Environmental Quality in Connecticut

Council on Environmental Quality

2018 Annual Report

STATE OF CONNECTICUT

COUNCIL ON ENVIRONMENTAL QUALITY

May 29, 2019

The Honorable Ned Lamont
Governor of Connecticut
State Capitol
Hartford, CT 06106

Dear Governor Lamont:

I am pleased to submit Connecticut's forty-seventh Annual Report to the Governor. In accordance with CGS 22a-12, this report describes environmental conditions for the 2018 calendar year. The report is best read as an on-line document on the Council's website.

In any year, specific measures of environmental health may vary from their long-term trend. Consequently, each of the report's indicators is best considered in the context of its trend. The Report is frank about Connecticut's progress and its remaining challenges. It identifies areas where Connecticut will not meet its stated goals without a significant increase in effort and resources.

The programs and policies, set out many years ago, have resulted in significant environmental improvements, many quite dramatic. Bald Eagles and Piping Plovers have made a remarkable comeback, due to human interventions to improve their habitats. Air quality has greatly improved and per-capita carbon dioxide (CO2) emissions are on track to meet the state's short term goal. If similar focus and effort are applied to the formidable environmental challenges ahead, there is reason to be optimistic about future success.

Two of the State's most formidable challenges are developing climate resiliency and accomplishing its long-established land conservation goals. These two challenges are intertwined. Preservation of open space, forests and farmland will increase climate resiliency by sequestering CO2, reducing surface runoff, limiting flooding, increasing cooling through evaporation and transpiration, and abating sprawl. Needless to say, numerous wildlife benefits result from land preservation. As of 2018, annual public investment in the acquisition of open space and farmland has been insufficient to achieve Connecticut's preservation goals. The agencies charged with advancing conservation and environmental protection are performing those functions at staffing levels which are a fraction of their prior strength.

Perhaps the greatest threat to the state's environmental health is not measureable over time, as are the environmental indicators in this Report. It is the proposal to strip the Draft State Water Plan of reference in its introduction to the long established principle that water is a public trust to be managed for the public good. That principle is enshrined in statute and common law. It is foundational to the Connecticut Environmental Policy Act, and consequently, to all environmental regulation. Its inclusion in the State's water planning policies is

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appropriate; its exclusion is a reversal that is fraught with risk.

To expedite reviewing the report's environmental indicators, quick summary boxes above the data are provided.

As always, the Council looks forward to providing you with any additional information you might request.

Respectfully submitted,

Susan D. Merrow
Chair
Council on Environmental Quality

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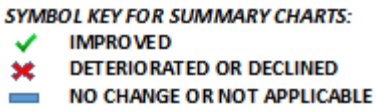
Annual Report 2018

May 29, 2019

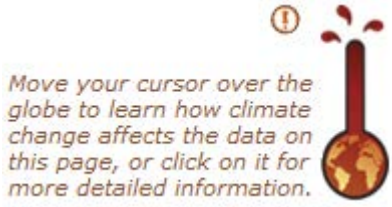
Welcome to *Environmental Quality in Connecticut*. This edition documents the condition of Connecticut's environment through 2018. If viewing it on-line, which is how it is designed to be read, use the navigation buttons on the left to move from section to section within the report.

The "Introduction" pages present some of the important conclusions and new features of this edition, as well as a page about invasive insects, *Invasions*. There are six sections of environmental indicators, from "Air" through "Personal Impact", that display a comprehensive set of environmental data for the 10 years ending in 2018.

For most of the indicators of the state's environmental health there is a summary box with the following meanings:



Also, at the top of nearly every page, there is a symbol:



Running your cursor over the symbol will reveal a brief explanation of the indicator's connection to a warming climate. Clicking on the symbol will open a page with more details.

The final section, "About the CEQ" describes the members and major activities of 2018 and also includes acknowledgements of sources, illustrations, and the hard work of interns, for which the Council is grateful.

There may be updates to the 2018 Annual Report. Sign up for e-alerts to receive a notice when updates are published.

The Council welcomes your comments and questions.

This is a printed version of the Council on Environmental Quality's Annual Report to the Governor.

The online version allows viewing of its web links and interactive charts. The online version is the only way to access all the information in the report.

To view the online version go to: https://www.ct.gov/ceq/AnnualReport

Progress and Problems

An Encouraging History

In many ways Connecticut is geographically disadvantaged when it comes to environmental conditions, yet Connecticut's residents, businesses and government have made notable progress dealing with many environmental challenges.

Connecticut is the "sink" into which air currents from across the country deposit air pollutants from states to the west and southwest. Though there is still unhealthful air on many summer days, steps taken by residents to reduce their carbon output, such as the installation of photovoltaic electricity generation and switching to more efficient vehicles have, no doubt, contributed to the improved air quality over the last ten years.

Nutrients from sewage treatment plants in New York and Connecticut contribute to hypoxic episodes in Long Island Sound. Government mandated reductions in nitrogen discharges from those plants have coincided with lower dissolved nitrogen and slightly smaller hypoxic zones during the last few years.

The Climate Challenge

Such successes are a testament that Connecticut residents and businesses can improve the environment, even when the root causes lay totally, or partially, outside the State's borders. Many other challenges, with their genesis beyond Connecticut remain. Foremost among them is the climate. The warming of Connecticut's climate threatens to undo much of the environmental progress of past decades. For example, the benefit from the millions of dollars that were spent to reduce nutrient discharges to Long Island Sound can be undone by warming waters. Increased precipitation that is expected to accompany Connecticut's warming climate will increase surface water runoff and overload sewage treatment facilities through infiltration and inflow. Evidence of this was already seen in the data for 2018.

Connecticut's warming climate is creating compatible loci for invasive insect pests, like the Asian tiger mosquito (*Aedes albopictus*) and the emerald ash borer (*Agrilus planipennis*). These, and others likely to follow, will have negative economic, ecological, and public health impacts. Native animals and plants will diminish as their habitat transforms. This is already evident in the near collapse of Connecticut's lobster harvest. Foresters predict eventual reduction in the population of iconic New England species like Sugar maples and the Oaks upon which very many forest species depend.

Nearly every environmental indicator in the 2018 Annual Report has a tie to global warming. (These connections in the Annual Report are highlighted by a symbol of a globe in the shape of a thermometer.) Because the global causes of the problem are exogenous, solutions must be also. Connecticut, alone, will not reverse climate change. Therefore Connecticut's citizens and leaders must think in terms of resiliency through adaptation and mitigation.

Preservation and Conservation

Within Connecticut, many species are approaching "endangered" or "special concern" status. These include eight of the state's nine bat species and five of the state's eight resident turtle species. Ruffed Grouse have declined dramatically too. Monitoring and preservation techniques for these and other species are underway. Some Bat hibernacula have been closed to lower man-induced stressors. The state has programs to enhance and expand the diminishing grassland and young forest habitats on which many species depend. These and other preservation efforts are most likely to succeed when conducted on preserved land that can be managed for conservation.

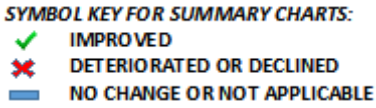
Land conservation programs allow the State to better adapt to its changing climate. Reaching the statutory goal for land preservation will require nearly doubling the preservation rate of the past

ten years. A doubling of farmland preservation efforts will also be needed if the state goal for preservation is to be reached by 2050. There is more to these efforts than merely preserving habitats and farming. Forests and open space provide multiple ecological services including sequestering carbon dioxide, controlling floods, reducing erosion, improving water quality and creating recreational opportunities.

An unexpected and major threat to Connecticut's conservation ethic arose in 2018 when the inclusion of the principle of the "public trust" in the draft State Water Plan, was called into question by some individuals. The principle that the public owns commonly shared resources, like water and air, has been long enshrined in common law and statute in Connecticut. It is the foundational principle of the Connecticut Environmental Policy Act and is a foundational authority for the regulation of those resources for the public good. The Council published *Connecticut Residents and the* Public Trust *in Air, Water, Wildlife and Other Resources* in March 2018 to help guide public discussion of the issue. Recognition of the public trust in natural resources has been critical to Connecticut's environmental progress for decades and must remain so. Short term, there is no greater challenge to environmental regulation than the attempt to eliminate the principle that the waters of the State are held in trust for public benefit.

New in This Edition:

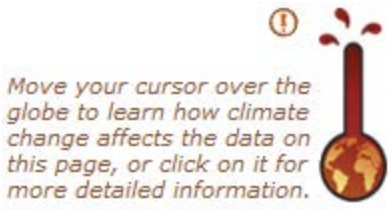
A "summary box" was added at the top of the data detail for most of the environmental indicators. The box displays whether the most recent year in its accompanying chart had improved, declined or did not change. The most recent year's value is also compared to the trend of the prior decade. Where there is an established goal for the indicator, it will show whether the trend is on track to meet that goal.



Just as last year, and possibly for years to come, the environmental indicators in this report illustrate the effects of a warming climate that is accompanied by heavy precipitation. Both are major factors that work in opposition to Connecticut's pollution-control efforts. A summer of hot days and big storms will lead to more bad-air days and more closed beaches. But those obvious consequences are not the only effects. Invasive pests are expected to continue to negatively affect Connecticut's ecology, economy and public health.

This year a section on the emerald ash borer has been added to the information about Asian tiger mosquitoes, which was new to last year's report. Future editions will expand on the problems posed by invasive species.

Because the *majority* of Connecticut's key environmental indicators are strongly affected -- almost always negatively -- by a changing climate, this year's report retained the symbol of the overheating globe where climate change is directly related to the indicator.



Running your cursor over the symbol will reveal a brief statement of the indicator's connection to climate. Clicking on the symbol will open a page with more details.

Air and water quality have the most immediate and direct connections to weather variations that are caused by the changing climate. Connecticut's forests and wildlife are changing and invasive species -- most of which arrive here from more southern locations -- are expanding.

All of the efforts that residents put forth to conserve their environment, from preserving land to protecting turtles to driving efficient vehicles, are critical to Connecticut's march toward its environmental goals. This year's report highlights the fact that residents are having to work even harder because the changes in the climate are working against them.

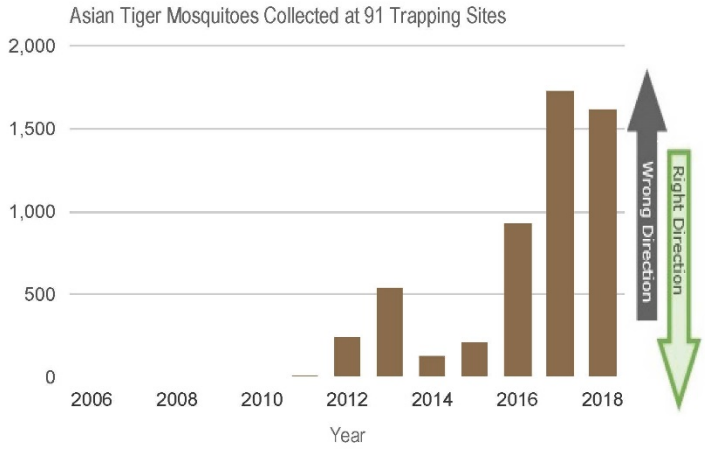
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Asian Tiger Mosquitoes

QUICK SUMMARY:

COMPARED TO LAST REPORT
COMPARED TO 10 YR. AVERAGE
ON TRACK TO MEET GOAL

The Asian tiger mosquito continues to expand its range northward as the climate warms.



The range of the Asian tiger mosquito is expanding in the United States, particularly into Connecticut and other northeastern states. Infection rates of West Nile Virus and other mosquito-borne diseases, such as Dengue and Zika, are likely to rise as a warming climate creates more favorable habitats for mosquitoes. Much of Connecticut is expected to get warmer and wetter over the coming century, enhancing mosquito populations by creating more suitable habitat.

The invasive Asian tiger mosquito, *Aedes Albopictus,* first appearance in the United States was in Texas in 1985 and was followed by rapid expansion. This mosquito was first discovered in Connecticut in 2006.

Scientists at the Connecticut Agricultural Experiment Station (CAES) published a study in 2017 that documents the recent statewide expansion. Another recent study projected a significant expansion of the Asian tiger mosquito's range under two climate change scenarios. The most expansion would occur in southern New England where this species is predicted to occupy most of Connecticut by 2039.

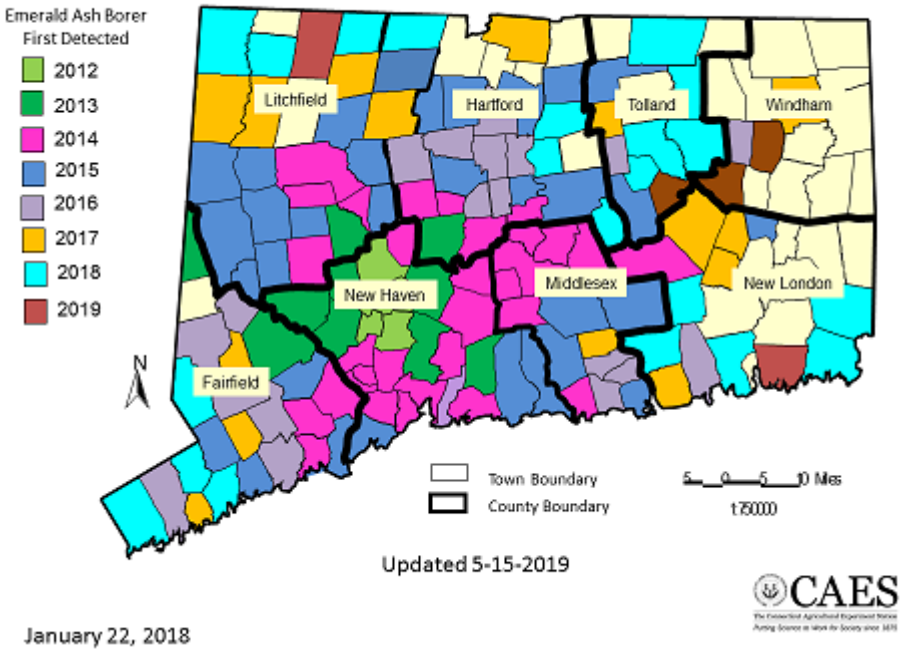
It is not just the expansion of suitable habitat that allows mosquitoes to thrive here. As the temperature rises, everything about the disease-spreading biology of mosquitoes speeds up. Warmer temperatures are more likely to make mosquitoes breed, get infected, and transmit

disease at a faster rate. Warmer air incubates the virus faster in the cold-blooded mosquito. Warmer temperatures make the mosquito hungrier, so it bites more people.

Additional information about mosquito management in Connecticut can be found on this dedicated website or www.epa.gov/mosquitocontrol.

Emerald Ash Borer

The emerald ash borer is an insect that is not native to North America. It was first found in 2002 in the vicinity of Detroit, MI and Windsor, ON. In 2012, Connecticut became the 16th state known to have emerald ash borer within its borders. Since 2012, the emerald ash borer has spread to 136 towns in all eight counties.



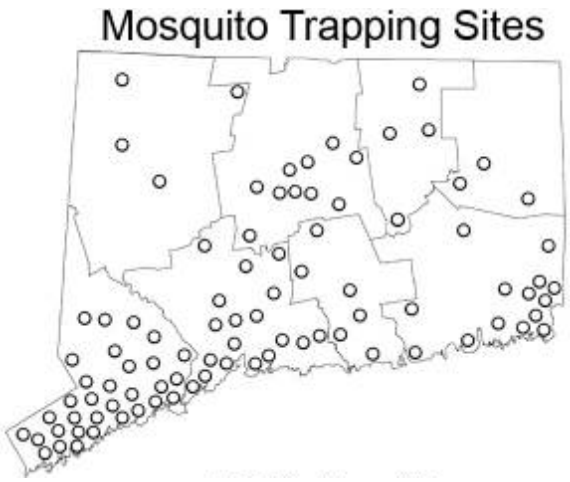
The emerald ash borer attacks ash trees almost exclusively. In Connecticut, ash trees make up just slightly less than three percent of the trees in the forest, most of which are white ash. The loss of ash trees from the forest, like the loss of any specific kind of tree, would lead to rippling effects on other organisms living in the woods. Butterflies and moths from nearly 30 different families live on ash trees. Seeds of ash are eaten by wood duck, bob white, purple finch, pine grosbeak and fox squirrels. The loss of ash trees in a forest stand also reduces vital habitat and allows undesirable invasive plants to fill the gap created.

Movement of ash, in particular as firewood, nursery stock, logs and wood packaging materials, has been cited as the most likely means by which emerald ash borer has spread so rapidly.

Additional information about the emerald ash borer in Connecticut can be found on this dedicated website or at www.emeraldashborer.info.

Technical Notes:

1) The Connecticut Agricultural Experiment Station collects mosquitoes from June through October at 91 trapping locations as part of the Connecticut Mosquito and Arbovirus Surveillance Program. In 2016, new sites were added to the surveillance network. The data in this indicator is restricted to the original 91 sites that have been in continuous operation for 20 years at CAES (shown below).



COMING SOON: Future editions of this report will document other invasive-species populations in Connecticut.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

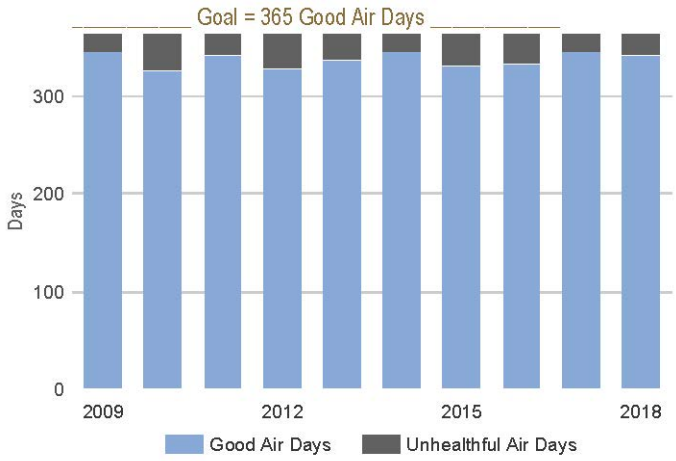
Good Air Days

The Number of Days When There Was No Exceedance of a Federal Air Standard in Connecticut

QUICK SUMMARY:

- ✗ COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- — ON TRACK TO MEET GOAL

Connecticut residents breathed unhealthful air on 23 days in 2018: three more days than in 2017, but an improvement over the 10-year average.

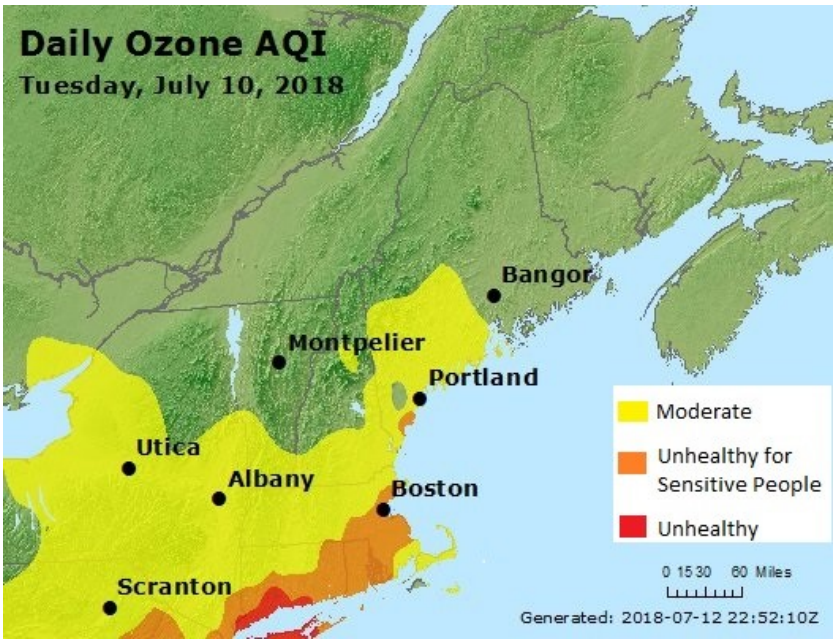


A Good Air Day is when every monitoring station in the state records satisfactory air quality. "Satisfactory air quality" is defined here as air that meets the health-based ambient air quality standards for all of the following six pollutants: sulfur dioxide, lead, carbon monoxide, fine particles, nitrogen dioxide and ground-level ozone.

