SWIMMABLE CITIES:

Lessons for Baltimore from five cities that have cleaned up their rivers, lakes, and estuaries

WATERFRONT PARTNERSHIP OF BALTIMORE

HealthyHarbor
A swimmable, fishable Baltimore Harbor
A Waterfront Partnership Initiative

CENTER FOR WATERSHED PROTECTION

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INTRODUCTION

As a city whose sewer system is more than 100 years old in places, Baltimore has been plagued by problems with raw sewage entering local waterways and ultimately flowing into the Baltimore Harbor. Wet weather overflows are the most commonly cited cause of sewage in Baltimore waterways. These occur when cracks in the City's aging sewer pipes allow rainwater to enter the sewer system, reducing its capacity to carry sewage. The resulting overflows discharge untreated sewage from the municipal sanitary sewer system out of manholes and into streets and streams. However, sewage also enters local waterways during dry weather for a variety of reasons. Sewer lines may become blocked by grease or tree roots, private properties may have sewer lines that are illegally connected to the storm drain system, or old broken pipes may continually leak sewage into groundwater and storm drain pipes. Cumulatively, these issues likely contribute more sewage to Baltimore waterways than overflows that occur during wet weather.

Sewer overflow in Baltimore (Photo source: Blue Water Baltimore)

Like many older urban areas, Baltimore City is under a legal mandate from EPA, known as a consent decree, to eliminate these sources of sewage. Baltimore's consent decree has been in place since 2002 and required the elimination of all overflows by January 1, 2016. Over the past 14 years, the Baltimore City Department of Public Works has been implementing a $1.1 billion

plan to repair the City's aging sewage system. During that time, the Department of Public Works undertook an extensive study of the sewer system, which included examining every major pipe using closed circuit TV. Thirty-one consent decree projects have been completed including 163 miles of sewer rehabilitation and the elimination of 60 (out of 62) sewer overflow structures that released wastewater into city streams. Baltimore is currently in negotiations with EPA and State agencies for an amendment to the consent decree that would grant an extension to complete the work.

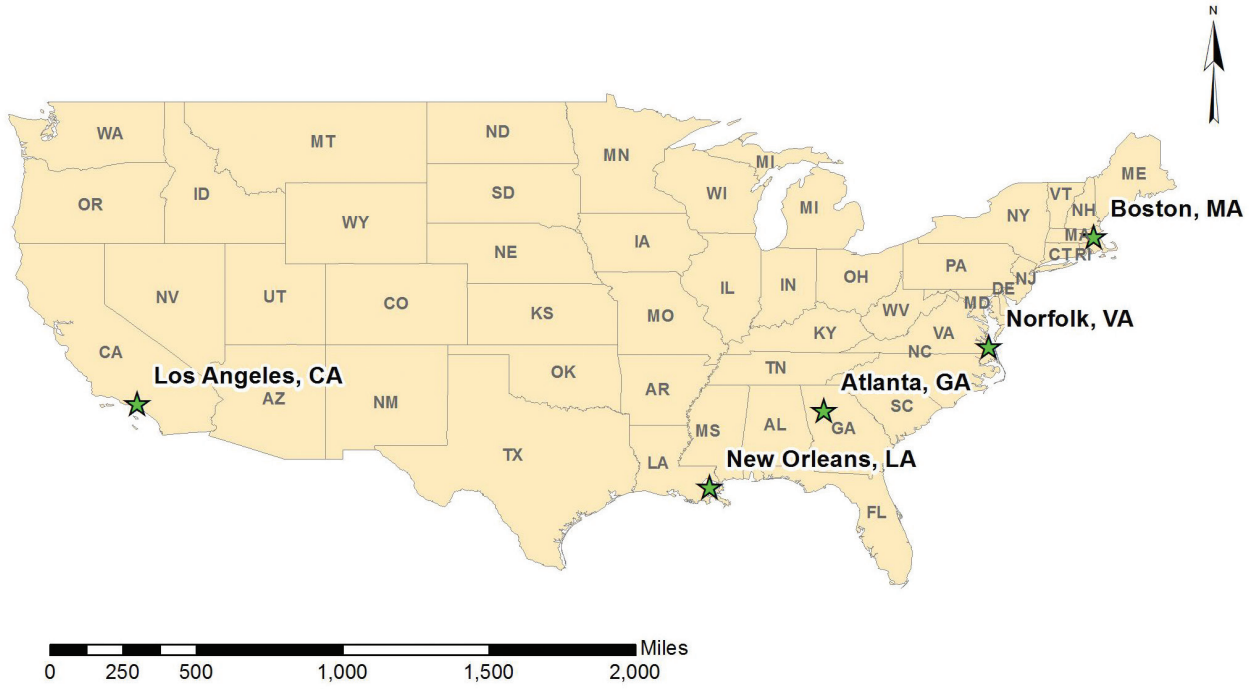
In December 2015, the Environmental Integrity Project issued a report titled "Stopping the Flood Beneath Baltimore's Streets" that detailed the City's failure to comply with the consent decree. The report found that Baltimore releases millions of gallons of sewage into its waterways each year through the two remaining sewer overflows structures in order to prevent sewage from backing up into the basements of property owners. The report raised important questions regarding transparency, public notification, and the lack of overall progress in fixing the City's sewer overflow problem.

In recent years the Baltimore City Department of Public Works has implemented some important course corrections, which will help ensure greater progress in the years ahead. The City is committed to repairing by 2020 a century-old, 12-foot diameter sewage pipe that feeds into the City's Back River Wastewater Treatment Plant, even though the repair was not required by the consent decree. A hydraulic restriction in this pipe routinely causes sewage to back up for 10 miles beneath the City and is the source of the overflows coming from the two remaining open sewer overflow structures along the Jones Falls. Also, in 2011 the Department of Public Works adopted what is known as an Integrated Planning Framework. The Integrated Planning Framework is a comprehensive approach, endorsed by the EPA, in which the City considers the environmental, social, economic, and efficiency benefits of potential remediation projects and then prioritizes those projects with the greatest cumulative impacts. This approach should allow Baltimore to implement high-impact projects while keeping spending in a range that is affordable for its citizens.

Baltimore is far from the only city spending considerable time and resources on this issue, and yet some U.S. cities have seen significant water quality improvements while Baltimore has not. In fact, the 2014 Healthy Harbor Report Card gave the Harbor an "F" grade for overall water quality. The Waterfront Partnership of Baltimore, with funding from the Abell Foundation, hired the Center for Watershed Protection to produce this technical report of case studies on sewage cleanup efforts in five cities similar to Baltimore from around the country. These case studies provide a detailed look at what made these cities successful and what lessons and strategies could be applied to Baltimore to ensure that the path to a swimmable and fishable Harbor is timely, affordable, and supported by a broad base of champions for clean and healthy waterways.

CASE STUDY SUMMARY

This report presents five case studies of communities who have had success in reducing sewage flows to their waterways and, in some cases, documented water quality improvements that allowed these waters to be used for recreation once again. The case studies include the Upper Chattahoochee River (Atlanta, GA), the Charles River (Boston, MA), Santa Monica Bay (Los Angeles, CA), Lake Pontchartrain (New Orleans, LA), and the Lafayette River (Norfolk, VA). While there are some notable differences between Baltimore and the case study cities, they were chosen because they are generally comparable to Baltimore and the sewage pollution in the Baltimore Harbor. The matrix below compares each city to Baltimore in terms of demographics, sewage problems, sewage solutions, and indicators of improvement. It is followed by a table outlining key factors in each city's success.



Case study locations

City	Baltimore, MD	Atlanta, GA	Boston, MA	Los Angeles, CA	New Orleans, LA	Norfolk, VA
Waterbody	Baltimore Harbor	Upper Chattahoochee River	Charles River	Santa Monica Bay	Lake Pontchartrain	Lafayette River
Type of waterbody	Estuary	River	River	Estuary	Estuary	Estuary
Watershed area	632 mi2	3,600 mi2	308 mi2	385 mi2	10,000 mi2	13.87 mi2
Annual rainfall	40.72 inches	47.12 inches	43.8 inches	10.62 inches	63.5 inches	46.5 inches
City population	622,793	456,000	655,884	4 million	384,320	245,428
Sewer system	100% separate	85% separate, 15% combined	80% separate, 20% combined	100% separate	100% separate	100% separate
Major sources of sewage	sewer overflows; illicit discharges	CSOs; dry and wet weather sewer overflows	CSOs; illicit discharges	Stormwater outfalls; various sources	Sewer overflows; small wastewater systems	Dry and wet weather sewer overflows
Legal mandates on sewage discharges	SSO and CSO consent decree	Consent decrees for CSOs and sewer overflows	Federal court order for CSOs; consent decree for illicit discharges	Consent decrees for TMDLs and sewer overflows	SSO consent decree	Special orders of consent for sewer overflows
Timeframe of cleanup	2002-2016 (14 years)	1998-2027 (29 years)	1985-2019 (34 years)	1999- 2014 (15 years)	1998-2025 (27 years)	2001-2018 (17 years)
Estimated costs *	$700 million, plans to spend another $400 million	Spent $2 billion	Spent $3.8 billion	Spent over $3 billion	Spent $220 million, will spend $170 million more	Spent $76 million
Local partners	Blue Water Baltimore, Waterfront Partnership of Baltimore	Chattahoochee Riverkeeper	Charles River Watershed Association	Heal the Bay and LA Waterkeeper	Lake Pontchartrain Basin Foundation	Elizabeth River Project and Hampton Roads Sanitation District
Indicators of success	Healthy Harbor Report Card gives the Harbor an "F"	The City reduced 99% of its untreated sewage flows from the 1990s to 2014	Recreational swimming for the public permitted for first time in 50 years; Charles River Report Card score went from a "D" to an "A"	83% of City's sewer overflows reduced since 2000/2001; Beach Report Card gives LA beaches an "A" or "B" grade for summer dry weather water quality	Lake Pontchartrain removed from impaired waters list for recreational use in 2006	State report recommends removing River from impaired waters list; State of the River report gives the river a "B" score for bacteria; sewer overflows reduced from 200/year to 15/year
City	**Baltimore, MD**	**Atlanta, GA**	**Boston, MA**	**Los Angeles, CA**	**New Orleans, LA**	**Norfolk, VA**

SSOs = sanitary sewer overflows; CSOs = combined sewer overflows; TMDLs = total maximum daily loads

*Cleanup costs should be considered approximate estimates only. Cleanups include efforts by numerous partners over long periods of time and costs are not consistently tracked by all cities.

WATERBODY	KEY FACTORS IN SUCCESS
Upper Chattahoochee River: Atlanta, GA	• **Political leadership** – Mayor Shirley Franklin enthusiastically embraced the title of "sewer mayor" and made fixing the City's sewer system a priority. Therefore, citizens knew the issue and supported increases in water fees and sales tax to fund repairs. • **Government/NGO partnerships** – Volunteers with the Chattahoochee Riverkeeper help the city monitor the river and alert the proper organization when problems are identified. The Riverkeeper's Neighborhood Water Watch program uses volunteers to conduct bacteria sampling that helps to pinpoint where sewage leaks are present. • **Consent decree tied to water quality improvement** – The City's consent decree required water quality monitoring to demonstrate that projects were successful. The City now operates a long-term monitoring program to track water quality improvements, with support from USGS and the Chattahoochee Riverkeeper
Charles River: Boston, MA	• **Participation and support from state and federal government** – EPA's New England headquarters are located in Boston. In 1995 EPA Administrator John P. DeVillars developed the Clean Charles Initiative and set a goal of a swimmable Charles River by 2005. This highly publicized initiative uses an annual Report Card to evaluate progress towards the goal. • **Government/NGO partnerships** – The EPA provided funding for the Clean Charles Initiative and awarded $400,000 to the Charles River Watershed Association for monitoring and the development of a public warning system. The volunteer monitoring program, with over 80 volunteers, monitors 35 sites every month and sends data to EPA to analyze and produce the annual Report Card. • **Address both wet and dry weather sources of sewage** – Two separate consent decrees dealt with sewage discharges. The illicit discharge consent decree required surveys of all outfalls during both wet and dry weather. It also set a timeframe of 60 days to fix sewage leaks, providing another mechanism for enforcement. The City has eliminated more than 48,000 gallons per day of sewage-contaminated stormwater in the Lower Charles since 2004.
Santa Monica Bay: Los Angeles, CA	• **Development of new technologies** – Low-flow diversion structures send water from the City's storm drain system into a separate sewage system for treatment during dry weather.

