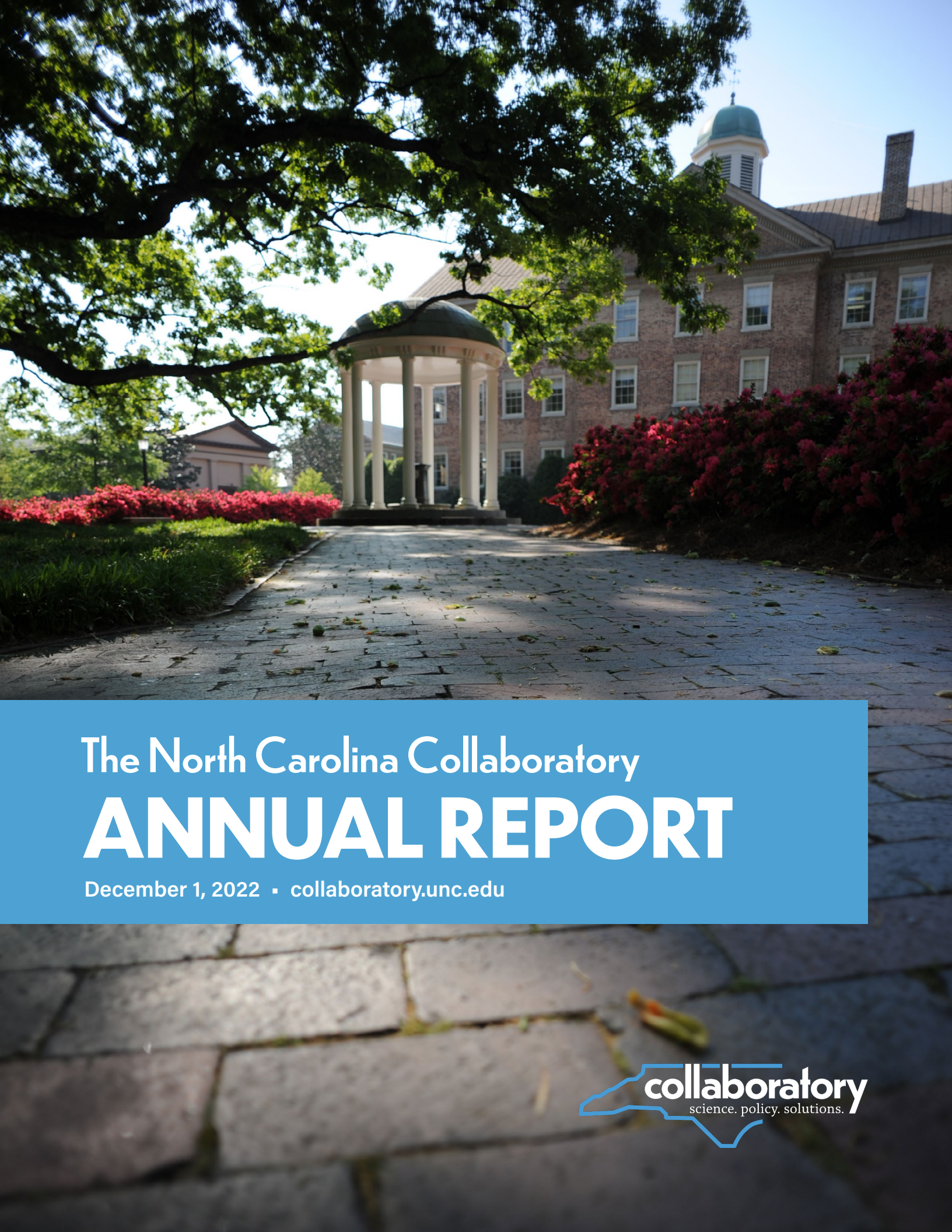


The North Carolina Collaboratory

ANNUAL REPORT

December 1, 2022 ▪ collaboratory.unc.edu

collaboratory
science. policy. solutions.

