WASTEWATER

2015 SUMMARY

The latest Clean Water Needs Survey Report identified a $6.8 billion need for wastewater infrastructure in the State of Virginia, which is a 45% increase from the $4.7 billion published in the 2009 ASCE infrastructure report card. That 45% increase is up from a 20% increase noted in the previous report. Significant additional funding is needed to meet EPA mandates for an ambitious "pollution diet" with rigorous accountability measures to restore clean water in the Chesapeake Bay and Virginia's waterways. This includes complying with EPA Consent Orders to reduce sanitary sewer overflows and reducing nutrients from treatment plant discharges. Virginia has $1 billion of identified needs to control combined sewer overflows alone, which allows raw untreated sewage to discharge to Virginia's waterways.

Wastewater Category D

Virginia has $6.8 billion of needs over the next 20 years; a 45% increase from the previous report. Virginia has made progress and has a comprehensive plan but has tremendous challenges ahead.

Factors include aging infrastructure, regulations for nutrient reduction, reducing infiltration from wet weather flows, increasing capacity, meeting demands for growth, and increases in construction costs are all driving this increasing funding need. To address this need, various federal, state, and local funding sources are supporting projects that focus on improvements to our current wastewater infrastructure.

Unfortunately, residents of Virginia are ultimately responsible for addressing this need, with an 88% increase in wastewater rates over the last 10 years. With the continuing occurrence of sanitary sewer overflows (SSO) and high nutrient discharge violations, it is clear that improvements in wastewater system efficiency and reliability must be achieved through sustained funding and improved operations if we are to adequately protect our valuable water resources and meet regulatory requirements.

Discharge from Virginia's estimated 746 municipal wastewater treatment facilities is the sixth largest source of nitrogen pollution in the Chesapeake Bay. Nitrogen contributes to the Bay's 150-mile "dead zone" from Baltimore to the York River. **Virginia has an estimated $3.3 billion of wastewater treatment needs.**

There are an estimated 746 municipal **wastewater treatment** facilities serving over 2 million households in Virginia. The majority of these treatment facilities discharge treated wastewater into a receiving water body. This discharge has the potential to introduce excess nutrient concentrations into aquatic environments, resulting in ecosystem degradation. Additionally, raw untreated wastewater sewage is discharged directly into our streams and waterways after significant rainfall events due to sanitary sewer overflows (SSO). The SSO are caused by failing sewer pipes and joints allowing elevated groundwater levels to infiltrate into the collection system exceeding pipe capacities. Increased flows in sewer pipelines can even exceed treatment plant capacities potentially causing raw untreated sewage to discharge to receiving waterways. The volume of wastewater to treat increases significantly as does the cost to treat due to increased flows. Further, Virginia

Virginia cities have invested $428 million in controlling combined sewer overflows. **Virginia has a documented $616 million of controlling combined sewer overflow needs.**

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has three cities, Richmond, Lynchburg and Alexandria that have **combined sewer systems** (CSS) in portions of their city that convey both stormwater and sanitary sewage together in the same piping system. During periods of rainfall that exceed the capacity of the collection system, the treatment plant is bypassed and raw untreated sewage is allowed to discharge to Virginia's rivers by combined sewer overflows (CSO).

Pipeline conveyance system malfunctions are the largest contributor to sanitary sewer overflows (SSO) which adversely affect the environment. These negative environmental impacts include a reduction in aquatic species, declining public health, and economic losses through industry and recreational tourism. Aging infrastructure is the main concern with many pipelines and structures nearing the end of their useful life. As such, they represent a majority of the funding needs to evaluate, monitor, rehabilitate and/or replace pipelines and structures. Root intrusion, joint failure, structural failure, and clogging are typical issues related to the failure of aging pipe lines. Increased federal regulatory requirements and Consent Order and Decree requirements for managing wet weather flows and nutrient reduction for wastewater treatment plant discharges represent significant funding needs.

