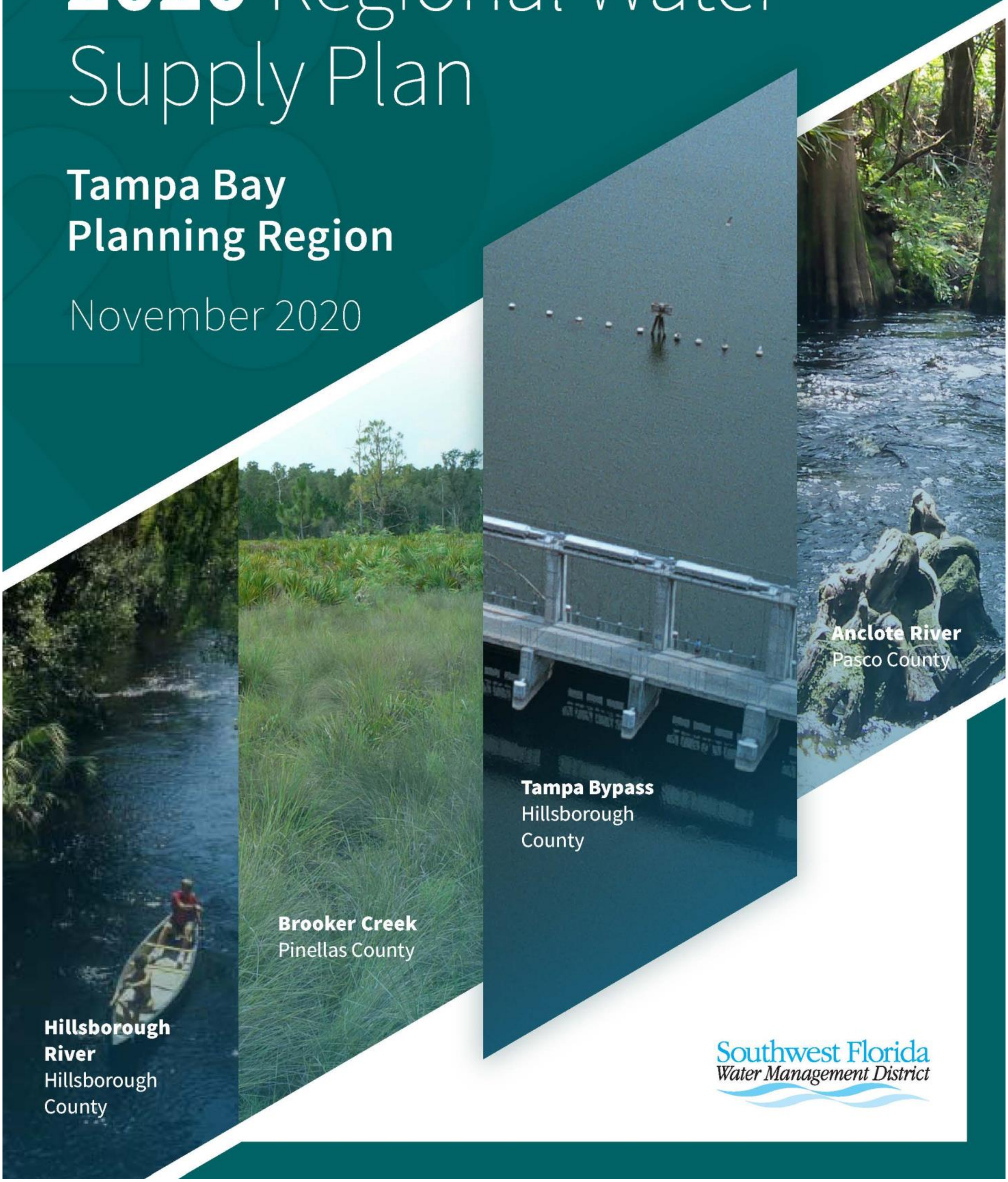
2020 Regional Water Supply Plan

Tampa Bay Planning Region

November 2020



Southwest Florida Water Management District

2020 Regional Water Supply Plan
Tampa Bay Planning Region

Board Approved

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Southwest Florida Water Management District

2020 Regional Water Supply Plan

This report is produced by the Southwest Florida Water Management District

November 2020

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List of Abbreviations

AG	Agriculture
AMA	Advanced Metering Analytics
AR	Aquifer Recharge
ASR	Aquifer Storage and Recovery
AWE	Alliance for Water Efficiency
AWEP	Agriculture Water Enhancement Program
AWS	Alternative Water Supply
BEBR	Bureau of Economic and Business Research
BMP	Best Management Practices
CAR	Consolidated Annual Report
CDD	Community Development District
CFI	Cooperative Funding Initiatives
CFS	Cubic Feet per Second
CFWI	Central Florida Water Initiative
CHAMP℠	Conservation Hotel and Motel Program
CII	Commercial, Industrial, and Institutional
COC	Cycle of Concentration
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
DOH	Department of Health
DPCWUCA	Dover/Plant City Water Use Caution Area
DSS	Domestic Self Supply
DWRM	Districtwide Regulation Model
EDR	Electro-Dialysis Reversal
ELA	Environmental Look Arounds
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ER	Environmental Restoration
ET	Evapotranspiration
ETB	Eastern Tampa Bay
ETBWUCA	Eastern Tampa Bay Water Use Caution Area
F.A.C.	Florida Administrative Code
FARMS	Facilitating Agricultural Resource Management Systems
FDACS	Florida Department of Agriculture and Consumer Services
FDOT	Florida Department of Transportation
FFL	Florida-Friendly Landscaping™
FPL	Florida Power & Light
F.S.	Florida Statutes
FTMR	Focus Telescopic Mesh Refinement
FWS	Florida Water Star℠
FY	Fiscal Year
GAL	Gallons
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellites
GPD	Gallons per Day
GPF	Gallons per Flush
GRP	Gross Regional Product

HE	High Efficiency
HET	High Efficiency Toilets
HRWUCA	Highlands Ridge Water Use Caution Area
I/C	Industrial/Commercial
ICU	Intermediate Confining Unit
IAS	Intermediate Aquifer System
IFAS	Institute of Food and Agricultural Sciences
INTBM	Integrated Northern Tampa Bay Model
IPCC	Intergovernmental Panel on Climate Change
L/R	Landscape/Recreation
LFA	Lower Floridan aquifer
LHR	Lower Hillsborough River
MAL	Minimum Aquifer Level
MAPPZ	Minimum Aquifer Level Protection Zone
MCU	Middle Confining Unit
MCU I	Middle Confining Unit I (1)
MCU II	Middle Confining Unit II (2)
M/D	Mining/Dewatering
MFL	Minimum Flows and Levels
MGD	Million Gallons per Day
MG/L	Milligrams per Liter
MIA	Most Impacted Area
NDM	Northern District Model
NHARP	North Hillsborough Aquifer Recharge Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPR	Northern Planning Region
NRCS	Natural Resources Conservation Service
NTB	Northern Tampa Bay
NTBWUCA	Northern Tampa Bay Water Use Caution Area
O&M	Operation and Maintenance
OFW	Outstanding Florida Water
OPPAGA	Office of Program Policy Analysis and Governmental Accountability
PG	Power Generation
PRMRWSA	Peace River Manasota Regional Water Supply Authority
PRSV	Pre-rinse Spray Valve
PRWC	Polk Regional Water Cooperative
PS	Public Supply
PSI	Pounds per Square Inch
QWIP	Quality of Water Improvement Program
RC&D	Florida West Coast Resource Conservation and Development Council
RIB	Rapid Infiltration Basin
RO	Reverse Osmosis
ROMP	Regional Observation and Monitor-well Program
RPC	Regional Planning Council
RWSP	Regional Water Supply Plan
SHARE	South Hillsborough Aquifer Recharge Expansion
SHARP	South Hillsborough Aquifer Recharge Project
SJRWMD	St. Johns River Water Management District

SMS	Soil Moisture Sensor
SPJC	Shell, Prairie, and Joshua Creek
STAG	State and Tribal Assistance Grants
SWCFGWB	Southern West-Central Florida Groundwater Basin
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management Program
SWIMAL	Saltwater Intrusion Minimum Aquifer Level
SWUCA	Southern Water Use Caution Area
TBC	Tampa Bypass Canal
TBW	Tampa Bay Water
TDS	Total Dissolved Solids
TECO	Tampa Electric Company
TMDL	Total Maximum Daily Load
UFA	Upper Floridan aquifer
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geologic Survey
WISE	Water Incentives Supporting Efficiency
WMD	Water Management District
WMP	Watershed Management Program
WPCG	Water Planning Community Group
WPSPTF	Water Protection and Sustainability Program Trust Fund
WQMP	Water Quality Monitoring Program
WRAP	Water Resource Assessment Project or West-Central Florida Water Restoration Action Plan
WRD	Water Resource Development
WRWSA	Withlacoochee Regional Water Supply Authority
WSD	Water Supply Development
WTF	Water Treatment Facility
WTP	Water Treatment Plant
WUCA	Water Use Caution Area
WUP	Water Use Permit
WUWPD	Water Use Well Package Database
WWTP	Wastewater Treatment Plant
ZLD	Zero Liquid Discharge

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Chapter 1. Introduction

The Regional Water Supply Plan (RWSP) for the Southwest Florida Water Management District (SWFWMD) (District) is an assessment of projected water demands and potential sources of water to meet these demands for the period from 2020 through 2040. The RWSP has been prepared in accordance with the Florida Department of Environmental Protection's (FDEP) 2019 Format and Guidelines for Regional Water Supply Planning. The RWSP consists of four geographically based volumes that correspond to the District's four designated water supply planning regions: Northern, Tampa Bay, Southern and Heartland (Figure 1-1). This volume is the 2020 RWSP update for the Tampa Bay Planning Region, which includes Hillsborough, Pasco, and Pinellas counties. The District completed RWSPs in 2001, 2006, 2010, and 2015 that included the Tampa Bay Planning Region.

The purpose of the RWSP is to provide the framework for future water management decisions in the District. The RWSP shows that sufficient alternative water sources (AWSs) for the Tampa Bay Planning Region (sources other than fresh groundwater from the Upper Floridan aquifer [UFA]) exist to meet future demands and to replace some of the current fresh groundwater withdrawals causing hydrologic stress.

The RWSP also identifies potential options and associated costs for developing alternative sources as well as fresh groundwater. The options are not intended to represent the District's most preferable options for development. They are, however, provided as reasonable concepts that water users in the planning region can pursue to meet their water supply needs. Water users can select a water supply option in the RWSP or combine elements of different options that better suit their water supply needs, provided such options are consistent with the intent and direction of the RWSP. Additionally, the RWSP provides information to assist water users in developing funding strategies to construct water supply projects.

The requirement for regional water supply planning originated from legislation passed in 1997 that significantly amended Chapter 373, Florida Statutes (F.S.). Regional water supply planning requirements are codified in Part VII of Chapter 373 (373.709), F.S., and this RWSP has been prepared pursuant to these provisions. Key components of this legislation included:

- Designation of one or more water supply planning regions within the District.
- Preparation of a Districtwide water supply assessment.
- Preparation of an RWSP for areas where existing and reasonably anticipated sources of water were determined to be inadequate to meet future demand, based upon the results of the water supply assessment.

Regional water supply planning requirements were amended as a result of the passage of Senate Bill 444 during the 2005 legislative session. The bill substantially strengthened requirements for the identification and listing of water supply development projects. In addition, the legislation was intended to foster better communications among water planners, local government planners, and local utilities. Local governments are now permitted to develop their own water supply assessments, which the water management districts (WMDs) are required to consider when developing their RWSPs. Finally, a trust fund was created that provides the WMDs with state matching funds to support the development of AWSs by local governments, water supply authorities and other water users.

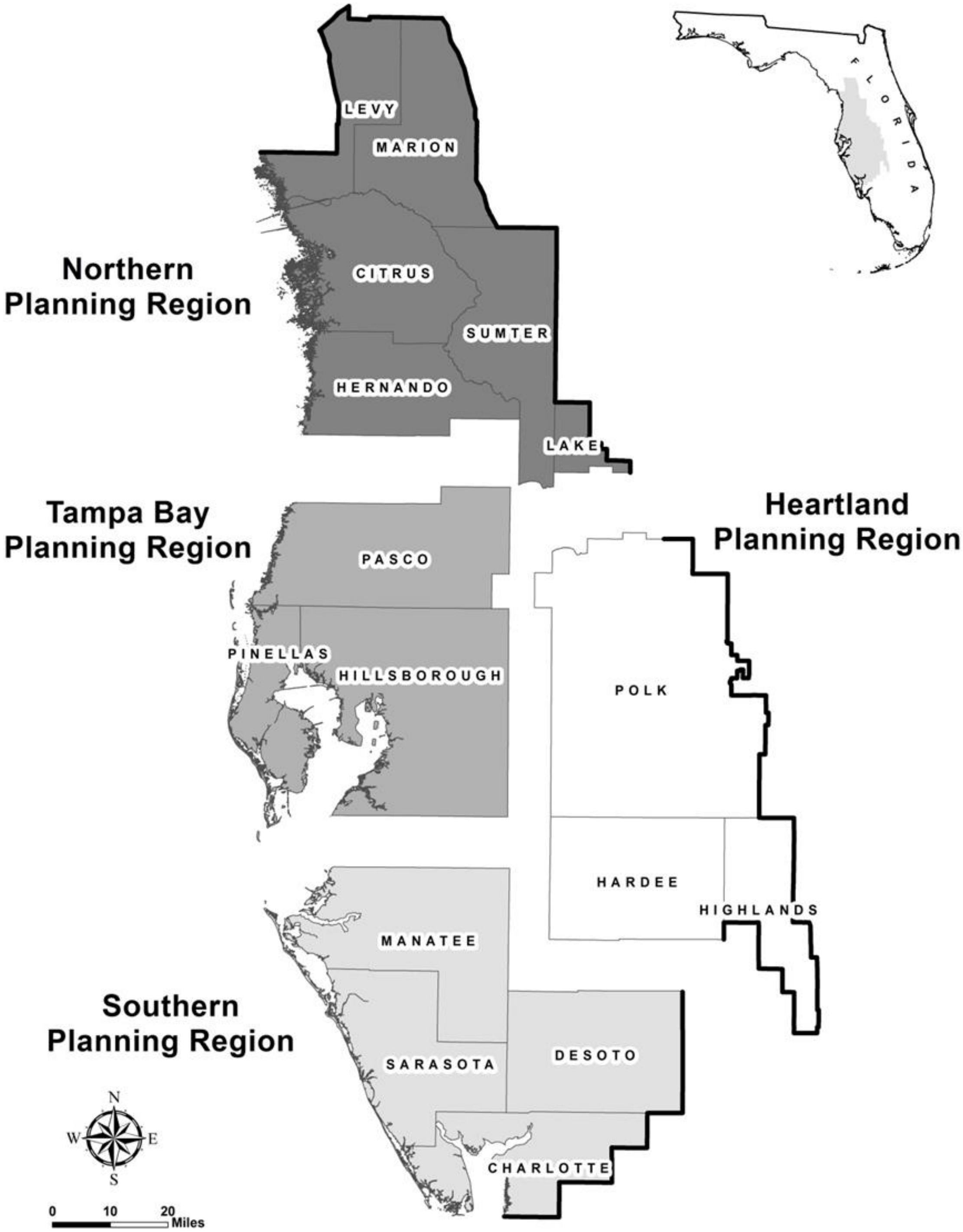

Figure 1-1. *Location of the four water supply planning regions within the District*

Part A. Introduction to the Tampa Bay Planning Region Regional Water Supply Plan

The following describes the content of the Tampa Bay Planning Region RWSP: Chapter 1, Introduction contains an overview of the District's accomplishments in implementing the water supply planning objectives of the 2015 RWSP; a description of the land use, population, physical characteristics, hydrology and geology/hydrogeology of the area; and a description of the technical investigations that provide the basis for the District's water resource management strategies. Chapter 2, Resource Protection Criteria, addresses the resource protection strategies that the District has implemented or is considering implementing, including water use caution areas (WUCAs) and the District's minimum flows and levels (MFLs) program. Chapter 3, Demand Estimates and Projections, is a quantification of existing and projected water supply demand through the year 2040 for public supply (PS), agricultural (AG), industrial/commercial (I/C), mining/dewatering (M/D), power generation (PG), and landscape/recreation (L/R) users. Chapter 4, Evaluation of Water Sources, is an evaluation of the future water supply potential of traditional and alternative sources. Chapter 5, Water Supply Development Component, presents a list of AWS development options for local governments and utilities, including surface water and stormwater, reclaimed water and water conservation. For each option, the estimated amount of water available for use and the estimated cost of developing the option are provided. Chapter 6, Water Supply Projects Under Development, is an overview of water supply development projects that are currently under development and receiving District funding assistance. Chapter 7, the Water Resource Development Component, is an inventory of the District's ongoing data collection and analysis activities and water resource projects that are classified as water resource development (WRD). Chapter 8, Funding Mechanisms, provides an estimate of the capital cost of water supply and WRD projects proposed by the District and its cooperators to meet the water supply demand projected through 2040 and to restore MFLs to impacted natural systems. An overview of mechanisms available to generate the necessary funds to implement these projects is also provided.

Part B. Accomplishments since Completion of the 2015 RWSP

The following is a summary of the District's major accomplishments in implementing the objectives of the RWSP in the planning region since the 2015 update was approved by the Governing Board in November 2015.

Section 1. Alternative Water Supply Conservation, and Reuse Development

1.0 Alternative Water Supply

The District has provided cooperative funding to Tampa Bay Water (TBW) for several projects, including the System Configuration II project and a surface water expansion study. In 2018, TBW completed its fourth update to its Long-Term Master Water Plan. The update indicates an additional 20 million gallons per day (mgd) of supply is needed through 2040 planning horizon and construction of these projects could be delayed by implementation of conservation and efficiency initiatives. These initiatives, which involve District cooperative funding, would also be more cost-effective than new water supply projects. Potential new projects for accomplishing the 20 mgd include upgrades and enhancements to TBW's surface water and desalination water treatment plants. Another potential option is New Groundwater via Net Benefit from the South Hillsborough Aquifer Recharge Program (SHARP). Several configurations of these three projects were investigated to meet future demands.

The District has also provided cooperative funding for aquifer storage and recovery (ASR) and recharge projects within the region. District-funded recharge feasibility and pilot testing projects include those for Hillsborough County and the cities of Tampa and Clearwater. The SHARP project is a direct aquifer recharge pilot project utilizing reclaimed water. The TAP involves a study that explores the cost and feasibility of beneficially reusing reclaimed water from the Howard F. Current Advanced Wastewater Treatment Plant. The City of Clearwater Groundwater Replenishment Project (Phase 3) involves the design, third-party review, permitting and construction of a full-scale water purification plant and injection and monitor well systems to recharge the UFA with 2.4 mgd annual average of purified recycled water at the City's Northeast Water Reclamation Facility.

Finally, the District is cooperatively funding a Brackish Feasibility and Testing Project for the Town of Belleair. The study will evaluate the suitability of the aquifer as a potential AWS source.

2.0 Water Conservation

The District continues to promote and cooperatively fund water conservation efforts to more efficiently use existing water supplies. In the public supply sector, for fiscal years 2015-2019, this includes cooperatively-funded projects for toilet rebates, rain sensors, water-efficient landscape and irrigation evaluations, soil moisture sensors, Florida Water Star℠ (FWS) rebates, advanced metering analytics (AMA) customer portals, conservation kits, satellite leak detection, and clothes washers. The District has funded conservation projects undertaken by Pasco and Hillsborough counties and the cities of St. Petersburg, Tampa, New Port Richey, and Port Richey. The District also formed the Water Conservation Initiative to assist public supply utilities in achieving their water conservation goals.

In the AG water use sector, the District's primary initiative for water conservation is the Facilitating Agricultural Resource Management Systems (FARMS) Program. Established in 2003, in partnership with the Florida Department of Agriculture and Consumer Services (FDACS), FARMS is a cost-share reimbursement program for production-scale best management practices (BMPs) to reduce groundwater use and improve water quality. To date, more than 194 operational projects Districtwide are providing a groundwater offset of more than 27 mgd. An additional nine projects in the planning, design or construction phase are expected to yield another 0.98 mgd of offset. Within the Tampa Bay Planning Region, FARMS has funded 49 operational projects providing 2.6 mgd of offset with another 2 projects under construction that are expected to yield an additional 0.04 mgd.

3.0 Reclaimed Water

The District has continued its highly successful program to cooperatively fund projects that make reclaimed water available for beneficial reuse. These include more than 385 projects between fiscal year (FY)1987 and FY2020 for the design and construction of transmission, distribution, recharge, natural system enhancement, storage and pumping facilities, metering, feasibility studies, reuse master plans, and research projects. As a consequence of District and utility cooperation, reuse projects were developed that will result in the 2025 Districtwide utilization of reclaimed water of more than 228 mgd and a water resource benefit of more than

137 mgd. Utilities are on their way to achieving the 2040 Districtwide goals of 353 mgd utilization (75 percent) and 269 mgd of water resource benefit (75 percent efficiency).

In 2015, utilities within the Tampa Bay region were utilizing approximately 36 percent or 89 mgd of the 248 mgd of available wastewater treatment plant flows resulting in nearly 63 mgd of water resource benefits (70 percent efficiency). There are 22 reclaimed water supply projects under development and at least one other that is estimated to experience additional future supply growth. When complete, these projects will supply 49 mgd of reclaimed water that will result in approximately 39 mgd of potable-quality water benefits at a total cost of approximately $70 million.

Section 2. Support for Water Supply Planning

The District is actively involved in providing technical support to local governments as they prepare statutorily required Water Supply Facilities Work Plans and related updates as part of their comprehensive plans. District staff worked with the Department of Economic Opportunity and its predecessor (Department of Community Affairs), the FDEP, and the other WMDs to develop a guidance document for preparing the work plans. Staff provides ad hoc assistance to local governments and instituted a utility services program to assist utilities with planning, permitting, and information/data needs.

Section 3. Minimum Flows and Levels Establishment

1.0 Established Minimum Flows and Levels

Minimum flows and water levels (MFLs) established or reevaluated in the planning region during or since 2015 include those for lakes Alice, Allen, Big Fish, Bird, Brant, Buddy, Crews, Crystal, Dan, Deer, Dosson, Hanna, Harvey, Hobbs, Horse, Juanita, Keene, Kell, Little Moon, Merrywater, Moon, Padgett, Pasadena, Pierce, Rainbow, Round, Saddleback, Starvation, Sunset, Sunshine, and Virginia. Camp lake was reevaluated, but no changes were necessary to the adopted levels. Flowing water body MFLs made effective during or since 2015 include those for the lower and upper segments of the Pithlachascotee River. The District continues to re-evaluate and establish new MFLs per the Priority List and Schedule for the Establishment of Minimum Flows, Minimum Water Levels and Reservations, and as part of the Comprehensive Environmental Resources Recovery Plan for the Northern Tampa Bay Water Use Caution Area (NTBWUCA) (see Chapter 2, Part B, and Appendix 2).

2.0 Minimum Flows and Levels Recovery Initiatives

The northern portion of the Southern Water Use Caution Area (SWUCA) lies in the southern portion of the Tampa Bay Planning Region. In 2018, the District completed its second five-year assessment of the SWUCA recovery strategy (SWFWMD, 2018). The purpose of the five-year assessment, which is required by rule, is to evaluate and assess the recovery in terms of resource trends; trends in permitted and used quantities of water; and completed, ongoing, and planned projects. The assessment provides the information necessary to determine progress in achieving recovery and protection goals, and allows the District to revise its approach, if necessary, to respond to changes in resource conditions and issues. Results from the second five-year assessment indicate the District continues to make progress toward recovery, but challenges remain to full recovery by 2025. Recovery will ultimately be achieved through a combination of maintaining existing withdrawals at or below current levels and implementing WRD projects designed to augment or preserve existing flows and water levels.

The NTBWUCA also occurs in the Tampa Bay Planning Region. The first phase of the recovery strategy for the NTBWUCA (2000-2010) was primarily focused on reducing withdrawals from TBW's Central System Facilities to 90 mgd on a 12-month moving average basis as required in their water use permit. Through conservation efforts and development of an enhanced surface water system and a seawater desalination facility, this objective has been achieved since 2008. The second phase of the recovery strategy (2010-2020) focuses on the assessment of recovery in waterbodies due to the reduced groundwater withdrawals.

The District expects to receive a Water Use Permit (WUP) renewal application for TWB's Consolidated Permit in late 2020. The Consolidated Permit includes ten public supply wellfields (the permit initially included 11 wellfields, but the North Pasco wellfield was permanently closed in 2018), providing 90 mgd of water supply for most of the Northern Tampa Bay (NTB) area. In addition, the results of the Comprehensive Environmental Resources Recovery Plan, also known as the Phase II Recovery Plan, developed and adopted by rule and as a permit condition for assessing the hydrologic recovery achieved in the Phase I Recovery Plan (1998 to 2010), will be submitted to the District by TBW by the end of 2020.

The District established revised minimum flows for the lower Hillsborough River (LHR) in 2007, along with a recovery strategy for achieving the minimum flows within a decade. As part of the recovery strategy, the District entered into a joint funding agreement and additional project-specific agreements with the City of Tampa to assess and implement projects associated with diversion of water from various sources to meet minimum flow requirements in the river. During and since 2015, the City has continued diversion of water from Sulphur Springs to the base of the Hillsborough River Reservoir Dam, as necessary to support river recovery. In addition, the District and more recently the City have continued the diversion of water from the Tampa Bypass Canal (TBC) to the Hillsborough River Reservoir for subsequent diversion to the lower river. The City assumed responsibility for these diversions in 2018, with transfers of water from the reservoir to the lower river made using a newly constructed sluice gate in the dam that was cooperatively funded by the District. In 2017, the City, with support from the District, completed the Blue Sink Project, which facilitates diversion of water from Blue Sink to the base of the dam for minimum flow recovery, and use of the sink as a recovery source was initiated in 2018. A project between the District and City associated with investigation of storage or additional supply options was completed in 2018 and identified the proposed TAP as a potential source for additional water that may be needed for recovery of the lower river. Permitting, design, and permit-required monitoring associated with a project involving potential diversion of water from Morris Bridge Sink for river recovery have also been completed, although project implementation is contingent upon future recovery need assessments.

During and since 2015, the District has continued to annually assess and report progress on the LHR recovery strategy. In addition, two of three planned five-year recovery strategy assessments have been completed (SWFWMD and Atkins North America, Inc., 2015, SWFWMD and Water & Air Research, Inc. 2020). The goals of the annual and five-year assessments, which are required by rule, include evaluation of the hydrology, selected water quality characteristics, and biological effects achieved from implementation of recovery strategy projects. The annual and five-year assessments have documented improvements in water quality and other ecological conditions in the LHR as a result of minimum flow implementation, although minimum flow requirements have not been met on all days. Flow deficits, i.e., flows needed to meet minimum flow requirements, are expected to be eliminated upon full implementation of all projects identified in the recovery strategy.

Section 4. Quality of Water Improvement Program and Well Back-Plugging

Since the 1970s, the Quality of Water Improvement Program (QWIP) has prevented waste and contamination of water resources (both groundwater and surface water) by reimbursing landowners for plugging abandoned or improperly constructed artesian wells. The program focuses on the southern portion of the District where UFA is under artesian conditions, creating the potential for mineralized water to migrate upward and contaminate other aquifers or surface waters. The program reimburses approximately 200 well-pluggings per year and more than 6,800 have been reimbursed since inception. In the Tampa Bay Planning Region, 1,313 well-pluggings have been reimbursed since the QWIP program began.

A related effort, now part of the FARMS Program, involves the rehabilitation (or back-plugging) of agricultural irrigation wells to improve water quality in groundwater and surface waters and improve crop yields. The program initially targeted the Shell Creek, Prairie Creek, and Joshua Creek watersheds to decrease the discharge of highly mineralized water into Shell Creek, the City of Punta Gorda's municipal water supply. The program has retrofitted 85 wells as of September 2018, with 63 of these in the target watersheds. Six of these wells were in the Tampa Bay Planning Region.

Section 5. Regulatory and Other Initiatives

For over 40 years, the farmers in the Dover/Plant City area pumped groundwater to protect their crops by irrigating when temperatures dropped below freezing. This had been a BMP for many agricultural commodities such as strawberries, blueberries, citrus, nurseries, and aquaculture. Because most farmers in the area turned on their irrigation systems to their full capacity all at the same time, it placed a tremendous strain on the aquifer, lowering groundwater levels. This, in turn, impacted residential wells and caused sinkholes to form. During an eleven-day freeze event in January 2010, approximately 750 residential wells were impacted, and more than 140 sinkholes were reported. In 2011, the District adopted a multifaceted, comprehensive management plan to address these impacts. In addition to declaring a 256 square mile area in the Dover/Plant City area as a WUCA, rules were adopted that established a minimum aquifer level (MAL) and related protection zone (MALPZ) and a recovery strategy to help meet the MAL.

Part C. Description of Tampa Bay Planning Region

Section 1. Land Use and Population

The Tampa Bay Planning Region encompasses approximately 2,120 square miles, covering all of Hillsborough, Pasco, and Pinellas counties, in west-central Florida. This area is bounded on the west by the Gulf of Mexico, on the north by Hernando County, on the east by Polk County, and on the south by Manatee County. Major cities within the area include Tampa, St. Petersburg, and Clearwater. Tampa Bay is the major surface water feature in the region. The region is characterized by a diversity of land-use types (Table 1-1), ranging from urban/built-up areas such as the cities of St. Petersburg, Clearwater, Tampa, Plant City, New Port Richey, and Zephyrhills to predominantly agricultural land uses in the inland portions of Hillsborough and Pasco counties.

In southeastern Hillsborough County, the phosphate industry maintains significant processing operations and has been restoring large tracts of mined lands. However, mining operations continue to move southward as phosphate reserves at existing mines are depleted. The population of the planning region is projected to increase from approximately 3.2 million in 2015 to approximately 4.1 million in 2040. This is an increase of approximately 900,000 residents, a 28 percent increase over the 25-year planning period. The majority of this population growth will be due to net migration.

Table 1-1. *Land-use/land cover in the Tampa Bay Planning Region (2017)*

Land-Use/Land Cover Types	Acres	Percent
Urban and Built-up	533,825.94	39.3
Agriculture	222,692.77	16.4
Rangeland	30,784.38	2.3
Upland Forest	141,072.70	10.4
Water	51,285.17	3.8
Wetlands	250,341.38	18.4
Barren Land	3,751.33	0.3
Transportation, Communication and Utilities	42,405.23	3.1
Industrial and Mining	80,892.82	6.0
Total	**1,357,051.72**	**100.0**

Source: SWFWMD 2017 LULC GIS layer (SWFWMD, 2019).

Section 2. Physical Characteristics

The topography of the Tampa Bay Planning Region is largely a result of limestone dissolution and sediment deposition. Numerous closed depressions and sinkholes throughout the area reflect active solution of the underlying limestone. These sink features are especially prevalent in Hillsborough and Pasco counties and are the primary source of recharge to the underlying aquifers. Land surface elevations gradually increase from sea level at the gulf coast to a high of approximately 150 feet in eastern Pasco and Hillsborough counties. Pinellas County is largely characterized by hilly to flat uplands and level lowlands. The maximum elevation in Pinellas County is approximately 100 feet in the vicinity of Clearwater and Safety Harbor where a lineament of sandy ridges extends from Oakhurst northward to Tarpon Springs. Another rounded, 50-foot topographic high exists between Pinellas Park and St. Petersburg, with a diameter of five miles.

Section 3. Hydrology

Figure 1-2 depicts the major hydrologic features in the planning region including rivers, lakes, and springs.

1.0 Rivers

The planning region contains six major rivers and the TBC. The rivers include the Alafia, Little Manatee, and Hillsborough, which discharge to Tampa Bay, and the Withlacoochee, Anclote, and Pithlachascotee, which discharge to the Gulf of Mexico. There are many smaller tributaries to these systems as well as several coastal watersheds drained by small tidally influenced or intermittent streams. The TBC is the former Six Mile Creek/Palm River that was extensively altered by construction of the canal. The canal is designed to divert floodwaters from the Hillsborough River away from the cities of Tampa and Temple Terrace and into McKay Bay and is an important water source for the City of Tampa and Tampa Bay Water.

2.0 Lakes

There are more than 150 named lakes with extensive water-level data in the planning region. Lakes greater than 20 acres in size are included in Figure 1-2. Many lakes were formed by sinkhole activity and some retain a hydraulic connection to the UFA. Others along the Brooksville Ridge in Pasco County are surface depressions perched on relatively impermeable materials that hydraulically isolate them from the UFA. Many of the lake systems are internally drained, while others are connected to river systems through natural streams or man-made canals. Many lakes have been altered by drainage and development, some with water-level control structures. Several lakes on or near TBW's central system wellfields have been, or are currently, augmented with groundwater from the UFA.

3.0 Springs

Several second-magnitude springs (discharge between 10 and 100 cubic feet per second [cfs]) are located in the planning region. These include the Crystal Springs Group in Pasco County, Wall (Health) and Crystal Beach springs in Pinellas County, and Sulphur, The Lithia and Buckhorn Springs Group in Hillsborough County.

Sulphur Springs is located on the Hillsborough River several miles north of downtown Tampa. During the dry season when the entire flow of the Hillsborough River is captured for water supply at the City of Tampa's dam, Sulphur Springs is one of the sources of water for minimum flow implementation to the lower Hillsborough River as part of the Lower Hillsborough River Recovery Strategy.

Wall (Health) and Crystal Beach springs are located on the gulf coast in northern Pinellas County. Limited data indicate that the springs discharge brackish water and are strongly tidally influenced. Wall Springs was formerly a private recreation area that was purchased by Pinellas County and included in a county park. Although no flow data are available, it is probably a second-magnitude spring. Crystal Beach Spring is located in the Gulf of Mexico approximately 500 feet west of the shoreline.

Lithia and Buckhorn springs, i.e., the Lithia and Buckhorn Springs Group, are located on the Alafia River, south of Brandon in southeastern Hillsborough County. Lithia Springs is composed of two vents: Lithia Major and Lithia Minor. Periodic measurements of Lithia Springs since the early 1930s indicate an average discharge of between 30 and 40 cfs. Buckhorn Springs, composed of a number of vents spread over several acres, is located at the head of a short run that enters the Alafia River several miles downstream of Lithia Springs. Periodic measurements made by District and TBW staff in the early 1990s indicated that the combined average flow from four significant vents was approximately 17.6 cfs. This included the water diverted from the spring for industrial purposes (Jones et al., 1993). An industrial operation is permitted to divert water from Lithia and Buckhorn springs. The majority of this diversion is pumped from Lithia Major.

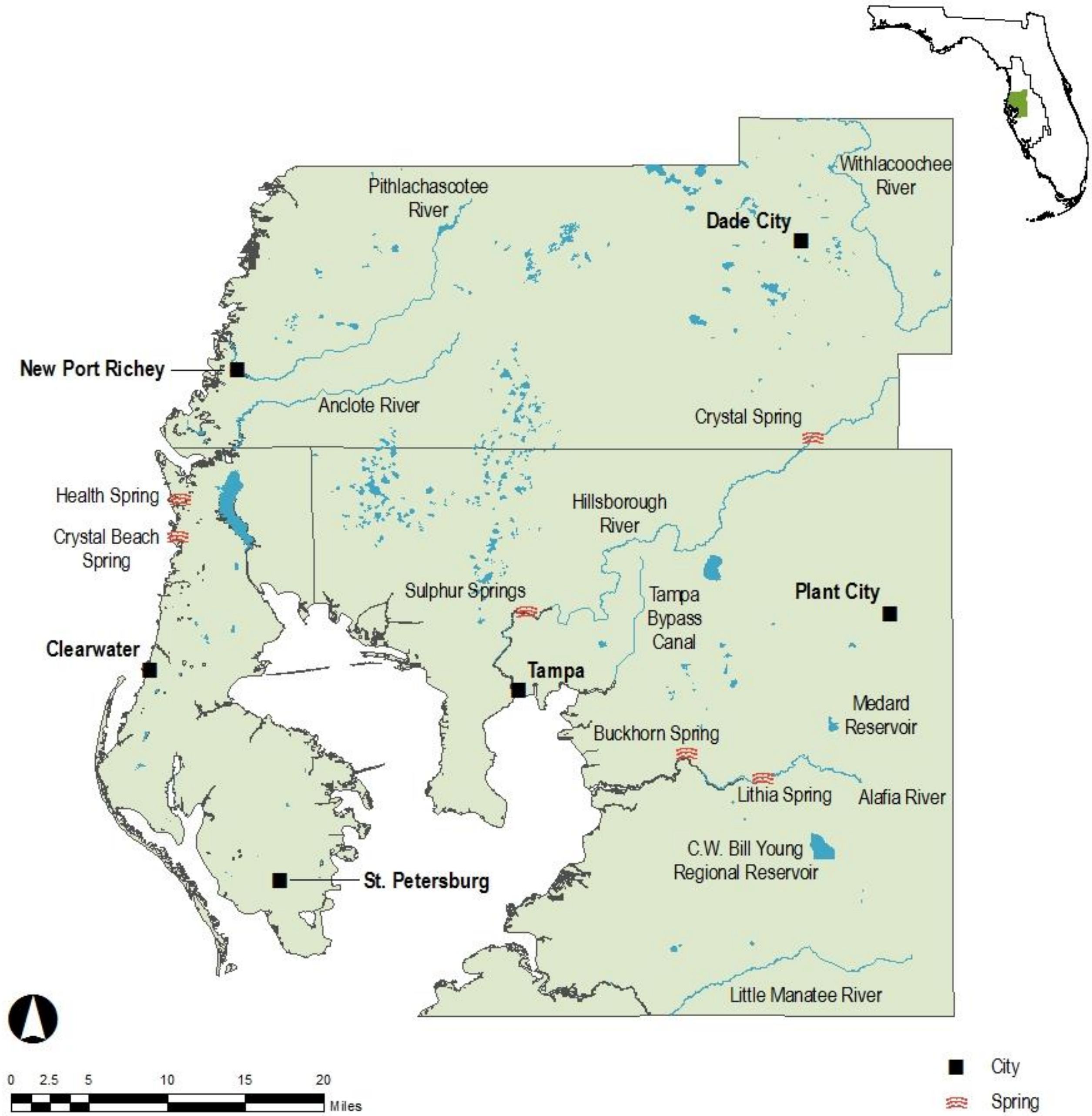

Figure 1-2. *Major hydrologic features in the Tampa Bay Planning Region*

The District is periodically questioned about freshwater springs in the Gulf of Mexico and the possibility of utilizing them for water supply. In response to these inquiries, the District conducted a two-year study of submarine springs in the Gulf of Mexico and Tampa Bay (Dewitt et al., 2003). The water quality and quantity of discharge were investigated at a number of submarine spring and karst features. Although some of the features discharged significant quantities of water, the quality of water in all cases was highly saline. This result was expected because the saltwater/freshwater interface (the boundary between fresh and saline groundwater in the UFA) is located onshore in much of the planning region. Therefore, it is highly unlikely that fresh groundwater could be discharging offshore through springs.

4.0 Wetlands

Prior to significant development, approximately 54 percent of Florida was covered by wetlands. However, due to drainage and development, only approximately 30 percent of the state currently remains covered by wetlands. Approximately 25 percent of the Tampa Bay Planning Region is covered by either isolated cypress or riverine wetlands. Wetlands in the planning region can be grouped into saltwater and freshwater types. Saltwater wetlands are found bordering estuaries that are coastal wetlands influenced by the mixing of fresh water and seawater. Salt grasses and mangroves are common estuarine plants. The Tampa Bay estuary contains the most significant portion of saltwater wetlands in the planning region. Significant coastal wetlands are also located along the western portions of northern Pinellas and Pasco counties. Freshwater wetlands are common in inland areas. Hardwood-cypress swamps and marshes are two major freshwater wetland systems. Both systems are found either bordering lakes and rivers or standing alone as isolated wetlands. The hardwood-cypress swamps are forested systems with water at or above land surface for a considerable portion of the year. Marshes are typically shallower systems vegetated by herbaceous plants rather than trees. Wet prairies, also present in inland areas, are vegetated with a range of mesic herbaceous species and hardwood shrubs and are inundated during the wettest times of the year. Extensive hardwood swamps and wet prairies occur throughout the Hillsborough and Withlacoochee river watersheds. The Green Swamp covers the entire eastern end of Pasco County with isolated wetlands typically vegetated by herbaceous plants.

Section 4. Geology/Hydrogeology

Three principal aquifer systems, the surficial, intermediate, and UFA, are present in the planning region and are used as water supply sources. The surficial and UFA are present throughout the region, while the intermediate aquifer system is present only in southern Hillsborough County. Where the intermediate aquifer system is absent, an intermediate clay confining bed separates the surficial aquifer from the underlying UFA. Figure 1-3 is a generalized north-south cross section of the hydrogeology of the District and Figure 1-4 shows the locations of the West-Central Florida Groundwater Basins.

As seen in the figures, the planning region is primarily located in the Central West-Central Florida Groundwater Basin, which is a hydrogeologic transition zone between the southern and northern parts of the District. The Southern West-Central Florida Groundwater Basin (SWCFGWB) encompasses the southern portion of the District where the intermediate aquifer system and its confining units become several hundred feet thick and separate the surficial and UFA. A small portion of the northeast part of the planning region is located in the North West-Central Florida Groundwater Basin where the confining unit is thin and discontinuous and eventually disappears further to the north.

The surficial aquifer is composed primarily of unconsolidated sediments made up of fine-grained sand, silt and clayey sands, with an average thickness of 30 feet. The aquifer is present throughout most of the region, except for limited portions of coastal Pasco County, and produces relatively small quantities of water, which are generally used for low-volume irrigation or domestic water supply.

Underlying the surficial aquifer over most of the planning region is the intermediate confining unit (ICU). The unit consists predominantly of thin and sometimes discontinuous clay that has been breached by karst features. This condition results in generally moderate-to-leaky confinement of the UFA over most of the planning area. As a result, groundwater withdrawals from the UFA in this leaky system can lower water levels in the overlying surficial aquifer, wetlands, and lakes. In southern Hillsborough County, an intermediate aquifer system exists that is composed of sand, gravel, and thin limestone beds with low permeability thicker sandy clays and clays lying above and below this unit. The aquifer system exists throughout the southern portion of the region, reaching a thickness of more than 100 feet in southern Hillsborough County. Further north, the unit thins and becomes a single ICU over the remainder of the planning region.

Underlying the ICU is the UFA. The UFA consists of a continuous series of carbonate units that include (in order of increasing geologic age and depth) portions of the Tampa Member of the Hawthorn Group, Suwannee Limestone, Ocala Limestone, and Avon Park Formation. The UFA is generally under semi-confined conditions in most of the region due to the presence of the ICU. The aquifer can be separated into upper and lower flow zones. The Tampa Member of the Hawthorn Group and the Suwannee Limestone form the upper flow zone. The lower zone is the highly transmissive portion of the Avon Park Formation. The two zones are separated by the lower permeability Ocala Limestone. The two flow zones are connected through the Ocala by diffuse leakage, vertical solution openings along fractures, or other zones of preferential flow (Menke et al., 1961). Gypsum beds become interbedded within the Avon Park Formation near its base which serves as the bottom confining unit of the freshwater flow system. This unit is referred to as middle confining unit II (MCU II) (Miller, 1986). It is composed of evaporite minerals such as gypsum and anhydrite, which occur as thin beds or as nodules within dolomitic limestone that overall has very low permeability. The MCU II is generally considered to be the base of the freshwater production zone of the aquifer. Water quality and yield of the UFA are generally good, except where brackish groundwater occurs in close proximity to the coast. Groundwater from the aquifer is widely used for municipal and private water supplies in the planning region.

