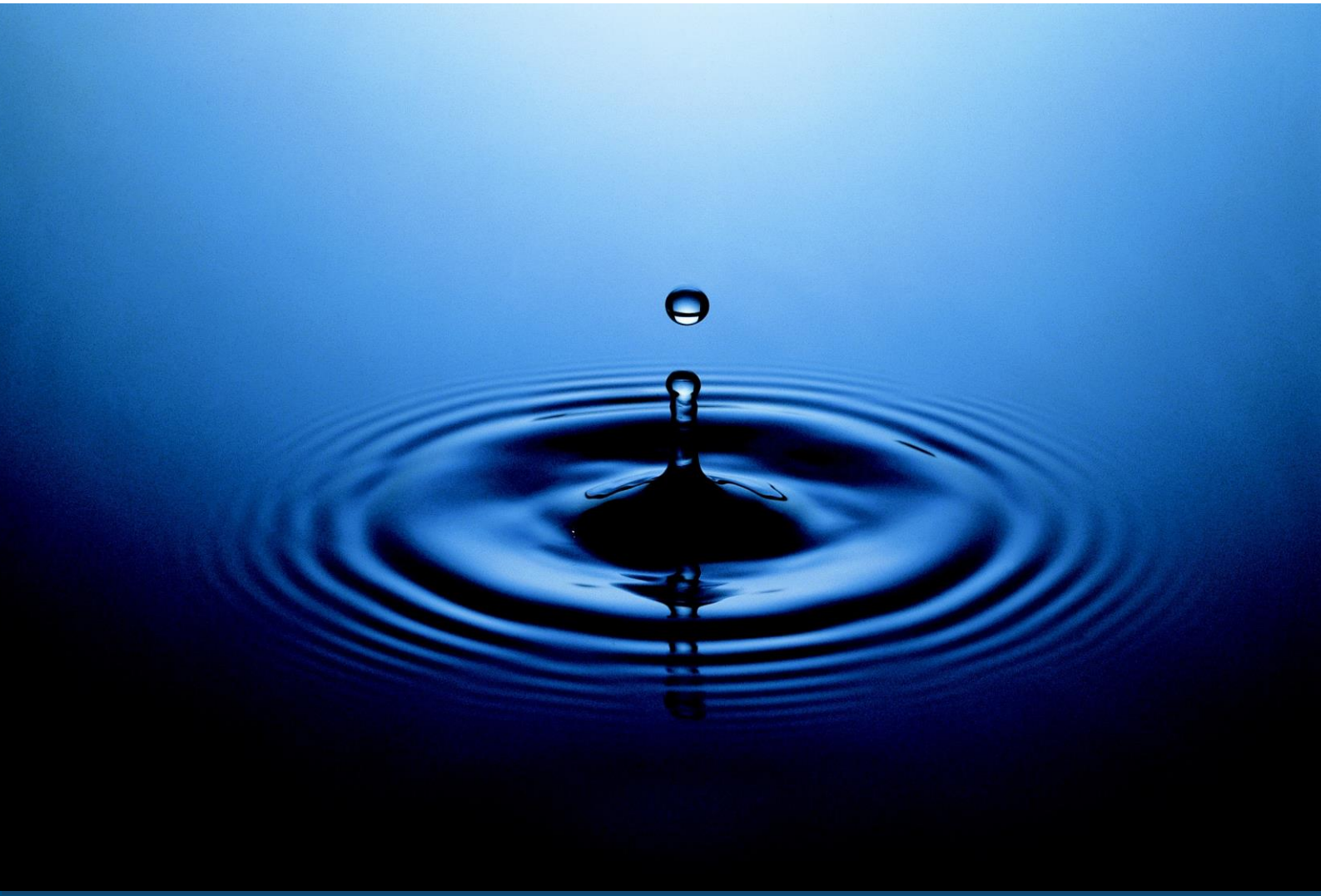
AHK German American Chambers of Commerce
Deutsch-Amerikanische Handelskammern

Building Partnerships for a ENVIRONMENTAL PROTECTION made in Germany Sustainable Infrastructure



Brief Analysis of Sustainable Water Infrastructure and Water Technologies

In Florida and Wisconsin 2018

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III. List of Abbreviations

ASCE	American Society of Civil Engineers
AWOP	Area-Wide Optimization Program
AWT	Association of Water Technologies
AWWA	American Water Works Association
BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
CFWI	Central Florida Water Initiative
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DEP	Florida Department of Environmental Protection
DNR	Department of Natural Resources
DNS	Department of Neighborhood Services
e.g.	exempli gratia
est.	estimate
EAA	Everglades Agricultural Area
EPA	United States Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FDOT	Florida Department of Transportation
ANSI	American National Standards Institute
FGWA	Florida Ground Water Association
FOWA	Florida Onsite Wastewater Association
FRWA	Florida Rural Water Association
FSAWWA	Florida Section of the American Water Works Association
FWEA	Florida Water Environment Association
FWPCOA	Florida Water and Pollution Control Operators Association
GACC	German American Chamber of Commerce
GDP	Gross Domestic Product
i.e.	That is
IPWA	International Private Water Association
km^2	Square kilometer
MDWASD	Miami-Dade Water and Sewer Department
Mgal/d	Million gallons per day
MMSD	Milwaukee Metropolitan Sewage District
MWW	Milwaukee Water Works
NPDES	National Pollutant Discharge Elimination System Standards
OSTDS	Onsite sewage treatment and disposal systems
PWRA	Provision of Water Restoration
PWS	Public Water Systems
SCADA	Supervisory Control and Date Acquisition
SDWA	Safe Drinking Water Act
SJRWMD	St. Johns River Water Management District
SRF	State Revolving Funds
sq mi	Square mile
SSAC	Site Specific Alternative Criteria
U.S.	United States
USA	United States of America

USD	US-Dollar
USGS	United States Geological Survey
WIFIA	Water Infrastructure Finance and Innovation Act
PCI	Per Capita Income
R&D	Research & Development
RTU	Remote Terminal Units
NFRWSP	North Florida Regional Water Supply Partnership
WIFIA	Water Infrastructure Finance and Innovation Act Program
WRWA	Wisconsin Rural Water Association
WTP	Water Treatment Plant
SSO	Sanitary Sewer Overflows

IV. Unit Conversion

Power units:
1000 Watt = 1 kW
1000 kW = 1 MW
1000 MW = 1 GW

Liquid volumes:
1 US gal. = 3,785 Liter (l)
1 l = 0,264 gal
1 Cubic m (1 m^3) = 1000 liters

Lenghts and distance:
1 inch (1" U.S.) = 2.54 cm
1 foot (1' U.S.) = 12 inches = 30 cm
1 yard (1 yd) = 3 feet = 90 cm

Surface areas:
1 square inch (in^2) = 6.5 square centimeters (cm^2)
1 square meter (m^2) = 11 square feet
1 hectare (ha) = 10,000 m^2 = 2.5 acres
1 square kilometer (km^2) = 100 ha = 0.4 square miles.

Weight:
1kg = 2.2 pounds
1 ounce (1 oz) = 28.35 grams
1 pound (1 lb) = 16 ounces = 454 grams

Temperatures:
0°Fahrenheit (F) = -18° Celsius (C)
0° C = 32° F

Currency Conversion:
1 USD = 0.80440 Euro
1 Euro = 1.24300 USD[1]

[1] https://www.oanda.com/currency/converter/, retrieved on 01/26/18

1. Project Introduction

1.1 Project description

In preparation for the Export Initiative Environmental Technology / "Environmental Protection - Made in Germany" of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the project called "German American Dialogue for Sustainable Water Infrastructure & Technologies" was created to examine the U.S. American Water Infrastructure and opportunities for future collaboration between American and German companies were identified. This is a joint project of the GACC South in cooperation with the GACC Midwest.

Through the application of strict requirements to environmental protection, sustainability and efficiency, Germany has taken a leading role in the area of water infrastructure. By the mid 1980's, Germany had already begun developing sustainable measures and activities for the improvement of water quality after rapid industrialization resulted in a significant deteroriation of the water quality. As of today, the quality of European drinking water is unique, with the quality of surface water being exceptionally good. The rate of non-revenue water in Germany is one of the lowest across Europe and since 1990, more than 110 billion Euros have been invested in the industry. The German water industry excels in the supply and disposal, the provision of quality drinking water and the sustainable handling of resources.

The vast majority of the U.S. American water infrastructure (urban drinking water and sewage systems, drinking water treatment, wastewater treatment plants, etc.) was built more than 50 to 100 years ago. Due to years of lacking financial investments and environmental pollution by industrial processes, American drinking water and wastewater systems are oftentimes in poor condition. It is estimated that every year, approximately 240,000 main pipeline breaks in the U.S., which accounts for a loss of about 14-18% of all treated water. It will require around $ 1 trillion in investments over the next 25 years to maintain and / or expand water systems. Based on various interviews with U.S. water experts, this analysis probes the causes of the outlined problems above and researches potential solutions.

The urgency of these issues and the potential for action and collaboration inspired German American Chambers of Commerce in Atlanta and Chicago to tackle the challenges facing the water sector as part of their mission to promote and support trade and investment between the U.S. and Germany. Given that Germany and the U.S. are two of the most innovative countries globally when it comes to water technologies, and Germany is well-known for its best practice technologies in the sustainability field, the German American Chamber of Commerce in Atlanta and Chicago saw it as an opportunity to connect U.S. and German stakeholders to foster a sustainable knowledge exchange on a professional level. This project gives U.S. decision makers the opportunity to engage in a bilateral dialogue with German organizations and companies.

1.2 Project Goals

The goal of the „German American Dialogue for Sustainable Water Infrastructure and Technologies" is to support communities in Florida and Wisconsin in order to develop a strategic plan for the sustainable modernization of the water infrastructure.

Stakeholders of the German water industry have the necessary know-how to modernize the water infrastructure in a sustainable fashion and consequently are valuable partners to support American municipalities to reach the common goals of sustainability and safety in the water industry.

In general, there are two areas of expertise in which Germany has taken on a leading role and which are gradually gaining importance in the U.S.:

- Stricter environmental control, as well as sustainability and efficiency requirements
- Needed updates to largely outdated water infrastructure systems

There is a particular potential in the following areas of U.S. water management: water recycling, water quality tests (body of waters), safety in the drinking water supply, reducing energy consumption or energy recovery in the treatment as well as micro irrigation in agriculture.

2. General Country Overview of the United States of America

The area size of the U.S. equals 9,833,517 sq. km, which is about half the size of Russia and more than twice the size of the European Union. The United States of America is the second largest democracy in the world by size of electorate with India being the largest one.

The U.S. has a per capita GDP of 57,600 USD and has the most technologically powerful economy in the world. U.S. companies are among the world technological leaders responsible for advances such as computers, pharmaceuticals and medical devices, aerospace and military equipment. In terms of purchasing power parity, the U.S. has had the second largest global economy since 2014, with China being the largest. In addition, the country has a highly developed service sector, comprising of 80.2% of the nation's GDP. Additional prominent sectors include the Agricultural sector, which generated 0.9% and the industry sector generated 18.9% of the nation's GDP in 2017.[2]

Figure 1: Economic Overview of the United States of America

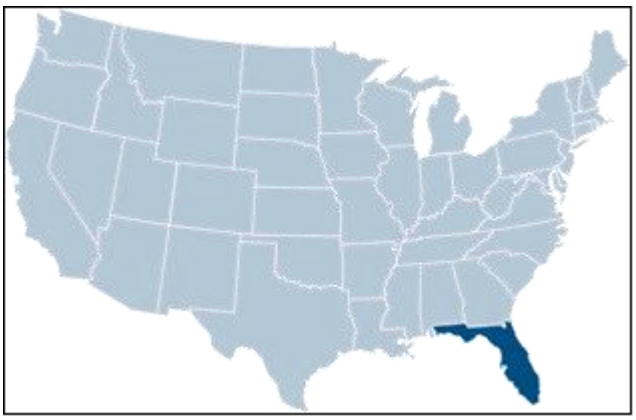
Population: 325,5 Million (2017)
Capital: Washington, D.C.
Correspondence Language: English, Spanish
GDP: 18.62 trillion (2016 est.)
GDP per Capita: 57,600 (2016 est.)
Unemployment Rate: 4.9% (2016 est.)
Public debt: 76.5% of GDP (2016 est.)
Gross national savings: 18% of GDP (2016 est.)
Total Imports: $2,208 billion (2016 est.)
Imports from Germany: $ 114.1 billion (2016)
Total Exports: $1,456 billion (2016 est.)
Exports to Germany: $ 49.4 billion (2016)

Source: Central Intelligence Agency (2017): The World Factbook, accessed on 12/20/2017 and United States Census Bureau (2017): Foreign Trade, accessed on 12/20/2017

[2] Central Intelligence Agency (2017): The World Factbook, accessed on 12/20/2017

2.1 State Profile: Florida

Figure 2: Geographical Location of Florida



The State of Florida is the most southeastern state of the United States of America, which borders the Gulf of Mexico on its west coast and to the Atlantic Ocean on its east coast. On a national level, Florida has one of the largest populations due to its mild climate and various coastal beaches, which also make it an ideal destination for tourists and retirees. Additionally to its strong tourism, Florida also accounts for approximately half of the U.S. American production of lemons.[3]

Figure 3: Overview of the State of Florida

Population: 20.612. 439 (July 2016, est.)
Area: 170.304 km² / 65,7 sq mi
State capital: Tallahassee

Source: Based on United States Census: Quick Facts Florida, accessed on 12/18/2017

Table 1: Gross domestic product (GDP) and unemployment rates in Florida between 2009 and 2016

Indicator	2009	2010	2011	2012	2013	2014	2015	2016
GDP in current dollars (in billion USD)	721,76	735,1	741,46	764,14	794,64	833,97	888,83	926,05
Real economic growth (in %)	-5,5	0,8	-0,6	0,8	2,1	2,8	3,9	2,4
Unemployment rates (in %)	10,53	10,90	9,80	8,35	7,09	6,18	5,33	4,92

Source: Based on U.S. Department of Commerce – Bureau of Economic Analysis (2015): Regional Economic Accounts, accessed on 12/01/2017 and United States Department of Labor - Bureau of Labor Statistics (2017): Local Area Unemployment Statistics, accessed on 12/01/2017

Table 2: Occupational Employment Statistics and Wage in Florida in the water and wastewater treatment industry, May 2016

Occupation	Employment per 1,000 jobs	Hourly mean wage	Annual mean wage
5,800	0.705	22.72 USD	47,250 USD

Source: Based on US Bureau of Labor Statistics (2017): State Occupational Employment and Wage Estimates Florida, accessed on 12/05/2017

[3] U.S. Energy Information Administration (2017): Florida – Data, accessed on 12/01/2017

Industry Clusters in Florida

There are over 19,000 manufacturers in Florida that employ approximately 331,000 workers in diverse manufacturing industries with a wide production range from plastics and tortillas, to motor vehicles. One sector that differentiates Florida from other U.S. states is the Clean Tech industry with industry innovators such as Mitsubishi Power Systems Americas and Siemens Energy, who play a key role in the state's Clean Tech technologies by combining economy with sustainability. Other economic strengths of Florida include energy, efficiency, and environmental technologies, which can be seen in the high number of producers of power generation systems, solar technology companies, biofuel producers, and battery and fuel cell manufacturers. Furthermore, Florida is home to specialized companies in the production of water testing, desalination and remediation technologies resulting in strong environmental monitoring, compliance and remediation sectors in the state.[4, 5]Florida Enterprise, a principal economic development organization for Florida, provides an interactive map that gives further insights into Florida's key industries and the location of industry clusters within Florida that were mentioned above. According to this map, industry clusters in close proximity to the City of Tampa and the City of Miami are highly developed.[6]

Florida has a diverse portfolio of industry clusters such as Life Sciences, Manufacturing, and Clean Tech, which directly influences water usage and water quality in Florida. Regarding Life Sciences, Florida has established itself as a true hub and is home to more than 1,100 biotech, pharmaceutical and medical device companies. More precisely, there are 260 biotech companies and R&D institutes and more than 220 pharmaceutical and medicine manufacturing companies in the state, comprising of 14% of the biotech and 22% of the pharmaceutical manufacturing workforce nationally. Within Florida, the City of Tampa and Hillsborough County are clusters for Life Sciences and Health Care industries and employ more than 62,100 workers.

Water Industry Clusters

According to Enterprise Florida, Florida companies are at the forefront of the latest water testing, desalination and remediation technologies. The environmental monitoring, compliance and remediation sector is also strongly represented in Florida. A look at Florida's Cleantech Cluster Map reveals that companies in the environmental sector are mainly located on the state's coastlines.[7]

In recognition of the importance of water issues and the need to address them in a new interdisciplinary manner, the University of Florida (UF) established a campus-wide interdisciplinary Water Institute in May 2006. The Water Institute develops engineering, policy, and legal solutions in Florida, providing a model, both nationally and internationally. Furthermore, the institute is committed to addressing Florida's issues while being recognized for providing solutions, science, and education for national and global water resource problems[8].