WATERBODY	KEY FACTORS IN SUCCESS
Santa Monica Bay: Los Angeles, CA	• **Government/NGO partnerships** – Environmental groups and City planning staff worked to collaboratively plan sewer and stormwater systems to meet regulatory requirements. This partnership drove the City to put a $500 million bond measure to a public vote for water quality improvement projects. The environmental organizations developed campaigns to promote the bond measure and it passed with 2/3rd of the general vote. • **Consent decree tied to water quality improvement** – The City's consent decree required water quality monitoring to demonstrate that projects were successful. In addition, development of bacteria regulations relied on innovative bacteria source tracking methods, which determined that storm drains were the primary source of human sewage. • **Address both wet and dry weather sources of sewage** – The City has adopted an aggressive fats, oils and grease program that has greatly reduced the number of sewage overflows related to grease clogs in the sewer lines.
Lake Pontchartrain: New Orleans, LA	• **Consent decree tied to water quality improvement** – The City's consent decree required quarterly storm event water quality monitoring for indicators of sewage before and after project implementation to demonstrate that projects were successful. A subsequent modification of the consent decree language was added to ensure consistency with other water quality-based regulatory requirements. This provided additional lines of enforcement to ensure that water quality goals were met. • **Participation and support from state and federal government** – The Lake Pontchartrain Basin Foundation is primarily supported by funds from EPA and the Louisiana Department of Environmental Quality. This organization conducts monitoring, education and restoration activities.
Lafayette River: Norfolk, VA	• **Government/NGO partnerships** – Rather than taking legal action, the Elizabeth River Project met with partners and asked for help. In return, the City and Hampton Roads Sanitation District provided assistance with tracking down sources of sewage even when it was not required. • **Address both wet and dry weather sources of sewage** – The City's programs have addressed all major sources and include upgrades to marina pumpout systems and a free boater sewage pumpout program during peak boating season. They have also established a state-of-the-art regional program that reduces sewer overflows related to clogs from fats, oils and grease in the sewer lines.

THE PATH TO A SWIMMABLE HARBOR: LESSONS FOR BALTIMORE CITY

Swimming in water contaminated with sewage comes with serious human health risks from contact with disease-causing water-borne pathogens. These risks can range in severity from intestinal discomfort to serious infections and disease. Reducing the amount of sewage released into City waterways needs to be a priority for Baltimore; however, the solutions require time and resources that are often in short supply in a City with competing demands on both. These case studies uncover ways that cities have found to harness additional resources and reveal important regulatory requirements that have helped them to stay focused on fixing their sewage problems.

In general, the causes of sewage pollution and the approaches to fixing the problems are similar in Baltimore compared to the case study communities. Baltimore's projected costs of the consent decree at $1.1 billion are in line with that of the profiled communities (as well as the national average of $709 million). Baltimore's original consent decree timeframe of 14 years is the most aggressive of all the case study cities and, even if extended by a decade, would still be comparable to Atlanta and New Orleans. In each city, sewer fee increases were the primary source of funding for sewer rehabilitation projects. In Los Angeles and Atlanta, citizens voted for a bond measure and sales tax increase to pay for projects, while New Orleans and Boston received federal funding and also utilized state loans.

Baltimore has undertaken many of the same activities used to clean up waters in the case study communities. This includes making a comprehensive evaluation of the sewer system using closed circuit TV to evaluate conditions, development of a sewer rehabilitation program and implementation of numerous projects to eliminate wet weather sewer overflows, as well as improvements to operation and maintenance activities to reduce sewer overflows caused by clogs from fats, oils, and grease. The City has embraced the fishable and swimmable goal for the Harbor, which is being championed by local partners such as the Waterfront Partnership of Baltimore and Blue Water Baltimore, who produce an annual water quality report card for the Harbor. The City also coordinates with Baltimore County and Blue Water Baltimore on a regional water quality monitoring effort.

Despite the similarities between Baltimore and the profiled communities, there are some key elements of the cleanup efforts in the case studies that are missing in Baltimore. These key elements are presented below with a discussion of how they can be transferred to Baltimore.

1. ADDRESS BOTH WET AND DRY WEATHER SEWAGE FLOWS

Each of the cities profiled tackled their sewage problems by addressing all sewage sources, often through multiple initiatives led by various partners. Some had consent decrees that explicitly called for fixing both dry and wet weather sewer overflows (e.g., Norfolk), while others had

entirely separate regulatory drivers for each source (e.g., Boston). Generally, the path was to fix the most obvious sewage problems first and then use water quality monitoring to evaluate progress. This monitoring was key to prioritize further improvements, for example in Boston it highlighted that even though the wet weather overflows had been tackled, there was still a major problem with sewage flows in dry weather. Using this process, most of the cleanup efforts first addressed wastewater treatment plant upgrades and sewer overflows and then illicit discharges from leaks and illegal connections.

Baltimore's consent decree was designed to primarily address wet weather overflows and maintenance-related dry weather overflows (e.g., from clogs in the system). However, the City does not collect water quality data to gauge the effectiveness of completed consent decree projects. Therefore, consent decree projects may address wet weather overflows, which typically have a short lived effect on sewage levels in the receiving waters, while dry weather overflows (from leaks or illegal connections) continue unabated.

Monitoring by Blue Water Baltimore shows that locations along both the Jones Falls and Gwynns Falls streams have exceedingly high levels of fecal bacteria at all times, regardless of precipitation. Cumulatively, these dry weather flows may actually exceed those from wet weather, including the flows from the City's two remaining overflows structures. These dry weather discharges into the storm sewer system are discovered by storm drain outfall monitoring and, though Baltimore has a monitoring network to identify these sources, City records confirm that there has been limited success in tracking down and fixing the sources of these flows. For example, according to the Department of Public Works' quarterly report to EPA ending September 30, 2015, 7 out of 18 dry weather flows are still active after having been discovered more than 3 years ago.

An important aspect of Baltimore's story is that the City has an existing program under their municipal stormwater permit to find and fix illicit discharges of sewage to the storm sewer system, which is entirely separate from the consent decree. Tracking and elimination of these dry weather discharges is a difficult process that is hampered by the shared responsibility requiring the coordination of four different divisions across two departments. While the stormwater permit and consent decree programs are becoming better integrated, neither has a process that weighs the cost-effectiveness of eliminating both wet and dry weather sources to meet water quality goals.

Baltimore's new Integrated Planning Framework is ideal for addressing these concerns because it will optimize the City's investments in water, sewer, and stormwater infrastructure to best serve its customers and the environment. In theory, this can help the City to prioritize projects that provide the greatest impact, regardless of whether the problems occur during wet or dry weather. However, the information available on the City's framework does not mention dry weather sewage discharges as one of the project types on which cost-effectiveness is considered as a decision-making factor. To effectively address both wet and dry weather sources of sewage, this framework must incorporate elimination of illicit discharges and other dry weather sewage flows as one of the management alternatives.

2. MEASURE EFFECTIVENESS USING WATER QUALITY ENDPOINTS

Most of the case study communities were required to conduct water quality monitoring to verify improvements as a result of sewer rehabilitation projects. In all cases, the cities worked with local partners such as a watershed group to conduct the monitoring. These non-governmental organizations not only assist the cities with compliance, they also serve as watchdogs and communicate results to the public through weekly data reports, annual Report Cards or State of the River reports, which are important tools for increasing the public's awareness of the problem and support for restoration efforts.

Baltimore City's consent decree program has no defined water quality endpoints and water quality monitoring is not required to verify that the projects have actually improved the receiving water quality. The program instead focuses on implementation of projects as the endpoints and as such, lacks an element of accountability. While the City does use water quality monitoring to help track down sources of illicit discharges, and to determine that unpermitted discharges have been repaired, it is not a major part of the consent decree effort. Baltimore's Integrated Planning Framework should include bacteria standards as endpoints so that, in addition to using monitoring for tracking and identifying problems, it can also be used to measure progress.

The Waterfront Partnership's Healthy Harbor initiative works to promote cleaning up the streams and Harbor of Baltimore through an annual report card, neighborhood cleanups, and innovative projects at the Inner Harbor. However, publicity for similar campaigns in the case study cities appear to be much more widespread and visible. A shift towards measuring the progress of the consent decree using water quality would be complemented by expanding these efforts to have a broader reach and impact.

3. PROVIDE MULTIPLE LINES OF ENFORCEMENT

Each case study city is/was under consent decree or a similar type of legal mandate to eliminate sewer overflows. However, not all sewer overflow consent decrees are the same. Our success stories showed consent decrees that contained language tying the required actions to other regulations, such as bacteria TMDLs and municipal stormwater permits. This provided multiple lines of enforcement and therefore more accountability, helping to ensure the desired end results. Most of the consent decrees required some form of water quality monitoring to verify water quality improvements. They also incorporated specific timeframes for all actions, including reporting and fixing illicit discharges. For example, Boston's consent decree for illicit discharges requires all leaks be fixed within 60 days. It also appears that the EPA regional office and/or State agencies responsible for enforcement in each community provided adequate oversight, levying fines for noncompliance when necessary.

In Baltimore enforcement has been lacking on the dry weather sewer overflow problems, in part because there are no timeframes associated with fixing them. This is evidenced by reviewing the City's quarterly consent decree reports to EPA, which show that many of the discharges have been

ongoing for months or even years. There are also no provisions in the consent decree for water quality monitoring (unless an overflow is reported) or any tie to the bacteria TMDL or municipal stormwater permit. The opportunity is ripe for adding these enforcement elements to the City's modified consent decree. Only then can they be enforced by the appropriate regulatory agency.

4. GARNER SUPPORT FROM STATE AND FEDERAL PARTNERS

Each case study involved federal and state partners working towards a common goal to protect a valued resource. In New Orleans and Boston, State and Federal agencies played an important role in helping to ensure the success of the cleanup. In Boston, EPA developed the Clean Charles Initiative, issued a report card for the River, and provided significant funding. They also conducted a study that showed a healthy Charles River contributed over $100 million to the local economy to help garner public support. New Orleans received similar financial support from EPA and State agencies to clean up Lake Pontchartrain.

In Baltimore, financial support from State and Federal agencies has been provided in the form of grants to assist with consent decree projects; however, because the amount of these grants has not been publicized it is not obvious that there is strong backing by these agencies. EPA has selected the Patapsco Watershed (which includes the Baltimore Harbor) as one of 19 focus areas for a partnership program to restore urban waterways. Greater support—both financial and technical—from the regional office and State agencies would be highly beneficial, as it was in Boston and New Orleans. We recommend that if grants are awarded, they be publicized to communicate to the public that the City has multi-agency support for cleaning up its streams and Harbor.

5. FOSTER STRONG LOCAL PARTNERSHIPS

In all of the cities we profiled, the relationship between the city and the local watershed group was particularly important as they worked together to find and fix pollution problems. While these environmental organizations were typically involved in the original lawsuits that resulted in the consent decrees, their relationships have evolved into mutually beneficial partnerships. These grassroots organizations help the cities identify water quality problems, while also acting as a sort of watchdog, and the cities use their data to track down and fix the problems. Because they are working towards a common goal, the partners trust each other to work together to find solutions.

While Baltimore City Department of Public Works also works with Blue Water Baltimore and the Baltimore Harbor Waterkeeper on numerous activities including restoration projects, public outreach and monitoring, there are strong differences of opinion regarding the role Blue Water Baltimore should play in the renegotiated consent decree process. To Baltimore City's consternation, after two years of dialogue and little progress, Blue Water Baltimore took legal action in 2013 to have a seat at the table during the negotiation process with EPA. Through these negotiations, Blue Water Baltimore seeks to improve citizen representation and assure maximum improvements to water quality and the protection of public health.

These types of issues between environmental organizations and municipalities are not unique to Baltimore. In almost every case study, there was contention between the sewer authority and the local environmental group that resulted in lawsuits ending in consent decrees and other enforcement actions. Regardless of these past differences, the municipality, environmental groups and other stakeholders have found a way to overcome their differences and effectively work together. This "spirit of collaboration" is a major contributor to the case study cities' successes and could greatly improve the Harbor's chances for a successful cleanup if the City can build a stronger working relationship with its environmental community.