Connecticut's goal is to have air that meets health-based standards for all six pollutants. Violations of health-based air quality standards have been eliminated for five of the six pollutants, leaving ground-level ozone as the only remaining chronic problem. (As described on the CEQ Air Pollution Index page, the levels of lead are so low that the possibility of violations is remote; the standards remain in place, however.)

Ground-level ozone is created when nitrogen oxides and organic compounds in the air react in the presence of sunlight. Weather is a major factor in year-to-year fluctuations. Motor vehicles remain a large source of ozone-forming emissions despite improvements in tailpipe standards.

The map below illustrates a bad-air day in 2018 that was more intense than average but followed the typical pattern of Connecticut having the worst ozone pollution in New England.



Source: U.S. Environmental Protection Agency Region 1

The yellow areas met the air quality standard for ground-level ozone, while the orange and red areas did not. Some residents in yellow areas who are unusually sensitive to pollution might have been affected. Much of Connecticut's ground-level ozone originates in states to the west. Unless emissions in those states are reduced substantially, Connecticut residents could continue to breathe unhealthful air.

Cities and towns in coastal regions of the state usually see more bad ozone days than inland locations. Coastal towns with monitoring stations that saw the most unhealthful days in 2018, included Stratford and Greenwich (14 each), Madison (13), Westport (12), and Middletown (8), while East Hartford (1) saw the fewest. No other New England state had more days with unhealthful levels of ozone than Connecticut, which had a total of 23. Massachusetts was the next highest, with 12 unhealthful days.

The number of statewide good air days was lower in 2018 (342) than in 2017 (345). However, 2018, like 2017, showed an improvement over the average of the previous ten years (336).

Temperatures during the 2018 ozone season (April through September) were very high with 26 days exceeding 90 degrees Fahrenheit. Over the preceding decade, there were three years (2010, 2016, and 2018) that had 25 or more days in exceedance of 90 degrees F (measured at Bradley International Airport). Because levels of ground-level ozone generally rise with the temperature, Connecticut will have to reduce pollution even more just to maintain current air quality as the climate warms.

Fine particles, such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. (For reference, a typical human hair is about 70 micrometers in diameter.) Connecticut has not seen *any* violations of the fine-particle standard since 2014.

Technical Notes:

1) The federal air quality standard for ozone was revised prior to the 2016 ozone season. The new standard (0.070 parts per million over eight hours) is slightly more protective of human health than the older standard (0.075). As it always does when a standard is revised, the Council re-calculated the data for all previous years. In order to display an accurate trend, the chart shows the number of good and unhealthful days for each year as if the new standard had been in effect all along.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

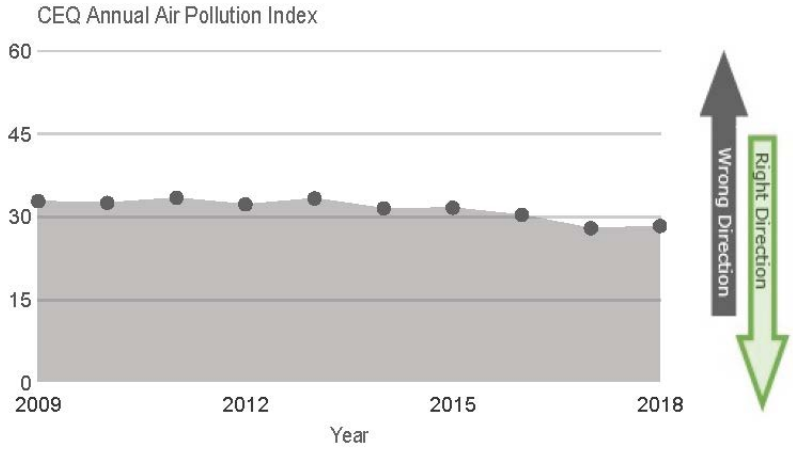
CEQ Annual Air Pollution Index

Average Levels of All Air Pollution Combined Into a Single Index of Overall Air Quality

QUICK SUMMARY:

- COMPARED TO LAST REPORT
- COMPARED TO 10 YR. AVERAGE
- ON TRACK TO MEET GOAL

Connecticut saw a slight increase in low levels of air pollution in 2018, but remained below the 10 year average.



The chart shows the average level of pollution in Connecticut's air.

Five air pollutants -- sulfur dioxide, carbon monoxide, fine particles, nitrogen dioxide and ground-level ozone -- are measured continuously across the state by DEEP. At the end of every year, the Council calculates the average level of each pollutant on a numerical scale where zero equals no pollution and 100 would represent the “unhealthful” level of the specified pollutant. The Council takes this annual number for each of the five pollutants and averages them to yield the single index value on the chart.

Connecticut's air quality was, on average, slightly worse in 2018 than in 2017. Encouragingly, levels of air pollution in 2018 remained below the current 10-year average.

The trend in sulfur dioxide (which is a component of the index value above but not shown separately) is worth noting. The average concentration in Connecticut's air in 2017 was a 47 percent reduction from 10 years prior. Since late 2014, heating oil sold in Connecticut and several other northeastern states has, by law, contained very low concentrations of sulfur. Given this, we can expect the trend in sulfur dioxide specifically to continue downward.

Lead is Out

Until 2012, this indicator charted the combined average level of six pollutants, not five as it now does. The sixth pollutant was lead. In the early 1980s, lead was a serious problem, but unleaded gasoline and other advances have reduced lead levels dramatically. Levels of lead have dropped so low that in recent years they barely registered in this indicator. By removing lead from this indicator, the Council declared victory on behalf of Connecticut residents. (Lead still is subject to regulation and health-based standards and still is monitored by DEEP, so it can be brought back into this indicator if levels rise unexpectedly in future years.)

Preserved Land

Connecticut has two land conservation goals for 2023:

Goal #1: State Lands

State parks, forests, wildlife management areas and other state-owned conservation lands shall constitute 10 percent of Connecticut's land area.

Rate of Preservation

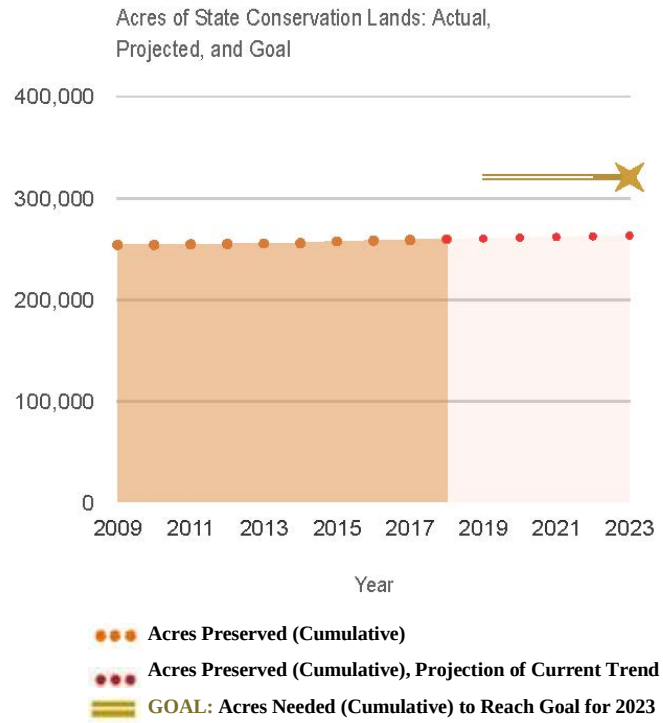
QUICK SUMMARY:

X COMPARED TO LAST REPORT

— COMPARED TO 10 YR. AVERAGE

X ON TRACK TO MEET GOAL

In 2018, the state acquired 704 acres, less than in 2017, but approximately the same as the ten-year average of 708 acres. State preservation efforts are not nearly on track to reach the state preservation goal by 2023, which would require an annual procurement of approximately12,200 acres.



More information about the pace of state land preservation can be found on the To Get Back on Track page.

Goal #2: All Conservation Lands

Land conserved by towns and cities, the state, land trusts and other nonprofit organizations and water utilities shall constitute 21 percent of Connecticut's land area.

Nobody knows what that total is today.

State law sets a goal of conserving 21 percent of Connecticut's land area. The Green Plan, Connecticut's official land conservation plan, establishes 2023 as the target date. That goal includes conservation land owned by towns and cities, land trusts and other nonprofit organizations, water utilities and the state.

As Connecticut comprises 3,205,760 acres, fulfilling this goal would require protection of 673,210 acres.

In addition to its own land acquisitions, State grants helped municipalities and land trusts acquire 1,443 acres through the Open Space and Watershed Land Acquisition Grant Program, nearly one-third more than in 2017.

Many acres also are preserved each year by municipalities and land trusts without state grants, but that information is not reported to the state. The oft-cited estimate that Connecticut has achieved about 74 percent of its goal is inaccurate. A review by the Council in 2015 of published landholdings of land trusts showed nearly 60,000 acres held in fee and close to 30,000 in easements -- far more land than what is included in most published estimates. There is, however, no accurate, current census of all the preserved properties in the state.

The absence of an accurate inventory of protected land in Connecticut is a serious deficiency. DEEP had been collecting data from municipal records in a sequential fashion for 14 years; that effort almost certainly will not be completed, and in any event the earliest-collected data is well out of date. To make land preservation more strategic and cost-effective, Connecticut needs a reliable and up-to-date registry of the protected lands. An Act Concerning the State's Open Space Plan, adopted in 2012, should eventually lead to an accurate tally of preserved lands, but progress has been slow. DEEP has launched a registry portal as a pilot.

How the Goal is Calculated

The State of Connecticut has been acquiring land for parks, forests and wildlife conservation for more than a century. In 1997 and again in 1999, it committed itself to the goals stated above. For the state itself, this meant acquiring another 104,000 acres to reach the goal of 321,000 acres (or 10 percent of the land within Connecticut's borders) by 2023. Achieving this goal would have required Connecticut, beginning in 1999, to acquire about 4,500 acres per year (on average), a rate that had been met (on average) up to 2008. Because the state has fallen below the goal track, it now will need to acquire about 12,200 acres per year. For more information about the pace of preservation, please see the To Get Back on Track page.

Preserved Forests = Clean Water

Rain that falls on land flows toward the nearest stream. If that land is mostly woods, there is a high probability that the stream will support a full range of aquatic life. If even 12 percent of the land is paved or built upon, then the life in the stream is almost certain to be affected. These revealing statistics are discussed further on the *Rivers, Streams and Rain* page.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

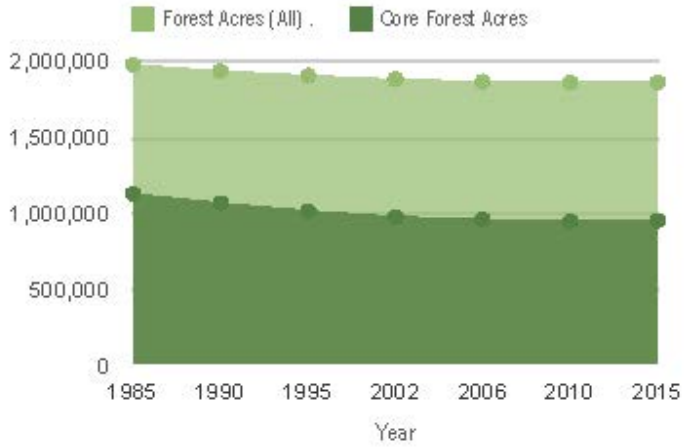
Forests

QUICK SUMMARY:

- COMPARED TO LAST REPORT
- COMPARED TO 10 YR. AVERAGE
- ON TRACK TO MEET GOAL

Most Recent Available Data

The years from 2010 through 2015 were unusual: gains in forest acreage equaled the losses. Before 2010, Connecticut's forests had been shrinking for three decades.



This indicator shows the total acreage of forests in Connecticut, through 2015, the most recent year for which satellite data is available. The forests are divided into core forests and other forests. Continue reading about the decline in forest acreage...

The chart above shows the *acreage* of forest. The *health* of those forests is reflected in the populations of forest birds.

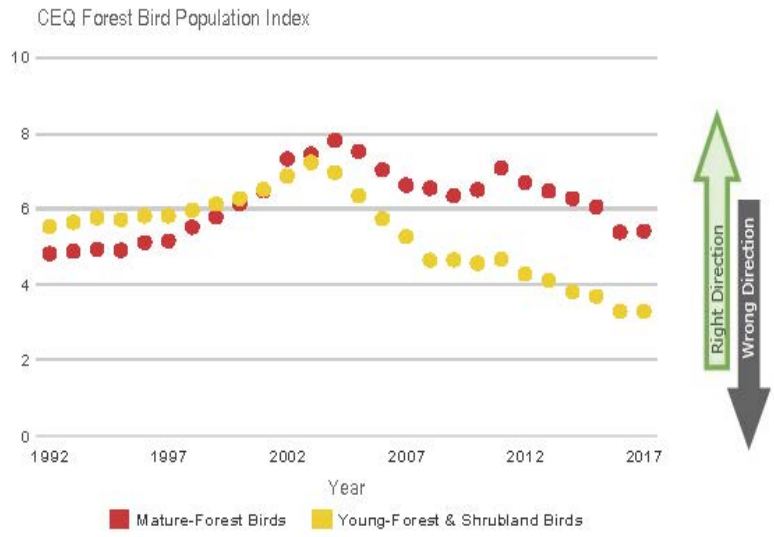
Forest Birds

QUICK SUMMARY:

- COMPARED TO LAST REPORT
- X COMPARED TO 10 YR. AVERAGE
- ON TRACK TO MEET GOAL

The number of birds nesting in Connecticut's forests has been shrinking. This is true for birds that nest in mature forests as well as for birds that nest in young

forests and "shrublands." The 2017 nesting season (most recent data) brought a slight improvement for most forest-bird species, though some declined.



Birds that nest in Connecticut's forests have been declining in number for a decade, which could reflect changes in the health of the forest ecosystems.

Top chart (Forest Acres): Forests that are at least 300 feet from non-forest development -- roads, buildings and farms -- are classified as core forests. Core forests provide habitat for many species of wildlife that cannot tolerate significant disturbance. Forests that are *fragmented*, or divided by roads and clearings, provide some forest functions but are not fully-functioning forest ecosystems. Fragmented forests are known to provide substandard or poor habitat for some species of wildlife and, in many cases, less opportunity for hunting and other types of recreation. Invasive species of plants and animals appear in the wake of activities that fragment the forests.

The acreage of forests can fluctuate over years or decades, increasing as fields grow into forests and declining as timber is harvested by clear-cutting or as agricultural fields are expanded. These temporary fluctuations are distinct from permanent declines caused by road and building construction.

The economic recession that began in 2008 slowed (but did not halt) new construction in most parts of the state. During the lull in land development, some areas that were observed to be cleared land in 2010 became forests by 2015. Gains appear to have balanced the losses. This five-year period of unchanging forest acreage is highly unusual in Connecticut's modern history.

Birds as Indicators of Forest Health

The Connecticut Forestlands Council Forest Ecosystem Health Committee* developed a list of Avian Forest Health Indicator Species that "can be used as indicators in identifying both positive and negative areas of forest ecosystem health." From that list, the Council on Environmental Quality selected two groups of species that best typify forest birdlife throughout the state.** In selecting the species, the Council was aided invaluably by five experts in ornithology.***

The Council calculates index values (using advice from statistics experts) to show the combined population trends of several woodland species. In the **bottom chart,** the **red dots** follow the combined nesting populations of eight species of birds that typically inhabit mature forests in Connecticut:

Hairy Woodpecker	Wood Thrush
Eastern Wood-Pewee	Red-eyed Vireo
Scarlet Tanager	Black-and-white Warbler
Veery	Ovenbird

The **yellow dots** track the nesting populations of five bird species that typically inhabit forests that are young or dominated by shrubby vegetation, sometimes known as "shrublands":

American Redstart
Blue-winged Warbler
Chestnut-sided Warbler
Eastern Towhee
Yellow Warbler

Both categories of forest birds have been declining faster than the forests themselves. This rapid decline could be caused by several factors. Most of the mature-forest bird species are affected greatly by fragmentation. Predators, invasive species, overpopulating deer and human activities follow roads and other intrusions into the forests and cause nesting success to falter. The true forest birds, those that are not adapted to disturbed roadside or suburban habitat, will succeed in the long term only in forests that are not fragmented. After years of decline in the acreage of core forest, one would expect to see declines in many bird species, and Connecticut is seeing such a decline. Many studies have identified a time lag period between the fragmentation of a forest and the decline in birds, explained probably by the fact that the birds' breeding success diminishes gradually, not instantaneously, when a forest is divided into smaller parcels. The link between the conservation of unbroken forests and bird populations is the subject of the Connecticut Audubon Society's 2015 State of the Birds report.

Songbirds that depend on *young* forests have seen their habitat lost to development and to aging of the trees. Other young-forest wildlife, such as the New England Cottontail and Ruffed Grouse, also have declined as such habitat has dwindled. Many landowners, including the state, have taken action to expand this type of forest habitat. Where land is managed to encourage young forests and shrublands, the wildlife responds favorably, but such managed areas are small in total. In late 2016, the federal government approved the creation of the Great Thicket National Wildlife Refuge across six states that could protect habitat for many young-forest and shrubland bird species; the focus in Connecticut will be in western and southeastern areas of the state. It is too soon to conclude that these efforts led to the uptick in some nesting populations in 2017, but they do provide some hope.

The decline of Connecticut's forest birds has landed the majority of the above species on the state's 2015 list of wildlife species of greatest conservation need. The decline can be attributed to a combination of shrinking core forests, a lack of young forests and a surge in other threats. Connecticut's current efforts to maintain and improve forest ecosystems evidently are inadequate.

Forests and People

Research is showing that visiting a forest has real, quantifiable health benefits, both mental and physical. Forests are estimated to sequester ten to twenty percent of carbon emissions annually. In Connecticut the target replacement to removal ratio of trees is approximately 5:1.

*The Connecticut Forestlands Council Forest Ecosystem Health Committee prepared a list of forest ecosystem health indicator species for *Connecticut's Forest Resource Assessment and Strategy* (see Appendix 4 of that document for the list of species).

**The Council used five criteria to select species that represent the birdlife of Connecticut forests. The species that meet the criteria are songbirds (excepting the Hairy Woodpecker) that have been nesting for decades throughout Connecticut where suitable habitat exists. Species thought to be moving into or out of the state because of a changing climate were excluded. (Information about climate-sensitive species can be found in a 2014 report by the National Audubon Society.) Annual nesting data are obtained from the North American Breeding Bird Survey (BBS), a cooperative effort between the U.S. Geological Survey and the Canadian Wildlife Service to monitor the status and trends of North American bird populations. Using a rigorous protocol, BBS data are collected by thousands of dedicated participants along thousands of randomly established roadside routes throughout the continent. Population data for the eight species are combined into an annual index value. The annual values depicted on the chart are five-year moving averages, which smooths the year-to-year fluctuations that might be caused by weather or other short-term factors. A parallel method was used to select and chart the populations of birds that inhabit young forests and shrublands. The Council welcomes questions about the criteria and methods used for this indicator.

***Five biologists (please see the acknowledgments from the 2015 report) with expertise in ornithology were asked to review the criteria and a draft list of species. Their comments led to several improvements, including changes to the lists of species selected for the indices. The Council greatly appreciates their learned input but assumes full responsibility for any weaknesses in the charts.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

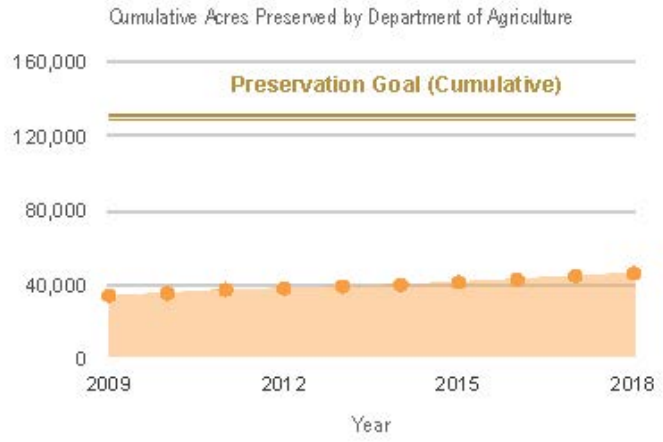
Farmland

Rate of Preservation

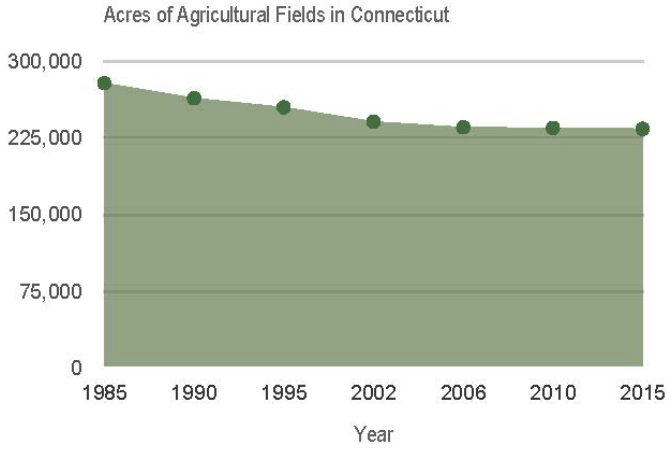
QUICK SUMMARY:

- ✗ COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- ✗ ON TRACK TO MEET GOAL

Preservation: In 2018, Connecticut preserved 1,378 acres of agricultural land on 15 farms. This is less than the 1,850 acres preserved in 2017.



