REPORT CARD FOR CONNECTICUT'S INFRASTRUCTURE

2022

CONNECTICUT SECTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

INFRASTRUCTUREREPORTCARD.ORG/CONNECTICUT

Cover photo: Pearl Harbor Memorial Bridge (i.e., Q-Bridge), New Haven, Connecticut. Photo Credit: Connecticut Department of Transportation / H.W. Lochner, Inc.

This page photo: A bright orange maple tree in a Connecticut country setting during the autumn months. Copyright: arenacreative

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Executive Summary

The people of Connecticut are concerned about the State's economy. Residents and elected leaders seek a business-friendly environment and improvements to their quality of life. Infrastructure is vital for our society's economic health – a cornerstone that is especially important to a densely populated state such as Connecticut. Infrastructure includes surface transportation networks such as bridges, streets for motorists, bicyclists, and pedestrians, and railroads carrying freight and passengers. Infrastructure also includes water systems: sourcing, treating, and sending clean water to the tap, plus wastewater collection and treatment facilities. Infrastructure is the backbone of our modern communities. Investments in our physical capital leads to increased opportunities for economic prosperity and helps improve the quality of life for residents.

The Connecticut Society of Civil Engineers, in conjunction with the American Society of Civil Engineers, has evaluated five infrastructure networks important to the State of Connecticut – roads, bridges, rail transportation, drinking water systems, and wastewater systems. Grades ranged from a D+ for roads to a B for rail, with an overall grade of C. Three out of five categories – bridges, drinking water, and wastewater showed incremental improvement in their grades over the last four years since the first Connecticut Infrastructure Report Card was issued in 2018 - and no categories had their grades go down. The age of our infrastructure is a challenge across the categories. Connecticut has some of the oldest infrastructure in the country, much of it over 50 years old and beyond its intended life. While some conditional improvements have been made in recent years, there remains a significant long-term funding gap between predicted funding and needed capital improvements. This gap puts any progress at risk.

The recent passage of the federal Infrastructure Investment and Jobs Act (IIJA) is expected to provide Connecticut with over $5 billion in infrastructure funding over the next five years, which will help address some of the age, capacity, and condition challenges. Inflation levels at 40-year highs and Connecticut's gas tax suspension through November 30, 2022 present additional headwinds. Capital improvement projects out for bid today are coming in higher and gas tax receipts have been reduced. Connecticut's civil engineers are working hard to do more with recent public investment. But it remains vital that Connecticut's leaders back a bold vision for our infrastructure to foster opportunities that improve our economy and increase prosperity for residents.

The 2022 Connecticut Infrastructure Report Card looks at the following five categories of infrastructure in the State, highlighting concerns and challenges while offering several proposed solutions.

- Bridges
- Drinking Water
- Rail
- Roads
- Wastewater

Grading Methodology

The 2022 Report Card for Connecticut's Infrastructure was written by a committee of 18 civil engineers from Connecticut who volunteered their time to collect and analyze data, prepare and review their findings. The committee worked with staff from ASCE National and ASCE's Committee on America's Infrastructure to provide a snapshot of our infrastructure, as it relates to us at home, and on a national basis.

The Report Card sections are graded based on the following eight criteria:

CAPACITY

Does the infrastructure's capacity meet current and future demands?

CONDITION

What is the infrastructure's existing and near-future physical condition?

FUNDING

What is the current level of funding from all levels of government for the infrastructure category as compared to the estimated funding need?

FUTURE NEED

What is the cost to improve the infrastructure? Will future funding prospects address the need?

OPERATION AND MAINTENANCE

What is the owners' ability to operate and maintain the infrastructure properly? Is the infrastructure in compliance with government regulations?

PUBLIC SAFETY

To what extent is the public's safety jeopardized by the condition of the infrastructure and what could be the consequences of failure?

RESILIENCE

What is the infrastructure system's capability to prevent or protect against significant multi-hazard threats and incidents? How able is it to quickly recover and reconstitute critical services with minimum consequences for public safety and health, the economy, and national security?

INNOVATION

What new and innovative techniques, materials, technologies, and delivery methods are being implemented to improve the infrastructure?

GRADING SCALE

EXCEPTIONAL: FIT FOR THE FUTURE

The infrastructure in the system or network is generally in excellent condition, typically new or recently rehabilitated, and meets capacity needs for the future. A few elements show signs of general deterioration that require attention. Facilities meet modern standards for functionality and are resilient to withstand most disasters and severe weather events.

GOOD: ADEQUATE FOR NOW

The infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention. A few elements exhibit significant deficiencies. Safe and reliable with minimal capacity issues and minimal risk.

MEDIOCRE: REQUIRES ATTENTION

The infrastructure in the system or network is in fair to good condition; it shows general signs of deterioration and requires attention. Some elements exhibit significant deficiencies in conditions and functionality, with increasing vulnerability to risk.

POOR: AT RISK

The infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of significant concern with strong risk of failure.

FAILING/CRITICAL: UNFIT FOR PURPOSE

The infrastructure in the system is in unacceptable condition with widespread advanced signs of deterioration. Many of the components of the system exhibit signs of imminent failure.

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A special thanks to Don Shubert and the Connecticut Construction Industries Association

Old Saybrook Old Lyme Bridge.
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Recommendations to Raise the Grade

Connecticut needs to rehabilitate, modernize, and fund the necessary improvements in our built environment to bolster the economy and the quality of life for its residents. The Connecticut Society of Civil Engineers (CSCE) has ideas to start raising the grade on infrastructure:

1. Increase Investment

Connecticut has a substantial and widening gap between its long-term infrastructure investment objectives and expected revenues to fund these needs. This threatens the State's economic strength, business climate, and quality of life. Transportation, water, and sewer systems in Connecticut are among the oldest in the country. Our roads are clogged with cars and trucks that threaten the safety of pedestrians and bicyclists. Our intercity rail networks are heavily used and crowded. Local infrastructure owned by municipalities continues to face severe operational and funding shortfalls. Connecticut's funding gap faces additional pressures due to the suspension of the state gas tax. 40-year high levels of inflation are impacting the cost of infrastructure projects throughout the state and reducing the benefit of additional revenues from the Infrastructure Investment and Jobs Act.

If Connecticut is serious about meeting its future infrastructure funding needs, it is critical that elected leaders change course and assemble the political will to develop additional revenue sources within the state. This increased revenue is necessary to pay for required maintenance and rehabilitation. Beyond that bare minimum for state-of-good repair, capacity improvements to our infrastructure demands greater funding.

2. Improve Resilience

As a coastal state, Connecticut's infrastructure is increasingly vulnerable to the impacts of climate change. Rising sea-levels, increasing rainfall intensities and precipitation rates, combined with the extreme summer droughts, all pose challenges to the State's infrastructure systems. Wastewater and drinking water systems – as well as roads, bridges, and railroads – must be resilient and able to maintain operations during increasingly severe storms. That anti-fragility allows emergency response and a return to regular order as efficiently as possible.

Connecticut must double down on recent momentum toward this end. Projects here must meet recent regulations requiring back-up power to water systems, emergency contingency plans, vulnerability assessments, as well as physical upgrades.

3. Labor Recruitment

Labor shortfalls represent a grave threat to infrastructure improvements, regardless of effective planning and sufficient funding. Connecticut, like much of the nation and world, faces substantial labor shortfalls. The contractors on our infrastructure projects are having serious issues finding skilled laborers. Suppliers are having difficulties maintaining satisfactory staffing levels to meet demand.

Beyond the contracting community, Connecticut's state agencies overseeing our infrastructure systems have recently suffered through a significant retirement wave – resulting in staff reductions and a loss of institutional knowledge. This has necessitated a large-scale recruiting and hiring effort by the State that is on-going. Private firms in the consulting engineering community are having difficulties recruiting and hiring qualified professionals.

If our engineering and contracting communities cannot find qualified and skilled individuals to perform the required planning, design, and construction of the needed infrastructure projects in the state, Connecticut will not be able to execute the vision required to improve our infrastructure systems – even with all the money in the world.

Connecticut leaders must come together to:

a) Work with engineering professional organizations such as ASCE, ACEC, and others, to create and promote workforce development programs to increase the number of students pursuing engineering degrees.

b) Work with contractor organizations such as CCIA, AGI, and others to develop apprenticeship programs to recruit workers to the building trades.

c) Develop engineering and building-trade outreach programs in our middle and high schools, as well as our colleges and universities, to educate the next generation of workers to the potential careers opportunities afforded in engineering and construction trades.

2022 Connecticut's Infrastructure Report Card

G.P.A.

C

BRIDGES	C
DRINKING WATER	C
RAIL	B
ROADS	D+
WASTEWATER	C-

Bridges

Gold Star Memorial Bridge, New London – Groton, Connecticut
Photo Credit: Cardinal Engineering Associates

EXECUTIVE SUMMARY

Consistent funding, a preventative maintenance focus, and further adoption of innovative materials and techniques have all contributed to a marked improvement in Connecticut's bridge infrastructure condition since the previous 2018 Report Card. The percentage of National Highway System bridges in Connecticut that are in poor condition is now in compliance with the Federal Highway Administration's 10% threshold since its reduction from 13% to 7.5% (measured by deck area). Connecticut's improvement on this statistic has outpaced its New England peers. However, across the board improvements have generally been limited to state maintained bridges; conditions of locally maintained bridges (which account for about 25% of the bridges in the state) are lagging. The overall outlook is positive, and additional federal funding from recent legislation will be leveraged to keep up the momentum. Still, the foreseeable future includes challenges that may slow or reverse system-wide improvement. There appears to be a substantial funding gap that is delaying enhancements and reconstructions for several major bridges. These delayed projects are critical to the state's economic vitality, and, so far, no permanent solution has been identified that will address the funding gap and allow the state to meet its long-term commitments.

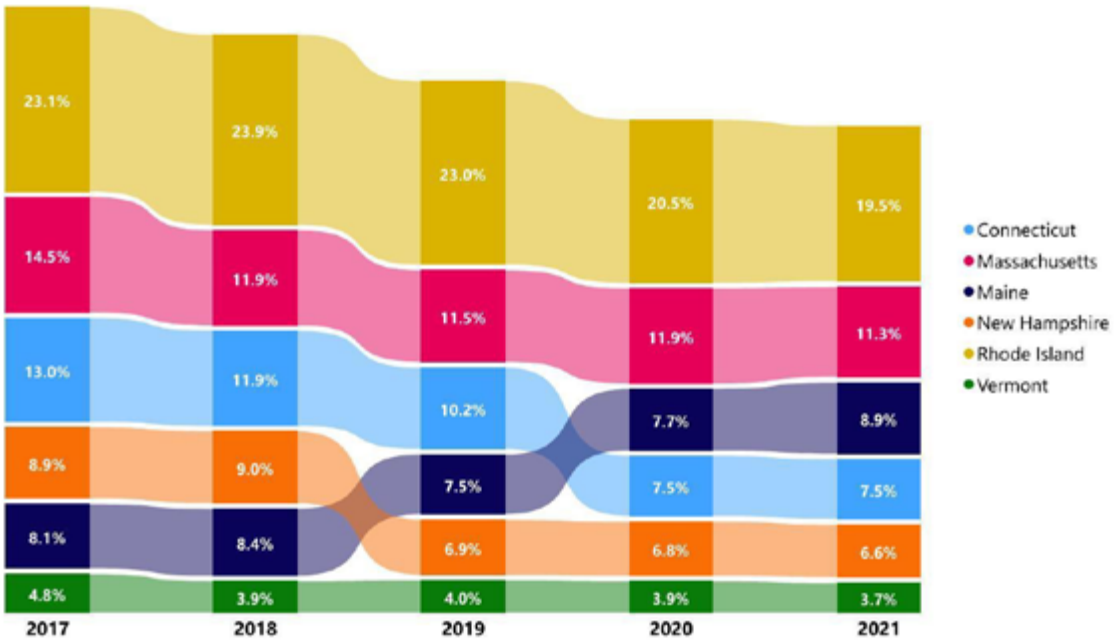
CONDITIONS & CAPACITY

The Federal Highway Administration (FHWA) defines a National Bridge Inventory (NBI) bridge as a structure measuring more than 20 feet in length. CTDOT inspects 5,429 roadway bridges in the state, 1,821 of which are NBI structures on the National Highway System (NHS). The average NHS-NBI bridge in Connecticut is 53 years old, which is 9 years older than the national average of 44 years. More than half of Connecticut's in-service bridges exceed their original design lifespan of 50 years.

NBI bridges are inspected at least every two years and their major components (Deck, Superstructure, and Substructure) are assigned condition ratings of Good, Fair, or Poor. Bridges are considered to be in a State of Good Repair (SOGR) with condition ratings of Fair or better for all of their major components. In 2021, the condition of Connecticut NHS-NBI bridges were 14% Good, 77% Fair, and 8% Poor. It is more economical to proactively maintain a bridge in a SOGR than to rehabilitate or replace a bridge once it reaches a Poor condition.

Federal requirements stipulate NHS-NBI bridge conditions must be maintained such that less than 10% are rated Poor by deck surface area. According to the American Road and Transportation Builders Association (ARTBA), the condition of NHS-NBI bridges in Connecticut has improved in recent years and now meets the Federal requirement with 7.5% of bridge deck area in Poor condition, as shown in Figure 1 which compares states in New England. The condition of bridges in both the state and region has improved in recent years, with Connecticut improving by one spot in this regional ranking.

Figure 1: NHS-NBI Bridges in Poor Condition as % of Total Surface Area



Of the statewide NHS-NBI bridges in Poor condition according to ARTBA (231 total), the following counties have the highest percentage:

- Fairfield: 21.2%
- Hartford: 17.3%
- New Haven: 17.3%
- Litchfield: 13.9%
- All others under 10%

In addition to the 5,429 roadway bridges CTDOT inspects at least every two years, there are an additional 2,116 roadway bridges inspected and maintained by Connecticut cities and towns. These bridges are all under 20 feet in length and as such, are non-NBI with no federal or state inspection interval requirements. Condition data for these additional bridges is only updated as inspected. When available, this data could be anywhere from 0-30 years old as the latest statewide full bridge inspection program was conducted in the early 1990's and the latest statewide screening program was conducted in the mid-2010's. Of the additional 2,116 bridges with any condition data on file (2,065), 10.6% of them are in Poor condition as of the last inspection. Without current condition data, proper maintenance, and adequate funding, it is anticipated that the deterioration of locally inspected and maintained bridges will continue to outpace that of NHS-NBI bridges. If this disparity continues, future local and state budgets will be strained when rehabilitation or replacement of these locally owned bridges becomes necessary.

Another factor for a bridge to be in a SOGR is the bridge's capacity to safely carry traffic loads in its current condition. There are 58 (1.4%) NBI bridges "posted" for having a load carrying capacity below current standard loading. Load posting of bridges, while necessary for safety, can have a negative economic impact by requiring longer, alternative routes, in particular for heavy commercial and permit vehicles.

While the CTDOT has reduced the number of NHS-NBI bridges in Poor condition in recent years, CTDOT projects that if current funding and staffing levels are maintained, the NHS-NBI bridges in Poor condition will continue to climb back near the Federal limit of 10% by 2032. This is true even after accounting for additions from the federal Infrastructure Investment and Jobs Act. Accounting for that short-term funding jump, CTDOT estimates by 2030, the percentage of Poor bridges will increase from the current 7.5% to the 8-10% range.

OPERATIONS & MAINTENANCE

The CTDOT employs sophisticated business practices and programs to manage its bridge maintenance and operations in a cost-effective way.

Transportation asset management is a business best practice that combines existing condition data with predictive modeling technology to inform maintenance decisions. The CTDOT implemented this data-driven asset management approach in 2018 and it now provides decision makers with a rational, long-term, systematic process for making complex decisions about bridge maintenance priorities. The CTDOT's transportation asset management plan goes beyond federal mandates and was created to preserve the state's infrastructure, minimize whole life cost, and manage risk, while operating in a financially sustainable manner.

The CTDOT has also created new initiatives to reduce future bridge maintenance needs. These new initiatives include preventative maintenance programs such as replacing or eliminating bridge joints, coating steel components with spray-applied zinc (known as metallizing) and sealing concrete surfaces. Preventative maintenance activities like these preserve structural components by protecting them from water and deicing salts which are the common causes of deterioration.

FUNDING & FUTURE NEED

Congress passed the Infrastructure Investment and Jobs Act in late 2021. The Act will provide Connecticut with about $5.38 billion of federal transportation funding over a five-year period. This is a $1.6 billion increase over the previous federal authorization and good news for the state's transportation system. The Act will result in an additional $112 million of bridge funding per year over the next five years.