[4] Enterprise Florida (2018): Industry Overview, accessed on 01/08/2017
[5] Tampa Hillsborough Economic Development Corporation (2018): Life Sciences & Health Care, accessed on 01/08/2018
[6] Enterprise Florida (2018): Maps, accessed on 01/08/2018
[7] Enterprise Florida: Cleantech: Water Air & Environment, accessed on 01/26/2018
[8] University of Florida: Water Institute, accessed on 01/26/2018

2.2 State Profile: Wisconsin

The State of Wisconsin is located in the north central region of the United States in the heartland of the Midwest and is second to Michigan in the Great Lakes coastline. Agriculturally, Wisconsin is a major producer of dairy products; producing the largest quantities of cheese of any U.S. state.

Figure 4: Geographical Location of Wisconsin

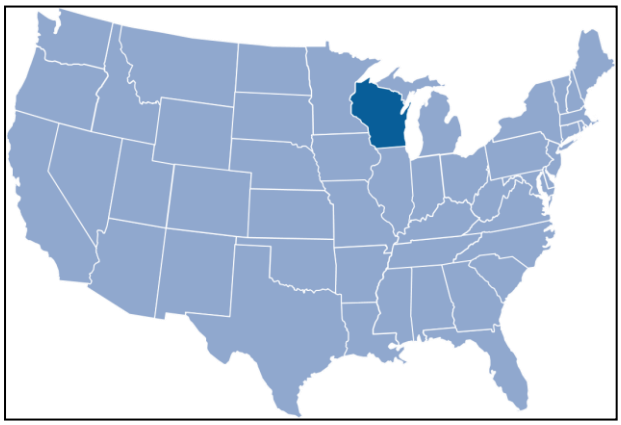


Figure 5: Overview of the State of Wisconsin

Population: 5,795,483 (July 2016, est.)
Area: 170.304 km² / 54,157.80 sq mi
State capital: Madison

Source: United States Census Bureau (2017): Quick Facts Wisconsin, accessed on 01/08/2018

Table 4: Gross domestic product (GDP) and unemployment rates in Wisconsin between 2009 and 2016

Indicator	2009	2010	2011	2012	2013	2014	2015	2016
GDP in current dollars (in million USD)	245	252,88	262,46	272,42	281,57	291,40	304,66	313,09
Real economic growth (in %)	-2,7	2,2	2,1	1,0	1,0	1,0	1,0	1,0
Unemployment rates (in %)	9,00	8,40	7,80	7,10	6,60	5,30	4,50	4,20

Source: Based on U.S. Department of Commerce – Bureau of Economic Analysis (2015): Regional Economic Accounts, accessed on 01/11/2018 and United States Department of Labor - Bureau of Labor Statistics (2017): Local Area Unemployment Statistics, accessed on 01/11/2018

Table 5: Occupational Employment Statistics and Wage in Wisconsin in the water and wastewater treatment industry, May 2016

Occupation	Employment per 1,000 jobs	Hourly mean wage	Annual mean wage
2,480	0.884	22.80 USD	47,420 USD

Source: Based on US Bureau of Labor Statistics (2017): State Occupational Employment and Wage Estimates Florida, accessed on 12/05/2017

Water Industry Clusters

84% of the drinking water available in North America comes from the Great Lakes, which is why the Midwest region plays such an important role in the water industry. Consequently, the Midwest is a hub of water clusters with know-how centers in Minneapolis-St. Paul, Minnesota, the Confluence Water Technology Innovation Cluster in Cincinnati, Ohio, the Water Council in Milwaukee, Wisconsin (WI), and the Blue Tech Alliance in Chicago, Illinois. According to the American Society of Civil Engineers (ASCE), new technologies and infrastructure solutions are in high demand. Industries located in the region with higher water consumption, such as food, agriculture and paper industries, are particularly faced with the challenge of using more sustainable and efficient systems and technologies for water supply and wastewater treatment.

The Water Council, located in Milwaukee, WI, is the leading U.S. cluster for water. As a result of being situated next to the largest source of freshwater in the U.S. (totally 84%), it stands not only as a national innovator in the field of water provisioning and waste water management, but also as an international center for connecting informational resources. Comprising of 11 global partners, 170 Water Council members and almost 200 affiliated businesses in water technology, making it Wisconsin's main water industry cluster with a truely global reach.

As a result of the region's significant water cluster, various stakeholders and major players in Wisconsin's water industry came together to tackle current water industry issues and founded the Global Water Center in 2013. The center is a 98,000 square feet (9104.5 square meter) facility offering research space for universities, existing companies and an accelerator space for new, emerging water technology companies. Interested parties from all over the world come to Milwaukee to use the space and expand their network.[9]

[9] The Water Council: About us, accessed 01/11/2018

3. Market situation

Across the United States, there is a general trend of deteriorating water infrastructure that was largely constructed 50 to 150 years ago and consists of more than water mains and the distribution system, but also recycling and treatment facilities, as well as the natural water resources.

The effect of the aging water infrastructure far extends public usage, as U.S. businesses rely directly or indirectly on the aging and outdated technology with operations being greatly impacted through utility service interruptions, polluted drinking water, and higher water bills. Currently, as reported by the American Society of Civil Engineers (ASCE) in 2017, the American drinking water infrastructure network is equivalent to a grade "D". However, water infrastructure conditions across the United States vary greatly from state to state and even city to city. This paper will examine two distinct regions within the United States, Florida and Wisconsin, whose current infrastructure and immediate needs vary significantly, yet both states face similar problems in obtaining and maintaining needed technology.

3.1 Water Infrastructure

Providing safe drinking water for the country is a cooperative effort between public water systems, federal and local government agencies, consumers and many more. As stated in the federal Safe Drinking Water Act (SDWA) every state must test their public water system to meet minimum outline drinking water standards set by the United States Environment Protection Agency (EPA) and report all yearly violations. EPA is a federal agency of the U.S. and serves the purpose of protecting human health and the environment by writing and enforcing relevant regulations in these fields based on laws that have been passed by Congress.[10]

In 2016, the American Society of Civil Engineers (ASCE) created a Report Card for Florida, which evaluated and analyzed the condition and management of Florida's drinking water infrastructure utilizing quantitative and qualitative evaluation methods. According to the results, Florida's utilities are safe and resilient, and provide relatively high level of service. However, Florida's drinking water infrastructure was rated with a C+(with an A being the best and a D being the worst grade). The lowest score were in the categories "asset management" and "condition of infrastructure" and were lower due to a significantly higher number of utilities that inspect less than 20% of their distribution system annually for leaks. Infrastructure scores were also relatively low as a result of outdated utilities, sometimes older than 30 years, which require high levels of maintenance and also due to a high number of unplanned annual service disruptions.[11]

In contrast, 99% of the public water systems in Wisconsin met EPA requirements, high above the national average. However, roughly 76 systems monitored higher contaminations, including bacteria, nitrate arsenic and radioactive chemicals such as radium and uranium. A bigger problem than violations of contaminant levels were public notice regulations, as 15% of all water systems that experienced nitrate and bacteria contaminations failed to announce it publicly. Even though they are ahead of other states and cities across the United States, the American Society of Civil Engineers estimates that the state of Wisconsin will need about $1 billion over the next 20 years to rehabilitate domestic clean water infrastructure. Another $6.33 billion is needed to repair the wastewater system and restore them to proper working conditions.[12] A failure in updating the infrastructure will result in a danger to public health, higher legal exposure costs and business losses.

[10] United States Environmental Protection Agency (2018): About EPA, accessed on 1/18/2018
[11] American Society of Civil Engineers (2016): 2016 Report Card for Florida's Infrastructure, accessed on 12/12/2017
[12] American Society of Civil Engineers (2017): Infrastructure Report Card for Wisconsin, accessed on 12/10/2017

3.1.1 Water Supply

Both surface and ground waters are part of an interconnected and complex natural system, which remains indispensable to the nation's water infrastructure. Each state within the nation faces varying water resource challenges based on their unique geography, which has a direct impact on the water infrastructure of the state.

Florida is surrounded by the ocean and has vast amounts of water resources including 33 first-magnitude springs. In terms of surface water, there are approximately 10,000 miles (16,000 km) of rivers and streams, and approximately 7,800 lakes within Florida. Despite half of the state's original wetlands being drained for development in previous years, the state still has diverse surface water resources, especially in its southwest region, including the Florida Everglades and Big Cypress Swamp. Additionally, Florida is estimated to have 1 quadrillion gallons of groundwater available through its aquifers. [13]

In comparison to Florida, Wisconsin's main water resource is Lake Michigan where the Milwaukee Water Works operate two water treatment plants to provide around 1 million residents in the Milwaukee, Ozaukee, and Wauhesha Counties with fresh water.[14] Both plants, Linnwood Water Treatment Plant and the Howard Avenue Water Treatment Plant have received $508 million to improve their overall infrastructure including state-of-the-art filters, particle monitors, and ozone disinfection and have a combined capacity of 380 million gallons per day.[15] After being purified, Lake Michigan water flows into large underground clear wells at the water treatment plants that temporarily hold the water before it is pumped into the distribution system. The Milwaukee Water Works also partners with a variety of agencies to promote the health of their watershed.

3.1.2 Water Distribution

Across the nation, drinking water distribution systems consist of various interconnected components, such as pipes, storage facilities and components that convey drinking water, providing uninterrupted supply of pressurized safe drinking water to all consumers with drinking water distribution systems accounting for the vast majority of the physical infrastructure. As development occurs, new pipes added to the existing grid result in a wide variation in pipe size, materials and methods used and deterioration resulting from corrosion, materials erosion and external pressures.

In Florida alone, there are 5,275 active public and private drinking water treatment systems providing an estimated population of 20.2 million inhabitants with drinking water. At this point, agriculture and water supply account for the largest portion of freshwater usage in the state (roughly 39% each). Freshwater usage for commercial/ institutional/ industrial purposes, domestic and small public supply (3%) and power generation (3%) are other significant contributors to the overall freshwater usage in Florida.[16]

Looking at Wisconsin, Milwaukee's distribution system includes over 200 miles of water mains that carry over 100 million gallons of treated water every day to 865,000 residents in 16 communities in Milwaukee, Ozaukee and Waukesha Counties.[17] The larger diameter water mains range in diameter from 20 to 84 inches, with smaller mains ranging from 4 to 16 inches in diameter and range in age from 1873 to present day. The mains primarily carry water from the three major pumping stations to smaller mains and then to seven booster stations that regulate water pressure. The pumping and booster stations also pump water into storage facilities such as two elevated storage tanks and four ground level tanks for additional supply during periods of increased water demand.[18] The Milwaukee Water Works uses sustainable practices such as supply-side conservation, water accountability, energy conservation, operational efficiency and consumer advocacy for preventing water waste. These actions aim to ensure the long-term availability of safe and affordable drinking water, while considering the other uses and priorities for water in the area.

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[13] United States Geological Survey: Florida's Water Resources, accessed on 12/05/2017
[14] Wisconsin Department of Natural Resources Bureau of Drinking Water and Groundwater (2003): Water Assessment for Milwaukee Waterworks, accessed on 12/10/2017
[15] Milwaukee Water Works (2014): Milwaukee Water Works Today, accessed on 12/20/2017
[16] American Society of Civil Engineers (2016): 2016 Report Card for Florida's Infrastructure, accessed on 12/05/2017
[17] City of Milwaukee: About the Milwaukee Water Works, accessed 12/20/2017
[18] Milwaukee Water Works: Water Mains: Replacement and Repair, accessed 12/20/2017

3.1.3 Water recycling / Water reclamation

In Florida, there is continuously growing demand for fresh water and wastewater removal systems. Wastewater treatment systems in the state treat 2.7 billion gallons of wastewater per day, with 1.5 billion gallons per day being reclaimed water. The State of Florida is a national leader in terms of efficiently reusing reclaimed water for beneficial purposes and in 2015, 44% of reclaimed water could be utilized for beneficial purposes.

Highighting the importance of water reclamation in Florida, the The South Florida Water Management District (SFWMD) Governing Board declared May 14-20, 2017 as Water Reuse Week in Florida. The resolution urges local governments, utilities and businesses to implement water reuse programs to help protect future water supply of 8.1 million South Florida residents. The SFWMD Governing Board continues to partner with utilities to expand their water reuse capabilities. [19]

Currently, there are more than 3,800 wastewater treatment facilities in Florida, which serve about 2/3 of the population and have a capacity greater than 1 million gallons per day account for approx. 2% of the total permitted domestic wastewater treatment capacity in the state.[20] The remaining population relies on onsite sewage treatment and disposal systems (OSTDS) or more commonly known as septic systems and when designed, installed and maintained properly, these systems help to protect Florida's precious water supplies.[21]

Independent from the wastewater systems, the state's storm water systems primarily capture rain water which is then transported for cleaning or release via drainage pipes, storm water ponds and runoff treatment devices. With approximately 1 in every 3 localities introducing storm water programs, there is in total, 165 local storm water systems, serving 116,665 people per system. The storm water system in Florida requires significant capital improvements, estimated at to $ 1 billion through 2019 with only 1 in 4 utilities expressing adequate funds from usage fees meeting the most recent needs.

In Wisconsin, Milwaukee Metropolitan Sewage District (MMSD) is the regional government agency that provides water reclamation and flood management services for about 1.1 million people in 28 communities in the Greater Milwaukee Area, covering all 6 area watersheds. Since 1994, MMSD has been able to capture and clean 98.4% of all rain and wastewater that enters the sewer systems and return the water to the lake per the Jones Island Water Reclamation Facility and the South Shore Water Reclamation Facility. Despite the fact that both facilities started operating several decades ago, the facilities operate well above the national goal of 85%. MMSD is responsible for cleaning billions of gallons of wastewater every year and treats a wide range of wastewater sources including residential, industrial and surface runoff with the Jones Island Water Reclamation Facility producing Milorganite, a fertilizer produced from of human feces Similar, the South Shore Water Reclamation Facility creates energy at this facility through the process of using anaerobic digester to turn organic material into methane gas, used to produce electricity.

MMSD is also responsible for the sanitary sewer system in the area, which consist of over 3,000 miles of sewer pipes, serving 28 communities in the region. Additionally, MMSD also has an approximate 300 miles of regional sewer pipes, responsible for transporting wastewater to the reclamation facilities. In addition to the sewer pipes, MMSD has a Deep Tunnel that prevents more than 110 billion gallons of pollution from entering into Lake Michigan annually. Since 1994, 98.4% of all water that has entered into the sewer system has been captured and cleaned. MMSD began construction on the Deep Tunnel in the 1980's and it became fully operational in 1994. The tunnel is carved out in bedrock 300 feet underground and has 19.4 miles of pipes. The region has spent over $4 billion to reduce sewer overflows and prior to the Deep Tunnel, the region polluted Lake Michigan with between 8 to 9 billion gallons of sewage each year. Another $1

[19] South Florida Water Management District: Governing Board Declares Water Reuse Week May 14-20, accessed on 01/26/2018
[20] Florida Department of Environmental Protection (2017): General Facts and Statistics about Wastewater in Florida, accessed on 12/06/2017
[21] The Florida Department of Health (DOH): Onsite Sewage Programs, accessed on 12/07/2017

billion was invested in the Deep Tunnel system in 2010, which increased the storage capacity to 521 million gallons and is now 28.5 miles long.

3.1.4 Outlook

In May 2017, the Trump Administration laid out the first vision for a $1 trillion national infrastructure plan which outlined $200 billion in direct federal spending over the next decade on needs such as roads, bridges, tunnels, railroads and expanded broadband, along with incentives for states, cities and private investors and efforts to reduce the burdens of regulations.[22] In January 2018, the White House reported it would delay the release of its long-awaited infrastructure package yet again, after announcing it would come to realization by the end of January.[23]

In terms of water infrastructure, the initial fact sheet argued that "underperformance is evident in many areas, from our congested highways, which costs the country $160 billion annually in lost productivity, to our deteriorating water systems, which experience 240,000 water main breaks annually." The two pillars of funding addressed by this new infrastructure initiative included the Water Infrastructure Finance and Innovation Act (WIFIA) Program as well as a reform of the laws governing the Inland Waterways Trust Fund.[24]

In February, Bloomberg reported that "water infrastructure funding would be essentially shielded from the deep cuts the Trump administration is seeking in Environmental Protection Agency funding in fiscal 2019…" notwithstanding the government's intention to cut or substantially downsize regional water quality programs. Despite a 25 percent funding cut in comparison to fiscal year 2017, "the proposed budget would maintain funding levels for EPA-funded water infrastructure projects," with the EPA's two largest water funds, which give money to states for infrastructure loans, receiving almost $2.3 billion in 2019. However, most regional water quality programs, in which the EPA supports cooperative efforts by states, would take a hard hit under President Trump's 2019 budget request. As the article states, the plan proposes "to eliminate EPA support for all such regional programs, with the exception of the Chesapeake Bay and the Great Lakes. Those two programs would be cut to 90 percent below the fiscal 2017 enacted levels."[25]

Critics maintain the plan does not go far enough to address water infrastructure in rural areas. The activism group, Food & Water Watch, claims that the new infrastructure plan will privatize much of the infrastructure and according to the group's research, privately owned water systems charge 59% more than publicly owned systems. As a result, Food & Water Watch is urging Congress to approve only plans that would keep these critical systems publicly controlled. [26]

Regarding the nation's aging and deteriorating water infrastructure, the urge for financial investments remains clear, despite of the above mentioned uncertainties. The Clean Water State Revolving Fund (CWSRF) and the Drinking Water Sate Revolving Fund (DWSRF), for instance, continue to be powerful investment tools for a sustainable water infrastructure. Through these programs, the EPA provides communities and government agencies with financial aid for a range of water quality infrastructure projects, which organizations, associations, municipalities and utilities in each state profit from.

