

SECTION 6 – CONCLUSION

6.1 RECOMMENDATIONS

CMA prepared this Stormwater Master Plan for the entire limits for the City of Pompano Beach. The purpose of this Stormwater Master Plan was to identify any deficiencies in the existing stormwater management system and to recommend system improvements to alleviate flooding issues throughout the City. Within the Stormwater Master Plan, CMA provided recommendations for improvements to the system that will reduce the ponding currently encountered within right-of-way areas during or after rainfall events. The recommendations include regional alternatives and local alternatives to address flooding issues within the City, which are defined below.

6.1.1 RECOMMENDED STORMWATER CAPITAL IMPROVEMENT PROJECTS (CIP)

Based on our analysis with the stormwater model, CMA has developed the recommended system improvement alternatives for each study area within the City of Pompano Beach. The recommended system improvement alternative for each study is defined in detail within Section 5 of this report. CMA has prepared a conceptual layout for the recommended system improvements within each study area along with a preliminary cost estimate for the implementation of each recommended system improvement. The conceptual layouts of the recommended system improvements within each study area are enclosed within Appendix A-1 of this report. The preliminary cost estimates of the recommended system improvements within each study area are enclosed within Appendix A-2 of this report. The estimated implementation costs for these recommended system improvements are summarized for each priority study area within the Table 6.1 – Recommended Stormwater CIP Cost Summary on the following page. The recommended system improvements are listed in the order of the study area prioritization, as determined by the basin prioritization formula.

Table 6.1 – Recommended Stormwater CIP Cost Summary		
No.	Study Area	Cost
1	Pompano Park Place & Andrews Avenue*	\$396,000
2	Northwest CRA – TOC Area**	\$1,982,000
3	Lyons Park Neighborhood	\$2,434,000
4	Avondale Neighborhood	\$2,488,000
5	Esquire Lake Neighborhood	\$1,656,000
6	Gateway Drive	\$3,524,000
7	Kendall Lake Neighborhood	\$2,720,000
8	US-1 & NE 14th Street Causeway	\$909,000
9	NE 4th Street & NE 3rd Street	\$942,000
10	Dixie Highway & McNab Road	\$52,000
11	Bay Drive Neighborhood	\$1,210,000
12	North Riverside Drive & NE 14th Street Causeway	\$980,000
13	Atlantic Boulevard & South Riverside Drive	\$2,873,000
14	NE 27th Avenue & NE 16th Street	\$2,572,000
15	Powerline Road & NW 33rd Street	\$1,480,000
16	NW 22nd Street	\$349,000
17	SE 28th Avenue South of Atlantic Boulevard	\$585,000
18	NW 22nd Court	\$1,012,000
19	NE 10th Street & Dixie Highway	\$1,348,000
20	US-1 & SE 15th Street	\$1,185,000
21	SE 9th Street	\$377,000
22	NW 16th Lane	\$436,000
23	NE MLK Boulevard & Powerline Road***	\$0
24	NW 7th Terrace	\$93,000
25	SE 15th Avenue	\$394,000
	TOTAL	\$31,997,000

Stormwater CIP Cost Notes

- * Study Area #1 (Pompano Park Place & Andrews Avenue) – As defined in more detail within Section 5.2.1, the estimated costs for this study area are for recommended system improvements which are to alleviate the localized flooding problems in City right of way areas without existing drainage infrastructure. Any comprehensive basin-wide stormwater improvements which would meet level of service criteria throughout this study area are not currently feasible due to the lack of available property for stormwater storage.
- ** Study Area #2 (Northwest CRA – TOC Area) – As defined in more detail within Section 5.2.2, the estimated costs for this study area include stormwater improvements that would serve the existing conditions of the TOC area. However, CMA recommends a master stormwater management system which would serve the entire TOC Area under future development conditions defined by the CRA. Since these recommended improvements would not be necessary under the existing conditions and would be funded by the CRA, the future conditions estimated cost is not included in the total Stormwater CIP cost.
- *** Study Area #23 (NE MLK Boulevard & Powerline Road) – As defined in more detail within Section 5.2.23, system improvements are not recommended for this study area since the bulk of the flooding problems are located on various private properties within the study area and along Powerline Road, which is not the responsibility of the City of Pompano Beach.