Despite this, there still appears to be a substantial and widening gap between the CTDOT's ability to achieve long-term investment objectives and total available funding. Funding for the CTDOT's overall capital program has not grown significantly in the past decade (see graphic). The capital program is funded with a mix of federal and state monies, and state revenue sources such as the gas tax support financing of the state's portion.

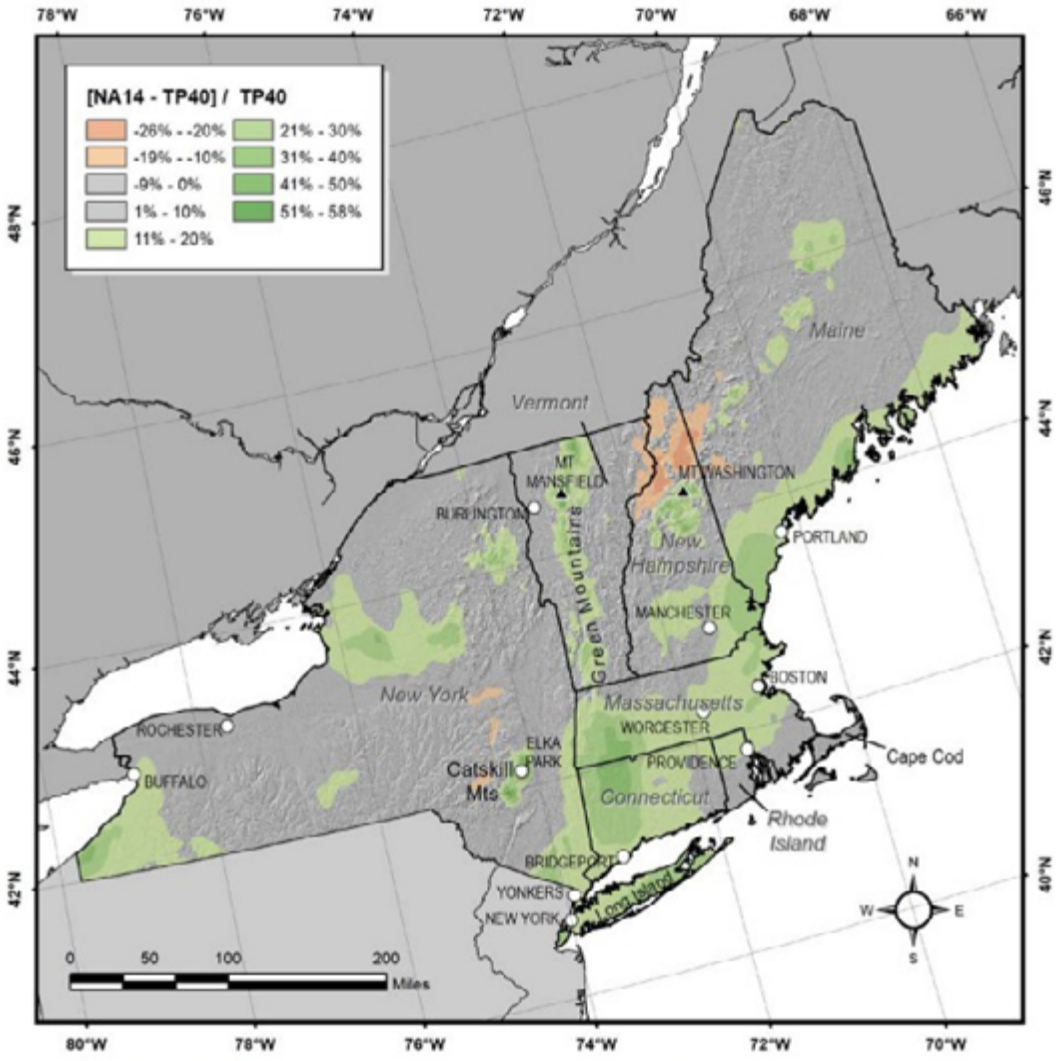
The latest Capital Plan Report notes several major bridge investments that are planned, critical to the state's economic vitality, but also likely to exceed fiscal resources. Analysis of the 2018 Connecticut Statewide Long-Range Transportation Plan and the CTDOT's 2021 Highway Asset Fact Sheet showed an approximately $650 million per year gap between current bridge funding levels and long-term preservation and enhancement needs. The CTDOT has initiated a number of Planning and Environmental Linkages (PEL) studies for major bridge projects to mitigate this. These PEL studies are identifying opportunities for spreading costs over a longer duration and increasing major project fundability. While the CTDOT forecasts that current and proposed funding levels are adequate for meeting most bridge condition goals through the year 2032, funding adequacy for the projected backlog of work beyond remains uncertain.

Finally, while the Act will provide significant funds for improving poor-condition bridges that belong to the National Bridge Inventory, there are less resources available for the 2,116 non-NBI bridges that are maintained by municipalities and often ineligible to receive federal funds. These bridges are in worse condition relative to those in the National Bridge Inventory, and municipalities will need to seek more local or state funding if the criteria for federal funding is not expanded.

RESILIENCE & PUBLIC SAFETY

With the early effects of climate change upon us, our infrastructure must be resilient enough to continue to be able to convey traffic across Connecticut's waterways and along the coast both during and after storm events. New bridges and culverts are being designed to span wider and deeper rivers and channels, and those bridges and culverts which will remain will see an increasing need for repairs. While CTDOT regularly performs underwater inspections at structures and checks for undermining of bridge foundations to ensure public safety, an increasing portion of funds will be needed to maintain and replace structures. NOAA is forecasting that rainfall will increase for design storms for most of the State, with portions of Northwestern Connecticut receiving up to 2.5 inches more (a 40% increase) than had been used to design structures over waterways in the past (see Figure 2).

Figure 2: Map showing percent differences in 100-year and 24-hour estimates between NOAA; Atlas 14 Volume 10 and TP40



CTDOT has taken other steps to improve resilience, including revising concrete specifications to increase resistance to deterioration from winter deicing operations. And an emphasis on upgrades of the bridge parapets and their transitions to guiderails to meet the most recent requirements for crash-tested systems has improved public safety. Public safety has also been improved in the state by a CTDOT's emphasis to use accelerated bridge construction techniques. This type of construction is intended to allow work to be performed with minimal traffic impacts, dramatically improving safety in work zones.

A best value design-build incentivizes the teams to consider innovation to reduce maintenance, improve the life of a bridge, or reduce traffic impacts during construction - while also looking at construction costs.

INNOVATION

CTDOT continues to ramp up innovation for bridges – both from a materials and construction standpoint. Partnering with UCONN, an innovative technique for repairing bridges has been rolled out with the use of Ultra High Performance Concrete (UHPC), which is 5 times as strong as normal concrete. This technique will improve durability and accelerate construction, and CTDOT has just published new standards for UHPC repairs to increase its use in the state. UCONN and CTDOT are collaborating on a third phase of the implementation and testing of this repair detail to provide engineers additional data and with the intent to see its use increase throughout the state.

CTDOT has completed two design-build projects with bridges and will be soliciting for two more in 2022 (and two others that are highway resurfacing contracts). The design-build contracting technique allows CTDOT to shortlist qualified teams of contractors and designers, who then collaborate as individual teams to design and construct a best value project for the Department. A best value design-build incentivizes the teams to consider innovation to reduce maintenance, improve the life of a bridge, or reduce traffic impacts during construction - while also looking at construction costs. For example, on CTDOT's second design-build, the successful contractor's team was more than $2 million lower than the next bidder, yet they added scope to entirely replace two bridges while CTDOT only required the superstructure to be replaced.

Bridges

RECOMMENDATIONS TO RAISE THE GRADE

- Continue to fund research into the use of innovative technologies, materials, and construction techniques that extend the life of bridges, minimize whole life costs, and to construct them with less disruption to traffic.
- Reimagine Connecticut's Statewide Long-Range Transportation Plan as a financially constrained plan which considers fiscal resources that could reasonably be made available.
- Create a long-term funding solution for transportation infrastructure that relies on state monies to reduce the gap between current funding levels and the state's long-term transportation commitments.

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Drinking Water

Gatehouse Bridge in West Hartford Reservoir
Photo credit: Wirestock Creators

EXECUTIVE SUMMARY

Connecticut residents benefit from high quality sources of drinking water supply. Over 97% of the population is served drinking water that meets all applicable health standards, well above the national target of 92%. However, systems are aging and in need of repair, rehabilitation, and maintenance, estimated to cost more than $4 billion over the next 20 years. Leaking watermains contribute to losses estimated between 15 to 20% of total water production. To proactively ensure smart planning decisions about the future of Connecticut's drinking water, the state formally adopted a State Water Plan in 2019. Asset management planning will be required to ensure the limited available funding is used expeditiously.

Figure 1: Connecticut's Community Water Systems Service Areas

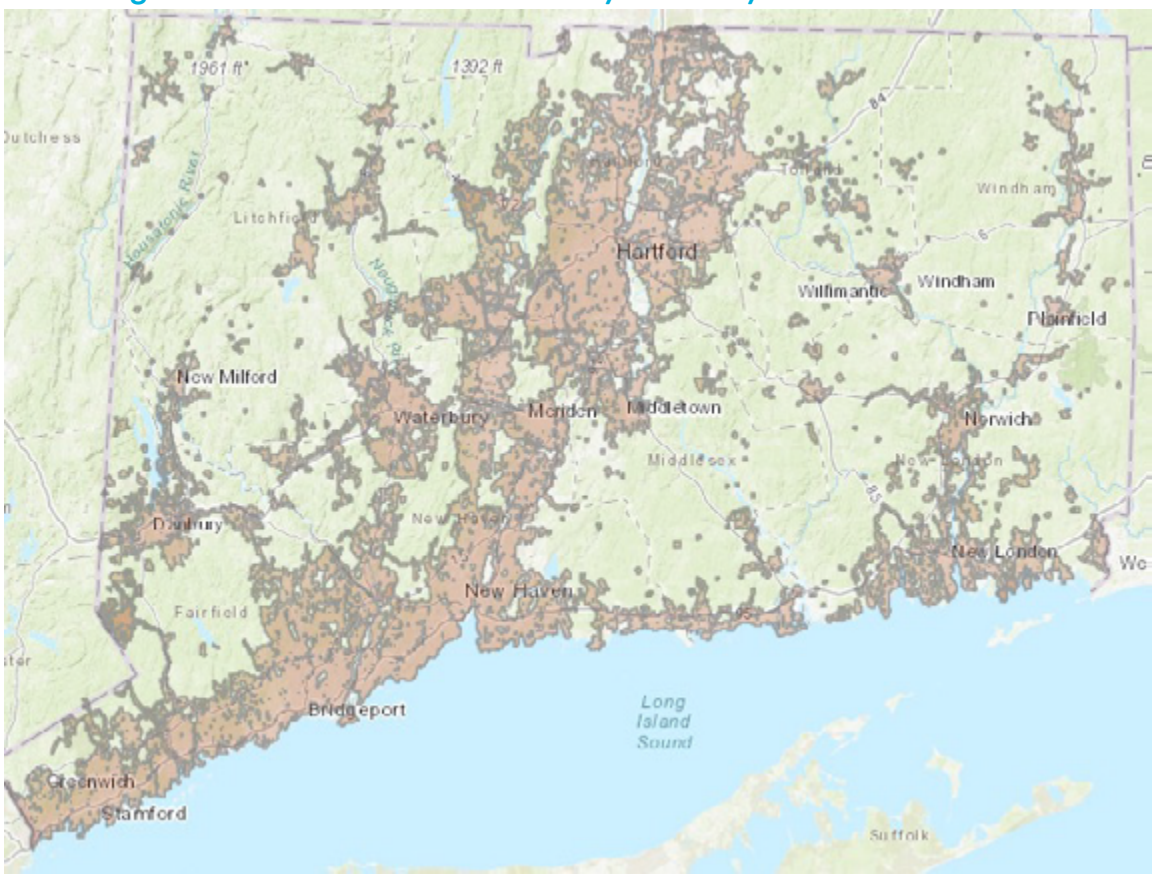


Figure 2: Public Water System Types and Definitions

Public Water System (PWS)	• A public water system provides water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year. A public water system may be publicly or privately owned.
Community Water System (CWS)	• A public water system that supplies water to the same population year-round.
Non-Transient Non-Community Water System (NTNC)	• A public water system that regularly supplies water to at least 25 of the same people at least six months per year. Some examples are schools, factories, office buildings, and hospitals that have their own water systems.
Transient Non-Community Water System (TNC)	• A public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time.
Small water system	• A community water system serving 10,000 or fewer people. Some very small water systems serve 500 or fewer, such as homeowner associations, apartment buildings, condominiums, and mobile home parks.

OVERVIEW

Connecticut public water systems (PWS) provide drinking water to more than 2.8 million people - about 80% of the State's total population. Figures 3, 4 and 5 show the breakdown of water systems in Connecticut. The rest of the population gets their water from private wells.

Figure 3: Public Water System in Connecticut

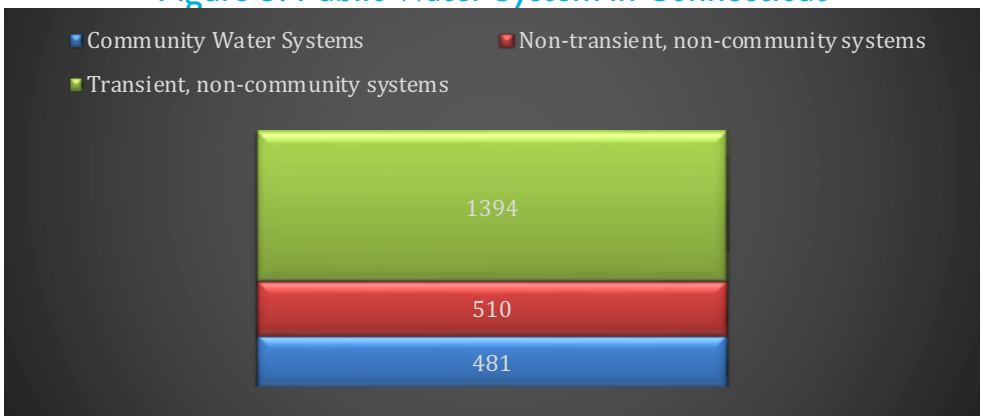


Figure 4. Components of the CWS

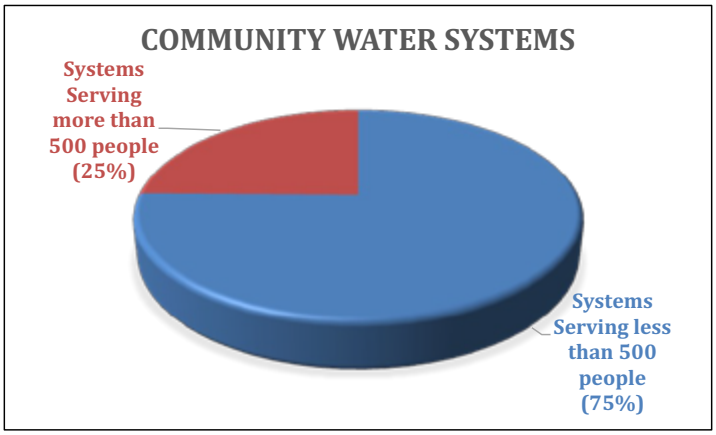


Figure 5. Population served by Public Water Systems Vs. Private Wells in Connecticut.