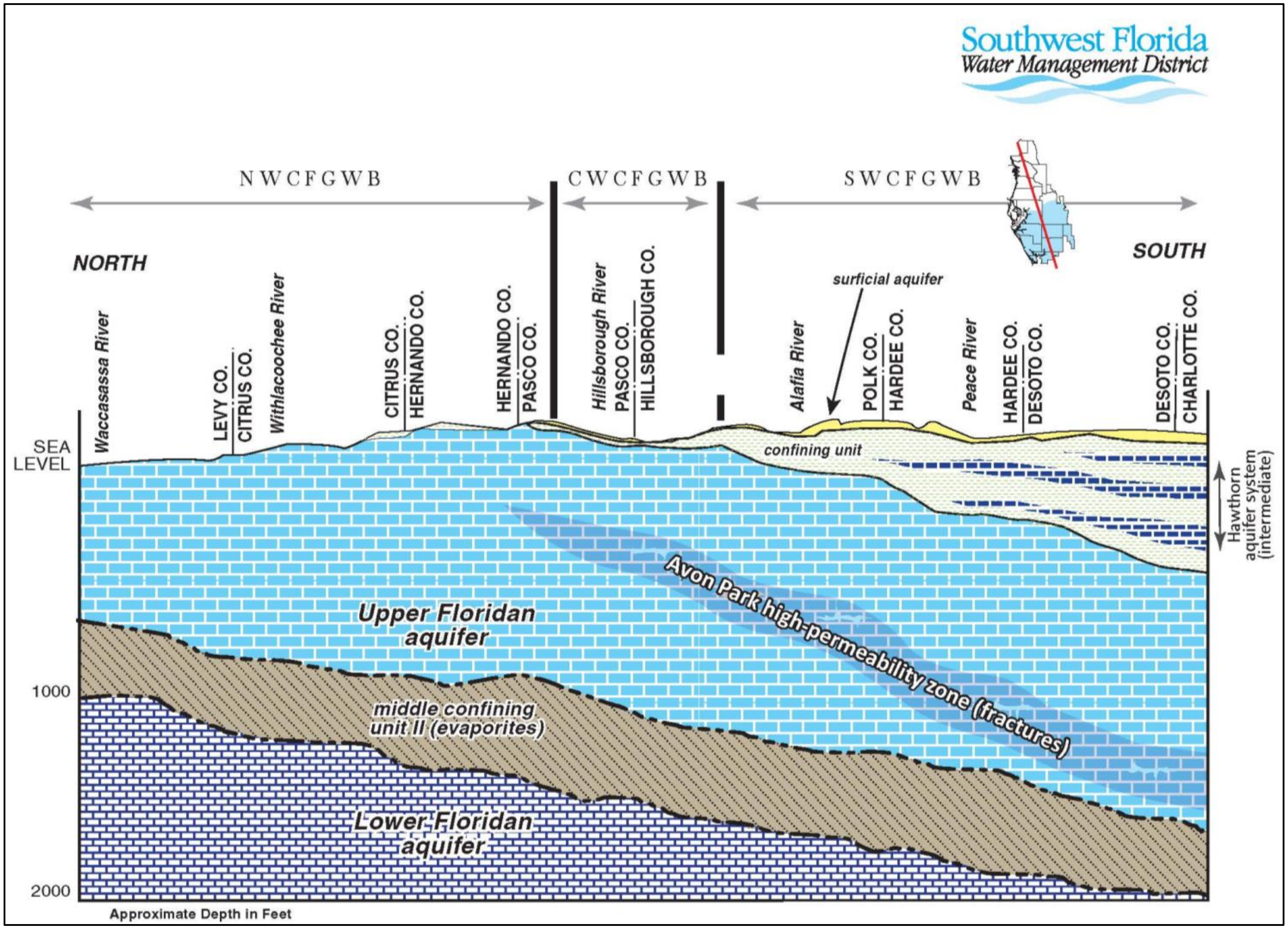

Figure 1-3. *Generalized north-south geologic cross section through the District*

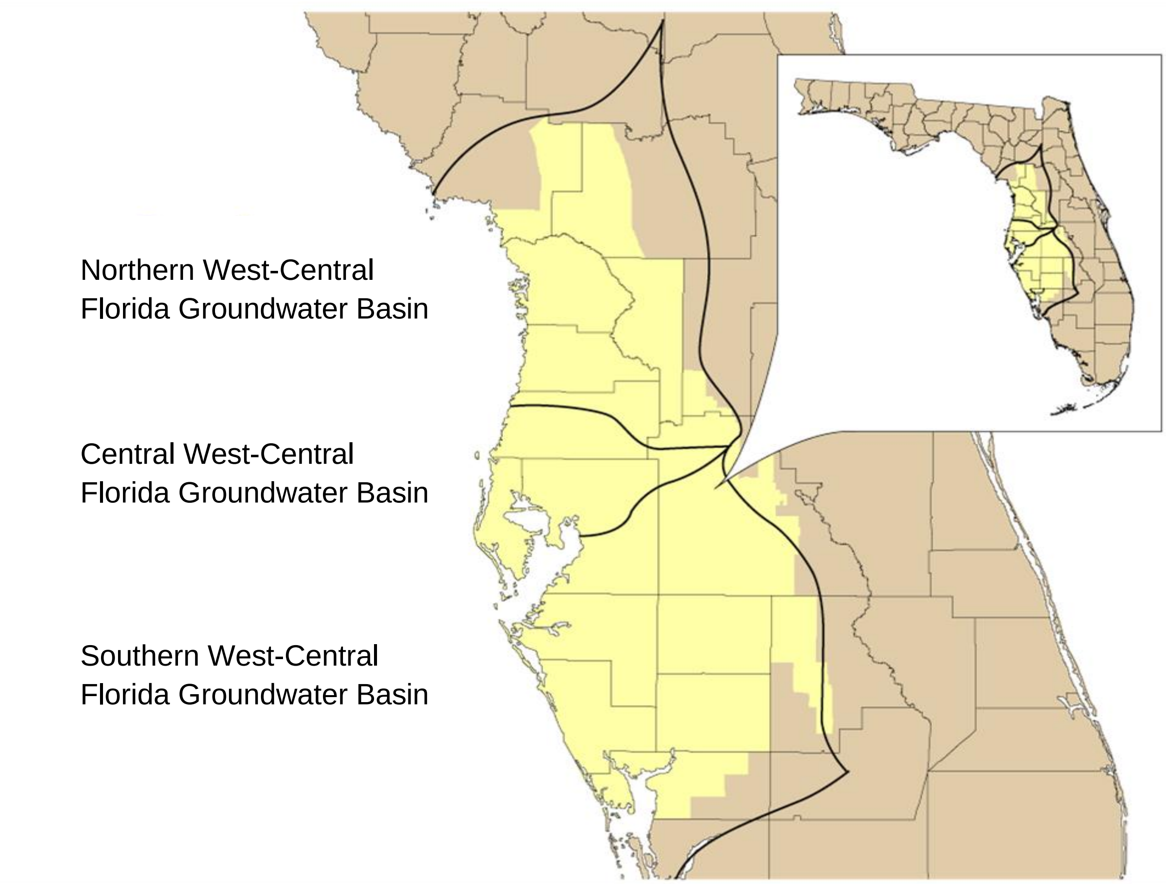

Figure 1-4. *The District and the West-Central Florida Groundwater Basins*

Part D. Previous Technical Investigations

The 2020 RWSP builds on a series of cornerstone technical investigations that were undertaken by the District and the U.S. Geological Survey (USGS) beginning in the 1970s. These investigations provide the District with an understanding of the complex relationships between human activities (i.e., surface water and groundwater usage and large-scale land-use alterations), climatic cycles, aquifer/surface water interactions, aquifer and surface hydrology, and water quality. Investigations conducted in the planning region and in areas adjacent to it are listed by categories and briefly outlined below.

Section 1. Water Resource Investigations

During the past 30 years, various water resource investigations were initiated by the District to collect critical information about the condition of Districtwide water resources and the impacts of human activities on them. Following the Florida Water Resources Act of 1972 (Chapter 373, F.S.), the District began to invest in enhancing its understanding of the effects of water use, drainage and development on the water resources and ecology of west-central Florida. A major result of this investment was the creation of the District's Regional Observation and Monitor-well Program (ROMP), which involved the construction of monitor wells and aquifer testing to better characterize groundwater resources and surface water and groundwater interactions. Approximately a dozen wells were drilled annually and in the 1980s, data collected from these wells began to be used in a number of hydrologic assessments that clearly identified regional resource concerns.

During the 1980s, hydrologic and biologic monitoring from the District's expanded data collection networks began to reveal water resource impacts in other areas of the District. In the late 1980s, the District initiated detailed water resource assessment projects (WRAPs) of the Eastern Tampa Bay (ETB) and NTB areas to determine causes of water level declines and to address water supply availability. Resource concerns in these areas included lowered lake and wetland levels in the NTB area and saltwater intrusion in the UFA aquifer in the ETB area.

In 1989, based on the preliminary findings of the WRAP studies and continued concern about water resource impacts, the District established the NTB and ETB WUCAs (NTBWUCA and ETBWUCA) and implemented a strategy to address the resource concerns, which included comprehensive studies to determine long-term water supply availability. From May 1989 through March 1990, there were extensive public work group meetings to develop management plans for the ETB and NTB WUCAs. These meetings are summarized in the Eastern Tampa Bay Work Group Report (SWFWMD, 1990) and Management Plan (SWFWMD, 1990b) and Northern Tampa Bay Work Group Report (SWFWMD, 1990c) and Management Plan (SWFWMD, 1990d). These deliberations led to major revisions to the District's water use permitting rules as special conditions were added that applied to the ETBWUCA, NTBWUCA, and other WUCAs. It was also during these deliberations that the original concept of the SWUCA emerged. The ETB Work Group had lengthy discussions on the connectivity of the groundwater basin and how withdrawals throughout the basin were contributing to saltwater intrusion. A significant finding of the ETB WRAP was that the lowering of the potentiometric surface within the area was due to groundwater withdrawals from beyond, as well as within the area. Additionally, the ETB WRAP concluded that there was a need for a basin-wide approach to the management of the water resources. Based on results of these studies and work group discussions, in October 1992, the District established the SWUCA to encompass both the ETB area and the remainder of the SWCFGWB.

Beginning in October 1998, the District adopted MFLs for several water bodies in the NTBWUCA (Chapter 40D-8, Florida Administrative Code [F.A.C.]). To address recovery of these natural systems, the District adopted the Recovery Strategy for Pasco, Northern Hillsborough, and Pinellas counties, or the "Recovery Strategy" (Rule 40D-80.073, F.A.C.) in 2000. Among other stipulations, the Recovery Strategy required that groundwater withdrawals from TBW's central system would be reduced to rates that could not exceed 90 mgd on a 12-month moving average basis by 2008. To compensate for this reduction in groundwater withdrawals, greater reliance would be placed on using alternative public water supplies, such as surface waters and a seawater desalination facility. In keeping with the intent of the Recovery Plan, TBW now obtains surface water supplies from the TBC, the Hillsborough and Alafia Rivers, maintains a 15.5 billion gallon offline reservoir, and maintains a 25 mgd capacity seawater desalination plant on Tampa Bay. In 2010, the District adopted a second phase of recovery for the NTBWUCA, entitled the Comprehensive Environmental Resources Recovery Plan for the NTBWUCA (Rule 40D-80.073, F.A.C.), or the "Comprehensive Plan". Among other actions, the Comprehensive Plan requires TBW to assess the water resources of the area and identify any remaining unacceptable adverse impacts caused by the 90 mgd of groundwater permitted to be withdrawn from their wellfields. The plan also requires TBW to develop a plan to address any identified unacceptable adverse impacts by 2020. The District is currently working with TBW on these assessments and plans.

The District also established MFLs for several water bodies in the SWUCA and adopted a SWUCA Recovery Strategy (SWFWMD, 2006) to address depressed aquifer levels causing saltwater intrusion along the coast, reduced flows in the upper Peace River, and lower lake levels in areas of Polk and Highlands counties. A five-year assessment of the recovery strategy for FY2007 to FY2011 was completed in 2013 (SWFWMD, 2013), with the second five-year assessment for FY2012 to FY2016 completed in 2018 (SWFWMD, 2018). The District continues to work with key stakeholders and the public on the development and implementation of recovery options within the SWUCA.

Section 2. U.S. Geological Survey Hydrologic Investigations

The District has a long-term cooperative program with the U.S. Geological Survey (USGS) to conduct hydrogeologic investigations that are intended to supplement work conducted by District staff. The projects are focused on improving the understanding of cause-and-effect relationships and developing analytical tools for resource evaluations. Funding for this program is generally on a 50/50 cost-share basis with the USGS. However, this varies based on whether other cooperators are involved in the project and if requests for non-routine data collection or special project assignments are implemented. The District's cooperative investigations with the USGS have typically been focused on regional hydrogeology, water quality, and data collection. Over the years, several groundwater and surface water cooperative projects have been completed in and around the planning region. In addition, a number of projects and data collection activities are in progress. Completed and ongoing cooperative District/USGS investigations and data collection activities are listed in Table 1-2.

Table 1-2. *District/USGS cooperative hydrologic investigations and data collection activities applicable to the Tampa Bay Planning Region*

Investigation Type	Description
Completed Investigations	
Groundwater	Regional Groundwater Flow System Models of the SWFWMD, Cypress Creek, Cross Bar and Morris Bridge Wellfields, and the St. Petersburg Aquifer Storage and Recovery Site
	Hydrogeologic Characterization of the Intermediate Aquifer System
	Parameter Estimation and Optimization Simulating Groundwater Flow in the NTB Area
Groundwater and Surface Water	Hydrologic Assessment of the Alafia River
	Statistical Characterization of Lake-Level Fluctuations
	Lake-Stage Statistics Assessment to Enhance Lake Minimum Level Establishment
	Lake Augmentation Impacts
	Effects of Using Groundwater for Supplemental Hydration of Lakes and Wetlands
	Use of Groundwater Isotopes to Estimate Lake Seepage in the NTB and Highlands Ridge Lakes
	Effects of Recharge on Interaction Between Lakes and the Surficial aquifer
	Relation of Geology, Hydrology, and Hydrologic Changes to Sinkhole Development in the Lake Grady Basin
	Relationship Between Groundwater Levels, Spring Flow, Tidal Stage, and Water Quality for Selected Springs in Coastal Pasco, Hernando, and Citrus Counties
	Surface and Groundwater Interaction in the Upper Hillsborough River Basin
	Hydrologic Changes in Wellfield Areas of NTB
	Effects of Development on the Hydrologic Budget of the SWUCA
Surface Water	Primer of Hydrogeology and Ecology of Freshwater Wetlands in Central Florida
	Methods to Define Storm-Flow and Base-Flow Components of Total Stream Flow in Florida Watersheds
	Factors Influencing Water Levels in Selected Impaired Wetlands in the NTB Area
Ongoing Investigations/Data Collection Activities	
Data Collection	MFL Data Collection
	Surface Water Flow, Level, and Water Quality Data Collection
	Statewide Light Detection and Ranging (LiDAR) Mapping
	Mapping Actual Evapotranspiration Over Florida Model Support
	Statewide Geostationary Operational Environmental Satellites (GOES) Evapotranspiration (ET) Project

Section 3. Water Supply Investigations

Water Supply investigations for the planning region were initiated in the 1960s as part of the U.S. Army Corps of Engineers (USACE) Four River Basins project. The Four River Basins project began as a flood control project developed in response to severe coastal and inland flooding caused by Hurricane Donna in September 1960. The District was formed in 1961 to help implement this federal project, which led to development of several large control structures including the TBC, the Lake Tarpon and Tsala-Apopka Outfalls, and the Masaryktown Canal. Following a period of drought conditions in the mid-1960s that led to numerous dry well complaints, along with findings of project-related ecological studies, there was an apparent need for a broader-based approach to water management than just flood control. The scope of the Four River Basins project was expanded into a more comprehensive effort to assess water resources in the region and determine ways to utilize excess surface water and groundwater for regional water supply solutions. The revised approach led to changes for the TBC design to allow surface water transfers to the City of Tampa; the use of land preservations for water recharge and natural flood attenuation; and the cancellation of other structural projects that would have greatly altered environmental resources.

Since the 1970s, the District conducted numerous hydrologic assessments designed to assess the effects of groundwater withdrawals and determine the availability of groundwater in the region. In the late 1980s, the Florida Legislature directed the WMDs to conduct a Groundwater Basin Resource Availability Inventory (Section 373.0395, F.S.) covering areas deemed appropriate by the WMD Governing Boards. The District completed inventory reports for the 13 counties predominantly located within its jurisdiction. These reports described the groundwater resources of the individual counties and respective groundwater basins.

Based on the hydrologic assessments and the District's continuous hydrologic and biologic monitoring programs, the District established three WUCAs in the late 1980s in response to observed impacts of groundwater withdrawals. The District subsequently prepared the Water Supply Needs & Sources: 1990–2020 study (SWFWMD, 1992) to assess future water demands through the year 2020 and groundwater supply limitations in some areas. One objective of the study was to optimize resource management to provide for reasonable and beneficial uses without causing unacceptable impacts to water resources, natural systems, and existing legal users. Major recommendations of the study included reliance on local sources to the greatest extent practicable before pursuing more distant sources; requiring users to increase their water use efficiency; and pursuing a regional approach to water supply planning and future development.

In 1997, the Florida Legislature significantly amended Chapter 373, F.S., to include specific regional water supply planning requirements for the WMDs. The statutes were revised to require the preparation of a Districtwide Water Supply Assessment; the designation of one or more water supply planning regions within each district; and the preparation of a RWSP for any planning regions where sources of water were determined to be inadequate to meet future demands. The statute requires the reassessment of the need for a RWSP every 5 years, and that each RWSP shall be based on a minimum 20-year timeframe (Section 373.0361, F.S.). In response to the amended statutes, the District completed a Water Supply Assessment in 1998 that quantified water supply needs through the year 2020 and identified areas where future demand could not be met with traditional groundwater sources (SWFWMD, 1998). The District published its first RWSP in 2001 for the 10 counties located in the SWUCA and NTBWUCA (SWFWMD, 2001).

The 2001 RWSP quantified water supply demands through the year 2020 within these counties and identified water supply options for developing sources other than fresh groundwater.

The RWSP was updated in 2006, and the planning period was extended to 2025. The 2006 RWSP concluded that fresh groundwater from the UFA would be available to meet future demands on a limited basis only and that sufficient alternative sources existed in the 10-county planning region to meet projected demands through 2025 (SWFWMD, 2006). It also concluded that a regional approach to meeting future water demands, including regional transmission systems, was required for some areas that had limited access to alternative water supplies.

The District's 2010 and 2015 RWSP updates extended the planning horizons to 2030 and 2035, respectively, and included four regional volumes covering all counties of the District. It was concluded that the Northern Planning Region demand for water through 2035 could be met with fresh groundwater; however, the need for additional fresh groundwater supplies could be minimized through the use of available reclaimed water and implementation of comprehensive water conservation measures. This could result in averting impacts such as those witnessed in other regions. For the remaining three planning regions, both the 2010 and 2015 RWSPs adopted several AWS options that were developed or are currently under development by the respective regional water supply authorities in those regions.

Section 4. Minimum Flows and Levels Investigations

Extensive field-data collection and analysis is typically required to support MFLs development. These efforts include measurement of water levels and flows, assessment of aquatic and semi-aquatic plant and animal species or communities and their habitats, water quality characterization, and assessment of current and projected withdrawal-related impacts. Ultimately, ecological and hydrological information are linked using some combination of conceptual, statistical, and numerical models to assess environmental changes associated with potential flow or level reductions. Goals for these analyses include identifying sensitive criteria that can be used to establish MFLs and prevent significant harm to a wide-range of human-use and natural system values.

Section 5. Modeling Investigations

Since the 1970s, the District has developed numerous computer models to support resource evaluations and water supply investigations. These models have been subdivided into groundwater flow models for general resource assessments and solute transport models to assess past and future saltwater intrusion. In recent years, the District has begun to support the use of integrated hydrologic models that simulate the entire hydrologic cycle and include information of both the surface water and groundwater flow systems. These models are used to address issues where the interaction between groundwater and surface water is significant.

Many of the early groundwater flow models were developed by the USGS through the cooperative studies program with the District. Over time, as more data was collected and computers became more sophisticated, the models developed by the District have included more detail about the hydrologic system. The end result of the modeling process is a tool that can be used to assess effects of current and future withdrawals and better understand hydrologic relationships.

1.0 Groundwater Flow Models

Beginning in the late 1970s, the USGS, with cooperative funding from the District, created several models of the NTB area that were generally used to evaluate effects of withdrawals for specific wellfield areas. Using information from these models, the District (Bengtsson, 1987) developed a transient groundwater model of the NTB area with an active water table to assess effects of withdrawals on surficial aquifer water levels. In 1993, the District completed development of the NTB model, which covered approximately 1,500 square miles (Hancock and Basso, 1993). Together with monitoring data, the NTB model was used to characterize and quantify the magnitude of groundwater withdrawal impacts occurring in the region. In addition to the models developed by the District and USGS, models have been developed by TBW to support requests for surface water and groundwater withdrawals.

The Northern Planning Region groundwater flow model (also known as the Northern District Model [NDM]) covers the northern half of the District, and portions of the St. Johns and Suwannee River WMDs (HydroGeoLogic, Inc., 2008, 2010, 2011, 2013, Dynamic Solutions Inc. and HydroGeoLogic, Inc., 2016). This model, first completed in 2008, has been updated in 2010, 2011, 2013, and most recently in 2016 with version five. When first developed, the model was unique for west-central Florida in that it was the first regional groundwater flow model that represented the aquifer system as fully three-dimensional. The model contains seven active layers, which include the surficial aquifer or unsaturated zone, the ICU, Suwannee Limestone, Ocala Limestone, Avon Park Formation, middle confining unit (MCU) and the Lower Floridan aquifer (LFA). The model was expanded eastward in 2013 to the St. Johns River to encompass all of Marion County through a cooperatively funded agreement between the District, St. Johns River Water Management District (SJRWMD), Withlacoochee Regional Water Supply Authority (WRWSA), and Marion County. The model was expanded at the request of Marion County so that one model could be used by both districts for Marion County water resource investigations. The Northern Planning Region model serves as an important tool to examine potential impacts to wetlands, lakes, springs, and the Withlacoochee River from regional groundwater withdrawals. The results of these predictions have been used by the District to support water supply planning assessments and establishment of MFLs, primarily from Hernando County north.

The Districtwide Regulation Model (DWRM) was developed to produce a regulatory modeling platform that is technically sound, efficient, reliable, and has the capability to address cumulative impacts. The DWRM was initially developed in 2003 (Environmental Simulations, Inc., 2004). It is mainly used to evaluate whether requested groundwater withdrawal quantities in WUP applications have the potential to cause unacceptable impacts to existing legal users, off-site land uses, and environmental systems on an individual and cumulative basis. The DWRM Versions 1, 2, 2.1, and 3 (Environmental Simulations, Inc., 2004, 2007, 2011, 2014) incorporate Focused Telescopic Mesh Refinement (FTMR), which was developed to enable DWRM to be used as a base model for efficient development of smaller scale sub-models (FTMR models). The FTMR uses a fine grid around a well or group of wells and increasing grid spacing out to the edge of the model. It was specifically designed to enhance WUP analysis. DWRM Version 3 simulates groundwater flow of the entire District using a quasi-3D conceptualization of the Modular finite Difference Groundwater Flow Model code (MODFLOW2005). DWRM3 simulates groundwater flow in the surficial, intermediate, UFA and LFA. The DWRM3 supports current regulatory functions as a core business process addressed in the District's Strategic Plan.

2.0 Saltwater Intrusion Models

There have been three major models developed to simulate historical and future saltwater intrusion in the SWUCA. The first of these models was a series of three, two-dimensional cross-sectional models capable of simulating density-dependent flow known as the ETB Cross-Section Models (HydroGeoLogic, Inc., 1994). Each model was designed as a geologic cross section located along flow paths to the Gulf of Mexico or Tampa Bay. These models were used to make the initial estimates of movement of the saltwater-freshwater interface in the former ETBWUCA. To address the three-dimensional nature of the interface, a sharp interface code, known as Saltwater Intrusion Model for Layered Aquifer Systems, was developed by HydroGeoLogic, Inc. (1993) for the District. The code was applied to the ETB area, creating a sharp interface model of saltwater intrusion. Subsequent to this, the cross-sectional models were refined (HydroGeoLogic, Inc. 1994) and the results were compared to those of the sharp interface model (HydroGeoLogic, Inc. 1994). The cross-sectional models compared well with the sharp interface model.

In support of establishing a MAL to protect against saltwater intrusion in the most impacted area (MIA) of the SWUCA, a fully three-dimensional, solute transport model of the ETB area was developed in 2002 by HydroGeoLogic, Inc. The model encompasses all of Manatee and Sarasota counties, the southern half of Hillsborough and Pinellas counties, and extends approximately 25 miles offshore. The model only simulates flow and transport in the UFA. Estimates of the number of wells and amount of water supply at risk to future saltwater intrusion under different pumping scenarios were derived using this model.

Although regional saltwater intrusion in the NTB and Northern Planning Region areas is not a significant resource concern, salinity increases have been observed in local areas. Saltwater intrusion models completed for the area include Dames and Moore, Inc. (1988), GeoTrans, Inc. (1991), HydroGeoLogic, Inc. (1992) and Tihansky (2005). These models have generally confirmed the localized nature of saltwater intrusion in the NTB area. HydroGeoLogic, Inc. completed a regional saltwater intrusion model in 2008 that covered the coastal region of Pasco, Hernando, Citrus, and Levy counties. This work was completed in conjunction with the development of the Northern District groundwater flow model. Results of the saltwater intrusion model showed no significant regional movement of the saltwater interface over the next 50 years (HydroGeoLogic, Inc., 2008).

3.0 Integrated Groundwater/Surface Water Models

In 1997, SDI-Environmental developed the first fully integrated model of the area that covered an area larger than that of the NTB model. The District worked with TBW to develop a new generation of integrated model, the Integrated Northern Tampa Bay model (INTBM), which was initially used in 2007 and finalized in 2013 (Geurink and Basso, 2013). The model covers a 4,000-square-mile area of the Tampa Bay region. This advanced tool combines a traditional groundwater flow model with a surface water model and contains an interprocessor code that links both systems, which allows for simulation of the entire hydrologic system. The model has been used in MFL water resource investigations of the Hillsborough, Anclote, and Pithlachascotee rivers and Crystal and Weeki Wachee springs. The INTBM has been and will be used in water supply planning to determine future groundwater availability, evaluate MFLs and evaluate recovery in the NTB area resulting from the phased reductions in withdrawals from TBW's 11 central-system wellfields, as required by the Partnership Agreement.

Chapter 2. Resource Protection Criteria

This chapter addresses the primary strategies the District employs to protect water resources, which include water use caution areas (WUCAs), minimum flows and levels (MFLs), prevention and recovery strategies, reservations, and climate change.

Part A. Water Use Caution Areas

Section 1. Definitions and History

Water Use Caution Areas (WUCAs) are areas where the District's Governing Board has determined that regional action is necessary to address cumulative water withdrawals that are causing adverse impacts to the water and related natural resources or the public interest. District regional water supply planning is the primary tool in ensuring water resource sustainability in WUCAs. Florida law requires regional water supply planning in areas where it has been determined that existing sources of water are not adequate for all existing and projected reasonable-beneficial uses, while sustaining the water resources and related natural systems. Regional water supply planning quantifies the water needs for existing and projected reasonable-beneficial uses for at least 20 years, and identifies water supply options, including traditional and alternative sources. In addition, MFLs, established for priority water bodies pursuant to Chapter 373, Florida Statutes (F.S.), identify the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. If the existing flow or level of a water body is below, or is projected to fall below, the applicable minimum flow or level within 20 years, a recovery or prevention strategy must be implemented as part of the regional water supply plan (RWSP). Figure 2-1 depicts the location of the District's current WUCAs. In order to determine whether an area should be declared a WUCA, the Governing Board must consider the following factors:

- Quality of water available for use from groundwater sources, surface water sources, or both, including impacts such as saline water intrusion, mineralized water upconing or pollution.
- Environmental systems, such as wetlands, lakes, streams, estuaries, fish and wildlife, or other natural resources.
- Lake stages or surface water rates of flow.
- Off-site land uses.
- Other resources as deemed appropriate.

In the late 1980s, the District determined that certain interim resource management initiatives could be implemented to help prevent existing problems in the water resource assessment project (WRAP) areas from getting worse prior to the completion of each WRAP. As a result, in 1989, the District established three WUCAs: Northern Tampa Bay (NTBWUCA), Eastern Tampa Bay (ETBWUCA), and Highlands Ridge (HRWUCA). For each of the initial WUCAs, a three-phased approach to water resource management was implemented, including: (1) short-term actions that could be put into place immediately, (2) mid-term actions that could be implemented concurrent with the ongoing WRAPs, and (3) long-term actions that would be based upon the results of the WRAPs. In addition to the development of conservation plans, cumulative impact analysis-based permitting and requiring withdrawals from stressed lakes to cease within three years, the District developed management plans for each WUCA to stabilize and restore the water resources in each area through a combination of regulatory and non-regulatory efforts. One significant change that occurred as a result of the implementation of the management plans was the designation of the most impacted area (MIA) in the ETBWUCA. The MIA consists of the coastal portion of the SWUCA in southern Hillsborough, Manatee and northern Sarasota counties. The Saltwater Intrusion Minimum Aquifer Level (SWIMAL) was established to stabilize regional water level declines so that long-term management efforts could slow the rate of regional saltwater intrusion in the MIA. Within this area, no increases in permitted groundwater withdrawals from the UFA were allowed and withdrawals from outside the area could not cause further lowering of UFA levels within the area. The ETBWUCA and HRWUCA were superseded in 1992 by the establishment of the Southern Water Use Caution Area (SWUCA), which encompasses the entire southern portion of the District. The NTBWUCA was expanded in 2007 to include an additional portion of northeastern Hillsborough County and the remainder of Pasco County. In 2011, the District established the Dover/Plant City WUCA (DPCWUCA) in eastern Hillsborough and western Polk counties following impacts from intense frost/freeze protection withdrawals. The District has not declared a WUCA in the Northern Planning Region; however, the St. Johns River Water Management District (SJRWMD) has declared a priority water resource caution area adjacent to the District boundary in Lake and Marion counties.

The District established the Dover/Plant City WUCA in eastern Hillsborough and western Polk counties following impacts from intense frost/freeze protection withdrawals.

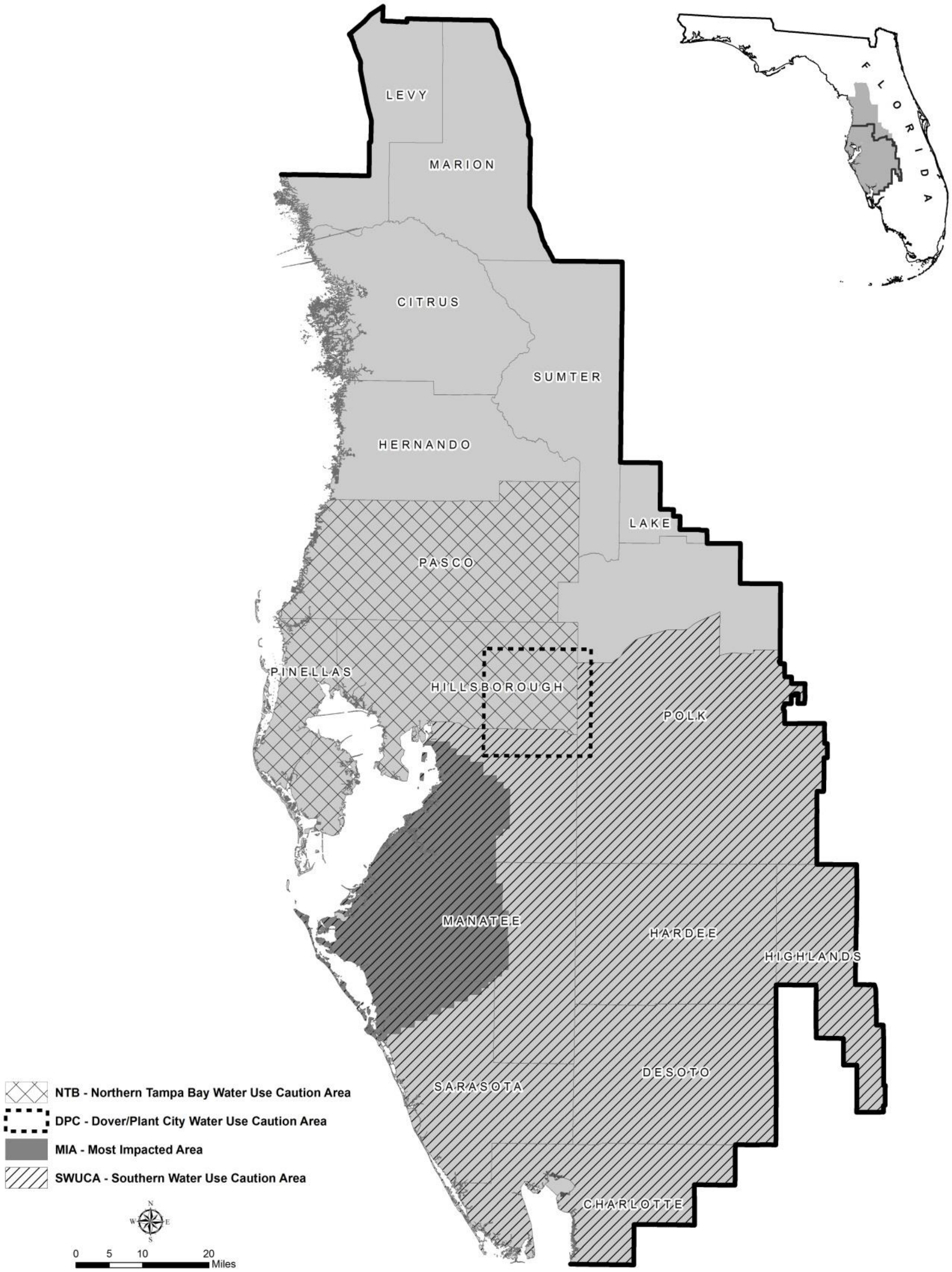

Figure 2-1. *Location of the District's water use caution areas and the MIA of the SWUCA*

1.0 Northern Tampa Bay Water Use Caution Area

In 1989, the District established the NTBWUCA, an area encompassing parts of Hillsborough and Pasco counties and all of Pinellas County. In 2007, the NTBWUCA was expanded to include an additional portion of northeastern Hillsborough County and the remainder of Pasco County. The District took these actions based on concerns about hydrologic impacts to wetlands, lakes, and rivers resulting from groundwater withdrawals and concerns regarding rapid growth and development pressures in the region. Because the majority of groundwater use in the NTBWUCA is for public supply, most of the water resource impacts were located in areas surrounding the major public supply (PS) wellfields.

To address effects of these water resource impacts, the District has taken several important actions, including the implementation of an enhanced MFLs program. Beginning in October 1998, the District approved and ultimately established new MFLs in the Northern Tampa Bay (NTB) area for cypress wetlands, lakes, rivers, springs and the UFA. Additionally, the District has committed to collecting additional data to support the refinement and improvement of its MFLs methodologies and to study the benefits of using other management methods, such as augmentation, to achieve adopted MFLs. In 2000, the District initiated the Northern Tampa Bay Phase II Local Technical Peer Review Group to coordinate with local governments, agencies and other stakeholders on hydrologic, biologic and geologic studies being performed in the NTBWUCA.

Concurrent with the District's efforts to establish and refine MFLs in the region, Tampa Bay Water (TBW) and its member governments entered into an agreement in 1998 with the District to significantly reduce groundwater withdrawals from its Central System Facilities (Cosme-Odessa, Eldridge-Wilde, Section 21, South Pasco, Cypress Creek, Cross Bar Ranch, Starkey, Morris Bridge, Northwest Hillsborough Regional, Cypress Bridge, and North Pasco wellfields) and work toward recovery in areas where water resources had been impacted. This agreement, commonly referred to as the Partnership Agreement, established that groundwater withdrawals from the Central System Facilities operated by TBW would be reduced from 158 mgd to 90 mgd (12-month moving average) by January 1, 2008. The Partnership Agreement was one part of the Recovery Strategy for Pasco, Hillsborough, and Pinellas counties (Recovery Strategy), a plan adopted by rule 40D-80.073, Florida Administrative Code (F.A.C.) in 1999 for environmental recovery in the NTBWUCA. As part of the Partnership Agreement, the District combined all of the permits for the Central System Facilities into a single permit known as the Consolidated Permit. The Consolidated Permit requires an extensive water resource monitoring network around the individual wellfields, along with many other data reporting and planning requirements. It is anticipated that a monitoring network developed by TBW will address most of the data collection needs in and around major withdrawal centers, while District efforts will focus on the areas between and beyond the TBW withdrawal centers.

In 2010, the District adopted a second phase of recovery for the area, entitled the Comprehensive Environmental Resources Recovery Plan for the Northern Tampa Bay Water Use Caution Area (Comprehensive Plan). Among other actions, the Comprehensive Plan requires TBW to assess the water resources of the area and identify any remaining unacceptable adverse impacts caused by the 90 mgd of groundwater withdrawn from their Central System Facilities. The plan also required TBW to develop a plan to address any identified unacceptable adverse impacts by 2020. This plan could include projects that require an environmental restoration demand.

In 2011, the District renewed the Consolidated Permit through 2020, at which time many of the requirements of the Comprehensive Plan are due for District approval. The District expects to receive a Water Use Permit renewal application for Tampa Bay Water's Consolidated Permit during the summer of 2020. The Consolidated Permit includes ten PS wellfields (the North Pasco wellfield was permanently closed in 2018), providing 90 mgd of water supply for most of the NTB area. In addition, the Comprehensive Environmental Resources Recovery Plan, also known as the Phase II Recovery Plan, developed and adopted by rule and as a permit condition for assessing the hydrologic recovery achieved in the Phase I Recovery Plan (1998 to 2010), will be submitted to the District by Tampa Bay Water by the end of 2020.

2.0 Southern Water Use Caution Area

Since the early 1930s, groundwater withdrawals steadily increased in the Southern West-Central Florida Groundwater Basin (Figure 2-2) in response to growing demands for water from the mining and agricultural industries and later from public supply, power generation, and recreational uses. Before peaking in the mid-1970s, these withdrawals resulted in declines in UFA levels that exceeded 50 feet in some areas of the groundwater basin. The result of the depressed aquifer levels was saltwater intrusion in the coastal portions of the UFA, reduced flows in the upper Peace River and lowered water levels in some lakes within upland areas of Polk and Highland counties. In response to these resource concerns, the District established the SWUCA in 1992. The SWUCA encompasses all or portions of eight counties in the southern portion of the District, including all of the ETBWUCA, the HRWUCA, and the MIA within these counties. Although groundwater withdrawals in the region have stabilized over the past few decades as a result of management efforts, area water resources continue to be impacted by the historic decline in aquifer water levels.

In 1994, the District initiated rulemaking to modify its water use permitting rules to better manage water resources in the SWUCA. The main objectives of the rules were to (1) significantly slow saltwater intrusion into the confined UFA along the coast, (2) stabilize lake levels in Polk and Highlands counties, and (3) limit regulatory impacts on the region's economy and existing legal users. The principal intent of the rules was to establish a minimum aquifer level (MAL) and to allow renewal of existing permits, while gradually reducing permitted quantities as a means to recover aquifer levels to the established minimum level. A number of parties filed objections to parts of the rule and an administrative hearing was conducted. In March 1997, the District received the Final Order upholding the MAL, the science used to establish it, and the phasing in of conservation. However, in October 1997, the District appealed three specific components of the ruling and withdrew the MAL. Withdrawal of the MAL resulted because parts of the rule linked the level to the provisions for reallocation of permitted quantities and preferential treatment of existing users over new permit applications, both of which were ruled to be invalid.

In 1998, the District initiated a reevaluation of the SWUCA management strategy and, in March 2006, established minimum flows for the upper Peace River, minimum levels for eight lakes along the Lake Wales Ridge in Polk and Highlands counties, and a SWIMAL for the UFA in the MIA. Since most, if not all, of these water resources were not meeting their established MFLs, the District adopted a recovery strategy for the SWUCA in 2006 (SWFWMD, 2006). When the recovery strategy was adopted in 2006, it was estimated that recovery could be achieved if total groundwater withdrawals were reduced to approximately 600 mgd. As part of the strategy, the status of District monitoring efforts are reported to the Governing Board on an annual basis, and every five years a comprehensive review of the strategy is performed. Adjustments to the strategy will be made based on results of the ongoing monitoring and recovery assessments. In 2013, the District completed the first five-year review of the recovery strategy (SWFMWD 2013) that addressed the period from 2007 through 2011. It was found that recent groundwater withdrawals in the region had declined to below 600 mgd; however, the upper Peace River, 16 lakes, and the most impacted area (MIA) aquifer level all remained below adopted MFLs. Because adopted MFLs for many water bodies were still not being met, the District initiated a series of stakeholder meetings to review results of the technical assessments and identify potential recovery options.

Four meetings were held in 2015 to address issues associated with MFLs recovery in the MIA and in the ridge lakes area. Meeting participants represented all the major water use groups, a variety of environmental organizations, state agencies and other interested parties. For the MIA, six options were identified to help meet the SWIMAL goal. The Governing Board voted to support five options (see below) and directed staff to gather more information on the exploration of aquifer recharge (AR) and aquifer storage and recovery (ASR). There was also subsequent approval of an increase to the District's cost share to 75 percent for Facilitating Agricultural Resource Management Systems (FARMS) projects in the MIA for a period of three years. This action was to encourage participation in the program. For the Ridge Lakes, three options were identified. The Board supported all three options (see below).

MIA Options:

- Continue Monitoring
- Update analytical tools
- Promote water conservation initiatives
- Expand FARMS
- Expand beneficial reuse

Ridge Lakes Options:

- Continue monitoring
- Reevaluate established minimum lake levels
- Evaluate options for individual lakes

The second SWUCA Recovery Strategy Five-Year Assessment addressed the period from 2012 through 2016 (SWFWMD 2018) and evaluated and assessed recovery in terms of trends in water resources, permitted quantities, and the development of projects and initiatives that address issues within the SWUCA. An important conclusion of the second five-year assessment was that the District continues to make progress toward recovery, but challenges remain to achieving full recovery by 2025. Recovery will ultimately be achieved through a combination of maintaining existing withdrawals at or below current levels and implementing water resource development (WRD) projects designed to augment or preserve levels and flows.

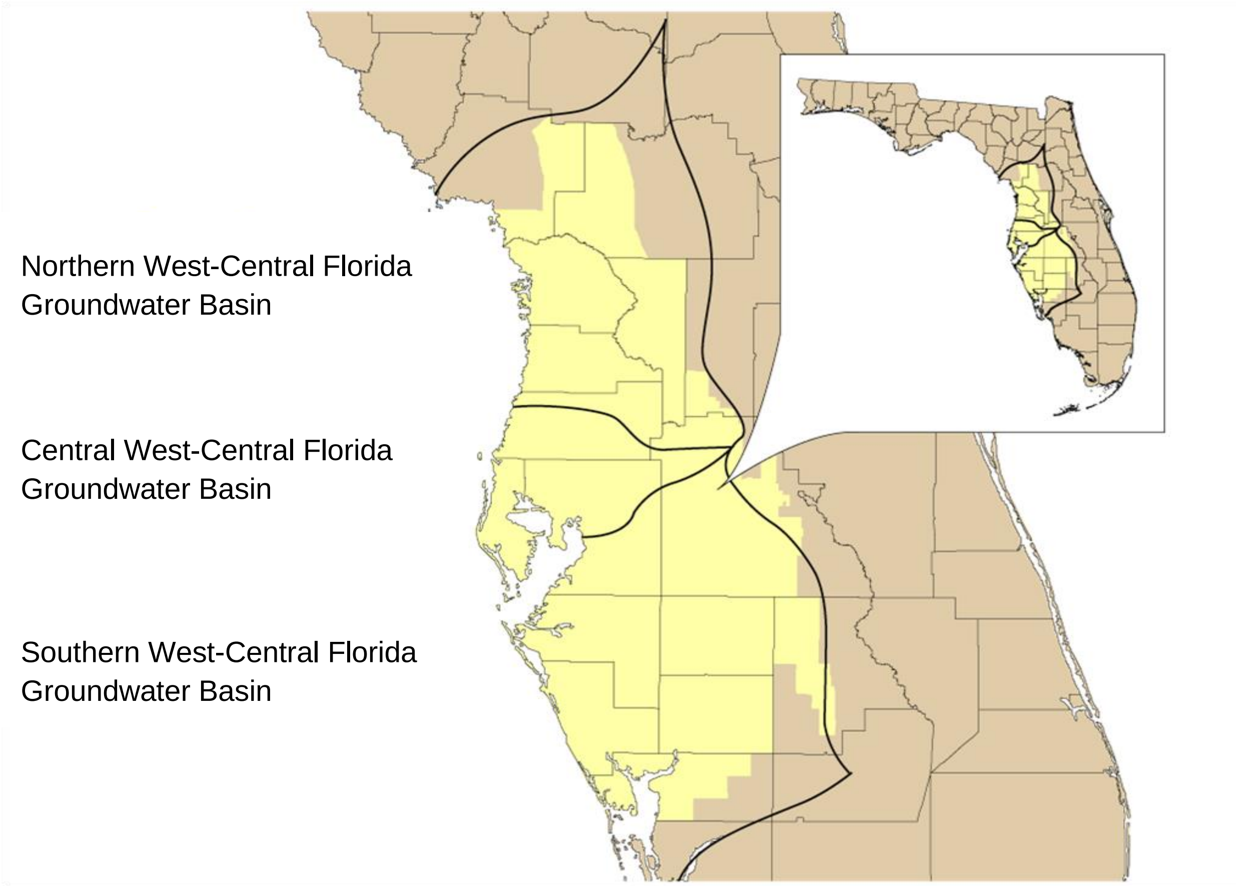

Figure 2-2. *Southwest Florida Water Management District and the West-Central Florida Groundwater Basins*

3.0 Dover/Plant City Water Use Caution Area

Groundwater withdrawals used for freeze protection of crops in the DPCWUCA between January 3, 2010, and January 13, 2010, resulted in UFA drawdown that contributed to a large number of sinkhole occurrences and more than 750 dry well complaints from neighboring domestic well owners. Agricultural users growing strawberries, citrus, blueberries, nursery ornamentals, as well as tropical fish farms at risk of frost/freeze damage and crop loss are permitted to use Floridan aquifer groundwater withdrawals as the primary freeze protection method. During an unprecedented nine nights of freezing temperatures over eleven consecutive days in January 2010, withdrawals totaling nearly 619,000 gpm occurred for approximately 65 hours in the Dover/Plant City area and were followed by withdrawals at a rate of approximately 433,000 gpm for an additional 19 hours.

In 2011, based on impacts associated with these withdrawals, the District established the DPCWUCA. This WUCA extends over a 256 square mile area in northeast Hillsborough County and eastern Polk County within portions of the NTBWUCA and the SWUCA (see Figure 2-1). Concurrent with the establishment of the DPCWUCA, the District adopted the MAL, Minimum Aquifer Level Protection Zone (MALPZ) and recovery strategy for the DPCWUCA.

The objective of the recovery strategy established by Rule 40D-80.075, F.A.C., for the DPCWUCA is to reduce groundwater withdrawals used for frost/freeze cold protection by 20 percent from the January 2010 withdrawal quantities by January 2020. Meeting this objective will lessen the potential for drawdown during future cold protection events to lower the UFA level at District monitor well DV-1 Suwannee below 10 feet (NGVD 1929). Recovery mechanisms identified in the rule include non-regulatory and regulatory approaches. The non- regulatory mechanisms include assistance in offsetting groundwater withdrawals for cold protection through the FARMS program, providing enhanced data for irrigation system management and other means. Projects are co-funded by the District and private enterprise to develop and enhance water conservation projects for the direct benefit of reducing cold protection groundwater withdrawals. For the regulatory approach, water use permitting rules in Chapter 40D-2, F.A.C., and the Water Use Permit (WUP) Applicant's Handbook, Part B, incorporated by reference in Rule 40D2.091, F.A.C., Section 7.4, address groundwater withdrawal impacts, alternative water supplies (AWSs), frost/freeze cold protection methods and resource recovery. New groundwater withdrawals for cold protection are not authorized within the MALPZ and any new permitted groundwater withdrawals outside the MALPZ cannot cause new drawdown impact at the MALPZ boundary. Alternative methods to groundwater withdrawals used for cold protection are to be investigated and implemented where practicable.

Part B. Minimum Flows and Levels

Section 1. Definitions and History

Section 373.042 of the Florida Water Resource Act of 1972 (Chapter 373, F.S.) directs the Florida Department of Environmental Protection (FDEP) or the water management districts (WMDs) to establish MFLs for priority water bodies using the best available information. The minimum flow for a given watercourse is defined by statute as the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. The minimum water level of an aquifer or surface waterbody is similarly defined as the level of groundwater in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources or ecology of the area.