3.2 Challenges

In the United States, there are over 150,000 active public drinking water systems that collectively deliver treated water through an estimated 1.2 million miles of distribution pipes. As such, the municipal water systems and the clean water they provide are one of the country's greatest health achievements. However, the infrastructure of these essential systems face an array of challenges that are described below.

[22] Politico (2017): Trump slips infrastructure plan into budget, accessed on 1/10/2018
[23] Politico (2018): Release of Trump infrastructure plan may slip past January, accessed on 1/10/2018
[24] Water Online (2017): What Could Trump's Infrastructure Plan Mean For Water?, accessed on 1/10/2018
[25] Scott, Dean (2018, February 12). Water Infrastructure Among Few EPA Winners in Trump Budget Plan. *Bloomberg BNA*. Retrieved from https://www.bna.com/water-infrastructure-among-n57982088642/, accessed 2/22/2018
[26] Food & Water Watch (2017): Trump's Water Infrastructure Plans in Two Words: Higher Rates, accessed on 1/10/2018

3.2.1 Aging Water Infrastructure

To supply the nation's homes and businesses with water, the United States depend on a country-wide network of aging underground pipes, many of which are reaching or have exceeded the end of their useful life. As stated earlier in this study, according to the American Water Works Association (AWWA), updating the water infrastructure will cost $1 trillion over the course of the next 25 years.

The effect of the aging water infrastructure far extends public usage as U.S. businesses rely directly or indirectly on the water infrastructure, and in light of the aging and outdated technology, business operations will be greatly impacted through utility service interruptions, polluted drinking water, and higher water bills. The EPA estimates that it could cost between $2,500 to $8,000 to replace a typical home's full service line with total costs on a national level between $16 billion to $80 billion.[27] Furthermore, about 6 billion gallons of treated water are lost every day due to broken and leaky pipes alone according to the American Society of Civil Engineers.

However according to expert interviews, repairs to the underground water infrastructure are often only made when failure occurs and only act as a short term solution.

William Young, Chairman of the Florida Section of the American Water Works Association and Utilities Director at St. Johns County, highlighted that pipe breaks in Florida occur on a daily basis. However once noticed, authorities are relatively quick about fixing these issues. [28]

As wastewater infrastructure of municipalities across the United State are old and in disrepair, environmental events can also have significant effects on the state's water infrastructure. For example, in September 2017, Hurricane Irma hit the mainland of Florida, which lead to the evacuation of millions of Americans. In terms of Florida's water infrastructure, heavy rains and flooding from storm surges caused by the hurricane overran sewage treatment plants that already were taxed by rapid population growth and deferred maintenance. In the City of Delray Beach located on Florida's east coast, 70 % of the city's sewage pumping stations lost power which contributed to sewage backups. Although hurricane Irma affected Florida's water infrastructure only temporarily, rising sea water levels most likely will impose similar, but permanent effects on Florida.[29]

Based on ASCE's estimates there is a need to invest a total of $123 billion annually in water infrastructure over the next 10 years (in current 2016 dollars) to achieve a good state of repair.[30]

The aging wastewater systems in Florida have led to a declining condition of installed treatment and conveyance over the years. According to Addie Javed, who is the former President of the Florida Section of the American Society of Civil Engineers, deferred maintenance as the biggest problem as sooner or later large investments for maintaining Florida's water infrastructure will have to be made. He identifies tightening budgets as the key reason why costly maintenance has been deferred in the States. Mr. Javed also explained, that much of Florida's infrastructure has reached the end of its useful life and that the swelling population makes future investments into Florida's water infrastructure even more important.[31]

Wisconsin faces similar problems. The American Society of Civil Engineers estimates that the state of Wisconsin will need about $1 billion over the next 20 years to rehabilitate domestic clean water infrastructure. Another $6.33 billion is needed to repair the wastewater system and restore them to proper working conditions.[32]

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[27] Berkey (2017): Understanding Aging Water Infrastructure in the US, accessed on 1/10/2018
[28] Expert Interview with William Young, Chairman of the Florida Section of the American Water Works Association and Utilities Director at the St. Johns County
[29] Think Progress (2017): Florida's sewage infrastructure woes come gushing to the surface with Irma, accessed on 12/08/2017
[30] Value of Water Campaign (2017): The Economic Benefit of Investing in Water Infrastructure, accessed on 1/10/2018
[31] New York Times (2017): Irma Will Test Florida's Infrastructure, From Dikes to Sewage Plants, accessed on 12/08/2017
[32] American Society of Civil Engineers (2017): 2017 Infrastructure Report Card for Wisconsin, accessed on 12/10/2017

To react to the aging and deteriorating water infrastructure, the EPA created a review on how to enforce that the states adequately monitor and report drinking water sampling results from public water systems (PWSs) through the Safe Drinking Water Act (SDWA). Secondly, the EPA aimed to determine how the agency could improve its overall oversight of state drinking water sampling programs. The review concluded that there are limitations to the EPA's oversightthat affect the agency's ability to actually maintain a consistent oversight of the national drinking water program. Furthermore, these limitations of the EPAreduce the reliability of EPA monitoring and reporting data. In order to correct these issues and to address these limitations, the agency is engaging in ongoing activities.

"EPA works with collaborators and stakeholders to conduct projects that will fill identified aging drinking water and wastewater research gaps," said Thomas Speth, Director of the Water Supply and Water Resources Division at the EPA's National Risk Management Research Laboratory. "The application of new technologies and management practices from this research could also narrow the large funding gap."[33]

3.2.2 Contamination

Another problem for the aging water infrastructure is contamination. According to the EPA, at least 10 million homes and buildings in the U.S. receive water from lead pipelines.[34] Every year across the country, there are approximately 240,000 water main breaks and as many as 75,000 yearly sanitary sewer overflows that discharge three to ten billion gallons of untreated wastewater, leading to some 5,500 illnesses due to exposures to contaminated recreational waters.[35]

As a result of the nation's severely outdated sewer systems and due to the lack of capacity for the growing population, billions of raw sewage is discharged into local surface water every year when heavy rains exceed the capacity of the sewer systems.

Sanitary Sewer Overflows (SSO) are a significant problem in the Southeast of the U.S. due to aging water infrastructure. In 2013, the Miami-Dade County agreed to invest $ 1.6 billion in rehabilitating its existing wastewater treatment plants and collection and transmission system within the next 15 years to eliminate these SSOs. Within the State of Florida, Miami-Dade County's commitment to address its sewage problems is a leading example and underlines the importance of reducing SSOs. The county also has been implementing and developing management operation and maintenance programs to minimize 211 sanitary sewer overflows that occurred in the county the between January 2007 and May 2013.[36]

Furthermore, the aging water systems are burdened by increasing populations and are struggling to treat and remove new and persistent chemicals found in the wastewater.

At least 20 million Americans in 33 states have perchlorate in their drinking water supply that can affect the development of the brain and possibly lead to developmental disabilities and cancer. The EPA already has this on their radar but other chemicals such as trichloroethylene (TCE), hexavalent chromium, and atrazine remain in drinking water supplies nationally.[37]

Other studies have found the presence of other chemicals, antibiotics, and hormones from pharmaceuticals in the water supply, as a result of improper disposal, urinary excretion and waste from the manufacturing processes.
The presence of these various chemicals in the water supply complicates water treatment and elevates pollution in the drinking water.

3.2.3 Urbanization and Agriculture

[33] EPA: EPA Research Highlights - Aging Water Infrastructure, accessed on 1/10/2018
[34] Berkey (2017): Understanding Aging Water Infrastructure in the US, accessed on 1/10/2018
[35] EPA: EPA Research Highlights - Aging Water Infrastructure, accessed on 1/10/2018
[36] The United States Department of Justice (2013): Miami-Dade Agrees to $1.6 Billion Upgrade of Its Sewer System to Eliminate Sewage Overflows, accessed on 01/08/2017
[37] Antonia Sohns: Water pollution, old infrastructure contaminates water supplies, accessed 1/11/2018

In Wisconsin one of the leading problems of water quality issues is polluted runoff from agriculture.

In Florida, agriculture also accounts for a significant portion of Florida's freshwater withdrawals and also contributes to the gradual deterioration of the state's water quality, which directly affects the state's natural water reservoir and environment. The United States Geological Survey (USGS) published the report "Water Withdrawals in Florida, 2012", which gives a general overview of water use by category and by water management district. The report underlines the importance of groundwater sources which supplied drinking water to 17.699 million residents which equaled 93% of the state's population and 4,173 Mgal/d of groundwater withdrawals in 2012. Fresh surface water, all from public water-supply systems, provided 1.375 million residents, which equaled 7% of Florida's population in 2012.

Agricultural self-supplied was the largest user of freshwater in Florida in 2012. The term "Agricultural self-supplied use" is defined by all water withdrawals for crop irrigation and also for all other agricultural and farming operations. It accounted for 39% of all Florida's freshwater withdrawals in 2012 which equals a total of 2,505 Mgal/d. 56% (1,400 Mgal/d) of these freshwater withdrawals were supplied by groundwater's, whereas the remaining 43% (1,105) were supplied by surface water. The majority of water for agricultural irrigation purposes in Florida is freshwater, only 73 Mgal/d of reclaimed wastewater was used for irrigation purposes additional to freshwater supplies. 99% (2,480 Mgal/d) of the water used in agriculture are used for the irrigation of crops whereas only 1% (25 Mgal/d) is used for no irrigational causes related to livestock and fish farming. There are a 2.744 million acres of cropland in Florida, 1.493 million acres, which is the majority of cropland (54%), were estimated to be irrigated.[38]

In large parts of southern Florida, water quality has been deteriorating gradually by human activities resulting in high nutrient concentrations of water, primarily through agricultural activities. The high levels of nutrient concentration then contribute to the over-enrichment of surface waters, including important natural systems, such as Lake Okeechobee and the northern Everglades. The source of these high phosphorus concentrations is fertilizer used in agricultural runoff. Phosphorus then enters the northern Everglades and significantly contributes to the ecosystem degradation.[39]

To conclude, the agricultural runoff in Florida not only accounted for 39% of the states freshwater withdrawals. However, agricultural runoff is also related to deteriorating the overall water quality in Florida and has significant impacts on its environment and ecosystems.

Wisconsin has the largest number of public water systems in comparison to all other states in the U.S., around 11,408. The largest share consists of municipal community water systems owned by cities, villages, towns or sanitary districts with the biggest municipal water system, Milwaukee Water Works, serving almost 650,000 residents. Additionally, non-community water systems serve workplaces, schools, restaurants, and other public venues with 10,354 non-community systems statewide, whose water comes from privately owned wells. This group of systems is divided into transient non-community systems, which serve primarily motels, campgrounds, and non-transient non-community systems, which serve a similar population including schools, and day care centers. Overall, Wisconsin has 9,463 transient non-community systems.

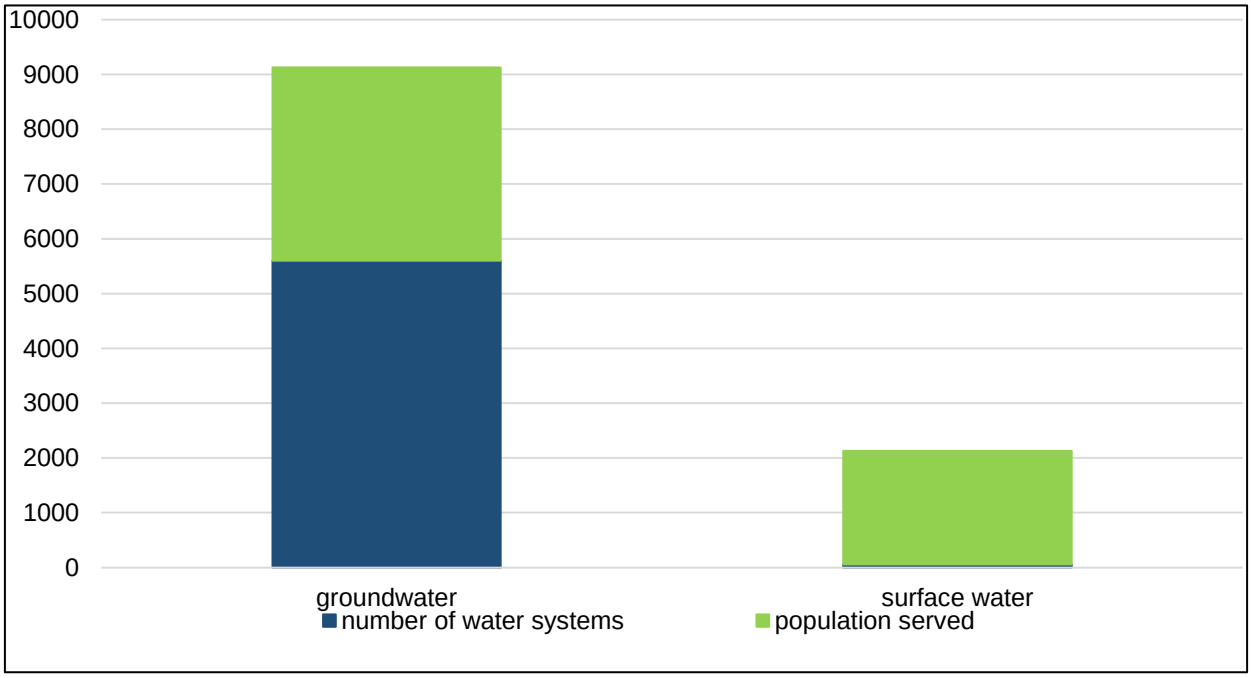
Similar to many areas across the Midwest, most public water systems in Wisconsin rely on groundwater. However, some of the largest communities such as Milwaukee and Green Bay, receive water through one of 56 surface water systems, which receive water from one of Wisconsin's numerous lakes. Even though most of the state's public water systems rely on groundwater, the surface water systems, encompassing one percent of all water systems, serve 37% of the state's population as shown in Figure 6 below.[40] This relatively high population dependence on surface water systems highlights the state's reliance on the Great Lakes and their environmental stability.

[38] United States Geological Survey (2012): Water Withdrawals in Florida, 2012, accessed on 12/19/2017

[39] United States Geological Survey: Major Findings, accessed 12/19/2017

[40] Wisconsin Department of Natural Resources Bureau of Drinking Water and Groundwater (2017): Wisconsin Public Water Systems 2016 Annual Drinking Water Report, accessed on 1/10/2018

Figure 6: Ratio of the number of water systems in Wisconsin to the number of population served

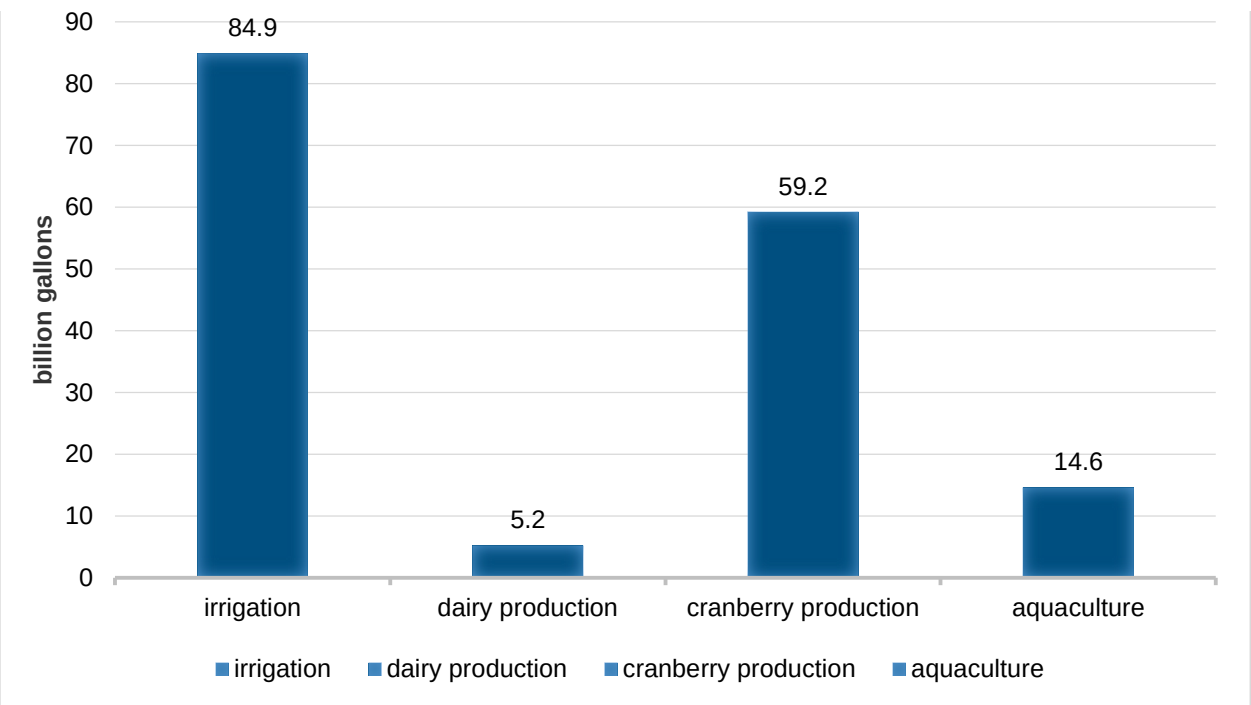


Source: Own diagram based on Wisconsin Department of Natural Resources Bureau of Drinking Water and Groundwater (2017): Wisconsin Public Water Systems 2016 Annual Drinking Water Report, accessed on 1/10/2017

Though appearing to have an almost unlimited supply of freshwater supplied by the Great Lakes and other abundant lakes, Wisconsin has more than 12,000 registered sources that actively withdraw water. In 2015 this exceeded 2.04 trillion gallons.