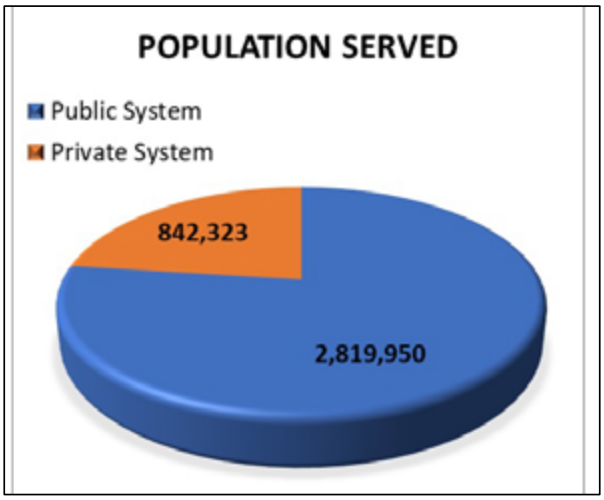
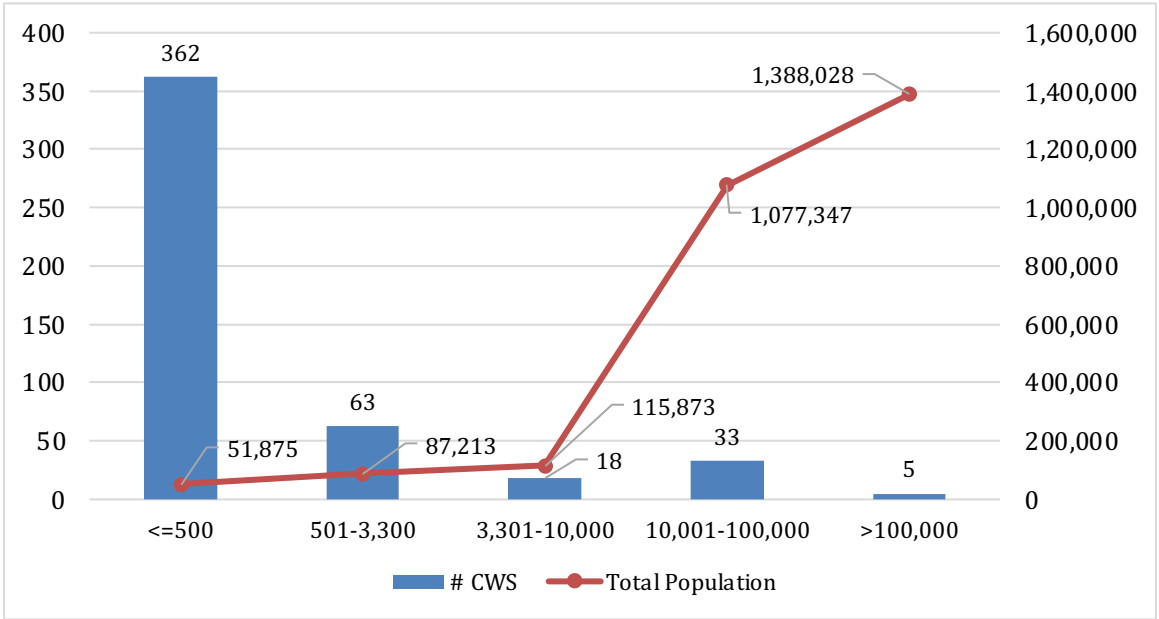


Figure 6. CWS by Size and Population Served



In January 2019, Connecticut formally adopted the State Water Plan which addresses all water uses: drinking water, industry, environmental health, agriculture, energy, and recreation. Additionally, on December 20, 2018, the Department of Public Health (DPH) approved the coordinated water system plans for the Western, Central, and Eastern Water Utility Coordinating Committees.

These plans are the result of over 24 months of work by state agencies, local government and water utilities. The plans will ensure that smart planning decisions are made about the future of Connecticut's drinking water and will guide the approximately 2,500 public water systems in Connecticut.

This collaborative effort will formalize the expansion of public water supplies, ensuring that future development is provided the best option for safe and adequate drinking water, while ensuring that Connecticut's environmental resources and rural areas are protected. The plans also analyze other drinking water concepts important to Connecticut including water conservation, water rates, droughts, small water system viability and protection of drinking water supply sources.

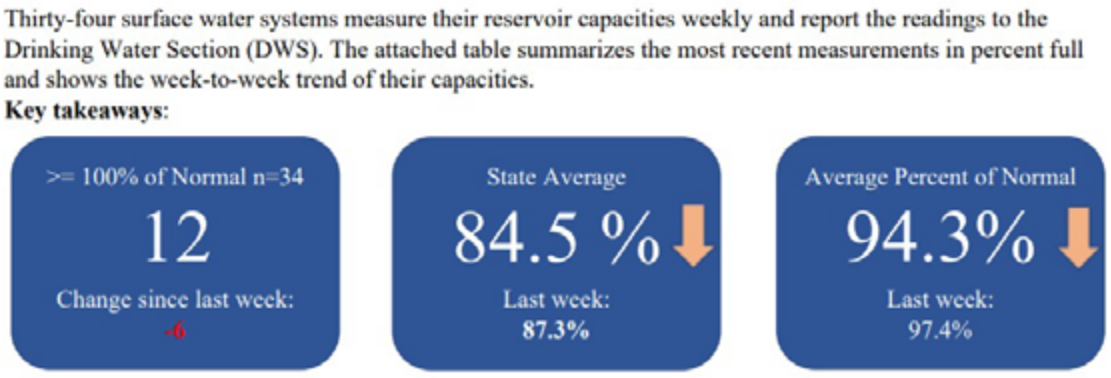
Figure 7: Water Supply Planning

CAPACITY

Typically, a large Community Water System (CWS) can meet current demand, however, these systems are at risk of shortages during times of drought. The DPH routinely monitors surface water reservoir levels reported by CWS (Figure 9). The Connecticut Drought Response Plan includes early communications with municipalities and PWS during times of drought using the Municipal Drought Liaison. Many CWS have emergency interconnections which can be activated if conditions warrant; the interconnections allow for inter-basin water transfers and increase the resiliency of the interconnected systems. A PWS's susceptibility to drought can vary widely depending on the source of supply and demand, such as small water systems, which typically have limited sources of supply. Stage D3 drought conditions (Figure 8) have occurred as recently as the Fall of 2020 and Summer of 2022.

Figure 8: Stages of Drought for Connecticut

Figure 9: DPH reservoir capacity monitoring



The current Water Use Restriction Ordinance and Non-Essential Use Restrictions were included in the State's 2003 Drought Plan and were not revised in the 2018 update. Both of these guidelines are in need of updating and may offer limited guidance to municipalities in its present form.

Statewide, there is declining overall water consumption. But, when coupled with aging public water systems

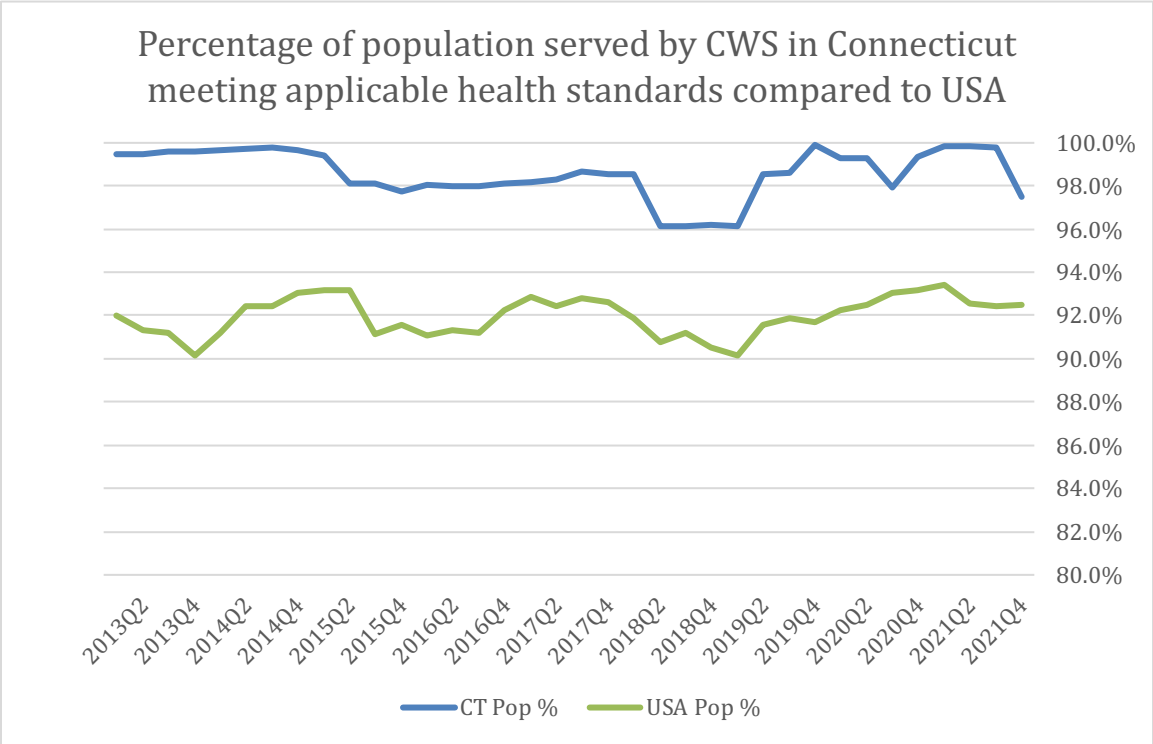
throughout the state, it highlights: the importance of annual water audits and proper metering of water losses to identify and schedule repairs to curtail system losses ahead of drought events, must be continued.

Growth and increased demand is generally expected with the larger systems, whether through development of new properties or interconnections with small systems. This will force the search for increased supply and potentially additional treatment and storage facilities. Several large systems have identified additional potential interconnections that address both future demand and the need for an emergency supply.

CONDITION

CWS's consistently provide good quality drinking water. As of 2021, 97.5% of the population served by CWS's were provided drinking water that meets all applicable health standards — well above the national target of 92% (Figure 9).

Figure 10: Compares number of CWS in Connecticut that meet all applicable health standards to the national statistics.



The majority of Connecticut water treatment facilities were built in the 70's and 80's to comply with the Safe Drinking Water Act (SDWA). Many water systems have pipe systems dating back to the late 1800's/early 1900's and continue to be the weak link in providing reliable water service. Larger PWS suppliers report ongoing annual efforts to update older water mains. Leaking watermains contribute to losses estimated between 15 to 20% of total water production.

Connecticut has seen an increase in sodium and chloride in groundwater and surface. In 2006, the Connecticut Department of Transportation (DOT) switched from a sand/salt mixture to salt only. Sodium-based salt is the most cost-effective option and is used throughout New England. From 2009 to 2014, Connecticut used an average of 500,000 tons of salt on public roads. This number does not include salt used on private properties.

Since 2013, the Connecticut Department of Energy and Environmental Protection (DEEP), DPH, and Local Health Departments and Districts have seen an increase in complaints related to elevated sodium and chloride levels in private wells (Figure 11). Sodium chloride or salt is a common element in both nature and the human diet. It is naturally occurring in groundwater and poses little risk at low concentrations. However, elevated sodium and chloride in drinking water supplies can cause corrosivity of plumbing fixtures and pipes and the leaching of lead and copper along with the mobilization of manganese, iron, radium, and radon.

Figure 11. Private well standard vs. measured concentrations in CT

	Private Well Standard	Typical CT Well Concentration	Impact
Sodium	100 mg/L	200-400 mg/L	Health concerns
Chloride	250 mg/L	400-900 mg/L	Corrosiveness and aesthetics

Public Act 22-118 Sections 139-142 codifies measures that the state will undertake to reduce the impacts that winter maintenance has on drinking water supplies including funding the University of Connecticut's Training and Technical Assistance (T2) Center to offer Green Snow Pro training to a wider audience and development of regulations governing the use of sodium and chloride for anti- and deicing.

FUTURE NEEDS

According to the Environmental Protection Agency's (EPA) 2015 Drinking Water Infrastructure Needs Survey and Assessment (DW Needs Survey), Connecticut requires more than $4 billion to maintain existing infrastructure over the 20-year period of 2015-2034. This cost does not include infrastructure needed for growth or fire protection. The 2015 survey, the most recent published by EPA, estimated the need to be ~ $500 million more than the 2011 survey. A subsequent needs survey was conducted in 2021; however, the results are not yet available.

The recent Lead & Copper Rule Revisions require all CWS to develop an inventory of water service lines and replace any which contain lead. Given the age of systems in Connecticut, it is expected that many larger CWS will find lead service lines which will need to be replaced.

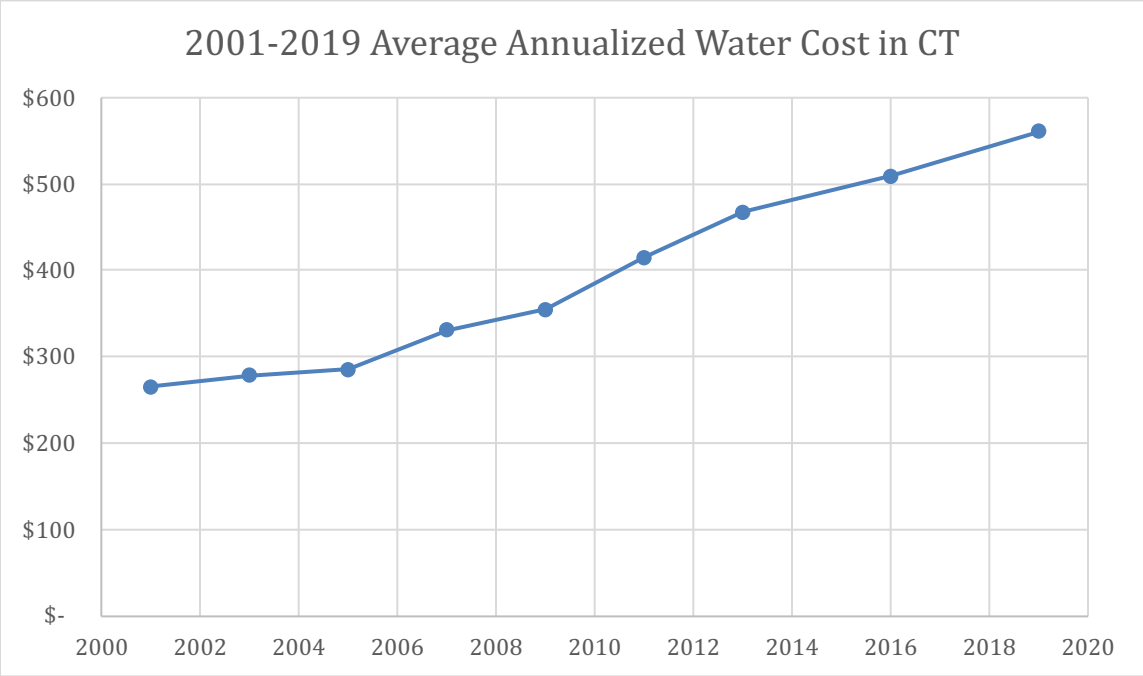
FUNDING

Funding is primarily through the Drinking Water State Revolving Fund (DWSRF) and rate-based customer usage system. Average use ranges from 58 to 75 gallons per capita/day and at rates typically between $50 & $75 per month per household. A 2019 rates survey and found that the average annualized water costs was $561 (Table 1). Two thirds of the respondents (67%) reported increased rates since the previous survey in 2016.

Table 1. Historical Rate Survey Data (Tighe & Bond)

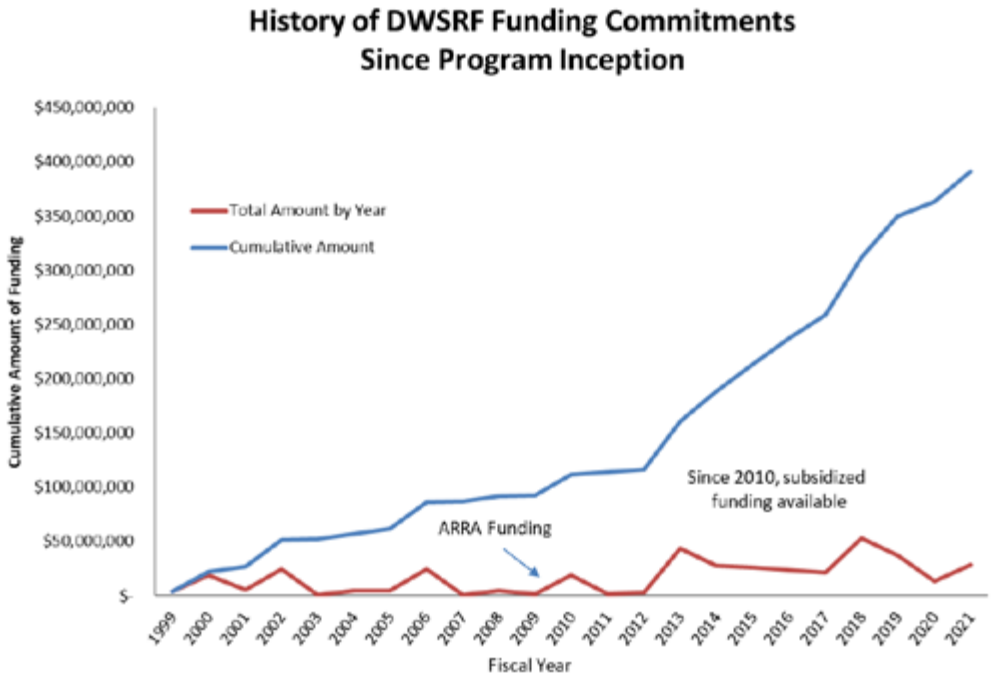
Survey Year	Average Annualized Cost	% Increase from the prior survey
2001	$ 265	-
2003	$ 278	5%
2005	$ 285	3%
2007	$ 331	16%
2009	$ 355	7%
2011	$ 415	17%
2013	$ 467	13%
2016	$ 509	9%
2019	$ 561	10%

Figure 12: Water Costs in Connecticut



State and Federal funding through the DWSRF has resulted in $388 million provided for drinking water infrastructure projects through June 30, 2021. While significant, $388 million is only 9.6% of the total need. Strict requirements of the DWSRF deter some systems from applying. However, DPH is working on streamlining the process.

