2019

Broward County-wide Integrated Water Resource Plan Update: Building Resiliency in Water Management

ENVIRONMENTAL PLANNING & COMMUNITY RESILIENCE DIVISION
115 South Andrews Ave., Room 329H
4/24/2019

Table of Contents

Executive Summary

This Report provides an update on the 2009 Broward County-wide Integrated Water Resource Plan (IWRP) Report, which continues to guide the management of water resources across Broward County. This update summarizes the progress made in responding to the recommendations of that earlier report and discusses how the County and regional water management community are responding to address present and future water management challenges. This report is divided into eight sections:

1. Introduction and Background
2. Broward's Water Resources
3. Goals and Objectives
4. Status of Recommendations from the 2009 IWRP
5. Water Resources Assessment of Current and Future Conditions
6. Coordination with Other Planning Efforts
7. Governance
8. 2019 Recommendations

This report reflects the information and recommendations reviewed and approved of by the Technical Advisory Committee on February 15, 2019 and the Water Advisory Board on March 29, 2019. That information is presented in a web-based presentation that augments this document and can be accessed at: https://sway.office.com/gPzvfswYyFzqIErc?ref=Link. The online cloud-based presentation provides for greater distribution and easier access to this update and allows for future edits to be made easily on a regular basis.

Introduction and Background

In 1997, the Broward County water management community and South Florida's regional water management agency, the South Florida Water Management District, came together to develop an integrated water resources management approach to address the water management challenges associated with the unique geological, hydrological, meteorological, and physical conditions that shape our South Florida environment and the 1.9 million Broward residents that occupy the urban area bordered by the Everglades and the Atlantic Ocean.

In January 2010, the Broward County Board of County Commissioners officially adopted the **Broward County-wide Integrated Water Resource Plan (IWRP) Report** as an integral part of the County's long-term water conservation, management and supply strategy with a 10-year planning horizon.

The IWRP provides the framework for effective and efficient local water management on a regional scale and is designed to assist local planners and water suppliers in meeting the present and future urban and natural systems water needs. The plan has four main goals:

- *Make the most of local water resources*
- *Coordinate with a diverse community*
- *Match up local sources and users*
- *Diversify supplies*

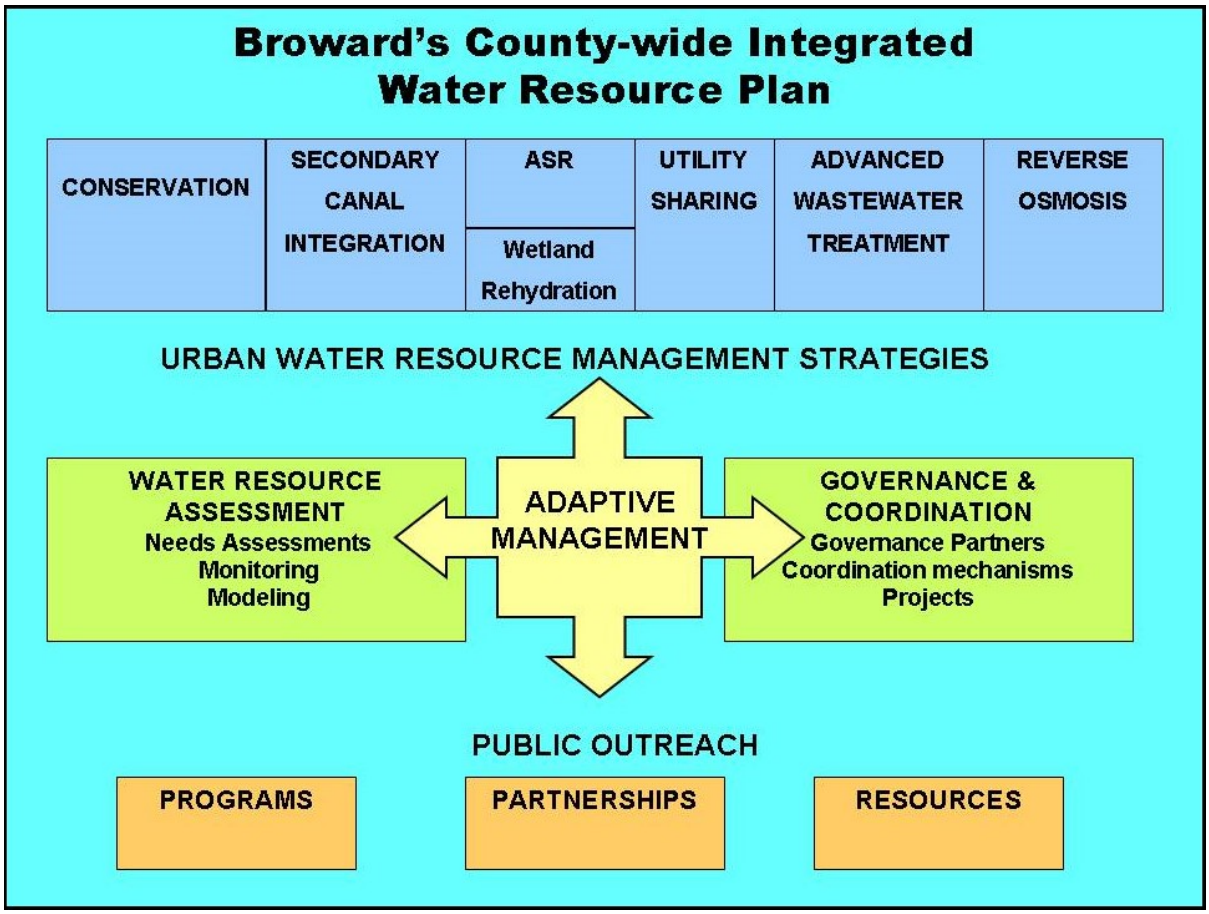
This update to the 2009 IWRP Report summarizes the substantial progress over the past 10 years in advancing regional water resource initiatives and discusses the additional challenges identified since that time and describes how the collective water management community is organizing to address these emerging issues. Among the challenges water management is facing now are saltwater intrusion, sea level rise, and changing rainfall patterns.

IWRP STRUCTURE

A strong water management system is needed to address these challenges. Broward County's water management system is managed, enhanced, and supported through coordinated activities involving a diverse field of water

managers, technical resources, governing bodies, and the public. The 2009 IWRP presented an organizational framework for integration of these activities with a focus on sustainable, high quality, and cost-effective water resource management for the benefit of the County's diverse water needs and users.

The 2009 IWRP structure consists of four components that function together. A series of **Urban Water Resource Management Strategies** provides alternatives towards meeting our future water needs, moving from low-cost conservation measures to higher cost water treatment alternatives. A robust **Water Resource Assessment Program** ensures that studies, programs, and projects are driven by good science, utilizing the latest water resources models. **Regional Governance and Coordination** is provided through the policy forums and planning activities of the Broward Water Advisory Board and its Technical Advisory Committee. **Public Outreach** is critical to keeping stakeholders engaged, aware of the water management community's activities and challenges, and participants in solutions.



The 2009 Conceptual IWRP structure

The four components of the IWRP have incorporated new creative strategies and actions to address the additional challenges and emerging issues and to promote greater resilience in our water management system.

A VERY BRIEF HISTORY OF WATER MANAGEMENT IN SOUTH FLORIDA

South Florida's environment and its ability to support a large population is a direct result of early and ambitious efforts to drain the Everglades. Broward County's development is directly attributable to the "success" of these early efforts by both individuals and government to develop drainage systems for flood control that initially paved the way for agriculture, and later for homes, businesses, and transportation routes.

Early efforts to drain lands in Broward County by individual landowners were piecemeal and only marginally successful. This began to change in 1905, when the Florida Legislature passed an act establishing a board of drainage commissioners with the power to build canals, establish drainage districts, and levy annual taxes on landowners within that district. That same year, the Everglades Drainage District, the predecessor of today's South Florida Water Management District, was established.

On July 4, 1906, Governor Napoleon B. Broward formally opened the drainage project. The resulting network of canals and locks which were constructed over the next 20 years opened thousands of acres of virgin land to settlement and cultivation, creating an over-drained landscape that remained floodprone.

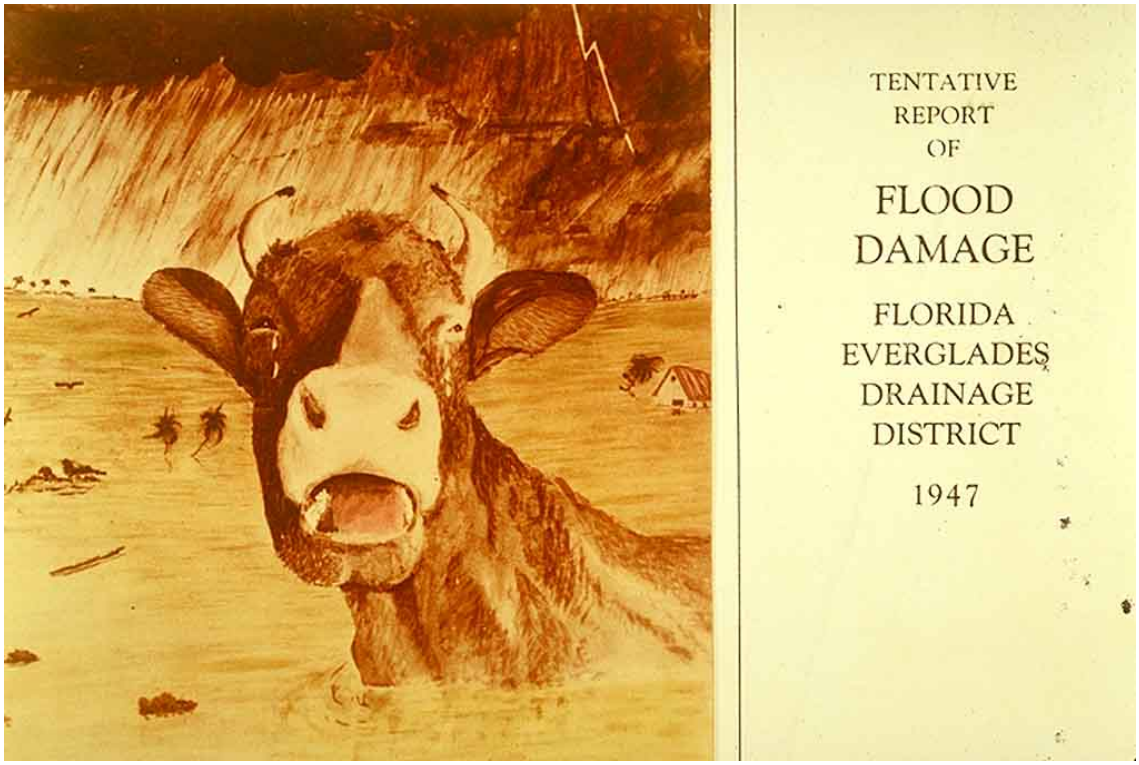
A history of man's efforts to develop the Everglades can be found in Michael Grunwald's book *"The Swamp: The Everglades, Florida, and the Politics of Paradise"* and the recent PBS documentary *The Swamp*.

BROWARD'S POPULATION GROWTH

Despite these efforts and those of early developers to market the area's lands to northerners, population growth in the County remained slow until the prosperity and optimism following World War I set off the first of Broward's great land booms.

However, this growth was not without disruption. Major hurricanes in 1926, 1928 and 1947 caused extensive damage in South Florida and drove further alteration of the natural drainage system through the 1950's and 60's with the construction of the Herbert Hoover Dike along the southern rim of Lake Okeechobee and the undertaking of the Central & Southern Florida (C&SF) Project, an expansive canal and levee network that was originally authorized by Congress in 1948.

In numbers, the population boom following World War I pales in comparison to that which followed World War II, where the average gain per year between 1950 and 1970 was 26,808 resulting in a population that soared from 83,933 to 620,100 in just two decades.



The "Crying Cow" report was submitted to US Congress in 1947 following extensive flooding in South Florida in 1947 and sought funds for the Central & Southern Florida project.

THE CENTRAL & SOUTHERN FLORIDA PROJECT

The C&SF Project, which was originally designed to accommodate a population of 2 million, continues to serve its primary purpose of flood control today, even as South Florida's population has swelled to over 8 million. The regional water management system operated by the South Florida Water Management District –

with approximately 2,100 miles of canals and more than 2,000 miles of levees/berms, 77 pump stations, 600 water control structures and 620 culverts – helps to protect regional water supplies and provide flood control. Yet, even as it still functions largely as it was originally intended to do, the ability to provide the same level of flood protection as it has in the past is compromised by sea level rise and extreme rainfall events which greatly impact the performance of this all-important regional system.

