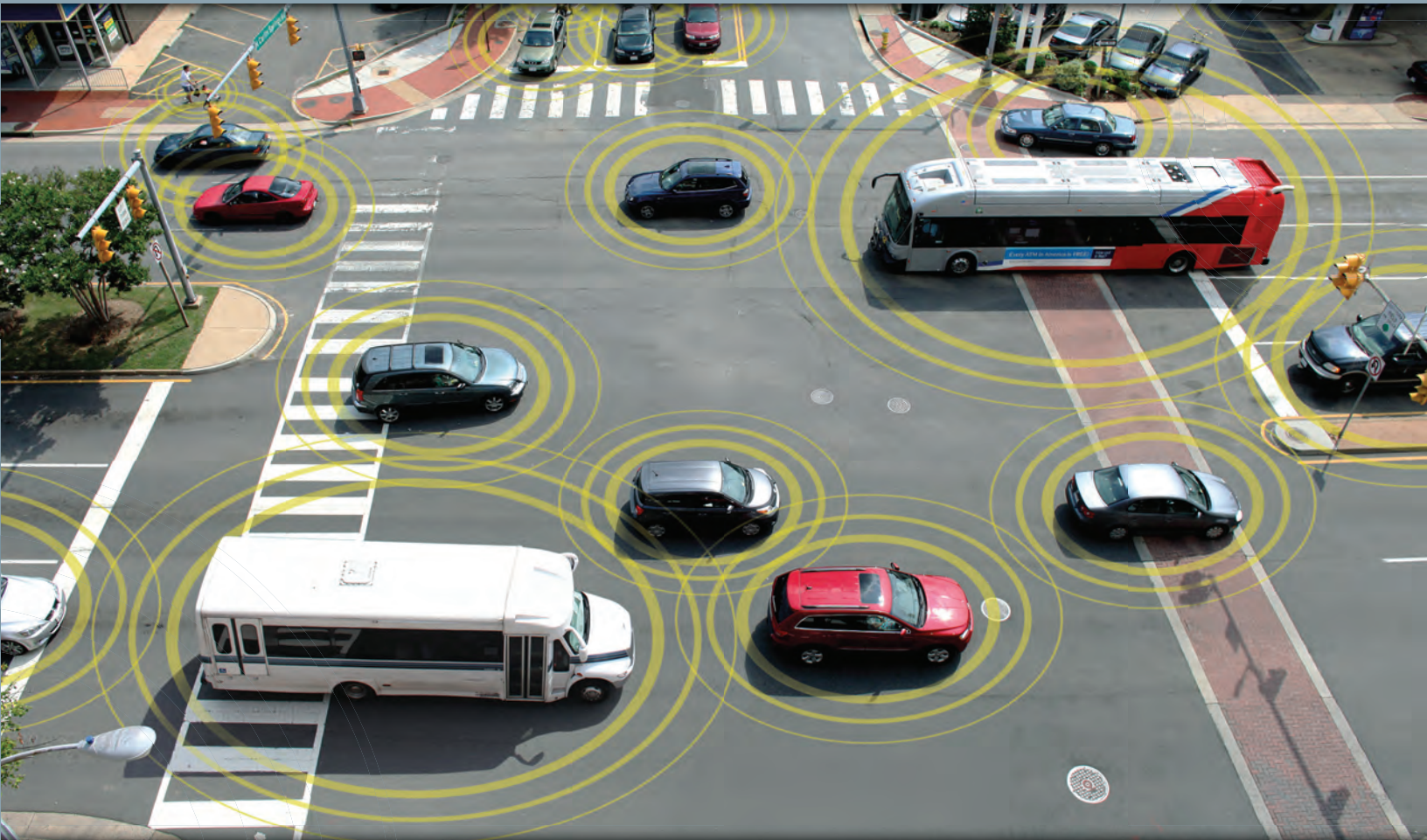


NCHRP

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

2015 Annual Report



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NCHRP

**NATIONAL
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PROGRAM**

2015 Annual Report

Research sponsored by the American Association of State Highway and Transportation Officials
in cooperation with the Federal Highway Administration

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2015
www.trb.org

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research is the most effective way to solve many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation results in increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

Recognizing this need, the leadership of the American Association of State Highway and Transportation Officials (AASHTO) in 1962 initiated an objective national highway research program using modern scientific techniques—the National Cooperative Highway Research Program (NCHRP). NCHRP is supported on a continuing basis by funds from participating member states of AASHTO and receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board (TRB) of the National Academies of Sciences, Engineering, and Medicine was requested by AASHTO to administer the research program because of TRB's recognized objectivity and understanding of modern research practices. TRB is uniquely suited for this purpose for many reasons: TRB maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; TRB possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; TRB's relationship to the Academies is an insurance of objectivity; and TRB maintains a full-time staff of specialists in highway transportation matters to bring the findings of research directly to those in a position to use them.

The program is developed on the basis of research needs identified by chief administrators and other staff of the highway and transportation departments and by committees of AASHTO. Topics of the highest merit are selected by the AASHTO Standing Committee on Research (SCOR), and each year SCOR's recommendations are proposed to the AASHTO Board of Directors and the Academies. Research projects to address these topics are defined by NCHRP, and qualified research agencies are selected from submitted proposals. Administration and surveillance of research contracts are the responsibilities of the Academies and TRB.

The needs for highway research are many, and NCHRP can make significant contributions to solving highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement, rather than to substitute for or duplicate, other highway research programs.

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The National Academies of
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The **National Academy of Sciences** was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, non-governmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Ralph J. Cicerone is president.

The **National Academy of Engineering** was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. C. D. Mote, Jr., is president.

The **National Academy of Medicine** (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the **National Academies of Sciences, Engineering, and Medicine** to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.

Learn more about the National Academies of Sciences, Engineering, and Medicine at www.national-academies.org.

The **Transportation Research Board** is one of seven major programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to increase the benefits that transportation contributes to society by providing leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

Learn more about the Transportation Research Board at www.TRB.org.

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PREFACE

By Christopher Hedges

Manager

National Cooperative Highway Research Program

Does the phrase “disruptive technologies” make you think of something positive? Something we would look forward to? The phrase was coined by Harvard Business School professor Clayton Christensen in 1997. Disruptive technologies are those that start off with a small market share and then grow exponentially until they completely displace the status quo, forever changing the way we live and work. Think of the personal computer, the internet, or the smart phone. Look further back in time and think about how the development and proliferation of automobiles and airplanes changed our lives.

A more neutral term being used to describe these technologies is *transformational*. A number of new technologies have the potential to transform our ideas about transportation. These include alternative-fueled vehicles, on-demand shared-ride programs like Uber and Lyft, and drones. However, the transformational technologies that have most captured the imagination of the public and the attention of transportation community alike are connected and automated vehicles (CV/AV). As illustrated on this report’s cover, connected vehicle technologies involve communication between vehicles, and between vehicles and the roadway infrastructure. These have the potential to improve safety, reduce congestion, and improve the efficiency of the road network. Automated vehicle technologies take a major leap in reducing reliance on the driver. The National Highway Traffic Safety Administration (NHTSA) developed a taxonomy describing five levels of vehicle automation, ranging from 0 (no automation) to 4 (a vehicle can drive itself with no input from the driver—or no driver at all). Level 2 technologies (e.g., adaptive cruise control, blind-spot warning) are available on vehicles today. Levels 3 through 4 technologies are at various levels of development and a deployment schedule is difficult to predict. How long it will be before automated vehicles become commonplace is debatable, but in April of this year an automated vehicle designed by Delphi Automotive travelled from San Francisco to New York—nearly 3,400 miles—over 9 days with the vehicle in fully automated mode for 99 percent of the drive. The vehicle’s “driver” took control of the vehicle for just 1 percent of the trip.

Transportation agencies need to know how to prepare for increased automation of vehicles on the roadway. There are likely to be impacts on planning, design, maintenance, and operations as well as policy and legal issues to contend with. More than 10 states now have

significant CV pilot programs; allow AV testing on public roads; and/or are in the planning stages for CV/AV programs, projects, and deployments. The National Cooperative Highway Research Program (NCHRP) has identified CV/AV as a key emphasis area. Earlier this year, NCHRP completed the development of a research roadmap for connected/automated vehicles [NCHRP 20-24(98)]. The roadmap lays out research needs in four major categories: institutional and policy, operational, legal, and planning. Based on this research roadmap, NCHRP's governing body, AASHTO's Standing Committee on Research, approved an additional \$2 million for CV/AV research in 2015 and 2016 (NCHRP 20-102). You can follow the progress of these and related research at NCHRP by entering "CV/AV Research" in the search box on the TRB home page at www.trb.org.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

ANNUAL REPORT

.....
December 31

2015
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INTRODUCTION

The National Cooperative Highway Research Program (NCHRP) is a unique contract research effort designed to respond to the practical needs of state departments of transportation (DOTs). The Transportation Research Board (TRB) administers the program, for which the state DOTs fund, select, and oversee the research. NCHRP is an applied research program, and every possible effort is made to help administrators and practitioners put the findings to early use in the form of policies, procedures, specifications, and standards.



During 2015 NCHRP completed 84 research projects, published 62 research products, and approved 61 new and continuation projects. This *Annual Report* provides, in Table 1, a concise list of research published in 2015 and, in Table 2, a list of all active projects, projects completed in 2015, and projects that were approved in 2015 but not yet under contract. The *Annual Report* also presents detailed information about the operation of NCHRP through the Standing Committee on Research (SCOR) of the American Association of State Highway and Transportation Officials (AASHTO).

The *NCHRP Annual Report* supersedes the *Summary of Progress*, which was published in hard copy for the last time in 2014. The *Summary of Progress* documented all NCHRP projects since the inception of the program in 1962. While it provided a useful reference, this information is now readily available on the TRB and NCHRP websites. Therefore, the new annual report series focuses on activities conducted in the current year. See the following search tips for information on how best to locate NCHRP research and publications online.

We hope you like the new *NCHRP Annual Report* format. Comments are always welcome; email Chedges@nas.edu.

Finding information on the TRB/NCHRP websites

There are many points of entry to the TRB and NCHRP websites, depending on the kind of information you're looking for. For a general search of all TRB activities on a given topic, enter keywords related to that topic in the search box at the top of the TRB website at www.trb.org.

To find specific projects, use the "Find a Project" option in the left-hand navigation bar at www.trb.org/NCHRP. You can restrict your search to NCHRP research by selecting NCHRP in the "Program" dropdown menu, or select "All" to include projects from our transit, aviation, freight, hazardous materials, rail, and strategic highway research programs. Enter keywords from the title, a project number, or the staff officer's name in the appropriate box. The "Research Area" dropdown menu lets you view all projects in any of 27 subject areas. If you select "All Projects" in the left-hand menu bar, you will see NCHRP projects categorized by subject area dating back to 1988 when our systems were first digitized. A summary of NCHRP projects from 1962 through 1988 is available online as *NCHRP Web Document 7* and can be accessed through a link on the NCHRP home page or by going to <http://tinyurl.com/WebDoc7>.

If you are interested in publications in a specific series, such as NCHRP Reports or Syntheses of Practice, direct links are provided on the right-hand side of the NCHRP home page. The home page also includes links to our quick-response series of projects supporting AASHTO committees.

To search all TRB publications, you can visit the TRB Online Bookstore at www.mytrb.org/store.

Finally, the most comprehensive source of information on transportation research globally is the TRID database, available at trid.trb.org.

NCHRP

Transportation research that works

Objective national highway research since 1962
Managed by the Transportation Research Board
Funded cooperatively by AASHTO member
departments • Project topics determined by state
DOTs • Competitive selection of investigators
Oversight by technical specialists • Wide
dissemination of findings • Focus on practical
results that impact practice

The critical role of state DOTs

The state DOTs created NCHRP in 1962 to find answers to common problems in highway planning, design, construction, operation, and maintenance. The state DOTs, through AASHTO, are the sole sponsors of NCHRP. The program is operated in cooperation with the Federal Highway Administration (FHWA) and is administered through the Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine.

Fifty-three years after the program's creation, state DOTs continue to be the driving force behind NCHRP research. The members of AASHTO—the DOTs of the 50 states and the District of Columbia—come together every year to fund, select, and oversee NCHRP research projects aimed at addressing the states' most critical research needs.

“NCHRP works to address our most critical transportation challenges through applied research. These valuable research projects result in practical solutions that improve the nation's transportation system.”

*Paul Trombino
Director, Iowa DOT, and President, AASHTO*

States provide the funding for NCHRP

Each year, state DOTs voluntarily commit to NCHRP research 5.5 percent of the State Planning and Research (SPR) portion of their Federal-Aid-Highway funds. FHWA requests and pools these state contributions and, under a cooperative agreement, makes them available for research contracts and for administration of the program through TRB.

Available funds for NCHRP have remained strong during the past 20 years, rising along with increases in the Federal-Aid-Highway funds provided by Congress and the corresponding growth of SPR funds. The Intermodal Surface Transportation Efficiency Act (ISTEA) resulted in a funding level of approximately \$17 million for NCHRP for fiscal years 1992 through 1997. This was increased by more than 50 percent on average in fiscal years 1998 through 2003 by the Transportation Equity Act for the 21st Century (TEA-21), which Congress extended, resulting in \$35.4 million for FY 2004.

The most recent federal legislation—the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) and the Moving Ahead for Progress in the 21st Century Act (MAP-21)—resulted in an average of \$40 million being programmed for fiscal years 2012 through 2016. See Exhibit 1.

Exhibit 1. Budget Allocations for NCHRP, FY 2012 to FY 2016

Allocations	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
New projects and continuation projects	\$31,470,000	\$26,465,000	\$29,916,000	\$28,630,000	\$30,840,000
Administration, technical direction, panels, and publications	\$10,521,969	\$11,121,473	\$11,300,600	\$12,064,000	\$11,332,000
Total	\$41,991,969	\$37,586,473	\$41,216,600	\$40,694,000	\$42,172,000

States select NCHRP research projects

A thorough process of consultation and review gives states a strong voice in selecting NCHRP research projects. The process is led by AASHTO SCOR, which provides oversight to NCHRP. SCOR is composed of 16 state DOT members (four from each of the four AASHTO regions) plus ex officio members from FHWA and other federal agencies. In addition, the SCOR chair must be the CEO of one of the state DOTs, and the vice-chair is the chair of the AASHTO Research Advisory Committee (RAC), composed of research directors from all AASHTO member departments.

In July of every year, SCOR invites the submission of research problem statements from three authorized sources: (1) AASHTO member transportation departments, (2) the chairs of AASHTO's committees and subcommittees, and (3) FHWA.

Research in Progress



Searching TRB databases helps submitters of problem statements avoid duplicating research.

Individuals from the three sources have until October 15 to submit their ideas, describing why the research they are proposing represents an immediate need and is of interest to the majority of states. The problem must be one that can be handled effectively under a cooperative program and have a high probability of success. Submitters are asked to search the relevant literature in TRID—a database that combines the records of TRB's Transportation Research Information Services (TRIS) and the Organization for Economic Cooperation and Development (OECD) Joint Transport Research Centre's International Transport Research

Documentation—and the Research in Progress (RiP) database to determine if similar efforts are already under way or if satisfactory answers are already available.

NCHRP and FHWA staff and other technical experts review all problem statements for technical merit and request clarification from submitters when appropriate. At the same time, NCHRP panels and staff also prepare recommendations for continuation of projects begun in earlier years.

In December, NCHRP prepares a report of proposed continuation projects and new problem candidates. This report is sent to members of SCOR and RAC as a ballot for rating each of the candidates according to need, value, and appropriateness. The ballot results are used to establish a preliminary ranking to help structure the discussion of candidates by SCOR at its March meeting.

In March, based on expected funding for the next fiscal year, SCOR allocates funds for new and continuation projects. Once the program is developed, SCOR sends a report to the AASHTO Board of Directors (CEOs of each of the member departments) requesting final approval. A favorable vote of at least two-thirds of the

member departments is required. In addition, each year's program must be approved by FHWA and accepted by the Academies.

“The best thing about NCHRP is that it's 50 states coming together saying ‘here is what we need,’ then agreeing on what the problem is, and then finding that research solution.”

*Kirk Steudle,
Director, Michigan DOT*

In each of the last several years, approximately 120 problem statements and 20 requests for continuation have been balloted. SCOR typically funds a number of requests for continuation projects each year. These include quick-response research for AASHTO committees; research carried out under NCHRP subprograms, such as the Synthesis series, the IDEA program, and the

domestic scan program; and projects from previous years that request additional funds to build on their success with additional research. In recent years, SCOR has funded approximately 40 new projects each year.

A cumulative total of 1,717 research contracts have resulted from all NCHRP yearly programs through 2015. The FY 2016 program will add another 45 new contracts and 16 continuations. See Exhibit 2.

Exhibit 2. Number of Research Projects Selected by SCOR, FY 2012 to FY 2016

Projects	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Continuation projects	18	17	15	12	16
New projects	46	41	50	46	45
Total projects	64	58	65	58	61
Total project funds	\$31,470,000	\$26,465,000	\$29,916,000	\$28,630,000	\$30,840,000

Funding for the FY 2016 program is expected in early 2016, permitting execution of contracts and initiation of research. SCOR will formulate the FY 2017 program in March 2016 based on proposals solicited in July 2015, the beginning of another cycle of NCHRP research.

States help guide NCHRP research projects

Each research project is assigned to a panel of subject experts who are very knowledgeable in the project area and who are looked to for technical guidance and counsel throughout the research and reporting phases. A broad search is made for these individuals, and TRB usually receives about four to five times as many nominees as can be used in the available panel positions.

Panel members do not act as consultants or advisors to project investigators; they may not submit proposals for research. All members serve without compensation, and their total yearly contribution to the program adds up to thousands of staff-days. The panel members are drawn from all walks of professional life, with heavy dependence on practitioners from AASHTO member departments. See Exhibit 3.

**Exhibit 3. Affiliations of Panel Members on Active Projects
(Current number of active projects = 376)**

Affiliation	Panel Members*	
	Number	Percentage
State agencies	1,328	55
Federal agencies	79	3
Local, transit agencies, MPOs	122	5
Educational institutions	270	11
Industry, consultants, associations	643	26
All	2,442	100

* Does not include liaison representatives.

