

**INFRASTRUCTURE ELEMENT
DATA AND ANALYSIS**

WATER

EXISTING CONDITIONS

The Village of Estero potable water service is divided into two service areas. The area north of Williams Road is provided potable water services by Lee County Utilities. The area south of Williams Road is provided potable water services by Bonita Springs Utilities.

[The 2017 Lower West Coast Water Supply Plan Update was approved by the District's Governing Board on December 14, 2017 and the Village's Water Supply Facilities Work Plan is due to be adopted by June 14, 2019.](#)

Lee County Utilities

The standard practice in Lee County is to connect to public utilities if available and avoid installing additional private potable wells. Per the Lee County Land Development Code Section 10-352 – Potable Water Systems, a connection to the public potable water system is required for “any residential, commercial or industrial development of any size where central water lines are or will be available within 90 days of the issuance of the development order.” The term “available” means located in the public right-of-way or easement adjacent to the property.

Bonita Springs Utilities

The standard practice in Bonita Springs is to connect to the public utilities if available and avoid installing additional private potable wells. Per the Bonita Springs Land Development Code Section 3-352 – Potable Water Systems, a connection to the public potable water system is required for “any residential, commercial or industrial development of any size where central water lines are or will be available within 90 days of the issuance of the development order.” The term “available” means located in the public right-of-way or easement adjacent to the property.

PLANT CAPACITY

The Village of Estero is served with potable water produced from water treatment plants within the Lee County Utilities service area and the Bonita Springs Utilities service area.

Lee County Utilities Water Treatment Plants

Lee County Utilities operates five water treatment plants that are interconnected. The majority of the potable water demand within the north area of the Village of Estero is provided by the Pinewoods Water Treatment Plant, however the Corkscrew Water Treatment Plant, Green Meadows Water Treatment Plant, Olga Water Treatment Plant, and the North Lee County Water Treatment Plant can supply water to this area as well. Raw water is obtained from the Sandstone, Surficial, and Lower Hawthorn aquifers, as well as the Caloosahatchee River. These plants utilize Lime Softening, Nanofiltration, or Reverse Osmosis as a treatment process. These treatment plants are currently permitted for a combined capacity of 45.9 Million Gallons per Day (MGD), however the Green Meadows Water Treatment Plant expansion is currently under construction and will increase the total capacity to 50.9 MGD. Per the Lee County Utilities Engineering Department, these facilities produced a total max day flow of 36.8 MGD. Therefore, there is an estimated surplus capacity of 14.1 MGD after the Green Meadows Water Treatment Plant expansion is complete. Lee County Utilities also has plans to expand the North Lee County Water Treatment Plant to a capacity of 15.0 MGD in fiscal year

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2018. This future expansion would increase the combined capacity to 54.3 MGD, or an estimated surplus capacity per current operations of 17.5 MGD.

Bonita Springs Utilities Water Treatment Plant

The Bonita Springs Water Treatment Plant is located along East Terry Street near the I-75 overpass and provides potable water to the south area of the Village of Estero. Raw water is obtained from the Lower Tamiami and Upper Floridan aquifers. This treatment plant uses Lime Softening and Reverse Osmosis as its primary treatment process. This water treatment plant is currently permitted for a capacity of 15.5 MGD of production. Per the Bonita Springs Utilities Engineering Department, this facility has produced a maximum daily flow of 11.7 MGD. Therefore, there is an estimated surplus capacity of 3.8 MGD. Bonita Springs Utilities has plans to expand the Water Treatment Plant to a capacity of 17.5 MGD by the year 2018, which will increase the estimated surplus capacity per current conditions to 5.8 MGD.

WELLFIELD PROTECTION ZONES

Wellfield protection zones are identified in Lee County Ordinance No. 14-07 based on modeling performed by RMA GeoLogic Consultants, Inc. and documented in the reports titled "Supporting Documentation for the Update of the Lee County Wellfield Protection Zones," dated January 2009 and "Supporting Documentation for the 2011 Update of the Lee County Wellfield Protection Zones," dated October 2011.

Wellfield protection zones falling within the boundary of the Village of Estero include those for LCU's Pinewoods and Corkscrew wellfields, and that for BSU's West Wellfield. Wellfield protection zones are established for 6-month, 1-year, 5-year, and 10-year travel times around each public supply well. Under Lee County Ordinance 07-35, land use restrictions regarding toxic or hazardous substances and sanitary hazards become progressively more stringent for shorter travel time zones. Per Ordinance 07-35, any abandoned well within the 10-year travel time zone must be physically plugged. In addition, Lee County restricts construction of water supply wells within 2,640 feet (one-half mile) of an existing or permitted aquifer storage and recovery (ASR) well, unless confinement exists between the ASR well storage/production zone and the production zone of the water supply well (i.e. the wells are open to different aquifers).

Lee County Utilities

Of the wellfield protection zones depicted for LCU-operated wellfields, the zones established for the Bartow wellfield no longer correspond to public supply wells. The Bartow public supply wellfield and water treatment plant are no longer used for potable supply. The existing wells are now used to augment reclaimed water produced by the Three Oaks plant.

Bonita Springs Utilities

The wellfield protection zones for the Bonita Springs Utilities wellfields were last updated by Lee County in 2009, and may not accurately reflect current conditions with respect to well locations, source aquifers, and/or withdrawal volumes. In 2014 BSU hired Johnson Engineering to perform updated modeling in support of establishments of wellfield protection zones for the BSU wellfields. The results of the modeling effort are summarized in a technical memorandum dated December 18, 2014. To-date, BSU has not adopted a revised wellfield protection ordinance incorporating the updated wellfield protection zones.

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- Policies in the Infrastructure Element ensure the Village will coordinate with utility providers regarding potable water service.
- Policies in the Infrastructure Element ensure coordination with utility providers to identify future wellfields and/or relocation sites and implementation of wellfield protection through the land development code to protect water quality.

MINIMUM LEVEL OF SERVICE

Lee County Utilities

Minimum Acceptable Level of Service (LOS) is stated in “The Lee Plan” as of December 2017 as follows:

Within certificated, franchised, or designated service areas only: supply and treatment capacity of 250 gallons per day per Equivalent Residential Connection (ERC), except that facilities serving only multi-family or mobile home residential structures must have a capacity of 200 gallons per day, and facilities serving only recreational vehicle or travel trailer residential structures must have a capacity of 100 gallons per day.