6. INCORPORATE TECHNOLOGICAL INNOVATIONS

Los Angeles has successfully incorporated the use of new technology to help meet their consent decree. Low flow diversions, which redirect water from small rain events to sewage treatment plants for additional treatment, have been used in the City primarily during the summer months when use of area beaches is highest. In a 3-year monitoring study of six low flow diversions in storm drains discharging directly to Santa Monica Bay, the results show at least 90% reductions in pollutant concentrations from post-construction samples compared to pre-construction samples. All post-installation samples had pollutant concentrations below water contact recreation limits. In Baltimore, these practices could possibly be very effective but would need to be adapted for the local rainfall conditions and topography.

CONCLUSION

These case studies show that comparable cities across the country have been successful at eliminating sewage flowing into their rivers and harbors. Baltimore's sewage problems, remedial actions, and financial resources dedicated to the cleanup are in line with that of other cities, but Baltimore has yet to see significant water quality improvements. While it is true that Baltimore's original consent decree timeline may have been too ambitious, the case study cities have been more resourceful, more dynamic, and more comprehensive in their approach to solving their sewage problems. It is important to remember that this is a persistent threat to public health and, therefore, the process of repairing the City's infrastructure should be as aggressive, transparent, and collaborative as possible regardless of the timeline.

Baltimore City now has an opportunity to make changes based on lessons learned from these other cities. It is recommended that the Department of Public Works incorporate some of the key elements that made the other cities successful including: focusing on water quality as the endpoint for consent decree projects, using consistent water quality monitoring to track progress, and addressing both wet and dry weather sources of sewage. The ability to enforce the consent decree through multiple avenues is also important, as is consideration of new technologies that can reduce costs, or result in water quality improvements more quickly. Perhaps one of the most important overarching factors responsible for the successes in the case study cities is the strong support of local, state and federal partners working towards a common goal.

It is important for the City to prioritize projects that will eliminate the last of the two sewer overflow structures on the Jones Falls, but not at the expense of ignoring the more insidious problem of continuous sewage leaks throughout the system. These problems must be weighed in the same context before the City can make an informed decision about how to address them.

Baltimore's vision of a clean Harbor is in sight. The time is now to make course corrections by transferring lessons from other cities that have successfully addressed their sewage problems. We can still have swimmable waterways if City government, environmental nonprofits, and everyday citizens learn from these success stories and come together in support of a clean and healthy harbor.

CASE STUDY:
UPPER CHATTAHOOCHEE RIVER, ATLANTA, GA

The City of Atlanta reduced their untreated sewage flows to the Chattahoochee by 99% from the 1990s to 2014.

BACKGROUND

The Chattahoochee River flows for 430 miles from the north Georgia mountains to the Florida-Georgia border, where it meets up with the Flint River to form the Apalachicola River and eventually empties into the Gulf of Mexico. The upper portion of this heavily dammed river encompasses 3,600 square miles from its headwaters through metropolitan Atlanta down to West Point Lake (EPA, 2000). Lake Lanier in the headwaters and the Chattahoochee River National Recreational Area—which includes a 48-mile stretch—are heavily used for recreation, including swimming, boating, canoeing, tubing and fishing. Although the river runs through a portion of the City proper, most Atlanta residents do not use this portion for recreation instead traveling the 12 miles to the Chattahoochee River National Recreation Area, 45 miles to Lake Lainer, or 80 miles to West Point Lake.

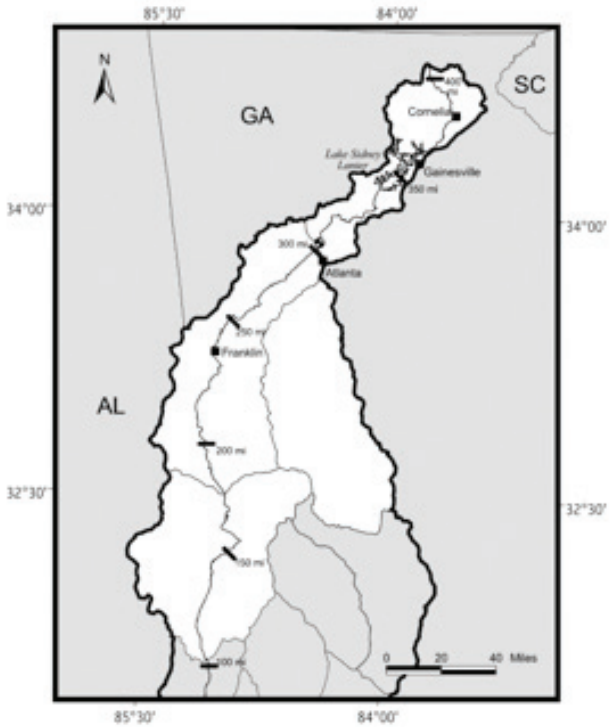


Figure 1: Map of Upper Chattahoochee River Watershed. River miles shown are distances from Gulf of Mexico. (EPA, 2000)

The Chattahoochee is used to supply 70% of the City of Atlanta's drinking water, as well as for wastewater assimilation, agriculture, recreation and power generation (CRK, 2015). All of these uses put a huge strain on the river, especially as Atlanta's population keeps growing. Cities downstream are also affected by Atlanta's pollution and growing water demand. Seven of the ten watersheds in the City drain into the Upper Chattahoochee, including Long Island, Nancy, Peachtree, Proctor, Sandy, Utoy, and Camp Creeks (City of Atlanta Department of Watershed Management, 2015).

QUICK STATS

Upper Chattahoochee River		**Atlanta**	
Type of waterbody:	River (freshwater)	Annual rainfall:	47.12 inches
Watershed area:	3,600 mi^2	Population:	City of Atlanta: 456,000 (2014)
Average depth:	3-6ft (near Atlanta)	Sewer system:	85% separate, 15% combined
Active shipping channels?	No	MS4 status:	Phase I
Watershed population:	3.5M (1996)	Recreation:	One kayak launch and one boat ramp

Sources: EPA, 2000; U.S. Census Bureau, 2014; Clean Water Atlanta, n.d.

SEWAGE POLLUTION PROBLEMS

Major sewage sources: CSOs; dry and wet weather SSOs

With an outdated combined sewer system and a lack of investment in the maintenance and repair of both combined and separate sewer pipes, the City of Atlanta's sewer system was plagued by clogged and broken pipes which caused thousands of overflows and spills of untreated wastewater into the Chattahoochee River and its tributaries in the early 1990s. This contributed to poor water quality downstream, affecting the fish population and generating public health issues, with over 600 stream miles in Atlanta being listed as impaired in the State of Georgia Environmental Protection Division's 1994-1995 305(b) report. Rapid development in Atlanta added to the pollution issue, as the antiquated infrastructure could not handle the huge influx of people. The City was facing millions of dollars in penalties due to the sewer overflows, yet still was not investing enough into upgrading the sewer system. From November 1992 to May 1999, the state had assessed the City $20.7 million in fines for violations (EPA, 1999).

In 1995, the Chattahoochee Riverkeeper (CRK) and several cities and counties downstream of Atlanta filed a lawsuit against the City for discharging sewage into the River, violating the Clean Water Act and the Georgia Water Quality Control Act. The suit was settled in 1998 and as part of the consent decree, the City paid a $2.5 million civil penalty and was required to fix the combined sewer overflows (CSOs) to be in compliance and spend $27.5 million to create a Greenway corridor. In 1999, the consent decree was amended to include projects eliminating separate sanitary sewer overflow (SSO) violations (EPA, 1999). The estimated sewer improvement program cost was $3 billion, with $950 million for CSO capital costs (Clean Water Atlanta, n.d.).

KEY PLAYERS

EPA Region 4: Conveniently located in Atlanta, EPA is responsible for Clean Water Act enforcement in Atlanta, including the CSO and SSO consent decree. In 2013, the EPA Urban Waters Federal Partnership designated Proctor Creek to be a priority Urban Waters location, increasing the resources available.

Georgia Environmental Protection Division (EPD): EPD is the State agency responsible for collecting water quality data to determine the status of water impairments and developing TMDLs.

City of Atlanta: The City is the defendant in the 1998 consent decree for sewer overflows. Known as a "Sewer Mayor," the City's Mayor Shirley Franklin pushed for the sewer system upgrades and developed the Clean Water Atlanta Program.

Chattahoochee Riverkeeper: The CRK initiated the push that eventually led to the consent decree. As a result of concerns from citizens, they continue to help the City of Atlanta by taking on the role of bacteria monitoring to ensure quick responses by the City.

Citizens of Atlanta: The citizens continue to pay the high prices of the water and sewer bills in the city, and voted to increase sales tax to help fund these projects.

SEWAGE POLLUTION SOLUTIONS

In 2001, Shirley Franklin was elected as Mayor of Atlanta and was subsequently known as the "sewer mayor." Franklin embraced the infrastructure needs and initiated the Clean Water Atlanta Program, with the consent decree as the driver. The Clean Water Atlanta Program focused on

capital improvement programs to improve water quality in Atlanta. Franklin moved the water-related services from the Department of Public Works to the new Department of Watershed Management. $759 million was spent from 1998-2009 for the CSO Consent Decree, and $916 million spent from 1999-2012 for the SSO Consent Decree.

In accordance with the consent decree, the city accelerated their sewer improvements, including:

- Sewer System Evaluation Survey with closed circuit TV
- Capacity certification program to review building permit applications that propose adding new flows into the sewer system
- Grease permitting program
- Management plans to operate collection system more effectively

In order to fund all these projects, the City of Atlanta has the highest water (including water, sewer and stormwater) rates in the country at $326 per month for a family of four (Circle of Blue, 2015). Although it is a burden on the citizens, most feel that it is necessary for public health. The City also implemented a 1% increase in sales tax, known as Municipal Option Sales Tax (MOST), which helps transfer some of the costs to visitors and business people who use the City's water resources but don't pay the water and sewer bill. The tax was reauthorized twice by voters since its inception in 2004. This tax has provided over $700 million from 2004 and 2010, and is expected to generate another $750 million (City of Atlanta, n.d.). The funds have helped the City's water infrastructure projects including construction of Nancy Creek Tunnel, eliminating SSOs in North Atlanta; inspection of 1,596 miles of Atlanta's 1,600 miles of sewer pipe; and rehabilitation/replacement of 460 miles of damaged or leaking pipes.

The City cleans 25% of the entire sewer system every year, focusing on hotspots that have the greatest need. This program also works with the City's Grease Management Program. Although the City completed their original consent decree aimed at reducing CSOs in 2009, they have not yet met the requirements of the amended consent decree, aimed at reducing SSOs. In 2012, Atlanta was granted a 13-year extension from the original completion date of 2014 to implement the changes needed to meet the amended consent decree (City of Atlanta, 2014a). The extension was granted based on the $445 million worth of work remaining and financial constraints of the City. The City hired consultants to review revenue and spending projections, and found that with the recession and the strain on non-consent decree infrastructure (e.g., drinking water), a 13-year extension will be able to help Atlanta and its citizens reduce the burden of meeting the remainder of the costs and still maintain other necessary infrastructure in the City.

In conjunction with the infrastructure projects, the City also conducts a Long-Term Watershed Monitoring Program to track water quality improvements. USGS, CRK, and the City of Atlanta work together to monitor 20 sites across the City and use the data to track progress as well as identify sources of impairment. In addition to this monitoring, the CRK started the Neighborhood Water Watch program in 2010. This program is aimed at finding sewage leaks through the use of local volunteers testing for E. coli. They currently have over 70 sites and partner with over 30 different organizations. The CRK developed a monitoring plan that the EPA certified, gaining validation of their science. Now they are able to provide solid, trustable data for the City, decreasing the burden on them for monitoring and allowing the City to use their limited resources on focused areas.

This extensive monitoring program has shown to be a tremendous benefit to the City. In 2013, the Neighborhood Water Watch volunteers tested an area of Proctor Creek and found chronically high levels of bacteria. The area was part of an infrastructure upgrade, where the City of Atlanta renovated an underground pipe system, intending to separate stormwater flow from the sewage flow. CRK contacted the City about their findings, leading to an extensive camera survey of over 20 miles. The City found that thirteen sewer pipes had accidently been left connected to the stormwater pipes and were discharging raw sewage into the stream. Without the help of the volunteers, it would have taken much longer for the City to find out about the illicit connection and to fix the system. The sound science from the CRK allows the City to act quickly to resolve these problems. In 2013, the EPA designated Proctor Creek, a tributary of the Chattahoochee that runs through Atlanta, as one of 19 priority Urban Waters location in the U.S. The EPA and the partners in the program are working to improve water quality, create green space, increase green infrastructure, decrease public health issues, and advance economic development in the area.

