DEP AGREEMENT NO. 23PLN101

Vulnerability Assessment **REPORT**

for

Resilient Florida – Florida Department of Environmental Protection

Prepared for:

Town of Loxahatchee Groves, FL

Issued: August 19, 2025

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K&A Project No. 23-1436

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Executive Summary

Purpose

The study and report are intended to meet the requirements of Florida Statute 380.093 (380.093 F.S.) for conformance with the Statewide Flooding and Resilience Plan as stated therein. The study included collection of real-world asset data and review of published materials, modeling specified storm events, and categorizing risk to Critical Assets as defined in 380.093 F.S., (2)(a).

Study Area

The Study Area encompasses the entire service limits of the Loxahatchee Groves Water Control District (approximately 8,000 acres) which overlaps the incorporated limits of the Town of Loxahatchee Groves and is located within the Western C-51 Basin in eastern Palm Beach County. The Study Area contains mainly open and agricultural land uses, with limited commercial uses located along the southern limits of the Town and scattered pockets of more compact single-family residential areas dispersed among the more typical five-acre lots.

The general boundary of the Study Area spans from 162nd Drive North along the western boundary to Folsom Road/ Crestwood Boulevard along the eastern boundary, from Southern Boulevard (State Road 80) along the southern boundary to the northern limits of parcels fronting North Road. A map of this area is provided in Exhibit 1 – Town of Loxahatchee Groves Location and Boundary Map.

A grid of seven (7) major north-south and two (2) main east-west canals outfalls to the C-51 Canal on the south side of Southern Boulevard/ State Road 80 through a primary gated structure located at D Road and secondary operable gates at the south ends of A Road and Crestwood Boulevard. The major north-south canals are connected by lateral canals at North Road and Collecting Canal Road for conveyance to the main outfall structure at D Road.

Modeling

Workflow for this study utilized multiple software programs to coordinate inputs and results for display with modeling software from StormWise Version 4.08.02 from Streamline Technologies, Inc. (formerly ICPR). Primary model inputs are based on survey data, aerial imagery, and LiDAR topography. A sample report of modeling inputs is included in Appendix 1 – Modeling Input Report. These inputs are identical throughout the model runs, with the exception of the tailwater time series data for the C-51 Canal. Tailwater time series inputs were set for each specific modeling scenario to reflect results of previous regional modeling efforts of the C-51 Canal by the SFMWD.

Scenarios encompass the 2025 (Present), 2040 and 2070 Planning Horizons using a 100-year recurrence interval (1% chance annually) and three-day rainfall events. Present-day (2025) precipitation values were obtained from NOAA. 2040 and 2070 rainfall amounts are based on the upper range emission (RCP 8.5) scenario from NCICS. Two control structures in the C-51 Canal separate the Town from direct impact by tidal and storm surge impacts, but those effects will presumably influence water levels in the receiving C-51 Canal. To account for the effects of future tide and sea level rise, this model uses C-51 tailwater stages from the recent (2025) Eastern Palm Beach County Flood Protection Level of Service Study (FPLOS) completed by the SFWMD.

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Scenario Summary				
Horizon, Event	**FPLOS SLR (ft)**	**Rainfall (in)**	**Tailwater Max. (ft NAVD)**	**NOAA SLR (ft)**
2025, 100Y-3D	--	17.0	15.22	--
2040, 100Y-3D	1	19.86	16.2	Intermediate-High (0.75 IL - 0.92 IH)
2070, 100Y-3D	3	22.61	16.2	Intermediate-High (1.44 IL - 2.59 IH)

Summary of Results

A storm water management system model was created in ICPR using County-published topographic data and field-surveyed data acquired for the Town's operational assets. A complete report of modeling outputs is included in Appendix 2 – Modeling Output Report. Town-wide maps of resulting flood depths are included in Appendix 3 – Flood Depth Maps. Exhibits of flood depths at the locations of Critical Assets are included in Appendix 4- Critical Asset Flood Depth Maps.

Specified storm events were modeled and resulting water elevations were compared to the Critical Asset Inventory to categorize the potential risk of impacts to Critical Assets or interference with services provided to the public in association with these Critical Assets as follows:

Critical Assets Risk Level

Level 0: No apparent interference with functions or services.

Level 1: Some interference with functions of the Critical Asset

Level 2: Function limited

Level 3: Strong possibility for functional impact

Town Roadways Risk Level

Level 0: Minimal Impact. Flood depth less than 1 foot depth, less than 100 continuous feet of roadway travel length

Level 1: Minor Impact. Flood depth from 0 to 1 foot for a minimum of 100 continuous feet of roadway travel length

Level 2: Medium Impact. Flood depth from 1 to 2 feet for a minimum of 100 continuous feet of roadway travel length

Level 3: Significant Impact. Flood depth greater than 2 feet for a minimum of 100 continuous feet of roadway travel length

Ranking points were assigned by multiplying the resulting Risk Level of each scenario by the Planning Horizon multiplier to emphasize time proximity:

2025	X3
2040	X2
2070	X1

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Critical Asset Risk Level Summary

ID	Critical Asset Name	Asset Relevancy	Asset Group	Address	Drainage Basin
1	PBC Fire Station 21	Regional	3	14200 OKEECHOBEE BLVD	OK-S-03
2	Palms West Hospital	Regional	3	13001 SOUTHERN BLVD	CC-12
3	LG Town Hall	Local	3	155 F RD	CC-S-09
4	Communication Tower (PBCSB)	Regional	2	14367 CITRUS DR	DS-E-01
5	LGWCD Primary Discharge Structure	Local	2	D RD CANAL AT TANGERINE DR	DS-01
6	LGWCD Maintenance/Pump House	Local	2	245 W D RD	DS-W-01
7	US Transportation / Fire Tower	Local	2	14400 6TH CT N	CC-S-05
8	Forest Service	Regional	3	600 D RD	CC-S-05
9	LG Elementary School	Regional	3	16020 OKEECHOBEE BLVD	OK-01

Elevations in US ft, NAVD88

	2025 (X3 Points)			2040 (X2 Points)			2070 (X1 Points)			TOTAL	
ID	Max.El.	% Basin Area	Risk Level	Max.El.	% Basin Area	Risk Level	Max.El.	% Basin Area	Risk Level	Ranking Points	Rank
1	18.42	88.82%	2	18.68	90.91%	2	18.89	94.61%	2	12	3
2	17.61	61.86%	0	17.97	63.39%	1	18.16	64.80%	2	4	6
3	17.59	97.42%	2	17.95	99.95%	3	18.14	100.00%	3	15	1
4	17.27	73.86%	2	17.61	79.75%	3	17.76	82.21%	3	15	2
5	16.47	50.77%	0	17.16	54.66%	2	17.28	55.34%	2	6	5
6	17.43	79.73%	0	17.78	85.01%	0	17.95	93.38%	0	0	---
7	17.40	87.91%	0	17.81	89.79%	0	18.00	93.22%	0	0	---
8	17.40	87.91%	0	17.81	89.79%	0	18.00	93.22%	0	0	---
9	17.94	91.16%	1	18.10	91.65%	2	18.22	92.01%	3	10	4

