

# **Annual Implementation Report Research Completed in 2021-22**

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Submitted by:

Alan M. Voorhees Transportation Center  
Rutgers University



NJDOT Bureau of Research,  
Innovation and Information Transfer

In cooperation with

New Jersey  
Department of Transportation  
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and  
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# Technology Transfer Program Annual Implementation Report – 2021-22

## Executive Summary

The **New Jersey Department of Transportation, Bureau of Research, Innovation, and Information Transfer** supports transportation research necessary in order to provide relevant information, analysis, and value-added solutions to transportation agencies and professionals. The results enhance the quality and cost-effectiveness of the policies, practices, standards, and specifications required when planning, designing, building, and maintaining the State's infrastructure. The funded research results in the discovery of new materials, improvement of processes, refinement of systems, and the generation of innovative ideas that improve the durability and efficiency of infrastructure and the mobility, accessibility, and safety of the State's residents, workers, and visitors.

The Bureau is often approached to justify the value of these research projects to a broader audience than transportation professionals. However, the long-term benefits are not always fully known or measured. Research projects may also require subsequent research phases and other technology transfer activities to advance implementation and to fully realize benefits. The Bureau and NJDOT's Research Oversight Committee need to understand the project objectives and types of benefits that various research projects have produced -- or still promise to produce -- to ensure that available resources are prioritized for future funding optimally.

The purpose of the Annual Implementation Report is to review these effects and opportunities to further advance research to implementation. Where applicable, and where the results were reported or could be obtained, examples of the return on investment or the identification of other benefits to the State of New Jersey have been noted.

The Annual Implementation Report is also a means to screen for noteworthy uses of research products and researcher accomplishments during and after project completion. The report documents the activities and strategies that have been used for knowledge sharing and technology transfer of research findings to the State's transportation community, including its transportation agencies, workforce, and the broader community of transportation practitioners.

## Introduction

The project team collected information for this report through review of technical briefs, final research reports, dissemination of an online survey and supplementary interviews and email communications with principal investigators, NJDOT research managers and research customers. A summary of each funded project completed in 2021 and 2022 was developed.

The role and importance of technology transfer within the State transportation research program function has been the subject of continuing study. Several useful definitions for considering the role of technology transfer that were provided in a U.S. DOT Volpe Center study (Cuddy et. at, 2016) help frame and inform the process of considering effects and are shown below:

- **Research and Development (R&D):** Any activity that aims to create or improve a technology.
- **Technology:** Any knowledge, process, system, or other tangible or intangible thing that could be used to create benefits. Examples of new technologies include a survey, hiring process, a piece of software or “app”, a traffic model, a new road construction technique or an unmanned aircraft.
- **Technology Transfer (T2) Activities:** All activities designed to help ensure that technologies created or improved through R&D are widely adopted for use outside or within the research-producing organization.
- **Adoption:** The decision to make a technology available for use in ordinary operational situations. This may or may not involve commercialization.
- **Implementation Activities:** Activities led by an adopter to make a technology available for ordinary operational use. These activities are generally preceded by adoption, and they often draw on research organizations for technology information and support.

## Research Approach

In 2021 and 2022, the Bureau of Research received 12 final research reports for work undertaken in previous years. The contracted value of the completed research projects was approximately \$3,600,513. As shown in Table 1, Policy and Organization related research accounted for the most completed research projects and funding. Multiple projects were also completed in Capital Improvement and Infrastructure and Mobility and Operations categories.

**Table 1**  
**Number and Value of Completed Research Reports by Research Category, 2021-2022**

Research Category	Number of Reports Completed	Total Contract Value Completed
Capital Improvement & Infrastructure	2	\$292,299
Multimodal	3	\$710,565
Policy & Organization	3	\$1,827,900
Mobility & Operations	1	\$459,349
Safety Management	1	\$60,400
Planning & Environment	1	\$250,000
<b>Total</b>	<b>12</b>	<b>\$3,600,513</b>

Source: NJDOT Bureau of Research, Database of Final Reports

<https://www.njdottechtransfer.net/research/research-projects/>

As shown in Table 2, the completed research reports vary in their approach to research and how implementation is addressed. The completed research reports and implementation activities can be characterized into several, sometimes overlapping categories:

- Some research reports were primarily analytical or evaluative studies which result in the reporting of findings to the stated research question with no attention to implementation.
- Some studies made recommendations for future research to further refine technologies or advance research questions to a next stage.
- Some of the studies made recommendations for implementation that could be pursued in the future.
- Another segment of studies made implementation or technology transfer activities an element of the completed research study, or have since acted on recommendations that were made at the time of the study's completion.

