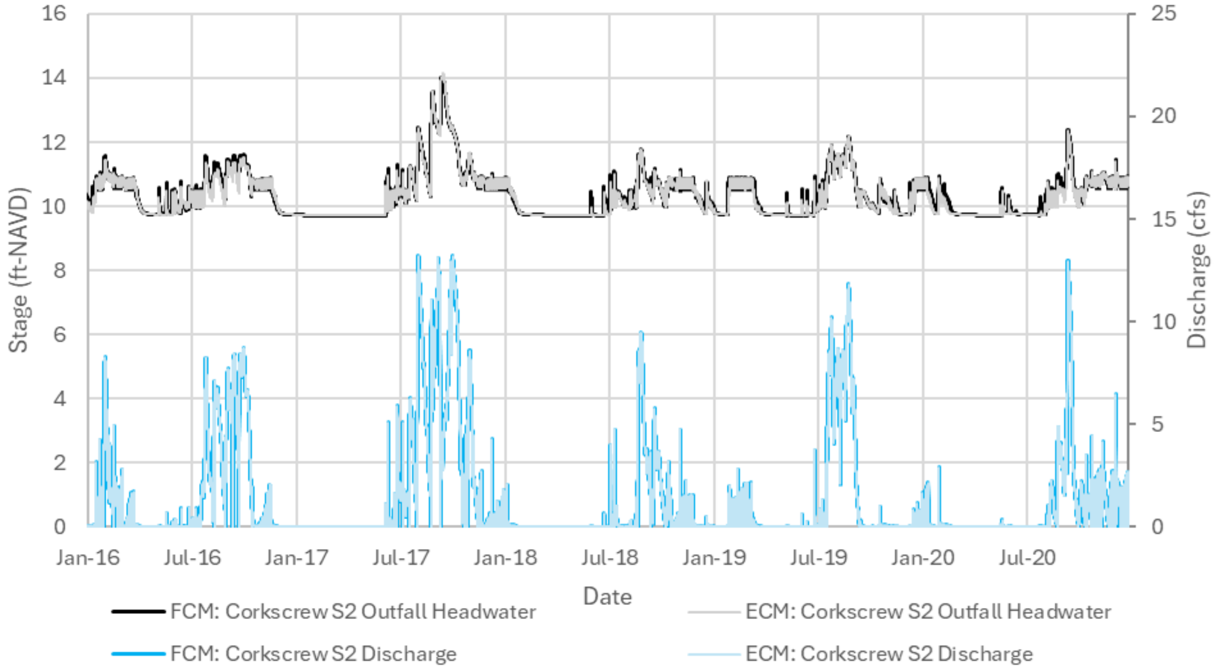

Figure D-27. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S2 Flow Way, East of COCO3.

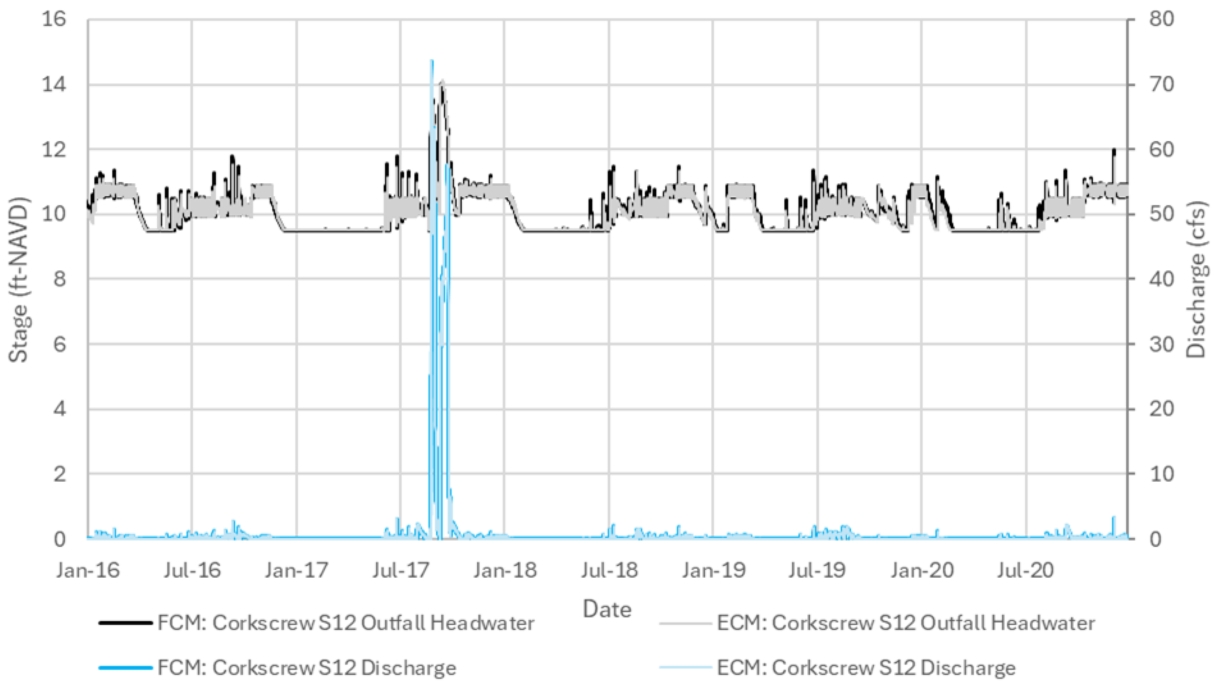

Figure D-28. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S12 Flow Way, East of COCO3.