High water withdrawal puts stress on the natural ecosystems and are a significant contributor to Wisconsin's impending water infrastructure issues. For example, Wisconsin's agricultural landscape, largely comprised by dairy production, relies heavily on a constant, reliable supply of clean water. Agricultural production accounted for 5,171 billion gallons of withdrawn water in 2015. Figure 7 depicts the withdrawn water by Wisconsin's largest agricultural industries in 2015.

Figure 7: Water withdrawal in Wisconsin's agriculture in 2015



Source: Own diagram based on Wisconsin Department of Natural Resources Bureau of Drinking Water and Groundwater (2017): Wisconsin Public Water Systems 2016 Annual Drinking Water Report, accessed on 1/10/2018

As a result of manure spills in dairy operations, 14% of domestic wells in Wisconsin have higher nitrate concentrations than recommended. The EPA estimated, that a dairy farm with 2,000 cows produces more than 240,000 pounds of manure per day, which adds up to nearly 90 million pounds a year. In comparison, this is about as much nitrogen as a sewage of a community with 50,000-100,000 people would produce. About one third of all the private wells in Kewaunee County experienced nitrate pollution in 2016, and additionally, La Crosse County reported about 2,000 possible bacteria or nitrate pollutions in wells in early 2017.[41]

In addition to nitrate pollutants, the state also suffers from lead in drinking water lines, toxic algae, sewage overflows from overburdened wastewater systems and impacts from extreme weather events.[42] Traces of pharmaceutical drugs found in drinking water and in recycled water are also problems.

This problem is not unique to the United States; Germany also struggles with nitrate contamination of groundwater due to agricultural practices. The use of excessive mineral fertilizer, as well as slurry, has resuled in up to eight times the legal value of nitrate in groundwater in North Rhine Westphalia, Lower Saxony and parts of Bavaria. Only a handful of German cities match the threshold of 50mg nitrate per litre. One solution to combate increased nitrate levels is to mix contaminated water with uncontaminated water, drill deeper wells or move the wells entirely. Some companies are also trying to rent the land above the wells. Since currently no longterm solution exists, experts expect to start obtaining fresh water from other areas where the contamination is not as severe and results in a need to update the infrastructure, which ultimately will result in an estimated water price increase of 62%.[43]

[41] Wisconsin State Journal (2017): Study: Wisconsin will face huge water infrastructure problem, accessed on 12/10/2017
[42] Great Lakes Commission des Grand Lacs (2017): Water Infrastructure Priorities for the Great Lakes, accessed on 12/10/2017
[43] WELT Online (2017): In diesen Regionen ist das Grundwasser besonders belastet, accessed on 02/15/2017

3.3 Regulatory Environment

Nationwide Regulatory Environment

In terms of the regulatory framework in the U.S., the Clean Water Act (CWA) creates the basic structure for regulating dischargers of pollutants into water resources and the quality standards for surface waters. Under this nationwide law, the EPA implemented pollution control programs, for example, by setting wastewater standards.[44] The basis of the CWA was enacted in 1948 under a different name and officially became the Clean Water Act with amendments in 1972.

The Safe Drinking Water Act (SDWA) was initially passed in 1974; it applies to every public water system in the U.S. (more than 170,000) and aims to protect the public health by regulating the nation's public drinking water supply. The SDWA originally focused primarily on providing safe drinking water at the tap and was further extended in 1996. Source water protection, operator training, public information and funding for water system improvements were added admendments to the law.[45] One of the main differences between the CWA and the SDWA is that the latter covers groundwater, whereas the CWA does not. The EPA administers the SDWA on a state level and then delegates these responsibilities to the local authority.

In terms of the regulatory framework for distribution systems on a national level, the following EPA drinking water regulations hold:

Table 3: Overview of EPA drinking water regulations

Name of EPA drinking water regulation	Explanation
Surface Water Treatment Rules	**Disinfectant residual and sanitary survey requirements.**
Stage 1 and 2 Disinfectants and Disinfection Byproducts Rules (DBPR)	**Monitoring for DBPs in the distribution system.**
Ground Water Rule	**Sanitary surveys.**
Total Coliform Rule	**Monitoring for bacterial contamination in distribution systems**

Source: Based on United States Environmental Protection Agency (2017): Drinking Water Distribution Systems, accessed on 12/12/2017

Water Quality Standards in Florida

In Florida, the following Water Quality Standards are in effect for CWA purposes and are listed below:

Table 4: Sections overview of Florida Administrative Code addressing water quality standards

Name of Section	Content
Section 62-4 – Permits (Effective July 24, 2017)	**This document contains all of Section 62-4, although only 62-4.242 through 62-4.246 include water quality standards provisions. Not all sections are effective for Clean Water Act purposes.**
Sections 62-600.120 and 62-660.300, F.A.C.	**This document contains sections 62-611.450, 62-611.500, and 62-611.600 that address treatment and receiving wetland, including discharge limits, permitting requirements, and standards apply within the waterbodies.**
Section 62-303 - Identification of Impaired Surface Waters (Effective July 24, 2017)	**This document establishes the methodology and protocols by which the state identifies, lists, and delists impaired surface waters.** It gives further information about the components of water quality standards, designated uses, criteria for water quality, ant degradation policies and more.
Section 62-302 - Surface Water Quality Standards (Effective October 19, 2017)	**This document establishes water quality standards for surface waters.** For further information on water quality standards, please refer to the following attachments: • Attachment A - Provisions of the March 2013 Implementation Document that constitute new or

[44] United States Environmental Protection Agency (2017): Summary of the Clean Water Act , accessed on 12/08/2017

[45] United States Environmental Agency (2004): Understanding the Safe Drinking Water Act (2004), accessed on 12/08/2017

	revised water quality standards • Attachment B - Provisions of the Process for Reclassifying the Designated Uses of Florida Surface Waters document that constitute new or revised water quality standards • Attachment C - Provisions of the SCI Primer document that constitute new or revised water quality standards • Attachment D - Related to Location of Endangered Species Specific Dissolved Oxygen Criteria • Attachment E - List of CWA Effective Type I and Type II Site Specific Alternative Criteria (SSAC)

Source: Based on United States Environmental Protection Agency (2017): Water Quality Standard, accessed on 12/08/2017

The State of Florida also established a number of Site Specific Alternative Criteria (SSACs) which are in effect for Clean Water Act purposes. These criteria are either adopted or established by Secretarial order. In the past, the specific SSAC have not been listed in the water quality standards regulations.

Several Water Quality Standards Variances were adopted by Florida and submitted to the EPA for approval, in the past, these variances have not been included in Florida's water quality standards regulations.

Table 5: Sections of Florida Statute (F.S.) addressing water quality standards

Name of Section of Florida Statute (F.S.)	Content
Everglades Forever Act, Section 373.4592(4)(f), F.S.	**Provision from Everglades Forever Act addressing best management practices in the Everglades Agricultural Area (EAA).**
Grizzle-Figg Statute, Section 403.086, F.S.	**This provision addresses sewage disposal facilities and advanced secondary treatment of discharges from such facilities.**
Florida Statute (F.S.) 403.0882 Discharge of Demineralization Concentrate (Effective December 13, 2006)	**Please note that only sections 403.0882(4) and 403.0882(6) were updated in December of 2006.**

Source: Based on United States Environmental Protection Agency (2017): Sections of Florida Statute (F.S.) addressing water quality standards, accessed on 12/08/2017

Water Quality Standards in Wisconsin

The water system in Wisconsin is mainly managed by the Wisconsin Department of Natural Resources (WDNR), headquartered in Madison, WI, with four satellite centers and local offices across the state. The WDNR works closely with public water systems, professional associates, and individual operators, local agencies, the EPA, water consumers and many more to protect and manage natural resources while supporting the economy and the well-being of the state's citizens. In Wisconsin, the DNR is responsible for enforcing and implement the SDWA.[46] Its authority derives from Chapter 281, Part 12, Wisconsin Statutes.[47]

Figure 8: Wisconsin Department of Natural Resources: Service/Satellite Center Locations by Region

Northern Region | Northeast Region | West Central Region | South Central Region | Southeast Region

Source: Wisconsin Department of Natural Resources: DNR service/satellite center locations by region, accessed 01/10/2018

[46] Wisconsin Public Water Systems 2017: Annual Drinking Water Report, accessed on 12/10/2017
[47] Wisconsin State Legislature: Statutes Chapter 281, accessed on 01/10/2018

In Wisconsin, the following water quality standards are in effect for CWA purposes:

Table 6: State Standards in Effect for CWA Purposes in Wisconsin

Name of Chapter	Content
Chapter NR 2. Procedure and Practice	Document contains rules that apply during all hearings and proceedings before the department of natural resources unless otherwise specified.
Chapter NR 102. Water Quality Standards for Wisconsin Surface Waters (Effective March 7, 2011)	This document, in conjunction with NR 103 to 105 establishes water quality standards for surface waters of the State.
Chapter NR 103. Water Quality Standards for Wetlands	This document establishes water quality standards for wetlands.
Water Quality Standards for Wetlands	This document provides background for NR 103 Water Quality Standards for Wetlands and guidance for its implementation.
Chapter NR 104. Uses and Designated Standards (Effective September 30, 2004)	This document specifies the designated uses, effluent limitations, provisions for changes, and applicable variances for intrastate and interstate waters of the State.
Variances from Water Quality Standards Since 2004 (Effective August 16, 2017)	This table presents approved variance changes that have occurred since the 2004 Wisconsin Water Quality Standards.
Chapter NR 105. Surface Water Quality Criteria and Secondary Values for Toxic Substances	This document establishes water quality criteria, methods for developing water quality criteria and secondary values for toxic substances.
Chapter NR 106. Procedures for Calculating Water Quality Based Effluent Limitations for Point Source Discharges to Surface Waters	This document specifies the calculation of water quality based effluent limitations and subsequent inclusion of limitations in Wisconsin pollution discharge elimination system (WPDES) permits.
Chapter NR 205. General Provisions	The document specifies definitions for use in Chapters 200-298.
Chapter NR 207. Water Quality Ant degradation	This document sets forth the ant degradation implementation procedures for the ant degradation policy in NR 102.5.
Chapter NR 217. Effluent Standards and Limitations for Phosphorus	This document establishes effluent standards and limitations, including water quality based effluent limitations, for phosphorus in effluent discharged to surface waters of the state.
Chapter 227. Administrative Procedure and Review (Effective February 6, 2017)	This document provides the administrative procedure and review provisions of Wisconsin's statute.
Chapter 281. Water and Sewage (Effective February 6, 2017)	This document grants necessary powers and organizes a comprehensive program under a single state agency for the enhancement of the quality management and protection of all waters of the state, ground and surface, public and private.
Chapter 283. Pollution Discharge Elimination (Effective February 6, 2017)	The document grants the department of natural resources all authority necessary to establish, administer, and maintain a state pollutant discharge elimination system. Chapter 283.15 describes the process for establishing water quality standard variances. Chapter 283.16 establishes the statewide variance for phosphorus.
Stream Classification Guidelines for Wisconsin	This document describes potential stream designated uses and provides a basis for making and supporting water quality management decisions.

Water Quality Rules Implementation Plan	This document describes the implementation of water quality regulations adopted by the State in 1997.
Mixing Zone Guidance for Chronic Toxicity and Zones of Initial Dilution	This document provides guidance on the selection of the correct mixing zone size for chronic toxicity mixing zones and zones of initial dilution.

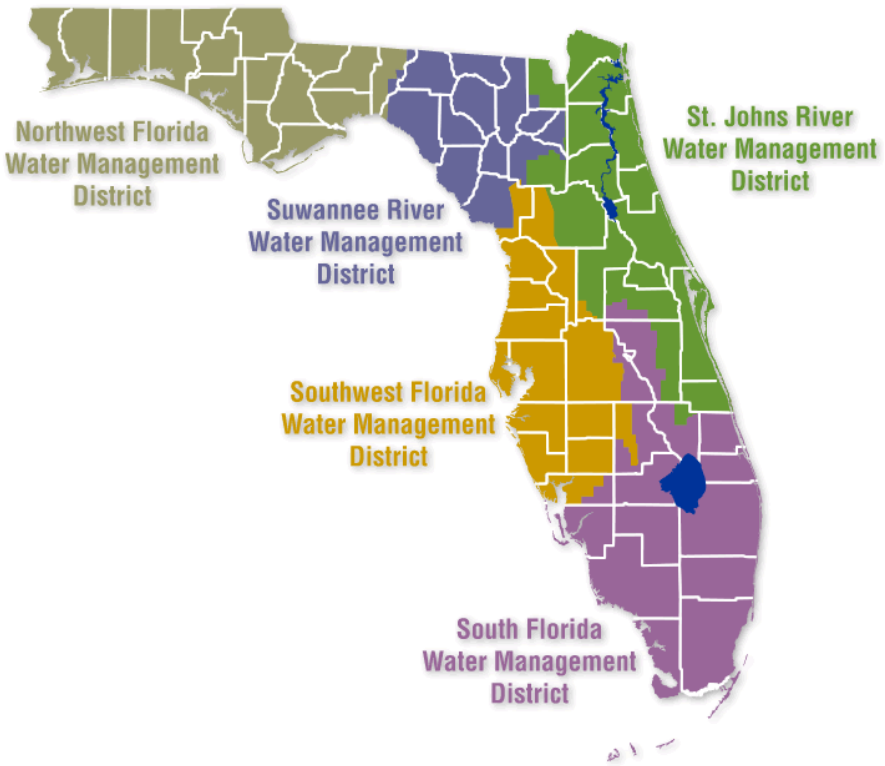
Source: Based on United States Environmental Protection Agency: Water Quality Standard, accessed on 01/10/2018

As stated earlier, in 2016, 99% of the public water systems in Wisconsin met EPA requirements, high above the national average and despite roughly 76 systems monitoring higher contaminations including bacteria, nitrate arsenic and radioactive chemicals such as radium and uranium. Also previously noted, a bigger problem than violations of contaminant levels were public notice regulations where 15 percent of all water systems that experienced mainly nitrate and bacteria contamination, failed to announce it publicly. In contrast, various programs contracted by the DNR offer technical assistance, training and compliance support to improve Wisconsin's water system, such as inspections, assessments and water sampling done by county health departments or trainings for new water systems operators done by the Moraine Park Technical College and the Wisconsin Rural Water Association.[48]

Regulatory Environment in the State of Florida

The Florida Department of Environmental Protection (DEP) is responsible for regulating public water systems in Florida, its authority derives from Chapter 403, Part IV, Florida Statutes. Water systems that are not classified as public water systems, yet supply water for public consumption, are regulated by the Florida Department of Health and the county health departments.[49] The DEP is the state's primary agency with 6 regional offices that protect Florida's natural resources on a state level with a mission to create strong community partnerships by collaborating with local businesses, associations and residents. More precisely, it applies a diversified portfolio of land and recreation, regulatory and ecosystem restoration programs and oversees permitting and compliance activities which protect Florida's natural resources. DEP oversees 175 state parks and trails, with approximately 12 million acres of public lands and 4 million acres of coastal areas and submerged land.[50]

[48] Wisconsin Public Water Systems 2016: Annual Drinking Water Report, accessed on 12/10/2017
[49] Florida Department of Environmental Protection (2017): Source & Drinking Water Program , accessed on 12/08/2017
[50] Florida Department of Environmental Protection (2017): About DEP, accessed on 12/06/2017



Source: Lucas Lindsey: Growth Management, accessed on 1/26/2018

The State of Florida also established a number of Site Specific Alternative Criteria which are in effect for Clean Water Act purposes. These criterias are either adopted or established by Secretarial order and historically have not been listed in the water quality standards regulations.