This report provides results from an investigation into steps taken, if any, at the conclusion of the research efforts. Research faculty, consultants, research customers, and NJDOT staff (current and former) were contacted through an online survey and supplementary interviews and follow-up communications were conducted by telephone, email or in person. The review of implementation activities that have followed from the research shows that some efforts resulted in research papers and presentations at conferences to disseminate key findings, while implementation in other cases may have been realized through specific policy changes or the institutionalization of new standards or tools for doing business. Where available or discovered, potential benefits related to the research study topic were noted. None of these studies would have been possible without public support.

**Table 2: Research Reports by Type of Research and Treatment of Implementation Theme, 2021-2022**

<b>ID</b>	<b>Title</b>	<b>Implementation Activities</b>	<b>Implementation-Minded Recommendations</b>	<b>Recommendations for Future Research</b>	<b>No Discussion of T2</b>	<b>Research Type</b>	<b>Research Category</b>
NJ-2021-001	UAS/Drone Procedures Manual and Best Practices for Use in New Jersey	X	X	X		Literature Review, Guidance Manual, Training, Survey	Policy and Organization
NJ-2021-002	Research Library Action Plan		X			Literature Review, Survey, Peer Review	Policy and Organization
FHWA-NJ-2021-002	Research Library Operations (2019-2020)		X			Customer Service, Data Collection, Online Resource Tool, Digitization, Cataloging	Policy and Organization
FHWA-NJ-2021-003	Implementation of a Protocol for Acceptance of New Over-Coating Systems for Steel Surfaces			X		Testing, Data Collection, Model Development	Capital Improvement and Infrastructure
FHWA-NJ-2021-004	Technology Transfer Program (2017-2020)	X	X	X		Literature Review, Survey, Software, Database, Training, Marketing	Policy and Organization
FHWA-NJ-2021-005	Understanding the Transportation Mobility Needs for an Aging New Jersey Population		X			Literature Review, Survey	Planning & Environment
FHWA-NJ-2021-006	Marketing Research for the Quantitative Benefits of Transit in New Jersey		X			Literature Review, Data Collection, Marketing and Infographics	Multimodal
NJ-2022-001	Highway Safety Improvement Program Implementation Plan				X	Literature Review	Safety Management
FHWA-NJ-2022-001	Implementation of Porous Concrete for Sidewalks in New Jersey	X	X	X		Survey, Data Collection, Testing	Capital Improvement and Infrastructure
FHWA-NJ-2022-002	Real-Time Traffic Signal System Performance Measurement Phase II	X	X	X		Testing, Data Collection	Mobility and Operations
FHWA-NJ-2022-003	Understanding the Needs of Current and Potential Bus Transit Riders					Literature Review, Survey	Multimodal
FHWA-NJ-2022-005	NJ Transit Grade Crossing Safety		X			Data Collection, Database	Multimodal

## **NJ-2021-001**

### **UAS/Drone Procedures Manual and Best Practices for Use in New Jersey**

Research Category: Policy & Organization  
Project Budgeted Cost: \$448,394  
Project Customer: NJDOT  
Organization: The City College of CUNY

#### **Background**

Due to the recent advances in Unmanned Aircraft Systems (UAS) there are new opportunities to enhance the reliability and efficiency of inspections of transportation infrastructure. UAS, or drones, were promoted by the Federal Highway Administration (FHWA) as one of the Every Day Counts Round 5 (EDC-5) innovations. New Jersey has been a national leader in UAS and initiated several activities before and since the EDC-5 was announced. However, two



major challenges existed to the widespread adoption of this technology. First, the regulatory compliance with the FAA regulated airspaces, and second, the absence of comprehensive operational procedures and guidelines for performing UAS missions.

The main objectives of this research were to investigate the local laws, statutes and conditions affecting the NJDOT's UAS operations, and develop comprehensive procedures for the use of UAS by a public agency, such as NJDOT for their inspection, operation, and management activities. These UAS procedures comply with current Federal regulations and include appropriate forms to maintain documentation and ensure FAA compliance.

#### **Implementation**

The project resulted in the development of the Unmanned Aircraft Systems Flight Operations Manual (UASFOM). This UASFOM provides guidance for NJDOT personnel, employees, consultants, and contractors in the performance of UAS Operations. The manual presents NJ's laws and regulations affecting UAS operations, discusses NJDOT's safety management system and risk management approach, established best practices, the agency's three-phase training program, and incident reporting. The manual also provides NJDOT's UAS forms needed for documentation and to ensure compliance with Federal Aviation Administration (FAA) regulations. The manual is intended to be a "living document" to incorporate changes as experience grows with UAS within the agency.