Minimum flows and levels (MFLs) are established and used by the District for water resource planning as one of the criteria used for evaluating WUP applications and for the design, construction, and use of surface water management systems. Water bodies with MFLs benefit from District funding of water resource and water supply development (WSD) projects that are part of a recovery or prevention strategy identified for achieving an established MFL. The District's MFLs program addresses all MFLs-related requirements expressed in the Florida Water Resources Act and the Water Resource Implementation Rule (Chapter 62-40, F.A.C.).

Section 2. Priority Setting Process

In accordance with the requirements of Sections 373.036(7) and 373.042(2), F.S., the District annually updates its priority list and schedule for the establishment of MFLs. As part of developing the priority list and schedule, which also identifies water bodies scheduled for development of reservations, the following factors are considered:

- Importance of the water bodies to the state or region.

- Existence of or potential for significant harm to the water resources or ecology of the state or region.
- Required inclusion of all first-magnitude springs and all second-magnitude springs within state or federally owned lands purchased for conservation purposes.
- Availability of historic hydrologic records (flows and/or levels) sufficient to allow statistical analysis and calibration of computer models when selecting particular water bodies in areas with many water bodies.
- Proximity of MFLs already established for nearby water bodies.
- Possibility that the water body may be developed as a potential water supply in the foreseeable future.
- Value of developing an MFL for regulatory purposes or permit evaluation.
- Stakeholder input.

The updated priority list and schedule is submitted to FDEP for approval by November 15th each year and, as required by statute, is published in the District's Consolidated Annual Report The District's current priority list and schedule is also posted on the District website and is included in the Chapter 2 Appendix to this RWSP.

Section 3. Technical Approach to the Establishment of Minimum Flows and Levels

District methods used to establish MFLs for wetlands, lakes, rivers, springs, and aquifers are briefly summarized in the Chapter 2 Appendix to this RWSP. Additional details regarding MFLs methods are provided in District rules (Chapter 40D-8, F.A.C.) and within MFLs reports that are developed for individual priority water bodies and posted on the District website. Refinement and development of new MFLs methods and ongoing and new data collection efforts ensure that MFLs are established and reevaluated, as necessary, using the best available information.

The District's technical approach for MFLs development assumes that alternative hydrologic regimes may exist that differ from historic conditions but are sufficient to protect water resource features from significant harm. For example, consider a historic condition for an unaltered river or lake system with no local groundwater or surface water withdrawal impacts. A new hydrologic regime for the system would be associated with each increase in water use, from small withdrawals that have no measurable effect on the historic regime to large withdrawals that could substantially alter the regime. A threshold hydrologic regime may exist that includes water levels or flows that are lower or less than those of the historic regime, but which protects the water resources and ecology of the system from significant harm. This threshold regime could conceptually allow for water withdrawals while protecting the water resources and ecology of the area. MFLs established based on such a threshold hydrologic regime may therefore represent minimum acceptable, rather than historic or potentially optimal, hydrologic conditions.

1.0 Scientific Peer Review

Section 373.042(4), F.S., permits affected parties to request independent scientific peer review of the scientific and technical data and methodologies used to establish MFLs. In addition, the District or FDEP may decide to voluntarily subject MFLs to independent scientific peer review, based on guidelines provided in Rule 62-40.473, F.A.C.

Currently, the District voluntarily seeks independent scientific peer review of methods used to develop MFLs for all water body types. Similarly, the District voluntarily seeks peer review of MFLs proposed for all flowing water bodies and aquifer systems, based on the unique characteristics of the data and analyses used for the supporting analyses.

Section 4. Established and Proposed Minimum Flows and Levels

Figure 2-3 depicts priority MFLs water resources as of October 22, 2019, that are in or partially within the Tampa Bay Planning Region. A complete list of water resources with established MFLs in the District is provided in the Chapter 2 Appendix to this RWSP.

Water resources with established MFLs within or extending into the planning region include the:

- Alafia River (lower segment);
- Alafia River (upper segment, which is partially located in the Heartland Planning Region)/Lithia-Buckhorn Spring Group;
- Anclote River (lower segment);
- Anclote River (upper segment);
- Crystal Springs;
- Dover/Plant City Water Use Caution Area Minimum Aquifer Level;
- Hillsborough County Lakes – Alice (reevaluated), Allen (reevaluated), Barbara, Bird (reevaluated), Brant (reevaluated), Calm, Carroll, Charles, Church, Crenshaw, Crescent, Crystal (reevaluated), Cypress, Dan (reevaluated), Deer (reevaluated), Dosson (reevaluated), Echo, Ellen, Fairy [Maurine], Garden, Halfmoon, Hanna, Harvey (reevaluated), Helen, Hobbs (reevaluated), Hooker, Horse (reevaluated), Jackson, Juanita (reevaluated), Keene, Kell, Little Moon (reevaluated), Merrywater (reevaluated), Mound, Platt, Pretty, Rainbow (reevaluated), Raleigh, Reinheimer, Rogers, Round (reevaluated), Saddleback (reevaluated), Sapphire, Starvation, Stemper (reevaluated), Strawberry, Sunset (reevaluated), Sunshine (reevaluated), Taylor, Virginia (reevaluated), Wimauma;
- Hillsborough County Wetland Sites – CBRWF #32, Cosme WF Wetland, CR1, CR2, CR3, CR4, CR5, CR6, EWWF NW-44, MBWF Clay Gully Cypress, MBWF Entry Dome, MBWF Unnamed, MBWF X-4, S21 WF NW-53 East;
- Hillsborough River (upper segment, which is partially in the Heartland Planning Region)
- Hillsborough River (lower segment) (reevaluated);
- Northern Tampa Bay – 7 Wells – Upper Floridan aquifer/Saltwater Intrusion
- Pasco County Lakes – Bell, Big Fish (reevaluated), Bird, Buddy (reevaluated), Camp (reevaluated), Clear, Crews, Green, Hancock, Iola, Jessamine, King, King [East], Linda, Middle, Moon (reevaluated), Padgett (reevaluated), Parker aka Ann, Pasadena (reevaluated), Pasco, Pierce (reevaluated), Unnamed #22 aka Loyce;
- Pasco County Wetland Sites – CBARWF Q-1, CBARWF Stop #7, CBARWF T-3, CBARWF TQ-1 West, CBRWF A, CBRWF #4, CBRWF #16, CBRWF #20, CBRWF #25, CC Site G, CC W-11, CC W-12, CC W-17, CC W-41, NPWF #3, NPWF #21, SPWF NW-49, SPWF NW-50, SPWF South Cypress, STWF Central Recorder, STWF Eastern Recorder, STWF D, STWF M, STWF N, STWF S-75, STWF Z;
- Pinellas County Wetland Site – EWWF Salls Property Wetland 10S/10D
- Pithlachascotee River (lower segment);
- Pithlachascotee River (upper segment);

- Saltwater Intrusion Minimum Aquifer Level (SWIMAL) - Upper Floridan aquifer (which is partially located in the Southern Planning Region, and is affected by withdrawals in the Tampa Planning Region, Southern Planning Region, and Heartland Planning Region);
- Sulphur Springs;
- Tampa Bypass Canal.

Priority water resources within or extending into the planning region for which MFLs have not yet been established or are being reevaluated include the:

- Cypress Creek;
- Hillsborough County Lakes (reevaluations) – Barbara, Calm, Charles, Church, Crenshaw, Cypress, Echo, Ellen, Garden, Halfmoon, Helen, Jackson, Mound, Sapphire, Strawberry (North Crystal);
- Hillsborough County Wetland Sites (reevaluations) – Cosme WF Wetland, CR4, CR5, CR6, S21 WF NW-53 East;
- Hillsborough County Wetland Sites (reevaluations) – CBRWF #32, CR1, CR2, CR3, EWWF NW-44, MBWF Clay Gully Cypress, MBWF Entry Dome, MBWF Unnamed, MBWF X-4;
- Little Manatee River (lower segment);
- Little Manatee River (upper segment, which is partially located in the Southern Planning Region);
- Pasco County Lakes (reevaluations) – Linda, Pasco;
- Pasco County Wetland Sites (reevaluations) – CBRWF #20, CBRWF #25, NPWF #3, NPWF #21, SPWF NW-49, SPWF NW-50, SPWF South Cypress, STWF Central Recorder, STWF Eastern Recorder, STWF Z;
- Pinellas County Wetland Site (reevaluation) – EWWF Salls Property Wetland 10S/10D
- Southern Water Use Caution Area Saltwater Intrusion Minimum Aquifer Level (SWIMAL) (reevaluation);
- Withlacoochee River (upper segment, upstream of U.S. Geological Survey Croom gauge).

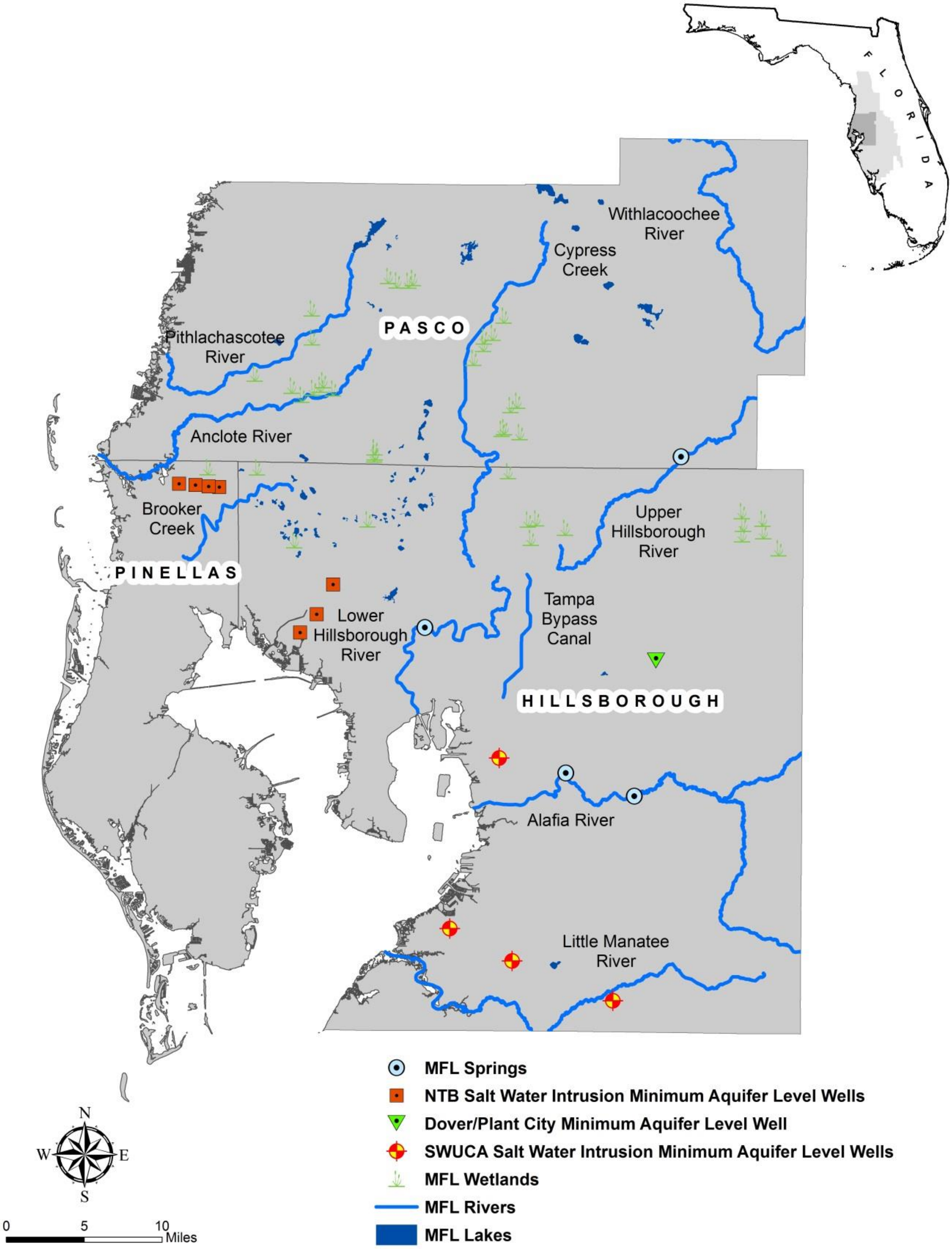

Figure 2-3. *MFL priority water resources in the Tampa Bay Planning Region*

Part C. Prevention and Recovery Strategies

Section 1. Prevention Activities

Section 373.0421(2), F.S., requires that a prevention strategy be developed if within 20 years the flow or level in a water body is projected to fall below an applicable MFL. A three-point prevention strategy has been developed to address MFLs: (1) monitoring water levels and flows for water resources/sites with established MFLs to evaluate the need for prevention strategies; (2) assessment of potential water supply/resource problems as part of the regional water supply planning process; and (3) implementation of the water use permitting program, which ensures that water use does not cause violation of established MFLs.

In addition to water supply planning activities initiated by the District, other entities in the planning region are engaged in planning efforts that are coordinated with and complement those of the District. A goal of these efforts is to ensure that future water supply demands will be met without adversely impacting proposed or established MFLs. The following is an example of an additional water supply planning activity in the planning region.

1.0 Tampa Bay Water Long-Term Water Supply Master Plan

The purpose of TBW's long-term water supply planning is to ensure that water supplies are sufficient to meet current and future demands. This is being accomplished through reduced reliance on groundwater and increased development of alternative supplies in order to allow recovery of natural systems within the TBW service area. The most recent (fourth) update to the current Long-Term Master Water Plan was completed in 2018. This document analyzed current and future water supplies and demands to determine when new supplies will be required. The current Master Water Plan recommends the addition of 20 mgd to meet forecasted demands. TBW anticipates 10 mgd will be needed by 2028 with the remaining 10 mgd by the 2040 planning horizon. TBW also continues to investigate a Demand Management Plan and Water Shortage Mitigation Plan to help conserve water.

Section 2. Recovery Strategies

Section 373.0421(2), F.S., requires that a recovery strategy be developed if the existing flow or level in a water body is below an applicable MFL. The District has established recovery strategies by rule in Chapter 40D-80, F.A.C. When an MFL for a water resource is not being met or, as part of a recovery strategy, is not expected to be met for some time in the future, the District will first evaluate the established MFL in light of any newly obtained scientific data or other relevant information to determine whether or not it should be revised. If no revision is necessary, management tools that may be considered include the following:

- Developing AWSs.
- Implementing structural controls and/or augmentation systems to raise levels or increase flows in water bodies.
- Reducing water use permitting allocations (e.g., through water conservation).

The District has developed several recovery plans for achieving recovery to established MFLs as soon as practicable in the Tampa Bay Planning Region. Regional strategies have been developed for the NTBWCA, SWUCA, and DPCWUCA. Recovery strategies have also been developed for the Lower Hillsborough and Lower Alafia rivers. Regulatory components of the recovery strategies for water resources in these areas have been incorporated into District rules (Chapter 40D-80, F.A.C.), into individual WUPs, and outlined in District reports.

1.0 Northern Tampa Bay Water Use Caution Area

The first phase of the NTBWUCA Recovery Strategy was approved by the District in 1999 and required that new withdrawals not violate established MFLs unless the withdrawal was part of the NTBWUCA Recovery Strategy. The strategy included the establishment of MFLs, reductions in groundwater withdrawals and the development of AWSs as required in the Partnership Agreement. Executed in 1998, the Partnership Agreement required a reduction in groundwater withdrawals from the TBW Central System Facilities (Cosme-Odessa, Eldridge-Wilde, Section 21, South Pasco, Cypress Creek, Cross Bar Ranch, Starkey, Morris Bridge, Northwest Hillsborough Regional, Cypress Bridge, and North Pasco wellfields) from 158 mgd to 90 mgd (12-month moving average) by 2008. As part of the Partnership Agreement, the District also committed to provide funding assistance to TBW for the development of AWS projects designed to replace the reductions in groundwater withdrawals. The first phase of the strategy extended through 2010 and was based on current knowledge of the state of the area's water resources, the technology for WSD including alternative sources and conservation, and existing and future reasonable-beneficial uses. The District evaluated the degree of recovery that had occurred in the region and determined that a second phase of recovery was necessary. This determination was based largely on the need for additional time to evaluate the full hydrologic and biologic effects of the reduction in groundwater withdrawals that took place during the first phase of recovery, as well as the need for further assessment of the optimized distribution of the 90 mgd of withdrawals.

Tampa Bay Regional Reservoir

In December 2009, the District approved the second phase of the recovery strategy for the NTBWUCA (Rule 40D-80.073, F.A.C) for implementation through 2020. Major components of the strategy, which was adopted in 2010 as the Comprehensive Environmental Resources Recovery Plan for the Northern Tampa Bay Water Use Caution Area (Comprehensive Plan,) include: (1) the Consolidated Permit issued to TBW was renewed for 90 mgd for 10 years; (2) TBW will continue to conduct withdrawals pursuant to the Operations Plan; (3) TBW will continue expansive environmental data collection and analysis; (4) TBW will continue to evaluate and implement environmental mitigation; (5) TBW member governments will continue water conservation activities; (6) further impacts caused by other WUP holders will continue to be limited; and (7) a "reservoir renovation exception period" that allowed a temporary exceedance of the 90 mgd permit limit during the period while the C. W. Bill Young Regional Reservoir was under repair. The repairs were completed in 2014 and the temporary allowance was never used.

The current Consolidated Permit expires at the end of 2020, at which time many of the requirements of the Comprehensive Plan are due for District approval. The District expects to receive a WUP renewal application for TBW's Consolidated Permit in late 2020. The Consolidated Permit includes ten PS wellfields, providing 90 mgd of water supply for most of the NTB area. In addition, the results of the Comprehensive Environmental Resources Recovery Plan, also known as the Phase II Recovery Plan, developed and adopted by rule and as a permit condition for assessing the hydrologic recovery achieved in the Phase I Recovery Plan (1998 to 2010), will be submitted to the District by TBW by the end of 2020.

2.0 Lower Hillsborough River

The District established revised MFLs for the lower Hillsborough River (LHR) in 2007. Revised minimum flows were established at 24 cubic feet per second (cfs) (15.5 mgd) fresh water equivalent from April 1 through June 30 and 20 cfs (13 mgd) fresh water equivalent the remainder of the year, as adjusted based on a proportionate amount that flow at the U.S. Geologic Survey Hillsborough River gauge near Zephyrhills, Florida, is below 58 cfs. Because the MFLs were not being met, the District incorporated a recovery strategy for the river into Rule 40D-80.073(8), F.A.C. As part of the recovery strategy, the District entered into a joint funding agreement and additional project-specific agreements with the City of Tampa to assess and implement projects associated with diversion of water from various sources to meet minimum flow requirements in the river. Estimated costs for recovery strategy projects, and their status are listed in Table 2-1.

In accordance with the recovery strategy, the City has diverted water from Sulphur Springs to the base of the Hillsborough River Reservoir Dam, as necessary to support river recovery. In addition, the District, and more recently the City, have diverted water from the Tampa Bypass Canal (TBC) to the Hillsborough River Reservoir for subsequent diversion to the lower river. The City assumed responsibility for these diversions from the TBC through the reservoir in 2018, with transfers of water from the reservoir to the lower river made using a newly constructed sluice gate in the dam that was cooperatively funded by the District and the City. In 2017, the City, with support from the District, completed the Blue Sink Project, which facilitates diversion of water from Blue Sink to the base of the dam for minimum flow recovery, and use of the sink as a recovery source was initiated in 2018. A project between the District and City associated with investigation of storage or additional supply options was completed in 2018 and identified the proposed Tampa Augmentation Project as a potential source for additional water that may be needed for recovery of the lower river. Permitting, design and permit-required monitoring associated with a project involving potential diversion of water from Morris Bridge Sink for river recovery have also been completed, although project implementation is contingent upon future recovery need assessments.

The District annually assesses and reports progress on the LHR recovery strategy. In addition, the first of three planned five-year recovery strategy assessments was completed in 2015 (SWFWMD and Atkins North America, Inc., 2015) and a second assessment (SWFWMD and Water & Air Research, Inc., 2020) was completed in 2020. The goals of the annual and five-year assessments include evaluation of the hydrology, selected water quality characteristics, and biological effects achieved from implementation of recovery strategy projects. The annual and five-year assessments have documented improvements in water quality and other ecological conditions in the LHR as a result of minimum flow implementation, although minimum flow requirements have not been met on all days. Flow deficits (i.e., flows needed to meet minimum flow requirements) are expected to be eliminated upon full implementation of all projects identified in the recovery strategy.

Table 2-1. *LHR recovery strategy projects*

Project	Cost	Status
Sulphur Spring Weir Modification and Pump Station	$5.8 million	Completed
Blue Sink	$7 million	Completed
Transmission Pipeline	$26 million	Completed (pipeline deemed not necessary)
Investigation of Storage Options	$28 thousand	Completed
Tampa Bypass Canal and Hillsborough Reservoir Diversions	$1.6 million	Completed
Morris Bridge Sink	$2.1 million	Ongoing

3.0 Southern Water Use Caution Area

The purpose of the SWUCA recovery strategy (Rule 40D-80.074, F.A.C. and SWFWMD, 2006) is to provide a plan for reducing the rate of saltwater intrusion and restoring low flows to the Upper Peace River and lake levels by 2025, while ensuring sufficient water supplies and protecting the investments of existing WUP holders. The strategy has six basic components: (1) regional water supply planning, (2) use of existing rules, (3) enhancements to existing rules, (4) financial incentives, (5) projects to achieve MFLs, and (6) resource monitoring. Regional water supply planning allows the District and its communities to strategize on how to address growing water needs while minimizing impacts to the water resources and natural systems. Existing rules and enhancements to those rules will provide the regulatory criteria to accomplish the majority of recovery strategy goals. Financial incentives to conserve and develop AWSs will help meet water needs, while implementation of WRD projects will help reestablish minimum flows to rivers and enhance recharge. Finally, resource monitoring, reporting, and cumulative impact analysis will provide data to analyze the success of recovery. Resource recovery projects, such as the project to raise the levels of Lake Hancock for release to the Upper Peace River during the dry season, are actively being implemented and considered.

The success of the SWUCA recovery strategy will be determined through continued monitoring of area resources. The District uses an extensive monitoring network to assess actual versus anticipated trends in water levels, flows, and saltwater intrusion. Additionally, the District assesses the cumulative impacts of factors affecting recovery. Information developed as part of these monitoring and assessment efforts is provided to the Governing Board on an annually and on a five-year basis. Results from two five-year assessment of the SWUCA recovery strategy (SWFWMD 2013, 2018), indicate the District continues to make progress toward recovery, but challenges to achieving full recovery by 2025 remain. Recovery will ultimately be achieved through a combination of maintaining existing withdrawals at or below current levels and implementing WRD projects designed to augment or preserve levels and flows.

4.0 Lower Alafia River System

In establishing the MFLs for the Lower Alafia River system in 2010, the District determined that flow rates under certain conditions were below the minimum flows due to withdrawals from Lithia and Buckhorn springs by Mosaic Fertilizer, LLC ("Mosaic") for use at its Riverview plant. The District incorporated conditions associated with a phased recovery strategy into a WUP issued to Mosaic in 2009. Conditions in the current WUP (No. 20013228.001) require Mosaic to augment the South Prong of the Alafia River with up to 4.5 mgd of groundwater when flow in the Alafia River at the Lithia falls below 67 cfs, provided the augmentation does not exceed the quantity of water withdrawn by Mosaic from the Lower Alafia River System on the previous day.

To meet adopted MFLs, the Alafia River is augmented with groundwater during low flow periods

5.0 Dover/Plant City Water Use Caution Area

In 2010, the District determined that groundwater withdrawals used for frost/freeze protection in the Dover/Plant City area contributed to water level declines that are significantly harmful to the resources of the area. In June 2011, the District adopted the DPCWUCA MAL (Figure 2-1), related MALPZ (Rule 40D-80.075, F.A.C.), and a recovery strategy as part of a comprehensive management program intended to arrest declines in area water levels in the UFA during frost/freeze events. These efforts were also undertaken to minimize the potential for impacts to existing legal users and sinkhole occurrence. The DPCWUCA MAL is the 10-foot potentiometric surface elevation (NGVD 1929) at District Well DV-1 Suwannee. The District concluded that this was the elevation below which the greatest incidence of well failures and sinkholes occurred during the 2010 frost/freeze event. The goal of the recovery strategy is a 20 percent reduction in frost/freeze protection groundwater withdrawals in the Dover/Plant City DPCWUCA by January 2020, as compared to the estimated frost/freeze withdrawals used during the 2010 event. This should reduce the potential for drawdown during future frost/freeze events to lower the aquifer level at District Well DV-1 Suwannee below 10 feet (NGVD 1929).

Part D. Reservations

Reservations of water are established by rule and authorized as follows: "The governing board or the department, by regulation, may reserve from use by permit applicants, water in such locations and quantities, and for such seasons of the year, as in its judgment may be required for the protection of fish and wildlife or the public health and safety…" (Section 373.223(4), F. S.).

The District will consider establishing a reservation of water when a District WRD project will produce water needed to achieve adopted MFLs. The rule-making process associated with reservation adoption allows for public input to the Governing Board in its deliberations about establishing a reservation, including, among other matters, the amount of water to be reserved and the time of year the reservation would be effective. When a reservation is established and incorporated into Rule 40D-2.302, F.A.C., only those water use withdrawals that do not reduce the reserved quantity can be evaluated for permitting.

In 2007, as part of the recovery strategy for the LHR, the District established that "all available water from the Morris Bridge Sink, but not greater than 3.9 mgd on any given day, is reserved to be used to contribute to achieving or maintaining the minimum flow for the lower Hillsborough River…" (Rule 40D-2.302(1), F.A.C.). In support of this reservation, the District has obtained a consumptive use permit from the FDEP, in 2016, that authorizes withdrawal of up to 3.9 mgd from for Morris Bridge Sink to help achieve minimum flow in the LHR. Project design and permit-required monitoring associated with the potential diversion of water from Morris Bridge Sink for river recovery have been completed. Project implementation is contingent upon future recovery need assessments.

Part E. Climate Change

Section 1. Overview

Climate change has been a growing global concern for several decades. According to the Intergovernmental Panel on Climate Change (IPCC), the global mean average land and ocean temperatures have likely increased approximately 1.4 to 2.2°F from pre-industrial levels (IPCC, 2018). Such increases are driving a slow but persistent increase in sea levels and are altering precipitation regimes. These conditions will likely have local impacts including changes to natural habitats, encroachment of seawater into surface and groundwater resources, risk to public infrastructure, warmer temperatures that increase evaporation and impact agriculture, and changes to seasonal and annual rainfall patterns. Climate change is a global issue that requires international coordination and planning, although strategies for assessing vulnerabilities and developing adaptation plans are necessary on the local, regional, and statewide level.

In recent years, numerous agencies and organizations in Florida have developed initiatives to address climate change. Many of the state's Regional Planning Councils (RPCs) have pooled resources and are developing vulnerability assessments, climate adaptation plans, and post-disaster redevelopment plans for member communities. The Florida Department of Environmental Protection's Community Resilience Initiative provides planning tools and promotes collaboration among RPCs and coastal communities. The WMDs and other agencies participate in focus groups organized by RPCs, Florida Sea Grant, and other entities to consolidate climate information, develop consistent approaches to planning, and provide technical expertise when appropriate. Other participants in these initiatives include the National Weather Service; regional water supply authorities; state universities; and Florida Fish and Wildlife Conservation Commission, Department of Transportation, Department of Health, Department of Environmental Protection, and the Division of Emergency Management. Climate change is one water supply challenge among others such as droughts, water quality deterioration, and limitations on the availability of water resources. This section of the RWSP addresses climate issues for water supply planning, identifies current management strategies in place to address these concerns, and considers future strategies necessary to adaptively manage water supply resources.

Section 2. Possible Effects

The District's water supply planning efforts may be affected by climate change in three primary ways: sea level rise, air temperature rise, and changes in precipitation regimes.

1.0 Sea Level Rise

Data from the National Oceanic and Atmospheric Administration (NOAA) tide gauge in St. Petersburg shows that monthly mean water levels have already increased 7.8 inches from the gauge's first reliable records in 1946 to 2019 (CSAP, 2019). The latest NOAA projections over this report's 20-year horizon (2020 through 2040) estimate that local sea levels will rise by 3.5 inches based a linear extrapolation, 4.3 inches by factoring the likely acceleration, and over 12 inches if accounting for potential polar ice sheet instabilities. With a 50-year horizon (2020 through 2070), a common lifecycle for infrastructure design, the NOAA projections range from 9 inches to over three feet (Sweet et al, 2017).

Sea level rise is likely to stress the District's water resources in a variety of ways. The inundation or upward migration of coastal wetlands may affect their ability to improve the quality of stormwater runoff and provide natural habitats. Estuarine water encroachment in coastal rivers may reduce the viable withdrawal periods at non-isolated freshwater intakes of water treatment facilities. Saltwater intrusion reduces water quality in aquifers that supply urban, agricultural, and industrial water users. Aging municipal sewer systems can experience infiltration that reduces the quality of reclaimed water currently used to offset fresh water demands.

One positive aspect is that sea level rise is projected to occur relatively slowly, although persistently, which allows time to thoroughly evaluate the impacts to natural resources and public infrastructure, plan and implement adaptation strategies, and continue to use most existing coastal infrastructure for several decades. The cost of initiating sea level rise planning or incorporating it into other existing efforts is relatively low compared to disaster recovery efforts.

2.0 Air Temperature Rise

The IPCC estimates that current green-house emission levels will cause mean global air temperatures to reach or stabilize at approximately 2.7°F above pre-industrial levels (1850through 1900) by the end of this century, with greatest warming at inland and polar regions (IPCC, 2018). The impacts to southwest Florida will likely be more hot days and few cold days seasonally. Evaporation is likely to increase with a warmer climate, which could result in lower surface water levels and increased irrigation demand. Increased evaporation is likely to impact stormwater runoff, soil moisture, groundwater recharge, and reservoir storage losses (Bates et al., 2008). Additionally, higher air temperatures may exacerbate algal blooms and declines in reservoir water quality that could raise treatment costs for potable water supply.

3.0 Precipitation Regimes and Storm Frequency

Increasing temperatures are expected to change global precipitation patterns, although changes will likely be more pronounced in the earth's tropical and temperate zones. Southwest Florida, being sub-tropical, has climatic precipitation patterns largely influenced by Atlantic multidecadal oscillations (AMO) of ocean sea surface temperatures, along with shorter-term El Nino southern oscillations (ENSO). The AMO warm periods tend to make the region's summer-fall seasons wetter, while strong ENSO phases, caused by warming in the eastern Pacific, make the region's winter and spring seasons wetter (Cameron, 2018). An AMO warm phase is currently in effect.

Warming temperatures in the Atlantic and Gulf of Mexico can increase the likelihood of intense tropical storms and hurricanes that can generate storm surge, strong winds, and heavily concentrated rainfall. Hurricane activity near Southwest Florida is statistically more common during AMO warm periods. Higher summer temperatures and humidity may also increase the frequency of local convective weather events, resulting in thunderstorms, higher peak surface water flows, and increased flooding in some areas (Groisman et al., 2005).

Section 3. Current Management Strategies

The District has taken several steps to address the management of water resources that will also benefit efforts to plan and prepare for climate change impacts. First, the District's data collection and monitoring activities are likely to provide information critical to monitoring and responding to local climate change. Long-established networks of rainfall and streamflow gauge stations, many with real-time electronic reporting, provide continuous streams of data that will enable the District to monitor changes in local hydrology. In addition to monitoring rivers, lakes, springs, and wetlands to ensure adequate water for natural systems and human use, the District has an extensive network of coastal and inland surface and groundwater monitoring sites to collect and analyze water quality data, including information about saltwater intrusion. In those places where water quantity and quality issues become evident, the District implements programs, projects, and regulations to address them. The District also participates in local, state and national discussions on these issues in order to accommodate timely and effective responses to climate changes as they become evident.

The Coastal Groundwater Quality Monitoring and Water Use Permit networks are the largest and longest ongoing well sampling networks of their kind at the District. The networks currently have a combined total of over 350 wells that cover 13 counties, and new wells have been added to the networks at a rate of 5 to 10 wells per year. Having long-term water quality data will become increasingly important with continued demands for groundwater withdrawals in the District and statewide. Although the entire coastal region of the District is included in the monitoring effort, much emphasis is placed on the southern region of the District formally designated as the SWUCA. District staff is also determining how to use or modify existing groundwater models to predict density and water-level driven changes to aquifers utilized for water supply. Through cooperative funding, the District is assisting water utilities and regional water supply authorities with wellfield evaluations for improving withdrawal operations and planning for brackish treatment upgrades.

The District also encourages maximizing the use of diverse water supply sources and establishing system redundancies to ensure a resilient water supply. The District promotes water conservation across all use sectors, including agricultural and industrial uses, which not only saves supplies for the future but also reduces chemical and energy use. Through partnerships, the District continues to increase the availability and use of reclaimed water, the development of wet-weather storage facilities, and enhanced water efficiencies. Additionally, the District supports and co-funds projects to interconnect water supply systems, either potable or nonpotable, to ensure adequate supplies from dispersed sources and redundancy for emergencies. The District also helps to fund environmentally sustainable and drought-resistant water supply options such as reclaimed water, stormwater reuse, brackish groundwater treatment, surface water reservoirs, ASR, AR, and seawater desalination.

Section 4. Future Adaptive Management Strategies

While ongoing District efforts can provide critical information and allow flexibility to accommodate future changes in water supply, local governments and industries are principally tasked with developing and communicating the appropriate risk assessment and adaptation strategy for each municipality or other significant water user. The commonly evaluated community adaptation strategies can be grouped into three generalized approaches: armament, accommodation, or organized retreat. The District is able to provide a supporting role during the planning and implementation for each of these approaches.

- Armament. An armament strategy involves the erection of defensive barriers such as dikes and pumping systems to protect existing infrastructure from storm surges and sea level rise. Armament may be a preferred approach for dense urban and commercial areas, although they may limit transitional natural habitats and create an effective tipping point for inundation. The community's existing water supply infrastructure and demand centers would be maintained.
- Accommodation. An accommodation strategy utilizes improved infrastructure such as elevated roads and buildings and canal systems that allow coastal inundation to occur. Accommodation strategies may suit growing municipalities that can apply innovative community planning to assure longevity. The District's water supply planning efforts may involve the technological development of alternative water supplies including AR systems, direct and indirect reuse, and reverse osmosis treatment options for these communities. The District would also have a role in assuring the transitional health of water bodies.
- Organized Retreat. An organized retreat strategy may involve the rezoning of property threatened by inundation, or transfer to public ownership, potentially through rolling easements or post-disaster development plans. Retreat strategies typically include ecological engineering projects to assist the transition of natural habitats that will also provide shelter to upland infrastructure.

The District would account for these strategies through the five-year update schedule of the RWSP. The schedule allows sufficient time to anticipate transitional changes to population centers in the water demand projections, and to develop appropriate water supply options. Continued development of regionally interconnected water systems also allows large-scale water treatment facilities to adjust distribution to new demand locations.

Climate change may have a significant potential to affect water supply sources and should be factored into evaluations of the adequacy of supplies to meet future demand. It also has the potential to dramatically change patterns of demand and could, therefore, be an important consideration in demand projections. Changes in the nature of supply and demand would necessitate infrastructure adaptation. High cost and relative uncertainty can make these adaptations problematic; however, as related information is generated, existing and proposed water sources and projects will be evaluated to determine their feasibility and desirability. For these reasons, the District is maintaining a "monitor and adapt" approach toward the protection of natural resources from climate change. The District will actively monitor research projects, both locally and nationally, interpret the results, and initiate appropriate actions necessary to protect the water resources in our region as the effects of climate change become more evident.

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Chapter 3. Demand Estimates and Projections

This chapter is a comprehensive analysis of the water demand for all use categories in the Tampa Bay Planning Region for the 2015-2040 planning period. The chapter includes methods and assumptions used in projecting water demand for each county, the demand projections in five-year increments, and an analysis and discussion of important trends in the data. The Southwest Florida Water Management District (SWFWMD) (District) projected water demand for the public supply (PS), agricultural (AG), industrial/commercial (I/C), mining/dewatering (M/D), power generation (PG), and landscape/recreation (L/R) sectors for each county in the planning region. The methodologies used to project demand for each category are briefly summarized in this chapter and presented in greater detail in the Chapter 3 Appendix.

The demand projections represent reasonable and beneficial uses of water that are anticipated to occur through the year 2040. The District determined 5-in-10 (average condition) and 1-in-10 (drought condition) demands for each five-year increment from 2015-2040 for each sector. Decreases in demand are reductions in the use of groundwater for the AG, I/C, M/D, and PG use categories.

General reporting conventions for the Regional Water Supply Plan (RWSP) were guided by the document developed by the Water Planning Coordination Group: Final Report: Development and Reporting of Water Demand Projections in Florida's Water Supply Planning Process (WPCG, 2005). This document was produced by the Water Demand Projection Subcommittee of the Water Planning Coordination Group, a subcommittee consisting of representatives from the water management districts (WMDs) and the Florida Department of Environmental Protection (FDEP), formed in 1997 as a means to reach consensus on the methods and parameters used in developing RWSPs. Some of the key guidance parameters include:

- Establishment of a base year: The year 2015 was agreed upon as a base year to develop and report water demand projections. This is consistent with the methodology agreed upon by the Water Planning Coordination Group. The data for the base year consists of reported and estimated usage for 2015; whereas, data for the years 2020 through 2040 are projected demands.
- Water use reporting thresholds: Minimum thresholds of water use within each water use category were agreed upon as the basis for projection.
- 5-in-10 versus 1-in-10: For reporting demand in average versus drought conditions, specific parameters were prescribed for at least a portion of the demand related to all water supply categories except I/C, M/D, and PG. In general, demand is reported for a 5-in-10 average annual effective rainfall condition and a 1-in-10 drought year condition (an increase in water demand having a 10 percent probability of occurring during any given year).

The projected demand represents the total amount of water required to meet reasonable and beneficial water needs through 2040. Total demand does not account for reductions that could be achieved by additional demand management measures. Water conservation and other sources are accounted for separately in Chapter 4 as a means by which demand can be met.

Part A. Water Demand Projections

Demand projections were developed for five sectors; (1) PS, (2) AG, (3) I/C, M/D, (4) PG, and (5) L/R. The categorization provides for the projection of demand for similar water uses under similar assumptions, methods and reporting conditions

Section 1. Public Supply

1.0 Definition of the Public Supply Water Use Sector

The PS sector consists of four subcategories: (1) large utilities (permitted for 0.1 mgd or greater), (2) small utilities (permitted for less than 0.1 mgd), (3) domestic self-supply (individual private homes or businesses that are not utility customers that receive their water from small wells that do not require a water use permit (WUP)), and (4) additional irrigation demand (water from domestic wells that do not require a WUP and used for irrigation by residences that rely on a utility for indoor and other non-irrigation water needs).

2.0 Population Projections

2.1 Base Year Population

All WMDs agreed that 2015 would be the base year from which projections would be determined. The District calculated the 2015 population by extrapolating from GIS Associates, Inc.'s 2016 population estimate. Utilities with permitted quantities less than 100,000 gallons per day are not required to report population or submit service area information. Subsequently, population was obtained from the last issued permit.

2.2 Methodology for Projecting Population

The population projections developed by the University of Florida’s Bureau of Economic and Business Research (BEBR) are generally accepted as the standard throughout Florida. However, these projections are made at the county level only and accurate projections of future water demand require more spatially precise data. Subsequently, the District’s projections are BEBR projections disaggregated to land parcel level, which is the smallest area of geography possible for population studies. In turn, these parcel-level projections are normalized to the BEBR medium projection for the counties. Using this methodology, the District contracted with GIS Associates, Inc. to provide small-area population projections for the 16 counties entirely or partly within the District.

3.0 2015 Base Year Water Use and Per Capita Rate

3.1 Base Year Water Use

The 2015 PS base year water use for each large utility is derived by multiplying the average 2011 to 2015 unadjusted gross per capita rate by the 2015 estimated population for each individual utility. For small utilities, per capita information is found in the last issued permit. If no per capita information is available, the per capita is assumed to equal the average county per capita. Base year water use for small utilities is obtained by multiplying the per capita from the current permit by the 2015 estimated population from the last issued permit. Domestic self-supply (DSS) base year is calculated by multiplying the 2015 domestic self-supply population for each county by the average 2011 to2015 residential countywide per capita water use.

4.0 Water Demand Projection Methodology

4.1 Public Supply

Water demand is projected in five-year increments from 2020 to 2040. To develop the projections, the District used the 2011 to 2015 average per capita rate multiplied by the projected population for that increment. An additional component of public water supply demand is water derived from domestic wells for irrigation. These wells have a diameter of less than 6 inches, do not require a WUP and are used for irrigation at residences that receive potable water for indoor use from a utility. These wells are addressed in a separate report entitled *Southwest Florida Water Management District Irrigation Well Inventory* (D.L. Smith and Associates, 2004). This report provides the estimated number of domestic irrigation wells within the District and their associated water demand. The District estimates that approximately 300 gallons per day are used for each well.

4.2 Domestic Self-Supply

Domestic Self-Supply (DSS) is any portion of the county population not served by a utility. County DSS population estimates and projections were calculated as the difference between the total county population estimate or projection and the total population served by the utilities. For counties that are in multiple districts, only that portion of the population within the District was included.

5.0 Water Demand Projections

Table 3-1 presents the projected public supply demand for the planning period. The table shows that demand is projected to increase by 87.36 mgd for the 5-in-10 condition. These projections are lower than those in the District's 2015 RWSP. The differences can be attributed to slower than anticipated regional population growth and more accurate utility level population projections using a GIS model that accounts for growth and build-out at the parcel level.

Table 3-1. *Projected demand for PS, DSS, and private irrigation wells in the Tampa Bay Planning Region (5-in-10 and 1-in-10) (mgd)*

County	2015 Base		2020		2025		2030		2035		2040		Change 2015-2040		% Change	
	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10
Hillsborough	146.78	155.48	161.51	171.21	175.53	186.07	187.90	199.17	197.59	209.44	206.51	218.91	59.73	63.43	40.8%	40.8%
Pasco	56.60	59.99	61.93	65.64	66.86	70.88	71.06	75.32	74.92	79.42	78.38	83.08	21.78	23.09	38.5%	38.5%
Pinellas	101.25	107.33	102.44	108.59	103.97	110.21	105.33	111.65	106.58	112.98	107.10	113.52	5.85	6.20	5.8%	5.8%
Total	**304.63**	**322.80**	**325.88**	**345.44**	**346.36**	**367.16**	**364.29**	**386.14**	**379.09**	**401.84**	**391.99**	**415.51**	**87.36**	**92.72**	**28.7%**	**28.7%**

Note: Summation and/or percentage calculation differences occur due to rounding. See Appendix 3-3 for source values.

6.0 Stakeholder Review

Population and water demand projection methodologies, results, and analyses were provided to the District's water use regulation staff and public water use stakeholders for review. Changes suggested by stakeholders were incorporated only if they were based on historical regression data and long-term trends and supported by complete documentation.

Section 2. Agriculture

1.0 Description of the Agricultural Water Use Sector

Agriculture (AG) represents the second largest sector of water use in the District after PS. Included in this category are irrigated crops and other miscellaneous water uses associated with agricultural commodity production within the District. Irrigation demand was determined and reported in the RWSP for each of the following major categories of irrigated crops: (1) citrus, (2) field crops, (3), fruits (non-citrus), (4) greenhouse/nursery, (5) hay, (6) potatoes, (7) sod, and (8) fresh market vegetables. Most of these crop categories are self-explanatory, but some include several crops which are grouped together for reporting purposes by Florida Department of Agriculture and Consumer Services (FDACS). The fruits category includes several prominent crops in the District, such as strawberries, blueberries, and peaches, and the fresh market vegetables category includes tomato production along with cucumbers, peppers, and other vegetables. Water demands associated with non-irrigated AG such as aquaculture and livestock were also estimated and projected.

2.0 Water Demand Projection Methodology

Demand projections for irrigated commodities were determined by multiplying projected irrigated acreage by the irrigation requirements of each commodity. Acreage projections were developed by the FDACS as part of the Florida Statewide Agricultural Irrigation Demand (FSAID5) projections through 2040. These projections were based on trends in historic National Agricultural Statistics Service irrigated acreage data. Irrigation requirements were adjusted from the FSAID5 demands and were based on permit-level metered water use data. Where possible, permit by permit water use rates were maintained, and in non-metered operations, average application rates were developed for each crop category by county. Per acre water use for each crop category was held constant, and changes in projected water demands are based on increases or decreases in irrigated acreages for each crop type. The methodologies are described, and data provided in more detail in Appendix 3-1.

Non-irrigation demand (e.g., aquaculture and livestock) was based on a combination of metered water use at the permit level and estimated demands from the FSAID5 geodatabase which were based primarily on livestock count data and water demands per head. The projected trends were based on the FSAID5 projections, and demands were held steady throughout the planning period, based on steady statewide livestock counts and lack of data upon which to make better projections. The methodologies are described, and data provided in more detail in Appendix 3-1.

In addition to the method developed by the District, which is based on the FSAID5 acreage projections and District metered water use rates, the FDACS has also developed a complete set of alternate water use projections through 2040. The District elected to use its modified FSAID5 approach to meet the statutory directive to use the best available data in developing agricultural water use projections. In this case, the District has extensive metered data on AG water use at the permit level, and the use of direct metered water use application rates will provide a more accurate assessment of local water use than a synthesized modeled water use rates. This allows the District projections to capture permit-level and regional variations in grower irrigation practices. This also means that the application rates in the projections will also be reflective of the progress made in agricultural conservation through the District's FARMS program and other regional efforts such as the SWUCA Recovery Strategy.

3.0 Water Demand Projections

Trends indicate that agricultural activities are expected to continue to decrease in the Tampa Bay Planning Region as the area continues to urbanize during the planning period. Irrigated acreage is expected to decrease by 12 percent, from 37,700 acres in 2016 to about 30,000 acres in 2040. This reduction in irrigated acreage will likely be most prominent in Hillsborough County, which accounts for the vast majority of the irrigated lands in the region. Hillsborough County has historically been a major center for strawberry production in the Plant City area, but total irrigated acreage in the county has declined from a peak nearly 50,000 acres in the late 1990s to around 30,000 acres in 2016. Total AG water use in the Tampa Bay region has experienced a similar decline from over 80 mgd annually in the late 1990s to about 50 mgd from 2014-2016. Due to the abundance of strawberry production in the Plant City area, this region can be subject to large swings in annual water use due to demands for freeze protection in certain years depending on weather patterns. This has historically resulted in significant acute groundwater drawdown impacts, which the District is addressing through the Dover-Plant City Recovery Strategy.