Our Story

Established in 2016 by the North Carolina General Assembly (NCGA), the North Carolina Collaboratory, headquartered at the University of North Carolina at Chapel Hill, translates academic research into practical application for the people of the State.

Expanding our Mission

Originally focused on natural resources and environmental issues, the Collaboratory has since expanded to numerous other research areas in response to some of the state's most pressing challenges, including public health, education, clean energy, economic recovery and technology development.

In 2021 the NCGA codified the Collaboratory as a freestanding Article 31A of General Statute Chapter 116 (NCGS 116-255) and, in doing so, dropped 'Policy' from its name and widely expanded its scope. In addition, the NCGA codified several other statutes to further define the Collaboratory's mission:

1) Research support across the UNC System's six historically minority-serving institutions.

2) Active pursuit of research and development partnerships between institutions of higher learning and government agencies, nonprofit organizations, and both private and public businesses.

3) Continued dissemination of research results, and making policy and funding recommendations to the General Assembly.

4) Training students and faculty to engage in neutral and unbiased research and advice on science policy-related issues.

Increased Funding for Research Impact

The NCGA approved an additional $8.86 million in appropriations for fiscal year (FY) 2022-23 in its July 2022 biennial budget adjustment (Session Law 2022-74). This brings the Collaboratory's gross biennial funding (2021-2022) to $85.6 million, more than double the amount of NCGA appropriations received by the Collaboratory during its first five years (2016-2021). This brings the cumulative total of NCGA support to approximately $150 million.

Strengthening our Organization

While the first five years of the Collaboratory were focused on building out this novel proof of concept, these next five years will be focused on the growth and efficient management of our increased funding and research portfolio.

Starting with just one full-time employee, the Collaboratory has grown in legislative funding and responsibilities, necessitating the creation of five new positions, with a focus on responsible management of state and federal research dollars. In March of 2023, the Collaboratory will move into a new space on the ninth floor of Kenan Laboratories in the center of UNC-Chapel Hill's campus.

This move is made possible in large part due to the UNC-Chapel Hill Board of Trustees, who supported recommendations from campus leadership to fully cover the operational costs of the Collaboratory starting July 1, 2022. This financial support is representative of the true partnership between the legislature and the university, and it ensures that moving forward, 100% of NCGA appropriations to the Collaboratory will go directly towards research.

"The North Carolina Collaboratory has been extremely important to us and we can't be more grateful to the General Assembly for the funding."

Kevin M. Guskiewicz, Chancellor
The University of North Carolina at Chapel Hill

Funding from NCGA 2021-2023

In November 2021, the NCGA approved its annual budget bill (Session Law 2021-180) and in July 2022 made second-year budget adjustments (Session Law 2022-74). These budget bills had several legislative provisions providing the Collaboratory with new funding and specific directives to develop new research initiatives, continue ongoing studies, and implement additional projects. The funding amounts and brief project descriptions are outlined below.

$30 Million
COVID-19 Research Projects

The state budget includes an allocation for Collaboratory-led research projects related to public health and economic impacts of COVID-19.

$20 Million
Wastewater Pilot Program

This pilot program will help distribute grants to local governments to develop wastewater treatment systems.

$14.15 Million
Water Safety Act

The budget appropriates funds to continue research on PFAS through the NC PFAS Testing Network. The funding also supports the development of a new novel resin to remove PFAS from drinking water.

$7.8 Million
Opioid Projects

The budget provides funding to expand research across the UNC System for opioid abatement and community engagement.

$5 Million
Cyanobacterial Algal Bloom Treatment

This study will evaluate an in-situ treatment and its ability to remediate and prevent cyanobacterial algal blooms in the lakes and reservoirs of North Carolina.

$2 Million
Targeted Research for Impact

By funding for impact across the state, the Collaboratory's research portfolio includes a marine fisheries study, coastal marsh surveys, a longleaf pine fire frequency study, supporting leukemia vaccine research, an ocular melanoma study and dozens of other projects.