The research project has contributed to NJDOT's adoption of UAS technology in various inspection, traffic operation, and construction management activities, among other use cases. NJDOT divisions interested in using UAS for their projects need to be able to demonstrate that can save time, save money, increase safety or increase efficiency. The Principal Investigator, Dr. Anil Agrawal, and the research project were recognized at the 24<sup>th</sup> Annual Research Showcase with the 2022 Research Implementation Award.



## NJ-2021-002

### Research Library Action Plan

Research Category: Policy & Organization  
Project Budgeted Cost: \$73,560  
Project Customer: NJDOT  
Organization: Cambridge Systematics

#### **Background**

The NJDOT Research Library serves New Jersey state government employees and members of the general public by providing reference and referral services. Materials may be used onsite or, for state government employees, by loan. The research librarian will also provide literature searches and notifications of new materials for NJDOT employees. This project examined key issues and needs, including matching library offerings to users' needs, operations and staffing considerations, and the role technology should play in content management and website functionality. This research utilized a customer survey to gather information from users and potential users of the Research Library's resources, a review of literature, and interviews with representatives from other states to learn about customer needs, best practices, and approaches to optimize the utility of the Research Library to its customers



#### **Implementation**

The project resulted in an action plan that envisioned the changes that could be made to future library operations. The Action Plan provides a Recommended Future State that revisits the Mission Statement and accompanying Goals and Objectives for the Research Library, a Summary of Gaps between the current state and desired future state, and an Action Plan that lays out specific guidance for modernizing the Research Library via a Procurement Strategy and Summary Implementation Matrix. The Action Plan contained near-term recommendations, including:

- Developing an outreach strategy to educate more stakeholders about the library's offerings;
- Developing a roles and responsibilities strategy and staffing plan; and
- Implementing annual performance reporting.

The Action Plan also included long-term recommendations, including:

- Determining the necessary space requirements and optimal location for the library; and
- Taking steps to revitalize the Research Library's catalog.

## **FHWA-NJ-2021-002**

### **Research Library Operations (2019-2020)**

Research Category: Policy & Organization  
Project Budgeted Cost: \$100,000  
Customer: NJDOT  
Organization: NJ State Library - Thomas Edison State University

#### **Background**

The NJDOT Research Library has operated since 1998 as a branch of the New Jersey State Library (affiliated with Thomas Edison State University) to provide onsite library services to NJDOT, to support the research and technical work of the Department and its affiliated agencies, and to provide stewardship of the Research Bureau's collection of technical reports and other materials.

This project sought to operate and improve the Research Library as a major resource for transportation knowledge sharing and technology transfer. By partnering with NJDOT staff and Department units whenever possible, and with other transportation libraries and entities, Library staff sought to provide support to the organization and the industry, to assist people in their professional endeavors, and to fill gaps in the body of knowledge within the Department and externally.

#### **Implementation**

This project examined research library operations from July 2019 through December 2020, focusing on collection management. Recognizing the need to have more digital content available to all transportation researchers, the NJDOT Library staff in conjunction with the State Library staff created a robust LibGuide for Transportation Resources and expect to build this out more in the coming year. Because the State Library's LibGuide collection is public facing, it contains proprietary content restricted to NJDOT staff only. This leaves a gap in the LibGuide for making available unique content like AASHTO subscription reports, ASTM standards and other fee-based services that are available for exclusive use by NJDOT staff.

The State Library continues to support digitization of NJDOT reports that exist only in print to incorporate them in the digital collection of New Jersey documents maintained on its website. Further recommendations were made to enhance collaboration, networking, and marketing of library operations to staff.



## **FHWA-NJ-2021-003**

### **Implementation of a Protocol for Acceptance of New Over-Coating Systems for Steel Surfaces**

Research Category: Capital Improvement & Infrastructure  
Project Budgeted Cost: \$124,411  
Project Customer: NJDOT  
Organization: Rutgers University

#### **Background**

The project was undertaken to identify a procedure to accept new coating systems for over-coating of steel surfaces. It was concluded that a new protocol for accepting new systems is needed. This new protocol should provide results in a timely manner, preferably within nine months and it should be reasonably economical to conduct the tests. Therefore, a new protocol for evaluating durability of coatings and their effectiveness in reducing corrosion of steel structures was developed.



#### **Implementation**

The project developed new test methods for conducting accelerated environmental exposure tests and reporting the information needed for approval. The new test method is based on direct pull-off (adhesion) strength at various stages of corrosion and provides clearly measurable degradation within three months of accelerated exposure. The results show a clear difference between the best and the poor coatings and also correlate well with results of long-term field study.

A model for predicting the service life of coatings using the accelerated test results, presented in the final report, is based on the science of corrosion, models available in existing literature and information available on field performance. The model can be used to estimate the service life new formulations using accelerated test results that can be completed within one year.