PROGRESS TO DATE

Spending over $2 billion dollars, the City of Atlanta went from having a severely failing sewer system to reducing their untreated sewage flow by 99% in 2014 compared to the 1990s. CSOs were reduced to an expected average of four per year, compared to 100+ per year before 2000 (City of Atlanta, 2014b). All the Capital Relief Projects have been completed, with the remaining years and funding saved for the sewer rehabilitation projects. This remaining 1% of sewage flow will be address in stages through 2027, focusing on the most needed upgrades first. All 1,574 miles of the sewer system have been surveyed and over 373 miles (71%) of the system have been rehabilitated (Clean Water Atlanta, 2015).

The Chattahoochee River near Atlanta is still not a popular place for water recreation, due to the presence of the water treatment plant and low water levels. Much of the tributaries are channeled, making it difficult to recreate in. Specifically in the poorer, urban areas, these waters tend to still be perceived as sewer water. Community groups, such as West Atlanta Watershed Alliance (WAWA), are working with neighborhoods to educate them about water quality and to help clean up the river.

TIMELINE

- 1994: Chattahoochee Riverkeeper filed Lawsuit against City of Atlanta
- 1998: Case settled with a Consent Decree to eliminate CSO violations
- 1999: Consent Decree amended to include eliminating SSOs
- 2001: Shirley Franklin elected as Mayor of Atlanta
- 2002: Department of Watershed Management created
- 2003: Long Term Water Quality Monitoring Program created
- 2004: MOST tax approved by Atlanta citizens
- 2008: Consent Decree completed for CSOs
- 2010: Neighborhood Water Watch created
- 2014: Sewer overflows reduced by 99% (2004 baseline)
- 2027: Revised Consent Decree deadline for SSOs

KEY FACTORS IN SUCCESS

Having government leadership back the issue of failing sewer infrastructure was definitely a key factor in the success story of Atlanta. This put the government and the citizens working on the same side, allowing for various partnerships to occur, leveraging resources efficiently. The partnership between the City of Atlanta and the CRK is very important in reducing SSOs. The volunteers with the Neighborhood Water Watch program were able to help the City monitor the river, and with CRK, were able to be certain of an issue to alert the proper organization to fix the situation. Likely due to the Mayor Franklin's initiatives, the issue became known to citizens across Atlanta, and they supported increases in water fees and sales tax to help pay to fix these issues.

MOTIVATING FACTORS

Regulatory: Consent decree required reductions in SSO and CSO, as well as monitoring.

Enforcement: Before the consent decree, Atlanta was fined for almost $20 million for violations of the Clean Water Act.

Funding: The MOST tax provided $700k from 2004-2010 for sewer upgrades.

Champions: The City's "sewer mayor" Shirley Franklin pushed for the sewer system upgrades and developed the Clean Water Atlanta Program.

Local Partners: Chattahoochee Riverkeeper represented the citizens' disapproval of how they handled the sewer situation. CRK, along with over 30 other partners worked to increase education and outreach.

Public Engagement: The citizens of Atlanta voted to increase sales tax to help fund these issues.

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CASE STUDY:
CHARLES RIVER, BOSTON, MA

In July 2013, recreational swimming for the general public was permitted for the first time in over 50 years

BACKGROUND

The Charles River runs 80 miles from Hopkinton, Massachusetts to the Boston Harbor. The river splits Cambridge and Boston and drains a 308 square mile watershed, home to 900,000 people. The Charles River watershed is comprised of 35 towns and cities and has 20 dams along the way. The river is divided into three regions: the rural upper basin, suburban middle region, and urban lower basin, where Boston is located. The upper and middle watersheds contain over 8,000 acres of protected wetlands, known as the Charles River Natural Valley Storage areas. The Boston Water and Sewer Commission (BWSC) maintains and operates 1,512 miles of sewer pipes—677 miles of sanitary sewer, 185 miles of combined sewer, and 657 miles of storm sewer—(BWSC, 2012) in the lower basin. The Massachusetts Water Resource Authority (MWRA) manages the Deer Island Sewer Treatment Plant, where BWSC sends its waste water.

The River's importance as a recreational centerpiece is especially evident in the lower Charles, which is lined with boat houses, jogging paths and sports fields and is well known for rowing, sculling, dragon boating, and sailing. This area is home to Community Boating, the Harvard University Sailing Center, and the MIT Sailing Pavilion. The Head of the Charles Regatta is held here every October. In early June, the annual Hong Kong Boston Dragon boat Festival is held in Cambridge.

QUICK STATS

Charles River		Boston	
Type of waterbody:	River (freshwater)	Annual rainfall:	43.8 inches
Watershed area:	308 mi^2	Population:	655,884 (2014)
Average depth:	6-40ft	Sewer system:	80% separate, 20% combined
Active shipping channels?	No	MS4 status:	Phase I
Watershed population:	900,000	Recreation:	Rowing, sailing, swimming, boating

Sources: U.S. Census Bureau, 2014; CRWA, n.d.; BWSC, n.d. Mass.gov, n.d.

SEWAGE POLLUTION PROBLEMS

Prior to the 1900s, the Charles River was an important source of industrial power, with 20 dams constructed along its length. As a result of these activities, the River became heavily polluted from industrial and domestic waste discharges. In the 1900s, extensive urbanization, especially in the lower portion of the watershed, further overwhelmed the ability of the River to cleanse itself. The population growth also decreased the City's ability to treat domestic, municipal, and industrial wastes.

Increasing awareness of these water quality problems resulted in closure of the River for swimming in the 1950s. With the formation of the Charles River Watershed Association in 1965 and the passage of the Clean Water Act in 1972, significant efforts were made to reduce sewage and industrial discharges to the River. Prior to 1988, over 1.7 billion gallons per year of combined sewer overflows (CSO) were discharged into the Charles River. Efforts to address the area's long-standing sewage problem intensified in the 1980s with three different lawsuits involving the City of Quincy, EPA, and the Conservation Law Fund (CLF), which ended with a Federal Court Order for the Metropolitan District Commission (MDC) to clean up Boston Harbor in 1985 (University of Massachusetts Boston, n.d.). The state of the Boston Harbor was even discussed during a presidential campaign in 1988, with then Vice President Bush calling the Harbor "the dirtiest" in America and the "harbor of shame," a jab at his opponent, Massachusetts Governor Michael Dukakis (NY Times, 1988).

In 2010, CLF and the EPA filed a lawsuit against the BWSC for failing to control polluted discharges from its stormwater systems, violating their National Pollutant Discharge Elimination System (NPDES) and Municipal Separate Storm Sewer System (MS4) permits. The EPA found numerous BWSC stormwater outfalls with untreated sanitary sewage discharge (U.S. District Court District of Massachusetts, 2012).

In 2012, the BWSC entered into a Consent Decree with EPA that required the utility to minimize the discharge of sewage and other pollutants into the Boston waterbodies, focusing on storm drains and sanitary sewer systems. The Consent Decree includes

- Monitoring for and removal of illicit discharges of untreated sewage
- Stormwater runoff best management practices
- Better reporting and response to sanitary sewer overflows (SSOs)
- Monitoring and enforcement at construction sites and industrial facilities

SEWAGE POLLUTION SOLUTIONS

In 1985, the Massachusetts Water Resource Authority (MWRA) was formed to manage the water and sewer systems. The 1985 Court Order directed the MWRA to build a primary and secondary treatment facility and to construct an outfall pipe to send the treated sewage elsewhere. MWRA was also tasked with developing a CSO reduction plan and reconstruction of much of the sewer system in metropolitan Boston. The total cost of these upgrades is estimated to be $3.8 billion dollars (MWRA, 2009).

In 1995, EPA New England issued a "report card" for the Charles River, and its resulting "D" score prompted EPA to launch an ambitious effort called the Clean Charles River Initiative. The goal of this initiative was to make the lower Charles River, from Watertown to Boston Harbor, "fishable" and "swimmable" by 2005. The Charles River Watershed Association (CRWA) was tasked with collecting the bacteria data for the report card. The volunteer monitoring program, with over 80 volunteers, monitor 35 sites every month and the data is sent to the EPA to analyze to produce the report cards. This set of data is the most consistent and comprehensive in the Charles River.

The primary focus of the Clean Charles River Initiative has been on reducing bacteria by addressing CSOs and reducing illicit sewage discharge to storm drain systems. EPA targeted enforcement efforts on CSO discharges to the Charles River as well as to Boston Harbor and South Boston beaches. This resulted in implementation of major capital improvement projects, such as sewer separation, facility upgrades, localized hydraulic relief and construction of new wastewater facilities. The changes reduced CSO discharges from 1.7 billion gallons per year in 1988 to approximately 20 million gallons in 2014, and is expected to keep dropping over the next few years (EPA, n.d.). This billion dollar investment yielded dividends of a drastic reduction of CSOs into Boston Harbor and its tributaries leaving Boston with some of the cleanest urban rivers and urban beaches in the nation.

The BSWC Illicit Discharge Detection and Elimination (IDDE) program has spent over $4.67 million dollars from 1999-2012 to investigate illegal connections. The Citywide Illegal Connection Investigation Program Phase 3 began in 2012 with a contract ceiling of $3.18 million for four years. In 2014, BSWC spent $482,236 (not including the cost of permits, inspection fees, pavement restoration, lateral testing/cleaning, or cost covered by property owners) to correct or repair ninety-six illicit discharges, removing 41,886 gallons per day (GPD) of wastewater from receiving waters (BWSC, 2014a). Within the lower Charles River (Boston, Cambridge, Newton, Brookline Watertown and Waltham), over 48,000 gallons per day of sewage contaminated stormwater has been removed from the River since 2004 (EPA, n.d.).

The 2012 Consent Decree has motivated the BWSC to continue to clean up the waters around Boston. BWSC had to pay a $235,000 civil penalty for violating the Clean Water Act and perform a supplemental environmental project worth at least $160,000 (EPA, 2012). The BWSC is required to conduct Dry and Wet Weather Outfall Monitoring and remove any illicit discharge found within 60 days of identifying them. BWSC is also required to report all SSO events to the EPA and Massachusetts DEP within 24 hours and developed a SSO Emergency Response Plan.

Since 1978, tremendous progress has been made in Boston (BWSC, 2014b):

- Replaced 82.8 miles of damaged sanitary sewers and drains
- Rehabilitated 54.7 miles of sewers and drains
- Inspected 585 miles of sewer pipes with CCTV,
- Cleaned 45.6 miles of large sewer drains
- Installed 94 miles of new storm drains to separate CSO

Over $3.8 billion has been spent in the last 20 years to fix the sewer issues. As of today, the Charles River is safe for swimming 70% of the time, but significant water quality problems still exist, primarily related to bacteria from CSOs and illicit sewage discharge to storm drains and excess nutrients (primarily phosphorus) from stormwater runoff. The nutrients contribute to algae blooms containing a toxic form of algae called cyanobacteria. Despite the tremendous work done in the Charles, there are still occasions where the water is unsafe for swimming. In order to best predict when bacteria would be high without the need to rely on intensive monitoring, CWRA invested in monitoring and modeling the data. This model is used as a predictive tool for the Charles River Notification Flagging System (Eleria, A. et al., 2005).

The Flagging System uses a system of color coded flags to notify the public when the river is safe for boating or when a public health threat may be present due to bacterial contamination or toxic algae blooms. Flags are posted by CRWA at 9 boating facilities from July-October and are blue (safe), yellow (risks are possible) or red (risks are probable or confirmed). CRWA uses a mathematical model to estimate the probability of the river water exceeding state standards for bacteria. The model relies on recent rainfall data and river conditions. Health risks due to toxic algae blooms are based on the weekly water sampling and communication with public health officials.

To increase public awareness, there is a buoy in front of the Museum of Science that streams live data on the EPA Charles River Website. An exhibit on the Charles River will be placed inside the museum, teaching visitors about the River and the urban environment. The CWRA bacteria data is posted on their website for the public to see.

PROGRESS TO DATE

Significant water quality improvements have been made in the Charles as a result of the Clean Charles River Initiative. By 2004, the River report card score went from a “D” to a “B+” and has remained there or risen ever since, earning its highest score of an “A-“ in 2013. The latest (2014) “report card” issued by the EPA gave the Charles River a B+, with the river meeting the boating bacteria standards 91% of the time and swimming standards 65% of the time. This is a drastic difference from the 39% (boating) and 19% (swimming) the River received in 1995. The Charles is now regarded as one of the cleanest urban waters in the U.S.