Farmland loss slowed considerably after 2006.



The **top chart** shows the cumulative acreage preserved by the Connecticut Department of Agriculture, which began preserving land by purchasing development rights in 1978. In 2011, the Department launched the Community Farms Preservation Program for farms that do not meet all eligibility requirements of the longstanding farmland preservation program but are nonetheless worthy of preservation. The acreage figures since 2014 include both programs. State bonding, the Community Investment Act and federal funds are the main sources of funding.

The **bottom chart** presents an estimate of the total area of land used for crops and pasture in Connecticut, developed by the Center for Land Use Education and Research (CLEAR) at the University of Connecticut using satellite-derived data. It shows that less farmland was lost to development between 2006 and 2015 than in prior periods, presumably because of the downturn in real estate development associated with the recessionary economy.

The top chart does not show agricultural land acquired for preservation by municipalities and nonprofit organizations. Several towns purchased farms in recent years with no state assistance, and those acres are not reported or recorded at the state level. Along with a central registry of preserved open space, Connecticut needs a registry of preserved farmland to help state agencies and other organizations preserve land strategically.

The Source of the Goal

The Connecticut Department of Agriculture adopted a farmland preservation goal -- 130,000 acres in total, with at least 85,000 acres in cropland -- that originally was based on the amount of land needed for food production to sustain Connecticut's population.

Council projections prepared in 2019 indicate that the goal of preserving 130,000 acres could be reached by 2050 at an annual preservation rate of approximately 3,750 acres per year, if the rate of farmland loss continues as it has for the past 30 years. Since 2014, farmland preservation has progressed at approximately 40 percent of the needed rate (acres/year). Please see the To Get Back on Track page for more information.

Technical Notes:

1) The analysts at CLEAR made slight revisions to all years' data in 2015, and the chart above was modified accordingly.

To Get Back on Track

Milestones

The previous three pages of land indicators illustrate Connecticut's insufficient progress in land conservation. This page tracks the mandatory milestones which, if met, are expected to get the state's land conservation effort moving forward at a greater pace.

In 2012 and 2014, legislation was adopted and signed (Public Acts 12-152 and 14-169, respectively) that set specific targets and timeframes for land-conservation planning.

Mandate for DEEP	Deadline	Done?	Notes on Progress
Prepare comprehensive land conservation strategy (including an estimate of total conservation acreage in the state) *CGS Section 23-8(b)*	December 2012	✔	
Establish a process for state agencies to identify landholdings that might be valuable for conservation *CGS Section 23-8(d)*	No specific date	✘	Process established for CT DOT; other state agencies pending.
Establish a publicly-accessible registry of conservation lands *CGS Section 23-8(e)*	January 1, 2015 Quarterly updates thereafter	✘	Under development; over 70,000 acres in registry but none of the data is publicly accessible at this time.

The Pace of Preservation

The gauges below show the differences between the current rates of land preservation and the rates needed to meet the goals Connecticut has set for itself.

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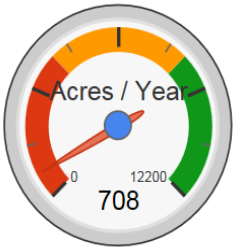
Preservation of Land by the State for State Parks, Forests, and Wildlife Management Areas

(Goal = 10% of Connecticut's Land Area)
Average Annual Rate of State Land Acquisition Over the Last 10 Years



Current Trend

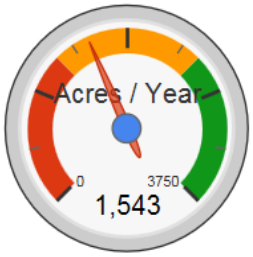
Please see the Preserved Land page for more information about this goal.

In the last ten years, the State of Connecticut has added about 6,700 acres to its network of state parks, forests and wildlife management areas. Achieving the State's goal would require almost doubling that ten-year total every year.

———————————

Preservation of Farmland by the State

Average Annual Rate of Farmland Preservation (1,543 Acres) Since 2014 and the Annual Preservation Rate Needed (3,750 Acres) to Reach the Preservation Goal by 2050



Current Trend & Goal Track

Please see the Farmland page for more information about this goal.

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Preservation of Land by Cities, Towns, State, Nonprofit Organizations and Water Utilities

(Aggregate Goal = 21% of Connecticut's Land Area)

The gap between the goal and the rate of acquisition by these land-conserving organizations is difficult to assess. Acquisition data are not yet collected by DEEP or any other organization.

Small Parcel Size: A Big Impediment

One of the reasons that Connecticut probably will not meet its goals for land conservation is the fact that most forest land is owned in small parcels. Read more about this in a December 2015 CEQ staff memo.

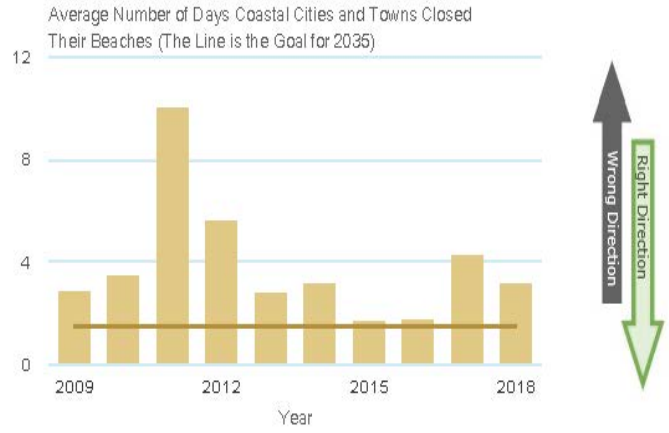
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Swimming

QUICK SUMMARY:

- ✓ COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- — ON TRACK TO MEET GOAL

Coastal swimmers saw fewer beach closings in 2018 than in 2017, but still more than in 2015-16.



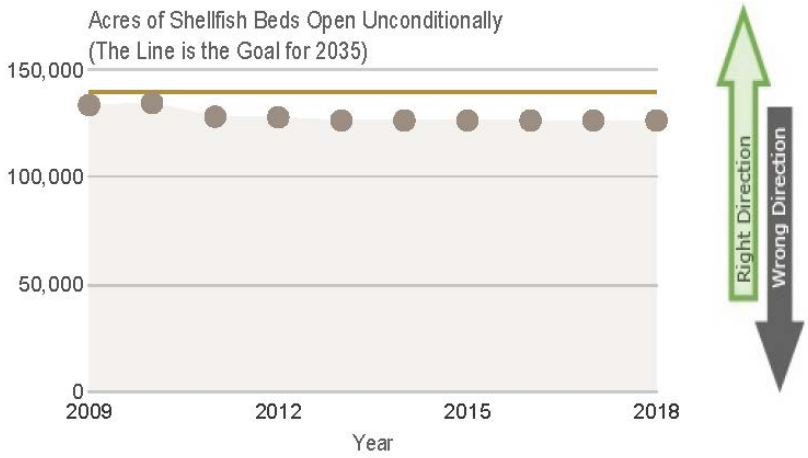
The Council adds up the number of days that each coastal city and town closed one or more of its public beaches, and calculates an average for all the coastal cities and towns with beaches. Continue reading about beach closings caused by pollution...

Clamming and Oystering

QUICK SUMMARY:

- — COMPARED TO LAST REPORT
- ✗ COMPARED TO 10 YR. AVERAGE
- ✗ ON TRACK TO MEET GOAL

The area of the Sound unconditionally approved for harvesting shellfish was unchanged in 2018.



The Connecticut Department of Agriculture's Bureau of Aquaculture and Laboratory Services monitors shellfish beds and classifies them according to their potential for yielding healthful, uncontaminated shellfish. The chart immediately above shows the acreage of shellfish beds that are included in the "approved" category for direct harvesting because they are generally unaffected by pollution.**

There is also a "conditionally approved" category, which requires a management plan and might be subject to closings seasonally or after rainfalls. (Even areas that are "approved" may be closed as a precaution following exceptional rainfalls of three or more inches.) Aquaculture experts have suggested that the gradual, historic shrinkage of "approved" shellfish beds is associated with an increasing volume of runoff from lawns and pavement flowing further into the Sound. Shellfish beds can be closed in anticipation of rain events that will wash pollutants into receiving waters. The drought conditions which persisted during 2016 resulted in fewer closures.

The Source of the Goal

The goal for shellfish beds, adopted in the 2015 edition of the Long Island Sound Study's Comprehensive Conservation and Management Plan, is to upgrade five percent of the 2014 restricted acres so that shellfish may be harvested in those areas freely. Adding those upgraded acres results in a target of approximately 139,550 "approved" acres by 2035, shown on the chart as a horizontal line.

Forecast: More Heavy Rains

Connecticut residents have witnessed a steep increase in the amount of rain arriving in downpours. In October 2015, the National Weather Service updated the precipitation frequency data for Connecticut that had last been published in 1961. The new data confirm what had been predicted by many: rainfalls are getting heavier, and heavy rains are becoming more frequent. In 1961, most of the state would have expected a four-inch one-day rainfall every five years or so; in some northwestern towns, that five-year storm would have brought less than four inches. Now, all portions of the state can expect the five-year storm to bring well over four inches and, in some northwestern Connecticut towns, close to five inches.

While this trend, generally attributed to a changing climate, can be found throughout the country, it is particularly strong in the northeastern states. The 2014 National Climate Assessment predicts this trend to strengthen.

More about beaches...

Coastal swimmers enjoyed more "open" beach days in 2018 than in 2017, but still had to contend with more days closed than any other year since 2012.

Yearly variations are products of rainfall patterns and unusual incidents such as sewer-line ruptures. Polluted surface runoff and sewage overflows after rainstorms are the most common sources of bacteria. After heavy rains, health officials must assume that polluted runoff and/or overflows from combined sanitary/storm sewers have raised bacteria levels. Though beaches are regularly monitored for bacteria, test results are not immediate. More closings are initiated preemptively, as a precaution after heavy rain, than are initiated due to actual monitoring results. Over fifty percent of beach closures in 2018 were attributed to the impacts from storms and runoff.

The cities and towns on the western half of the state's shoreline usually have a higher frequency of closings. The western half of the coastline has more sewer systems with overflows and more paved surfaces that send contaminated runoff into the waters.

The water is tested at beaches from Memorial Day through Labor Day. At other times, the water could be clean or contaminated; it is not tested. Most sewage treatment plants along the coast disinfect their routine effluent discharges all year, but most treatment plants north of I-95 do not disinfect their effluent before May and after September.

How this indicator is calculated: The number of days that each coastal town and city closed one or more of its public beaches is added, and an average is calculated for all the coastal cities and towns with beaches. Because the bathing season is approximately 100 days long, the number of days shown on the top chart also equals the percentage of the bathing season when beaches were closed.

The Source of the Goal

The goal line on the top chart is an approximation of the target adopted in the 2015 edition of the Long Island Sound Study's Comprehensive Conservation and Management Plan. That plan's goal calls for cutting the number of beach closings in half by 2035 (from 2014, with the number for 2014 calculated using a five-year rolling average). The plan's goal is tied to individual beaches, while the indicator above counts beach closings by grouping together the beaches within each municipality. A fifty percent reduction in individual beach closings will likely result in a comparable reduction in the indicator above.

*Precipitation data are from the Bradley International Airport monitoring station.

**The changes in "approved" acres over the past decade have reflected changes in federal regulations and more accurate spatial measurement techniques in addition to water quality changes.

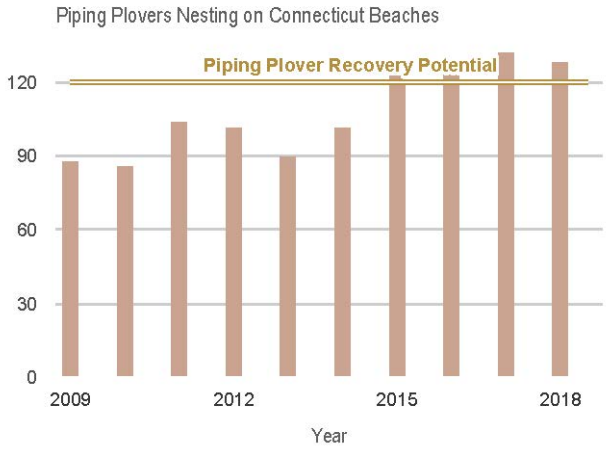
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Piping Plovers and Others

QUICK SUMMARY:

✗ COMPARED TO LAST REPORT
✓ COMPARED TO 10 YR. AVERAGE
✓ ON TRACK TO MEET GOAL

The amount of successful plover nests in 2018 was down from 2017, but the productivity rate was close to the goal.



Piping Plovers are small shorebirds that nest only on sandy beaches with sparse vegetation. People, storm tides and predators frequently destroy nests.

The number of plovers on Connecticut's beaches now exceeds the estimated "recovery potential" level (see above). However, the modest size of the population requires that the species continue in threatened status at the state and national level.

Nesting adults are counted (and in most cases protected) every spring by hundreds of volunteers working with the Audubon Alliance for Coastal Waterbirds, The Nature Conservancy and other organizations.

Their habitat is a narrow strip squeezed between a rising Sound and higher ground. The Piping Plover population is, according to the United States Fish and Wildlife Service, "an indicator of the health of the fragile beach ecosystem." (*Atlantic Coast Piping Plover Revised Recovery* Plan*)*

Since protection and monitoring efforts began in 1984, nesting success has improved, resulting in more returning adults in subsequent years. In 2018, 64 pairs successfully raised 75 young plovers on 11 Connecticut beaches, predominantly between Bridgeport and West Haven; down from 100 young plovers and 66 pairs in 2017 (a modern record). Scientists estimate that each pair must successfully raise an average of 1.20 young per year to maintain a stable population of Piping Plovers. In 2018, Connecticut plovers raised an average of 1.17 chicks per nest.

Other Beach Residents

The protections afforded Piping Plovers benefit other threatened species, including American Oystercatchers and Least Terns.

The least tern count was noticeably lower again in 2018: 236 adult least terns were counted on Connecticut shores, down from 244 adult terns in 2017 and 250 adult terns in 2016. This year's pairs were only able to raise 14 chicks, a significant decrease from 31 fledged chicks in 2017. This low number reflects the numerous challenges confronting wildlife on Connecticut beaches. While Connecticut's least tern numbers have been variable from year to year, the recent steep decline in Connecticut and the Northeast region is currently being investigated.

Oystercatcher pairs had a record high year in 2017, with a population of 63 pairs and the second best year for productivity: 63 oystercatcher fledglings, a better-than-average number. Figures for 2018 have not yet been made available.

American Oystercatchers
parent and young

QUICK SUMMARY:
- COMPARED TO LAST REPORT
- COMPARED TO 10 YR. AVERAGE
- ON TRACK TO MEET GOAL

Least Terns
still in their eggs

QUICK SUMMARY:
- COMPARED TO LAST REPORT
- COMPARED TO 10 YR. AVERAGE
- ON TRACK TO MEET GOAL

The Goal for Piping Plovers

When the federal government listed the Piping Plover as a threatened species in 1986, Connecticut was home to an estimated 40 nesting adults (in 20 pairs). The entire population inhabiting the Atlantic coast from Canada to North Carolina was estimated to number about 1,600. An initial recovery goal was set for 2,400 birds over the plover's entire Atlantic coast range. The federal government reviewed the goal in 1996 and revised the overall Atlantic coast goal upward to 4,000 birds; New England's share of the newer target is about 1,200 birds. At that time, scientists estimated Connecticut to have habitat for at least 120 nesting birds (depicted above as "recovery potential"). The breeding population of Massachusetts has been so successful

since then that New England's overall goal has been met. Connecticut now appears to have reached its potential (as estimated in 1996); perhaps a future reassessment will show the potential habitat to be greater than it was known to be.

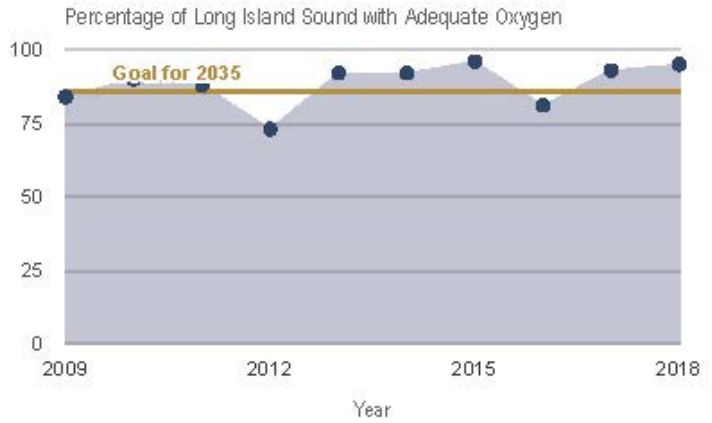
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

The Water of Long Island Sound

QUICK SUMMARY:

- ✓ COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- ✓ ON TRACK TO MEET GOAL

The areas with acceptable levels of dissolved **oxygen** throughout the year are on track to meet the 2035 goal.



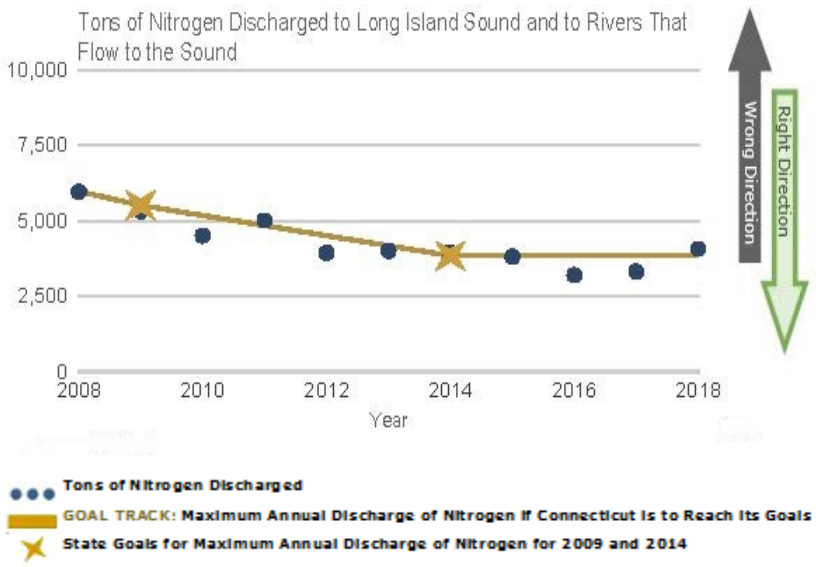
Marine life requires oxygen. The percentage of Long Island Sound that has adequate oxygen throughout the year is shown in the chart above. Continue reading about oxygen in Long Island Sound...

———————————

QUICK SUMMARY:

- ✗ COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- ✗ ON TRACK TO MEET GOAL

2018 saw the highest nitrogen **discharged** to the Sound since 2013.



Connecticut's investments in nitrogen-removal technology at sewage treatment plants have been successful. Continue reading about the critical role of nitrogen pollution in Long Island Sound...