The protocol being implemented won the NJDOT Implementation Award, as well as being selected as one of AASHTO's Sweet 16 projects by FHWA. Poster Presentations were made at TRB in 2020, as well as a presentation at that year's TRB Conference. Another Presentation was made at the TRB Committee on Corrosion the following year, a regional meeting of DOTs in Michigan, and the Society for Protective Coatings Conference in California.

## FHWA-NJ-2021-004

### Technology Transfer Program (2017-2020)

Research Category: Policy & Organization  
Project Budgeted Cost: \$1,205,946  
Project Customer: NJDOT  
Organization: Rutgers University

#### **Background**

The New Jersey Department of Transportation Bureau of Research issued a Request for Proposal seeking research and technical assistance for the development and implementation of a Technology Transfer Program. NJDOT retained a research team from two centers based at Rutgers University: the Alan M. Voorhees Transportation Center (Rutgers-VTC) at the Edward J. Bloustein School for Planning and Public Policy, and the Center for Advanced Infrastructure and Transportation (Rutgers-CAIT) to develop, implement, and support a NJDOT Technology Transfer Program.



#### **Implementation**

In the four-year period of the agreement, the T2 program conducted literature reviews, interviews and surveys to garner information on topics related to model policies and procedures and research, innovation, and knowledge management. The T2 program developed and implemented several activities and tools that address technology transfer and knowledge management needs. This included the establishment of the “Tech Talk!” Program, which informed attendees about recent NJDOT sponsored research and other events to highlight research and emerging trends. The Tech Talks series were held both in-person and via webinar and covered a wide range of topics. Video technical assistance products have been delivered to address knowledge needs, convey model practices, and promote “innovation” and “implementation” practices and accomplishments.

The T2 program also developed and managed several tools and processes to support research needs identification and promote innovation. This included the establishment of the NJ Transportation Research ideas portal, the NJDOT Innovative Ideas database which was open to the public, and the Build a Better Mousetrap Competition which encouraged participants to share their creative, implemented ideas with others around the state.

The T2 website became a focal point of the program, acting simultaneously as a repository for news and spotlight articles, sharing resources and as a marketing platform. The website houses other tools, such as the Knowledge Management Toolbox which presents information on key roles and responsibilities among state agency staff to advance knowledge transfer/capture. The website also serves as a home for reporting on research in progress and final reports funded by NJDOT. The T2 program's knowledge sharing activities aid in inter- and intra-agency coordination and celebrate innovations and research implementation accomplishments to foster a culture of learning, innovation and workforce development. Most report recommendations were carried out and/or continue to be carried out in the renewed Technology Transfer and Implementation Program (2021-2026).

## **FHWA-NJ-2021-005**

### **Understanding the Transportation Mobility Needs for an Aging New Jersey Population**

Research Category: Planning & Environment  
Project Budgeted Cost: \$250,000  
Project Customer: NJ TRANSIT  
Organization: Rutgers University

#### **Background**

Despite the expected growth of older adults in New Jersey, statewide efforts to understand their transportation mobility needs and barriers have been lacking. The mobility needs and barriers of older adults vary widely because of variations in personal and household characteristics as well as the characteristics of the places where they live. This research undertakes the challenging tasks of demonstrating the New Jersey older adults' mobility needs and barriers and recommends measures to enhance their transportation mobility.

#### **Implementation**

The project conducted a large-scale survey covering more than 3,000 adults and over 150 New Jersey municipal officials. One of the most striking results from the older adult survey was that approximately 15 percent of New Jersey adults aged 55 or over, amounting to more than 360,000 people, forgo at least some trips for lacking transportation. Among older adults from households without cars, about 55 percent forgo trips, whereas 49 percent of older adults with disabilities, 33 percent of older adults from households with income below \$25,000, and 29 percent of older adults aged 85+ forgo trips.



The five most desired mobility-enhancing strategies for older adults of New Jersey, in order of preference, are (a) free or more affordable transit fare for buses and trains, (b) subsidized Uber and Lyft for older adults, (c) more public transport for older adults and/or people with disabilities, (d) subsidized taxi for older adults, and (e) more and safer sidewalks for pedestrians/walkers and wheelchairs. These results indicate that there is a desire for more flexible travel options such as ride hailing and taxis, but at the same time, service affordability is a significant concern for older adults.

The results indicate that there is a need to assess alternative forms of public transportation, such as deviated-route transit, door-to-door transit, or collaboration with ride hailing companies. The survey of municipal officials indicated that door-to-door transit service is viewed as the most appropriate mobility-enhancing option for older adults. The project made several recommendations based on these results; however, one or more champions will be needed to engage with multiple public and private sector partners to advance recommendations some of which involve significant costs.