By 2020, an estimated 45 percent of water and sewer pipes in Virginia will need major renovation or replacement, sustained funding and improved operations are needed. **Virginia has an estimated $2.9 billion of pipeline conveyance needs.**

Upgrading and replacing aging facilities and infrastructure is required for compliance with the mandated Clean Water Act (CWA), Chesapeake Bay 2000, and the new Chesapeake Bay Watershed (June 2014) agreement regulations, as well as keeping up with demands caused by continued population growth and economic development. The discharge of high nutrient loads into receiving waters has led to publicized fish kills, "dead zones", and a reduction in recreational water use, a result of which has been stricter basin-specific regulations. The state currently has a number of projects underway in different localities that are addressing some causes of these issues, but additional projects in other areas of the state are necessary. Increases in treatment costs, aging infrastructure, and reductions in state and local budgets are creating financial strains on individual utilities to remain compliant with strict state and federal regulations. Ultimately, the residents of Virginia will bear the burden of the utilities' financial strains with increased wastewater rates and higher taxes. If funding needs are not met, the state can expect a reduction in public health and environmental quality, which have seen vast improvements over the past thirty years.

Funding needs for wastewater infrastructure is up 45% from 2008 to a total of $6.8 billion.

The economic benefits of a cleaner Chesapeake Bay are $8.3 billion per year to Virginia. [

The State Water Control Law mandates the protection of existing high-quality state waters and provides for the restoration of all other state waters so they will permit **reasonable public uses and will support the growth of aquatic life**.

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INTRODUCTION AND BACKGROUND

The water quality of Virginia's creeks, streams, rivers, estuaries, and coastal waters are necessary for maintaining both human and environmental health, as well as sustained economic development. With over 3,000 square miles of surface water in the state, a large segment of the population in Virginia lives in close proximity to a water body. A substantial portion of the Virginia economy is dependent on the availability of clean water. Fishing, agriculture, military installations, water-based tourism, ecotourism and shipbuilding attract large numbers of people and generate revenue for the state. For example, the Chesapeake Bay, which is the largest estuary in the country, runs along much of the eastern portion of the state. It generates significant revenue for the state through both tourism and the fishing industry.

The quality of these surface waters is directly impacted by the management of the states wastewater treatment systems. The state has an estimated 746 municipal wastewater treatment facilities, serving approximately two-thirds of the households in the state, a majority of which discharge treated effluent into a water body. High nutrient levels in the effluent play a role in the high percentage of impaired bodies of water in the state (Table 1). The Chesapeake Bay had a 150-mile "dead zone" between Baltimore, MD and the York River in Virginia. This is a result of excess nutrients in the water, with the number one and predominant source of nutrients attributed to surface water runoff. Wastewater treatment plants were cited as the second highest rate of nitrogen pollution. Of the wastewater plants discharging into the Chesapeake Bay ecosystem, one quarter are located in Virginia.

The economic benefits of a cleaner bay are $8.3 billion to Virginia. $2.1 billion is attributed to enhancements to wastewater treatment systems.

With an estimated thirteen percent increase in the state's population over the next ten years, demands for adequate wastewater treatment and disposal are expected to place immense strains on current systems as well as drive up costs for system expansions and new facilities.

TABLE 1. IMPAIRED AREA BY WATERBODY TYPE (2004 – 2012)

Waterbody Type	2004	2006	2008	2012	% of Total*
Rivers & Streams 52,257 miles	6,931 miles	9,002 miles	10,543 miles	13,140 miles	25%
Lakes 116,364 acres	89,834 acres	109,208 acres	94,044 acres	94,041 acres	81%
Estuaries 2,684 miles	1,907 miles	2,216 miles	2,182 miles	2,134 miles	80%

***** % of total is based on data from 2012 survey, Information taken from 2008 Water Quality Assessment by Virginia Department of Environmental Quality (VA DEQ).

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Virginia utilizes many government entities with varying responsibilities to oversee our wastewater infrastructure. These responsibilities range from regulatory groups to groups that manage economic resources distributed to individual localities. For example, the Virginia Resources Authority is responsible for overseeing the distribution of low interest State Revolving Fund (SRF) loans for infrastructure. The distribution of state and local funds is impacted by the apparent need seen by the general public and its officials. Unfortunately in many cases, the population is unaware of the deteriorating condition of the wastewater system, and much needed economic support is routed elsewhere.

Additionally, these loans help reduce the level of cost placed on individual localities. For instance, a small rural system must charge higher rates to residents due to a smaller local economy to cover costs, whereas a larger system can often avoid charging higher rates. These smaller localities could benefit from funds to improve their wastewater infrastructure. Seven percent of the population was serviced by small treatment systems and this comprised fourteen percent of the total state need.