Panel members assume a number of key responsibilities for helping ensure the quality of NCHRP research. The project panel analyzes the initial problem that was submitted, develops a final project scope and objectives, and then prepares a formal research project statement by which proposals are solicited from qualified research agencies. The panels review the research proposals, recommend contract awards, and provide counsel to the NCHRP staff members responsible for management of the research contracts. Finally, the panels review final reports for acceptability and for accomplishment of the approved research plan.

A model for cooperative research

The model developed for NCHRP not only has functioned effectively for more than 50 years but also has served as the foundation for five other successful applied research programs managed by TRB. TRB now has national cooperative research programs in the fields of highways, transit, airports, hazardous materials, freight, and rail transportation. Beyond the walls of TRB, much of the research community looks to NCHRP as a model of what works. Many of the research programs in state departments of transportation use procedures modeled on NCHRP. From other units of the Academies to industry associations in a variety of fields, experts approach NCHRP for advice on how best to manage cooperative research.



NCHRP tackles issues that are of common concern among multiple states. Addressing the impacts of extreme weather on highways is just one of many examples of how NCHRP helps leverage resources to provide shared solutions.

Academies, the NCHRP does not own roads, make laws, or set policy. It provides a neutral forum for objective research without bias or prejudice. NCHRP does not bend to changing political whims or a need to generate profit. NCHRP panels bring diverse stakeholder groups together with a common interest for a common objective.

The program is not intended to be “all things to all people.” NCHRP research is effective because each project is directly targeted at a current problem. When a project is completed, there is an audience waiting to implement the results.

Stakeholders drive success

What makes this model so effective? Why has NCHRP been supported by voluntary contributions for 50 years? One of the key success factors is stakeholder involvement. Those who will ultimately benefit from the research are involved from beginning to end, starting with the identification of research ideas that might address their day-to-day problems. Once these ideas are identified, stakeholders review them and select and prioritize projects that will provide the greatest benefit. When projects are selected, stakeholders help to craft requests for proposals, and then provide technical guidance throughout the project to ensure that the research will provide practical, beneficial, and implementable results. When an NCHRP research project is completed, every step has been taken along the way to make sure the research product will address a real need in the real world.

An objective eye

Another key element in the NCHRP model is objectivity. Operating within the structure and guidelines of the nonprofit

Investing wisely in research

Further, by working on shared, national problems and issues, the NCHRP model is designed to seek solutions effectively and efficiently. Every dollar spent on NCHRP research is a dollar saved by each of the state and local agencies that would need to seek independent solutions to its problems in the absence of a coordinated, national program. The reduction of duplication allows all stakeholders to leverage their funds for a common goal and provides them a body of knowledge far in excess of what they could achieve on their own.

The NCHRP model is designed to spend its stakeholders' dollars wisely and to save them time, money, and lives. Transportation research helps in a variety of ways—for example, minimizing the time wasted by the travelling public due to roadway congestion, keeping down vehicle costs and commuting times, improving the efficiency and cost effectiveness of government programs, reducing vehicle crashes, and lessening the tragic loss of life and its impacts on families and communities. NCHRP fosters innovation in design, construction, and materials that results in better-performing, longer-lasting products and savings for road users.

Competitive investigator selection

Finally, one of the most significant success factors is the competitive process used to select NCHRP contractors. Each project panel develops a request for proposals that is posted publicly and can be responded to by any private firm or academic institution. Contractors are selected based on the qualifications of their team members and the merit of their research approach.

“We used [NCHRP Report 597 on controlled low-strength material in highway construction] as a jumping-off point for our own in-house research and development.”

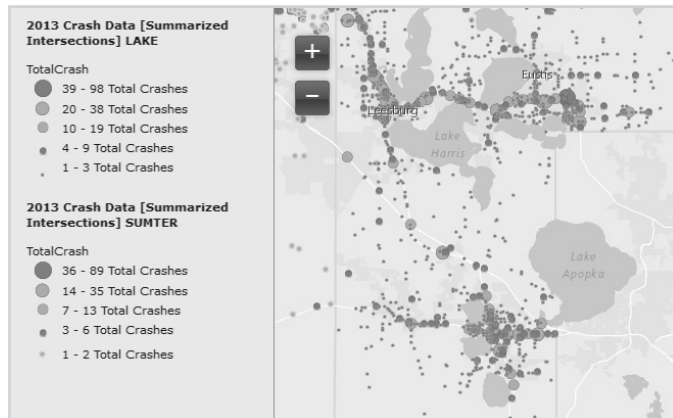
*Mike Arellano,
District Maintenance Engineer, Texas DOT*

Topics across the spectrum of highway concerns

The subject matter of NCHRP projects extends across the full spectrum of concerns within the highway industry and demonstrates AASHTO's interest in acquiring answers to the many acute problems facing DOT administrators and engineers. Problems submitted as candidates for funding each year are given a unique identification number based on the NCHRP Classification System. See Exhibit 4.

This identification number, corresponding to the specific problem area addressed, is part of the number that identifies a research project throughout its life cycle, until the project is given an NCHRP publication number when the final deliverable is published. For example, NCHRP Project 08-76 identifies a project in Area 8 (Forecasting). NCHRP Project 09-52 identifies a project in Area 9 (Bituminous Materials). Once research was completed, final reports for these projects were published, respectively, as *NCHRP Report 811: Institutionalizing Safety in Transportation Planning Processes* and *NCHRP Report 815: Short-Term Laboratory Conditioning of Asphalt Mixtures*.

Table 2 of the *Annual Report* uses this project numbering system to present information about active, completed, and pending NCHRP projects in 2015. The projects are grouped sequentially from Area 1: Design—Pavements through Area 25: Transportation Planning—Impact Analysis.



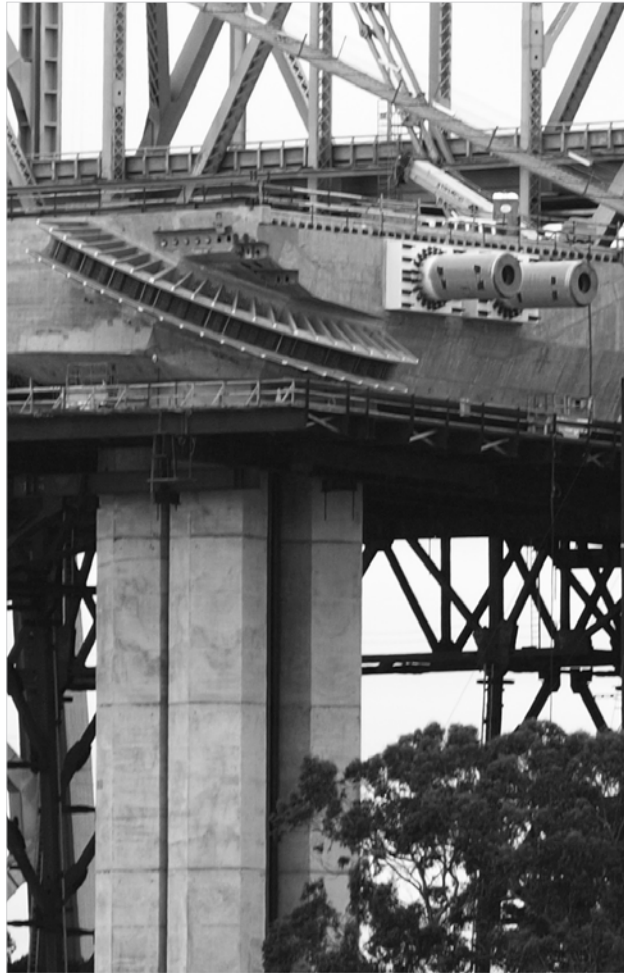
NCHRP Project 08-76 defined a transportation safety planning framework, which includes collection and analysis of crash and road data. The project led to the publication of *NCHRP Report 811: Institutionalizing Safety in Transportation Planning Processes*.



Loose mix sampling at the New Mexico field site of NCHRP Project 09-52 led to the publication of *NCHRP Report 815: Short-Term Laboratory Conditioning of Asphalt Mixtures*.

Exhibit 4. Problem Areas

1	Pavements
2	Economics
3	Operations and Control
4	General Materials
5	Illumination and Visibility
6	Snow and Ice Control
7	Traffic Planning
8	Forecasting
9	Bituminous Materials
10	Specifications, Procedures, and Practices
11	Law
12	Bridges
13	Equipment
14	Maintenance of Way and Structures
15	General Design
16	Roadside Development
17	Safety
18	Concrete Materials
19	Finance
20	Special Projects
21	Testing and Instrumentation
22	Vehicle Barrier Systems
23	Properties
24	Mechanics and Foundations
25	Impact Analysis (Social, Environmental, Economic, Energy)



“[An NCHRP domestic scan] helped drive national efforts to develop AASHTO code provisions for applying [accelerated bridge construction] in high seismic areas.”

*Alexander Bardow,
Director of Bridges and Structures,
Massachusetts DOT*

SELECTING THE BEST INVESTIGATORS

A rigorous, competitive process

NCHRP does not award grants for research. Rather, the program invites competing proposals from prospective investigators who can demonstrate capability and experience in the problem area to be researched. Eligible organizations can be from either the public or private sector and include universities, nonprofit institutions, consulting and commercial firms, and individual consultants. Throughout its history, NCHRP has awarded research contracts to agencies headquartered in 47 states, the District of Columbia, Canada, and England. Agencies selected to conduct NCHRP research fall, principally, into two categories—industry/consultant and university/research institute—as shown in Exhibit 5.

Exhibit 5. Agency Distribution Across Contracts

Contractor Type	FY 2012		FY 2013		FY 2014		FY 2015		FY 1963 - FY 2015	
	No.*	%	No.*	%	No.*	%	No.*	%	No.*	%
Industry/consultant	37	61	31	58	36	63	25	56	952	55
University/research institute	23	38	22	42	21	37	20	44	742	43
Other	1	1	0	0	0	0	0	0	23	2
Total	61	100	53	100	57	100	45	100	1,717	100

* Contract totals do not include the individual topics and tasks for Projects 08-36, 20-07, 20-65, and 25-25 (quick-response research for AASHTO committees); 20-05; 20-06; 20-30; 20-36; 20-44; and 20-68.

Requests for proposals are issued on TRB's website, announced through the weekly TRB E-Newsletter, and distributed to a self-subscription listserv. Proposals must comply with the format outlined in the publication *Information and Instructions for Preparing Proposals for the Transportation Research Board's Cooperative Research Programs*.

The proposed budget total is not a primary factor in selecting an investigator because the funds available for research are announced in the project statement. Specific budget items in the proposal are reviewed to determine staff allocations and distribution of resources. When the proposed cost exceeds the funds stated to be available, the proposal is rejected on receipt.

The project panels select investigating agencies based on careful evaluation of all proposals and a review of available information on proposers' past performance on other research projects sponsored by NCHRP or others. The successful proposals are retained by panel members for use in monitoring the research. Proposals, panel deliberations, and meeting notes are considered to be privileged information and are not released outside of TRB.

“[NCHRP’s Foresight 750 Series] represents big-picture, strategic thinking.... Each of the six reports offers new insights and new tools for managing the future.”¹¹

*John Halikowski,
Director, Arizona DOT, and
Chair, AASHTO Standing Committee on Research*

To support AASHTO's interests, needs, and capital investments, a contract is not signed with the selected agency until the NCHRP staff and project panel are satisfied that the proposed scope of work provides the best probability for a successful outcome. Furthermore, soon after contract execution, the investigating agency is required to submit a Working Plan (an amplified version of the research plan), against which project progress is monitored by the staff and project panel.

NCHRP will provide a debriefing, if requested, to unsuccessful proposers to indicate the technical areas in which their proposals were judged to have weaknesses or deficiencies that were factors in not being selected.

Selection of an agency is made by the responsible project panel considering the following factors*:

- (1) the proposer's demonstrated understanding of the problem;
- (2) the merit of the proposed research approach and methodology;
- (3) experience, qualifications, and objectivity of the research team in the same or closely related problem area;
- (4) the plan for ensuring application of results;
- (5) the proposer's plan for participation by Disadvantaged Business Enterprises—small firms owned and controlled by minorities or women; and
- (6) the adequacy of the facilities and equipment.

*From *Information and Instructions for Preparing Proposals for the Transportation Research Board's Cooperative Research Programs*



“We have used NCHRP to help us set up lead states and training to implement the *Highway Safety Manual*.”

*Brian Blanchard,
Assistant Secretary for Engineering
and Operations, Florida DOT*

The central role of NCHRP professionals

TRB is headquartered at the Keck Center of the Academies, 500 Fifth St. NW, Washington, D.C.

Once research starts, administrative and technical oversight of progress is performed by NCHRP staff. In-depth oversight by project managers with wide-ranging expertise is an important factor contributing to project success.

In addition to reviewing monthly progress schedules and quarterly progress

reports, the project managers maintain frequent contact with the research agencies throughout the contract periods. They review the project's status to learn whether the research is being pursued in line with the approved research plan, and they provide guidance to the investigator in all technical and administrative matters. They also serve as liaisons to the project panels to keep them abreast of progress and to acquire panel guidance and counsel in technical matters, particularly regarding the needs of the DOT practitioner.

The principal investigator has flexibility in managing the project budget up to the point of not materially departing from the approved research plan or exceeding the contract's maximum allowable cost. Any major changes to account for promising new research leads or unproductive lines of study must be approved in advance by the staff and project panel and are authorized through a contract amendment. Agency invoices are checked by the staff for deviations from the approved budget. Based on

all oversight activities, the staff members update project status on the NCHRP website. Finally, the staff and panels evaluate the completed research to determine the degree of technical compliance with the contract so that recommendations for contract close-out can be made.

NCHRP project managers require research agencies to present results in a form that is directly usable by practitioners in AASHTO member departments.

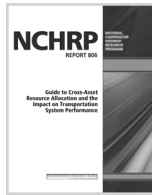


Panel members Naveen Lamba and Victor Hom of NCHRP Project 17-75, "Leveraging Big Data to Improve Traffic Incident Management."

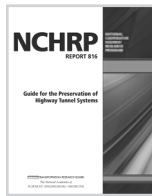
RESEARCH PRODUCTS

Disseminating research and documenting success

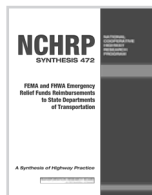
Dissemination of research findings to practitioners is a primary objective of the entire NCHRP research process. Publication of the final report or other deliverables is a key means of dissemination. NCHRP research findings are published in a number of series, which are listed in Table 1 of this *Annual Report*. Quantities for these series published over the past five years are shown in Exhibit 6. Some NCHRP publications produced this year are:



- *NCHRP Report 806: Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance* provides guidance and a spreadsheet tool to help managers with applying data-driven techniques to project prioritization, program development, scenario analysis, and target setting. The tool and guide are intended to assist managers with analyzing and communicating performance impacts of investment decisions. (Project 08-91)



- *NCHRP Report 816: Guide for the Preservation of Highway Tunnel Systems* presents an asset management tool that will help tunnel owners set priorities and make informed funding decisions for highway tunnel preservation. This guide provides DOTs credible, evidence-based information on bridge tunnel funding needs, as well as the means for communicating those needs. (Project 15-34A)



- *NCHRP Synthesis of Practice 472: FEMA and FHWA Emergency Relief Funds Reimbursements to State Departments of Transportation* summarizes efforts and enhancements made by DOTs to secure appropriate reimbursements and simplify cost identification. (Project 20-05/Topic 44-01)



- *NCHRP Legal Research Digest 65: Liability Aspects of Pedestrian Facilities* addresses legal claims that relate to pedestrian facilities, such as sidewalks and crosswalks, and focuses on allegations of violations of the Americans with Disabilities Act (ADA) and lawsuits alleging that a government agency has been negligent in maintaining its facilities. (Project 20-06)

Exhibit 6. Number of NCHRP Publications, 2011 to 2015

Publication Series	2011	2012	2013	2014	2015 (est.)
<i>NCHRP Reports</i>	34	31	25	39	20
<i>NCHRP Syntheses of Highway Practice</i>	13	14	14	14	17
<i>NCHRP Research Results Digests</i>	14	13	9	5	7
<i>NCHRP Legal Research Digests</i>	1	2	4	2	5
Web-Only Documents	16	10	8	9	8
CD-ROMs	3	3	4	9	5
Total	81	73	64	78	62

Publications are distributed widely by NCHRP and through TRB's distribution process, with print runs for reports ranging from 1,000 to 3,000 copies. Print copies are mailed to AASHTO, the CEOs of state DOTs, and the following individuals and organizations:

- TRB members who have chosen to receive publications in the particular subject area of the report
- About 100 libraries
- TRB representatives in the state DOTs
- Numerous educational institutions
- Liaison representatives from industry and transportation organizations in other countries
- Appropriate TRB panels and committees

NCHRP subprograms

Several "subprograms" are carried out within NCHRP. Results may be published in hard copy, delivered in the form of internal reports and presentations, published on the TRB website, or made available upon request.

Synthesis of Information Related to Highway Problems (Project 20-05)

Administrators, practicing engineers, and researchers continually face highway problems on which much information already exists, either in documented form or in terms of undocumented experience and practice. Unfortunately, this information is often fragmented and scattered, and therefore overlooked. The NCHRP Synthesis series aims to remedy this lack of awareness of existing solutions by assembling and organizing relevant information, practices, and research for particular highway problems.

Legal Problems Arising out of Highway Programs (Project 20-06)

State DOTs have an interest in evaluating the operating practices, administrative procedures, and legal issues associated with planning, design, and construction of transportation projects. Individual state legal experiences need to be compared and made available for possible wider application. This research identifies and evaluates legal options for DOTs, which facilitate the handling of both immediate and long-range needs.

Research for AASHTO and State DOT Leadership (Project 20-24)

NCHRP conducts focused research that addresses and responds to the evolving challenges facing state DOT decisionmakers. Reports from this project deliver timely information on topics including asset management, innovative financing and contracting, performance measures, and e-business, as well as emerging topics such as connected automated vehicles.

NCHRP IDEA Program (Project 20-30)

The Innovations Deserving Exploratory Analysis (IDEA) program funds research into promising but unproven innovations for highway design and construction, materials, operations, maintenance, and other areas of highway systems. A progress report that describes current and completed projects is published annually. A high percentage of products funded by the IDEA program have been successfully implemented.

International Highway Research and Technology (Project 20-36)

The International Highway Research and Technology program provides a coordinated approach to international information sharing and technology exchange. The program's overall objective is to improve highway safety, development, maintenance, and operations through dissemination of innovative technology and successful policies and practices from around the globe.