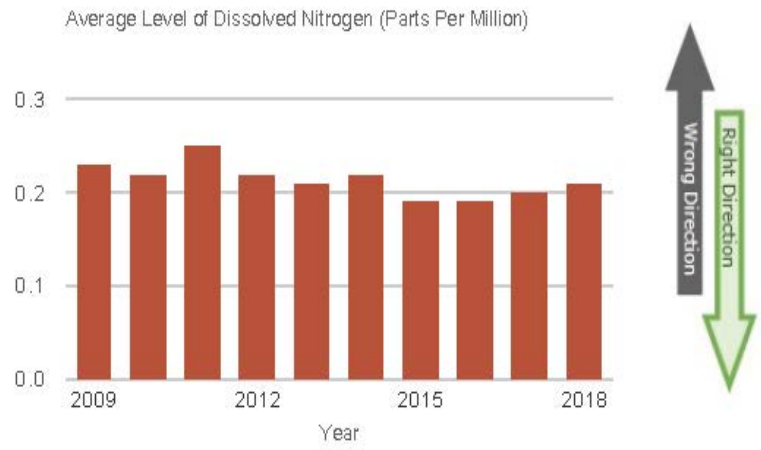
QUICK SUMMARY:

✗ COMPARED TO LAST REPORT

✓ COMPARED TO 10 YR. AVERAGE

— ON TRACK TO MEET GOAL

As Connecticut reduces or increases the amount of nitrogen discharged into the Sound, the level of **dissolved nitrogen in the water** usually follows suit.



Top chart (Oxygen): During the summer, some areas of the Sound experience hypoxia, which is a condition in the water where oxygen levels are not adequate to fully support desirable forms of life, including fish and lobsters. Hypoxia occurs when the nitrogen in pollution stimulates excessive growth of aquatic plants, which die and get consumed by oxygen-using bacteria. Hypoxia occurs predominantly in the western portions of the Sound. Weather greatly influences hypoxia, making year-to-year changes less important than long-term trends.
Detailed reports that include maps of the extent and duration of hypoxia in Long Island Sound are produced annually by the Department of Energy and Environmental Protection.

Goal for hypoxia: The goal line on the top chart, set at 86 percent of the Sound, is an approximation of the target adopted in the 2015 edition of the Long Island Sound Study's Comprehensive Conservation and Management Plan. That plan's goal calls for "measurably reducing the area of hypoxia in Long Island Sound from pre-2000 averages." A "measurable reduction" is at least a 28 percent reduction, according to the plan's statistical analysis that accounts for the year-to-year weather-induced fluctuations that bedevil this indicator.

The **middle chart** tracks the amount of **nitrogen** discharged by 80 sewage treatment facilities across Connecticut, two large coastal industrial facilities and a small group of industrial sources in the Naugatuck River watershed. The sewage treatment plants include those along the coast and many more that discharge to rivers that flow to the Sound. Connecticut's investments in nitrogen-removal technology at many of those plants have been successful. DEEP attributes the higher discharges of 2018 to increased precipitation, which can lead to overflows of combined sewers and exacerbate infiltration of groundwater and inflow of surface water into the sewers. The nitrogen discharges of New York, which lags Connecticut in nitrogen control, are not shown.

To reduce the nitrogen inputs that cause hypoxia, Connecticut and New York adopted The Comprehensive Conservation and Management Plan in 1994, and built upon that plan with an expanded agreement in 2002.

Connecticut's share of the total nitrogen pollution in Long Island Sound is about one-third, and New York's is two-thirds. In 2001, the Federal Environmental Protection Agency approved the New York and Connecticut joint plan for implementing a Total Maximum Daily Load (TMDL). The TMDL is the maximum amount of pollutants that can be discharged while still allowing water quality standards to be attained.

Despite the greater nitrogen discharges from 2013 through 2015, DEEP reports that Connecticut met the goal for the "trade-equalized load," which takes into account the distance of inland treatment plants from Long Island Sound. A portion of the reduction in nitrogen discharges in 2016 was due to the drought, when less stormwater flowed into and through the sewer systems, and another portion was the result of capital improvements in New Haven. Also, more nitrogen is discharged when the weather is cold, so the warmth of 2016 probably was a factor.

The effectiveness of Connecticut's approach to reducing nitrogen in the Sound is confirmed in two ways. First, the **bottom chart** shows the average level of dissolved nitrogen in the water of Long Island Sound. Levels have improved as Connecticut has reduced its nitrogen discharges.

Second, the United States Geological Survey published a report in 2016 that analyzed the nutrients being carried to the Sound by Connecticut's rivers and streams; since 2001, the total amount of nitrogen was reduced by more than ten percent.

Large uncontrolled quantities of nitrogen enter Long Island Sound when rainfall carries fertilizer from residents' lawns along with the pollutants that have accumulated on impervious surfaces.

Technical Notes:

1. The top chart shows the area of Long Island Sound (both states combined) that had adequate oxygen levels throughout each year. The sampling area (2700 square kilometers) does not include the whole Sound (3400 square kilometers). The areas not sampled are shallow waters (less than two meters deep) near shore, which generally do not experience hypoxia; bays; the eastern end of the Sound, which is not expected to experience hypoxia; and an area in the far western end, which probably becomes hypoxic in most years.

2. More about the new hypoxia goal: Progress toward the goal should be assessed using a five-year rolling average. One or two years of promising data could be natural variability at work. The five-year rolling average is not shown here, but can be calculated or inferred fairly easily.

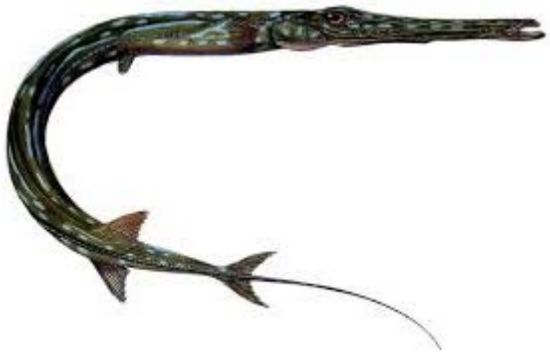
3. Hypoxia was redefined by DEEP in 2011. Areas of the Sound are now considered hypoxic where a liter of water contains less than 3.0 mg of dissolved oxygen. This is the criterion that was used prior to 2004. From 2004 through 2010, DEEP used 3.5 mg/l as the determining level. The threshold was returned to the 3.0 level in 2011 to be consistent with the definitions used by New York and the Long Island Sound Study. Data for all previous years were recalculated to show the area of the Sound having adequate oxygen under the current definition (that is, at least 3.0 mg/l).

4. The nitrogen in the bottom chart is total dissolved nitrogen in the bottom waters of Long Island Sound.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Trends Under the (Rising) Surface of Long Island Sound

The water is warming...



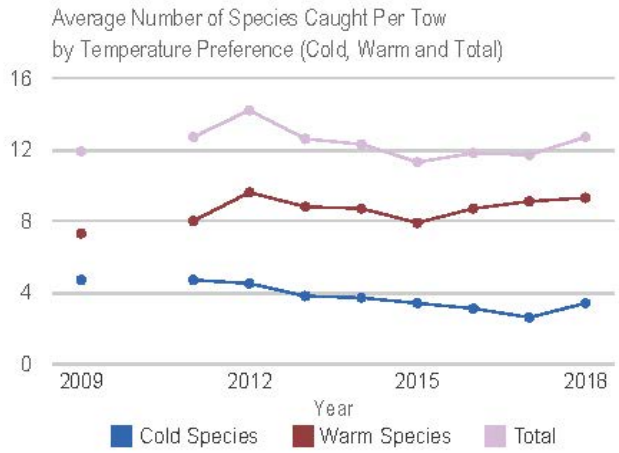
Fish species that thrive in cold water have become less common. Fishes from warmer regions are more common than they used to be.

QUICK SUMMARY:

✓ COMPARED TO LAST REPORT

✓ COMPARED TO 10 YR. AVERAGE

— ON TRACK TO MEET GOAL



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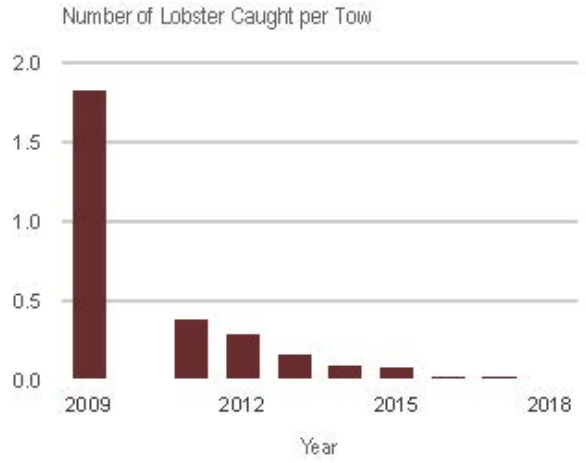
The lobster population of Long Island Sound has failed to recover.

QUICK SUMMARY:

X COMPARED TO LAST REPORT

X COMPARED TO 10 YR. AVERAGE

— ON TRACK TO MEET GOAL



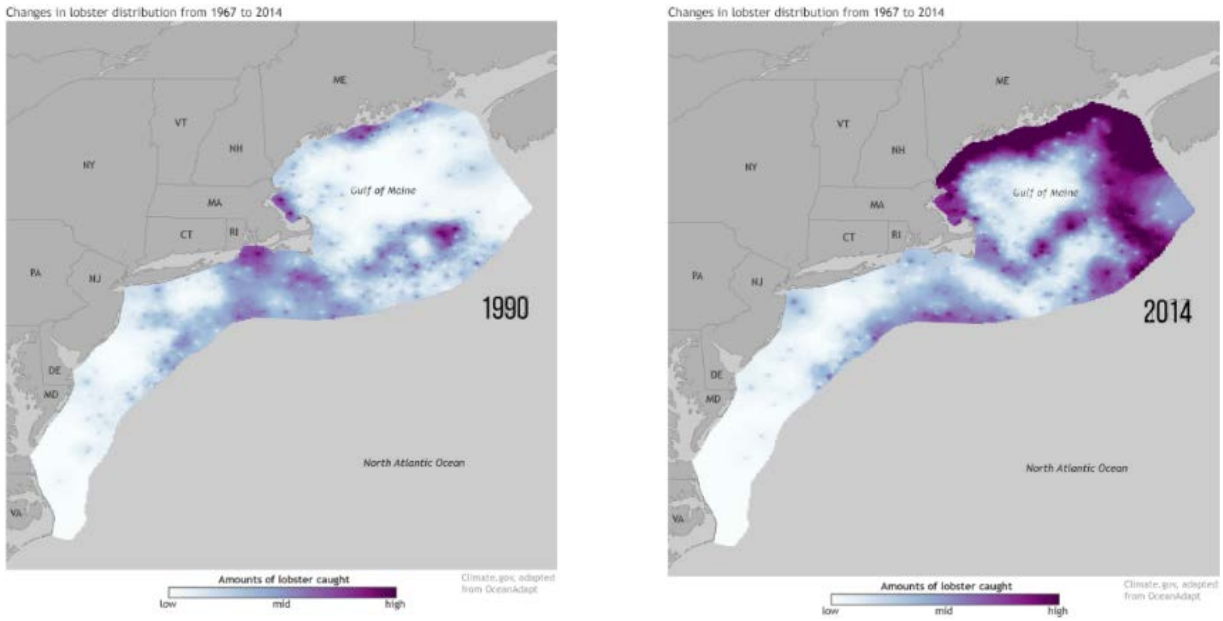
DEEP surveys marine fish, squid and lobster populations every spring and fall by towing nets from a research vessel. The **top chart** shows the average number of fish species caught in each tow during the spring and fall surveys combined. The well-documented trend toward species that favor warm water is apparent. The chart does not include the small but growing number of sub-tropical species captured in the fall tows. In 2014, the researchers netted their first Bluespotted Cornetfish (a skinny fish, depicted above), more commonly found in the tropics and sub-tropics. Data from 2010 are missing because no fall survey was conducted that year.

One study of 686 species, published in 2018, projects the shifts in thermal habitat for fish species all along the North American continental shelf. Water temperature is a major factor in determining the geographic distribution and preferred habitats of marine species. Future shifts in species distribution were generally found to be poleward and followed the coastline. It is shown in this study that climate change in the 21st century will shift the location and available area of suitable thermal habitat for species inhabiting the North American shelf. These results stress the importance of the level of global warming for the magnitude of changes in living marine resources by the end of this century.

The **lower chart** shows the number of lobster caught in the average tow during DEEP's fall survey of marine life. The numbers caught in 2016 and 2017 (most current data) were the lowest ever. The decline in the lobster population began in 1999. Throughout most of the 1990s (not shown on the chart), researchers generally caught between seven and eleven lobster per tow, with a spike to nearly 20 in 1997. From 2006 to 2014 commercial lobster landings in Connecticut declined dramatically (not shown); however, there was a slight increase in the commercial catch in 2015 and 2016. Researchers investigated several possible causes for the dramatic downturn in lobster populations since 1998 including disease, changes in water quality, changes in climatic conditions and other human impacts to the Sound such as the presence of insecticides. Scientists did not detect pesticides in lobsters collected in 2014, leaving the warming waters as the most likely problem for Connecticut's lobster.

As with finfish, there appears to be a shift northward over time of the lobster, which prefer a cold water habitat, as evident in the two illustrations below of the shift in the distribution of the Atlantic lobster catch. There is no "goal" for the lobster population but the "Quick Summary" box above presumes a decrease is not a desired trend.

Change in Lobster Catch Distribution 1990 vs. 2014



Source: NOAA, Climate.gov "Climate & Lobsters", Emily Greenhalgh, October 6, 2016

The average temperature of the water in Long Island Sound has been rising, with the surface temperature rising slightly faster than the bottom water. The frigid weather of early 2015 led to the coldest wintertime water temperature in at least 25 years; the weather and water then heated up more than usual in the summer. In 2017, the winter and summer water temperatures were well above average at the surface and at the bottom. Hypoxia is most likely to be a problem when water is warmer. The slightly lower average water temperature of 2018, compared to 2017 and most prior years, can be part of the reason that 2018 had less hypoxia than did 2017.

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...and rising.

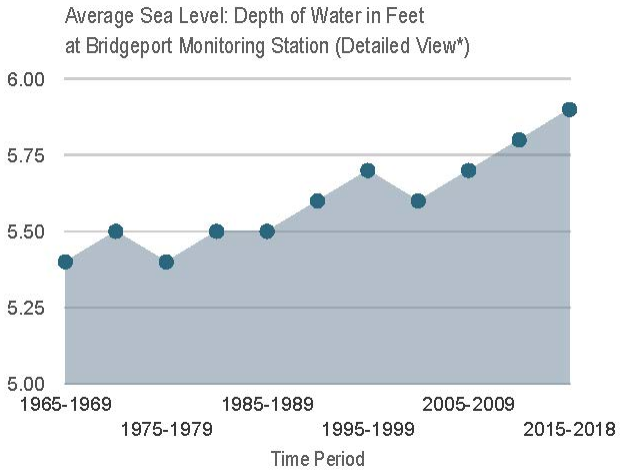
QUICK SUMMARY:

X **COMPARED TO LAST REPORT**

X **COMPARED TO 10 YR. AVERAGE**

— **ON TRACK TO MEET GOAL**

The **chart below** displays average sea level from 1965 to the present at a monitoring station in Bridgeport, where sea level rise has accelerated since 1990.



University of Connecticut scientists participated in a multi-year, multi-state assessment of bird species that nest in coastal marshes. The results, published in 2015, reveal several species in sharp decline. For Saltmarsh Sparrows and Clapper Rails, the declines of 10 to 13 percent *annually* since 1998 pose a risk of local extinction. From the report: "The declines can be explained by increases in rates of nest flooding since 2002." A scientific paper published in 2016 concludes that 1) for Saltmarsh Sparrows, the extinction will not just be local, but global, 2) extinction can only be averted through immediate conservation action, and 3) human influences on tidal flows are as big a factor as climate change.

The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) at the University of Connecticut projected a sea level change scenario of 0.5 m (1 foot 8 inches) higher than the national tidal datum in Long Island Sound by 2050. DEEP's Commissioner adopted CIRCA's recommended sea level change scenarios on December 26, 2018.

As the Sound rises, more tidal wetlands will be flooded. The natural "migration" of wetlands landward in response to sea level rise is prevented in many places by fill and development. There is no "goal" for coastal sea level, but the "Quick Summary" box above presumes this flooding is not a desired trend.

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The changes in marine life, temperature and sea level are signs of a warming Sound. The Long Island Sound Study is working on a "sentinel" monitoring strategy that will track changes in the Sound related to climate change. If successful, that strategy will help Connecticut residents understand the changes in the Sound more fully. In the meantime, change is ongoing and Connecticut will need to pay close attention, as gradual change can become sudden change.

Technical Notes:

1. The cold-adapted species (numbering 33) shown on the top chart are those that prefer water temperatures below 60 degrees Fahrenheit. The warmer-adapted species (numbering 38) prefer water ranging from 50 to 72 degrees Fahrenheit. Many factors affect the number of species in the Sound and their abundance, and although the composition of the finfish community is changing in favor of species tolerant of warming temperatures, the overall diversity in the Sound remains high. 2010 was excluded from the chart because no survey was conducted during the fall of that year.

2. Lobster data for 2010 are absent because repairs to the research vessel *John Dempsey* precluded the fall Long Island Sound trawl survey.

3. The bottom chart shows the average level of the Sound at a point in Bridgeport, expressed as the number of feet above a submerged reference point.

*The term "detailed view" on the bottom chart refers to the fact that the vertical axis has been shortened, beginning at five (feet) rather than the customary zero. This detailed view allows the reader to discern changes in the *rate* of sea level rise across decades.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

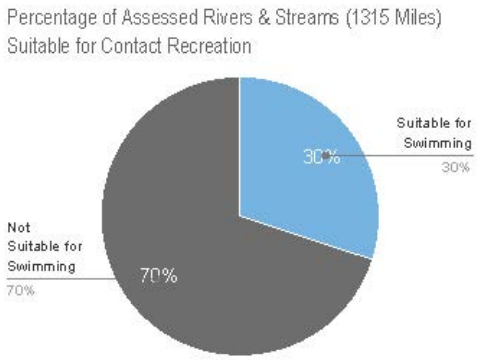
Rivers and Streams

and Rainfall Trouble

QUICK SUMMARY:

- COMPARED TO LAST REPORT
- COMPARED TO 10 YR. AVERAGE
- ON TRACK TO MEET GOAL

Throughout the state, about **30 percent** of assessed river miles are classified as being clean enough for swimming and other water contact sports.



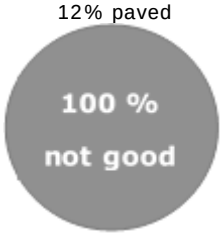
More than 1,300 miles were assessed by DEEP as to their safety for swimming and other recreation. About 397 miles (30 percent) are clean enough to fully support contact recreation. Read more about recreation in Connecticut's streams...

The ecological health of a stream depends very much on a single factor: the percentage of the land in its watershed that is paved.

In nearly all cases, a stream that has *less* than 12 percent of its watershed covered by impervious surfaces will fully support aquatic life (shown as **blue**). Impervious surfaces are largely pavement and rooftops.

If watershed is **less** than 12% paved

In all cases, streams where *more* than 12 percent of the watershed is impervious will **not** fully support aquatic life (shown as **gray**).



If watershed is **more** than 12% paved

The watershed of a stream is all of the land from which water flows to the stream. For illustration, think of a stream as the drain of a bathtub; the watershed is the entire bathtub.

A survey of 99 stream segments conducted by DEEP found that aquatic life is measurably affected when impervious surfaces -- largely pavement and rooftops -- cover 12 percent or more of the stream's watershed. (See pages 35 and 36 of linked document.) *No* stream fully supported aquatic life where this 12-percent threshold was exceeded. Read more about aquatic life...

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Rain: Too Little and Too Much

or, It Never Rains But it Pours

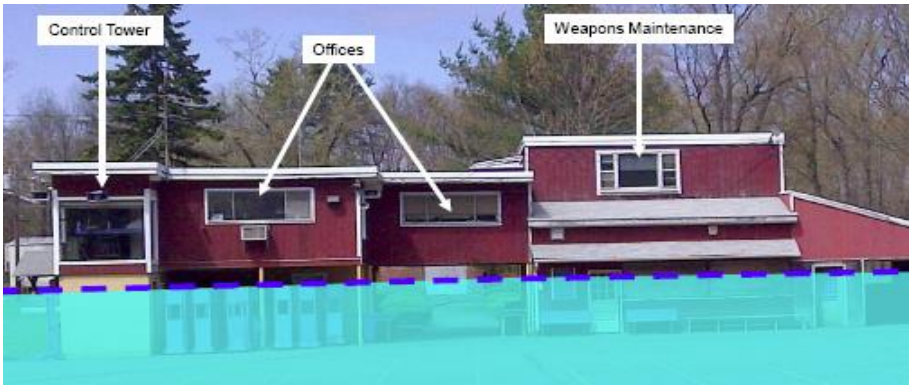
Dry streambeds were a common sight in 2016 as most of Connecticut experienced extreme or severe drought.