The data that was gathered was reportedly helpful for NJ TRANSIT in other areas or studies. Additional future funding would need to be needed to assist in the implementation of some of the recommendations and foster further coordination between entities.

Members of the research team put together a “roadshow” presentation sharing study findings to create awareness of this important research and generate discussion among stakeholders on how to pursue recommendations. Two presentations were made on this research by the co-PI, Karen Alexander and lead researcher, Andrea Lubin. These occurred at the NJ Advocates for Aging Well Annual Conference and another at the NJ TRANSIT Citizens Advisory Council. The results were also shared by Ms. Lubin at a Rutgers University class entitled "Bridging Public Health and Urban Planning" and another university course entitled: "Public Health and Aging".

## FHWA-NJ-2021-006

### Marketing Research for the Quantitative Benefits of Transit in New Jersey

Research Category: Multimodal  
Project Budgeted Cost: \$249,973  
Project Customer: NJ TRANSIT  
Organization: Rutgers University

#### **Background**

For much of the past two decades, New Jersey policy makers have been mired in debates on how best to fund transportation capital and operating costs in an era of significant fiscal strain. NJ TRANSIT in particular faces many challenges related to maintaining legacy infrastructure systems and assets in a state of good repair, meeting operating budget needs and paying for needed system improvements large and small, as noted in NJ TRANSIT's Capital Program. When this study began in 2019, the public narrative surrounding transit in New Jersey was that NJ TRANSIT was a system in crisis. Today, as the world emerges from the depths of the global COVID-19 pandemic, there is a renewed focus on recovery and investment.

This research sought to quantify the economic mobility, accessibility, environmental, and social benefits of public transportation to New Jersey.

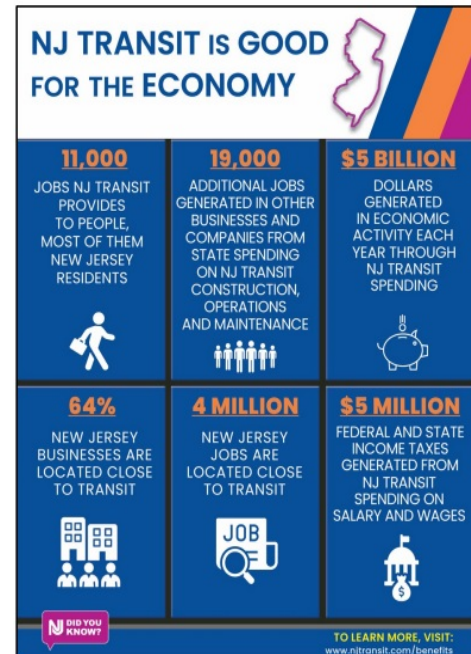
#### **Implementation**

The research team developed a series of sample marketing materials including reports, briefing books, tables, charts, infographics, and others to "tell the story" of transit services and benefits. These work products could be used by not only NJ TRANSIT but by other organizations such as NJDOT, the Governor's Office, the state's MPOs, and other state, county, and municipal officials, and more. The content is versatile enough to be featured as part of webinars, social media campaigns, and website posts and can be kept up to date with relative ease. Recommendations were made by the research team to implement a series of stakeholder briefings and a partnership campaign to promote the results of the research.

NJ TRANSIT created a Research webpage as part of their Transit-Friendly Planning Program. The site includes the research methodology and shares high-level results and can be found here: <https://transit-friendly-planning-njtransit.hub.arcgis.com/pages/research>. Some of the graphics created through the project were shared via social media.

NJ TRANSIT now also has a page that identifies the benefits of transit that their customers can see, which can be found at <http://www.njtransit.com/transitbenefits>

The research was cited in an advocacy report issued by the New Jersey Policy Perspective, [Getting Back on Track: Fully Fund NJ Transit by Taxing Big Corporations](#). The study research was cited, among other publications, to convey ridership volumes, transit use to sports and entertainment venues, and the economic benefits and return on investment of public transportation to New Jersey residents.



## NJ-2022-001

### Highway Safety Improvement Program Implementation Plan

Research Category: Safety Management  
Project Budgeted Cost: \$60,400  
Project Customer: NJDOT  
Organization: Cambridge Systematics

#### **Background**

The goal of the Highway Safety Improvement Program (HSIP) Implementation Plan is to help the state of New Jersey meet its safety targets by reducing transportation fatalities and serious injuries on all public roads, including non-State-owned roads. The Implementation Plan requires a data-driven, strategic approach to improving highway safety with a focus on performance. To complete the HSIP Implementation Plan, New Jersey reviewed recent safety data, studied five years of funding data and how that aligned with safety data, identified noteworthy practices that could help the state meet its future goals, and identified specific opportunities that could be incorporated in future HSIPs to improve safety in the state.

