

States are moving slowly to guard nation's infrastructure from climate change

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“These things are becoming increasingly more difficult to deal with,” said Lock, the town’s mayor. “Early on, we just didn’t have these same problems.”

As climate change causes seas to rise and storms to become more severe, the roads that connect Slaughter Beach and other hamlets up and down the coast to the rest of the state are flooding more often. The road repair bills are rising alongside the waters.

Lock would like the state to raise the road by half a foot to better protect it from the encroaching water. But it is up to Jim Pappas, director of the Delaware Department of Transportation’s new resiliency and sustainability division, to help determine which of the state’s growing number of vulnerable roads can be saved — and at what cost.

While low-lying Delaware is especially vulnerable, roads nationwide are increasingly at risk as state transportation officials begin to confront streets that buckle under intense heat or are washed away in floods. The Washington Post asked each state transportation department how the agency is planning for a changing planet. Only a handful of the two-dozen that responded pointed to projects that had been designed with climate-change-driven weather in mind.

The responses paint a picture of a nation only beginning to grapple with increasing climate threats to its infrastructure. The \$1.2 trillion infrastructure package represents a down payment on the billions of dollars needed to maintain roads and bridges in the future, but it is a sliver of the long-term federal investment that will be required.

In many cases, the risks are subtle but are forecast to cost as much as \$20 billion a year to manage by the end of the century, according to the [2018 federal climate change assessment](#) — a sum equivalent to about 40 percent of current federal road spending.

President Biden signed an infrastructure bill Nov. 15 with provisions to prompt states to take more action on resilience projects. Meanwhile, Democrats continue negotiating over a sprawling social [spending bill](#) that includes about \$20 billion in incentives for [electric vehicles](#) to cut emissions from transportation, the country’s largest source of greenhouse gases.

In some parts of the country, state transportation leaders say heavier rains are the chief threat. Elsewhere, it is warmer winters or hotter summers. Experts say building durable infrastructure means taking new approaches: Turning to historical weather data that has guided projects in the past is no longer sufficient.

Adapting roads for future climate

Heat waves and storms this year provided dramatic examples of how a changing climate is harming the nation's infrastructure: Highways turned into waterways in Pennsylvania and Virginia, while pavement buckled amid high temperatures in Washington state and Minnesota.

A new U.S. Transportation Department plan to help guard against climate change predicts no aspect of the nation's transportation system is likely to go untouched, saying the effects threaten to "compromise the safety of the traveling public." The department also plans to prioritize resilience projects in grant-making decisions and steer states toward projects that can withstand a changing climate.

"The good news is that we know what to do about it, and America is fully capable of rising to the occasion," Transportation Secretary Pete Buttigieg said when the plan was issued.

The infrastructure measure signed into law this month includes \$7.3 billion that states would be required to spend on resilience projects. Another \$1.4 billion for competitive grants would give cities and counties a chance at federal help to adapt their road networks. The federal government would also cover more of the cost if states or local governments produce resilience plans that demonstrate how a project would protect the transportation system.

While there are partisan divides over the questions of how and how quickly to reduce carbon emissions from transportation, leaders across the country are grappling with adaptations to the road network — even if engineers in more conservative areas cast the scope of their work differently.

"In the last five years it feels like there is general acceptance that resilience is really important and that resilience can be worked on without talking about climate change," said Tim Sexton, assistant commissioner for sustainability at the Minnesota Department of Transportation, referring to transportation officials nationwide.

But while researchers have been issuing warnings for at least a decade, the government agencies responsible for building and maintaining roads have been slower to act. Researchers who wrote transportation-related portions of the federal government's Fourth National Climate Assessment reached the conclusion in 2018 that "proactive implementation of resilience measures is still limited."

Determining the precise risks and developing plans to guard against them are vast undertakings.

California — which has the second-largest transportation department in the nation, after the federal government — illustrates the scale. It has spent \$1.2 million assessing climate-related threats to its roads, concluding that 7,600 miles will be vulnerable to wildfires by 2055. The

state has logged its findings in public reports that run to hundreds of pages.

But Nicole Mowers, a spokeswoman for the department, said it is unknown what it might cost to prepare the state for what's to come.

“Integration of climate risk and planning for climate resilience are frontiers for transportation infrastructure in California and across the country,” she said.

Limited proactive measures despite need for ‘dramatic change’

As assessments creep forward, there are warning signs for the nation's infrastructure.

In Washington this past summer, the state logged almost three dozen incidents of severe damage to roads caused by a protracted heat wave that cooked the Pacific Northwest. Pictures from state crews showed concrete pavement that expanded and blew apart. One showed concrete sections that formed into what was effectively a ramp.

“That could launch a vehicle pretty good,” said Kim Schofield, the state's pavement engineer.

The Washington State Department of Transportation knew the prolonged heat would spell trouble, but Schofield said damage was more widespread than she had seen in the past. She said there is no realistic way for crews to take preventive steps for an entire road network when heat is forecast.

The state is in the process of seeking emergency federal funding to help defray the cost of repairs.

While heat waves and storms can cause sudden, dramatic problems, engineering researchers say gradually changing weather is already altering road conditions in several states.