LAKE OKEECHOBEE

Lake Okeechobee, the second largest natural freshwater body in the U.S., is considered the liquid heart of Florida. Lake Okeechobee as an important component of the South Florida water management system. Covering 730 square miles, it is exceptionally shallow with an average depth of only 9 feet. The Lake is actively managed to provide flood protection; navigation; water supply for salinity control in the estuaries, regional groundwater control, agricultural irrigation, and municipalities and industry; environmental enhancement; and, recreation. The U.S. Army Corps of Engineers controls the four major water control structures/outlets on the Lake, however the SFWMD is responsible for moving the Lake water south, the ability of which is limited by the capacity of South Florida's flood control system of canals and water control structures. https://sfwmd.maps.arcgis.com/apps/MapTour/index.html?appid=cca90b996fbe45ea9b9c39539738f9a2

For Broward County, Lake Okeechobee is not considered as a back-up water supply, although SFWMD routinely makes water deliveries from Lake Okeechobee to WCA-2 to Broward County canals including the North New River, Hillsboro, and C-9 canals. These water deliveries provide direct supply, recharge the aquifer near wellfields, and maintain groundwater levels to inhibit saltwater intrusion. Currently, water levels in Lake Okeechobee are maintained at one foot lower than historic levels under the Lake Okeechobee Regulation Schedule because of concerns regarding the safety of the Herbert Hoover Dike, and while work to rehabilitate the dike is currently under way, less water is available for downstream needs. Even if the Lake level is higher, it is not expected to be used as a back-up supply for Broward County.

Broward's Water Resources

INTRODUCTION TO BROWARD COUNTY'S WATER MANAGEMENT SYSTEM

Water management in Broward County is different than in many other places given the constraints of an extensively altered landscape; a lack of natural storage; porous geology; seasonal and spatial variability in rainfall; and, the close integration of ground water and surface water. In addition, the policies which guide the broader long-term regional plans for Everglades restoration and regional water supply and availability impact how water is managed in Broward County.

The following sub-sections provide background on our water resources and how they are managed.

FROM SAWGRASS TO SEAGRASS

Urban Broward County stretches from the Everglades to the Atlantic Ocean or from "Sawgrass to Seagrass". While we are most familiar with the urban part of our environment, it is important to recognize that two-thirds of Broward County is protected as part of Everglades water conservation areas which serve multiple water resource and environmental purposes, including flood control, water supply, and the preservation of habitat for South Florida's plant and animal communities. Thus, urban Broward County occupies just the eastern third of the County as a whole.

If you have spent much time in the County, you soon learn that you are never far from a pond, wetland, canal, or similar water feature. Collectively, it is the network of these water bodies that make up our water management system.

BISCAYNE AQUIFER

The major source of fresh water in Broward County is the “Biscayne Surficial Aquifer”, a shallow layer of highly permeable limestone. It is an unconfined coastal aquifer, which means it is largely recharged from the surface and rainfall, and also influenced by what happens along the coastal boundary with the Atlantic Ocean. The Biscayne Aquifer is deemed one of the most productive aquifers in the world,

providing nearly 1 billion gallons a day on average for drinking and irrigation needs in South Florida. Because it sits so near the surface at depths from a few feet near its western limit to about 240 feet near the coast, is highly transmissive, and readily recharged, it directly interacts with natural and man-made bodies of surface water, such as streams, lakes, and canals. When it rains, water that ponds on the soil eventually filters down into the ground and into this limestone layer where it "recharges" the Aquifer or collects in water storage areas and canals. In addition to direct structure releases, Broward County canals and the Biscayne aquifer benefit from seepage from the regional system, especially during the dry season.

Because it is highly permeable and lies at shallow depths, the Biscayne Aquifer is vulnerable and readily susceptible to contamination from the urban environment, as well as from the ocean, where saltwater can infiltrate drinking water wells. It is also susceptible to a decline in water levels in response to drought events.

FLORIDAN AQUIFER

Below the Biscayne Aquifer is the Floridan Aquifer, often called Florida's rain barrel and this lower-lying Aquifer is recognized as one of the most productive aquifers in the world. It underlies about 100,000 square miles in southern Alabama, southeastern Georgia, southern South Carolina and all of Florida. In Northern Florida, the Floridan is fresher and shallower, but in South Florida, it is deeper and saltier and has not traditionally been considered as a main source for fresh water supply because of more expensive development costs associated with a higher level of treatment. However, with limitations placed on the amount of water that can be drawn from the Biscayne Aquifer, the Floridan has recently been developed as an alternative water supply in South Florida, where it is often blended with Biscayne Aquifer-sourced water.

WATER CONSERVATION AREAS

Broward's urban area is separated from the Everglades by a protective levee. West of the protective levee that separates urban Broward County from the Everglades lies Water Conservation Areas 2 and 3. Water Conservation Area 2 (WCA-2), the smallest of the Water Conservation Areas, is a sawgrass wetland that encompasses an area of 210 square miles. Below that is WCA-3, west of Broward and Miami Dade which consists of 915 square miles. The WCAs serve multiple water resource and

environmental purposes including flood control, water supply and habitat for South Florida's plant and animal communities. Water levels are maintained on an average of 4' higher on the west side of the levees which allow for gravity to drain water from west to east.

BROWARD'S CANAL SYSTEM

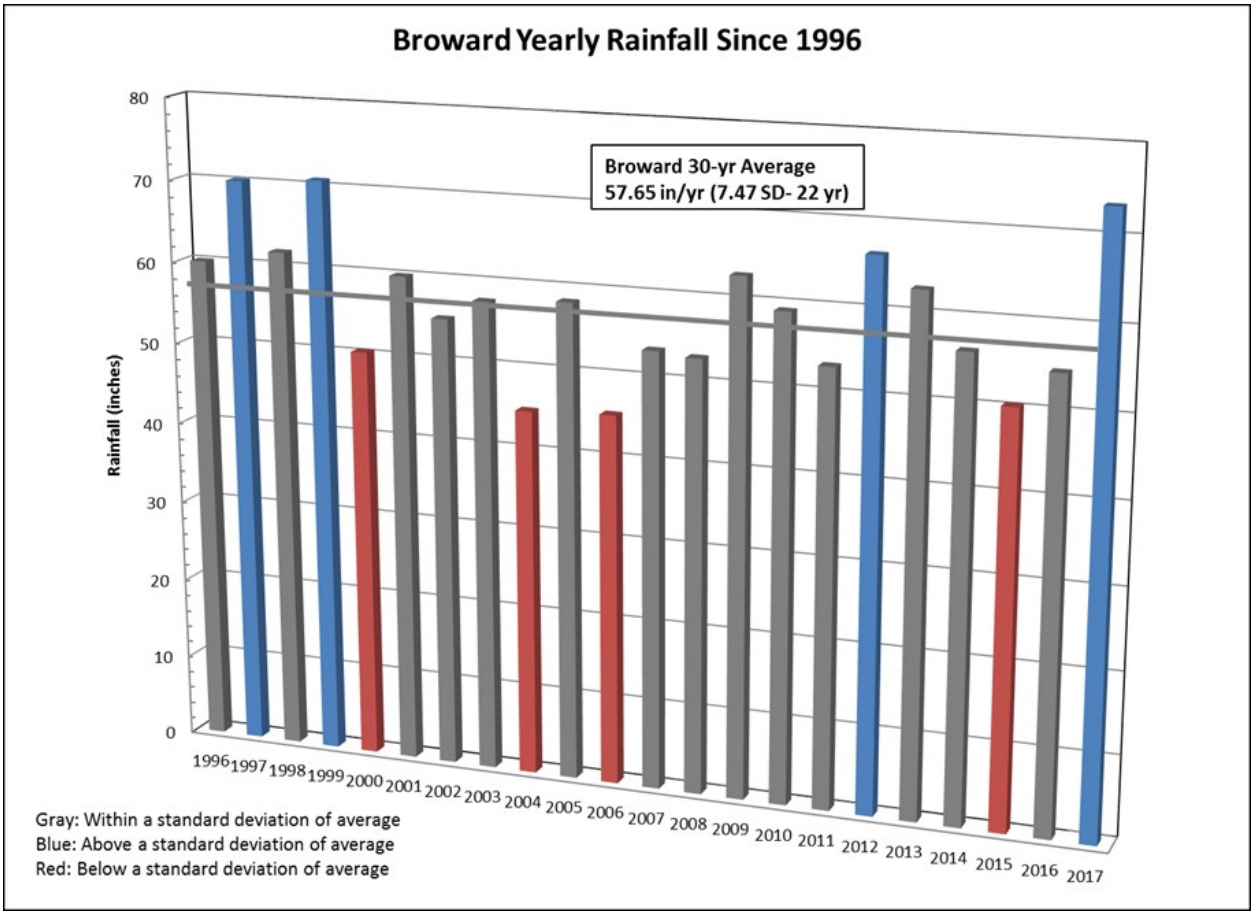
In addition to the approximately 266 miles of canals in Broward County which are part of the primary drainage system managed by the SFWMD, the County's current drainage system consists of approximately 1,800 miles of canals, including many secondary canals managed by local drainage/water control districts and smaller tertiary canals as well. In addition to the primary canals operated by the SFWMD, there are a number of smaller, or secondary, canals which are managed by local drainage/water control districts and which are responsible for flood control within a specific jurisdiction. Tertiary canals, the smallest of the canals move water into the secondary canals from our neighborhood surface water features, such as our community ponds which drain into them to protect our properties from flooding. The tertiary system may be managed by a local government, homeowner's association, or through coordination with a local drainage/water control district. The County has been able to utilize this network to enhance its ability to move water north to south and west to east to provide wellfield recharge, recharge of urban wetlands (restoring natural system function), recharge to the aquifer for abatement of saltwater intrusion from the ocean, as well as flood protection.

With the proliferation of secondary drainage canals and associated development, the population of Broward County exceeded 1,000,000 by 1980.

RAINFALL IN BROWARD COUNTY

The relative contribution of rainfall to Broward County's water supplies can not be underestimated. With an average annual rainfall of over 57 inches, Broward County should receive sufficient rainfall to easily meet its demands most years. However, the majority of rain (41 inches) falls during the wet season (May 1-November 1), while the remainder falls in the dry season, when demands are often highest. 2017 was the 5th wettest year in Broward County since 1942 with over 73 inches of rain. Here are the current water conditions for South Florida.

Managing our water resources to benefit our residents, businesses, tourists, and natural environment is about Broward's water management community working together to ensure efficient and effective management, while adapting to changing needs, regulatory environment, and hydrologic conditions, and planning for the challenges that lie ahead.



Yearly rainfall in Broward County since 1996

Goals and Objectives

USING LOCAL WATER RESOURCES TO MEET OUR LONG-TERM NEEDS

While the overall goal of the Integrated Water Resources Planning process is to **ensure more effective and efficient management of our water resources**, there are four objectives that guide this process.

The first objective is to "**Make the most of local water resources to meet our long-term water supply needs".**

Within this objective, four actions are key to helping make this occur:

- Capturing the water that is now discharged to ocean waters
- Storing this water for later use
- Redistributing water for beneficial uses
- Reusing waste water

Capturing the water that is now discharged to ocean waters - Unlike many places, urban Broward County lacks both the land and the ability to store water in reservoirs as a result of the porous geology in which the water moves readily through. A significant amount of fresh water is sent through the canals that ultimately discharge to the marine environment. Even during one of our more recent significant drought periods which lasted from 2006 to 2008, the average discharge to the Atlantic Ocean from Broward County canals was 432 MGD (million gallons per day), because we simply have no place to store the water when it does fall. The **Comprehensive Everglades Restoration Program (CERP)** is designed to capture, store, or convey water now discharged to marine waters, making it available for all users and yielding benefits for both the regional system and local partners. Once important components of the CERP are completed, including the **Broward County Water Preserve Areas** project which will reduce seepage loss from WCA 3A/3B to the C-11 and C-9 basins, some of the water that currently flows out of our canals will be redirected south to restore the southern Everglades. This will result in enhanced water quality. It is expected that large amounts of fresh water will still be regularly discharged to the ocean.