Presently the County meets the minimum LOS for the interconnected water treatments plants mentioned previously and there is a surplus of approximately 56,400 equivalent residential connections (ERC’s) of additional flow based on 14.1 MGD of available capacity for the entire Lee County Utilities service area. It should be noted that the Village is newly incorporated as of 2015, and the growth and expansion plans of Lee County Utilities has always factored the growth of the Estero community within its service area in projecting the service demands and capacity needs.

Projected Potable Water Demands and Adequacy of Capacity

Data and analysis supporting the Housing Element identified ~~3,599~~3,683 additional dwellings are projected for Estero through the ~~ten-year planning horizon (2025)~~long-term planning period (2018-40). The location of the dwellings has not been correlated to the utilities service areas of Lee County Utilities (north of Williams Road) and Bonita Springs Utilities (south of Williams Road). Assuming a worse-case scenario of all projected additional dwellings concentrating in the Lee County Utilities service area, the Village’s additional ~~3,599~~3,683 dwellings in the next ~~ten~~22 years would only consume ~~6.4~~6.5% of the surplus capacity of 56,400 ERC’s within Lee County’s system. This does not include the added capacity that will result after completion of the planned North Lee County Water Treatment Plant expansion. The existing and anticipated water demands resulting from industrial or agricultural uses are de minimus due to a lack of such uses in the Village. Therefore, they do not have an impact on these 22 year projections.

- Policies in the Infrastructure Element ensure the Village will coordinate and adopt the level of service standards of its utility providers regarding potable water service levels.

Bonita Springs Utilities

Minimum Acceptable Level of Service (LOS) is stated in the City of Bonita Springs Land Development Code, Section 1 Policy 1.1.1, as follows:

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Within certified, franchised or designated service areas an available supply, treatment and delivery of 235 gallons per day per equivalent residential connection (ERC) and delivery of potable water at a minimum pressure of 20 pounds per square inch (psi) at the meter anywhere in the system. (Cross Reference: Capital Improvements Element Policy 1.1.3.a)

Presently the City meets the minimum LOS for the Bonita Springs Utilities Water Treatment Plant and there is a surplus of approximately 16,170 ERC's of additional flow based on 3.8 MGD of available capacity for the entire Bonita Springs Utilities service area. It should be noted that the Village is newly incorporated as of 2015, and the growth and expansion plans of Bonita Springs Utilities has always factored the growth of the Estero community within its service area in projecting the service demands and capacity needs.

Projected Potable Water Demands and Adequacy of Capacity

Data and analysis supporting the Housing Element identified 3,599,683 additional dwellings are projected for Estero through the ten-year planning horizon (2025) long-term planning period (2018-40). The location of the dwellings has not been correlated to the utilities service areas of Lee County Utilities (north of Williams Road) and Bonita Springs Utilities (south of Williams Road). Assuming a worse-case scenario of all projected additional dwellings concentrating in the Bonita Springs Utilities service area, the Village's additional 3,599,683 dwellings in the next ten years would only consume 22.322.8% of the surplus capacity of 16,170 ERC's within Bonita Spring's Utilities System. This does not include the added capacity that will result after completion of the planned Water Treatment Plan expansion in 2018. The existing and anticipated water demands resulting from industrial or agricultural uses are de minimus due to a lack of such uses in the Village. Therefore, they do not have an impact on these 22 year projections.

- Policies in the Infrastructure Element ensure the Village will coordinate and adopt the level of service standards of its utility providers regarding potable water service levels.

Potable water conservation can be promoted by several mechanisms including, but not limited to, the following: discouraging use of potable water for non-potable uses, such as irrigation, use in ornamental water features, large-scale power washing operations, etc.; ensuring new development complies with applicable State codes regarding low flow plumbing fixtures; promoting the use of fixtures that conserve water beyond the minimum requirements; promoting the use of reclaimed water for irrigation; promoting the use of Florida-Friendly landscaping; ensuring new development complies with applicable State codes regarding use of reclaimed water; implementing educational programs for water conservation awareness; and coordinating with utility providers to encourage pricing rate structures designed to promote water conservation, including increasing block rates, seasonal rates, quantity-based surcharges, and/or time of day pricing. Other opportunities for water conservation and compliance with the SFWMD plans include: irrigation system audits, installation of rain and/or soil moisture sensors, water conserving irrigation system upgrades, capture of grey water, use of rain barrels, and utilization of water conservation programs/training available through the SFWMD, IFAS, etc.

The Village's operations shall be in accordance with the SFWMD's Lower West Coast Water Supply Plan Update. The District-wide mandatory year-round landscape irrigation conservation measures limiting the days and times of residential and commercial landscape irrigation will be applicable in the Village, as will any emergency measures at time of drought.

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While the Village is in its formative years, the municipal staff is limited. To begin with policies that can be accomplished in its formative years, these initial water conservation steps are outlined in the policies in the Infrastructure and Conservation and Coastal Management Elements: promoting Florida Friendly landscaping techniques, water conservation education, cooperation with water conservation measures of the SFWMD, encouraging "green" infrastructure such as rainwater harvesting, establishing reuse water as the first option for irrigation needs when and where available, and encouraging extension of reuse water service.

SANITARY SEWER

EXISTING CONDITIONS

The Village of Estero wastewater collection services are divided into two service areas. The area north of Williams Road is served by Lee County Utilities. The area south of Williams Road is served by Bonita Springs Utilities. There is a total of 247 septic tanks within the Village of Estero. Per Florida Statutes, a septic tank permit will not be issued within a ¼-mile of public utilities, therefore a connection to public utilities will be required.

- Policies in the Infrastructure Element and Conservation and Coastal Management Element identify the public interest in abating and ceasing the use of septic tanks.
- These policies call for inventorying the septic tanks, evaluating water quality issues associated with them, and coordinating with property owners, utility providers and Florida Department of Environmental Protection to address the issue.

Lee County Utilities

The standard practice in Lee County is to connect to public utilities if available and avoid installing additional septic tanks. Per the Lee County Land Development Code Section 10-353 – Sanitary Sewer Systems, a connection to the public sanitary sewer system is required for "any residential, commercial or industrial development of any size where central sewer lines are or will be available within 90 days of the issuance of the development order." The term "available" means located in the public right-of-way or easement adjacent to the property.