6.1.2 SWALE RESTORATION PROGRAM

Grass swale areas within the right-of-way are intended to collect stormwater runoff from adjacent roadways, to provide water quality treatment by filtering pollutants and sediments carried by the stormwater runoff, and to control flooding by providing stormwater storage volume and allow stormwater to infiltrate into the ground surface. The majority of residential properties within the City have grass swale areas located within the right-of-way areas adjacent to the roadways. These grass swales areas were intended to be the primary component of the stormwater management system. Although limited existing underground drainage facilities are typically found within these residential neighborhoods, the grass swale areas were supposed to provide storage capacity for stormwater runoff before it reaches the underground drainage facilities for eventual disposal via the existing outfalls.

Based on our observations of the existing conditions, the grass swale areas are typically overgrown and overbuilt throughout the City’s residential neighborhoods, which causes ponding within roadway areas during rainfall events. This can happen if the swales were not originally constructed properly, if the resident modifies the swale by adding landscape features, or if sediment builds up within the swale over time. Typically, the center of the grass swale areas should be 6 inches deeper than the edge of pavement elevation. Since the existing swale areas within the City residential areas are not properly graded to provide adequate storage for stormwater runoff and to allow for infiltration into the ground surface, the stormwater management system does not meet level of service criteria for the roadways. The overbuilt swales can cause stormwater ponding within roadway areas in various ways. The overbuilt swale will block stormwater runoff from flowing off the roadway areas, which can create ponding within the travel lanes. The overbuilt swale can prevent stormwater runoff from reaching drainage inlets by trapping it in low lying areas, such as driveway approaches. The overbuilt swale can also cause stormwater runoff to collect initially over impervious surfaces, which prevents any infiltration into the ground surface.

The regrading of the grass swales will increase the depth which provides additional storage volume for stormwater runoff. Since the regraded grass swale areas will now be at a lower elevation than the adjacent roadway, stormwater runoff will flow from the roadway and accumulate in the swale areas to infiltrate into the ground surface. Based on the soil conditions within the City, the stormwater runoff from these residential roadways can be expected to infiltrate into the ground surface within 6 hours if the swale area is properly graded. Properly graded grass swale areas will reduce the flooding of roadway areas by providing additional storage capacity and reducing the total discharge from the existing outfalls by allowing for infiltration into the ground surface. Grass swale areas are the most cost effective method of reducing flooding within the roadway areas of residential neighborhoods when compared to exfiltration trench, which is the other option within South Florida. For comparison purposes, the advantages and disadvantages of grass swale areas and exfiltration trench are listed within Table 6.2 below.

	Grass Swale Areas	Exfiltration Trench
Advantages	<ul style="list-style-type: none"> • Limited capital costs • Additional green space • Limited maintenance requirements • Significant pollutant load reduction • Attenuation of stormwater flooding • Recharge groundwater 	<ul style="list-style-type: none"> • Preservation of land for other uses • Easily incorporated for retrofit • Typical in South Florida region • Limited pollutant load reduction • Attenuation of stormwater flooding • Recharge groundwater
Disadvantages	<ul style="list-style-type: none"> • Standing water during wet periods • Objections from some residents • Potential alteration by property owners 	<ul style="list-style-type: none"> • Limited longevity • High maintenance requirements • Potential clogging due to sediments
Requirements	<ul style="list-style-type: none"> • Surface soils with high permeability • Adequate open space 	<ul style="list-style-type: none"> • Subsurface soils with high permeability • Deep water table

The City should implement an annual swale program to systematically regrade grass swale areas within the residential neighborhoods to address localized ponding issues by providing additional storage volume for stormwater runoff adjacent to the roadway. The Swale Restoration Program will need to rehabilitate swales throughout entire neighborhoods since restoration of isolated swales will not be sufficient to resolve flooding issues. In order for the Swale Restoration Program to be effective, all non-essential items will need to be removed from the public right-of-way to allow the existing swales to be excavated up to 6 inches deeper than the edge of pavement elevation. Upon completion of the grading operation, the swale area should be immediately re-sodded. Since it will not be feasible to implement the Swale Restoration Program across the entire City immediately, the City should plan on implementing the program on a basin by basin basis.