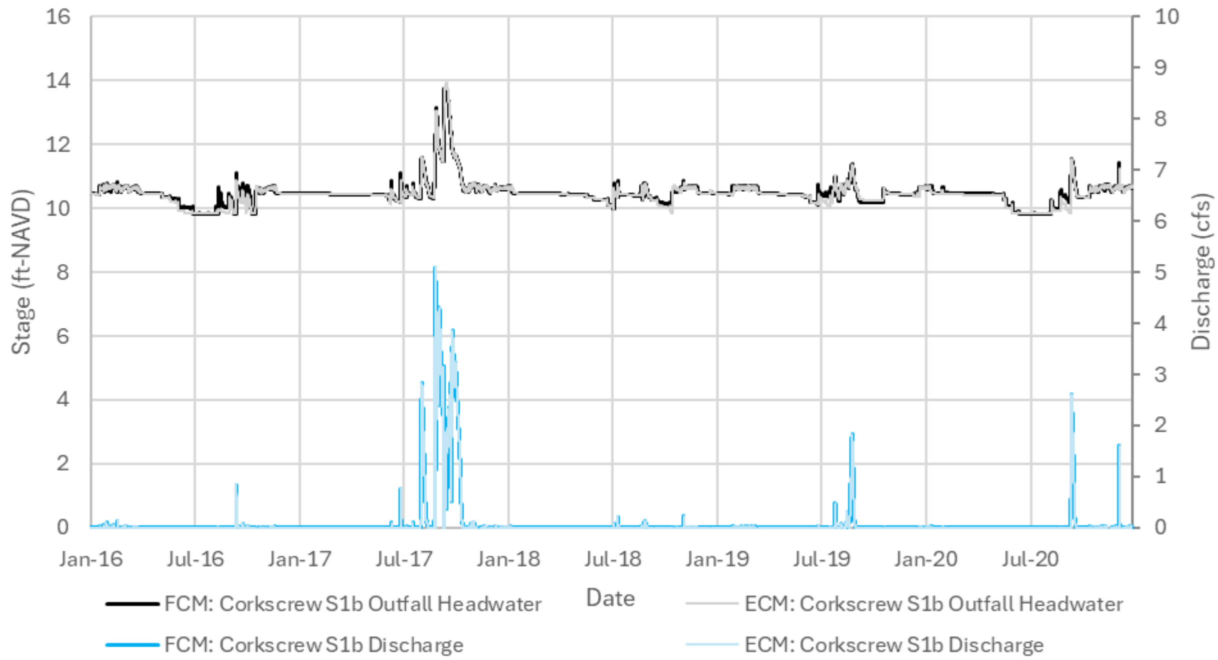

Figure D-29. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S1b Flow Way, East of COCO3.

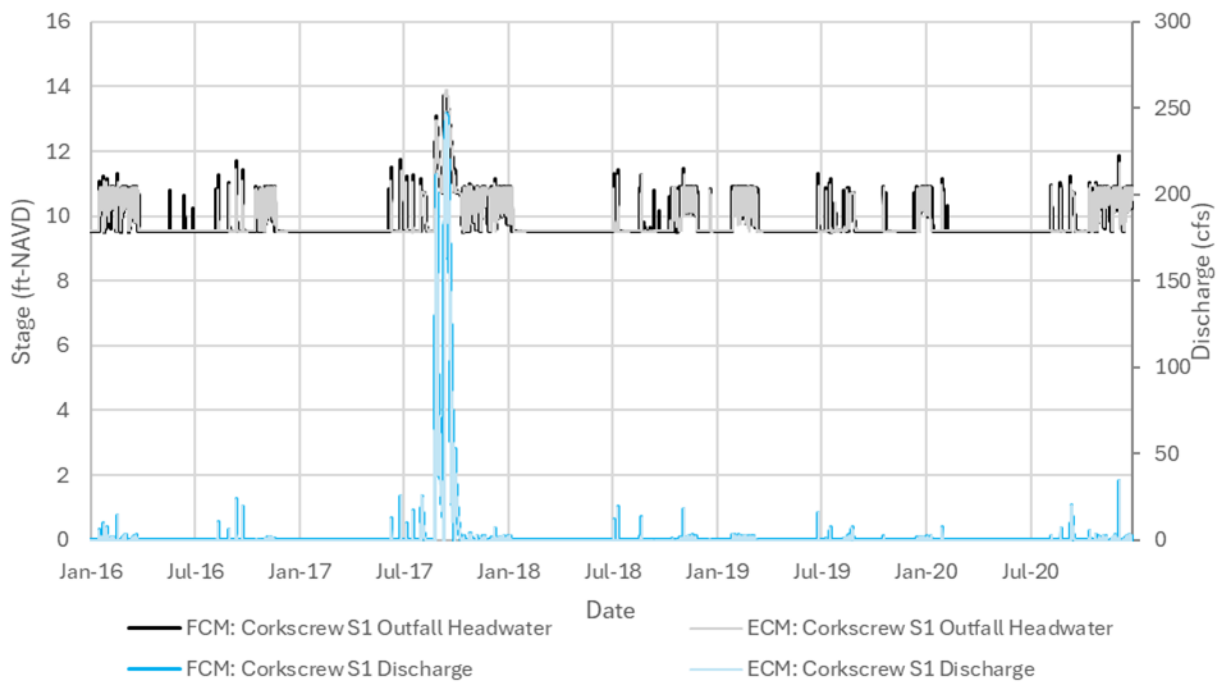

Figure D-30. Long Term Simulation Flow and Stage Hydrographs for Corkscrew S1 Flow Way, East of COCO3.