Domestic Scan Program (Project 20-68)

The NCHRP Domestic Scan Program is broad, considering any innovative practices of high-performing transportation agencies that could be beneficially adopted by other interested agencies. The purpose of each scan and of the program as a whole is to facilitate information sharing and technology exchange among the states and other transportation agencies and to identify actionable items of common interest.

Long-Range Strategic Issues Facing the Transportation Industry (Project 20-83)

AASHTO has invested \$7 million to examine strategic issues, both global and domestic, that will likely affect state DOTs over the next 30 to 40 years. Issues examined include potential changes in goods movement and freight; advance adoption of new technologies; preservation, maintenance, and renewal of highway infrastructure; changing transportation energy supplies and alternative fuel sources; and potential impacts of climate change on transportation infrastructure and operations.

Quick-response research for AASHTO committees

- **Standing Committee on Highways (Project 20-07)**

Through this project, the Standing Committee on Highways obtains guidance on an accelerated schedule through a continuing research program geared to the needs of the committee in the development of guides, standards, policies, and other AASHTO activities.

- **Standing Committee on Planning (Project 08-36)**

The objective of this project is to provide a flexible, ongoing program of quick-response research for the Standing Committee on Planning to improve analytical methods, decision support tools, procedures, and techniques employed by practitioners to support statewide and metropolitan transportation planning, programming, and development.

- **Standing Committee on the Environment (Project 25-25)**

This project provides flexible, ongoing, quick-response research to the Standing Committee on the Environment. The research is focused on environmental analysis, streamlining, stewardship, and planning to respond effectively to program delivery and project development issues.

- **Standing Committee on Public Transportation (Project 20-65)**

This project comprises quick-response research tasks to assist in the fulfillment of Standing Committee on Public Transportation responsibilities. Research is carried out on transit planning, operations, transit delivery, and related matters as state involvement in public transportation continues to grow.



Since the launch of the Domestic Scan Program (NCHRP Project 20-68) in 2006, nearly 30 scans covering all DOT business areas have connected practitioners nationwide and advanced the state of technology and practice.

The final report

As an applied research program, NCHRP expects final research reports to be presented in language understandable to both administrators and practitioners and in a format that permits easy assimilation and application. The detailed research techniques and analyses in which a researcher would be interested are generally presented in appendixes. NCHRP specifies the style and organization of all reports to guide the researchers in their writing so that AASHTO member departments may obtain the greatest benefit.

NCHRP staff write a foreword to each published report that (1) identifies the fields of specialty of those likely to be most interested in the results and (2) suggests how the results fit into present knowledge and practice. All published reports are offered for sale through TRB's Business Office. Since 2001, published reports also have been made available electronically on TRB's website. For ready availability to interested parties, unpublished reports are available in hard copy or electronically.

Promoting useful results before publication

NCHRP undertakes a number of activities before formal publication of the final reports to increase the probability that results will be applied:

- Initial research proposals are required to state how the anticipated results can be used to improve practice.
- Panel members—who not only are experts in the particular problem area, but also have a good understanding of practitioner needs—define the research problem and its objectives. Experts from state DOTs play a major role in this task.
- Investigators are selected both for the clarity of their research objectives and the likelihood that the research will be usable and readily implementable.
- Staff and panel members establish agreement with the investigator on what is expected from the project and the researchers in order to meet the needs of the practitioner.
- Project oversight aims to keep the research in line with the approved research plan and ensure that all project developments through final reporting center on practitioner needs.

Implementing research results

Over the years, NCHRP staff and various AASHTO committees have worked together to structure research findings into the best possible form for immediate use by the practitioner. Such joint efforts have facilitated implementation of the findings. AASHTO has provided NCHRP with frequent opportunities for staff and project researchers to go before the association's various committees to present their findings and recommendations directly to the user community. At the request of project panels, NCHRP will provide additional funding to accelerate the implementation of promising products through workshops, presentations, and demonstration projects.

Documenting success

For the past several years, NCHRP has addressed the challenge of documenting or showcasing successful research products. Several approaches are being used, and NCHRP will continue to explore new and better ways to meet this challenge.

Every four years, NCHRP surveys panel members from completed projects to identify known applications of research results. Feedback from these surveys enables NCHRP to confirm high usage and application of research results, to improve the implementation of future research results, and to identify successful applications of research.

These successful applications of NCHRP research are showcased in a series of case studies, “Impacts on Practice,” based on interviews with DOT practitioners. More than 30 of these case studies are posted on the TRB website.

In addition, the interviews with DOT practitioners have identified the various ways that states implement NCHRP research results. NCHRP documents some of these implementation efforts and methods in the “Paths to Practice” series.

Two examples each of “Impacts on Practice” and “Paths to Practice” case studies are included in the following pages.

- NCHRP Synthesizes Highway Solutions
- Game-Changing Ideas in Transportation Research
- A Revolution in Highway Safety Planning
- How to Minimize Deicing’s Environmental Impact

NCHRP synthesizes highway solutions

“State DOTs aren’t satisfied with the status quo,” says Brian Blanchard, Florida DOT’s assistant secretary for engineering and operations. “We all want to innovate. We also know that often the most efficient path to innovation is to borrow good ideas from one another.” That’s exactly what the NCHRP synthesis program helps state DOTs do through a formal process of documenting leading technologies and practices on a wide range of transportation topics.

Compiling best practices

Blanchard is chair of the NCHRP Project 20-05 panel that oversees the NCHRP Syntheses of Highway Practice (trb.org/SynthesisPrograms/SynthesesNCHRP.aspx). “For a given issue or area in transportation,” he says, “there are sure to be many successful practices out there, but the information is often fragmented and hard to find. The NCHRP synthesis program serves to locate and assemble techniques that have been used to address a particular problem.”

About 15 NCHRP syntheses are funded each year, says Jon Williams, director of the NCHRP synthesis program. To date, NCHRP has published nearly 500 syntheses (those produced since 2001 are available at trb.org/Publications/PubsNCHRPSynthesisReportsAll.aspx/), with complementary TRB programs synthesizing practice for airports and transit topics.

NCHRP synthesis topics are selected to address problems that are widespread enough to generate broad interest and that are timely and critical with respect to safety, economic, or social impacts. Topics typically address practices that are not uniform or consistent from agency to agency and where there is

Anatomy of an NCHRP Synthesis

Regardless of the topic, each NCHRP synthesis shares these aims:

- Locate and assemble documented information on the selected topic.
- Learn what practices have been used to solve or alleviate the problem.
- Identify all relevant ongoing research.
- Identify gaps in knowledge and research needs.
- Organize, evaluate, and document the useful information that is acquired.
- Disseminate the synthesis information to all who might benefit from it.

“The NCHRP synthesis program serves to locate and assemble techniques that have been used to address a particular problem.”

a need to organize and condense existing knowledge.

“For a given topic,” Williams says, “the expert investigator conducts a study that includes an exhaustive literature search as well as a survey of state DOTs.” Williams notes that the required minimum survey response rate of 80 percent ensures credible findings.

In addition, a technical oversight panel is established for each topic to guide the investigator in organizing and evaluating the collected data and to review the report. This assures readers that the contents of the syntheses have been thoroughly evaluated by topic experts.

Timely and valid findings

John Mason, vice president for research and economic development at Auburn University, has a multifaceted perspective on the program, having served in several roles: NCHRP synthesis program oversight panelist, member of several technical review

“The synthesis gave states the chance to see what other agencies are doing. It served as an important reality check.”

panels for individual syntheses, and principal investigator for *NCHRP Synthesis 316: Design Exception Practices*.

Based on this experience, Mason concludes that NCHRP synthesis reports are among TRB’s top products. “The utility of a synthesis is very high,” he says. The timeliness and validity of synthesis findings are of particular importance to Mason.

“The synthesis process is rapid, with a typical timeline of about a year from project commencement to report publication,” Mason says. As a consequence, each published synthesis represents the state of the art for the selected topic. Further, because each synthesis is formally reviewed by a technical panel of experts, the findings are highly credible and valuable to state transportation agencies.



NCHRP Synthesis 364 has helped forge public-private partnerships by compiling best practices on forecasting toll road demand and revenue.

In the case of *NCHRP Synthesis 316*, Mason reports that the compilation of design exception practices proved to be used widely among state DOTs. “The synthesis gave states the chance to see what other agencies are doing,” he says. “It served as an important reality check in considering the varying approaches to management, analysis, and rulemaking for design exceptions.”

The target audience often goes beyond DOT practitioners to include academia and industry as well. *NCHRP Synthesis 364: Estimating Toll Road Demand and Revenue* compiled best practices that helped public agencies and

(continued)

NCHRP — Transportation research that works

Objective national highway research since 1962 • Focused on practical problems of state DOTs • Contract researchers competitively selected • Overseen by balanced panels of technical experts • Reviewed by TRB highway specialists

private industry alike make better traffic forecasts and more informed infrastructure investments. “More reliable traffic numbers can mean more credible revenue forecasts, better bond ratings, and lower costs for all concerned,” says principal investigator David Kriger of David Kriger Consultants.

The value of *NCHRP Synthesis 364* extends past the original scope, permeating public sector decision making. “The forecasting methodologies in this synthesis are used beyond toll roads,” Kriger says. “Agencies rely on credible demand forecasts for highway and transit projects of all kinds, as well as environmental and economic impact studies.”

“A transportation agency interested in learning about this practice would want to start by reading the NCHRP synthesis.”

Making state and national impacts

NCHRP Synthesis 402: Construction Manager-at-Risk Project Delivery for Highway Programs was another among many syntheses that had a big payoff. Interest in the construction manager-at-risk delivery method (equivalently called “construction manager/general contractor”) is high, and the synthesis was timely.

“Many state DOTs have adopted this practice, and the number keeps going up,” says synthesis principal investigator Doug Gransberg, a professor at Iowa State University.



GPS-guided construction was just starting to take off when *NCHRP Synthesis 372* assembled best practices on this and other new construction technologies.

The synthesis of findings in this area became a springboard for a follow-up NCHRP research study. Gransberg went on to conduct NCHRP Project 10-85, “A Guidebook for Construction Manager-at-Risk Contracting for Highway Projects.” AASHTO is in the process of adopting the findings as an official guidance document, he says.

Even given all this follow-up work, the synthesis itself remains a highly relevant tool. “It continues to provide a concise description and examples of how this delivery method works,” Gransberg says. “A transportation agency interested in learning about this practice would want to start by reading the NCHRP synthesis.”

Moreover, this synthesis has had a reach beyond state DOTs, playing a role in federal policy and funding. In 2011, the U.S. DOT’s review of a draft transportation authorization bill cited *NCHRP Synthesis 402* to explain the benefits of construction manager-at-risk contracting. Similar language was ultimately included in the Moving Ahead for Progress in the 21st Century Act, effectively fast-tracking this delivery method for federal-aid highway projects.

On the leading edge

Syntheses also help lead the way on emerging practices. John Hannon, a professor with the University of Southern Mississippi, was the principal investigator for *NCHRP Synthesis 372: Emerging Technologies for Construction Delivery*. He describes the project conducted nearly a decade ago as ahead of its time. “Many of the technologies that are more commonplace now—remote monitoring, GPS machine guidance, 4-D modeling—were just in the process of becoming available,” Hannon says.

“The synthesis came at a perfect time,” he says. “There was a lot of excitement about what different states were doing. The synthesis was instrumental in spurring along state-sponsored studies, pilot projects, and implementation of these technologies.”

This project too led to follow-up research: NCHRP Project 10-77, “Use of Automated

“The synthesis was instrumental in spurring along state-sponsored studies, pilot projects, and implementation.”

Machine Guidance (AMG) within the Transportation Industry.” The forthcoming report will provide AMG technical specifications and implementation guidelines for DOTs.



NCHRP Research Results Digest 392 provides a comprehensive overview of the NCHRP synthesis program and results to date.

As technology continues to evolve, Hannon thinks the time is right for another synthesis in this area. “A new synthesis on construction delivery systems would similarly help guide DOTs in the decade to come,” he says.

An enduring legacy

Given the successes seen in this small selection of syntheses, it is not surprising that the program has been greeted with ongoing enthusiasm and has enjoyed such longevity. The synthesis program is in its 46th

year, making it just a few years younger than NCHRP itself.

Mason explains that each year, the fifteen or so funded projects are selected from a pool that typically exceeds 100. “This large application pool is a real positive,” he says. “Practitioners in every area of transportation see that the synthesis program can address their needs.”

Blanchard also sees the value of the comprehensive reach of the program. “The synthesis program helps us address problems in all areas of transportation,” he says. “That includes design, contracting, operations, maintenance—everything that we do as a DOT.”

A recent program update is available in *NCHRP Research Results Digest 392: Continuing Project to Synthesize Information on Highway Problems* (trb.org/Main/Blurbs/171932.aspx).

“Practitioners in every area of transportation see that the synthesis program can address their needs.”

ACKNOWLEDGMENT OF SPONSORSHIP Work was sponsored by the American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program, which is administered by the Transportation Research Board of the National Academies.

DISCLAIMER The opinions and conclusions expressed or implied in reports are those of the research agencies. They are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors.

Game-changing ideas in transportation research

While transformative technologies in transportation often begin simply as ideas, the gap between concept and practice can be formidable. Because the greatest innovations often involve the highest risks, funding for such research can be difficult to obtain. The NCHRP Innovations Deserving Exploratory Analysis (IDEA) program helps inventors take promising but unproven ideas in transportation engineering to the next level.

The next big idea

NCHRP's Highway IDEA program provides grants of up to \$150,000 for eight to 10 projects a year. "We're interested in high-risk but potentially game-changing concepts in transportation," says Jon Williams, IDEA program director. The program is a complement to traditional applied research. "We want to hear the big ideas—those untested but visionary concepts that might not otherwise have a platform to develop," he says.

Created in 1988 as part of the Strategic Highway Research Program, the IDEA program was transferred to TRB in 1992 and is now funded by state highway agencies via AASHTO. The NCHRP IDEA program, which focuses on highway transportation systems, is one of three active IDEA programs along with Transit IDEA and Rail Safety IDEA.

The NCHRP IDEA program is open to anyone with an innovative idea to solve a highway problem, and so far it has funded or approved 184 projects. Of 162 completed projects, one in six has been successfully commercialized, and many more show great promise.

"We want to hear the big ideas—those untested but visionary concepts that might not otherwise have a platform to develop."

"For such high-risk projects, we thought one in 10 would be a great success rate," says Inam Jawed, a senior program officer at TRB who manages the NCHRP IDEA program. "So we feel really good about a rate of one in six."

Reducing risk in bridge assembly

One of IDEA's success stories involves the development of a laser measurement system to dramatically increase the efficiency of the way steel bridge girders are assembled.



The Bridge Virtual Assembly System's laser detection allows bridge girders to be fitted via a computer model rather than manually in fabrication shops.

Developed by Paul Fuchs of Fuchs Consulting in Leesburg, Va., the Bridge Virtual Assembly System allows fabricators to generate 3-D computer models of girders to ensure that they will fit when assembled in the field.

Virtual fitting replaces a laborious manual process that can account for as much as 15 percent of manufacturing costs. It also increases accuracy by providing digital records that are orders of magnitude more detailed than typical paper records.

"Ensuring accuracy is critical to preventing costly errors in which girders get to the field and turn out not to fit," says Fuchs. "This system helps catch errors in the shop, before girders reach the field." When an error is discovered, the system provides precise and traceable documentation of what a fabricator produced, which can be critical to finding out what went wrong.

"The IDEA program was central to getting us where we are with the system."

The complexity of this system required development over many years to overcome both technical and institutional hurdles. "A system like this requires buy-in from fabricators, states, and FHWA," says Fuchs, since all three must agree on any changes to standard procedures. That's a process that took more than 15 years, and wouldn't have been possible without the assistance of the NCHRP IDEA program in 2007.

With an IDEA grant, Fuchs was able to test the system at the facilities of steel bridge fabricators in Pennsylvania and South Dakota, demonstrating its ability to work in a shop environment.

"The IDEA program was central to getting us where we are with the system," says Fuchs, "especially with initial system development."

The project also led directly to a follow-up pooled fund study in which the system could be put to the test. The system was recently used for the first time to manufacture a bridge in Tennessee, and will be used for a second production job on a bridge in Virginia.

"We were looking to develop a better pavement. What we found was a solution that also helps the environment."

Environmental and performance benefits with bio-asphalt

Another IDEA-funded project is helping to address two problems at once: decreasing the environmental impacts of swine farming while producing a better method for incorporating recycled tire rubber into asphalt.

(continued)

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While using recycled rubber in asphalt is both environmentally friendly and can improve pavement performance, mixing it with asphalt binder can be difficult. The process requires extensive grinding of the rubber, which can reduce the rubber's performance benefits by damaging its structure. These mixtures can also require more energy for heating and pumping, making some contractors reluctant to use them.



An IDEA project has unlikely partners in an effort to improve asphalt modification.

IDEA-funded research by Elham Fini of North Carolina A&T State University is using swine manure to help rubber and asphalt work better together by developing a bio-binder alternative to the petroleum-based binder typically used in asphalt. "This binder reacts with the surface of rubber particles to produce a better mixture that is easier to pump and has a longer storage time," says Fini.

The resulting bio-asphalt also reduces construction costs and ensures that rubber-based asphalt will perform more consistently. Cost savings come from both the lower costs of using recycled rubber and the fact that farmers will pay to have swine manure reclaimed, which is also very beneficial to the environment. Where typical asphalt costs around \$2 a gallon, Fini's bio-asphalt could cost as little as 50 cents a gallon.

While the environmental and cost benefits are important, the project's main goal was to improve pavement performance. "We were looking to develop a better pavement," says Fini. "What we found was a solution that also helps the environment."

With the first phase of the project nearly complete, several companies are showing interest in funding further development of the product. "We hope with the help of NCHRP and industry to bring the technology closer to market," says Fini. "The aim is not only to enhance the properties of rubber-modified asphalt but also to facilitate and promote scrap rubber application."

Building a better bridge beam

One of the IDEA program's most successful projects was funded by both the NCHRP IDEA program and the now closed High-Speed Rail IDEA program: developing a hybrid-composite bridge beam for highway and railroad construction. This beam combines concrete, steel, and a fiber-reinforced plastic shell to obtain the best combination of compressive strength, tensile strength, weight, and corrosion resistance.