Bonita Springs Utilities

The standard practice in Bonita Springs is to connect to public utilities if available and avoid installing additional septic tanks. Per the Bonita Springs Land Development Code Section 3-353 – Sanitary Sewer Systems, a connection to the public sanitary sewer system is required for "any residential, commercial or industrial development of any size where central sewer lines are or will be available within 90 days of the issuance of the development order." The term "available" means located in the public right-of-way or easement adjacent to the property.

PLANT CAPACITY

Wastewater generated in the Village is conveyed to treatment plants within the Lee County Utilities Service area and the Bonita Springs Utilities service area.

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Three Oaks Wastewater Treatment Plant

The Three Oaks Wastewater Treatment Plant is owned and operated by Lee County Utilities and is located along Three Oaks Parkway near the intersection with San Carlos Boulevard. This treatment plant provides wastewater treatment for wastewater generated in the area north of Williams Road. This facility utilizes a biological treatment process. The treatment plant is currently permitted for a capacity of 6.0 MGD. Per the Lee County Utilities Engineering Department, this facility has received a maximum monthly average daily flow of 3.3 MGD. Therefore, there is an estimated surplus capacity of 2.7 MGD. Lee County Utilities has plans to expand the Three Oaks Wastewater Treatment Plant to a capacity of 8.0 MGD in future years.

Bonita Springs Utilities Water Reclamation Facility

The Bonita Springs Water Reclamation Facility is located along Wellfield Road near the Liberty Youth Ranch and provides wastewater treatment for wastewater generated in area south of Williams Road. This facility utilizes state-of-the-art membrane-bioreactor technology. This reclamation facility is currently permitted for a capacity of 11.0 MGD. Per the Bonita Springs Utilities Engineering Department, this facility has received a maximum monthly average daily flow of 6.0 MGD. Therefore, there is an estimated surplus capacity of 5.0 MGD. Bonita Springs Utilities has plans to expand the Water Reclamation Facility to a capacity of 13 MGD by the year 2028.

MINIMUM LEVEL OF SERVICE

Lee County Utilities

Minimum Acceptable Level of Service (LOS) is stated in "The Lee Plan" as of December 2017 as follows:

Within certificated, franchised, or designated service areas only: average treatment and disposal capacity of 200 gallons per day per Equivalent Residential Connection (ERC), except that facilities serving only multifamily or mobile home residential structures shall have a capacity of 160 gallons per day, and facilities serving only recreational vehicles or travel trailer residential structures must have a capacity of 80 gallons per day.

Presently the County meets the minimum LOS for the Three Oaks Wastewater Treatment Plant and there is a surplus of approximately 13,500 ERC's of additional flow based on 2.7 MGD of available capacity for the entire Three Oaks Wastewater Treatment Plant service area. It should be noted that the Village is newly incorporated as of 2015, and the growth and expansion plans of Lee County Utilities has always factored the growth of the Estero community within its service area in projecting the service demands and capacity needs.

Projected Sanitary Sewer Demands and Adequacy of Capacity

Data and analysis supporting the Housing Element identified ~~3,599~~**3,683** additional dwellings are projected for Estero through the ~~ten-year planning horizon (2025)~~**long-term planning period (2018-40)**. The location of the dwellings has not been correlated to the utilities service areas of Lee County Utilities (north of Williams Road) and Bonita Springs Utilities (south of Williams Road). Assuming a worse-case scenario of all projected additional dwellings concentrating in the Lee County Utilities service area, the Village's additional ~~3,599~~**3,683** dwellings in the next ~~ten~~**22** years would only consume ~~26.7~~**27.3**% of the surplus capacity of 13,500 ERC's within the Three Oaks Wastewater Treatment Plant. This does not

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include the added capacity that will result after completion of the planned 2.0 MGD expansion of this Plant.

- Policies in the Infrastructure Element ensure the Village will coordinate and adopt the level of service standards of its utility providers regarding sanitary sewer service levels.

Bonita Springs Utilities

Minimum Acceptable Level of Service (LOS) is stated within the City of Bonita Springs Land Development Code, Section 2 Policy 1.1.1, as follows:

Within certified, franchised or designated service areas an available capacity to treat and dispose of a volume of wastewater equal to 200 gallons per day per equivalent residential connection (ERC), except that facilities serving only mobile home residential structures shall have a capacity of 150 gallons per day and facilities serving only travel trailer residential structures shall have a capacity of 120 gallons per day.

Presently the minimum LOS is met by the Bonita Springs Utilities Water Reclamation Facility. There is a surplus of approximately 25,000 ERC's of additional flow based on 5.0 MGD of available capacity for the entire Bonita Springs Utilities Service Area. It should be noted that the Village is newly incorporated as of 2015, and the growth and expansion plans of Lee County Utilities has always factored the growth of the Estero community within its service area in projecting the service demands and capacity needs.

Projected Sanitary Sewer Demands and Adequacy of Capacity

Data and analysis supporting the Housing Element identified 3,5993,683 additional dwellings are projected for Estero through the ten-year planning horizon (2025)long-term planning period (2018-40). The location of the dwellings has not been correlated to the utilities service areas of Lee County Utilities (north of Williams Road) and Bonita Springs Utilities (south of Williams Road). Assuming a worse-case scenario of all projected additional dwellings concentrating in the Bonita Springs Utilities service area, the Village's additional 3,5993,683 dwellings in the next ten22 years would only consume 14.414.7% of the surplus capacity of 25,000 ERC's within the Bonita Springs Utilities Water Reclamation Facility. This does not include the added capacity that will result after completion of the planned 2.0 MGD expansion of this Plant.

- Policies in the Infrastructure Element ensure the Village will coordinate and adopt the level of service standards of its utility providers regarding sanitary sewer service levels.

RECLAIMED WATER

EXISTING CONDITIONS

Lee County Utilities

The Three Oaks Wastewater Treatment Plant and the Bartow Well Field currently provide 3.3 MGD annual average daily flow of irrigation quality reclaimed water to fifteen customers within Lee County. Fourteen of

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those customers are located within the Village of Estero. There is currently no additional reclaimed water available for new customers.

Bonita Springs Utilities Water Reclamation Facility

The Bonita Springs Utilities Water Reclamation Facility currently does not send reclaimed water to the Village of Estero.

While the infrastructure and sources of reclaimed water are limited and utilities are not within control of the Village, it is in the Village's interest to support and promote development of the necessary infrastructure and use of reclaimed water as a more sustainable alternative for irrigation where feasible.