Figure 13: Historical DWSRF Funding



The Infrastructure Investment and Jobs Act (IIJA) will provide significant additional funding, however this act is a limited-time federal funding increase. Over the 5-year period of this Act, Connecticut expects to receive approximately $304 million through the DWSRF Program. This is more than the state has received in federal funding in the 25 years since the creation of the DWSRF in 1996 but is still only a small part of the need. Connecticut DWSRF IIJA allocation for FY22 includes $17.9 million for general capital projects, $28.35 million for lead service line replacement, and $7.56 million for Emerging Contaminants. Improved asset management can help systems prioritize projects and better determine appropriate rates.

OPERATION AND MAINTENANCE

Operator Certification requirements mandate each CWS and non-transient non-community PWS have a certified operator in charge of the system. A Water Supply Plan is required for all CWS serving over 1,000 people that includes asset management planning and a capital improvement plan. Pursuant to CGS 19a-37e, all small community public water systems serving < 1,000 residents shall complete a fiscal and asset management plan for all capital assets by no later than January 1, 2021.

During the COVID-19 pandemic, PWS were faced with protecting critical water facilities while protecting operators. Non-essential outside contractors and vendors were prohibited from visiting the facilities. Split shifts (one day on/one day off) were implemented in critical facilities. Masking, social distancing, and routine surface disinfection was implemented. Critical maintenance was performed, but other maintenance tasks were deferred.

The experienced workforce of the drinking water industry is aging, and personnel are retiring. Cooperative efforts between water industry leaders and higher education institutions have created training and water operator certification opportunities. Likewise, apprenticeship programs are available for journeymen plumbers.

DPH provided information to small systems on the technical, managerial, and financial capacities necessary to own and operate a water system, including appropriately charging for water.

PUBLIC SAFETY

State law mandates that only the highest-quality water sources may be used for drinking water; Connecticut is the only State in the country that prohibits wastewater discharges into drinking water sources. In addition, Connecticut has stringent protections of the land surrounding drinking water sources, requiring that a water company receive a permit to sell, lease assign or change the use of any water company land and provides restrictions for the sale of water company land and allowable and prohibited uses of water company land.

Water supplies are vulnerable to nefarious actors including ransomware attacks. Attacks include unauthorized access to billing information, SCADA systems and chemical dosing systems. Implementing best security practices in system design and operations, educating employees and employing the latest technologies are all important to protect water supplies. DPH and water utilities constantly work the Cybersecurity and Infrastructure Security Agency (CISA) to minimize the risk of these attacks; these efforts include water utility self-assessments under the guidance of CISA.

RESILIENCE

All facilities must be located above the 100-year flood elevation. Climate change has required new facilities to be evaluated against the 500-yr flood elevation.

The increasing severity of storms requires emergency power capabilities and back-up sources of supply. Several extreme storm events in 2011 and 2012 led to the development of regulations that require all CWSs to have back-up power provisions in place by December 2018; large systems are also required to have Emergency Contingency Plans.

INNOVATION

Modern life comes with conveniences including the use of non-stick pans, water repellants, flame retardants, fire-fighting foam, and fabric stain repellants. These products all contain toxic per-and polyfluoroalkyl (PFAS) chemicals which are now being detected throughout the environment. Understanding the ubiquity of these chemicals in the environment, Governor Lamont convened a PFAS Task Force that created a PFAS Action Plan for Connecticut. Implementing the actions within the plan, DPH has set drinking water action levels for 4 PFAS that are the most studied chemicals and are most frequently found in the drinking water and groundwater in Connecticut.

DPH has been encouraging water utilities to voluntarily test their water for PFAS and works directly with water utilities that have identified PFAS levels exceeding the drinking water action level. DPH also anticipates EPA rulemaking for PFOA and PFOS in the near future and is prepared to work together with water utilities to reduce exposure to PFAS through drinking water. Ongoing work by the DPH includes the formation of the emerging contaminants unit to address PFAS and other emerging contaminants.

Harmful algal blooms appearing in drinking water reservoirs, can lead to the presence of cyanotoxins which must be removed.

The repair and rehabilitation of water mains, as opposed to full replacement, is becoming more common, as these techniques have improved. Budget constraints have forced water systems to explore less costly, long-term solutions.

DPH, PURA, DEEP, OPM, other agencies as well as manufacturers, engineers, academia and contractors are successfully working together to deliver the quantity and high quality drinking water to users across the state., continue to participate in the Governor's GC3 efforts and continue to implement the State Water Plan.

Drinking Water

RECOMMENDATIONS TO RAISE THE GRADE

- Identify drinking water sources that are vulnerable to drought conditions and identify measures to ensure that those water systems can maintain continuous service to their customers.
- Implement full cost of service rate structures to help public water systems address needed repairs, rehabilitations, or replacements.
- Maintain strict source protection laws for drinking water. Including continuing to limiting sources of pollution.
- Maintain sufficient DPH staffing for providing regulatory oversight and assistance to public water systems.
- Maintain a knowledgeable and well-trained drinking water treatment plant and distribution system certified operator workforce by promoting these jobs and expanding training opportunities.
- Continue to identify and protect drinking water facilities that are vulnerable to extreme weather events and identify measures to ensure that those water systems can maintain continuous service. Continue to utilize DPH's Drinking Water Resilience Study and Report
- Ensure research continues to identify potentially harmful contaminants in drinking water (e.g. PFAS) and the means to remove them.
- Use Asset Management to better maintain existing infrastructure and do proactive and preventative maintenance.
- Encourage municipalities and contractors to implement winter maintenance Best Management Practice's (BMPs), taking advantage of recently passed legislation supporting smart road salt practice training and continue to address remaining issues related to use of salt and explore the use of alternative deicers. .

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Drinking Water

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Rail

B

CP243 Interlocking Project, Norwalk, CT
Connecticut Department of Transportation / HNTB Corporation

EXECUTIVE SUMMARY

Connecticut's passenger rail system is both intrastate and interstate, although interstate passenger rail dominates. The Connecticut rail system is connected to the New York-centric Metro-North Railroad (MNR), with ridership of over 40 million passengers per year. This means Connecticut is part of the most active passenger rail system in the nation. Secondary to passenger rail use, freight short haul rail operates on the Connecticut rail system. In the past five years, CTDOT and Amtrak have upgraded facilities, improved safety, and invested in major infrastructure replacement/rehabilitation projects. However, greater state and federal investment is needed to increase the frequency, reliability, and coverage area to ultimately sustain the rail system with high ridership attracted away from driving and flying.

BACKGROUND

Rail plays a vital role in the state's economy and the region's multimodal transportation system. CTDOT's Office of Rails developed the *Connecticut State Rail Plan 2012-2016 (State Rail Plan)*[1]. The *State Rail Plan's* goal is to bring the state rail network to a state-of-good repair through cyclical replacement of infrastructure elements.

The Connecticut passenger rail system consists of 234 route miles (a mix of 1, 2, 3, and 4 track layout) of rail line moving approximately 40 million passengers annually (2018 ridership)[2]. The complete Connecticut passenger rail system (CT*rail*) consists of the Shore Line East (SLE, New Haven to Old Saybrook), the Hartford Line (HL, New Haven to Springfield, MA) and the Metro-North Rail (MNR, New Haven Line from the Connecticut / New York border to New Haven). In addition to these commuter rail lines Amtrak's northeast corridor (Washington DC to Boston MA) traverses the state. Amtrak also owns and maintains passenger service starting in New Haven going north to Burlington, VT and Montreal, Quebec, Canada.

Connecticut passenger rail infrastructure upgrades are underway in coordination with neighboring states through the efforts of the Northeast Corridor Commission (NEC)[3].

Freight rail is predominantly linked to local shippers and industries supporting local haulage and last mile deliveries. A lack of connections over the Hudson River to the New York/New Jersey Ports, New England, and Canada limits the market for interstate rail freight in Connecticut. Connecticut freight rail infrastructure upgrades are underway through private investment and CTDOT efforts.

CAPACITY

Metro-North Rail (MNR) New Haven Line (NHL) passenger rail infrastructure in Connecticut is comprised of several segments: CTDOT owns and is responsible for the maintenance of MNR service lines within Connecticut (105 miles), including:

- New Haven Mainline (NHL Mainline), and
- New Haven Branch Lines
  - New Canaan Branch
  - Danbury Branch
  - Waterbury Branch

The overall passenger rail system consists of 234 route miles (a mix of 1, 2, 3, and 4 track layout) of rail line moving approximately 40 million passengers annually[4]. Outside of the pandemic years 2020 - 2021, ridership of the Metro-North Railroad - New Haven Line has held steady at about 40 million passengers per year from 2015 through 2019. During this same time period, annual passenger traffic on the Shore Line East (SLE) segment increased from 660,000 to 854,000 people. The Hartford Line (HL) started service in 2018 and reported ridership of 634,000 passengers in 2019.

CTDOT has two passenger rail lines using Amtrak-owned rail:

- Shore Line East (SLE) (67 miles)
- The Hartford Line (HL) (62 miles)

The Connecticut rail system provides a high level of service with HL currently operating 53 trains into Grand Central Terminal (GCT) each weekday during morning peak hours (6:00 AM to 10:00 AM).

Existing track geometry and spacing between trains limit operable speeds throughout the network, leading to a broad range of maximum allowable speeds and inefficiencies in operation. Poor stormwater drainage in localized areas is also cause for concern, especially as the effects of climate change are realized.

CTDOT has ambitious goals to decrease automobile-based travel even as Connecticut's population and job growth are estimated to increase 6% by 2026 from 2016, according to the state's Department of Labor. Connecticut must focus on increasing rail and transit use to accomplish that goal of mode shift. Increasing passenger rail service, focusing frequency outside of traditional rush hours, and coordinating with other agencies on transit-oriented development are all necessary.

The freight rail network[5] in CT consists of approximately 129 miles owned by the state, two miles owned by the city of Bristol, and 247 miles owned by private freighters. The freight network includes 17 branches or lines with different ownership. Approximately 109 miles of freight line operate at Class 3 (40 mph) and 207 miles operate at Class 2 (25 mph) or Class 1/Excepted (10 mph). The rail freight operator CSX has rights on portions of passenger track and operates at Class 4 (60 mph) or Class 5 (80 mph).

CONDITION

Ownership and operation / maintenance responsibilities of the various lines are divided in a complex manner. CTDOT owns and maintains 105 miles of rail within the state and Amtrak owns 129 miles. Operation and maintenance of 67 of 129 miles is an Amtrak responsibility. Trans America Service is under contract to operate the SLE and Alternative Concepts is under contract to operate the HL between New Haven and Springfield, MA.

CTDOT owns and maintains 105 miles of rail on which MNR operates the commuter trains from New York to New Haven and along the New Canaan, Danbury and Waterbury branch lines. Amtrak also operates on the CTDOT owned lines between New York and New Haven (operated by MNR).

The MNR system contains 195 bridges. The condition of existing bridges is a major concern. Four moveable structures (draw, swing, or lift bridges) on the heavily traveled NHL are more than 125 years old. Furthermore, 53 MNR bridges are rated in poor condition and 108 in fair condition. The number of bridges rated in poor condition has remained relatively constant, demonstrating that rehabilitation work is barely keeping pace with deterioration.

CTDOT's rolling stock consists of approximately 516 locomotives, self-propelled coaches, and passenger coaches[6]. The condition of the rolling stock varies widely by line. Measured by the Federal Transit Administration's Useful Life Benchmark (ULB). ULB is the maximum age of an asset based on operational characteristics before it is replaced or enters into state of good repair backlog. Eighty percent of rolling stock for the NHL (360 coaches and 22 locomotives) is below the ULB while 100% of the SLE and HL rolling stock (33 coaches and 12 locomotives) exceeds ULB4.5. Stations, platforms, catenary, traction power, signalization, and Positive Train Control (PTC) infrastructure are generally considered to be in good condition. The term "catenary" refers to the overhead electric lines that supply power to electrified locomotives and coaches. New stations are currently being designed or constructed for the MNR Waterbury Branch, Hartford Line, and Shore Line East rail segments. Several stations have been upgraded or newly constructed on the Hartford

Line and Shore Line East within the past five years.

For 20+ years starting in 2001 the CTDOT Office of Rail completed the New Haven Mainline Catenary Replacement Program, restoring the 100+ year old catenary system. This catenary replacement project included expansion to electrify additional branch miles[7].

OPERATIONS AND MAINTENANCE

Ontime performance, based on MNR criteria, for the New Haven mainline has consistently exceeded 97%[8]. Amtrak reports[9] an 86.9% on-time performance (Amtrak criteria) rating within the Northeast Corridor.

CTDOT has continued to invest in expanding and modernizing the state's rail infrastructure network[10]. CTDOT purchased new electric coaches (M8s) for the NHL mainline and New Canaan Branch Line services. Additionally, in June 2018, CTDOT opened the Hartford Line, connecting New Haven, Hartford, and Springfield, Massachusetts, to the NHL in New Haven. After extensive signalization improvements, service was also expanded on the Danbury Branch Line. Multiple construction projects, especially along the NHL, create the potential to reduce capacity during construction and possibly a potential for cross-project interference.

CTDOT is replacing the Walk Bridge in Norwalk along the NHL and Amtrak is replacing the moveable bridge over the Connecticut River. The bridge replacements will improve reliability and offer higher speeds for MNR, Amtrak, and SLE services. Operations are constrained throughout the construction phase, leading to restricted speed limits and other service impacts.

The upcoming Metropolitan Transportation Authority (MNR's parent corporation) five-year plan[11] includes replacement of railroad ties, rail resurfacing, improvements to switches and crossings, and at-grade crossing gate improvements.

The New Haven Maintenance Facility (components completed between 2015 and 2020) allows for more efficient maintenance of the rolling vehicle stock. It also allows for greater ease of inspection, repair, and cleaning of the vehicles. The Component Change-Out shop (storage and retrieval of railroad parts and components in a dedicated and automated facility) and the independent wheel truing facility (to keep rail wheels within allowable specification for profile, roundness, finish, and parity) are complete and in service.

FUNDING AND FUTURE NEED

Rail funding in Connecticut is provided by CTDOT, MNR, Amtrak, private freight operators, and federal Department of Transportation programs. Funds for Amtrak-owned track are administered through the Northeast Corridor Commission (NEC)[12]. The NEC's mission is to "allocate capital and operating costs based on usage, make recommendations to Congress, and facilitate collaborative planning".

Historically, funding has been allocated on a project-by-project basis and through annual capital renewal. In July of 2021, NEC released CONNECT NEC 2035[13] (C35), a "a multi-agency, multi-year, shared action plan guided by a long-term vision". This funding plan represents a "detailed and efficient sequencing of infrastructure investments over 15 years... to improve service and eliminate the state-of-good-repair (SOGR) backlog, while running safely and reliably."

C35 represents a dramatic change in approach to funding rail infrastructure by focusing on long-term goals and continued renewal of the system. The guiding principles for C35 are:

1) Make funding predictable;

2) Fund the plan rather than individual projects.

C35 is structured in 5-year increments; currently Fiscal Years (FY)22-26 are in effect. C35 includes several major backlog projects to address SOGR. The NEC Capital Investment Plan identified five bridges in Connecticut with major funding challenges. Their projected total cost for upkeep and maintenance is estimated as $3.5 billion. Table 1 - Major Backlog Projects, from C35, reports levels of anticipated funding in Connecticut for FY 22-26 with estimated costs (billions).

Table 1 - Major Backlog Projects

Major Backlog Projects		
CT	Connecticut River Bridge Replacement	$0.4
	Devon Bridge Replacement	$1.0
	Saugatuck Bridge Replacement	$0.4
	Walk Bridge Program	$0.7
	Cos Cob Bridge Replacement	$1.0

Special projects sponsored by CTDOT in FY 21 had an actual expenditure of $160 million, exceeding the planned expenditure of $148 million. The Walk Bridge Program received $102 million in actual expenditures from CTDOT special project funding in FY 21. The New Haven Line Yard and Facility Program had actual expenditures of $34 million in FY 21.

