



**CTE**

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TERIS

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The Center for Transportation and the Environment  
North Carolina State University

The Center for Transportation and the Environment (CTE) is a university research institute funded by the US Department of Transportation and the North Carolina Department of Transportation, and located at The Institute for Transportation Research and Education, North Carolina State University. CTE's mission is to conduct programs of research, education, and technology transfer which seek to mitigate the impacts of surface transportation on the environment.

## Preface to Volume 2, Issue 1

The core emphasis of *EnvRIP*, Environmental Research in Progress, continues to be environmental research conducted or funded by the U.S. Department of Transportation, state departments of transportation (DOTs), and university transportation centers. However, we also review the environmental research of a wide range of resource agencies and organizations in order to include selected environmental research of interest to transportation professionals. The index, which is organized by sponsoring/funding agencies, will provide a quick reference to the wide range of agencies included in this issue of *EnvRIP*.

As a result of the diligent and persistent efforts of the TERIS staff\*, eight additional state DOTs are represented in this issue. Four other state DOTs have advised that they have no environmental research in progress at this time. Therefore, a total of 44 states DOTs have provided research records in this issue, four states acknowledge no environmental research at this time and just two states have not confirmed the status of their environmental research. A similarly high response rate was achieved with the university transportation centers. We thank everyone for their contributions and their willingness to share this information.

The 83 research projects identified as completed since the last issue of *EnvRIP* are listed in Appendix A and include citations to final reports. Completed projects appear in one issue only, since this information is or soon will be available in bibliographic databases such as the Transportation Research Board's TRIS database or the National Technical Information Services' (NTIS) database.

A new feature in this issue is the inclusion of any interim reports or other publications for research still in progress. As in the previous issue, we continue to track and identify the National Cooperative Highway Research Program (NCHRP) funded projects that meet the criteria of the Transportation Research Board's Circular 469, *Environmental Research Needs in Transportation*.

As part of the update process this time, the TERIS staff asked research sponsors and funders about their research selection and funding cycle in order to determine the frequency with which *EnvRIP* should be updated. Based on this information, the update schedule for *EnvRIP* will change from semiannual to annual.

\*Special thanks to Lisa Rockwell, Information Specialist with CTE, and Corrie Lisk-Hurst, Research Assistant with CTE/ITRE, for the many hours they dedicated to updating records and identifying new research for this issue.

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## Introduction

The Center for Transportation and the Environment (CTE) is a university research institute located at North Carolina State University. CTE's mission is to conduct programs of research, education, and technology transfer which mitigate the impacts of surface transportation on the environment. In keeping with this mission, CTE emphasizes the dissemination and sharing of information.

As an outgrowth of the November 1996 Environmental Research Needs in Transportation Conference hosted by the Transportation Research Board (TRB), the Center for Transportation and the Environment has created a specialized database of environmental research in progress, *EnvRIP*. CTE has initiated this project to achieve two major objectives: track research that meets the research needs identified at the conference and inform the transportation community about environmental research in progress to encourage collaboration.

This report is intended to provide a systematic index to environmental research in progress of interest to the transportation community. The contents include records of environmental research in progress from the Transportation Research Board's TRIS database. CTE has supplemented these records with records gathered directly from state DOTs, university transportation centers, and other agencies and organizations.

In addition to distributing this information on diskette as a searchable database and in portable document format (PDF) ready for printing, we are developing a searchable database at CTE's Web site. The Web version will offer greater flexibility for accessing and updating the information.

The PDF version is organized by the thirteen broad subject categories used in TRB's Circular 469, *Environmental Research Needs in Transportation*. Where appropriate, some projects have been listed in more than one category. In addition, we have included an index of project titles organized by sponsoring or funding agency as a ready reference to the activities of each organization. Records of active research will be maintained in future editions; however, once research is completed and reports are available, the record will appear one time in an appendix of completed research, then will be removed from *EnvRIP*.

CTE especially thanks the Transportation Research Board for permission to include records from the National Cooperative Highway Research Program (NCHRP) and from the TRIS database.

We trust that you will find *EnvRIP* useful in your work and we encourage your contributions to the database. You may wish to consult the agency index to determine how accurately your organization or agency is represented. In collaboration with Jerry Maddock, Manager of the TRB Information Services, CTE contributes all newly identified research for possible inclusion in the TRIS database.

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## **Aesthetics and Visual Quality**

### **AESTHETIC DESIGN OF PROTOTYPE NOISE BARRIER. (ENV1034)**

*Sponsored by:* New Jersey Department of Transportation. Bureau of Environmental Services. Trenton. NJ.

*Project Monitor:* Marsella, Mark.

*Performed by:* New Jersey Institute of Technology. National Center for Transportation and Industrial Productivity. Newark, NJ.

*Investigator(s):* Golub, Eugene.

*Status:* Active, *Contract No.:* Project No. NC-19 .

*Start date:* 1 Jul 1997; *Estimated completion date:* 31 Dec 1999.

*Notes:* Design details for this project have been finalized, and the construction and evaluation phases are beginning.

The purpose of this project is to design and construct a prototype noise barrier that will be more aesthetically acceptable than existing barriers and, if possible, utilize recycled plastics or other recyclable material. Various materials will be examined for suitability to prefabricate add-on "fins" to produce changing shadow patterns under varying light conditions. New panel-to-post attachment systems will also be studied. Ease and cost of construction and retrofit, durability, cost of materials, and other factors will be studied. Barrier design itself will proceed through computer modeling, construction of 1/3 scale model, and finally a full-scale prototype.

Accomplishments to date include

- (1) Construction of the 1/3 scale model;
  - (2) Finalization of the panel attachment system;
  - (3) Finalization of the "fin" material, shape, and color;
  - (4) Finalization of the "fin" attachment method;
  - (5) Arranging for the prefabrication of full-size panels and construction of a prototype barriers.
- Construction will take place early in 1998 at the prefabricator's plant. All activities will be videotaped and notes will be taken for later analysis.

### **DEVELOPMENT OF LOW-COST SOUND BARRIERS AND LAND USE ORDINANCES TO MINIMIZE FUTURE ROAD NOISE IMPACTS. (ENV1062)**

*Sponsored by:* Pennsylvania Department of Transportation. U.S. Department of Transportation.

*Project Monitor:* Byers, James.

*Performed by:* West Virginia University.

*Investigator(s):* Martinelli, D.

*Status:* Active.

*Start date:* 11 Apr 1996; *Estimated completion date:* 18 Dec 1998.

Traffic noise has long been regarded as one of the most significant environmental effects associated with both existing and new freeways. Communities located near freeways are most affected negatively by traffic noise. These communities seek relief through the construction of noise abatement devices such as barrier walls. These noise barriers are generally expensive to produce and erect, and the cost of construction often falls on the authorized transportation agency. What is needed is an approach to the problem that simultaneously addresses both the noise problems facing existing communities and the reduction of future problems through proactive prevention methods. MAUTC researchers at West Virginia University have worked with Pennsylvania DOT to investigate and develop low-cost noise abatement systems emphasizing recycled materials. Land use ordinances that minimize exposure to freeway noise while considering ancillary attributes such as aesthetics and constructibility will also be developed.

**DEVELOPMENT OF SEED STOCKS. (00722890)**

*Sponsored by:* Alaska Department of Transportation and Public Facilities. Juneau. AK.

*Project Monitor:* Reckard, M.

*Performed by:* Alaska Plant Materials Center. Division of Agriculture. Palmer. AK.

*Investigator(s):* Wright, S.

*Status:* Active.

*Start date:* Mar 1995; *Estimated completion date:* Sep 1996.

The state of Alaska lacks a sufficient number of native seed species in commercial production for proper seeding of roadsides to permit specifying seed types that will have the best survival chances. This is especially true for wildflowers and for RS and for D-adapted species. The national trend is indicated by a federal requirement for using native species for seed types where federal funds are involved. Seed collection and species success evaluation studies under this project will be done at or near the Alaska, Steese, Glenn and Nome-Taylor Highways. More than forty species will be evaluated and considered for seed production and potential use in revegetation. The timing of seed collection will be species specific. Following collection the seeds must be cleaned and sorted, followed by germination tests. Seeds will be given to potential commercial growers in the second year of this study in order to have more seeds produced and their production efforts will be monitored. Those species proving suitable for expanded seed production will be identified, and seeding requirements will be prepared as possible specifications. The investigation of native species of vegetation and seed collection from species favorable for commercial production will be implemented. The benefits of this study will be: improved roadside vegetation survival, prevention of slope erosion problems, and roadsides and highway facilities beautified with wildflowers. Until seed stocks are made available in quantities suitable for wide use, their potential benefits cannot be realized and they cannot even be specified for use in construction revegetation work.

**EVALUATION OF SERVICE LIFE OF NOISE BARRIER WALLS. (ENV1004)**

*Sponsored by:* Illinois Department of Transportation.

*Project Monitor:* Bruns, Mike.

*Performed by:* Southern Illinois University at Edwardsville.

*Investigator(s):* Kay, Diane.

*Status:* Active, *Contract No.:* ITRC Project IIB-H1, FY 97.

*Start date:* 26 Sep 1997; *Estimated completion date :* 25 Dec 1998.

Noise barrier walls are a costly addition to many highway projects in Illinois. Current cost can approach \$1 million per mile for walls installed on one side of the roadway. Several types of materials are currently used in the construction of noise barrier walls, including wood, concrete, and several proprietary products. Designers attempting to make a rational choice between these products, however, are hampered by a current lack of information on possible differences in service lives of these materials.

Research is needed to determine whether the service lives of the available materials are measurably different, how such differences can be quantified, and whether life-cycle cost of barrier walls should be a determining factor in the decision to use a given material. The trade-off between lower life-cycle of a material and the degradation of its aesthetic and acoustical properties must also be addressed. Finally, the list of currently approved materials and the construction/installation methods currently specified by the Department need to be evaluated for potential improvements which could yield benefits for the Department.

The objectives of this study are to:

1. develop methods to evaluate service life of materials used for noise barrier walls in Illinois,

2. develop a means of evaluating life-cycle costs with consideration given to service life, aesthetics and acoustics,
3. make recommendations regarding the use of life-cycle costing as a determining factor in material choice, and
4. make recommendations regarding the Special Provisions used by the Department to specify materials and construction/installation methods.

Accomplishment of these objectives will permit more rational choices among competing materials and may result in significant cost savings.

**INPUTS AND MAINTENANCE FOR REVEGETATION WITH NATIVE AND HERBACEOUS SPECIES.** (00735165)

*Sponsored by:* California Department of Transportation. Office of Structural Foundations. Sacramento. CA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Haynes, J.

*Performed by:* California Department of Transportation. Office of Structural Foundations. Sacramento. CA.

*Investigator(s):* Haynes, J.

*Status:* Active.

*Start date:* 1 Jun 1996; *Estimated completion date:* 30 Jun 1999.

The research objective is to investigate the following: 1) differential responses of individual species, 2) mixture dynamics in response to fertilizer, mulch and management treatments, 3) management practices for cost-effective long-term maintenance of established native herbaceous plant communities, 4) the effects of amount and type of fertilizer and mulch of herbaceous species establishment, and 5) compare seedings methods. Our goal is to include district 3 environmental, design, and maintenance personnel in the planning and execution of the experiment to develop long term monitoring and maintenance program for native vegetation on CalTrans rights-of-ways.

**LOS CAMINOS ANTIGUOS SCENIC AND HISTORIC BYWAYS.** (CRIS 0177300)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service. Arizona Forestry Station.

*Performed by:* Northern Arizona University. School of Forestry. Flagstaff. AZ.

*Investigator(s):* Lee, M. E.

*Status:* Active, *Contract No.:* ARZZ-NAU-FOR394Q.

*Start date:* 24 Oct 1997; *Estimated completion date:* 24 Oct 1999.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

The purpose of this project is to determine the individual, household, community, and environmental benefits and disbenefits provided by the Los Caminos Antiguos Scenic and Historic Byway as perceived by five groups: residents, members of local governments, private-sector recreation and tourism service providers, public land managers, and non-local recreation users of the byway. This information will be gathered using focus groups and surveys administered on site and via mail. Questionnaires are being designed during winter-spring 1998 to be administered in the summer and fall 1998.

**METHODS OF CONTEMPORARY COMMUNITY DESIGN AT ZUNI AND ACOMA PUEBLOS BASED ON SUSTAINABLE AGRICULTURE.** (CRIS 0175818)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* Cornell University. Landscape Architecture Department. Ithaca. NY.

*Investigator(s):* Gleason, K. L.

*Status:* Active, *Contract No.:* NYC-146402.

*Start date:* 1 Oct 1997; *Estimated completion date:* 1 Jun 2001.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

This project will adapt traditional agriculture and building technologies to address contemporary development issues in rural Native American communities. In evaluating the contemporary design of parks, roads and housing, the Principal Investigator will focus on traditional methods of cultivation, erosion control, and water management and how these may be reintroduced into village life to reinforce the cultural ways of the pueblo communities.

The project seeks to establish a partnership approach between the pueblos and Cornell. The Principal Investigator brings a combined knowledge of landscape architectural design, arid-climate agriculture and archaeology. She will work with the pueblos and Cornerstones Community Partnership to explore the objectives described above. Groups and Cornell students will work with students from Zuni and Acoma to actually build and test ideas produced through discussion and research at Cornell and in the South West. The results will be disseminated in a product developed in collaboration with the pueblo groups.

**THE VIEW FROM THE ROAD: COSTS AND BENEFITS OF URBAN FORESTS FOR BUSINESS DISTRICTS.** (CRIS 0177499)

*Sponsored by:* OCI WN.Z (Other Cooperating Institutions, which report research to U.S. Dept. of Agriculture).

*Performed by:* University of Washington. Ecosystems, Horticulture, and Conservation Department. Seattle. WA.

*Investigator(s):* Wolf, K. L.

*Status:* Active, *Contract No.:* WNZ-EHC-776.

*Start date:* 1 Aug 1997; *Estimated completion date:* 30 Jul 1999.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

Objectives of this project are to gain information about public preferences and perceptions regarding the benefits and costs of trees on urban roadsides. By means of surveys, elicit response from business owners and highways regarding the benefits and values of urban forests for roadside business districts. Conduct project initially in the Pacific Northwest, then expand nationally. Research results will be reported to business and commerce organizations, as well as to urban forestry professionals and managers.



## Air Quality

### **ACQUISITION AND MANAGEMENT OF TRANSPORTATION DATA FOR MANAGEMENT SYSTEMS AND LONG-RANGE PLANNING. (SWUTC 407510-00003)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Olavson, Chris.

*Performed by:* Texas A&M University.

*Investigator(s):* Benz, Robert J.

*Status:* Active, *Contract No.:* 128XXA1001, Task C.

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Aug 1999.

The key objectives for this project, Task C of Project 407510, include: vehicle emissions/air quality analysis, congestion management, and the development of an automated infrastructure information and analysis system. The main objective of vehicle emissions/air quality analysis is to find cost-effective methods to measure and monitor air quality. Congestion management is a tool that non-attainment areas can use to improve air quality. Congestion management actively monitors and evaluates traffic conditions through the use of several data collection methods. These methods include: travel time and speed surveys, traffic and vehicle classification counts, as well as a physical inventory of roadway conditions and characteristics. In addition, the data is used in regular updates produced by TxDOT for the Houston-Galveston Regional Transportation Study, and is extremely valuable for TxDOT's long range planning efforts and activities. The last key objective, the development of an automated infrastructure information and analysis system, is vital to enable the department to meet the demand for transportation information by allowing transportation professionals to make specific queries regarding operational and physical roadway characteristics and present "hot spot" areas that meet user-specified threshold levels on the system's graphical display interface. This system could also help the department with a wide range of transportation planning analysis functions.

### **AIR QUALITY/CONFORMITY. (SWUTC 407370)**

*Sponsored by:* Texas Department of Transportation.

*Performed by:* Texas A&M University.

*Investigator(s):* Dresser, George B.

*Status:* Active, *Contract No.:* 507XXA3013 SPR-0420(098).