CONDITION AND ADEQUACY

By the year 2020, an estimated 13% of the nation's water and wastewater pipes will be classified as being in poor condition, 23% in very poor condition, and 9% beyond their lifespan. Considering these estimates, along with the estimated 13% increase in Virginia's population by 2020, it is evident that the state will have issues with regards to the conveyance of increased volumes of raw wastewater to the plants. Virginia has been addressing this issue, through the Clean Water State Revolving Fund (CWSRF) providing loans for plant expansion projects.

Table 2 provides a description of the design life in years of different components that make up wastewater infrastructure. In general, older pipe materials have longer useful life spans when compared to newer installed materials, however the tentative retirement dates align from oldest to newest materials. The types of material used in wastewater infrastructure follow historic trends revolving around population booms, infrastructure construction overhauls, and federal legislation. These historic periods include the 1890's, World War I, the "Roaring 20's", post-World War II, and the passing of the Clean Water Act in the early 1970's[15]. Based on these historic time periods and the estimated years of design life, much of the wastewater infrastructure is approaching or has surpassed the useful portion of its design life.

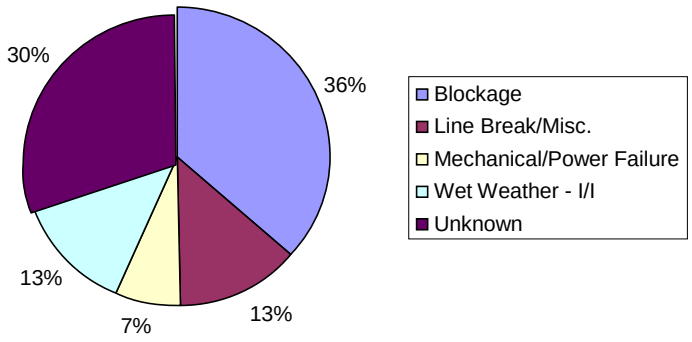
TABLE 2. APPROXIMATE DESIGN LIFE OF WASTEWATER INFRASTRUCTURE COMPONENTS

Components	Years of Design Life
Collection Systems	80-100
Treatment Plant-Concrete Structures	50
Treatment Plant-Mechanical & Electrical	15-25
Pumping Stations-Concrete Structures	50
Pumping Stations-Mechanical & Electrical	15
Interceptors	90-100

Data was taken from the Clean Water and Drinking Water Infrastructure Gap Analysis Report by the U.S. EPA.

A good indicator of the condition of a wastewater system is the frequency of sanitary sewer overflows (SSO). The nation has an estimated 23,000 to 75,000 SSO events each year, resulting in a loss of between 3 and 10 billion gallons of untreated wastewater. Figure 1 provides a breakdown of the causes of SSO events for EPA region 3, which includes Virginia. One primary cause of SSOs can be attributed to aging infrastructure, which over time degrades and eventually fails.

FIGURE 1. PERCENTAGE OF SSO EVENTS BY CAUSE FOR EPA REGION 3.



Data taken from 2004 Report on Control and Impacts of CSOs and SSOs by the U.S. EPA.

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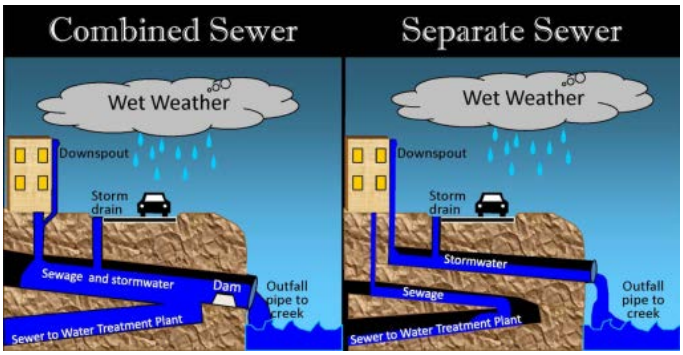
Combined Sewer Systems

In Virginia, the cities of Richmond, Lynchburg and Alexandria are known to have combined sewer systems. These combined sewer systems (CSS) carry both stormwater and sanitary sewage and are designed to overflow to rivers and streams whenever there is significant rainfall. This causes raw untreated sewage to discharge to Virginia's rivers and waterways. The CSS systems require a separate permit from the Virginia DEQ. CSS permits require nine technology-based minimum controls and a long-term control plan that includes water quality impact considerations.