Table 2 - Baseline Capital Charges - Planned versus Actual Expenditure

Project Sponsor	Number of Special Projects in Plan	FY21 Planned Expenditure	FY21 Actual Expenditure	Percent of Plan Spent
Amtrak [1]	30	$334.9	$516.1	154%
MBTA	8	$112.7	$12.3	11%
Rhode Island DOT	3	$35.5	$16.2	46%
Connecticut DOT	8	$148.0	$159.7	108%
MTA [2]	7	$128.0	$309.2	242%
NJ TRANSIT	14	$203.2	$58.1	29%
SEPTA	5	$27.6	$13.5	49%
Pennsylvania DOT	6	$32.0	$19.1	60%
Delaware DOT	3	$51.5	$20.3	40%
MDOT MTA / MARC	1	$0.0	<$0.1	n/a
VRE	1	$8.4	<$0.1	0%
Total	86	$1,081.8	$1,124.6	104%

As Table 2 indicates, the plan for future funding of Baseline Capital Charges (BCC) for rail infrastructure in Connecticut is higher than historical levels and represents an ambitious plan to further improve the rail system. FY22 planned capital renewal for BCC within Connecticut totals $162 million. Some $122.5 million of this BCC capital renewal is allocated to Segment 6 between New Haven and the New York state line.

FY22 special projects planned expenditures within Connecticut total $310 million. The Walk Bridge Program accounts for $222 million of FY22 special projects.

Although FY22 funding levels are notably higher than previous years, the expected funding in FY23-26 will be increased further if C35 is fully funded. C35 sample project descriptions (Table 3), funding projections for Connecticut – Westchester (CTW) and New England territories (Table 4), and a schedule of improvements for the CTW territory are shown in the tables below.

Table 3 - Sample Project Descriptions

2 Connecticut-Westchester (New Haven Line)

Capital renewal investments in Connecticut-Westchester (NHL) include:

- Advancing design and preparing temporary power sources for the **Substations 128 and 178 Replacement Project**;
- Continuing construction of the Willet Avenue and Highland Street **undergrade bridge spans**;
- Completing software revisions and final fiber optic tie-in for **Positive Train Control** installation on the NHL;
- Completing preliminary engineering and commencing final design for the **Time for CT Program**; and
- Beginning **pre-construction activities** to install nearly 31,000 ties, surface approximately 51 track miles, lay about 33 miles of rail, and install approximately 26 switches.

Stamford Station Improvements. Finishing upgrades and repairs to ensure continued safe operations and improve passenger experience. Enhancements include increasing canopy and windscreen coverage, adding pedestrian paths a new pedestrian bridge and parking garage, rehabilitating aging sections of the platforms, and improving ADA compliance.

More Connecticut-Westchester (NHL) special project highlights:

- **Walk Bridge Program.** Entering construction phase for bridge proper including utility relocation and demolition of south half of bridge.
- **New Haven Line Station Platform Replacement Program.** Beginning construction of new platforms at Darien Station and design of new platforms at New Haven Station.

Table 4 - Planned Expenditures

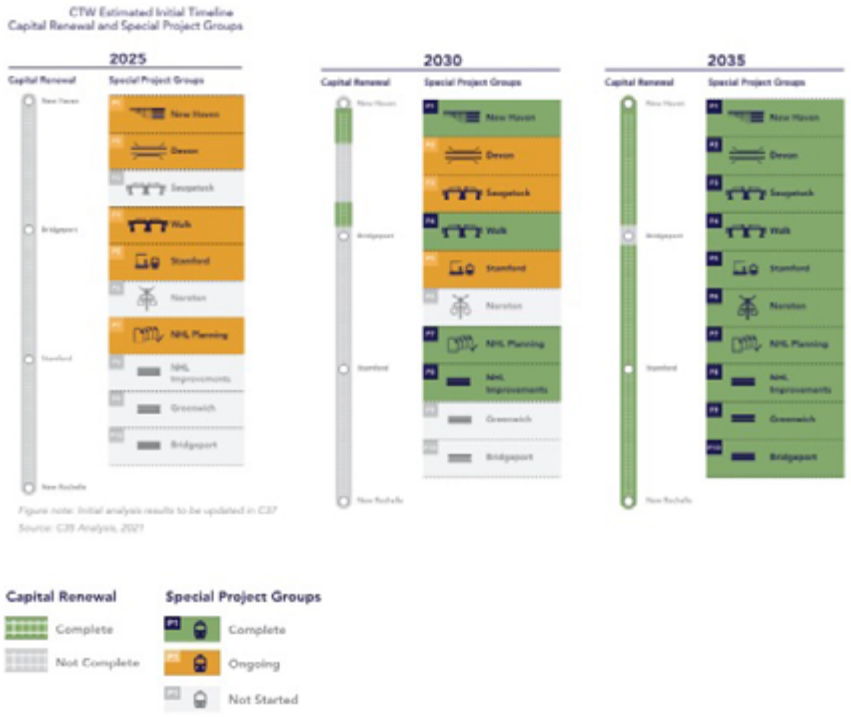
FY22 Connecticut-Westchester (NHL) planned expenditures

			FY22 Planned Expenditure
Capital Renewal by BCC Segment	**Owner**	**Operators**	**$146,600,000**
6: New Haven to CT/NY State Line	Connecticut DOT	Amtrak, Metro-North (on behalf of CTDOT)	$122,500,000
7: CT/NY State Line to New Rochelle	Metro-North	Amtrak, Metro-North	$24,100,000
Special Projects by Project Sponsor			**$274,200,000**
Connecticut DOT			**$274,200,000**
Devon Bridge Replacement			$500,000
New Haven Line Signal System Replacement: Stratford to New Haven			$500,000
New Haven Line Station Platform Replacement Program (New Haven, Darien)			$20,000,000
New Haven Line Yard and Facility Program			$10,000,000
New Haven Union Station Improvements			$1,000,000
Saugatuck River Bridge Replacement			$200,000
Stamford Station Improvements			$20,000,000
Walk Bridge Program			$222,000,000
Total			**$420,800,000**

Table 5 - Estimated Initial Timeline for Capital Renewal and Special Projects

FY22 New England planned expenditures

			FY22 Planned Expenditure
Capital Renewal by BCC Segment	**Owner**	**Operators**	**$86,533,501**
1: Boston South Station to MA/RI State Line	MBTA	Amtrak, MBTA	$23,323,941
2: MA/RI State Line to Providence	Amtrak	Amtrak, MBTA	$7,709,567
3: Providence to Wickford Junction	Amtrak	Amtrak, MBTA (on behalf of RIDOT)	$6,779,454
4: Wickford Junction to New London	Amtrak	Amtrak	$9,213,312
5: New London to New Haven	Amtrak	Amtrak, CTrail Shore Line East	$15,588,797
25: Springfield to New Haven	Amtrak	Amtrak, CTrail Hartford Line	$23,918,429
Special Projects by Project Sponsor			**$109,732,786**
Amtrak			**$22,562,702**
Connecticut River Bridge Replacement			$8,204,410
Fitter Interlocking			$12,652,452
Veltri Interlocking			$1,705,840
Connecticut DOT			**$28,000,000**
Enfield Station			$2,000,000
North Haven Station			$2,000,000
Shore Line East Track & Catenary Improvements (FY22)			$4,000,000
Windsor Locks Station and Interlocking Improvements			$20,000,000
Windsor Station Improvements			TBD



The current and proposed funding levels for Connecticut rail infrastructure appear adequate. Assuming this trend continues and C35 is fully funded and implemented, the Connecticut rail network is well-funded.

PUBLIC SAFETY

Operational safety of the rail system in Connecticut has improved in recent years. Twelve major service incidents[14] (a single event causing multiple train delays) were documented within NEC territory during FY 2021, and only one major service incident occurred within Connecticut, which was a result of a December 2020 Nor'easter that affected much of the East Coast. The number of NEC territory major service incidents in recent years are as follows: 58 in FY18, 85 in FY19, 31 in FY20, and as stated above, 12 in FY 21. Over half of these major service incidents were due to infrastructure failures, such as signal power failure.

Operation Lifesaver, a program that offers public outreach, is focused on educating the public, especially motorists, on the dangers near rails and how to avoid incidents in Connecticut.

There are 55 active public and private crossings on the MNR lines. Sixteen crossings have been upgraded since 2018 with a combination of gates, flashers, or traffic control devices. Several at-grade crossings have been permanently closed in the past five years and additional at-grade removals are in the design phase.

No major incident that required Federal Railroad Administration to conduct a "significant investigation" has occurred since the last infrastructure report card.

CTDOT collaborates with municipalities to develop real estate along transportation corridors. Hartford, West Hartford, Newington, New Britain, Wallingford, Meriden, and New Haven have actively collaborated with CTDOT to promote transportation-oriented development.

RESILIENCE AND INNOVATION

Several items have been implemented to improve the resiliency of the rail network, such as power upgrades at the New Haven Rail Yard and the Walk Bridge. New projects, listed below, must meet flood standard requirements and incorporate anticipated effects from climate change.

- Floodwalls - Bridgeport
- Power stations/substations - out of the flood zone
- Amtrak bridge across Connecticut River

Multiple projects demonstrated innovative solutions for the rail network, such as the New Haven Rail Yard's new state-of-the-art CCO (Component Change Out Shop) facility for maintenance of the rolling stock.

CTDOT has implemented additional project delivery methods[15] and other project delivery innovations. These include alternative project delivery, construction manager at risk/construction manager general contractor (CMGC), design build project delivery, project team co-location, 3D Engineering modeling, and e-Construction. The use of CMGC on the Walk Bridge replacement project is targeted to improve cost controls throughout the duration of the project from design through turnover[16]. Project team co-location means locating the project owner (project CTDOT staff), prime designer and selected design consultants, and prime contractor in the same building or in close proximity to facilitate on-site collaboration and rapid problem solving to address actual field conditions encountered.

CTDOT collaborates with municipalities to develop real estate along transportation corridors. Hartford, West Hartford, Newington, New Britain, Wallingford, Meriden, and New Haven have actively collaborated with CTDOT to promote transportation-oriented development. Example developments include new residential and commercial uses of vacant properties adjacent to transit facilities resulting in increased tax revenue, more jobs, fewer auto trips, and elimination of "eyesore" properties.

Rail

RECOMMENDATIONS TO RAISE THE GRADE

The recommendations to improve Connecticut rail infrastructure further include:

- Fund replacements of movable bridges in full
- Consider converting movable bridge(s) into non-movable bridge(s) by raising the railroad or otherwise increasing the clearance below the bridge
- Increase funding for small bridge and track repair as noted by the NEC reports
- Continue at-grade crossing signal upgrades and removals
- Continue the use of Alternative Delivery methods, including CMGC
- Consider alternative funding mechanisms, including infrastructure bank, increased parking lots with ticketing, or public-private partnerships
- Coordinate with other states and federal agencies to make high-speed rail possible

Rail

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Roads

D+

CT Route 15 Exit to I-91 North approaching the Charter Oak Bridge, Hartford
Photo Credit: Connecticut Department of Transportation / AECOM

EXECUTIVE SUMMARY

There are 21,430 miles of roadways in the state of Connecticut; 19% of which are owned and maintained by the Connecticut Department of Transportation (CTDOT) and the remaining 81% by municipalities, of which 77% of local miles are in poor riding condition. Connecticut struggles with roadway congestion, containing six of the top 15 national freight bottlenecks. The state has not raised its gas tax since 2001, a funding stream that has lost 50% of its value to inflation and vehicle efficiency. Connecticut faces further revenue declines resulting from its suspension from April 1 through November 30, 2022 to combat increasing fuel prices. CTDOT has adopted transportation asset management and completed a state-wide climate resilience assessment, but the state's roads carry more vehicles than before COVID-19. Traffic safety has only recently become a priority statewide with traffic deaths persisting and rural roads lacking sidewalks or bike lanes, posing an outsized danger.

INTRODUCTION

Transportation is a major economic driver by providing the means of movement of people and goods. These roadway networks are a major factor in where Americans decide to live and work. Investing in the state's roadway network for driving, walking, biking, and transit adds significant benefits. Connected, comfortable systems for all road users can reduce congestion, improve economic development, increase land values, provide job creation, reduce household costs of goods and services, reduce vehicle operation and maintenance costs, and improve the health and safety of the state's residents.

CAPACITY

According to the 2021 TRIP Interstate Highway Report, Connecticut has the 12th busiest roadways in the nation, yet according to the 2020 US Census Bureau data Connecticut only ranks as the 29th most populous state in the United States with 3.6 million residents. The roadway network across the state is experiencing numerous capacity issues which contributes to severe passenger and truck congestion across the major arteries of Interstate 95, Interstate 84, and Interstate 91. Furthermore, per the 2021 TRIP report, Connecticut ranks 8th highest in the nation on urban interstate congestion: 68% of those lane miles are plugged up. That encumbers supply chains. Six of America's top 15 freight/trucking bottlenecks are located on Connecticut highways. This congestion causes Connecticut drivers to spend an average 40 hours per year stuck in traffic. Time is money, and Nutmeg State drivers lose more than $1,000 on average in lost time and wasted fuel according to CTDOT.

Interstate 84, Waterbury looking East to Scott Road

Photo Credit: Connecticut Department of Transportation / I-84 Constructors JV

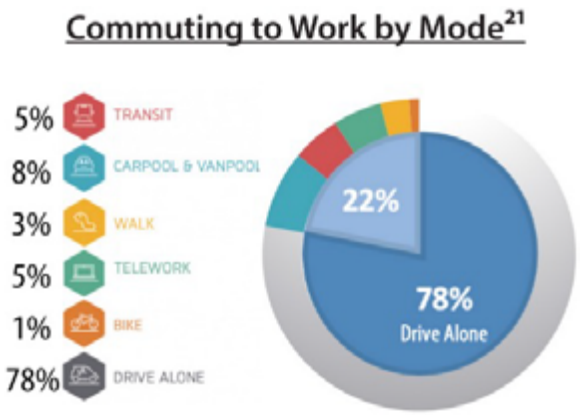
In the January 2022 updated state key fact sheet published by TRIP, the Covid-19 pandemic caused a significant drop, around 51%, of vehicle miles travelled (VMT) in the year 2020. However, by November of 2021, VMT had rebounded to 10% above levels measured pre-pandemic in November 2019. Despite the persistence of remote work, Connecticut residents are driving more – outside rush hours – for school, errands, other essential travel, and recreation.

CTDOT estimates that 94%, or nearly 94 million tons, of goods transported through the state is by truck across the network of interstate highways. Reducing or eliminating the 6 major freight bottlenecks located in Connecticut will require reduced passenger vehicle usage and improvements to the state's freight rail network. These improvements would aid interstate commerce and allow for improved economic development. One example of a successfully completed project which eliminated a bottleneck was the rehabilitation of I-84 in Waterbury. That project added a third travel lane in each direction to nearly 3 miles of interstate highway. It improved traffic flow, but that benefit is likely to fade without dedicated freight priority and increases in passenger travel by transit and active modes, such as bike commuting.

Major Truck Bottlenecks in Connecticut[56]

1. Hartford, CT: I-84 at I-91
2. Stamford, CT: I-95
3. Norwalk, CT: I-95
4. New Haven, CT: I-95 at I-91
5. Waterbury, CT: I-84 at SR 8
6. Bridgeport, CT: I-95 at RT 8

Promoting and building out enhanced multi-modal transportation networks is the most promising method to reduce traffic congestion. Connecticut already offers multi-modal options by way of commuter rail, transit buses, and numerous park and ride locations. However, park and ride locations have not attracted significant ridership. CT Transit served only 660,000 trips in January 2022, compared to 1.4 million in January 2020.



Recent data show nearly 80% of the state's workforce commute to work alone. The Department of Transportation estimates that 30% of congestion may be relieved by removing just 4% of cars from the roadway. Therefore, greater investment into multi-modal alternatives, and road projects delivering dedicated transit lanes and protected bike lanes may alleviate some existing congestion and capacity issues.

CONDITION

As reported by TRIP, a majority (61%) of Connecticut's roadway network is in a state of poor or mediocre condition as measured by ride quality, compared to the national average of 43% from ASCE 2021. A partial factor in poor ride quality is the age of the infrastructure. The Connecticut Department of Transportation reports that 79% of the state's network was built prior to 1980. Unfortunately, Connecticut road users pay more due to these aging routes in poor condition: flat tires, busted bike wheels, and shot suspensions. It costs Connecticut road $2.3 billion annually in additional vehicle operating and maintenance costs (approximately $800/registered motor vehicle).