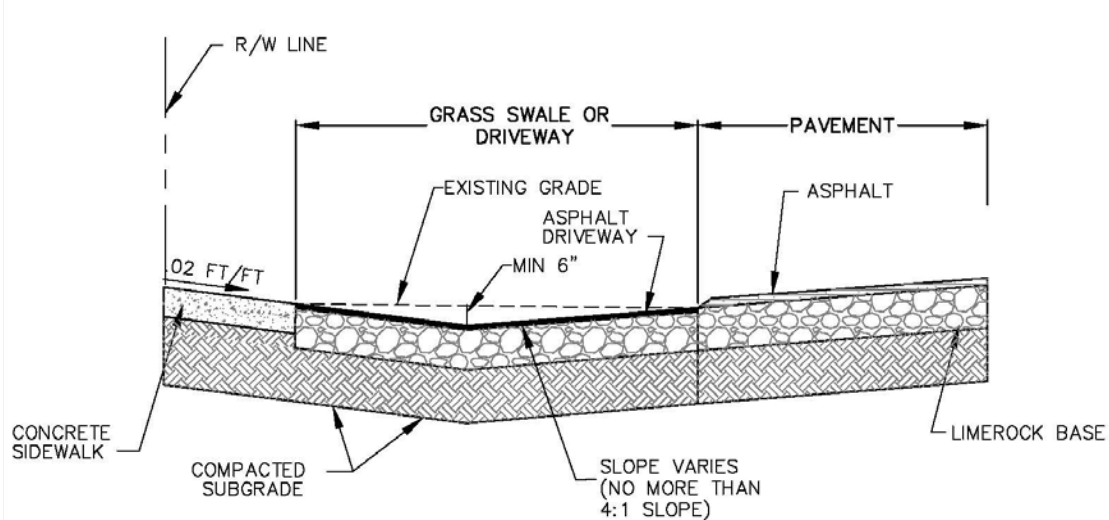


Figure 6-1 Typical Swale Restoration Detail

The City should expect some opposition to the Swale Restoration Program from residents since most view the grass swale areas within the right-of-way to be their private property, which is not the case. Prior to any implementation of the Swale Restoration Program, the City should develop a Community Outreach Program on the importance of the swale restoration program. The purpose of the Community Outreach Program is to provide educational information to residents on the objectives of the Swale Restoration Program along with the flood control and environmental benefits. The City should include an annual budget for a Swale Restoration Program, which would improve the performance of the stormwater management system on an incremental basis as existing swale areas are regraded neighborhood by neighborhood over the years. The City should also consider various implementation strategies for the Swale Restoration Program. Some other municipalities within South Florida implement their Swale Restoration Program using the following options:

- Voluntary: City will allow residents to volunteer for the Swale Restoration Program. City shall begin swale restoration along a roadway once sufficient percentage of residents along the roadway volunteer for Swale Restoration Program.
- Mandatory: City will provide residents an adequate amount of time to remove private landscaping and other items from right-of-way before beginning the restoration of the swale areas
- Mandatory: City will be responsible for the relocation of private landscaping and other items from the right-of-way to private property before beginning the restoration of the swale areas.

6.1.3 OPERATIONS AND MAINTENANCE

The existing stormwater management system requires a significant operations and maintenance effort by the City to ensure that it continues to operate at full capacity while complying with all regulatory requirements. The operations and maintenance of the stormwater management system is an on-going effort, which includes the routine inspection of drainage structures, the routine cleaning of drainage structures and piping, the repair of any damaged drainage structures, the replacement of any collapsed piping, the removal of any sediments and debris from the system, and annual compliance with regulatory programs. An adequate operations and maintenance program is necessary to limit flooding problems throughout the City during rainfall events.

The routine maintenance of drainage piping and structures on an annual basis is necessary to remove any sediment from the stormwater management system. Typically, sediments can accumulate within the drainage structures and drainage piping over time if the drainage system does not undergo routine cleaning. The accumulation of sediments within the drainage piping can significantly reduce the transmission capacity of the pipe, limit the discharge capacity from system outfalls, and slow the percolation rate via exfiltration trenches, which will slow the draining of stormwater runoff from the right-of-way areas during a rainfall event. The accumulation of sediments within the stormwater management system can also negatively impact the water quality within receiving water bodies when pollutant loading is transmitted within the stormwater runoff to the outfalls. The routine maintenance of outfalls from the stormwater management system into surface water bodies is also necessary on an annual basis. In coastal areas such as the City of Pompano Beach, many of the existing outfalls will have an accumulation of sediment and/or barnacles, which can negatively impact the performance of the existing stormwater management system. A partial blockage of the outfall pipe can significantly reduce the peak discharge capacity via the outfall, which will slow the draining of stormwater runoff from the right-of-way areas during a heavy rainfall event.