Table 7: Sections of Florida Statute (F.S.) addressing water quality standards

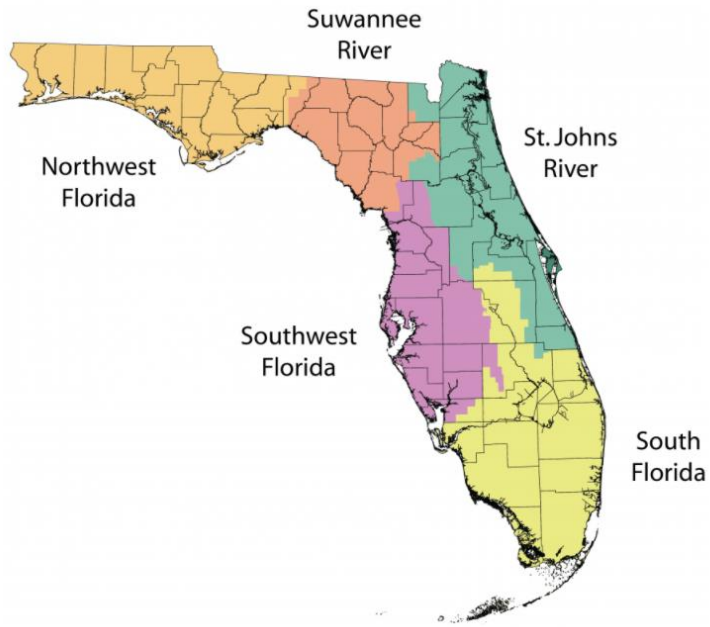
Name of Section of Florida Statute (F.S.)	Content
Everglades Forever Act, Section 373.4592(4)(f), F.S.	Provision from Everglades Forever Act addressing best management practices in the Everglades Agricultural Area (EAA).
Grizzle-Figg Statute, Section 403.086, F.S.	This provision addresses sewage disposal facilities and advanced secondary treatment of discharges from such facilities.
Florida Statute (F.S.) 403.0882 Discharge of Demineralization Concentrate (Effective December 13, 2006)	Please note that only sections 403.0882(4) and 403.0882(6) were updated in December of 2006.

Source: Based on United States Environmental Protection Agency (2017): Sections of Florida Statute (F.S.) addressing water quality standards, accessed on 12/08/2017

DEP has a general supervisory authority over all five Water Management Districts through cooperative working relationship and guidance memos. The five Water Management Districts then administer water resources on a regional level by focusing on four core responsibilities: water supply, water quality, flood protection and floodplain management and natural systems [51]

Figure 10 illustrates the location of each of the five Water Management Districts in Florida and their geographic responsibility.

Figure 9: Overview of Florida's five Water Management Districts



Source: Florida Department of Environmental Protection: Water Management Districts, accessed on 12/06/2017

3.4 Financing Opportunities

The estimated funding needed for the water sector in the United States is over $1 trillion over the next 25 years and municipals are facing significant funding gaps despite new initiatives and existing programs. Tony Mardam, Vice President Water Market Leader by Stanley Consultants, states that funding streams to build or improve the infrastructure have changed over the years. For example, significant grants existed in the 1980's, where a majority of the financial burden was covered at the national level.

Currently, there are several funding programs regarding investments into water infrastructure, both on a national and state level, with the two most prominent programs being the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund; further details found in the following paragraphs. The majority of these funding programs are based on a strong partnership between the EPA and the individual state. Eligible applicants of funding include municipalities and local governments including sanitary districts, sewage districts, public inland lake protection and rehabilitation districts, joint local water authorities and federally recognized tribes or bands.

Clean Water State Revolving Fund (CWSRF)
The Clean Water State Revolving Fund (CWSRF) program is administered by the EPA andprovides communities in all 50 states, plus Puerto Rico, a source of low-cost financing for a wide range of water quality infrastructure projects. The

[51] Florida Department of Environmental Protection: Water Management Districts , accessed on 12/06/2017

individual states contribute an additional 20% to match the amount of federal grants provided. In 2016, the CWSRF provided a total amount of more than $ 118 billion to communities and more than 38,450 loans for projects related to public health, the protection of aquatic resources and meeting environmental standards.[52,53]

The Clean Water State Revolving Fund (CWSRF) program is overseen by the local state's Department of Environmental Protection and provides funding for wastewater, storm water, energy and other types of projects. The agency receives requests for such projects throughout the year to gather information and to establish project priorities for listing projects in order to priority for funding.

Funds of the CWSRF are made available for Planning Loans, Design Loans and Construction Loans and also for disadvantaged communities. Part of the loan terms is a 20-year amortization and low interest rates, financing rates average less than 50 % of the market rate.[54]

Small Loans Program (SLP)
Within the CWSRF, the Small Loans Program exists as a subprogram that offers a less costly solution to wastewater treatment and storm water projects. Administered by the DNR, estimated project costs must be below $2 million and eligible for an interest rate subsidy.[55]

Drinking Water State Revolving Fund (DWSRF)
The Drinking Water State Revolving Fund (DWSRF) is also a federal-state partnership and administered by EPA. It grants low-interest loans to eligible entities for planning, designing and constructing public water facilities. It was created in 1996 and helps to ensure safe drinking water by providing financial support, specifically to water systems and to state safe water programs. After Congress appropriates funding for DWSRF, the EPA then awards each state grants for their DWSR. The granted amount is based on the results of the most recent Drinking Water Infrastructure Needs Survey and Assessment. In 2016, DWSRF provided more than $32.5 billion to water systems through over 12,800 assistance agreements for the following:

- improving drinking water treatment
- fixing leaky or old pipes (water distribution)
- improving source of water supply
- replacing or constructing finished water storage tanks
- other infrastructure projects needed to protect public health [56,57]

The DWSRF is administered by the local state's Department of Environmental Protection and receives joint funding both from the EPA and the respective state. In Florida, the program has awarded more than $273 million for 62 drinking water improvement projects between 2011 and 2016 and awarded more than $925 million of funds since its inception in 1998. The City of Tampa, for instance, received an $18.4 million loan in August 2016 that was executed by the DWSRF program for the installment of new water transmission mains and for the replacement of aging water pipes. Approximately 7,000 feet of 48 inch water transmission were installed to provide drinking water to southern parts of Tampa and also to improve water pressure in order to increase reliability. The funding was also used to replace over 51,000 feet of 6-inch aged water mains to avoid future maintenance and health-related issues caused by corrosion.[58]

In Wisconsin, the DWSRF funding has been used to reduce nitrate contamination in the watershed. The increased nitrate levels require additional equipment for the purification. The project focused on practices to alter nitrogen in ground

[52] United States Environmental Protection Agency (2017): Clean Water State Revolving Fund (CWSRF), accessed on 12/21/2017
[53] United States Environmental Protection Agency (2017): Learn about the Clean Water State Revolving Fund (CWSRF), accessed on 12/21/2017
[54] Florida Department of Environmental Protection (2017): CWSRF Program, accessed on 12/20/2017
[55] Department of Natural Resources (2017): Small Loans Program accessed on 1/10/2018
[56] United States Environmental Protection Agency (2017): Drinking Water State Revolving Fund (DWSRF), accessed on 12/21/2017
[57] United States Environmental Protection Agency (2017): How the Drinking Water State Revolving Fund Works, accessed on 12/21/2017
[58] Florida Department of Environmental Protection (2017): Recent Awards - State Revolving Fund, accessed on 12/21/2017

water to mitigate pollution. Going forward, the project will also focus on the effect of said practices on microbial and pesticide levels.[59]

Figure 10: Wisconsin Funding per Program by Biennium

Biennium	Clean Water Fund Program (in EUR)	Safe Drinking Water Loan Program (in EUR)
1989-91	152.6	
1991-93	395.8	
1993-95	188.5	
1995-97	224.3	
1997-99	214.9	53.0
1999-01	222.9	19.8
2001-03	502.9	20.0
2003-05	252.9	74.6
2005-07	380.9	41.4
2007-09	500.9	73.2
2009-11	461.4	71.1
2011-13	393.0	102.2
2013-14 actual**	149.4	33.4
2015-17 est**	463.1	148.0
2017-19 est**	196.6	84.9

Based on Wisconsin Legislative Fiscal Bureau (2015): Program Funding accessed on 1/10/2018

Figure 11 gives an overview of Wisconsin project funding for the various programs as estimated by the DNR and DOA. Financed at the national level and allocated at the state level, the award and approval process can be difficult to navigate for foreign entities as each state has a slightly different processes and procedures.

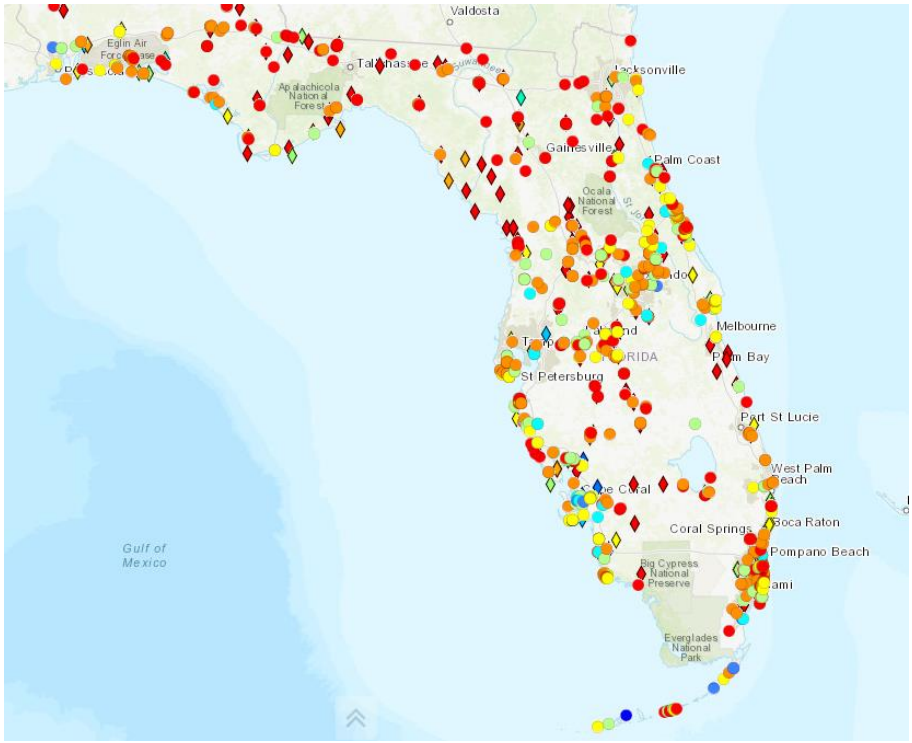
In Florida for example, the FDEP has to submit a request every year to receive any form of federal funding for their DWSRF and CWSRF programs, the so-called EPA Capacity or Cap. An essential part of the request is the intended use plan (IUP) that provides detailed information of the operation of Florida's SRF program and how exactly the requested funds will be spent. This also includes giving insights into the 20% state match that is required for the SRF and other monies earned by the program, such as repaid loans or interest.[60]

Florida applicants interested in seeking funding from the State Revolving Fund Programs must place their applications on the funding portion of either the CWSRF or DWSRF at a public meeting. The first public meeting of the fiscal year (from July to June) is always held on the second Wednesday of August. The meeting is held for both programs, CWSRF and DWSRF, during the meeting, the priority lists of funded projects are adopted for the relevant fiscal year, and subsequent meetings are then used to add eligible projects to the portfolio and are held quarterly thereafter and until funding for that fiscal year are depleted.

First, projects of the CWSRF and DWSRW are placed on the funding list at priority list meetings according to their priority score. Then, project sponsors are given the opportunity to submit their loan applications to secure funds for the projects. An overview of the Project Application Forms and all required documents and forms are given in the Drinking Water and Clean Water Program Manuals and provide support to navigate through the State Revolving Fund (SRF).[61] These manuals also provide the Request for Inclusion, which was mentioned above, as well as example documents, and checklists that are both needed and helpful to navigate through the SRW process.[62]

[59] United States Environmental Protection Agency (2017): Analysis DWSRF Fund , accessed on 1/10/2018
[60] Florida Department of Environmental Protection (2017): State Revolving Fund Resources and Documents, accessed on 12/21/2017
[61] Florida Department of Environmental Protection (2017): Priority Lists - State Revolving Fund (2017), accessed on 12/21/2017
[62] Florida Department of Environmental Protection (2017): State Revolving Fund Resources and Documents, accessed on 12/21/2017

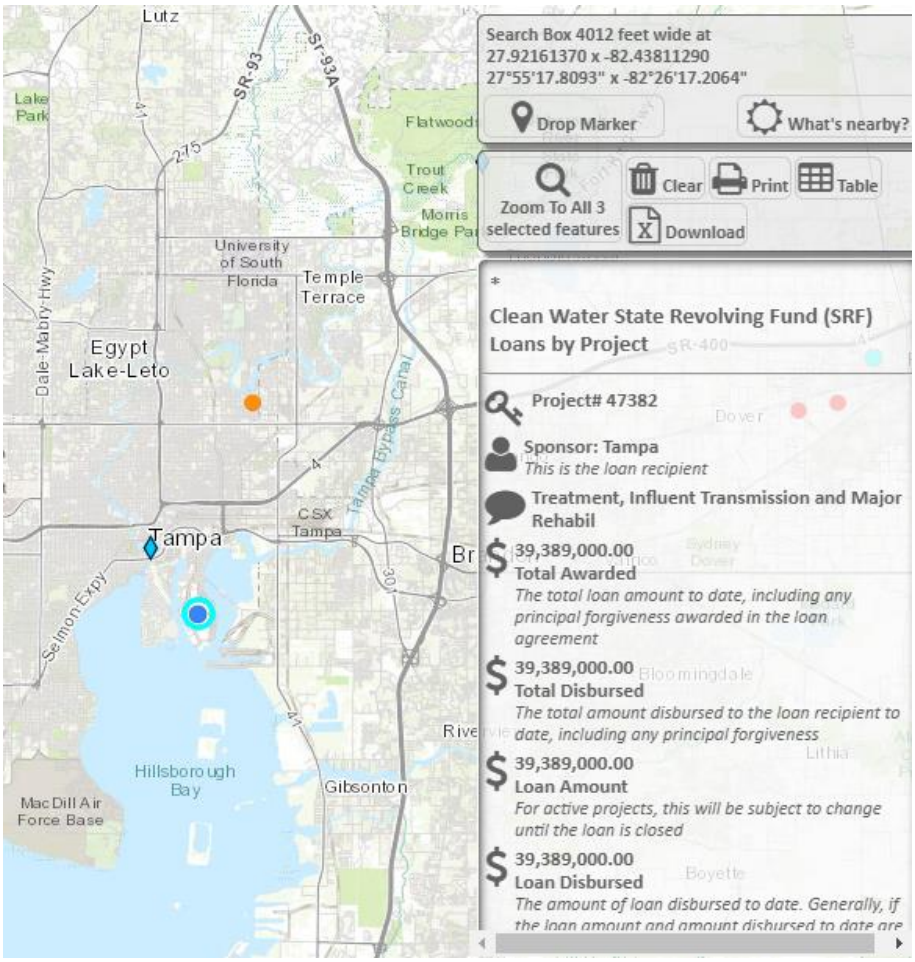
Figure 11: Map of State Revolving Fund Loans by Projects in Florida



Source: Florida Department of Environmental Protection (2017): State Revolving Fund Resources and Documents: Interactive Map of Projects , accessed on 12/21/2017

Figure 12 is based on an interactive map of projects provided by the DEP and gives further insights into both projects and sponsors that benefit from funding made available in the State of Florida. The map includes and illustrates in which location and to which extend funds such as theClean Water State Revolving Fund, the Drinking Water State Revolving Fund, or the Small Community Wastewater Facilities Grants (SCWFG) are used. When using the legend on the right hand side, which can be adjusted in the upper left corner, the interactive map also includes active water infrastructure projects that currently are conducted is . Figure 12 provides a broad overview where water infrastructure related projects in Florida are located within the state. The interactive map linked above gives precise information regarding the exact name, amount, sponsor, and financial details of each project. Figure 13 serves as an example for the City of Tampa with detailed information that is made available by the interactive map for each project. Projects are categorized by their individual project number. The interactive map then identifies the loan recipient of the project, the total loan amount to date awarded to the recipient, as well as the total amount disbursed to the loan recipient.