- Policies in the Infrastructure Element encourage the developer driven expansion of reuse water infrastructure and prioritization of reuse water for irrigation when sufficient supply is available.

SOLID WASTE

EXISTING CONDITIONS

The Village of Estero is provided solid waste collection services by Waste Pro and Advanced Disposal. The solid waste generated within the Village of Estero is transported to the Lee County Solid Waste Resource Recovery Facility. This facility provides solid waste disposal services for all Lee County, as well as some areas outside of Lee County. This facility has a nameplate capacity of 670,000 tons of solid waste per year (1,836 tons per day). Per the Lee County Solid Waste Division, this facility currently receives an average of 1,700 tons per day on a 7 day per week basis. Therefore, there is an estimated surplus capacity of 136 tons per day. Lee County is currently in a master planning effort to evaluate options and strategies to manage the County's solid waste into the future.

MINIMUM LEVEL OF SERVICE

Minimum Acceptable Level of Service (LOS) is stated within "The Lee Plan," (Policy 95.1.3) as:

Disposal facility capacity for 7 pounds of waste (or equivalent volume) per day per capita.

Presently the County meets the minimum LOS for the Lee County Solid Waste Resource Recovery Facility and there is a surplus of 38,857 capita per day of additional solid waste based on 136 tons per day of available capacity for the entire Lee County Solid Waste Resource Recovery Facility service area. It should be noted that the Village is newly incorporated as of 2015, and the growth and expansion plans of Lee County have factored the growth of the Estero community within its service area in projecting the service demands and capacity needs.

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Projected Solid Waste Demands and Adequacy of Capacity

Population projections for Estero indicate addition of ~~14,521~~15,285 permanent residents and ~~21,695~~22,837 peak seasonal residents are projected for Estero through the ~~ten-year planning horizon~~long-term planning period (2018-40). The Village's additional ~~14,521~~15,285 permanent residents in the next ~~ten~~22 years would constitute service needed for an additional ~~50.8~~53.5 tons per day. Alternatively, the additional ~~21,695~~22,837 peak seasonal residents would constitute service needed for an additional ~~75.9~~79.9 tons per day. The currently available surplus capacity of 136 tons per day is adequate for both the permanent and peak seasonal population growth projections for the next ~~ten~~22 years. This does not include additional capacity as a result of Lee County's master planning efforts for future solid waste management system improvements.

- Policies in the Infrastructure Element ensure the Village will coordinate and adopt the level of service standards of solid waste providers.

DRAINAGE

INTRODUCTION

Drainage is an important issue in Southwest Florida at the forefront of many Estero residents' minds because of the unusual back-to-back significant storm events during August 2017 and Hurricane Irma in September 2017. The data and analysis of stormwater levels resulting from those storms and the drainage system adequacies and deficiencies determined as a result of these events are still being collected and evaluated by Lee County and by the consultant preparing the Village's Stormwater Master Plan. The Village's Stormwater Master Plan is anticipated for completion in Spring 2018.

Historically there have been a number of surface water management studies conducted on or over portions or all of what is now the Village. In the early 1960's, Smalley, Welford, and Nalvin did a surface water management analysis for Lee County. The Estero River was one of the streams studied. An update to that study was done in 1972 by Johnson Engineering and again in 1979. The Federal Emergency Management Agency (FEMA) produced its first analysis of the Estero River in 1983. In 1992, there was a Lee County Surface Water Management Plan Update that included the Estero River, Halfway Creek and Spring Creek. These same streams and others were part of the South Lee County Watershed Plan published in 1999 by Johnson Engineering and Agnoli, Barber and Brundage. This study was later updated in 2009 by Boyle Engineering with modeling by A.D.A. Engineering. Other studies have been done of Estero Bay that may have data in the upstream watershed also.

Drainage is addressed in the Comprehensive Plan to ensure adequate levels of service are provided to protect health, safety and welfare of residents now and into the future.

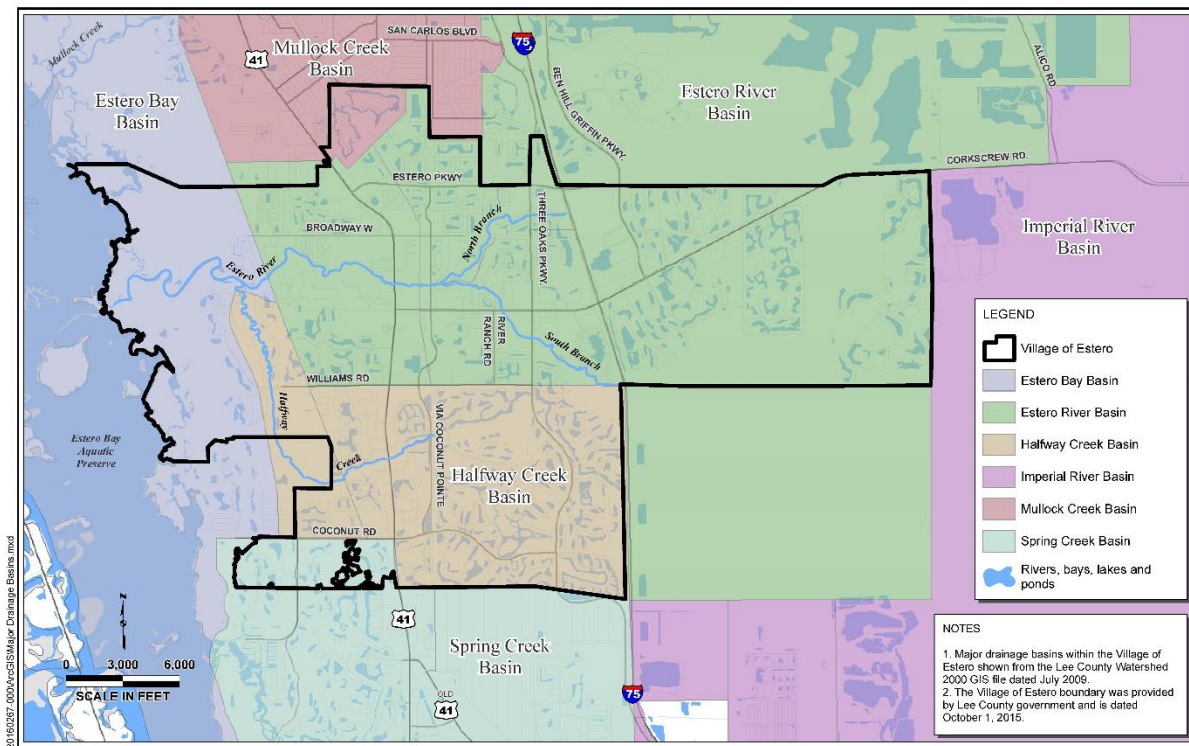
- Policies in the Infrastructure Element identify that the Village will prepare and implement a Stormwater Master Plan based on best available data to address current and future conditions.