#### **Implementation**

As part of the development of the HSIP Implementation Plan, New Jersey identified several opportunities and actions to explore and advance in an effort to address challenges. Highlights of these actions include:

- Align project development and safety investments with the New Jersey 2020 SHSP, while including equity in the process.
- Increase the development and implementation of HSIP-funded pedestrian and bicycle infrastructure projects with a focus on underserved communities.
- Conduct annual safety summits to update stakeholders on the status and progress of the SHSP actions and goals while maintaining partnerships for future safety plans and initiatives.
- Engage with Metropolitan Planning Organization (MPO) partners to initiate the development of Local Strategic Highway Safety Plans.
- Lead efforts to streamline the Capital Project Delivery Process for HSIP Projects



The report reported on studies/methods that were already completed by NJDOT in other contexts. For example, the "summary of benefits" section of the report contained references that benefit-cost ratios (BCRs) were calculated for some of the projects in the final project list.

The project itself was completed to ensure that NJDOT was in compliance with Federal Highway Administration (FHWA) requirements.



## FHWA-NJ-2022-001

### Implementation of Porous Concrete for Sidewalks in New Jersey

Research Category: Capital Improvement and Infrastructure  
Project Budgeted Cost: \$167,888  
Project Customer: NJDOT  
Organization: Rutgers University

#### **Background**

This project builds on previous research where pervious concrete sidewalk was implemented in the field to evaluate porous concrete construction practices and its short- and long-term performance. The sidewalk was monitored periodically through visual inspections for raveling and infiltration rate measurements for potential clogging. The implementation project also developed and life cycle analysis tool of pervious concrete sidewalk. The objectives of this research were the following: 1) evaluate existing porous concrete sidewalks in New Jersey, 2) improve porous concrete mix designs for filed applications, 3) build a porous concrete sidewalk as a pilot project in New Jersey, and 4) collect data on its short-and long-term performance through periodic monitoring, and 5) develop life cycle analysis tool for porous concrete sidewalks.

#### **Implementation**

The project resulted in a series of recommendations and best practices that were delivered in a final report. The specifications were an important deliverable that can be used for guidelines for future use and implementation of pervious concrete. A life cycle cost analysis was also delivered that compares the use of conventional concrete versus pervious concrete. The project itself included a demonstration installation in Montgomery Township and followed from an earlier study.



The results were presented at the 54th Annual Mid-Atlantic Quality Assurance Workshop in February 2022.

The research project activities and demonstration project field testing efforts were the subject of a "Research to Implementation" video produced by NJDOT's Technology Transfer Program, "[Implementation of Porous Concrete for Sidewalks](#)". The video featured interviews with the Principal Investigator, Dr. Husam Najm, and several research customer representatives from

Montgomery Township who spoke about the project, how the field installation was conducted, and how it has been received by the municipality and the public.

Plans for the project implementation on the Skillman Road Pathway in Montgomery Township Skillman Road Pathway were also featured in a poster session topic at the 22<sup>nd</sup> Annual Research Showcase, [Implementation of Porous Concrete in Sidewalks in New Jersey](#), authored by Kathleen Stavole, Jack Cannon, Luke Dragon, Hardik Yagnik, Husam Najm, Rutgers University.

Various design mixes for porous concrete were featured in a poster session topic at the 23<sup>rd</sup> Annual Research Showcase, [An Innovative Green Pervious Concrete Made with Modified Geopolymer Materials](#), authored by Wei Huang and co-PI Hao Wang.

During the 23<sup>rd</sup> Annual Research Showcase, the project was recognized with two awards: the “2021 Outstanding University Student in Transportation Research Award” given to Wei Huang, Rutgers University; and the “2021 NJDOT Research Implementation Award” given to Dr Husam Najm and Dr. Hao Wang both from Rutgers University.

In reflecting upon future next steps for implementation, Dr. Najm, the PI, observed that there is need for investigation of certain properties of pervious concrete prior to institutionalizing implementation for other applications such as parking and lightly traveled lanes. Among these properties is the fatigue strength and the abrasion resistance. This additional research could be performed or focused on parking lots.

## **FHWA-NJ-2022-002**

### **Real-Time Traffic Signal System Performance Measurement - Phase II**

Research Category: Mobility and Operations  
Project Budgeted Cost: \$459,349  
Project Customer: NJDOT  
Organization: Rutgers University

#### **Background**

This project developed the ATSPMs system considering existing implementation options according to agency capabilities and resources. The research team specifically designed the system based on Adaptive Signal Control Technology (ASCT) and ATSPM open-source software to develop an economically justifiable ATSPMs for arterial traffic management in New Jersey. During phase two, the team utilized multiple sources to show additional performance metrics.