Storing this water for later use - Lack of storage of our water resources due to topography, land availability, and a porous geology presents significant challenges for our community and region. However, the County is seeking creative strategies for building storage into the existing water management system. One approach that has shown great success in providing for storage has been demonstrated in the County's North Broward Regional Recharge System (NBRRS), a Diversion and Impoundment operation, where a series of inter-connected canals, culverts, and pumps allow water to be stored and distributed before being used further. Aquifer Storage and Recovery (ASR) and regional collaborations such as the proposed C-51 reservoir in Palm Beach County provide opportunities for additional alternative water storage.

Redistributing water for beneficial uses - Having a water management system that consists of approximately 1,800 miles of canals provides us with a somewhat unique ability to redistribute water to where it is needed, effectively and efficiently, through interconnections between canal systems and coordinated management. As demonstrated with the operation of the Northern Broward Regional Recharge System, water can be redistributed for wellfield recharge, to rehydrate wetlands, or for other beneficial uses.

The Sunshine and Old Plantation Water Control Districts are also Diversion and Impoundment operations that store water that would otherwise be sent to marine waters.

Reusing wastewater - Wastewater treatment allows for the conversion of wastewater into water that can be returned to the water cycle with minimal impact on the environment or directly reused. Reclaimed water is currently discharged through Broward's two ocean outfalls located in Pompano Beach and Hollywood. By state law, the County is required to cease using the outfalls by 2025 and reuse 60% of the wastewater flows at that time. This will require development of 46.5 million gallons per day (MGD) in additional reuse applications. Given the fact that urban Broward County has essentially reached "build out", the options for use of treated waste water are somewhat limited. Unlike Palm Beach County, which is able to take advantage of a large wetland complex within their urban county area, discharge into a "treatment wetland" is not feasible in densely-populated urban Broward County.

One of the most viable options for reuse of reclaimed water in Broward County is landscape irrigation, particularly for golf courses and other large landscaped areas. Beyond this, or another acceptable reuse method such as in some industrial processes, disposal by injection deep into the ground may be the primary remaining option. Broward County has worked with wastewater utilities such as Pompano Beach to develop plans to identify possible reuse opportunities. Identifying locations and additional opportunities where reuse water can be effectively used for landscape irrigation or other beneficial uses has been a focus of Broward's water management community which has developed a Water Reuse Master Plan which is discussed later in this document.

Pompano Beach wastewater reuse facility

In 2017, almost 220 MGD of wastewater was treated by wastewater treatment facilities in Broward County. Only 18 MGD was reused, while 202 MGD of potentially reusable effluent was disposed of via deep well injection or discharged to the ocean.

COORDINATING WITH A DIVERSE WATER MANAGEMENT COMMUNITY

The second objective that guides the IWRP planning process is to **"Coordinate with a diverse water management community."**

Water management in Broward County is a shared responsibility and involves dozens of entities that need to work together to ensure that the resource is effectively and efficiently managed. While we have professional water managers to coordinate the operation and maintenance of Broward County's water and wastewater utilities as well as those managing our major stormwater drainage systems, we also need our 1.9 million residents to do their part to conserve our water resources and protect water quality. Coordination is especially important during extreme events such as floods and droughts, but it also needs to take place throughout the year to guarantee efficient responsive water management including maintaining water levels, providing for recharge, and achieving the goals of water management.

Education and outreach provide an opportunity to involve residents, property managers, and others in better understanding the uniqueness of our water management systems and challenges in Broward County.

The water management community actively participates in a number of forums which allow it to share information and be part of the dialog on planning for the future.

MATCHING UP LOCAL WATER SOURCES AND USERS

The third objective is to **"Match up local water sources and users to ensure supplies are available"** when and where they are needed.

Efficient and effective integrated water management links water supply, waste water, and storm water, with business, agriculture, and societal needs, through highly coordinated management as opposed to the conventional approach where integration may occur by accident. In the conventional approach, water supply, waste water, and storm water may be managed by the same agency as a matter of historical happenstance, but physically these systems are often separated. This is the path that characterizes the initial development of systems in Broward County.

However, over time as the IWRP process has evolved, the need to identify alternative water supplies and regional strategies has become more apparent and has provided opportunities for further integration of our water management systems. This focus has been reinforced by policy changes on the state and regional level that limit the withdrawal of Biscayne Aquifer waters and require the closure of Broward's ocean outfalls. In addition, the pressures of climate change are limiting available well withdrawals and creating other pressures in our system that affect drainage capabilities.

Future potable water demand estimates are often revised to reflect new data whether it be changing population projections or results from hydrologic modeling studies. According to the Lower East Coast Water Supply Plan Update of 2018, the estimated Public Water Supply demand in Broward County will be 271.37 MGD by 2030, an increase of 37.20 MGD from 2016 water demands.

How this demand will be met requires careful consideration of multiple strategies and analysis of current and anticipated future conditions. The "**One Water**" concept considers the urban water cycle in the same context as we see in the natural water cycle - where water is water - and looks to identify projects, programs and policies that will yield sustainable, long-term water supplies and provide greater resiliency to drought conditions and climate change.

DIVERSIFYING WATER SUPPLIES

The fourth objective is to **"Diversify water supplies to create flexibility and meet the needs of urban and natural systems under dry and wet conditions."**

Fortunately, there are numerous options available to help our transition to more diverse water sources and our current reliance on the Biscayne Aquifer. Each one of these options/strategies comes with its own benefits and costs. ***Conservation*** of water resources is the most cost-beneficial option. As the old adage goes, "the cheapest gallon of water is the one not used". Among the other alternative water supply options available are development of **Floridan Aquifer** resources, generally considered to be brackish in southeast Florida, and requiring advanced treatment. ***Aquifer storage and recovery*** may be another option. This option involves collecting water during heavy rainfall periods, storing that water in a deeper aquifer such as the Floridan, and pumping that water back up during dry periods to

augment existing supplies. Increased ***Reuse of Reclaimed Water*** presents another good option for consideration, and would help utilities meet State law regarding closure of the ocean outfalls. ***Seawater desalination*** is a strategy, albeit an expensive one, when considering overall costs and energy demands. Finally, development of the ***C-51 Reservoir*** project in Palm Beach County is a newer, but highly promising strategy, when weighed against many other more-costly options. Phase I of the project, which will capture and store excess surface water from the C-51 basin, will provide 14,000 acre-feet of storage and 35 MGD for water supply. The project, originally considered as part of the Everglades Re-study, the predecessor of the CERP, is the most attractive and cost-effective option to enhance water security and increase drought resilience in Broward County.

The Unique Challenges Ahead

In addition to the original IWRP goals and objectives, there is a need to recognize the latest efforts towards ensuring that our water resources will be sustainable under future conditions. In order to promote more effective and efficient management of our water resources, it is necessary that we have an understanding of future conditions, particularly as it relates to potential climate impacts including extreme droughts and rainfall events, along with sea level rise and related saltwater intrusion. These include drainage, flooding, and loss of wellfields. The Broward County water management community works with many groups including the state and federal government, academia, and the private sector to study the impacts that a changing climate brings and to develop plans for mitigation and adaptation.

Therefore, it is recommended that a new objective be incorporated in this 2019 IWRP Update:

Promote water resources resiliency by evaluating future conditions, including potential climate impacts and adopt strategies to mitigate, adapt, and prevent disruptions to our overall goal of more efficient and effective water management.

This is further explored in the section on Water Resources Assessment of Current and Future Conditions in this document.

Status of Recommendations from 2009 IWRP Report

URBAN WATER MANAGEMENT STRATEGIES

The 2009 IWRP identified seven priority urban water management strategies as part of its regional water management plan. Goals were proposed for four of these strategies for which the County felt it could provide a lead role in coordinating and implementing (Conservation, Secondary Canal Integration, Aquifer Storage & Recovery, and Wetland Rehydration) with the utilities, municipalities, and water management/drainage districts providing a supporting role. The remaining three strategies (Utility Sharing, Advanced Wastewater Treatment, and Reverse Osmosis) were viewed primarily as either strategies that would need to be spearheaded by individual entities for construction with the County playing a supporting role or by the County spearheading regional planning studies and evaluations to guide utility investments. Below is an update on the status of meeting those 2009 goals.

2009 Conservation Goal: *Achieve 10.3 MGD of water savings by 2019 through implementation of water conservation programs.*
Conservation of our water resources is crucial. Water conservation:

- Provides the lowest cost source of future water
- Reduces the need for development of more costly alternative water supplies
- Lessens the severity of water shortages
- Helps to maintain groundwater levels and protect existing water supplies
- Will become increasingly important with climate change

The outcome of the multiple measures and programs that the County has initiated and implemented since 2009, have been substantial and have contributed to the success in already achieving this 2009 goal. In 2009, the pumpage by Broward utilities from Broward wellfields was 258.57 MGD and the per capita usage was

approximately 147 gallons per day (GPD). Since 2012, the average pumpage has been about 228 MGD with a per capita usage of 126.5 GPD. In 2017, the most recent year for which data is available, pumpage from Broward wellfields was 229 MGD and the per capita usage was approximately 118 gallons per day per person.

A discussion of some of the programs and policies that have helped reduce water usage in the County follows.

Water Conservation Programs - Implementation

The County, working with municipal partners, has actively continued to promote and implement a number of water conservation programs including the **NatureScape Broward** and NatureScape Irrigation Service programs which focus on reducing outdoor water usage. NatureScape Broward is about creating Florida-friendly landscapes that conserve water, protect water quality, and create wildlife habitat. The program promotes the replacement of turf and invasive and exotic species with native and drought-tolerant landscapes. NatureScape Broward works closely with the state's Florida-Friendly Landscaping program and the National Wildlife Federation's Community Wildlife Habitat program. There are over 4,500 certified NatureScapes in Broward County.

Outdoor water conservation

Landscape irrigation accounts for the majority of urban water use and is therefore a key focus area of the County's water conservation efforts. The NatureScape Irrigation Service (NIS) is a partnership between the County and 20 municipal and water utility partners. The program conducts irrigation system evaluations and provides recommendations to improve the efficiency of these systems. Water savings realized through the NatureScape Irrigation Service have resulted in over 1.5 billion gallons of water saved since 2004 with a 24% reduction in water demand on average per site evaluated. Additionally:

- In 2010, the Broward County Board of County Commissioners passed an Irrigation ordinance adopting year-round irrigation restrictions limiting landscape watering to two days per week.

- In 2012, the Broward County Board of County Commissioners passed a new water-efficient model landscape ordinance, in support of implementing Florida-friendly principles within unincorporated Broward. A number of municipalities have incorporated much of the language from this ordinance as they have developed their own new Florida-friendly ordinances.

Indoor water conservation

While much emphasis has been placed on outdoor water conservation, the County has also partnered with seventeen municipal and utility partners to form the Broward Water Partnership which provides support for indoor water conservation measures. Operating as Conservation Pays since launching in September 2011, the program's goals are to:

- Achieve and sustain a minimum 10% County-wide per capita reduction over 20 years to achieve 30 MGD water savings (includes all conservation programs)
- Encourage a stronger water conservation ethic among water users through increased public education and outreach
- Provide incentives and resources to residents for significant water savings through plumbing retrofits

To date, the program has achieved over 2.0 billion gallons water saved, primarily through a rebate program for the replacement of old inefficient toilets and the distribution of water-saving devices such as shower heads and faucet aerators.

Broward Water Matters Day

Broward's premier environmental conservation education and outreach event, **Broward Water Matters Day** is held the second Saturday in March annually and provides an opportunity for residents to learn about water conservation and environmental stewardship. The event is supported by local governments, water management/drainage districts, the engineering/consulting community, the business and non-profit sectors, and the School Board of Broward County. Water Matters Day typically includes over 50 exhibitors which showcase how to save and protect water through landscape best management practices and through indoor and outdoor water conservation. They also help explain local water management,

water supply, Everglades restoration, and how our canals connect the County's urban and natural systems. The event also provides an opportunity for environmental groups and schools to showcase their environmental programs.

By visiting at least 12 exhibitor booths and having their event program stamped, attendees are eligible to receive free trees and native plants. Raffles, workshops, and children activities are all part of the event festivities. Water Matters Day continues to enjoy wide participation from residents eager to learn about water management and ways to save water, with 3,686 attendees in 2019, the 17th year of the event.

Environmental Partnership with Broward County Public Schools

The Broward County Public School District (BCPS) is the 6th largest school district in the nation, as well as being a major landowner in Broward County. Since 2006, Broward County, through an **Environmental Partnership agreement** with BCPS is providing students, teachers, and school staff with NatureScape-based and environmental sustainability training, as well as making physical improvements to school properties to reduce water consumption. Through June 2018, over 1700 teachers and staff have been trained in NatureScape best management practices; over 70,000 students have received programming; almost 600 irrigation system evaluations have been conducted resulting in $923,000 in annual water and energy savings; 216 Schoolyard Habitats have been certified by the National Wildlife Federation; and over $150,000 in cash and in-kind prizes have been awarded to schools, teachers, students, and staff through the P3 Eco-Challenge.