$2.5 Million
Research Funding for Historically Minority- Serving Institutions

The Collaboratory received $2.5 million for a research grant program for institutions in the UNC System identified as historically minority-serving.

$750,000
Jordan and Falls Lake Nutrient Management Study

The last year of funding of this multi-year study will provide for continued development of nutrient management strategies and identification of water quality improvement for Falls Lake.

$330,000
FerryMon and ModMon

The ongoing FerryMon program collects water quality data in the nation's second largest estuary through a ferry-based monitoring system. The ModMon program monitors and assesses water quality and environmental conditions in the Neuse River Estuary.

$100,000
Firefighting Foam Project

The Collaboratory received funds to develop an aqueous film forming foams (AFFF) inventory. The Collaboratory and the NC Office of the State Fire Marshall (OSFM) developed an online reporting database for these PFAS-containing foams.

COVID-19: Assessing Impacts and Aiding Recovery

Learning Impact Awards with NCDPI

The N.C. Department of Public Instruction (NCDPI) and the Collaboratory are leading a joint $6.73 million effort to spur research on COVID-19's impact on student learning in the state, with the goal to help educators and students recover from pandemic-related disruptions and lost instructional time. Based on NCDPI's Office of Learning Recovery and Acceleration (OLR) identified priorities, the partnership will fund 20 academic research teams across North Carolina to understand the effectiveness of existing state and local programs and policies that were supported through federal Elementary and Secondary School Emergency Relief (ESSER) legislation. This unique program will strengthen partnerships between state education leaders and academic researchers on a priority issue that impacts many North Carolinians. The 20 research teams, many of which will collaborate with elementary schools, will receive between $150,000 and $500,000 to conduct the projects. Each project will last approximately two years.

"This joint effort will be instrumental for policymakers as we seek to address the most pressing challenges K-12 students and educators face as a result of the pandemic. More importantly, this research provides a unique opportunity for the K-12 system to harness the research power of North Carolina's great institutions of higher education."

Catherine Truitt,
State Superintendent of Public Instruction

Business Academia Partnership

The Collaboratory is awarding eleven applied research and development grants through a new Business-Academia Partnership Program to help address the public health and economic impacts of COVID-19 in North Carolina.

Supported by a $15,000,000 appropriation made by the North Carolina General Assembly, the research program aims to foster and strengthen partnerships between businesses and academic research groups to transform applied research and innovation into technological solutions for the benefit of public health and the economy in North Carolina.

Recipients of the awards include faculty from across the UNC System and their partners in startup, for-profit and nonprofit organizations. The grants will last for three years and tackle issues ranging from COVID-19 drug development, to personal protective equipment manufacturing methods, to home ownership disparities exacerbated by the pandemic.

COVID-19: Serving the State

CORVASEQ

The Collaboratory with its partners developed a streamlined surveillance network of SARS-CoV-2 variants across the state. The project is funded by a $15,000,000 Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC) grant from the CDC to the NC Department of Health and Human Services (DHHS).

After the NC General Assembly appropriated the ELC funds, CORonavirus VAriant SEQencing (CORVASEQ) was formed. The team is under the guidance of DHHS and is led by researchers at UNC-Chapel Hill: Dirk Dittmer, director of the UNC Vironomics Core and member of the Lineberger Comprehensive Cancer Center, Amir Barzin, medical director for the UNC Health Virtual Care services and leader of the Carolina Together Testing Program and Audrey Pettifor, professor in department of epidemiology in the UNC-Chapel Hill Gillings School of Global Public Health. In addition to UNC-Chapel Hill, the CORVASEQ team consists of the following institutions: Atrium Health, Duke University, East Carolina University, HCA Healthcare, Novant Health, UNC-Charlotte, the VA System, Vidant Health and Wake Forest Baptist Health.

Through this network of institutions, it is possible to capture samples from all 100 counties, and genetically sequence positive COVID-19 tests. After sequencing, the information about the variant of concern is sent to DHHS to provide accurate tracking of those variants across the state. As of November 1, 2022, the project has sequenced more than 40,695 samples.