Late in 2015, several sizable streams in Woodbury, Bristol, and other Connecticut towns already had dried up. Connecticut had been experiencing a moderate drought, far from severe but bad enough: there simply was not enough water to keep drinking water wells and surface waters flowing*. The streams and their inhabitants were out of luck (and water).

Weekeepeemee River (in Woodbury), 2015
(Photo courtesy of the Pomperaug River Watershed Coalition)

Some large streams go dry during less-than-severe droughts because too much water is taken from the underground aquifers that would, under natural conditions, supply the waterways during dry weather. Only new commercial wells must obtain a permit to withdraw water; wells that existed before the state water diversion law was enacted in 1982 need only be registered with the state. Many streams are affected greatly by these older wells in their watersheds. (Streams that are impaired by diversions of water are identified in DEEP's 2016 Integrated Water Quality Report).

At the same time, Connecticut faces increasing probabilities of intense rains that cause flooding and pollution. At the Connecticut Department of Emergency Services and Public Protection's Division of State Police firearms training facility in Simsbury, for example, floodwaters have reached or exceeded the level shown below at least five times in the last ten years.



(Photograph courtesy of the Dep't of Administrative Services Construction Services)

Most of the pollution problems observed in small streams, discussed above, can be traced to excessive runoff from land, especially land covered by impervious surfaces such as pavement. Additional information on the growing frequency of heavy rains can be found on the Swimming, Clamming, and Heavy Rain page of this Report.

One solution to both rainfall problems -- dry streams and floods -- is to reduce the area of impervious surfaces. Such reductions allow more rain to reach the groundwater table to keep wells and stream flowing during dry weather.

More about recreation in Connecticut's streams

In most sections of rivers and streams, bacteria levels are higher, at least some of the time, than what is considered safe for a person swimming or playing in the water. Detailed information is contained in the 2016 Integrated Water Quality Report released by DEEP in early 2017. The 2014 edition also estimated the percent of suitable streams to be 30%. The 2011 edition of that report estimated the percentage of fully safe rivers to be about 11, while the 2008 edition of that report estimated the percentage to be 15.

A separate statistical analysis performed by DEEP in 2010 estimated that 47 percent of wadeable streams (which are streams shallow enough to be sampled using methods that involve wading) are suitable for recreation that involves contact with the water. (See page 42 of linked document.)

Apparent fluctuations in year-to-year results are probably due to limitations in data collection and study design and not to widespread changes in water quality. There are estimated to be 5,830 river miles in Connecticut. Not all are sampled with the same frequency. Sampled locations retain their designation until re-sampled, at irregular intervals. The inescapable conclusion of all the analyses is that the water in most Connecticut streams and rivers might not always be safe for swimming and similar activities.

More about aquatic life

Numerous analyses point to the importance of keeping impervious surfaces to a minimum and reducing the runoff that flows directly from pavement into waterways. The University of Connecticut's NEMO (Nonpoint Education for Municipal Officials) program maintains an atlas of projects and an inventory of municipal regulations designed to reduce the impacts of impervious

surfaces. About one in five municipalities have adopted regulations that protect vegetation along streams; such regulations can yield significant beneficial results for streams and rivers, but nearly all of those towns limit the protection to a small number of named streams.

There are hundreds of small streams where the water is very clean, and many of these have been documented by volunteers working with DEEP's Riffle Bioassessment by volunteers (RBV) program. In 2017-2018, RBV enlisted more than 400 students and adults to sample the aquatic life from 97 unique locations on 81 different waterbodies. Sixty-six (66) of the monitoring sites had four or more types in the 'Most Wanted' taxa type, indicating that these stream segments had excellent water quality.

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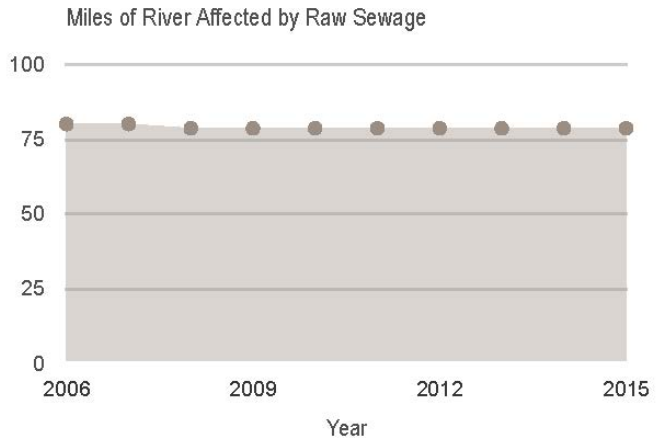
About 80 miles of rivers are polluted by overflows of **raw sewage**.



In 15 Connecticut cities and towns, sanitary sewers were built in combination with storm sewers. When it rains, these combined systems carry more water than their treatment facilities can handle, and a combination of stormwater and untreated sewage overflows directly into the rivers and Long Island Sound. Regrettably, scientists predict climate change to yield more frequent high-intensity rainfall events in Connecticut. During very heavy rains, the sewage treatment systems of many other municipalities, even those without combined sanitary and storm sewers, are overwhelmed and spill untreated or poorly-treated sewage to rivers and harbors.

Several of the combined sewer systems have been completely or partly separated since 1990, reducing the volume of untreated sewage in rivers. Four cities that still contain multiple combined-sewer overflows -- Bridgeport, Hartford, New Haven and Norwich -- have reduced the number of overflow points, but about a hundred remain. Two other cities, Norwalk and Waterbury, have reduced their overflows to periods of exceptionally wet weather. New Haven is working on several projects that result in storing sewage within the sewer pipes so that the discharge points release less untreated sewage. New Haven estimates a 12.9 million gallon reduction in discharge from the amount in 2014 to what was released in 2016.

DEEP maintains an interactive map showing the exact locations where sewage is known to overflow into waterways. The law that led to the map also required DEEP to publish notices of actual overflow events starting in 2014, but that deadline was not met.

Connecticut's goal is to eliminate the effects of raw sewage discharges from combined sewer systems. Progress is slow because of the extraordinary expense of separating the sewers.

*Links to flow data for many Connecticut streams, as monitored and reported by the U.S Geological Survey, and other useful information about streamflow can be found on the website of the nonprofit organization, Rivers Alliance of Connecticut.

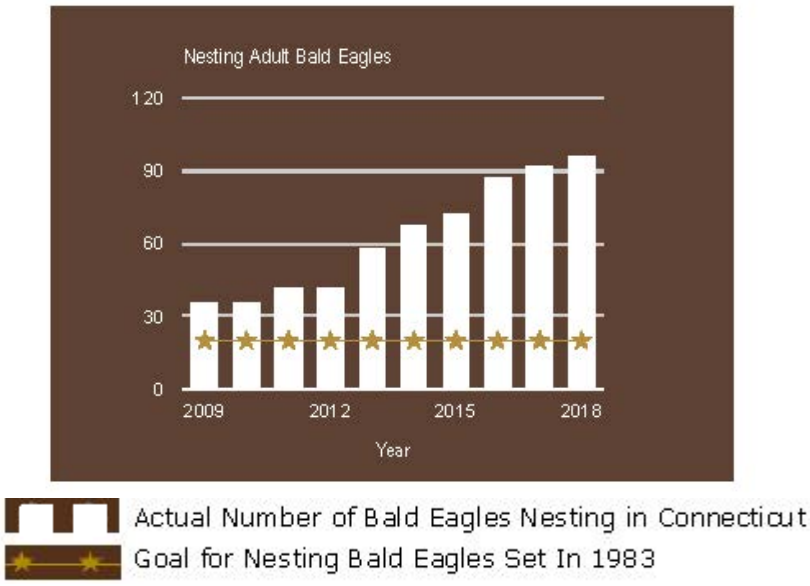
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Bald Eagles

QUICK SUMMARY:

- ✓ **COMPARED TO LAST REPORT**
- ✓ **COMPARED TO 10 YR. AVERAGE**
- ✓ **ON TRACK TO MEET GOAL**

Bald Eagles continued their dramatic surge (and Ospreys are doing well, too).



Bald Eagles had stopped breeding in Connecticut in the 1950s. The species declined throughout the lower 48 states and was declared endangered in 1967. A variety of environmental conditions harmed the eagle, including the widespread use of certain chemicals (chlorinated hydrocarbons) that accumulated in its prey (mostly fish). When those chemicals were banned and polluted waterways were improved, the Bald Eagle was able to reproduce again. Young eagles were reintroduced into nearby states in the 1980s, and a pair found their way to Connecticut in 1991 and successfully raised a family in 1992. In 2000, there were known to be eight nesting adults. Many more have since found acceptable nesting habitat on land protected by government and private landowners including utility companies and land trusts. DEEP monitors the eagles with the assistance of the Bald Eagle Study Group and other volunteers.

The population of Bald Eagles is included as an indicator because the eagle is representative of species, especially predators, which share similar habitat requirements: large areas of relatively undisturbed land near rivers or lakes where the birds can find adequate supplies of fish and other prey that are – very importantly – only minimally contaminated.

Bald Eagles can be seen fairly frequently where for decades they were scarce. On one morning in January of 2019, for example, 22 Bald Eagles were reported by experienced birdwatchers at various sites around Connecticut. Last year, Connecticut's mid-winter survey recorded 167 bald eagle sightings at 142 locations throughout the state. Eagles spend their winter mostly along larger rivers where they have become a regular sight. Iced-over rivers to the north can push more eagles south to Connecticut.

The federal government removed the Bald Eagle from its list of threatened and endangered species in 2007. In 2010, Connecticut changed the eagle's in-state status from endangered to threatened.

Another large fish-eating bird of prey, the Osprey, has rebounded in similar fashion. From a low of nine nesting pairs in 1974, Ospreys -- counted by the Connecticut Audubon Society's volunteers -- were seen at more than 416 active nests, meaning they were occupied by an Osprey pair. The 416 active nests fledged 725 Osprey in 2018, an increase of 5.5 percent in the number of active nests in the state and an increase of 19.4 percent in the number of fledglings from 2017. The Council once included Osprey population data in these annual reports, but discontinued that indicator when the Department of Environmental Protection stopped counting them in 2004. Now that the Connecticut Audubon Society and its volunteers have started their census-taking, the Council intends to publish annual numbers after a few years of data are collected.

Osprey over Fairfield

The Source of the Goal

The 1983 Northern States Bald Eagle Recovery Plan, prepared by the United States Fish and Wildlife Service, established a goal for Connecticut of 20 breeding birds (10 nests), which was reached for the first time in 2005. According to experts in the Bald Eagle Study Group, Connecticut could eventually host up to 200 nesting eagles (100 nests). (See page nine of the linked document.)

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Public Drinking Water

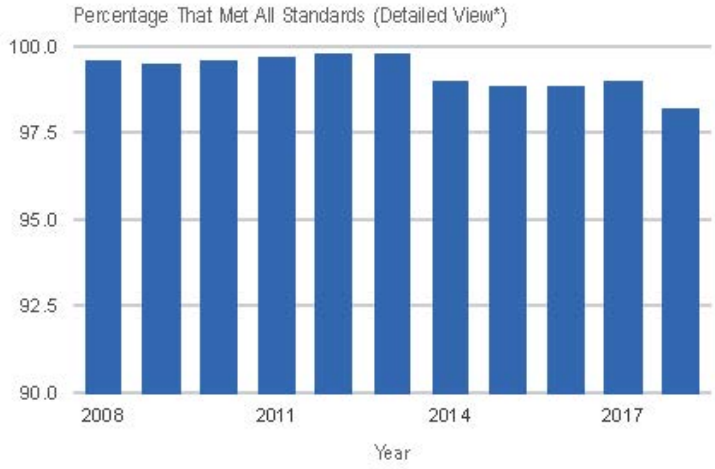
QUICK SUMMARY:

X **COMPARED TO LAST REPORT**

X **COMPARED TO 10 YR. AVERAGE**

— **ON TRACK TO MEET GOAL**

The presence of chloride is the largest contaminant detected in public water systems in 2018.



Every public water system submits monthly quality reports to the Department of Public Health (DPH). This indicator shows the percentage of monthly reports that demonstrate full compliance, after weighting the reports to account for the number of people served by each system. Though long-term problems occur, they are rare in large systems. This indicator would show greater fluctuations if the larger utilities failed to deliver good water.

The list of systems with violations includes several chronic or repeat offenders that serve relatively small numbers -- usually dozens, sometimes hundreds -- of customers.

By far, the most common problem during 2018 in systems with violations was excessive levels of chloride,** which is typical of most years. Other violations included excessive byproducts of disinfection and other chemicals. One system showed an unacceptable level of uranium, a naturally occurring contaminant. When a system has a violation, it can be required to provide additional monitoring and corrective action. The public must be notified of systems that are in violation. A 2019 report by the Auditors of Public Accounts for calendar year 2017 recommended that DPH strengthen oversight and enforcement. Data show a reliance on informal enforcement and an increase in 2017 and 2018 on informal enforcement over formal enforcement.

The modest decline of 2014 reflects the discovery of water-treatment byproducts following new rules that became effective for small and medium-sized drinking water systems. New requirements for measuring and reporting total trihalomethanes (TTHM), four chemicals that are byproducts of using chlorine for disinfection during the treatment process were implemented in late 2013. The changes resulted in more violations being reported in subsequent years. Not all

of the downward trend depicted in the chart above necessarily reflects changes in the quality of the drinking water; some of it could reflect post-2013 reporting of TTHM that had been present in the water in prior years when such a presence was not required to be reported as a violation. TTHMs are regulated because they have been determined to pose risks to human health.)

A Note About Lead

Lead contamination in Flint, Michigan gained national attention in 2015 and 2016. Usually, as in Michigan, large-scale lead contamination is a result of mismanagement. The lead normally is not found in the water source (such as reservoir, river or well). The problem occurs when corrosive water enters homes and schools through pipes that contain lead. The Connecticut DPH oversees the monitoring for lead by public water supplies, and also requires public water to be tested for corrosive properties (including pH). Lead contamination is an uncommon problem here, generally affecting only very small systems. Lead is not included in the chart above.

Data are not completely comparable across all states, but federal reports suggest that Connecticut is among the very best in delivery of safe water from public supplies. This excellent record can be attributed to many factors, including Connecticut's policy of not permitting direct discharges of pollution into streams that flow to drinking water reservoirs.

About 80 percent of people in Connecticut are supplied by the public water systems included in the chart above. The remainder of the population relies on private wells, which are not monitored by any government agency and are not counted in this indicator. An unknown but significant number of private wells are contaminated by pollution or naturally-occurring toxins such as arsenic and uranium. Residents who drink from private wells are not required to test their water routinely, so the number of people who drink contaminated water from private wells cannot be measured.

*The term "detailed view" on the chart refers to the fact that the vertical axis has been shortened, beginning at 90 percent rather than the customary zero. This allows the reader to see year-to-year differences, which would be nearly imperceptible if the chart ran from zero to 100 percent.

**The standard for chloride is set by state regulation. Violations are reported to the Department of Public Health but are not included in the Department's annual compliance reports that are submitted to the federal government.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

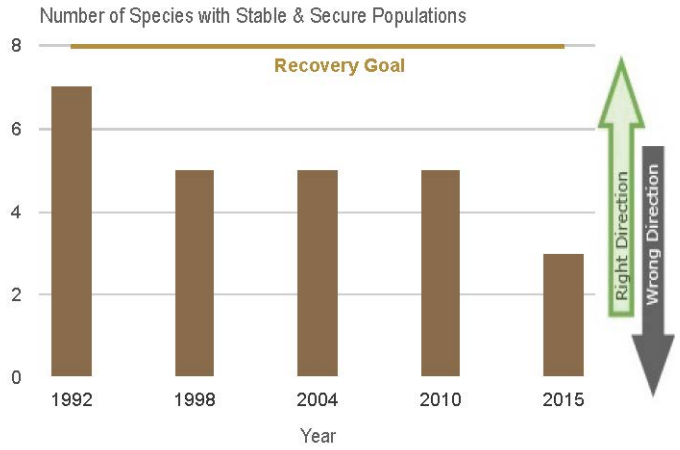
Some of Connecticut's wildest residents do not restrict themselves to one particular type of habitat; in fact, they can't. They live among mature forest trees some of the time but at other times require fields, young forests, shrublands or, in many cases, clean waterways for their continued existence. If this mosaic of habitats is fragmented with roads and other intrusions, these species will decline. To track the condition of these productive mosaics in Connecticut, the Council selected three types of animals that depend on them: turtles, grouse and bats.

Resident Turtles

QUICK SUMMARY:

X COMPARED TO LAST REPORT
X COMPARED TO 10 YR. AVERAGE
X ON TRACK TO MEET GOAL

Five of the eight turtle species that live year-round in Connecticut are on the latest list of species that are endangered or of special concern.



Turtles are excellent indicators of ecological health. They live long lives, reproduce slowly and decline in number when their habitat declines. This indicator includes the eight species of turtle that live in Connecticut (but not the four marine species that visit Long Island Sound in summer, all of which also are threatened or endangered).

Until 2015, only three of the eight resident turtle species were listed as endangered or of special concern: bog turtle (endangered), eastern box turtle and wood turtle (both species of special concern and particularly representative of mosaic habitats). The other five -- common musk turtle, common snapping turtle, northern diamondback terrapin, eastern painted turtle and spotted turtle -- were considered stable and secure enough to be kept off the list.

The 2015 list classified two more species as being of special concern: northern diamondback terrapin and spotted turtle. Classification and protection of endangered species in Connecticut dates back to 1989 and the adoption of "An Act Establishing a Program for the Protection of Endangered and Threatened Species" (Public Act 89-224). The Department of Environmental Protection published the first list of Connecticut's Endangered, Threatened and Special Concern Species in 1992. At that time, only the bog turtle was on the list. The wood turtle and the eastern box turtle joined the list in 1998 as species of special concern.

The Goal for Turtles

The goal for all endangered and threatened species is for recovery of their populations to a stable, sustainable level.

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Ruffed Grouse

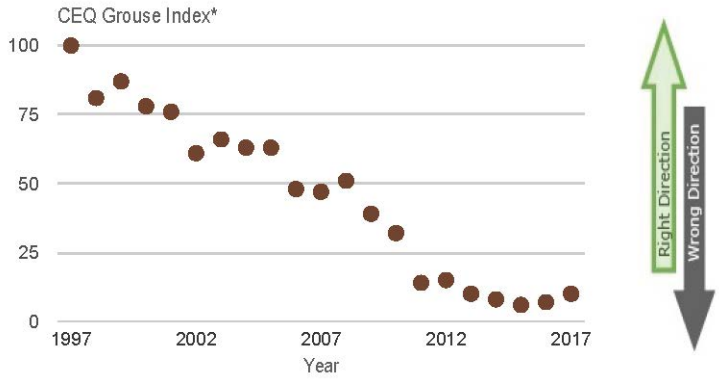
QUICK SUMMARY:

✓ COMPARED TO LAST REPORT

✗ COMPARED TO 10 YR. AVERAGE

— ON TRACK TO MEET GOAL

The Ruffed Grouse population recovered slightly after declining to its lowest level in decades.



The chart illustrates a dramatic decline in Ruffed Grouse (*Bonasa umbrellas*). The annual index value is the mean of population counts from the Christmas Bird Count and Summer Bird Count. A similar decline in the Ruffed Grouse population has been documented by the Department of Energy and Environmental Protection from actual observations by turkey hunters over a ten year period.

Once prevalent throughout the state, this game bird is rarely seen outside the northwest corner, where it also is uncommon. The most likely cause is a decline in young forests, worsened by the effects of human activities including roads, development and introduction of invasive species and pests that have reduced the vegetation favored by grouse. Too many deer reduced the forest understory where the grouse lived.

Grouse is an excellent indicator species for New England hardwood-dominated forested landscapes. Grouse have well-defined habitat requirements: multiple stages of forest including newly disturbed forest, shrub openings and mature stands, all within a 15 to 40 acre area. Much

like terrestrial turtles, grouse are sensitive to habitat fragmentation. They are readily detected and recorded, and do not migrate.

The mosaic habitats that support Ruffed Grouse also sustain many other species such as American woodcock, New England cottontail, and numerous songbirds. While 60 percent of Connecticut is forested, the Connecticut Department of Energy and Environmental Protection estimates that only five percent contains the early-stage forest that grouse depend upon. Recent efforts to create young forest habitat might be one reason for the slight increase in sightings since 2015.