Other water conservation measures

Other accomplishments that address water conservation include the following:

- In March 2012, the Broward County Board of Rules and Appeals, per the recommendation of the Water Resources Task Force, advanced amendments to Chapter 6, Section 604.4, of the Florida Building Code which contains standards for ultra-low volume plumbing fixtures to be used in all new construction. The Board, working with County staff, also endorsed changes promoted by the Water Resources Task Force to Chapter 9, Section 908.8. These changes include requiring a minimum of 8 cycles of

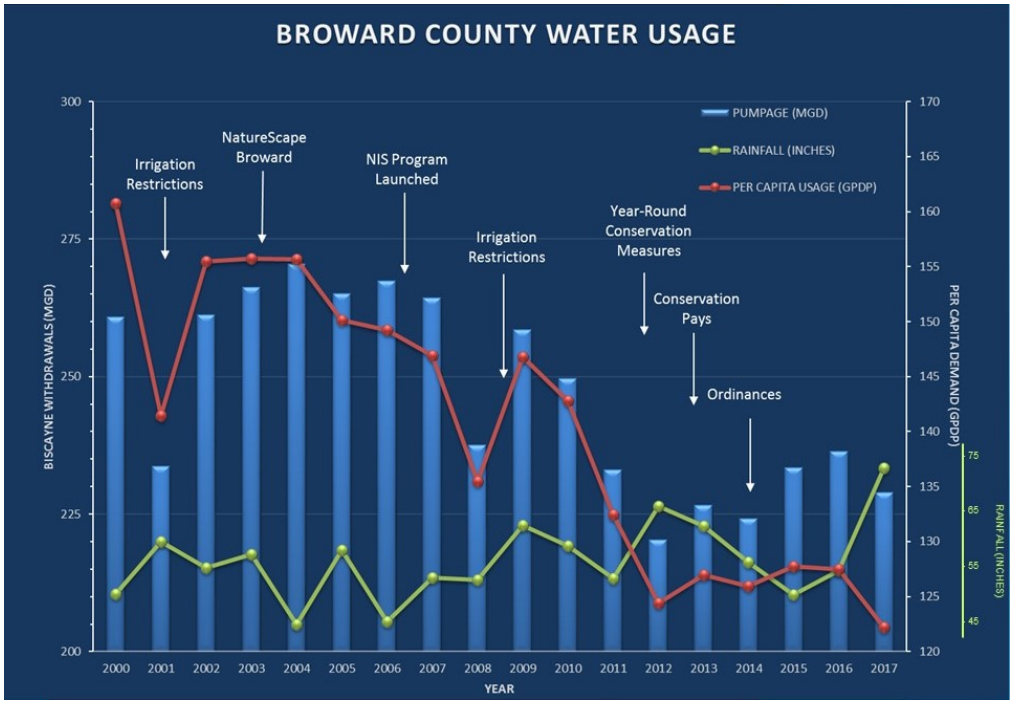
concentration for cooling towers, and requirements for reuse concentrate for cooling tower make-up water for air handling systems with a 4-ton BTU capacity air handling system or greater as a condition for the receipt of Certificate of Occupancy.

- Tiered rate structures that encourage water conservation reward consumers that have low rates of water consumption with the lowest per gallon charge and penalize those showing higher rates of water consumption with a higher per gallon charge. **Broward County Water and Wastewater Services**, as well as other Broward municipal utilities have adopted a tiered rate structure that promotes water conservation.

Our water conservation efforts are working!

The many conservation programs that the County has implemented, in conjunction with the Broward water management community's efforts and support, have helped to greatly reduce the amount of water used per person in Broward County. As can be seen on this graphic, the importance of complying with irrigation restrictions greatly improve the ability to reduce our demand for water.

As we move forward, water conservation will remain a primary water management strategy.



Raw water pumpage, per capita usage, and rainfall in Broward County, 2000-2017

2009 Secondary Canal Integration Goal: ***Complete integration of the Northern Broward County Recharge System and expand this effort to the central and southern parts of the County.***

Secondary canal integration remains a relatively attractive urban water management strategy given the vast network of canals that exist in Broward County and the relatively inexpensive infrastructure (culverts, pumps, etc.) required to implement greater integration of the system. Although progress has been made on the Northern Broward County Recharge System, it has not yet been completed. There are three identified projects that need to be completed to integrate the system:

- The C-1/C-2 Interconnect near Sample Road and the CSX Railroad. The project has been designed and construction funding is being sought.

- The study of a potential C-4 Interconnect between North and South Tradewinds Park was completed and it was determined that the environmentally friendly directional drilling project is not financially feasible at the present time.

- The C-7 Interconnect just north of Sample Road in the Coconut Creek Main Street Project will coincide with development of the area. The basin divide control structure is being constructed with the development of the parcel just to the north of Sample Road. The interconnect will be complete when the final canal segment is built with the development of the remaining farm land.

Depending upon the final routing of water deliveries associated with development of the C-51 reservoir project, additional construction may be required in the central and southern parts of the County to further integrate the system. No other projects are currently planned in the central and southern parts of the County at this time.

2009 Aquifer Storage & Recovery Goal: ***Identify feasibility and location for Aquifer Storage and Recovery within Broward County by 2009***

Although the completion date for having this work was not addressed as originally planned, recent studies including the Floridan Aquifer Study and seismic work by the United States Geological Survey (USGS) in partnership with utilities has advanced our knowledge and information about the potential for Aquifer Storage and Recovery (ASR) development in Broward County. The Hillsboro ASR test site was developed by SFWMD and Broward's Water and Wastewater Services (WWS) in order to determine the feasibility of ASR in northern Broward County. Currently, ASR development has not been prioritized given other options, but the information gathered to date will remain relevant.

2009 Wetlands Rehydration Goal: ***Provide water deliveries to a minimum of 14 urban natural areas to provide storage for aquifer recharge and improve habitat function by 2019***

The 2009 IWRP discussed several urban rehydration projects that had been completed including Fern Forest, Hillsboro Pineland Natural Area, and the Tall Cypress Natural Area along with additional projects which were being considered at that time as well. The status of recently completed and studied projects is discussed here:

- The Tradewinds Environmentally Sensitive Land (ESL) project, constructed at a cost of $120,192 is able to provide a maximum daily volume of 0.75 MGD.
- The Warbler rehydration project, constructed at a cost of $104,084 is able to provide a maximum daily volume of 0.20 MGD.
- The Shooster rehydration project, expected to be completed in August 2019, will be able to provide a maximum daily volume of 0.50 MGD.
- The Wiles Road Dome rehydration project, constructed at a cost of $168,950 is capable of providing a maximum daily volume of 0.20 MGD.
- The Forman rehydration project is estimated to cost $138,537 and will be able to provide a maximum daily volume of 0.35 MGD-its completion date is unknown at this time.
- The Hillsboro Pineland project, expected to be completed in August 2019 is being redesigned to utilize the existing source to rehydrate two additional sites-the Hillsboro Pineland Addition (Pujara) and Willow Pond (School Board site).

Two other rehydration projects that were proposed-the Helene Kline Pineland ESL and Woodmont ESL were considered not feasible.

OTHER WATER MANAGEMENT STRATEGIES

As mentioned, the IWRP also included three strategies (Utility Sharing, Advanced Wastewater Treatment, and Reverse Osmosis) that were considered to primarily be strategies that would need to be spearheaded by parties other than the County, either working collectively or individually. While no specific goals were established for these strategies, the County has invested resources in supporting several of these strategies to move them forward.

Utility Sharing

Water utilities routinely enter into emergency interconnection agreements in order to provide neighbor utilities with supplies as necessary to be able to meet potable water needs. While this has not historically been a type of project supported by IWRP grant funds (see below), there have been instances where IWRP funding has supported interconnections to better facilitate the movement of water for purposes supportive of the IWRP fundamentals

including wellfield/canal recharge and to support sub-regional and multi-jurisdictional projects.

Since 2008, the County has also taken a lead in developing 10-Year Water Supply Facilities Workplans as required by state law and which have improved the coordination of future land use and water supply planning between local government and water providers. Development of the 2014 Broward County Water Supply Facilities Work Plan included two workshops with other utilities and municipalities that were looking to incorporate changes to their comprehensive plans which primarily focused on climate change. A new Water Supply Facilities Work Plan will be completed in 2019 and data for that Plan is currently being gathered.

The C-51 Reservoir: A Regional Collaboration in Water Supply

The proposed C-51 Reservoir project in western Palm Beach County represents a type of project that has garnered significant support from Broward municipalities along with water providers in Palm Beach County. Broward County has provided significant leadership in advancing the project over the past 10 years with investments in feasibility and economic studies along with organization of project participants. The C-51 Reservoir Phase 1 project has been designated as a priority pilot alternative water supply development project pursuant to Section 373.037 F.S. by SFWMD as it recognizes that development of the project would provide environmental benefits by reducing stormwater flows into the Lake Worth Lagoon. It would also provide water supply benefits by providing a reliable source of supply that could be used to recharge Broward wellfields, while also providing for drainage, flood control, and saltwater management. Unlike the majority of Southeast Florida, the geology in the project area supports in-ground storage. Water from the reservoir would be transported through the existing South Florida canal network, subject to obtaining all necessary permits and funding.

Phase 1 of the project will provide 14,000 acre-feet of storage with 35 MGD available for water supply. To date, agreements have been executed for 13 MGD of storage capacity out of the available 35 MGD of storage capacity in Phase 1: Broward County (6 MGD); Sunrise (5 MGD); and Hallandale Beach and Dania Beach (1 MGD each). Permitting for each of these participants is in various stages but not yet complete. In 2017, the Florida Legislature approved the project as a priority

water supply project under enabling legislation Senate Bill 10. A commitment for construction financing has been extended to June 30, 2019. It is hoped that construction can commence in October 2019 and be completed by October 2021. Phase 2 would expand the project area to include 46,000 acre-feet of storage and potentially another 115 MGD which is envisioned for environmental purposes.

Advanced Wastewater Treatment and Reuse

The advanced wastewater treatment strategy involves the promotion of reuse of treated wastewater for beneficial uses such as landscaping irrigation. Reuse of reclaimed water has increased 8 MGD from 2009 levels to 18 MGD in 2017; however, the percentage of domestic wastewater reused is only about 8%.

Recognizing that the impending closures of the two ocean outfalls in Broward County by 2025 will require the implementation of additional reuse in the County, the County initiated a regional study to look at then-existing water demands and opportunities for reuse. The Broward County Reuse Master Plan was completed in early 2014 and identifies opportunities for reuse throughout the County and includes a number of interactive tools that can be used and modified for further analyses. This includes a GIS planning tool and Excel-based project evaluation model. It provides a database of existing reclaimed water infrastructure County-wide which was not previously available, and which can help catalyze multi-jurisdictional partnering. This plan provides documentation of reuse projects for future state funding should funds become available and can be used for reducing engineering costs for future planning efforts, allowing visual options, providing a platform to coordinate with future public works projects, and, potentially reducing construction costs.

In addition, the County is providing “seed money” through IWRP Grant funds to initiate construction of some reuse projects to help expand distribution systems. To date, a total of six projects have been considered, with three receiving construction funds. While direct potable reuse discussions are advancing at the state level, Broward County has not yet prioritized this water supply option.