Rainfall in combined sewers causes raw untreated sewage to discharge to waterways. Rainfall amounts as little as 0.2 inches per hour cause overflows.

Graphics Source: www.phillyriverinfo.org

The City of Richmond reports having investd $242 million to control combined sewer overflows and has documented another $500 million; and Lyncburg reports having invested $186 million and documents another $314 million. The City of Alexandri has estimated needs of $200 million. This would bring the total funding needs of Virginia to control CSO events at over $1 billion.

When assessing the condition of wastewater infrastructure, it is necessary to look at both existing structures as well as gaps where new structures are needed. A report by The Rural Community Assistance Partnership (RCAP) found that Virginia ranked 7th for highest percent of occupied rural housing units lacking complete plumbing facilities and 16th in the nation for highest percent of all occupied housing units lacking complete plumbing facilities[11]. The report also showed that between 1990 and 2000, the state had reduced the number of public housing units lacking complete plumbing facilities by 50%.

Total Maximum Daily Load (TMDL) - Chesapeake Bay Milestones

On May 15, 2014, EPA received the second set of two-year milestones from Chesapeake Bay jurisdictions as part of the "**pollution diet**" or Bay TMDL. The milestones outline steps the Bay jurisdictions will take in the next two years to reduce nitrogen, phosphorus and sediment pollution to the Chesapeake Bay and the regions rivers and streams, and what reductions those measures will achieve.[20]

The TMDL – the largest ever developed by EPA – identifies the necessary pollution reductions of nitrogen, phosphorus and sediment across Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia and sets pollution limits necessary to meet applicable water quality

standards in the Bay and its tidal rivers. Specifically, the TMDL sets Bay watershed limits of 185.9 million pounds of nitrogen, 12.5 million pounds of phosphorus and 6.45 billion pounds of sediment per year – a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus and 20 percent reduction in sediment is required. These pollution limits are further divided by jurisdiction and major river basin based on state-of-the-art modeling tools, extensive monitoring data, peer-reviewed science and close interaction with jurisdiction partners.

Achieving these reductions will not be easy, but VADEQ is taking action and addressing these challenges. and as of 2008 have developed 546 Total Maximum Daily Load (TMDL) allocations for tributary segments within Virginia, with another 217 slated in the future. This still leaves over 1,500 TMDLs to be developed in order to cover the Virginia portion of the Bay watershed entirely. There is limited funding for performing TMDL studies to develop the rest of the tributary allocations; however, federal mandates will still require the Chesapeake Bay TMDLs be completed.