Dr. Amir Barzin, Co-PI of CORVASEQ, discusses COVID testing at UNC-Chapel Hill.

VISION Study

The VISION Study is the Collaboratory's largest single grant in the institution's history. The UNC School of Medicine received $6 million in funding from the Collaboratory to research COVID-19's long-term impacts on North Carolina residents. The study will recruit and follow 7,500 people who recently tested positive for COVID-19, tracking each participant's health for the following 18 months after entering the study. Researchers begin enrolling participants in early October 2022. VISION's overarching goal is to answer lasting questions, including who is most at risk for infection, the COVID-19 vaccine's efficacy over time, and effects of long COVID.

SAS Project Award

During the early stages of the pandemic the Collaboratory partnered with SAS to deploy freezers across the state for vaccine storage. The project supports real-time data streams from freezers into a centralized dashboard to ensure an unbroken cold chain to maintain COVID-19 vaccine integrity. This partnership project received an EdScoop award for University Technology Innovation of the Year.

Addressing PFAS Concerns Across North Carolina

PFAS Testing Network

The North Carolina Per and Polyfluoroalkyl Substances (PFAS) Testing Network is a statewide research collaboration to test for current levels of PFAS chemicals in drinking water and air samples across the state. Several projects within the scope of the PFAS Testing Network are highlighted below:

- ECU researcher Dr. Jamie Dewitt will utilize analytical instrumentation (Agilent Seahorse XF Pro Complete with Normalization) to enhance the ongoing Collaboratory funded project investigating the toxicology of PFAS found within the State of North Carolina.

- UNC-Wilmington researchers will investigate a multidimensional approach to trace sources of PFAS in the atmosphere by developing a novel environmental forensics tool.

- Researchers at UNC-Chapel Hill will conduct a two-year project to understand the chemical characterization of PFAS in indoor and outdoor air environments in the state. Another project from Duke University will work to improve estimates of PFAS exposure from indoor air.

- Research from NC State will investigate the timescale for persistence of GenX and other PFAS in drinking water wells. Another project will complete a multimedia analysis to clarify PFAS exposure pathways in the community surrounding Fayetteville Works.

- Researchers from UNC-Charlotte, NC State, and Duke University will collaborate on a project titled "Sample Acquisition and PFAS Sample Analysis."

NC Pure

Co-led by UNC-Chapel Hill researchers Dr. Orlando Coronell and Dr. Frank Leibfarth, this Collaboratory- funded project developed a new technology that selectively captures and removes PFAS compounds from water using a novel resin. The technology will be deployed in three pilot areas of the state. The project will generate a wealth of data and prove useful for utilities across the state in the selection of appropriate sorbents for PFAS removal from North Carolina waters.

DEQ Fellowship Program

The Collaboratory and N.C. Department of Environmental Quality (DEQ) announced a new partnership in June of 2022 at the Third National PFAS Meeting in Wilmington. Focusing on PFAS, the institutions are partnering to create fellowship positions for university faculty members to work in DEQ. These fellows will work side-by-side with DEQ staff in the office, laboratory or field. Fellows will collaborate with DEQ staff on sampling, data analysis and lab standards, while getting an up-close view of the regulatory process.

2022 DEQ Fellows, from left to right, Drs. Detlef Knappe (NCSU), Ralph Mead (UNCW), Jamie DeWitt (ECU, and Lee Ferguson (Duke). Photo courtesy of UNCW University Relations.

Historically Minority-Serving Institutions Research Grant Program

In 2021, the Historically Minority-Serving Institutions Research Grant Program was established with funds appropriated by the North Carolina General Assembly to benefit North Carolina schools identified as Historically Minority-Serving Institutions (HMSIs). Over the last two legislative sessions the NCGA provided $2.5 million to support this new initiative. This funding enhances these institutions' research capacities while also serving the needs of the state. The following projects are just a sampling of the research grant program initiatives funded across the six HMSI Institutions.