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EXISTING CONDITIONS

Similar to most of Southwest Florida, the eastern portion of Estero’s land area is rather flat and poorly drained. Over the years, considerable modification has been made to the drainage system in what is now the Village of Estero. The upper reaches of the Estero River, both north and south branches, have had some excavation of the channel and considerable filling of the floodplain. Much of the sheet flow from the eastern area and outside the Village has been altered by development of all types. This and filling of the floodplain have increased ponding depths in the upstream areas. The major drainage basins within the Village are shown below in **Figure 23: Major Drainage Basins Map**.

Figure 23: Major Drainage Basins Map



The western portion of Estero has well incised conveyances for storm water through the coastal plain. There has been little flooding along these conveyances due to lack of capacity. The flooding is generally caused by secondary or tertiary conveyances being too small or somehow being compromised. The very western portion of Estero has coastal land along the east side of Estero Bay. This land has elevations that are near present sea level. Based on the Fort Myers tide station, mean sea level has risen just under one foot in the past 100 years. There are many estimates of future sea levels, but there are no predictions for the level to decrease anytime in the foreseeable future.

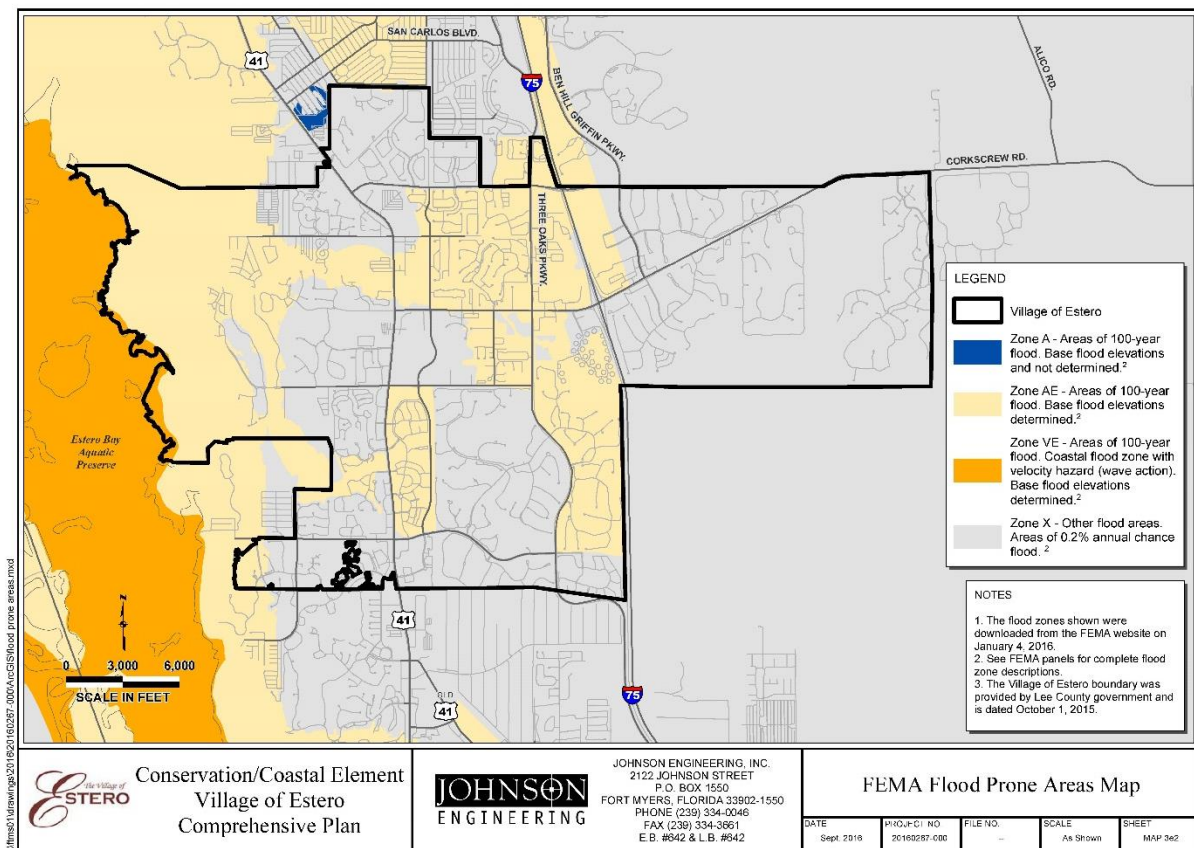
- The Conservation and Coastal Management Element includes policies to encourage environmentally compatible shoreline stabilization and to work to determine how best to integrate sea level rise adaptation policies into existing processes.

Historically, Bonita Springs has been victim of flooding events, particularly in 1995 due to poor connections between the source of the water east of I-75 and the well incised streams to the west. While the design of

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I-75 acknowledged substantial flow across the road, there were some shortcomings of the design. In this portion of Lee County, it was in a sheetflow area. There were major bridges and culverts spaced along the route. In many locations, there was not a conveyance upstream or downstream from the opening under the road. Water upstream from the road had to flow along the roadway embankment, perpendicular to where it needs to flow, to reach one of these openings. This caused the water depths upstream to increase above natural conditions. These same openings often had no or poor conveyance downstream. While flooding has not been experienced within the Estero Village limits to the extent it has in Bonita Springs, the Village's vigilance in collecting data, assessing conditions, evaluating options and coordinating to implement improvements through the ongoing Stormwater Master Planning effort will be important to fortifying the Village against flooding in the future. Estero's flood zones are depicted in **Figure 24** below.