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Aug 1999.

The primary purpose of this interagency contract is to provide for TTI technical support to TxDOT and selected MPOs in the area of transportation/air quality planning and analysis. Due to proposed changes in the National Ambient Air Quality Standards (NAAQS), significant changes in the number of urban areas impacted by the Clean Air Act Amendments (CAAA) are expected. The effect of these changes will not be known for several months. Consequently, this IAC is written with considerable flexibility. The specific tasks to be worked on will be selected by the project director quarterly. TxDOT will notify TTI as to the tasks to be accomplished each quarter of each year. In general, TTI shall provide professional and technical staff services to assist TxDOT and selected MPOs in performing data collection, data analysis, travel modeling, and other transportation/air quality related tasks as required to comply with state and federal requirements and to meet the needs of federal and state transportation and environmental agencies.

**AIR QUALITY IMPACTS OF HIGHWAY CONSTRUCTION AND SCHEDULING.**

(SWUTC 417458)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Neeley, Melissa.

*Performed by:* Texas A&M University.

*Investigator(s):* Dresser, George B.

*Status:* Active.

*Start date:* 1 Sep 1996; *Estimated completion date:* 30 May 1998.

This study will assess the impact of traffic congestion, operation of construction equipment, and use of construction materials on urban air quality. Researchers will evaluate benefits of construction abatement, especially on ozone alert days, and identify alternative construction practices to minimize negative impacts on air quality. In addition, researchers will evaluate the emission reduction benefits and ensuing costs of alternative construction scheduling, including lengthening contract time, construction during non-summer months, night construction, etc. Results of this work will provide TxDOT with information on the contributions to regional emissions from highway construction projects and the additional costs incurred when highway construction contractors must participate in ozone alert programs. The study will also provide information that the department can use to develop policy guidance concerning the participation in ozone alert programs.

**AIR QUALITY MONITORING COMPUTER SYSTEM. (ENV1035)**

*Sponsored by:* New Jersey Department of Transportation. Bureau of Project Support and Engineering. Trenton, NJ.

*Project Monitor:* Sasor, S. Robert.

*Performed by:* New Jersey Institute of Technology. National Center for Transportation and Industrial Productivity. Newark, NJ.

*Investigator(s):* Wen, H. Joseph.

*Status:* Active, *Contract No.:* Project No. NC-20.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Mar 1999.

NJDOT is currently using a DOS-based air monitoring program that requires manual data entry. This system is inefficient and subject to error. The system needs to be redesigned for Windows-based operation, so that data collection and data entry can be automated. Data entry will also be tied to a statistical analysis program which will produce statistical reports to be used in the design process. The current system is presently being analyzed, and the user's needs are being determined.

**AIRBORNE PARTICULATE SOURCES IN ANCHORAGE. (00726676)**

*Sponsored by:* Alaska Department of Transportation and Public Facilities. Juneau. AK; Federal Highway Administration. Washington. DC.

*Project Monitor:* Reckard, M.

*Performed by:* Alaska Department of Transportation and Public Facilities. Juneau. AK.

*Investigator(s):* Morris, S.

*Status:* Active.

*Start date:* 1 Jan 1996; *Estimated completion date:* 30 Sep 1996.

The municipality of Anchorage and the Alaskan Department of Environmental Conservation are required to prepare a draft PM-10 control plan by February 28, 1997. The Anchorage Air Pollution Control Agency is coordinating the planning process. The major source of PM-10 must be identified and their relative contributions quantified before appropriate control strategies can be evaluated and selected for inclusion on the PM-10 control plan. A number of studies have been

conducted in Anchorage to identify and quantify particulate sources. Chemical mass balance receptor modeling was used in a characterization of Anchorage particulate in 1985 and Eagle River particulate in 1988. Optical microscopy was used in 1993 by another municipality of Anchorage consultant (Crutcher) to estimate the contribution of Mount Spurr ash to Anchorage PM-10 exceedances measured in 1993 and 1994. Crustal sources of PM-10 were determined to be the major source (about 90%) of particulate. The chemical mass balance studies have been successful in identifying non-crustal sources like diesel and wood smoke but less successful in identifying sub-categories of the larger crustal fraction. Chemical profiles are available for many sources. Receptor samples are also available. Studded tires may contribute to the PM-10 problem in Anchorage by pulverizing the road sand applied to roadways to sub-10 micron particle sizes or by abrading the wearing course of the roadways itself. However, little information exists regarding the role of studded tires in PM-10 emissions. The results of this testing could be incorporated into the PM-10 emission inventory.

### **ASSESSING THE AIR QUALITY IMPACTS OF TRANSPORTATION STRATEGIES IN GEORGIA. (ENV1178)**

*Sponsored by:* Georgia Department of Transportation.

*Project Monitor:* Deaver, Rick.

*Performed by:* Georgia Institute of Technology.

*Investigator(s):* Leonard, John.

*Status:* Active, *Contract No.:* RP 9813.

*Start date:* 31 Aug 1998; *Estimated completion date:* 30 Jun 2000.

The Georgia Department of Transportation (GDOT) is committed to minimizing the air quality impact of future projects. Technology is playing a larger role in the design and management of transportation systems. Transportation strategies and designs that minimize vehicle emissions can be implemented once these relationships are known. This project is conducted by Georgia Tech to quantify the relative emission impacts of various transportation control measures and intelligent transportation systems that will prioritize transportation strategy developments based on the ability to reduce emissions.

### **ASSESSMENT OF SHORT-TERM VERSUS LONG-TERM AIR QUALITY EFFECTS . (ENV1229)**

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Project Monitor:* McCready, Ronald D.

*Status:* Pending, *Contract No.:* Project 25-21.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The effect of transportation projects on air quality is frequently not clear. Some projects may have short-term benefits and long-term impacts. Other projects may have the reverse effect. For example, it is said that capacity improvement projects or Intelligent Transportation System projects have a short-term air quality benefit by reducing congestion and increasing speed yet have a negative effect by encouraging additional travel. Also, transportation actions such as HOV projects, tolling strategies, reduction in parking availability, may have long-term air quality benefits by reducing VMT and trips yet might make air quality worse in the short term by increasing congestion and queuing.

The objectives of the research are: to determine the short-term and long-term air quality benefits and impacts of transportation projects; to evaluate the magnitude and duration of the benefits and

impacts; to determine the scales of effect (for example, corridor or longitudinal versus regional); to assess when and if trade-offs occur between benefits and impacts; and the public understanding and acceptance of these issues.

This research will be accomplished through the following tasks: (1) Literature search - A literature search will be done to determine previous and ongoing research that may be of help in meeting the objectives of the research. The search will find other studies that may not have been designed to provide guidance for this research, but the results and approaches may yield appropriate insights. (2) Design of an Analytical Approach - A methodology will be devised to thoroughly analyze the air quality impacts and benefits of transportation projects. The methodology will include analysis of secondary and tertiary effects, as well as direct, air quality effects. The methodology will consider all appropriate transportation-related air pollutants. (3) Implementation of an Analytical Approach - A range of transportation projects will be selected and the analytical approach will be used to assess the short-term, long-term, and overall quality effects of the projects. (4) Case Studies - A number of projects that have already been implemented will be selected to evaluate the validity of the analytical approach and to assess if expected air quality effects of the projects actually occurred. The selection of projects for the case studies will be such as to include different types of projects and projects whose long-term effects can be determined. (5) Public Acceptance - A determination will be made of the public's understanding, acceptance, and interest in these concerns. Use of surveys or other techniques will be considered. (6) Final Report - A final report will be prepared that documents the results of the research. If the research for Task 2 results in a computer-based analytical approach, this will be thoroughly documented in a users' guide.

**ASSESSMENT OF THE POTENTIAL FOR TRIP-CHAINING, RIDE-SHARING, AND CAR-POOLING MANDATES TO REDUCE ENERGY CONSUMPTION AND VEHICLE EMISSIONS. (ENV1243)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Irvine. Civil & Environmental Engineering Department.

*Investigator(s):* Recker, Will.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

The 1990 Clean Air Act Amendments (CAAA) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) have combined to define a broad range of transportation control measures (TCMs); however, it is not clear how much change in travel behavior can be achieved with incentive programs only. This project will empirically assess impacts of policy mandates on urban transportation energy consumption and emissions, and will concurrently measure corresponding changes in mobility/accessibility associated with these policies by building on the record of research in activity-based behavioral analysis of transportation policy options.

**AUTOMOTIVE EXHAUST EMISSIONS DURING COLD STARTING. (ENV1218)**

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Cady, Richard and Pasch, Dan.

*Performed by:* University of Minnesota.

*Investigator(s):* Kittelson, David.

*Status:* Active, *Contract No.:* 97-061R.

*Start date:* 2 Jan 1998; *Estimated completion date:* 31 Mar 1999.  
No abstract provided.

**BRITE EXPANSION.** (ENV1194)

*Sponsored by:* New Mexico State Highway & Transportation Department.

*Project Monitor:* Skrupskis, Michelle.

*Performed by:* Alliance for Transportation Research Institute.

*Investigator(s):* Cockerill, Kristan.

*Status:* Active.

*Start date:* Nov 1998; *Estimated completion date :* Jun 2000.

This effort builds upon the work done to establish a repository for border region transportation related research and information. This continuation will expand the BRITE (Border Region Information on Transportation and the Environment) repository to include a segment on connections between transportation and habitat and land use issues. Additionally, the researchers will update the air quality segment created in the first phase of this project.

**CARBON MONOXIDE ANALYSIS FOR HIGHWAY PROJECTS.** (ENV1002)

*Sponsored by:* Illinois Department of Transportation.

*Project Monitor:* Zyznieuski, Walt.

*Performed by:* University of Illinois. Urbana-Champaign.

*Investigator(s):* Larson, Susan.

*Status:* Active, *Contract No.:* ITRC Project IIIA-H1, FY 97.

*Start date:* 3 Apr 1997; *Estimated completion date:* Oct 1998.

Under a 1978 agreement between the Illinois Environmental Protection Agency (IEPA) and the Illinois Department of Transportation (IDOT), a carbon monoxide (CO) air quality analysis is required if a highway project is located within one of nine designated urban areas in Illinois, or if the average daily traffic (ADT) exceeds 16,000 by the end of the first year of project operation. According to the Federal Highway Administration (FHWA), however, "a CO analysis is unnecessary where such impacts (project CO contribution plus background) can be judged well below the 1-hour (35 ppm) and 8-hour (9 ppm) National Ambient Air Quality Standards (or other applicable state or local standards)." It is difficult to assess whether the IDOT/IEPA standard, which uses the simple parameter of traffic volume, is meeting or exceeding the FHWA standards, especially since vehicle emissions have improved tremendously.

The IDOT Air Quality Manual, written in the 1980s and incorporating the criteria established in the 1978 agreement, is currently being revised. Research is needed to develop a computer screening model to indicate the need for a CO air quality analysis for highway projects. Use of a computer model similar to COSCREEN, recently developed for use in Florida, will be explored as a potential screening tool which may be adapted for use in Illinois. Use of a computer model such as CAL3QHC or CALINE, used by the United States Environmental Protection Agency (USEPA), should be evaluated as a method of quantifying CO levels on projects where air quality analysis is judged necessary.

**Objectives and Benefits:** The objectives of this research are to

1. establish whether computer modeling can be used as a screening tool to determine whether or not a full CO analysis is warranted on specific projects;
2. study the COSCREEN model used by Florida DOT;
3. study the usefulness of the CAL3QHC and CALINE computer models recommended by USEPA as a tool for quantifying CO levels on highway projects in Illinois; and

4. develop an appropriate computer screening model for establishing the need for a full CO study.

Establishment of a computer screening method will allow the districts to perform CO screening. This should reduce the number of CO analyses required, allowing IDOT to redirect limited resources to other areas.

**CASE STUDY OF EMISSIONS AND FUEL CONSUMPTION AT I-10/ZARAGOZA ROAD DIAMOND INTERCHANGE IN EL PASO AFTER CONSTRUCTION OF FREE U-TURN LANES. (SWUTC 467506)**

*Sponsored by:* State of Texas.

*Performed by:* University of Texas.

*Investigator(s):* Lee, Clyde.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1997.

The existing diamond interchange on I-10 at Zaragosa Road in El Paso, which presently does not have free u-turn lanes, is being reconstructed to include free u-turn lanes and other improvements. Work should be completed early in 1997. Previous studies have documented geometry, traffic volumes, and signal timing at this site before and during reconstruction. The proposed research involves collecting field data about traffic, geometric features, and signal control after reconstruction. The TEXAS Model for Intersection Traffic will then provide the means (via simulation) for comparing the relative quantity of air pollutants and fuel consumption for three cases: before, during, and after adding the special u-turn lanes. Emissions and fuel consumption are of critical concern in El Paso, and a more sensitive methodology for assessing the effects of site-specific congestion relief than is now utilized is needed. This project can potentially provide such an improved technique.

**COOLSIDE WASTE MANAGEMENT DEMONSTRATION. (00608970)**

*Sponsored by:* Ohio Coal Development Office. Columbus. OH.; Department of Energy. Morgantown, WV.

*Performed by:* University of Kentucky. Kentucky Transportation Center. Lexington. KY.

*Investigator(s):* Burke, F.

*Status:* Active.

*Start date:* 1 Jul 1991; *Estimated completion date:* 30 Jun 1995.

The major objective of this study is to develop and demonstrate disposal and utilization options for coolside and similar SO<sub>2</sub> abatement wastes likely to be generated by technologies which were demonstrated in the state of Ohio and which will be used in the state of Ohio to comply with proposed Clean Air Act revisions. The coolside process is a retrofit dry flue gas desulfurization (FGD) technology for removal of SO<sub>2</sub> in coal-fired power plants. In the process, hydrated lime is pneumatically injected dry into the power plant duct work on the "cool side" of the air preheater. The coolside wastes are relatively unknown as engineering materials. The principal goal of phase I is to ensure that adequate information is developed on the physical and chemical nature of the coolside waste to design and construct safe, economical, and stable landfills. Phase I consists of three major areas: (1) chemical and geotechnical characterization of the waste; (2) field and laboratory lysimeter leaching studies; and (3) fill liner compatibility studies. An extensive series of geotechnical tests will be performed. Utilization of the solid waste produced from SO<sub>2</sub> scrubbing is the objective of phase 2. This phase includes two major study areas: (1) determination of the pelletization characteristics of the material and the production of 40 tons of pellets, and (2) the assessment of the unconsolidated and pelletized wastes in a prototype highway construction or similar application. The unconsolidated waste will be evaluated as chemical

stabilizing admixtures for highway subgrades. Phase 3 consists of operations of the coolside pilot plant to provide a wider range of materials for use in phase 1.

**COORDINATION OF THE SERVICE OPERATION OF SELECTED THIRD PARTY PROVIDERS IN HARRIS COUNTY: A DEMONSTRATION PROJECT.** (SWUTC

466010)

*Sponsored by:* Subcontract with Texas Southern University. Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* Texas Southern University.

*Investigator(s):* Lewis, Carol A.

*Start date:* 1 Sep 1993; *Estimated completion date:* 31 Aug 1997.

Research has identified more than twenty-five social service agencies as providing transportation service to their client base in the greater Houston area. As the Houston-Galveston urban area strives to attain air quality standards mandated by the Clean Air Act Amendment, the blending of the routes and schedules of third party service providers will lower miles and hours of travel, thereby reducing emissions. The basic questions this research seeks to resolve are these: to what extent can independent providers of social agency-based transportation be coordinated, and what environmental and operational efficiencies can be gained by that coordination?

**COSCREEN UPDATE FOR MOBILE 6.** (00744196)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Project Monitor:* Lindeman, Win.

*Performed by:* University of Central Florida. Orlando. FL.

*Investigator(s):* Cooper, D.

*Status:* Active.

*Start date:* 15 Aug 1996; *Estimated completion date:* May 2000.

The 1996 version of the emissions factor program mobile will be released shortly. This project will update the department's coscreen program.