Over the years, there has been an increase of people making use of the harbor, from duck tours to paddle boarding to kayaking. In the Summer of 2013, the first public swim in over 50 years was held in the Charles River, with swimmers accessing the water from a dock to avoid contact with contaminated bottom sediments. It was a momentous day in the River’s history—and a celebration for so many people who have worked for decades to improve the water quality of the river. The Charles River Conservancy has made this community swim an annual event. This event has demonstrated the great enthusiasm among the public to reclaim the Charles for recreational swimming. Another indicator of improvement is that wildlife has returned to the River, which now hosts otters, beavers, fish, herons, hawks, herring, and migrating loons.

TIMELINE

- 1950s Charles River closed for swimming due to pollution
- 1965 Charles River Watershed Association formed
- 1982-1985 Various lawsuits involving Town of Quincy, Metropolitan District Commission (MDC), Conservation Law Fund and EPA due to discharges of untreated sewage into the Charles and Boston Harbor
- 1985 Federal Court Order issued to Massachusetts Water Resource Authority to clean up Boston Harbor
- 1995 Charles River Initiative launched by EPA, received a "D" score on the Charles River report card
- 2004 The River received a "B" score on the Charles River report card
- 2006 Settlement between EPA and Massachusetts Water Resource Authority to implement a long term control plan to reduce CSOs.
- 2009 Massachusetts legislature passes a bill to establish a Charles River Water Quality Commission charged with investigating the feasibility of and what is needed to make the lower Charles safe for swimming.
- 2012 Boston Water and Sewer Commission enters into Consent Decree with EPA focusing on sewage in stormwater outfalls
- 2012 Citywide Illegal Connection Investigation Program established
- 2013 First public swim in the Charles in over 50 years
- 2013: The River received a "A" score on the Charles River report card
- 2014 CSO discharges reduced by 99.5% from 1988

Photo Credit: Charles River Watershed Association

KEY FACTORS IN SUCCESS

- MWRA was initially resistant in CSO investments because they did not believe reducing CSOs would have a big impact on the river due to the other sources of contamination. Various drivers were able to convince MWRA to make changes, including the court order to reduce CSOs, monitoring data by the CRWA showing improvements, significant EPA funding through the Clean Charles Initiative, and media coverage of the Initiative (Metzenbaum, S., 2001).
- Existence of strong and technically advanced local watershed organizations to provide a scientific basis for goals and actions through collection of water quality data, and also to advocate for legislation that directed funding and resources towards the watershed.
- The Consent Decree requires that the BWSC IDDE program report all SSO events to EPA and Massachusetts DEP within 24 hours and remove identified illicit discharge within 60 days.
- Notification of the public about Charles River water quality issues through the report card, flag system, and various outreach programs.
- Various and coordinated efforts to promote public swimming on the Charles and to connect this goal with an improved quality of life have heightened public awareness and support.
- The key principles of the Clean Charles River Initiative that made it successful included the focus on a high value resource; an integration of a variety of federal, state and municipal tools, including enforcement, assistance, education, and permitting all directed at solving a clearly articulated problem and achieving a clearly articulated goal; measurement of progress in the metrics of actual environmental improvement; and working in partnership with the full range of institutions that are necessary for watershed restoration.

MOTIVATING FACTORS

Regulatory: Court Order in 1985 and Consent Decree in 2012.

Champions: Judge A. David Mazzone presided over the federal lawsuit in 1985. His ruling led to the Boston Harbor cleanup. EPA New England Regional Administrator John P. DeVillars developed the Clean Charles Initiative, creating a collaboration between EPA, other Federal and state agencies, NGOs and the private sector (The Charles River Conservancy, 2011).

Funding: The EPA provided funding for the Clean Charles Initiative and awarded $400,000 to the Charles River Watershed Association for monitoring and development of the flag warning system. Other funding sources for the cleanup included federal grants and funds, State Revolving Funds, local municipal funds and water/sewer user fees. MWRA estimated that the average home saw a rate increase of 420% between 1985 when the cleanup began and 1992.

Local Partners: Charles River Watershed Association (CRWA) has been focused on cleaning the river for the 50 years, taking a huge part in bacteria monitoring. Conservation Law Fund took part in both lawsuits and the Charles River Conservancy has spearheaded efforts to bring recreation back to the River.

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CASE STUDY:
SANTA MONICA BAY, LOS ANGELES, CA

Los Angeles has reduced 83% of their sanitary sewer overflows since 2000/2001

BACKGROUND

Despite its dry climate and historic drought, the Los Angeles area has an abundance of water resources which include more than a dozen beaches spanning over 50 miles from Malibu to Torrence Beach along Santa Monica Bay. These beaches provide a wide range of economic, environmental, and public safety benefits to the State of California's citizens, visitors, and wildlife. They also provide habitat for numerous species and are an important source of food for shorebirds, seabirds, marine mammals and fishes. The Bay's extensive coastline provides recreational opportunities for an estimated 500,000 visitors a day at the height of the summer season. This includes swimming, surfing, sport fishing and boating.

The Santa Monica Bay Watershed drains 385 square miles covering seven jurisdictions with 55 miles of coastline. The watershed has approximately 200 separate storm drain outlets that convey over 30 billion gallons of runoff to the Bay each year. The City of Los Angeles contributes 42 square miles to this drainage. As of March 2012, the U.S. EPA has approved 22 total maximum daily loads (TMDLs) throughout the region that list the City of Los Angeles as a responsible jurisdiction.

QUICK STATS

Santa Monica Bay		**Los Angeles**	
Type of waterbody:	Estuary	Annual rainfall:	10.62 inches
Watershed area:	385 mi^2	Population:	4 million
Watershed population:	2.18 million	Sewer system:	100% separate
		MS4 status:	Phase I
		Recreation:	The City operates 11 open water facilities offering fishing, paddle boating, and small craft programs

Source: LA County Public Health

SEWAGE POLLUTION PROBLEMS

An epidemiological study in Santa Monica Bay (Pruss, 1998) was one of the first of its kind to make the connection between increased health risks to people who swam in marine waters and proximity to outfalls contaminated by urban runoff. This and other studies established that the source of bacteria was not effluent from a sewage treatment plant, but instead came from urban runoff discharged from storm drains.

To address these and other historic water quality issues causing beach closures and loss of other water uses in the Los Angeles area, a 1999 consent decree between U.S. EPA, Heal the Bay, and Los Angeles Waterkeeper (formerly Santa Monica BayKeeper) was issued which directed the U.S. EPA to ensure that TMDLs for all impaired waters on the 1998 CWA 303(d) list in the Los Angeles Region were established within 13 years. The consent decree identified 92 waterbody pollutant combinations in the Los Angeles Region, which has resulted in 57 TMDLs for over 175 water bodies that address numerous pollutant impairments including bacteria, metals, pesticides, PCBs and trash.

Source: LA Times

KEY PLAYERS

EPA Region 9: Responsible for Clean Water Act enforcement in California, including the SSO consent decree and bacteria and trash TMDLs.

Los Angeles Area Regional Water Quality Control Board: This State agency collects water quality data to determine the status of water impairments, oversees implementation of the MS4 permit program, and is a defendant in the consent decree.

Los Angeles Stormwater: Agency under Environment LA responsible for implementing City of Los Angeles Stormwater Programs to meet TMDLs, MS4 permits, and other regulatory programs.

Heal the Bay, and Los Angeles Waterkeeper (formerly Santa Monica BayKeeper): NGOs named in the lawsuit responsible for the 1999 consent decree and also important stakeholders that have participated in monitoring and outreach activities throughout implementation.

In addition to its role in the consent decree, the Santa Monica BayKeeper filed a lawsuit against the City of Los Angeles in 1998 over sewer overflows that occurred during a severe El Niño rainy season. The overflows were linked to water quality impacts that affected local businesses and residents. The lawsuit, which was finally settled in 2004, resulted in a Collection System Settlement Agreement between the City of Los Angeles and EPA and the Regional Water Quality Control Board.

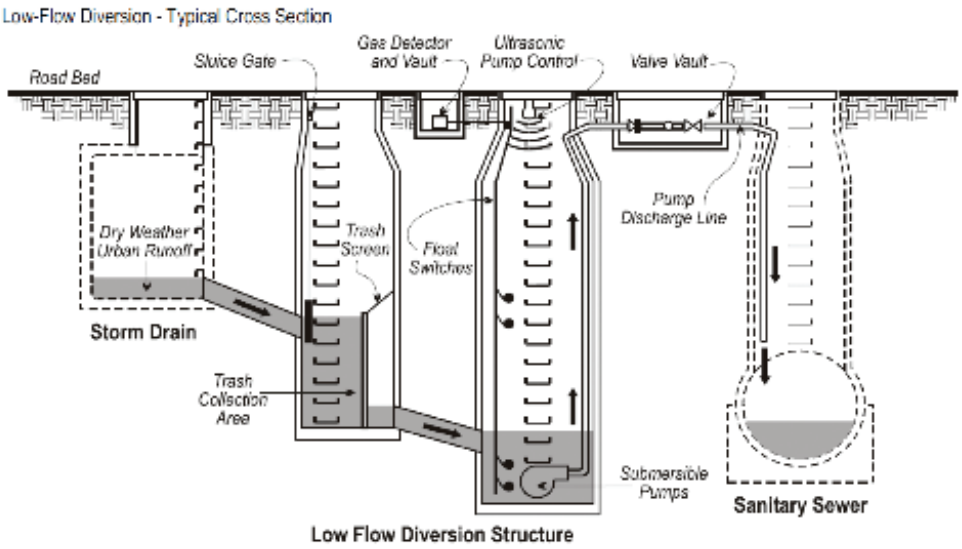
In 2002, a bacteria TMDL was developed for the Santa Monica Bay which identified dry weather flows from the storm drainage system as the primary source of controllable e.coli to the Bay. SSOs in the watershed are estimated to be 2% of the total dry weather load and an even smaller percentage of the wet weather load; however, during El Nino wet weather SSOs can be expected to be a much greater source. According to the Santa Monica Bay bacteria TMDL, the specific sources of bacteria from the storm drain system could not be identified and were attributed to a variety of non-point sources including sanitary sewer leaks and spills, illicit connections of sanitary lines to the storm drain system, runoff from homeless encampments, pet waste, wildlife, illegal discharges from recreational vehicle holding tanks, and malfunctioning septic tanks, among others.

One problem with the bacteria indicators used to assess water quality (e.g., e.coli, fecal coliform) is that they are not specific to human sewage; therefore, fecal matter from animals and birds can also be a source of elevated levels of bacteria. Microbial Source Tracking (MST) is a more sophisticated assessment tool that uses a combination of techniques (e.g., genetic markers, enteric virus detection) to isolate human-borne sources of bacteria. The most notable MST studies in the Santa Monica Bay watershed were conducted in the Ballona Creek watershed, a tributary that drains through the City of Los Angeles to Santa Monica Bay. This study used a variety of MST methods and found human-specific fecal indicator bacteria and enteric viruses in 92% of all samples collected (Nobel et al., 2005).

SEWAGE POLLUTION SOLUTIONS

Environmental groups from the Los Angeles area and City planning staff began working together through a stakeholder process in the early 2000s to collaboratively plan sewer and stormwater systems to meet TMDLs, NPDES, and other regulatory requirements. This collaborative planning drove the City to put a $500M bond (Proposition O) measure to a public vote for water quality improvement projects – primarily for urban runoff and stormwater. These were generally multi-benefit projects that created or improved habitat and recreation space. The environmental organizations developed campaigns to promote the bond measure and it passed with 2/3 of the general vote. This measure has been used to construct many regional runoff and stormwater capture projects, plus many low flow diversions along coastal outfalls to reduce bacteria discharges. One of the more successful approaches identified to address the bacteria TMDL is the diversion of low-flow urban runoff to sanitary sewer treatment plants prior to reaching the waterways (Minamide et al. 2011). A low flow diversion directs non-storm flows in storm drains to sewage treatment plants for additional treatment. The diversion system includes a low flow diversion weir; a stormwater/sediment separator; and a sump with pumps, control system, and discharge pipes. The efficacy of low-flow diversions is dependent on several factors such as treatment and transport capacity and assurance that the urban runoff pollutants will not upset the treatment process at the waste treatment plant. Most of the low flow diversions to coastal areas require pumping, which adds to their operation and maintenance. However, Los Angeles has implemented low flow diversions using gravity flow to address bacteria and other contaminant flows to Santa Monica Bay and the Los Angeles River as well.