Figure 24: FEMA Flood Prone Areas Map



Challenges to providing additional improvements include, but are not limited to, development in the floodplain, lack of funds, differing direction or lack of direction by various levels of government and private property rights. Development of the floodplain can be done with minimal impact or major impact to upstream water levels that in turn cause upstream flooding where it had not previously flooded or the flooding depths are increased. The challenge is that usually the minimal impact solutions cost more money than those that cause more impact to water levels. There is need for incentives to be provided to lessen the impact of the land development. These might include density adjustments for clustering, easements across portions of the land to maintain sheet flow with units transferred to the property along the easements, and purchasing the property in order to prevent it from being developed.

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- The Infrastructure Element includes policies to encourage performance and design of development that is protective of the functions of drainage systems.

Estero Bay, the Village's receiving water body, is an Aquatic Preserve within Florida which requires additional protections for water quality. The Comprehensive Plan addresses the needs of the downstream receiving body in addition to quantity and water quality requirements.

- The Infrastructure Element establishes minimum acceptable levels of service for preventing flooding and for meeting water quality standards.

The Village of Estero lies within the permitting and planning jurisdiction of the South Florida Water Management District (SFWMD). Drainage improvements proposed in the Village will require permits from SFWMD. SFWMD has participated in several alterations to the surface water management system within the Village, most often by providing money to a public or private entity to make an improvement. The Florida Department of Transportation (FDOT) has also assisted with improvements to the surface water system as a way of meeting requirements of permits from SFWMD.

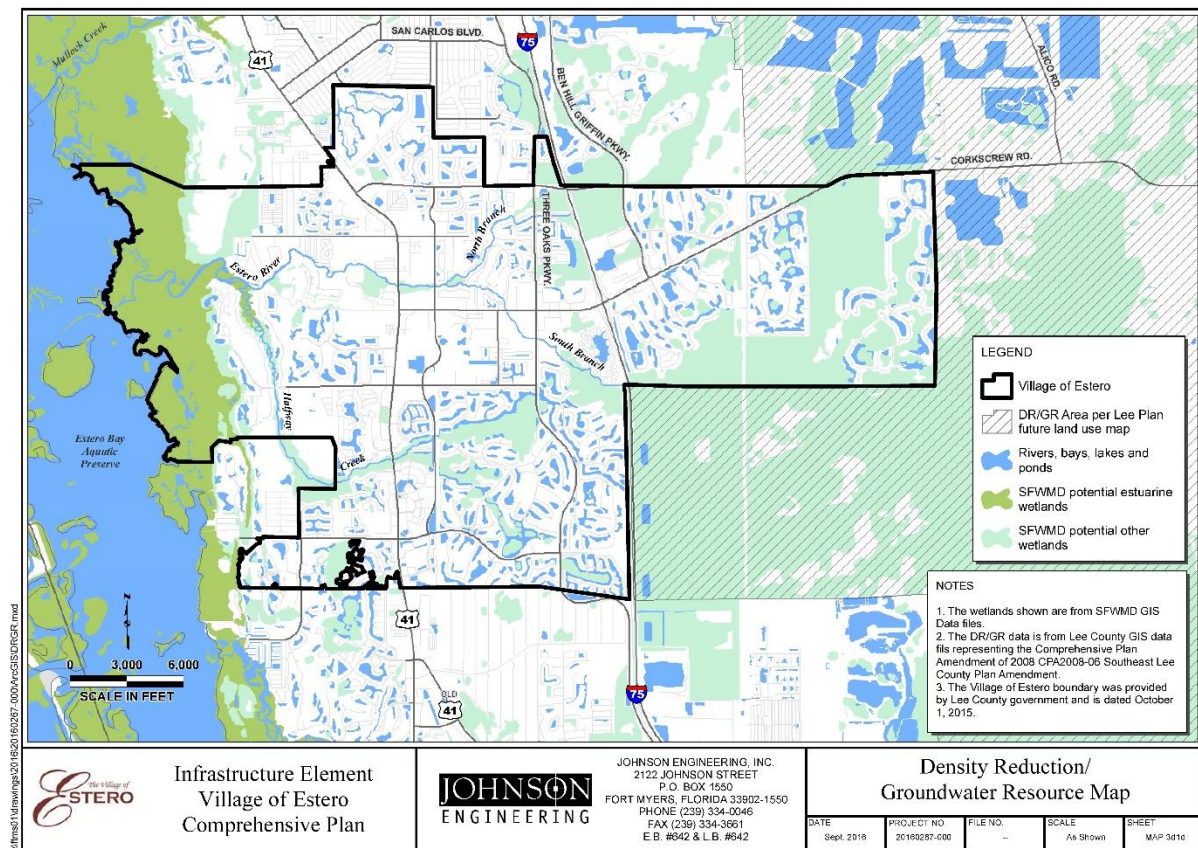
- The Intergovernmental Coordination Element establishes the coordination procedures for the Village to cooperate with state agencies.

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GROUNDWATER RECHARGE AREAS

Adjacent to the Village's eastern, southeastern and northeastern boundaries are lands designated on the Lee County Future Land Use Map as DR/GR, Density Reduction/Groundwater Resource. The Lee Plan defines the DR/GR as lands that provide substantial recharge to aquifers most suitable for future wellfield development. Permitted land uses include agriculture, natural resource extraction and related facilities, conservation uses, public and private recreation facilities, and residential uses at a maximum density of one dwelling unit per 10 acres. The DR/GR designated lands are not within the Village limits, but the immediate proximity of these lands to the Village's eastern boundary and the significance of these lands to the regional groundwater system render them very important to the Village's interests in protecting natural resources and water supply. The DR/GR area is shown on **Figure 25** below.

Figure 25: Density Reduction/Groundwater Resource Map



In 1995, the South Florida Water Management District (SFWMD) published Technical Publication 95-02, "Mapping Recharge (Infiltration/Leakage) Throughout the South Florida Water Management District." For the area covered by the Village, the publication provides two quantities termed Average Precipitation Recharge and Average Excess Precipitation for the Surficial Aquifer System. The term Average Precipitation Recharge is defined as rainfall minus runoff minus evapotranspiration (ET) from the unsaturated zone, the last of which is considered to be negligible by the report authors. This amount of water is essentially that portion of rainfall that reaches land surface and does not immediately runoff. In reality, a significant portion of ET losses occur within the unsaturated zone under non-inundated conditions, and the omission of this term by the report authors may be due to the constraints of modeling capabilities at the time (i.e. difficulty

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for older model codes to simulate the unsaturated zone). The term Average Excess Precipitation is defined as rainfall minus actual ET. Average Excess Precipitation, therefore, represents the water available for runoff and/or longer-term infiltration and recharge to underlying aquifers.