Figure 12: Project overview of Clean Water State Revolving Fund (SRF) Loans Project in Tampa, FL



Source: Florida Department of Environmental Protection (2018): State Revolving Fund Resources and Documents: Interactive Map of Projects, accessed on 01/26/2017

In contrast to Florida, Wisconsin applicants enter into a joint effort between the municipality, a consulting engineer and the local DNR. Prior to submitting the formal application, the applicant must submit a notice of Intent and a Priority Evaluation and Ranking Formula to the DNR. Projects will then receive a score and be put on the Project Priority List, ranked per score, and thus become eligible for funding and officially applying for funding. After being placed on the Project Priority List, the applicant obtains a checklist for the formal application for either the CWSRF or DWSRW. Similar to Florida's application process, the example documents and checklists are both needed and helpful to navigate through the SRW process. Additionally, a DNR project manager will be assigned to assist in the process and act as a guide for finding the best financial strategy.[63]

Water Infrastructure Finance and Innovation Program (WIFIA Program)

The Water Infrastructure Finance and Innovation Program (WIFIA Program) provides long-term, low-cost supplemental loans for both regional and national projects to accelerate overall investments into the U.S. American water infrastructure. It was established by the WIFIA of 2014 and is a federal credit program administered by EPA for specific water and wastewater infrastructure projects.

Eligible borrowers are for instance WIFIA program and government entities, partnership and joint ventures, corporations and trusts. Eligible projects are for instance enhanced energy efficiency projects at drinking water and wastewater facilities or brackish or seawater desalination, aquifer recharge, alternative water supply, and water recycling projects.

[63] Department of Natural Resources- Wisconsin (2017): Application Process accessed on 1/10/2018

According to Thomas Burke, Chief Professional Engineer at the Southwest Florida Water Management District, in terms of incentives, the State Revolving Fund loan program has been very effective in supporting local community programs for water and wastewater utility management. Furthermore, Mr. Burke says that in terms of policies geared towards modernizing the water infrastructure, the State of Florida administers a capital project loan program and offers small community loans and grants to encourage utility system maintenance and improvements. He further says that the SWFWMD has a well-established capital project grant program to encourage water supply, water quality, natural systems and flood protection projects throughout its 16 county region. In terms of local utility system projects, Mr. Burke states that they were commonly financed with revenue bonds supported by customer rate and user charge systems, and that the basis for such programs varied with the utility system.

In addition to national funding programs, there are also several localized funding programs. Below is a sample of the prominent localized programs in Florida and Wisconsin. A comprehensive list of all funding source for Florida and Wisconsin respectively is available from the Environmental Finance Center Network.[64, 65]

Small Community Wastewater Construction Grants Program (SCWCG)
The Small Community Wastewater Construction Grants Program (SCWCG) assists small communities and wastewater authorities in Florida in terms of planning, designing and constructing wastewater management facilities. Small communities are defined as a municipality, county or authority with both a total population equal or less than 10,000 and have a per capita income (PCI) less than the average PCI in Florida.[66]

Efficient Equipment for Agriculture, Schools, & Government (AgSG) Faculties
The Agriculture, Schools and Government programs assists educational institutions, local governments, municipals and tribe entities in obtain needed technology to improve energy efficiency. Specific for water and wastewater facilities, funding can be used for equipment upgrades, operational modifications, and upgrades to facility buildings. The program also offers study grants for renewable energy biogas projects at existing or new anaerobic digester facilities.[67]

Wisconsin Rural Water SIMPLE Loans (WRWA)
The Wisconsin Rural Water SIMPLE Loans programs provides an alternative conventional bond sale for various projects including sewer and water facilities, street improvements, building improvements, refinancing of existing debt or preliminary engineering costs. The program is available to Wisconsin governments with a population greater than 250 people and with a total debt below $5,000 per capita.[68]

Despite these prominent programs and additional smaller programs, various other approaches are needed to fill in the funding gap with solutions ranging from public-private partnerships (PPPs) as with MMSD and Veolia in Milwaukee, green bonds or increased water prices to consumers. Kevin Shafer, Executive Director at MMSD in Milwaukee, states that many municipalities supplement funding of projects and improvements via two main consumer charge systems: User direct charge and property taxes. However, the majority of the project costs are funded from EPA based loan programs. Though utility companies have legal rights to consumer water prices, there is strong public opinion and political pressure to minimize rate increases. Additionally, low return on investment (ROI) for water infrastructure projects limits private investment. As a result, significant funding gaps still exist despite these additional funding initiatives.

For German companies it is important to note, that the U.S. is a popular area for economic investments as the population and markets are open to new products, ideas and investments. As the largest single market in the world, the U.S. offers several opportunities for German companies. However, obstacles do exist and must be taken into account when entering the market including cultural differences, differences in contract negotiations and liability and technical. Several regulations also vary between the individual states. As a results, forgein companies operating in the U.S. should be fully aware of the relevant legal situation at a regional and national level in order to hedge against any recourse claims.

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[64] Environmental Finance Center Network (2017): Florida Water and Wastewater Funding Sources, accessed on 1/26/2018
[65] Environmental Finance Center Network (2017): Wisconsin Water and Wastewater Funding Sources, accessed on 1/10/2018
[66] Florida Department of Environmental Protection (2017): CWSRF Program, accessed on 12/20/2017
[67] Department of Natural Resources- Wisconsin (2017): Agriculture, Schools and Government Programs, accessed on 1/10/2018
[68] Wisconsin Rural Water SIMPLE Loans (2017): WRWA Financing Program, accessed on 1/10/2018

Additionally, when importing into the U.S. it is also important to know that trade barriers exist in some geographic areas, including so-called local content requirements (ex; Buy America / Buy American).

3.5 Trends and Market Opportunities

One of the biggest issues influencing development in the water industry nationwide is financing current and future projects, especially updating the infrastructure. In many states, water utilities struggle to make ends meet since their costs are higher than what they charge for the water they deliver. Where the money to overhaul water infrastructure should come from is a hotly discussed topic all over the U.S., with the most likely solution being that water prices need to be increased. Additionally, innovations in technology are in high demand to cut down on costs long term.

The capital needed comes in part from water usage fees and local taxes. The biggest concern here is that the current fee structure does not even fully cover all costs associated with upkeeping the infrastructure. In fact, only a little more than one-third of water utilities earn enough revenue to cover all operating costs.

Most water utilities with a usage based fee structure struggle, especially, since water usage drops with higher prices. Less water usage may be good in terms of water conservation, but it does not help with covering costs. A commonly suggested solution to lessen the pressure on utilities by shifting a greater degree of cost recovery from a usage based fee to fixed fees.[69]

Shifting the cost of improving the water infrastructure over to the consumer is a sensitive matter, since a drastic raise in prices can have big consequences for the population. One example is the city of Chicago, were the costs for replacing water mains was financed through a raise of water prices by about 90% over the course of four years. This resulted in many lower-income residents not being able to pay their water bills and water supply shut offs. As a result, the residents could not shower, use the bathroom or wash dishes anymore because they did not have the money to pay the water bill.

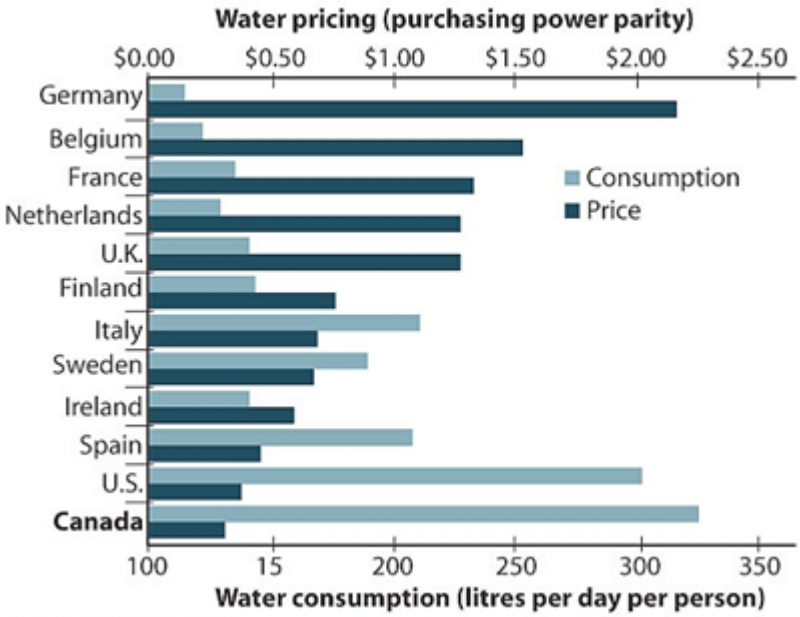
One question that arises is, why are their significant price differences in different regions and how do these differences develop. The reason for this price gap is that water prices depend on water supply, the population income and on the infrastructure issues of the respective community. Water prices in Milwaukee, for example, are one of the lowest nationwide, since Wisconsin has an abundent water supply and minimal infrastructure issues. The price for water is currently $2.02 per 100 cubic feet. The average single family customer that uses 1,500 cubic feet of water per quarter has a water usage charge of $30.30 per quarter.[70] An average residential customer in Florida uses about 2,100 cubic feet of water quarterly. The Florida resident pays a monthly combined water and sewer bill of $42.53, which results in $127.59 per quarter or $6.08 per 100 cubic feet.[71]

These numbers show that U.S. water prices in relation to water consumption are relatively low and futher depicts the significant difference between Germany and the U.S. in the water sector. The fact that U.S. water consumption is so high offers, especially in terms of water conservation, a big opportunity for German companies that want to enter the water infrastructure market.

Even though environmental protection is a significant driver for the needed infrastructure updates, all programs are heavily dependent upon their financing. Without the necessary funds, there is no way to modernize the current structures in order to minimize runoffs and contamination, or even invest in consumer engagement projects.

[69] Deloitte Insights (March 2016): The aging water infrastructure: Out of sight, out of mind?, accessed 01/11/2018
[70] City of Milwaukee: Water Use and Service Charges, accessed 01/11/2018
[71] Miami Dade County: Water and Sewer (2018): Rates, fees and charges, accessed 01/18/2018

Figure 13: Water Pricing in Relation to Water Consumption



Source: The Polaris Project: Water pricing versus water consumption, accessed 01/18/2018

Smart Technologies / Energy Generating Technologies

Due to the aging infrastructure and the lack of funding required for a complete overhaul, it is estimated that smart water technologies have the potential to become a multi-billion dollar industry over the next decade. Technological innovations make water management systems more efficient by gathering meaningful data about flow, pressure, distribution and quality, resulting in reduced water and energy consumption.[72] As a result, trends and market developments for technologies are opening up potential opportunities for companies with innovative technologies.

Climate change and urbanization have put additional stress on the aging system with smart water technologies offering a feasible solution. For example, Thomas Burke, Chief Professional Engineer at the Southwest Florida Water Management District, stated that the aging water infrastructure in Florida has financial impacts in urban areas more so than impacts on the environment. Utility reconstruction would impact streets, roads and consequently traffic and the availability for public usage. He adds that excavating and disturbing roads and other utilities always posses issues. Mr. Burke says that there was an increasing reliance on directional drilling and "No Dig" technologies. This form of technology is based on minimizing the excavation and surface disruption due to the installation, replacement or renewable of underground water infrastructure and includes underground utilities such as water, sewer, gas, and industrial pipelines. Regarding the need of maintaining and replacing the aging core water infrastructure in urban and highly developed areas, "No Dig" technologies are an attractive alternative to traditional maintenance, which includes excavations and thus disturbances of traffic, additional pollution and higher financial expenses.[73] As urbanization continues to increase, so will long term demand for smart technology.

All regions across the nation are highly interested in smart and energy generating technologies, including geothermal technology, sensors or wireless technology, which would work to offset the funding gap. For example, Gary Williams, Director at the Florida Rural Water Association, states the importance of avoiding costly and disturbing excavations, which also occur not only for repairing utilities, but also for asset management. He points out that there is a significant demand for innovative technologies capable of analyzing water infrastructure underground effectively and without having

[72] Global Opportunity Network (2017) Smart Water Tech accessed on 1/10/2018
[73] The International Society for Trenchless Technology (2018): Why Trenchless? ('No-Dig'), accessed on 01/08/2017

to excavate it. He further noted that the high demand for such technologies are based on several potential advantages, such as huge financial savings and the avoidance of traffic disturbances.[74]

This need for smart technology is further supported by William Young, Chairman of the Florida Section of the American Water Works Association and Utilities Director at St. Johns County, who stated that technologies that allow for the collection of real time data in the field of asset management are in high demand. Furthermore, he points out that Supervisory Control and Data Acquisition (SCADA) is another highly useful technology. SCADA supports utilities in their daily field work by allowing for automation and to control infrastructure processes, for instance to regulate water levels remotely and efficiently. The importance of these systems has been growing continuously and is an essential part in water technology operations. Remote Terminal Units (RTUs), a subsystem in SCADA systems, connect to sensors and convert the sensor signals to digital data and send the relevant data to supervisory streams. Thus, SCADA can be identified as a significant trend in the water infrastructure market due its importance for asset management and system control.[75] Accurate and up-to-date asset management technologies effectively evaluate the quality of water infrastructure, allowing utilities to prioritize maintaining and replacing the existing water infrastructure.

Dr. Berrin Tansel, Professor at the Florida International University's Civil and Environmental Engineering Department, underlines the importance of asset management and leakage detection to effectively upgrade the aging water infrastructure. According to Dr. Tansel, the Miami-Dade Water and Sewer Department, for instance, has implemented intensive leak detection, as well as asset management programs. A leak detection program uses sound analysis, based on sound generated by leaking water. Additionally, the water use trends of customers are analyzed for unusual water use rates or sudden increases in water usag.[76] Thus, smart technologies related to asset management and analyzing water use rates are potential opportunities for companies to enter the water infrastructure market and an important step to be taken for effectively upgrading the aging water infrastructure.

According to Steve Riedel, International Trade Representative Environmental & Energy Industries for Minnesota Trade office, improvements of sensors and smart metering technology would have a significant impact on monitoring and treating water. Specifically, sensors that monitor pollution from agricultural run-off would have lasting effects on the environment. Using Florida as an example, the effect agriculture imposes on the state's water resources increase the demand and create a trend for pollutant control technologies and source control. The South Florida Water Management District's Regulatory Source Control Programs aim to improve water quality in the region and identify source control and relevant technologies as first steps to target pollutants. These source control programs by SFWMD are based on Best Management Practices (BMPs) and focus on both the reduction of volume of water discharged offsite and the reduction of the nutrient concentration in the water discharged offsite. Following this example, there is a demand for technologies and innovative practices to reduce the impact agriculture has on Florida's water resources.[77] Sensors on pipes or other systems have the ability to detect leaks, collect weather related data, pH, temperature, turbidity, flow, pressure, and quality and have the ability to be wireless enabled. By monitoring in real time, municipalities can reduce water losses, decrease consumption, increase efficiency and increase overall service.[78]

Another technology that continuously has been growing in importance are GPS technologies. Locating underground utilities traditionally is based on representing the location and path of a pipeline based on historical "As Built" drawings, which, unfortunately, oftentimes contain positional errors. Thus, the construction of new underground water infrastructure can damage the already installed water infrastructure. Locating technologies help utilities in precisely identifying sewer and storm water pipelines and contribute to the avoidance of such accidents and damages. GPS technologies incorporate radio frequency sounds to trace underground utilities in terms of their horizontal and vertical position and thus facilitate the construction of new infrastructure. Combining GPS, GIS and digital video inspections helps utilities, system operators and construction contractors to create a better infrastructure mapping and locating system, to reduce cost, and to improve safety.

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[74] Expert Interview with Gary Williams, Director at the Florida Rural Water Association
[75] SCADASystems: SCADA Systems, accessed on 01/08/2017
[76] Expert Interview with Dr. Berrin Tansel, Professor at the Florida International University
[77] South Florida Water Management District (2018): Regulatory Source Control Programs, accessed on 01/08/2017
[78] Global Opportunity Network (2017) Smart Water Tech accessed on 1/10/2018

In terms of energy generation or energy efficiency technologies, sewer thermal or geothermal energy technologies have seen a significant increase in interest in the United States as stated by Kevin Shafer, Executive Director of MMSD. Heat from the sewers (~10 to 20 degrees Fahrenheit) could be used to heat neighboring buildings. Traditional technology requires special heat exchangers that are expensive and require high maintenance. Such technology allows for the efficient use of renewable energy sources with cost, carbon and other environmental benefits.[79]

Water management technology overall enhances the infrastructure visibility and allows for an increased situational awareness, event management and decision making and communication between stakeholders. Smart technology also helps to improve environmental sustainability of this precious resource.

3.6 Current and Future Projects

The state of Florida and the state of Wisconsin work continuously to improve their respective water infrastructures. Since the two states are on different levels of development and facing different problems, the projects conducted focus on various areas of their water systems. Current and future projects in Florida and Wisconsin are stated below.