"Fiber-reinforced polymer composites have long been used to build airplanes, boats, and anything else that benefits from the combination of high strength, light weight, and corrosion resistance," says beam inventor John Hillman of HCB Inc. "We had the epiphany that you could combine concrete and steel with advanced composites to create a beam that's really efficient and utilizes material in the most structurally efficient manner."

At about one-tenth the weight of a typical precast concrete girder of the same length, the beam is far less costly to ship and much easier to erect, making it well suited to accelerated bridge construction. It also resists cracking and rusting, reduces the carbon footprint of structures by requiring fewer delivery trucks, and increases bridge service life to more than 100 years.



The hybrid-composite beam uses a tested technology to make structures lightweight, strong, and corrosion resistant.

To date, Hillman's hybrid-composite beam has been installed in 18 highway bridges in nine states and is receiving tremendous interest internationally. Hillman is convinced that composites will one day be as commonplace in the transportation industry as they are in other industries.

A distinct place in transportation research

Moving forward, the IDEA program will continue to play its singular role in the transportation research landscape.

"We had the epiphany ... to create a beam that's really efficient and utilizes material in the most structurally efficient manner."

"This is a unique program," says Williams. "Instead of simply saying no to unconventional ideas that don't fit into their research programs, transportation agencies can send them to us."

"Generally research is funded when it looks promising or is already a proven concept," says Iowa DOT's Sandra Larson, chair for six years of the project panel that oversees the NCHRP IDEA program. "The IDEA program is really unique among transportation research programs in providing seed money to explore unproven ideas."



The program's annual progress report includes descriptions and updates for all ongoing and completed projects.

It is also noteworthy, she adds, in its level of success. "I'm amazed by the impacts some of the products funded by the IDEA program are making," says Larson. "The program really is making an incredible difference in the transportation world."

A recently published report, *Products with an Impact or Potential Impact on Current Highway Practice—Notable Examples* (www.trb.org/Main/Blurbs/172600.aspx), highlights commercialized and other promising NCHRP IDEA products. Additional information about the NCHRP IDEA program may be found at www.trb.org/IDEA Program/IDEA Highway.aspx.

"Instead of simply saying no to unconventional ideas that don't fit into their research programs, transportation agencies can send them to us."

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A Revolution in Highway Safety Planning

The first edition of the *Highway Safety Manual* is the product of more than \$3 million of NCHRP research over 10 years. Using quantitative methods, the manual gives practitioners state-of-the-art tools to predict and evaluate the safety-related impacts of transportation decisions throughout the project development process.



The first edition of the *Highway Safety Manual* is a milestone in science-based safety planning.

Making Safety a Science

The safety of the traveling public on the nation's roadways is a top priority among transportation agencies, both at the national and the state levels. Yet even as recently as 1999, planners, designers, and traffic engineers had no consistent and reliable way to predict the safety impacts of decisions made throughout the project development process. Without a standard, data-driven approach available for anticipating potential crashes, safety considerations often took a back seat to other planning and development considerations.

In 1999, a TRB joint task force was established to initiate the development of an authoritative guide for evaluating the safety performance of transportation projects. With strong support from AASHTO and FHWA, TRB spearheaded a 10-year research and development process that led to publication of the nation's first *Highway Safety Manual* (HSM) in 2010.

The HSM fundamentally changes the way transportation professionals develop projects by supporting a quantitative safety evaluation of specific treatments or programs and predictive modeling of the safety impacts from varying geometric or operational decisions. The HSM consists of four parts, all

intended to support front-line decision making in transportation agencies:

- Part 1: Introduction, Human Factors, and Fundamentals of Safety
- Part 2: Roadway Safety Management Process
- Part 3: Predictive Methods
- Part 4: Crash Modification Factors

NCHRP Projects 17-18(4), 17-26, 17-27, 17-29, 17-34, and 17-36 provided the foundational research and production coordination for this edition. Additional studies fed into the ultimate manual and are contributing to ongoing enhancements.

Paths to Practice

Building the foundation

It was clear from the start that developing the new manual would require extensive and sustained coordination among multiple organizations, not only to effectively conduct the research needed to develop the HSM content but also to provide the organizational channels needed to produce, distribute, and promote the results. The new TRB joint task force spearheaded development of the HSM and provided the necessary framework for ongoing collaboration among TRB, AASHTO, and FHWA.

"It was a formal and committed process," says Geni Bahar, the investigator with NAVIGATS Inc. for HSM Parts 1 and 2. "Going from a report to a manual involved many years of work with volunteers from TRB and practitioners around the country." Each step in the development process

"It was a formal and committed process."

required extensive review and approval from the NCHRP project panels guiding the research, the TRB task force coordinating the overall effort, and the AASHTO committee

"We presented the science as it evolved to the TRB committees to make sure they were aware of what we were doing as we were doing it."

that would ultimately publish the manual. "We had to get the trust as well as the confidence of the professionals and researchers together to encourage adoption of the HSM," Bahar says.

Raising awareness, anticipating challenges

Getting support for the HSM at the national level was only the beginning, however. The TRB task force members knew that getting buy-in for the HSM among end users would

(continued)

Implementation Strategies AT A GLANCE

- **Cooperative National Effort:** Developing and implementing the *Highway Safety Manual* required broad and sustained collaboration among TRB, AASHTO, FHWA, and other transportation stakeholders.
- **Engaging End Users:** TRB established a user liaison subcommittee that was dedicated to educating end users about HSM, inviting feedback, and addressing practitioner concerns.
- **Providing Implementation Tools:** TRB, AASHTO, and FHWA worked together to support practitioner implementation by producing companion tools and resources and funding pilot implementations.

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be critical for widespread implementation. The task force established a user liaison subcommittee to identify potential HSM users and effective approaches to promoting the new concepts in the manual.

Chaired by Bahar, the subcommittee began simply by spreading the word about HSM at TRB conferences and inviting technical feedback from TRB committees. The group's work quickly became more formal, with systematic outreach efforts planned during frequent meetings and teleconferences. "We presented the science as it evolved to the TRB committees to make sure they were aware of what we were doing as we were

"We needed to create enough know-how to overcome the fears of change."

doing it," Bahar says. "We also invited state DOT engineering practitioners, through AASHTO, into the process throughout the HSM development. We worked with both sides—the TRB researchers as well as the practitioners who would be adopting and using the manual—so that when the manual was ready, there would be confidence and understanding."

HSM Implementation Tools and Support

- HSM web portal: www.highwaysafetymanual.org
- *HSM Implementation Guide for Managers* (including who to involve, how to address questions, what additional data may be needed, how to develop an implementation plan, and lessons from lead states)
- *Integrating the HSM into the Highway Project Development Process* (including planning, design, operations, and maintenance)
- Protocols and guidance documents for using crash modification factors and other resources with the HSM
- Lead state pilot implementation projects funded through NCHRP
- Companion tools and AASHTOWare, such as FHWA's Safety Analyst, Crash Modification Factors Clearinghouse, and Interactive Highway Safety Design Model
- Brochures, training materials, and technical support
- Workshops and webinars
- HSM User Discussion Forum

The subcommittee members also worked hard to acknowledge and address the concerns and challenges standing in the way of implementation in the states. For example, the data-driven approaches to safety quantification in the HSM represented a huge shift in practice for most transportation agencies. "The practice was far away from what we were trying to bring forward," Bahar says. "We needed to create enough know-how to overcome the fears of change."

Some states also expressed concerns about potential liability in relying on the manual to estimate safety impacts. The task force involved planners and legal experts to address potential issues throughout the development process.

Providing tools and technical support

Since the *Highway Safety Manual* became ready for purchase and use by practitioners in 2010, TRB, AASHTO, and FHWA have made every effort to provide support and guidance for putting the HSM into practice. A comprehensive HSM online portal (www.highwaysafetymanual.org) developed by AASHTO provides a single place to access numerous HSM guidance and reference documents, case studies, protocols, brochures, and training materials. An HSM User Discussion Forum also promotes information sharing and problem-solving among practitioners.

Leanna Depue, highway safety director at the Missouri DOT, says that implementation on this scale is always a work in progress. "You can't just produce a manual," she says. "You have to develop implementation strategies and nurture implementation. It's going to require updating for many years to come."

Implementation Success

The HSM has already been implemented in some form by more than half of the states, expedited through the participation of 21 DOTs as lead states or support states in the Lead States Initiative for Implementing the *Highway Safety Manual* (NCHRP 17-50). FHWA has also published case studies on HSM implementation in five states (Florida, Illinois, Idaho, New Hampshire, and Ohio), highlighting how transportation agencies are moving forward with enhancing their data collection efforts, developing new policies, assessing their skill gaps, and developing implementation plans to support HSM use.



The HSM methodology allows for the systematic comparison of design alternatives and their anticipated impacts on safety.

The TRB Highway Safety Performance Committee (ANB25) has taken the place of the joint task force to continue implementation coordination of the HSM with AASHTO and FHWA. These efforts include new research projects that will help enhance and expand agency capabilities when using the manual. Even as the methodology advances and evolves, the first edition of the HSM will remain a true milestone in science-based safety planning—the core of a fundamental shift in how transportation agencies plan for safety throughout the project development process.

"You have to develop implementation strategies and nurture implementation. It's going to require updating for many years to come."

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How to Minimize Deicing's Environmental Impact

As concern for the environment continues to grow among the public and winter maintenance professionals, NCHRP oversaw development of comprehensive guidelines for selecting environmentally friendly snow and ice control materials. AASHTO implemented these guidelines in a computer-based winter maintenance training program, and other organizations took a proactive role in encouraging their use at the state and local levels.



The winter maintenance community is increasingly interested in minimizing the environmental impacts of deicing chemicals.

Establishing Guidelines to Minimize the Environmental Effects of Winter Maintenance

Every winter, transportation agencies apply large quantities of salt and other chemicals to roads to keep them clear of snow and ice. Rational decision-making guidelines were needed to help maintenance managers assess the properties of various materials and take steps to minimize their environmental effects.

To help meet this need, NCHRP conducted NCHRP Project 06-16 and produced *NCHRP Report 577: Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts* (www.trb.org/Main/Blurbs/158876.aspx). The report provides guidelines through an evaluation of cost, performance, and impacts on the environment and infrastructure.

The project also produced a decision tool for selecting snow and ice control materials to suit the specific needs of any given highway agency (www.trb.org/NotesDocs/NCHRP06-16_MaterialSelectionWizard.zip). The software serves as a purchasing specification and as a quality assurance monitoring program that includes evaluation procedures and standard test methods.

At the conclusion of the research, there was a need to communicate the guidelines and tools to practitioners at state and local transportation agencies.

“This project produced very useful results that needed to be implemented in state DOT training programs,” says project panelist Lee Smithson, coordinator for AASHTO’s Snow and Ice Pooled Fund Cooperative Program and former Iowa DOT state maintenance engineer. “Training needs included processes for field personnel to assess potential impacts to the natural environment along roadways in their maintenance area, as well as procedures for determining comparative material prices and writing material purchase specifications.”

“A key to implementation of this project was AASHTO taking the lead....”

Paths to Practice

AASHTO computer-based training modules

AASHTO often serves as a critical bridge between NCHRP research and practitioners, and played an especially crucial role in this project, developing a computer-based training program on all aspects of winter maintenance and snow and ice control.

“A key to implementation of this project was AASHTO taking the lead and utilizing expertise from experienced state and local snow and ice control experts to develop these modules,” Smithson says.

“These modules are successfully teaching field and central office maintenance personnel how snow and ice control materials impact the receiving environment.”

Self-paced and accommodating multiple learning styles, the program’s eight modules can be accessed on maintenance garage computers or via the web. The web-based version was also made Shareable Content Object Reference Model-compliant, allowing integration with state DOT learning management systems.

The AASHTO computer-based training program is in use at nearly all state DOTs,

(continued)

Implementation Strategies AT A GLANCE

- **Partnering with AASHTO to Deliver Training:** Results were used to create computer-based training modules on all aspects of winter maintenance and snow and ice control.
- **Facilitating State and Local Implementation:** The American Public Works Association and the National Association of County Engineers helped incorporate results into the winter maintenance training programs of state and local agencies.
- **Disseminating Results:** Panel members presented results at conferences, symposia, and AASHTO meetings.
- **Framing Research for Practitioner Use:** Implementation was a key consideration in developing research goals.

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according to Smithson. The American Public Works Association (APWA) and the National Association of County Engineers (NACE) also include it in their recommended training programs.

“Implementing results often requires a willingness to accept risks—because sometimes there will be setbacks.”

“These modules are successfully teaching field and central office maintenance personnel how snow and ice control materials impact the receiving environment, and how to recognize and rank these impacts,” Smithson says.

Facilitating state and local implementation

While AASHTO took the lead in making the guidelines and tools available nationally, APWA and NACE led implementation efforts at the state and local levels.



Chlorides from deicing salts can cause leaf burn—discoloration and decay in plant tissues—and other environmental effects.

“There were many marketing champions from both APWA and NACE,” Smithson says. “APWA incorporated research results into its certification program, and some state DOTs made the guidelines a requirement in their training programs.”

Ultimately, implementation of research depends on state and local agencies being proactive, according to Smithson, and sometimes this requires a change in culture. Michael Fitch, project panel member and associate principal research scientist at the Virginia Center for Transportation Innovation and Research, agrees. “There are risks involved with changing the way you do things,” Fitch says. “Implementing results

often requires a willingness to accept risks—because sometimes there will be setbacks.” Fitch advocates seeing such setbacks not as failures but as stepping stones to meaningful change.

Overcoming this resistance, according to Smithson, requires advocates within the agencies themselves to show that the potential benefits are worth the risks. “The money and support are out there,” Smithson says. “It’s just a matter of convincing people there are achievable outcomes that produce savings and improve customer service.”

Disseminating results

Disseminating results is critical to such advocacy and overcoming resistance at all levels—national, state, and local. “The more that agencies stay informed and key leaders stay current with research, the more likely implementation is to be successful,” Smithson says.

However, there’s still a risk, notes Fitch, that key decision makers won’t have the time to read lengthy reports. “*NCHRP Report 577* is a big document,” Fitch says. “It’s crucial that this really important research be boiled down into summaries and highlights so it’s accessible to leaders who are pressed for time.”

Also critical is presenting findings to fellow practitioners. Smithson himself wrote technical papers about the computer-based training program and presented them at conferences and symposia, including Transportation Association of Canada Annual meetings, PIARC in Sweden, SIRWEC in Finland, AASHTO Highway Subcommittee on Maintenance summer meetings, and various regional snow conferences for APWA and state DOTs.

There is evidence that such efforts have led to *NCHRP Report 577* having a significant reach within the transportation community. “The report is commonly referenced in other research designed to reduce the impacts of winter maintenance practices on the environment,” Fitch says. “It is also very commonly mentioned among DOT winter maintenance experts.”

“There were many marketing champions from both APWA and NACE.”



AASHTO’s computer-based training program uses animation, video, and pre- and post-assessment to foster environmentally aware decision making.

Keys to Implementation Success

In the end, successful implementation of *NCHRP Report 577* depended on multiple channels—from AASHTO, APWA, and NACE involvement to aggressive dissemination efforts and proactive engagement by state and local agencies.

“The more that agencies stay informed and key leaders stay current with research, the more likely implementation is to be successful.”

Fitch also believes that the way the research project was framed from the beginning was critical to its implementation success. “You have to ask the right questions from the get-go to optimize chances for implementation,” he says. “That’s something the excellent research team for this project did very well.”

Smithson agrees, noting that the report served as an excellent foundation for the development of computer-based training.

“When the project started, I was hoping for a broad foundation in the subject area that could be made understandable to field and central office personnel,” Smithson says. “That’s exactly what we got.”

Fitch concludes, “I felt really good about this project, because I saw a product that could clearly serve as a critical foundation to implementation on both the operations and research sides of organizations.”

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Table 1. 2015 Publications of the National Cooperative Highway Research Program

Reports		
No.	Proj. No.	Title, Pages
797	07-19	Guidebook on Pedestrian and Bicycle Volume Data Collection (& WOD 205), 158 p.
798	08-36/Task 113	The Role of Planning in a 21st Century State Department of Transportation—Supporting Strategic Decisionmaking, 118 p.
799	20-89	Management Guide to Intellectual Property for State Departments of Transportation, 150 p.
800	08-87	Successful Practices in GIS-Based Asset Management, 160 p.
801	10-86	Proposed Practice for Alternative Bidding of Highway Drainage Systems, 144 p.
802	25-41	Volume Reduction of Highway Runoff in Urban Areas—Guidance Manual (& CD 162; & WOD 209), 228 p.
803	07-17	Pedestrian and Bicycle Transportation Along Existing Roads—ActiveTrans Priority Tool Guidebook (& CD 163), 96 p.
804	25-35	Guidebook for Designing and Managing Rights-of-Way for Carbon Sequestration and Biomass Generation (& CD 165), 54 p.
805	04-35	Improved Test Methods for Specific Gravity and Absorption of Course and Fine Aggregate, 104 p.
806	08-91	Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance (& CD 166), 122 p.
807	09-53	Properties of Foamed Asphalts for Warm Mix Asphalt Applications, 132 p.
808	10-83	Guidebook on Alternative Quality Management Systems for Highway Construction (& WOD 212), 90 p.
809	25-39	Environmental Performance Measures for State Departments of Transportation, 146 p.
810	01-48	Consideration of Preservation in Pavement Design and Analysis Procedures, 68 p.
811	08-76	Institutionalizing Safety in Transportation Planning Processes: Techniques, Tactics, and Strategies, 54 p.
812	03-103	Signal Timing Manual: Second Edition, 322 p.
813	20-98	A Guide to Agency-Wide Knowledge Management for State Departments of Transportation, 96 p.
814	08-92	Data to Support Transportation Agency Business Needs: A Self-Assessment Guide (& WOD 214), 122 p.
815	09-52	Short-Term Laboratory Conditioning of Asphalt Mixtures, 184 p.
816	14-27	Guide for the Preservation of Highway Tunnel Systems, 138 p.
Syntheses of Highway Practice (Project 20-05)		
No.	Topic No.	Title, Pages
466	45-16	Alliance Contracting—Evolving Alternative Project Delivery, 80 p.
467	45-17	Visualization of Geotechnical Data for Hazard Mitigation and Disaster Response, 88 p.
468	44-12	Interactive Training for All-Hazards for Emergency Planning, Preparation, and Response for Maintenance and Operations Field Personnel, 180 p.
469	45-10	Impacts of Energy Developments on U.S. Roads and Bridges, 216 p.
470	45-13	Maintenance Quality Assurance Field Inspection Practices, 52 p.
471	45-02	Practices for Developing Transparent Best Value Selection Procedures, 76 p.
472	44-01	FEMA and FHWA Emergency Relief Funds Reimbursements to State Departments of Transportation, 118 p.
473	45-09	Indefinite Delivery / Indefinite Quantity Contracting Practices, 144 p.
474	45-01	Service Life of Culverts, 142 p.
475	45-15	Fiber Additives in Asphalt Mixtures, 64 p.
476	45-14	Practices for Superheavy Load Movements on Highway Pavements, 50 p.
477	45-12	Methods and Practices on Reduction and Elimination of Asphalt Mix Segregation, 114 p.
478	45-05	Design and Load Testing of Large Diameter Open-Ended Driven Piles, 136 p.
479	45-07	Forecasting Transportation Revenue Sources: Survey of State Practices, 50 p.
480	45-11	Economic and Development Implications of Transportation Disinvestment, 68 p.
481	45-03	Current Practices to Set and Monitor DBE Goals on Design-Build Projects and Other Alternative Project Delivery Methods, 136 p.
482	45-06	Work Zone Speed Management, 148 p.
Research Results Digests		
No.	Proj. No.	Title, Pages
391	10-84	Modulus-Based Construction Specification for Compaction of Earthwork and Unbound Aggregate, 20 p.
392	20-05	Continuing Project to Synthesize Information on Highway Problems, 24 p.
393	20-65/Task 52	Selected Indirect Benefits of State Investment in Public Transportation, 40 p.
394	20-65/Task 55	Estimating the Long-Term Impacts of MAP-21 on the Nation's Local Rural Transit Bus Infrastructure, 48 p.