The EPA does not include stormwater diversions in the list of “stormwater BMPs,” as the practice of diverting dry weather or wet weather/first flush flows to a sanitary sewer collection system is relatively new with potential challenges as well as benefits. Typically low flow diversions operate during the summer months when the level of storm drain discharge is relatively low and the use of Los Angeles beaches is high.



Low flow diversion structure (Source: CD:CDM 2005)

Since the late 1990s, 23 low flow diversions have been installed and divert flow to the Hyperion Wastewater Treatment Plant where it is treated before being discharged into Santa Monica Bay. In 2012, Los Angeles completed the last phase of a $40 million-plus dry-weather runoff diversion project that diverts eight storm drains that operate year round during dry weather along the Pacific Coast Highway into a sanitary sewer system and to the Hyperion Treatment Plant.

In 2005, the Los Angeles Bureau of Sanitation developed a comprehensive plan that resulted in the following actions to address the SSO problem:

- Annual closed circuit television inspection and condition assessment of more than 600 miles of sewer.
- Annual cleaning of more than 2,600 miles of sewer.
- Annual inspection of 95 percent of permitted food service establishments for compliance with the Fats, Oils, and Grease (FOG) Control Program.
- Building 55 sewer rehabilitation and replacement projects during the first three years.
- Rehabilitate 50 miles of sewers per year up to year 10 and afterwards rehabilitate 60 miles per year in targeted SSO prone areas.
- Building 11 sewer relief projects, beginning design and construction of two more, and identifying future relief projects in a capacity plan.

PROGRESS TO DATE

The SSO elimination plan has resulted in sewer spill reductions of 83% percent from the 2000 – 2001 baseline year through 2014. In FY2009-10 there were a total of 139 sewer spills compared to 687 sewer spills in the baseline FY 2000-01. This equates to approximately 2.1 sewer spills per 100 miles of sewer, which is the lowest recorded for the City and substantially below the national average of 3.0 sewer spills per 100 miles of sewer pipe in the collection system. As a result of the City's chemical root control program, root related sewer spills have been reduced by 76 percent since FY 2002-03. Sewer spills caused by fats, oils, and grease have been reduced by 91 percent since FY 2000-01 when the City began implementing its fats, oils, and grease Control Program.

The conservation group Heal the Bay notes in their Beach Report Card for 2006-2007 that, as a result of the City's low flow diversion projects and other initiatives, "Stretches of beach with good

TIMELINE

- 1999: Consent Decree between U.S. EPA, Heal the Bay, and Los Angeles Waterkeeper (formerly Santa Monica BayKeeper) was issued requiring the establishment of multiple TMDLs in the Los Angeles Region by 2012.
- 2002: Los Angeles Area Regional Water Quality Control Board adopted dry and wet weather bacteria TMDLs for the Santa Monica Bay Beaches.
- 2004: The City of Los Angeles and LA Waterkeeper reached a settlement agreement—the Collection System Settlement Agreement (CSSA)—that required the City to take drastic measures to clean up their system and eliminate the pollution; Los Angeles residents passed a $500 million water bond known as Proposition O that provided funding for TMDL implementation.
- 2012: Los Angeles completed the last phase of a $40 million-plus dry-weather runoff diversion project that diverts eight storm drains that operate year round during dry weather.
- 2014: In implementing strategies to meet the CSSA, the City has reduced sewage spill overflows by 82%.
- 2015: Heal the Bay beach report cards gives 94% of Los Angeles beaches an "A" or "B" grade for summer dry weather water quality.

Low flow diversion projects implemented by the City of Los Angeles have resulted in much improved beach water quality (A and B grades, up from D and F grades). Beach water monitoring data has been showing a general long-term downward trend in bacteria counts, when shown in correlation with the timeline of diversion installation.

KEY FACTORS IN SUCCESS

Several factors were important in the success of Los Angeles' cleanup of the Santa Monica Bay:

- Thanks to a partnership between local environmental groups and the City of Los Angeles, on November 2, 2004, an overwhelming majority (76%) of Los Angeles residents passed a $500 million water bond known as Proposition O that provided the resources for many of the BMPs used to meet bacteria, trash and other TMDLs.
- The use of a comprehensive monitoring plan that showed a large source of the bacteria was coming from dry weather discharges from the storm drainage system.
- The use of the dry weather diversion as an innovative BMP.
- Through sewer cleaning, inspection, source control and renewal, the City of Los Angeles and LA Sanitation have invested over $3 billion dollars in system upgrades and enhancements.
- LA Sanitation has adopted an aggressive fats, oils, and grease ordinance governing all 14,000 food service establishments in the City.

MOTIVATING FACTORS

Regulatory: Consent decree required consistency with bacteria TMDLs and MS4 Permits, and monitoring to verify water quality improvements

Enforcement: $2 billion settlement reached in EPA/Santa Monica Baykeeper Lawsuit Settlement Agreement and $1.6 million in civil penalties and fines of up to $15,000 per day for non-compliance.

Funding: $150 million from Proposition O

Local Partners: Heal the Bay and Los Angeles Waterkeeper named in the lawsuit which prompted the 1999 consent decree. Multiple NGOs participated in the development of the LA River bacteria TMDL.

Unifying Issues: 50 miles of recreational beaches in close proximity to urban area and resultant beach closures due to bacteria.

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LOS ANGELES'S SUCCESS WITH REDUCING TRASH

Proposition O also funded several trash capture devices. Besides bacteria, trash is a major impairing contaminant to coastal and inland waterways. After the trash TMDL was approved in September 2001, the City of Los Angeles conducted a study to characterize baseline trash generation rates in catch basins as high, medium, or low trash generating areas of the City (City of Los Angeles, 2001). The study was used to assist with strategic targeting of best management practices (BMPs). Two of these BMPs included catch basin inserts with 5 millimeter (mm) openings, and catch basin opening retractable screen covers. The City studied the effectiveness of these BMPs and determined that the 5 mm inserts were 100 percent effective in preventing the trash generated from a one-year, one-hour storm event from entering the storm drain. The catch basin opening retractable screen covers were found to be 86% effective.

To meet the TMDL implementation schedule, full capture systems were installed in the high trash generating areas of the City; and partial capture systems were installed in the low and medium trash generating areas of the City.

The City has installed trash capture BMPs and has achieved 100% compliance one year ahead of schedule.

CASE STUDY:
LAKE PONTCHARTRAIN, NEW ORLEANS, LA

Lake Pontchartrain was removed from the Louisiana DEQ impaired waters list for primary contact recreation as of 2006

BACKGROUND

Lake Pontchartrain is just one part of a vast ecological system called the Pontchartrain Basin. Known for its slow-flowing rivers and bayous, tranquil swamps, and lush hardwood forests, the Basin provides essential habitat for countless species of fish, birds, mammals, reptiles, and plants. The Basin comprises over 10,000 square miles of land in 16 Louisiana parishes and 4 Mississippi counties. All of these lands drain into rivers and bayous, which empty into Lake Pontchartrain and its connecting sister Lakes, Maurepas and Borgne. The Lake also exchanges water with the Gulf of Mexico, making it one of the largest estuarine systems in the nation.

The Lake itself covers 630 square miles and is used for boating, recreational fishing and swimming, with two beaches providing access for swimmers: Pontchartrain Beach on the South Shore and Fountainbleau State Park on the North Shore. The South Shore of the Lake is bordered by the City of New Orleans, while the North Shore is comprised of suburban communities, forests, wetlands and some farmland. Because the Mississippi River levees are higher than the Lake levees, most rainwater collected by the storm drainage system in New Orleans is pumped into Lake Pontchartrain.

Source: http://coastal.er.usgs.gov/pontchartrain/

http://kayakitiyat.com/big-easy-bayou-tour/

QUICK STATS

Lake Pontchartrain		New Orleans	
Type of waterbody:	Estuarine	Annual rainfall:	63.5 inches
Watershed area:	10,000 mi^2	Population:	384,320
Average depth:	12-14ft	Sewer system:	100% separate
Active shipping channels?	Yes	MS4 status:	Phase I
Watershed population:	2.1 million	Recreation:	1 swimming beach, 8 public boat ramps, 4 kayak/canoe rentals

SEWAGE POLLUTION PROBLEMS

Major sewage sources: small wastewater systems, SSOs caused by infiltration and inflow

In 1972, the highly popular Pontchartrain Beach swimming area was closed due to high levels of pollution from sewage, and then in 1979, "no swimming" advisories (which were often ignored) were posted along the Lake's South Shore by the Louisiana Department of Health and Hospitals. By the 1980s, Lake Pontchartrain was literally a brown mess. At the end of the decade, the swimming advisories included the entire South Shore and also covered the rivers on the North Shore. In the spring of 1989, a report called "To Restore Lake Pontchartrain," written by professors at Tulane University and the University of New Orleans, identified sewage as one of four major sources of pollution to the lake.

By 1996, Lake Pontchartrain was included on the Louisiana Department of Environmental Quality's (LDEQ's) impaired waters list, with fecal coliform one of the causes of impairment. In 1998, after several years of litigation, the Sewerage and Water Board of New Orleans, City of New Orleans and the State of Louisiana entered into a consent decree with EPA to address illegal discharges of untreated sewage from the Sewerage and Water Board's East Bank collection system into Lake Pontchartrain. These discharges were primarily overflows from manholes on the streets of New Orleans caused by blockages in the sewer line and from force main breaks and sewer pump station failures. A major contributor to the overflows were the numerous leaks and cracks in the City's aging sewer system (up to 100 years old in some areas) which, when combined with the City's below sea level elevation and intense rainfall, caused rapid increases in wastewater flows during and after storms that exceeded the system's capacity.

The consent decree involved $1.5 million in civil penalties and required the Sewerage and Water Board to address these problems through the following compliance measures, primarily for the East Bank collection system. These measures included:

1. Pump station backup plan in event of failure
2. Supervisory controls and data acquisition program
3. Plan for ensuring cross connections are fixed
4. Preventative maintenance program
5. Sewer overflow action plan
6. Tracking and reporting plan for unauthorized discharges
7. Remedial action plan to address capacity and condition of the system
8. Storm sewer monitoring program
9. Employee training
10. Outreach and public awareness
11. A $2 million Lincoln Beach Water Quality Improvement Plan

In 2012, EPA finalized a fecal coliform TMDL for 15 waterways in the Lake Pontchartrain Basin, including numerous drainage canals and leveed waterways that are impaired as a result of SSOs and stormwater runoff in Orleans and Jefferson Parishes. Modifications to the consent decree in 2013 required the Sewerage and Water Board to coordinate with EPA and LDEQ to ensure that the remediation work is consistent with the TMDL requirements as well as the municipal separate storm sewer system (MS4) Permit, for which the Board is a co-permittee with the City of New Orleans, Port of New Orleans, Orleans Levee District, Jefferson Parish, and the Louisiana Department of Transportation.

On the North Shore of Lake Pontchartrain, rapid growth and development led to its sewage pollution problems. Data collected in the early 1990s in the Tchefuncte River and Bogue Falaya show that the bacteria counts were greater than 10,000 MPN/100 ml, causing the rivers to be placed under swimming advisories and ultimately listed on Louisiana's list of impaired waters for fecal coliform bacteria in 1992. Sewage sources on the North Shore include discharges from overburdened wastewater treatment plants (WWTPs) or poorly maintained and improperly operating home septic and mechanical treatment systems. With many of these small systems, gaps in the permitting system resulted in owners/operators having inadequate information about how to properly operate or maintain their systems. One other direct source of sewage to the Lake was a series of old camps with no waste treatment systems.

KEY PLAYERS

EPA Region 6: Responsible for Clean Water Act enforcement in Louisiana, including the SSO consent decree and bacteria TMDLs.

Louisiana Department of Environmental Quality: This State agency collects water quality data to determine status of water impairments and is a defendant in the SSO consent decree

Sewerage and Water Board of New Orleans: Formed in 1899, this utility operates the City of New Orleans' drainage, water and sewer programs and is the primary defendant in the SSO consent decree

Lake Pontchartrain Basin Foundation: In the spring of 1989, a report called "To Restore Lake Pontchartrain," written by professors at Tulane University and the University of New Orleans, called for the establishment of an entity whose sole focus would be a healthy Lake and Basin. That report became the rallying point for a citizen-led effort that resulted in the formation of the Lake Pontchartrain Basin Foundation that same year. This non-profit organization conducts monitoring, education and restoration activities and are primarily funded by EPA and LDEQ.