In 2021, Connecticut ranked 31st in overall highway performance and cost effectiveness maintenance. The state ranks 44th in performance and cost effectiveness maintenance for state-controlled highways. The breakdown of condition by responsible agency is as follows:

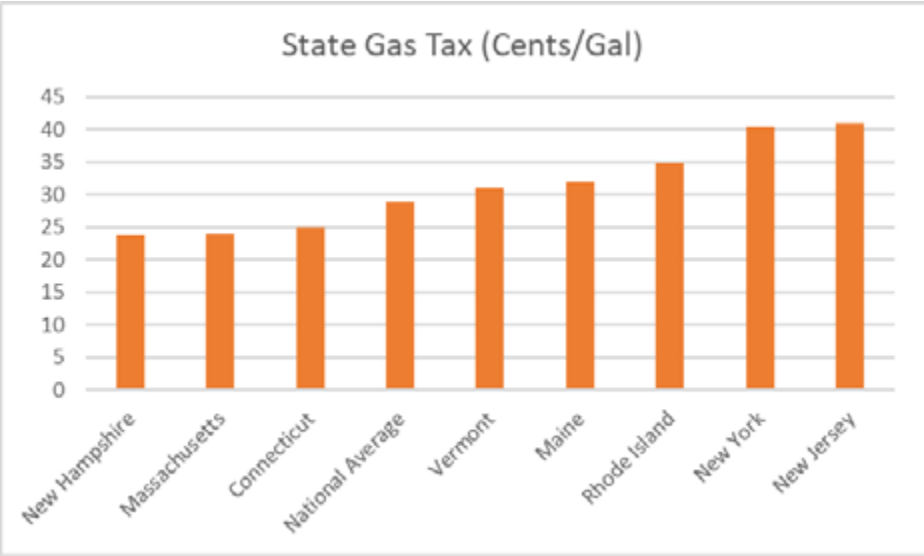
- 77% of town-maintained roads are in poor condition, this represents approx. 13,409 out of 17,414 miles of roads
- 23% of state-maintained roads are in poor condition, this represents approx. 924 out of 4,016 miles of roads

FUNDING AND FUTURE NEED

Of the more than 21,000 miles of roadways in the state of Connecticut, 19% are owned and maintained by CTDOT which has both state and federal funding programs, and the other 81% of roads are owned and maintained by the towns. The state generates the majority of its road funding from the gas tax, with additional revenue generators being vehicle registration, vehicle sales tax, and vehicle permits/fees. Unlike surrounding states, Connecticut does not have any revenue generated from toll lanes.

The state gas tax was last raised or adjusted in 2001 to $0.25 per gallon. There is no provision for inflation adjustment. The 25-cent level is below the national average and below that of most states surrounding Connecticut. Due to inflation and rising construction costs, increases in average vehicular fuel efficiency, and increasing use of electric vehicles, the purchasing power from the gas tax has dropped by 50% since 2001. Meanwhile, Connecticut towns rely on general funding from municipal budgets and additional funding from CTDOT to pay for their local road and bridge capital and maintenance programs.

Gas tax rates for Northeast states, in cents per gallon



Recent economic forces will have long-term implications for the availability of funds for roadway infrastructure: supply chain shortages have constrained auto sales, limiting the collection of vehicle sales tax collections. Input prices have jumped for roadway and streetscape projects. Workforce challenges have increased the cost and complexity of procurement. The passage of HB-5501 cut off revenue imperative for road improvements by suspending the collection of Connecticut gas taxes through at least November 30, 2022.

The Infrastructure Investment and Jobs Act of 2021 is expected to provide $3.3 billion in automatic, formula funds over the next five years to federal-aided highway programs in Connecticut. While this provides massive funding to improve poor-conditioned highways, it gives limited funding for town-owned roads that make up 81% of the roads in the state. Those municipalities and towns will have to compete for the Act's smaller competitive grants, partner with CTDOT for technical assistance, and seek additional funding if the conditions of non-state roads are to improve.

Connecticut is expected to have a slow population growth, 0.35% per year for the next few decades, increasing population by approximately 500,000 people by 2040. While this is a relatively small increase, the highways and local roads already struggle to meet current capacities and will thus require roadway improvements and multimodal enhancements to meet future capacity.

OPERATIONS AND MAINTENANCE

The condition of Connecticut's roadways is a direct consequence of the amount of funding available. The state has increased funding for roadway maintenance over the past 10 to 12 years. In the years since the last Report Card in 2018, CTDOT has annually increased the allocated funds for capital resurfacing projects from $67 million in FY2018 to an estimated $95 million in FY2021. CTDOT currently awaits the proposed FY2022 expenditures. These investments have paid off, notably in 2021 the Reason Foundation ranked CT 31st, up from 44th in their prior reporting, for overall highway performance and cost effectiveness maintenance.

During snowstorms, it is the Department's goal to have lanes cleared within four hours on limited access highways and within six hours on secondary roads. Both snow removal operations and general highway maintenance across the state is currently challenged by staffing and equipment shortfalls; this may be an even more acute issue as there is an anticipated significant loss of staff in mid-year 2022 which the Department is currently attempting to fill an excess of 400 jobs.

Connecticut road infrastructure conditions

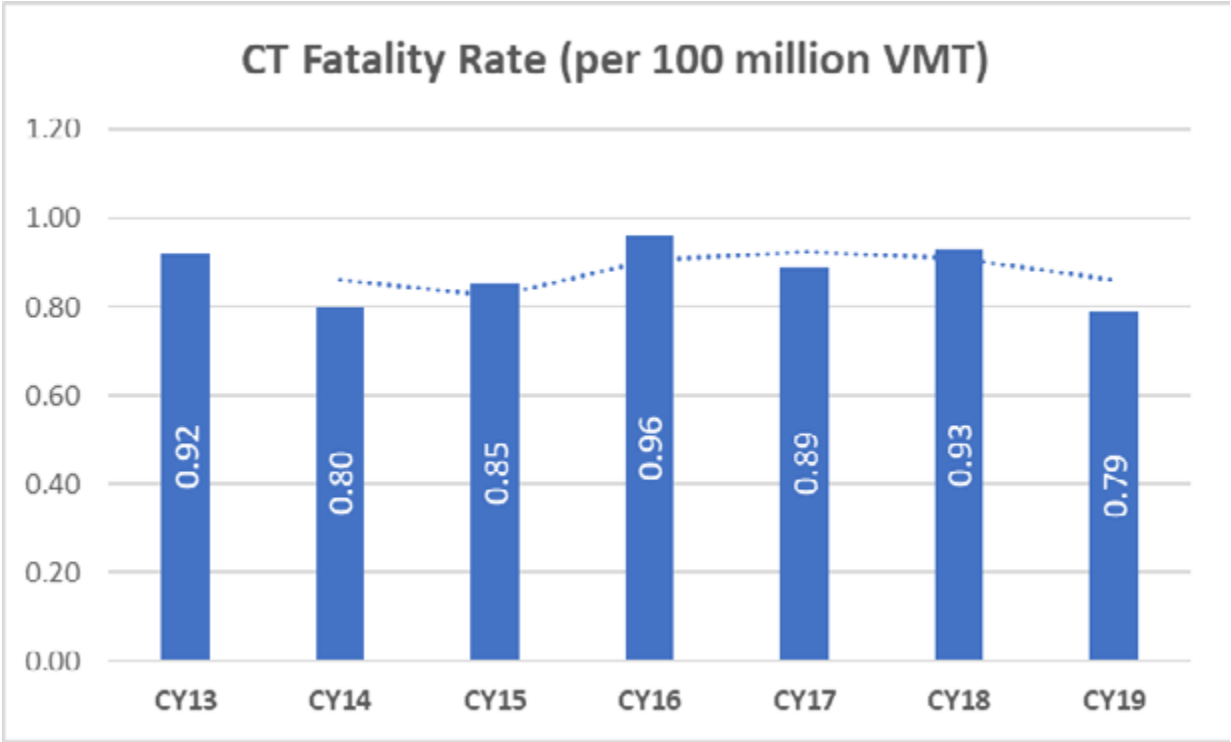
CTDOT-Maintained	Inventory	Good	Fair	Poor
Bridges	4,017 Bridges	26.8%	68.0%	5.2%
Pavement	3,718 Centerline miles	63.2%	34.1%	2.7%
Traffic Signals	2,777 Assets	35.3%	39.2%	25.5%
Signs (approximate inventory)	263,000 Assets	31.1%	9.5%	59.4%
Sign Supports	1,654 Assets	41.7%	56.9%	1.4%
		State of Good Repair		Poor
Pavement Markings (estimated by assumptions)	163,000,000 Linear feet of pavement lines	27.4%		72.6%
	2,200,000 Square feet of pavement symbols	55.1%		44.9%

PUBLIC SAFETY

As of 2022, Connecticut was ranked 11th for least number of fatal crashes per 100 million VMT in the country by the Insurance Institute for Highway Safety. From 2015 to 2019, an average of 276 residents lost their lives to traffic violence. In 2019, the state fatality rate was 0.79 per 100 million VMT. This is below the national average of 1.11 per 100 million VMT. The need for safer streets is most dire in Connecticut's rural communities. Road users die 2.5 times more on rural non-interstate roadways than all other roads: 1.70 per 100 million VMT. As with the majority of the country, Connecticut saw an increase in fatalities during 2020.

Connecticut has committed to reaching zero traffic deaths. The General Assembly passed transportation safety legislation in 2021 establishing a Vision Zero Council. CTDOT announced a "Toward Zero Deaths" campaign and adopted a Comprehensive Pedestrian Safety Strategy. These are promising commitments, but no significant progress has been made in reducing the number of fatalities from the 2017 baseline. Most alarmingly, as of August 1 there had been more than 11 fatal wrong-way crashes in 2022 according to the Connecticut Transportation Institute at UCONN. This has prompted the CTDOT to allocate $20 million for installation of cameras on wrong-way signs across the state, designed to trigger flashing lights to alert motorists when wrong-way driving is detected.

Connecticut traffic deaths, as a rate of driving, CY2013-19



Eliminating traffic deaths – and minimizing severe injuries – requires reallocating road space and new street designs for the most vulnerable users: pedestrians, cyclists, transit riders, and the disabled. Engineering changes and roadway modifications determine whether inevitable mistakes on Connecticut roads become deadly. In 2019, CTDOT upgraded 1,500 pedestrian crossings throughout the state to meet new standards and incorporated the data into asset inventory for advanced safety analysis and future network improvements.

RESILIENCE

Connecticut is committed to infrastructure resiliency. In the wake of storm systems that battered the state's infrastructure those like Super Storm Sandy, Hurricanes Irene, and Isaias, the Department has spent significant time conducting studies and asset assessment. CTDOT completed the inaugural Transportation Asset Management Plan (TAMP) in 2018. Since then, the Department has adopted state standards for new roads that exceed federal mandates.

CTDOT also completed their 1st state-wide vulnerability assessment under the Federal Highway Administration's (FHWA) Climate Resilience Pilot Program, allowing the Department to have a better understanding of potential future impacts of climate change, changes in annual precipitation levels and rates, and sea-level rise. As a coastal state, there are numerous town and state roads which are impacted sea-level rise and changes in precipitation events which convey runoff to the Long Island Sound, all of which need to be assessed, designed, constructed and maintained for the changing conditions brought by climate change.

INNOVATION

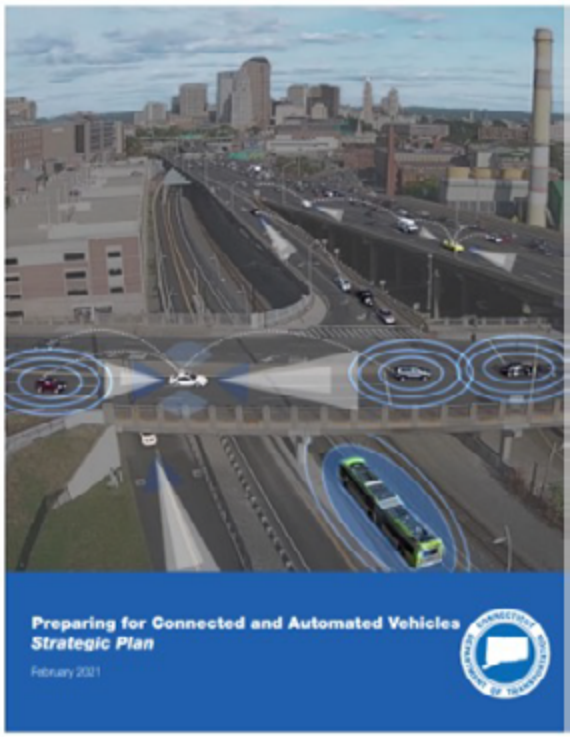
State agencies are increasingly utilizing effective contracting practices such as Design-Build, CM-GC/CMAR, and other alternate delivery methods. Moving forward these contracting processes will help deliver completed cost-effective projects at a faster pace.

CTDOT recently issued a request for proposal (RFP) for a research study on the next generation of automated work zone speed control to be implemented within active roadway construction projects to study equipment to reduce traffic speed within work zones, which will reduce traffic accidents and provide safer working conditions for construction personnel.

CTDOT has become a leader with numerous sustainability efforts, including LED traffic signals, solar panels, battery electric bus (BEB) initiative, and the recently announced electrical vehicle (EV) charging infrastructure program. In recent years the state general assembly approved bills to amend the state statutes to mandate reductions in greenhouse gas (GHG) emissions to 45% of 2001 levels by 2030 and 80% of 2001 levels by the year 2050. The deployment of electrical vehicles, including school and transit buses, has been deemed a primary solution for achieving these GHG reductions. As a result, the State has committed to 50% of the state's light duty fleet of vehicles and 30% of heavy-duty fleet shall be electrified by the year 2030.

Alternative/multi-modal transportation initiatives such as commuter rail, bus networks, CT fast track, bicycle lane, walk lanes, complete street initiatives are being studied and various initiatives are being funded and promoted. One example is the statewide Pedestrian Pavement Marking Upgrade Program to replace existing pedestrian signing and improve crosswalk visibility on roughly 1,500 pedestrian crossings on state-maintained roads which was completed in 2019. These initiatives can help reduce congestion and alleviate capacity issues.

Furthermore, CTDOT is actively studying and preparing for the future of the auto industry with connected/automated vehicles featuring vehicle-to-everything (V2X) communication technologies and has issued a report in 2021 for Connected-Automated Vehicles (CAV). CAVs are anticipated to provide a powerful tool to improve roadway safety; enhance mobility, accessibility, and reliability; reduce congestion; fix and upgrade infrastructure; provide efficiencies; improve air quality; and support economic growth. Some of these technologies will be driven by the auto-manufacturers and tecnology companies, but State leaders and Department officials should be ready for rapid changes that will occur as these technologies become widely adopted.



Roads

RECOMMENDATIONS TO RAISE THE GRADE

- Implement the proposed Connecticut Infrastructure Bank, or other innovative funding and financing sources such as tolls, and/or adopt a highway program.
- Re-institute Connecticut's state gas tax, raise based on current needs, and set up automatic adjustments for inflation.
- Explore the feasibility of replacing the gas tax with vehicle mileage tax to secure long-term funding for the necessary future of electric vehicles for passengers and freight.
- Prioritize capital and operating funds to non-car transportation modes: expand commuter rail, increase bus fleet sizes and make them electric, install dedicated funding to complete Connecticut's 2019 Active Transportation Plan.
- Embrace and promote work-from-home policies which can help alleviate capacity and congestion issues without large capital improvement expenditures.
- Improve capacity issues in Connecticut's worst trucking bottlenecks: dedicated road space for freight traffic, increase transit services, and install protected bike lanes.
- Continue to study and prepare the state's infrastructure for the future of autonomous driving and vehicle-to-everything (V2X) communication technologies.
- Offer technical assistance for municipal funding applications and seek new dedicated revenue regarding non-state-owned roads, which are the largest contributor to the percentage of poor conditioned roads.

Roads

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Wastewater

C-

CT Water Pollution Control Plant Phosphorus Removal Upgrade, Southington, CT
Photo Credit: Town of Southington Water Pollution Control

EXECUTIVE SUMMARY

Connecticut wastewater is treated by sanitary sewer systems and onsite septic systems. Septic systems service approximately 45% of residents. There are 94 permitted, domestic wastewater treatment plants. Connecticut residents paid an average of $520 annually for sewer services in 2019, with increases outpacing national averages, but lagging the need of the Constitution State's very old infrastructure. To meet those needs, increased funding levels from the federal and state government must continue past the end of recent federal legislation. Like the infrastructure they maintain, Connecticut's wastewater engineers are aging, and successful services depend on more significant workforce development efforts from all stakeholders.

OVERVIEW

Connecticut encompasses public and private wastewater infrastructure including several types of collection and treatment facilities, including:

1. Sanitary sewer systems;
2. six remaining communities with combined sewer systems;
3. municipally owned wastewater treatment plants (WWTP);
4. private wastewater facilities;
5. large, regulated subsurface sewage treatment systems;
6. alternative treatment systems;
7. estimated 700,000 decentralized systems (septic systems).

Regulatory oversight of wastewater facilities depends on the size and type of the facility. Table 1 shows the system associated with each regulator.