The routine inspection of drainage structures on an annual basis is necessary to identify any locations within the stormwater management system in need of system maintenance. According to the requirements of the NPDES Permit, all components of the stormwater management system must be inspected on a routine basis to ensure that it is operating appropriately. The new requirements of the NPDES Permit specify that the City must now inspect 10% of all drainage structures within the stormwater management system each year. The City must also prepare and submit an annual NPDES compliance report to FDEP for the structural controls and components of the stormwater management system, which is summarized in Section 3.4 for this report and defined in detail within digital Appendix B-13. CMA has also developed Standard Operating Procedures (SOPs) which have been developed to provide guidance on the frequency of inspections and maintenance activities related to the stormwater management system, which are enclosed within digital Appendix B-14 for future use. The City must continue to track and report all routine inspection activities in order to meet the requirements of the NPDES Permit.

The City's Stormwater Management Utility provides funding for the operations and maintenance program for the existing stormwater management system. The primary role of the Stormwater Management Utility is to clean drainage structures and drainage pipe, to repair damaged drainage structures, to replace collapsed drainage piping, to remove collected debris and sediments from the system, and to inspect drainage structures on a routine basis. This effort is completed by staff members of the Stormwater Management Utility, which currently consist of 8 positions. The Stormwater Management Utility staff consists of 1 Utilities Stormwater Supervisor position, 1 Utilities Maintenance Foreman position, 2 Utilities System Operator III positions, 2 Utilities System Operator II positions, and 2 Utilities System Operator I positions. The Stormwater Management Utility is also responsible for equipment, which include vector trucks for system maintenance and service trucks for staff members. The Stormwater Management Utility had a total budget for operations and maintenance activities of \$2,148,688 in FY2010, \$2,397,993 in FY2011 and \$2,137,594 in FY2012, which do not include any capital

improvement costs. The adopted budget for the Stormwater Management Utility is \$2,764,784 for FY2013. The City Stormwater Management Utility tracks their performance measures on an annual basis which is outlined within Table 6.3 below.

Performance Measures	FY2011	FY2012	FY2013
Structure Cleaning (EA)	1,291	1,700	1,700
Pipe Cleaning (LF)	48,016	41,500	49,500
Structure Repairs (EA)	81	100	100
Pipe Replacement (LF)	260	200	200
Debris Removal (TN)	170	120	170
Inspections (EA)	1,503	1,650	1,650

Due to previous and planned improvements to the existing stormwater management system along with additional regulatory requirements, the City will need to expand its stormwater operations and maintenance program to ensure the stormwater management system continues to operate at full capacity in the future. Although the stormwater management system has expanded and the regulatory compliance issues have increased over the years, the manpower and equipment dedicated to the stormwater operations and maintenance program has remained relatively unchanged over the years. With the stormwater improvements proposed within this Stormwater Master Plan along with the additional regulatory compliance requirements, the City should budget for any additional manpower and equipment necessary for this additional maintenance of an expanded stormwater management system.

CMA has assembled a breakdown to display the recent expansion and the planned future expansion of the City’s stormwater management system. The City has recently implemented multiple stormwater improvement projects since the previous Stormwater Master Plan in 1999, which has expanded the extent of the stormwater management system. The City has also recently annexed previously unincorporated areas of Broward County, which include the Highlands, Collier Manor, Cresthaven, and Leisureville neighborhoods, into the northeast portion of the City. During the annexation process, Broward County completed extensive drainage improvements throughout these neighborhoods. By annexing these neighborhoods, the extent of the City’s stormwater management system was significantly expanded with additional drainage structures and pipes. As outlined within this Stormwater Master Plan, the recommended stormwater improvements will expand the stormwater management system with additional drainage structures and pipe. The expanded stormwater management system will require additional labor and equipment to ensure the additional drainage structures and piping continues to be properly maintained. The recent and planned expansion of the stormwater management system is summarized within Table 6.4 below, which tabulates the additional drainage structure and additional drainage piping added to the system.

Stormwater Component	1999 Stormwater System	Stormwater Improvements (since 1999)	North Annexation Area	Recommended Stormwater Improvements	Future Stormwater System
Structures (EA)	3,655	801	1,954	427	6,837
Pipe (LF)	315,977	53,251	162,073	76,896	608,197

The City’s stormwater management system has expanded significantly since 1999 while additional stormwater improvements are recommended in the future to address flooding issues within the City. The number of drainage structures has increased by 2,755 structures or 75% since 1999. The length of drainage piping has increased by 215,324 linear feet or 68% since 1999. Based on the recommended

improvements within this Stormwater Master Plan, the stormwater management system will expand by an additional 427 drainage structures and 76,896 linear feet of drainage piping, which will need to be maintained by the City in the future. In order to properly maintain the expanded stormwater management system, the recommended staffing increases are displayed within proposed organization chart for the Stormwater Management Utility in Figure 6.2 below, which displays the existing positions in blue and the proposed additional positions in green.