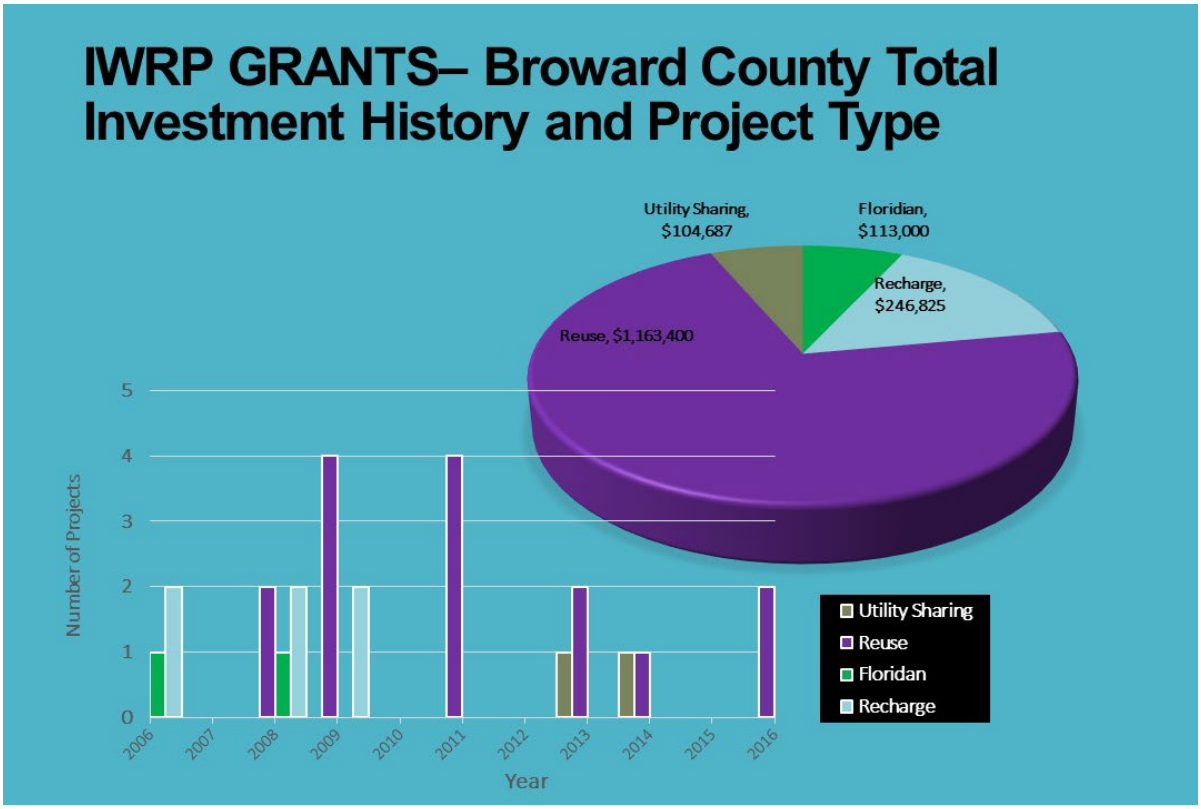
Reverse Osmosis

While many people are familiar with the use of reverse osmosis in the removal of salts in the production of drinking water, reverse osmosis is an integral, and often-used part of the water treatment process, regardless of the source. On occasions when local utilities seek use of the Floridan Aquifer to supplement their Biscayne Aquifer-sourced water, they are faced with higher energy costs associated with treatment of the Floridan Aquifer water in south Florida which has elevated chloride concentrations above those that are found elsewhere in northern and central Florida. Typically, the utilities in Broward County that utilize the Floridan Aquifer mix that water with Biscayne water supplies, thereby diluting the chlorides and subsequently providing a finished water requiring less treatment than water that is derived solely from the Floridan Aquifer.

Since 2009, the use of the Floridan Aquifer (using reverse osmosis) by public water supply facilities has increased over 2,000% to 12.61 MGD in 2016. There are currently five utilities in Broward County that have tapped the Floridan Aquifer System treated by reverse osmosis with a total treatment capacity of 17 MGD.

IWRP Grants and Support for Implementation of IWRP Projects

A number of projects have benefited from receiving cost-share funds through the County's IWRP grants program. The competitive grants are utilized to advance the feasibility analysis and design of regional water resource management strategies and alternative supply development projects consistent with the Broward County-wide Integrated Water Resource Plan. From 2006 through 2016, over $1.6 million has been awarded to Broward utilities to support water management and water resources development, including $1.16 million for reuse projects, $0.25 million for recharge, $.11 million for Floridan projects, and $.10 million for utility sharing. Recently, cost-share funding was also made available for reclaimed water construction projects that support the Broward County Reuse Master Plan.



IWRP grants have supported projects and studies to more effectively and efficiently manage Broward's water resources

2009 IWRP REPORT Recommendations

The 2009 IWRP Report also included 17 recommendations addressing four key questions which the County, working with the larger Broward water management community, has worked diligently to address since 2009. The four key questions were:

- How can we better understand our water resource management challenges?
- How can we better manage our water resources?
- Where will funding come from?
- How do we best implement the IWRP?

Here is the current status of those recommendations:

2009 RECOMMENDATION	STATUS	PROJECT DESCRIPTION
How can we better understand our water resource management challenges?		
The County should continue support of its water resource assessment programs, including needs assessments, monitoring, and modeling.	Ongoing	A Saltwater Network workshop was hosted where gaps in the monitoring network were identified and prioritized by the County and municipalities. Additional Hollywood area wells were constructed by both the City and County through a cost share agreement. The Future Conditions Map Series evaluates future groundwater and flood elevations, given 2ft of Sea Level Rise by 2060 as defined at Southeast Florida Regional Climate Compact's Unified Projections, and using MODFLOW and MIKE SHE/MIKE 11 hydrologic models.
The County should work closely with municipalities to identify needs as part of the 10-year facility work plans to be prepared and as required by State law, and in order to better track anticipated water demands.	Ongoing	The County continues to work with municipalities to identify water supply needs. The projected Unmet Water Demands Map is being updated as part of the 2018 Lower East Coast Water Supply planning process to support the elaboration of the 10-year facility work plans in 2019.
The County should work with the SFWMD to develop a local drought management strategy consistent with the regional strategy.	Ongoing	The SFWMD are working with Everglades restoration and have asked RSMAS climatologists to determine future climate trends and weather patterns that may influence the degree and duration of droughts. That would aid in future drought management plans. Additionally, C-51 reservoir planning is continuing which would be an additional water source in times of drought. WWS signed a capacity allocation agreement with Palm Beach Aggregates to purchase 6 million gallons per day of storage allocation in Phase 1 of the C-51 reservoir.

The Broward water management community should refine the SFWMD's Phase II Upper Floridan model to guide the placement and operation of any additional Floridan wells within the County.	Completed	The model has been completed.
How can we better manage our water resources?		
The County should continue to conduct surface water and groundwater modeling to identify viable water supply and management projects and quantify their benefits.	Ongoing	Phase 1 of the USGS Inundation modeling is complete. It identified future threats of flooding and quantified the amounts of water that would have to be removed to maintain the current level of service. Work on Phase 2, which expanded the project throughout the entire urban extent of the County was begun in June 2018 and is expected to be completed in the summer of 2021. The Future Conditions Maps Series was approved and the first map, *Future Conditions Wet Season Average Groundwater Elevation,* was approved and is being used for stormwater permitting as of July 1, 2017. The second map, *Future Conditions 100-yr Flood Elevation*, was initiated in 2018, with the support of Geosyntec Engineering and Taylor Engineering to update the Broward County MIKE SHE model. Initial results are expected in the summer of 2019.
The County should work with the SFWMD to include projects identified through the IWRP in updates to the Lower East Coast Water Supply Plan.	Ongoing	The County works closely with SFWMD on updates to the Lower East Coast Water Supply Plan and implementation of alternative water supply (AWS) projects, as identified. IWRP Grants are offered biannually to partner municipalities to implement such projects in a cost-share basis.
The County should work with the SFWMD and U.S. Army Corps of Engineers staff to identify what portion of water associated with CERP projects might be made available for	Ongoing	The County works closely with the SFWMD and the U.S. Army Corps of Engineers on review of CERP projects. The County provided Agency Review for the Central Everglades Planning Project, Post-

urban water use and to determine whether these projects might be improved to enhance their environmental and water supply benefits.		Authorization Change Report, including the Everglades Agricultural Area Storage Reservoir Project.
The County should continue to pursue geotechnical analysis of the Upper Floridan Aquifer to support the expanded development of this resource as an alternative water supply in Broward County.	Completed	Phase 1 and Phase 2 of Upper Floridan Feasibility Studies have been completed. These included geophysical analysis of a core from a newly drilled well and interpretation of seismic profiling throughout most major canals in Broward County to map elevations of key aquifer layers and identify possible abnormalities (faults).
The County should continue to develop the secondary canal network as a water delivery network and management strategy.	Ongoing	The secondary canal network is still being pursued. It is proposed to be utilized in the delivery of C-51 reservoir water.
The County should expand the development of a saltwater intrusion model along its entire coast to aid in the management of saltwater intrusion and provide a better understanding of the impacts of sea level rise and climate change on our groundwater supplies.	Ongoing	The Central and Southern Variable Density model was completed and published by the USGS. County staff is working towards updating and recalibration of the Northern model to consolidate with Central and Southern model.
The County should develop a stormwater management model to investigate the influence of rising sea level and other climate change influences on local water resources and our water management system with emphasis on drainage and flood control.	Ongoing	Phase 1 of the USGS Inundation model development is completed and results were published in 2019. Phase 2 of the model was initiated in June 2018 to expand the model throughout the entire County and enhance model resolution. In addition, the Broward County MIKE SHE/MIKE 11 model is being updated a part of the Future Conditions 100-year Flood Elevation Map.
The County should investigate the potential for sub-regional and regional projects that serve multiple jurisdictions to address water supply and	Completed	This was a major focus of the Water Resources Task Force. IWRP Grants are offered biannually to partner municipalities to implement AWS projects in a cost-share basis.

other water management challenges.		
The County should undertake a reuse feasibility study to identify opportunities for reuse applications and projects County-wide.	Completed	The Regional Reuse Master Plan was completed in 2014
The County should partner with local water providers and municipalities to develop and coordinate a county-wide water conservation rebate program to support water conservation as a critical part of long-term planning efforts.	Ongoing	The Broward Water Partnership (BWP) was formed in 2011 as a partnership of local governments including 18 municipalities and water utilities. The BWP offers toilet rebates of up to $100 each for qualifying residents, businesses and nonprofits. BWP also offers eligible residents water-efficient showerheads and low-flow faucet aerators. Commercial kitchens can get pre-rinse spray valves.
Where will funding come from?		
The County should work with its partners to identify new sources for funding of conservation programs and to assist with AWS implementation projects such as residential hook-ups to reuse systems for irrigation.	Ongoing	The County continues to work with partners to identify funds for projects that support water conservation. IWRP Grants are offered biannually to partner municipalities to implement AWS projects in a cost-share basis.
The County should work with municipalities and utilities to coordinate funding for water supply efforts; with FEMA where funds for drainage and recharge improvements related to hazard mitigation may be available; with SFWMD to identify sub-regional and other AWS projects eligible for funding under Alternative Water Supply Funding and water conservation projects eligible for funding under the Water Savings Incentive Program; with SFWMD and the U.S.	Ongoing	The County continues to work closely with municipalities and utilities to seek funding for projects that further the goals of the IWRP. Legislative funding has been made available to support construction of the C-51 Reservoir project. Broward County supported the Southeast Florida Regional Climate Compact efforts to request the 2018 Disaster Recovery Supplemental providing for funding of the South Atlantic Coastal Study to ensure inclusion of the previously authorized Central and South Florida Flood Control Project.

Congress for funding of CERP; and, with the Florida Legislature for funding of the 2005 water resources program and to pursue water projects through CERP and other programs.		
How do we best implement the IWRP?		
The County should encourage continued participation and coordination of municipalities and local water managers in forums such as the Water Advisory Board and its Technical Advisory Committee, the Surface Water Coordinating Subcommittee, Southeast Florida Utilities Council, and other working groups. A new governance structure may be premature as it still remains to be determined what projects might be developed. An alternative form of governance might be required or beneficial.	Ongoing	The County continues to coordinate with municipalities and local water managers through the Water Advisory Board and its Technical Advisory Committee, as well as active participants in other working groups. A new governance structure has been developed to specifically address the C-51 reservoir project.

Facing Our Shared Challenges

Water management in Broward County, as it is throughout much of South Florida, is facing numerous challenges as the impacts of climate change are becoming better understood. Primary among these threats is the loss of the effectiveness of existing drainage infrastructure associated with increased flooding from extreme rainfall events, higher tides and rising sea levels, and the potential loss of potable water supplies from saltwater intrusion.

Broward County has taken the lead in addressing these issues through enhanced solutions that are being implemented with the support of various assessment tools that serve as the basis to guide technical decision-making in both water

management and land use. These include saltwater intrusion and groundwater monitoring, inundation modeling of stormwater, advancement of the C-51 reservoir, and the future conditions map series. Through modeling efforts such as these, the representation of Broward County's water management system and its complex elements allows exploring alternative strategies and their associated impacts. Given climate change implications, the successful evaluation of current and future conditions and necessary adaptation strategies is dependent upon continuous efforts. The next section details the water resources assessments that are helping to provide answers.