Table 1: System type regulator based on capacity and final disposal

Type of System	Flow Capacity	Regulator
Subsurface	More than 7,500 GPD	Department of Energy and Environmental Protection (CTDEEP)
	2,000 to 7,500 GPD	Department of Public Health (DPH)
	Less than 2,000 GPD	Local Health Department
Surface	All flows	CTDEEP
Tribal Activities and Discharges	All flows	EPA

CAPACITY & CONDITION

Approximately 55% of the 3.6 million residents are served by sanitary sewers that flow to a WWTP. As impervious surfaces like parking lots, roads, sidewalks, and buildings increase and system demands expand, combined sewer systems are less able to handle sanitary flow during rain events due to the increased runoff volume entering the collection system. Further, Inflow and Infiltration (I/I) increase treated flows. Heavy rains can result in WWTP bypasses and/or reduce the effectiveness of treatment and contribute to water quality concerns in receiving waters.

Combined Sewer Overflows (CSO) occur when the capacity of the system is exceeded at the CSO structures. Since the 1990's, Connecticut has spent over $1.2 billion eliminating over 130 CSO structures and reducing total CSO volume by approximately 22% (from 1,493 million gallons to 1,158). There are six remaining CSO communities in Connecticut that are actively working to reduce and/or eliminate these combined flows. For example, Greater New Haven Water Pollution Control Authority implemented green and gray water infrastructure projects according to a legally binding plan. A 2020 analysis of CSO monthly data showed that the plan's short-term measures reduced CSO volume from approximately 32 million gallons (before implementation) to 19 million gallons (after implementation) for a 40% reduction in volume. Similarly, the overflow frequency went from 110 events to 53 events for a 50% reduction in frequency. The program was implemented with an overall cost of $10.2 million and won the 2020 ASCE Achievement in Civil Engineering (ACE) Award.

Similar projects are ongoing at different stages in other CSO communities like Bridgeport and Hartford. CT DEEP provides wastewater funding to municipalities and districts. The Clean Water State Revolving Fund (CWSRF) sets the State's priorities to fund wastewater projects (See Figure 1). Figure 2 showcases the 2022-2023 program priorities.

Figure 1: State Revolving Fund (SRF) Flowchart

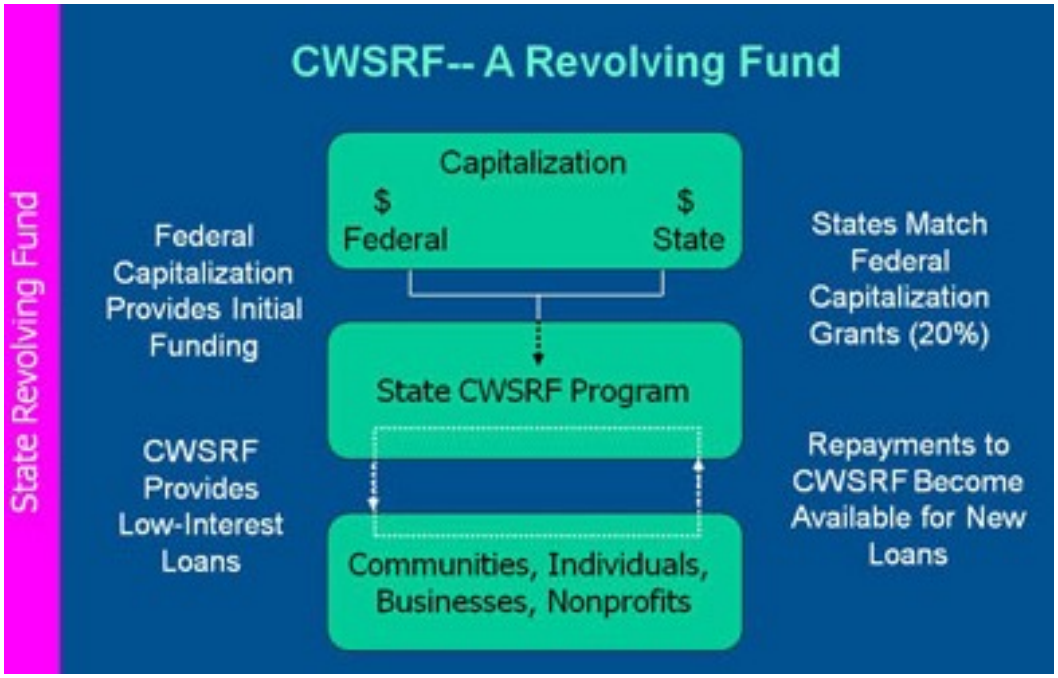
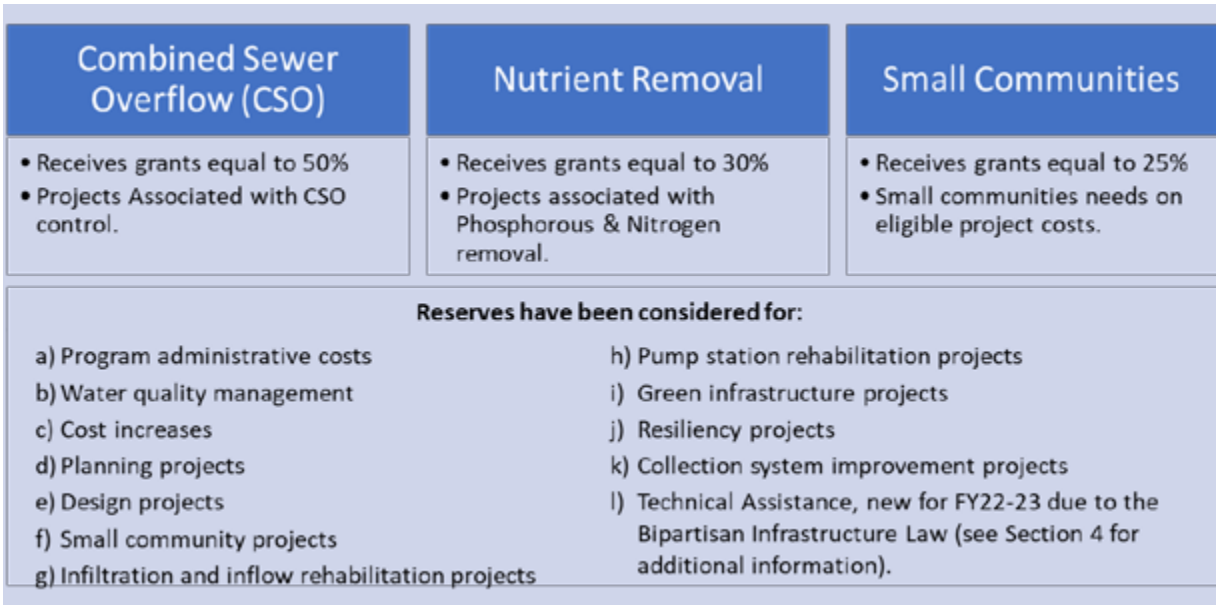


Figure 2: CWSRF Program Priorities



All the WWTPs within the state have a permitted or design capacity above the current flows they are receiving. The upgraded plants through CWSRF and other funding sources also included some increasing capacity upgrades. It is expected that future treatment needs will be met by the current infrastructure if population and industrial growth continues at the current rate. However, peak flows because I/I are still a major concern in most communities. Consequently, there is a need to continue or increase the efforts to eliminate I/I from the collection systems.

On-site subsurface sewage treatment (septic systems) are not connected to a municipal collection system. These systems are not designed to handle excess flow from inflow or high groundwater tables, meaning wet weather events may flood these systems resulting in untreated sewage mixing with groundwater or running off above grade. Further, lack of maintenance of these systems leads to failures. Nutrient pollution (nitrogen and phosphorous) to the local groundwater and the Long Island Sound is a major concern with 45% of residents served by septic systems.

To improve the ecosystem of Long Island Sound (LIS), CTDEEP has increased funding for water quality improvements, including the priorities mentioned in Figure 2. The Connecticut River discharges nutrients to the LIS, which negatively impacts the water and aquatic ecosystems. Forty-four (44) WWTPs along the Connecticut River were identified in 2020 as contributing nitrogen loads to the river ranging from 249 to 722,000 kg/year. Upstream plants feeding the river in MA, VT, and elsewhere are now being targeted for nutrient removal. Within CT non-tidal areas, upgrades for nitrogen removal are substantially completed and upgrades for phosphorous removal are close to completed. Some examples of recent projects are listed in Table 2.

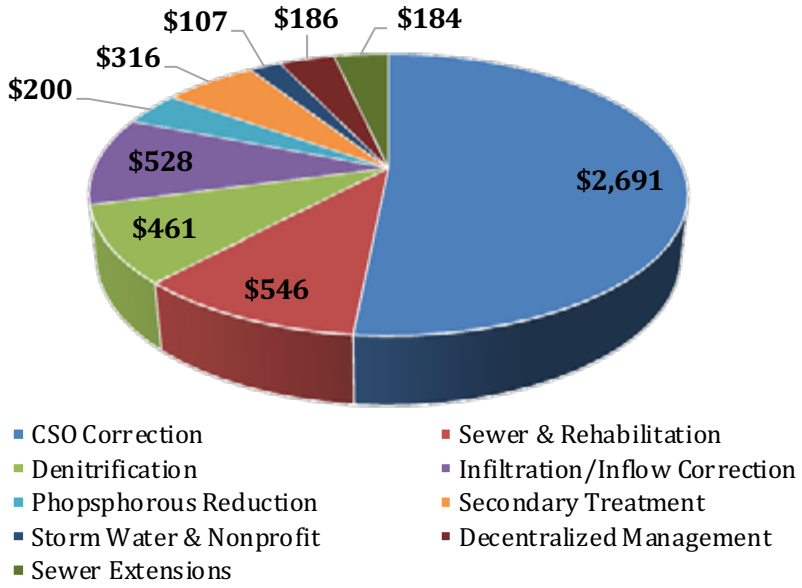
Table 2: Examples of recent WWTP upgrade projects for Total Nitrogen and Total Phosphorus reduction funded by CWSRF.

No.	Plant Name	Total Nitrogen Upgrade	Total Phosphorous Upgrade
1	Wallingford WPCF	No	Yes
2	Killingly WPCF	Yes	Yes
3	Waterbury WPCF	No	Yes
4	Vernon WWTF	Yes	Yes
5	Southington WPCF	No	Yes
6	Meriden WPCF	No	Yes
7	Ridgefield WPCF	No	Yes
8	Torrington	Yes	Yes
9	Enfield WPCF	Yes	No
10	Plainville WPCF	No	Yes

FUTURE NEED

CTDEEP estimated in 2018 that over $5.22 billion is needed for wastewater infrastructure improvements, and that number was only an update from a 2012 needs survey. The largest infrastructure need is in CSO communities at over $2.7 billion (Figure 3). This needs survey had limitations – it did not account for privately owned wastewater facilities – but it includes data from several long-term control plans from facility operators.

Figure 3: 20-year Wastewater Infrastructure Needs by Category.



FUNDING

Connecticut maintains 94 permitted, domestic WWTP, with average capacities ranging from 100,000 gallons per day (gpd) to 60 million gpd. Funding for the life cycle cost of the plants is primarily through: Clean Water State Revolving Fund (CWSRF), rate-based customer usage and property taxes.

Connecticut set up a sustainable CWSRF decades ago. Table 2 is a summary of the level of funding through CT's CWSRF over the last 20 years. These funds provide municipalities and districts to plan, design, and construct wastewater treatment projects.

Table 2: CWSRF Funding Summary

Category	Loan	Grant	Total
CSO (million)	$439	$388	$827
CWSRF (million)	$2,229	$1,033	$3,262

Note: The first line is for CSO related work, the second line item is all clean water projects (incl. CSO projects).

The Infrastructure Investment and Jobs Act (IIJA) allocated $14.4 billion to wastewater and storm water infrastructure nationally. This is a significant improvement to the pre-existing funding allocations. However, due to the infrastructures age and needs, this rate of funding would need to continue far past IIJA's end date, especially here in Connecticut (one of oldest areas of the nation). Funding for wastewater systems in the state is expected to roughly double from the IIJA. The CWSRF funds for years 2022-2023 are summarized in Figure 4. All projects placed on the "Call for Projects" 2021 will receive funding due to IIJA.

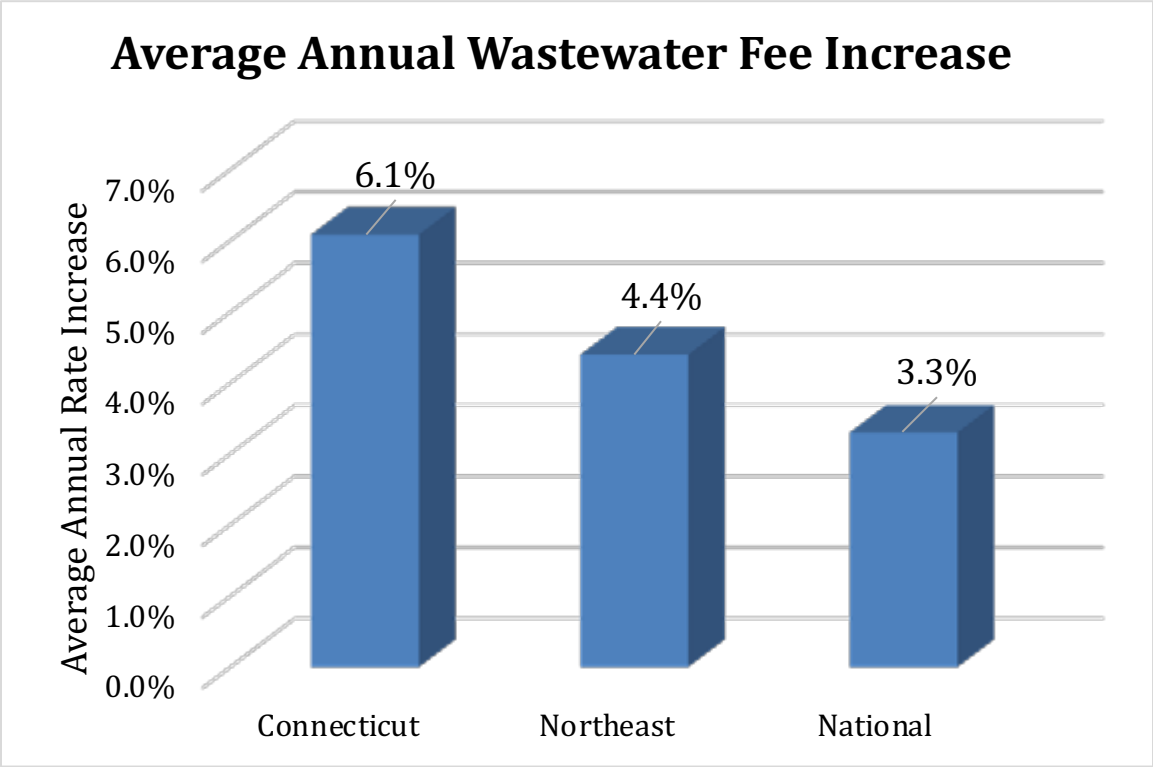
Figure 4: Summary of anticipated CWSRF funds allocation per FY.

	FY 22 Allocation	FY 23 Allocation	State Match
Supplemental Clean Water State Revolving Fund Grant	$21,804,000	$25.7M	1. Match of 10% in FY22 and 23 (increases to 20% in FY24-26) 2. 49% of grant funds ($10,683,960) must be additional subsidy (i.e. grants). Note: CT DEEP will determine one or more projects (as previously identified in this Priority List) which will receive additional subsidy based on a project(s) which meet the affordability criteria in Section 603(i) of Water Resources Reform and Development Act (WRRDA) to Titles I, II, V, and VI of the Federal Water Pollution Control Act and/or CT's existing affordability criteria used by the Department of Economic and Community Development (DECD) to develop a list of distressed municipalities in Connecticut
Emerging Contaminants Grant	$1,145,000	$2.25M	1. Match not required 2. 100% of EPA's capitalization grant to be provided as an add. Subsidy (i.e. grant)
Sewer Overflow & Stormwater Reuse Municipal Grants	$6.2M	$6.2M	1. Match of 20% in FY 22 and 23

Rate revenue helps keep the infrastructure in good working order and allows for replacement and rehabilitation of aging systems. The 2019 Connecticut Sewer Rates Survey found average annualized sewer costs of $520.