The values depicted in the publication were developed using data from numerical groundwater models and standardized to reflect long-term annual precipitation trends. The SFWMD states these generalized values are intended as regional planning tools, and not for use on a site-specific basis. Recharge and infiltration behaviors can be highly localized and site-specific, as well as time-dependent. To fully assess the recharge or discharge characteristics of a site, extensive data collection is required, including soil mapping, determination of hydraulic properties of the aquifers present at the site, rainfall and ET measurements, stream gauging, topographic mapping, etc. In southwest Florida, sandy areas with higher topographic relief, such as relic dunes along the coast and inland areas associated with the geomorphologic feature called the Immokalee Rise, are characterized by higher recharge rates (that component of rainfall not lost to runoff and ET over a short timeframe). These areas are typically among the first to develop because they are well-drained with a lower occurrence of wetlands, and generally require less fill and mitigation for environmental impacts. On the other hand, as stated in the Henigar and Ray report on characteristics of the DR/GR prepared for Lee County in 1993, "In an area with little topographic relief, such as that found in Lee County, discharge from areas of the water table are apparent in the form of lakes, streams, rivers and the Gulf of Mexico." Such discharge features within the Village include the Estero River and Halfway Creek. SFWMD Technical Publication 95-02 lacks the resolution to capture the behavior of some of these smaller scale, but locally important, features, and so does not identify them as discharge areas.

According to Technical Publication 95-02, the entire area within the Village of Estero has an Average Precipitation Recharge of 43 to 56 inches annually. On average, rainfall recorded at the Page Field weather station for a 57-year period has totaled approximately 53 inches annually, as taken from the SFWMD modified Blaney-Criddle irrigation model. Using this value as the upper limit, the Village of Estero may receive Average Precipitation Recharge, as defined by Technical Publication 95-02, between 43 to 53 inches on an annual basis. Forty-three inches of Average Precipitation Recharge corresponds to approximately 10 inches per year (in/yr) of runoff, using the SFWMD's definition of the term, and 53 in/yr would correspond to zero runoff. Given that zero runoff on an annual basis across a board area is not realistic, actual Average Precipitation Recharge for the Village of Estero likely falls in the lower end of the range provided in Technical Publication 95-02. Again, this term does not include ET losses, which is the second largest component of a typical water budget in southwest Florida after rainfall.

As shown in Technical Publication 95-02, most of the Village of Estero has Average Excess Precipitation between 10 to 14 in/yr. The SFWMD publication depicts the far southeastern part of the Village as having between 6 to 10 in/yr of Average Excess Precipitation. To reiterate, the SFWMD basically intends this term to represent the portion of the water budget available for runoff and/or recharge. Based on these values, the southeastern portion of the Village may receive less runoff and/or long-term infiltration than the western portion. *The Water Resources Atlas of Florida* (Fernald and Purdum, 1998), shows regional runoff for south Florida as less than 10 in/yr based on data collected from 1965 to 1974. Runoff for an area typically increases as the area experiences development, due the amount of impervious area (e.g. roads, buildings, parking lots, etc.) added. Many stormwater management professionals estimate an average annual runoff of 10 in/yr for this part of Lee County, which falls within the range of values given in Technical Publication 95-02, and is consistent with the values provided in the *Water Resources Atlas of Florida*. Assuming an average annual runoff of 10 in/yr for the Village of Estero (possibly less for the southeastern part), between 0 and 4 in/yr is available for long-term infiltration to the Surficial Aquifer System and/or recharge to

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underlying aquifers. This represents a typical recharge value for many parts of Lee County, taken within the context of an average annual water budget. As discussed above, areas along the Estero River, Halfway Creek, and other natural surface water feature will exhibit discharge behavior under normal conditions.

Recharge to an aquifer is a function of the hydraulic head differential (i.e. water levels) between two aquifers and the leakance of the confining layer separating them (i.e. how easily water can pass through). If the hydraulic heads of two aquifers are similar and/or the confining layer exhibits very low leakance, little recharge will occur, and vice-versa. Recharge is induced around pumping wells because the groundwater withdrawals by the wells create a greater hydraulic head differential than would exist under natural conditions (i.e. pumping the wells lowers the water level in the source aquifer). Therefore, recharge will be greater in the vicinity of production wells. In addition to numerous irrigation wells permitted by the SFWMD throughout the Village of Estero, Lee County Utilities' Pinewoods public supply wellfield is located entirely within the Village of Estero. Lee County Utilities' Corkscrew public supply wellfield, and Bonita Springs Utilities' Western public supply wellfield are also located at or near the Village of Estero boundary. As discussed above, recharge will be greater in the vicinity of these wellfields. The Pinewoods wellfield withdraws water from the Water Table, Sandstone and Lower Hawthorn aquifers, as does the Corkscrew wellfield. Bonita Springs Utilities sources water from the Lower Tamiami and Upper Floridan aquifers. Both the Water Table and Lower Tamiami aquifers are considered part of the Surficial Aquifer System. The lower production zone of the Water Table aquifer, the Lower Tamiami aquifer, and the Sandstone aquifer likely receive induced recharge in the vicinities of the public supply wellfields.

- The Transportation Element contains a policy to discourage any increased density in the DR/GR area east of Estero.
- The Infrastructure Element Groundwater Recharge Objective and associated policies provide for protection and coordination with relevant agencies to review and manage impact of activities on groundwater resources.

AREAS SUBJECT TO THE IMPACTS OF SEA LEVEL RISE

The Southwest Florida Regional Planning Council (SWFRPC) prepared the *Lee County Climate Change Vulnerability Assessment* in 2010, which discussed sea level rise and its associated impacts, among other topics. Various projections of sea level rise have been published by multiple federal and international organizations, with predicted values showing progressive divergence further into the future. The SWFRPC report looked at sea level rise in Lee County for the years 2050, 2100 and 2200 for three different probability scenarios (least, moderate, and worst). Sea level rise projections appear to be relative to year 2000 levels. Between 1900 and 2000, the SWFRPC shows southwest Florida experienced an approximate 8-inch historical rise in sea level. Based on the three main scenarios used in the report, by the year 2050 sea level may rise between 5 to 16 inches compared to sea level in 2000. By 2100, sea level may rise between 10 to 36 inches, and the area may experience between 21 and 110 inches of sea level rise by 2200.