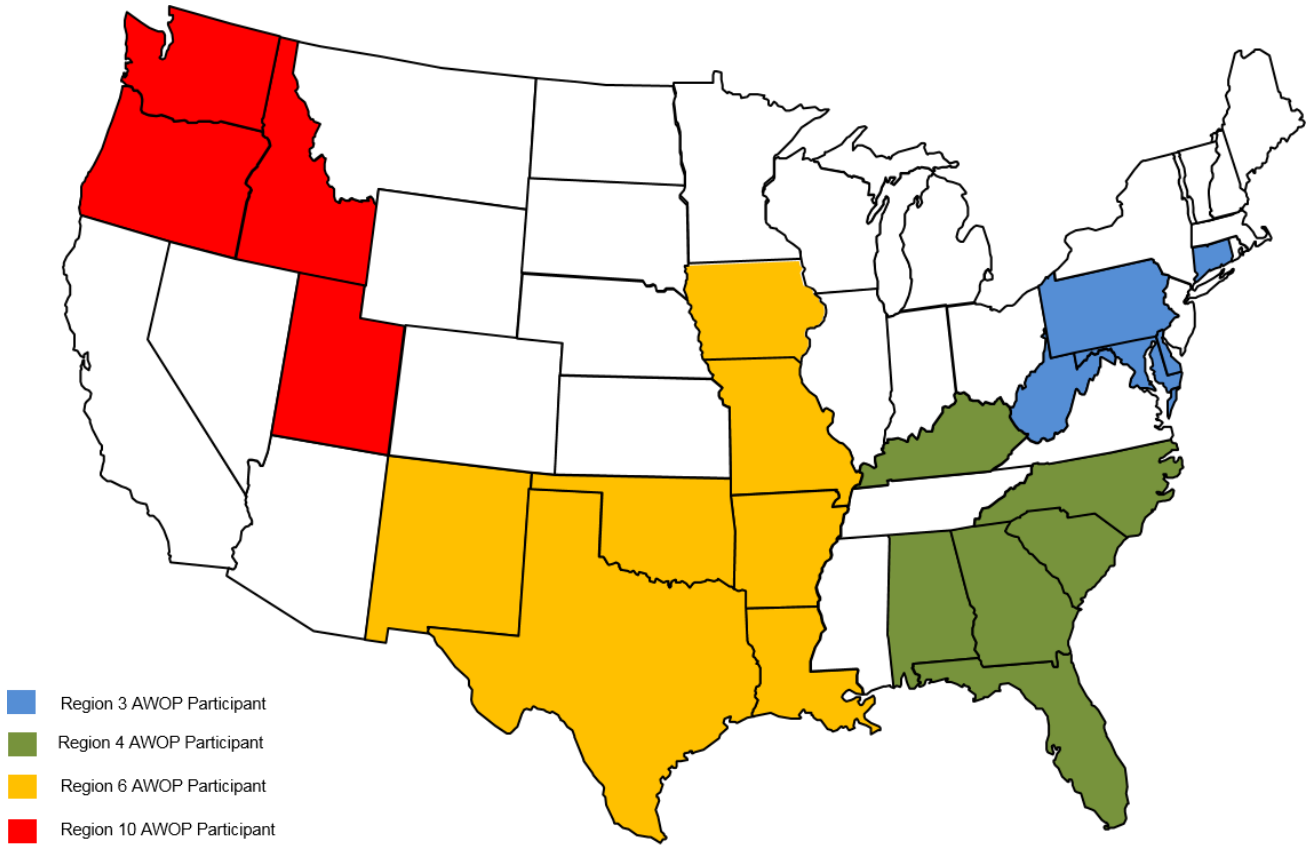
Florida

The EPA invited Miami-Dade County, Florida's Ocean Outfall Discharge Reduction and Resiliency Enhancement Project to apply for the WIFIA Loans.. In April, 2017, the EPA selected 12 projects in 9 states out of 43 projects that submitted letters of interest with the Miami-Dade County project for more than $2 billion in WIFIA loans.[80]

The Area-Wide Optimization Program (AWOP) is based on a partnership among the EPA, state agencies and various supporting organizations andas of May 2014, the state of Florida and five other states in the Southeastern region of the U.S. entered the program, which is illustrated in the following figure.

[79] Huber Technology (2017) Heat Recovery from Sewers accessed on 1/10/2018
[80] United States Environmental Protection Agency (2017): EPA Selects Miami-Dade County, Florida Project to Apply for Water Infrastructure Finance and Innovation Act (WIFIA) Loans, accessed on 12/13/2017

Figure 14: Area-Wide Optimization Programs May 2014



Source: Based on United States Environmental Protection Agency (2017): Optimization Program for Drinking Water Systems, accessed on 12/13/2017

The program provides support, tools and approaches for drinking water systems which enable them to meet water quality optimization goals and to provide an increased and sustainable level of public health protection to all their consumers. AWOP can also be utilized to support small- and medium-sized systems by providing compliance assistance through optimization. More precisely, the program focusses on teaching problem solving skills to improve operations at drinking water systems. States can choose to participate in the program, the optimization goals are relatively high, and however, the participation in AWOP comes with various benefits.[81]

Tetra Tech, a provider of engineering and consulting services focusing on water, environment, and infrastructure, assisted the City of Clearwater with the operation of an innovative treatment process pilot system to treat reclaimed water. The initial phase of the pilot testing lasted a year, concluded in June 2014 and is the longest pilot demonstration of this purification process in Florida. Through the project, the City of Clearwater was investigating the feasibility of replenishing intervals of brackish water of the Floridian aquifer system with purified water in order to create an indirect potable reuse system. The company used a multi-barrier, full advanced treatment process for purification of reclaimed water at a rate of three million gallons per day and determined the technical and financial viability of this procedure. The data collected from the pilot operationsillustrated that power treatment technologies and cutting-edge solutions in post-treatment are able to provide sustainable water supplies for the City of Clearwater's future.

This project is unique as it is the only potable reuse pilot-scale chemical post-treatment project and additionally the only pilot project to demonstrate membrane contactors, which is essential when it comes to the removal of dissolved oxygen and halting arsenic release.[82]

[81] United States Environmental Protection Agency (2017): Optimization Program for Drinking Water Systems, accessed on 12/13/2017
[82] Tetra Tech, Inc. (2017): Groundwater Aquifer Replenishment, Florida, accessed on 12/13/2017

Wisconsin

Milwaukee Water Works (MWW) is currently working on replacing water mains at 66 different locations in 11 districts.[83] Like most water mains in the United States, the ones in Milwaukee are reaching the end of their useful lives. Milwaukee has been continually investing in replacing old water mains with a goal of 15 miles of main per year in 2015 and 2016 and increasing this goal to 18 miles by 2018 and 20 miles in 2020. In previous years, the goal ranged from anywhere to 2 to 6 miles per year. From 2007 to 2015, the MWW repaired a yearly average of 431 main breaks with an average cost $2,400.00 per break. Almost half of these breaks occurred between December and February, and predominately in the 6- and 8-inch pipes. Replacement of a mile of water main costs roughly $1.2 million with new mains being made of ductile iron pipe, designed to last over 100 years. These new mains provide reliability of service, continued high quality water, as well as sufficient pressure to customers and for firefighting.[84]

Since Wisconsin is one of the more advanced states in terms of water infrastructure, the state has shifted its focus to engaging consumers in current projects. Milwaukee, for example, now focuses on engaging its consumers in order to educate about the importance of water for the region and to explain, for example, raises in water prices. One upcoming program are "Watermarks in Milwaukee" by the City as Living Laboratory – Sustainability Made Tangible through the Arts. This program aims to educate Milwaukee citizens on the importance of water systems and infrastructure through strategically placed information points across the city.[85]

Additionally, the Milwaukee Metropolitan Sewerage District's 2035 Vision is a sustainability project to improve integrated watershed management and climate change mitigation/adaptation with an emphasis on energy efficiency. In addition, the Fresh Coast 740 program was implemented to collect as much rainwater as possible to reduce water pollution and improve the quality of natural watersheds.[86]

Another project to engage the public is operated by the Milwaukee Water Commons. This project is designed to strengthen, link and expand water stewardship in the city. The organization offers various events for consumers to experience water and the water system through hands-on demonstrations.[87]

Lastly, the BREW (Business/Research/Entrepreneurship in Wisconsin) program helps startups in the water innovation field to finance their work. The program brings together companies and other professionals to accelerate business.[88]

[83] Milwaukee Water Works (2017): 2017 Water Main Replacement Projects, accessed on 12/11/2017
[84] Milwaukee Water Works (2017): Water Mains: Replacement and Repair, accessed 12/20/2017
[85] Milwaukee / City as Living Lab: Watermarks, accessed 12/11/2017
[86] Milwaukee Metropolitan Sewerage District: The Milwaukee Metropolitan Sewerage District's 2035 Vision and Strategic Objectives, accessed 12/20/2017
[87] Milwaukee Water Commons (2017): Our Programs, accessed 12/12/2017
[88] Milwaukee Water Council (2017): BREW Accelerator, accessed 12/12/2017

3.7 SWOT Analysis

The SWOT analysis below shows the strengths, weaknesses, opportunities and threads for German companies interested in entering the market. The analysis takes into account both the United States, as a whole as well as the country's water industry.

Strength (German Products)	**Weaknesses**
• Good reputation of „made in Germany" products • Understanding of water infrastructure needs • Experience with the installation and integration of smart and automated technologies • Expertise and technical know-how to adapt products to the US market • Operational data from existing business activities can be used when entering the market • If necessary product maturity • Forefrontrunner of technology and quality	• German products are considered „over-engineered" (strong focus on technical/ not enough marketing) • Time-to-Market is comparatively long • Less understanding for customer service • Products need to be adjusted according to US regulations and standards • Company presence in the US (proximity to clients is necessary) • Small or non-existent contact and service network in the US • Underestimation of different business culture • Lack of experience with regulatory environment • Funding gaps in the market
Opportunities (in the Market)	**Threats**
• high investment need in water infrastructure • Cooperation-driven competitive environment • Need for sustainable, durable and cost-effective water infrastructure technologies • Business culture keen to evolve and improve water systems • Establishment of clusters with manufacturers, suppliers, networks and research institutes	• Uncertainty regarding the new administration (e.g. in regards to trade agreements and regulations such as "Buy American") • Standards and regulations are not standardized across states • No uniform structure of US companies and decision processes • Exchange rate fluctuations • Lack of technically qualified employees

Source: Own Illustration

The SWOT analysis illustrates unique selling points of German products, as well as opportunities for German companies in the U.S. water infrastructure market and outlines potential hurdles that German companies may encounter. Products "made in Germany" as forefront runner of technology and quality are referred to as highly innovative and durable. However, in the U.S. Business environment, German products sometimes seem over-engineered. Further potential threats to a successful market entry for German companies are based on a different regulatory framework, additional licenses that have to be acquired, as well as different methods of distribution. Nevertheless, funding for water infrastructure related projects is available, potentially opening up new market opportunities for innovative, cost-effective products that are needed to build a sustainable water infrastructure.

4. Contacts in the U.S.

This section gives a general overview of government agencies, organizations and associations, and institutions that are relevant for water infrastructure. These stakeholders are categorized and then listed alphabetically and are not ranked by importance.

4.1 Government Agencies – National Level

United States Environmental Protection Agency (EPA)
The EPA is a federal agency of the U.S. and since its creation in 1970, it serves the purpose of protecting human health as well as the environment by writing and enforcing relevant regulations based on laws that have been passed by Congress.

Scott Pruitt, Administrator
1200 Pennsylvania Ave NW.
Washington, DC 20004
+1 (202) 564-4700
www.epa.gov

4.2 Government Agencies – Florida

Environmental Protection Agency (EPA) Florida
The EPA is a federal agencies, writes and enforces regulations based on law to protect human health and the environment. EPA has 10 regional offices, each of them execute the agencies programs in several states. Region 4 includes the State of Florida among Alabama, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and is managed from an office in Atlanta, Ga.

Dawn Harris-Young, Press Officer, Georgia/Florida (Water)
West Palm Beach, FL 33409
+1 (404) 562-8421
harris-young.dawn@epa.gov
www.epa.gov/fl

Florida Department of Environmental Protection (FDEP)
The Florida Department of Environmental Protection is Florida's lead agency for environmental management and stewardship regarding air, water and land. DEP is divided into three primary areas of land and recreation, regulatory and ecosystem programs. The Division of Water Resource Management (DWRM) implements state laws to protect the quality of Florida's drinking water, ground water, rivers, lakes, estuaries and wetlands; reclaims mined lands, and preserves the state's beach and dune systems.

Justin Green, Director, Division of Water Resource Management
2600 Blair Stone Road
M.S. 3500
Tallahassee, FL 32399
+1 (850) 245-8336
DWRM_Info@dep.state.fl.us
https://floridadep.gov/water

Florida Department of Transportation (FDOT)
The Florida Department of Transportation (FDOT) is an executive agency and as such, FDOT directly reports to the Governor. The agency's primary responsibility is to coordinate the planning and development of a secure and viable state transportation system serving all regions of the state.

Mike Dew, Secretary of the Central Office
605 Suwannee Street
Tallahassee, Florida 32399-0450
+1 (850) 414-4100
www.fdot.gov

Northwest Florida Water Management District
The State of Florida consists of five Water Managing Districts and are authorized by the Florida Department of Environmental Protection to protect and regulate the state's water resources. The Northwest Florida Water Management District is in the northwest of the state. In cooperation with state and federal agencies and local governments, the Water Management District ensures a clean water supply, protects, maintains and improves water quality, promotes flood protection and the protection of natural systems. The Northwest Florida Water Management District pursues Chapter 373 of the Florida Statutes.

Jim Lamar, Communications Director
81 Water Management Drive
Havana, FL 32333-4712
+1 (800) 913-1518
jim.lamar@nwfwater.com
www.nwfwater.com

South Florida Water Management District
The South Florida Water Management District is a regional governmental agency, responsible for managing the water resources in the southern part of Florida, covers 16 counties and serves a population of approximately 8.1 million people. It was created in 1949 and is the oldest and largest of the five Water Management District in Florida.

Terrie Bates, Water Resources
3301 Gun Club Road
West Palm Beach, FL 33406
+1 (561) 686-8800
tbates@sfwmd.gov
www.sfwmd.gov

Southwest Florida Water Management District
The Southwest Florida Water Management District serves a population of nearly 5 million residents in 16 counties in the southwestern region and is one of Florida's five water management districts. The district's main goals are to protect and preserve the districts water resources, minimize floods risks, protect natural systems and improve water quality in order to meet the populations water needs.

Brian Armstrong, Executive Director
brian.armstrong@watermatters.org
2379 Broad Street
Brooksville, FL 34604-6899
+1 (352) 796-7211
brian.armstrong@watermatters.org
www.swfwmd.state.fl.us/

St. Johns River Water Management District (SJRWMD)
The St. Johns River Water Management District is one of five regional water management districts in Florida. The environmental regulatory agency focusses on guaranteeing a sustainable supply of drinking water, protection water bodies in its 18 counties in northeast and east-central Florida. The main water body is the St. Johns River, a northerly flowing water body and Florida's longest river.

Ann Shortelle, Executive Director
4049 Reid Street
Palatka, FL 32177"
+1 (386) 329-4214
ashortelle@sjrwmd.com
www.sjrwmd.com

Suwannee River Water Management District
The Suwannee River Water Management District is the smallest of the five regional water management's districts in Florida in terms of population size serviced, geographical area, tax base and agency staff. The regional districts manages water and related natural resources in north-central Florida, it's responsibilities include but are not limited to providing water quality and quantity monitoring and research.

Thomas, Hugh
9225 CR 49
Live Oak, FL 32060
+1 (386) 362-1001
Hugh.Thomas@srwmd.org
www.mysuwanneeriver.com

City of Tallahassee
The City of Tallahassee's city administration oversees the maintenance, expansion and improvement of the municipality. Their responsibilities include ensuring high levels of water quality and the implementation of efficient wastewater and storm water systems. The "North Monroe Street Water and Sewer Project" is a joint project with the Florida Department of Transportation (FDOT) to renew the existing water infrastructure underneath part of North Monroe Street in Tallahassee.

Mike Tadros, General Manager
Underground Utilities & Public Infrastructure
City Hall
300 S. Adams St.
Tallahassee FL 32301
+1 (850) 891-5111
mike.tadros@talgov.com
www.talgov.com/Main/Home.aspx

City of Tampa
The City of Tampa's two designated Water Department and Wastewater Department is to deliver high quality potable and reclaimed water services to its 124,000 locations, as well as providing Wastewater services to its customers and protecting public health and the environment.

Chuck Weber, Director, Water
Tampa Municipal Office Building
306 East Jackson Street
Tampa, FL 33602
+1 (813) 274-8070
chuck.weber@tampagov.net
www.tampagov.net

Miami-Dade Water and Sewer Department (MDWASD)
The Miami Dade County is the southwestern region in Florida and includes the City of Miami. The Miami-Dade Water and Sewer Department (MDWASD) is responsible for providing water related services.

Lester Sola, Director
3071 SW 38th Ave
Miami, FL 33146
+1 (305) 665-7477
WASD_CUSTRELATIONS@miamidade.gov
www.miamidade.gov/water/

4.3 Government Agencies – Wisconsin

Milwaukee Metropolitan Sewerage District
MMSD is a regional government agency that provides water reclamation and flood management services for about 1.1 million customers in 28 communities in the Greater Milwaukee Area.