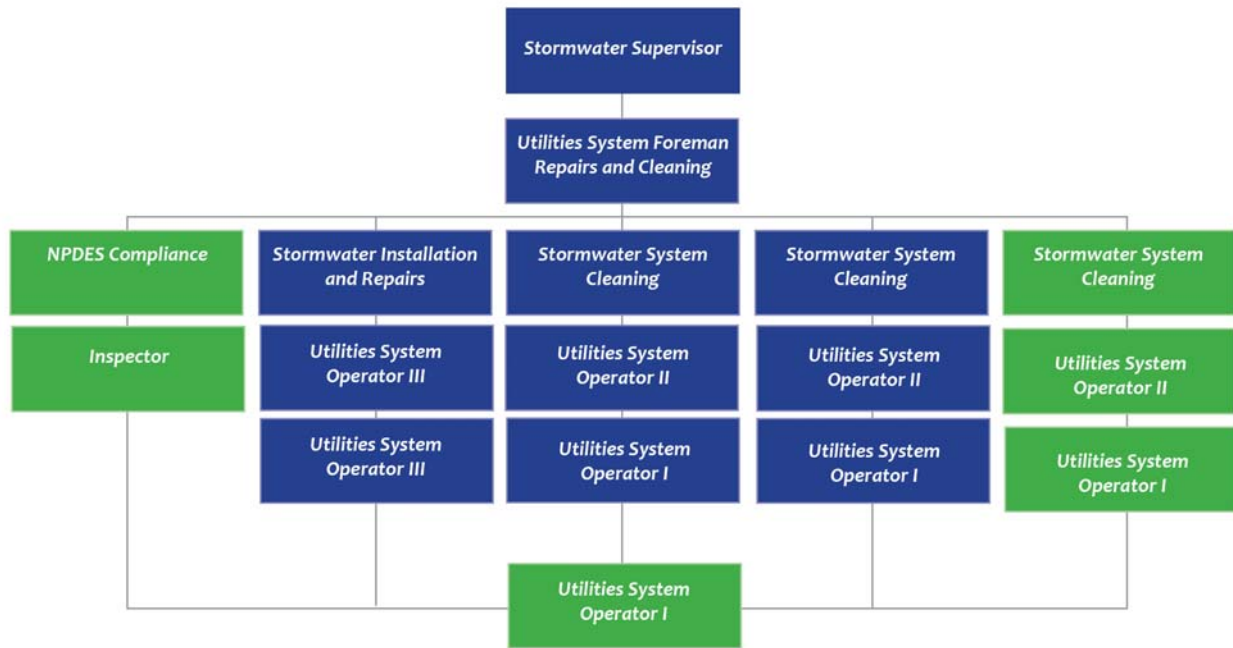


Figure 6-2 Stormwater Utility Proposed Organizational Chart

The estimated annual and capital costs for the recommended staffing increases and equipment purchases for the Stormwater Management Utility are summarized within Table 6.5 below.

Table 6.5 – Stormwater Utility O&M Increases		
Recommended Additions	Estimated Annual Costs	Estimated Capital Costs
Hire Utility System Operator II Position (Additional Stormwater System Cleaning Crew)	\$70,000	N/A
Hire Utility System Operator I Position (Additional Stormwater System Cleaning Crew)	\$55,000	N/A
Hire Utility System Operator I Position (Miscellaneous)	\$55,000	N/A
Hire Engineering Inspector Position (NPDES Program Compliance)	\$70,000	N/A
Purchase/Lease Service Truck (Additional Stormwater System Cleaning Crew)	N/A	\$35,000
Purchase/Lease Vactor Truck (Dedicated to Stormwater System Maintenance)	N/A	\$390,000
Total	\$250,000	\$425,000

6.1.4 FUNDING

The City of Pompano Beach needs to develop a plan to fund the proposed stormwater CIP improvements recommended within this Stormwater Master Plan along with the additional manpower and equipment needed to adequately operate and maintain the stormwater management system. The City will need to increase the Stormwater Utility Fee in order to accomplish the following goals defined within this Stormwater Master Plan.

- Recommended Stormwater CIP Improvement Projects
- Additional Stormwater Utility Staff for O&M Purposes
- Additional Stormwater Utility Equipment for O&M purposes