Research Results Digests

No.	Proj. No.	Title, Pages
395	20-06/Topic 21-02	Claims Related to Stormwater Discharges, 12 p. (Revision pending)
396	14-25	Approach to Level-of-Service Target Setting for Highway Assets, 6 p.
397	20-65/Task 53	Independent Cost Estimates for Design and Construction of Transit Facilities in Rural and Small Urban Areas, 56 p.

Legal Research Digests (Project 20-06)

No.	Topic No.	Title, Pages
64	19-02	Legal Aspect of Environmental Permitting in the Emergency Response Environment, 76 p.
65	20-01	Liability Aspects of Pedestrian Facilities, 76 p.
66	20-04	Due Diligence for Insurance Coverage in Transportation Construction Contracts, 56 p.
67	20-03	Permissible Changes in Scope of Work for Construction Projects, 48 p.
68	20-02	Liability of Design-Builders for Design, Construction, and Acquisition Claims, 124 p.

Web-Only Documents

No.	Proj. No.	Title, Pages
209	25-41	Volume Reduction of Highway Runoff in Urban Areas: Final Report and NCHRP Report 802 Appendices C through F (& Rep. 802), 219 p.
210	25-38	Input Guidelines for Motor Vehicle Emissions Simulator Model, Vol. 1: Practitioner's Handbook: Regional Level Inputs, 255 p.
210	25-38	Input Guidelines for Motor Vehicle Emissions Simulator Model, Vol. 2: Practitioner's Handbook: Project Level Inputs, 163 p.
210	25-38	Input Guidelines for Motor Vehicle Emissions Simulator Model, Vol. 3: Final Report, 201 p.
211	25-36	Close to Home: A Handbook for Transportation-Efficient Growth in Small Communities and Rural Areas, 118 p.
212	10-83	Research Report for Alternative Quality Management Systems for Highway Construction (& Rep. 808), 322 p.
213	03-109	Potential MUTCD Criteria for Selecting the Type of Control for Unsignalized Intersections, 127 p.
214	08-92	Transportation Agency Self-Assessment of Data to Support Business Needs: Final Research Report (& Rep. 814), 143 p.
216	20-59(47)	Emergency Exit Signs and Marking Systems for Highway Tunnels, 91 p.
217	10-88	Developing Precision and Bias Statements for AASHTO Standard Methods of Test TP 98 and TP 99, 130 p.

CD-ROMs

No.	Proj. No.	Title
20	J-05/Topic 05-04 TCRP	Selected Studies in Transportation Law, Vol. 5 2014 Supplement: Transit Law
162	25-41	Volume Performance Tool (& Rep. 802)
163	07-17	ActiveTrans Priority Tool Programmed Spreadsheet and Contractor's Final Report (& Rep. 803)
165	25-35	The Right-of-Way Carbon Sequestration and Bioenergy Feedstock Feasibility Toolkit (& Rep. 804)
166	08-91	Prototype Resource-Allocation Assessment Tool and User's Guide (& Rep. 806)

Notes

Publications in parentheses with an ampersand (&) are companion publications.

See Table 2 for project titles or use the information on page 2 to locate project information on the TRB website. Progress reports are superseded annually. See inside back cover of this document for ordering information.

TABLE 2
STATUS (AS OF 12/31/2015) OF PROJECTS ACTIVE OR PENDING DURING 2015

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
AREA ONE : DESIGN--PAVEMENTS						
01-50	Quantifying the Influence of Geosynthetics on Pavement Performance	Texas A&M Research Foundation	600,000	9/1/2011	5/31/2016	Research in progress
01-51	A Model for Incorporating Slab/Underlying Layer Interaction into the MEPDG Concrete Pavement Analysis Procedures	University of Minnesota	449,998	8/24/2012	1/29/2016	Research in progress
01-52	A Mechanistic-Empirical Model for Top-Down Cracking of Asphalt Pavement Layers	Texas A&M Transportation Institute	500,000	3/4/2013	3/4/2016	Research in progress
01-53	Proposed Enhancements to Pavement ME Design: Improved Consideration of the Influence of Subgrade and Unbound Layers on Pavement Performance	Texas A&M Transportation Institute	400,000	10/1/2014	3/31/2017	Research in progress
01-54	Guidelines for Limiting Damage to Flexible and Composite Pavements Due to the Presence of Water	Applied Pavement Technology	349,881	8/1/2014	8/1/2016	Research in progress
01-55	Performance-Based Mix Design of Porous Friction Courses	Auburn University	300,000	7/31/2014	7/30/2016	Research in progress
01-57	Standard Definitions for Comparable Pavement Cracking Data	----	300,000			Contract pending
AREA THREE : TRAFFIC--OPERATIONS AND CONTROL						
03-62	Guidelines for Accessible Pedestrian Signals (APS)	University of North Carolina - Chapel Hill	1,070,000	10/4/2001	9/30/2016	Research in progress; interim materials summarized in NCHRP Research Results Digest 278; contractor's final report pending. Workshops completed.
03-78B	Guidelines for the Application of Crossing Solutions at Roundabouts and Channelized Turn Lanes to Assist Pedestrians with Vision Disabilities	North Carolina State University	380,000	6/12/2013	12/31/2015	Completed---Publication decision pending
03-78C	Training and Technology Transfer for Accessibility Guidelines for Roundabouts and Channelized Turn Lanes	----	250,000			In development
03-96A	Analysis of Oversaturated Traffic Flow Conditions on Freeway Facilities	----	350,000			In development
03-99	Development and Application of Access Management Guidelines	Oregon State University	400,000	5/26/2009	11/30/2015	Completed---Publication decision pending
03-101	Costs and Benefits of Public-Sector Deployment of Vehicle to Infrastructure Technologies	Science Applications International Corporation	547,296	5/6/2011	11/5/2015	Completed---Publication decision pending
03-104	Unsignalized Intersection Guide	Vanasse Hangen Brustlin, Inc.	502,610	6/6/2012	4/5/2015	Completed---Published at http://www.ite.org/uiig

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
03-105	Design Guidance for Interchange Loop Ramps	MRIGlobal	675,000	7/30/2012	1/29/2016	Research in progress
03-106	Guidelines for Traffic Control Devices for Curves	Texas A&M Research Foundation	495,357	6/19/2012	4/18/2015	Completed---To be made available as an NCHRP Web-Only Document
03-107	Work Zone Capacity Methods for the Highway Capacity Manual	Kittelson & Associates	600,000	5/17/2012	4/16/2015	Completed---To be made available as an NCHRP Web-Only Document; results being incorporated into HCM update
03-108	Guidance on Quantifying Benefits of TIM Strategies	Noblis Inc.	499,985	7/10/2013	6/1/2016	Research in progress; interim report under review
03-109	Potential MUTCD Criteria for Selecting the Type of Control for Unsignalized Intersections	Texas A&M Transportation Institute	250,000	9/1/2013	3/16/2015	Completed---Agency report available as NCHRP Web-Only Document 213
03-110	Estimating the Life-Cycle Cost of Intersection Designs	Kittelson & Associates	300,000	5/16/2013	8/15/2015	Completed---Publication decision pending
03-111	Effectiveness of Work Zone Transportation Management Plan Strategies	KLS Engineering LLC	749,961	6/24/2014	12/24/2016	Research in progress; interim report pending
03-112	Operational and Safety Considerations in Making Lane Width Decisions on Urban and Suburban Arterials	MRIGlobal	750,000	8/4/2014	8/4/2017	Research in progress; draft final report pending
03-113	Guidance for Traffic Signals at Diverging Diamond Interchanges and Adjacent Intersections	North Carolina State University	499,993	6/13/2014	6/12/2016	Research in progress
03-114	Planning and Evaluating Active Traffic Management Strategies	Texas A&M Transportation Institute	700,000	1/16/2014	7/15/2016	Research in progress
03-115	Production of a Major Update to the 2010 Highway Capacity Manual	Kittelson & Associates	1,379,737	9/20/2013	3/19/2016	Research in progress
03-117	Traffic Control Devices and Measures for Deterring Wrong-Way Movements	Texas A&M Transportation Institute	298,697	5/11/2015	9/11/2017	Research in progress
03-118	Decision-Making Guide for Traffic Signal Phasing	Vanasse Hangen Brustlin, Inc.	600,000	8/13/2015	8/12/2017	Research in progress
03-119	Application of MASH Test Criteria to Breakaway Sign and Luminaire Supports and Crashworthy Work Zone Traffic Control Devices	George Mason University	599,134	9/28/2015	3/28/2018	Research in progress
03-120	Assessing Interactions Between Access Management Treatments and Multimodal Users	Kittelson & Associates	800,000	8/11/2015	2/11/2018	Research in progress; interim report pending
03-121	Transit, Freight, and Emergency Services Integration in Integrated Corridor Management Using SHRP2 Business Process Tools	-----	400,000			In development
03-122	Performance-Based Management of Traffic Signals	-----	600,000			In development
03-123	Proposed Practices for the Application of Dynamic Lane Use Control	-----	350,000			In development

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
03-124	Principles and Guidance for Presenting Drivers with Dynamic Information on Active Traffic Management	-----	750,000			In development
03-125	Evaluation of Change and Clearance Intervals Prior to the Flashing Yellow Arrow Permissive Left-Turn Indication	-----	300,000			In development
AREA FOUR : MATERIALS AND CONSTRUCTION--GENERAL MATERIALS						
04-39	Field Performance of Corrugated Pipe Manufactured with Recycled Polyethylene Content	TRI/Environmental, Inc.	600,000	7/11/2013	7/11/2016	Research in progress; Phase II underway
AREA FIVE : TRAFFIC--ILLUMINATION AND VISIBILITY						
05-20	Guidelines for Nighttime Visibility of Overhead Guide Signs	Texas A&M Research Foundation	720,000	4/1/2011	8/31/2015	Completed---Publication decision pending
05-21	Safety and Performance Criteria for Retroreflective Pavement Markers	Texas A&M Transportation Institute	675,000	9/1/2015	12/1/2017	Research in progress
AREA SEVEN : TRAFFIC--TRAFFIC PLANNING						
07-17	Pedestrian and Bicycle Transportation along Existing Roads	Toole Design Group	500,000	3/18/2011	1/1/2015	Completed---Published as NCHRP Report 803
07-19(02)	Methods and Technologies for Collecting Pedestrian and Bicycle Volume Data [Follow-On]	Kittelson & Associates	49,982	4/13/2015	1/13/2016	Research in progress
07-21	Asset Management Guidance for Traffic Control Devices, Barriers, and Lighting	Vanasse Hangen Brustlin, Inc.	550,000	4/10/2013	4/9/2016	Research in progress
07-22	Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual	Kittelson & Associates	400,000	6/4/2013	6/3/2015	Completed---Publication decision pending
07-23	Access Management in the Vicinity of Interchanges	Texas A&M Transportation Institute	575,000	6/20/2013	4/30/2016	Research in progress; contractor's draft report pending
AREA EIGHT : TRANSPORTATION PLANNING--FORECASTING						
08-36	Research for the AASHTO Standing Committee on Planning	-----	600,000 **	5/4/1999		Ongoing---Refer to project writeup on CRP website
08-36/Task 116	Development of Transportation Asset Management Plan Templates	RAND Corporation	159,721	6/12/2013	10/30/2015	Research in progress; continuation request under review
08-36/Task 117	Sketch Planning Tools for Regional Sustainability	Cambridge Systematics	85,000	10/4/2013	2/15/2016	Research in progress; final report pending
08-36/Task 119	Transportation Users Guide to the Economic Census	Cambridge Systematics	80,000	10/24/2013	5/15/2015	Completed---Final report sent to AASHTO
08-36/Task 120	Snapshots of Planning Practices	Cambridge Systematics	190,000	4/22/2013	10/31/2016	On-going research in progress; fifth snapshot pending

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
08-36/Task 121	Successful Implementation of Enterprise Risk Management in State Transportation Agencies	Parsons Brinckerhoff	100,000	10/8/2013	3/31/2015	Completed---Final report sent to AASHTO
08-36/Task 123	Survey Sample Size and Weighting	RAND Corporation	100,000	5/13/2015	2/12/2016	Research in progress
08-36/Task 124	Continuation of Task 120 Snapshots of Planning Practices	-----	75,000		10/31/2016	Funds added to Task 120
08-36/Task 125	Transportation Asset Management Knowledge Portal	RAND Corporation	125,000	12/13/2013	6/13/2016	Research in progress; draft final report under review
08-36/Task 126	Development of a Risk Register Spreadsheet Tool	Parsons Brinckerhoff	115,000	5/5/2015	5/4/2016	Research in progress
08-36/Task 127	Employment Data for Planning: Do You Know What You're Getting, Who's Your Supplier, and How Good are the Goods?	Cambridge Systematics	99,975	6/18/2015	6/17/2016	Research in progress
08-36/Task 128	What You Get is What You See: Modern Visualization and Analysis Tools for Strengthening Transportation Agencies' Reporting and Analysis Requirements	Cambridge Systematics	100,000	6/18/2015	6/17/2016	Research in progress
08-36/Task 129	Scoping Study to Establish Standards and Guidance for Data for Transportation Planning and Traffic Operations Purposes	Cambridge Systematics	80,000	6/18/2015	6/17/2016	Research in progress
08-36/Task 130	Inventory and Assessment of Methods for Making Collected Transportation Data Anonymous	RAND Corporation	74,353	6/2/2015	6/1/2016	Research in progress
08-36/Task 131	Transportation Data Integration to Develop Planning Performance Measures	Cambridge Systematics	100,000	9/25/2015	9/24/2016	Research in progress
08-36/Task 132	Understanding Changes in Youth Mobility	RAND Corporation	124,976	7/21/2015	7/20/2016	Research in progress
08-36/Task 134	Transportation Asset Management Research Roadmap	RAND Corporation	99,791	9/25/2015	9/24/2016	Research in progress
08-36/Task 135	Addressing Margins of Error in Small Areas of Data Delivered through the American Fact Finder or the Census Transportation Planning Products Program	RAND Corporation	74,997	9/25/2015	9/24/2016	Research in progress
08-36/Task 136	License Plate Reader Technology: Privacy Risk Analysis and Case	Cambridge Systematics	125,000	9/11/2015	9/10/2016	Research in progress
08-36/Task 137	Continuation of Task 116	-----	60,000		10/30/2015	Funds added to Task 116
08-88	Effective Project Scoping Practices to Improve On-Time and On-Budget Delivery of Highway Projects	Texas A&M Research Foundation	250,000	6/1/2012	11/30/2015	Completed---Final report pending
08-91	Cross-Asset Resource Allocation and the Impact on System Performance	CH2M HILL	489,835	3/28/2013	9/28/2016	Completed---Published as NCHRP Report 806
08-92	Implementing a Transportation Agency Data Self-Assessment	Spy Pond Partners	399,972	5/17/2013	7/16/2015	Completed---Published as NCHRP Report 814

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
08-93	Managing Risk Across the Enterprise: A Guidebook for State Departments of Transportation	Gordon Proctor & Associates, Inc.	500,000	4/18/2014	3/15/2016	Research in progress; draft final report pending
08-94	Guidelines for Selecting Travel Forecasting Methods and Techniques	Resource Systems Group, Inc.	499,911	5/16/2014	7/15/2016	Research in progress
08-95	Cell Phone Location Data for Travel Behavior Analysis	Cambridge Systematics	250,000	5/30/2014	3/1/2016	Research in progress
08-96	Integrating Goods and Services Movement by Commercial Vehicles in Smart Growth Environments	Cambridge Systematics	300,000	4/9/2014	7/31/2016	Research in progress
08-97	Finding and Using Data to Identify and Evaluate Corridors for Transporting Multi-state, Multi-modal Oversize/Overweight Freight	CPCS Transcom Inc.	500,000	5/9/2014	5/8/2016	Research in progress; Phase II underway
08-98	Guide for Identifying, Classifying, Evaluating, and Mitigating Freight Truck Bottlenecks	Cambridge Systematics	350,000	2/24/2014	2/28/2016	Research in progress; draft guidebook under review
08-99	Methodology for Estimating the Value of Travel Time Reliability for Truck Freight System Users	Parsons Brinckerhoff	199,796	5/1/2014	9/30/2015	Completed---To be published as an NCHRP report
08-100	Environmental Justice Analyses When Considering Toll Implementation or Rate Changes	Louis Berger Group	499,915	7/29/2014	7/28/2016	Research in progress
08-101	Enhanced Truck Data Collection and Analysis for Emissions Modeling	Cambridge Systematics	500,000	6/22/2015	6/22/2017	Research in progress
08-102	Bicyclist Facility Preferences and Effects on Increasing Bicycle Trips	Georgia Tech Research Corporation	350,000	6/24/2015	6/24/2017	Research in progress; interim report pending
08-103	Test and Demonstrate the Implementation of NCHRP Project 08-91, Cross-Asset Allocation	----	400,000			In development
08-104	A Guidebook for Post-award Contract Administration for Highway Projects Delivered Using Alternative Contracting Methods	----	500,000			In development
08-105	Measuring the Effectiveness of Public Involvement in Transportation	----	350,000			In development
08-106	Getting Innovations in Metropolitan Freight Implemented	----	375,000			In development
08-107	A Guidebook for Emergency Contracting Procedures for Administration of a Regional Emergency	----	250,000			In development