SEWAGE POLLUTION SOLUTIONS

In 1995, a comprehensive management plan was finalized for the Basin by the Lake Pontchartrain Basin Foundation (LPBF), a non-profit organization focused on restoring the health of the Lake, in concert with EPA. The plan laid out a roadmap for addressing the major pollution sources, including:

1. Maintenance and education for the owners/operators of small community/business WWTPs and individual home WWTPs;
2. Septic disposal facility construction;
3. Fund parish planning and construction of larger community/regional sewerage systems and better maintenance of existing systems; and
4. Funding for stormwater system investigations and repairs

In 1996, the Sewerage and Water Board began a major rehabilitation and capacity upgrade of its aging sewage collection system, following a public hearing to obtain citizen input on the plan. The Sewer System Evaluation and Rehabilitation Program was eventually incorporated into the consent decree. To date, sanitary sewer evaluation surveys to identify structural sewer rehabilitation needs are complete for the entire East Bank collection system. Implementation of the remediation projects—including trenchless pipe lining and manhole rehabilitation—have been completed for half of the collection system, with an expected final completion date of 2025.

The consent decree also required quarterly storm event monitoring for indictors of sewage (fecal coliform, fecal strep, enterococci and caffeine) before and after remediation projects to verify their effect on water quality. The LPBF wanted to do more frequent monitoring and be able to communicate to the public that the Lake's water quality was improving. In 2000, they began sampling for fecal coliform (as per State water quality standards) at ten historically recreational sites on a weekly basis and another ten sites of interest on a monthly basis.

As a result of this monitoring, it soon became apparent that the Tchefuncte River and its tributary the Bogue Falaya, were contributing significant bacteria loads to the Lake. So LPBF and St. Tammany Parish began more investigative monitoring in 2002 to identify and correct pollution sources, which turned out to be primarily leaking or inadequately maintained small wastewater systems. LPBF has focused this monitoring—referred to as the Pollution Source Tracking Program—on the Tchefuncte River system and works with a wastewater contractor to assist operators (e.g., homeowners, municipalities, businesses) with making the needed repairs or corrections once the bacteria hotspots are pinpointed.

Given the findings of the Pollution Source Tracking Program, LPBF partnered with LDEQ's Small Business Assistance Program to document how to operate and maintain small package waste treatment systems and to provide free assistance for the owners/operators. The focused effort included direct contact and one-on-one educational outreach with area residents, small-business operators and community groups. St. Tammany Parish entered into a cooperative agreement

with LDEQ to inspect septic systems and implement a parish-wide educational program on septic system maintenance and repair using Clean Water Act Section 319 funds. The parish took further action, passing an ordinance requiring that on-site sewage disposal systems be inspected before a residential certificate of occupancy could be awarded and electrical power connections activated.

Old Beach, one of LPBF's weekly monitoring sites in New Orleans (Source: www.saveourlake.org)

In 2005, Hurricane Katrina hit southeast Louisiana, setting back progress on water quality improvements in the Basin, including the consent decree. As a result, most consent decree objectives were put on hold for two years while damages to the wastewater system were repaired. Modifications to the consent decree were approved in 2010, 2013, and 2014 that extended the deadlines for remediation due to continuing effects from Katrina. Until Katrina hit, the Board had been in compliance with all aspects of the consent decree, and with the 2014 modifications, is on track to complete the required activities by 2025.

After Hurricane Katrina, there was a galvanizing of the regulatory community. Says Andrea Bourgeois-Calvin, PhD, Water Quality Program Director of the LPBF, "the silver lining of Katrina was that everyone realized we all need to work together and there was greater education of the public." One example of this heightened awareness is that the old camps on the Lake, which had been wiped out during Katrina, were not allowed to rebuild.

The efforts to address sewage on the North Shore were largely funded through EPA grants and parish funds, while the South Shore improvements were financed through multiple sources including a $100 million grant from EPA (over 10 years) and service rate increases (two service rate increases between 1998 and 2002, followed by an annual 10% increase from 2013 through 2020). A 2014 estimate shows that the Sewerage and Water Board has spent $220 million on evaluating and rehabbing the sewer system, with plans to spend another $170M. That price does not include the costs of the Katrina-related work in those four basins, a sewage overflow tracking and reporting program, flood protection upgrades, or legal fees for the negotiations. The Board plans to spend another $87.7 million in 2015 for sewerage system upgrades, including $33 million for replacing sewer lines.

PROGRESS TO DATE

Water clarity in Lake Pontchartrain began improving in the mid-1990s. Pelicans began returning in the late 1990s, while blue crab harvest increased. By 2000, Lake Pontchartrain appeared suitable for swimming again. In 2005, over 20 manatees were sighted in the Lake. The testing that LPBF conducts through its water quality-monitoring program has shown that water quality has improved significantly on the Lake's South Shore. In 2006, despite the major setbacks brought on by Hurricane Katrina, Lake Pontchartrain was removed from the LDEQ impaired waters list for primary contact recreation (except for a sliver along the South Shore which is still under review).

Today, South Shore water quality is almost always suitable for swimming, based on the State of Louisiana's water quality standards for primary contact recreation of fecal coliform levels below 200 MPN (most probable number of colonies of bacteria per 100ml). In 2009, the inaugural Ochsner Ironman Triathlon included a 1.2 mile swim in the Lake. While Pontchartrain Beach was closed for swimming in 2012 due to safety concerns, LPBF is working towards a renovated, safe and supervised public beach and swimming area in the near future as funding becomes available. These results demonstrate that improvements to the City of New Orleans' sewerage system have had a tremendous impact on cleaning up Lake Pontchartrain.

On the North Shore, bacteria counts in the rivers have declined significantly and now meet standards for primary contact recreation limits. As a result, LDEQ removed the Tangipahoa, Bogue Falaya and the Tchefuncte rivers from the 2008 CWA section 303(d) list of impaired waters for fecal coliform. The Pollution Source Tracking program and resulting wastewater improvements are to credit for this water quality success story.

TIMELINE

- 1972: Pontchartrain Beach closed due to pollution
- 1979: No Swimming advisories posted along South Shore
- 1989: Lake Pontchartrain Basin Foundation established
- 1995: Comprehensive Management Plan finalized for the Basin; North Shore rivers included on impaired waters list for bacteria
- 1996: Lake Pontchartrain included on impaired waters list for bacteria; Sewerage and Water Board of New Orleans began sewer upgrades
- 1998: Consent decree to address SSOs between EPA and Sewerage and Water Board of New Orleans, Louisiana DEQ and City of New Orleans
- 2000: Lake Pontchartrain Basin Foundation began fecal coliform sampling
- 2002: Lake Pontchartrain Basin Foundation began Pollution Source Tracking program
- 2005: Hurricane Katrina hits
- 2006: Lake Pontchartrain removed from impaired waters list
- 2008: North Shore rivers removed from impaired waters list
- 2010: First modification of consent decree
- 2012: Fecal coliform TMDL established for drainage canals and leveed waterbodies in the New Orleans area draining to Lake Pontchartrain
- 2013 and 2014: Second and third consent decree modifications
- 2025: Expected completion date for consent decree projects

KEY FACTORS IN SUCCESS

In New Orleans, the consent decree was the initial driver to fix the sewer system, but the City's MS4 permit and TMDLs soon also became important. In the 2013 modification of the consent decree, the following language was added to help ensure that the remediation measures would be tied to local water quality:

"The Board commits to consult with EPA and LDEQ to ensure, to the maximum extent possible, that the RMAP work is consistent with the requirements of the Total Maximum Daily Loads (TMDLs) for Fecal Coliform Bacteria and Dissolved Oxygen for Selected Subsegments in the Lake Pontchartrain Basin and the Board's MS4 (Municipal Separate Storm Sewer System) discharge permit. The Board will include a summary and description of any such discussions in its Quarterly and Annual Reports."

Another unique element of the consent decree that likely contributed to the City's success is the requirement to establish a storm sewer monitoring program. The intent of the monitoring is to provide baseline data on the presence of sewage indicating pollutants in the East Bank stormwater drainage system prior to and following completion of the remediation projects, to ensure the projects result in the intended improvements. Large fines of up to $15,000 per day may also have been a motivator for the Board to complete the consent decree projects on time.

LPBF attributes its success in helping to clean up Lake Pontchartrain to the fact that its mission is focused on water quality improvements and this mission drives all of their activities. The organization is primarily supported by funds from EPA and LDEQ and their unique focus on the Lake supersedes jurisdictional boundaries. Throughout the basin and region, the impact of Hurricane Katrina also spurred unprecedented cooperation among the jurisdictions and other entities to work towards a common goal of restoring the Lake.

MOTIVATING FACTORS

Regulatory: Consent decree required consistency with bacteria TMDLs and MS4 Permits, and required monitoring to verify water quality improvements.

Enforcement: Consent decree involved $1.5 million in civil penalties, and fines of up to $15,000 per day for non-compliance.

Funding: $100 million from EPA, followed by 10% annual sewer rate increase over eight years.

Local Partners: Public outcry in the1980s led to the formation of the Lake Pontchartrain Basin Foundation with its mission to "Save the Lake." The organization is funded by federal and State agencies, was a plaintiff-intervener in the original lawsuit against the Water and Sewerage Board of New Orleans, and now works cooperatively with local agencies to find and fix pollution sources.

Unifying Issues: After Hurricane Katrina hit New Orleans in 2005, there was unprecedented cooperation among partners in the region.

SOURCES

Sub-Basin Pollution Source Tracking Program:
http://water.epa.gov/polwaste/nps/success319/la_tchef.cfm

Sewerage and Water Board of New Orleans Consent Decree website:
http://www.swbno.org/docs_consentdecree.asp

Lake Pontchartrain Basin Foundation: http://saveourlake.org/

Ochsner Ironman New Orleans Triathlon:
http://www.the2040project.com/2010/09/lake-pontchartrain-water-quality-is-it.html

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Louisiana Water Quality Assessment Report:
http://ofmpub.epa.gov/waters10/attains_state.control?p_state=LA

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http://www.nola.com/politics/index.ssf/2014/02/new_orleans_deadline_for_feder.html

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CASE STUDY:
LAFAYETTE RIVER, NORFOLK, VA

In 2014, the Virginia Department of Environmental Quality issued a draft report that the Lafayette River meets water quality standards for recreational contact

BACKGROUND

The Lafayette River is a 6.2-mile-long tidal estuary that forms the northernmost branch of the Elizabeth River, the largest natural harbor in the world. The Elizabeth River in turn empties into the southern end of the Chesapeake Bay in southeast Virginia. The Lafayette River watershed, which covers 13.87 square miles of mostly residential land, is entirely located in the city of Norfolk, Virginia.

Marsh and farmland were the predominant land covers until the first streetcar crossed the 26th Street Bridge in 1899. Decades of discharges from factories and shipyards resulted in a legacy of contamination in the river bottom. Today, this river promises to become the first branch of the Elizabeth River to return to health. The River is used for recreation, especially boating, tubing, and water-skiing. There are no public access points for swimming.

QUICK STATS

Lafayette River		City of Norfolk	
Type of waterbody:	Estuarine	Annual rainfall:	46.5 inches
Watershed area:	13.87 mi^2	Population:	245,428
Watershed population:	98,000	Sewer system:	100% separate
		MS4 status:	Phase I
		Recreation:	8 public boat ramps/kayak launch sites, 1 community pier, 2 kayak/jet ski rentals

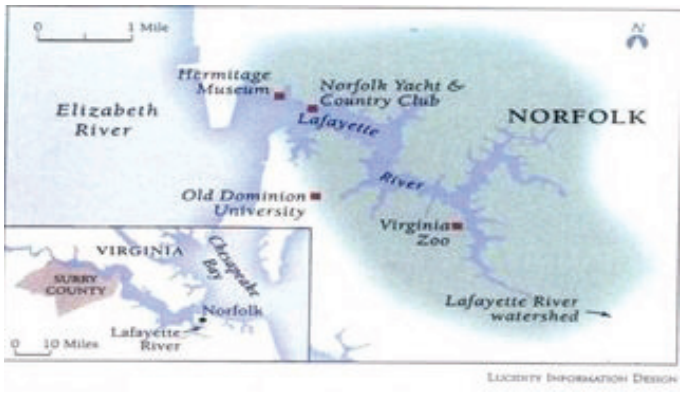

Figure 1. The Lafayette River watershed
(Source: http://cbf.typepad.com/bay_daily/2011/04/things-looking-up-for-the-lafayette.html)

Major sewage sources: wet weather SSOs from I&I; dry weather SSOs from grease-related clogs

SEWAGE POLLUTION PROBLEMS

For most of the 20th century, the Elizabeth River was routinely labeled the "dirtiest" on the East coast. The River and its tributaries were plagued by problems from industry, including contaminated bottom sediments and cancer-causing toxics. In the 1920s, the harvest of clams and oysters from the Elizabeth River was banned due to bacteria and other contamination. The oyster ban brought attention to the issue of sewage pollution, leading to the establishment of Hampton Roads Sanitation District (HRSD) in 1940. Then in 1991, the Elizabeth River Project (ERP) was founded by four citizens with a goal of restoring the health of the river and the local economy, further raising awareness about water quality concerns in the region.