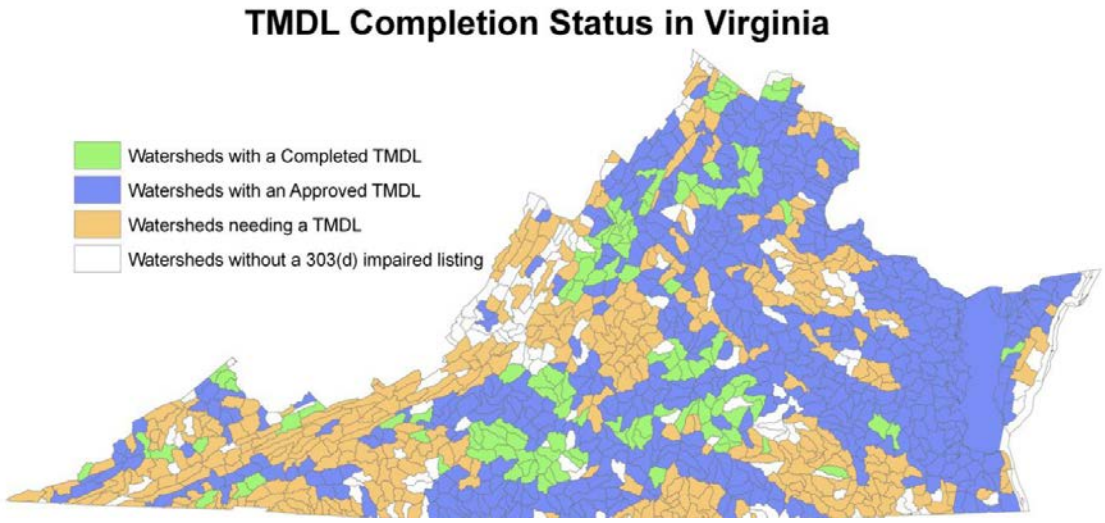


FIGURE 2. TMDL COMPLETION STATUS IN VIRGINIA

These efforts to improve stormwater quality are targeted on making Virginia's water "fishable and swimmable" in accordance with the U.S. Clean Water Act enacted over 38 years ago. In 2014, of the 52 beaches monitored in Virginia, there were 113 days of posted swimming advisories, 32 times when two or more consecutive days were posted as a swimming advisory, and two locations that had repeated and lengthy posted advisories. Virginia still has a significant number of waterways which have fish consumption advisories posted, indicating there is still significant work to be done.

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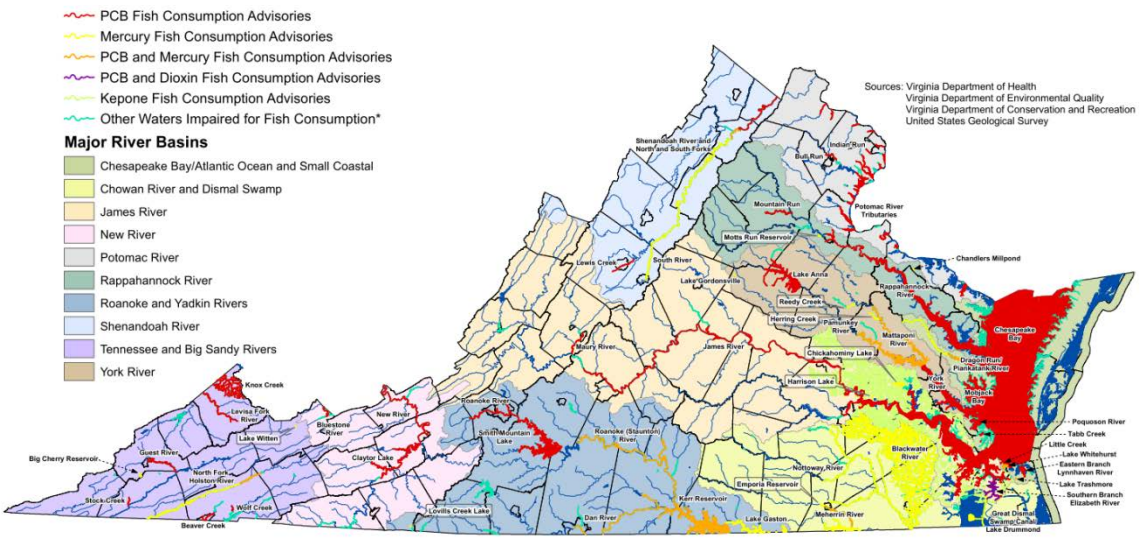

FIGURE 3. VA WATERS UNDER FISH COMPSUMPTION ADVISORIES ((SOURCE: VADEQ 2012 305(B)/303(D) REPORT)

INVESTMENT NEEDS AND FUNDING DEDICATED

In the past, Virginia has made use of state and federal funding programs for maintenance of wastewater infrastructure in order to offset the cost for individual households. With rising costs for construction, maintenance, and necessary upgrades to public treatment facilities, these programs have provided a means for our state's localities to cost effectively comply with federal clean water regulations.

In the Clean Watershed Needs Survey, the Environmental Protection Agency (EPA) reported a need of $6.8 billion in Virginia which is a forty-five (45%) percent increase from the previous 2004 report[1]. The national average need for wastewater infrastructure per capita is $971. Virginia falls in the $500-$1,000 range of per capita need[1]. It is necessary to address this need identified by the EPA in order to meet water quality and water-related public health goals of the Clean Water Act for the State of Virginia. The need is focused on upgrades and improvements for wastewater treatment plants, addition and rehabilitation of wastewater collection and conveyance systems, and the reduction of sanitary sewer overflows.