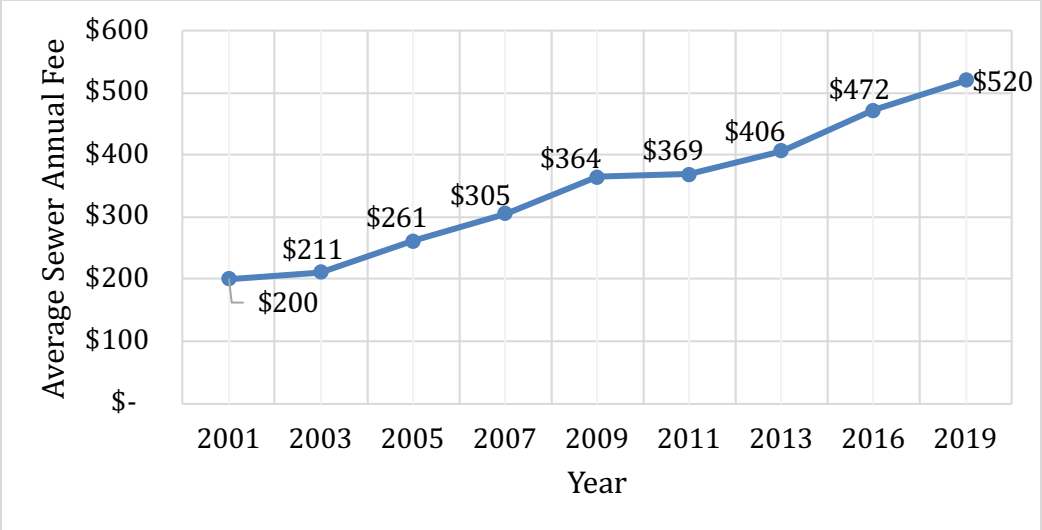
Wastewater rate increases in Connecticut between 2008 and 2016 were above the national and regional averages (see Figure 5). These fees in Figure 5 and Figure 6 highlight CT priorities and needs discussed above.

Figure 5: Comparison of Connecticut Average Annual Wastewater Fee Increase to the Northeast Region and National Average.



Note: Data available for comparison 2008-2016.

Figure 6: Connecticut Historical Sewer Fee



OPERATIONS AND MAINTENANCE

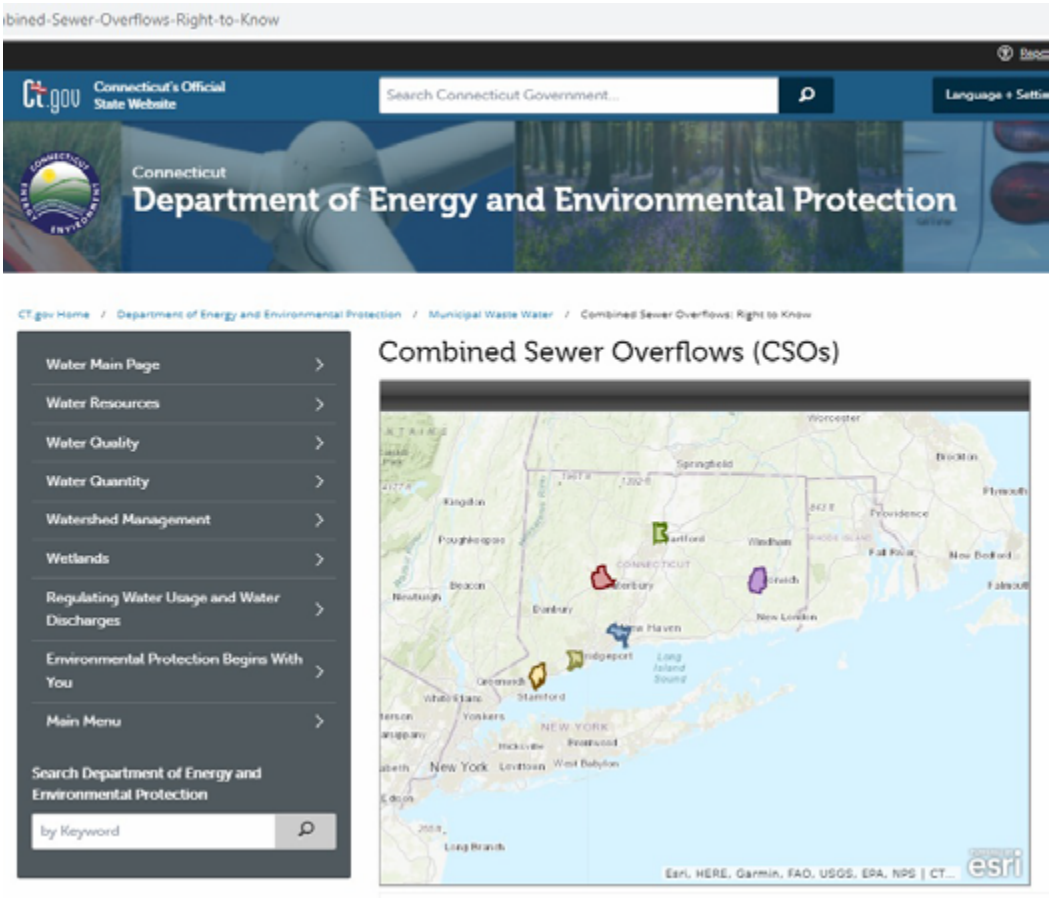
WWTPs employ operators, collection system staff, lab analysts, and office staff. For each operator level, education, experience, and exams can be required to achieve licensure. Maintaining licensure requires continuing education. Collection systems Management Operations and Maintenance (CMOM) programs have helped operators with industry and regulatory guidelines to set expectations for their wastewater infrastructure. The experienced workforce of the wastewater industry is aging; personnel are retiring. Cooperative efforts between industry leaders, CTDEEP, and educational institutions training/certification opportunities need to be accelerated.

An Asset Management Plan is a plan that includes inventory of critical assets, assets condition, assets performance, and a clear strategy for maintaining the assets and future needs of WWTP facilities and funding for these needs. The development of this plan is a critical part of the fiscal sustainability plan (FSP). The FSP development and implementation is a mandatory for the projects funded by the CWSRF. However, not all the WWTP have an Asset Management Plan or a systemized tracking of assets maintenance and repairs.

PUBLIC SAFETY

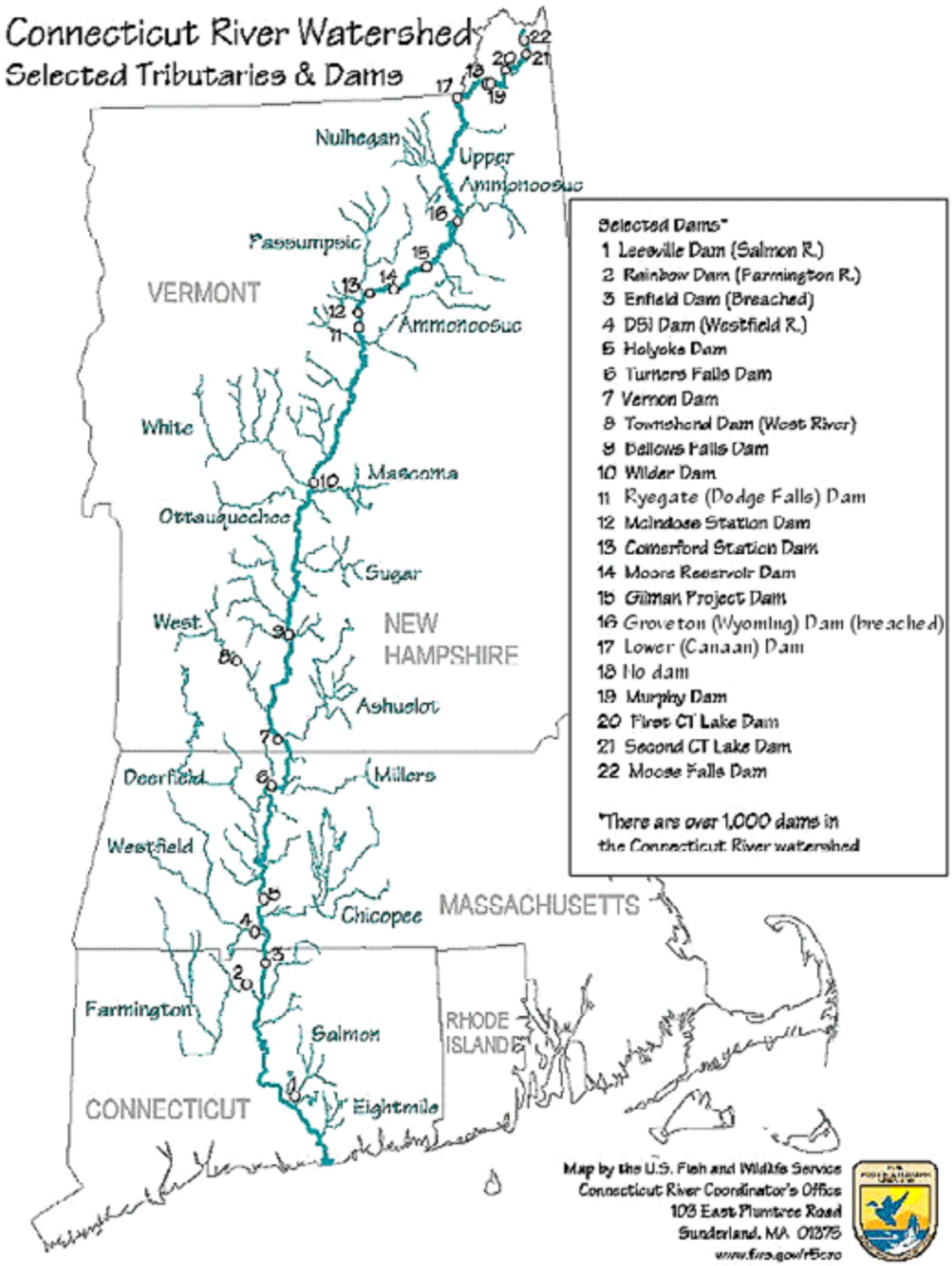
Releasing untreated sewage is the greatest risk to public safety associated with a WWTP. Recreational waters are closed if bacteria levels are elevated. In Connecticut, a Right to Know website and Twitter feed inform the public of accidental releases.

Figure 7: DEEP Combined Sewer Overflow Right to Know Website



Wastewater nutrients cause harm to the environment. Excess nitrogen is the primary pollutant causing hypoxia in LIS. Excess phosphorous originates from WWTP discharges and urban/agricultural runoff, negatively affects aquatic life, and disrupts recreational use. A statewide strategy to reduce phosphorous loading to inland, non-tidal waters is required by law. In 2017, grant funding in the CWSRF increased and fast-tracked WWTP upgrades to encourage compliance. By 2022, a total of 88 upgrades to WWTPs using the CWSRF funding have been completed. Now, CT complies with the Total Maximum Daily Load (TMDL) for the Sound. However, work upstream of Connecticut needs to continue (See Figure 8).

Figure 8: Geography of the Connecticut River



Per- and polyfluoroalkyl substances (PFAS/PFOA) are a chemical group having negative health effects and are difficult to destroy. Due to the wastewater quantity and constituents, it is impractical to treat for PFAS/PFOA. Consequently, source control is very important. Sampling in Connecticut began in 2021 to see the impacts at the influent, effluent, sludge, and scrubber waters.

Pharmaceuticals enter a WWTP through either flushed, unused pills (which should not be done) or drug excretion. Current technologies for treatment are not able to remove all constituents received by a WWTP which impacts the ecosystems in the receiving waters. Connecticut is not largely affected by this because of wastewater disposal regulations and the robust pharmaceutical "takeback program" across the State.

During the pandemic, WWTPs were faced with protecting critical operators from exposure to/spread of COVID. Split shifts (days on/days off), masking, social distancing, and routine surface disinfection were all implemented. Certain Connecticut plants assisted the CDC with testing wastewater to monitor spread of the virus in sewersheds.

Cybercrimes at WWTPs are increasing. Equipment remote monitoring and control for better treatment and energy usage is a benefit, however this potentially allows unauthorized access. Implementing good security practices is important. CTDEEP has provided protocols for SCADA use (See Figure 9).

During the pandemic, WWTPs were faced with protecting critical operators from exposure to/spread of COVID. Split shifts (days on/days off), masking, social distancing, and routine surface disinfection were all implemented. Certain Connecticut plants assisted the CDC with testing wastewater to monitor spread of the virus in sewersheds.

Figure 9: Connecticut Cybersecurity Resource Website

RESILIENCE

Since wastewater collection systems utilize gravity whenever possible most WWTPs are located at lower elevations. As the severity of storms and frequency of weather events increase, climate adaptation considerations are required.

Fifty (50) WWTP have been identified as "high-risk" for flooding during storm events. A 2015/2016 survey showed that 57% of the 31 surveyed WWTPs were impacted by flooding. The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) found that 72% of coastal WWTPs would experience flooding from the 100-year flood event.

CWSRF projects need to consider mitigating the impact of a rise in sea level over the projected life span of a facility. New projects must follow minimum flood protection levels. Upgraded wastewater infrastructure must be able to maintain operations during a 100-year storm. Critical equipment/structures require designing to the 500-year flood elevation. WWTPs should assess the risk to existing infrastructure from climate change and propose corrective actions.

Septic systems are at risk of failure from climate change, this is especially true for systems in coastal and other low laying areas. Systems 7,500-gpd and larger are regulated by DEP. Smaller systems are regulated by DPH and Local DPH. It is recommended that larger size systems accommodate changing water elevations to protect the nearby and downstream communities and environment. This can be achieved by using future flooding areas and groundwater elevations under climate change to identify the vulnerable systems and finding cost-effective solutions to address this issue.

INNOVATION

The term Water Resources Recovery Facility (WRRF) instead of Wastewater Treatment Plant was adopted by Water Environment Federation (WEF) 2012 and is gaining momentum. The terminology change focuses on the products and benefits of WWTPs rather than the waste entering facilities. Recoverable resources include electricity from sludge digestion, treated water recycling and reuse. Future resources may include phosphorous, metals, and other materials recovery from the liquid and solid streams.

New technologies, like nitrogen removing Septic Systems, offer protection to our waters. As research deems pollutants harmful to people and the environment, enhanced treatment processes/mitigation measures will be required including stricter effluent limits for metals, pharmaceuticals, PFAS, and personal care products along with adaptations necessary to combat climate change and sea level rise.

Connecticut sets asides reserve money for innovations. These funds are to promote the State's priorities, see Figure 2.

Wastewater

RECOMMENDATIONS TO RAISE THE GRADE

- Continue increased funding to eliminate the combined sewer overflows.
- Continue increased funding, i.e. IIJA levels, to address water quality concerns and reduce levels of nutrients, metals and emerging contaminants.
- Increase rebates, tax relief, or other financial aid to residents for increased reliability of private septic systems.
- Implement full cost of service rate structures to help wastewater systems address needed repairs, rehabilitations, or replacements before the infrastructure fails.
- Maintain a knowledgeable and well-trained wastewater treatment plant operator workforce by promoting these jobs and expanding training opportunities.
- Identify wastewater facilities that are vulnerable to extreme weather events and identify measures to ensure that those facilities can maintain continuous operation.
- Support research and pilot projects to identify and remove harmful wastewater contaminants.
- Increase funding to complete infiltration and inflow investigations and mitigation projects within the sewer collection system.
- Use Asset Management to better maintain existing infrastructure and do proactive and preventative maintenance.

DEFINITIONS

BYPASS – the diversion of wastes from any portion of the wastewater collection or treatment facilities.

DRUG EXCRETION – the removal of drugs from the body, either as a metabolite or unchanged drug. There are many different routes of excretion, including urine, bile, sweat, saliva, tears, milk, and stool.

SANITARY SEWERS – pipes that carry wastewater from homes and businesses (i.e. wastewater from toilets, laundry, bathing, dishwashing).

STORM SEWERS – pipes that carry rainwater or melted snow from storms.

COMBINED SEWER SYSTEMS - pipes that are designed to carry both sanitary and stormwater flow. When many systems were first constructed, it was considered economical to combine the wastewater and stormwater pipes and discharge overflow directly into a body of water to protect the plant.

COMBINED SEWER OVERFLOW (CSO) - An event within the combined (wastewater and stormwater) sewer system to discharge excess sewer water from the piping to local water bodies in order to prevent back-ups of untreated wastewater into buildings, street flooding during heavy rains, or cause problems at the WWTP. These events occur only when certain peak flow is reached at a determined CSO structure location causing the structure to overtop excess flow to the water body.

STORMWATER – rain or melted snow that washes off streets, parking lots and other surfaces.

HYPOXIA – a condition of low dissolved oxygen concentrations in the waters of Long Island Sound that impacts up to half of the Long Island Sound's waters each summer.

Wastewater

DEFINITIONS (cont.)

WASTEWATER TREATMENT PLANT (WWTP) - a facility that receives wastewater (and sometimes stormwater) from domestic and/or industrial sources, and by a combination of physical, chemical, and biological processes, removes contaminants from the wastewater.

INFILTRATION– groundwater that seeps, trickles, or flows into old or leaky sewer collection pipes, manholes and laterals from the surrounding soil.

INFLOW – stormwater that flows into sewer collection systems from sources such as catch basins, manhole covers or private residences with stormwater drains, sump pumps and/or roof leaders connected to the sewer system.

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Wastewater

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