Current average year demands are estimated at 48 mgd for 2016 acreage levels. In 2040, the District estimates that the projected decrease in acreage will result in a 21 percent decrease in water demands to about 38 mgd. Most of the decrease in acreage will be in strawberry acreage, with similar reductions in acreage for fresh market vegetables and citrus. FDACS forecasts that Hillsborough County will lose about 7,000 acres of irrigated land, while Pasco County is expected to have a slight decrease in irrigated acreage of about 500 acres. Pinellas County is already highly urbanized and has minimal active irrigated acreage. Urbanization and development pressure are expected to be major drivers in agricultural trends in this region. Table 3-2 displays projected combined agricultural irrigation and non-irrigation demands for the 5-in-10 (average) and 1-in-10 (drought) conditions for the planning period.

4.0 Stakeholder Review

District staff began presenting draft AG I demand projections to the District's Agricultural and Green Industry Advisory Committee, permit evaluation staff, and FDACS staff in September 2018. The District additionally requested input from the Agricultural and Green Industry Advisory Committee on the FSAID5 water use projections and methodology as well as the adjusted FSAID 5 method developed by the District. The Committee wished to take time to consider the proposed methods and adjourned to solicit feedback from industry groups and other stakeholders. In October 2018, the Committee reconvened, and District staff provided an additional presentation on the potential AG projections methods and draft results. Stakeholders present included representatives from the Florida Turfgrass Association, Florida Citrus Mutual, the Florida Strawberry Growers Association, the Florida Nursery Growers and Landscape Association, and the University of Florida Institute of Food and Agricultural Sciences, among others. After discussion, the Agricultural and Green Industry Advisory Committee voted to support the District's updated Agricultural Water Demands Projections Methodology based on the FSAID5 projected acreages and adjustments to incorporated District metered water use data. The vote was passed unanimously. Additionally, the District consulted with staff from the FDACS Office of Agricultural Water Policy on the proposed method, and FDACS accented to the Districts' method based on FSAID5 acreage projections, and District metered water use data.

Strawberries are a significant agricultural product in the Tampa Bay Planning Region

Table 3-2. *Projected total AG demand in the Tampa Bay Planning Region (5-in-10 and 1-in-10) (mgd)*

County	2015 Base		2020		2025		2030		2035		2040		Change 2015-2040		% Change	
	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10
Hillsborough	43.2	55.49	41.32	52.99	39.44	50.54	37.64	48.18	35.79	45.8	33.55	42.94	-9.65	-12.55	-22.3%	-22.6%
Pasco	4.89	6.76	4.78	6.61	4.72	6.53	4.69	6.47	4.64	6.41	4.59	6.34	-0.30	-0.42	-6.1%	-6.2%
Pinellas	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.0%	0.0%
Total	**48.11**	**62.27**	**46.12**	**59.62**	**44.18**	**57.09**	**42.35**	**54.67**	**40.45**	**52.23**	**38.16**	**49.30**	**-9.95**	**-12.97**	**-20.7%**	**-20.8%**

Note: Summation and/or percentage calculation differences occur due to rounding. See Appendix 3-1 for source values. Changes in small demand numbers across time can represent significant percent changes in demand over time that are not readily apparent from the rounded values in the table.

Section 3. Industrial/Commercial and Mining/Dewatering

1.0 Description of the Industrial/Commercial and Mining/Dewatering Water Use Sectors

The I/C and M/D uses within the District include chemical manufacturing, food processing and miscellaneous industrial and commercial uses. Much of the water used in food processing is for citrus and other AG commodities. Chemical manufacturing is associated with phosphate mining and consists mainly of phosphate processing. The M/D water use is associated with a number of products mined in the District, including phosphate, limestone, sand, and shell.

2.0 Demand Projection Methodology

Demand projections for the 2020 RWSP were developed by multiplying the 2015 amount of water used for each I/C and M/D facility by growth factors based on Woods & Poole Economics' gross regional product (GRP) forecasts by county in five-year increments. For example, if an I/C facility used 0.30 mgd in 2010 and the county calculated growth factor from 2010 to 2015 was 3 percent, the 2015 projection for that facility would be 1.03 x 0.30 = 0.31 mgd. If the 2015 to 2020 growth factor was 4 percent, the 2020 projection would be 0.32 mgd. Water use for 2015 is derived from the District's 2015 Water Use Well Package Database (WUWPD).

This methodology was applied for all sectors with the exception of Mosaic Company M/D permits (ore processing). The District was asked by Mosaic to consider data on future mining activity at current and future mine sites that was contained in a recently prepared environmental impact study. In lieu of changing 2015 baseline pumpage in accordance with growth factors based on projected gross regional product, percent changes in Mosaic-projected permitted quantities by county were used to project use quantities from the 2015 baseline pumpage. Please see Appendix 3-2 for more detail.3.0 Water Demand Projections

Table 3-3 shows the projected decrease in I/C and M/D water demand for the planning period. The table shows a change in demand for the planning period of -4.53 mgd, primarily due to a projected decrease in M/D use in Hillsborough County. For several years, the permitted quantity in the I/C and M/D sectors has been declining. Much of this reduction was due to revisions in the way permitted quantities for M/D are allocated by the District's WUP bureau. Non-consumptive dewatering uses are no longer included in permitted quantities. Starting with the 2015 RWSP, demand projections were included for all 16 counties; whereas, earlier RWSPs included demand projections for only the 10 southern counties.

Additionally, mining quantities permitted for product entrainment were not included in the 2010 or 2015 demand projections because the District considers such quantities incidental to the mining process and not part of the actual water demand (i.e., the quantities necessary to conduct the mining operation).

In accordance with the 2019 Format and Guidelines, the 5-in-10 and 1-in-10 demands are the same. The uses "are assumed to be reasonably the same in a 1-in-10-year drought event as in an average year (i.e., no significant demand variation)" (FDEP et al., June 2009).

Table 3-3. *Projected I/C and M/D demand in the Tampa Bay Planning Region (5-in-10 and 1-in-10) (mgd)*

County	2015 Base	2020	2025	2030	2035	2040	Change 2015-2040	% Change
Hillsborough	17.49	24.97	25.14	12.57	12.72	12.87	-4.61	-26.4%
Pasco	0.98	0.95	0.98	1.00	1.02	1.05	0.07	7.1%
Pinellas	0.19	0.19	0.19	0.20	0.20	0.20	0.01	5.3%
Total	**18.66**	**26.11**	**26.31**	**13.77**	**13.94**	**14.12**	**-4.54**	**-24.3%**

Note: Summation and/or percentage calculation differences occur due to rounding. See Appendix 3-2 for source values. Changes in small demand numbers across time can represent significant percent changes in demand over time that are not readily apparent from the rounded values in the table.

4.0 Stakeholder Review

The demand projection methodology, results and analyses were provided to the District's water use permitting staff and I/C and M/D sector stakeholders for review and comment. The projections were reviewed by the District's Industrial Advisory Committee, which concurred with the projection methodologies and outcome. Upon receiving additional stakeholder comments, the District reviewed suggested changes and, when appropriate, included updates.

Section 4. Power Generation

1.0 Description of the Power Generation Water Use Sector

The PG uses within the District include water for thermoelectric power generation used for cooling, boiler feed make-up, or other purposes associated with the generation of electricity. The PG quantities have previously been grouped with I/C and M/D quantities but are provided separately in this section per the 2019 Format and Guidelines (FDEP et al., June 2019).

2.0 Demand Projection Methodology

Demand projections for the 2020 RWSP were developed by multiplying the 2015 amount of water used by each PG facility by growth factors based on Woods & Poole Economics' GRP forecasts by county in five-year increments. Water use for 2015 is derived from the WUWPD. For example, if a PG facility used 0.30 mgd in 2015 and the county calculated growth factor from 2015 to 2020 was 3 percent, the 2020 projection for the facility would be 1.03 x .030 =0.31 mgd. If the 2015 to 2020 growth factor was 4 percent, the 2020 projection would be 0.32 mgd.

3.0 Water Demand Projections

Table 3-4 shows the projected increase in PG water demand for the planning period. The table shows an increase in demand for the planning period of 0.12 mgd, or 46.2 percent. The demand projections do not include reclaimed, seawater, or non-consumptive use of freshwater.

In accordance with the 2019 Format and Guidelines, the 5-in-10 and 1-in-10 demands are the same. Power generation uses "are assumed to be reasonably the same in a 1-in-10-year drought event as in an average year (i.e., no significant demand variation)" (FDEP et al., June 2009).

Table 3-4. *Projected PG demand in the Tampa Bay Planning Region (5-in-10 and 1-in-10) (mgd)*

County	2015 Base	2020	2025	2030	2035	2040	Change 2015-2040	% Change
Hillsborough	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
Pasco	0.26	0.34	0.35	0.36	0.37	0.38	0.12	46.2%
Pinellas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
Total	**0.26**	**0.34**	**0.35**	**0.36**	**0.37**	**0.38**	**0.12**	**46.2%**

Note: Summation and/or percentage calculation differences occur due to rounding. See Appendix 3-2 for source values. Changes in small demand numbers across time can represent significant percent changes in demand over time that are not readily apparent from the rounded values in the table.

4.0 Stakeholder Review

The demand projection methodology, results, and analyses were provided to the District's water use permitting staff and PG sector stakeholders for review and comment. The projections were reviewed by the District's Industrial Advisory Committee, which concurred with the projection methodologies and outcome. Upon receiving additional stakeholder comments, the District reviewed suggested changes and, when appropriate, included updates.

Section 5. Landscape/Recreation

1.0 Description of the Landscape/Recreation Water-Use Sector

The L/R sector includes the self-supplied water use associated with the irrigation of golf courses, cemeteries, parks, medians, attractions, and other large self-supplied green areas. Golf courses are major users within this category.

2.0 Demand Projection Methodology

Landscape/Recreation (L/R) baseline use data is from the WUWPD (SWFWMD, 2017). This database includes metered use for active individual/general permits and estimated use for General Permits by Rule. The projection methodologies are divided into those for golf and those for other landscape and recreation. A more detailed description of the methodologies used is contained in Appendix 3-4.

Based on comments from knowledgeable stakeholders that initial demand projections for golf may be too high, the District engaged the services of a respected golf industry consulting firm to develop county-level percent changes in demand for 18-hole equivalent golf courses for each five-year period of the planning period. The percent changes were then applied to the previous five-year period's pumpage beginning with the 2015 baseline pumpage. The projected percentage changes were based on projected socioeconomic factors such as, household income and ethnicity, and golf play rates associated with those socioeconomic factors.

Other (non-golf) L/R demands are based on population growth within each county. Water use for this sector is assumed to grow at the projected county-level percent change in population. The five-year population percent changes for each five-year period were calculated and then applied to the previous five-year period's pumpage, beginning with the baseline pumpage.

3.0 Water Demand Projections

Table 3-5 provides total L/R demand for the planning period (both golf and other L/R demand). An increase in demand of 3.05 mgd for the 5-in-10 condition is projected between 2015 and 2040. This represents an increase in demand of 21.6 percent.

4.0 Stakeholder Review

The demand projection methodology, results, and analyses were provided to the District's water use permitting staff and L/R use sector stakeholders for review and comment. The District's Agricultural and Green Industry Advisory Committee generally confirmed stable or decreasing water demands for golf as part of the L/R projections.

Table 3-5. *Projected increase in L/R demand in the Tampa Bay Planning Region (5-in-10 and 1-in-10) (mgd)*

County	2015 Base		2020		2025		2030		2035		2040		Change 2015-2040		% Change	
	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10
Hillsborough	8.45	10.77	9.01	11.48	9.54	12.15	10.02	12.75	10.42	13.26	10.80	13.73	2.35	2.96	27.8%	27.5%
Pasco	3.53	4.52	3.68	4.71	3.82	4.89	3.95	5.05	4.06	5.19	4.16	5.32	0.63	0.80	17.8%	17.7%
Pinellas	2.18	2.79	2.20	2.82	2.21	2.84	2.22	2.85	2.23	2.87	2.24	2.87	0.06	0.08	2.8%	2.9%
Total	**14.15**	**18.08**	**14.89**	**19.01**	**15.57**	**19.88**	**16.19**	**20.65**	**16.71**	**21.32**	**17.20**	**21.92**	**3.05**	**3.84**	**21.6%**	**21.2%**

Note: Summation and percentage calculation differences occur due to rounding. See Appendix 3-4 for source values.

Section 6. Summary of Projected Demands

Tables 3-6 summarizes the demands for the 5-in-10 and 1-in-10 conditions for water use categories in the planning region. This table shows that 76.03 mgd of additional water supply will need to be developed and/or existing use retired to meet the 5-in-10 demand in the planning region through 2040. Public supply water use will increase by 87.36 mgd during the planning period. This is the largest increase of all the water use categories. Table 3-6 shows a -9.95 mgd reduction in agricultural water use and a net decrease of -4.54 mgd in I/C and M/D water use, most of which is groundwater. Table 3-7 summarizes the projected demands by each county in the planning region for the 5-in-10 condition.

Table 3-6. *Summary of the projected demand in the Tampa Bay Planning Region (5-in-10 and 1-in-10)[1] (mgd)*

Water Use Category	2015 Base		2020		2025		2030		2035		2040		Change 2015-2040		% Change	
	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10	5-10	1-10
PS	304.63	322.81	325.88	345.44	346.36	367.16	364.29	386.14	379.09	401.84	391.99	415.51	87.36	92.70	28.7%	28.7%
AG	48.11	62.27	46.12	59.62	44.18	57.09	42.35	54.67	40.45	52.23	38.16	49.30	-9.95	-12.97	-20.7%	-20.8%
I/C & M/D	18.66	18.66	26.11	26.11	26.31	26.31	13.77	13.77	13.94	13.94	14.12	14.12	-4.54	-4.54	-24.3%	-24.3%
PG	0.26	0.26	0.34	0.34	0.35	0.35	0.36	0.36	0.37	0.37	0.38	0.38	0.12	0.12	46.2%	46.2%
L/R	14.16	18.08	14.89	19.01	15.57	19.88	16.19	20.65	16.71	21.32	17.20	21.93	3.04	3.85	21.5%	21.3%
Total	**385.82**	**422.08**	**413.34**	**450.52**	**432.77**	**470.79**	**436.96**	**475.59**	**450.56**	**489.7**	**461.85**	**501.24**	**76.03**	**79.16**	**19.7%**	**18.8%**

Note: Summation and/or percentage calculation differences due to rounding.

Table 3-7. *Summary of the projected increase in demand for counties in the Tampa Bay Planning Region (5-in-10) (mgd)*

Water Use Category	Planning Period						Change 2015-2040	
	2015	2020	2025	2030	2035	2040	mgd	%
Hillsborough								
PS	146.78	161.51	175.53	187.90	197.59	206.51	59.73	40.7%
AG	43.20	41.32	39.44	37.64	35.79	33.55	-9.65	-22.3%
I/C & M/D	17.49	24.97	25.14	12.57	12.72	12.87	-4.62	-26.4%
PG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
L/R	8.45	9.01	9.54	10.02	10.42	10.80	2.35	27.8%
Cumulative Total	**215.92**	**236.81**	**24.65**	**248.13**	**256.52**	**263.73**	**47.81**	**22.1%**
Pasco								
PS	56.60	61.93	66.86	71.06	74.92	78.38	21.78	38.5%
AG	4.89	4.78	4.72	4.69	4.64	4.59	-0.30	-6.1%
I/C & M/D	0.98	0.95	0.98	1.00	1.02	1.05	0.07	7.1%
PG	0.26	0.34	0.35	0.36	0.37	0.38	0.12	46.2%
L/R	3.53	3.68	3.82	3.95	4.06	4.16	0.63	17.8%
Cumulative Total	**66.26**	**71.68**	**76.73**	**81.06**	**85.01**	**88.56**	**22.30**	**33.7%**
Pinellas								
PS	101.25	102.44	103.97	105.33	106.58	107.10	5.85	5.8%
AG	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.0%
I/C & M/D	0.19	0.19	0.19	0.20	0.20	0.20	0.01	5.3%
PG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
L/R	2.18	2.20	2.21	2.22	2.23	2.24	0.06	2.8%
Cumulative Total	**103.64**	**104.85**	**106.39**	**107.77**	**109.03**	**109.56**	**5.92**	**5.7%**
Region Total	**385.82**	**413.34**	**432.77**	**436.96**	**450.56**	**461.85**	**76.03**	**19.7%**

Note: Summation and percentage calculation differences occur due to rounding. Changes in small demand numbers across time can represent a large percent change in demand over time that is not readily seen from the rounded values in the table. Additional water quantities may be required over the planning period to address environmental restoration needs for water bodies discussed in Chapter 2.

Section 7. Comparison of Demands between the 2015 Regional Water Supply Plan and the 2020 Regional Water Supply Plan

There are notable differences between the 2015 and 2020 RWSP demand projections in the AG, PS, I/C, M/D, PG, and L/R water use categories. The 2015 base numbers are reduced for all sectors except PS from the 2015 projected numbers used in 2015 RWSP. The increase in PS is largely due to methodology changes that include a parcel-based population projection approach. Regarding the PS category, the 2015 RWSP projected an increase of 83.11 mgd for the 2010–2035 planning period while the 2020 RWSP projects an increase of 87.36 mgd from 2015–2040, slightly greater than the 2015 RWSP.

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Chapter 4. Evaluation of Water Sources

This chapter presents the results of investigations by the Southwest Florida Water Management District (SWFWMD) (District) to quantify the amount of water that is potentially available from all sources of water within the planning region to meet demands through 2040. Sources of water that were evaluated include surface water/stormwater, reclaimed water, seawater desalination, brackish groundwater desalination, fresh groundwater, and conservation. Aquifer storage and recovery (ASR) is also discussed as a storage option with great potential to maximize the utilization of surface water and reclaimed water. Aquifer recharge (AR), either indirect through rapid infiltration basins (RIBs) or direct through injection wells, is discussed as an option to increase water supply, restore aquifer levels, and manage saltwater intrusion. The amount of water that is potentially available from these sources is compared to the demand projections for the planning region presented in Chapter 3, and a determination is made as to the sufficiency of the sources to meet demand through 2040.

Part A. Evaluation of Water Sources

Fresh groundwater from the Upper Floridan aquifer (UFA) is currently the primary source of supply for all use categories in the planning region. It is assumed that the principal source of water to meet projected demands during the planning period will likely come from sources other than fresh groundwater. This assumption is based largely on the impacts of groundwater withdrawals on water resources in the planning region, as discussed in Chapter 2, and previous direction from the Governing Board. Limited additional fresh groundwater supplies will be available from the surficial and intermediate aquifers and possibly from the UFA, subject to a rigorous, case-by-case permitting review.

Water users throughout the region are increasingly implementing conservation measures to reduce their water demands. Such conservation measures will enable water supply systems to support more users with the same quantity of water and hydrologic stress. However, the region’s continued growth will require the development of additional alternative sources such as reclaimed water, brackish groundwater, seawater, and surface water with off-stream reservoirs and ASR systems for storage or AR to provide recovery and offset impacts from withdrawals. To facilitate the development of these projects, the District encourages partnerships between neighboring municipalities and counties for purposes of developing regionally coordinated water supplies.

The following discussion summarizes the status of the evaluation and development of various water supply sources and the potential for those sources to be used to meet the projected water demand in the planning region.

Section 1. Fresh Groundwater

Fresh groundwater from the UFA is the principal source of water supply for all use categories in the planning region. In 2017, approximately 61 percent (242 million gallons per day [mgd]) of the 397 mgd of water (including domestic self-supply) used in the planning region was from groundwater sources. Approximately 51 percent (154 mgd) of the fresh groundwater used was for public supply (PS) (permitted and domestic self-supply [DSS]). Fresh groundwater is also withdrawn from the surficial and intermediate aquifers for water supply, but in much smaller quantities. The following is an assessment of the availability of fresh groundwater in the surficial, intermediate and UFA in the planning region.

1.0 Surficial Aquifer

Due to the karst geologic setting of the region, the thickness of the surficial aquifer is highly variable, ranging from less than 5 to more than 90 feet. The aquifer is generally low in permeability due to the presence of fine-grained sediments, has limited saturated thickness and is suitable mostly for lawn irrigation and watering livestock. The surficial aquifer in the northern half of Hillsborough County and all of Pasco County provides very little water for water supply and is not anticipated to supply a significant amount in the future.

Because the clay-confining layer between the surficial and UFA is thin and leaky in this area, groundwater withdrawals from the UFA can significantly affect water levels within the surficial aquifer, thereby impacting surface features such as wetlands and lakes. Decades of large-scale groundwater withdrawals from the UFA for PS have lowered surficial aquifer water levels near wellfields. Although there are no permitted withdrawals from the surficial aquifer in Pinellas County, the aquifer is used as a source of supply for irrigation of residential turf and landscaping. A shallow well reimbursement program has been implemented in Pinellas County to encourage homeowners to install wells into the surficial aquifer for lawn irrigation as an alternative to utilizing potable water from their PS connection.

In 2014, the surficial aquifer yielded 3.7 mgd of unpermitted withdrawals in Pinellas County, which was mostly used for landscape irrigation. It is anticipated that an additional irrigation demand of 0.4 mgd can be met through the use of the surficial aquifer in Pinellas County. In Pasco County, there were 0.3 mgd of permitted withdrawals from the surficial aquifer in 2014. There were no quantities of permitted withdrawals in Hillsborough County.

2.0 Intermediate Aquifer System

The intermediate aquifer system in the planning region exists only in central and southern Hillsborough County. Annual average water use from permitted withdrawals in the intermediate aquifer system in 2014 was 1.4 mgd in Hillsborough County. There were no permitted withdrawals in Pinellas or Pasco counties. Small unpermitted quantities are also withdrawn from the aquifer for lawn watering or individual household use. The quantity of water for these uses was estimated to be a total of 2 mgd in Hillsborough County in 2014.

Due to its limited extent, only approximately one-third of projected 2040 demand for domestic self-supply, landscape irrigation and recreational water use in Hillsborough County can be met from the aquifer. Projected 2040 demand supplied through withdrawals from the surficial and intermediate aquifers in the planning region is expected to total 4.8 mgd, with 0.8 mgd allocated to recreational use and 4.0 mgd to DSS and household irrigation use. See Table 4-1 for a summary of this estimated demand.

Table 4-1. *Estimated demand for groundwater from the surficial and intermediate aquifers (mgd)*

County	Domestic Self-Supply/Irrigation	Recreation	Total
Hillsborough	3.6[1]	0.8[1]	4.4[1]
Pinellas	0.4	0.0	0.4
Pasco	0.0	0.0	0.0
Total	**4.0**	**0.8**	**4.8**

[1] Reduced due to limited extent of the intermediate aquifer system in this count

3.0 Upper Floridan Aquifer

To reverse the extensive water resource impacts of large-scale groundwater withdrawals from wellfields in the Northern Tampa Bay Water Use Caution Area (NTBWUCA), the District and Tampa Bay Water (TBW) agreed to phased reductions that would scale down production from 159 mgd to an annual average of 90 mgd. As a result of the development of alternative water supply (AWS) projects and favorable hydrologic conditions, TBW achieved the reduction in withdrawals in 2003. The Phase II Recovery Plan was implemented in 2010 to monitor the impacts of 90 mgd of withdrawals over a 10-year period. By the next permit renewal due in 2020, a determination will be made as to whether or not an additional reduction in groundwater withdrawals and/or mitigation will be required. Because so much of the planning region is still in recovery, the development of additional groundwater quantities from the UFA will be very limited.

3.1 Upper Floridan Aquifer Permitted/Unused Quantities

A number of PS utilities in the planning region are not currently using their entire permitted allocation of groundwater. The District anticipates that these utilities will eventually grow into these unused quantities to meet future demand. Based on a review of the unused quantities of water associated with PS water use permits (WUPs), approximately 33.1 mgd of additional groundwater quantities are available to PS utilities from the UFA.

Section 2. Water Conservation

1.0 Non-Agricultural Water Conservation

Non-agricultural water conservation is defined as the beneficial reduction of loss, waste, or other inefficient uses of water accomplished through the implementation of mandatory or voluntary best management practices (BMPs) that enhance the efficiency of both the production and distribution of potable water (supply-side measures) and indoor or outdoor water use (demand-side measures). The implementation of a comprehensive portfolio of conservation measures creates the benefits listed below:

- Infrastructure and Operating Costs. The conservation of water allows utilities to defer expensive expansions of potable water and wastewater systems while limiting operation and maintenance costs at existing treatment plants, such as the use of electricity for pumping and treatment or expensive water treatment chemicals.

- Fiscal Responsibility. Most water conservation measures have a cost-effectiveness that is more affordable than that of other AWS sources such as reclaimed water or desalination. Cost-effectiveness is defined as the cost of each measure compared to the amount of water expected to be conserved over the lifetime of the measure.
- Environmental Stewardship. Proper irrigation designs and practices, including the promotion of Florida-Friendly Landscaping™ (FFL), can provide natural habitat for native wildlife as well as reduce unnecessary runoff from properties into water bodies. This can reduce nonpoint-source pollution, particularly from operations that use fertilizers, pesticides or fungicides which, in turn, may hamper a local government's overall strategy of dealing with total maximum daily load (TMDL) restrictions within their local water bodies or maintain spring water quality health.

Since the 1990s, the District has provided financial and technical assistance to water users and suppliers in the planning region for the implementation of local and regional water conservation efforts. The District has a long history of successful water use reduction projects, which encourages water users to seek assistance by working with District staff when implementing water-saving and educational water conservation programs.

Water savings have been achieved in the Tampa Bay Planning Region through a combination of regulatory and economic measures, as well as incentive-based outreach and technical assistance for the development and promotion of the most recent technologies and conservation activities. Regulatory measures include WUP conditions, year-round water restrictions, and municipal codes and ordinances that require water-efficiency standards for new development and existing areas. For example, the National Energy Policy Act of 1992 requires all new construction built after 1994 to be equipped with low-flow plumbing fixtures. In Florida, Senate Bill 494, which took effect in July 2009, requires all automatic irrigation systems to use an automatic shutoff device. Senate Bill 2080 prohibits contractual and/or local government ordinance restrictions on the implementation of FFL. Periodically, water management districts (WMDs) in Florida issue water shortage orders that require short-term mandatory water conservation through situational BMPs and other practices.

Economic measures, such as inclining block rate structures, are designed to promote conservation by providing price signals to customers of public water supply systems to reduce inefficient use. Incentive programs include rebates, utility bill credits, or giveaways of devices and fixtures that will replace older, less water-efficient models. Such equipment includes, but is not limited to, high-efficiency toilets (HET), low-flow faucet aerators, high-efficiency showerheads, smart irrigation controllers, rain sensors, and soil moisture sensors (SMSs). Recognition programs, such as the District's Water Conservation Hotel and Motel Program (CHAMP℠) and Florida Water Star℠ (FWS), are also incentive programs that recognize homeowners and businesses for their environmental stewardship.

FWS landscapes use large mulch beds to reduce irrigable turf.

The District's Utilities Services Group provides guidance and technical expertise to PS water utilities and helps identify and reduce water loss. The non-regulatory assistance and educational components of the program maximize water conservation throughout the PS water use sector and improve both local utility system efficiency and regional water resource benefits. Among the services provided upon request are leak detection surveys, meter accuracy testing, and water audit guidance and evaluation. Since the program's inception, the leak detection team has conducted 155 leak detection surveys throughout the District, locating 1,554 leaks of various sizes and totaling an estimated 5.86 mgd. For the Tampa Bay Planning Region, the leak detection team has conducted 33 comprehensive leak detection surveys, locating 313 leaks totaling an estimated 1.25 mgd.

For the past ten years, the District has administered the statewide FWS voluntary water conservation certification program for new and existing homes and commercial developments. Residences, businesses, and communities can earn FWS certification through meeting efficiency standards in appliances, plumbing fixtures, irrigation systems, and landscapes.

A single-family home built to meet FWS criteria may use at least 40 percent less water outdoors and approximately 20 percent less water indoors than a home built to the current Florida Building Code. Local governments that adopt FWS criteria as their standard for new construction can expect greater long-term savings to occur than for similar structures built to conventional standards. In addition, FWS offers installation and BMPs training for landscapers and irrigation contractors, providing an opportunity for them to become FWS accredited professionals.

Education is an important element of a successful conservation program. While the actual quantity of water saved as a result of customer education is not measurable, the effort greatly increases the success of all other facets of a conservation program by raising customer awareness and changing attitudes regarding water use. Educating the public is a necessary facet of every water conservation program, and conservation education programs accompanied with other effective conservation measures can be an effective supplement to a long-term water conservation strategy. On a Districtwide scale, water conservation efforts have contributed to declining unadjusted gross per capita use rates, from 115 gallons per day (gpd) per person in 2005 to 97 gpd per person in 2015. The per capita use rate for the District is the lowest of all five WMDs. The per capita trend for the Tampa Bay Planning Region is also decreasing as shown in Figure 4-1.

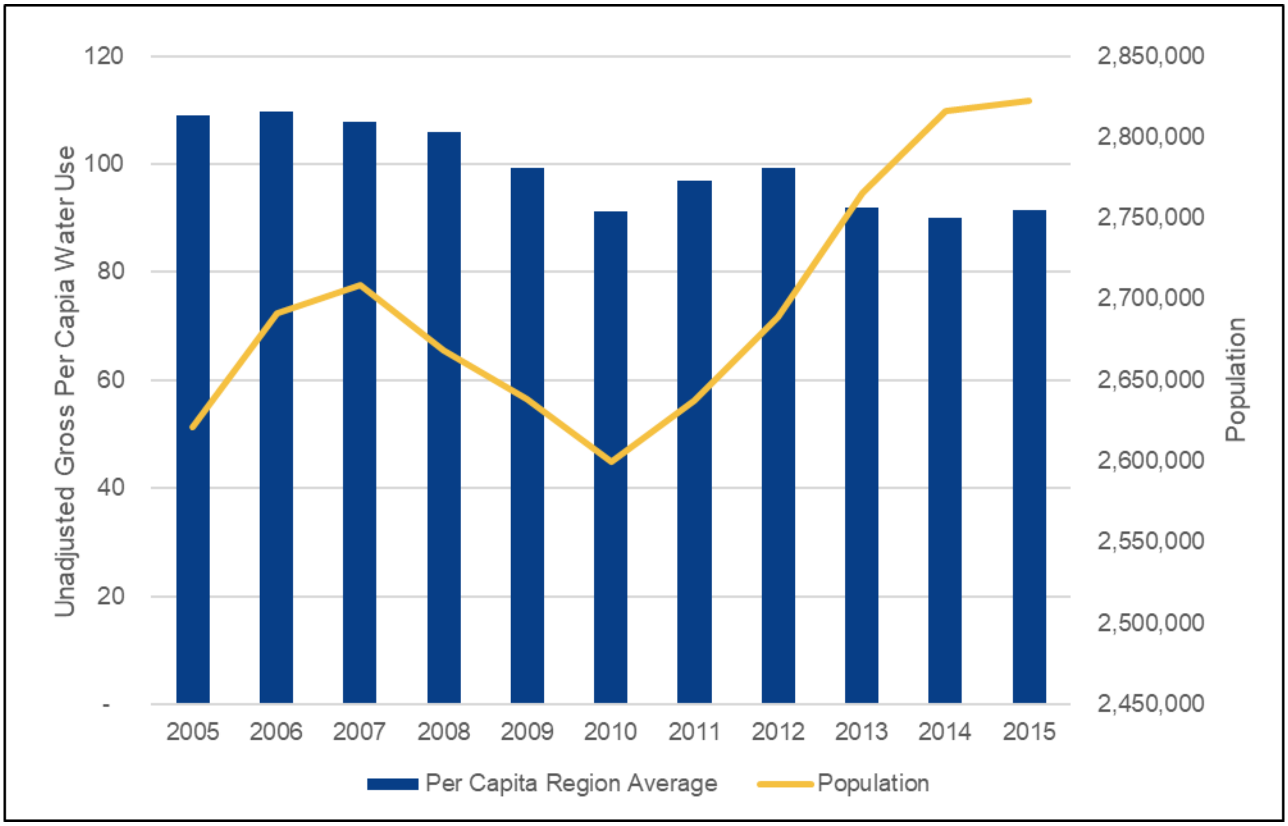


Figure 4-1. *Per capita water use rates in the Tampa Bay Planning Region, 2005-2015*

1.1 Public Supply

The PS sector includes all water users that receive water from public water systems and private water utilities. The PS sector may include non-residential customers such as hospitals and restaurants that are connected to a utility potable distribution system. Water conservation in the PS sector will continue to be the primary source of water savings in the District. Public supply systems lend themselves most easily to the administration of conservation programs since they measure each customer's water use and can focus, evaluate, and adjust the program to maximize savings potential. The success of the District's water conservation programs for PS systems to date is demonstrated by the 15.8 mgd in savings that has been achieved within the District since programs began in 1991. Within the region, it is estimated that savings for the PS sector could be 40 mgd by 2040, if all water conservation programs presented below are implemented (see Table 4-2).

1.1.1 Water Conservation Potential in the Tampa Bay Planning Region

Estimated conservation potential for the planning region is based on the 2018 TBW Water Demand Management Plan Update which is a part of TBW's 2018 Long-term Master Water Plan. The update uses the 2015-2040 planning horizon and is understood to be a well-quantified demand management plan. The plan analyzes the potential for 11 water conservation activities within the TBW member governments' service areas, using the Water Conservation Tracking Tool (Alliance for Water Efficiency, 2019) to calculate the associated savings and costs.

1.1.2 Assessment Methodology

Tampa Bay Water includes six member governments (City of New Port Richey, City of St. Petersburg, Hillsborough County, Pasco County, Pinellas County, and City of Tampa) and, as a single entity, accounted for 82.5 percent of PS water use in the planning region in 2015. In order to assess the region's entire conservation potential, including what is available for the other 17.5 percent of demand, the District has projected the TBW estimates onto the demand of the entire planning region. Water conservation is divided into two categories, passive and active, and the estimation methodology is described further below.

Passive Conservation

Passive water conservation savings refer to water savings that occur as a result of users implementing water conservation measures in the absence of utility incentive programs. These are typically the result of building codes, manufacturing standards, and ordinances that require the installation of high-efficiency plumbing fixtures and appliances in new construction and renovations. Passive water conservation has been observed as a major contributor to decreasing per capita water use across the country.

Tampa Bay Water divides water demand into three major sectors: (1) single-family residential, (2) multi-family residential, and (3) non-residential. Single-family residential water demand is greater than multi-family residential and non-residential demand combined. Single-family demand and its potential for conservation was examined by conducting a residential end users survey within the planning region followed by a statistical evaluation of actual billing data matched with parcel-level information. These results show that the majority of indoor water use is attributable to showers, clothes washers, and toilets. This is consistent with national studies on the end uses of water. Parcel-level data that contains home age and heated square footage was used to estimate the original number of plumbing fixtures and their age and efficiency. This information was used to calculate passive conservation for TBW member governments. To obtain the passive savings estimate across the planning region, the percent reduction in 2040 demand due to passive conservation was multiplied by the 2040 regional demand.

Active Conservation

Active water conservation encompasses a variety of measures, practices, and programs sponsored or encouraged by utilities and municipal governments which result in water use reductions. By their nature, active water conservation programs are typically funded and administered by PS utilities or other regional entities.

In the 2018 Demand Management Plan Update, TBW selected the 11 potential conservation activities listed below:

1. Alternative Irrigation Sources
2. High-efficiency Toilets (HET) (Single-family)
3. Smart Irrigation Controllers
4. Florida Water Star/Florida-Friendly Landscaping™
5. High-efficiency Toilets (HET) (Multi-family)
6. Cooling Towers
7. High-efficiency Toilets (HET), Valve (Industrial/Commercial)
8. High-efficiency Urinals (0.5 gallon) (Industrial/Commercial)
9. Pre-rinse Spray Valves (Industrial/Commercial)
10. I/C High-efficiency Toilets (HET), Tank (Industrial/Commercial)

11. Conveyor Dishwashers (Industrial/Commercial)

In the TBW 2018 Demand Management Plan Update, the implementation period for active conservation ends in 2030. This falls 10 years short of the 2020 RWSP's planning horizon. In an effort to maintain savings beyond 2030, the number of implementations per year were extrapolated for four of the conservation activities: (1) smart irrigation controllers (referred to as SMS and evapotranspiration irrigation controllers by TBW), (2) Florida Water Star/Florida-Friendly Landscaping™, (3) cooling towers, and (4) pre-rinse spray valves. These activities either had a participation rate lower than 20 percent or a life expectancy shorter than the 20-year planning horizon. Those not selected for extrapolation were assumed to have a high participation rate at or above 50 percent in the TBW plan and were therefore left out in order to be more conservative in the 2020 RWSP estimates. The savings and costs for these four conservation activities were adjusted accordingly.

After extending the implementation period for the aforementioned conservation activities, the adjusted percent reduction in 2040 TBW demand was applied to the 2040 Tampa Bay Planning Region demand. Using the resulting total adjusted active savings across the planning region, the 2040 savings for each of the 11 activities were estimated. This was done by calculating the proportion of savings attributed to each activity according to TBW estimates and applying these same ratios to the District regional total. Similarly, the total costs for each conservation activity across the planning horizon were calculated.

1.1.3 Results

The TBW 2018 Demand Management Plan Update results adjusted for an extended implementation period project that there will be a passive savings rate of 6.30 percent in 2040. Applying this rate to the higher SWFMWD demand yields a passive savings of 21.68 mgd across the planning region in 2040, which is 53.9 percent of total savings. Similarly, the adjusted TBW figures project an active savings rate of 5.38 percent, which, when applied to the total regional demand, yields an active savings of 18.51 mgd by 2040. These active savings constitute 46.1 percent of total savings. Combined, passive and active savings total 40.19 mgd by 2040 for the planning region. The drop in regional demand over time associated with both passive and active savings is shown in Figure 4-2 and Table 4-2 below.

For the purposes of this RWSP, the cost effectiveness of the active conservation activities analyzed are calculated using SWFWMD methods rather than those of TBW. The unit cost is amortized at 8 percent and compared to the unit savings over the activity's anticipated service life. On average, the 11 conservation activities cost $0.99 per thousand gallons. The most cost-effective conservation activity is the cooling tower retrofit/upgrade at $0.13 per thousand gallons, while the least cost-effective activity is the Florida Water Star/Florida-Friendly Landscaping™ program at $2.14 per thousand gallons. The region-wide total cost for active programs across the planning horizon is estimated at $60.5 million.

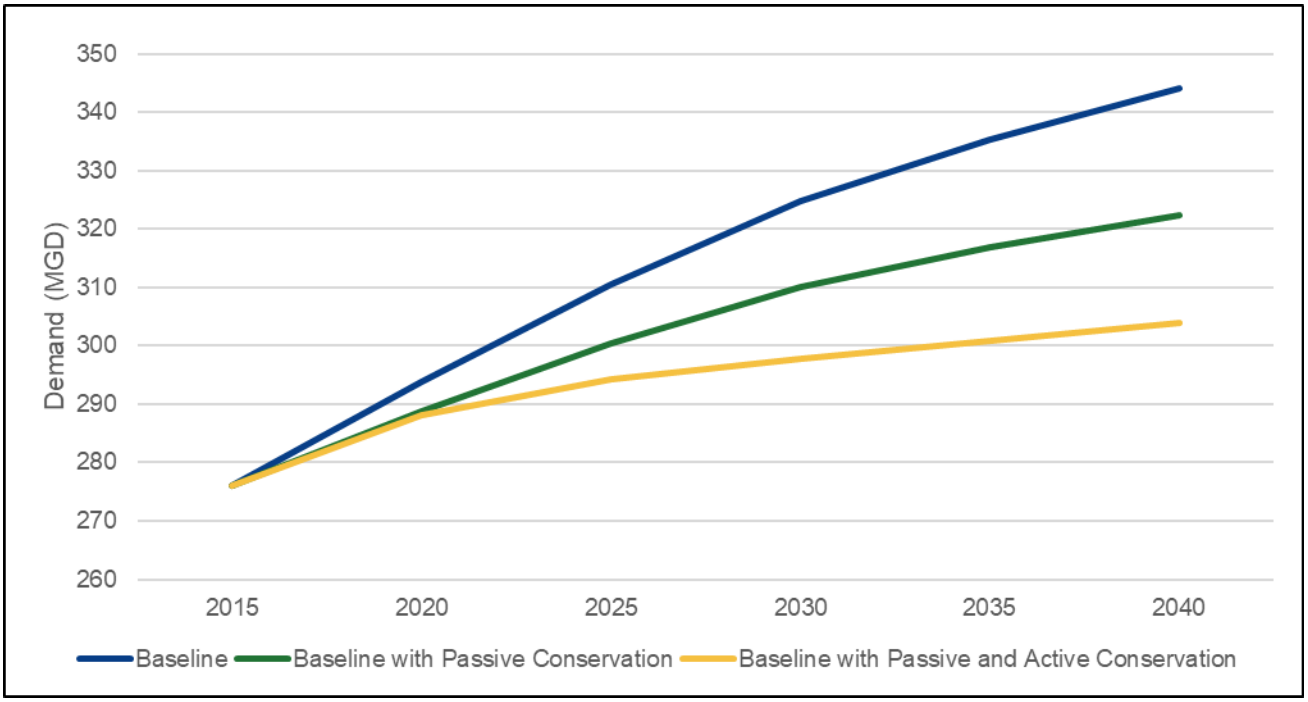


Figure 4-2. *Potential effects of conservation on projected PS demand*

1.1.4 Additional Considerations

The active conservation analysis builds on the passive estimate as it considers only the inefficient stock not already replaced passively. However, it is not comprehensive as there are many other activities that could result in substantial water savings. These active estimates also factor in the effective life of various activities; therefore, for items that have a short-expected life (e.g., rain sensors), repetitive implementations, and reoccurring costs are required just to maintain savings.

1.2 Domestic Self-Supply

The DSS sector includes individual private homes and businesses that are not utility customers and receive their domestic water supply from a well or from a surface supply for uses such as irrigation. DSS wells do not require a District WUP, as the well diameters do not meet the District's requirement for a permit. DSS systems are not metered and, therefore, changes in water use patterns are less measurable than those that occur in the PS sector. Only passive conservation was estimated for DSS systems in this RWSP. Within the region, it is estimated that passive savings for the DSS sector could be 2.0 mgd by 2040.

1.2.1 Domestic Self-Supply Assessment Methodology

To calculate DSS passive savings, it was assumed that the DSS sector will experience the same percent savings as the PS sector over the planning horizon. The percent of passive savings calculated in the PS analysis was therefore applied to the SWFWMD total DSS 2040 demand projection for the Tampa Bay Planning Region to obtain passive savings specific to the DSS sector. In other words, the DSS 2040 demand (31.7 mgd) was multiplied by the PS passive savings rate (6.3 percent) to yield the DSS passive savings estimate (1.9 mgd).

1.3 Industrial/Commercial Self-Supply

This water use sector includes factories and other industrial enterprises that obtain water directly from surface water and/or groundwater sources through a WUP. Businesses try to minimize water use to reduce pumping, purchasing, treatment, and disposal costs. To date, the District has focused efforts on education, indoor and outdoor surveys, and commercial applications, such as spray valves and HET. The industrial processes being used in this category present unique opportunities for water savings and are best identified through a site-specific assessment of water use at each (or a similar) facility. It is estimated that the savings for the I/C sector could be 0.32 mgd by 2040 (See Table 4-2).

1.3.1 Industrial/Commercial Assessment Methodology

The I/C savings estimate utilized the same methodology outlined in the 2020 Draft Central Florida Water Initiative (CFWI) RWSP. This methodology was based on a study by Dziegielewski et al. (2000) that examined the impact of water audits on improving water efficiency within this sector. The lower-bound savings determined in this study was 15 percent, and this number was used in lieu of the higher estimate to be more conservative. The 15 percent participation rate used in the 2020 Draft CFWI RWSP was also assumed. Therefore, the self-supplied I/C 2040 demand (14.11 mgd) multiplied by both the savings and participation rates (15 percent for both) yields the estimated water savings over the planning horizon for the self-supplied I/C sector within the Tampa Bay Planning Region (0.32 mgd).

1.4 Landscape/Recreation Self-Supply

The Landscape/Recreation (L/R) water use category includes golf courses and large landscapes (e.g., cemeteries, parks, and playgrounds) that obtain water directly from groundwater and surface water sources rather than from a PS system. It is acknowledged that some amount of water savings has been achieved in this category through the use of efficient irrigation practices and technology. Within the region, it is estimated that the savings for the L/R water use category could be 0.99 mgd by 2040 (See Table 4-2).

1.4.1 Landscape/Recreation Assessment Methodology

As with the self-supplied I/C sector, the estimate of the water conservation potential of the L/R sector was derived using the same methodology as the 2020 Draft CFWI RWSP. Conservation in this sector primarily comes from updating inefficient sprinkler heads and installing smart irrigation controllers, such as SMS or weather-based controllers. Based on two studies by the University of Florida, it was determined that the lower-bound savings from retrofits and smart irrigation controllers are 10 percent and 20 percent, respectively. These values were used along with the 15 percent savings rate also assumed in the 2020 Draft CFWI RWSP to estimate self-supplied L/R water conservation. In other words, the 2040 L/R demand (21.93 mgd) was multiplied by the participation rate (15 percent), and this product was multiplied by each of the savings rates (10 percent and 20 percent). The sum of these final two numbers (0.33 mgd and 0.66 mgd) equates to the total L/R savings over the planning horizon (0.99 mgd). The 1-in-10

2040 demand projections were used instead of the 5-in-10 projections in an effort to be more conservative.

1.5 Summary of the Potential Water Savings from Non-Agricultural Water Conservation

Table 4-2 summarizes the potential non-agricultural water conservation savings in the Tampa Bay Planning Region. This table shows that, through the implementation of all conservation measures listed above for the PS, DSS, I/C, and L/R water use sectors, it is anticipated that approximately 43.50 mgd could be saved by 2040 at a total projected cost of $60.5 million. This is a 10.56 percent reduction in total demand.

Table 4-2. *Potential non-agricultural water conservation savings in the Tampa Bay Planning Region*

Sector	2040 Demand (mgd)	Savings (mgd)	Potential Reduction in Demand (%)	Average Cost Effectiveness ($/kgal)
PS Total	344.06	40.19	11.68%	-
PS Passive	-	*21.68*	*6.31%*	-
PS Active	-	*18.51*	*5.38%*	*$0.99*[1]
DSS	31.71	2.00	6.30%	-
I/C	14.11	0.32	2.27%	-
L/R	21.93	0.99	4.51%	-
Total	**411.81**	**43.50**	**10.56%**	**-**

[1]Total cost efficiency is weighted by each project's percent share of total savings in relation to the cost.