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Town Roadways Risk Level Summary

(North-south roads divided into north (N) and south (S) segments at Okeechobee Blvd)

Roadway Name	Asset Group	2025 Risk Level	2040 Risk Level	2070 Risk Level	Ranking Points	Rank
25th St N	1	1	1	1	6	12
A Rd (N)	1	1	2	2	9	7
A Rd (S)	1	1	1	1	6	12
B Rd (N)	1	1	1	2	7	9
B Rd (S)	1	2	2	3	13	1
C Rd (N)	1	1	1	2	7	9
C Rd (S)	1	1	1	1	6	12
D Rd (N)	1	1	1	1	6	12
D Rd (S)	1	1	1	1	6	12
E Rd (N)	1	1	2	2	9	7
E Rd (S)	1	1	1	2	7	9
F Rd (N)	1	1	1	1	6	12
F Rd (S)	1	2	2	3	13	1
G Rd (E)	1	2	2	2	12	3
G Rd (W)	1	1	1	1	6	12
North Rd (West of E Rd)	1	0	1	1	3	21
North Rd (East of E Rd)	1	2	2	2	12	3
Collecting Canal Rd	1	2	2	2	12	3
Okeechobee Blvd (County)	1	2	2	2	12	3
Folsom Rd (N) (County)	1	1	1	1	6	12
Folsom Rd (S) (County)	1	1	1	1	6	12
Southern Blvd (State)	1	0	0	0	0	----

Summary of Recommendations for Development of Adaptation Strategies

Public Outreach and Education

- Enhance opportunities for public awareness, information, and input

Storage Capacity

- Investigate land acquisition for creation of reservoir area(s)
- Evaluate storage requirements for new development to balance Town-wide flood resistance
- Evaluate use of operable gates at Okeechobee Boulevard to maintain variable control elevations in north and south basins

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- Evaluate interlocal partnership opportunities for offsite storage of captured water during larger storm events

Conveyance Capacity

- Evaluate upsizing undersized culverts
- Evaluate reduction in required culvert size for north-south canals
- Continue canal maintenance and debris removal
- Evaluate use of specific lettered canals as emergency outfall channels with larger pipes and greater outfall capacity to C-51 Canal
- Evaluate improvements in conveyance from north portion of Town where access to outfall is most restricted

Outfall Operations

- Replace/ update outdated control systems and software
- Increase telemetry within Town system for better response control
- Consider adjustment of operation protocol to address a greater range of events and tailwater conditions
- Update/ upgrade outfall control structures at A Rd and Folsom Road to improve release capacity

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I. Introduction and Background

Introduction

The Town was incorporated in 2006 within a framework of historically agrarian properties, with drainage canals and unpaved roads managed since 1929 by the Loxahatchee Groves Water Control District. The Town is a recognized rural community and seeks to maintain its rural character while prioritizing safety and improving municipal services to its residents.

The Town's drainage system serves approximately 7,820 acres (12.2 sq. mi.), with the following use characteristics:

Land Use Category	Acres	
Commercial	150.49	1.92%
Agricultural	4092.83	52.33%
Residential	2486.97	31.80%
Government/ Inst.	18.70	0.24%
School/ Community/ Church	123.32	1.58%
Park	28.79	0.37%
Municipal Road and Drainage	286.48	3.66%
Vacant	608.10	7.78%
Commercial/ Open (Out of Boundary)	24.78	0.32%
TOTAL	**7,820.46**	**100.00%**

The Town system contains seven (7) major north-south canals parallelling the main roads. These primary canals are connected by two (2) lateral canals, one at North Road and one at Collecting Canal Road, for conveyance to the primary gated outfall structure at D Road. The Town's internal canal network outfalls to the C-51 Canal on the south side of Southern Boulevard/ State Road 80 through D Road and, as needed, secondary operable gates at the south ends of A Road and Folsom Road.

A detailed regional study of the C-51 Canal was completed by the South Florida Water Management District (SFWMD) in 2015 under the C-51 Basin Rule Re-Evaluation Study. The Town of Loxahatchee Groves is represented as Subbasin 11 within the C-51 West Watershed in that study. The Town's three gravity outfall structures to the C-51 Canal are represented in that model, and the results of the 100-Year, 3-Day scenario in that model are used as the basis for the current FEMA flood zone contours.

Based on the maximum 100-year stage in Subbasin 11 from that model, a FEMA Special Flood Hazard Area (SFHA) boundary was established at elevation 17.6' NAVD 88 (19.2' NGVD 29). Approximately 42% of the Town lies below this elevation, which puts it at significant risk of flood damage during a 1-in-100-Year design event.

In 2021, the Florida State Legislature enacted Florida Statute 380-093 Resilient Florida Grant Program, which set out guidelines for completion of vulnerability assessments to emphasize protection of critical assets which provide emergency and government services. The statute mandates completion of a

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statewide resiliency plan that deals with the vulnerability of these critical assets to storm surge, sea level rise, and rainfall-related flooding issues, and implementing methods to reduce potential risks to the critical assets. Within the Resilient Florida Grant Program, the State of Florida Department of Environmental Protection (FDEP) is authorized to partner with local governments, districts, and other public entities to complete the vulnerability assessment process and facilitate corrective measures.

The Town is bounded almost entirely by raised earthen berms which prevent overland flow from neighboring properties, and positive outfall is achieved via gravity to the SFWMD C-51 Canal at Southern Blvd/ SR 80. The Town does not provide any water or sewer service to residents, although some properties near the Town's southern boundary may have access to potable water and sanitary sewer from Palm Beach County utilities located along Southern Blvd/ SR 80 roadway corridor. A second County-operated potable water line exists along North Road. When lowered, water levels within the Town's system are maintained from the C-51 Canal using a permitted pump station located at D Road to replenish supply for emergency fire protection and irrigation, as well as recharge groundwater wells which are the primary resource for residential users within the Town.

Location

The boundary of the Town of Loxahatchee Groves within Palm Beach County is shown in Exhibit 1 – Town of Loxahatchee Groves Location and Boundary Map. The Town's three gravity outfall structures connect to the C-51 Canal in the stream reach between SFWMD structures S-5A to the west and S-155A to the east. The Town is bordered by the City of Westlake to the north, the Village of Royal Palm Beach to the east, the Village of Wellington to the south, and unincorporated Palm Beach County to the west. Drainage service in the neighboring unincorporated area is provided by the Indian Trails Improvement District (ITID), a separate entity.

II. Description of Vulnerability Assessment

Critical Asset Categories per F.S. 380.093

The procedure for Vulnerability Assessment as described in 380.093 F.S. includes specific requirements for modeling and reporting to encompass present and anticipated conditions. The focus of the modeling effort is to assess potential risks to Critical Assets (as defined in the statute), and requires preparation of a Critical Asset Inventory which lists any such assets located within the study area. The Town's Critical Assets are shown in Exhibit 2 – Critical Asset Location Map.