COVID-19 Mitigation Efforts at Elizabeth City State University

Through surveillance and research efforts, researchers at ECSU will continue to monitor COVID-19 spread among the northeastern region of North Carolina by collecting samples from the population and analyzing for variants and new mutants.

Molecular Mechanisms of PFAS in the Modulation of Hepatotoxicity and Non- Alcohol Fatty Liver Disease

This project will examine the effects of PFAS exposure on liver diseases and development in zebrafish at levels of typical human exposures to provide insight into future human exposure.

Autonomous Multi- drone System for Search Operations in Challenging Environments

This project's goal is to develop an autonomous prototype AI drone software to conduct search operations in confined spaces and places where GPS is not available. Autonomous drones such as these will eliminate the need for human guidance and enhance the effectiveness of AI-led search operations.

New Competitive Research Grant Program

Supported by Collaboratory funds, the UNC Pembroke Office of Academic Affairs has launched a new program to provide faculty with grants of up to $250,000 for research that aligns with the institution's mission, vision and values, with the goal of increasing competitiveness for extramural support and addressing issues currently faced by people in North Carolina.

Biotreatment of GenX Using Combined Attached Growth Anaerobic Digester Sludge Reactors

This study will combine GenX with swine wastewater to better understand how PFAS are degraded within traditional municipal wastewater treatment processes, since GenX is very difficult to degrade on its own.

Collaboration between UNCSA's Media + Emerging Technology Lab and the WSSU Division of Nursing

This proposal represents the advancement of critical nurse training through Virtual Reality modules, an emerging technology proven to enhance education through active learning and increased retention.

"My favorite part of this research was being able to say that I am trying to let the truth be told and talking to the people that matter."

Dr. Tanya Hudson, Associate Professor, College of Education
Fayetteville State University

Dr. Hudson recently completed an HMSI-funded project on COVID-19 Learning Loss in local communities in the Sandhills Region of North Carolina.

Opioid Research and Community Engagement

The General Assembly appropriated $5,556,203 to the Board of Governors of The University of North Carolina to be allocated to UNC-Chapel Hill for the North Carolina Collaboratory, funding a variety of research on opioids across the state, including the following:

- The University of North Carolina Injury Prevention Research Center will continue to operate and expand the Community Opioid Resources Engine for North Carolina (NC-CORE) as a state of the art information clearinghouse for reports on the use and impact of North Carolina's opioid settlement funds. These funds will:

  - Develop and display high-quality resources and data to assist counties and municipalities in maximizing the long-term positive impact of the opioid settlement funds.
  - Develop and operate information portals enabling counties and municipalities to transmit required reports and data regarding opioid settlement funds in a timely and efficient manner.
  - Expand user-friendly, public-facing dashboards to ensure a high level of transparency and accountability with respect to the use of opioid settlement funds flowing to North Carolina counties and municipalities.

- Funding will support North Carolina Central University's opioid remediation project management and community partnership outreach.

- Grants will be available on a competitive basis to each campus of the constituent institutions of The University of North Carolina for opioid abatement research and development projects.

- Funds will support a research partnership concerning opioid abatement with the Eshelman Institute for Innovation at the University of North Carolina at Chapel Hill School of Pharmacy.

"It [the Collaboratory's funding] brings a lot of trust to a system on how these dollars are distributed and projects implemented."

Dr. Deepak Kumar, Interim Associate Provost and Dean of RSP/Director of BBRI, Julius L. Chambers Biomedical/Biotechnology Research Institute, North Carolina Central University

Spotlight on Natural Resource Projects

Marine Fisheries Study

The Collaboratory's Fisheries Study is in response to the General Assembly of North Carolina's 2021 Appropriations Act directive for a study on the status and management structures of the state's marine fisheries and coastal habitats. The project has two core components: gauging the status of North Carolina's fisheries through the construction of a database and exploring management structures and influences associated with fishery status. The end goal of these efforts is an NC Fisheries System Status Report to aid in conservation of federally managed species.