**DEMONSTRATION OF FUEL SAVINGS FROM FREE U-TURN LANES AT DIAMOND INTERCHANGES.** (SWUTC 465560)

*Sponsored by:* Subcontract with the University of Texas. Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* University of Texas.

*Investigator(s):* Lee, Clyde.

*Start date:* 1 Sep 1993; *Estimated completion date:* 31 Aug 1997.

U-turning vehicles at conventional diamond interchanges must pass through the two closely spaced at-grade intersections on the crossing roadway, making a left turn at each, in order to reverse direction. It is difficult to provide traffic signal plans that will accommodate these vehicles, along with the other straight, left-turn, and right- turn movements using the two intersections. Consequently, traffic congestion, delay, wasted time, pollution, and excessive fuel consumption can result from u- turns. An alternative way to handle the u-turning vehicles is to provide separate, free u-turn lanes for their use in advance of the crossing roadway, thereby removing them from the intersection traffic demand, shortening their travel distance, reducing fuel consumption and pollution, possibly eliminating some stops and starts, and reducing delay. The recently enhanced TEXAS (Traffic EXperimental Analytical Simulation) Model for Intersection Traffic in its Version 3.2 (August 1993) now provides a unique tool for evaluating traffic performance at diamond interchanges under various geometric lane arrangements, traffic

controls, and traffic demands via sophisticated computer simulation of individual vehicle behavior. A special feature of the output data from the TEXAS Model is a measure of fuel consumption for each simulated vehicle passing through the interchange. Researchers will use this powerful computer simulation program in at least two case studies to demonstrate quantitatively the amount of fuel that can be, or is being, saved at diamond interchanges equipped with free u-turn lanes.

**DEVELOPMENT AND DEMONSTRATION OF SUSTAINABLE TRANSPORTATION CONTROL.** (SWUTC 472840-00013)

*Sponsored by:* DOT-University Transportation Centers Program.

*Performed by:* Texas A&M University.

*Investigator(s):* Messer, Carroll J.

*Status:* Active, *Contract No.:* DTRS95-G-0006.

*Start date:* 1 Sep 1996; *Estimated completion date:* 30 Sep 1999.

The efficient provision of mobility of persons and goods should directly consider the energy consumed, environmental impacts, and the economic costs involved in providing transportation. This is not true in the traffic signal controller industry in the United States today. While micro-electronics have been improved in the traffic signal systems, the fundamental signal control strategy used today remains locked in the operational concepts of the 1960s, when explicit considerations of energy consumption and environmental impacts (e.g., on air quality) were nil.

**DEVELOPMENT OF A MODAL-EMISSIONS MODEL.** (ENV1014)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Performed by:* University of California-Riverside.

*Investigator(s):* Barth, Matthew J.

*Status:* Active, *Contract No.:* Project 25-11, FY '95.

*Start date:* 15 Aug 1995; *Estimated completion date:* 14 Aug 1998.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Recent studies have revealed that brief but rapid accelerations can contribute significantly to a vehicle's carbon monoxide and hydrocarbon emissions during a typical urban trip. Current emission-factor models are insensitive to the distribution of such modal events (i.e., cruise, acceleration, deceleration, and idle) in the operation of a vehicle and instead estimate emissions by average trip speed.

The Clean Air Act Amendments (CAAA) of 1990 and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 place great emphasis on modeling to provide accurate accounting of progress toward meeting air quality goals and deadlines that, if not met, could lead to highway funds being withheld. Congestion mitigation and transportation management strategies will only be possible if it can be shown that their implementation will not further impair air quality in specific urban areas.

The current models, MOBILE and EMFAC, are being used to develop and evaluate transportation policy throughout the country under the authority of the CAAA. However, these models offer little help for evaluating operational improvements that smooth traffic flow such as ramp metering, signal coordination, and many IVHS strategies. Such operational improvements help reduce acceleration events and the queuing of vehicles, but they cannot be evaluated accurately by MOBILE or EMFAC because these models predict emissions only for average trip



speeds.

Although some work by the U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) is underway on modal-emission models, the most optimistic estimate for the implementation of a fully operational model is five years. Until an accurate and defensible modal-emissions model is available to demonstrate the air quality benefits of congestion relief, the fate of many operational programs and improvements will be determined by ill-suited models. The overall objective of this research is to develop and verify a modal-emissions model that accurately reflects impacts of speed, engine load, and start conditions on emissions under a comprehensive variety of driving characteristics and vehicle technologies. The research will be divided into three phases. The objectives of Phase I are as follows: (1) conceptualize a modal-emissions model, (2) develop an interim working model, and (3) define the research plan needed to develop the model into an effective tool. This tool should be able to reliably estimate emission impacts from changes in driving characteristics associated with traffic operations and transportation system improvements. The objectives of Phase II are to collect data and to refine, test, and validate the modal-emissions model. The Phase III objective is to demonstrate that the model is responsive to the regulatory compliance needs of transportation and air quality agencies.

Phase I: (1) Investigate and summarize existing literature concerning factors in the vehicle operating environment that may affect modal emissions, such as, hydrocarbon (HC), carbon monoxide (CO), and nitrogen oxides (NO<sub>x</sub>). At a minimum, factors addressed will include vehicle technology, fuel formulation (for example, reformulated gasoline), operating mode (cold starts, hot starts, acceleration), vehicle maintenance (inspection and maintenance programs), accessories (air conditioning), and road geometry (such as, steep grades). (2) Use existing data to define the domain and distribution of the modal parameters of cruise speeds, acceleration rate, idle, and deceleration rate for all facility types (freeway, highway, main arterial). (3) Critically evaluate existing models to determine if any meet the project objective or whether a new model is needed. The evaluation should consider ongoing regulatory changes in emissions certification procedures and compatibility with conventional emissions-factor models. The evaluation should also include a review of related work being conducted by the EPA and the CARB. Based on this evaluation, select the modal-emissions model type most suitable for accomplishing the project objective. (4) Based on Tasks 1, 2, and 3, design a testing protocol that will measure vehicle modal emissions over the domain of cruise, acceleration, idle, and deceleration conditions. Prepare an interim report that summarizes Tasks 1 through 4. The interim report will be distributed to the project panel for review and comment. (5) Using the protocol developed in Task 4, conduct preliminary testing on a representative sample of vehicles now in use. These data shall supplement existing data for the purpose of developing an interim working model. (6) Develop an interim working model applicable for analysis in the years 1990 to 2020 that covers the full domain of vehicle activities and significant factors affecting modal emissions. Demonstrate potential capabilities, limitations and maintenance requirements of the model. (The contractor will provide the interim working model and an interim report on Tasks 5 and 6 for NCHRP panel review and approval. The contractor will be required to make a presentation to the project panel. The contractor will not proceed with Phase II until NCHRP has approved the interim report and working model.)

Phase II: (7) Adjust the testing protocol developed in Task 4 for use in this task. Conduct testing compatible with the model developed in Task 6 on a sample of currently used vehicles. The vehicle sample shall represent the national fleet, including factors such as vehicle maintenance, vehicle type, vehicle age, mileage accrual, technology group, and emitter category. The sample size should be adequate to develop a comprehensive national model. (8) Using the data set collected in Task 7 and any other appropriate data available, examine the model developed in

Task 6 and modify it as necessary to produce a final version of the model. (9) Verify, with an independent data set representative of real on-road conditions, that the testing method used adequately represents on-road emissions. The contractor will prepare an interim report that documents the research performed in Phase II for review and approval by the NCHRP panel.

Phase III: (10) Demonstrate how the model can be used with travel forecasting and traffic models in the design and evaluation of transportation systems and operational improvements. Also demonstrate how the modal-emissions model might be used to replace the current average speed correction algorithms in MOBILE and EMFAC. (11) Submit a final report that documents the entire research effort. This shall include an instructor's manual and user's manual for the modal-emissions model and the model software.

The research team has completed the model development. A continuation project has been approved to allow for additional testing and presentation of the model to practitioners. A contract amendment will be requested along with a new schedule.

**EVALUATE CONGESTION MANAGEMENT MEASURES IN TEXAS AND THE UNITED STATES AND DEVELOP NEW INNOVATIVE TECHNIQUES.** (SWUTC 417988)

*Sponsored by:* Texas Department of Transportation.

*Investigator(s):* Crawford, Jason and Frawley, William.

*Status:* Active.

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Aug 1999.

Traffic congestion has become a problem for many metropolitan areas and there is a wide array of congestion relief techniques. The use of these techniques has become even more necessary because of pending changes in the EPA air quality standards. Currently, the information that makes successful implementation of these programs possible is scattered throughout various reports, technical journal articles, and technical notes. Although these resources are excellent for their intended purposes, accessing the information is difficult and time consuming, and successful, innovative projects may be overlooked because of the difficulty involved in identifying them.

**EVALUATION AND ENHANCEMENT OF TEXAS RAMP METERING STRATEGIES, COMPLIANCE, AND ALTERNATIVE ENFORCEMENT TECHNIQUES.** (SWUTC 412958)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Gaynor, John M.

*Performed by:* Texas A&M University.

*Investigator(s):* Messer, Carroll J.

*Status:* Active.

*Start date:* 1 Sep 1995; *Estimated completion date:* 31 Aug 1998.

The Texas Department of Transportation (TxDOT), as part of its Freeway Traffic Management (FTM) systems, is planning to use ramp metering to improve freeway operations, air quality, and mitigate traffic congestion in several large urban districts in the state. Ramp metering is the process of regulating flow onto the freeway at entrance ramps using two post-mounted traffic signals, usually located on either side of the ramp, operating at very short signal cycles to control the ramp flow rate onto the freeway. No ramp metering currently exists in Texas and no large-scale metering has been operational since the North Central Expressway Project in Dallas ended in the mid-1970s, nearly 20 years ago. Ramp meters are traffic control devices, yet few Texas

drivers or law enforcement agencies have operational experience with them. Consequently, several related concerns have been expressed about ramp metering that this project will address.

**EVALUATION OF MAGIC INCIDENT MANAGEMENT SYSTEM. (ENV1053)**

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Marsella, Mark.

*Performed by:* HNTB, Fairfield, NJ.

*Investigator(s):* Mirza, Wasif.

*Status:* Active, *Contract No.:* 7290.

*Start date:* Sep 1995; *Estimated completion date:* 31 Mar 1999.

*Publication(s):* Final report in preparation.

Provide traffic data in support of the LIDAR project, and the “before” phase of the I-80 MAGIC incident management system.

**EVALUATION OF RAMP METERING IMPACTS ON AIR QUALITY. (ENV1179)**

*Sponsored by:* Georgia Department of Transportation.

*Project Monitor:* Deaver, Rick.

*Performed by:* Georgia Institute of Technology.

*Investigator(s):* Guensler, Randall.

*Status:* Active, *Contract No.:* RP 9814.

*Start date:* 31 Aug 1998; *Estimated completion date:* 20000430.

Five ramp meters have been installed along the northbound Interstate 75 in metropolitan Atlanta, to control the flow of traffic onto the mainline interstate. In addition, detectors on the ramps monitor the vehicles entering the ramps and allow the ramp meters to turn green when vehicles begin to back up onto the adjacent street. The congestion and air quality analyses of these studies will be used to identify the geometric design and ramp timing plan parameters that significantly impact the emissions quality benefits of metered systems.

**AN EXAMINATION OF ARTERIAL STREET HIGH-OCCUPANCY VEHICLE (HOV) LANES IN TEXAS. (SWUTC 460042 60042)**

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* Texas A&M University.

*Investigator(s):* Turnbull, Katherine F.

*Start date:* 1 Aug 1992; *Estimated completion date:* 31 Aug 1997.

This research project examined the current use of arterial street HOV lanes in cities in Texas and North America. It included the identification of issues and concerns associated with the design and operation of arterial street HOV lanes and techniques and approaches used to address these. The use of existing projects and the benefits relating to increased use of high-occupancy commute modes, energy savings, improved fuel efficiency, and enhanced air quality were examined. A set of general guidelines for planning, designing, and operating arterial street HOV projects in Texas were developed based on this analysis.

**FORECASTING TRAVEL AND MOBILE SOURCE EMISSIONS.** (SWUTC 407500-00001)

*Sponsored by:* Texas Department of Transportation.

*Performed by:* Texas A&M University.

*Investigator(s):* Benson, Jim D.

*Status:* Active, *Contract No.:* 14-8XXA3004, Tasks 1 & 2.

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Aug 1998.

The objective of this task is to provide assistance to the Austin District in the development of mobile source emission estimates for the conceptual alternatives being evaluated for the Interstate 35 Major Investment Study. The Texas Mobile Source Emissions software developed by TTI will be used in these analyses. The mobile source emissions estimates will be developed using a procedure similar to that currently being used to produce mobile source emissions estimates for conformity analyses in the El Paso area and the Beaumont-Port Arthur area. This work was originally scheduled for initiation in FY96 or 97 but was rescheduled for initiation in FY98.

**FUNDAMENTALS OF AIR QUALITY FOR HIGHWAY PLANNING AND DEVELOPMENT.** (00662618)

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Project Monitor:* Miller, A.

*Performed by:* Tennessee University-Knoxville. Transportation Center. Knoxville. TN.

*Status:* Active, *Contract No.:* DTFH61-93-P-00910.

*Start date:* 15 Jun 1994; *Estimated completion date:* 30 Jun 1999.

Student research assistance is being provided to help in running and analyzing studies of sign visibility.

**HEAVY-DUTY VEHICLE EMISSIONS (A Circular 469 Environmental Research Needs in Transportation project).** (ENV1017; 00748061)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor :* McCreedy, Ronald D.

*Status:* Pending, *Contract No.:* Project 25-14, FY '98.

*Start date:* *Estimated completion date:* Contract duration: 30 months.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Together, the Clean Air Act Amendments of 1990 (CAAA) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) represented a major step in directly linking statewide and metropolitan transportation planning and development decisions to attainment and maintenance of national air quality standards. An important element of ISTEA is a shift toward flexible intermodal transportation solutions tailored to the specific needs of the state or metropolitan area in both planning and implementation. This policy shift includes the requirement for states and their metropolitan planning organizations (MPOs) to consider transportation of freight as well as people in their decisions on transportation system performance and air quality.

Throughout the last several decades, the United States has experienced a steady and significant growth in heavy-duty vehicle transport on its highway systems. This growth has had substantial impacts on roadway deterioration, urban and suburban traffic congestion, and particulate and ozone air quality problems. Recently, National Ambient Air Quality Standards (NAAQS) for particulate matter and ozone have been revised to a more stringent level. State and metropolitan area planners and decision makers will be required to more aggressively implement strategies to reduce ozone and particulates associated with all components of the transportation system. A

major contribution to this pollutant reduction will have to come from heavy-duty vehicles and their operations. However, accurately tracking and monitoring heavy-duty vehicle emissions, specifically oxides of nitrogen (NO<sub>x</sub>), volatile organic compounds (VOCs), both contributors to the ozone problem, and particulate matter (PM), is extremely difficult compared with other types of vehicles.

Travel patterns of heavy-duty vehicles in urban areas are irregular and difficult to track and model. Without understanding their travel patterns and emission rates, there is no basis for determining cost-effective strategies to reduce negative air quality impacts from heavy-duty vehicles. Without such understanding, state departments of transportation (DOTs), MPOs, and other agencies cannot fully evaluate policy options, planning initiatives, or programming commitments, especially in terms of achieving air quality objectives. Finally, for multimodal solutions to meet the needs of urban regions and states, heavy-duty vehicle impacts must be fully and accurately integrated into transportation and air quality planning.

The objectives of this research are as follows: (1) enhance the basic understanding of heavy-duty vehicle activities and associated emissions; (2) develop tools for MPOs and states to evaluate future policies, plans, or programs on exhaust emissions (including NO<sub>x</sub>, PM, and VOCs); and (3) test, evaluate, and apply the tools in order to demonstrate their applicability to the transportation and air-quality planning processes.