Figure 26: Southwest Florida Regional Planning Council's 5-Foot Sea Level Rise Map

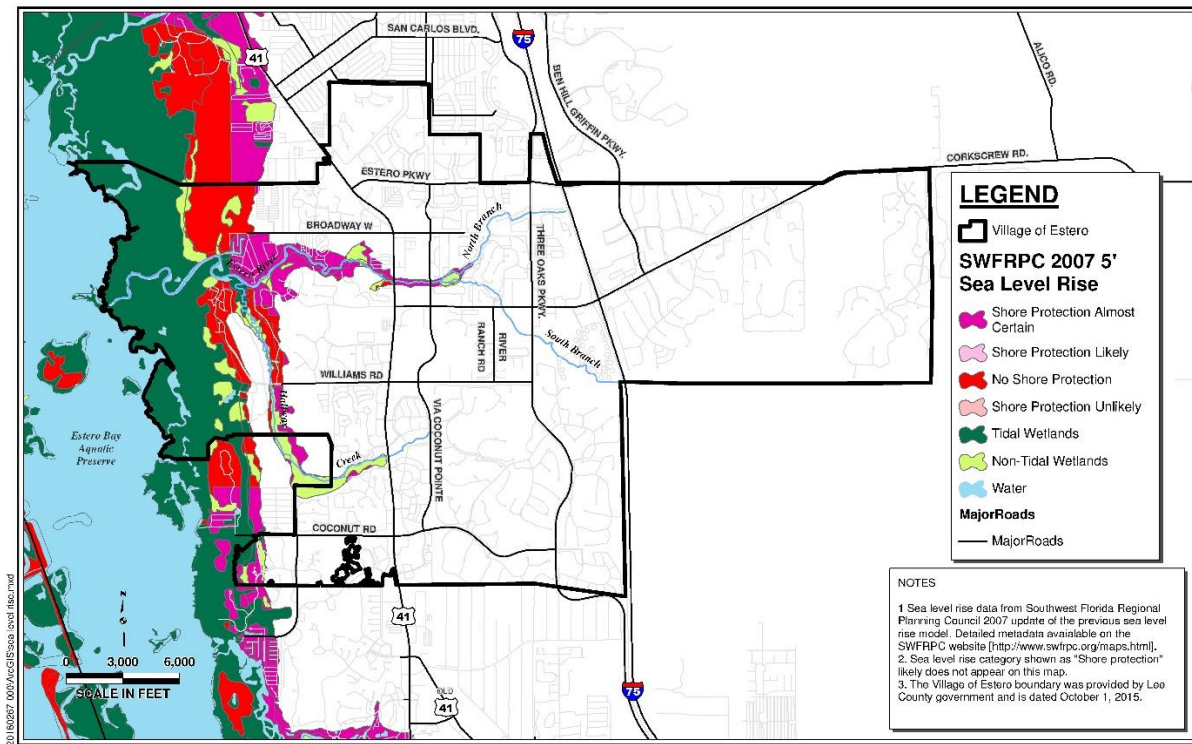


Figure 26 above shows areas likely impacted by a "5-foot" rise in static sea level, as taken from the SWFRPC report, determined using LiDAR elevations available at the time of report preparation. The SWFRPC developed sea level response maps for areas situated below the 10-foot NGVD contour or within 1,000 feet of the shore. The SWFRPC report authors cite several reasons for use of the 10-foot NGVD contour, including the fact that mean tidal level is at 0.75 feet NGVD (location unspecified), with mean diurnal high tide at 1 to 2 feet NGVD, and the poor vertical and horizontal resolution of the datasets used (+/- 2.5 feet). The areas subject to impact within the Village, as depicted in the SFWRPC report, include coastal areas, and areas adjacent to the Estero River and Halfway Creek. Most areas predicted for impact within the Village by the SWFRPC are west of US 41, although areas adjacent to the Estero River to the east of US 41 also fall within the 5-foot sea level rise zone defined by the SWFRPC. Based on projections reported by the SWFRPC for the years 2050, 2100 and 2200, a 5-foot sea level rise (60 inches) will likely not be realized until after 2100, and may not occur through 2200, depending on the projection used.

For the sea level response study area described above, the SWFRPC categorized potentially impacted areas as "Shore Protection Almost Certain," "Shore Protection Likely," "Shore Protection Unlikely," "No Shore Protection," "Tidal Wetlands," and "Non-Tidal Wetlands." SWFRPC staff assigned locations to each category based on discussion with local officials, and environmental policies/ policies regarding shoreline protection. The types of "shore protection" the report assumes may be used mainly include hard stabilization methods, such as seawalls, dikes, groins, and levees. The SWFRPC categorizes areas where wetlands are present that can potentially migrate inland as unlikely to be protected, since use of hard stabilization methods for such systems may be prohibited or discouraged. Conversely, the SWFRPC considers urbanized areas likely or certain to be protected using these methods. Agricultural, mining, and upland preserves are assumed not to be protected by the SWFRPC; whereas commercial, industrial, institutional, and residential areas would

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almost certainly be protected. The SWFRPC recommended that critical facilities below 5 feet NGVD not be protected, but rather relocated to higher ground. The various protection classifications established by the SWFRPC are intended for planning purposes, but do not commit a local government or property owner to addressing shore protection in a particular manner.

All shore protection categories described above in the SWFRPC report are present within the Village of Estero, with the exception of "Shore Protection Likely" and "Shore Protection Unlikely." Many areas along the coast are depicted as either wetlands, which presumably would not be protected, or areas categorized as "No Shore Protection." Other areas along the Estero River and some portions of Halfway Creek are shown as "Shoreline Protection Almost Certain." These shore protection classifications do not necessarily follow current land use, as shown on 2016 aerial photos from Lee County, which may be due to the age of the SWFRPC report. For example, portions of existing communities near the coast are alternatively shown as falling within both "Shore Protection Almost Certain" and "No Shore Protection" categories with little correlation with existing land use. However, the categories established by the SWFRPC are not binding, and revised categories specific to the Village could be established at a future date.

- The Conservation and Coastal Management Element includes policies to encourage environmentally compatible shoreline stabilization and to work to determine how best to integrate sea level rise adaptation policies into existing processes.