Professor Joel Fodrie of the UNC Institute of Marine Sciences leads the Collaboratory's Marine Fisheries Study.

Jordan and Falls Lake Nutrient Management Study

Since the North Carolina General Assembly approved a special provision to the annual budget bill in 2016, $500,000 annually has been dedicated to UNC-Chapel Hill to study nutrient management strategies and water quality data at Jordan and Falls Lakes. This fiscal year is the project's final year of annual funding. The results of this funding have brought researchers from universities across the state to collaborate on various water quality projects at these lakes and watersheds. The research teams published a final report on Jordan Lake in 2019, and a 2022 Research Symposium was held in April to inform stakeholders about current research efforts and updates on the Falls Lake Nutrient Management Strategy.

Research Projects at Falls Lake

- Assessment of zoo-plankton-phytoplankton relationships in Falls Lake to guide development of site-specific numeric nutrient criteria.

- Evaluating the financial considerations of stormwater control measures and water quality improvements throughout the Falls Lake watershed.

- Nutrient Loading from onsite wastewater systems in the Falls Lake watershed: Evaluating the potential for nutrient load reductions via bioreactors, and many more.

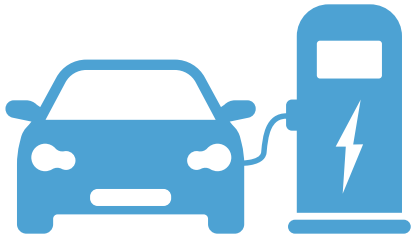
A research team member deploys monitoring equipment in Jordan Lake.

On the Horizon

Advancing North Carolina as a Leader in Electric Vehicle Production

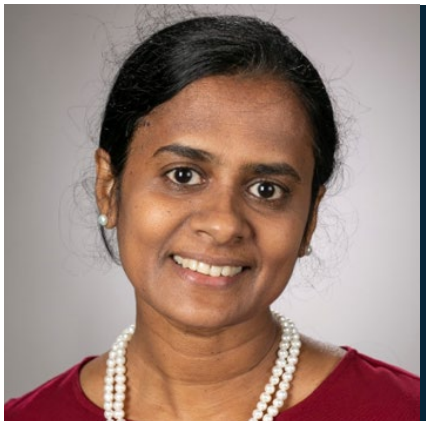
Over the past couple of decades, there is a growing emphasis in the transportation sector to increase the percentage of electric vehicles on the road. Recent actions in North Carolina demonstrate the interest in this issue and the potential economic development opportunities related to electric vehicle production. Of particular note, VinFast, in Chatham County, is beginning to build electric vehicles and Toyota, in Randolph County, will manufacture batteries for electric vehicles.

North Carolina has potential supplies of critical minerals, such as lithium, phosphate, and nickel, needed for battery and semi-conductor production. For example, the U.S. Geological Survey estimates that three known deposits in Kings Mountain, Bessemer City, and Cherryville contain a substantial amount of lithium—enough to supply batteries for over 50 million electric vehicles. Consequently, there is significant opportunity to support this transformation that could support new jobs and assist in moving our transportation system towards an increased electric fleet.



The Collaboratory is supporting initial research that will help guide private companies and policy-makers in exploring the full potential of this market:

- A geological study across central Carolinas to begin the process for identifying key mineral deposits.
- Funding work to further a technology that will extract lithium in an energy efficient and cost-effective manner from lithium rich sources.
- Research to identify the potential mineral mining and economic impact of that mining.



"Our technology will bring back the lithium supply chain to North Carolina with minimal environmental impact, low carbon footprint, and less water and energy consumption, while booming the job growth in the region."