In 2001, the Virginia State Water Control Board issued a special order of consent with the HRSD and the City of Norfolk to resolve Clean Water Act violations from sanitary sewer overflows (SSOs) to the Elizabeth River and its tributaries. These SSOs were caused by infiltration and inflow of groundwater into the system through leaks and cracks in old pipes, which then overloaded the capacity of the system when it rained. Dry weather SSOs were also occurring, primarily caused by clogs from grease poured down the drain. Because HRSD and the City of Norfolk each own and maintain a portion of the sewer lines in the City of Norfolk and the waste is then treated by HRSD, the two entities worked cooperatively to eliminate SSOs in the City. In 2005, after the sanitary sewer evaluation survey (SSES) required by the special order of consent was complete, the Board entered into a new agreement with HRSD and City of Norfolk to establish a schedule for completion of the recommended sewer remediation projects. The City of Norfolk is also

voluntarily working with the HRSD municipalities on the development of a regional wet weather management plan required by a federal consent order with EPA.

The upper reaches of the Lafayette River were first included on the Virginia Department of Environmental Quality's impaired waters list in 2002 for bacteria (enterococcus). The source of the impairment was listed as unknown but the River was also listed as impaired for estuarine bioassessment, PCBs, and dissolved oxygen, with sources that included municipal sewage and SSOs. A bacteria total maximum daily load (TMDL) was approved in 2010 for the Elizabeth River watershed. The TMDL identified pet waste and SSOs as the primary sources of bacteria to the Lafayette. During the period 2005-2009, there were 49 reported SSOs in the Lafayette watershed alone that discharged to surface waters. Stormwater runoff, failing septic systems, wildlife, livestock, and marinas were identified in the TMDL as less significant bacteria sources. The Lafayette River bacteria TMDL requires a 100% reduction from SSOs and failing septic systems, and a 98% reduction in bacteria load from pet waste and livestock.

KEY PLAYERS

Virginia State Water Control Board: Responsible for administrating the Virginia Water Control Law, including issuance of special orders to resolve violations of its regulations and permits

Virginia Department of Environmental Quality: This State agency handles day-to-day administration of Virginia's water laws, including impaired waters, TMDLs and MS4 permits

City of Norfolk, Virginia: The City of Norfolk was issued a special order of consent by the State Water Control Board for SSOs and as a result has spent millions fixing leaks and cracks in its collection system

Hampton Roads Sanitation District: Formed in 1940 to protect public health and the waters of Hampton Roads by treating wastewater effectively, HRSD is also named in the special order of consent with the City of Norfolk and is addressing SSOs by increasing the capacity of their treatment systems

Elizabeth River Project: Founded in 1991 by four citizens with a goal of restoring the health of the river and the local economy, ERP works on restoration and education and conducts monitoring throughout the watershed.

SEWAGE POLLUTION SOLUTIONS

The 2001 special order of consent comprehensively addressed sanitary sewer overflows by requiring development of collection system plans, an expenditure of $13.5 million on capital improvements and system operation, and completion of the SSES and a sewer line inspection program in the City of Norfolk. The 2005 agreement set forth a schedule for rehabilitation and required the City of Norfolk to spend $46 million on repairs. Since 2002, Norfolk has spent $76 million in sanitary sewer improvement projects in the Lafayette River watershed. The SSES has allowed the City to prioritize neighborhoods that are in the worst shape and are close to the River. To prevent stormwater from overwhelming sewer lines, Norfolk is phasing in the upgrade of all 17,000 manholes to add steel inserts that keep stormwater out. The City is replacing leaking sewer pipes and is part of a regional effort to address leaking lines on private property. These remediation projects were funded by a sewer rate increase of 30% in 2004, 14% in 2005, and an annual 4% hike after 2005. All of these efforts have reduced the number of SSOs in the City from 200/year to about 15/year.

To address the dry weather SSOs caused by grease clogs, the City developed its fats, oils and grease (FOG) program as part of a regional effort with HRSD. This included developing standards, investigating each food service establishment in the City and providing educational materials to facility owners. This effort has helped to reduce main line stoppages in the City and, now that the program has been established, the City is working on inspections and enforcement.

In 2009, the ERP began organizing community-wide efforts to improve the Lafayette that involved everyone from residents, businesses, volunteers and scientists as well as the HRSD and City of Norfolk. ERP introduced a Lafayette River Action Plan in 2011 with a key goal to remove the Lafayette from the state's impaired list for bacteria by 2014. The 2011 plan was developed with the Chesapeake Bay Foundation (CBF) with input from 100 stakeholders from all walks of life. Another goal of the plan was to meet Virginia Department of Health Shellfish Sanitation's bacteria limits for consumption of shellfish.

Some accomplishments resulting from the Lafayette River Action Plan include:

- Testing for bacteria in 15 sites in the Lafayette (expanded from previous sampling)
- Installation of pet waste stations by ERP
- ERP enlisted half of the Lafayette River marinas as Virginia Clean Marinas and RiverStar businesses which involved upgrades to one of the marina pumpout stations
- HRSD expanded its free boater pump out program to visit all Norfolk marinas every weekend in the summer and every Saturday in winter
- Implementation of bank stabilization and floating wetland project at Virginia Zoo
- Installation of 300 storm drain markers by CBF
- 15 acres of wetland restoration by City of Norfolk, and funding acquired for restoration of an additional seven acres
- 9.5 acres of new oyster reef, plus funding for two additional acres
- More than 800 “oyster reef balls”
- 13 million young oysters grown for the Lafayette by CBF
- 1,200 RiverStar homes certified in the Lafayette
- Implementation of green stormwater projects (e.g., wetlands, Filterra, rain gardens) by the City of Norfolk to meet their nutrient TMDL but that also remove bacteria and provide amenities for the community as well as habitat

TIMELINE

- 1920s: Ban instituted on harvesting oysters and clams in the Elizabeth River due to bacterial contamination
- 1940: Establishment of the Hampton Roads Sanitation District
- 1991: Elizabeth River Project founded
- 2001: Special order of consent between Virginia State Water Control Board and City of Norfolk for SSOs
- 2002: Lafayette River included on State impaired waters list
- 2004: Sewer rate increase of 30% approved to pay for rehabilitation projects
- 2005: Revised special order of consent between Virginia State Water Control Board and City of Norfolk and HRSD for SSOs
- 2010: Bacteria TMDL developed for the Elizabeth River watershed
- 2011: Lafayette River Action Plan developed
- 2012: Seahorse spotted in the Lafayette River

TIMELINE - CONTINUED

- 2012: Seahorse spotted in the Lafayette River
- 2014: Lafayette River Report Card gives the River a "B" for bacteria; Virginia DEQ draft report recommends removing the Lafayette from the impaired waters list
- 2018: Projected end date for completion of consent order projects
- 2022: Long term improvements in bacteria trends to be evaluated for the Lafayette

ERP's bacteria testing has led to source tracking efforts that resulted in successful elimination of sewage discharges and also spurred a regional effort to apply bacteria source tracking (BST) technology to isolate human sewage sources. When the ERP's sampling data showed consistently high bacteria levels at one site in the upper reaches of the Lafayette, the City of Norfolk did additional bacteria testing upstream in the stormwater system to narrow down the source of the problem. HRSD then also collected samples, which were analyzed using BST to determine if the source of the bacteria at each site was human or non-human. Using this method, the partners ultimately found a pump station with a cracked force main and the City was able to fix the problem. Based on the success of applying BST to source tracking, HRSD has since established a state-of-the-art lab for BST and this year the Commission approved five new positions that will focus just on source tracking to reduce pathogens. HRSD is not required to undertake these activities but were driven by their mission to "protect public health and the waters of Hampton Roads" to voluntarily work to eliminate raw sewage.

PROGRESS TO DATE

The intensive focus on restoration of the Lafayette watershed has resulted in significant reduction in bacteria levels in the River. The Elizabeth River State of the River Steering Committee's 2014 Water Quality Scorecard for the Lafayette gives the River a "B" for bacteria, as measured by enterococcus levels compared to State criteria for recreational human contact. Virginia DEQ measures bacteria in the Lafayette once a month at two stations. The state reviews six years of data to recommend whether to remove a river from a list of waterways impaired for recreational contact. During these six years, no more than 10% of the total samples can exceed 104 colony forming units (CFU) per 100 ml. of enterococci bacteria. DEQ's 2014 draft Water Quality Assessment Integrated Report, which summarizes the results of this monitoring, says the Lafayette branch has achieved the state standard for bacteria. As with any urban river, meeting state standards does not mean a waterbody is always safe for swimming. Elevated bacteria levels are still highly

likely for up to 72 hours after a rain. The State Health Department determines which waters are "safe" for swimming through weekly testing but does not test in the Lafayette because there are no public swimming areas.

Figure 2. A seahorse found in the Lafayette has spurred more searching by scientists (Source: CBF)

The reduction of sewage flows to the Lafayette River has not only affected bacteria levels, but also has improved shellfish quality and water quality overall. The 2014 Water Quality Scorecard indicates that more than 50% of the Lafayette may now meet state bacteria levels for shellfish consumption. The Virginia Division of Shellfish Sanitation is evaluating whether to lessen the ban from prohibited to restricted, in consideration of other factors such as viruses and PCBs. The 2014 Water Quality Scorecard gives the Lafayette an "A" for dissolved oxygen, the highest of any branch on the Elizabeth River. ERP staff Joe Reiger and Marjorie Mayfield Jackson, both of whom live on the River, have observed an increase in recreational use of the River over the years, mostly by kayakers, canoes, etc. One of the more inspiring indicators of success was the discovery of a lined seahorse by scientists during an aquatic survey in the Lafayette in 2012. Seahorses prefer clean water and its sighting may be a harbinger of the river coming back to life. Long-term improvements in bacteria trends in the Lafayette will be evaluated in 2022, when scientists will have ten years of data.

KEY FACTORS IN SUCCESS

The relatively small size of the Lafayette River watershed provided an ideal laboratory to study the effects of intensive restoration and facilitated the ability to measure improvements soon after projects are implemented. The location of the watershed within a single municipality and the consent order requirements to spend a specific and very large amount of money on restoration may also have been factors contributing to success.

The partnership between ERP, the City and HRSD was cited by all three partners as extremely important because each partner did their part and had a singular focus on restoration. While the City and HRSD worked to improve their assets along the River, ERP acted as another set of eyes to look for problems. Rather than point fingers or threaten to sue, ERP met with the partners and asked for help. In return, the HRSD and City of Norfolk provided assistance with tracking down sources of sewage even when it was not required. The HRSD has gone above and beyond the requirements of the consent orders—for example, establishing the source tracking program and adopting state-of-the-art methods—simply because of their commitment to their mission of keeping sewage out of the water.

MOTIVATING FACTORS

Regulatory: Special order of consent for SSOs and bacteria TMDL were regulatory drivers.

Funding: consent order required the City of Norfolk to allocate more than $59 million for rehabilitation; projects were funded by sewer rates hikes of 30% in 2004, 14% in 2005 and an annual increase of 4% after 2005.

Local Partners: The Elizabeth River Project plays an important role in helping to identify problems and bring them to the attention of the City, as well as to engage the public in doing their part to restore the River.

Champions: HRSD has gone above and beyond their requirements by establishing a pollution source tracking program using state-of-the-art bacteria source tracking techniques, while the City of Norfolk's Director of Utilities Kristen Lentz has been known to put on her boots and walk around the shoreline after work hours searching for sewage leaks.

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