$3.2 billion is needed to meet EPA Consent Order driven capital improvements for the wastewater treatment system serving Hampton Roads municipalities to reduce wet weather flows, provide capacity and treatment plant upgrades. [25]

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TABLE 3: TOTAL VIRGINIA DOCUMENTED NEEDS BY CATEGORY (UP TO 20 YEARS) [1]

Categories	Funding Needs ($, million) Tab. B-1
Secondary wastewater treatment	1,522
Advanced wastewater treatment	1,804
Infiltration/inflow correction	366
Sewer replacement/rehabilitation	1,427
New collector sewers & appurtenances	733
New interceptor sewers & appurtenances	380
Combined sewer overflow correction	616
TOTAL	6,848

It should be noted, the cities of Richmond and Lynchburg have studies documenting cumulative needs of over $814 million to further control raw untreated sewage from discharging to Virginia's streams and rivers due to combined sewer systems. This is greater than the $616 milion reported in Table 3 for combined sewer overflow correction.When included with Alexandria's estimated $200 million that exceeds $1 billion of funding needs to control CSO in Virginia

Providing funding for Wastewater Infrastructure supports jobs. The Hampton Roads Sanitation District will have a total regional economic impact of $4.7 Billion over the next 10 years and will support 3,060 jobs each year.

To address this need, the state has taken advantage of grants and low interest loan opportunities under the guidance of specific state agencies. For example, the Virginia Clean Water SRF Loan Program has provided over one billion dollars in loans since 1987, which has successfully funded over 250 wastewater projects through the state. Another example is the Water Quality Improvement Fund (WQIF) which is limited to design and installation of nutrient reduction technology at Chesapeake Bay watershed publicly owned wastewater treatment plants. For 2014 WQIF has approved proceeds of $106 million, since 1998 WQIF has provided $849 million of funds. Table 4 provides a list of the major funding sources and dollar amounts the state will be benefiting from. A number of funding programs specifically target rural communities and small treatment systems. These funding programs provide economic assistance to struggling localities in the form of employment, as well as for the improvement of public and environmental health within the community by enhancing public facilities. These programs also

encourage the development of economically and environmentally sustainable projects such as "green" infrastructure, alternative energy sources, and water reuse.

According to the "FY 2014 Chesapeake Bay and Virginia Waters Clean-Up Plan" which is a consolidated progress report required by the Code of Virginia, "for the fiscal years 2016 – 2021, an estimate of $1.55 billion may be required from state and federal funds as well as farmer financial contributions to meet statewide water quality goals by 2025. Further, projected funding needs from state sources for implementation of agricultural best management practices from FY16 through the FY17-FY18 are estimated to be $333.65 million. This Fiscal Year 17-18 funding schedule will not provide the estimated funding necessary to achieve 60% of the Chesapeake Bay agricultural implementation by 2017. Despite this fiscal challenge, it is anticipated that the Commonwealth's 2017 Bay goal will still be met by over-achievement in other sectors, specifically wastewater treatment plants.

TABLE 4: FUNDING AGENCIES, FUNDING TYPES AND DOLLAR AMOUNT OF FUNDS ALLOCATED TO THE STATE OF VIRGINIA FOR FY 2014.

Funding Agency/Manager	Funding Type	Amount of Funding ($, million)
Virginia State Revolving Loan Fund	State Loans (21 projects)	139.4
Water Quality Improvement Fund	Grant	106.0
Virginia Nutrient Trading Program	Nutrient Trading	520.0
Water Quality Improvement Funds	Construction Bonds	250.0

*** Represents funding allocated at the national level**.

Unfortunately, it is clear that this level of funding falls short of all the previously described needs placing a great deal of pressure on localities to find alternative sources of funding. The gaps in funding have led to increased public wastewater rates, with communities bearing 95% of clean water costs. The average wastewater rate for the state in 2008 was $27.74, which equates a 9.5% increase from the previous year and a 65% increase since 1998. The national average for that same year was slightly higher at $29.17. Although Virginia falls well below the EPA's current measure of affordability for wastewater rates based on household income, the burden of increasing these rates during a time of economic recovery will be strongly felt.