There are four (4) categories of Critical Assets defined in the statute:

1) **Transportation assets and evacuation routes**
   All major Town-operated north-south roadways were included in the listing, divided into north and south regions at Okeechobee Boulevard. Major east-west roadways (North Road, Collecting Canal Road) were also included. In addition, potential impacts to State Road 80 (Southern Boulevard, under FDOT jurisdiction) and Okeechobee Boulevard under the jurisdiction of Palm Beach County were categorized.

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Roadway Name	Asset Group
25th St N	1
A Rd (N)	1
A Rd (S)	1
B Rd (N)	1
B Rd (S)	1
C Rd (N)	1
C Rd (S)	1
D Rd (N)	1
D Rd (S)	1
E Rd (N)	1
E Rd (S)	1
F Rd (N)	1
F Rd (S)	1
G Rd E	1
G Rd W	1
North Rd (West of E Rd)	1
North Rd (East of E Rd)	1
Collecting Canal Rd	1
Okeechobee Blvd (County)	1
Folsom Rd (N) (County)	1
Folsom Rd (S) (County)	1
Southern Blvd (State)	1

2) Critical Infrastructure

This category includes wastewater treatment, water supply, electrical distribution, communications, and disaster management. Four (4) assets within the Town were identified under this category.

3) Critical Community and Emergency Facilities

This category includes schools, universities, community centers, emergency medical services, emergency operations facilities, fire stations, hospitals, law enforcement facilities, and other government facilities. Five (5) assets within the Town were identified under this category.

Town Critical Asset Inventory

ID	Critical Asset Name	Category	Address	DrainBasin
1	PBC Fire Station 21	3	14200 OKEECHOBEE BLVD	OK-S-03
2	Palms West Hospital	3	13001 SOUTHERN BLVD	CC-12
3	LG Town Hall	3	155 F RD	CC-S-09
4	Communication Tower (PBCSB)	2	14367 CITRUS DR	DS-E-01
5	LGWCD Primary Discharge Structure	2	D RD CANAL AT TANGERINE DR	DS-01
6	LGWCD Maintenace/Pump House	2	245 W D RD	DS-W-01
7	US Transportation / Fire Tower	2	14400 6TH CT N	CC-S-05
8	Forest Service	3	600 D RD	CC-S-05
9	LG Elementary School	3	16020 OKEECHOBEE BLVD	OK-01

4) **Natural, cultural, and historical resources**
This category includes conservations lands, parks, surface waters and wetlands, and historical or cultural resources. There were no assets identified within the Town under this category.

Flood Risk Scenarios per F.S. 380.093

Modeling included an Exposure Analysis, in which the depth of flooding was determined based on the combined effects of rainfall, storm surge, and sea-level, and a Sensitivity Analysis, in which this depth of flooding was reviewed at critical asset locations and a risk level was assigned to categorize the potential for impacts. Specified future planning horizons include 2040 (approx. 15 years) and 2070 (approx. 45 years), and all simulations use a 100-Year, 3-Day storm event. A time scale multiplier was applied to the risk level under each simulation to determine a ranking with priority given to conditions with the most immediate risk.

See Section VII(5) of this report for detailed descriptions of the Flood Risk Scenarios.

Tidal Flooding per F.S. 380.093

Tidal flooding impacts are not currently expected to affect the Town directly, but will influence the tidal (downstream) connection of the receiving canal. Tidal flooding effects are considered by inclusion of the SFWMD FPLOS results for stages in the C-51 Canal in the tailwater time series for the Town model. FPLOS results are based on fixed incremental increases in sea level rise, which were compared to other agency data and correlated to the planning horizons in this study. A one-foot rise in sea level (SLR +1) corresponds to the approximate range for the 2040 planning horizon (NOAA 2017 Intermediate-Low = 0.75 ft - Intermediate-High = 0.92 ft), and the SLR +3 scenario conservatively approximates the 2070 event (Intermediate-Low = 1.44 ft – Intermediate-High = 2.59 ft).

Storm Surge per F.S. 380.093

Storm surge impacts are not currently expected to affect the Town directly, but will influence the tidal (downstream) connection of the receiving canal. Storm Surge effects are considered by Inclusion of the SFWMD FPLOS results for stages in the C-51 Canal in the tailwater time series for the Town model. The Town's surface water management system is maintained at a control elevation of 14.5 ft NAVD 88, which exceeds the highest anticipated storm surge elevations. Additional separation provided by two in-line control structures in the C-51 Canal physically prevents the incident storm surge at the coastline from reaching the Town via the SFWMD canal network.

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III. Background Data

1) Town and Property Boundaries

   Geographic information for the Town of Loxahatchee Groves municipal boundary and for individual property boundaries within the Town was obtained from the Palm Beach County online GIS data catalog.

2) Roadways and Utilities

   Geographic information for roadway centerlines was obtained from the Palm Beach County online GIS data catalog. The Town has no significant underground utilities for water or sewer. The overwhelming majority of occupants rely on groundwater supplies and septic systems for residential uses, and surface water from the canal system for irrigation purposes and fire protection.

3) Topographic Data

   Topographic data for the study area was obtained from Palm Beach County in the form of processed LiDAR contours released in 2017. This topographic data was used to create a digital surface model and analyzed in the modeling software to determine stage-area relationships for upland drainage areas. LiDAR data is shown in Exhibit 3 – LiDAR Map.

   Field survey of the canals was conducted to overcome inherent limitations in the use of LiDAR for mapping underwater environments, as light detection becomes less accurate when interacting with the reflective surface of a water body. Field survey data and cross-sections were used as the basis for determining canal basin stage-storage relationships in the modeling software and assigning cross-section geometry to channel segments for hydraulic analysis. This allowed the simulations to account for the full storage and conveyance capacity of canals beneath the existing water surface during scenarios involving drawdown or lowering of the controlling elevations for gate operations.

4) Records Review

   Review of publicly available records was conducted to establish a baseline for property inclusion/exclusion and other operational aspects of the existing surface water management system. These records included permits issued by public agencies, property records, and previous studies of the drainage area.

   Previous regional modeling of the C-51 Basin in 2015 by the South Florida Water Management District (SFWMD) was used to establish tailwater conditions at the Town's outfall connection to the C-51 Canal in the 2025 10- and 25-Year events. More recent modeling of the C-51 Canal and tributary watersheds in 2025 was used to establish tailwater conditions for the 100-Year events in the 2025, 2040 and 2070 planning horizons using climate projection data for sea-level rise at high tide and storm surge effects.

5) Rainfall Induced Flooding

   Present-day (2025) rainfall amounts were obtained from the NOAA Atlas 14, Volume 9, Version 2, Point Precipitation Frequency Estimates (90% confidence interval, median value) for the nearest available station:

Location name: Loxahatchee, Florida, USA

Latitude: 26.6833°, Longitude: -80.2667°

2025 NOAA Atlas 14 Precipitation Values		
Event		**Amount (in)**
10Y-3D		9.86
25Y-3D		12.3
100Y-3D		17

Future (2040 and 2070) rainfall amounts were obtained from the NCICS Precipitation Frequency Estimates for Loxahatchee, FL, Latitude 26.7°, Longitude: -80.3° in years 2045 and 2077. NCICS lists values for two projected scenarios: RCP 4.5 (mid-range emissions scenario) and RCP 8.5 (high emissions scenario). Values used in this study correspond to the high emissions scenario. For the purposes of this assessment, the values for 2045 and 2075 were conservatively applied as upper-range estimates for the 2040 and 2070 planning horizons, respectively.