The Goal for Grouse

The Association of Fish and Wildlife Agencies, of which Connecticut's DEEP is a member, prepared a plan in 2006 that set a target of restoring the Ruffed Grouse throughout North America to 1980 population levels by 2025.

*The CEQ Ruffed Grouse Index is based on the mean of winter and summer bird counts conducted by volunteers. This index is the CEQ's first use of these extensive troves of data collected by the National Audubon Society and its affiliated organizations. The scale of the index value is set by the CEQ; a value of 100 equals the highest population level detected over the 20 years shown on the chart. The Council is grateful to the organizations and individuals who provided data and advice for creating this new index.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Bats

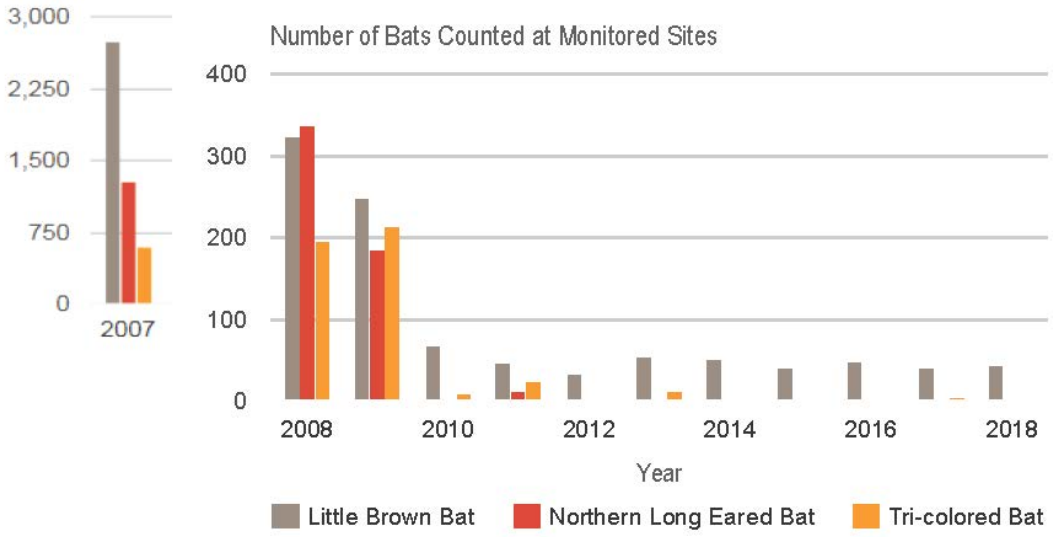
QUICK SUMMARY:

COMPARED TO LAST REPORT

COMPARED TO 10 YR. AVERAGE

ON TRACK TO MEET GOAL

Cave-dwelling bat species have declined catastrophically as indicated in the chart below that contrasts the monitored population in 2007 with recent years.



The chart above depicts the winter population of three cave-dwelling bat species monitored annually by the Department of Energy and Environmental Protection (DEEP). (The number of sites monitored by DEEP has declined since 2007 because so few bats remain.)

An epidemic fungal disease called white-nose syndrome (WNS) is the primary cause of the bats' demise. WNS has been documented in at least 33 states since its first appearance in New York in 2006. All but one Connecticut bat species are listed as endangered or of special concern.

The catastrophic decline in bat populations, which is not confined to cave dwelling species, has raised concerns about the future of bats in the state. Recovery, if one occurs, will be slow: adult female bats usually produce just one pup per year. Of the nine species native to Connecticut, only the big brown bat is not categorized as a species of special concern or as endangered; however, its population has also declined. In 2015, the big brown bat was added to the list of species of Greatest Conservation Need in Connecticut's Wildlife Action Plan.

The absence of bats from Connecticut's evening air will be a boon to the nocturnal moths and beetles that continually threaten to infest forests and crops. Bats also eat mosquitoes, a number of which carry diseases that affect humans, birds, horses and other animals. Nationally, bats feast on insects each night, adding up to more than $3.7 billion worth of pest control each year. Though seldom seen, bats play big ecological roles.

Not all bats live or hibernate in caves; many inhabit trees. If data become available, future editions of this report will contain information on the tree-dwelling species (three of which are on the list of species that are of special concern. They are not represented on the chart above)

The goal for bats is for recovery of all nine species to a stable, sustainable level.

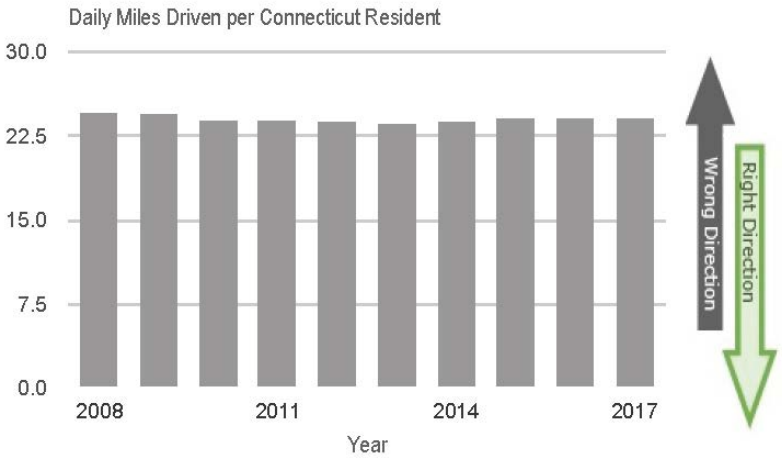
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Driving

QUICK SUMMARY:

- — COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- — ON TRACK TO MEET GOAL

The transportation sector contributes 38 percent of Connecticut's economy-wide emissions, principally from the use of fossil fuels in passenger cars and light duty trucks.



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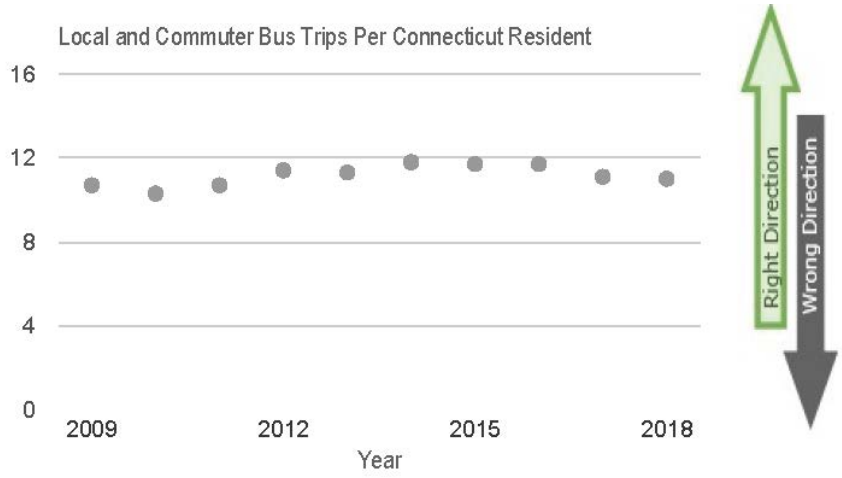
Riding

QUICK SUMMARY:

- X X COMPARED TO LAST REPORT
- X COMPARED TO 10 YR. AVERAGE
- — ON TRACK TO MEET GOAL

People got on the bus less often.



Top chart: Driving a car, truck or sport utility vehicle is one of the most environmentally harmful activities a Connecticut resident will engage in personally. Impacts are direct (air pollution, oil leakage, etc.) and indirect (creating demand for new roads). In nearly every year for several decades, the average Connecticut resident drove more miles than in the previous year. That trend halted in 2008. The reasons for the decades of increasing vehicle use are complex and include the fact that most new development was accessible only by private vehicle. The drop in driving by Connecticut residents that began in 2008 mirrored the national trend. As residents drove less, gasoline consumption decreased and pollution was reduced. From 2007 through 2013, the miles driven by the average resident was on a steady decline. The slight increase in miles driven in 2014 also followed the national trend. Even as travel leveled off in 2016, gasoline consumption, which began to rise in 2014, continued to rise, apparently an effect of less efficient vehicles on the road. Gasoline and diesel consumption is displayed on the Climate Changers page.

Bottom Chart: In 2018, ridership on in-state local and commuter busses declined again, giving us our lowest ridership numbers since 2011. In late 2016, CTtransit fare prices were increased in eight transit service areas. The fare increase might not be the sole reason for the decline in ridership. Other factors that could include success in ride sharing efforts (see below) and gasoline prices that have stayed below the highs of some previous years.

Using mass transit or ride-sharing are effective ways to avoid the negative environmental consequences of driving a car. The Department of Transportation's transit and ride-sharing website helps commuters find the best way to get to work or school and offers information & resources for travel options throughout Connecticut. Recent metrics from CTrides shows an increase in general program usage.

In 2015, new routes were added and CTfastrak service was launched on the Hartford to New Britain corridor, but total ridership remained about the same. Ridership data, collected by the Department of Transportation, are estimated for 2016 and 2017 and will be refined in future reports.

*Personal impact indicators illustrate trends in behavior or practices that can be expected to influence the condition of tomorrow's air, water, land and wildlife.

Compliance

There were 1,248 violations of environmental laws necessitating enforcement action in 2018, a significant increase over 2017.

QUICK SUMMARY:
X COMPARED TO LAST REPORT
X COMPARED TO 10 YR. AVERAGE
— ON TRACK TO MEET GOAL

DEEP conducted fewer inspections in 2018 than they did in 2017.

In 2018, the number of violations found was greater than in 2017 and also greater than the five year average. The Council will be examining, again, the relationship between inspection frequency and violations discovered. Past inquiries into this topic determined that decreasing staffing levels resulted in fewer inspections and, consequently, fewer violations. (See below).

Who is breaking Connecticut's environmental laws?

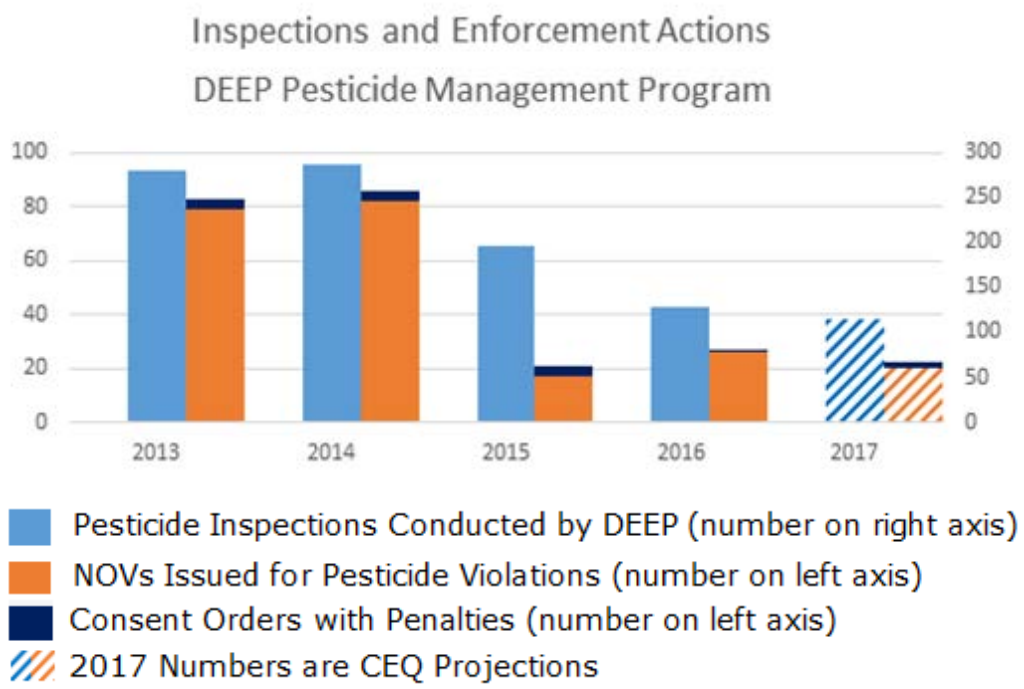
To answer this question, the Council reviewed the Notices of Violation (NOVs)** issued by DEEP in (fiscal years) 2011 through 2016.*** The conclusions of the first year's analysis are summarized in an April 2012 staff memo and the violators are characterized in a series of charts. The overwhelming majority of businesses found to be in violation were small companies, and most violations were related to the storage, transport or distribution of petroleum. The largest group, by far, were gas stations and convenience stores. Only seven percent of NOVs were issued to manufacturers with more than 20 employees, fewer than the number issued to individual citizens.

The Council's review of the 1,098 NOVs issued in 2013 found similar data, though the numbers of inspections and violations were beginning downward trends that continue today. Again, the largest portion were related to violations of laws pertaining to the storage or distribution of petroleum, and most of the laws broken were aimed at reducing the risk that pollution (from spills, discharges, leaks, etc.) would occur in the future. This was true again in 2014, when more than 1,200 NOVs were issued, in 2015 when more than 900 violations were found, and in 2016 which saw about 800 violations.

Focus on Pesticides

DEEP inspected 128 businesses -- mostly stores and certified applicators -- for compliance with pesticide laws in 2016.*** These resulted in 26 NOVs and two other enforcement actions. The greatest number of violations (10) were found at the 25 stores inspected. Only two were agricultural in nature.

The Council inspected the pesticides enforcement data for the first three quarters of 2017. (As noted in the footnotes, indicators on this page only track data by federal fiscal year rather than calendar year; the federal fiscal year ends on September 30.) With the issuance of nine NOVs in June, DEEP has issued a total of 15 NOVs for 2017. The chart below includes the Council's projection for all of 2017 (20 NOVs and two consent orders).****



As recently as 2014, when DEEP had more staff, it conducted more than twice as many pesticide inspections (287), which resulted in 82 NOVs and eight other enforcement actions.

Each year, DEEP signs a cooperative agreement with the USEPA that projects pesticide enforcement activity. In 2016, DEEP devoted fewer than half of the projected hours to enforcement, took fewer samples, and conducted about half of the projected inspections.

Because NOVS carry no penalties, a person violating pesticide laws bears only a slight risk of being penalized. With compliance rates as low as they are, DEEP's shrinking enforcement presence probably contributes to the large majority of violations going undetected. It is impossible to calculate a precise compliance rate, as many inspections are prompted by complaints and are not conducted randomly. Information about reporting potential violations can be found on the National Pesticide Information Center website.

According to the US EPA, "inspections are the core" of pesticide compliance monitoring.

The Council has discontinued the Compliance Rate indicator.

The Compliance Rate -- the percentage of inspections that find facilities to be in full compliance -- was developed when physical inspections were more important to the state's enforcement of environmental laws. Now that many violations are detected by other means (such as reviews of monitoring reports submitted electronically, cross-checking data sources to find unpermitted facilities, and following up on companies' failures to respond to initial notices), the Council has concluded that it is impossible to estimate the percentage of companies that are operating in compliance with all environmental laws. A reliable estimate would depend on random sampling of regulated facilities, but such sampling is not likely to occur. Instead, faced with dwindling resources, DEEP focuses enforcement on sectors where violations are commonplace (as discussed below). With no Compliance Rate to report, this page now focuses on aspects of compliance that can be documented.

The Changing Tools of Enforcement

Faced with diminishing staff resources, DEEP has streamlined enforcement procedures in some programs, resulting in issuance of notices to more violators. Electronic submission of reports by permit-holders in some programs also has allowed for more targeted enforcement. To use the well-worn police-and-speeders analogy, this would be concentrating a smaller police force on the roads where speeding is believed to be most prevalent, with the result of more tickets being issued. But targeted enforcement alone might not explain the larger number of violations. Numerous studies have shown that the average speed on highways increases when drivers believe there are no police looking for speeders. Is there an analogous increase in environmental violations when people know that fewer inspections are being conducted?*****

Compliance and Environmental Quality

The role of compliance has changed. For decades, the extent to which people, companies and government complied with environmental laws had an immediate effect on the condition of the state's environment. As compliance improved, so did the air, water, wildlife and other natural resources. With a few notable exceptions, such as some municipal sewage treatment facilities that still pollute large bodies of water from time to time, the current environment owes more to past compliance efforts than to current ones. According to the Council's analysis of enforcement data (see above), most violations and enforcement actions now relate to the prevention of petroleum leaks and spills. In contrast to those, many sites that are not violating any laws contribute enormous amounts of pollution to rivers and streams every time it rains, or in some cases pump so much groundwater that a stream dries up. Compliance and enforcement remain important for maintaining a habitable state, but Connecticut residents should no longer expect higher compliance rates (should they occur) to lead to dramatic improvements in statewide environmental indicators.

*Personal Impact indicators illustrate trends in behavior or practices that can be expected to influence the condition of tomorrow's air, water, land and wildlife.

**Notices of Violation (NOVs) are informal enforcement tools, generally issued whenever DEEP detects one or more violations at a facility. They carry no financial penalty. The recipient has 30 days to respond. They can be issued for relatively minor or major violations; in cases of the latter type, the recipient might also receive an order, which might carry a financial penalty. NOVs typically outnumber orders by a factor of five or more in any year. NOVs are good indicators of trends in violations because almost all violations found through inspections result in NOVs. DEEP also issues a smaller number of warning letters, and those are included in the NOV totals above.

***For this indicator only, years pertain to federal fiscal years (i.e., October 1 through September 30), not calendar years.

****The projections for 2017 enforcement actions are based on extrapolations of the data from the first three quarters of the (federal fiscal) year. Because it does not have any numbers for inspections conducted in 2017, the Council based the projected number of inspections on the historic ratio of enforcement actions to inspections.

*****The analogy between speeders and environmental violators is imperfect at best. Speeders hope to avoid a ticket that comes with a significant financial penalty. A Notice of Violation (NOV) issued by DEEP, on the other hand, carries no financial penalty.

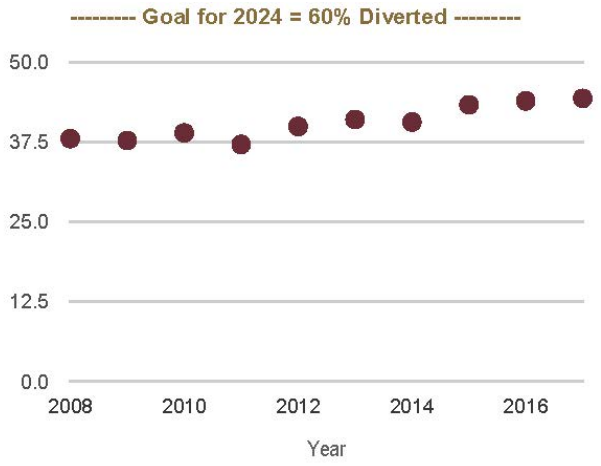
Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Waste Diversion

QUICK SUMMARY:

- ✓ COMPARED TO LAST REPORT
- ✓ COMPARED TO 10 YR. AVERAGE
- ✗ ON TRACK TO MEET GOAL

In 2017, an estimated 1.7 million tons (44.3 percent) of solid waste was diverted from disposal.



The Source of the Goal

With adoption of An Act Concerning Connecticut's Recycling and Materials Management Strategy in 2014 (Public Act 14-94**), Connecticut set a challenging goal for itself to achieve by 2024: divert 60 percent of solid waste from disposal. "Diversion" includes reduction of materials before it makes it into the waste stream, reuse, recycling, composting, and waste conversion. According to DEEP's Comprehensive Materials Management Strategy, revised and adopted in 2016, one path to achieving the 60 percent diversion goal will be to boost recycling to 45 percent; however, this may be challenging without 1) additional public education on recycling, source reduction, and composting and 2) markets for the recyclable materials.

In 2017, approximately 500,000 tons of bottles, cans, and paper was recycled. Bottles, cans, and paper make up the majority but not all of the material recycled in 2017. The amount of bottles, cans, and paper recycled in 2017 was ten percent less than in 2016 and the lowest overall total reported since 2010. A 2015 study commissioned by DEEP found that about 16 percent of the material in Connecticut's garbage was readily recyclable but did not find its way into recycling bins.

Recycling, as mentioned above, is not the only method for diverting waste from disposal. The Strategy also identifies tactics to divert an additional 15 percent to get Connecticut to its goal of 60 percent diversion. Yard and food waste can be composted or even converted to fuel, as can agricultural waste. Waste can be avoided altogether through more efficient packaging. Such tactics count toward the diversion rate.

Some types of waste can be handled through programs established by the industries that produce the products. Connecticut requires producers to establish opportunities for consumers to return electronic equipment, mattresses and unwanted paint for recycling, and sees potential for more product take-backs. The effectiveness of the existing programs was evaluated in 2016.