**Phase I--Heavy-Duty Vehicle Usage Patterns:** (1) Identify and evaluate existing data sources and synthesize current research and planning activities associated with heavy-duty vehicle usage patterns. (2) Develop and characterize heavy-duty vehicle operating factors based upon heavy-duty vehicle classes, usage patterns, and operating conditions for various area types (e.g. urban area, suburban, regional, and interstate). Also include a range of roadway types within the given areas. (3) Prepare an interim report that summarizes the findings of Phase I and identifies the need for specific data improvements.

**Phase II--Heavy-Duty Vehicle Emission Factors and Rates:** (4) Identify and evaluate existing data sources and synthesize current research and planning activities associated with heavy-duty vehicle emissions. (5) Develop and estimate emission factors for NO<sub>x</sub>, PM-2.5 (particulates with a diameter of less than 2.5 micrometers), and VOCs by the vehicle classes, usage patterns, and operating conditions developed in Task 2. It is expected that these estimates would be based on existing data sources. Compare the estimates to emission factors from current versions of the MOBILE, PART, and EMFAC models. (6) Prepare an interim report covering Phase II that identifies the need for specific data improvements. Discuss the information in the Phase I and II interim reports at a meeting of the panel and obtain NCHRP approval before initiating Phase III.

**Phase III--Development of Analytic Tools and Application Methodology:** (7) Analyze and integrate the emissions factors developed in Task 4 and the operating factors developed in Task 2. (8) Develop and document an analytic tool (or tools) that can support the development and evaluation of policy, plans, and programs related to heavy-duty vehicle operations and emissions. (9) Develop, test, and refine an application methodology for employing the analytic tool(s) developed in Task 8. Ensure compatibility with current transportation planning tools. (10) Prepare a plan for identifying and selecting cases for the application of the methodology and tools developed in Tasks 8 and 9. Include the justification for the case locations, geographic considerations, data availability, staff capabilities, and other selection factors. Obtain panel approval prior to initiating Task 11.

**Phase IV--Application and Evaluation of Analytic Tools and Application Methodology:** (11)

Apply the analytic tool(s) and methodology to at least one metropolitan area and to one state. Assess strengths and weaknesses in terms of supporting policy analyses, transportation planning, and priority programming. Present the applications in the form of case studies. (12) Refine and revise the methodology and tool(s) as needed based upon the application assessment in Task 11. (13) Prepare a plan for maintenance, distribution, and support for the analytic tool(s) and the application methodology. (14) Prepare a final report that documents the entire research effort and includes the case studies applications. Also include the needs and opportunities for improved data identified in Phases I and II and the maintenance plan developed in Task 13.

**HOT/COLD START PREDICTION MODEL.** (00744197)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Project Monitor:* Lindeman, Win.

*Performed by:* University of Central Florida. Orlando. FL.

*Investigator(s):* Wayson, R.

*Status:* Active.

*Start date:* 15 Aug 1996; *Estimated completion date:* 31 Jan 1999.

This research was needed to provide hot/cold start information that can be used in the department's version of Mobile 6. The network will validate existing data.

**INTEGRATING TRAVEL BEHAVIOR AND URBAN FORM DATA TO ADDRESS TRANSPORTATION AND AIR QUALITY PROBLEMS IN ATLANTA.** (ENV1180)

*Sponsored by:* Georgia Department of Transportation.

*Project Monitor:* Deaver, Rick.

*Performed by:* Georgia Institute of Technology.

*Investigator(s):* Frank, Lawrence.

*Status:* Pending, *Contract No.:* RP 9819.

*Start date:* 21 Sep 1998; *Estimated completion date:* 21 Mar 2007.

No summary provided.

**INTERSECTION AIR QUALITY MODELING.** (ENV1011)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Jencks, Crawford F.

*Performed by:* Systems Applications International.

*Investigator(s):* Ireson, Robert G.

*Status:* Active, *Contract No.:* Project 25-06, FY '93.

*Start date:* 1 Feb 1993; *Estimated completion date:* 30 Nov 1998.

*Publication(s):* Final report in progress. A draft summary of Phase I and an excerpted chapter on the database structure from the Phase II interim report are available.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Passage of the Clean Air Act Amendments of 1990 requires transportation agencies to assure that their actions do not create or exacerbate violations of ambient air quality standards. For carbon monoxide, these actions must also reduce the severity and number of existing violations. Projects that do not conform cannot proceed. To demonstrate conformance with carbon monoxide (CO) standards, computer models are used to predict concentrations at hot spot locations either directly or indirectly affected by a project. Because CO concentrations tend to be highest near areas of heavy traffic congestion, signalized intersections in urban and suburban areas are often the focus of this modeling effort.

There are many fundamental questions regarding current methods for modeling CO concentrations near intersections. For instance, do vehicle emissions need to be resolved by discreet modes of operation (i.e., cruise, acceleration, deceleration, and idle) or are estimated emissions based on average speed accurate and sensitive enough? Are dispersion theories and empirical formulations that are derived from data associated with rural conditions and free-flow traffic appropriate for use near suburban and urban intersections? What traffic variables are needed to drive the emissions and dispersion components of the modeling process?

The lack of compatibility between traffic, emissions, and dispersion models is another difficulty inherent in current methods. These models have evolved separately over time with the result that the outputs of one model may not be compatible with the inputs of the next. Users need a fully integrated package of models to be able to address intersection air quality problems efficiently. Only when the traffic, emissions, and dispersion components are linked together can mitigating strategies involving design and operational modifications be tested interactively.

A better understanding of emissions, dispersion, traffic, and their interrelationships is needed for more accurate predictions of CO concentrations at intersections. The research must be national in scope and be coordinated with other relevant ongoing efforts.

The objectives of this research are to: (1) evaluate information on intersection carbon monoxide concentrations and the pattern of monitored violations, the significance of modal emissions, and the current state of the practice in carbon monoxide intersection modeling; (2) assess the suitability of existing intersection air quality models (emissions, dispersion, and traffic components); and (3) develop an improved integrated model and a computer program for the air quality assessments of intersections at urban and suburban locations.

The accomplishment of these objectives will require the completion of the following tasks:

Phase I--Problem Assessment: (1) Current practice--A national database shall be developed for monitored carbon monoxide violations in areas that are currently designated as nonattainment. The database will include CO concentrations and concurrent, relevant data from nearby sources on traffic, meteorology, and background CO levels. Using available EPA and state air quality agency monitoring records, concentration patterns will be evaluated to identify and document factors and conditions that are present when elevated readings and violations of the standard occur. These evaluations will also include the relationship between high 1-hour and 8-hour averages and between areawide and hot spot concentration patterns. Particular attention should be paid to evaluating sites that are near signalized intersections and have substantial historical records that could be used to accomplish subsequent tasks under Phase II. An interim report will be prepared to document the information and insights gained from this task. The report will also include the current state of practice on carbon monoxide intersection modeling as done by state air quality, state transportation, and other appropriate agencies. The interim report will be submitted within 6 months for review and approval by the NCHRP. (2) Modal Emission Data--Obtain all available data on modal emissions (i.e., emissions released during the cruise, acceleration, deceleration, and idle operating modes) and vehicle performance at intersections. At least two such databases are known: EPA's Office of Mobile Sources and the California Air Resources Board. These and other databases shall be studied to evaluate the differences in emissions during various modes of vehicle operation and the relationship of modal emissions to average speed-adjusted emissions. Any available information on modal emissions models shall be included. (3) Site-Monitoring and Evaluation Plan--Prepare a site-monitoring plan, which will be executed under Task 4, to obtain new data for evaluating existing air quality models and for developing new or modified models. The site-monitoring plan shall include, as a minimum: the

number, type, and location of sites; the necessary permission to use sites for monitoring purposes; the schedule and duration of the monitoring period; the location and type of equipment (such as that needed to obtain data on the meteorology, existing and background CO concentration, traffic and vehicle performance characteristics, and vehicle emissions); and costs. Protocols will be developed and included that describe the techniques for the assessment required under Task 5. The site-monitoring plan, protocol, and the results of Task 2 will be submitted in a second interim report. Initiation of Phase II will be contingent on the approval of the second interim report.

Phase II--Site Monitoring and Evaluation: (4) Monitoring--Monitor a representative number of suburban and urban intersections, geographically distributed and covering a variety of congestion, operation, and geometric conditions. The monitoring program will provide information on the validity of dispersion mechanisms contained in existing models, the proper location of receptors, and the importance of modal emissions in intersection modeling. Multi-probe CO monitoring will be installed to get a detailed picture of CO concentration patterns. Multiple meteorological measurements will be obtained to characterize the meteorology of the site. It is especially important to accurately describe the wind field and the vertical distribution of CO concentrations near the intersections where idle and acceleration emissions occur and at mid-block where cruise emissions predominate. Atmospheric stability should be determined by on-site measurement. Depending on the outcome of Task 2, it may be necessary to obtain more refined measurements of in-use modal emissions and atmospheric dispersion. For example, this could involve remote sensing of carbon monoxide, vehicle(s) equipped to emit a tracer gas, or mass balance determinations using the vertical distribution of CO concentrations near the intersection and mid-block. Traffic data will be collected concurrently with the air quality and meteorological data. This will allow the determination of the traffic parameters more important in establishing air quality levels, including delay times, acceleration rate, overall speed profile, traffic mix, traffic volumes, signal timing, and percentage of cold starts. (5) Data Analysis and Assessment--Synthesize and analyze the data collected in Task 4. The theory, principles, and formulation of existing models will be assessed for consistency with the collected data. The suitability of current theory, principles, and formulations to characterize carbon monoxide concentrations at intersections will be evaluated. As appropriate, improvements or adjustments will be recommended to current theory and formulations to more closely simulate observed air quality levels. In the event that the data do not support current theory and formulations in suburban or urban locations, a new methodology will be recommended. A third interim report will be prepared to document Phase II, including the assessments of existing models and recommendations for any changes. Initiation of Phase III will be contingent on the approval of this third interim report.

Phase III--Model Development: (6) Integrated Air Quality Intersection Computer Model--Develop an integrated (emissions dispersion, and traffic) computer model that is PC-based, IBM compatible, and user friendly. This integrated model will be based on modified existing models or, if needed, will be newly created. The dispersion component of this model may take the form of a Gaussian puff or numerical simulation as opposed to the current steady-state Gaussian formulation. The model must include screening techniques to assess the degree of severity of existing intersection conditions and to address the question of 1-hour versus 8-hour CO concentrations. The end product of this task shall be an improved intersection air quality model. (7) User's Guide--Develop a User's Guide with adequate documentation and examples so that an individual unfamiliar with transportation air quality modeling could successfully run the model. The documentation shall also include sensitivity analyses, recommended worst-case meteorological conditions, and options for mitigation analyses. (8) Final Report--Prepare a final report that documents the entire research effort, including the Task 7 User's Guide. Software documentation, including the source code of the operational model and the various databases



created throughout the research effort, will be submitted with the report. All computer programs and databases will be in the public domain.

Research is nearing completion, draft documentation of all products is expected by the end of August 1998. The agency will have to carefully control time and money, both are now of short supply.

**ITS INTEGRATION OF REAL-TIME EMISSIONS DATA AND TRAFFIC MANAGEMENT SYSTEMS. (ENV1028)**

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* North Carolina State University. Department of Civil Engineering. Raleigh. NC.

*Investigator(s):* Roupail, Nagui.

*Status:* Active.

*Start date:* 1 Aug 1997; *Estimated completion date:* 28 Feb 1999.

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

This National Research Council TRB-IDEA project will design and test a field deployable ITS system capable of integrating data from conventional or advanced emission sensors with operational traffic data for traffic management. The project for the first time will provide an empirical linkage between traffic management strategies and en-route vehicle emissions rates. Traffic data will be collected using loop and video detection systems. En-route vehicle emissions will be collected using a remote sensing device (RSD) which measures the concentration of carbon monoxide and hydrocarbons in vehicle exhaust emissions. Comparative traffic data will be gathered from loop detectors and a wide-area detection device, which uses vehicle tracking technology (MOBILIZERTM), recently acquired by NCSU. This device is capable of collecting and reporting traffic data at the microscopic vehicle level.

**MODELING FOR ESTIMATING THE VEHICLE EXHAUST EMISSIONS FROM THE REMOTE VEHICLE: EMISSION DATA COLLECTION. (SWUTC 467600)**

*Sponsored by:* State of Texas.

*Performed by:* Texas Southern University.

*Investigator(s):* Yu, Lei.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1997.

Recent studies have revealed that brief but rapid accelerations can contribute significantly to a vehicle's CO and HC emissions during a typical urban trip, which suggests that new transportation projects and traffic management strategies that attempt to minimize changes in vehicle speed have a much greater emission reduction benefit. However, the existing vehicle emission factor model for estimating HC, CO, and Nox, MOBILE5A, which is specifically designed by EPA to be used by all states but California, and EMFAC, which is specifically designed for use in California, only require the traffic stream's average speed as the input data. This limitation of the current emission factor models has significantly restricted the accurate evaluation of transportation projects and traffic management strategies from an air quality perspective. This research will conduct the collection and evaluation of the on-road vehicle emission rates under vehicle's acceleration, deceleration, cruise and idle modes and various highway and traffic conditions, using the advanced Smog Dog infrared equipment. The emission factor models MOBILE5A and EMFAC will be extensively examined and compared using the collected on-road emission data and their respective capabilities in estimating the modal sensitive

vehicle emission rates will be then explored. Subsequently, the collected on-road vehicle emission data will be used to develop a working emission model that will be made sensitive to a vehicle's modal events and can be used by agencies to evaluate various new transportation projects and traffic management strategies that target on improving the air quality. The final objectives of the research are to prepare agencies to use the next generation of emission rates models and to assist in the preparation of the highway mobile source section of its emission inventory required by the 1990 Clean Air Amendment.

**MONITORING ENERGY & EMISSIONS BENEFITS OF TRANSPORTATION CONTROL MEASURES.** (SWUTC 465090)

*Sponsored by:* DOT-University Transportation Centers Program.

*Project Monitor:* unknown.

*Performed by :* Texas A&M University.

*Investigator(s):* Rao, Kethireddipalli S.

*Status: Contract No.:* none.

*Start date:* 1 Sep 1994; *Estimated completion date:* 31 Aug 1997.

The Comprehensive National Energy Policy Act of 1992, the Intermodal Surface Transportation Efficiency Act of 1991, and the Clean Air Act Amendments of 1990 created a climate for transportation control strategies aimed at reducing the use of single occupant vehicles. Several metropolitan areas in Texas are classified as nonattainment areas for carbon monoxide, ozone, and particulate matter. These areas are currently implementing several transportation control measures (TCMs) as a means of attaining the national Ambient Air Quality Standards. TCMs also can be used as strategies for energy conservation. Due to the lack of programs to monitor the effectiveness of implemented TCMs, information on the level of participation in these programs and the resulting energy and emission benefits are virtually unavailable. This project's aim was to develop a strategy for monitoring the employee trip reduction programs and use it to evaluate the effectiveness of the programs being implemented in the Houston nonattainment areas.

**PARTICULATE MATTER (PM<sub>2.5</sub> AND PM<sub>10</sub>) APPORTIONMENT FOR ON-ROAD MOBILE SOURCES (A Circular 469 Environmental Research Needs in Transportation project).** (ENV1095)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Status:* Proposed, *Contract No.:* Project 25-18.

*Start date:* *Estimated completion date:* Contract duration: 30 months.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The Environmental Protection Agency (EPA) has adopted new standards for particulate matter (PM) with potentially broad effects on the transportation sector. These new standards are based on particles 2.5 microns in diameter and smaller (PM 2.5); the previous standard was based solely on particles 10 microns in diameter and smaller (PM 10). The new particulate standards have been established on the basis of health impacts but were created with limited knowledge of emission sources. Regional- and project-level modeling of particulates are likely to be required by federal regulations. However, current methodologies are inadequate and uncertain for estimating PM 2.5 and PM 10 emissions. The EPA has stated that full implementation of the conformity rule will be deferred until acceptable methodologies are developed and approved.