High tides can cause saltwater to flow up through porous asphalt

Water Resources Assessments of Current and Future Conditions

WATER RESOURCE ASSESSMENTS

The IWRP is supported by robust water resources assessment efforts being carried on by Broward County in partnership with the federal and state governments, academia, the private sector, municipalities, and special water control/drainage districts. Such technical tools are critical to county-wide planning and informing decision-making, promoting effective and efficient local water management.

The goals of this program are to monitor current water resources conditions related to water supply; the feasibility of alternative sources; flood protection and canal operations; saltwater intrusion; and, water quality; and, to evaluate future conditions water resources management strategies that are responsive to addressing the implications of climate change. The program also monitors regional initiatives such as the Comprehensive Everglades Restoration Plan (CERP) and components that will affect Broward County, such as the Central Everglades Planning Project and Broward County Water Preserve Areas.

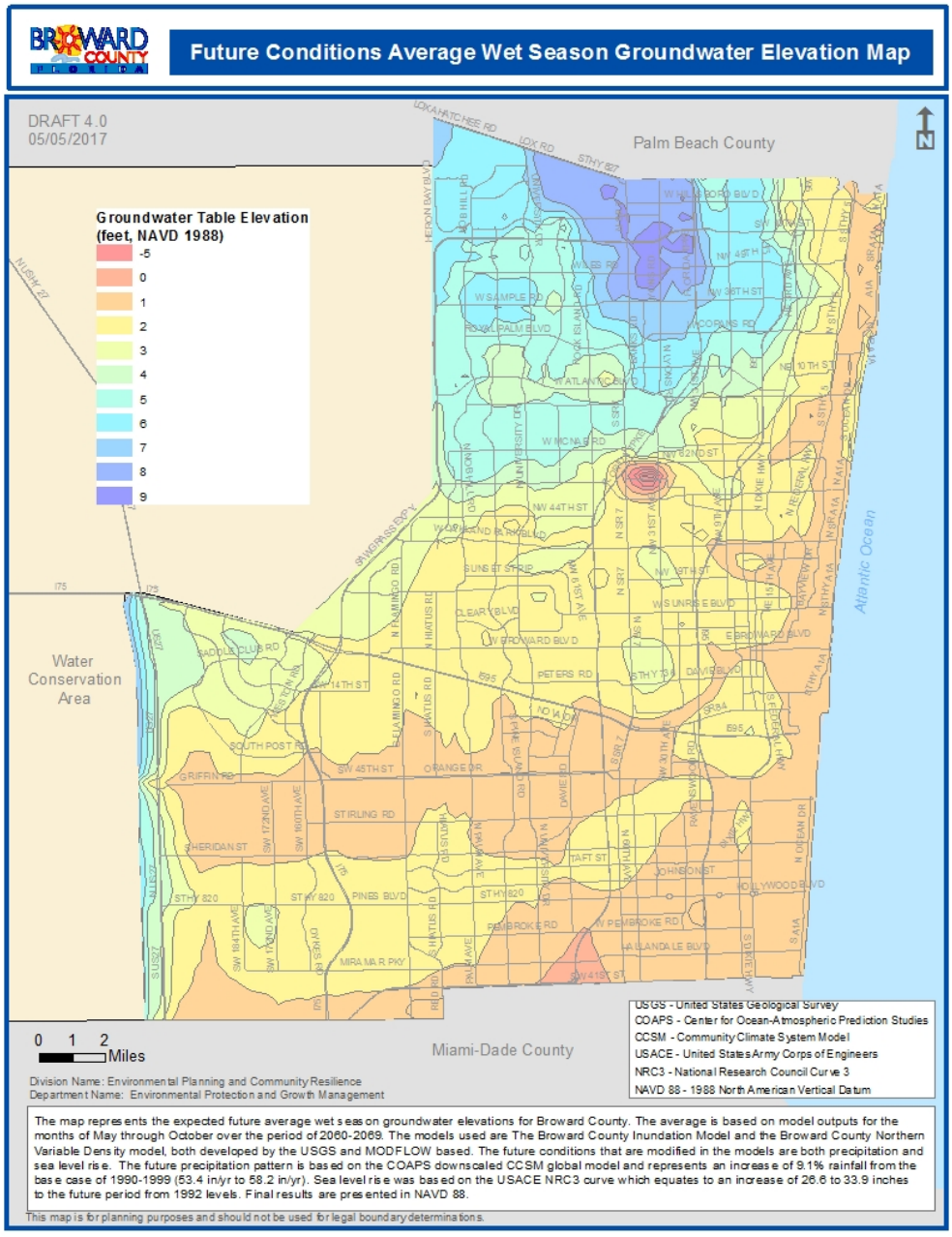
The following topics summarize the water resources assessments and most recent climate resilience efforts and respective implications on future conditions and planned adaptation strategies.

Future Conditions Map Series

The Future Conditions Map Series is a series of maps used to aid in the development of new infrastructure standards designed to be resilient with anticipated climate change effects. Specifically, these maps are based off modeling scenarios with future sea level rise and climate patterns applied.

The first map in the series is the Future Conditions Average Wet Season Groundwater Elevation Map. This map provides the antecedent conditions for new or major modifications to surface water permitted projects and has been in effect

for the design of stormwater systems in new development or major redevelopments since July 2017.



The Future Conditions Average Wet Season Groundwater Elevation map is the first of two maps that will help guide future design standards

The second map, under development, is the updated Broward County 100-yr Flood Elevations map, which constitutes a design aid to help properly set finished floor

elevations. Building to a higher standard helps to reduce current flood insurance premiums and increase resilience.

Saltwater Intrusion Monitoring

Many of Broward County's oldest and largest cities are found along the coast where their drinking water supplies are threatened by acceleration of saltwater intrusion. Broward County, in collaboration with the United States Geological Survey, has been developing variable density models to help better monitor this threat. The models are calibrated to historic data sets and are subject to sensitivity analyses to determine the relative contributions of natural and anthropogenic stressors. The model also performs predictive analyses to evaluate future conditions scenarios and potential performance of adaptation strategies.

Inundation Modeling - Stormwater

With increased flooding events due to high tides and/or more intense rainfall events, the County is expanding its inundation groundwater modeling to include a new Urban Runoff Package that incorporates more surface water features to the otherwise groundwater-centric MODFLOW model previously used. The model focuses on two representative areas of Broward County: 1) a tidally influenced community and 2) an inland community dependent on downstream drainage. The model looks at the effects that downscaled climate data and projected sea level rise scenarios will have with and without adaptive strategies to help mitigate future conditions. Phase 2 of the model was initiated in June 2018 to expand the model throughout the entire County and enhance model resolution.

C-51 Reservoir

The C-51 Reservoir is an alternative water supply which would capture stormwater runoff in the C-51 basin, north of Broward County. Consideration of the use of the reservoir dates back to at least 2008, when the Water Resources Task Force (WRTF) was established as a collaboration between the Broward County Board of County Commissioners, the South Florida Water Management District Governing Board, and the Broward League of Cities to identify potential environmentally, economically, and technically feasible strategies and solutions to the County's future water resource needs, and, to provide recommendations.

When implemented, the reservoir will help reduce harmful runoff of stormwater to the Lake Worth Lagoon, while also providing an alternative source of water supply that would be released and routed to municipal wellfields in the dry season. Broward County evaluated numerous routing alternatives and supported the project's economic and financial analyses.

Additional information about this project can be found here:
C-51 Reservoir - Palm Beach Aggregates
Broward County Water Resources Task Force - C-51 Update
Preliminary Design and Cost Estimate
C-51 Governance and Finance Work Group Report

Other Studies

Flood Risk Management Study for Tidally Influenced Coastal Areas - Broward County has partnered with the United States Army Corps of Engineers to conduct a **Flood Risk Study** on the feasibility of raising sea wall heights to improve resiliency to future flooding related to sea level rise, King Tide flooding, and associated storm events.

CIRCLE - Deltares - Broward County partnered with Deltares and SFWMD to identify critical infrastructure sectors and cascading effects in relationship to future flooding events. This exercise first inventoried key pieces of infrastructure in various sectors (power, telecommunications, transportation, healthcare) in the County and estimated thresholds before they would be impacted. Next, relationships between sectors were established to show the interconnectivity of infrastructure and help prioritize areas of needed adaptation. 3D visuals were also developed to show areas of impact and how, for instance, a flooded FPL substation may impact other infrastructure that itself may not be flooded but is dependent on the substation such as telecommunication towers, gas stations, schools, etc. A final report is forthcoming.

RAND Corporation - Adapting to a Changing Climate in Southeast Florida - RAND Corporation supported the evaluation of how Broward County is vulnerable to flooding and intrusion of saltwater into drinking water. These risks are driven by sea level rise, changes in precipitation, and urban development. The final report presents information on how the region, including Miami Dade County, can adapt.

Floridan Aquifer Feasibility

The use of the Floridan Aquifer as an alternative water supply, given increasing population and possible loss of traditional sources to saltwater intrusion, requires additional studies for optimal and sustainable use, and determination of its feasibility.

Phase I of the Upper Floridan Feasibility Study gathered all available well information and commissioned a new well (G-2984) to be drilled, cored, and logged. In total, 84 wells at 33 sites were utilized to help construct the cross-sections and maps representing the stratigraphic and hydrogeologic units of the Floridan Aquifer in urban Broward County. An additional component of the project was to complete seismic profiling along approximately 14 miles of the Hillsboro Canal.

Phase II of the Upper Floridan Feasibility Study further refined the hydrogeologic framework and regional extent developed from Phase I. Enhanced technology and data collection methods now allow for the viewing of the part of the surficial aquifer, Upper Floridan, Avon Park Permeable Zone, Lower Floridan, Boulder Zone, and possibly, upper Cretaceous limestone.

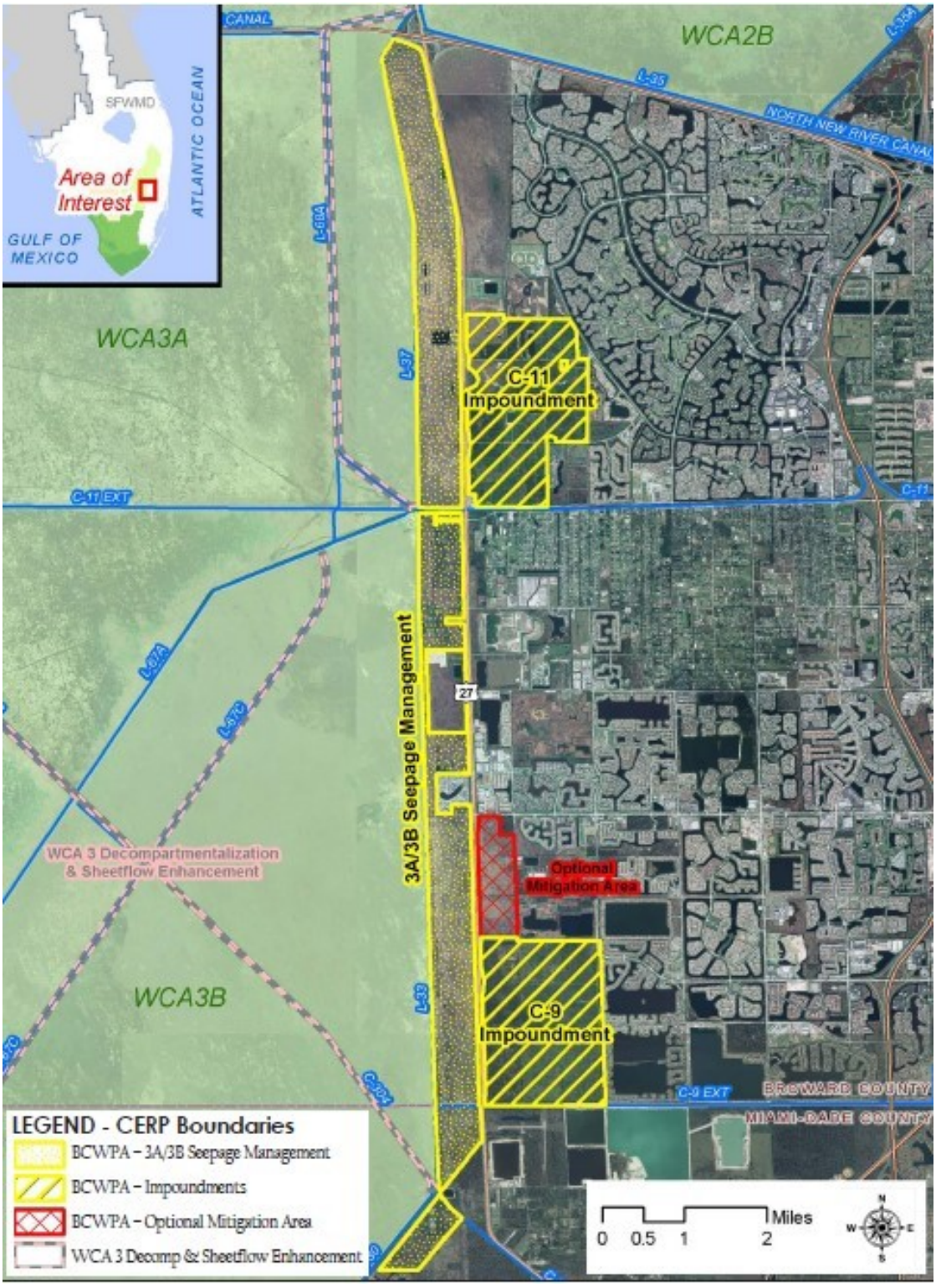
Groundwater Monitoring

Monitoring of groundwater conditions is essential to ensuring successful water management programs and enables water resource managers to verify that operations are producing their desired results to meet urban and natural system needs, and if not, to make necessary changes. Broward County, the U.S. Geological Survey, the South Florida Water Management District and numerous municipalities fund the monitoring of water quality (chlorides and nutrients) and quantity (groundwater and surface water elevation). These data sets provide reliable information for management and planning, and are available on numerous water websites, as follows:
https://groundwaterwatch.usgs.gov/netmapT6L1.asp?ncd=BIS
Broward Canal Water Quality
USGS Water Quality and Levels
South Florida Water Management District DBHYDRO Database