AREA NINE : MATERIALS AND CONSTRUCTION--BITUMINOUS MATERIALS

09-40A	Field Evaluation of the Louisiana Interlayer Shear Strength Tester	Louisiana Transportation Research Council	186,407	6/1/2013	12/31/2015	Completed---Final report pending
09-48	Field versus Laboratory Volumetrics and Mechanical Properties	Louisiana State University	600,000	8/1/2009	9/30/2015	Completed---Final report pending

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
09-49A	Performance of WMA Technologies; Stage II--Long-Term Field Performance	Washington State University	1,010,925	4/29/2011	7/28/2016	Research in progress; Phase II underway
09-49B	Performance of WMA Technologies; Stage I--Moisture Susceptibility--Validation	Texas A&M Transportation Institute	81,500	4/1/2014	12/31/2015	Completed---Publication decision pending
09-50	Performance-Related Specifications for Asphaltic Binders Used in Preservation Surface Treatments	North Carolina State University	500,000	8/1/2011	11/30/2015	Completed---Publication decision pending
09-51	Material Properties of Cold In-Place Recycled and Full Depth Reclamation Asphalt Concrete for Pavement Design	University of Maryland	499,234	6/4/2012	1/31/2016	Research in progress; final report pending
09-52	Short-Term Laboratory Conditioning of Asphalt Mixtures	Texas A&M Research Foundation	800,000	6/1/2012	8/31/2015	Completed---Published as NCHRP Report 815
09-53	Properties of Foamed Asphalt for Warm Mix Asphalt Applications	Texas A&M Research Foundation	699,854	6/1/2012	1/31/2015	Completed---Published as NCHRP Report 807
09-54	Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction	North Carolina State University	800,000	5/21/2013	5/21/2016	Research in progress; Phase II underway
09-55	Recycled Asphalt Shingles in Asphalt Mixtures with Warm Mix Asphalt Technologies	Auburn University	600,000	6/10/2013	9/10/2016	Research in progress; Phase II underway
09-56	Identifying Influences on and Minimizing the Variability of Ignition Furnace Correction Factors	Auburn University	500,000	4/15/2014	10/15/2016	Research in progress; Phase II underway
09-57	Experimental Design for Field Validation of Laboratory Tests to Assess Cracking Resistance of Asphalt Mixtures	Texas A&M Transportation Institute	250,000	9/1/2014	3/1/2016	Research in progress; Phase II underway
09-58	The Effects of Recycling Agents on Asphalt Mixtures with High RAS and RAP Binder Ratios	Texas A&M Transportation Institute	1,500,000	5/2/2014	10/2/2017	Research in progress; Phase II underway
09-59	Relating Asphalt Binder Fatigue Properties to Asphalt Mixture Fatigue Performance	Advanced Asphalt Technologies, LLC	1,000,000	4/20/2015	10/20/2017	Research in progress; Phase I underway
09-60	The Impacts on Pavement Performance from Changes in Asphalt Production	-----	1,000,000			In development

AREA TEN : MATERIALS AND CONSTRUCTION--SPECIFICATIONS, PROCEDURES, AND PRACTICES

10-77	Use of Automated Machine Guidance (AMG) within the Transportation Industry	Iowa State University	350,000	7/24/2009	12/31/2015	Research in progress; contractor's draft final report under review
10-80	New Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals	BridgeTech, Inc.	500,000	5/21/2010	12/31/2015	Completed---Published as NCHRP Report 796
10-82A	Performance-Related Specifications for Pavement Preservation Treatments	Michigan State University	349,997	2/3/2014	2/3/2016	Research in progress
10-86A	Software for Bidding Alternative Drainage Pipe Systems	Golder Associates Inc.	234,608	1/5/2015	3/5/2016	Research in progress

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
10-88	Developing Precision and Bias Statements for AASHTO Standard Methods of Test TP 98 and TP 99	HDR Engineering, Inc.	450,000	10/24/2012	10/30/2015	Completed---Publication decision pending
10-89	Best Practices Guidebook for Optimal Construction Inspection	Applied Pavement Technology	200,000	6/12/2012	7/31/2015	Terminated; no report
10-91	Guidebook for Selecting and Implementing Sustainable Highway Construction Practices	Parsons Brinckerhoff	475,000	4/22/2013	5/1/2016	Research in progress; interim report pending
10-92	Optimizing the Risk and Cost of Materials QA Programs	Hill International Inc.	399,970	9/16/2013	2/29/2016	Research in progress; Phase II underway
10-93	Measuring, Characterizing, and Reporting Pavement Roughness of Low-Speed and Urban Roads	University of Michigan	450,000	10/1/2013	4/15/2016	Research in progress
10-94	Mitigation of Weldment Cracking of Highway Steel Structures due to the Galvanizing Process	University of Kansas	499,975	7/1/2014	12/31/2016	Research in progress
10-95	Toughness Requirements for Heat-Affected Zones of Welded Structural Steels for Highway Bridges	Lehigh University	500,000	8/1/2014	1/31/2017	Phase I completed; further research on hold
10-96	Guide for Civil Integrated Management (CIM) in Departments of Transportation	University of Texas - Austin	249,988	5/20/2014	1/19/2016	Research in progress
10-97	Detection and Remediation of Soluble Salt Contamination Prior to Coating Steel Highway Structures	Elzly Technology Corporation	500,000	9/15/2015	7/15/2018	Research in progress; Phase I underway
10-98	Protocols for Network-Level Macrotexture Measurement	-----	500,000			In development
AREA TWELVE : DESIGN--BRIDGES						
12-87A	Fracture-Critical System Analysis for Steel Bridges	Purdue University	260,000	9/18/2014	12/17/2016	Research in progress
12-89	Recommended AASHTO LRFD Tunnel Design and Construction Specifications	PB Americas, Inc.	699,979	6/21/2011	5/31/2016	Research in progress
12-90	Guidelines for Shielding Bridge Piers	Roadsafe LLC	450,000	11/20/2012	1/31/2017	Research in progress
12-91	Strand Debonding for Pretensioned Girders	University of Cincinnati	650,000	9/13/2012	12/31/2016	Research in progress
12-92	Proposed LRFD Bridge Design Specifications for Light Rail Transit Loads	University of Colorado - Denver	349,754	7/26/2013	4/25/2016	Research in progress
12-93	Contribution of Steel Casing to Single Shaft Foundation Structural Resistance	State University of New York - Buffalo	469,818	6/13/2013	6/12/2016	Research in progress
12-94	LRFD Minimum Flexural Reinforcement Requirements	Iowa State University	550,000	9/30/2013	12/29/2016	Research in progress
12-95	Connection Details of Adjacent Precast Concrete Box Beam Bridges	Iowa State University	449,400	8/5/2013	11/4/2016	Research in progress

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
12-96	Simplified Full-Depth Precast Concrete Deck Panel Systems	George Washington University	400,000	7/1/2013	6/30/2016	Research in progress
12-97	Guide Specification for the Design of Concrete Bridge Beams Prestressed with CFRP Systems	University of Houston	500,000	8/1/2013	7/31/2016	Research in progress
12-98	Recommended Guidelines for Prefabricated Bridge Elements and Systems Tolerances and Dynamic Effects of Bridge Moves	CME Associates Inc.	299,875	5/20/2014	8/19/2016	Research in progress
12-100	Guidelines for Maintaining Small Movement Bridge Expansion Joints	University of Delaware	150,000	7/16/2014	1/16/2016	Research in progress
12-101	Seismic Design of Bridge Columns with Improved Energy Dissipating Mechanisms	Infrastructure Innovation LLC	250,000	7/7/2014	10/7/2016	Research in progress
12-102	Recommended AASHTO Guide Specification for ABC Design and Construction	CME Associates Inc.	369,842	5/20/2014	8/19/2016	Research in progress
12-103	Bridge Superstructure Tolerance to Total and Differential Foundation Movements	Drexel University	349,870	12/19/2013	6/15/2016	Research in progress
12-104	Guidelines to Improve the Quality of Element-Level Bridge Inspection Data	University of Missouri	347,961	8/11/2015	11/10/2017	Research in progress
12-105	Proposed AASHTO Seismic Specifications for ABC Column Connections	University of Nevada - Reno	450,000	9/1/2015	12/31/2018	Research in progress
12-106	Proposed Guidelines for Performance-Based Seismic Bridge Design	-----	350,000			In development
12-107	Development of Guidelines for Full and Hybrid Use of Stainless Steel for Bridge Girders	-----	400,000			In development
12-108	Development of Guidelines for Uniform Service Life Design for Bridges	-----	300,000			In development
12-109	Design, Fabrication, and Construction of Long-Span Precast Pretensioned Girders Made with 0.7" Diameter Strands	-----	600,000			In development
12-110	Development of Live Load Distribution and Impact Factors for the Analysis of Implements of Husbandry Vehicles on Bridges	-----	650,000			In development
12-111	Evaluating the Effectiveness of Vibration-Mitigation Devices for Structural Supports of Signs, Luminaires, and Traffic Signals	-----	400,000			In development

AREA THIRTEEN : MAINTENANCE--EQUIPMENT

13-04	Guide for Optimal Replacement Cycles of Highway Operations Equipment	Dye Management Group	398,059	5/1/2015	4/30/2017	Research in progress
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TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
13-05	Guide for Utilization Measurement and Management of Fleet Equipment	Washington State University	399,998	6/1/2015	5/31/2017	Research in progress
AREA FOURTEEN : MAINTENANCE--MAINTENANCE OF WAY AND STRUCTURES						
14-19	Culvert Rehabilitation to Maximize Service Life While Minimizing Direct Costs and Traffic Disruption	Louisiana Tech University	749,643	6/9/2008	9/30/2015	Terminated; no report
14-20A	Consequences of Delayed Maintenance of Highway Assets	University of Texas - El Paso	450,000	12/9/2013	3/9/2016	Research in progress; interim report pending
14-26	Culvert and Storm Drain Inspection Manual	Simpson Gumpertz & Heger, Inc.	250,000	8/24/2012	1/31/2016	Research in progress
14-27	A Guide for the Preservation of Highway Tunnel Systems	Gannett Fleming, Inc.	374,997	5/14/2012	8/31/2015	Completed---Published as NCHRP Report 816
14-28	Condition Assessment of Bridge Post-Tensioning and Stay Cable Systems Using NDE Methods	Texas A&M Transportation Institute	650,000	11/29/2012	3/31/2016	Research in progress
14-29	Assessing, Coding, and Marking of Highway Structures in Emergency Situations	Oregon State University	399,655	11/1/2013	3/11/2016	Research in progress
14-30	Spot Painting to Extend Highway Bridge Coating Life	University of Kentucky	350,000	9/3/2013	7/31/2016	Research in progress; draft final report pending
14-31	Developing a Pavement-Maintenance Database System	Pavia Systems Inc.	249,790	5/28/2013	11/30/2015	Completed---Publication decision pending
14-32	Proposed Revisions to the AASHTO Movable Bridge Inspection, Evaluation, and Maintenance Manual	Parsons Brinckerhoff	210,000	7/31/2013	12/30/2015	Completed---Publication decision pending
14-33	Pavement Performance Measures that Consider the Contributions of Preservation Treatments	AMEC Foster Wheeler Environ & Infrastructure Inc.	399,993	6/2/2014	6/1/2016	Research in progress
14-34	Guide for Performance Measures in Snow and Ice Control Operations	ICF Incorporated	299,956	4/20/2015	4/19/2017	Research in progress
14-35	Acceptance Criteria of Complete Joint Penetration Steel Bridge Welds Evaluated Using Enhanced Ultrasonic Methods	Purdue University	538,965	4/24/2015	4/23/2018	Research in progress
14-36	Proposed AASHTO Guide for Bridge Preservation Actions	-----	626,579			Contract pending
14-37	Guide Specifications for the Construction of Chip Seals and Microsurfacing	-----	150,000			In development
14-38	Guide for Timing of Asphalt-Surfaced Pavements Preservation	-----	300,000			In development
AREA FIFTEEN : DESIGN--GENERAL DESIGN						
15-44	Guidelines for the Use of Mobile LIDAR in Transportation Applications	Oregon State University	400,584	9/14/2011	6/30/2016	Implementation activities in progress; final report published as NCHRP Report 748

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
15-45	Proposed Update of the AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities	Sprinkle Consulting, Inc.	349,454	4/12/2012	6/1/2015	Completed---Forwarded to AASHTO for balloting
15-47	Developing an Improved Highway Geometric Design Process	CH2M Hill	524,967	3/15/2013	6/14/2016	Research in progress
15-48	Developing a Methodology for Designing Low and Intermediate Speed Roadways that Serve All Users	Gresham, Smith and Partners	499,900	7/22/2013	10/31/2016	Research in progress; draft final report pending
15-49	Geometric Design Guidelines for Managed Lanes	Texas A&M Transportation Institute	750,000	9/1/2013	4/15/2016	Research in progress; Phase II studies underway
15-50	Guidelines for Integrating Safety and Cost-Effectiveness into Resurfacing, Restoration, and Rehabilitation Projects	MRIGlobal	680,000	7/3/2013	9/3/2016	Research in progress
15-51	Preconstruction Services Cost Estimating Guide	Iowa State University	424,995	3/27/2013	2/26/2016	Research in progress
15-52	Developing a Context-Sensitive Functional Classification System for More Flexibility in Geometric Design	University of Kentucky	250,000	1/15/2015	5/14/2016	Research in progress
15-53	Roadside Design for Conflicts in Proximity to Bridge Ends and Intersecting Roadways	KLS Engineering LLC	499,767	8/25/2014	8/25/2017	Research in progress; interim report under review
15-54	Proposed Modifications to AASHTO Culvert Load Rating Specifications	Michael Baker, Jr., Inc.	499,773	7/7/2015	7/6/2018	Research in progress
15-55	Guidance to Predict and Mitigate Dynamic Hydroplaning on Roadways	Virginia Polytechnic Institute	499,992	6/17/2015	12/16/2017	Research in progress
15-56	Guidelines for Selecting Ramp Design Speeds	MRIGlobal	400,000	11/10/2015	11/9/2017	Research in progress; interim report pending
15-57	Interaction Effects between Freeway and Surface Street Facilities: System Considerations in a Highway Capacity Context	----	800,000			In development
15-58	An Assessment of Safety and Geometric Design Criteria for Diverging Diamond Interchanges	----	500,000			Being incorporated into NCHRP project 03-113
15-59	Horizontal Sightline Offset Design Criteria, Exceptions, and Mitigation Strategies	MRIGlobal	400,000	8/10/2015	8/10/2017	Research in progress
15-60	Proposed Update of the AASHTO Guide for the Development of Bicycle Facilities	Toole Design Group	400,000	6/1/2015	9/1/2017	Research in progress
15-61	Applying and Adapting Climate Models to Hydraulic Design Procedures	----	750,000			In development
15-62	Access Management and Design Guidelines for Truck Routes	----	500,000			In development
15-63	Design Options to Reduce Turning Motor Vehicle Conflicts with Bicyclists and Pedestrians at Intersections	----	500,000			In development

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
15-64	Unsignalized Median Openings in Close Proximity to Signalized Intersections	----	325,000			In development
AREA SIXTEEN : DESIGN--ROADSIDE DEVELOPMENT						
16-05	Guidelines for Cost-Effective Safety Treatments of Roadside Ditches	Texas A&M Research Foundation	400,000	5/14/2010	3/1/2016	Research in progress; Phase II underway
AREA SEVENTEEN : TRAFFIC--SAFETY						
17-11(02)	Development of Clear Recovery Area Guidelines	Texas A&M University	270,000	9/7/2008	4/30/2016	Research in progress; interim report pending
17-43	Long-Term Roadside Crash Data Collection Program	Virginia Polytechnic Institute	1,000,000	4/27/2010	6/30/2017	Research in progress; interim report pending
17-46	Comprehensive Analysis Framework for Safety Investment Decisions	Cambridge Systematics	912,884	4/14/2010	4/30/2016	Research in progress; contractor's draft final report pending; Phase 3 underway
17-50	Lead States Initiative for Implementing the Highway Safety Manual	CH2M Hill	299,000	1/11/2011	12/31/2016	Research in progress; two additional peer exchanges and webinars in process; contractor's draft user guide and final report pending
17-51(03)	Communication Plan for the National Highway Safety Strategy	Penna Powers Brian Haynes	100,000	6/24/2011	6/30/2015	Completed---See NCHRP Project 17-64 for follow-on activity
17-54	Consideration of Roadside Features in the Highway Safety Manual	Roadsafe LLC	1,310,000	4/4/2011	11/30/2016	Research in progress; Phases 2 and 3 underway
17-55	Guidelines for Slope Traversability	Texas A&M Research Foundation	500,000	5/2/2012	3/31/2016	Research in progress; interim report pending
17-56	Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments	University of North Carolina - Chapel Hill	500,000	11/1/2012	1/31/2016	Research in progress; draft final report pending
17-57	Development of a Comprehensive Approach for Serious Traffic Crash Injury Measurement and Reporting Systems	University of Michigan	449,986	5/22/2012	4/30/2016	Research in progress also in coordination with NCHRP project 20-24(37)K; final report under review
17-58	Safety Prediction Models for Six-Lane and One-Way Urban and Suburban Arterials	Texas A&M Transportation Institute	599,910	1/14/2013	1/13/2016	Research in progress; interim report approved; beta testing in process
17-59	Safety Impacts of Intersection Sight Distance	Vanasse Hangen Brustlin, Inc.	450,000	5/14/2012	3/31/2016	Research in progress; final report pending
17-60	Cost-Benefit Metrics for Behavioral Highway Safety Countermeasures	HDR Engineering, Inc.	499,841	4/16/2012	1/31/2016	Research in progress; final report pending
17-61	Work Zone Crash Characteristics and Countermeasure Guidance	Texas A&M Research Foundation	600,000	9/19/2012	9/30/2016	Research in progress; draft final report pending
17-62	Improved Prediction Models for Crash Types and Crash Severities	University of Connecticut	800,000	7/2/2013	9/30/2017	Research in progress; interim report under review