Connecticut has been a leader on the Extended Producer Responsibility (EPR) or Product Stewardship programs for the collection and recycling of several materials, including used or unwanted electronics equipment, mattresses, and paint.

Electronics
In 2007, Connecticut became one of the first states in the country to pass a law requiring manufacturers of computers, monitors and televisions to finance the transportation and recycling of their products. In FY2018, over 15 million pounds of unwanted electronics were collected and recycled, which equates to a state rate of 4.27 lbs/capita.

Mattresses
In 2013, Connecticut became the first state to pass extended producer responsibility legislation that requires mattress manufacturers to manage unwanted mattresses generated in Connecticut. In FY2018, over 4,700 tons of mattresses, which is more than 181,000 mattresses, were collected and recycled - diverting approximately 2,800 tons of material from disposal.

Paint
In 2011, Connecticut established a Paint Stewardship Program to collect and recycle old paint. In FY 2018, the program processed 342,350 gallons of postconsumer paint, a 6 percent increase over FY2017. Latex paint made up 80 percent of total paint, of which 81 percent was made into recycled-content paint, and oil base paint made up the remaining 20 percent of the paint collected. In addition to paint, 200 tons of metal and plastic paint containers were recycled.

*Personal Impact indicators illustrate trends in behavior or practices that can be expected to influence the condition of tomorrow's air, water, land and wildlife.

**The goal adopted by Public Act 14-94 has been codified in Section 22a-241a of the Connecticut General Statutes. Estimated "Diversion" based on 2005 Baseline of 3.8 million tons.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

Climate Changers

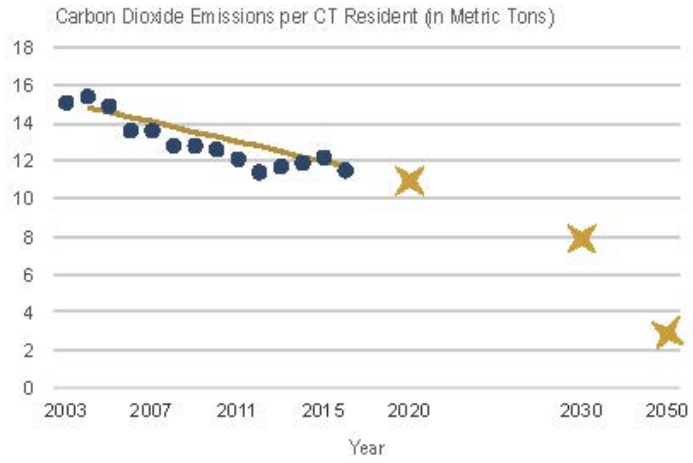
Per-Capita CO2 Emissions

The most recent data available are for 2016

QUICK SUMMARY:

- ✓ **COMPARED TO LAST REPORT**
- ✓ **COMPARED TO 10 YR. AVERAGE**
- ✓ **ON TRACK TO MEET GOAL**

Connecticut residents were meeting the 2020 goal for carbon dioxide emissions from 2006 to 2014, but saw rising per capita emissions from 2013 to 2015. Increases in gasoline consumption will move this indicator in the wrong direction.



Annual Carbon Dioxide Emissions per Connecticut Resident

GOAL TRACK: Maximum Level of Carbon Dioxide Emissions per Resident if Connecticut is to Reach Goal for 2050

State Goals for Maximum Level of Carbon Dioxide Emissions for 2020 and 2050 (Converted to Per-Capita Goals Based on Projected Population)

Certain gases in the air function like the glass of a greenhouse: they allow the sun's energy to pass through the atmosphere to the ground, then trap the heat that radiates from the ground. These gases often are called "greenhouse gases." Worldwide, a build-up of greenhouse gases is contributing to the ongoing rise in temperature. Carbon dioxide is not the only greenhouse gas nor even the most powerful, but carbon dioxide emissions are far greater in quantity than the others. Continue reading about Connecticut's carbon dioxide emissions...

———————————

Per-Capita Motor Fuel Consumption

The most recent data available are for 2017

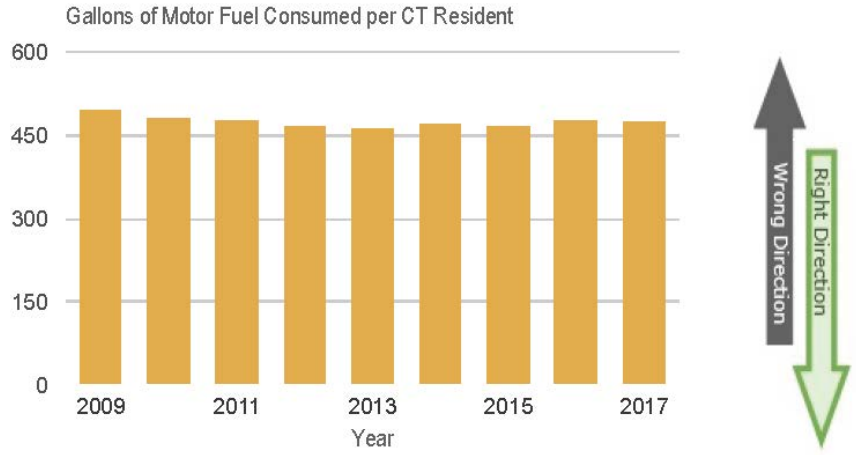
QUICK SUMMARY:

✓ COMPARED TO LAST REPORT

✓ COMPARED TO 10 YR. AVERAGE

— ON TRACK TO MEET GOAL

Connecticut residents bought more gasoline in 2016 and 2017 compared to the four years prior, reversing a long trend toward greater efficiency.



Early in 2016, transportation (primarily the combustion of gasoline and diesel fuel in vehicles) overtook power plants as the largest source of carbon dioxide emissions in the United States.** Recent data for individual states are not yet available, but transportation had already been the largest source of carbon dioxide emissions in Connecticut (about 38 percent). As residents buy more petroleum, their carbon dioxide emissions rise. After vehicles, the largest sources are power plants, homes and industrial facilities.

The **top chart** shows the total amount of carbon dioxide emitted in Connecticut from the burning of petroleum products, natural gas and coal divided by the population. The most recent data available are from 2016. Year-to-year fluctuations could be adjusted in future years***. For display purposes, the X axis on the chart is not to scale.

Connecticut is more energy-efficient than the nation as a whole, and thus the average Connecticut resident's contribution to global climate change is smaller than the average American's.

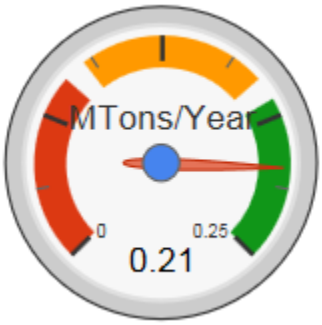
How the Goal Track is Calculated

State law sets two goals for greenhouse gas emissions: reduce statewide emissions to 10 percent below 1990 levels by 2020 and 80 percent below 2001 levels by 2050. As directed in Executive Order 46, the Governor's Council on Climate Change (GC3) conducted a thorough analysis of mitigation scenarios to reduce state-wide GHG emissions and made a recommendation to set a mid-term reduction target of 45 percent below 2001 levels by 2030.

The top chart shows emissions *per Connecticut resident*, not total emissions. The goals on the chart have been adjusted to account for the growth in population that is projected for 2020 and 2050. Many more people are projected to be living in Connecticut in 2020 and 2050, so the average resident will have to work that much harder to reduce carbon dioxide emissions if the statewide goal is to be met.

Connecticut's goals are in line with national and international estimates of the extent carbon dioxide emissions from industrialized nations will need to be reduced in order to limit the rise in global mean temperature to no more than 3.6 degrees Fahrenheit (2.0 degrees Celsius) above preindustrial temperatures. In December 2015, most countries of the world agreed to this limit and also a further goal to pursue steps to limit warming to no more than 2.7 degrees Fahrenheit (1.5 degrees Celsius).

Goal Track vs. the Current Trend
The Needle Shows The Current Average Annual
Per-Capita Reduction (.21 metric tons) of
Carbon Dioxide Emissions Over the Last 10 Years.
The Annual Per-Capita Reduction Needed to
Achieve the 2050 Goal is .25 Metric Tons



Current Trend & Goal Track

*Personal Impact indicators illustrate trends in behavior or practices that can be expected to influence the condition of tomorrow's air, water, land and wildlife.

**Nationwide data are from the April 2019 Monthly Energy Review published by the U.S. Energy Information Administration (specifically pages 208 - 209).

***The Council compared the federal and state data back to 2003 and determined that the trends were identical.

Move your cursor over the globe to learn how climate change affects the data on this page, or click on it for more detailed information.

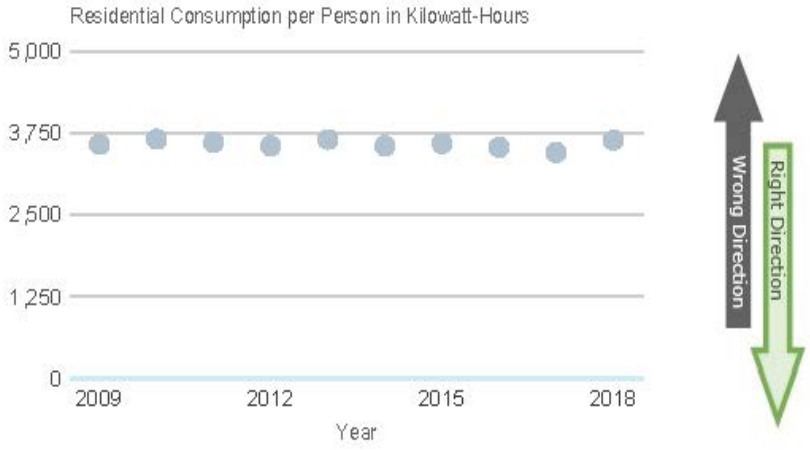
Electricity at Home and Work

At Home:

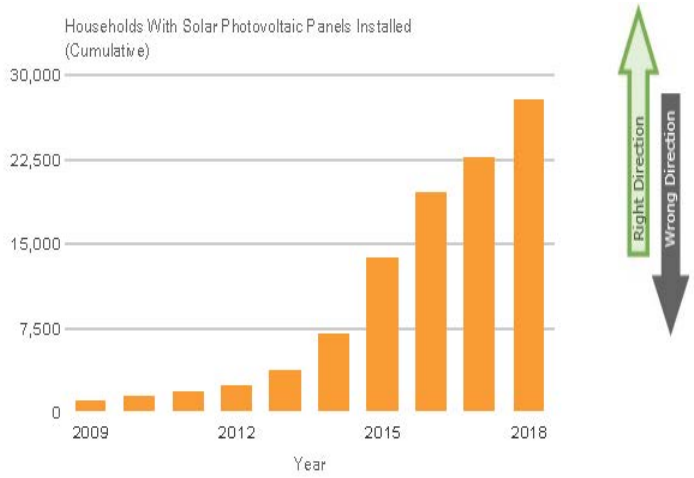
QUICK SUMMARY:

X COMPARED TO LAST REPORT
X COMPARED TO 10 YR. AVERAGE
— ON TRACK TO MEET GOAL

The average Connecticut resident's electric consumption spiked in 2018, reversing a four year downward trend.



In 2018, the amount of solar photovoltaic (PV) panel installations in Connecticut increased considerably over 2017.



At Work:

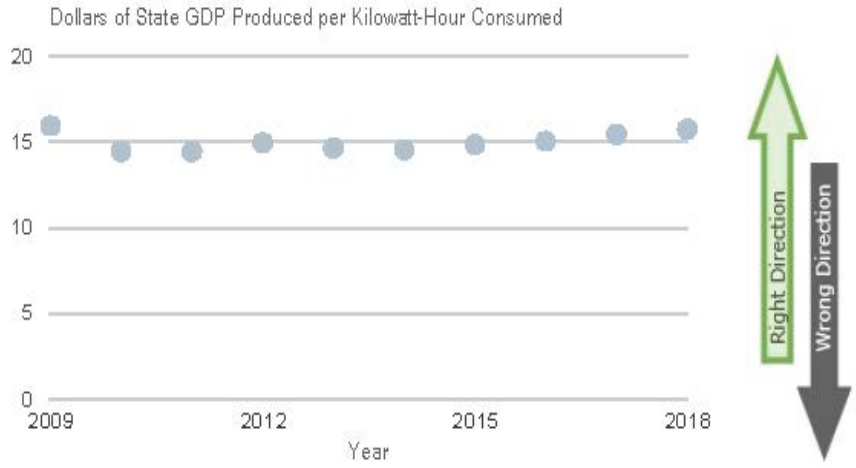
QUICK SUMMARY:

✓ COMPARED TO LAST REPORT

✓ COMPARED TO 10 YR. AVERAGE

— ON TRACK TO MEET GOAL

Connecticut's businesses and industries continue to use energy efficiently.



Efficiency at Home (Top Chart): In 2018, average Connecticut household consumption of electricity increased dramatically. Consumption had been trending lower since 2013. The uptick of 2018 came in a year with a hot summer that had 26 days with temperatures greater than 90 days.

According to the Connecticut Siting Council, peak demand occurs during hot, humid summer days when residents use air conditioning. (See page 5 - 6 of linked document for details.) Excessive electricity consumption in the summertime has had significant environmental consequences. On the hottest days, Connecticut's base-load power plants are unable to meet the additional demand, and older petroleum-fueled plants are brought online. Because they are used sporadically, some of these older plants are permitted to operate with no pollution control equipment. As a result, state residents generate the most air pollution on the hottest summer days when air quality is already bad.

Nuclear power and natural gas supply the majority of Connecticut's electricity generation. Connecticut is part of a regional grid and can receive electricity generated by oil and other fuels. Hydropower, wind, solar and other renewable resources are small but growing sources of electricity within and outside Connecticut. Each source, renewable or not, has its own environmental consequences. Reducing those consequences will require Connecticut households to use electricity more efficiently. Such efficiency can be attained in part with ENERGY STAR appliances. (See technical note below.) Further efficiencies can be achieved by taking advantage of programs available through Energize Connecticut that are estimated by the Energy Efficiency Board to have provided twenty-six million dollars in savings for residents. Without those savings 65,000 tons of CO2 would have been put into the atmosphere in 2018. More information about Connecticut's carbon emissions in the "Climate Changers" section of this report.

A significant percentage of Connecticut consumers do not purchase the most efficient air conditioners that would help to reduce peak summer demand. (Appliance purchasing data for Connecticut previously was tracked in this report but became unavailable after 2010. Energy Star air conditioner sales had not topped fifty percent of sales at that time. More recent national data do not show an improvement in the market penetration of efficient room air conditioners.)

Residential Solar Energy Producers (Middle Chart): Thousands of Connecticut homes now use the sun to generate much of their own electricity. Legislation adopted in 2011 (CGS 16-245ff) set a goal of 30 megawatts of new photovoltaic capacity installed on residential properties by the end of 2022. The Residential Solar Investment Program of the Connecticut Green Bank (formerly the Clean Energy Finance and Investment Authority) reports that this goal was exceeded in 2014. In 2015, the law was amended to continue subsidies for residential photovoltaic installations until 300 megawatts is achieved, or until 2022. By the end of 2018, the Connecticut Green Bank had assisted in the installation of over 200 megawatts. In 2018, 4,668 systems were installed. The highpoint for residential installations came in 2015 (8,197 installations) and 2016 (6,936 installations).

For customers who do not sign up to purchase electricity from renewable sources, a percentage of their "regular" electricity service is required by statute to be from renewable sources; that minimum percentage was 25 percent in 2018 and will escalate to 48 percent in 2030 (Class I, II and III). More than a dozen types of energy qualify as renewable under this requirement. Projects selected for renewable generation in Connecticut have largely been solar photovoltaic facilities proposed to be built on farmland and forest, as documented in the Council's 2017 special report, Energy Sprawl in Connecticut.

Efficiency at Work: The **bottom chart** shows the trend in the efficiency with which Connecticut's economy uses electricity to produce goods and services.

Connecticut's businesses generally have been using less electricity to produce a unit of goods or services. Gross Domestic Product (GDP) is the total value of goods and services produced within the state in a single year. The Federal Bureau of Economic Analysis (BEA) put Connecticut's 2018 GDP at $242 billion (seasonally adjusted chained dollars). The data tracked is utility electricity sales to commercial and industrial end users. It does not account for electricity sourced from solar panels, fuel cells or other alternative sources.

The Council investigated the question of whether the apparent long-term improvement in efficiency might have been caused by a shift in Connecticut's economy from energy-intensive manufacturing to financial services and other business sectors that consume less electricity. That shift probably has been a factor. Manufacturing GDP grew from 2009 through 2018 at a slower rate than information services but at a faster rate than finance and insurance. The latter sectors probably use less electricity to create a dollar of GDP in comparison to manufacturing. (See technical note below.)

Technical Notes:

1) Both the "Efficiency at Home" and the "Efficiency at Work" indicators use retail sales of electricity (in kWh) by utilities as the measure of electricity consumption in the residential, commercial and industrial sectors. A distortion due to the increased contribution of renewable generation might exaggerate the apparent drop in Residential Efficiency and also exaggerate the increase in Efficiency at Work. For 2018, all the values shown were updated to reflect the most recent revisions of historical data by the data sources.

*Personal Impact indicators illustrate trends in behavior or practices that can be expected to influence the condition of tomorrow's air, water, land and wildlife.

Climate Notes

This page explains how climate change affects the environmental indicators in this report.

Good Air Days: The number of days with bad air is directly related to the number of days when the high temperature exceeds 90 degrees (F.), primarily as a result of the chemistry of ground-level ozone. Also, the extra use of air conditioners on hot days leads to more pollution from power plants. Connecticut is forecast to see more hot days as the earth's average temperature increases. Unless summertime emissions of air pollution are reduced, the number of bad air days is likely to increase. The correlation between hot days and bad air is explained more fully in a 2017 technical document prepared by the Department of Energy and Environmental Protection.

CEQ Air Pollution Index: Air pollution and climate change are closely related. Emissions of certain pollutants into the air can result in changes to the climate, which in turn has negative consequences for air quality. The U.S. Environmental Protection Agency (EPA) states that while the U.S. has made progress over the last 40 years improving air quality, climate change will make it more difficult to meet pollution standards in the future.

Preserved Land: The climate influences the structure and function of forest ecosystems and plays an essential role in forest health. Forests are sensitive to changes in temperature and precipitation and are greatly affected by the expanding ranges of fire, invasive species and disease outbreaks. One study by the United States Department of Agriculture (USDA) states that climate also affects the frequency and severity of many forest disturbances. Land conservation can help to reduce the impacts of climate change by absorbing carbon dioxide from the air.

Farmland: The extent of farmland in Connecticut depends greatly on farms' profitability. Climate change may benefit some plants by lengthening growing seasons and increasing carbon dioxide. However, other effects of a warmer climate, such as more pests, droughts, flooding, changes in atmospheric carbon dioxide and ground-level ozone concentrations will be less beneficial for agriculture. It is also noted in one report published by the U.S. EPA that warmer temperatures cause cows to eat less and produce less milk, negatively affecting agriculture: "that could reduce the output of Connecticut's $70-million dairy industry, which provides 13 percent of the state's farm revenue."

Swimming, Clamming and Heavy Rain: As the atmosphere warms, changes to the amount, timing, distribution, and intensity of precipitation will continue. Warmer temperatures increase the rate of evaporation of water into the atmosphere and increase the atmosphere's capacity to hold water. What evaporates will fall as excess precipitation in many regions. Over the past 50 years, the amount of rain falling during very heavy precipitation events has increased for most of the United States. As more intense precipitation leads to increased runoff, more pollution is washed into waterways, including sediments, nitrogen from fertilizers, disease pathogens and pesticides. The same factors that affect beaches present problems for shellfish beds.

Plovers and Others: Coastal-nesting birds such as the Piping Plover are among the species most threatened by climate change. Rising sea levels will reduce nesting areas available for many coastal and nesting birds.

The Water of Long Island Sound: Climate change has a variety of direct and indirect effects on ocean ecosystems. Increasing temperatures have the capability to make coastal and marine ecosystems more vulnerable to hypoxic conditions, as well as drive the expansion of hypoxic environments. Temperature is an integral component of how ecosystems and organisms generate hypoxic conditions. In general, warmer water holds less dissolved oxygen than colder water. As the estuaries and oceans heat up, less oxygen is held; stratification of the Sound waters intensifies and deeper waters then lose even more oxygen. As temperatures

increase, some marine animals require more, not less, oxygen to survive. In addition, the earlier arrival of summer results in the earlier development of hypoxia and the expansion of hypoxic environments. Precipitation also is important climate factor that can affect hypoxic rates and expansion. Changes in precipitation patterns affect nutrient and hypoxic dynamics in coastal ecosystems.