BASIS OF GRADE

The State of Virginia currently lacks the necessary statistical data on the condition of our wastewater infrastructure to determine an objectively measured grade. Further, funding needs are broad and projected over long periods of time and are difficult to compare with specific, short-term funding allocations. As a result of this, a subjective grade was determined from a panel of experienced professionals in the field of wastewater engineering. The subjective grade was based on the following:

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- The evaluation of conditions since the 2009 ASCE Virginia Infrastructure Report Card. Condition comparisons include, infrastructure conditions, funding needs, federal regulatory mandates in-place and scheduled reduction requirements.

- The significant increase of funding needed to address wastewater treatment for nutrient reduction, pipeline and conveyance evaluation, monitoring and replacement, and combined sewer overflow correction. The current $6.8 billion need is an increase of 45% over the previous report in 2009, which had a stated need of $4.5 billion.

- The cost of complying with federal mandates associated with the Clean Water Act and the Chesapeake Bay 2000 agreement and the new Chesapeake Bay Watershed Agreement (June 2014)

- The urgency of protecting water quality in the Chesapeake Bay and other valuable Virginia waterways as they impact the quality of life and economic prosperity of the Commonwealth.

- Comparison with the ACSE National Wastewater Report Card grade of D based on:

    - The national and Virginia's per capita need.

    - Virginia's ranking of 16th in the nation for highest percentage of total occupied housing units lacking complete plumbing facilities.

    - The national and Virginia's monthly wastewater rates.

- Virginia is utilizing a number of state and federal resources to address the recognized $6.8 billion dollar wastewater infrastructure need. These include the Virginia SRLF, WQIF, grants, construction bonds, nutrient trading program, and sewer rate increases by localities. These resources are funding projects that address current infrastructure issues.

- It is assumed that the majority of Virginia's wastewater infrastructure was installed prior to the 1980's. A good indication of infrastructure age is the majority of SSOs occurring in Region 3 has been identified to be caused by blockages, line breaks, and mechanical failures, adding validity to the previous assumption. Using accepted materials lifespan estimates, along with these two points, it is clear that Virginia faces significant challenges to meet the needs of replacing an ageing wastewater infrastructure.

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Conclusions and Recommendations

The Virginia Section of the American Society of Civil Engineers assigns a grade of D to Virginia's Wastewater Infrastructure. This is a reduction from the 2009 grade assigned of D+. Virginia has made considerable investments in wastewater infrastructure improvements and has made considerable progress in reducing the levels of nutrients being discharged to the Bay. However, in a 4-year period the estimated wastewater infrastructure needs have increased 45% to $6.8 billion up from $4.7 billion. The previous 4-year period had an increase of 20%, this reflects a significant, continual upward trend of increasing needs. Continued and increasing federal regulations for reducing nutrient discharges and sanitary sewer overflows will contribute to this trend of increasing costs including increased emphasis on improving water quality in the Chesapeake Bay. Funding needs to control combined sewer overflows are reported at $814 million in documented needs from Richmond and Lynchburg. Including reported needs of $200 million from Alexandria, brings the total to over $1 billion to control CSO in Virginia.

Wastewater Category D

Virginia has $6.8 billion of needs over the next 20 years; a 45% increase from the previous report. Additional funding is needed to meet EPA mandates for an ambitious "pollution diet" with rigorous accountability measures to restore clean water in the Chesapeake Bay and Virginia's waterways. This includes complying with EPA Consent Orders to reduce sanitary sewer overflows and reducing nutrients from treatment plant discharges. Virginia has $1 billion of needs to control combined sewer overflows which allows raw untreated sewage to discharge to Virginia's waterways.

In order to preserve the integrity of our wastewater systems, the following recommendations are made:

- The Virginia Section of the American Society of Civil Engineers encourages local, state, and federal officials to support long-term funding of wastewater infrastructure projects designed to reduce the funding gap. The purpose of these funded projects is to improve the quality of both public and environmental health, while allowing for sustainable economic growth.
- Included in any future government stimulus packages and grants should be funding for projects specifically addressing wastewater infrastructure.
- State and localities should promote asset management projects that allow better oversight of current wastewater infrastructure and assessment of age, condition and future needs.

ASCE 2013 National Infrastructure Report Card reports an improvement from D- (2009) to a D.