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
17-63	Guidance for the Development and Application of Crash Modification Factors	University of North Carolina - Chapel Hill	600,000	8/1/2013	7/31/2016	Research in progress; interim report approved
17-64	Guidance for the Implementation of the Toward Zero Deaths National Strategy on Highway Safety	-----	500,000			Contract pending
17-65	Improved Analysis of Two-Lane Highway Capacity and Operational Performance	University of Florida	499,213	9/22/2014	12/22/2016	Research in progress; draft final report pending
17-66	Guidance for Selection of Appropriate Countermeasures for Opposite Direction Crashes	Texas A&M Transportation Institute	350,000	8/27/2014	8/27/2016	Research in progress; Phase 2 underway
17-67	Identification of Factors Contributing to the Decline of Traffic Fatalities in the United States	University of Michigan	299,738	9/22/2014	9/22/2016	Research in progress; interim report pending
17-68	Intersection Crash Prediction Methods for the Highway Safety Manual	MRIGlobal	600,000	9/1/2014	9/1/2017	Research in progress; interim report approved; Phase 2 underway
17-69	A Strategic Approach to Transforming Traffic Safety Culture to Reduce Deaths and Injuries	Montana State University	299,989	7/1/2014	7/1/2016	Research in progress; revised interim report pending
17-70	Development of Roundabout Crash Prediction Models and Methods	Kittelson & Associates	600,000	7/14/2014	11/14/2016	Research in progress; draft final report pending
17-71	Proposed AASHTO Highway Safety Manual, Second Edition	Kittelson & Associates	800,000	10/12/2015	4/12/2019	Research in progress
17-72	Update of Crash Modification Factors for the Highway Safety Manual	University of North Carolina - Chapel Hill	400,000	8/31/2015	12/31/2017	Research in progress
17-73	Conducting Systemic Pedestrian Safety Analyses	University of North Carolina - Chapel Hill	300,000	7/28/2015	7/28/2017	Research in progress; interim report pending
17-74	Developing Crash Modification Factors for Corridor Access Management	-----	450,000			In development
17-75	Leveraging Big Data to Improve Traffic Incident Management	-----	275,000			In development
17-76	Understanding the Relationship between Operating, Posted, and Design Speeds and Safety in the Setting of Speed Limits	-----	500,000			In development
17-77	Quantitative Approaches to Systemic Safety Analysis	-----	300,000			In development
17-78	Understanding and Communicating Reliability of Crash Prediction Models	-----	300,000			In development
17-79	Safety Effects of Raising Speed Limits to 75 mph and Higher	-----	500,000			In development
17-80	Expansion of Human Factors Guidelines for Road Systems, Second Edition	-----	500,000			In development

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
AREA EIGHTEEN : MATERIALS AND CONSTRUCTION--CONCRETE MATERIALS						
18-16	Self-Consolidating Concrete for Cast-in-Place Bridge Components	University of Nebraska - Lincoln	449,831	7/1/2011	11/13/2015	Completed---Publication decision pending
18-17	Entrained Air Void System for Durable Highway Concrete	Iowa State University	599,986	11/2/2015	11/2/2018	Research in progress
AREA NINETEEN : ADMINISTRATION--FINANCE						
19-10	AASHTO Partnering Handbook, Second Edition	Iowa State University	400,000	4/9/2015	4/8/2017	Research in progress
19-11	Applying Risk Analysis, Value Engineering, and other Innovative Solutions for Project Delivery	Value Management Strategies Inc.	193,798	7/14/2015	1/31/2017	Research in progress
19-12	Development of Financial Plans and Performance Measures for Transportation Asset Management	-----	350,000			In development
19-13	Value Capture Toolkit for State Transportation Agencies	-----	350,000			In development
AREA TWENTY : SPECIAL PROJECTS						
20-05	Synthesis of Information Related to Highway Problems	TRB Studies and Special Programs Division	1,750,000 **	12/15/1967		Research ongoing; refer to NCHRP Research Results Digest 398 for topic reports published as NCHRP Syntheses
20-06	Legal Problems Arising Out of Highway Programs	TRB Technical Activities Division	350,000 **	11/1/1968		Research ongoing; published as Selected Studies in Transportation Law (CRP-CD-20, volumes 1-4 and 8) and various NCHRP Legal Research Digests
20-07	Research for AASHTO Standing Committee on Highways	Various	1,200,000 **	12/2/1968		Research ongoing
20-07/Task 294A	Continuation of Funding of 20-07 Task 294 - Update Bridge Temporary Works	Wiss, Janney, Elstner & Associates	19,926	4/2/2015	10/31/2015	Completed
20-07/Task 337	Complex Bridge Inspection Procedures	HDR Engineering, Inc.	83,414	8/7/2013	1/6/2015	Completed
20-07/Task 344	Practical Cost Estimating: Development of Training	Texas A&M Transportation Institute	100,000	10/4/2013	6/3/2015	Completed
20-07/Task 346	Completion of the Update to the AASHTO Guide for Transportation Landscape and Environmental Design	Avenue Design Partners	85,000	8/5/2013	10/1/2015	Completed
20-07/Task 347	Test Methods for Watertightness of Culvert Joints	Queens University	100,000	10/17/2013	2/27/2015	Completed
20-07/Task 348	Review of the AASHTO LRF D Movable Highway Bridge Design Specifications for future updates	Parsons Brinckerhoff	100,000	1/14/2014	7/30/2015	Completed

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-07/Task 349	Guidelines for Developing Materials Acceptance Plans for Alternative Contracting Methods	Diversified Engineering Services, Inc.	100,000	5/1/2014	1/31/2016	Research in progress
20-07/Task 351	Update to AASHTO's Visualization in Transportation: A Guide for Transportation Agencies	Parsons Brinckerhoff	93,769	4/11/2014	7/10/2015	Completed
20-07/Task 353	Development of a Strategic Research Plan for SCOHTS	Vanasse Hangen Brustlin, Inc.	100,000	7/7/2014	12/1/2015	Completed
20-07/Task 354	Work Zone Speed Limits and Crash Data Practices	-----	100,000			In development
20-07/Task 355	Guidelines for Reliable Fit-Up of Steel I-Girder Bridges	Georgia Tech Research Corporation	100,000	5/20/2014	8/31/2015	Completed
20-07/Task 356	Strategic Plan for Prioritization and Selection of Research Proposals for Hydrology and Hydraulics	-----	60,000			Contract pending
20-07/Task 357	Practices for Collecting, Processing and Managing Roadway Asset Inventory Data	Applied Pavement Technology	75,000	7/1/2014	6/30/2015	Completed
20-07/Task 358	Reducing Risks to Worker Safety in Work Zones Due to Distracted Drivers	-----	100,000			In development
20-07/Task 359	National Transportation System Management & Operations (TSM&O) Research Framework	University of Maryland	82,900	7/10/2014	1/9/2016	Research in progress
20-07/Task 360	Development of a Strategic Plan for the Technical Committee on Roadside Safety (TCRS)	Roadsafe LLC	75,000	7/28/2014	9/28/2015	Completed
20-07/Task 361	Hamburg Wheel-Track Test Equipment Requirements and Improvements to AASHTO T 324	Louisiana Transportation Research Center	100,000	7/1/2014	12/31/2015	Completed
20-07/Task 363	Recommended AASHTO Guidelines for Emergency Ventilation Smoke Control in Roadway Tunnels	Jacobs Civil Consultants Inc.	50,000	9/16/2014	1/31/2016	Research in progress
20-07/Task 364A	Revision of AASHTO PP-74 Test Method for Optical Sizing and Roundness Determination of Glass Beads Utilized in Traffic Markings	Pavement Systems LLC	100,000	3/30/2015	3/30/2016	Research in progress
20-07/Task 365	Transportation Systems Management & Operations Program Planning-- Experiences from the SHRP 2 Implementation Assistance Program	Cambridge Systematics	89,917	9/8/2015	5/7/2016	Research in progress
20-07/Task 366	A Review of Current Practice and Research Studies on Performance Measures for Transportation Systems Management and Operations (TSMO)	Florida Atlantic University	99,900	4/1/2015	3/31/2016	Research in progress
20-07/Task 367	Analysis of Crash Contributing Factors to Determine Appropriate Countermeasures	-----	100,000			In development
20-07/Task 368	Development of a Roadmap for Use of SHRP2 Safety Data to Enhance Existing Publications	-----	100,000			In development

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-07/Task 369	Update of SCOH Strategic Plan	----	100,000			In development
20-07/Task 370	Development of a Strategic Plan for the Subcommittee on Traffic Engineering (SCOTE)	----	90,000			In development
20-07/Task 371	DOT Technical Assistance in Using the HFG	----	50,000			In development
20-07/Task 372	Evaluation of MASH Test Vehicles	----	90,000			In development
20-07/Task 373	Utility Coordination Best Practices for Design-Build and Alternative Contracting Projects	----	100,000			In development
20-07/Task 374	Guidelines for Selecting Sign Sheeting Materials for AASHTO M268, "Standard Specification for Retroreflective Sheeting for Flat and Vertical Traffic Control Applications"	----	75,000			In development
20-07/Task 375	Improvements to AASHTO T209	Pavement Systems LLC	75,000	5/6/2015	5/6/2016	Research in progress
20-07/Task 376	Transportation Agency ITS Infrastructure Decisions Considering V2I Deployment	Florida International University	99,000	9/8/2015	9/7/2016	Research in progress
20-07/Task 377	Standardized Format for Bridge and Structure Information Models for Life Cycle Management	Michael Baker, Jr., Inc.	99,895	9/25/2015	9/24/2016	Research in progress
20-07/Task 378	Assessing Risk for Bridge Management	Western Management & Consulting LLC	100,000	8/25/2015	11/24/2016	Research in progress
20-07/Task 379	SCOM Strategic Plan Update - Facilitated Workshop	McNeil, Sue	10,000	4/27/2015	8/31/2015	Completed
20-07/Task 380	Review and Update of the AASHTO Maintenance Manual for Roadways and Bridges	----	150,000			In development
20-07/Task 381	Using Resistivity Measurements to Develop a Formation Factor Specification	----	100,000			In development
20-07/Task 382	Longer Pavement Life from Increased In-Place Density of Asphalt Pavements	Dale S. Decker LLC	75,000	10/5/2015	10/5/2016	Research in progress
20-07/Task 383	Review and update of the AASHTO Roadside Design Guide	----	100,000			In development
20-07/Task 384	Core Competencies for Key Safety Analyses	----	75,000			In development
20-07/Task 385	AASHTO Traffic Incident Management Working Group and Technical Advisory Group Business Plan	----	75,000			In development
20-07/Task 386	Update of the 2008 Guide Specifications for Highway Construction	----	100,000			In development
20-07/Task 387	Maintenance Actions for Fatigue Cracking in Steel Bridge Structures	----	100,000			In development

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-07/Task 388	Guidelines for Design and Construction of Temporary Bridges	----	100,000			In development
20-07/Task 389	Dig Law Revisions and an Assessment of Potential Impacts to State Transportation Departments	----	100,000			In development
20-07/Task 390	Parametric Study & Cost Effects for the USDOT Truck Size & Weight Study Vehicles	----	75,000			In development
20-07/Task 391	Develop criteria that establish the amount of energy required to maintain fully-animated particles of loose asphalt within the test procedure AASHTO T 209	----	100,000			In development
20-07/Task 392	Transportation System Management and Operations Standards for Highway Infrastructure	----	100,000			In development
20-07/Task 393	Impacts of Motor Vehicle Safety Countermeasures on Pedestrian and Bicyclist Safety	----	100,000			In development
20-07/Task 394	Development of Performance-Based Geometric Design Content for the Next Edition of the AASHTO Green Book	----	20,000			In development
20-24(89)B	Role and Value of Transportation for U.S. Industries and Sectors (Project B)	ICF Consulting, Inc.	250,000	8/7/2014	1/7/2016	Research in progress
20-24(92)	Evaluation of State-of-the-Art Transportation Funding and Finance Methods	Mercator Advisors LLC	99,983	9/18/2013	3/17/2015	Completed---Contractor's final report sent to AASHTO
20-24(93)B(02)	Communicating Performance Management-State DOTs Continuing To "Tell Their Story"	Spy Pond Partners	124,969	4/16/2014	11/15/2015	Completed---Report given to AASHTO and available on project web page
20-24(93)C	Public Communication -- Outreach	Parsons Brinckerhoff	124,955	4/30/2014	4/29/2015	Completed---Contractor's final report sent to AASHTO and available on project web page
20-24(94)	Support for Development of AASHTO's 2013-2018 Strategic Plan	Cambridge Systematics	380,000	10/8/2013	1/7/2015	Completed---Contractor's final report sent to AASHTO
20-24(95)	Next Generation Workforce Management	----	325,000			In development
20-24(97)	Advancing Performance Management under a National Framework	Spy Pond Partners	240,000	6/13/2014	10/12/2015	Completed---Contractor's final documents sent to AASHTO
20-24(98)A	Connected/Automated Vehicle Research Roadmap for AASHTO	University of California - Berkeley	42,500	8/1/2014	4/30/2015	Completed---Agency report available on project webpage
20-24(98)B	Connected/Automated Vehicle Research Roadmap for AASHTO	Kimley-Horn & Associates	42,500	6/25/2014	6/24/2015	Completed---Agency report available on project webpage
20-24(99)B	CEO Peer Exchange on Agency Management and Emerging Issues	Parsons Brinckerhoff	209,963	1/16/2015	9/15/2015	Completed---Contractor's final report sent to AASHTO and available on project web page

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-24(101)	An Introduction to Knowledge Management and Workforce Issues for CEOs: A CEO Leadership Workshop	-----	250,000			In development
20-24(102)	Executive Strategies to Deliver Practical Design	Leidos Inc.	199,997	7/14/2015	9/13/2016	Research in progress
20-24(103)	Peer Exchange on Transportation Investment for Economic Development: Making the Case	TRB Technical Activities Division	100,000			Research in progress
20-24(104)	State DOT Implementation of MAP21 Performance Measure Rules	-----	150,000			In development
20-24(105)	Launching U.S. Transportation Enterprise Risk Management Programs	Spy Pond Partners	200,000	5/27/2015	7/26/2016	Research in progress
20-24(107)	Update to Transportation Governance: A 50-State Review of State Legislatures and Departments of Transportation	-----	100,000			In development
20-24(108)	CEO Peer Exchange	-----	300,000			In development
20-24(109)	Research on enhancing transportation system resilience	-----	500,000			In development
20-30	NCHRP-IDEA Program	TRB Studies and Special Programs Division	1,250,000 **	7/8/1992		Research ongoing; see project write-up on NCHRP website
20-44	Accelerating the Application of NCHRP Research Results	Various	31,870	8/1/1995	9/30/2018	Support for various implementation activities continuing
20-44Q	Communication Services for NCHRP	CTC & Associates LLC	70,810	5/7/2015	5/6/2017	In progress
20-59(14)B	Research Support for the AASHTO Special Committee on Transportation Security and Emergency Management	Countermeasures Assessment & Security Experts, LLC	245,000	8/15/2013	9/30/2015	Completed---"Fundamentals" published by AASHTO
20-59(14)C	Strategic Plan Implementation Support Services for SCOTSEM	DeCoster, Thomas A.	14,750	4/13/2015	7/12/2015	Completed---Final report sent to AASHTO
20-59(14)C(02)	Strategic Plan Implementation Support Services for SCOTSEM	Geographic Paradigm Computing Inc.	100,000	8/11/2015	2/10/2017	Research in progress
20-59(30)	Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff	San Jose State University	100,000	9/18/2014	12/31/2015	Completed---Agency report available as NCHRP Web-Only Document 215
20-59(33)A	A Pre-Event Recovery Planning Guide for Transportation (Update)	-----	40,000			In development
20-59(47)	Emergency Exit Signs and Marking Systems for Highway Tunnels	Texas A&M Transportation Institute	200,000	8/15/2013	8/14/2015	Completed---Agency report available as NCHRP Web-Only Document 216
20-59(48)	Effective Practices for the Protection of Transportation Infrastructure from Cyber Incidents	Countermeasures Assessment & Security Experts, LLC	300,000	5/2/2013	12/31/2015	Completed---Publication decision pending; jointly funded with TCRP project D-15
20-59(50)	Mainstreaming Transportation Hazards and Security Risk Management: CAPTA Update and Implementation	Countermeasures Assessment & Security Experts, LLC	175,000	8/5/2014	4/30/2016	Research in progress; interim report under review

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-59(51)A	Update of Security 101: A Physical Security Primer for Transportation Agencies	----	100,000			Contract pending
20-59(51)B	Update of A Guide to Emergency Response Planning at State Transportation Agencies	----	100,000			Contract pending
20-59(51)C	Research Support for Implementing Security, Emergency Management, and Infrastructure Protection at State Transportation Agencies	----	100,000			In development
20-59(52)	Communications Worker Credentialing Requirements	Virginia Polytechnic Institute	75,000	9/16/2015	9/15/2016	Research in progress; interim report pending
20-59(53)	FloodCast: A Framework for Enhanced Flood Event Decision Making for Transportation Resilience	Dewberry Consultants LLC	248,236	9/2/2014	3/1/2016	Research in progress; contractor's draft final report pending
20-63B	Performance Measurement Tool Box and Reporting System for Research Programs and Projects	ICF Incorporated	367,655	7/20/2010	7/19/2016	Research in progress; final website deployed and maintenance ongoing
20-65	Research for the AASHTO Standing Committee on Public Transportation	Various	450,000 **			Research in progress---Refer to project writeup on CRP website
20-65/Task 49	Impact Assessment Indicators for Administration of Public Transportation Grants	AECOM Consulting Transportation Group	75,000	5/22/2013	7/30/2015	Completed
20-65/Task 54	Determine the Benefits and Costs of Alternative Methods Used by States to Administer FTA's State Rail Safety Oversight Program	Transportation Resource Associates Inc.	49,818	1/28/2014	2/2/2015	Canceled
20-65/Task 56	Best Practices in Rural Regional Mobility	Cambridge Systematics	100,000	2/3/2015	2/2/2016	Research in progress
20-65/Task 57	Assessment of State DOT Transit Vehicle Procurement Models	AECOM Consulting Transportation Group	100,000	12/8/2014	6/30/2016	Research in progress
20-65/Task 58	Documentation of FTA Section 5310 Recipients and Projects Before the Enactment of Moving Ahead for Progress in the 21st Century (MAP-21)	Parsons Brinckerhoff	100,000	11/11/2014	11/30/2015	Completed
20-65/Task 59	The Determination of How Federal Section 5316 Funds Were Used Under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy For Users (SAFETEA-LU) and The Transportation Equity Act For The 21st Century (TEA 21)	Parsons Brinckerhoff	74,956	11/11/2014	11/30/2015	Completed
20-65/Task 60	The National Mobility Management Initiative: State DOTs Connecting Users and Rides for Specialized Transportation	ICF Incorporated	75,000	11/17/2014	11/30/2015	Completed
20-65/Task 61	Determine the Degree To Which JARC And New Freedom Activities are Being Continued or Initiated Under Map-21	Parsons Brinckerhoff	50,000	10/20/2015	10/19/2016	Research in progress