2.0 Agricultural Water Conservation

The Florida Department of Agriculture and Consumer Services (FDACS) develops conservation projections as part of the Florida Statewide Agricultural Irrigation Demand (FSAID5) projections. Those conservation projections were based on historical trends (1973-2013) in irrigation of water applied per acre per year. The historical trend of the ratio was used to predict future irrigation conservation through 2040. The trend accounts primarily for gains in irrigation system distribution uniformity. This methods limitation is that it does not completely account for existing regulatory constraints (SWUCA rules) that have resulted in increased water use efficiency, thus limiting future water conservation savings potential. However, future savings could still come from developing new technology, sensor-based automation, and scheduling changes.

This RWSP uses the trend as a percent reduction (approximately 13 percent) in 2040 demand. The county-by-county savings percentages derived from FSAID5 data were applied to the 2040 agricultural (AG) demands shown in Table 3-2 which are District specific demand projections and lower than FSAID5 demands. Results are shown below in Table 4-3.

Table 4-3. *Potential agricultural water conservation savings in the Tampa Bay Planning Region*

County	Projected 2040 demand (mgd)	Savings as a percentage (derived from FSAID5)	Agricultural Conservation Potential by 2040 (mgd)
Hillsborough	31.41	13.37%	4.20
Pasco	4.47	12.97%	0.58

County	Projected 2040 demand (mgd)	Savings as a percentage (derived from FSAID5)	Agricultural Conservation Potential by 2040 (mgd)
Pinellas	0.02	0%	0
Total	**35.90**		**4.78**

These estimates should be considered as potential conservation and should not be treated as "water supply" or directly removed from AG water demand estimates. Substantial investments will be necessary to realize these savings. District investment paired with other government assistance programs like those for the FDACS and the Natural Resources Conservation Service could accelerate the rate at which these savings occur. Water resource benefits from the Facilitating Agricultural Resource Management Systems (FARMS) Program are categorized as water resource development (WRD) or water conservation (gains in efficiency). Benefits associated with WRD (primarily tail water recovery) projects are estimated to be 0.75 mgd during the planning horizon. Additional information on the FARMS Program and its potential impact on water resources is located in Chapters 5 and 7.

Section 3. Reclaimed Water

Reclaimed water is defined by the Florida Department of Environmental Protection (FDEP) as water that is beneficially reused after being treated to at least secondary wastewater treatment standards by a domestic wastewater treatment plant (WWTP). Reclaimed water can be used to accomplish a number of goals, including decreasing reliance on potable water supplies, increasing groundwater recharge and restoring natural systems. Figure 4-3 illustrates the reclaimed water infrastructure, utilization, and availability of reclaimed water within the District in 2015, as well as planned utilization that is anticipated to occur by 2025 as a result of funded projects. Existing and funded projects are expected to result in reclaimed water increases of 36 mgd, bringing utilization within the planning region to approximately 126 mgd by 2025. Appendix 4-1 contains anticipated 2025 reclaimed water utilization.

The benefit that can be obtained from the use of reclaimed water is governed by the concepts of utilization and water resource benefit. Utilization rate is the percent of treated wastewater from a WWTP that is beneficially used in a reclaimed water system. The utilization rate of a reclaimed water system varies by utility. Typically, only 50 to 70 percent of treated wastewater flows go to reclaimed water customers. The highest utilization rates occur in utilities in urban areas where large industries and numerous residential customers can be supplied. Utilization is also limited by seasonal supply and storage. A utility cannot expand its reuse system beyond peak flow demand, which occurs during dry periods when demand is highest, without experiencing shortages. For example, a reclaimed water system with a 1 mgd average annual flow normally is limited to supplying 0.5 mgd (50 percent utilization) on a yearly basis. This is because during the dry season, demand for reclaimed water for irrigation can more than double.

The six main options to increase utilization beyond 50 percent include seasonal storage, system interconnects, an interruptible customer base, environmental enhancement/recharge, potable reuse, and supplementing reclaimed water supplies with other sources.

Seasonal storage is the storage of excess reclaimed water in surface reservoirs or ASR systems during the wet season when demand is low. This stored reclaimed water can be used to augment daily reclaimed water flows to meet peak demand in the dry season. System interconnects involve the transfer of reclaimed water from areas of excess supply to areas of high demand. This transferred reclaimed water can be used to augment daily reclaimed water flows to meet peak demand in the dry season.

An interruptible customer base is where a utility has golf course, recreational, commercial, agricultural, industrial, and other bulk customers that have multiple sources of irrigation or process water. Reclaimed water is supplied to these customers during certain times of the day and during certain seasons, but they may be requested to go “offline” and switch to backup sources during peak demand times or seasons. This enables a utility to develop a much larger customer base and maximizes the utilization of reclaimed water, while avoiding the negative consequences of running out of reclaimed water during peak irrigation times/seasons.

Environmental enhancement and recharge involves using excess reclaimed water to enhance wetland habitat, meet minimum flows and levels (MFLs) or recharge the UFA to achieve water resource benefits.

Potable reuse involves purifying reclaimed water to a quality for it to be used as a raw water source for potable supplies. Supplementing reclaimed water supplies with other water sources such as stormwater and groundwater for short periods to meet peak demand also enables systems to serve a larger customer base.

TECO Advanced Treatment Facility

Water resource benefit is the amount of potable-quality groundwater or surface water that is replaced by reclaimed water usage or the amount of reclaimed water used for environmental enhancement. Customers tend to use more reclaimed water than potable water because reclaimed water is generally less expensive and not as restricted as potable water. For example, a single-family residence with an in-ground irrigation system connected to potable water uses approximately 330 gpd for irrigation. However, if the same single-family residence converts to an unmetered flat rate, reclaimed water irrigation supply without day-of-week restrictions, it will use approximately two and one-half times (804 gpd) this amount. In this example, the benefit rate would be 41 percent (330 gpd benefit for 804 gpd reclaimed water utilization). Different types of reclaimed water uses have different benefit potentials. For example, a power plant or industry using 1 mgd of potable water for cooling or process water will, after converting to reclaimed water, normally use approximately the same quantity. In this example, the benefit rate would be 100 percent. Most reclaimed water utilities provide service to a wide variety of customers and, as a result, the average reclaimed water benefit rate is estimated to be 65 percent. The District is actively cooperating with utilities to help identify ways to increase reclaimed water utilization and benefit. For example, efficiency can be further enhanced with practices such as individual metering coupled with storage, water-conserving rates, and efficient irrigation design and irrigation restrictions.

The District’s goal is to achieve a 75 percent utilization rate of all WWTP flows and benefit efficiency of all reclaimed water used of 75 percent by the year 2040. This goal is intended to reduce the overuse of reclaimed water and increase potable and groundwater benefits. Opportunities may exist for utilization and benefit to be even greater in some cases by utilizing methods such as customer base selection (i.e., large industrial), project type selection (i.e. recharge) and implementation of developing technologies.

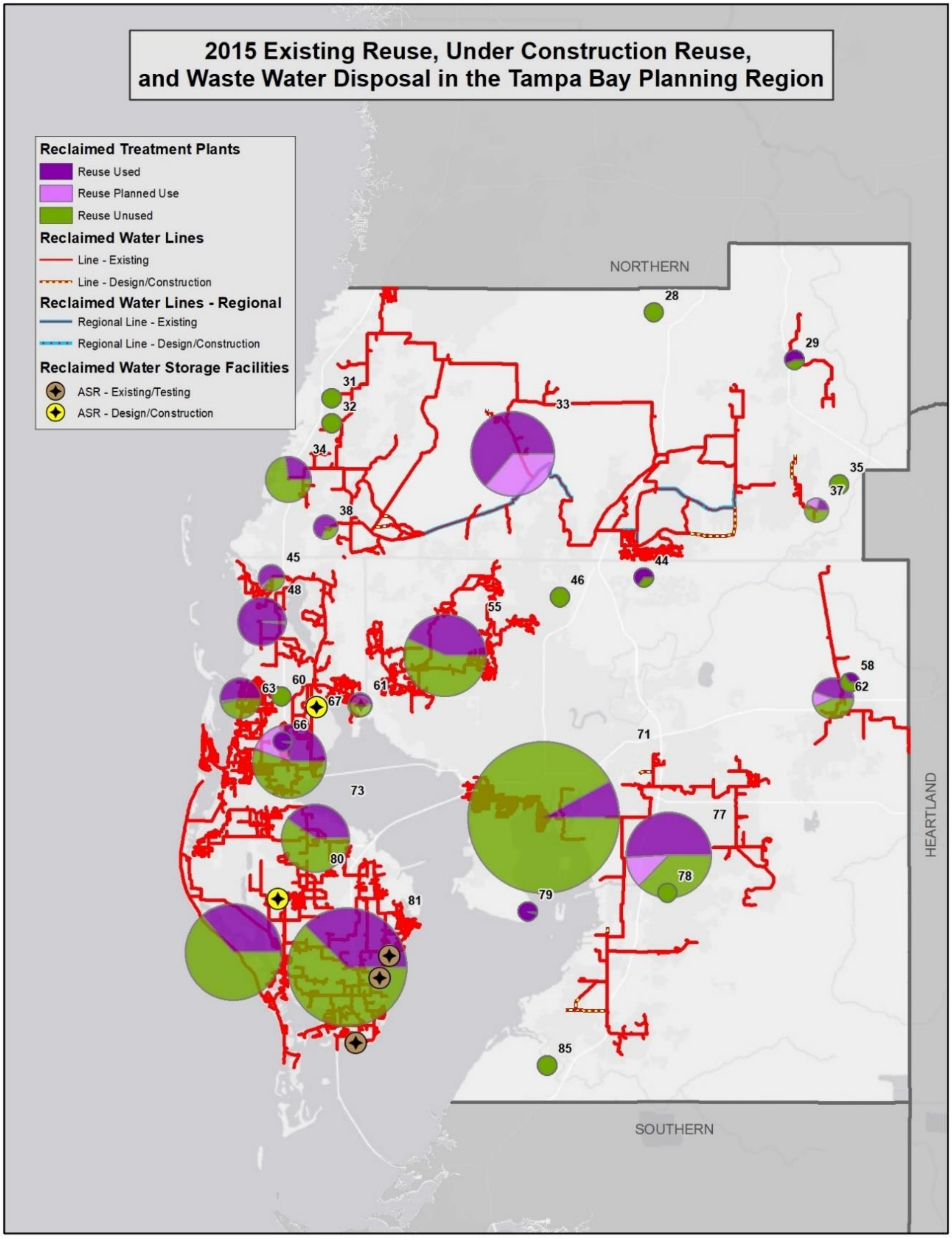


Figure 4-3. *Tampa Bay reclaimed water map (information on numbered facilities is available at http://www.swfwmd.state.fl.us/conservation/reclaimed/*

1.0 Potential for Water Supply from Reclaimed Water

Table 4-4 provides information on the current and future availability of reclaimed water in the planning region and the potential to achieve potable-quality water benefits through 2040. In 2015, there were 44 WWTPs in Hillsborough, Pasco, and Pinellas counties that collectively produced approximately 248 mgd of treated wastewater. Of that quantity, 89.31 mgd was used resulting in approximately 62 mgd of benefits to traditional water supplies. Therefore, only approximately 36 percent of the wastewater produced in the region was utilized for irrigation, industrial cooling, or other beneficial purposes. By 2040, it is expected that more than 75 percent of wastewater available in the planning region will be utilized, and that efficiency of use will average more than 75 percent through a combination of measures, such as development of a customer base with significant numbers of high-volume, high-efficiency users, metering, volume-based rate structures, storage, and education. As a result, by 2040, it is estimated that 221.26 (approximately 75 percent) of the 295.02 mgd of wastewater produced will be beneficially reused. This will result in approximately 166 mgd of benefits, of which 104.07 mgd is additional post-2015 (75 percent efficiency).

Table 4-4. *2015 Actual versus 2040 potential reclaimed water availability, utilization, and benefit (mgd) in the Tampa Bay Planning Region*

County	2015 Availability, Utilization, and benefit[1]				2015–2040 Potential Availability, Utilization, and benefit[2]			
	Number of WWTPs in 2015	WWTP Flow in 2015	Utilization in 2015 (36%)	Potable-Quality Water Benefit (69%)	2040 Total WWTP Flow	2040 Utilization (75%)[3]	2040 Potable-Quality Water Benefit (75%)[3]	Post 2015 Benefit
Hillsborough	15	109.49	26.62	19.27	141.75	106.31	79.73	60.46
Pasco	14	29.79	17.85	11.09	40.08	30.06	22.54	11.45
Pinellas	15	109.10	44.84	31.51	113.19	84.89	63.67	32.16
Total	**44**	**248.38**	**89.31**	**61.87**	**295.02**	**221.26**	**165.94**	**104.07**

[1]Estimated at 63 percent regionwide average.
[2]See Table 4-1 in Appendix 4.
[3]Unless otherwise noted.

Section 4. Surface Water

The major river systems in the planning region include the Anclote, Hillsborough (including the Tampa Bypass Canal [TBC]), Alafia, and Little Manatee. Major public utilities use the Alafia and Hillsborough rivers and the TBC for water supply. The Hillsborough River has an in-stream dam that forms a reservoir for storage. The potential yield for all rivers will ultimately be determined by their established minimum flows. However, yields associated with rivers that have in-stream dams also depend on the degree of structural alteration that has occurred and the habitat that is supported by the flows. The City of Tampa, which relies on the Hillsborough River and the TBC for most of its water needs, is currently permitted an annual average quantity of 83 mgd from these sources. Tampa bay Water (TBW) also uses the Hillsborough River and the TBC. From January 2007 to December 2018, TBW supplied an average of 36.9 mgd from the TBC (including withdrawals from the TBC Middle Pool, which is augmented by the Hillsborough River, and the Lower Pool). Water from these withdrawals is treated at TBW's regional water treatment plant (WTP) and conveyed to the regional distribution system.

1.0 Criteria for Determining Potential Water Availability

The available yield for each river was calculated using its established minimum flow and/or hydrodynamic modeling (if available) and its current permitted allocation. If the minimum flow for the river was not yet established or a hydrodynamic model was not available, a planning-level minimum flow criterion was utilized. A five-step process was used to estimate potential surface water availability that included (1) estimation of unimpacted flow, (2) selection of the period used to quantify available yield, (3) application of minimum flow or planning level criteria, (4) consideration of existing legal users, and (5) application of engineering limitations. The amount of water that can be developed in the future will depend on adopted minimum flows and the permitting process. A detailed explanation of this methodology is included in the Chapter 4 Appendix 4-2.

2.0 Overview of River Systems

2.1 Anclote River

The Anclote River originates in south-central Pasco County and discharges to the Gulf of Mexico at Tarpon Springs. The headwaters are poorly defined and consist mostly of AG and natural lands. The lower portion of the watershed is urbanized. The watershed area is approximately 120 square miles and contains several gauging stations with long-term flow data. The annual average discharge from 1965 through 2018 at the most downstream gauging station was 43. 7mgd (67.6 cubic feet per second [cfs]).

The Anclote River is located in Pasco and Pinellas counties and has a watershed of 120 square miles

The Anclote Power Station withdraws water from the river near the confluence with the Gulf of Mexico; however, there are no permitted surface withdrawals upstream of the gulf. According to *Anclote River System Recommended Minimum Flows and Levels* (Heyl et. al., 2010) and more recently completed MFLs status assessments, there may be little or no water available from the river. Declines in flow have occurred due to groundwater withdrawals from the five regional wellfields in the Northern Tampa Bay Region. River flows are expected to improve as a result of the recovery strategy for the NTBWUCA.

2.2 Alafia River

The Alafia River watershed encompasses approximately 460 square miles. While most of the watershed is within Hillsborough County, the headwaters are located in an area of Polk County that has been extensively mined for phosphate ore. The river extends 23 miles from its mouth at Hillsborough Bay near Gibsonton, eastward to the confluence of its two major tributaries (North and South prongs). Below this confluence, the river has three major tributaries: Turkey, Fishhawk and Bell creeks. Two minor permitted agricultural-use withdrawals are located in the upper watershed, on Bell Creek and Howell Branch. The annual average flow of the Alafia River at Lithia Pinecrest Road at Lithia, FL, not adjusted for these withdrawals was 213.8 mgd (331.0 cfs) for the period from 1933 through 2018.

Mosaic Fertilizer is permitted to withdraw an annual average of nearly 6.0 mgd from Lithia and Buckhorn springs, which both supply base flow to the river downstream of Lithia Pinecrest Road. Tampa Bay Water (TBW) also withdraws water from the downstream portion of the river for direct use or diversion to the C.W. Bill Young Regional Reservoir for storage. Tampa Bay Water's (TBW) withdrawals are permitted according to a flow-based withdrawal schedule, which for the period from 2007 through 2018, authorized an average withdrawal of up to 18.9 mgd. For this period, combined withdrawals from the springs and lower river averaged 13.9 mgd. Based on the annual flow in the lower river of 236.5 mgd adjusted for these withdrawals, consideration of established MFLs for the lower and upper Alafia River and existing permitted quantities, an additional 6.4 mgd of water supply is potentially available from the river.

2.3 Hillsborough River

The Hillsborough River, with a watershed area of 650 square miles, is the most hydrologically significant river in the planning region. The interactions between the Hillsborough River watershed and the UFA are complex and result in large wetland areas that act as groundwater discharge points in some areas and surface water storage basins in others. Minimum flows have been established for both the freshwater and estuarine reaches.

Although most of the river systems in the northern Tampa Bay Planning Region are fed almost totally by overland flow or surficial aquifer discharge, the Hillsborough River receives significant discharge from the UFA. The river originates in the Green Swamp, but much of the base flow entering the river is discharged from the UFA and surficial aquifers along the course of the river. Several reaches of the river have direct contact with the UFA and many springs are found along the bottom and banks. The Hillsborough River corridor is heavily urbanized in its lower reaches and the river has been dammed 10 miles upstream from its mouth to create a reservoir for the City of Tampa's water supply. The greater part of the headwaters and upper reaches of the river are undeveloped.

The annual average discharge from 1965 through 2018 was 185 mgd (286 cfs) as measured at the Hillsborough River. This is net discharge after withdrawals. The annual average flow for the other rivers in the District included in the RWSP for each planning region is calculated after all upstream withdrawals have been added back to reproduce the unimpacted flow. The transfer of water to and from the Hillsborough River is extremely complex, involving not only PS use but also transfers to and from the TBC. Consequently, the reported flow in Table 4-7 is not corrected for withdrawals.

Two withdrawals are permitted on the Hillsborough River - one for the City of Tampa and one for TBW. The City is currently permitted to withdraw an annual average of 82 mgd from the Hillsborough River Reservoir for delivery to the City's WTP, located upstream of the dam. Tampa Bay Water (TBW) is permitted to divert up to 194 mgd (dependent on flows over the dam) from the Hillsborough River to the TBC Middle Pool for withdrawal at TBW's pump station. The City can accept an annual average of up to 20 mgd into its reservoir from the TBC Middle Pool in accordance with TBW's WUP. From January 2007 through December 2018, the City of Tampa's annual average withdrawal from the Hillsborough River was approximately 70 mgd. TBW's annual average diversion from the Hillsborough River to the TBC Middle Pool was 1.9 mgd. The net withdrawal from the Hillsborough River was approximately 72 mgd. During the same period, TBW diverted 6.74 mgd from the TBC Middle Pool to augment the Hillsborough River.

2.4 Tampa Bypass Canal

The TBC System was built by the U.S. Army Corps of Engineers to provide flood protection for the Tampa metropolitan area. The canal system was completed in 1984 and extends 18 miles from the Lower Hillsborough Flood Detention Area to McKay Bay. The canal breaches the UFA, which allows groundwater to discharge from the aquifer into the canal. Minimum flows have been established for the TBC Lower Pool.

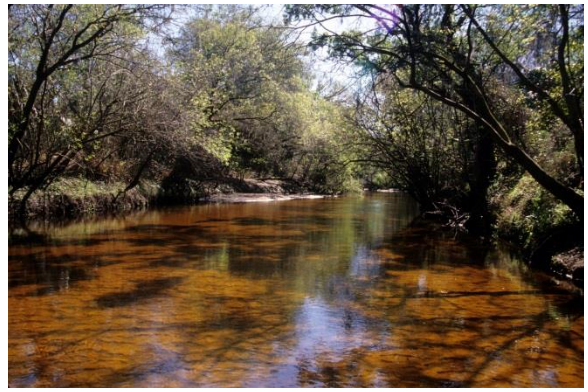
Tampa Bay Water (TBW) operates two pumping stations on the TBC. The Harney Pump Station withdraws water from Harney Canal (Middle Pool) of the TBC and delivers this water to the City of Tampa's Hillsborough River Reservoir. The purpose of this transfer of water is to augment the City's reservoir during low-flow conditions in the Hillsborough River. Tampa Bay Water (TBW) also operates the TBC Pump Station, which is permitted to withdraw water from the Middle Pool and Lower Pool of the TBC. The withdrawal intakes are located just upstream and downstream of District Structure S-162, which separates the Middle and Lower canal pools. Tampa Bay Water's (TBW) Harney Canal augmentation permit allows withdrawals up to an annual average of 20 mgd. Tampa Bay Water's (TBW) Hillsborough River/TBC WUP does not limit the annual amount of withdrawal allowed. Diversions from the Hillsborough River to the TBC are based on flow calculated at the Hillsborough River Dam. Water is diverted from the Hillsborough River through District Structure S-161 into the TBC for subsequent use by TBW. Tampa Bay Water's (TBW) withdrawals from the TBC Lower Pool are based on stage. The minimum flow at Structure S-160 is zero, so no flow downstream of Structure S-160 is required. Tampa Bay Water (TBW) is permitted to take 100 percent of the available water when the pool stage is at nine feet or above, up to the permit capacity of 258 mgd. Tampa Bay Water (TBW) manages the pool stages in the Middle Pool and Lower Pool to maximize the availability of water on a day-to-day basis. Tampa Bay Water's (TBW) long-term yield analysis estimates that 88.5 mgd of water is available for withdrawal from the TBC, including the current flow-based diversions from the Hillsborough River.

From 2007 through 2018, TBW withdrew a 12-year average of 47.9 mgd from the TBC for distribution to their regional system. Approximately 3.6 mgd was water taken from the Middle Pool of the TBC and 44.3 mgd was non-augmented water from the Lower Pool of the TBC. During the same period, TBW diverted 6.74 mgd from the Middle Pool to augment the Hillsborough River. Total net diversions from 2007 through 2018 were 54.7 mgd.

As part of the recovery strategy for the NTBWUCA, TBW developed the enhanced surface water system, which withdraws additional quantities of water for potable supply from the TBC. This water can be used directly or diverted to the C. W. Bill Young Regional Reservoir for storage.

2.5 Little Manatee River

The Little Manatee River watershed straddles the Manatee/Hillsborough county line and encompasses approximately 225 square miles. The river extends nearly 40 miles from its source in southeastern Hillsborough County, westward to its mouth at Tampa Bay near Ruskin. Tidal effects in the Little Manatee River are discernible up to 15 miles upstream from the mouth. Based on flow data collected at the U.S. Geological Survey (USGS) gauge near Wimauma, average annual discharge for the Little Manatee River is approximately 113 mgd (173 cfs).



The Little Manatee River is located in Manatee and Hillsborough counties and extends 40 miles from its source to Tampa Bay near Ruskin

Florida Power and Light (FPL) withdraws water from the Little Manatee River and stores it in a 3,500-acre cooling pond (Lake Parrish) for its 1,600-megawatt power generation facility. Average annual diversions from 2007 to 2018 were approximately 6 mgd. The original WUP authorized FPL to withdraw water from the river during high-flow periods and for quantities greater than 10 percent of total flows. Under a permit revised in 2017, FPL is now authorized to withdraw up to an annual average of 8.5 mgd, with maximum daily withdrawals limited to 122 mgd. The revised permit includes a single withdrawal schedule for normal operations and a schedule for what is termed “emergency conditions.” Emergency conditions become active when the level of the cooling pond falls below a pre-determined level. An additional 0.54 mgd is permitted to AG operations on the Little Manatee River. Total permitted withdrawals are 9 mgd. Based on permitted withdrawals and the planning level minimum flow criteria, no additional water is available from the river.

3.0 Potential for Water Supply from Surface Water

Table 4-5 summarizes potential surface water availability for rivers in the planning region. The estimated additional surface water that could potentially be obtained from rivers in the planning region ranges from approximately 89.9 mgd to 108.9 mgd. The lower end of the range is the amount of surface water that has been permitted but is currently unused (235.40 mgd minus 143.90 mgd), and the upper end includes permitted, but unused quantities (89.9 mgd) plus the estimated remaining unpermitted available surface water (19 mgd). Additional factors that could affect the quantities of water that are ultimately developed for water supply include the future establishment of minimum flows, the ability to develop sufficient storage capacity, variation in discharges to the river from outside sources, and the ultimate success of adopted recovery plans.

Table 4-5. *Summary of current withdrawals and potential availability of water from rivers/Tampa Bypass Canal in the Tampa Bay Planning Region (mgd) based on planning-level minimum flow criteria (p85/10 percent) or the proposed or established minimum flow*

Water Body	In-stream Impoundment	Adjusted Annual Average Flow[1]	Potentially Available Flow Prior to Withdrawal[2]	Permitted Average Withdrawal Limits[3]	Current Withdrawal[4]	Unpermitted Potentially Available Withdrawals[5]	Days/Year New Water Available[6]		
							Avg	Min	Max
Anclote River[7]	No	43.7	TBD	0.0	0.0	TBD	--	--	--
Alafia River @ Bell Shoals Rd.[8]	No	236.5	31.2	24.9	13.9	6.4	109	33	182
Hillsborough River @ Dam[9,10]	Yes	185	18.5	113.0	70.0	TBD	TBD	TBD	TBD
Tampa Bypass Canal @ S-160[10,11]	Yes	NA	0	88.5	55.0	TBD	TBD	TBD	TBD
Little Manatee River @ FPL Reservoir	No	113.0	11.3	9.0	5.0	TBD	--	--	--
Total				**235.4**	**143.9**	**6.4**			

[1] Mean flow based on recorded USGS flow plus reported WUP withdrawals added back when applicable. Maximum period of record used for rivers in the region is 1965–2018. An MFL of zero has been established for the TBC at S-160; therefore, adjusted annual average flow is indicated as not applicable (NA).
[2] Based on 10 percent of mean flow for Little Manatee River. Established MFLs were applied to calculate potentially available quantities for Alafia River. Adopted MFL for TBC at S-160 is zero.
[3] Based on individual WUP conditions, which may or may not follow current 10 percent diversion limitation guidelines.
[4] Based on average reported withdrawals from 2007–2018.
[5] Equal to remainder of 10 percent of total flow after permitted uses allocated, with minimum flow cutoff for new withdrawals of P85 and max system diversion capacity of twice median flow (P50), except as noted in subsequent footnotes.
[6] Based on estimated number of days that additional withdrawal is available considering current permitted quantities and withdrawal restrictions. Min and max are the estimated range of days that additional withdrawals would have been available in any particular year.
[7] Anclote River flow recovery will be based on monitoring and reporting required by the Northern Tampa Bay New Water Supply and Ground Water Withdrawal Reduction Agreement (Rule 40D-80.073(3), F.A.C.
[8] Permitted Alafia River withdrawals are sum of TBW's long-term annual yield based on WUP withdrawal schedule, Mosaic Fertilizer withdrawals from Lithia and Buckhorn springs, and two small AG permitted withdrawals. Current use for TBW withdrawals is water sent to regional distribution system and was 11.1 mgd, based on average pumping from 2007–20011. May be possible to develop additional supply from these sources by expanding current WUP withdrawal limits. Additional work necessary to ensure additional withdrawals do not cause impacts.
[9] Adjusted annual average flow not corrected for withdrawals due to complex transfer of water to/from Hills. River involving PS use and transfers to/from TBC. TBW's permitted withdrawals from Hills. River based on their WUP flow schedule, as described in Footnote 11. City of Tampa's permitted withdrawals from Hills. River are 82 mgd, which is quantity permitted for PS. Availability of the 82 mgd is dependent on Hills. River augmentation with water from TBC (up to 20 mgd), Sulphur Springs (up to 11 mgd), and stored Hills. River water from City of Tampa ASR that is returned to river as needed (up to 10 mgd). Current use for Jan. 2007–Dec. 2018 includes 70 mgd used by city and 1.9 mgd by TBW for total of 72 mgd. Current use does not include 6.74 mgd transferred from TBC to augment Hills. River.
[10] May be possible to develop additional water from Hills. River and TBC by expanding current WUP withdrawal limits. Additional work necessary to ensure additional withdrawals do not cause environmental impacts.
[11] TBW's permitted TBC withdrawals are flow schedule-based; annual average withdrawals expected to be 29 mgd, based on analysis of 1975–1995. TBW's permitted withdrawals from TBC Middle Pool to augment Hills. River Reservoir are 20 mgd. Total permitted withdrawals from TBC are 49 mgd. Current augmentation use for Jan. 2007-Dec. 2018 from TBC Middle Pool to Hills. River is 6.74 mgd. Current use based on Jan. 2007–Dec. 2018 is difference between 44.3 mgd withdrawn by TBW from Lower and Middle Pools and 3.6 mgd transferred from Hills. River to augment TBC Middle Pool. Net withdrawal from TBC is 47.9 mgd. Total current use for TBC is 54.7 mgd. TBW's permitted TBC withdrawals based on stage levels in Lower Pool and a flow-based diversion schedule from Hills. River through S-161. Permitted withdrawal capacity from TBC is 258 mgd. TBW is permitted for 100 percent of water in Lower Pool when stage is above 9.0 feet. Long-term yield from TBC estimated by TBW to be 88.5 mgd, including diversion from Hills. River through S-161 with estimated long-term yield of 45 mgd.

Section 5. Brackish Groundwater Desalination

Brackish groundwater suitable for water supply is available from two general sources within the District: (1) in the UFA and intermediate aquifer system along coastal areas and (2) inland at greater depths within the Lower Floridan aquifer (LFA) below middle confining unit II (MCU II). The coastal brackish groundwater is found as a depth-variable transition between fresh and saline waters. Figure 4-4 depicts the generalized location of the freshwater/saltwater interface (as defined by the 1,000 milligrams per liter (mg/L) isochlor) in the Avon Park high production zone of the UFA in the southern and central portions of the District. Generally, water quality declines to the south and west of the District.

Outside of the immediate coastal zone, brackish water sources in the LFA originate from mixing with relic seawater or contact with evaporitic and organic-rich strata. Recent hydrogeologic investigations in Polk County have found groundwater below MCU II to be mildly brackish, and also reasonably confined from the UFA, to suggest development of the source may be feasible. At greater depths, the groundwater is saline, so future projects must address potential upwelling of saline groundwater to supply wells that could deteriorate water quality over time.

Brackish groundwater is defined as groundwater having impurity concentrations greater than drinking water standards (i.e., total dissolved solids (TDS) concentration greater than 500 mg/L), but less than seawater (SWFWMD, 2001). Seawater has a TDS concentration of approximately 35,000 mg/L. Brackish water treatment facilities typically use source water that slightly or moderately exceeds potable water standards. Raw water with TDS values less than 6,000 mg/L is preferable for treatment due to recovery efficiency and energy costs. Groundwater with TDS greater than 10,000 mg/L generally exceeds feasibility because treatment would require high-pressure pumps and reverse osmosis (RO) membranes that are more costly to operate. Many treatment facilities will blend fresher water or recirculate some RO permeate to maintain a consistent raw water quality for efficient operation. Pure RO permeate can have very low TDS and may be corrosive to pipe metals and prior mineral deposits, so bypass blending of some raw water into the RO permeate is common for buffering, and also increasing the total yield.

While RO is the most common brackish water treatment technology, electro-dialysis reversal (EDR) systems may also be viable and are in use within the District at the T Mabry Carlton facility in Sarasota County. The EDR method uses an electrical current to pull ionic minerals outward from water flowing through a gel membrane, and the electrical current is frequently reversed to prevent buildup in the membrane. Both RO and EDR systems should be considered in brackish water supply project conceptualization and feasibility studies.

Both RO and EDR treatment systems generate a concentrate byproduct that must be disposed of through methods that may include surface water discharge, deep-well injection, or dilution at a WWTP. Surface water discharges require a National Pollutant Discharge Elimination System (NPDES) permit and may be restrained by TMDL limitations. In some cases, brackish water treatment facilities have been required to run below their potential efficiencies to reduce the strength of the concentrate. Because of these environmental considerations, deep-well injection is becoming more prevalent. Deep-well injection may not be permittable in some areas with unsuitable geologic conditions. An additional but costly disposal option is zero liquid discharge (ZLD). Zero liquid discharge (ZLD) is the treatment of concentrate for a second round of high-recovery desalination, then crystallization or dehydration of the remaining brine. The resulting solids might have economic value for various industrial processes.

The Florida Legislature declared brackish groundwater an AWS in 2005 (Senate Bill 444). However, it remains a groundwater withdrawal and must occur in a manner that is consistent with applicable rules, regulations, and water use management strategies of the District. Factors affecting the development of supplies include the hydrologic properties and water quality of the aquifer, rates of groundwater withdrawal, and well configurations.

The District revised its Cooperative Funding Initiative policy in December 2007, recognizing brackish groundwater as an AWS and allowing for assistance with construction projects. Since then, the District has assisted constructing five brackish groundwater treatment projects in the cities of North Port, Oldsmar, Tarpon Springs, Clearwater, and Punta Gorda. Each City has a regionally interconnected water supply system. The District is also co-funding two additional brackish groundwater projects for the Polk Regional Water Cooperative that are under design. The funding is intended to incentivize the development of integrated, robust, multijurisdictional systems that are reliable, sustainable, and utilize diverse water sources. While the District's regional water supply development processes have traditionally been based on meeting increasing demand projections, several brackish groundwater projects have been pursued for other needs: to blend permeate with treated surface water in order to meet finished water quality standards, to maintain viability of existing wellfields with deteriorating water quality, and to provide seasonal source substitution to meet an MFL. Future projects might also incorporate indirect potable reuse. The District recognizes the importance of maintaining the viability of existing supplies, but also encourages the consideration of alternate options based on economics and long-term regional benefit. A phased approach to brackish groundwater development is recommended that includes hydrogeologic evaluations to determine project viability, design phases that help refine the economic and permitting feasibility, and construction procured through a competitive bidding process.

Historically, the District's regional water supply planning process has evaluated brackish groundwater (and other AWS options) on the basis of meeting increasing demand projections. In recent years, a growing number of utilities are expressing interest in brackish treatment systems to address issues with deteriorating source water quality. The District recognizes the importance of maintaining the viability of existing supplies, but also encourages the consideration of alternate options based on economics and long-term regional benefit.

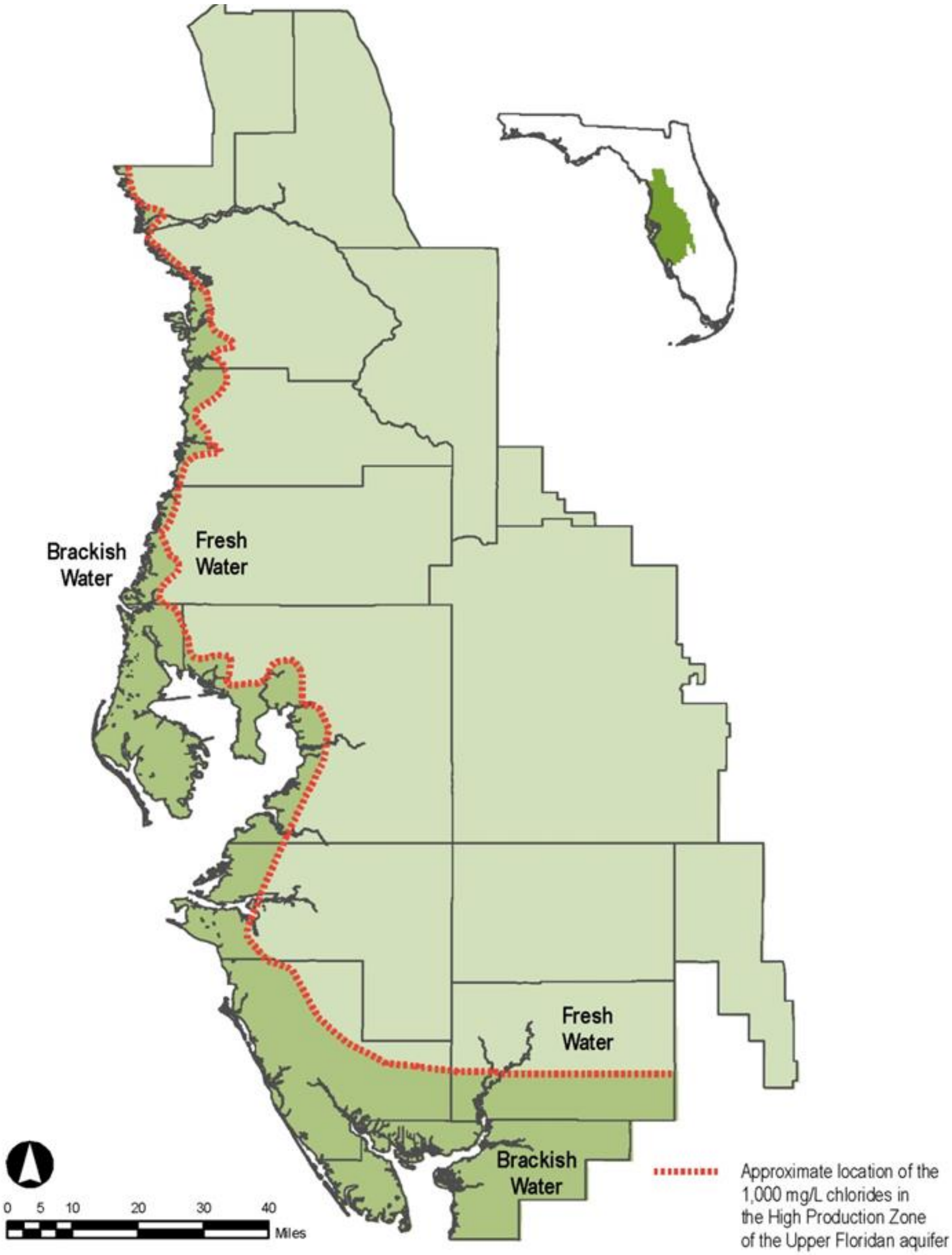


Figure 4-4. *Generalized location of the freshwater/saltwater interface*

1.0 Potential for Water Supply from Brackish Groundwater

Impacts from excessive withdrawals of groundwater from the UFA in the NTBWUCA have significantly lowered water levels in lakes and wetlands throughout the region. Though withdrawals from TBW's wellfields in Pasco and northern Hillsborough counties have created a regional drawdown effect and degraded water quality in some wells, the water quality effects are associated primarily with localized upwelling of brackish water, rather than exacerbated saltwater intrusion. In Pinellas County, the water quality in the UFA has degraded over the last century, although recharge quantities have been sufficient to maintain some fresh-quality production zones that are still utilized for PS. Approximately three quarters of the PS currently used in Pinellas County is imported from sources outside the county, originating primarily from TBW's consolidated wellfields. As listed in Table 4-6, four utilities in Pinellas County are currently treating brackish groundwater. These facilities are helping to reduce demands on fresh groundwater resources in the NTBWUCA.

The southern coastal portion of Hillsborough County is located within the Most Impacted Area (MIA) of the Southern Water Use Caution Area (SWUCA) and impacts from saltwater intrusion have occurred here prompting a recovery strategy that limits additional groundwater withdrawals. Proposed groundwater withdrawals, fresh or brackish, cannot impact UFA water levels in the MIA or other MFL water levels. Groundwater withdrawals have been evaluated by this criterion since the early 1990s and, since that time, there has been no net increase in quantities of water permitted from the UFA in the MIA. Requests for new withdrawals outside the MIA will be granted only if it is demonstrated that the withdrawals have no effect on groundwater levels in the UFA in the MIA.

With the proper evaluation of groundwater resources, utilities may be able to obtain or modify permits to withdraw brackish groundwater from the UFA in Pinellas, Pasco, and northern Hillsborough counties, so long as existing users and natural resources are not negatively impacted. Brackish groundwater wellfields have environmental monitoring programs for detecting impacts. The monitoring data will be beneficial for future determinations of whether additional quantities are permittable.

The City of Clearwater has three water treatment facilities, and two have RO systems. The City also imports water from Pinellas County Utilities. RO Facility #1, located in the southwestern portion of the city, has been in operation since 2009 and has a 4.5 mgd average treatment capacity. The City's RO facility #2 is located in the southeast portion of the city and began operation in 2015. The facility was built with a 5.0 mgd average treatment capacity, but poorer-than-anticipated raw water and other technical issues have limited production to approximately 2.5 mgd to date. The City is pursuing improvements to Facility #2 to reach the design capacity. The third facility is a freshwater wellfield located in the northeast portion of the City. Some of Facility #3 wells have deteriorating water quality, and the City is evaluating whether to integrate the wellfields so a milder blend of brackish raw water can be treated at Facility #2. The City is also evaluating additional wells near Facility #2 and aquifer recharge projects that would use highly treated reclaimed water to alleviate lateral seawater intrusion and improve aquifer levels near existing or expanded wellfields.

Table 4-6. *Brackish groundwater desalination facilities in the Tampa Bay Planning Region (mgd)*

Name of Utility	County	Brackish GW Treatment Capacity (mgd)	Annual Average Permitted Withdrawal (mgd) [1]	2018 Total Withdrawals (mgd)	2018 Finished Supply (mgd)	Estimated Available Supply [2] (mgd)	Source Aquifer	Raw Water Quality TDS (mg/L)	Concentrate Discharge Type [3]
Dunedin	Pinellas	9.50	5.243	4.655	3.461	0.437	UFA	250 - 990	WWTP
City of Clearwater (Plants 1 & 2)	Pinellas	9.25	14.300	7.692	6.674	1.352	UFA	300 –5,000	WWTP
City of Tarpon Springs	Pinellas	5.00	4.200	3.476	2.561	0.533	UFA	480 - 9,800	Surface/ Deep Well
City of Oldsmar	Pinellas	2.00	2.700	1.845	1.383	0.116	UFA	200 - 2,600	Deep Injection Well

[1] Estimated available supply is calculated as either the Treatment Capacity or Permit Capacity (whichever is less) subtracted by the 2018 withdrawals, then multiplied by the treatment efficiency (Finished Supply/Withdrawal).
[2] WWTP: wastewater treatment plant, SWP: surface/stormwater pond.
[3] WWTP: wastewater treatment plant, DIW: Deep Injection Well.
Note: The utilities shown have water use permits with the District. Other small RO systems exist for self-supplied users.

In 2015 the City of Tarpon Springs completed a brackish wellfield and RO facility with a 5.0 mgd flow capacity located north of the Anclote River. The City also withdrawals fresh groundwater from wells located south of the Anclote River and imports water from Pinellas County Utilities.

The City of Oldsmar completed construction of a 2.0 mgd RO facility and brackish wellfield in 2012. Prior to 2012, the City imported approximately 1.5 mgd of water supply from Pinellas County Utilities. The interconnection between the entities is maintained as a back-up supply for the City and a potential source for the County during emergencies.

The City of Dunedin has operated a RO facility with a treatment capacity of 9.5 mgd since 1991. The facility's capacity exceeds the city's current and projected water demands due to conservation efforts.

The Town of Belleair has historically used up to 1.1 mgd of locally withdrawn fresh groundwater. The chloride concentration in some of the Town's wells has been increasing in recent years. The District has cooperatively funded studies with the Town to determine the feasibility of brackish water treatment, along with innovative wellfield withdrawal management strategies.

The ultimate availability of additional brackish groundwater in the planning region for water supply, whether through the development of new facilities or expansion of existing ones, must be determined on a case-by-case basis through the permitting process. Because of this approach, an analysis to determine the total amount of brackish groundwater available for future water supply in the planning region has not been undertaken. As an alternative, the availability of brackish groundwater for water supply planning purposes was estimated by the unused capacity at existing facilities and facilities under development. The unused capacity of existing/ongoing facilities was calculated by subtracting the permittee's 2018 water withdrawals from either the permit capacity or treatment capacity, whichever was less. Using the lower value helps account for utilities that have more than one wellfield or treatment facility under their permit or have additional fresh groundwater available. The unused capacity was reduced by each utility's treatment efficiency to determine water available to meet demands. The treatment efficiency was calculated as the ratio of finished supply per the total withdrawal. The unused available quantity is shown on Table 4-6.

Section 6. Aquifer Storage and Recovery

Aquifers are reservoirs and conveyance systems that can provide tremendous storage capabilities, enabling rapid storage or recharge of captured excess wet season flows. Aquifer Storage and Recovery (ASR) and recharge projects enable us to smooth out the wet and dry cycles and better manage droughts, which are already challenging and could become even more difficult to manage as the impacts from climate change become more pronounced and population increases. Utilization of the aquifer system's reservoir potential is accomplished through an ASR, direct AR, or indirect AR system. Each of the methods has different levels of regulatory constraints that are largely based on the source water quality and the water quality of the receiving aquifer. Each method offers unique opportunities that match up with the various sources and qualities of available water.

ASR is the process of storing water in an aquifer when water supplies exceed demand and subsequently withdrawing the water when supplies are low and/or demands are high. The locations of ASR projects in the District are shown in Figure 4-5. ASR may be used for potable, reclaimed, groundwater, or partially treated surface water. If water stored in the aquifer is for potable supply, when it is withdrawn from the aquifer it is disinfected, retreated if necessary, and pumped into the distribution system. District projects include storage projects that use the same well to inject and withdraw water, and AR and recovery projects that use one location for injection and another for withdrawal.

Aquifer Storage and Recovery (ASR) offers several significant advantages over conventional water storage methods, including the ability to store large volumes of water at relatively low cost with little environmental impact and no evaporative losses. The success of an ASR project is generally measured in terms of recovery efficiency, which is the percentage of the original injected water recovered from the storage zone before water quality or impacts from the recovery phase (withdrawal) become unacceptable. Since brackish aquifers (those aquifers with high TDS) may be used for storage, mixing of the injected water with native water is generally the limiting factor on recovery efficiency.

Within the District, there are five fully permitted reclaimed water ASR projects and five fully permitted potable water ASR facilities. Recent advancements in pre-treatment technologies and Underground Injection Control regulations addressing arsenic mobilization issues in the aquifer (which were previously limiting) provide a viable means for successful completion of ASR projects.