Everglades Restoration

Broward County supported the development of the Comprehensive Everglades Restoration Plan (CERP) as well as the more recent Central Everglades Planning Project (CEPP). This initiative involved linking many previously planned projects into one that could be implemented sequentially to provide immediate benefit and restore traditional sheet flows through the Central Everglades. Broward County participated in project update meetings, evaluated preliminary results, and ensured the County's interests were represented.

Specifically, the ***Broward County Water Preserve Area (WPA) projects*** will reduce seepage losses from the Water Conservation Area (WCA) via the 3A/3B buffer strips and store and distribute stormwater in the C-11 and C-9 impoundments. On June 10, 2014, the project received congressional authorization in the Water Resources Reform and Development Act (WRRDA) of 2014. Congressional authorization now makes this project eligible for funding during the appropriations process.



The Broward County Water Preserve Area projects will help improve water quality in the Everglades

Coordination with Other Planning Efforts

OTHER RELATED PLANNING EFFORTS

The Broward County-wide Integrated Water Resources Plan supports other local and regional planning efforts including the County's comprehensive and land use plans, the Climate Action Plan, the Lower East Coast Water Supply Plan, and the Comprehensive Everglades Restoration Plan as summarized in this section.

The County's new planning process, Broward NEXT, has been developed to better inform the public on the County's comprehensive planning efforts. This plan has been developed to dovetail with that process by more closely aligning the County's Integrated Water Resources planning process with the goals, objectives, and policies for various water-related elements found in the County's land use and comprehensive plans.

The Broward NEXT 2017 Broward County Land Use Plan, developed by the Broward Planning Council also includes policies that influence water resources management, particularly as it relates to the use of certain lands including wellfields, wetlands, and other water resources. Within the World-Class Natural Resource Protection & Enhancement Vision, Strategy EP-2 calls for the creation of a countywide water management/flood protection plan. Within the Climate Change Resilience Vision of the Plan, Strategy CCR-3 calls for maintaining adequate water supply through efficiency and conservation efforts and increasing the resilience of natural systems through water resource management.

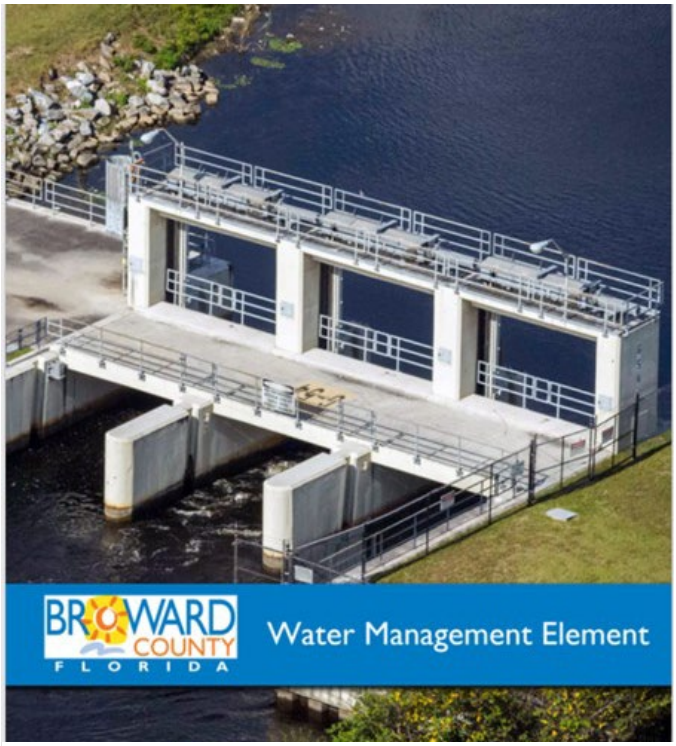
Broward's Comprehensive Plan

The Broward County Comprehensive Plan includes goals, policies, and objectives that help guide how the County, in its capacity as a utility through Water & Wastewater Services, and as environmental resource managers, through the Environmental Planning & Community Resilience Division, plan for and manage our water resources.

Through the Broward Next 2.0 Planning process, the County's Planning and Development Division is in the process of updating the Comprehensive Plan, incorporating policies previously found in the potable water, sanitary sewer, and drainage and aquifer recharge elements into a new combined Water Management Element. The new combined element's goal states that:

"*Broward County will manage its water resources and infrastructure using a collaborative, equitable and cost-effective integrated approach that optimizes water supplies, wastewater, reclaimed water, stormwater, existing infrastructure, and natural systems to meet the short- and long-term needs of the County's residents, businesses, visitors, and tribal communities, while addressing water management challenges associated with climate change*."

Additionally, several other elements of the Comprehensive Plan include policies that also impact water resources management including the Climate Change and Intergovernmental Coordination elements. The policies included in the Plan codify many of the recommendations found in the IWRP including development of regional strategies and coordinated management addressing integration of urban and natural water resource needs.



The Broward NEXT 2.0 planning process includes a new combined Water Management Element

Lower East Coast Water Supply Plan

The South Florida Water Management District's (SFWMD) Lower East Coast Water Supply Plan Update is a planning document that identifies the needs of utilities and the environment in Southeast Florida over a 20-year period. The Lower East Coast Water Supply Planning Area includes Palm Beach, Broward, Miami-Dade and parts of Monroe, Collier and Hendry counties. SFWMD, in conjunction with utilities and municipalities, has recently completed the 2018 Lower East Coast Water Supply Plan Update to assess projected water demands and potential sources of water for the period from 2016 to 2040. This plan update is used by local governments, water users and utilities to update and modify local comprehensive plans, water supply facility work plans and ordinances, and supports the County-wide IWRP.

Everglades Restoration

Local water managers need to ensure that their operations and projects sync with regional water management objectives. Of major importance is how water management in Broward County supports efforts to restore the Everglades, and which can affect both its water quality and water quantity. The County has long gone on record of supporting **Everglades Restoration**.

The Comprehensive Everglades Restoration Plan (CERP) was authorized by Congress in 2000 as a plan to *"restore, preserve, and protect the south Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection".*

The CERP consists of 68 individual components relating to storage, stormwater treatment, seepage management, and removing barriers to flow and is expected to take more than 35 years to complete.

In October 2011, the Corps and SFWMD launched the **Central Everglades Planning Project (CEPP)** as a means to bundle a subset of high impact CERP projects to initiate restoration in the heart of the Everglades. At a total cost of $2.1 billion, there are four project components: storage and treatment, distribution, conveyance, and seepage management.

Broward County Climate Action Plan

The Broward County Climate Action Plan Water Supply Actions are intended to maintain adequate water supply through conservation and adaptation, development of decision support tools necessary to build community resilience, and increase the resilience of natural systems through integrated water resource management. The 11 actions that are proposed include:

- Continue local water conservation programs
- Include climate change in updates of Lower East Coast Plan
- Investigate regionalization of water supply
- Monitor and protect wellfields
- Develop alternative water supply strategies
- Model the sustainable use of the aquifer
- Evaluate impacts of flooding of contaminated sites
- Evaluate reuse water interaction with and impacts to the natural systems
- Implement reuse strategies
- Evaluate reuse considering sea level rise
- Increase percentage of pervious areas

Southeast Florida Regional Climate Action Plan

Broward's Climate Action Plan supports the work of the Southeast Florida Regional Climate Action Plan (RCAP), which is the four-County Southeast Florida Regional Climate Compact's guiding tool for coordinated climate action in Southeast Florida. Broward County has taken a lead role as a compact partner in organizing the water section of the Water Goal of the document, which is designed to "*advance the water management strategies and infrastructure improvements needed, in parallel with existing water conservation efforts, to mitigate the potential adverse impacts of climate change and sea level rise on water supplies, water and wastewater infrastructure, and water management systems, inclusive of regional canal networks, pumps, control structures, and operations.*" Twenty-one actions are included within this goal. Compact documents produced to assist policymakers, administrators, and program staff include Integrating Climate Change and Water Supply Planning in Southeast Florida and "Regional Impacts of Climate Change and Issues for Stormwater Management".

Governance

Engaging Stakeholders and Policymakers

A major reason that the implementation of the IWRP is successful is its commitment to engaging stakeholders and policymakers in the decision-making process to advance studies, projects, and programs. The Broward Water Advisory Board or WAB, is a 15 member board of elected officials and others, along with 9 alternates, that advises and makes recommendations to the Broward County Board of Commissioners in matters relating to the development, use and management of water resources within Broward County. This may include, but is not limited to, water supply, water conservation, ground water recharge, reuse of wastewater effluent, and stormwater management. The WAB is provided technical support by the **Technical Advisory Committee's** (TAC) 26 members which include water managers, utility directors, business interests, and representatives from state agencies. The purpose of the TAC is to provide technical expertise from a diverse group of water managers, school district, state agencies, and business interests.

In addition, the Broward Leaders Water and Climate Academy is held bi-annually to ensure that local civic and business leaders are informed on various water and climate issues. The Academy is a partnership between the SFWMD and Broward County.

The **Broward Water Resources Task Force (WRTF),** now dissolved, was convened by the Broward County Board of County Commissioners, Broward League of Cities, and South Florida Water Management District, in September 2008. The purpose of the WRTF was to bring together municipal, county and state officials to evaluate potential regional and sub-regional strategies for meeting the County's water supply needs and water conservation goals. The 15-member WRTF was tasked to work collaboratively to identify and evaluate potential regional and sub-regional water supply strategies and solutions of appropriate water quality to meet county-wide future water resource needs and water conservation goals, and to meet the objectives of the enabling resolutions and was provided technical support by 21 appointed Technical Team members including water managers, utility directors and business interests. The WRTF's Report of 40 recommendations was approved by the County Commission in September 2010 and has, in conjunction with the IWRP,

led to many of the successful programs and projects undertaken since that time, including the Conservation Pays program, the Reuse Master Plan, and the advancement of the C-51 reservoir project. Upon completion of their work, members of the WRTF were incorporated into the Water Advisory Board.

Other Working Groups

The Surface Water Coordinating Committee (SWCC) consists of drainage and water control district and government water managers that meet quarterly to discuss issues of mutual interest and concern. Its purpose is to encourage all water control districts, municipalities and regional water managers to participate in surface water resources management and to assist in surface water efficiency for Broward County. Two members of the SWCC also serve on the Technical Advisory Committee.