The primary objective of the second phase of this project was to develop and deploy a significantly enhanced version of the original toolbox, NJDOT ATSPM 2.0, along with a pilot study on the integration of adaptive signal controllers with CAV technologies. NJDOT arterial management operators can then use the ATSPM platform to generate key performance metrics and conduct system analysis for NJDOT's ASTC corridors.

#### **Implementation**

The research team created data management manual for adaptive traffic signal processing and established a metadata table for the test signal controllers.

The research team worked with automated traffic signal control vendors/contractors more directly to make this project a standard ATSPM solution. The project enabled automated traffic signal control to generate ATSPM-like data such as queue/wait time, degree of saturation, predicted volumes, etc., into the ATSPM software.

The team further initiated pilot experiment and integration of Real-Time Traffic Signal Performance Measures (RT-SPM) with connected and automated vehicle technologies at intersections in collaboration with NJ connected technology integration and implementation program. The team conducted case studies of system deployment. The research team has also implemented the process of pulling 1 month data into the TCNJ ATSPM platform. The team also completed the full deployment of the developed ATSPM 2.0 platform on NJDOT servers. NJDOT ATSPM 2.0 will allow the NJDOT to be able to conduct comprehensive assessment and monitoring of their arterial corridors and further accelerate the process of identifying, assessing, and addressing signal control and maintenance problems.

The methods and results of Phase I research on Real-Time Traffic Signal Performance Measurement and Phase II research underway was given at an NJDOT Tech Talk on June 29, 2021. The presentation, [Automating Traffic Signal Performance Measures for NJDOT Adaptive Traffic Signal Control Systems](#), was led by Dr. Peter Jin, of Rutgers-CAIT, Dr. Thomas Brennan, from the College of New Jersey, and Kelly McVeigh from NJDOT's Mobility Engineering Unit.

Research results were also presented at the 2022 Annual Transportation Research Board Conference and at the NJDOT Research Showcase in October 2022. The 2022 Research

Showcase presentation, Real-Time Traffic Signal System Performance Measurement Phase II: Data and Functionality Enhancement, Large Scale Deployment, Connected and Autonomous Vehicles Integration, can be found as a set of [presentation slides](#) and [recording](#).

Some recent research publications from this study include:

Zhang, T. T., Jin, P. J., Brennan Jr, T. M., McVeigh, K., Jalayer, M., & Patel, D. (2023). Arterial Vehicle Trajectory Reconstruction Based on Stopbar Video Sensor for Automated Traffic Signal Performance Measures. *Journal of Transportation Engineering, Part A: Systems*, 149(4), 04023014.

Zhang, T. T., Jin, P. J., Brennan Jr, T. M., McVeigh, K., & Jalayer, M. (2021). *Automating the Traffic Signal Performance Measures for Adaptive Traffic Signal Control Systems* (No. TRBAM-21-04207).

Plans are underway to produce a short “research-to-implementation” video on the efforts to-date as part of the Technology Transfer Program’s video technical assistance task.

## **FHWA-NJ-2022-003**

### **Understanding the Needs of Current and Potential Bus Transit Riders**

Research Category: Multimodal  
Project Budgeted Cost: \$260,592  
Project Customer: NJ TRANSIT  
Organization: Rutgers University

#### **Background**

Public transit ridership has been decreasing substantially in the United States even before the COVID-19 pandemic impacted the industry in March 2020. The decrease in ridership has been more substantial for buses than rail transit. The decrease in ridership has been experienced in New Jersey as well. Average weekday bus ridership for NJ TRANSIT decreased by 7.5 percent between 2015 and 2019 and weekend ridership decreased at a slightly higher rate, necessitating research to comprehend the reasons for the ridership decline and to identify remedial strategies. This research adopted a mixed-method approach that included a literature review, telephone interviews with representatives of eight transit agencies from different parts of the country, an online survey of more than 3,000 NJ TRANSIT bus riders, and a random-digit-dialing telephone survey of 1,313 New Jersey residents supplemented by a mail survey of 130 people living in disadvantaged communities where respondents are difficult to reach for telephone surveys.

#### **Implementation**

Recommendations from this research included, but were not limited to: (a) prioritize retention of current riders over attracting non-riders, (b) focus on providing better service in areas already served by local buses, (c) prioritize bus frequency over other transit improvements, (d) retain and improve weekday off-peak bus service and weekend bus service, (e) prioritize accommodating non-discretionary trips such as work trips over discretionary trips such as recreational trips, and (f) improve bus and bus-stop amenities by utilizing newer technologies such as Wi-Fi and real-time information.