Research is needed to determine emission factors from transportation-related sources. Particulates directly emitted by motor vehicles (e.g., vehicle exhaust, tire, and brake wear) as well as

indirectly emitted particulates (e.g., dirt or other materials from vehicles) need to be characterized and quantified. Re-entrained road dust also needs to be quantified. Large variations in particulate emissions occur because of various factors such as vehicle type and condition, roadway type, and climate. These important factors affecting emission rates must be quantified. Once PM 2.5 and PM 10 emission rates are known, dispersion-modeling algorithms may need to be revised to more accurately predict ambient particulate concentrations.

The objectives of this research are as follows: (1) to apportion, from among major sources, the contribution of on-road mobile sources of direct and indirect emissions that contribute to ambient PM 2.5 and PM 10 concentrations near roadways; and (2) to determine appropriate PM 2.5 and PM 10 emission factors for use in estimating emission rates with microscale dispersion models. This research should focus its primary emphasis on PM 2.5 and is confined to paved road surfaces in urban environments. The research objectives will be accomplished through the following tasks: (1) Literature Search--Throughout the study, the research team is expected to perform critical reviews of relevant regulations and completed and ongoing research. A database of literature and other information will be maintained throughout the study. (2) Research Design--A detailed study design for Tasks 4 and 5 will be prepared that provides for identification, collection, analysis, control, and measurement of key variables leading to the emissions apportionment and determination of emissions factors for PM2.5 and PM10. The research team will prepare a quality assurance/quality control (QA/QC) plan for data collection, handling, and analysis including both roadway-monitoring data as well as laboratory data where appropriate. Attention must be given to regional and temporal variations in emissions due to climate, vehicle characteristics, geology, roadway types, and roadway maintenance. (3) Interim Report--Prepare initial findings from Tasks 1 and 2 and recommend any work plan modifications for panel review and approval. (4) Data Collection and Database Development--Based on the approved work plan, characterize mass emission rates, chemical composition, and size distributions of particles associated with traffic operating on paved urban roadways. Both re-entrained dust and vehicle exhaust emissions will be characterized to determine sources of PM 2.5 and PM 10. Compile a database appropriate for data validation and analysis. (5) Data Analysis and Emission Factor Development--Analyze the data and develop emission factors suitable as input for dispersion modeling. Validate data according to the QA/QC plan in order to establish the accuracy of the developed emission factors. (6) Panel Presentation--After initial analysis and preliminary development of emission factors, meet with the panel to present findings of the data collection and analysis and to discuss approaches for further development of emission factors and modeling input. (7) Dispersion-Modeling Application Test--Using existing dispersion models, develop a protocol for testing within a dispersion-model application the emission factors developed in Task 5. Evaluate the suitability of existing particulate matter data for this purpose, such as the National Air Monitoring System (NAMS and State and Local Air Monitoring System (SLAMS), and determine the need for new concentration-data collection. The protocol should be designed to compare actual monitored concentrations with modeled concentrations, adjusted for background. (8) Final Report--Prepare a final report that clearly presents the findings and recommendations from the previous tasks. If possible, identify and recommend possible transportation control strategies that may be effective in reducing and controlling PM 2.5 and PM 10 emissions and concentrations.

**POLLUTION PREVENTION STUDY. (ENV1308)**

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Fitch, Michael.

*Status:* Active.

*Start date:* 30 Nov 1998; *Estimated completion date:* 1 Dec 1999.

VDOT's Environmental Division has in place a recently developed pollution prevention plan that is administered by the Department of Environmental Quality. As a part of this plan, VDOT has agreed to investigate and develop new ways to decrease pollution. This research effort will look at several of the previously identified areas in which VDOT could potentially reduce pollution as a result of its normal operations. Specific examples are reducing potential contamination caused by salt ponds and reducing the quantity of used motor oil disposed of by VDOT.

It is anticipated that this research will not only fulfill the regulatory obligations placed on VDOT by DEQ, but will also likely save money normally devoted to these operations. The work proposal outlining the specific tasks associated with this research effort is under development. The study is scheduled to begin this quarter.

**POTENTIAL OF CONGESTION PRICING (SUBCONTRACT-UTA). (SWUTC 465620)**

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* unknown.

*Performed by:* Texas A&M University.

*Investigator(s):* Burke, Dock.

*Start date:* 1 Sep 1994; *Estimated completion date:* 31 Aug 1997.

This project intends to provide information and approaches to the potential of congestion pricing as a demand management strategy to reduce urban congestion and improve energy efficiency and air quality in Texas. It will develop a strategy for the possible implementation of congestion pricing in such a way that will be integrated with contemplated traffic management systems in IVHS in Texas.

**QUANTIFYING AIR-QUALITY AND OTHER BENEFITS AND COSTS OF TRANSPORTATION CONTROL MEASURES. (ENV1009)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Derr, B. Ray.

*Performed by:* Cambridge Systematics, Inc.

*Investigator(s):* Suhrbier, John H.

*Status:* Active, *Contract No.:* Project 8-33, FY '95 .

*Start date:* 1 Jul 1995; *Estimated completion date:* 31 Oct 1998.

*Publication(s):* A World Wide Web site has been developed that includes all of the project documents at <http://webservices.camsys.com/NCHRP833/index.htm>.

*Report Availability:* The individual task reports are available for viewing at the above website and for loan from the NCHRP. NCHRP Research Results Digest 217 and NCHRP Research Results Digest 223 are available for purchase from TRB.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The Clean Air Act Amendments (CAAA) of 1990 identify transportation control measures (TCMs) that are expected to provide emission-reduction benefits and, depending on the area's nonattainment status, mandate implementation of some of them. The CAAA also identifies other measures intended to modify motor vehicle use. States and MPOs require specific, quantitative information on the benefits, costs, and expected air-quality improvements of various TCMs in order to select those that will best meet their needs.

The objective of this research is to develop a framework for analyzing the air-quality and other environmental, social, and economic effects of TCMs.

The research consists of the following tasks:

Phase I: (1) Identify completed and ongoing research and other activities related to the effects of TCMs. Identify the users of TCM analysis techniques as well as other stakeholders. Conduct a workshop to assess the knowledge and needs of current TCM analysis techniques and assumptions. (2) Identify how current analysis techniques and assumptions could be reasonably and effectively strengthened. (3) Prepare performance criteria and a preliminary outline of the analysis framework to be developed in Task 6. Prepare preliminary plans for validating the framework in Tasks 7 and 9. (4) Examine the relationships among implemented TCMs, their calculated emissions, and measured pollutant levels. Identify major gaps in knowledge and areas needing research. Develop a plan for future work to better understand the impact of TCMs on measured air pollutant concentrations, being sure to consider the costs and expected contributions to the body of knowledge. (5) Prepare a Phase I Interim Report documenting the findings of Tasks 1 through 4 and providing a revised work plan for Phases II and III.

Phase II: (6) Develop a comprehensive framework that is suitable for analyzing TCMs recognizing that they are part of a total transportation system. TCMs to be analyzed include those designed to produce mode shifts, operational traffic changes, and reductions in motor vehicle usage. The framework must include the synergistic effects of employing various combinations of TCMs. Key variables will include number of trips, trip chaining, elasticity, vehicle miles traveled, delay, and vehicle modal activity (acceleration, deceleration, idling, etc.). Key outputs will be the effect on air pollutant emissions and the social, economic, and environmental effects. The research will evaluate the feasibility of including the effect on air pollutant levels as a key output. The framework should be compatible with federal requirements such as CAAA State Implementation Plans and ISTEA Management Systems. (6.1) Develop speed-correction factors to assess the emissions impact of ramp metering. (6.2) Document assumptions employed in emission factor models, particularly MOBILE5b and MVEI7G. (6.3) Evaluate the feasibility of using advanced air-quality monitoring systems to quantify the air-quality effects of transportation control measures. (6.4) Analyze transportation and air-quality monitoring data collected during the Atlanta Olympics to identify the air-quality impacts of transportation control measures. (7) Conduct a pilot validation study of the framework using the validation plan developed in Task 3 and presented in the Phase I interim report. This study has been completed using information from Sacramento, California. (8) Prepare a Phase II interim report documenting the findings of Tasks 6 and 7 and any needed changes in the Phase III work plan.

Phase III: (9) Validate and refine the framework. The following aspects of the framework should be evaluated: ease of use, accuracy, applicability to various urban areas, data and monitoring requirements, approach to estimating synergistic effects, and cost to implement. The validation could include case studies of existing TCMs and combinations of TCMs, before-and-after studies, and hypothetical scenarios. Use of actual data for validation is preferred. Based on the contractor's recommendation, Portland, Oregon will be used for this work. (9.1) Investigate the use of remote sensing techniques to directly measure changes in vehicle emissions and the use of personal monitors to measure changes in individual exposure to air pollutants. (9.2) Conduct additional validation testing in cooperation with the Sacramento Area Council of Governments. The primary intent of this additional validation is to identify specific causes for some of the results from Task 7. (10) Prepare a user's manual. The manual should be designed to enable state DOTs and MPOs to use the analysis framework developed in this project. It should include a summary of the strengths and limitations of the methodology, guidance on the analysis of combinations of TCMs, and recommendations on communicating the results to the public and elected officials. (11) Submit a final report documenting the research effort and including the

user's manual as a self-contained appendix.

Based on the results of Phase I, the panel added four new tasks to Phase II, which are described above as Tasks 6.1 through 6.4. Phase II is complete, and reports have been submitted for each of the Phase II tasks. The report from Task 6.2 will be published as a research results digest in 1998.

Based on the results of Phase II, the panel added two new tasks to Phase III, which are described above as Tasks 9.1 and 9.2. Phase III is almost complete with work well underway on the user's manual and final report.

**RESEARCH FOR AASHTO STANDING COMMITTEE ON HIGHWAYS. TASK 91. TRANSPORTATION IMPLICATIONS OF PROPOSED CHANGES TO NATIONAL AMBIENT AIR QUALITY STANDARDS (A TRB Circular 469 *Environmental Research Needs in Transportation* project). (00741826)**

*Sponsored by:* National Cooperative Highway Research Program; American Association of State Highway & Transportation Officials; Federal Highway Administration.

*Performed by:* Gary Hawthorn Associates, Ltd.

*Investigator(s):* Hawthorn, Gary.

*Status:* Active, *Contract No.:* Project 20-07, Task 91.

*Start date:* 20 Apr 1998; *Estimated completion date:* 31 May 1999.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The research for this project will help state agencies assess air-quality issues and the EPA's new air quality standards. It will address anticipated effectiveness of regional control strategies versus local control programs, effects of the new standards on transportation planning, current conformity requirements in light of the new standards, and the effect of the new standards on linkages between CAAA and the ISTEA. An advisory panel has been established to oversee the research. The panel has selected a principal investigator and approved the proposed research plan. A contract has been signed, and research is underway.

**RESEARCH FOR AASHTO STANDING COMMITTEE ON HIGHWAYS. TASK 94. MITIGATION OF NIGHTTIME CONSTRUCTION NOISE, VIBRATION, AND OTHER NUISANCES. (00748042)**

*Sponsored by:* National Cooperative Highway Research Program.

*Performed by:* Arizona State University.

*Investigator(s):* Schexnayder, Cliff J.

*Status:* Active, *Contract No.:* Project 20-07, Task 94.

*Start date:* 15 Jun 1998; *Estimated completion date:* 14 Mar 1999.

*Publication(s):* A draft report has been received and is now under review by the advisory panel.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

This task will produce a summary of innovative techniques that can be used to mitigate adverse effects of nighttime construction, including noise, dust, and vibrations. Information will be obtained on construction practices, including practices outside the field of highway construction and outside of the United States. Research is underway. The agency's principal investigator met with the AASHTO Highway Subcommittee on Construction at the Subcommittee's August 1998 meeting in Portland, Maine.

**SHORT-TERM MONITORING FOR COMPLIANCE WITH AIR QUALITY STANDARDS (A TRB Circular 469 Environmental Research Needs in Transportation project).**  
(ENV1018; 00748062)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Status:* Pending, *Contract No.:* Project 25-15, FY '98.

*Start date:* *Estimated completion date:* Contract duration: 15 months.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbrp/nchrp5.html>).

Passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Clean Air Act Amendments of 1990 (CAAA) have significantly changed the way in which transportation-system and project-development decisions contribute to air quality improvements. Transportation improvements must demonstrate conformity with national air quality standards. This is true for pollutants that impact the entire region as well as those that have more localized impacts in areas adjacent to transportation facilities. Carbon monoxide (CO) and particulate matter (PM) are considered microscale pollutants (their concentration can change significantly over a relatively small distance). In a nonattainment area, EPA regulations require that a project can not cause or contribute to a new violation of a national ambient air quality standard (NAAQS) and must reduce the concentrations of existing violations. To avoid a nonattainment designation, a project expected to cause a violation of the standards may not be advanced in an attainment area.

The air quality impacts of proposed transportation plans, programs, and projects are estimated and evaluated through the application of various required computer models. In the case of microscale pollutants, projects are assessed by so-called dispersion models that predict concentrations at specific locations either directly or indirectly affected by the project. The dispersion models take into account existing pollutant levels and present transportation characteristics at the specific location and meteorological conditions experienced at the site, in order to predict future concentrations of pollutants. Modeling techniques for CO have become more conservative, making it more difficult for projects to meet conformity tests. This is most apparent in the use of conservative default values (i.e., model inputs used where specific observed data are not available) that may overestimate potential pollution concentrations associated with a transportation improvement project. The justification for the use of conservative default values is to avoid future violations of air quality standards that might be caused by underestimating current pollution factors. Actual monitoring data seem to indicate that CO concentrations are being reduced. Because of the limited number of monitors and their sites, it is not clear whether monitoring results are giving a completely accurate picture of the entire situation. There appears to be a discrepancy between modeled and observed maximum pollutant concentrations, under current conditions, which can lead to vastly different assessments of future pollution impacts.

In cases where CO models predict possible violations, project development actions must be stopped while additional monitoring at the site is carried out. This monitoring is designed to obtain site-specific input data in order to calibrate the dispersion model to more accurately describe the current conditions at the project site. Such monitoring can add years to the project development cycle just to confirm that the high concentration predictions are due to inaccurate or overly conservative model input assumptions.

Research is needed to determine if a short-term CO and PM measurement procedure (e.g., day, week, month, three-month) can be developed that will give reliable input data for use in models to

estimate the potential to exceed the standards at a project location. If this short-term monitoring procedure can be linked to modeling as a validation tool for conformity and other environmental determinations, then unnecessary project development delays can be avoided.

The objective of this project is to develop a short-term monitoring procedure that can produce more accurate input data for air quality dispersion models and can do so in a manner requiring less data collection and less time to complete than do current monitoring requirements. This effort will require a determination of what monitoring and data are necessary to reliably estimate peak emission concentrations of carbon monoxide and particulate matter near proposed roadway improvements. Also, it will require examination and documentation of the conditions that produce observed high concentrations of CO and PM near roadway facilities, in cases where there are discrepancies between modeled and monitored concentrations describing current conditions. It should result in the development of a procedure that can accurately assess the validity of peak CO or PM predictions emanating from air quality models. This procedure should be based upon observed present conditions as opposed to modeled values and should provide an assessment of the differences between predicted and monitored concentrations appropriate for improving the reliability of model impact predictions.

Phase I--Literature and Practices Review: (1) Review and document current literature and research on regulatory monitoring and modeling practices associated with project-level air quality analysis. (2) Review and document the current monitoring and modeling guidance employed by federal and state agencies. This review should include: comparisons of modeled and monitored data; identification of key factors and variables affecting concentrations; and a review of existing and evolving modeling and monitoring requirements. (3) Compile recent CO and PM monitoring data from a variety of sources that can serve as the basis for further evaluation. Potential sources may include: EPA's National Air Monitoring Stations (NAMS); State and Local Air Monitoring Stations (SLAMS); Special Purpose Monitoring (SPM) network; other special state studies; and other data sources. Assess and compile, as appropriate, concurrent and comparable hourly traffic and meteorological data. (4) Based on the data compiled in Task 3, develop criteria for integrating and evaluating CO and PM data, meteorological data, and traffic data; propose possible test locations for which data are available to use in developing a short-term monitoring procedure; and propose an analytical approach for examining the data in order to develop the short-term monitoring procedure. (5) Identify a task group of experts to carry out the review identified in Task 10. (6) Submit an Interim Report, summarizing the findings of Tasks 1 through 5 and presenting an updated work plan for Phase II, and obtain NCHRP approval to proceed to Task 7.