Trends Under the (Rising) Surface: The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) recommending that Connecticut plan for and expect 50 centimeters (20 inches) of sea level rise by 2050 with further increases following that date. This much rise in water level is likely to have devastating effects on local coastal communities and ecosystems.

Rivers, Streams and Rain: Rivers and streams are affected greatly by fluctuations in precipitation and evaporation patterns around the world. Changes in the timing and location of precipitation combined with rising levels of water pollution will strain ecosystems and threaten the survival of many fish and wildlife species. Warming temperatures are altering the water cycle and shifting precipitation patterns. An increase in severe storms due to climate change will degrade water quality and increase the risk of catastrophic floods. On the other end of the spectrum, frequent droughts, enhanced evaporation, and decreases in overall annual rainfall result in reduced water levels in streams, rivers, and lakes, which leaves less water to dilute common pollutants. It goes without saying that rising levels of pollution, whether from too much or too little precipitation, will create a major strain on any ecosystem that relies on the freshwater provided by streams, rivers, and lakes, threatening the survival of many fish, plant, and wildlife species. In addition, climate change will contribute to a general upstream movement of river zones, particularly affecting species bound to small streams and springs, which cannot move further upstream.

Bald Eagles: Climate change affects the survival of bald eagles on multiple levels, according to scientists. "As climate change progresses, the Audubon Society's climate model projects that Bald Eagles will have just 26 percent of their current summer range by 2080. It is possible that the birds will adapt and reclaim summer terrain as new areas become hospitable, but it isn't known whether the birds will be able to find the food and habitat they need to survive."

Drinking Water: Extreme rainfall events lead to more runoff when the soil simply is not able to absorb the precipitation at the rate it is falling. In urban, suburban, and agricultural areas, this runoff will pick up pollutants from the landscape and carry them to nearby rivers and other waterways, ultimately affecting the quality of drinking water. In addition to more intense storms and flooding, more frequent or longer dry spells are also projected in many climate change scenarios. Connecticut is expected to have more frequent drought impacts.

Turtles and Grouse: "Some North American Turtles face an uncertain future as a warming climate threatens to reduce their suitable habitat," according to a 2013 study. This is particularly true for turtle species in the eastern United States. Their evolutionary history suggests that they will not be able to adapt to rapid changes caused by global warming.

Climate change has led to declines in forest species that are closely associated with the ruffed grouse. This habitat loss will continue to reduce grouse populations overtime. Adequate snow cover can also be important for overwinter survival in grouse populations, as they burrow into deep snow during cold winter periods. Warming temperatures will likely change the quantity and characteristics of snow, making snow roosting more difficult for the grouse.

Bats: As temperatures increase with climate change, bats' habitat range is expected to shift in a northerly direction or to higher elevations. Bats also are migrating earlier in the season. A change in bat migration patterns can affect their ability to reproduce and the resources they need to survive. Changes in temperature will also affect hibernation periods and the availability of resources for bats in the future if bats are induced to emerge from hibernation early.
A recent study even suggests that a changing climate could affect the ability of some bat species to hunt effectively using sound.

Driving and Riding: Burning gasoline and diesel releases carbon dioxide, a greenhouse gas, into the atmosphere. Both nationally and in Connecticut, the transportation sector is the greatest contributor to climate change. Increased utilization of zero emission vehicles will reduce the transportation effect.

Compliance: As climate change makes puts Connecticut's environmental goals harder to achieve, more will be expected of business and industry to reduce pollution. If the percentage of people and businesses who fail to comply with environmental laws remains constant, then more violations can be expected as regulatory burdens expand.

Climate Changers: Greenhouse gases (GHG), including carbon dioxide (CO2), from human activities are the most significant driver of observed climate change since the mid-20th century. Carbon dioxide is generated as a result of the combustion of fossil fuels and to a lesser extent, the clearing of land for agriculture, industry, and other human activities. As described in the most recent study released by the Governor's Council on Climate Change, carbon dioxide is the GHG that represents the greatest warming potential, which has resulted in a temperature increase of 0.9°C between 1980 and 2018 in Connecticut. There is also a feedback loop - with warmer summer temperatures, more people use air conditioning and use them more often - this results in more electricity demand, which may increase emissions from power plants.

Waste Diversion: Recycling and waste reduction have many direct benefits; however, the indirect benefits are also significant. Recycling and waste diversion reduces greenhouse gas (GHG) emissions that would be created by the production, transport, and disposal of municipal solid waste. Increasing recycling and source reduction has been identified as a key strategy for reducing GHG emissions in Connecticut's Climate Change Action Plan.

Electricity at Home and Work: A 2015 paper published in the Proceedings of the National Academy of Science examines "contribution of air conditioning adoption to future energy use under global warming". As incomes rise and global temperatures go up, people buy more air conditioners. This creates a feedback loop of increased warming and increased air conditioner use leading to more electricity demand, more emissions and more warming.

Renewable energy is one of the most effective tools against climate change. The sun provides a tremendous resource for generating clean and sustainable electricity without toxic pollution or global warming emissions. Solar panels do not release any emissions as they generate electricity. Emissions are released during the manufacturing, transportation, installation, maintenance, operation, and demolishing of these solar energy systems; while these emissions are minimal in comparison to emissions created by burning petroleum or coal, they reinforce the point that efficient use of electricity is warranted, regardless of its source. Wasted electricity always has impacts.

Invasions: Global warming threatens to increase the extent, frequency, and severity of invasive species. The milder winters and extended spring that comes with climate change are helping invasive species extend their ranges, pushing aside native species and transforming habitats. The removal of temperature or moisture constraints will allow species to move into and successfully invade new areas. Species range shifts will also lead to native species moving out of their current habitat, or becoming more rare. This creates ecological space for other species to increase in abundance and become invasive, or for non-native invasive species to move in. Invasive species are well adapted to thrive in environments with high resource availability, predicted under climate change scenarios. Climate change will in many cases lead to a future of warmer temperatures and increased carbon dioxide availability, allowing some species to invade new environments. Research has shown that some invasive species show a greater response to increased carbon dioxide than non-invaders. In addition, invasive species have short life spans, strong dispersal abilities and high environmental tolerances, all of which lead them to adapt to rapid changes. Extreme weather events may lead to increased disturbance, and invasive species generally thrive in disturbed landscapes with high light availability and fragmented communities. In other words, invasive species are adapted to living in disrupted environments.

Activities of the CEQ in 2018

Research and Reports

The Council published the state's annual environmental quality report in May, 2018. The Council continued to develop new indicators of ecological health for the report by adding a new indicator for invasive insects. The presence and spread of Asian Tiger Mosquito was included in the 2017 annual report. This year, the Emerald Ash Borer's expanding presence in Connecticut was added to the report. The inclusion of biological indicators requires considerable care in the selection of appropriate species, and the Council is grateful for the advice it received from experts.

Residents brought several deficiencies in current laws and policies to the Council's attention. Foremost among these was the controversial proposal to expand a commercial quarrying operation onto existing Class I and Class II protected public reservoir property.

The Connecticut General Assembly directed the Council to consult with the Water Planning Council regarding an environmental study of the City of New Britain's proposal to allow the expansion of a surface mining operation into a drinking water supply watershed. The Council reviewed the proposal for the study and after a series of meetings with the city's consultants, approved a plan for a more thorough and comprehensive study than what had been described in previous documents. The Council also was required to review the final report, which was submitted to the Council in February 2018. The Council's final comments were submitted to the City of New Britain in May 2018.

As 2018 began, the Council discussed the public trust in natural resources after citizens told the Council that the matter had become controversial following its insertion into the draft State Water Plan. The Council published *Connecticut Residents and the Public Trust in Air, Water, Wildlife and Other Resources* in March 2018 to help guide public discussion of the issue.

Advice to Other Agencies

Council staff reviewed two Environmental Impact Evaluations and twenty three scoping notices prepared by other agencies, and submitted comments when deemed appropriate. The Council also reviewed fifteen applications or petitions submitted to the Connecticut Siting Council to assess possible environmental concerns that could require comments.

A new category was created in the Council's publication, *Environmental Monitor,* to better inform the public regarding the status of State projects with possible environmental impacts. A "Post-EIE Project Cancellation" notice was added to inform when a project was dropped from active status by a State agency.

In response to a complaint from a citizen group regarding delays in obtaining environmental evaluations from state contractors, the Council communicated directly with the agency to request a modification of its notice on how to obtain those documents. The Council has subsequently included notice in each edition of the *Environmental Monitor* specific instructions that environmental documents be obtained from the sponsoring agency and not from the consultants who are doing the work.

The Department of Energy and Environmental Protection (DEEP) released draft regulations for the Connecticut Environmental Policy Act. These were reviewed by the Council and extensive, detailed comments were submitted to DEEP to consider in its regulation review process.

Citizen Concerns and Complaints

State law directs the Council to investigate citizen complaints alleging violation of any statute or regulation in respect to environmental quality. In every month but three, representatives of citizen groups came to Council meetings to express their concern and perspective on matters of environmental consequence. The Council receives many inquiries regarding routine matters that are addressed by providing the person who inquired with the correct person or agency to handle the matter. In 2018, fourteen inquiries were received that were not routine and required some investigation by Council staff or advocacy by staff on behalf of the citizen.

At its regular monthly meetings, the Council heard from many people and organizations including the New Britain Water Department and its consultants, the Rivers Alliance of Connecticut, Keep the Woods, and Friends of Pachaug Forest.

The Council on Environmental Quality was created by the legislature forty-seven years ago.

Council Duties

The main responsibilities of the Council on Environmental Quality are described in Sections 22a-11 through 22a-13 of the Connecticut General Statutes.

The Council is a nine-member board that works independently of the Department of Energy and Environmental Protection (except for administrative functions). The Chairman and four other members are appointed by the Governor, two members by the President Pro Tempore of the Senate and two by the Speaker of the House. The Council's responsibilities include:

1. Submittal to the Governor of an annual report on the status of Connecticut's environment, including progress toward goals of the statewide environmental plan, with recommendations for remedying deficiencies of state programs.

2. Review of state agencies' construction projects.

3. Investigation of citizens' complaints and allegations of violations of environmental laws.

4. Review of environmental impact evaluations that state agencies prepare for major projects under the Connecticut Environmental Policy Act (CEPA).

5. Publication of the *Environmental Monitor*, the site where all state agencies must post their scoping notices and environmental impact evaluations under CEPA.
The *Environmental Monitor* also is the official publication for notice of intent by state agencies to sell or transfer state lands.

In 2016, Public Act 16-61 instructed the Council to review the environmental study on a proposed change in use of New Britain Water Company Land. Those duties extended into 2018.

CEQ Members

Susan D. Merrow, Chair
Resident and former First Selectman of East Haddam. Member, East Haddam Conservation Commission; Board Member, Eightmile River Wild and Scenic Coordinating Committee; Former President, Connecticut Conference of Municipalities; Former President, National Board of Directors, Sierra Club; Author, One for the Earth: Journal of a Sierra Club President; Board Member, Connecticut League of Conservation Voters; and former Trustee, Connecticut River Watershed Council.

Keith Ainsworth

Keith Ainsworth has been an environmental and land use litigator of the New Haven Bar for nearly three decades. Keith has a broad conservation-based practice representing land trusts, non-profits, land owners and businesses in transactions and litigation throughout Connecticut before administrative agencies and state and federal courts. As a former chair of the Connecticut Bar Association Environmental Law section and a municipal first selectman (Haddam), Keith has a perspective from several sides of the table. A graduate of Tufts with a B.S. in biology, environmental studies and English literature, Keith brings a scientific and analytical background to the law. Keith is a life member of the Madison Land Conservation Trust and served on the national leadership council of Trout Unlimited. Keith also serves as General Counsel to Vista Live Innovations, Inc., a private educational institute for adults with intellectual disabilities. Keith is also an avid outdoorsman and author of several volumes of poetry.

Alicea Charamut
Resident of Newington. Lower River Steward at the Connecticut River Conservancy (formerly the Connecticut River Watershed Council); long-time grassroots advocate for Connecticut's water resources; Board of Directors, Rivers Alliance of Connecticut; Chair, Connecticut Council of Trout Unlimited; and Secretary, Fisheries Advisory Council.

Lee E. Dunbar
Resident of Mansfield. Retired. Previously, Assistant Director, Bureau of Water Management and Land Re-Use, Planning and Standards Division, Connecticut Department of Environmental Protection. Responsible for developing scientifically defensible water quality standards and criteria to protect human health and aquatic life. Developed and implemented environmental monitoring and assessment methods; participated in the development of regulations to better manage stream flow in Connecticut streams affected by water withdrawals and diversions; and oversaw the development of regulatory programs including the Total Maximum Daily Load (TMDL) Program, Nitrogen Trading Program, and Water Quality-based Discharge Permitting Program. Awarded Lifetime Achievement Environmental Merit Award by the U.S. EPA in 2010 for significant contributions to environmental awareness and problem solving. Board Member, Eastern Connecticut Forest Landowners Association and Board Member, Wolf Den Land Trust.

Alison Hilding

Resident of Mansfield. Long-time advocate for the environment and children, viewing the protection of clean water and air as important dimensions of child advocacy, President, Mansfield Environmental Trust. Commissioner and Executive Board Member, Connecticut Commission on Children, 2003 to 2016; and founding member, Mansfield's Citizens for Responsible Growth. Background in financial management; worked for NYNEX Corporation on the capital budget with

responsibility for growth and modernization; currently engaged on the grassroots level in promoting streambelt protective zoning and sustainable land use practices in Mansfield and the northeast corner of CT. Member of various CT environmental organizations.

David Kalafa
Resident of Middletown. Over thirty years working for the State of Connecticut developing and implementing policy for energy and conservation at the Office of Policy and Management and Department of Energy and Environmental Protection. Retired as Undersecretary for Comprehensive Planning and Intergovernmental Policy at the Office of Policy Management. Served on the State Water Planning Council and Governor's Climate Change Commission. Holds a Master of Public Administration from the State University of New York and a Bachelor's degree in Economics from Skidmore College.

Kip Kolesinskas

Resident of Manchester. Consulting Conservation Scientist. Current projects include assisting agencies, NGO's, and private individuals with farmland protection, land access and affordability for new and beginning farmers, farmland restoration, and climate change adaptation strategies. Member of the Working Lands Alliance Steering Committee, and has contributed to numerous publications and initiatives including Conservation Options for Connecticut Farmland, Planning for Agriculture-A Guide for Connecticut Municipalities, and the award-winning training videos for CT DEEP's Municipal Inland Wetland's Agency Training Program. Formerly USDA Natural Resources Conservation Service State Soil Scientist for Connecticut and Rhode Island, where he worked extensively with farmers, educators, government and nonprofits to help them protect farmland and wetlands, and use soils information to make better informed land use decisions. He is a recognized regional and national speaker on soils and land use planning, farmland protection, climate change adaptation, farmland access, and wetlands.

Matthew Reiser

Resident of Avon. Environmental, health and safety consultant with over 20 years of experience performing regulatory compliance auditing, planning, training and reporting; air, water and waste discharge permitting; and air, water and waste sampling for industrial, commercial, municipal and institutional facilities. Member, Connecticut Chapter of the Academy of Certified Hazardous Materials Managers and Connecticut Marine Trades Association Environment Committee.

Charles Vidich

Resident of Ashford. Environmental and land use consultant concerned with energy efficient and sustainable patterns of development. Served as manager of the United States Postal Service Corporate Sustainability Initiatives program with responsibility for sustainability, energy efficiency and environmental management systems for the nation's 32,000 domestic and overseas Post Offices. Previously served as the principal planner for the Central Naugatuck Valley Council of Governments where he developed solar conscious land use ordinances and the nation's first comprehensive regional plan of development. Appointed to the Connecticut Land Use Education Council with the mission to improve the skills and resources available to local planning and zoning commissions. Received the Lifetime Achievement Award from EPA's National Sustainable Materials Management program. Appointed as a visiting scientist to the Harvard School of Public Health as well as the Harvard Humanitarian Initiative where he lectured on scientific approaches on the use of quarantine and the environmental control of communicable disease. He served as the pivotal expert witness in a celebrated Connecticut Supreme Court case that successfully overturned

restrictive zoning regulations and in a federal district court case that successfully overturned discriminatory land use practices.

CEQ Members Whose Terms Ended in 2018

Janet P. Brooks
Resident of Middletown. Attorney with a law office in East Berlin with a practice in environmental, administrative and land use law. Member of the Connecticut Bar Association Planning & Zoning Section and Environment Section. Co-author of Connecticut Environmental Protection Act, Volume 15 of the Connecticut Practice Series published by Thomson West. Formerly Assistant Attorney General in the Environment Department of the Connecticut Attorney General's (AG's) Office for 18 years enforcing the state's environmental laws that included noise, odor, water pollution, air pollution, pesticides, habitat protection, and preservation of land. While at the AG's Office, coordinated the wetlands appeal practice and developed the legal training for wetlands commissioners for DEEP's annual training. Recipient of the 1984 German Marshall Fund Grant to study the effect of citizen participation on hazardous waste clean-ups in four European countries. Based on those experiences, authored a chapter published in America's Future in Toxic Waste Management: Lessons from Europe. Staff Attorney for five years at the Connecticut Fund for the Environment, Inc. representing citizens groups in administrative and court proceedings. Began practice of law assisting the Middletown City Attorney in the city's opposition to the utility company's burning of PCB waste oil within the city boundaries.

Karyl Lee Hall

Resident of Branford. Attorney with the Connecticut Legal Rights Project. Formerly with Murtha Cullina LLP, the Connecticut Fund for the Environment, and Connecticut Legal Services. Member, Branford Conservation Commission, Chair from 2005-2015. Former Board Member, Connecticut League of Conservation Voters; Co-chair, Scenic Roads Advisory Committee for Routes 146 and 77; Member, Advisory Board, Branford Land Trust; Vice President, Citizens for Branford's Environment, 2002-2009; former Co-chair, State Implementation Plan [for Air Management] Revision Advisory Committee; and recipient of the Connecticut Bar Association Pro Bono Service Award, 2003.

Acknowledgments

The acknowledgements this year must note with prominence the retirement of Karl Wagener in July of 2018. For over 30 years Karl shepherded the Council with exceptional dedication and insight.

He is widely recognized for his expertise regarding the state's environment and the laws and regulations created to protect it, many of which resulted from initiatives, launched by the Council when he was Executive Director. A partial list includes a law to provide safeguards for core forest or prime farm soils when solar energy facilities are built, increased penalties for unauthorized tree cutting on protected lands, and mapping to protect previously un-mapped lands along state highways that had been acquired as "scenic buffers". A list of many of the reports and initiatives launched when Karl was Executive Director can be found on the Council's website.

All who collaborated with Karl quickly appreciated his keen insights and problem solving skills. His sense of humor and kindness made those collaborations a pleasure.

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The Council appreciates the assistance of the many people in the Departments of Agriculture, Energy and Environmental Protection (DEEP), Transportation, and Public Health and the Connecticut Siting Council who provided data and to DEEP technical staff who assisted in creating this online version of the Report.

The Council especially thanks the many citizens, businesses, and organizations who offered information and viewpoints to the Council throughout the year.

The Council also appreciates the work of its Executive Director, Peter Hearn, and its Environmental Analyst, Paul Aresta, in drafting this report for review by the Council and preparing the final version for publication.

The Council notes the valuable contributions of these four Trinity College interns in 2018 and early 2019: Blair Frantz (a 2017 graduate), Rafal Szacilowski, Colbie Cook, Jackson Ruprecht and of Paul MacGillis-Falcon (University of Connecticut).

Image Credits: The "overheating earth" symbol used to denote indicators affected by climate change was created by Tracey Saxby, Integration and Application Network, University of Maryland Center for Environmental Science.

The photograph of the Chimney Swift on the Good Air Days page was taken by Julian Hough; the Scarlet Tanager on the Forest and Forest Birds page was taken by A. J. Hand; the Osprey on the Bald Eagle page is part of a photograph taken by Anastasia Zinkerman; the Ruffed Grouse on the Turtles and Grouse page is part of a photograph taken by Paul Fusco; and the image of the Asian tiger mosquito on the Invasions page was provided by James Gathany and the Centers for Disease Control and Prevention. The Council greatly appreciates their generosity in allowing the use of these excellent photographs in this report.

Council on Environmental Quality

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