NCICS 100-Year, 3-day Precipitation Values		
Year	**Scenario**	**Amount (in)**
2045	RCP 4.5	19.52
2045	RCP 8.5	19.87
2075	RCP 4.5	19.96
2075	RCP 8.5	22.61

6) Tidal Fooding

The NASA Interagency Sea Level Rise Scenario Tool and NOAA Sea Level Rise Map Viewer were used to bracket Intermediate-High and Intermediate-Low values for sea level in the 2040 and 2070 scenarios.

NASA Sea Level Rise (Virginia Key, FL)		
Decade	**Intermediate- High (ft)**	**Intermediate Low (ft)**
2040-2050	0.9	0.75
2050-2060	1.32	0.97
2060-2070	1.87	1.20
2070-2080	2.59	1.43

NOAA Sea Level Rise (Local Scenario: Miami Beach, FL)		
Year	Intermediate-High (ft)	Intermediate-Low (ft)
2040	0.92	0.75
2050	1.31	0.38
2060	1.87	1.21
2070	2.59	1.44
2080	3.38	1.67

Values from NOAA and NASA were compared to conditions represented in the Eastern Palm Beach County Flood Protection Level of Service (2025 EPBC FPLOS) model and study from SFWMD to verify that tailwater elevations from that study are in general agreement with the sea-level rise projections and should adequately reflect any increase in sea level elevation corresponding to the specified planning horizons.

FPLOS C-51 Max. Stage (ft NAVD)		NOAA SLR Range		
Scenario	Max.	Year	NOAA Int.-High SLR	NOAA Int.-Low SLR
Current	15.22	2025	-----	-----
SLR +1	16.2	2040	0.92	0.75
SLR +2	16.2	2045	1.40	0.98
SLR +3	16.2	2070	2.63	1.44

7) Storm Surge Flooding

Several sources were consulted for Storm Surge information and/or projections in the Study Area, including NOAA, FDEP, and the National Hurricane Center. A comparative summary of values from the 2003 FDOT “Design Storm Surge Hydrographs for the Florida Coast” report for location 2503 Lake Worth Inlet is as follows:

FDEP: 9.5’ NAVD

FEMA: 5.5’ NAVD

USACE: 3.0’ NAVD

From the FDEP CCCL Report: RevisedCombinedTotalStormTideFrequencyAnalysis.pdf, 10.0 ft NAVD

Online mapping from the National Hurricane Center shows storm surge effects of a Category 5 storm do not extend sufficiently inland to directly impact the Town.

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IV. Field Data Acquisition

1) Asset Inventory

A field survey was conducted to acquire current information about the physical components of the Town's surface water management system. The field survey was completed in June of 2024. Location and elevation data were collected for 786 individual assets. In addition, the field survey acquired topographic data for canal cross-sections at 344 locations within canal segments, encompassing approximately 28.2 centerline miles of open channels and the adjacent roadways. A more detailed breakdown of the physical components is as follows:

Asset Type	Count		
Pipes	**644**		
Conveyance (Main) Pipes		*138*	
Drainage Connection Pipes		*506*	
Structures	**125**		
Catch Basins		*107*	
Manholes		*15*	
Control Structures		*3*	
Span Bridges	**17**		
Channel Segments	**182**		*(28.2 centerline miles)*
Channel Cross-Sections	**344**		

The locations of these components within the Town are shown in Exhibit 4- Stormwater Management System Map.

2) Condition Assessment

Upon completion of the field data acquisition for the above-listed assets, an in-field assessment of asset condition was conducted to identify any functional limitations of assets which might affect performance during a storm event. Field condition assessment was completed in December of 2024 and provided to the Town in a geodatabase.

V. Data Gaps

1) Upland Connectivity and Private Properties

Field survey data acquisition occurred only within the limits of the Town's right-of-way. Components and conditions located within private property were not observed or evaluated. The modeling effort and results do not reflect any modifications, control elements, storage below grade or other site storage not contained within the LiDAR dataset, water quality improvements, or other factors located upstream of the connection to the Town's surface water management system.

Resulting stages in upland basins should be viewed in consideration of these limitations, as components within private property that might provide additional storage, water quality treatment, or attenuation are not reflected in the output. Upland maximum water elevations exceeding warning stages, in this context, are indicators for further study or more detailed analysis but should not be viewed as exact representations of flood elevation.

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2) Unpermitted or Undiscovered Connections and Incomplete Permit Records

During the completion of the field survey, every effort was made to pinpoint expected pipe locations based on field reviews, previous records, aerial or street view imagery, and pictometry tools. It is possible that some pipes may not have been observed due to vegetative overgrowth, excessive siltation, bank failure, or other unforeseen limitations. In some cases, lack of visibility beneath the water's surface may have interfered with access to or collection of data for a component.

The possibility exists that modifications to the system may have occurred after acquisition of imagery, that components were not visually apparent at the time of inspection, that undocumented connections may have occurred in areas where the survey crew were not operating, or that connections were permitted but permit records were not available for review. These differences would account for only minor differences in the model and are not expected to have significant impacts on the predicted stages or results.

The stormwater GIS database provided to the Town should be reviewed for consistency with future permitted improvements and updated by Town staff as improvements are completed.

3) Operational Protocol for Discharge Structures

The permitted operational protocol for the control structures appears adequate to describe operation during a specific condition in which the stage within the Town remains relatively constant and gate opening is coordinated with head difference over the weir to maintain the permitted flow rate as the stage within the C-51 Canal approaches the Town's control elevation. It became evident early in the modeling process that this schedule of gate operations is not applicable during the 100-year event as the stages within the Town and the receiving C-51 Canal both rise significantly. The head difference over the outflow weir increases sharply when the stage in the C-51 Canal downstream of the Town's outflow weirs recedes at a faster rate than the upstream elevation within the Town's canals. In this case, gate operation based on head difference over the weir causes the gates to close while the Town's system is significantly higher than its intended control elevation.

Strict adherence to the permitted gate operation schedule during the 100-year simulation resulted in a discharge limitation that increased stages within the Town and delayed the recovery period following the storm. For this reason, discharge operations at the gate were configured based around the design performance curve for the Town's gated structure at D Road and the discharge rate was calculated dynamically based on the simulated stages without intermediate closures to more accurately represent actual operating protocols during excessive storm events..

4) Detailed Tailwater Time-Series Data and Models by Others

The tailwater elevation within the C-51 Canal, which serves as the receiving body for discharges from the Town's surface water management system, was determined through a regional modeling effort under the SFWMD in collaboration with the USACE (2015 model) and consultants (2025 model). The C-51 model inputs, assumptions, and reports were reviewed in preparation of the Town's surface water model, but resulting stages in the C-51 Canal were determined externally to this study and Vulnerability Assessment.