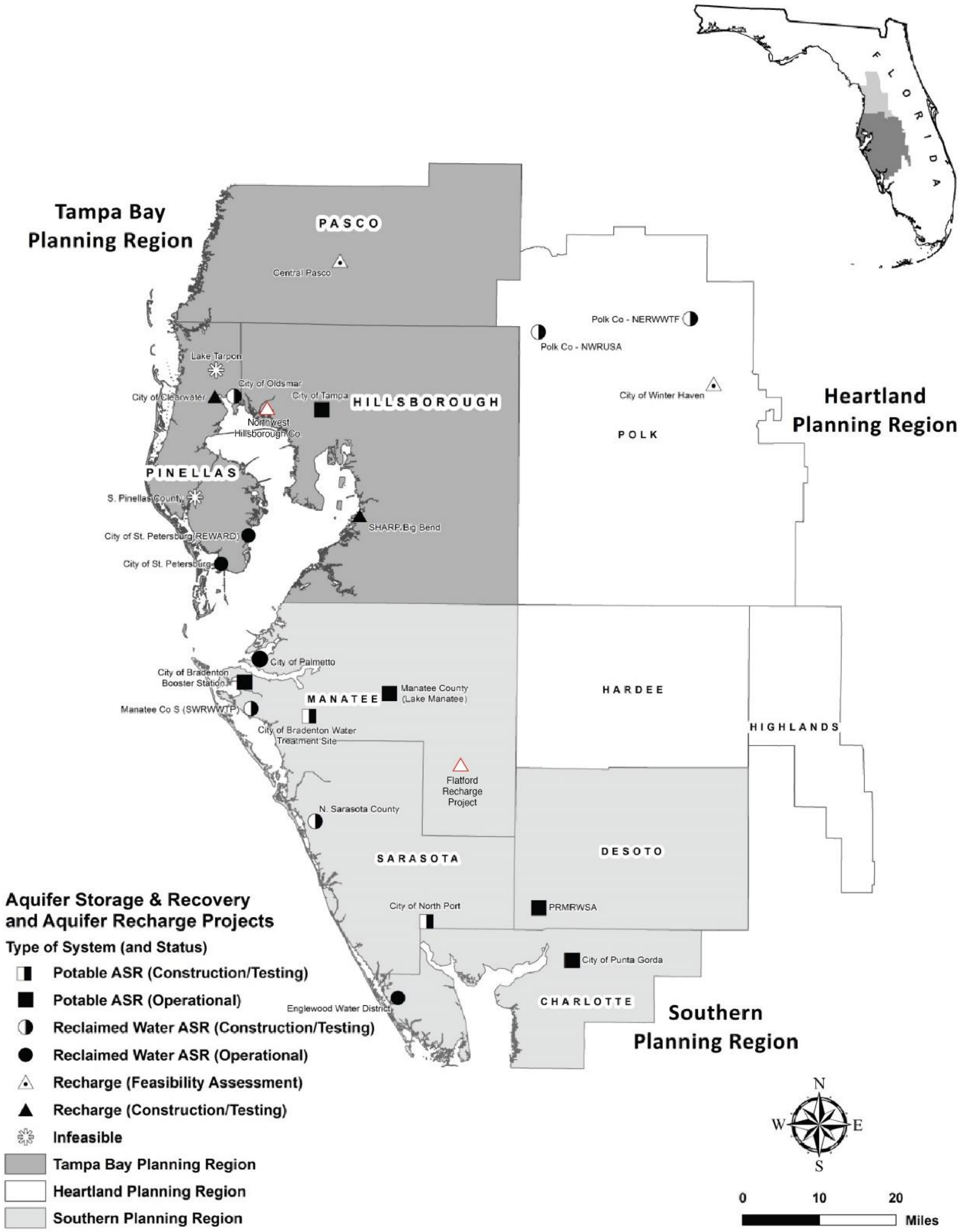


Figure 4-5. *Location of aquifer storage and recovery and aquifer recharge projects in the District that are operational or under development.*

Projects under development are those the District is co-funding and are either (1) actively in the planning, design, or construction phase, or (2) not yet in the planning phase but have been at least partially funded through fiscal year 2015, or (3) have been completed since the year 2010 and are included to report on the status of implementation since the previous RWSP.

1.0 Aquifer Storage and Recovery Hydrologic and Geochemical Considerations

The science behind ASR has advanced significantly since the first project at Manatee County's reservoir site. The focus in the early years was on the hydrologic conditions that control the rate of injection/recovery and degree of mixing with elevated TDS in the receiving zone. Early studies of the geochemical processes focused on the liberation of low concentrations of naturally occurring radionuclides at the Lake Manatee ASR site. Because the concentrations were below the drinking water standards, ASR projects proceeded while continuing to check for this issue. None of the ASR projects checked ever exceeded the radio-nuclide standards.

While checking the radionuclides for the City of Tampa ASR project, the first incidence of arsenic at concentrations greater than the drinking water standards were found, and geochemical processes became important to understand. Extensive research efforts to understand the cause of arsenic mobilization and methods to control it were successful, and multiple strategies to handle the arsenic mobilization are now available. Geochemical considerations have led to the reduction of oxidants such as dissolved oxygen (DO) and chlorine in the injection water, either through physical or chemical methods.

Hydrologic conditions that maximize the recoverability of the injected water include a moderately permeable storage zone that is adequately confined above and below by less permeable layers and that contains fairly well to moderate water quality. The permeability of the storage zone is important, since low permeability would limit the quantity of water that could be injected, while very high permeability would allow the injected water to migrate farther and mix more with native water. The presence of confining layers is necessary to limit or prevent the injected water from migrating upwards (a significant issue where density differences exist between the injected water and native water). Confining layers also serve to keep poorer quality water in adjacent zones from being captured during recovery. Poor native water quality in the storage zone will limit the percentage of usable water that can be recovered by degrading the injected water faster as a result of mixing processes. Additionally, the higher density of poor-quality water in the aquifer tends to cause the lower density injected water to migrate upwards and "float" in the upper portions of the storage zone.

In the District, the recoverable percentage of injected water is typically 70 to nearly 100 percent when the concentration of native groundwater in the ASR storage zone is less than 1,000 mg/L. Recovery can be less when the TDS concentration of native groundwater is higher. It is possible, depending on the hydrologic conditions, for the recoverable volume of water to be greater than the volume originally stored. This generally results when the native water quality is good to fairly good and mixing of the injected water and native water provides additional water of acceptable quality. In some cases, it may be desirable to leave behind a portion of injected water to restore depleted groundwater reserves. This also forms a buffer zone between the stored water and surrounding brackish or poor-quality native water to increase recovery percentage and minimize adverse geochemical reactions between waters with different chemistries. Buffer zones are considered an investment of water that improves performance and results in reserves for future recovery during extreme droughts or emergencies.

2.0 Aquifer Storage and Recovery Permitting

Permits to develop ASR systems must be obtained from the District, the FDEP, the Department of Health (DOH), and possibly the U.S. Environmental Protection Agency (EPA) if an aquifer exemption is requested. The District is responsible for permitting the quantity and rate of recovery, including potential impacts to existing legal users (e.g., domestic wells), off-site land uses and environmental features. The FDEP is responsible for permitting the injection and storage portion of the project, and the DOH is responsible for overseeing the quality of the water delivered to the public.

Significant clarifications of ASR regulations, as they apply to public water supply systems storing treated drinking water underground, were issued by the EPA in 2013. The 2013 guidance allows the FDEP to evaluate ASR systems on a case by case basis to determine if mobilization of arsenic and subsequent recovery and treatment of the water can be done in a manner that doesn't endanger the aquifer. The facility would need to verify that no existing user would be impacted through either property ownership or use of institutional controls, such as local ordinances prohibiting wells within a specified area around the ASR wells. The use of the ASR water re-treatment upon recovery to remove arsenic prior to distribution may be necessary. Re-treatment to remove arsenic has been successfully implemented by several public drinking water systems and, to date, arsenic concentrations have been within the drinking water standards prior to distribution to the public.

3.0 Aquifer Storage and Recovery and Arsenic

When the last RWSP was under development in 2015, permitting of potable water ASR facilities in Florida hindered by the mobilization of naturally occurring arsenic in the aquifer was possible on a case by case basis under a zone of discharge approach. Reclaimed water ASR projects, however, can't have a zone of discharge for any primary drinking water standards and the issue of using a similar zone of discharge for arsenic mobilization is undetermined by FDEP at this time. Since the last RWSP, effective solutions to the arsenic mobilization issue continue to be developed. The City of Palmetto successfully managed arsenic mobilization through the use of a chemical oxygen scavenger. Bradenton is presently running a pilot project that removed DO from the injection water via a vacuum degasification tower. Dissolved oxygen (DO) control offers one method of achieving an operation permit for ASR and recharge facilities. Dissolved oxygen (DO) control can be achieved through physical removal, chemical scavenging or direct use of groundwater as a source for injection. Projects are currently testing chemical scavenging as a method for arsenic control.

Another method of achieving an operation permit is the attenuation of arsenic through removal during successive cycles of operation. The City of Tampa has seen arsenic concentrations consistently diminish over the years since startup in 1996. Most of the City's wells are now within the drinking water standard for arsenic and those that exceed it are just barely over the limit for a brief period during recovery. In 2013, the City received its operation permit and is now fully permitted. All sites show the similar attenuation with cycling suggesting that this may be an option to achieve an operation permit. Facilities that pursue this path will need to be capable of re-treating the water upon recovery to remove the mobilized arsenic. This option also requires control of the area adjacent to the ASR wells, either through ownership or through institutional controls, such as an existing ordinance prohibiting wells from withdrawing from the ASR storage zone.

Most ASR projects in the District are located in coastal areas where UFA water is brackish. In much of this area, the aquifer is not utilized for potable supply and the recovered water from ASR systems is treated to remove arsenic prior to distribution. Therefore, there has been no known exposure to arsenic above the current drinking water standard from water injected into the aquifer as a result of ASR operations.

Section 7. Aquifer Recharge

Natural recharge of rainfall infiltration to the surficial aquifer and underlying aquifers is the primary source maintaining aquifer levels. Aquifer Recharge (AR) is the intentional process of beneficially using excess water to directly or indirectly recharge aquifers to achieve improved aquifer levels or water quality improvements (reduced saltwater intrusion). Aquifer Recharge (AR) may be accomplished by using wells or RIBs. In order to maximize environmental and water supply benefits, AR projects will generally target the fresher portions of the aquifer.

Successful AR projects will improve the groundwater levels. Water level improvement may result in improving local groundwater quality, mitigating or offsetting existing drawdown impacts due to withdrawals, providing storage of seasonally available waters and thereby augmenting water supplies, and potentially allowing additional new permitted groundwater withdrawals in areas of limited water supply. Aquifer Recharge (AR) project success criteria can include demonstration of the level to which aquifers have been restored, demonstrated improvements to aquifer water quality and/or increases in available water supply for existing and future users.

Sources of water for use in AR projects are often available seasonally and may include high quality reclaimed water, surface water, and stormwater. A total volume of 738 mgd of reclaimed water was used statewide in 2015 (FDEP, 2015), for water uses including residential, industrial, recreational (golf courses), WTPs, rapid infiltration basins, and spray field applications.

Each individual AR project will have distinctively different construction specifications, regulatory requirements and operational maintenance considerations. The hydrogeologic setting of an area often determines which AR approach can be used.

1.0 Direct Aquifer Recharge

Direct AR uses wells to inject water meeting applicable FDEP water quality standards into an aquifer. Direct AR water recovery may occur through other wells constructed in the area. However, direct AR projects are often designed to improve aquifer conditions.

Characterization of the targeted aquifer for direct AR is fundamental in the design, operation, and maintenance of a direct AR system. Understanding the permeability and the degree of aquifer confinement above and below the injection interval, along with a characterization of the difference in water quality between the injection source water and the ambient groundwater in the injection interval and existing aquifers above and below, is critical to direct AR project success. Direct AR system designs must address the potential for mobilization of naturally occurring arsenic on a site-specific basis. If not addressed in the design of a direct AR project, the related and undesirable geochemical reactions may occur when the injection water reacts with the aquifer. Properly designed projects can avoid or manage these reactions through the adjustment of injection water chemistry, such as the removal of DO. In certain circumstances, the FDEP may allow these chemical reactions to occur if an adequate property area is controlled by ownership and it can be demonstrated the reaction is limited to the controlled area and will not require any other users of the aquifer to implement additional treatment to continue their use.

Recent experience with operational ASR projects incorporating oxygen degasification systems and post treatment stabilization have proven that metals mobilization can be minimized and controlled by reducing the DO content in the injection source water, in addition to maintaining a negative oxygen reduction potential. Aquifer Recharge (AR) projects will need to function in the same manner. Groundwater flow resulting from injection and the natural groundwater flow gradient will have the potential to move dissolved metals down gradient. For this reason, it will be important to establish necessary aquifer monitoring and institutional controls to guard against public access to potentially contaminated groundwater if metals are mobilized.

2.0 Indirect Aquifer Recharge

Indirect AR is when water is applied to land surface where it can infiltrate and recharge the aquifer. Indirect AR can be accomplished by using a variety of techniques, including spray fields, recharge wetlands, large-scale drain fields, and RIBs. This recharge approach is used in areas where there is a good connection between the surface and source aquifer for water supply. Water applied to the surface must meet minimum water quality standards approved by the FDEP. Infiltration capacity and permeability of the soil; presence of drainage features; depth to the water table; local hydrogeology; locations of nearby drinking water wells; as well as locations of nearby wetlands and lakes are all important to identify, test and to determine the feasibility of indirect AR. In favorable regions, indirect AR can provide additional natural water quality treatment to the water as it percolates through sediments during infiltration, in addition to subsequently increasing aquifers levels. The District estimated that, as of 2015, 20 mgd of available reclaimed water (Districtwide) was being applied through RIBs for indirect AR (FDEP, 2015).

Section 8. Seawater Desalination

Seawater is defined as water in any sea, gulf, bay, or ocean having a total dissolved solids concentration of 35,000 mg/L or more (SWFWMD, 2001). Seawater can provide a stable, drought proof water supply that may be increasingly attractive as the availability of traditional supplies diminish and advances in technology and efficiency continue to reduce costs. There are five principal elements to a seawater desalination system that require extensive design considerations: (1) an intake structure to acquire the source water, (2) pretreatment to remove organic matter and suspended solids, (3) RO desalination to remove dissolved minerals and microscopic constituents, (4) post-treatment to stabilize and buffer product water and prepare it for transmission, and (5) concentrate disposal management (National Research Council, 2008). Each of these elements is briefly discussed below.

The intake structure is utilized to withdraw large amounts of source water for the treatment process. The volume of water withdrawn may significantly exceed the amount treated if concentrate dilution is necessary. The intake design and operation must address environmental impacts, because much of the District's near-shore areas have been designated as either Outstanding Florida Waters (OFW) or aquatic preserves. Ecological concerns include the risk of impingement and entrainment of aquatic life at the intake, entrainment of sediments and oils, and perturbation to seagrasses and hard-bottom communities.

The pretreatment of source water is imperative to protect the sensitive RO membranes from fouling prematurely from organic carbon and particulates, and this may be the most critical design element. A pretreatment system may require coagulation and/or microfiltration technology similar to the treatment of fresh surface water. A robust pretreatment may seem duplicative, but lessons learned from TBW and other facilities have demonstrated the importance of pretreatment to the long-term viability of the facility.

High-pressure RO membrane treatment is the most widely accepted seawater desalination technology. The RO system pressurizes saline water above the osmotic pressure of the solutes and passes the water through a network of semi-permeable membranes. Fresh water passes through the membranes, while a constant flow of raw water prevents the dissolved minerals from fouling the membrane's surface. The membranes are susceptible to fouling or damage from dissolved organic matter and fine suspended particles, which is why an effective pretreatment method is necessary. The pressurization step can be energy intensive. Seawater treatment requires pressures from 600 to 1,000 pounds per square inch (psi), compared to brackish groundwater systems (with <10,000 mg/L TDS) operating at 30 to 250 psi (FDEP, 2010). Most large-capacity seawater facilities have energy recovery systems that use turbines driven by high-pressure flow exiting the RO membranes to boost pressure to the pumps feeding the source water. Energy recovery systems reduce electrical demands, alleviate redundant pumping capacities, lower operational costs, and reduce the facility's carbon footprint.

Inside a desalination facility

The post-treatment element is necessary to protect the facility's infrastructure and distribution piping. The RO product water has a very low hardness and alkalinity, which can corrode piping and add unwanted metals into the finished water. Chemical post-treatment such as lime or caustic soda addition is often used for buffering and pH adjustment. A settling system may be necessary to reduce turbidity generated by chemical treatment. A degassing system may also be necessary, as dissolved gasses such as hydrogen sulfide can pass through RO membranes and create a noticeable odor in the finished water.

Nearly all seawater desalination facilities worldwide dispose of RO concentrate by surface water discharge, which entails significant environmental considerations. The salinity of the concentrate can be 50 percent higher than that of the source water, and the increased density of the concentrate may cause it to sink and impact benthic communities (National Research Council, 2008). A NPDES permit from the EPA and other local permits may be required to discharge the concentrate into surface waters. To obtain the NPDES permit, a variety of factors must be demonstrated to not impose harm to aquatic organisms. There are several technological approaches to alleviating these issues, including diffusion of the discharge using widely dispersed multiple outlets and pumping large volumes of additional water to dilute the concentrate to safe levels prior to discharge.

The co-location of desalination facilities with coastal electric power stations can significantly enhance their financial feasibility. Co-location produces cost and environmental compliance benefits by utilizing existing intake structures and blending concentrate with the power station's high-volume cooling water discharge. The complex infrastructure for the intake and outflow is already in place, and source water heated by the power station's boilers can be more efficiently desalinated.

Additional information on seawater desalination can be found in the FDEP report entitled *Desalination in Florida: Technology, Implementation, and Environmental Issues* (FDEP, 2010).

1.0 Potential for Water Supply from Seawater Desalination

Two options for large-scale seawater desalination facilities in the planning region were evaluated for TBW's Long Term Master Water Plan (2018). The options include expansion of TBW's existing facility at the Big Bend power station in Hillsborough County, and a new facility co-located with the Anclote River power station near the Gulf of Mexico in Pasco County.

The existing TBW desalination facility has transmission components that were designed to accommodate a future 10 mgd expansion, while the Anclote River desalination facility option was evaluated as a 25 mgd design capacity project. Additional information on these options is presented in Chapter 5. The proposed locations of these options, along with the locations of other existing and proposed seawater and brackish groundwater desalination facilities in the District, are shown in Figure 4-6.

Section 9. Stormwater

The FDEP and the water management districts define stormwater as the flow of water which results from, and which occurs immediately following, a rainfall event and which is normally captured in ponds, swales, or similar areas for water quality treatment or flood control. Development of the natural landscape can result in significant changes to the characteristics of stormwater flows. Stormwater runoff can provide considerable volumes of water that can be captured and beneficially used, resulting in water supply, aquifer recharge, water quality, and natural system benefits. Rule 62-40, F.A.C., defines "stormwater recycling" as the capture of stormwater for irrigation or other beneficial use. The reliability of stormwater can vary considerably depending upon climatic conditions and storage capability. Therefore, the feasibility of effectively utilizing stormwater as an AWS source often relies on the ability to use it in conjunction with another source (or sources) in order to decrease operational vulnerability to climatic variability (aka "conjunctive use"). Stormwater represents a potentially viable AWS at the local level, particularly for reclaimed water supplementation and irrigation water uses.

In the SWUCA and Dover/Plant City WUCA, the District FARMS program has had much historical success in developing tailwater recovery systems for AG operations to utilize stormwater supplies to reduce demands for fresh groundwater. A major future opportunity for stormwater development

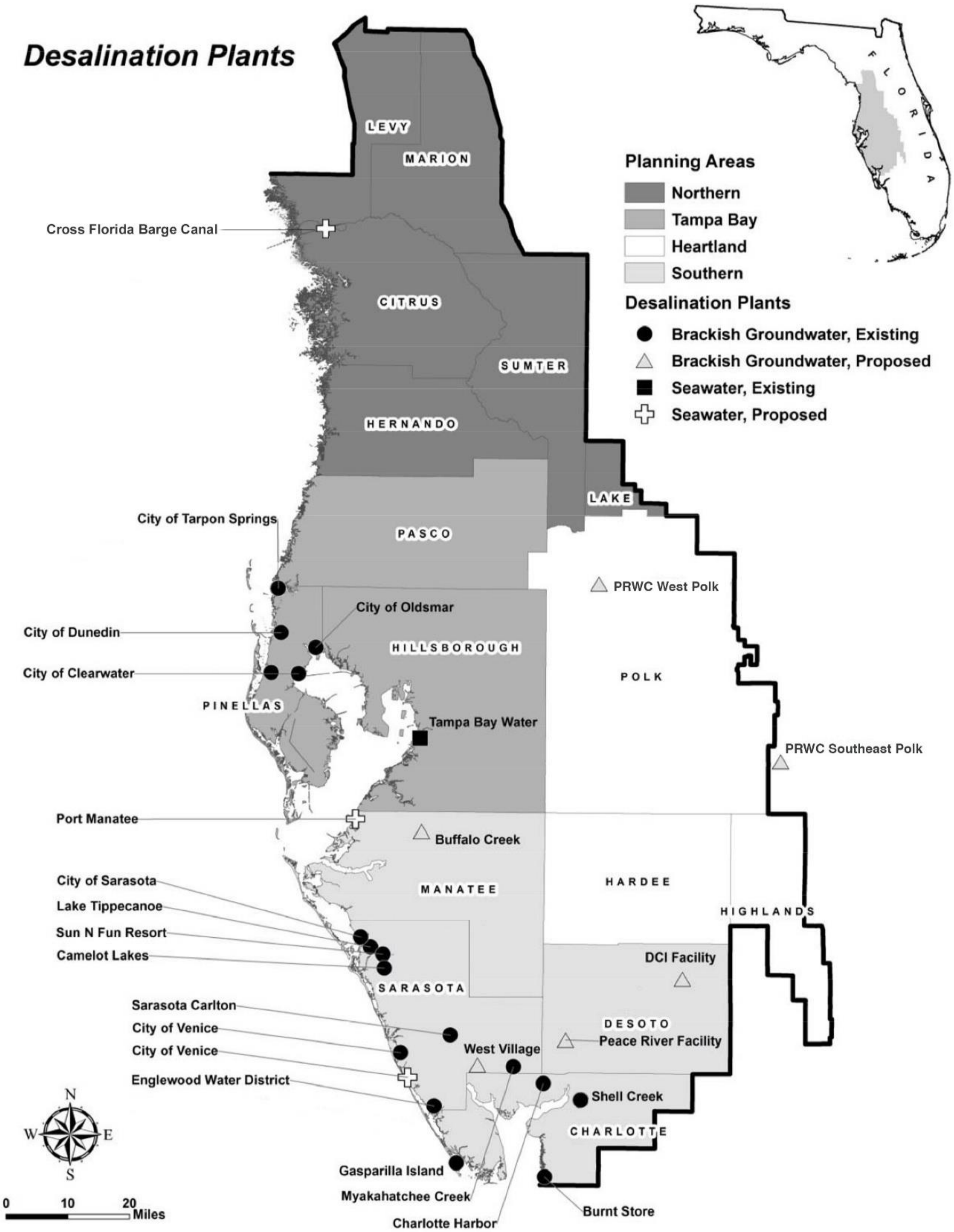


Figure 4-6. *Location of existing and potential seawater and brackish groundwater desalination facilities in the District*

is the ability for local governments and utilities to partner with the Florida Department of Transportation (FDOT) on stormwater capture and harvesting projects. Presently, FDOT's Efficient Transportation Decision Making Process gives the water management districts and other agencies an opportunity to provide comments during the Planning Screen phase of a project. When FDOT projects advance to the Project Development and Environment phase, FDOT uses Environmental Look Arounds (ELAs) to proactively look for cooperative and regional stormwater management opportunities. Environmental Look Arounds (ELAs) can assist the districts, other agencies, and local utilities with identifying sources of stormwater for activities such as reclaimed water augmentation and MFL recovery.

Section 10. Summary of Potentially Available Water Supply

Table 4-7 is a summary of the additional quantity of water that will potentially be available from all sources of water in each county in the planning region from 2015 through 2040. The table shows that the total quantity available is 294.71 mgd.

Part B. Determination of Water Supply Deficits/Surpluses

Future water supply deficits/surpluses in the planning region were calculated as the difference between projected demands for 2040 and demands calculated for the 2015 base year (Table 3-6). The projected additional water demand in the planning region for the 2015–2040 planning period is approximately 76.03 mgd. As shown in Table 4-7, up to 294.71 mgd is potentially available from water sources in the planning region to meet this demand. Based on a comparison of projected demands and available supplies, it is concluded that sufficient sources of water are available within the planning region to meet projected demands through 2040.

Table 4-7. *Potential additional water availability (mgd) in the Tampa Bay Planning Region through 2040*

County	Surface Water		Reclaimed Water	Desalination		Fresh Groundwater		Water Conservation		Total
	Permitted Unused	Available Unpermitted	Benefits	Seawater	Brackish Groundwater (Permitted Unused)[1]	Surficial and Intermediate	Upper Floridan[1] Permitted Unused	PS	AG	
Pasco	-	-	11.45	25.00	-	-	0.75	7.36	0.58	45.14
Pinellas	-	-	32.16	-	2.44	0.40	4.45	11.65	0	51.10
Hillsborough	91.5	6.40	60.46	10.00	-	4.40	0.33	21.18	4.20	198.47
Total	**91.5**	**6.40**	**104.07**	**35.00**	**2.44**	**4.80**	**5.53**	**40.19**	**4.78**	**294.71**

[1] Groundwater that is permitted but unused for PS. Based on 2018 Estimated Water Use (SWFWMD, 2019).

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Chapter 5. Overview of Water Supply Development Options

The water supply development (WSD) component of the Regional Water Supply Plan (RWSP) requires the Southwest Florida Water Management District (SWFWMD) (District) to identify water supply options from which water users in the planning region can choose to meet their individual needs. In addition, the District is to determine the associated costs of developing these options. As discussed in Chapter 4, the sources of water that are potentially available to meet projected water demand in the planning region include fresh groundwater, water conservation, reclaimed water, surface and stormwater, brackish groundwater desalination, Aquifer Storage and Recovery (ASR) and Aquifer Recharge, and seawater desalination. Investigations were conducted to identify reasonable options for developing each of the sources, to provide planning level technical and environmental feasibility analyses, and to determine costs to develop the options.

The RWSP Executive Summary presents statutory guidance on how water supply entities are to incorporate WSD options from the District's RWSP into their water supply planning and development of their comprehensive plans.

Part A. Water Supply Development Options

The District conducted preliminary technical and financial feasibility analyses of the options included in this chapter. The analyses provide reasonable estimates of the quantity of water that could be developed and the associated costs of development. The District referenced cost information for the options to the appropriate document or applied a cost index to update the value from the 2015 RWSP. The following sections include a description of several representative options for each source that more fully develops the concepts and refines estimates of development costs. This is followed by a table that includes the remaining options for each source.

Some of the options included in the 2015 RWSP that continue to be viable are presented in this chapter and are updated accordingly. Where applicable, water supply options developed through the work of additional regional planning efforts, such as Tampa Bay Water's (TBW) Long-Term Water Supply Plan, are incorporated into this chapter. These options are not necessarily the District's preferred options but are provided as reasonable concepts that water users in the region may pursue in their water supply planning. A number of the options are of such a scale that they would likely be implemented by either a regional water supply authority or a group of users. Other options, such as those involving reclaimed water and conservation, would be implemented by individual utilities. It is anticipated that users will choose an option or combine elements of different options that best fit their needs for WSD, provided they are consistent with the RWSP. Following a decision to pursue an option identified in the RWSP, it will be necessary for the parties involved to conduct more detailed engineering, hydrologic, and biologic assessments to provide the necessary technical support for developing the option and to obtain all applicable permits.

Section 1. Fresh Groundwater

In the vicinity of TBW's consolidated wellfield system, it is unlikely additional groundwater will be developed until a full evaluation of wellfield withdrawal reductions and water level recovery in the region is made. The permitted allocation for the combined 11 wellfields in the system is 90 mgd annual average, and the permit is effective through January 2021. The District and TBW will continue monitoring and modeling activities to evaluate progress of the Northern Tampa Bay recovery strategy.

A Thonotosassa Wells Feasibility Study was completed and documented in a Technical Memorandum dated April 2016. The study identified significant regulatory and environmental challenges associated with the Thonotosassa Wells and estimated that the average yield available from this water supply project would be limited to approximately 1 mgd.

Future requests for fresh groundwater will be evaluated based on projected impacts to existing legal users and water resources. The District will give further consideration to projects that can mitigate the impacts of groundwater withdrawals on water resources with established minimum flows and levels (MFLs), including those that use reclaimed water for direct and indirect aquifer recharge.

Section 2. Water Conservation Options

1.0 Non-Agricultural Conservation

Tampa Bay Water (TBW) identified a series of conservation activities that are appropriate for implementation by the public supply (PS) sector in their 2018 Water Demand Management Plan Update. However, while the analysis in this 2020 RWSP only estimates active conservation savings and costs for PS, some of these activities can also be implemented by the domestic self-supply (DSS), industrial/commercial (I/C), and landscape/recreation (L/R) water use sectors. A complete description of the criteria used in selecting these activities and the methodology for determining the water savings potential for each activity are described in detail in Chapter 4.

Some readily applicable conservation activities are not addressed due to the wide variance in implementation costs and the site-specific nature of their implementation. Two such measures are water-conserving rate structures and local codes/ordinances, which have savings potential, but are not addressed as part of the 2020 RWSP. The District strongly encourages these measures and, when properly designed, they can be effective at conserving water. In addition, permittees are required to address these measures in their water conservation plan, which is part of the package provided by permittees during the water use permit application or renewal process. Below is a description of each non-agricultural water conservation option. Savings and costs for each conservation activity evaluated in the 2020 RWSP are summarized in Table 5-1 below. Total savings are also depicted in Figure 5-1.

Table 5-1. *Conservation activity options for PS sector*

Conservation Activity	2040 PS Savings (mgd)	Average Cost Effectiveness ($/kgal)	Total Cost
Residential			
Alternative Irrigation Sources	5.07	$0.57	$11,312,173
High-efficiency Toilets (Single-family)	2.31	$0.99	$8,638,020
Smart Irrigation Controllers	2.44	$0.79	$8,713,635
Florida Water Star/Florida-Friendly Landscaping™	3.89	$2.14	$20,372,969

Conservation Activity	2040 PS Savings (mgd)	Average Cost Effectiveness ($/kgal)	Total Cost
High-efficiency Toilets (Multi-family)	1.16	$1.05	$4,877,616
Non-residential			
Cooling Towers	0.65	$0.13	$389,731
High-efficiency Toilets, Valve	1.07	$0.46	$2,205,991
High-efficiency Urinals (0.5 gallon)	1.37	$0.54	$2,605,175
Pre-Rinse Spray Valves	0.10	$0.30	$131,959
High-efficiency Toilets, Tank	0.41	$0.78	$1,191,866
Dishwashers, Conveyor	0.04	$0.72	$94,597
Total Public Supply	**18.51**	**$0.99[1]**	**$60,533,732**

[1]Total cost efficiency is weighted by each project's percent share of total savings in relation to the cost.

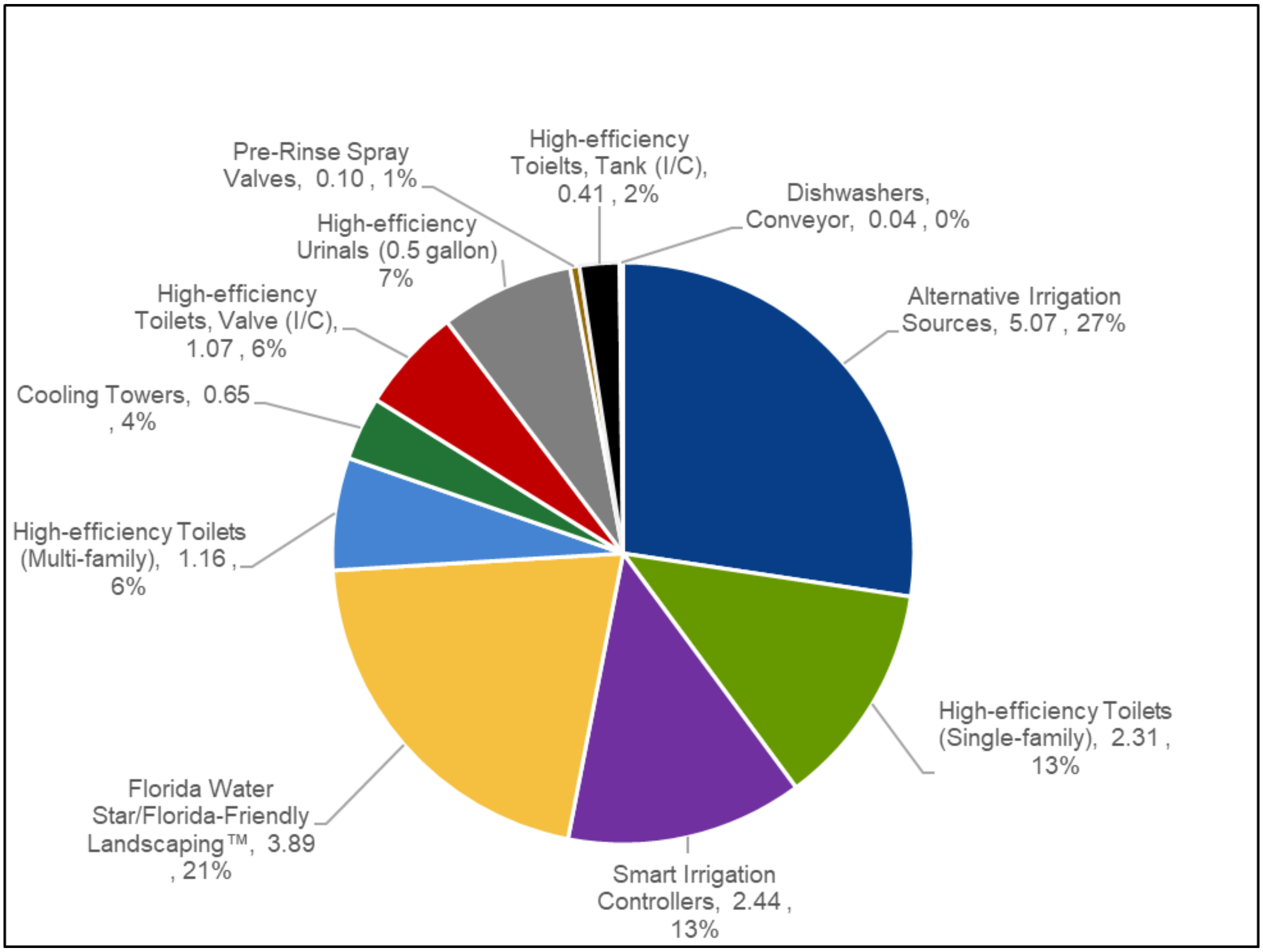

Figure 5-1. *Total 2040 active water savings (mgd) in Tampa Bay Region, by conservation activity*

1.1 Description of Non-Agricultural Water Conservation Options

1.1.1 Alternative Irrigation Source

Alternative irrigation sources reduce or eliminate outdoor potable water use through non-descriptive but reliable outdoor source modification. Examples of alternative sources may include irrigation wells, reclaimed water, and rainwater harvesting. Both irrigation wells and reclaimed water programs have been implemented successfully by TBW member governments. Alternative irrigation source programs present substantial opportunities for most regular users with automatic irrigation systems.

Toilet replacements were identified as a major potential source of water conservation.

1.1.2 High-Efficiency Toilet Rebates (Residential)

High-efficiency toilet (HET) rebate programs offer $100 rebates as an incentive for replacement of inefficient high-flow toilets with more water-efficient models. High-efficiency toilets (HETs) use 1.28 gallons per flush (gpf) as opposed to older, less-efficient models that could use 3.5 gpf or more, depending on the age of the fixture. Savings estimated in this plan are based on converting a 3.5 gpf or greater to a 1.28 gpf model. High-efficiency toilets (HETs) and dual-flush toilets are WaterSense® labeled by the U.S. Environmental Protection Agency. Also, gradually becoming more popular on the marketplace are 0.8 gpf models, which offer a 50% savings compared to 1.6 gpf models that are currently required by building code.

1.1.3 High Efficiency Toilet (Industrial/Commercial)

Similar to the residential HET retrofit programs, a non-residential fixture replacement program provides financial incentives to water customers to encourage conversion of higher flush volume toilets to HET models. These measures apply to office buildings, sports arenas, hospitals, schools, dormitories, and other commercial facilities.

1.1.4 High-efficiency Urinals (Industrial/Commercial)

In addition to toilets, urinals can also be replaced at non-residential facilities to high-efficiency models that use 1.0 gpf or less. Savings estimated in this plan are based on converting models that use 1.0 gpf or greater to a 0.5 gpf model. Waterless urinals are also available on the market and have been evolving in design over the years. This device is recommended primarily in new construction, as there are challenges to successful implementation in existing buildings due to potential drain line transmission issues.

1.1.5 Smart Irrigation Controllers and Soil Moisture Sensors

Smart irrigation controllers go a step further than rain sensors. This technology automatically adjusts irrigation runtimes according to the needs of the local landscape. It is often based on temperature, climate, rainfall, soil moisture, wind, slope, soil, plant type, and more. This data is obtained by an on-site evapotranspiration sensor or through the internet. Some units can be operated by smart phone and can incorporate a weather forecast to anticipate coming rain. As an example, winter season run times may be automatically dialed down 30 percent from summer run times. Soil moisture sensors (SMSs) have been available on the market for approximately 10 years, and costs have come down considerably since they were first released. These devices override (prevent) scheduled irrigation events when enough moisture is present at the site, thus reducing water usage by skipping irrigation cycles.

1.1.6 Florida Water Star℠ and Florida-Friendly Landscaping™

Florida Water Star℠ (FWS) is a certification program for both residential and commercial buildings. Certified buildings uphold higher standards for water conservation and efficiency, both indoors and outdoors. The primary water-saving feature of FWS is the limit on high-volume irrigation (maximum of 60 percent of the irrigable area). Many of the conservation activities discussed here are implemented within FWS properties. Florida-Friendly Landscaping™ (FFL) is a set of 9 principles developed by the University of Florida that detail landscaping practices for protecting Florida's natural resources, including water. Florida Water Star℠ (FWS) encourages the inclusion of FFL-approved landscaping.

1.1.7 Cooling Towers (Industrial/Commercial)

Some larger buildings use cooling towers as their primary cooling system. Water-cooled cooling towers use a circulating loop to recycle water. Cycles of concentration (COC) define the accumulation of dissolved minerals (e.g. chlorides, total dissolved solids, or calcium) as the number of times the tower water is concentrated over that of the makeup water. As water loss occurs through evaporation and drift, most contaminants are left behind, thus increasing the dissolved mineral concentration of the tower water. Water use occurs as makeup water is added to compensate for water losses in a system. Water use also occurs as a result of cooling tower blowdown (i.e., discharge or bleed-off), a process which removes a portion of the concentrated water from the cooling tower and replaces it with makeup water. By increasing the COC, the amount of supplemental make-up water needed to operate the cooling tower efficiently is reduced. Cycles of concentration (COC) can be optimized and increased based on tracking of pertinent water quality data and through use of conductivity controllers. High-efficiency drift eliminators that reduce drift loss are available and may yield considerable savings.

1.1.8 Pre-Rinse Spray Valves (Industrial/Commercial)

This measure offers rebates to hospitality/restaurant facilities to replace high water-volume spray valves with water-conserving low-volume spray valves. This measure applies to non-residential customers of the PS sector or any other applicable users within the I/C sector. A traditional pre-rinse spray valve uses 2 to 5 gallons per minute (gpm), while high-efficiency spray valves use no more than 1.6 gpm. High-efficiency valves are also more effective at removing food from dishware.

1.1.9 Dishwashers (Industrial/Commercial)

Restaurant dishwashers are available in a variety of types, sizes, and flow rates ranging from 2.5 to 8.0 gpm. Dishwashers are normally selected and sized based on their ability to meet the service requirements of the food establishment. Water use reduction can be achieved by converting older inefficient machines to an Energy Star product which typically uses 40 percent less water than a standard dishwasher. High-efficiency dishwashers include several innovations, such as ”soil” sensors, high-efficiency jets, and innovative dish rack designs that reduce energy and water consumption, as well as improve performance. In this RWSP, only conveyor dishwashers are considered for the savings and cost analysis.

2.0 Agricultural Water Conservation Options

The District has a comprehensive strategy to significantly increase the efficiency of the agricultural (AG) industry's water use over the next 20 years. A key component of this strategy is the cooperative programs the District has established with other agencies to provide the AG community with a wide array of technical and financial assistance programs to facilitate increases in water use efficiency. For nearly 30 years, the District has administered programs that have provided millions of dollars to fund more than 200 projects that have helped farmers increase the efficiency of their water use and improve water quality. Water conservation options for which the District will provide assistance as part of Facilitating Agricultural Resource Management Systems (FARMS) and other programs are described below.

2.1 Facilitating Agricultural Resource Management Systems

The District, in cooperation with the Florida Department of Agriculture and Consumer Services (FDACS), initiated the FARMS Program in 2003. The FARMS Program provides cost-share reimbursement for the implementation of AG best management practices (BMPs) that involve both water-quantity and water-quality aspects. It is intended to expedite the implementation of production-scale AG BMPs that will help farmers become more efficient in their water use, improve water quality, and restore and augment natural systems. The FARMS Program is a public/private partnership among the District, FDACS, and private agriculturalists. Reimbursement cost-share rates for agriculturalists are based on the degree to which they implement both water-quantity and water-quality BMPs. Facilitating Agricultural Resource Management Systems (FARMS) achieves resources benefits through two main types of projects, alternative water supply (AWS) and conservation through precision irrigation. These types of projects will be discussed below. The goal for the FARMS Program is to offset 40 mgd of groundwater use for agriculture within the SWUCA.

2.2 Facilitating Agricultural Resource Management Systems Conservation Potential

Districtwide, as of September 2019, FARMS has funded more than 200 projects with AG cooperators, for a total estimated reduction in groundwater use of more than 28 mgd. In the Tampa Bay Planning Region, there are 51 projects with an estimated reduction in groundwater use of more than 2.6 mgd. While the rate of FARMS participation has varied over time, difficulties within the citrus industry has resulted in a decreasing participation trend. This historical funded project information (2004-2019) was used to develop a long-term trend line as a means of estimating potential future program activity. Even with the decreasing participation trend, during the current planning horizon from fiscal year (FY)2015 through FY2040, if the current trends in agriculture and District cooperation continue, the FARMS program has the potential to reduce groundwater use by nearly 24 mgd through development of AWSs and more than 1.6 mgd through precision irrigation or other groundwater conservation BMPs. Within the Tampa Bay Planning Region, the District projects that AWSs could save approximately 0.75 mgd and conservation BMPs could save nearly 0.78 mgd over the same planning horizon of FY2015 through FY2040.

Table 5-2. *FARMS conservation potential within Tampa Bay Planning Region*

Project type	Potential resource benefit (mgd)	Estimated costs	Cost Benefit (cost per 1000 gallons saved)
Alternative water supply (tailwater recovery)	0.75	$4,800,000	$3.72
Conservation	0.78	$3,360,000	$2.57

Typical FARMS Project #1. Tailwater Recovery

Tailwater recovery has proven to achieve both water-quality improvements and groundwater conservation. Tailwater ponds are typically excavated below ground level at the low end of a farm to collect excess irrigation water and stormwater runoff. To utilize the pond as a source of irrigation water, pumps, filters and other appurtenances are needed to connect the pond to the existing irrigation system. The use of these ponds for irrigation offsets a portion of the groundwater used to irrigate the commodity and can improve water quality of the downstream watershed by reducing the concentration of mineralized groundwater applied to fields.

An example of a tailwater recovery project is the Loop Farms – Flowers Road project in Hillsborough County. The farm is permitted to withdraw up to 0.483 mgd of groundwater to irrigate citrus, strawberries, and melons. The goal of the project is to reduce groundwater withdrawals through the use of two tailwater recovery/surface water collection reservoirs. The project includes three surface water pump stations, filtration, and infrastructure necessary to operate and connect the reservoir to an existing irrigation system. The projected reduction in groundwater withdrawals is 37 percent, or 0.191 mgd of its permitted quantities.

Typical FARMS Project #2. Conservation Systems

Precision irrigation systems allow for the automatic remote control of irrigation pumps based upon information derived from SMSs that measure and monitor discrete sub-surface moisture levels. The system enables the grower to maintain soil moisture within optimized ranges, which reduces the potential for overwatering and prevents under-watering to avoid reduction in crop yields. A second system that increases irrigation efficiencies involves the use of automatic valves and on-off timers. These devices can be programmed to start and stop irrigation pumps to achieve maximum efficient irrigation durations. Without automatic valves and timers, the pumps must be manually turned off, which may not occur at the most optimum time. Several different types of electronic systems that increase irrigation system efficiency have been implemented through the FARMS Program.

An example of precision irrigation in the Tampa Bay Planning Region is Ocean Breeze Properties sod farm. The farm is a 230-acre sod farm just south of Ruskin in Hillsborough County. It is permitted for 0.58 mgd for supplemental irrigation. The FARMS program funded two irrigation conversion projects in addition to pump automation. It is estimated that the project will reduce groundwater use by approximately four percent or about 0.025 mgd. Because the District classifies FARMS projects as water resource development, additional information pertaining to the program, status of project implementation, and water savings achieved to date is provided in Chapter 7.

2.3 Mobile Irrigation Laboratory

The mobile irrigation lab program is a cooperative initiative between the District and the U.S. Department of Agriculture (Natural Resources Conservation Service (NRCS). The NRCS conducts efficiency and conservation evaluations of AG irrigation systems. Since 1986, the mobile irrigation lab service has evaluated irrigation systems at more than 900 sites in the District and recommended management strategies and/or irrigation system adjustments.