Dr. Hemali Rathnayake, Associate Professor of Nanoscience,
The University of North Carolina at Greensboro

Collaboratory in Focus: From the Mountains to the Coast

With dozens of active projects in all regions of North Carolina, the Collaboratory's work spans from public health protection to technology development to environmental research that informs policy decisions. Outlined briefly below are a few examples of our current projects in service to North Carolina citizens that are taking place at the intersection of public health concerns, threats to natural resources, and the value of those resources for economic development opportunities.

Western Carolina University:

Working to Address Public Health Threats

La Crosse Virus is the most common cause of pediatric encephalitis in the United States. The disease, which is transmitted by the bite of infected mosquitoes, is highly prevalent in the Appalachian region of Western North Carolina. This project will collect preliminary data to lay the foundation to improve the effectiveness of care for patients hospitalized with LACV infection and reduce disease transmission in the community.

Photo courtesy of Western Carolina University.

North Carolina State University:

Mitigating the Impact of Invasive Species

In June 2022, an established population of the spotted lanternfly was detected in North Carolina for the first time. Native to China, India, and Vietnam, this invasive insect was first detected in the United States in Pennsylvania in 2014. The spotted lanternfly feeds on plants, which causes wilting and, in some cases, plant death. This Collaboratory project is supporting research to document the entire spotted lanternfly life cycle in North Carolina and develop data to better inform leadership and staff at the state's Department of Agriculture and Consumer Services.

UNC-Chapel Hill:

Protecting the State's Shellfish Industry

North Carolina boasts a growing shellfish aquaculture market. Recent challenges to the industry, such as large storm events, have disrupted efforts made toward industry growth. One such issue, oyster mortality, can be managed to strengthen the industry. This project, being led by the UNC Institute of Marine Sciences, will identify stressors on oysters and also develop tools to address mortality issues.

Photo courtesy of Bax Miller.

Research With a Purpose: Collaboratory Impacts across North Carolina

Statewide Impact

The Collaboratory's research is focused within the state of North Carolina and is designed to inform the policy-making process at the state and local level with the latest research findings, relevant data and expert advice. Examples of Collaboratory projects with statewide impact are abundant, including:

- The Wastewater Surveillance Network, led by UNC Institute of Marine Sciences professor Rachel Noble, works across the state to monitor wastewater and identify COVID-19 hot spots five to seven days before they are reflected by clinical testing results.
- The PFAS Testing Network, a consortium of university researchers, includes a research team dedicated to water sampling across hundreds of sites in North Carolina to evaluate the level of PFAS, a class of "forever chemicals", in our state's water resources.
- A project being led by professor Anita Brown-Graham at the UNC School of Government is evaluating efforts to reinvigorate local economies in all regions of North Carolina that were negatively impacted by business closures during the pandemic.

"We were all also amazed by the extent and diversity of collaborations among local governments, business leaders, and community groups that rallied to respond to the economic crisis. Many of these were new partnerships with enormous impact for their communities. I hope they are studied for some time to come. We must not allow ourselves to forget the power that comes from working together."

Anita Brown-Graham, Gladys Hall Coates Distinguished Professor of Public Law and Government, Director, ncIMPACT Initiative,
The University of North Carolina at Chapel Hill

Sharing Research Findings and Partnerships

A significant component of the Collaboratory's work is sharing research results with policy-makers, stakeholders and the general public. As such, over the last year the Collaboratory and its partners have hosted symposiums, webinars, and public forums on a wide range of topics, from water quality concerns to education policy to the latest information on key public health research.

The foundation of the Collaboratory's work is based on university researchers addressing timely issues facing North Carolina through academically rigorous research projects. That work is strengthened and amplified when we work with partners in the private sector, nonprofit organizations and governmental agencies. The list of our partners is too long to catalog, but our ongoing and past partnerships with North Carolina state agencies are of particular note and include: Department of Agriculture and Consumer Services, Department of Environmental Quality, Department of Health and Human Services, Department of Public Instruction and the Wildlife Resources Commission.