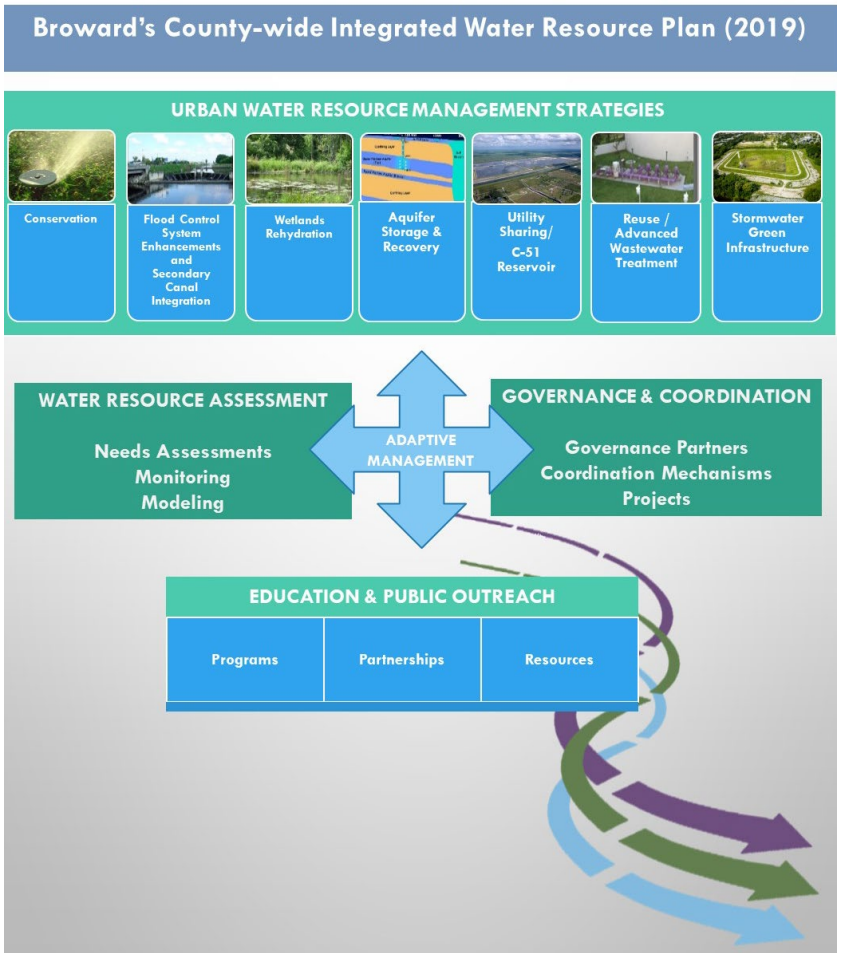
Broward County Environmental Planning & Community Resilience Division staff also participate in a number of other working groups that are involved in water management such as the **Southeast Florida Utility Council** and the **Resilient Utility Coalition**.

The Broward Leaders Water and Climate Academy meets every 2 years to introduce new elected officials to local water and climate issues

2019 Recommendations

Moving Forward

It is recommended that the goals and recommendations contained in the 2009 IWRP should continue to be promoted and developed further in accordance with ongoing planning efforts as described in the *Water Resources Assessments of Current and Future Conditions* section. Moving forward, greater emphasis should be given on future conditions planning and the integration of climate implications on water supply, water management, and flood scenarios, consistent with the Southeast Florida Regional Climate Compact guidelines.



2019 IWRP conceptual graphic

While integrated water resources planning has been the focus of the County's water planning activities for over twenty years, the movement nationally has been

towards what is known as the "One Water" concept. The **One Water** approach, promoted by the U.S. Water Alliance, is essentially an expanded version of integrated water resources planning and envisions managing all water in an integrated, inclusive, and sustainable manner to secure a bright, prosperous future for our children, our communities, and our country. One Water approaches are progressing in multiple arenas: from using advanced technologies to recover nutrients and energy from wastewater; to using green stormwater techniques to mitigate flooding while beautifying neighborhoods; to undertaking watershed-level planning and collaboration to address water quality issues; to implementing innovative financing and partnership models.

1.0 Understanding Our Water Resources Management Challenges

1.1 The County should continue to invest in regional water resources assessments, including utility needs assessments, monitoring, modeling, data analytics, and spatial analyses to inform water resources policy, planning, and investment decisions reflective of demands, operations, and the influences of sea level rise, changes in rainfall patterns and groundwater levels, and other climate impacts.

1.2 The County should work closely with municipalities to identify water supply needs and opportunities for regional projects as part of the 10-year water supply facilities work plans as required by State law, and in order to recognize anticipated water demands and develop a local drought management strategy consistent with the regional strategy.

1.3 The County should partner with municipalities to complete a regional vulnerability assessment and establish a shared resilient infrastructure improvement plan to address future flood conditions through the evaluation of appropriate adaptation measures, including flood control system enhancements and stormwater green infrastructure investments.

1.4 The County should continue to support maintenance and expansion of its regional monitoring network of surface and ground water resources, inclusive of Biscayne and Floridan Aquifers, to monitor storage levels and water quality aspects, including saltwater intrusion.

1.5 The County should continue to participate as an active member and leader of the Southeast Florida Regional Climate Compact to better understand the regional

effects of climate change, including sea level rise and flooding, related economic and social disruption, and, to coordinate mitigation and adaptation activities across county lines.

2.0 Managing Water Resources Challenges

2.1 The County should continue to enhance its surface water and groundwater hydrologic and hydraulic modeling capabilities by refining temporal and spatial resolutions, bringing better local data and downscaled information from Global Climate Models, and performing finer scale processes to investigate the influence of rising sea levels, extreme rainfall events, and other future climate impacts on local water resources and our water management system, and, to identify viable water supply, flood protection, and water management projects and adaptation strategies and their associated benefits.

2.2 The County should expand the development and application of the regional saltwater intrusion model along its entire coast to aid in the management of saltwater intrusion and provide a better understanding of the impacts of sea level rise and climate change on groundwater supplies.

2.3 The County should continue to work with the SFWMD, Florida Department of Environmental Protection (FDEP) and U.S. Army Corps of Engineers staff in the advancement of Everglades Restoration projects with consideration of water supply, flood mitigation, and environmental considerations, under current and future climate conditions, with emphasis on the integrated treatment of urban and natural systems.

2.4 The County should continue to work with the SFWMD to develop collaborative research and advance projects and water management strategies in furtherance of the County's IWRP in updates to the Lower East Coast Water Supply Plan.

2.5 The County should work with the SFWMD to prioritize the development of the Flood Protection Level of Service Program in Broward County, in coordination with a C&SF Project Restudy, in order to reevaluate canal systems operation under current and future conditions and identify priority flood protection adaptation measures and strategies needed to improve resilience of the Project and the Broward County community under conditions projected over the next 100 years.

2.6 The County should continue to pursue hydrogeologic analyses and monitoring of the Floridan Aquifer to support the expanded development of this resource as an alternative water supply in Broward County, as well as to identify the feasibility and preferential siting for aquifer storage and recovery projects.

2.7 The County should continue to support and coordinate the implementation of the C-51 Reservoir project as an alternative water supply source for Broward County and continue to develop and enhance regional and distributed surface water storage to increase the potential for stormwater capture, treatment, and reuse for water supply, aquifer recharge, flood management, and environmental benefits, including improved water quality.

2.8 The County should continue to develop the secondary canal network, improving its water delivery network and stormwater management capacity, and promoting better system integration.

2.9 The County should continue to provide water deliveries to urban natural areas to provide storage for aquifer recharge and improve habitat function.

2.10 The County should actively work with water and wastewater utilities to expand reclaimed water projects and the development of reuse technologies as a water demand reduction strategy.

2.11 The County should continue to identify and support additional sub-regional and regional projects that serve multiple jurisdictions by offering cost-share opportunities and seek cooperative funding, inclusive of utility sharing initiatives and interconnections, to better facilitate the movement of water including wellfield/canal recharge, as well as cost-effective and efficient water treatment processes that produce high quality water.

2.12 The County should continue to partner with local governments to promote and implement its county-wide water conservation programs – NatureScape, Conservation Pays, NatureScape Irrigation Services, and the Environmental Partnership with Broward Schools – including community outreach and public education efforts, as well as incentive programs offered to residents to support indoor and outdoor water conservation.

2.13 The County should coordinate with local governments to maintain water conservation as the foundation for water supply planning with a targeted goal to

achieve a minimum 10% reduction in raw water pumpage for potable water use relative to the county-wide 2018 per capita raw water demand by 2028.

2.14 The County should promote the development of stormwater green infrastructure to reduce and treat stormwater at its source and implement water management features and landscape components that promote distributed storage, thereby providing multiple community benefits including enhanced flood protection, enhanced aesthetics, improved water quality, and all together greater community development, socialization, and economic health.

2.15 The County should continue to build system resilience for water supply, flood management, and other water management challenges, particularly as it faces the various challenges associated with climate change that will impact our existing water resources; to identify existing under-performing infrastructure and perform upgrades; and, to implement adaptable infrastructure strategies that facilitate targeted investments, allow managed performance, and achieve greater flexibility in system operations.

2.16 The County should continue to support the development and adoption of regulatory tools through the implementation of the Future Conditions Map Series and incorporation into modern permitting, planning, and design standards for development, including infrastructure improvements to drainage systems, surface water management systems, sea wall heights, and finished floor elevations based on updates to groundwater table maps, flood elevation maps, and tidal elevations.

2.17 The County should continue to coordinate regionally, through the Southeast Florida Regional Climate Compact, and support the implementation of its Regional Climate Action Plan 2.0 and its Water Recommendations to advance the water management strategies and infrastructure improvements needed, in parallel with existing water conservation efforts, to mitigate the potential adverse impacts of climate change and sea level rise on water supplies, water and wastewater infrastructure, and water management systems, inclusive of regional canal networks, pumps, control structures, and operations.

2.18 The County should continue to foster the biennial convening of new and interested elected officials as part of the Broward Leaders Water Academy, to continue engaging its leaders and to educate them about water resources management and current challenges.

2.19 The County should continue to partner with academia and other research institutes to advance technical investigations, including future climate impacts on sea level rise, rainfall patterns, extreme events, and the identification of newer technologies that support program implementation.
2.20 The County, recognizing the need for a sustainable and resilient water portfolio, should work with water, wastewater and stormwater utilities to advance a One Water approach, with the goal to maximize the availability of potable water from existing water supply sources by collecting and enhancing the treatment of all available non-conventional resources, such as runoff, brackish groundwater, and municipal wastewater.

3.0 Funding Water Resources Projects

3.1 The County should work with municipalities and utilities to coordinate funding for water supply efforts, including conservation and other alternative water supply programs and expand the existing IWRP Grant process to support additional sub-regional and regional projects that serve multiple jurisdictions.
3.2 The County should work with the SFWMD to identify sub-regional and local alternative water supply, water conservation, and flood protection projects eligible for funding, and advocate for the SFWMD to consistently fund their cooperative funding program.
3.3 The County should work with the Florida Legislature to: expand existing funding to support water resources programs; pursue water projects through CERP and other programs; and improve statewide water, wastewater, and stormwater infrastructure funding by moving towards the Florida Department of Transportation's 5-year planning model.
3.4 The County should work with FDEP, SFWMD and the U.S. Congress to leverage existing funds and incorporate projects that would serve its communities, with the inclusion of the previously authorized Central and South Florida Flood Control Project needed to identify and prioritize infrastructure improvements to reduce flood damage and provide greater resilience to, and quick recovery from recurrent flooding, storms and droughts.

3.5 The County should work with FEMA to advance projects where funds may be available for drainage and recharge improvement related to disaster recovery and hazard mitigation.
3.6 The County should coordinate with local water, wastewater, and stormwater entities to investigate future funding opportunities in America's Water Infrastructure Act of 2018.

4.0 Implementing Water Resources Projects

4.1 The County should encourage continued participation and coordination of municipalities, local water managers, and other partner agencies in forums such as the Water Advisory Board and its Technical Advisory Committee, the Surface Water Coordinating Committee, Southeast Florida Regional Climate Compact, Southeast Florida Utility Council, Resilient Utility Coalition, and other working groups. The IWRP is not a self-executing document, as many elements of implementation require extensive collaboration among multiple entities. Beyond serving as a document for information purposes and guidance for policy makers and water managers, it is incorporated, by reference, into the Broward County Comprehensive Plan; recognized, within the 2018 Lower East Coast Water Supply Plan as a beneficial water management strategy for Broward County; and, endorses the water recommendations contained in the Southeast Florida Regional Climate Compact's Regional Climate Action Plan 2.0.

CONCLUSION

The IWRP process will continue to guide Broward County's water planning activities in the future. As the impacts of climate change alter our landscapes and how we manage water, our proactive efforts will ensure that we have the tools to adapt and improve the resiliency of our community.

You can also access the information presented in this report at:
https://sway.office.com/gPzvfswYyFzqIErc?ref=Link