A NJDOT Lunchtime Tech Talk, [Analysis of Local Bus Markets](#), was given by Dr. Deva Deka, the Principal Investigator, and Susan O'Donnell of NJ TRANSIT on October 7, 2020. During the presentation, Ms. O'Donnell offered insights into how bus ridership survey data is used by NJ TRANSIT for planning purposes. She also highlighted the early effects of the pandemic on bus travel based on surveys given at the height of the pandemic during April and June of 2020. The data showed how important the bus system has been to essential workers.

## FHWA-NJ-2022-005

### NJ Transit Grade Crossing Safety

Research Category: Multimodal  
Project Budgeted Cost: \$200,000  
Project Customer: NJ TRANSIT  
Organization: Rutgers University

#### Background

This research provided NJ TRANSIT (NJT) with a list of 20 crossings for closure from an initially supplied list from NJT of 100 crossings. The research results were intended to support NJ TRANSIT and NJDOT in the efficient spending of limited funds to maximize the benefit for the communities of New Jersey. Data for twenty different fields were collected and generated to prioritize the selected list of 100 crossings for closure. These data fields included: crash history; average annual daily traffic; roadway speed; roadway lanes; length of the crossing's street; weekday train traffic; train speed category; number of tracks; access to train platforms; intersection angle; distance to alternate crossings; distance to emergency and municipal buildings; whether emergency and municipal buildings are on the same street; and date of last or future planned signal and surface upgrades. Following the data collection, the crossings were ranked based on an analytical hierarchical process (AHP). First, crossings that could not be closed were filtered out. These include County or State routes and crossings with no alternate paths, as determined through GIS analysis of alternate routing.

Rank	Crossing ID	Line Name	Roadway Name	Town
1	263229H	Montclair Line	Walnut St	Montclair
2	263025W	Pascack Valley Line	Orchard St	Hillsdale
3	263418E	Bergen County Line	Hobart Place	Garfield
4	856967N	North Jersey Coast Line	Church St	Spring Lake
5	263046P	Pascack Valley Line	Euclid Ave	Hackensack
6	856936P	North Jersey Coast Line	Fifth Ave	Asbury Park
7	856934B	North Jersey Coast Line	Sixth Ave	Asbury Park
8	856962E	North Jersey Coast Line	Thirteenth Ave	Belmar
9	856956B	North Jersey Coast Line	Evergreen Ave	Bradley Beach
10	856941L	North Jersey Coast Line	First Ave	Asbury Park
11	266882G	Montclair Line	Jerome Place	Montclair
12	856969C	North Jersey Coast Line	St. Clair Ave	Spring Lake
13	263029Y	Pascack Valley Line	Irvington St	Westwood
14	856897B	North Jersey Coast Line	Chestnut St	Red Bank
15	263028S	Pascack Valley Line	Industrial Rd	Westwood
16	856964T	North Jersey Coast Line	Seventeenth Ave	Belmar
17	263227U	Montclair Line	Claremont Ave	Montclair
18	856923N	North Jersey Coast Line	Roosevelt Ave	Deal
19	856975F	North Jersey Coast Line	Shore Rd	Spring Lake
20	856957H	North Jersey Coast Line	Seventh Ave	Belmar

#### Implementation

To improve grade crossing safety in New Jersey, this research provided NJT with a decision-making process and tool to select grade crossings for closure. A listing of 100 crossings and associated features provided by NJT can be found in the final report. The research results have the potential to guide NJT and NJDOT in maximizing the benefits to the communities of New Jersey. The methodology used in the study can be reapplied to larger lists of crossings to prioritize crossings for closure in the future.

In addition to the recommendations, the research team looked at what other state agencies and transit agencies have done with grade crossing elimination, as well as criteria recommendations from Federal Highway Administration (FHWA) and Federal Railroad Administration (FRA). Following up on this study, NJ TRANSIT and NJDOT are considering next steps that would be needed to close the 20 identified grade crossings. The closings have all been reportedly included in NJ TRANSIT's capital program.

The corresponding research investigator, Asim Zaman, indicated that the research team is in the process of drafting a Transportation Research Board (TRB) paper that is planned for submission this year.

The researcher also suggested that one potential next step for research would be to investigate the safety effects – that is, crash avoidance, from any grade crossing closures actually resulting from the recommendations. The average estimated cost of a single highway-rail grade crossing crash is \$805,675 according to the U.S. Senate Commerce Committee. It can be anticipated that the number of grade crossing fatalities in the subject areas would be reduced. This could result in major cost savings for the railroad, municipalities, and others.

A follow-up interview about the benefits of this study was held with the NJ TRANSIT research customer and posted at <https://www.njdottechtransfer.net/2023/04/19/nj-transit-grade-crossing-safety/>.