Until recently, a widely used planning tool for road-building relied on climate data recorded from the 1960s to the 1990s. A study by a team of researchers at Arizona State University and the University of Arizona compared that climate record with data through 2014, concluding that higher summer temperatures mean many states should be changing their formulation of asphalt in some locations to avoid premature road failures.

Researchers at Texas Tech University and the University of New Hampshire found that changing temperatures are likely to shave years off the life span of roads in some parts of the country.

“The takeaway is really that in some areas there is going to be a dramatic change to the extent that we're going to use different materials,” said Jo Sias, an engineering professor at the University of New Hampshire who was involved in the study. “The time frame in which it happens is something that's manageable in the normal construction cycle, but it's something that engineers need to be aware of.”

Sias said the interaction between wetter weather — which weakens roads from below — and higher temperatures — which stresses them from above — is not well understood.

A Government Accountability Office study found the Federal Highway Administration had backed resilience research with \$7.2 million and supported pilot projects in several states. They included two bridges in Maryland that were raised by two feet in anticipation of rising waters and changes to the design of a bridge in Arizona to guard against erosion.

But the reviewers noted 10 ways the federal government could do more to help state and local governments responsible for maintaining most of the nation's roads. They include incorporating resilience requirements into grant programs and updating design guidance for bridges — approaches the U.S. Transportation Department endorsed in its plan this year.

Transportation officials in many states said hardening their road network against climate change was a priority that flowed from governors' offices, generally tied to work on driving down emissions. Elsewhere, officials said, work on resilience was advancing, even if not described in terms of a changing climate.

John Gleason, a spokesman for the Utah Department of Transportation, said the agency “does not have a policy directly regarding climate change.”

“Rather, UDOT is committed to reducing the impact of extreme events on the environment in every project we complete,” he said in an email. “This is done through the use of innovative materials, using mobility data to ensure reduced impacts on travelers, and forward-thinking policies.”

Eric Schroeter, assistant chief engineer at the Missouri Department of Transportation, said the state has seen increased flooding over the course of his 29-year career and said the agency has started working with more recent high-water-level data when planning bridges. Schroeter said the agency steers clear of the topics of climate change and global warming.

“We're trying to stick to the data to avoid that because some of that's not productive,” he said. “We have a system we have to build and maintain. You don't have the luxury of hitting the pause button.”

In one case, officials could not identify any work on resilience. Asked what the Mississippi Department of Transportation was doing to assess its vulnerabilities, spokesman Jas N Smith wrote in an email: “I talked with multiple divisions and engineers and currently there is no program studying climate change and its impacts at MDOT.”

‘Mother Nature decided for us’

In Delaware, Pappas's new two-person division was formed in May, partly with the expectation of new federal funds to shore up the state's road network.

State transportation officials already have abandoned one little-used road prone to flooding. Saving another road into a nearby community, down the shore from Slaughter Beach, was a \$21 million effort.

Raising every vulnerable road and bridge in Delaware would cost \$1.4 billion, according to state estimates. The state will decide what infrastructure can be saved and what cannot.

“We can build a road or a bridge to whatever elevation we want, but how much money do we want to spend?” Pappas said.

Outside Odessa in northern Delaware, state officials were trying to determine what to do about flood-prone Old Corbit Road. Then, Pappas said, “Mother Nature decided for us.”

“She took it out,” he said — and the state opted to keep that part of the road closed.

Its closure meant firetrucks and ambulances needed to detour, but it also saved them from having to rescue drivers stuck in the water. The road was the shortest way into town, leaving residents like Jeffrey Frank worried about what might happen in an emergency. He said those who live along the road tracked the tides and knew when it might be inundated.

“It floods,” he said. “But there’s other days that there’s no water.”

Other roads present tougher choices. In 2012, Hurricane Sandy worsened dune breaches, letting saltwater into the marshes of the Prime Hook National Wildlife Refuge. The only road into a nearby beach town, a community of about 200 homes, began to flood regularly.

“Essentially, they were trapped until it receded,” said Jason McCluskey, a state maintenance engineer.

Emergency officials would call to warn residents to stock up on medicine and food when a flood seemed likely. Each flood meant emergency maintenance and costly overtime pay.

Beginning in 2015, the state and U.S. Army Corps of Engineers fixed the breach and restored the marshes, putting an end to the floods.

Thirty miles south, Old Lighthouse Road straggles to an end in a waterside housing development where air conditioning units sit on raised platforms. Eight feet above, a new road runs along a viaduct, built to keep dry a vital evacuation route and road to the beaches, an important part of the economy. The structure is simple enough, Pappas said, but cost about \$16 million.

Bigger challenges loom, such as the four-lane Coastal Highway that connects beaches and resort towns along the ocean. The state Department of Natural Resources has built up dunes to protect the road, but Pappas said, ultimately, it too might need to be raised — a mammoth undertaking.

Pappas stood in the shadow of the new Indian River Inlet bridge, which carries the Coastal Highway and offers a glimpse into how future projects might stave off the threat of water. Built with the climate of the next century in mind, the bridge rises incongruously large — its concrete and steel bulk showing what it might take to keep water in check.

About this story

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