It is understood from the published reports of these studies that sea level rise, tide, and storm surge effects are considered in the flow calculations of the 2025 model in the form of tidal boundary conditions, and do affect the rate of discharge and recovery of basins located upstream and inland of the final (downstream-most) tidal control structure. Changes in the water elevation within the C-51 Canal impact the discharge and recovery period of the drainage system serving the Town of Loxahatchee Groves, but many agency-published estimates for storm surge height or elevation do not provide a specific value by recurrence interval and are assumed to be incident at the coastal limit. Storm surge height naturally decreases as the wave moves inland and interacts with ground, waterbodies, structures, trees, and other factors.

Obtaining numerical values for anticipated storm surge impacts at a specific location for a given recurrence interval requires a detailed analysis and modeling effort. Further adjusting these models or estimates for future conditions to account for potential increases in the many physical inputs tied to storm surge modeling is an extensive undertaking that is not presently warranted given the distance of separation of the Town's system from the point of tidal influence and presence of physical controls in the connecting channel that would prevent storm surge effects from extending to the upland portion of the Town.

5) Future Basin Characteristics

Topographical and land use characteristics were not modified for future events, and assume a consistent composition of pervious and impervious land at the same elevations across all planning horizons. Future iterations of modeling to obtain more detailed estimates of flooding extent and depth could include additional modification of basins and roadways to account for projected development and population growth.

6) Data Gap Rectification Strategy

At this time, the Town's surface water model has significant information and detail to provide a reasonable estimate of system behavior during the specified simulation events. Although there is always the potential to obtain more precise results at internal locations from a more detailed review of the previously mentioned data sources, it is not anticipated that further refinement would significantly alter the results relative to the Critical Asset locations within the Town's drainage area. There are no data gaps identified which would limit the applicability of the model results at this level of vulnerability assessment.

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VI. Modeling

1) Study Area

The study area includes the entirety of the Town's municipal boundary (7,950 acres), which coincides with the boundary of the Loxahatchee Groves Water Control District, a dependent drainage district responsible for the operation and maintenance of the Town's surface water management system. Calculations and results exclude 152 acres with direct drainage connections to the C-51 Canal which bypass the Town's canals and control structures, and include 25 acres of area outside of the Town's boundary with direct or overland drainage connections to the Town's canals upstream of the outfall control structures. The net modeled area is approximately 7,820 acres.

The study area is shown in Exhibit 1 – Town of Loxahatchee Groves Location and Boundary Map. Stormwater management system components within the Study Area are shown in Exhibit 4-Stormwater Management System Map.

2) Model Selection

This study utilized StormWise Version 4.08.02 from Streamline Technologies, Inc. (formerly ICPR) based on considerations which include compatibility with data from field survey (imported into Autodesk Civil3D 2025), functional interoperability with ArcMap ArcGIS Desktop 10.8.2 (used for mapping, integration of agency data, and exhibit preparation), and Microsoft Excel (for organization of data and results and coordination with Town personnel).

This model is an "order of magnitude" representation of flood elevations based on drainage area characteristics and specified rainfall amounts. Although more detailed modeling of groundwater interactions, soil storage, and runoff is possible within the selected software, the improvement in accuracy of results from further increasing the detail of these inputs is expected to be minimal. At this phase of Vulnerability Assessment, the model as prepared is sufficiently detailed to indicate any significant potential for risks associated with the Critical Assets.

3) GIS Interoperability and GIS Base Data – Boundaries, Locations and Modeling Parameters

The selected modeling software works cooperatively with GIS shapefiles to allow for some streamlining and automation of model setup and data entry. Pipes, channels, and basin outlines were created in CAD from survey and topographic data. The base objects were moved into a GIS software environment for the creation of additional fields to migrate data into the model. Created data included property fields such as connecting node identification and pipe material for use in the modeling software, as well as assignment of parameters like basin curve numbers and areas.

Additionally, 3D surfaces were created in a CAD program using LiDAR contour data and survey data points which were exported to digital elevation models (DEM's) with 5 ft grid spacing in GeoTIFF format. Geographic modeling allows continuity of location to be maintained between the source data (survey points) and final model, and allows for seamless integration of supplemental geographical data sets provided by other agencies that may include georeferenced information for soils data, roadway centerlines, aerial photography, boundaries, utilities, flood zone contours, and more.

Upland basin stage-storage tables are based on LiDAR data. Due to limitations of LiDAR in obtaining data below the reflective surface of water bodies, survey data acquired below the water surface was used to assign stage-area relationships to canal basins and allow any drawdown in the simulations to account for actual canal shape, storage and conveyance area below the control elevation.

Basin boundaries were assigned through a process that combined LiDAR information with parcel boundaries and surveyed assets to ensure reasonable inclusion of an outfall to the canal system for properties adjacent to connecting pipes. Upland basin nodes were assigned to each boundary and a stage-area relationship was determined by the modeling software using the boundary shape and LiDAR surface topography. Overland flow weirs were included where overland flow appeared to be the only reasonable means of outfall for a specific drainage area, as well as adjacent to the final outfall structure on D Road. Overland flow weir lengths and elevations were assigned based on the LiDAR data. Basin boundaries and Node identifications are shown in Exhibit 5 – Node Diagram.

A curve number of 75 was assigned to upland basins based on predominant soil types in the A/D hydrologic classification per NRCS soils mapping of the area with brush-weed type vegetative cover in good hydrologic condition. A curve number of 87 was assigned to road/canal basins along Okeechobee Boulevard to account for the proportion of water surface and impervious pavement to open and grass space. A curve number of 99 was assigned to canal basins, which include some amount of grassed bank with a large percentage of water surface.

Collection nodes were placed at various points along the canals to receive runoff from adjacent upland basins, and channel segments were created to connect the canal nodes. Canal nodes include their own basin area and stage-area tables to account for rainfall in the routing calculations. Representative cross-sections were selected for each channel segment and used to define the channel geometry in the model. A uniform generic value for channel surface roughness was used throughout the Town.

Pipe objects were created to connect surveyed endpoints. Where survey information was only available for one end of a pipe due to accessibility issues, the surveyed value was used to represent inverts at both ends of the pipe and a nominal length was assigned to extend beyond the adjacent property line. Nodes were created at pipe endpoints as needed to transition flow calculations between channel and pipe segments. Pipe elevations, size and material were collected during the field survey for inclusion in the model. Pipe, structure, and canal cross-section locations are shown in Exhibit 4- Stormwater Management System Map.

Rainfall amounts, as described in Section IV (4) of this report, were applied uniformly throughout the drainage area for each independent scenario.