2.4 Best Management Practices

Best Management Practices (BMPs) are individual AG practices or combinations of practices that, based on research, field testing, and expert review, have been determined to be the most effective and practical means for maintaining or improving the water quality of surface and groundwaters and conserving groundwater resources. Best Management Practices (BMPs) typically are implemented in combination to prevent, reduce, or treat pollutant discharges off-site. Best Management Practices (BMPs) must be based on sound science, be technically feasible, and be economically viable. In Florida AG BMPs are detailed in crop specific BMP manuals developed by the FDACS in cooperation with a wide spectrum of stakeholders within the community specific to that crop. Best Management Practices (BMP) manuals are available on the FDACS website and are used to evaluate a farm’s intent to implement practices that conserve groundwater, protect water quality, reduce nutrient impacts, control erosion, and implement integrated pest management to reduce environmental impacts.

Section 3. Reclaimed Water Options

The diversity and abundance of urban, industrial, and agricultural land uses in the planning region provides opportunities to use large quantities of reclaimed water in numerous, beneficial ways. Large wetland areas and abandoned mining operations in eastern Hillsborough County provide unique opportunities to beneficially utilize reclaimed water through restoration of natural systems and storage of wet weather flows for dry season use. Brackish aquifers in coastal Hillsborough and Pinellas counties may also be ideal for seasonal storage or long-term aquifer recharge. The reclaimed water systems in the region are generally mature and, as such, the representative project options are dominated by interconnections, recharge potential, purification, and seasonal storage project concepts.

Listed below are the different types of reclaimed water options that are compatible with the geology, hydrology, geography, and available reclaimed water supplies in the planning region.

- **Augmentation with Other Sources:** introduction of another source (stormwater, surface water, groundwater) into the reclaimed water system to expand available supply

- **ASR:** injection of reclaimed water into an aquifer during times of excess supply and the recovery of that same water for use during high demand
- **Distribution:** expansion of a reclaimed water system to serve more customers
- **Efficiency/Research:** the study of how utilities can maximize efficiency and offset potential of reclaimed water systems to conserve water (rate structures, telemetry control, watering restrictions, metering, and others) and research (water quality and future uses)
- **Interconnect:** interconnection of systems to enhance supply and allow for better utilization of the resource or to enable agricultural or other water use permit exchanges
- **Natural System Enhancement/Recharge:** introduction of suitably treated reclaimed water to create/restore natural systems and enhance aquifer levels (indirect potable reuse)
- **Saltwater Intrusion Barrier:** injection of reclaimed water into an aquifer in coastal areas to create a salinity barrier
- **Storage:** reclaimed water storage in ground storage tanks and ponds
- **Streamflow Augmentation:** introduction of reclaimed water downstream of water withdrawal points as replacement flow to enable additional utilization of the surface water supply
- **System Expansion:** construction of multiple components (transmission, distribution, and storage) necessary to deliver reclaimed water to more customers
- **Transmission:** construction of large mains to serve more customers
- **Potable reuse:** purification of reclaimed water to meet drinking water standards prior to introduction into a potable raw water source.

The beneficial utilization of reclaimed water has for decades been a key component of water resource management within the District. For the past several years, Districtwide reclaimed water utilization has been at around 50 percent for non-potable purposes such as landscape irrigation, agricultural irrigation, aesthetic uses, groundwater recharge, industrial uses, environmental enhancement, and fire protection purposes.

Recently, as drought and long-term water shortages have occurred within other states and countries, reclaimed water has been investigated as a potable source. The “unintentional” use of reclaimed water as a potable source is not new, as many surface water sources that are used for potable raw water supplies have upstream wastewater/reclaimed water discharges. For instance, much of the flow of the Trinity River in Texas during the dry season comes from Dallas and Fort Worth wastewater treatment plants and the Trinity River is the main source of drinking water for the City of Houston. However, what is relatively new is the discussion of “direct potable reuse” with little to no lag time between discharge of purified water from a reclamation facility and use as raw water by a potable water facility.

Several high-profile projects have been investigated in western states and in other countries which involve the process of treating reclaimed water to state and federal drinking water standards so that it can be recycled for potable water supply uses. Three notable potable reuse projects that have been implemented using purified water are the Big Springs Texas Water Supply Project, the Las Vegas/Southern Nevada Water Supply Authority augmentation of Lake Meade, and the Singapore NEWater Project.

Although direct potable reuse is not currently being implemented by utilities within the District, there is increasing interest in the concept and it is included as a viable future water supply option in this RWSP.

The District developed seven reclaimed water project options (Table 5-3) for the planning region with input from utilities and other interested parties. The District determined the quantity of reclaimed water available for each option based on an analysis of wastewater flows anticipated to be available in 2040 at a utilization rate of 75 percent or greater (see Chapter 4 Appendix, Table 4-1). The District recognizes that the viability of some options depends on whether certain other options are developed, and not all options can be developed because some would utilize the same reclaimed water source. The options are listed in Table 5-3.

Flow and capital cost data for the 39 funded reclaimed water construction projects identified as being under development (FY2015 through FY2020) in the District were used to develop a representative cost per 1,000 gallons supplied and capital cost for each option. The data show that for the 39 new reclaimed water projects anticipated to come online between 2015 and 2025, the average capital cost is $10.27 million for each 1 mgd supplied. This figure was used in cost calculations for individual reclaimed water options unless specific cost data were available.

Construction of Pasco County's 500 MG Boyette Reclaimed Water Reservoir

Table 5-3. *List of reclaimed water options for the Tampa Bay Planning Region*

Option Name and Entity	County	Type	Supply (mgd)	Benefit (mgd)	Capital Cost (Millions $)
TECO-Bayside Tampa Power Reuse	*Hillsborough*	*System Expansion*	*0.50*	*0.50*	*$3.50*
Tampa/Hillsborough Co./TBW-Tampa Bypass Canal Indirect Potable Reuse	*Hillsborough*	*Streamflow Augmentation*	*15.00*	*15.00*	*$43.60*
Tampa-Hillsborough River MFL & IPR Reuse	*Hillsborough*	*Streamflow Augmentation, Natural System Enhancement*	*10.00*	*10.00*	*$61.00*
St. Petersburg REWARD Type IPR Reuse	*Pinellas*	*Recharge*	*5.00*	*5.00*	*$55.00*
Pinellas Co. Lake Seminole IPR-SWIM Reuse	*Pinellas*	*Natural System Enhancement, Streamflow Augmentation*	*5.00*	*5.00*	*$80.00*
Pasco Co. SR54 Transmission	Pasco	System Expansion	TBD	TBD	TBD
Hillsborough Co. SHARE Expansion	Hillsborough	Recharge	14.00	TBD	TBD
Totals: 7 Options			**49.50**	**35.50**	**$243.10**

The use of italics denotes SWFWMD estimations.
Offset = (if estimated) Annualized Supply: 1. x 75% for Ag, & R/A/C, 2. x 100% for I/C, NSR, & PG. 3. x 75% for Variety and 4. for RES is number of customers X 300 gpd.

1.0 Reclaimed/Recharge Options

Reclaimed/Recharge Option #1: New Ground Water Supply and Treatment Plant via Net Benefit from South Hillsborough Aquifer Recharge Program

- Entity Responsible for Implementation: TBW/Hillsborough County

This water supply project involves the construction of a groundwater withdrawal wellfield and groundwater treatment facility in south Hillsborough County, with accommodations for finished water to be delivered to the regional system or to Hillsborough County by way of a new point of connection in proximity to the new groundwater treatment facility. The groundwater supply for this water supply project would be enabled by Hillsborough County's South Hillsborough Aquifer Recharge Program (SHARP), in which reclaimed water is used to recharge the coastal aquifer, thus serving as a barrier to saltwater intrusion, providing a net benefit to the aquifer, and also generating net benefit for additional groundwater withdrawals. The groundwater supply project is initially limited to a maximum yield of 7.5 mgd based on the availability of reclaimed water in south Hillsborough County. Hillsborough County and TBW have engaged in discussion to collaboratively evaluate the implications of SHARP, mutual commitments, and future negotiations regarding credit valuation. An additional option that was evaluated by TBW was the potential yield of 20 mgd with the requirement of 30 mgd of aquifer recharge. For the remaining 12.5 mgd of yield, it was assumed that reclaimed water would be obtained from the City of Tampa and delivered to an expanded aquifer recharge program for the generation of additional net benefit.

The project concept shown in Table 5-4, below, consists of the initial configuration from TBW's Long Term Water Supply Plan Update (2018).

Table 5-4. *Aquifer Recharge options quantity/costs*

Quantity Available (mgd)	Capital Cost	Cost/mgd	Annual O&M /1,000 gal	Cost/1,000 Gallons
7.5	$116,265,000	$15,502,000	$0.38	$3.11

Section 4. Surface Water/Stormwater Options

The Hillsborough River/Tampa Bypass Canal system has been an important source of water supply for the City of Tampa. Since 2002, TBW has also utilized this system to help meet regional water demands. In 2007, the completion of the studies necessary to determine minimum flows showed that additional water was available from the system, especially at higher flows. In 2012, TBW expanded its use of the system as a part of System Configuration II. Since 2003, TBW has utilized the Alafia River as a potable water supply source. Based on the evaluation of the Alafia River's flows, additional water supply could be developed from the river during high-flow periods.

1.0 Surface Water/Stormwater Options

Surface Water/Stormwater Option #1. Surface Water Treatment Expansion

- Entity Responsible for Implementation: TBW, District

This project includes options to expand TBW's enhanced surface water system using the Alafia River and Bullfrog Creek as two potential surface water sources. The Alafia expansion component of this project would include increasing the existing Alafia river pump station capacity to withdraw additional mid- to high-range flows from the river. A new withdrawal facility and pumping station would also be required on Bullfrog Creek to capture mid- to high-range flows.

Additional surface water treatment capacity may be necessary to treat the raw surface water that would be brought into the regional system. This raw water could be treated at a new surface water treatment facility (WTF) in Hillsborough County, or at the expanded City of Tampa WTF. Raw and finished water pipelines would be required to take the water to the treatment plant and to transmit the water to an appropriate location in TBW's regional transmission system. Additional storage in a potential second regional reservoir could also be included in the project.

The project concept costs shown in Table 5-5 consists of two potential configurations from TBW's Long Term Water Supply Plan Update (2018).

Table 5-5. *Surface Water option costs*

Quantity Available (mgd)	Capital Cost	Cost/mgd	Annual O&M/1,000 gal	Cost/1,000 Gallons
10-12.5	$88,238,000	$8,823,800-$7,059,040	$0.36-$0.38	$1.42-$1.78

Issues:

- Monitor any regulatory rule affecting levels of fluoride in drinking water and determine if additional treatment requirements or blending options may affect the overall cost, reliability, and quantity of additional surface water supply.
- Understanding and designing the project based on the quantity of water available from Bullfrog Creek, consistent with a future minimum flow for the creek.

2.0 System Interconnect/Improvement Options

Tampa Bay Water (TBW) has developed a number of system interconnect/improvement projects that are critical components of their regional system. The projects involve the construction of pipelines, treatment plants, and booster pumping stations. Development of these types of projects will facilitate the regionalization of potable water supplies by providing transmission of water from areas of supply to areas of demand. The projects will also increase the rotational and reserve capabilities and provide redundancy of water supplies during emergency conditions.

System Interconnect/Improvement Option #1 New Regional Feed Line to Balm Area

- Entity Responsible for Implementation: TBW

The Regional Surface Water Treatment Plant (WTP) Expansion and possibly the Seawater Desalination Plant Expansion would require a new regional pipeline to be constructed from the Regional Facilities Site to south Hillsborough County (Balm Point of Connection) in order to meet south Hillsborough County's growing water needs by 2025. This would be the delivery of existing regional supply to a new Point of Connection in the Balm area via approximately 20 miles of 42-inch transmission main from the TBW Regional Facilities Site to the Balm area, which could supply up to 25 mgd.

Table 5-6. *New Regional Feed Line to Balm Area options costs*

Quantity Available (mgd)	Capital Cost	Cost/mgd	Annual O&M/1,000 gal	Cost/1,000 Gallons
10-12.5	$75,900,000-$96,700,000	$7,590,000-$7,736,000	$1.08	$1.23-$1.95

Section 5. Brackish Groundwater Desalination

Brackish groundwater is considered to be a viable source of water supply that can be obtained from the Upper Floridan aquifer in certain areas in the planning region. Requests for brackish groundwater withdrawals will be evaluated similarly to requests for fresh groundwater withdrawals because all withdrawals, regardless of quality, cannot impact or delay the recovery of a stressed MFL water resource. Since publication of the 2010 RWSP, three additional brackish groundwater projects have been completed or are near completion in Pinellas County by the cities of Oldsmar, Clearwater, and Tarpon Springs.

Brackish Groundwater Option #1. Town of Belleair Water Treatment Plant Improvements

- Entity Responsible for Implementation: Town of Belleair

The Town of Belleair's water system consists of a conventional groundwater WTP and wellfield permitted for 1.16 mgd annual average. The wellfield's water quality has experienced increasing chloride levels and may exceed drinking water standards within five to ten years. The Town is investigating multiple options to maintain its potable supply including regional imports, innovative wellfield management strategies, and the addition of a reverse osmosis (RO) system at the existing facility to improve quality. The capital and operation and maintenance project costs shown in Table 5-7 are from a preliminary engineering report prepared for the town in 2015. The costs assume the addition of a RO system with 1 mgd annual average capacity (1.5 mgd peak design) and an injection well system for concentrate disposal. The facility's existing supply wells, storage tanks, and distribution pumps would be utilized.

Table 5-7. *Town of Belleair WTP option costs*

Quantity Available (mgd)	Capital Cost	Cost/mgd	Annual O&M / 1,000 gallons	Cost/1,000 Gallons
1.0	$5,702,400	$5,702,400	$0.41	$TBD

Section 6. Seawater Desalination

There is one seawater desalination option within the planning region associated with TBW's existing desalination facility on Tampa Bay in Hillsborough County. Conceptual costs for this option have been updated by TBW and reflected in their 2018 Long-Term Master Water Plan.

Seawater Desalination Option #1. Tampa Bay Seawater Desalination Plant Expansion (Big Bend)

- Entity Responsible for Implementation: Tampa Bay Water

Seawater desalination plant

This project concept is for a 10 mgd expansion of the Tampa Bay Seawater Desalination Plant located in Southern Hillsborough County. The existing desalination plant utilizes the Tampa Electric Company's Big Bend Power Station cooling water as its seawater supply source from Tampa Bay. The cooling water from the Power Plant is also used to dilute desalination concentrate before being returned to the Bay.

The expansion of the existing desalination plant would require additional water to be diverted from the Big Bend Power Plant cooling water system to the RO plant. Supply and finished water pipelines were originally sized to accommodate a 10 mgd expansion. Therefore, this option would take advantage of the previously installed pipeline capacity. An additional 10 mgd of treated water from the RO plant would be delivered to the Tampa Bay Regional Surface WTP for blending prior to distribution. The pretreatment and chemical facilities would be modified to accommodate the expansion. Additional RO treatment trains would be added to the existing system to provide the additional capacity.

The conceptual base cost estimate below is only for components not previously constructed, such as additional conventional pretreatment and RO treatment similar to the existing installation. Additional expansion components may be required, pending a more thorough design evaluation; including enhanced pretreatment, additional post-treatment, additional solids handling, expanded cooling water pumping and piping additions, and intake and concentrate piping replacement. The calculated project costs shown in Table 5-8 are in 2018 dollars.

Table 5-8. *TBW Big Bend Desalination option costs*

Quantity Produced (mgd)	Capital Cost	Cost/mgd	Annual O&M /1,000 gal	Cost/1,000 Gallons
10-12.5	$244,442,000	$24,444,200- $19,555,360	$1.70-1.69	$4.88-3.89

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Chapter 6. Water Supply Projects Under Development

This chapter is an overview of water supply projects that are under development in the Tampa Bay Planning Region. Projects under development are those the Southwest Florida Water Management District (District) is co-funding and are either (1) actively in the planning, design, or construction phase, or (2) not yet in the planning phase, but have been at least partially funded through fiscal year 2019, or (3) have been completed since the year 2015 and are included to report on the status of implementation since the previous Regional Water Supply Plan.

The demand projections presented in Chapter 3 show that approximately 76.0 mgd of new water supply will need to be developed during the 2020–2040 planning period to meet demand for all use sectors in the planning region. As of 2019, it is estimated that at least 27 percent of that demand (20.3 mgd) has either been met or will be met by projects that meet the above definition of being "under development." In addition, it is probable that additional water supplies are being developed by various entities in the planning region outside of the District's funding programs.

In addition to these projects under development, it is probable that additional water supplies are being developed by various entities in the planning region outside of the District's funding programs.

Projects under development in the planning region include major expansions of the water supply systems for Tampa Bay Water; brackish groundwater desalination in Tarpon Springs, Clearwater and Oldsmar; development and expansion of reclaimed water systems, including certain elements of the Tampa Bay Regional Reclaimed Partnership Initiative; aquifer storage and recovery (ASR) systems for both potable and reclaimed water; and conservation projects for public supply and agriculture.

Section 1. Water Conservation

1.0 Non-Agricultural Water Conservation Projects

1.1 Indoor Water Conservation Projects

Since 2015, the District has cooperatively funded the distribution of approximately 4,537 high-efficiency fixtures within the Tampa Bay Planning Region. These programs have cost the District and cooperating local governments a combined $770,649 and have yielded a potable water savings of approximately 107,769 gallons per day. Table 6-1 provides information on indoor water conservation projects under development in the planning region.

1.2 Outdoor/Other Water Conservation Projects

Since 2015, the District has cooperatively funded a variety of demand management projects, including 1,111 rain sensor rebates and landscape and irrigation evaluations. These programs have cost the District, Tampa Bay Water, and cooperating local governments a combined $2,185,338 and have yielded a potable water savings of approximately 711,229 gallons per day. Table 6-1 provides information on outdoor water conservation projects that are under development. Table 6-1 provides information on outdoor water conservation projects under development.

Table 6-1. *Water conservation projects under development in the Tampa Bay Planning Region*

Cooperator	Project Number	General Description	Savings (gpd)	Devices and Rebates	Total Cost[1]	District Cost	$/1,000 gal Saved
Indoor Projects							
City of New Port Richey	N593	Toilet Rebate	1,902	75	$11,221	$5,602	$1.65
City of Port Richey	N603	Toilet Rebate	114	7	$997	$499	$2.44
City of St. Petersburg	N655	Toilet Rebate	10,839	596	$99,465	$49,732	$2.56
Pasco County	N662	Toilet Rebate	9,372	556	$79,876	$39,871	$2.38
Pasco County	N732	Toilet Rebate	13,564	508	$72,707	$36,353	$1.50
Pasco County	N789	Toilet Rebate	11,321	424	$61,108	$30,554	$1.51
City of St. Petersburg	N819	Toilet Rebate	8,640	377	$65,782	$32,891	$2.12
Pasco County	N852	Toilet Rebate	9,585	359	$54,913	$27,456	$1.60
City of New Port Richey	N876	Toilet Rebate	1,874	80	$14,940	$7,470	$2.22
City of St. Petersburg	N890	Clothes Washer Rebate	1,500	100	$24,700	$12,350	$6.32
City of St. Petersburg	N955	Toilet Rebate	6,725	275	$50,000	$25,000	$2.07
Pasco County	Q014	Toilet Rebate	13,956	500	$100,000	$50,000	$2.00
City of New Port Richey	Q041	Toilet Rebate	1,874	80	$14,940	$7,470	$2.22
City of Tarpon Springs	Q068	Toilet Rebate	2,547	100	$20,000	$10,000	$2.19
Pasco County	Q078	Toilet Rebate	13,956	500	$100,000	$50,000	$2.00
Indoor Total			*107,769*	*4,537*	*$770,649*	*$385,248*	*$2.02*[2]
Outdoor/Other Projects							
City of St. Petersburg	N728	Irrigation System Evaluation	39,000	289	$96,088	$48,044	$1.69
City of St. Petersburg	N875	Florida Water Star	9,400	71	$49,700	$24,850	$2.16
City of St. Petersburg	N909	Irrigation System Evaluation	56,000	300	$100,000	$50,000	$1.23

Cooperator	Project Number	General Description	Savings (gpd)	Devices and Rebates	Total Cost[1]	District Cost	$/1,000 gal Saved
Hillsborough County	N988	Soil Moisture Sensor and Rain Sensor Rebate	13,380	150	$50,000	$25,000	
City of St. Petersburg	N961	Satellite-based Leak Detection	110,000	NA[3]	$120,000	$60,000	
Temple Terrace Golf Course	Q074	Advanced Irrigation System	47,449	1	$510,000	$255,000	
City of St. Petersburg	Q089	Irrigation System Evaluation	56,000	300	$100,000	$50,000	$1.23
Pasco County	Q109	Satellite-based Leak Detection	100,000	NA[3]	$60,000	$30,000	
Tampa Bay Water	Q087	Demand Managemen t Project	280,000-400,000	NA[4]	$1,099,550	$549,775	$1.12
Outdoor/Other Total			*711,229*	*1,111*	*$2,185,338*	*$1,092,669*	
Total			**818,998**		**$2,955,987**	**$1,477,917**	

[1] The total project costs may include variable project-specific costs including marketing, education and administration.
[2] Total cost efficiency is weighted by each project's percent share of total savings in relation to the cost.
[3]These projects involve the detection of leaks, rather than the provision of rebates.
[4]Ten types of conservation activities will be made available through this project, rather than a set number of devices/rebates.

2.0 Agricultural Water Conservation Projects

The District's largest agricultural water conservation initiatives, the Facilitating Agricultural Resource Management Systems (FARMS) Program is not included in this section because the District classifies these programs as water resource development. Program details, including projects under development, are contained in Chapter 7, Water Resource Development.

3.0 Institute of Food and Agricultural Sciences Research and Education Projects

The District provides funding for Institute of Food and Agricultural Sciences (IFAS) to investigate a variety of agricultural/ urban issues that involve water conservation. These include, but are not limited to, development of tailwater recovery technology, determination of crop water use requirements, evaluation of alternative irrigation methods, field irrigation scheduling, frost/freeze protection, residential irrigation, and urban water use. Institute of Food and Agricultural Sciences (IFAS) conducts the research and then promotes the results to the agricultural community. The District has funded research on strawberries, citrus, tomatoes, potatoes, peaches, biofuel grasses, turf grass, peppers, blueberries, and various landscape and nursery ornamental plants and trees. Of the 58 research projects, 48 have been completed. Completed projects include ten projects dealing with urban landscape issues and 38 involving various agricultural commodities. While the research projects are not specific to each planning region, they are specific to a commodity group that has a strong presence in each region. The research will help develop best management practices that will conserve water Districtwide. Specific benefits to the planning region are dependent on the commodities dominant in that planning region. The 10 ongoing projects are described in Table 6-2.

Table 6-2. *List of water conservation research projects*

Project	Total Project Cost + District Cooperator	Total Project and Land Cost	Funding Source	Planning Region(s)[1]
Leaching Fraction-Adjusted Irrigation Impact on Nutrient Load and Plant Water Use	$81,320	$81,320	District	All
Florida Automated Weather Network Data Dissemination and Education	$100,000	$100,000	District	All
Blueberry Water Allocation and Irrigation Scheduling Using Evapotranspiration-based Methods	$ 210,000	$ 210,000	District	All
Reduction of Water Use for Citrus Cold Protection	$21,000	$21,000	District	All
Effect of Water Scheduling and Amounts on Growth of Young Citrus Trees in High Density Plantings	$168,623	$168,623	District	All
New Practical Method for Managing Irrigation in Container Nurseries	$165,310	$165,310	District	All
Effect of Composting at Animal Stock Facilities on Nutrients in Groundwater	$175,000	$175,000	District	All
Evaluating Fertigation with Center Pivot Irrigation for Water Conservation on Commercial Potato Production	$400,000	$400,000	District	All
Evaluation of Water Use & Water Quality Effects of Amending Soils & Lawns with Compost Material	$60,000	$60,000	District	All
Evaluation of Nitrogen leaching from reclaimed water applied to lawns, spray fields, and rapid infiltration basins.	$294,000	$294,000	District	All
Total	**$1,675,253**	**$1,675,253**		

[1] Projects affecting several planning regions. The outcome of research projects can benefit all planning regions

The District funds IFAS water conservation research and education projects for many types of agricultural commodities, such as strawberries

Section 2. Reclaimed Water

1.0 Reclaimed Water Projects - Research, Monitoring and Education

Continued support of reclaimed water research and monitoring is central to maximizing reclaimed water use and increasing benefits. The District assists utilities in exploring opportunities for increased utilization of reclaimed water and supports applied research projects, which not only include innovative treatment and novel uses of reclaimed water, but also nutrient and constituent monitoring. Table 6-3 is a list, description and summary of the benefits and costs that have been, or will be, realized by the 21 reclaimed water projects currently under development and others that are estimated to experience additional future supply growth. It is anticipated that these projects will be online by 2025. Table 6-4 includes general descriptions and a summary of 10 research projects for which the District has provided more than $1,026,000 in funding. The District has also committed to developing a comprehensive reclaimed water education strategy. All reclaimed water construction projects funded by the District require education programs that stress the value and benefits of efficient and effective water use, regardless of the source. To provide reclaimed water information to a broader audience, the District has developed a web page, which is one of the top internet sources of reuse information, including GIS and other data. The District also produces reclaimed water publications that are offered to residents, utilities, engineering firms, environmental agencies, and other parties interested in developing and expanding reclaimed water systems.

Reclaimed water facility in Hillsborough County

Table 6-3. *List of reclaimed water supply projects under development in the Tampa Bay Planning Region*

Cooperator	General Project Description	Reuse (mgd)		Customer (#)			Costs	
		Produced	Benefit	Storage	Type	Total	Total	District[1]
Hillsborough County								
Hillsborough County	Trans N776	1.20	0.60	NA	Res	2000	$5,427,343	$2,713,671
Hillsborough County	Transmission N863	0.07	0.05	0	Rec	1	$155,000	$77,500
Hillsborough County	Trans, Env Q084	1.00	1.00		NAT	1	$1,200,000	$600,000
Hillsborough County	Trans Q117	0.09	0.07		Rec	1	$800,000	$400,000
City of Plant City	Trans/Pump L816	0.55	0.33	0	Rec, GC, Com	8	$6,126,000	$3,192,730
Pasco County								
Pasco County	Trans N743	0.41	0.31	0	Res	TBD	$1,910,000	$955,000
Pasco County	Trans N778	0.20	0.12	0	Res	TBD	$225,000	$112,500
Pasco County	Trans N791	0.29	0.22	0	Res	TBD	$913,600	$456,800
Pasco County	Trans N792	0.40	0.24	0	Res	TBD	$2,500,000	$1,250,000
Pasco County, Shady Hills Energy	Treat, Trans, Store	2.82	2.82	0.5	Ind	1	$27,100,000	$0
Pasco County	Trans N442	0.50	0.38	0	GC	2	$600,000	$300,000
Pasco County	Recharge N666	2.20	2.20	NA	NA	NA	$14,300,966	$7,150,483
Pasco County	Transmission N670	0.42	0.21	0	Res, Com	388	$1,221,660	$610,830
Pasco County	Trans N697	0.10	0.06	0	GC	1	$300,000	$150,000
Pasco County	Trans N547	0.43	0.26	0	Res	725	$1,266,600	$933,300
Pasco County	Trans/Store N837	0.19	0.11	0	Res	557	$315,000	$157,500
City of Zephyrhills	Trans Q057	0.33	0.22	0	Res, Ind	515	$1,421,300	$710,650

Cooperator	General Project Description	Reuse (mgd)		Customer (#)			Costs	
		Produced	Benefit	Storage	Type	Total	Total	District[1]
Pinellas County								
City of Clearwater	Trans N561	0.19	0.08	0	Res	145	$1,500,000	$750,000
City of Clearwater	Purification/ Recharge N665	2.4	2.4	0	City	1	$32,716,000	$16,358,000
City of Dunedin	Pump/ Storage N555	0.10	0.10	2	NA	NA	$2,165,820	$1,082,910
City of Tarpon Springs	Pump/ Store N805	0.07	0.04	0	Res	310	$595,417	$297,708
Total	**21 Projects**	**13.96**	**11.82**	**2.50**		**4,656**	**$102,759,706**	**$38,259,582**

[1] Costs include all revenue sources budgeted by the District[1]

Table 6-4. *Reclaimed water research projects co-funded in the District*

Cooperator	General Project Description	Costs[1]	
		Total	District[2]
WateReuse Foundation	Water Treatment Study L112	$500,000	$275,000
WateReuse Foundation	Water Quality Study P872	$520,000	$282,722
WateReuse Foundation	Pathogen Study P173	$216,000	$34,023
WateReuse Foundation	Research Cost Study P174	$200,000	$70,875
WateReuse Foundation	Research Study ASR P175	$393,000	$72,410
WateReuse Foundation	Storage Study P694	$300,000	$100,000
WateReuse Foundation	Soil Aquifer Treatment P695	$200,000	$66,667
WateReuse Foundation	Wetlands Study P696	$200,000	$66,667
WateReuse Foundation	Nutrient Study P698	$305,100	$16,700
WateReuse Foundation	Nutrient II P966	$380,000	$41,666
Total (Districtwide)	**10 Projects**	**$3,214,100**	**$1,026,730**

[1] Cost per 1,000 gallons offset benefits not applicable to research studies.
[2] Costs include all revenue sources budgeted by the District.

Section 3. Surface Water/Stormwater Projects

The District is cooperatively funding a feasibility study with TBW in 2020 to assess an expansion of the Regional Surface Water Treatment Plant to maximize the available yield of surface water supplies. A source water assessment and expansion project options are anticipated in early 2021.

Section 4. Aquifer Storage and Recovery Projects

Pinellas County Utilities has submitted a proposed project for District cooperative funding that includes design and construction of an aquifer storage and recovery (ASR) and aquifer recharge (AR) project to divert excess surface water from Lake Tarpon to an existing ASR well and proposed AR facility to supplement the reclaimed water supply during dry periods and assist in restoring water level elevations in the NTBWUCA.

Section 5. Aquifer Recharge Projects

One indirect aquifer recharge project being pursued in the planning region is the Pasco County Reclaimed Water Natural Systems Treatment and Restoration project located in central Pasco County. This cooperator, in partnership with the District, has completed construction and two years of operation of beneficial groundwater recharge at wetlands on the 4G Ranch. The facility consists of 175 acres of constructed wetlands divided into fifteen cells planted with native wetland vegetation. Each cell is operated independently through a valve manifold that includes flow control valves and flow meters and operated based on water elevation setpoints. These water level setpoints change frequently based on recommendations defined in the Operation and

Maintenance Manual to achieve a wetland hydroperiod that mimics natural Florida wetlands, with high levels in the summer wet season and lower levels in the winter dry season. The project is expected to provide between 2 to 5 mgd of potential recharge on a long-term annual average basis.

In the case of direct AR projects, the City of Clearwater's Groundwater Replenishment Project (Table 6-5) is currently delayed for a period of two years for the City to complete a master water plan investigation of their water supply and water treatment systems. This investigation is being pursued due to rising construction costs. If constructed, this project will use state-of-the-art water treatment technology and injection systems to recharge a brackish water interval of the Upper Floridan aquifer in northeast Pinellas County with 3 mgd of purified reclaimed water that meets all potable drinking water standards. Project benefits include an increase in local aquifer levels, reduced saline water intrusion, and the potential to provide for additional water supply production at existing city facilities. The water will be chemically adjusted prior to recharge to control arsenic mobilization.

Other applications of direct AR that are being investigated by Hillsborough County involve recharge of excess reclaimed water that may provide benefits in the form of saltwater intrusion barriers along the coast of Tampa Bay near Apollo Beach. These projects are referred to as the South Hillsborough Aquifer Recharge Project (SHARP I), with a single recharge well, and the South Hillsborough Aquifer Recharge Project (SHARP II), with two additional recharge wells in the same area (Table 6-5). If these projects are properly located, they have the potential to slow or reverse saltwater intrusion rates.

Table 6-5. *List of Direct Aquifer Recharge projects under development in the Tampa Bay Planning Region*

Project Site	Status[1]	Final System Goal		Approximate Cooperative Funding Total Project Costs (District Share Is Half of Reported Costs)
		Storage Volume (mgd)	Total Number of Wells	
Purified Reclaimed Water Aquifer Injection				
City of Clearwater – Groundwater Replenishment	Design and permitting in progress.	1	1	Full design and permitting = $1,554,000
	Final system. 100 % Design and all construction related permits issued. Project delayered.	3	4[2]	Full construction = $16,358,000
SHARP I	Operational	4	1	$2,765,000
SHARP II	Under Construction	8	2	$9,700,000

[1] Desktop feasibility and site assessment/pilot testing completed. Design and permitting are in progress for the full-scale project development

[2] Number of wells designed for injection wellfield includes one backup well. Wells will be designed to inject close to 1 mgd per well.

Chapter 7. Water Resource Development Component

This chapter addresses the legislatively required water resource development activities and projects that are conducted primarily by the District. The intent of water resource development projects is to enhance the amount of water available for regional-beneficial uses and for natural systems.

Section 373.019, Florida Statues (F.S.), defines water resource development as:

> *"Water resource development" means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and groundwater data; structural and nonstructural programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and groundwater recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities"* (Subsection 373.019[24], F.S.).

The District is primarily responsible for implementing water resource development; however, additional funding and technical support may come from state, federal, and local entities.

Part A. Overview of Water Resource Development Efforts

The District classifies water resource development efforts into two categories. The first category encompasses data collection and analysis activities that support water supply development by local governments, utilities, regional water supply authorities, and others. These activities are discussed in Section 1, below. The second category includes more narrowly defined "projects," which are regional projects designed to create an identifiable supply of water for existing and/or future reasonable-beneficial uses. These projects are discussed in Section 2.

Section 1. Data Collection and Analysis Activities

The District budgets significant funds annually to implement the water resource development data collection and analysis activities, which support the health of natural systems and water supply development. Table 7-1 displays the fiscal year (FY)2020 budget and anticipated five-year funding levels for Districtwide data collection and analysis activities. Approximately $40.8 million will be allocated toward these activities annually for a five-year total of approximately $204 million. Because budgets for the years beyond FY2020 have not yet been developed, but are projected to be fairly constant, future funding estimates for activities are set equal to FY2020 funding. Funding for these activities is primarily from the Governing Board's allocation of ad valorem revenue collected within the District. In some cases, additional funding is provided by water supply authorities, local governments, and the U.S. Geological Survey (USGS). The activities listed in Table 7-1 are described in subsections 1.0 through 5.0, below.

Table 7-1. *Water Resource Development data collection and analysis activities (Districtwide)*

	WRD Data Collection and Analysis Activities	FY2015 Funding	Anticipated 5-Year Funding	Funding Partners
1.0	**Hydrologic Data Collection**			SWFWMD, other WMDs, USGS, FDEP, FWC
1.1	Surface Water Flows and Levels	$2,715,842	$13,579,210	
1.2	Geohydrologic Data Well Network (includes ROMP)	$3,149,091	$15,745,455	
1.3	Meteorologic Data	$278,408	$1,392,040	
1.4	Water Quality Data	$1,003,524	$5,017,620	
1.5	Groundwater Levels	$891,391	$4,456,955	
1.6	Biologic Data	$1,502,627	$7,513,135	
1.7	Data Support	$3,776,719	$18,883,595	
2.0	**Minimum Flows and Levels Program**			SWFWMD
2.1	Technical Support	$1,718,986	$8,594,930	
2.2	Establishment	$678,495	$3,392,475	
3.0	**Watershed Management Planning**	$7,456,686	$37,283,430	SWFWMD, Local Cooperators
4.0	**Quality of Water Improvement Program**	$743,025	$3,715,125	SWFWMD
5.0	**Stormwater Improvements: Implementation of Storage and Conveyance BMPs**	$16,927,435	$84,637,175	SWFWMD, USGS
	TOTAL	**$40,842,229**	**$204,211,145**	

1.0 Hydrologic Data Collection

The District has a comprehensive, hydrologic conditions monitoring program that includes the assembly of information on key indicators such as rainfall, surface and groundwater levels and water quality, and stream flows. The program includes data collected by District staff and permit holders, as well as data collected as part of the District's cooperative funding program with the USGS. This data collection allows the District to gauge changes in the health of water resources, monitor trends in conditions, identify and analyze existing or potential resource problems, and develop programs to correct existing problems and prevent future problems from occurring. This data collection also supports District flood control structure operations, water use and environmental resource permitting and compliance, minimum flows and levels (MFL) evaluation and compliance, the Surface Water Improvement and Management (SWIM) program, the Southern Water Use Caution Area (SWUCA) recovery strategy, modeling of surface water and groundwater systems, and many resource evaluations and reports.

The categories of hydrologic data that are collected and monitored by District staff are discussed below. The District also evaluates the hydrologic data submitted by Water Use Permit (WUP) permit holders to ensure compliance with permit conditions and to assist with monitoring and documenting hydrologic conditions.

1.1 Surface Water Flows and Levels

This includes data collection at the District's 808 surface water level gauging sites, and cooperative funding with the USGS for discharge and water-level data collection at 129 river, stream and canal sites. The data is available to the public through the District's Water Management Information System and through the USGS Florida Water Science Center Web Portal.

1.2 Geohydrologic Data Well Network

The Geohydrologic Data Well Network is a monitor well network that supports various projects throughout the District including the Central Florida Water Initiative (CFWI), Water Resource Assessment Projects, Water Use Caution Areas, recovery strategies, the Springs Team, sea level rise and other salt-water intrusion assessments, and development of alternative water supplies (AWSs). The network includes the Regional Observation and Monitor-well Program which has been the District's primary means for hydrogeologic data collection since 1974. Data from monitor well sites are used to evaluate seasonal and long-term changes in groundwater levels and quality, as well as the interaction and connectivity between groundwater and surface water bodies. During construction of new monitor well sites, valuable hydrogeologic information is collected including the lithology, aquifer hydraulic characteristics, water quality, and water levels.

1.3 Meteorologic Data

The meteorologic data monitoring program consists of measuring rainfall totals at 171 rain gauges, most of which provide near real-time data. Annual funding is for costs associated with measurement of rainfall, including sensors, maintenance, repair, and replacement of equipment. Funding allows for the operation of one District evapotranspiration (ET) station for reference near Lake Hancock, and for District participation in a cooperative effort between the USGS and all five Florida water management districts (WMDs) to map statewide potential and reference ET using data measured from the Geostationary Operational Environmental Satellites. The program also includes a collaborative effort between the five WMDs to provide high-resolution radar rainfall data for modeling purposes.

1.4 Water Quality Data

The District's Water Quality Monitoring Program (WQMP) collects data from water quality monitoring networks for springs, streams, lakes, and coastal and inland rivers. Many monitoring sites are sampled on a routine basis, with data analysis and reporting conducted on an annual basis. The WQMP develops and maintains the Coastal Groundwater Quality Monitoring Network, which involves sample collection and analysis from approximately 380 wells across the District to monitor saltwater intrusion and/or the upwelling of mineralized waters into potable aquifers.

1.5 Groundwater Levels

The District maintains 1,618 monitor wells in the data collection network, including 856 wells that are instrumented with data loggers that record water levels once per hour, and 762 that are measured manually by field technicians once or twice per month.

1.6 Biologic Data

The District monitors ecological conditions as they relate to both potential water use impacts and changes in hydrologic conditions. Funding for biologic data collection includes support for routine monitoring of approximately 150 wetlands and a five-year assessment of over 400 wetlands to document changes in wetland health and assess level of recovery in impacted wetlands. Funding also supports an effort to map the estuarine hard bottom of Tampa Bay, as well as SWIM program efforts for mapping of seagrasses in priority water bodies including Tampa Bay, Sarasota Bay, Charlotte Harbor, and the Springs Coast area.

1.7 Data Support

This item provides administrative and management support for the WQMP, hydrologic and geohydrologic staff support, the District's chemistry laboratory, and the District's LoggerNet data acquisition system.

2.0 Minimum Flows and Levels Program

Minimum Flows and Water Levels (MFLs) are ecologically based, hydrologic standards that are used for permitting and planning decisions concerning how much water may be withdrawn from or near a water body without causing significant harm to water resources or ecology of the area. Chapter 373.042, F.S., requires the state water management districts or the Florida Department of Environmental Protection (FDEP) to establish MFLs for aquifers, surface watercourses, and other surface water bodies to identify the limit or level at which further withdrawals would be significantly harmful. Rivers, streams, estuaries, and springs require minimum flows; while minimum levels are developed for lakes, wetlands, and aquifers. Minimum Flows and Levels (MFLs) are adopted into District rules, Chapter 40D-8, Florida Administrative Code (F.A.C.), and are used in the District's WUP and water supply planning programs.

Reservations are rules that reserve water from use by WUP applicants, as necessary, for the protection of fish and wildlife or public health and safety. Reservations are adopted into District rules, Chapter 40D-2, F.A.C., pursuant to Chapter 272.223, F.S., and are also used for water use permitting and water supply planning.

The District's processes for establishing MFLs and reservations include opportunities for interested stakeholders to review and comment on proposed MFLs or reservations and participate in public meetings. An independent scientific peer review process is used for establishing MFLs for flowing water bodies, MFLs for all water body types that are based on methods that have not previously been subjected to peer review, and for establishing reservations. Stakeholder input and peer review findings are considered by the Governing Board when deciding whether to adopt proposed MFLs and reservations. District monitoring programs provide data for evaluating compliance with the adopted MFLs and reservations, determining the need for MFLs recovery or prevention strategies and assessing the recovery of water bodies where significant harm has occurred.

The District has planned to monitor and assess the status of 210 adopted MFLs, including MFLs for 23 river segments, 10 springs or spring groups, 127 lakes, 41 wetlands, 7 wells in the Northern Tampa Bay Water Use Caution Area (NTBWUCA), and the UFA in the Most

Impacted Area (MIA) of the SWUCA, and in the Dover/Plant City Water Use Caution Area (DPCWUCA). The District is scheduling the establishment or reevaluation of 96 additional MFLs and one reservation through FY2029. The District's annual MFL Priority List and Schedule and Reservations List and Schedule is approved by the Governing Board in October, submitted to FDEP for review in November, and subsequently published in the Consolidated Annual Report. The approved and proposed priority lists and schedules are also posted on the District's Minimum Flows and Levels Documents and Reports webpage at: https://www.swfwmd.state.fl.us/projects/mfl/documents-and-reports

3.0 Watershed Management Planning

The District addresses flooding problems in existing areas by preparing and implementing WMPs in cooperation with local governments. The WMPs define flood conditions, identify flood level of service deficiencies, and evaluate best management practices (BMPs) to address those deficiencies. The WMPs include consideration of the capacity of a watershed to protect, enhance, and restore water quality and natural systems while achieving flood protection. The plans identify effective watershed management strategies and culminate in defining floodplain delineations and constructing selected BMPs.

Local governments and the District combine their resources and exchange watershed data to implement the WMPs. Funding for local elements of the WMPs is provided through local governments' capital improvement plans and the District's Cooperative Funding Initiative. Additionally, flood hazard information generated by the WMPs is used by the Federal Emergency Management Agency to revise flood insurance rate maps. This helps better define flood risk and is used extensively for land use planning by local governments and property owners. Since the WMPs may change based on growth and shifting priorities, the District also cooperates with local governments to update the WMPs when necessary, giving decision-makers opportunities throughout the program to determine when and where funds are needed.

4.0 Quality of Water Improvement Program

The Quality of Water Improvement Program (QWIP) was established in 1974 through Section 373.207, F.S., to restore groundwater conditions altered by well drilling activities for domestic supply, agriculture, and other uses. The program's primary goal is to preserve groundwater and surface water resources through proper well abandonment. Plugging abandoned artesian wells eliminates the waste of water at the surface and prevents mineralized groundwater from contaminating surface water bodies. Thousands of wells constructed prior to current well construction standards were often deficient in casing, which interconnected aquifer zones and enabled poor-quality mineralized water to migrate into zones containing potable-quality water.

Plugging wells involves filling the abandoned well with cement or bentonite. Isolation of the aquifers is reestablished, and the mixing of varying water qualities and free flow is stopped. Prior to plugging an abandoned well, geophysical logging is performed to determine the reimbursement amount, the proper plugging method, and to collect groundwater quality and geologic data for inclusion in the District's database. The emphasis of the QWIP is primarily in the SWUCA where the UFA is confined. Historically, the QWIP has proven to be a cost-effective method to prevent waste and contamination of potable ground and surface waters.

5.0 Stormwater Improvements: Implementation of Storage and Conveyance Best Management Practices

The District's WMPs and SWIM programs implement stormwater and conveyance BMPs for preventative flood protection to improve surface water quality, particularly in urban areas, and to enhance surface and groundwater resources. The BMPs involve construction of improvements identified and prioritized in the development of WMPs. Most of the activities are developed through cooperative funding with a local government entity, Florida Department of Transportation, or state funding. As stormwater is a primary contributor of water quality degradation in older urban areas, the District seeks opportunities to retrofit or improve these systems to reduce impacts to receiving waters. Fiscal year (FY)2020 funding includes new storage and conveyance projects in the Tampa Bay area, particularly in Hillsborough and Pasco county, as well as several continuing Tampa Bay projects.

Section 2. Water Resource Development Projects

As of FY2020, the District has 20 ongoing projects that meet the definition of water resource development "projects." The projects are listed in Table 7-2, below, along with their funding to date, total costs, participating cooperators, the estimated water quantity to be become available, and the planning region benefitted by the project. The total cost of these projects is approximately $150 million and a minimum of 78 mgd of additional water supply will be produced or conserved.

These projects include feasibility and research projects for new alternative water supply (AWS), Facilitating Agricultural Resource Management Systems (FARMS) projects to improve agricultural water use efficiency, and environmental restoration (ER) projects that assist MFLs recovery. District funding for a number of these projects is matched to varying degrees by local cooperators, including local governments, regional water supply authorities, and others; and some projects have received state and federal funding provided through mechanisms described in Chapter 8. The operation and maintenance costs for developed infrastructure will be the responsibility of local cooperators, unless otherwise noted in the project descriptions provided in this section.