NC Department of Health and Human Services

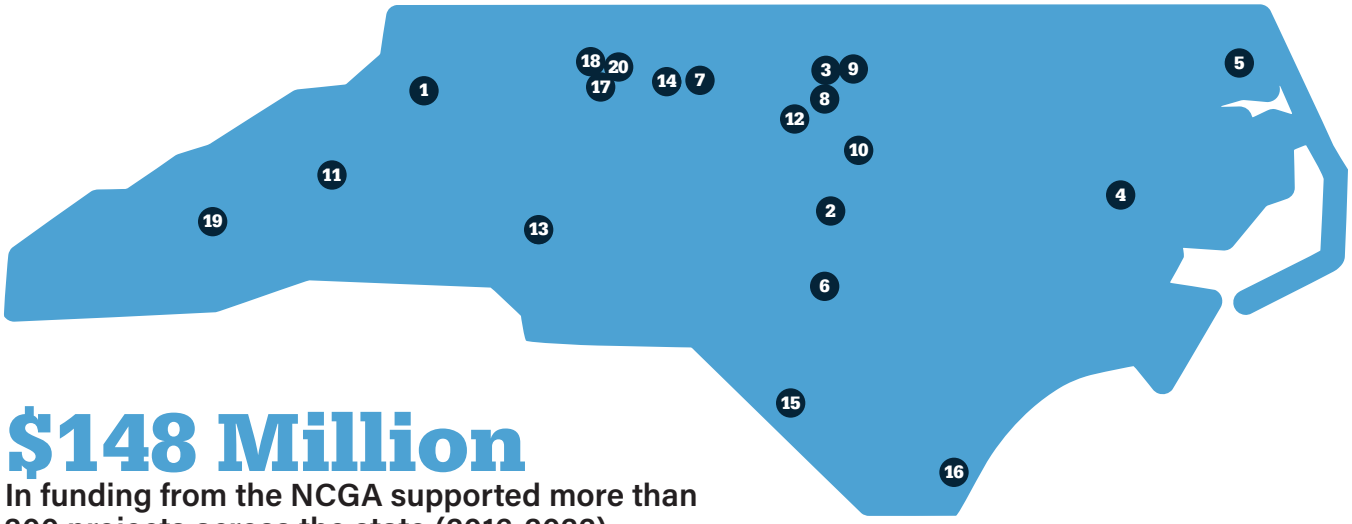
North Carolina Wildlife Resources Commission

Agriculture got to be NC

North Carolina Department of Public Instruction

North Carolina Environmental Quality

Research Partners



$148 Million

In funding from the NCGA supported more than 300 projects across the state (2016-2022).

1 Appalachian State University

2 Campbell University

3 Duke University

4 East Carolina University

5 Elizabeth City State University

6 Fayetteville State University

7 North Carolina Agricultural and Technical State University

8 NCCentral University

9 North Carolina School of Science and Mathematics

10 NC State University

11 University of North Carolina Asheville

12 The University of North Carolina at Chapel Hill

13 University of North Carolina Charlotte

14 UNC Greensboro — Find your way here

15 UNC Pembroke

16 UNCW

17 University of North Carolina School of the Arts

18 Wake Forest University

19 Western Carolina University

20 Winston-Salem State University

collaboratory

NC Collaboratory Staff

The development, selection and implementation of the projects outlined in this report has involved hundreds of faculty, staff and students at UNC-Chapel Hill and across the UNC System. The Collaboratory staff and board recognize the valuable contributions made by many to catalyze and undertake the research projects described in the report.

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Dr. Rick Luettich, Professor and Director, UNC Institute of Marine Sciences

Dr. Mike Piehler, Chief Sustainability Officer, UNC-Chapel Hill and Director, UNC Institute for the Environment

Acknowledgments

Sarah Padyk, a UNC-Chapel Hill graduate student in the Hussman School of Journalism and Media and communications intern with the NC Collaboratory, and Kyle McKay, with the UNC Service Center of Excellence, were instrumental in the development of this report.

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Gabrielle Schust, Boston, MA
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