Rating curve links were used for outflows through the control structure at D Road during all 100-year simulations, while upstream stage-dependent operating tables were used for outflow through the smaller horizontal gates in control structures at A Road and Folsom Road. The rating curve at D Road is representative of the capacity of the fully-opened radial gates based on the difference between the upstream and downstream elevation. Flow through the remaining gates is calculated in the simulation based on the upstream and downstream stage using weir links. This configuration prevented unwanted closures of the D Road gates caused by stage fluctuations in the furthest downstream basin of the model.

Tailwater conditions represent stages in the C-51 Canal operated by the South Florida Water Management District. Modeling of the receiving system was completed under a separate effort by the SFWMD. Results from the 2015 C-15 Basin Rule Re-evaluation Study were used for tailwater stages in the 2025 10- and 25-year scenarios, since this data was not available in the more recent SFWMD model. The 2025 Eastern Palm Beach County Flood Protection Level of Service Study reported only 100-year, 3-day storm events. Results from the 2025 SFWMD study were used for tailwater stages in the 100-year storm scenarios for 2025, 2040 and 2070 conditions.

C-51 Max. Stage (ft NAVD)			
Scenario	**Max.**	**Year**	**NOAA SLR**
Current	15.22	2025	----
SLR +1	16.2	2040	Intermediate-High (0.75 IL - 0.92 IH)
SLR +3	16.2	2070	Intermediate-High (1.44 IL – 2.59 IH)

4) Critical Asset Inventory and Additional Focus Areas

The Town's Critical Asset Inventory is listed in Section III of this report, and includes various parcels containing critical assets as well as generalized roadway segments. No additional Focus Areas have been included in the study or assessed for vulnerability at this time. Critical Asset locations and ID's are shown in Exhibit 2 – Critical Asset Location Map.

5) Existing System Simulations

The Existing System simulations include physical components for conveyance and control structures as surveyed. The response of the existing system configuration was modeled using 2025 conditions for 10-, 25-, and 100-year events, as well as 2040 and 2070 conditions for the 100-year event. Existing system simulations are intended to show resulting flood conditions if the system remains essentially unmodified through the 2070 planning horizon. These simulations discount deterioration and assume preservation of the existing functionality.

Reported results, Risk Levels and Rankings are based on the Existing System simulations.

Scenario Summary				
Horizon, Event	**FPLOS SLR (ft)**	**Rainfall (in)**	**Tailwater Max. (ft NAVD)**	**NOAA SLR (ft)**
2025, 10Y-3D[1]	--	10.0	12.74	--
2025, 25Y-3D[2]	--	12.3	13.86	--
2025, 100Y-3D	--	17.0	15.22	--
2040, 100Y-3D	1	19.86	16.2	Intermediate-High (0.75 IL - 0.92 IH)
2070, 100Y-3D	3	22.61	16.2	Intermediate-High (1.44 IL - 2.59 IH)

1. *10Y-3D simulation for calibration and model review purposes, not included in final results*

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2. *25Y-3D simulation represents approximate conditions of Hurricane Isaac (2012), not included in final results*

6) Conceptual Simulations

The conceptual simulations include various modifications to the physical components including upsizing of undersized pipes with placement at the design channel bottom, expansion of conveyance channels, restoration of design cross-sections in unmaintained channels, additional outfall capacity, and additional storage capacity. System functionality was characterized in terms of storage capacity, conveyance capacity, and outfall capacity, and simulations were varied with the intent to evaluate each functional aspect separately.

The results of the conceptual simulations were reviewed to assess the effectiveness of potential mitigation measures and alterations. Conceptual simulations are not included in the reported results, but provide a basis for recommendations to pursue more detailed investigation of specific approaches in the future.

7) Exposure Analysis

The Exposure Analysis consisted of running simulations for the various rainfall events, tailwater conditions, and outfall operations. At the conclusion of each simulation, a resulting surface was created by applying the maximum elevation of each basin to the basin outline and comparing that surface to the LiDAR data to determine the depth of flooding. Results of the Exposure Analysis are mapped in Appendix 3 – Flood Depth Maps.

Rainfall-Induced Flooding analysis uses 2025, 2040 & 2070 Rainfall Amounts and a 100-year, 3-day design event.

8) Sensitivity Analysis and Risk Level

Using the result surface from each simulation, the extent and depth of flooding within and around each critical asset location was reviewed and a Risk Level was assigned to assist in categorizing the severity of impacts and prioritizing potential protective measures. Risk Levels are conceptual and signify the potential for loss of the use of a Critical Asset in response to a given event. The "loss of use" concept varies among the Critical Assets depending on unique circumstances such as asset type, how the asset is used (for example, a building vs. radio tower), and accessibility. Results of the Exposure Analysis are mapped in Appendix 4 – Critical Asset Flood Depth Maps

VII. Results

The Exposure Analysis indicated several areas within the Town roadway system that are susceptible to impacts from flooding. Within the 18 Town-operated roadway segments, 17 locations of standing water were noted with 3 of those locations showing standing water greater than 12 inches in depth during even the smallest of the storm scenarios (10Y-3D, 10.0 in). These conditions worsen as rainfall amounts become larger during the 100-Year events used in the Sensitivity Analysis, showing an increase in the frequency of occurrence and severity of roadway flooding.

In the list of 9 Critical Assets, 4 locations showed signs of being affected during the 2025 100-Year rainfall event, 6 locations during the 2040 scenario with 2 high-risk results, and the same 6 locations during the 2070 scenario with 3 locations placed in the high-risk category for that event.

The depth and extent of flooding at these locations are depicted in the exhibits provided with this report.

1) Results of Exposure Analysis

A complete report of the basin maximum stages for each simulation is included in Appendix 2 – Modeling Output Report. Graphical depictions of the extent and depth of flooding are included in Appendix 3 – Flood Depth Maps.

2) Results of Sensitivity Analysis

Once the resulting depth and extent of high water was known, a risk level for each simulated event was qualitatively assessed and assigned based on the use and location of the Critical Asset.

Reported Risk Levels for Critical Assets are as follows:

Level 0: No apparent interference with functions or services

Level 1: Some interference with functions of the Critical Asset

> May entail obstruction of entrance driveway, water above the parking elevation, access or use of ancillary facilities such as storage areas or sheds may be affected.

Level 2: Function limited

> Conditions such as complete blockage of the entrance driveway, water blocking pedestrian access to buildings or facilities, or potential damage to ancillary facilities.

Level 3: Strong possibility for functional impact

> Resulting water elevations may exceed the main building floor elevation or impact facilities and equipment on site.

Reported Risk Levels for Roadway Assets are as follows:

Level 0: Minimal impact

> Flood depth less than 1 foot depth, affecting less than 100 continuous feet of roadway travel length

Level 1: Minor Impact

> Flood depth from 0 to 1 foot for a minimum of 100 continuous feet of roadway travel length

Level 2: Medium Impact

> Flood depth from 1 to 2 feet for a minimum of 100 continuous feet of roadway travel length

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Level 3: Significant Impact

Flood depth greater than 2 feet for a minimum of 100 continuous feet of roadway travel length

Appendix 2 – Modeling Output Report shows the resulting maximum stage of all model nodes for each simulation. The extent, depth of flooding, and risk level for each critical asset are shown graphically in Appendix 4 – Critical Asset Flood Depth Maps.