Karen L. Sands Aicp
Director of Planning, Research and Sustainability
260 W. Seeboth St.
Milwaukee, Wisconsin 53204
+1 (414) 225-2123
ksands@mmsd.com
www.mmsd.com

Wisconsin Department of Natural Resources
The DNR is dedicated to working with the citizens and businesses of Wisconsin while preserving and enhancing the natural resources of Wisconsin.

Paul B. Telander
Chief - Section of Wildlife
101 S. Webster St.
Madison, Wisconsin 53703
+1 (651) 259-5237
paul.telander@state.mn.us
dnr.wi.gov

Wisconsin Ground Water Association
The Wisconsin Ground Water Association (WGWA) is a non-profit volunteer organization whose purpose is to advance the understanding of ground water in Wisconsin.

Ms. Jodie Peotter PG
President
23713 W. Paul Rd. Unit D
Pewaukee, Wisconsin 53072
+1 (262) 522-1215
wgwa.org

Wisconsin Water Well Association
The Wisconsin Water Well Association represents over 300 licensed well drillers and pump installers. Its purpose is to increase the industry's knowledge and understanding of proper drilling, pump installation, and well abandonment techniques; work with the appropriate state agencies in the protection of Wisconsin's ground water, and increase the public's awareness of the importance of and involvement in ground water efforts.

6737 West Washington Street, Suite 4210
Milwaukee, WI 53214
+1 (414) 488-3908
www.wisconsinwaterwell.com

4.4 Organizations and Associations – National Level

Alliance for Water Efficiency
The Alliance for Water Efficiency is a stakeholder-based nonprofit organization. The organization provides information and assistance on water conservation efforts and is dedicated to the efficient and sustainable use of water.

Mary Ann Dickinson, President & CEO
33 N. LaSalle Street, Suite 2275
Chicago, IL 60602
www.allianceforwaterefficiency.org

American National Standards Institute (ANSI)
The American National Standards Institute (ANSI) oversees the creation, promulgation and use of norms and guidelines that have a direct impact on businesses in the U.S.. The institute aims to strengthen the global competitiveness of U.S. companies and to improve the U.S. quality of life.

1899 L St. NW, 11th Floor
Washington, DC 20036
+1 (202) 293-8020
www.ansi.org

American Water Works Association (AWWA)
The American Water Works Association is an international, nonprofit, scientific and educational society founded in 1881. It is the largest organization of water supply professional in the world and dedicated to provide water solutions to assure the effective management of water resources.

David B. LaFrance, CEO
6666 W. Quincy Ave.
Denver, CO 80235
+1 (800) 926-7337
www.awwa.org

Association of Water Technologies (AWT)
The Association of Water Technologies (AWT) is an international water treatment association and represents approximately 500 companies that apply water treatments for industrial or commercial cooling and heating systems. They offer their members training, certification, networking and regulatory and public awareness programs.

9707 Key West Ave., Ste100
Rockville, MD 20850
+1 (301) 740-1421
www.awt.org

International Private Water Association (IPWA)
IPWA was formed in 1999 as a reaction to reinforce the development of water/wastewater infrastructure projects and services. IPWA serves as a conduit between the public and private sector players, provides ministerial dialogues, workshops, networking receptions and project development.

Kathy Shandling, Executive Director
+1 (212) 873-0920
kshandling@ipwa1.org
www.ipwa1.org

U.S. Water Alliance
The U.S. Water Alliance is a member-supported national nonprofit organization that advances policies and programs that manage water resources and build a sustainable water future.

Radhika Fox, CEO
1010 Vermont Ave NW, Suite 1100
Washington DC 20005
+1 (415) 921-9010
RFox@uswateralliance.org

4.5 Organizations, Associations and Institutes – Florida

Florida Ground Water Association (FGWA)
The purpose of the Florida Ground Water Association is to service as a professional and technical leader in the support of the ground water industry, the protection, promotion and rational development and use of ground water in Florida. The association acts as a statewide education and information resource, communication link for its member to support all organizations,who produce, study, utilize or manage ground water or related products/services in Florida.

Danielle Jessup, Executive Director
325 John Knox Road, Ste. L103
Tallahassee, FL 32303
+1 (850) 205-5641
djessup@executiveoffice.org
www.fgwa.org

Florida International University (FIU)
The Florida International University (FIU) was founded in 1965 and with a student body of nearly 54,000, FIU is Florida's second largest university and among the top 10 largest universities in the U.S.. The institute is part of the State University System of Florida.

Kingsley Lau, Graduate Program Director
Department of Civil and Environmental Engineering
10555 W Flagler St,
Miami, FL 33174
+1 (305) 348-2824
kingsley.lau@fiu.edu
www.fiu.edu

Florida Onsite Wastewater Association (FOWA)
The Florida Onsite Wastewater Association is an organization based on members that engage in the manufacturing, installation, repair and / or maintenance of onsite sewage treatment and disposal systems and firms that service and supply the industry. The overall aim is to protect the health of Florida's residents by to improving the quality of these onsite sewage treatment and disposal facilities.

Michael Jones, President
P. O. Box 950368
Lake Mary, FL 32795-0368
Tel.: +1 (904) 545-4066
mike@metrorooter.com
www.fowaonsite.com/home

Florida Rural Water Association (FRWA)
The Florida Rural Water Association initially was founded to support small water and wastewater system in Florida, by now, the organization also benefits larger systems. The nonprofit, non-regulatory professional association offers services in the sections of wastewater treatment, groundwater/source service protection and engineering.

Gary Williams, Executive Director
2970 Wellington Circle
Tallahassee, FL 32309
+1 (850) 668-2746
Gary.Williams@frwa.net
www.frwa.net

Florida Section of the American Water Works Association (FSAWWA)
The Florida Section of the American Water Works Association (FSAWWA) is the state's premier water association with 2,771 members that include a total of 130 utility members that collectively supply more than 80% of Florida's population with potable water.

Peggy Guingona
Executive Director
1300 Ninth Street
B-124 | St. Cloud, FL 34769
Tel.: +1 (407) 957-8449
peggy@fsawwa.org
www.fsawwa.org

Florida State University (FSU)
The Florida State University (FSU) was founded in 1851 and is the oldest continuous site of higher education in Florida. There are 41,867 students enrolled to FSU, who come from every Florida county and 140 countries. The institute is part of the State University System of Florida, among 12 other universities in the State.

Lisa Spainhour, Ph.D., P.E. ,Interim Department Chair & Professor
Florida State University
600 W. College Avenue
Tallahassee, FL 32306
+1 (850) 410-6123
spainhou@eng.fsu.edu
www.fsu.edu

Florida Water and Pollution Control Operators Association (FWPCOA)
The Florida Water and Pollution Control Operators Association is an organization that consists of members that are engaged in three mayor areas: the production, treatment and distribution of drinking water; the collection, treatment and disposal of waste water and / or the collection and treatment of storm water. The organization's overall purpose is to protect the health of Florida's citizens and to preserve its natural resources.

Mike Darrow, Vice President
PO Box 33119
Palm Beach Gardens, FL 33420-3119
+1 (561) 840-0340
vice-pres@fwpcoa.org
www.fwpcoa.org

Florida Water Environment Association (FWEA)
The Florida Water Environment Association (FWEA) is a non-profit organization, its purpose is to create a clean and sustainable water environment for the state's future generations. It aims to support its members, to increase public awareness of water related topics and to promote public policy.

Tim Harley, P.E., FWEA President
P.O. Box 782164
Orlando, FL 32878
+1 (904) 209-2626
tharley@sjcfl.us
www.fwea.org

Tampa Bay Water
Tampa Bay Water is a non-profit, regional utility that supplies drinking water to more than 2.5 million people. The utility was created to plan, develop and deliver the supply of high quality-drinking water and to protect water supply sources.

Matthew Jordan, General Manager
2575 Enterprise Rd.
Clearwater, FL 33763
+1 (727) 796-2355
mjordan@tampabaywater.org
www.tampabaywater.org

University of Florida – Water Institute (UF Water Institute)
The UF Water Institute combines talent throughout the University's faculties to address complex water issues through innovative interdisciplinary research, education, and public outreach programs. The program's participants are comprised of water researches, educators and students. The overall aim is to develop creative engineering, new scientific breakthroughs, policy and legal solutions to address current water resource problems.

Wendy D. Graham, Director
Carl S. Swisher Chair in Water Resources
1949 Stadium Road, Weil Hall Room 570,
Gainesville, FL 32611
+1 (352) 294-7741
wgraham@ufl.edu
www.waterinstitute.ufl.edu

University of Miami (UM)
The University of Miami(UM) was founded in 1925 and is a private research university with more than 16,000 students from around the world. UM consists of 11 Colleges and offers 116 undergraduate, 105 master's, and 63 doctoral degree programs. The institute is part of the State University System of Florida.

Jean-Pierre Bardet, Professor and Dean
College of Engineering | Civil, Architectural and Environmental
1251 Memorial Drive
McArthur Engineering Building
Coral Gables, FL 33146
+1 (305) 284-6035
bardet@miami.edu
www.welcome.miami.edu

University of South Florida (USF)
The University of South Florida (USF) was founded in 1956. There were more than 48,793 students enrolled in 2015. The USF systems consists of 14 Colleges and includes three, separately accredited institutions: USF; USF St. Petersburg; and USF Sarasota-Manatee. The institute is part of the State University System of Florida.

Manjriker Gunaratne, Chair
4202 E. Fowler Avenue
ENB 118, Tampa, FL 33620, USA
+1 (813) 974-5818
gunaratn@usf.edu
www.usf.edu

4.6 Organizations, Associations and Institutes – Wisconsin

Milwaukee 7
Milwaukee 7 is an Economic Development Partnership focused on a robust and innovative ecosystem.

756 North Milwaukee Street, Suite 400
Milwaukee, WI 53202, USA
Phone: +1 (866) 596 6463
milwaukee7@mmac.org
www.mk7.com

The Water Council
The Water Council is a membership organization offering programs, research and events for water professionals. One of The Water Councils programs is the Global Water Center, which offers research space for e.g. universities and workspace for water technology startups.

247 W. Freshwater Way Suite 500
Milwaukee, WI 53204, USA
+1 (414) 988 8750
www.thewatercouncil.com

University of Wisconsin Milwaukee – School of Freshwater Sciences
The School of Freshwater Sciences at the University of Wisconsin Milwaukee researches new water technologies and educates the public about the importance of improving water infrastructure.

Great Lakes Research Facility
600 East Greenfield Avenue
Milwaukee, WI 53204, USA
+1 (414) 382 1700
http://uwm.edu/freshwater/

Wisconsin Economic Development Corporation
The Wisconsin Economic Development Corporation helps activate and accelerate economic opportunity in Wisconsin through programs in various industries.

201 West Washington Avenue
Madison, WI 53703, USA
+1 (608) 210 6700
www.inwisconsin.com

5. Conclusion

The evaluation of the U.S. water infrastructure with a focus on the states Florida and Wisconsin has shown that the market offers potential for German companies that can provide smart, innovative technological solutions. Entering the U.S. water infrastructure market contains a few challenges for foreign companies and requires sufficient amounts of planning and financial liquidity.

The quality of the U.S. water infrastructure systems varies significantly throughout the nation, which results in very diverse problems and challenges when it comes to updating the existing water infrastructure. When comparing Wisconsin and Florida in terms of their water infrastructure, each state suffers from varying problems and challenges. Florida's growing population requires the state's water infrastructure to expand gradually, including in less developed rural areas. New water infrastructure, however, is typically added to already existing core infrastructure. This procedure requires intense financial investments and maintenance to keep up with the additional capacity. The Environmental Protection Agency is providing financial support through various programs in order to help overcome these financial burdens of the utilities. Nevertheless, replacing and maintaining water infrastructure remains expensive so that further financial support is needed. At the same time, existing financial programs must be utilized more efficiently so that the available funding is used directly for updating water systems.

Similar to Florida, the state of Wisconsin will have to heavily invest in water infrastructure. Wisconsin will face steep costs when tackling all current challenges ranging from nitrate or lead polluted freshwater over sewage overflows to impacts from extreme weather conditions. Large investments must be made to improve distribution and transmission of fresh water. The state will also need to revise treatment plans for both freshwater and recycled water after having faced severe pollution problems in the past. Lastly, all types of water systems currently active need to be upgraded in order toprovide adiquent supply water.

As a result of the nation's severely outdated sewer systems and due to the lack of capacity for the growing population, the environment is impacted directly by billions of raw sewage discharge into local surface water every year. Furthermore, agriculture is a main user of fresh water resources and a contributor to the contamination of natural water resources and contributes to the pollution of the environment significantly.

Regarding the numerous challenges and its environmental impacts, the potential for new innovative technologies and development of existing technologies increases gradually. Aging water infrastructure, sanitary sewer overflows, rising sea levels and the augmented water use of agricultural operations make room for smart technologies, such as innovations in:

- Asset management systems
- Supervisory Control and Data Acquisition software
- Collection of real time data in the field of assessment management
- Leak detection systems
- "Trenchless Technologies", such as directional drilling or so called "No Dig" technologies
- Locating technologies or GPS technologies, GIS and digital video inspections

Due to the lack of funding required for a complete overhaul, such smart water technologies have the potential to become a multi-billion dollar industry over the next decade. The strategy paper identified a significant demand for technological innovations to facilitate asset management, reduce costs and maximize water and energy efficiency to ultimately create a sustainable water infrastructure.

As a result, trends and market developments for technologies are opening up potential opportunities for companies trying to enter the water infrastructure market in the U.S. or expand their presence. Despite financial hurdles, experts agree that significant investments into the existing water infrastructure must be made, not only to replace the status-quo, but also to make the switch to a durable and sustainable U.S. water infrastructure.

6. Preparation for Workshop

The core component of the project is the strategy workshop. The workshop enables a professional and solution-oriented exchange between relevant stakeholders in the U.S. and Germany. The aim is to lay the foundations for lasting collaboration through a targeted transfer of know-how.

The overall goal of the workshop is to analyze the effects of the U.S. water market on the environment, thereby identifying possibilities to preserve valuable natural resources and ecosystems. This will be achieved by cultivating a dialogue on policy and industry-related topics that will help generate ideas on how to improve the regulatory and technical frameworks of the U.S. water market. Similarities in specific expertise and technologies between the U.S. and Germany will be outlined and the potential for bilateral cooperation discussed. Given that the majority of laws and regulations in the U.S. are passed on the state level, we will invite the main stakeholders from both Florida and Wisconsin to better reflect the regional nature of water legislation in the United States.

The program consists of two 1.5 day workshops in Florida and Wisconsin in April 2018 aimed at developing a focused strategy to minimize the ecological impact of the U.S. water infrastructure on the environment. Below is a summary of the relevant discussion topics that will be addressed as part of the dialogue:

Water Infrastructure

- Capital improvement for storm water systems
- Consequences of deferred maintenance (further deterioration & increased costs)

Environmental Impact of Urbanization & Climate Change

- Rising sea levels
- Saltwater intrusion
- Sanitary Sewer Overflows (SSO)
- Agricultural usage and runoff
- Improvement of natural disaster relief efforts

Financing Structure

- Lack of local funding
- Lack of incentives for private entities
- Lack of communication between local and national authorities
- Balance between per-usage-funding vs. government subsidies
- Communication strategy to increase public awareness of water supply, cost, and prices

Trends & Market Opportunities

- Smart Technologies / Energy Generating Technologies
- Technologies capable of analyzing water infrastructure
- Asset management and leakage detection to effectively upgrade the aging water infrastructure
- Sensors and smart metering technology improvements/investments

7. List of Sources

This study was based on literature and online research as well as expert interviews with industry association and companies active in the US water sector listed below.

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Expert Interviews

- Berrin Tansel, Professor at the Florida International University's Civil and Environmental Engineering Department, interviewed on 11/30/2017
- David Garman, CTO, The Water Council, interviewed on 11/22/2017
- Dean Amhaus, Executive Director, The Water Council, interviewed on 12/12/2017
- Gary Williams, Director at the Florida Rural Water Association, interviewed on 11/27/2017
- Katy Sinnott, Vice President, International Business Development Division, Wisconsin Economic Development Corporation (WEDC), interviewed on 1/09/2018
- Kevin Shafer, Executive Director, Milwaukee Metropolitan Sewerage District (MMSD), interviewed on 1/09/2018
- Steve Jacquart, Government Relations Manager, Milwaukee Metropolitan Sewerage District (MMSD), interviewed on 12/12/2017
- Steve Riedel, International Trade Representative Environmental & Energy Industries, Minnesota Economic Development, interviewed on 11/20/2017
- Thomas Burke, Chief Professional Engineer at the Southwest Florida Water Management District, interviewed on 11/30/2017
- Tony Mardam, Vice President, Water Market Leader Stanley Consultants, interviewed on 12/12/2017
- William Young, Chairman of the Florida Section of the American Water Works Association and Utilities Director at the St. Johns County, interviewed on 12/15/2017