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-65/Task 62	The National Perspective –An Assessment of Section 5310 Program Administration Under MAP-21	Parsons Brinckerhoff	50,000	10/13/2015	10/12/2016	Research in progress
20-65/Task 63	DOT Oversight of Facility Projects	AECOM Consulting Transportation Group	100,000	11/9/2015	11/9/2016	Research in progress
20-65/Task 64	Health and Human Services (particularly Medicaid) Revenue as Match	Kittelson & Associates	74,963	9/16/2015	9/15/2016	Research in progress
20-65/Task 65	Best Practices for State DOTs to Meet Rural Bus Fleet Replacement and Expansion Needs	ICF Incorporated	100,000	9/16/2015	6/16/2016	Research in progress
20-65/Task 66	States and Local Use of Administrative Resources Provided by the Federal Transit Administration	ICF Incorporated	50,000	9/9/2015	9/8/2016	Research in progress
20-65/Task 67	Multi-Modal Project Planning	-----	100,000			In development
20-65/Task 68	Successful Mobility Management Practices for Improving Transportation Services in Small Urban and Rural Areas	-----	75,000			In development
20-65/Task 69	Consolidation of Rural Transit Systems	-----	75,000			In development
20-65/Task 70	Cross Modal Investment	-----	75,000			In development
20-65/Task 71	Transit Network Balance; Efficiency and Equity	-----	50,000			In development
20-65/Task 72	Small System Alternative Fuel Strategies	-----	75,000			In development
20-68A(02)	US Domestic Scan Program	Arora and Associates, P.C.	2,110,592	12/28/2012	12/26/2016	Research in progress
20-82A	Next Generation of the Transportation Pooled Fund (TPF) Website	Science Applications International Corporation	99,784	10/23/2012	10/22/2016	Maintenance ongoing
20-83(03)A	Long-Range Strategic Issues Affecting Preservation, Maintenance, and Renewal of Highway Infrastructure	Parsons Brinckerhoff	499,999	5/18/2015	5/18/2017	Research in progress
20-83B	Communicating the Results of NCHRP Strategic Transportation Issues Research	Burns & McDonnell Engineering Company Inc.	349,837	7/11/2013	7/11/2016	Research in progress
20-83C(01)	Technical Assistance for NCHRP Report 750, Vol. 2, "Climate Change, Extreme Weather and the Highway System: Impacts and Adaptation Approaches"	MMeyer Consulting LLC	30,000	3/17/2015	5/17/2016	Research in progress
20-83C(05)A	Technical Assistance for NCHRP Report 750, Vol. 4, "Sustainability as an Organizing Principle for Transportation Agencies"	McVoy Associates	30,000	3/17/2015	9/17/2015	Completed
20-95	Identifying Successful Practices in the FHWA Disadvantaged Business Enterprise (DBE) Program	Colette Holt & Associates	249,625	6/3/2013	9/3/2015	Cancelled

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-96	Leadership Guide for Strategic Information Management for State Departments of Transportation	Spy Pond Partners	250,000	4/16/2014	1/15/2016	Research in progress
20-97	Improving Findability and Relevance of Transportation Information	Spy Pond Partners	500,000	4/18/2014	3/17/2016	Research in progress
20-98	A Guide to Agency-Wide Knowledge Management for State Departments of Transportation	Spy Pond Partners	185,000	2/19/2014	6/18/2015	Completed---Published as NCHRP Report 813
20-99	Communication Guidelines for State Departments of Transportation	Parsons Brinckerhoff	300,000	6/30/2014	6/20/2016	Research in progress
20-100	Return on Investment in Transportation Asset Management Systems and Practices	Spy Pond Partners	350,000	1/28/2015	8/26/2016	Research in progress
20-101	Guidelines to Incorporate the Costs and Benefits of Adaptation Measures in Preparation for Extreme Weather Events and Climate Change	Dewberry Consultants LLC	299,210	9/1/2015	4/30/2017	Research in progress; interim report pending
20-102	Impacts of Connected and Automated Vehicles on State and Local Transportation Agencies	Various	300,000			Research in progress
20-102(01)	Identification of State and Local Policy and Planning Actions that Could Facilitate Implementation of CV and AV Systems	Texas A&M Transportation Institute	400,000	11/3/2015	2/2/2017	Research in progress
20-102(02)	Impacts of Transit System Regulations and Policies on CV/AV Technology Introduction	-----	150,000			Contract pending
20-102(03)	Critical Next Steps for AV/CV Applications in Freight Operations	Booz-Allen & Hamilton	150,000	10/15/2015	12/14/2016	Research in progress
20-102(04)	Evaluation Guidance for Automated Vehicle Pilot and Demonstration Projects	-----	75,000			In development
20-102(05)	Strategic Communications Plan	-----	100,000			In development
20-102(06)	Road Markings for Machine Vision	-----	200,000			In development
20-102(07)	Implications of Automation for Motor Vehicle Codes	-----	350,000			In development
20-102(08)	Dedicating Lanes for Priority or Exclusive Use by CVs and AVs	-----	350,000			In development
20-102(09)	Providing Support to the Introduction of CV/AV Impacts into Regional Transportation Planning and Modeling Tools	-----	300,000			In development
20-103	Guidance for Development and Management of Sustainable Information Portals	Applied Engineering Management Corporation	249,903	4/17/2015	4/16/2017	Research in progress
20-104	Capturing and Learning Essential Consultant-Developed Knowledge within Departments of Transportation	Spy Pond Partners	249,992	4/15/2015	10/14/2016	Research in progress

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
20-105	Development of Course Outlines for Ahead of the Curve Training Program: Mastering the Management of Transportation Research	Cambridge Systematics	55,000	2/23/2015	2/29/2016	Research in progress
20-106	Framing Surface Transportation Research for the Nation's Future	TRB Studies and Special Programs Division	750,000			Research in progress
20-107	Construction Project Staffing Strategies for Effective Program Oversight	----	500,000			In development
20-108	Effective Practices for Creating and Maintaining an Innovation-Delivery Culture within Departments of Transportation	----	300,000			In development
20-109	Improvements to the Transportation Research Thesaurus	----	350,000			In development
20-110	A Guide to Ensure Access to the Publications and Data of Federally Funded Transportation-Related Research	----	250,000			In development
20-111	Support for AASHTO RAC Task Forces in Response to the SCOR Strategic Plan	----	315,000			In development
AREA TWENTY-ONE : SOILS AND GEOLOGY--TESTING AND INSTRUMENTATION						
21-10	Manual on Subsurface Investigations -- Update	GeoSyntec Consultants of North Carolina PC	299,912	6/17/2014	1/17/2016	Research in progress; interim report pending
21-11	Improved Test Methods and Practices for Characterizing Steel Corrosion Potential of Earthen Materials	----	400,000			In development
AREA TWENTY-TWO : DESIGN--VEHICLE BARRIER SYSTEMS						
22-14(04)	Testing of Cable Median Barrier in a Narrow Ditch	Texas A&M Research Foundation	100,000	3/17/2011	7/31/2016	Research in progress; revised scope approved; draft final report pending
22-20(02)	Design Guidelines for TL-3 through TL-5 Roadside Barrier Systems Placed on Mechanically Stabilized Earth (MSE) Retaining Walls	Texas A&M Research Foundation	610,000	5/14/2010	1/15/2016	Research in progress; revised work plan approved; added TL-5 crash test completed; draft final report pending
22-22(02)	Effectiveness of Traffic Barriers on Non-Level Terrain	Texas A&M Research Foundation	420,742	6/12/2012	1/11/2016	Research in progress
22-26	Identification of Factors Related to Serious Injury and Fatal Motorcycle Crashes into Traffic Barriers	Virginia Polytechnic Institute	500,000	5/1/2009	12/31/2016	Research in progress; added additional driving season for added crash records; draft final report pending
22-28	Criteria for Restoration of Longitudinal Barriers, Phase II	Roadsafe LLC	300,000	1/2/2012	12/31/2015	Completed
22-29A	Evaluating the Performance of Longitudinal Barriers on Curved, Superelevated Roadway Sections	George Mason University	250,000	7/28/2014	4/26/2016	Research in progress

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
22-30A	In-Service Performance Evaluation of W-beam End Terminals	TRB Studies and Special Programs Division	836,000			Policy study
22-31	Recommended Guidelines for the Selection and Placement of Test Levels 2 through 5 Median Barriers	Roadsafe LLC	300,000	9/28/2015	9/28/2018	Research in progress
AREA TWENTY-FOUR : SOILS AND GEOLOGY--MECHANICS AND FOUNDATIONS						
24-20(02)	Evaluation of Abutment-Scour Equations from NCHRP Projects 24-15(2) and 24-20 Using Field Data	US Geological Survey	245,000	10/1/2012	8/31/2015	Completed---Publication decision pending
24-20(02)A	Evaluation of Abutment-Scour Equations from NCHRP Projects 24-15(2) and 24-20 Using Field Data	Ettema, Robert	10,000	12/16/2013	8/31/2015	Completed---No report
24-20(02)B	Evaluation of Abutment-Scour Equations from NCHRP Projects 24-15(2) and 24-20 Using Field Data	Briaud, Jean-Louis	10,000	7/10/2014	7/10/2015	Completed---No report
24-35	Guidelines for Certification and Management of Flexible Rockfall Protection Systems	Yeh & Associates	249,999	6/15/2012	12/31/2015	Completed
24-36	Scour at the Base of Retaining Walls and Other Longitudinal Structures	University of Minnesota	500,000	11/15/2012	5/31/2016	Research in progress; contractor's draft report pending
24-37	Combining Individual Scour Components to Determine Total Scour	Georgia Tech Research Corporation	600,000	10/1/2012	9/30/2016	Research in progress; contractor's draft report pending
24-38	Development of Bridge Foundation Movement Criteria	North Dakota State University	28,593	8/14/2012	2/13/2015	Terminated---Work continuing under NCHRP project 12-103
24-39	Evaluation and Assessment of Environmentally Sensitive Stream Bank Protection Measures	Ayres Associates	500,000	6/1/2013	12/1/2015	Completed---Publication decision pending
24-40	Design Hydrology for Stream Restoration and Channel Stability at Stream Crossings	Colorado State University	350,000	7/22/2013	6/30/2016	Research in progress; contractor's draft report pending
24-41	Defining the Boundary Conditions for Composite Behavior of Geosynthetic Reinforced Soil (GRS) Structures	University of Texas - Austin	500,000	9/1/2014	11/30/2017	Research in progress; contractor's draft report pending
24-42	Underwater Installation of Filter Systems for Scour and other Erosion Control Countermeasures	Ayres Associates	300,000	6/30/2014	9/1/2016	Research in progress; contractor's draft report pending
24-43	Relationship between Erodibility and Properties of Soils	Texas A&M Transportation Institute	300,000	8/11/2015	8/11/2018	Research in progress; interim report pending
24-44	Guidelines for Managing Geotechnical Risks in Design-Build Projects	Iowa State University	350,000	6/1/2015	12/1/2017	Research in progress; interim report pending
24-45	Evaluating Mechanical Properties of Earth Material During Intelligent Compaction	University of Texas - El Paso	500,000	7/27/2015	7/27/2018	Research in progress; interim report pending

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
24-46	Development of an Implementation Manual for Geotechnical Asset Management for Transportation Agencies	----	500,000			In development
24-47	Clear-Water and Live-Bed Scour in Long Contractions	----	500,000			In development
AREA TWENTY-FIVE : TRANSPORTATION PLANNING--IMPACT ANALYSIS						
25-25	Research for the AASHTO Standing Committee on the Environment	----	600,000			Research in progress---Refer to project writeup on CRP website and individual tasks
25-25B	Research for the AASHTO Standing Committee on the Environment	----	475,000			In development
25-25/Task 78	Programmatic Agreements for Project-Level Air Quality Analyses	ICF Incorporated	125,000	7/26/2013	6/30/2015	Completed---Final deliverables available for AASHTO use
25-25/Task 84	Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures	ICF Incorporated	125,000	6/17/2013	3/31/2015	Completed---Final deliverables available for AASHTO use
25-25/Task 90	Application of Geographic Information Systems (GIS) for Historic Properties	ICF Incorporated	90,000	4/8/2014	8/31/2015	Completed
25-25/Task 91	Synthesis of Transportation Exclusions to Section 106 Review	ICF Incorporated	75,000	4/9/2014	4/8/2015	Completed---Final deliverables available for AASHTO use
25-25/Task 92	Transferability of Post-Construction Stormwater Quality BMP Effectiveness Studies	ICF Incorporated	124,999	4/9/2014	7/8/2015	Completed---Final deliverables available for AASHTO use
25-25/Task 93	Long-Term Construction and Maintenance Cost Comparison for Road Stream Crossings: Traditional Hydraulic Design vs. Aquatic Organism Passage Design	Louis Berger & Associates	124,700	4/15/2014	3/1/2016	Research in progress
25-25/Task 94	Integrating Extreme Weather and Adaptation into Transportation Asset Management Plans	Parsons Brinckerhoff	124,941	4/11/2014	9/25/2015	Completed
25-25/Task 95	SCOE Strategic Plan and Research Plan for SCOE Areas of Interest	Parsons Brinckerhoff	74,619	2/11/2014	7/15/2015	Completed---Final deliverables available for AASHTO use
25-25/Task 96	Quick Reference Guide for Traffic Modelers for Generating Traffic and Activity Data for Project-Level Air Quality Analyses	Parsons Brinckerhoff	75,000	11/4/2015	11/4/2016	Research in progress
25-25/Task 97	Historic Roads: A Synthesis of Identification and Evaluation Practices	----	75,000			Contract pending
25-25/Task 98	Practical Guide for Developing Effective Scopes of Work for the Geophysical Investigation of Cemeteries	----	75,000			Contract pending
25-25/Task 99	Lessons Learned from State DOT NEPA Assumption	Louis Berger Group	125,000	7/21/2015	7/21/2016	Research in progress; draft final report pending

TABLE 2 (continued)

Project						
No.	Title	Research Agency	Contract Amount	Starting Date	Completion Date	Project Status*
25-25/Task 100	Compilation of Existing Data on Northern Long-Eared and Other Cave-Dwelling Bat Habitat and the Roadside Environment	-----	125,000			Contract pending
25-25/Task 101	Stormwater Monitoring Program Goals, Objectives and Protocols for State Departments of Transportation	-----	125,000			In development
25-37	A Watershed Approach to Mitigating Stormwater Impacts	Low Impact Development Center, Inc.	598,540	7/1/2012	4/30/2016	Research in progress; draft final report pending
25-39	Environmental Performance Measures for State Departments of Transportation	High Street Consulting Group	500,000	8/15/2012	4/3/2015	Completed---Published as NCHRP Report 809
25-43	Navigating Multi-Agency NEPA Processes to Advance Multimodal Transportation Projects	Parsons Brinckerhoff	249,988	6/3/2013	2/1/2016	Research in progress; final report pending
25-44	Field Evaluation of Reflected Noise from a Single Noise Barrier	Resource Systems Group, Inc.	349,969	9/4/2013	11/30/2015	Completed---Publication decision pending
25-45	Mapping Truck Noise Source Heights for Highway Noise and Barrier Analysis	Illingworth & Rodkin, Inc.	499,969	6/4/2013	1/31/2016	Research in progress; Phase III underway
25-46	Deploying Clean Truck Freight Strategies	ICF Incorporated	500,000	6/10/2014	10/10/2016	Research in progress
25-47	Strategies to Reduce Agency Costs and Improve Benefits Related to Highway Access Management	-----	600,000			In development; RFP pending publication of Access Management Application Guidelines
25-48	Combined Interface for Project Level Air Quality Analysis	Resource Systems Group, Inc.	499,706	4/24/2014	7/23/2016	Research in progress; interim report pending; additional \$80,000 from Federal Highway Administration
25-49	Development of a Highway Construction Noise Prediction Model	Gannett Fleming, Inc.	350,000			Research in progress; interim report pending
25-50	Prioritization Procedure for Proposed Road-Rail Grade Separation Projects along Specific Rail Corridors	Olsson Associates Inc.	349,763	9/28/2015	9/28/2018	Research in progress
25-51	Limitations of the Infiltration Approach to Stormwater Management in the Highway Environment	GeoSyntec Consultants	499,772	8/10/2015	2/10/2018	Research in progress
25-52	Meteorological Effects on Roadway Noise	Resource Systems Group, Inc.	299,912	6/8/2015	6/8/2017	Research in progress
25-53	Approaches for Determining and Complying with TMDL Requirements Related to Roadway Stormwater Runoff	-----	200,000			In development
25-54	Field Trials of BMP to Remove Dissolved Metals in Highway Runoff	-----	400,000			In development

* Information on all projects initiated under the NCHRP from its inception in 1962 through 1988 is included in NCHRP Web Document 7: Special Edition of Summary of Progress through 1988 located at <http://tinyurl.com/WebDoc7>. Detailed status reports on projects initiated after 1988 for which there is any type of contractual activity can be found on the NCHRP website at www.trb.org/nchrp.

** Continuing activity. Amount shown is for latest fiscal year in which funding was provided.

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