ID	Critical Asset Name	Asset Relevancy	Asset Group	Address	Drainage Basin
1	PBC Fire Station 21	Regional	3	14200 OKEECHOBEE BLVD	OK-S-03
2	Palms West Hospital	Regional	3	13001 SOUTHERN BLVD	CC-12
3	LG Town Hall	Local	3	155 F RD	CC-S-09
4	Communication Tower (PBCSB)	Regional	2	14367 CITRUS DR	DS-E-01
5	LGWCD Primary Discharge Structure	Local	2	D RD CANAL AT TANGERINE DR	DS-01
6	LGWCD Maintenance/Pump House	Local	2	245 W D RD	DS-W-01
7	US Transportation / Fire Tower	Local	2	14400 6TH CT N	CC-S-05
8	Forest Service	Regional	3	600 D RD	CC-S-05
9	LG Elementary School	Regional	3	16020 OKEECHOBEE BLVD	OK-01

Elevations in US ft, NAVD88

	2025 (X3 Points)			2040 (X2 Points)			2070 (X1 Points)			TOTAL	
ID	Max.El.	% Basin Area	Risk Level	Max.El.	% Basin Area	Risk Level	Max.El.	% Basin Area	Risk Level	Ranking Points	Rank
1	18.42	88.82%	2	18.68	90.91%	2	18.89	94.61%	2	12	3
2	17.61	61.86%	0	17.97	63.39%	1	18.16	64.80%	2	4	6
3	17.59	97.42%	2	17.95	99.95%	3	18.14	100.00%	3	15	1
4	17.27	73.86%	2	17.61	79.75%	3	17.76	82.21%	3	15	2
5	16.47	50.77%	0	17.16	54.66%	2	17.28	55.34%	2	6	5
6	17.43	79.73%	0	17.78	85.01%	0	17.95	93.38%	0	0	---
7	17.40	87.91%	0	17.81	89.79%	0	18.00	93.22%	0	0	---
8	17.40	87.91%	0	17.81	89.79%	0	18.00	93.22%	0	0	---
9	17.94	91.16%	1	18.10	91.65%	2	18.22	92.01%	3	10	4

(North-south roads divided into north (N) and south (S) segments at Okeechobee Blvd)

Roadway Name	Asset Group	2025 Risk Level	2040 Risk Level	2070 Risk Level	Ranking Points	Rank
25th St N	1	1	1	1	6	12
A Rd (N)	1	1	2	2	9	7
A Rd (S)	1	1	1	1	6	12
B Rd (N)	1	1	1	2	7	9
B Rd (S)	1	2	2	3	13	1
C Rd (N)	1	1	1	2	7	9
C Rd (S)	1	1	1	1	6	12
D Rd (N)	1	1	1	1	6	12
D Rd (S)	1	1	1	1	6	12
E Rd (N)	1	1	2	2	9	7
E Rd (S)	1	1	1	2	7	9
F Rd (N)	1	1	1	1	6	12
F Rd (S)	1	2	2	3	13	1
G Rd (E)	1	2	2	2	12	3
G Rd (W)	1	1	1	1	6	12
North Rd (West of E Rd)	1	0	1	1	3	21
North Rd (East of E Rd)	1	2	2	2	12	3
Collecting Canal Rd	1	2	2	2	12	3
Okeechobee Blvd (County)	1	2	2	2	12	3
Folsom Rd (N) (County)	1	1	1	1	6	12
Folsom Rd (S) (County)	1	1	1	1	6	12
Southern Blvd (State)	1	0	0	0	0	----

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VIII. Recommendations for Development of Adaptation Strategies

The Town of Loxahatchee Groves is a unique suburban feature within Palm Beach County, integrating an agrarian heritage with modern design, technology and construction practices. In order to keep pace with changing lifestyles, contemporary scientific analysis and planning practices should likewise be incorporated into the Town's operational and governmental structure. The Town is at increased risk from changes in precipitation and mounding of groundwater, strongly dependent on surface water and groundwater wells, and heavily reliant on separate onsite septic systems for containment of waste. Lower elevations relative to surrounding areas and the presence of a FEMA flood zone, combined with perimeter containment and limited options for release of accumulated runoff, create an area which is exceptionally vulnerable to damage and hazards created by larger than average rainfall events. Considering the outdated nature of its drainage system, limited right-of-way space within the Town footprint per it's hundred-year-old plat, age of the existing infrastructure, and scale of the deficit in design and installation, it seems unlikely that the Town can effectively further its ambitions of safety and resiliency without the contribution of financial assistance from agencies and/or entities that can assess larger regional impacts and see the considerable benefits to be derived from the pursuit of protective measures in this small community.

The Town administration and the Water Control District have programs, policies, and official documents in place which can be geared toward development and implementation of Adaptation Strategies. The Water Control Plan, Town Comprehensive Plan, Rural Vista Guidelines, Code of Ordinances, Unified Land Development Code, and Comprehensive Plan guide policies and direction for operation, maintenance and use of the stormwater system.

Aligning these guidance materials, as well as the departments and staff operating under them, requires a cohesive and intentional program of long-range goals that account for the many variables that influence the daily operations and decision-making of leaders and residents. For this reason, the Town is currently working on preparation of a Watershed Master Plan under the FDEM Watershed Planning Program which will delve more directly into the considerations of resiliency, level of service, and physical composition of the stormwater management system.

A central component of any long-range effort will be the support and understanding of the local residents and affected communities. The support of residents is indispensable for fostering agreement among the Town's departments and leadership, and generating the desired results despite unknown factors and unpredictable events in the interim. An active, positive, forward-looking, and community-based program of outreach and education is strongly recommended as a companion effort to the development of specific adaptation strategies intending to address stormwater concerns and prepare for changes in factors that are commonly perceived as immutable conditions of climate and precipitation.

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1) Drainage System and Infrastructure Improvements

Storage capacity (volume)

- Investigate land acquisition for creation of reservoir area(s)

  Conceptual simulations show that an increase in storage capacity at the downstream end of the system may help to stabilize the outflow condition by reducing fluctuations at the weir. The amount of storage needed to offset the 100-year runoff produced by the upland area is significant, and it will likely be undesirable to attempt to provide full containment of the excess volume within the limits of Town boundary, but creating storage for some portion of the excess can have other benefits including providing a reserve water supply in dry periods, environmental and recreational enhancements, and relief for smaller private residential properties which are unsuitable for storage of their own runoff.

- Evaluate storage requirements for new development to balance Town-wide flood resistance

  Including some provision for additional storage on upland properties located in FEMA Flood Zone X would decrease loading to the main canal system, increase available storage, and reduce delays for release of accumulated runoff from upland areas. Although not strictly required under FEMA rules for participation in the NFIP, additional storage requirements are within the purview of the Loxahatchee Groves Water Control District and may show a net benefit to the Town as a whole. It would potentially increase construction costs for properties which would otherwise be unaffected from floodplain compensation requirements, but would otherwise contribute to a reduction in size of the flood zone AE contour and decrease potential for flood-related damages to lower lying properties located throughout the Town.