Phase II--Data Analysis, Procedure Development, and Testing: (7) Analyze monitored CO and PM data. The following two steps should be conducted in this task: (a) Assess traffic, meteorological, and other relevant conditions leading to high observed CO and PM concentrations. As a starting point, compare and contrast the worst case factors (e.g., low wind speeds, low ambient temperatures, wind direction, and atmospheric stability) employed in a project-level analysis to those same factors observed during high concentration events. At a minimum, this analysis should include: (1) an examination of relationships between high concentrations and key variables; and (2) an evaluation of relationships between both CO and PM violations across NAAQS averaging time periods (e.g., the 1- and 8-hour standards for CO, or daily and annual standards for PM). (b) Develop a procedure for analyzing monitored data at selected sites identified in Task 4 to: (1) establish probability distributions of CO and PM concentrations; (2) determine the probability of exceeding NAAQS; (3) evaluate, at each site, the relationships between worst case model input assumptions and observed high concentration conditions; and (4) determine the validity for a short-term monitoring approach that can



accurately predict the frequency and probability of violating concentrations. (8) Document the short-term monitoring procedure for predicting CO and PM exceedances. At a minimum, apply and demonstrate the procedure in at least three locations, comparing the results of the short-term monitoring technique and the worst case EPA-approved modeling. (9) Submit an Interim Report summarizing and documenting the procedure and its development in Tasks 7 and 8. Obtain approval for proceeding to the next tasks.

Phase III--Review and Final Report: (10) Convene the expert task group to obtain feedback for further development and refinement of the monitoring procedure and recommendations regarding further field study of the procedure. (11) Refine and document the short-term monitoring procedure based on input received during the review. (12) Prepare a final report that documents the entire project and presents the recommended plan for further field study.

#### **TRANSPORTATION AIR QUALITY TECHNICAL SUPPORT. (SWUTC 402031)**

*Sponsored by:* Texas Natural Resource Conservation Commission.

*Project Monitor:* Hamlin, Lynne.

*Performed by:* Texas A&M University.

*Investigator(s):* Dresser, George B.

*Status:* Contract No.: 7500000041.

*Start date:* 16 Dec 1996; *Estimated completion date:* 31 Dec 1997.

The Federal Clean Air Act Amendments of 1990 and subsequent *Federal Register* rules require that states and Metropolitan Planning Organizations (MPOs) perform a variety of transportation planning activities directed toward improving air quality. The FCAA and Environmental Protection Agency guidance documents contain time schedules by which specific activities must be performed and the authority for the EPA to impose sanctions for failure to perform the specified activities. The EPA's implementing regulations for most activities are developed; however, the state and EPA continue to work together to define and revise some activities that will ultimately go through the rulemaking process. Not all local governments designated as nonattainment are able to perform the data collection and technical work required by the implementing regulations. Through this project, TTI will provide technical assistance to the TNRCC and affected MPOs to support development and evaluation of air emissions inventories.

#### **TRANSPORTATION AND LAND USE: ENERGY AND AIR QUALITY IMPACTS.**

(00755276)

*Sponsored by:* Natural Sciences and Engineering Research Council of Canada.

*Performed by:* Carleton University. Department of Civil and Environmental Engineering. Ottawa. Canada.

*Investigator(s):* Khan, A. M.

*Status:* Active.

*Start date:* 1994; *Estimated completion date:* 1999.

The objective of this research is to investigate urban transportation and land use structures for reducing energy consumption in transportation and improving air quality. In addition to the study of efficient compact urban structures, this research is examining the effect of improving job opportunities in a subregion on region-wide transportation fuel consumption and emissions. Furthermore, the effect of improving job opportunities in a number of satellite cities within a multinucleated urban area on region-wide transportation fuel consumption and emission is under investigation.

**TRANSPORTATION CONTROL MEASURE EFFECTIVENESS IN OZONE NONATTAINMENT AREAS.** (ENV1170)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Knowles, W. E.

*Investigator(s):* Bhat, C.

*Status:* Active, *Contract No.:* 0-1838.

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 2001.

No summary provided.

**TRANSPORTATION EFFECTS OF THE 1997 CHANGES TO THE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) (A Circular 469 Environmental Research Needs in Transportation project).** (ENV1094)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Status:* Proposed, *Contract No.:* Project 25-17.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The Environmental Protection Agency has made changes to the National Ambient Air Quality Standards (NAAQS) for ozone and particulate matter (PM). The new ozone standard is more stringent, and a new standard for very small particulates (PM 2.5) will be imposed in addition to retaining essentially the current standard for PM10. For many states, the number of counties in nonattainment for ozone and PM is expected to increase significantly. The new standards could require fundamental changes in the approach used to plan for and improve air quality. New transportation control strategies may be necessary, and new considerations may arise regarding ozone transport and growth in vehicle miles traveled. The new NAAQS could also precipitate changes to transportation planning on a par with those effected under the 1990 Clean Air Act Amendments (CAAA) and could create new administrative and technical challenges for federal, state, metropolitan, and local agencies. The full nature, magnitude, scope, and consequences of these changes are unknown.

Implementation of the new NAAQS will be an evolving process over the next decade. There is a need for research to enable the transportation community to provide reasoned input into the regulatory development process. In addition, the states, metropolitan planning organizations (MPOs), and local jurisdictions need information to effectively respond to evolving ozone and PM requirements.

The objective of this research project is to assess the expected effects of the new NAAQS for ozone and PM 2.5 on transportation planning, the project development process, and implementation of transportation system improvements. In light of the new standards, the research team will examine and assess probable impacts on conformity; the transportation planning process; the project development process; the NEPA process; and the potential contribution to air-quality attainment by transportation control strategies, transportation systems development, and mobile source technology improvements. The first phase of this project will focus largely on the near-term implementation of the 8-hour ozone standard. A possible second phase is intended to focus on new PM 2.5 standards and how they will impact transportation planning and development.

Phase I: (1) Throughout the study (Phases I and II), the research team is expected to review and

synthesize completed and ongoing ozone- and PM 2.5-related research, policy, and guidance documents. An annotated bibliography of relevant information will be maintained throughout the study and included in the final report. (2) Based on EPA's supplement to its rule for Reducing Regional Transport of Ground-Level Ozone dated 4/28/98 (the so-called "NOx Call"), and information from the states regarding anticipated ozone strategies, assess the degree to which NOx emission reduction targets are likely to be met and what types of anticipated local mobile source controls are likely to be needed. (3) Assess the institutional and technical responses (including the effects on metropolitan and statewide transportation planning) needed to implement conformity under the new ozone standards within existing nonattainment areas, transitional nonattainment areas, and new nonattainment areas. (4) Prepare an interim report documenting Tasks 1 through 3 and present findings to the panel. (5) Evaluate whether the change in the form of the ozone standard potentially changes the effectiveness of transportation control measures (TCMs) for reducing ozone. Specifically, analyze whether strategies to reduce peak-period travel are effective in reducing 8-hour ozone concentrations. (6) Beyond those already implemented or required to be implemented by the CAAA, identify additional fuel and vehicle technology measures that can be potentially useful in responding to the new ozone standard. Determine the range of potential reductions for each measure, and their implications for transportation planning and programming. (7) Develop options and recommendations for improving transportation agency input into the State Implementation Plan (SIP) development process. Identify examples of effective integration of transportation and SIP air-quality planning. Identify new transportation data requirements for effective SIP development under the new air-quality standards. (8) Prepare a final report documenting the findings of Phase I research, focusing on the new NAAQS for ozone. Include recommendations regarding opportunities for state DOTs and other transportation agencies to provide input into US EPA implementation efforts and state air-quality agency planning.

Phase II: (9) Compile and summarize information as it becomes available regarding PM 2.5 and the contribution of mobile sources to PM 2.5 levels. Include an assessment of PM 2.5 data and any other information regarding the initial identification of potential nonattainment areas, as it is made available by the EPA. Findings should be updated and reported to the panel regularly during the project. (10) Identify potential mobile source strategies (both technological and transportation system oriented) aimed at reducing PM 2.5 and its precursor pollutants. (11) Assess the ability of states, MPOs, and local jurisdictions to implement potential PM 2.5 strategies and how these efforts may relate to existing strategies to reduce ozone and other pollutants. (12) Examine how existing transportation conformity requirements may apply to PM 2.5 nonattainment areas, including major planning and decision-making issues (e.g., institutional arrangements, analytical tools, and data needs). Assess the opportunity for efficiency improvements to the conformity process, which may result from attempts to control multiple pollutants. (13) Prepare a final report documenting the findings of Phase II research. Include recommendations regarding opportunities for transportation agencies to provide input to US EPA implementation efforts and state implementation planning.

**TRAVEL MODEL DEVELOPMENT.** (SWUTC 407520)

*Sponsored by:* Texas Department of Transportation.

*Performed by:* Texas A&M University.

*Investigator(s):* Shunk, Gordon A.

*Status:* Active, *Contract No.:* 508XXA3019.

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Aug 1999.

This project will provide technical and administrative support by TTI for the Travel Model Improvement Program (TMIP) sponsored by the Federal Highway Administration, the Federal

Transit Administration, the Office of the Secretary of Transportation, and the Environmental Protection Agency. The TMIP is a multifaceted effort to improve existing travel forecasting models and to develop entirely new travel forecasting procedures that are specifically designed to meet the needs of today's transportation planning process. In particular, TMIP is intended to improve the ability of travel forecasting procedures to provide accurate assessments of the effects of transportation related policies and measures to improve traffic congestion and air quality. The principal role of TTI under this contract is to develop and conduct a comprehensive outreach program that disseminates information and provides training and technical assistance on travel forecasting procedures for transportation planners. As part of the training and assistance responsibilities, TTI is charged with developing a manual of technical procedures for use by transportation planners in smaller and medium-sized areas. The services to be provided by TTI are described here in the three phases mentioned above: support, outreach, and the manual of technical procedures.

**URBAN SYSTEM DEVELOPMENT AND ANALYSIS. (SWUTC 407510-00002)**

*Sponsored by:* Texas Department of Transportation.

*Performed by:* Texas A&M University.

*Investigator(s):* Ogden, Michael A.

*Status:* Active, *Contract No.:* 128XXA1001, Task B.

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Aug 1999.

In this Task B of project 407510, TTI will provide conceptual planning and engineering design services to TxDOT to address long range reconfiguration of the Houston freeway system. The description of types of work to be accomplished under this task include: benefit/cost analysis of transportation system management improvements to freeway facilities; experimental application of transportation analysis techniques to evaluate, monitor, and enhance traffic operations; demand estimation on existing and proposed high-occupancy vehicle lane improvements; multi-modal facility analysis; corridor capacity analyses; and pre-construction/construction traffic operations data collection. The effects of these projects on air quality will be an evaluation objective of this task where feasible and relevant.

**USE OF LIDAR TO EVALUATE MAGIC INCIDENT MANAGEMENT SYSTEM.**

(ENV1052)

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Marsella, Mark.

*Performed by:* Santa Fe Technologies, Inc. Albuquerque, NM.

*Investigator(s):* Krayer, Howard.

*Status:* Active, *Contract No.:* 7290.

*Start date:* Sep 1995; *Estimated completion date:* Jan 1999.

*Publication(s):* Eichinger, William, and Howard Krayer. 1998. *The Use of LIDAR to Evaluate Existing Incident Management System on I80 in Morris, Essex, and Passaic Counties in Northern New Jersey.* New Jersey Department of Transportation. Report no. FHWA/NJ-98-004-7290. 20 p.

Final report is being printed.

Evaluate the effectiveness of LIDAR in detecting the effects of incidents on air quality on I-80 and assist in evaluating the MAGIC incident management system.

**USING ON-SITE REMOTE SENSING TECHNOLOGY TO INVESTIGATE THE LEVELS OF TRACKSIDE EMISSIONS FROM FREIGHT LOCOMOTIVES. (ENV1223)**

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* University of Denver.

*Status:* Active .

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

Using on-site remote sensing technology, researchers are investigating the levels of trackside emissions from freight locomotives along a well-traveled section of freight railway in the local area. Research will focus on nitrogen oxides, hydrocarbons, carbon monoxide, and particulate matter.

**VALUE PRICING: TESTING PUBLIC ACCEPTANCE AND IDENTIFYING EQUITY ISSUES FOR THE CONCEPT OF HIGH OCCUPANCY TOLL (HOT) LANES ON HOV FACILITIES. (ENV1192)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Stutts, Liz.

*Performed by:* Center for Urban Transportation Research at the University of South Florida.

*Investigator(s):* Winters, Phillip.

*Status:* Active, *Contract No.:* BB-867 .

*Start date:* 1 Sep 1998; *Estimated completion date:* 1 Dec 1999.

The objective of this project is to evaluate commuter acceptance and equity impacts of the potential programs to convert High Occupancy Vehicle (HOV) lanes into High Occupancy Toll (HOT) lanes.

## Cultural Resources

### **CAREER: ASSESSMENT, MAINTENANCE, REPAIR, AND REHABILITATION OF HISTORIC STRUCTURES.** (Fed 00181411)

*Sponsored by:* National Science Foundation. Division of Civil and Mechanical Systems. Washington. DC.

*Project Monitor:* Scalzi, John.

*Performed by:* Pennsylvania State University. Architectural Engineering. University Park. PA.

*Investigator(s):* Boothby, T. E.

*Status:* Active, *Contract No.:* 9624614.

*Start date:* 15 Jul 1996; *Estimated completion date:* 30 Jun 1998.

This project will develop new repair techniques for historic structures and will develop educational activities that will cultivate a respect for historic buildings, structures, and civil works, and an interest in their maintenance, repair, and rehabilitation. The teaching and research activities will adopt a multidisciplinary perspective, including architectural history, architecture, civil/structural engineering, and landscape architectural input. The repair techniques to be studied involve the application of new composite fiber reinforced plastic (FRP) materials, and their application to historic structures is considered a demanding test bed for the more general use of FRP materials in the repair of concrete, steel, and masonry structures. The specific types of structures to be included in the study are masonry and concrete arch bridges, metal truss bridges, mid-20th-century slab girder and slab bridges, unreinforced load bearing masonry buildings, and thin-shell reinforced concrete structures. The specific issues to be addressed for these building types include: transverse effects in filled arch bridges, load distribution and floor system issues in truss bridges, the hazard of parapets and cornices of urm buildings in eastern locations in moderate earthquakes, and environmental damage to thin-shell concrete structures.

### **CONDITION ASSESSMENT STUDY OF LISTED OR POTENTIALLY ELIGIBLE NATIONAL REGISTER ARCHAEOLOGICAL SITES ON FDOT RIGHTS OF WAY.**

(ENV1187)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Ballo, George.

*Performed by:* University of South Florida.

*Investigator(s):* Weisman.

*Status:* Pending, *Contract No.:* BB-865.

*Start date:* 1 Jan 1999; *Estimated completion date:* 1 Apr 2000.

No summary provided.

### **CULTURAL RESOURCE MANAGEMENT.** (00744199)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Performed by:* University of South Florida. Tampa. FL.

*Investigator(s):* Weisman, B.

*Status:* Active.

*Notes:* This record is questionable; status could not be determined.

Archaeological sites were examined in this research to develop a ranking criteria for excavating and protecting known sites.

**HISTORIC ROADS OF VIRGINIA: AUGUSTA COUNTY ROAD ORDERS 1745-1769.**

(ENV1306)

*Sponsored by:* Virginia Department of Transportation.*Performed by:* Virginia Transportation Research Council.*Investigator(s):* Miller, Ann B.*Status:* Active.*Start date:* annual; *Estimated completion date:* ongoing.