Table 7-2. *Water Resource Development projects costs and District funding*

Water Resource Development Projects		Prior District Funding through FY2019	Total Project Cost (District + Cooperator)	Funding Source	Water to Become Available	Planning Region of Benefit
1) Alternative Water Supply Feasibility Research and Pilot Projects						
1.1	South Hillsborough Aquifer Recharge Program (SHARP) (N287)	$1,382,500	$2,765,000	SWFWMD, Hillsborough County	2 mgd	TBPR
1.2	Bradenton Aquifer Protection Recharge Well (N842)	$1,500,000	$5,050,000	District, City of Bradenton	5 mgd	TBPR
1.3	PRMRWSA Partially Treated Water ASR (N854)	$495,500	$8,300,000	District, PRMRWSA	0 mgd	SPR
1.4	Southern Hillsborough Aquifer Recharge Expansion (SHARP) Phase 2 (N855)	$4,500,000	$9,700,000	District, Hillsborough County	4 mgd	TBPR
1.5	Braden River Utilities ASR Feasibility (N912)	$2,736,250	$5,995,000	District, Braden River Utilities	TBD	SPR
1.6	Hydrogeologic Investigation of Lower Floridan Aquifer in Polk County (P280)	$11,375,000	$12,000,000	SWFWMD	TBD	HPR
1.7	Optical Borehole Imaging Data Collection from LFA Wells (P925)	$100,200	$167,000	District, USGS	NA	HPR
1.8	Sources/Ages of Groundwater in LFA Wells (P926)	$368,300	$555,800	District, USGS	NA	HPR
1.9	City of Venice Reclaimed Water Aquifer Storage Recovery (Q050)	$0	$5,065,000	District, City of Venice	0.17 mgd	SPR
1.10	Direct Aquifer Recharge-North Hillsborough Aquifer Recharge Program Phase 2 (Q064)	$0	$1,500,000	District, Hillsborough County	TBD	TBPR
1.11	Direct Aquifer Recharge-South Hillsborough Aquifer Recharge Program Phase 3 (Q088)	$0	$13,000,000	District, Hillsborough County	6 mgd	TBPR
2) Facilitating Agricultural Resource Management Systems (FARMS)						
2.1	FARMS Projects	$40,780,456	$71,791,225	SWFWMD, FDACS, State of FL, private farms	29 mgd	All

Water Resource Development Projects		Prior District Funding through FY2019	Total Project Cost (District + Cooperator)	Funding Source	Water to Become Available	Planning Region of Benefit
2.2	Mini-FARMS Program	$616,237	$150,000 (annual)	FDACS, SWFWMD	2 mgd	All
3) Environmental Restoration and Minimum Flows and Levels (MFL) Recovery						
3.1	Lower Hillsborough River Recovery Strategy (H400)	$5,464,712	$10,857,462	SWFWMD, City of Tampa	3.1 mgd	TBPR
3.2	Lower Hillsborough River Pumping Facilities	$394,512	$4,850,044	SWFWMD, City of Tampa	TBD	TBPR
3.3	Pump Stations on Tampa Bypass Canal (H404)	$486,428	$1,236,428	SWFWMD	3.9 mgd	TBPR
3.4	Haines City Reclaimed Water MFL Recharge & Advanced Treatment Feasibility Study (N888)	$225,000	$357,710	SWFWMD, Haines City	0.7 mgd	HPR
3.5	Lake Hancock Lake Level Modification (H008)	$9,989,166	$10,428,490	SWFWMD, State of FL, Federal	TBD	HPR, SPR
3.6	Aquifer Recharge for SWIMAL Recovery at Flatford Swamp with Natural Systems Enhancement (H089)	$5,044,012	$31,000,000	SWFWMD	10.0 mgd	SPR, HPR

Note: Tampa Bay Planning Region (TBPR); Southern Planning Region (SPR); Heartland Planning Region (HPR)

1.0 Alternative Water Supply Research, Restoration and Pilot Projects

The following projects are research and/or pilot projects designed to further the development of the innovative AWSs described in the Regional Water Supply Plan (RWSP). Included in these projects are feasibility projects for recharging the UFA with excess reclaimed water and the exploration of Lower Floridan aquifer (LFA) zones as a viable water source for inland utilities. These projects may lead to the development and protection of major sources of water supply in the future.

1.1 South Hillsborough Aquifer Recharge Program (SHARP) (N287)

This is an aquifer recharge pilot testing project that will design, permit, construct and test a 2 mgd reclaimed water UFA recharge well in the MIA of the SWUCA. The project will beneficially use reclaimed water and improve aquifer levels in the MIA to help meet the Salt Water Intrusion Minimum Aquifer Level (SWIMAL) defined in the SWUCA Recovery Strategy.

1.2 Bradenton Aquifer Protection Recharge Well (N842)

The project is for design, permitting, construction, and testing of one recharge well in the Avon Park production zone of the UFA and associated facilities to help prevent nutrient loading to the

Manatee River and Tampa Bay and to replenish groundwater in the MIA. The third-party review will provide necessary information to support District funding past the 30 percent design to final design, permitting, and construction.

1.3 PRMRWSA Partially Treated Water ASR (N854)

The project consists of site feasibility testing, 30 percent design, and third-party review of a partially treated water aquifer storage and recovery (ASR) project located at the Pease River Manasota Regional Water Supply Authority (PRMRWSA) ASR facility. Feasibility pilot testing will be implemented using partially treated surface water pumped from Reservoir No. 1 to recharge the UFA at two existing ASR wells and subsequently delivered back to the raw water reservoir system. The third-party review which will provide the necessary information on construction costs and project benefits to support District funding in future years to complete design, permitting, and construction.

1.4 Southern Hillsborough Aquifer Recharge Project (SHARP) Phase 2 (N855)

This project is for a third-party review of the County's 30 percent design, completion of design and permitting, and the initiation of construction for Phase 2 of the SHARP. Pending third-party review and approval, the project involves construction of 9,500 feet of transmission mains, two reclaimed water recharge wells (2 mgd each), eight monitoring wells, and associated appurtenances. The SHARP expands upon the county's SHARP Phase 1 recharge project (N287).

1.5 Braden River Utilities ASR Feasibility (N912)

This project will perform a third-party review for reclaimed water ASR feasibility studies at two sites. Pending the review, the project may include the construction of an ASR well at each site, monitoring wells, and partial infrastructure necessary to sufficiently and cost-effectively perform two cycle tests in accordance FDEP permit requirements.

1.6 Hydrogeologic Investigation of LFA in Polk County (P280)

This project explores the LFA in Polk County to assess its viability as an AWS source and to gain a better understanding of the Lower Floridan characteristics and groundwater quality. Three sites have been identified. At each site, if the tests on the initial exploration monitor well drilled are positive, a test production well may be constructed to conduct an aquifer performance test to obtain transmissivity and leakance information and to determine the quality of the formation water. The data gathered from the wells will improve the District's understanding of this potential AWS source, enhance groundwater modeling of the LFA, and determine the practicality of developing the LFA as an AWS source in areas facing future water supply deficits. Data from this project will also add to the geologic inputs in the Districtwide Regulation Model for the LFA to assess potential withdrawal-related impacts to water resources in the District. If the tests prove that the water quality and quantity are suitable, the water may be used by the regional entity established in Polk County as an additional source of public water supply.

1.7 Optical Borehole Imaging Data Collection from LFA Wells (P925)

This project collects optical borehole imaging data from LFA wells in Polk County. This data will aid in understanding the aquifer characteristics and groundwater quality in Polk County. The USGS is testing and providing the processed data to the District. Currently, nine LFA well sites have been identified for testing.

1.8 Sources/Ages of Groundwater in LFA Wells (P926)

This project collects isotope data from LFA wells from various sites in Polk County. The groundwater analysis will determine the sources and ages of the water from productive zones within the LFA and lower portions of the Upper Floridan aquifer. This data will aid in understanding the LFA characteristics (including flow paths) and groundwater quality in Polk County. The USGS is testing and providing the processed data to the District. Currently, six LFA well sites have been identified for testing.

1.9 City of Venice Reclaimed Water Aquifer Storage Recovery (ASR) (Q050)

This project is for the 30 percent design and third-party review of an ASR system to store and recover at least 25 million gallons per year of reclaimed water on-site at the City's Eastside Water Reclamation Facility, an advanced wastewater treatment plant. If constructed, ASR would let the City store excess reclaimed water in the wet season, to be used in the dry season when demand exceeds plant flow. The City has self-funded a feasibility study for FY2019, which will clarify project requirements, but its planning level study expects two production wells (1 mgd capacity each).

1.10 Direct Aquifer Recharge-North Hillsborough Aquifer Recharge Program Phase 2 (Q064)

This project includes completion of a direct aquifer recharge feasibility study, which includes the construction and testing of three exploratory wells necessary to evaluate recharge locations for the North Hillsborough Aquifer Recharge Program (NHARP). If approved, the study will aid in the determination of the hydrogeological characteristics and water quality of the targeted Avon Park Formation of the UFA and the approximate depth of the base of the underground source of drinking water in the general vicinity of NHARP.

1.11 Direct Aquifer Recharge-South Hillsborough Aquifer Recharge Program Phase 3 (Q088)

This project is for the third-party review of the County's 30 percent design, completion of design, permitting, construction, testing, and Independent Performance Evaluation for SHARP Phase 3. The Phase 3 project, if approved, will design, permit, construct, and test three recharge wells (2 mgd each) and design and construct well heads, appurtenances, monitoring wells, and approximately 4,000 feet of pipelines to connect the recharge wells to existing reclaimed water transmission mains. This project expands upon the County's current recharge projects resulting in six recharge sites anticipated to recharge approximately 14 mgd collectively.

2.0 Facilitating Agricultural Resource Management Systems Projects

The FARMS Program is an agricultural BMP cost-share reimbursement program consisting of many site-specific projects. The FARMS Program is a public/private partnership developed by the District and the Florida Department of Agriculture and Consumer Services (FDACS). The purpose of the FARMS initiative is to provide an incentive to the District's agricultural community to implement agricultural BMPs that will provide resource benefits including water quality improvement, reduced UFA withdrawals, and enhancements to the water resources and ecology.

The FARMS Program has five specific goals: (1) offset 40 mgd of groundwater within the SWUCA; (2) improve surface water quality impacted by mineralized groundwater within the Shell, Prairie, and Joshua Creek (SPJC) watersheds; (3) improve natural systems impacted by excess irrigation and surface water runoff within the Flatford Swamp region of the upper Myakka River watershed; (4) prevent groundwater impacts within the northern areas of the District; and (5) reduce frost-freeze pumpage by 20 percent within the DPCWUCA. These goals are critical in the District's overall strategy to manage water resources.

2.1 FARMS Cost-Share Projects

Facilitating Agricultural Resource Management Systems (FARMS) projects employ many of the agricultural water conservation strategies described in the RWSP to reduce groundwater withdrawals by increasing the water use efficiency of agricultural operations. The projects have the added benefit of reducing agricultural impacts to surface water features. The projects are public/private partnerships where the District provides financial incentives to farmers to increase the water use efficiency of their operations. Each project's performance is tracked to determine its effectiveness toward program goals. Since actual use of permitted quantities is dependent on hydrologic conditions, one of the objectives of FARMS projects is to reduce groundwater use regardless of hydrologic conditions. Facilitating Agricultural Resource Management Systems (FARMS) projects not only offset groundwater use with surface water, but also increases the overall efficiency of irrigation water use. The District has routinely budgeted approximately $6 million annually for these projects. A listing of cost-share projects within the planning region that meet the RWSP definition of being under development is provided in Table 7-3.

Table 7-3. *Specific FARMS cost-share projects within the Tampa Bay Planning Region that were funded post-FY2015*

Project Description	District Budget FY2015-2019	Benefit (mgd)	Primary Priority Area
Duggal Farm Amendment	$208,661	0.040	SWUCA
Halls Branch Farm	$200,100	0.082	SWUCA
Mathis Farms - Colson RD	$82,382	0.010	DPCWUCA
Hinton Farms	$218,793	0.058	MIA
Ocean Breeze	$32,064	0.010	MIA
Bonnie Blue Ranch, LLC	$297,610	0.050	MIA
Farmland Reserve	$196,300	0.055	MIA
Brenner Groves, LLC	$258,495	0.013	DPCWUCA
Frogmore Ranch, LLC - Amendment	$114,000	0.032	Springs Coast
Council Growers	$389,971	0.142	MIA

Project Description	District Budget FY2015-2019	Benefit (mgd)	Primary Priority Area
University of Florida GCREC	$65,794	0.023	MIA
Ocean Breeze - Phase 2	$79,030	0.015	MIA
Total	**$2,143,200**	**0.53**	

Notes: Projects were selected by funds budgeted in years FY2015 to FY2019, meeting District RWSP definition of "projects under development." The benefit is based on projected offset, with exceptions for observed results on high performing projects.

As of September 2019, there were 208 approved FARMS projects including 51 in the Tampa Bay Planning Region and 21 frost-freeze protection projects in the DPCWUCA. The projects are projected to have a cumulative groundwater offset of 28.48 mgd Districtwide and 2.68 mgd for the projects within the Tampa Bay Planning Region. The projected offset for the frost-freeze protection projects (post-January 2010) within the DPCWUCA is 38.43 mgd per 21-hour freeze event.

2.2 Mini-FARMS Program

Mini-FARMS is a scaled down version of the District's FARMS cost-share reimbursement program to implement agricultural BMPs on agricultural operations of 100 irrigated acres or less to conserve water and protect water quality within the District. Mini-FARMS is intended to assist in the implementation of the SWUCA Recovery Strategy, DPCWUCA Recovery Strategy, the Shell and Prairie Creek WMP, and the District's Strategic Plan. Much like the FARMS projects, the Mini-FARMS Program implements BMPs on agricultural operations to reduce UFA groundwater use and/or improve water quality conditions throughout the District. The maximum cost-share amount available from Mini-FARMS projects is $5,000 per agricultural operation per year, and the maximum cost-share rate is 75 percent of project costs.

From FY2006 through FY2018, the District's portion of the Mini-FARMS Program has reimbursed 159 water conservation BMP projects. The total cost of the Mini-FARMS projects was $ 856,086 and the District's reimbursement was $ 597,256. The Mini-FARMS Program continues to receive a strong demand from growers within the District, and it is projected that at least $150,000 will be budgeted for projects annually.

2.3 FARMS Irrigation Well Back-Plugging Program.

This program offers financial and technical assistance to well owners within the SWUCA to back-plug irrigation wells that produce highly mineralized groundwater. Back-plugging is a recommended practice to rehabilitate irrigation wells by identifying and restricting the intrusion of highly mineralized groundwater that often occurs from deeper aquifer zones in certain areas of the District. This program is separate from the QWIP, which focuses on proper well abandonment. The program was initiated in 2002 to improve water quality in watershed systems of the SWUCA, and later became an addition to the FARMS Program in 2005. Field investigations indicated that highly mineralized groundwater produced from older or deeper irrigation wells was the most likely source adversely impacting water quality downstream in Punta Gorda's public supply reservoir. Growers experience several advantages from well back-plugging including elevated crop yields from reduced salts in irrigation groundwater, decreases in soil-water requirements and pumping costs, and reduced corrosion and fouling of irrigation equipment.

A total of 85 wells have been back plugged in the SWUCA through FY2018, with 63 of these wells located in the SPJC priority watersheds. Analytical results for all back-plugged wells indicated conductivity, total dissolved solids, and chloride were decreased by averages of 42 percent, 42 percent, and 58 percent, respectively, with well volume yields retained at an average of 77 percent. Routine water quality monitoring of select back-plugged wells assures that these improvements are sustained long-term.

2.4 University of Florida's Institute of Food and Agricultural Services (IFAS) BMP Implementation Project.

The primary goal of this project is to assist IFAS in promoting statewide FDACS-adopted agricultural BMPs, typical FARMS projects, and other practices and preparation. District participation promotes the establishment of additional FARMS projects, which provides water resource benefits throughout the District. Assistance is provided to growers in conducting site assessments, selecting applicable FDACS BMPs, and filing notices of intent to implement the practices. Technical assistance may be provided directly or by coordinating with the appropriate FDACS staff or IFAS extension agents. Growers are informed of available BMP-related programs offered by FDACS, the WMDs, and other entities. Field demonstrations, workshops, and other educational opportunities are provided to growers and their employees. Technical assistance also identifies areas of future educational needs.

3.0 Environmental Restoration and MFL Recovery Projects

As of FY2020, the District has six ongoing ER and MFL recovery projects that benefit water resources. The Lower Hillsborough River Recovery Strategy, Lower Hillsborough River Pumping Facilities, and Pump Stations on the Tampa Bypass Canal (TBC) projects are in the Tampa Bay Planning Region. The Haines City Reclaimed Water MFL Recharge and Advanced Treatment Feasibility Study and the Lake Hancock Lake Level Modification projects are in the Heartland Planning Region. The Upper Myakka/Flatford Swamp Hydrologic Restoration and Implementation project is in the Southern Planning Region.

3.1 Lower Hillsborough River Recovery Strategy (H400)

The District established revised MFLs for the Lower Hillsborough River in 2007. Because the MFLs were not being met, the District incorporated a recovery strategy for the river into Rule 40D-80.073(8), F.A.C. As part of the recovery strategy, the District entered into a joint funding agreement and additional project-specific agreements with the City of Tampa to assess and implement projects associated with diversion of water from various sources to meet minimum flow requirements in the river.

3.2 Lower Hillsborough River Pumping Facilities and
3.3 Pump Stations on the Tampa Bypass Canal

In accordance with the recovery strategy, the City has diverted water from Sulphur Springs to the base of the Hillsborough River Reservoir Dam, as necessary to support river recovery. In addition, the District and more recently the City have diverted water from the Tampa Bypass Canal to the Hillsborough River Reservoir for subsequent diversion to the lower river. The City assumed responsibility for these diversions from the canal through the reservoir in 2018, with transfers of water from the reservoir to the lower river made using a newly constructed sluice gate in the dam that was cooperatively funded by the District and the City. In 2017, the City, with support from the District, completed the Blue Sink Project, which facilitates diversion of water from Blue Sink to the base of the dam for minimum flow recovery, and use of the sink as a recovery source was initiated in 2018. A project between the District and City associated with investigation of storage or additional supply options was completed in 2018 and identified the proposed Tampa Augmentation Project as a potential source for additional water that may be needed for recovery of the lower river. Permitting, design and permit-required monitoring associated with a project involving potential diversion of water from Morris Bridge Sink for river recovery have also been completed, although project implementation is contingent upon future recovery need assessments.

3.4 Haines City Reclaimed Water MFL Recharge and Advanced Treatment Feasibility Study (N888)

This project is for the evaluation of reclaimed water recharge sites, components, and advanced treatment necessary to assist in meeting MFLs on Lake Eva in the “Ridge Lakes” area of the CFWI.

3.5 Lake Hancock Lake Level Modification (H008)

This project is part of the recovery strategy to restore minimum flows in the upper Peace River, which is one of the four goals defined in the SWUCA Recovery Strategy. The project involved raising the control elevation of the existing outflow structure on Lake Hancock in order to slowly release the water during the dry season to help meet the minimum flow requirements in the upper Peace River between Bartow and Zolfo Springs. Increasing the operating level also helps restore wetland function for several hundred acres of contiguous lands to Lake Hancock and provide recharge to the UFA through exposed sinks along the upper Peace River. Construction is complete and the project is currently in the monitoring phase.

3.6 Upper Myakka/Flatford Swamp Hydrologic Restoration and Implementation (H089)

Hydrologic alterations and excess runoff have adversely impacted the Flatford Swamp in the upper Myakka watershed, and quantities of water should be removed from the swamp and surrounding areas to restore hydroperiods close to historic levels. The District has conducted evaluations to explore potential beneficial uses of water. In 2016, evaluations began on an injection recharge option that would use excess flow affecting the swamp to recharge the UFA in the vicinity of the MIA of the SWUCA to slow saltwater intrusion. The recharge system would assist with the SWUCA Recovery Strategy’s goal of meeting the SWIMAL to help recover and protect groundwater resources in/near the MIA. The ongoing evaluation includes construction of test recharge wells in the Flatford Swamp and the design and permitting of diversion infrastructure for source water.

Chapter 8. Overview of Funding Mechanisms

This chapter provides an overview of mechanisms available to generate the necessary funds to implement the water supply and water resource projects proposed by the District and its cooperators to meet the water supply demand projected through 2040 and restore minimum flows and levels (MFLs) to impacted natural systems.

Table 8-1 shows the projected increase in demand for each planning region for the planning period, as described in Chapter 3 of each volume of the Regional Water Supply Plan (RWSP). The table shows that approximately 209.7 mgd of new water supply is needed to meet user demands and to restore natural systems.

Table 8-1. *Summary of total projected increases in demand (5-in-10) (mgd) by each planning region from base year 2015 to 2040*

Planning Region	Projected Demand Increase
Heartland	38.9
Northern	50.4
Southern	44.4
Tampa Bay	76.0
Total	**209.7**

Note: Summation differences occur due to decimal rounding

A portion of the total demand shown above will be met by existing permitted quantities; however, new regional infrastructure may be required to deliver permitted quantities to end users, and additional water supply development is necessary to maintain adequate capacity for peak demand periods and continuing growth.

To prepare an estimate of the capital cost for projects needed to meet the portion of demand not yet under development, the District has compiled a list of large-scale water supply development (WSD) projects (Table 8-2). The District anticipates that a large portion of the remaining demand will be met through projects that users will select from the water supply options listed in Chapter 5 of this RWSP.

The amount of funding that will likely be generated through 2040 by the various utility, District, state, and federal funding mechanisms is compared to the capital cost of the potential large-scale projects. This comparison allows an evaluation of funding adequacy for support of projects necessary to meet water demands.

Part A. Statutory Responsibility for Funding

Section 373.705, Florida Statutes (F.S.), describes the responsibilities of the Water Management Districts (WMDs) in regard to funding water supply development and water resource development projects:

(1)(a) The proper role of the water management districts in water supply is primarily planning and water resource development, but this does not preclude them from providing assistance with water supply development.

(1)(b) The proper role of local government, regional water supply authorities and government-owned and privately owned water utilities in water supply is primarily water supply development, but this does not preclude them from providing assistance with water resource development.

(2)(b) Water management districts take the lead in identifying and implementing water resource development projects, and they are responsible for securing necessary funding for regionally significant water resource development projects.

(2)(c) Local governments, regional water supply authorities, and government-owned and privately owned utilities take the lead in securing funds for and implementing water supply development projects. Generally, direct beneficiaries of water supply development projects should pay the costs of the projects from which they benefit, and water supply development projects should continue to be paid for through local funding sources.

Section 373.707(2)(c), F.S., further describes the responsibilities of the WMDs in regard to providing funding assistance for the development of alternative water supplies:

(2)(c) Funding for the development of alternative water supplies shall be a shared responsibility of water suppliers and users, the State of Florida, and the water management districts, with water suppliers and users having the primary responsibility and the State of Florida and the water management districts being responsible for providing funding assistance.

In accordance with the intent of the Florida Legislature, direct beneficiaries of WSD projects should generally bear the costs of projects from which they benefit. However, affordability and benefits to natural resources are valid considerations recognized in Section 373.705(4)(a), F.S. for funding assistance from the WMDs:

(4)(a) Water supply development projects that are consistent with the relevant regional water supply plans and that meet one or more of the following criteria shall receive priority consideration for state or water management district funding assistance:

1. *The project supports establishment of a dependable, sustainable supply of water which is not otherwise financially feasible;*

2. *The project provides substantial environmental benefits by preventing or limiting adverse water resource impacts, but requires funding assistance to be economically competitive with other options; or*

3. *The project significantly implements reuse, storage, recharge, or conservation of water in a manner that contributes to the sustainability of regional water sources.*

Currently, the District funds both WSD and water resource development (WRD) projects. As discussed in Chapter 7, the District considers its WRD activities to include resource data collection and analysis as well as projects. In terms of WSD, the District has typically funded the development, storage, and transmission of non-traditional sources of water, including reclaimed water and conservation. Potential sources of funding for WSD and WRD projects are addressed below.

Part B. Funding Mechanisms

Section 1. Water Utilities

Water supply development (WSD) funding has been, and will remain, the primary responsibility of water utilities. Increased demand generally results from new customers that help to finance source development through impact fees and utility bills. Water utilities draw from a variety of revenue sources such as connection fees, tap fees, impact fees (system development charges), base and minimum charges, and volume charges. Connection and tap fees generally do not contribute to WSD or treatment capital costs. Impact fees are generally devoted to the construction of source development, treatment, and transmission facilities. Base charges generally contribute to fixed customer costs, such as billing and meter replacement. However, a high base charge, or a minimum charge, which covers the cost of the number of gallons of water use, may also contribute to source development, treatment, and transmission construction cost debt service. Volume charges contribute to both source development/treatment/transmission debt service and operation and maintenance (O&M).

Community development districts (CDDs) and special water supply and/or sewer districts may also develop non-ad valorem assessments for system improvements to be paid at the same time as property taxes. These entities generally occur in developed areas not served by a government-run utility and generally serve a planned development. Regional water supply authorities, such as Tampa Bay Water (TBW), are also special water supply districts, but do not have retail customers. Facilities are funded through fixed and variable charges to the utilities they supply which are, in the end, paid by the retail customers of the utilities. All the above-mentioned types of utilities and regional water supply authorities have the ability to issue secure construction bonds backed by revenues from fees, rates, and charges.

While some utility revenues will go to pay existing facility debt service, most of that service will be retired in various stages over the next 20 years and debt service for new projects will be added. Projects built late in the 20-year planning period will continue to generate revenues for debt service for many years after the planning period.

Financing through volume-related charges is the most economically efficient means to finance new WSD. Volume charge financing provides consumers and businesses the greatest degree of direct control over water-related costs and a direct incentive to conserve. Such financing increases utility revenue stream variability, but such variability may be reduced through the development of rate stabilization or reserve funds.

If volume charges are utilized to fund higher cost alternative water sources, the impact on ratepayers can be mitigated through existing and innovative rate structures and charges. High-usage rate blocks can be set to reflect the full marginal cost of the next source of supply. Usage by conserving customers can be set at the existing average embedded cost, as they are not driving the need for additional supply development (or below existing cost if a lifeline rate is necessary). If the rate change to implement this pricing is designed to exceed current revenue requirements, the additional revenue can be dedicated to new source development. Such pricing both encourages conservation and reduces the need for steeper increases in future rates.

Conservation incentivized by block rate structures, in combination with collecting project revenues in advance of construction, can distribute price increases more evenly over time and buffer price fluctuations inherent in common water-pricing practices. This allows customers to adjust water use practices and technology over time. Indexing of prices is another means of distributing price increases over time. If changes to water rates are revenue-neutral, additional conservation can still occur, as the difference between average and marginal price blocks for larger water users increases. There are a number of additional means available to mitigate the impact of higher cost sources to customers. Many of these are addressed in the American Water Works Association's publications Avoiding Rate Shock: Making the Case for Water Rates (AWWA, 2004) and Thinking Outside the Bill: A Utility Manager's Guide to Assisting Low-Income Water Customers (AWWA, 2014).

Section 2. Water Management District

The District's Governing Board provides significant financial assistance for conservation, planning, and alternative water supply (AWS) projects through programs including the Cooperative Funding Initiative (CFI) and other District initiatives. Financial assistance is provided primarily to governmental entities, but private entities also participate in these programs. Portions of state funding are also allocated by the District through state appropriations for the state's Water Protection and Sustainability Program, the District's West-Central Florida Water Restoration Action Plan, the state's Florida Forever Program, the District's Facilitating Agricultural Resource Management Systems (FARMS) Program, and Florida Department of Environment Protection (FDEP) funding for the Springs Initiative.

1.0 Cooperative Funding Initiative

The primary funding mechanism is the District's CFI, which includes funding for major regional water supply and WRD projects and localized projects throughout the District's 16-county jurisdiction. The Governing Board, through its regional sub-committees, jointly participates with local governments and other entities to ensure proper development, use, and protection of the regional water resources of the District. The CFI is a matching grant program and projects of mutual benefit are generally funded 50 percent by the District and 50 percent by the public or private cooperators. Any state and federal funds received for the projects are applied directly against the project costs, with both parties benefitting equally. The CFI has been highly successful; since 1988, this program has resulted in a combined investment (District and cooperators) of approximately $3.3 billion for a variety of water projects addressing the District's four areas of responsibility: (1) water supply, (2) natural systems, (3) flood protection, and (4) water quality. From fiscal year (FY)2016 through FY2020, the District's adopted budget included an average of $56.8 million in ad valorem tax dollars for the CFI program, of which $30 million (53 percent) was for WRD and water supply development assistance.

2.0 District Initiatives

Projects funded through the District Initiatives program are of great importance or a regional priority. The District can increase its percentage match and, in some cases, provide total funding for the project. Examples of these initiatives include: (1) the Quality of Water Improvement Program to plug deteriorated, free-flowing wells that waste water and cause inter-aquifer contamination, (2) the Utilities Services Group to conserve water by assisting utilities in controlling their water loss, (3) data collection and analysis to support major District initiatives such as the MFL program, (4) the FARMS program and other various agricultural research projects designed to increase the water-use efficiency of agricultural operations, (5) WRD investigations and MFL

Recovery projects which may not have local cooperators, and (6) the Water Incentives Supporting Efficiency (WISE) program launched in 2019 offers cost-share funding for a wide variety of water conservation projects (max of $20 thousand per project) to non-agricultural entities. From FY2016 through FY2020, the District's adopted budget included an average of $24.5 million in ad valorem tax dollars for District Initiatives, of which $9 million was for WRD and WSD assistance.

The average total commitment from FY2016 through FY2020 for CFI and District Initiatives was approximately $81.3 million. The continued level of investment for these programs depends on various economic conditions, resource demands, and the District's financial resources. However, the District believes it resources are sufficient to ensure the long-term sustainability of the region's water resources moving forward.

Section 3. State Funding

1.0 The Springs Initiative

The FDEP Springs Initiative is a special legislative appropriation that has provided revenue for protection and restoration of major springs systems. The District has allocated Springs Initiative funding to implement projects to restore aquatic habitats, to reduce groundwater withdrawals and nutrient loading within first-magnitude springsheds, and to improve the water quality and quantity of spring discharges. Projects include the reestablishment of aquatic and shoreline vegetation near spring vents, construction of infrastructure necessary to convey wastewater currently treated in septic systems or package plants to a centralized wastewater treatment facility which may increase reclaimed water production and implementation of other best management practices within springshed basins.

The first year of the appropriation was FY2014, when the District received $1.35 million from the FDEP to allocate for springs restoration. To date, the District has been allocated over $55.2 million in Springs Restoration funding from the FDEP, including $19.25 million for FY2020, of which $7 million will be budgeted in future years. The projects receiving Springs Initiative funding have been located primarily in the Northern Planning Region, where the majority of first and second magnitude springs within the District are located.

2.0 Water Protection and Sustainability Program

Large areas of Florida do not have sufficient traditional water resources to meet the future needs of the state's growing population and the needs of the environment, agriculture and industry. The state's Water Protection and Sustainability Program Trust Fund (WPSPTF) was created in the 2005 legislative session through Senate Bill 444 to accelerate the development of alternative water sources and later recreated in Chapter 373, F.S., as part of the 2009 legislative session. Legislation focused on encouraging cooperation in the development of alternative water supplies and improving the linkage between local governments' land use plans and water management districts' regional water supply plans. The program provides matching funds to the District for AWS development assistance. From FY2006 through FY2009, the District received a total of $53.75 million in legislative allocations through the program for WSD projects. Annual WPSPTF funding resumed in FY2020 with $250,000 allocated to the District.

Program funds are applied toward a maximum of 20 percent of eligible project construction costs. In addition, the Legislature established a goal for each WMD to annually contribute funding equal to 100 percent of the state funding for AWS development assistance, which the District has exceeded annually. The legislation also requires that a minimum of 80 percent of the WPSPTF funding must be related to projects identified in a district water supply plan. The District's RWSP is utilized in the identification of the majority of WPSPTF-eligible projects.

Projects are evaluated for funding based on consideration of the 12 factors described in Subsections 373.707(8)(f) and (g), F.S., and additional District evaluation factors as appropriate. If the Legislature continues to fund the state's Water Protection and Sustainability Program, it could serve as a significant source of matching funds to assist in the development AWSs and regional supply infrastructure in the region.

3.0 The Florida Forever Program

The Florida Forever Act, as originally passed by the Florida Legislature in 1999, established the 10-year $3 billion statewide Florida Forever Program. The Program was extended by the Legislature during the 2008 legislative session, allowing the Program to continue for 10 more years at $300 million annually. Since 1999, the District has allocated $95 million ($81.6 million for land acquisition and $13.4 million for water body restoration) of Florida Forever funding Districtwide in support of WRD. A "water resource development project" eligible for funding is defined in Section 259.105, F.S. (Florida Forever), as a project that increases the amount of water available to meet the needs of natural systems and the citizens of the state by enhancing or restoring aquifer recharge, facilitating the capture and storage of excess flows in surface waters, or promoting reuse. Implementation of eligible projects under the Florida Forever program includes land acquisition, land and water body restoration, aquifer storage and recovery (ASR) facilities, surface water reservoirs, and other capital improvements. An example of how the funds were used by the District for WRD was the purchase of lands around Lake Hancock within the Peace River watershed, as the first step in restoring minimum flows to the Upper Peace River. In addition, the District Governing Board has expended $35.7 million in ad valorem-based funding to complete the acquisition of lands associated with the Lake Hancock project, acquired on a voluntary basis and through eminent domain proceedings.

4.0 State Funding for the Facilitating Agricultural Resource Management Systems Program

Operating under Chapter 40D-26, Florida Administrative Code (F.A.C.), the FARMS Program, through the District, utilizes additional state funding when available. Since the inception of the program, the District has received $6.4 million in state appropriations and $1.3 million from the Florida Department of Agriculture and Consumer Services (FDACS). No funding was provided by the state from FY2016 through FY2020.

5.0 West-Central Florida Water Restoration Action Plan

The Water Restoration Action Plan (WRAP) is an implementation plan for components of the Southern Water Use Caution Area (SWUCA) recovery strategy adopted by the District. The document outlines the District's strategy for ensuring that adequate water supplies are available to meet growing demands, while at the same time protecting and restoring the water and related natural resources of the SWUCA. The WRAP prescribes measures to implement the recovery strategy and quantifies the funds necessary, making it easier for the District to seek funding for the initiative from state and federal sources. In 2009, the Legislature officially recognized the

WRAP through Senate Bill 2080, creating Section 373.0363, F.S., as the District's regional environmental restoration and water resource sustainability program for the SWUCA. In FY2009, the District received $15 million in funding for the WRAP, however, no new funding has been provided via state appropriation since that time.

Section 4. Federal Funding

In 1994, the District began an initiative to seek federal matching funds for water projects. Since that time, the Office of the Governor, the FDEP, other WMDs, and local government and regional water supply authority sponsors have joined with the District to secure federal funding. Through a cooperative effort with members of Florida's Congressional Delegation, the federal initiative has grown substantially. In 1999, the effort was expanded to seek funding for the development of alternative source projects and, in 2001, the state of Florida and the WMDs expanded a list of projects in order to seek all available resources to develop an environmentally sustainable water supply strategy that would meet the demands of growth throughout the state. The projects include the use of AWS technologies, as well as stormwater retention and filtering and wastewater treatment. Each WMD certifies that the projects submitted for funding are regional in scope and that matching funds are available either from the District's budget or from a local government sponsor.

Within the District, Federal matching funds from this initiative helped fund the construction of the Peace River Manasota Regional Water Supply Authority (PRMRWSA) reservoir and plant expansion. Funding for Tampa Bay Water's C.W. Bill Young Regional Reservoir came from individual project grant allocations through the State and Tribal Assistance Grants (STAG) program. However, Congress has not funded any individual project STAG grants for several years, so future funding for individual projects through this mechanism is uncertain. Congressional authorization through the Water Resources Development Act aids in the efforts to secure funding for the Peace and Myakka rivers' watershed restoration initiatives. District staff considers funding for water supply projects to be a top priority and continues to work with the Office of the Governor, the FDEP, the U.S. Army Corps of Engineers, and the members of the Florida Congressional Delegation to secure federal funding.

1.0 U.S. Department of Agriculture Natural Resources Conservation Service programs

The Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP) provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands. The program provides assistance to farmers and ranchers to comply with federal, state, and tribal environmental laws that encourage environmental enhancement. The program is achieved through the implementation of a conservation plan that includes structural, vegetative, and land management practices. The program is carried out primarily in priority areas where significant resource concerns exist. Agricultural water supply and nutrient management through detention/retention or tailwater recovery ponds can be pursued through this program.

In addition to EQIP, the FARMS Program has partnered with NRCS through the Agriculture Water Enhancement Program (AWEP) and the Florida West Coast Resource Conservation and Development Council (RC&D) to bring additional NRCS cost-share funding to the SWUCA. The AWEP was created by the 2008 Farm Bill with similar goals as the EQIP program, including conserving and/or improving the quality of ground and surface water. The RC&D is a nonprofit organization that promotes sustainable agriculture and local community food systems in Hillsborough, Manatee, Pinellas, and Sarasota counties.

The District's FARMS Program works cooperatively with the NRCS EQIP, AWEP, and RC&D programs on both financial and technical levels, and dual cost-share projects have been coordinated whenever possible. By an agreement between the District, FDACS, and the NRCS, the maximum funding for using both FARMS and EQIP is 75 percent of total project cost. As of FY2019, 41 FARMS projects Districtwide have involved some level of dual cost-share with EQIP, AWEP, and/or the RC&D, with several additional cooperative projects expected in the near future. On a technical level, agency interaction includes using the NRCS mobile irrigation lab to investigate using FARMS cost-share for improvements to overall irrigation system efficiency, using NRCS engineering designs for regulatory agricultural exemptions whenever possible, and coordinating cost-share on specific project related infrastructure. For example, FARMS may assist with an alternative source of irrigation water and EQIP assists with an upgrade to an irrigation delivery system. The relationship is mutually beneficial, extends cost-share dollars, and provides more technical assistance to participants in both programs.

Section 5. Public-Private Partnerships and Private Investment

As traditional water sources reach their capacity, alternative sources must be developed that involve specialized technical expertise and risky financial investments. The development of such technologies may be beyond the ability and level of tolerance of many water utilities. A range of public/private partnership options are available to provide this expertise and shift the financial risk. These options range from all-public to all-private ownership, design, construction, and facility operation. Investment and competition among private firms desiring to fund, build, or operate WSD projects could reduce project costs, potentially resulting in lower customer charges.

In addition to investor-owned public supply utilities, private risk sharing could be undertaken by three distinct forms of water supply entities: (1) public-private partnerships consisting of public utilities or regional water supply authorities contracting with private entities to design, build, or operate facilities; (2) cooperative institutions such as irrigation districts contracting with private entities; and (3) private entities, which could identify a customer base and become a water supplier to one or more water use types.

1.0 Public-Private Utility Partnerships

Two advantages of public-private partnerships are that (1) competition and economies of scale enjoyed by regional or national construction/operation firms or teams may reduce costs and complete a project in less time, and (2) some of the risk may be shifted to the private firms providing goods and services. As an example, TBW undertook a public-private partnership with Veolia Water, formerly USFilter, to design, build, and operate its surface water treatment plant that has been in operation since 2002. Veolia assumed all risks for cost, schedule, plant design and construction, equipment supply, startup services, and facility performance through (O&M). The cost savings over the life cycle of the contract is expected to be significant.

Public-private partnerships are becoming more common as water technology and regulation becomes increasingly complex. Increasing numbers of regulated pollutants and new higher-risk technologies drive privatization of some public water supply responsibilities. Partnerships work best where risks are beyond public sector tolerance, a project is new and standalone, construction and long-term operation are combined, there are clearly defined performance specifications, and there are clearly defined payment obligations (Kulakowski, 2005). Small utilities may not have the resources or project sizes sufficient to attract private interest but may participate through multi-utility agreements or through a regional water supply entity. A significant benefit of cooperation in larger projects is the economies of scale common in the water supply industry.

2.0 Cooperatives

Cooperatives are arrangements where multiple self-supplied water users pool their resources to construct water facilities that they could not technically or economically undertake on their own. They also share the risks. Such private or public/private cooperative institutions are more common where lengthy transmission systems are required, such as in the western U.S. where surface water is distributed to water districts and for irrigation. Water is usually obtained from a supplier at a cost and then distributed among members by the water district. Members cooperatively fund the construction of transmission and distribution facilities. As groundwater resources become increasingly limited and reclaimed water systems expand, the same type of economic forces that created irrigation and water districts in the west could develop in portions of Florida. Cooperatives may also shift financial risk by entering into design, build, and operate arrangements with contractors. One example of this structure is the Polk Regional Water Cooperative (PRWC), formed in 2016 to address the development and provision of alternative water sources to its member local governments. Other forms of cooperative institutions in Florida, such as drainage districts and grower cooperatives, have effectively reduced competition and litigation over resources (OPPAGA, 1999).

3.0 Private Supply Investment (Aside from Investor-Owned Public Supply)

Private Supply Investment is where investors identify an unserved customer base and develop water facilities to meet those needs. This type of investment may facilitate the development of alternative water supplies. Such private financial investment occurs where firm regulatory limits are in place to protect water resources and related environmental features, and further development of traditional sources are not allowable. Although the purpose of the regulatory measures is resource protection, they indirectly create a customer base for alternative source developers.

Part C. Amount of Funding Anticipated to be Generated or Made Available Through District and State Funding Programs and Cooperators

Section 1. Projection of Potentially Available Funding

Below is a summary of projected resources that could be generated by the District and state funding programs for water resource development and WSD projects. An explanation follows as to how the funding amounts are derived.

1.0 Cooperative Funding Initiative

With the Governing Board's direction for a continued investment in vital projects to protect the region's water resource needs, the District's most recent long-range funding plan estimated $1.33 billion in ad valorem tax dollars would be allocated for the CFI from 2021 through 2040. Assuming these funds are used for projects that would be matched by a partner on an equal cost-share basis, this would collectively result in $2.66 billion generated through this program. If the funding allocation summary of the program remains consistent with the previous five years, approximately $1.41 billion (53 percent) could potentially be utilized for water source development and WSD assistance. However, the allocation of resources is typically driven by new requests submitted through the CFI program each year, which could significantly influence this funding projection, as the Governing Board may direct more funding for the District's other areas of responsibility (i.e., flood protection, water quality, and natural systems). It is important to note that funding does not include state or federal funds, which the District and its partners continue to seek.

2.0 District Initiatives

Also consistent with the District's most recent long-range funding plan, an estimated $579 million in ad valorem tax dollars would be allocated for District Initiatives from 2021 through 2040. If the funding allocation of the program remains consistent with the previous five years, approximately $214 million (37 percent) could potentially be utilized for water source development and WSD assistance. However, the allocation of resources is typically driven by strategic priorities which could significantly influence this funding projection, as the Governing Board may direct more funding for the District's other areas of responsibility (i.e., flood protection, water quality, and natural systems). It is important to note that funding does not include state, federal, or local funds, which the District continues to seek.

3.0 Springs Initiative

The amount of future state funding for the Springs Initiative cannot be determined at this time. Any funding allocated to this District will be used for projects for the protection and restoration of major springs systems, including projects to reduce groundwater withdrawals and improve stormwater systems.

4.0 Water Protection and Sustainability Trust Fund

The amount of future state funding for this program cannot be determined at this time. As economic conditions improve and the state resumes funding, any funding allocated for this District will be used as matching funds for the development of alternative water supply (AWS) projects.

5.0 Florida Forever Trust Fund

The amount of future state funding for the Florida Forever Trust Fund cannot be determined at this time. Any funding allocated for this District will be used for land acquisition, including land in support of WRD.

If funding allocations remain consistent with the previous five years, approximately $1.62 billion could potentially be generated or made available to fund CFI and District Initiative projects necessary to meet the water supply demand through 2040 and to restore MFLs for impacted natural systems. This figure may be conservative, since it is not possible to determine the amount of funding that may be available in the future from the federal government and state legislative appropriations.

Section 2. Evaluation of Project Costs to Meet Projected Demand

Of the 209.7 mgd of projected Districtwide demand increases during the 2015–2040 planning period to meet the demand for all users and to restore MFLs for impacted natural systems, it is estimated that 46 mgd, or 22 percent of the demand, has either been met or will be met by reclaimed water and conservation projects that are under development. The total District share of cost for the projects currently under development including regional transmission, ASR, and brackish groundwater treatment systems is $490 million.

To develop an estimate of the capital cost of projects necessary to meet demand, the District compiled a list of large-scale WSD projects proposed for development within the 2040 planning timeframe. These projects, proposed by the PRMRWSA, TBW, and PRWC, could produce up to 105 mgd of water supply. The estimated costs and quantity of water they will produce are listed in Table 8-2. The categories shown each contain several projects that could be chosen for development to meet future needs. Many of these are AWS projects would be eligible for co-funding by the District. The table shows the estimated total cost of the 100 to 105 mgd of water supply that will be produced by these projects is up to $1.81 billion.

Tampa Bay Water's (TBW) Long-Term Master Water Plan 2018 contains several AWS projects, many of which would be eligible for co-funding by the District. The TBW priority projects range from 10 to 25 mgd in capacity with capital cost estimates of between $408 and $429 million.

A portion of new water demand in the Northern Planning Region will be met using available quantities of fresh groundwater, for which the District does not provide matching financial resources. The District is planning to assist with AWS options, including reclaimed water and conservation projects, which can help meet future demands in the Northern Planning Region and help prevent negative impacts on water resources from occurring. In other planning regions, additional new demands will be met through the development of AWS and conservation projects chosen by users. The potential water supply project options are discussed in Chapter 5 for each planning region.

Table 8-2. *Proposed large-scale water supply and water resource development projects by 2040 (millions of $)*

Project	Entity to Implement	Quantities (mgd)	Capital Costs
Peace River Facility Surface Water System Expansion and Regional Reservoir	PRMRWSA	15	$332
Phase II Capacity Expansion, New RO Water Treatment Plant, and Regional Loop System	PRMRWSA	10	$365
Aquifer Recharge for SWIMAL Recovery at Flatford Swamp Natural Systems Enhancement	TBD	10	$31
Southeast Wellfield and West Polk County Lower Aquifer Deep Wells	PRWC	45	$650
Big Bend Desalination	TBW	10-12.5	$244
Enhanced Surface Water Expansion from Alafia River	TBW	10-12.5	$88
New Regional Feed Line to Balm Area	TBW	N/A	$76-97
Subtotal Southern Planning Region		**35**	**$728**
Subtotal Heartland Planning Region		**45**	**$650**
Subtotal Tampa Bay Planning Region		**20-25**	**$408-429**
Total – Districtwide		**100-105**	**$1,786-1,807**

Section 3. Evaluation of Potential Available Funding to Assist with the Cost of Meeting Projected Demand

The conservative estimate of $2.66 billion in cooperator and District financial resources that will be generated through 2040 for funding is sufficient to meet the projected $1.79 to $1.81 billion total cost of the large-scale projects listed in Table 8-2. State and federal funding sources may also assist with any remaining and/or high-end costs for future AWS projects and water conservation measures where fresh groundwater resources are limited. These financial projections are subject to economic conditions that may affect the level of District ad-valorem tax revenue and the availability of federal and state funding; however, such conditions may similarly affect future water demand increases.

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