- Evaluate use of operable gates at Okeechobee Boulevard to maintain variable control elevations in north and south basins

  Separation into two drainage basins could allow the Town to improve attenuation in the northern half of the Town, and could facilitate staggering releases to reduce combined peak inflow rates during the storm. This would prioritize drainage leaving the lower lying southern half of the Town and improve flood protection capabilities there while maintaining usable irrigation quantities for agricultural users north of Okeechobee Boulevard where elevations are slightly higher.

- Evaluate interlocal partnership opportunities for offsite storage of captured water during larger storm events

  Partnerships with neighboring or regional entities to increase outflow routes or direct water in a manner that provides benefits to areas with greater storage capability may provide an alternate method for release of some portion of the accumulated runoff. This would relieve congestion and delay in the Town's system and reduce reliance on the C-51 Canal which provides drainage for many developed areas which essentially compete for discharge capacity during and following a large rainfall event.

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Conveyance capacity (flow rate)

- Evaluate upsizing undersized culverts

  Due the dynamic conditions and interconnections within the Town's canal system, culvert upsizing projects should be evaluated by simulation to determine whether the benefits of a specific installation would justify the costs.

- Evaluate reduction in required culvert size for north-south canals

  Inflows into the canal system combine in series, and demand for conveyance is at a maximum in the final outfall channel upstream of the discharge structure at D Road. Delay is experienced in upstream branches of the system due to the concentration of flows within this single stream reach. Since each north-south canal represents a portion of the combined flow at the D Road outflow channel, it is possible that culverts in these tributary canals can be smaller in size than those required in Collecting Canal without having a significant impact on maximum stages.

- Continue canal maintenance and debris removal

  Maintaining the maximum cross-sectional area of flow and reducing losses caused by vegetation and debris are key considerations for the continued operation of any drainage system. The Town needs to pursue its maintenance program and implementing canal rehabilitation as needed to ensure that system functionality is preserved if not improved as storm events produce greater volumes of runoff in the future.

- Evaluate use of specific lettered canals as emergency outfall channels with larger pipes and greater outfall capacity to C-51 Canal

  Conceptual simulations show that increasing the rate at which runoff leaves the northern portion of Town may help reduce maximum stages and improve flood protection in this area. When routing through the existing system, this runoff is delayed as downstream basins concentrate in the main flow channels, and more notably so in the northeastern and northwestern reaches when the only open gate is centrally located at the D Road structure.

  Improvement of channels along A and F Roads, for example, combined with control structure improvements would increase routes for flow to leave the northern half of the Town. This type of improvement should be combined with an increase in outfall capacity at A Road and Folsom Road to provide relief for the northern portion without increasing competition for access to the D Road outfall gate.

- Evaluate improvements in north portion of Town where access to outfall is most restricted

  Additional methods of increasing flood protection for the norther half of the Town might include addition of storage volume, enhancement of flow channels, installation of pumps or intermittent control structures. Since outfall from the north is affected by congestion in the south, methods to distribute this flow, delay this flow, or otherwise manage the interactions

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of north and south outflows could reduce maximum stages and provide better protection for Critical Assets.

Outfall capacity (release rate)

- Replace/ update outdated control systems and software

  Maintaining functionality of the existing discharge mechanism is a minimum step for preventing stages from exceeding the predictions of the model. A recent field investigation of the discharge facilities indicated signs of age and deterioration, and recommends several repairs to prevent loss of use.

- Increase telemetry within Town system for better response control
- Consider adjustment of operation protocol to address a greater range of events and tailwater conditions
- Update/ upgrade outfall control structures at A Rd and Folsom Road to improve release capacity

2) Critical Asset Improvements

Critical Asset No. 1 – PBC Fire Station 21

- Improve drainage along Okeechobee Blvd
  - ➢ Upsize culverts and canal between D and E Roads
  - ➢ Install catch basins
- Raise driveways and improve drainage on site
  - ➢ Regrade to increase storage below driveway and slope away from building
  - ➢ Elevate driveway entrances at canal to prevent inflow from Okeechobee Blvd
  - ➢ Install catch basins to collect water away from driveways
  - ➢ Evaluate underground storage chambers
  - ➢ Evaluate parking lot and driveway replacement

Critical Asset No. 2 – Palms West Hospital

- Restore Collecting Canal banks to design elevation between F Rd and Folsom Rd
- Evaluate relocation of outfall control structure at Folsom Rd north to Collecting Canal Rd
- Evaluate increase in outfall capacity at Folsom Rd (gate size or count)
- Improve system telemetry for better control in southeast portion
- Update or replace existing control system for outfall gate
- Replace outfall gate mechanism

Critical Asset No. 3 – Town Hall/ Emergency Operations

- Evaluate addition of pond to park parcel
- Evaluate practical limits of site regrading
- Evaluate underground storage chambers
- Evaluate parking lot and driveway replacement
- Evaluate direct connection to C-51 (culvert under Southern Blvd)
- Evaluate addition of emergency backup generator

Critical Asset No. 4 – Communication Tower

- Improve drainage along Citrus Dr, Tangerine Dr, Loxahatchee Ave, and Orange Ave to facilitate access, in conjunction with elevating driveway and parking area in vicinity of concrete pad
- Install secondary protection or elevated pad for storage tank and generator

Critical Asset No. 5 – Primary Outfall Control Structure at D Road

- Improve system telemetry for better operational control
- Update or replace telemetry and control equipment at structure
- Repair/ replace gate mechanism
- Evaluate operational adjustments to maximize discharges from gates at A Rd and Folsom Rd during high water conditions
- Evaluate addition of emergency backup generator

Critical Asset No. 6 – Maintenance Operations Building & Pump House

- Implement storm hardening as needed to protect equipment, personnel, water, sewer and electrical services
- Evaluate addition of emergency backup generator

Critical Asset No. 7 – Fire Tower & No. 8 - Forest Service

- Install catch basins along 6th Ct N to protect access
- Evaluate practical limits of site regrading to protect building and parking

Critical Asset No. 9 – Elementary School/ Emergency Shelter

- Evaluate installation of catch basins for protection of Okeechobee Blvd between 162nd Drive North and A Road
- Evaluate increase in size of canal along Okeechobee between 162nd Drive North and A Road
- Evaluate increasing culvert connection to A Rd
- Evaluate raising canal banks on Okeechobee to design elevation, using catch basins to intercept overland flow from school site

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IX. Exhibits and Appendices

Exhibit 1 – Town of Loxahatchee Groves Location and Boundary Map

Exhibit 2 – Critical Asset Location Map

Exhibit 3 – LiDAR Topography (2017) Map

Exhibit 4 – Stormwater Management System Map

Exhibit 5 – Node Diagram

Appendix 1 – Modeling Input Report

Appendix 2 – Modeling Output Report

Appendix 3 – Flood Depth Maps

Appendix 4 – Critical Asset Maps

Appendix 5 – GIS Data Files (Electronic)