Purpose: The Historic Roads of Virginia series, initiated by the Virginia Transportation Research Council (then the Virginia Highway & Transportation Research Council) in 1973, has resulted in the transcription and publication of the eighteenth century transportation-related court records (“road orders”) for numerous Virginia counties and the production of histories of a number of significant early Virginia roads. These records, and the corresponding publications, constitute the primary evidence for early road development and outline early settlement and transportation corridors in a large portion of Virginia. The latest volume, Augusta County Road Orders 1745-1769, is the nineteenth entry in the Historic Roads of Virginia series. It is also the first volume of published road orders to be concerned wholly with territory west of the Blue Ridge and covers the period when Augusta County was a giant county stretching through much of the Valley of Virginia and into southwest Virginia. The evidence contained in this volume has particular application to such projects as the cultural resource research relating to transportation projects in the Valley, including the improvements to I-81.

Expected Benefits: In addition to VDOT environmental and cultural resource work, these volumes have application for historical research and are extremely popular in the historical community (all of the previously published volumes are still in print and copies are still being requested). More than 75 requests for copies of Augusta County Road Orders 1745-1769 were received even before a publication date was announced. Upcoming projects include early road orders for Frederick County, Amelia County, Fairfax County, Franklin County, and Henry County. The majority of these projects are cooperative efforts whereby the records are transcribed by local groups or universities, after which the Research Council indexes and publishes the material.

The continuity of the Historic Roads of Virginia series is an excellent public relations tool, demonstrating a long-term commitment on the part of the Research Council and VDOT to painstaking and accurate historical and cultural resource research. The approximately \$9,000 per annum budgeted for this ongoing project is leveraged into a tremendous “bang for the buck.” Each dollar spent on this project results in a conservatively estimated return of approximately \$4 to \$5 in time saved or additional research undertaken by outside sources. VDOT personnel and consultants save numerous hours by having the information already published, indexed, and available; in addition, having the records available in published form allows university projects, historical societies, and independent historians to undertake additional in-depth analysis of early road networks and related research (at no cost to VDOT).

**A MANAGEMENT PLAN FOR HISTORIC BRIDGES IN VIRGINIA.** (ENV1305)*Sponsored by:* Virginia Department of Transportation.*Performed by:* Virginia Transportation Research Council.*Investigator(s):* Miller, Ann B.*Status:* Active.*Start date:* 1 Jul 1997; *Estimated completion date:* 30 Jun 2000.

Through the Virginia Transportation Research Council, VDOT has been proactive in identifying and determining the significance of its historic bridges (i.e., those eligible for the National

Register of Historic Places). Major thematic studies completed or nearly completed include those for non-arched concrete bridges, metal truss bridges, movable span bridges, and masonry/concrete arch bridges. Approximately 75 historic bridges are extant in Virginia, and most of them are under VDOT's purview.

Once historical significance has been determined, the next step in dealing with these historic structures is to develop a comprehensive treatment/management plan, which is the purpose of this project. The Virginia historic bridge management project is using the survey data and evaluations for historical significance already gathered by the Virginia Transportation Research Council. The interdisciplinary Historic Structures Task Group is providing input and technical support, and additional information and viewpoints are being gathered from other VDOT central and district personnel.

This project has identified the numerous issues (including legal, engineering, regulatory, financial, preservation and political issues) that arise concerning the management of historic bridges. Different treatment and management options have also been identified. Currently, the issues are being more closely examined, potential treatment and management options for historic bridges are being studied and evaluated, and a bridge management database is being developed and refined. Individual management recommendations are being formulated for each of Virginia's historic bridges.

The project is of major interest to VDOT (particularly the Environmental and Structure & Bridge divisions) in formulating historic bridge management plans to satisfy state and federal requirements for cultural resource documentation. The project is also of considerable interest to the FHWA and the Virginia Department of Historic Resources. The project began in July 1997 and was originally scheduled for completion in June 1999. However, the issues have proved to be more complex and numerous than anticipated, requiring additional research and the expansion of the project.

**METHODS OF CONTEMPORARY COMMUNITY DESIGN AT ZUNI AND ACOMA PUEBLOS BASED ON SUSTAINABLE AGRICULTURE. (CRIS 0175818)**

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* Cornell University. Landscape Architecture Department. Ithaca, NY.

*Investigator(s):* Gleason, K. L.

*Status:* Active, *Contract No.:* NYC-146402.

*Start date:* 1 Oct 1997; *Estimated completion date:* 1 Jun 2001.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

This project will adapt traditional agriculture and building technologies to address contemporary development issues in rural Native American communities. In evaluating the contemporary design of parks, roads and housing, the Principal Investigator will focus on traditional methods of cultivation, erosion control, and water management and how these may be reintroduced into village life to reinforce the cultural ways of the pueblo communities.

The project seeks to establish a partnership approach between the pueblos and Cornell. The Principal Investigator brings a combined knowledge of landscape architectural design, arid-climate agriculture and archaeology. She will work with the pueblos and Cornerstones Community Partnership to explore the objectives described above. Groups and Cornell students will work with students from Zuni and Acoma to actually build and test ideas produced through discussion and research at Cornell and in the South West. The results will be disseminated in a



product developed in collaboration with the pueblo groups.

**PRESERVATION ALTERNATIVES FOR HISTORIC TRUSS BRIDGES.** (ENV1166)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Sadowsky, S.

*Investigator(s):* Engelhardt, M.D.

*Status:* Active, *Contract No.:* 0-1741.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1999.

No summary provided.

**REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM DEVELOPMENT FOR ARCHAEOLOGICAL, ECOLOGICAL, AND GEOMORPHOLOGICAL RECONNAISSANCE ON THE PENINSULA.** (Fed 00182602)

*Sponsored by:* National Science Foundation. Office of Polar Programs. Washington. DC.

*Project Monitor:* Korsmo, Fae L.

*Performed by:* University of Wisconsin-Madison. Department of Anthropology. Madison. WI.

*Investigator(s):* Maschner, Herbert D. G.

*Status:* Active, *Contract No.:* 9630072.

*Start date:* 1 Jul 1996; *Estimated completion date:* 30 Jun 1999.

Recent research in the lower Alaska peninsula and Unimak Island has demonstrated that this area is critical to our understanding of the development of Aleut society and human adaptation to climate change and landscape evolution in the region. A broad regional approach to these problems depends on large-scale systematic archaeological survey. Because of the expense of doing surveys in this remote region, satellite images, aerial photography, a geographic information system and statistical modeling combined with field controls will be employed and tested. If successful, this method will greatly facilitate the discovery of archaeological sites and enhance our understanding of regional ecology and human adaptation in the North Pacific region.

**A SURVEY OF MASONRY AND CONCRETE ARCH BRIDGES IN VIRGINIA.**  
(ENV1307)

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Miller, Ann B.

*Status:* Active.

*Start date:* 1 Mar 1996; *Estimated completion date:* 30 Jun 1999.

This project updates and expands the survey of pre-1932 masonry arch and concrete arch bridges in Virginia originally done through the Virginia Transportation Research Council in the early 1980s. An update of the survey to include post-1932 arch bridges was a necessity, since any structure more than 50 years old (a criterion that currently includes bridges built before ca. 1950) can be considered for the National Register of Historic Places.

This project follows the format already used successfully to survey and evaluate non-arched concrete, metal truss, and movable span bridges in Virginia. All known masonry arch and concrete arch bridges now standing in Virginia are surveyed, historical research on arch bridges is undertaken (with special emphasis on arch bridges in Virginia and their place in the larger context of this structural form), and the field data are analyzed and tabulated. Those bridges under VDOT's purview are then evaluated for historic significance (i.e., eligibility for the National Register). As with similar projects, the evaluation of the structures for historic significance is

undertaken by the Historic Structures Task Group (composed of representatives from VDOT, the Research Council, the FHWA, and the Department of Historic Resources). The final report will include the information gathered from the field survey and documentary research and the results of the evaluations.

The update of the arch bridge survey is of major interest to VDOT (particularly the Bridge and Environmental divisions) and FHWA in formulating historic bridge management plans and satisfying state and federal requirements for cultural resource documentation. The historic bridge studies undertaken by the Research Council have proven to be of significant cost benefit to VDOT, providing concise, comprehensive information on our older bridges for use in evaluating historical significance. Information from these studies also streamlines the historic bridge management process and the review and planning process for new projects that affect historic bridges, thus avoiding costly project delays.

The updated arch bridge study began in March 1996. Field work is complete; historical research, tabulations, and analysis of the work are largely complete; the Historic Structures Task Group has met periodically to review the data and evaluate the bridges for historic significance (these evaluations are nearly complete); and the final report is being drafted.

**SYNTHESIS OF INFORMATION RELATED TO HIGHWAY PROBLEMS. TOPIC 28-08. HISTORIC HIGHWAY BRIDGE PRESERVATION PRACTICES. (00736776)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Jencks, Crawford F.

*Performed by:* Transportation Research Board.

*Investigator(s):* Liff, Sally and Maher, Stephen F.

*Status:* Active, *Contract No.:* Project 20-05, Topic 28-08.

*Start date:* 21 Aug 1996; *Estimated completion date :* 30 Jun 1998.

*Publication(s):* Final report in progress. A draft synthesis report is under review.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Historic highway bridges rarely meet AASHTO-recommended guidelines with respect to approach geometrics, load-carrying capacity, horizontal and vertical clearance, and other safety elements. Funds for the replacement and rehabilitation of functionally obsolete or structural deficient bridges, both on an off the federal-aid highway system are provided by the federal-aid bridge replacement and rehabilitation program. This synthesis will describe the practice and the decision making procedures or models that have been employed by agencies to determine which bridges to preserve. Decision factors will include identification of preservation, plans for standards, criteria used in the decision models, state or local legislative requirements, adaptive use decisions, and review of inventories to identify patterns in and reasons for the preservation of various types of bridges.

## Energy Conservation, Alternative Fuels, and Climate Change

### **ALTERNATIVE FUELS EVALUATION.** (Fed 00202254)

*Sponsored by:* We. NERDDP, 22000.

*Project Monitor:* Neumann, M. R.

*Performed by:* State Energy Commission of Western Australia. Perth. West Australia.

*Investigator(s):* Crawford, M. R.

*Status:* Contract No.: 45593.

*Start date:* unknown; *Estimated completion date:* unknown.

The objectives of this project are to evaluate in normal service the performance, operating costs, and maintenance costs of vehicles and stationary engines operating on the following alternative fuels: (1) Lpg and (2) Cng. Methodology includes operating possible engines in normal service without modification. Methodology will vary according to the fuel and its application.

### **AMMONIA FUEL CELL POWERED HIGHWAY ADVISORY RADIO (HAR) .** (ENV1157)

*Sponsored by:* New Jersey Department of Transportation. Bureau of Technology Deployment.

*Project Monitor:* Strizki, Mike.

*Performed by:* H-Power.

*Status:* Active.

*Start date:* Sep 1998; *Estimated completion date:* Sep 1999.

Like the solar powered VMS, the HAR also experiences power outages during low light level conditions. A prototype fuel cell power system has been developed for testing. It features a reformer which separates hydrogen from ammonia to power the fuel cell. Hydrogen rich ammonia increases the utility of fuel cells by overcoming hydrogen storage limitations. This is the next step in fuel cell technology development.

### **ANALYSIS OF IMPACTS OF URBAN TRANSPORTATION POLICIES ON ENERGY CONSUMPTION AND URBAN ENVIRONMENT.** (ENV1084)

*Sponsored by:* SEPTA; UPS Foundation; Energy Foundation; Mid-Atlantic Universities Transportation Center.

*Performed by:* University of Pennsylvania.

*Investigator(s):* Vuchic, V. R.

*Status:* Active.

*Start date:* 1 Jul 1994.

In most cities around the world, there is a trend toward physical dispersal of residences, retail businesses, and, increasingly, other business activities, with consequent growing reliance on travel by private automobile. On the other hand, the populace is demanding improvements of quality of life in cities and prevention of further environmental degradation. In addition, most countries face very high expenditures for energy (mostly oil) imports. Facing this dilemma of microtrends toward dispersal and increased vehicle miles traveled and the long-term goals of economically, socially, and environmentally sound metropolitan areas, cities in many industrialized countries have proposed or adopted various policies to protect the urban environment and reduce energy consumption. This research examines policies and specific measures proposed or introduced in different cities for reconciling these conflicts.

The first phase of this program has been completed. A final draft of the technical report titled "Urban Transportation: Understanding the Problems" has been prepared. This major work has been reviewed by the project advisory committee and is being finalized to incorporate comments

and suggestions by external reviewers. The transfer of the “technology” has advanced through numerous presentations and publications. There has been a contract signed with Rutgers University Press for publication of the book titled *Cars, Transit, and Livable Cities*. Phase II of this program has continued focusing on methods for improving urban transportation.

**ASSESSMENT OF POTENTIAL ENERGY SAVINGS (SUBCONTRACT-TSU). (SWUTC 466070)**

*Sponsored by:* Office of the Governor of Texas.

*Performed by:* Texas A&M University.

*Investigator(s):* Burke, Dock.

*Start date:* 1 Sep 1994; *Estimated completion date:* 31 Aug 1997.

Public and private transportation providers and other companies have aggressively pursued alternative fuel programs in response to legislative requirements to improve air quality. Simultaneously, clean air mandates are prompting changes in the home to work trips for employees across the nation. While both of these programs have air quality as the motive for implementation there are other benefits accruing as well. From the alternative fuel and trip reduction standpoint, there will also be a decrease in the utilization of oil, the current depletion rates of which are well documented. There will also be financial savings for those individuals who no longer drive alone. This research effort will set parameters to determine benefits beyond air quality that will accrue from the alternative fuel and employer trip reduction programs. These benefits will include the energy, financial, and social categories.

**ASSESSMENT OF THE POTENTIAL FOR TRIP-CHAINING, RIDE-SHARING, AND CAR-POOLING MANDATES TO REDUCE ENERGY CONSUMPTION AND VEHICLE EMISSIONS. (ENV1243)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Irvine. Civil & Environmental Engineering Department.

*Investigator(s):* Recker, Will.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

The 1990 Clean Air Act Amendments (CAAA) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) have combined to define a broad range of transportation control measures (TCMs); however, it is not clear how much change in travel behavior can be achieved with incentive programs only. This project will empirically assess impacts of policy mandates on urban transportation energy consumption and emissions, and will concurrently measure corresponding changes in mobility/accessibility associated with these policies by building on the record of research in activity-based behavioral analysis of transportation policy options.

**BRITE EXPANSION. (ENV1194)**

*Sponsored by:* New Mexico State Highway & Transportation Department.

*Project Monitor:* Skrupskis, Michelle.

*Performed by:* Alliance for Transportation Research Institute.

*Investigator(s):* Cockerill, Kristan.

*Status:* Active.

*Start date:* Nov 1998; *Estimated completion date:* Jun 2000.

This effort builds upon the work done to establish a repository for border region transportation

related research and information. This continuation will expand the BRITE (Border Region Information on Transportation and the Environment) repository to include a segment on connections between transportation and habitat and land use issues. Additionally, the researchers will update the air quality segment created in the first phase of this project.

**CAREER: HYDROLOGIC REGULATION OF WETLAND BIOGEOCHEMISTRY AND ECOLOGY AND THE IMPACTS OF CLIMATE CHANGE.** (Fed 00184840)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington, DC.

*Project Monitor:* Shaver, Gaius R.

*Performed by:* Michigan State University. W.K. Kellogg Biological Station. Hickory Corners, MI.

*Investigator(s):* Hamilton, Stephen K.

*Status:* Active, *Contract No.:* 9701714.

*Start date:* 15 Aug 1997; *Estimated completion date:* 31 Jul 1999.

The aims of this research are to investigate linkages between hydrology, biogeochemistry, and ecology of wetlands in glacial landscapes, with the long-term aim of developing a predictive understanding of the relative sensitivity of different wetlands to climate change. The research plan involves monitoring of a large number of different wetlands in relation to annual variation in climate, and as part of the NSF career program it includes significant student participation through class projects and independent research. The wetlands to be studied are all in central Michigan.

**CATHODIC BRIDGE PROTECTION.** (ENV1154)

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Strizki, Michael.

*Performed by:* New Jersey Department of Transportation. Bureau of Technology Deployment.

*Status:* Active.

*Start date:* Oct 1998; *Estimated completion date:* Feb 2000.

By introducing a small electric current into a titanium mesh grid located in the bridge deck, electrochemical corrosion and decomposition is reduced or eliminated. The project involves retrofitting an existing cathodic system with a fuel cell power supply. Fuel cell power is expected to overcome recurrent equipment failures related to variable grid voltage and voltage spikes. In some cases, it will eliminate costs associated with grid connections.

**DEVELOPMENT AND DEMONSTRATION OF SUSTAINABLE TRANSPORTATION CONTROL.** (SWUTC 472840-00013)

*Sponsored by:* DOT-University Transportation Centers Program.

*Performed by:* Texas A&M University.

*Investigator(s):* Messer, Carroll J.

*Status:* Active, *Contract No.:* DTRS95-G-0006.

*Start date:* 1 Sep 1996; *Estimated completion date:* 30 Sep 1999.

The efficient provision of mobility of persons and goods should directly consider the energy consumed, environmental impacts, and the economic costs involved in providing transportation. This is not true in the traffic signal controller industry in the United States today. While micro-electronics have been improved in the traffic signal systems, the fundamental signal control strategy used today remains locked in the operational concepts of the 1960s when explicit considerations of energy consumption and environmental impacts (e.g., on air quality) were nil.

**A DYNAMIC HOUSEHOLD ALTERNATIVE-FUEL VEHICLE DEMAND MODEL USING REVEALED AND STATED TRANSACTION INFORMATION.** (ENV1245)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Irvine. Department of Economics.

*Investigator(s):* Sheng, Hongyan.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

Stated Preference (SP) data is needed to estimate future alternative-fuel vehicle (AFV) demand for automobile manufacturers, public utility companies, and planning agencies. However, SP data may give biased estimates of household real market behavior. The focus of this project is the development of a dynamic state and revealed preference vehicle transaction model which adjusts for the possible biases of pure SP or RP data. The models developed here will incorporate household vehicle type choices as well as transaction choices. A preliminary study provides the basis for further joint estimation of the SP and RP data; recent applications of mixed logit models provides feasible ways to jointly estimate SP and RP data as well. The large panel data sets collected by the California Alternative-Fuel Vehicle Demand and Forecast Project will be used.

**EFFECTIVENESS OF TELECOMMUNICATIONS ON ENERGY COST SAVINGS.**

(SWUTC 466040)

*Sponsored by:* Subcontract with Texas Southern University. Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* Texas Southern University.

*Investigator(s):* Godazi, Khosro.

*Status:* Active.

*Start date:* 1 Sep 1993; *Estimated completion date:* 31 Aug 1997.

Increased awareness of environmental hazards associated with congestion has fostered the development of alternative travel strategies for the workplace. Telecommunications is an option for reducing travel demand since it enables the employee to work either at home or a location close to his/her home on some days. Most of the research to date has focused on the environmental and social aspects of telecommuting. One of the neglected aspects of telecommuting may involve energy utilization and efficiency. A need exists to measure the reductions of gasoline usage against the possible increases in household (kilowatt) energy consumption, as well as to record the changes in commuting patterns of those who telecommute and/or their families. This research will document the effect of telecommuting on energy utilization.

**ELECTRIC STATION CAR - PROJECT.** (ENV1156)

*Sponsored by:* New Jersey Department of Transportation. Bureau of Technology Deployment.

*Project Monitor:* Webber, Nancy.

*Performed by:* New Jersey Department of Transportation. Bureau of Technology Deployment.

*Status:* Active.

*Start date:* Mar 1997; *Estimated completion date:* Mar 2000.

Power Commute is a public/private demonstration project involving 21 electric cars. Reverse-commuting employees drive the vehicles from the train station to the work location to test the viability of the commuting model, increase transit use, reduce highway congestion and improve air quality. Participants include Lucent Technologies, Bayer Consumer Care, GPU Energy, Bell Atlantic Mobile, L3 Communications and others. Power Commute is located at Morristown

Station (NJ Transit), Princeton Junction (NJ Transit), and PATCO's Woodcrest Station.

**ENERGY CONSUMPTION RELATED TO EXCESSIVE USER-DELAY COSTS DURING HIGHWAY CONSTRUCTION.** (SWUTC 460058 60058)

*Sponsored by:* Subcontract with the University of Texas. Office of the Governor of Texas.

*Project Monitor:* Veasey, Renee.

*Performed by:* University of Texas.

*Investigator(s):* McCullough, B. Frank.

*Start date:* 10 Dec 1992; *Estimated completion date:* 31 Aug 1997.

Excess fuel consumption resulting from user-delay and congestion during highway rehabilitation and maintenance activities in urban areas will be quantified. The cost associated with this excess fuel consumption will be compared with the costs of conducting those same highway construction activities at an accelerated rate and at non-peak traffic times, i.e. nighttime and weekends. The feasibility of developing a model that will serve as a tool for engineers to use when considering various construction schedules, phasing options, and allowable construction times will also be explored.

**ENERGY EFFICIENT VEHICLES.** (Fed 00202508)

*Performed by:* University of New South Wales. School of Physics. Kensington. New South Wales; Solar Mobility Pty Ltd. North Epping. New South Wales.

*Investigator(s):* Storey, J. W. V. and Allen, M. R. G.

*Status:* Contract No.: 45847.

*Start date:* unknown; *Estimated completion date:* unknown.

The project objective is to develop extremely low-energy forms of transport. Such vehicles include electric commuter cars, solar powered cars, and efficient petrol-engined cars.

Methodology includes: (1) development of new aerodynamically efficient vehicle shapes; (2) investigation of low rolling-resistance tires; (3) development of lightweight vehicle construction techniques; (4) development of highly efficient motors and drive systems; and (5) investigation of the safety and survivability aspects of ultra-lightweight cars.

**EV FLEET DEPLOYMENT AND DEMO.** (ENV1155)

*Sponsored by:* New Jersey Department of Transportation. Bureau of Technology Deployment.

*Project Monitor:* Borowski, Don.

*Performed by:* Public/Private Consortium.

*Status:* Active.

*Start date:* Aug 1998; *Estimated completion date:* May 1999.

The project intends to build on DOT's experience with electric vehicles by paving the way for government and private sector acquisition of EVs. A consultant will be selected to assist fleet operators with vehicle selection, training, charging infrastructure and safety. This phase of the project is contingent upon introduction of the Governor's Advanced Technology Vehicle Incentive Program. The DMO portion of the project includes formation of a consortium to build a hybrid fuel cell/battery powered car to be entered in the 1999 Tour de Sol EV rally.

**EVALUATING TEXAS-MEXICO BORDER CROSSING (SUBCONTRACT-UTA).**

(SWUTC 465610)

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* unknown.

*Performed by:* Texas A&M University.

*Investigator(s):* Burke, Dock.

*Start date:* 1 Sep 1994; *Estimated completion date:* 31 Aug 1997.

Current crossing mechanisms between the United States and Mexico along the Texas border are both complex and inefficient. Such mechanisms create substantial vehicular congestion within border city gateways, resulting in higher fuel consumption, degraded air quality, and a rise in vehicle accident rates. The study evaluates a range of potential improvements to crossing mechanisms in terms of energy impacts and savings.

**EVALUATION OF ELECTRIC VEHICLES AS AN ALTERNATIVE FOR WORK-TRIPS AND COMMUTES. (ENV1140)**

*Sponsored by:* Connecticut Department of Transportation.

*Project Monitor:* Sime, James M.

*Performed by:* Connecticut Department of Transportation.

*Investigator(s):* Sime, James M.

*Status:* Active, *Contract No.:* (State Project Number) HPR-343EV.

*Start date:* 31 Jan 1996; *Estimated completion date:* 31 Jan 1999.

*Publication(s):* Final report anticipated by end of first quarter, 1999.

*Notes:* Evaluation is in final stages.

The overall objective of the research project is to evaluate the practicality of two typical present day electric vehicles (subcompact sedans) provided through a partnership with the Connecticut Rideshare Co. Technical objectives for the vehicle powered by the advanced lead acid battery (ALAB) are: (1) To determine whether the 1998-model ALAB provides 200 cycles at full capacity if driving is limited to less than or equal to 45 miles between charges and to less than or equal to a conservative 50 ampere-hours current draw from the battery (70% DOD of one-hour rate), and (2) To determine if maximum peak current (battery) loads are limited to less than or equal to 150 amperes.

Technical objectives for the vehicle powered by conventional lead acid batteries (CLAB) is to determine a realistic range and other operating parameters. Findings: The CLAB-powered vehicle has demonstrated a realistic range between charges of 35 miles in summer and 24-27 miles in winter. The vehicle has electric cabin heating and defrosting, which results in a shortened driving range in winter months. Also, an EV with CLAB weighs about 150 pounds more than the ALAB-powered sedan. Fuel-fired heaters/defrosters were not on the market at the time the vehicles were purchased. That technology addresses one of the shortcomings of the electric compact.

**AN EXAMINATION OF ARTERIAL STREET HIGH-OCCUPANCY VEHICLE (HOV) LANES IN TEXAS. (SWUTC 460042 60042)**

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* Texas A&M University.

*Investigator(s):* Turnbull, Katherine F.

*Start date:* 1 Aug 1992; *Estimated completion date:* 31 Aug 1997.

This research project examined the current use of arterial street HOV lanes in cities in Texas and



North America. It included the identification of issues and concerns associated with the design and operation of arterial street HOV lanes and techniques and approaches used to address these. The use of existing projects and the benefits relating to increased use of high-occupancy commute modes, energy savings, improved fuel efficiency, and enhanced air quality were examined. A set of general guidelines for planning, designing, and operating arterial street HOV projects in Texas were developed based on this analysis.

**FUEL CONSUMPTION AND LAND USE/TRANSPORT INFRASTRUCTURE . (Fed 00201973)**

*Sponsored by:* Vi. NERDDP, 33200.

*Project Monitor:* Howie, D.

*Performed by:* Loxton and Andrews, Pty Ltd. P.O. Box 323. Elsternwick. Victoria. 3185.

*Investigator(s):* English, N.

*Status:* Contract No.: 45312.

*Start date:* unknown; *Estimated completion date:* unknown.

The objective of this project is to provide an energy research component into studies by the proposed Victorian Roads Corporation. Specifically, this project will assess the opportunity to reduce urban fuel consumption by altering land use patterns and using Melbourne transport infrastructure more effectively. Methodology: Phase 1 - extensive literature search, discussions with government agencies and private industry, and, if appropriate, a structured process for assessing opinions and support for further research into the transport energy issue. Phase 2 - to model the interrelationship between resources consumed for transport purposes (particularly fuel), the patterns (and density) of land use, and the infrastructure to service transport needs. To provide a practical dimension to this approach, an existing urban area will be modelled.

**HAZARD ANALYSIS OF FUEL CELL AND HYBRID VEHICLE. (00751993)**

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Status:* Active.

*Start date:* 14 Apr 1998; *Estimated completion date:* 2000.

No summary provided.

**HAZARD ASSESSMENT AND MITIGATION OF ALTERNATIVE-FUEL-RELATED SYSTEMS IN TRANSIT BUS OPERATIONS. (00736513)**

*Sponsored by:* Transit Cooperative Research Program. Transportation Research Board. Washington. DC; Federal Transit Administration. Washington. DC.

*Project Monitor:* Andrie, Stephen J.

*Performed by:* Science Applications International Corporation. McLean. VA.

*Investigator(s):* Friedman, David.

*Status:* Active, *Contract No.:* Project C-11.

*Start date:* 1 Dec 1997; *Estimated completion date:* 30 Sep 1999.

Because of environmental and energy conservation imperatives, the public transit industry is implementing a variety of new technologies, including alternative fuels and hybrid-electric propulsion. Characteristics of these technologies, such as high-pressure fuel storage and high-voltage electric drive, have introduced new hazards to the transit bus operating environment. There is no reliable body of knowledge that identifies potential hazards and mitigation strategies for these technologies and their support infrastructure. Thus, there is a need to establish a practical, step-by-step procedure to identify, assess, and mitigate the potential hazards associated with operating, maintaining, and supporting transit buses using alternative fuels or hybrid-electric

propulsion. The objective of this project is to prepare a practical and credible tool for transit managers to assess, and design mitigation measures for, the hazards associated with the use of alternative fuels and propulsion technologies that have the greatest deployment potential over the next five years.

**PIV - "PERSONAL INDEPENDENT VEHICLE"**. (Fed 00206650)

*Sponsored by:* OLJE. Og Energiverndepartementet. Oslo. Norway.

*Performed by:* Bakelittfabrikken A/S, Oslo, Norway.

*Status:* Active, *Contract No.:* 51917.

*Start date:* 1992; *Estimated completion date:* 2000.

The objective of the project is to develop a vehicle that can meet future environmental demands. The vehicle is primarily intended to be used in urban areas. The idea is to use light material to lower the weight of the vehicle without reducing security for the passengers. Furthermore, the materials should be possible to recycle. It will preferably be fitted with an electrical engine. A prototype was ready by 1993, and further development is in progress.

**POTENTIAL OF CONGESTION PRICING (SUBCONTRACT-UTA)**. (SWUTC 465620)

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* unknown.

*Performed by:* Texas A&M University.

*Investigator(s):* Burke, Dock.

*Start date:* 1 Sep 1994; *Estimated completion date:* 31 Aug 1997.

This project intends to provide information and approaches to the potential of congestion pricing as a demand management strategy to reduce urban congestion, and improve energy efficiency and air quality in Texas. It will develop a strategy for the possible implementation of congestion pricing in such a way that will be integrated with contemplated traffic management systems in IVHS in Texas.

**REDUCING TRANSPORTATION ENERGY CONSUMPTION THROUGH TELECOMMUTING: FEASIBILITY AND DEMONSTRATION**. (SWUTC 465590)

*Sponsored by:* Subcontract with the University of Texas. Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* University of Texas.

*Investigator(s):* Mahmassani, Hani and Herman, Robert.

*Status:* Active.

*Start date:* 1 Sep 1993; *Estimated completion date:* 31 Aug 1999.

*Notes:* Dr. Herman passed away in 1997; contact Mahmassani

The alternative of telecommunication to transportation has long been preferred as an approach that might eventually alleviate the demand placed on transportation facilities and, thereby, reduce fuel consumption and air pollution. With the increased use of telecommunications in individual homes and businesses (and with the widespread availability of computing equipment, facsimile capabilities, and the like), there is renewed interest in exploring and encouraging telecommuting arrangements. These include work-at-home schemes, workplace decentralization with satellite work centers, and many other non-traditional approaches to structure workplace activities and worker responsibilities. This project will investigate the processes that determine the potential of telecommuting to improve urban mobility and reduce transportation fuel consumption. In particular, it addresses the linkages between the adoption of telecommuting by employees and employers, travel behavior, and area-wide fuel consumption implications. In addition, it examines issues of telecommuting program design, adoption, and implementation.

**TRANSPORTATION AND LAND USE: ENERGY AND AIR QUALITY IMPACTS.**

(00755276)

*Sponsored by:* Natural Sciences and Engineering Research Council of Canada.

*Performed by:* Carleton University. Department of Civil and Environmental Engineering.

Ottawa. Canada.

*Investigator(s):* Khan, A. M.

*Status:* Active.

*Start date:* 1994; *Estimated completion date:* 1999.

The objective of this research is to investigate urban transportation and land use structures for reducing energy consumption in transportation and improving air quality. In addition to the study of efficient compact urban structures, this research is examining the effect of improving job opportunities in a subregion on region-wide transportation fuel consumption and emissions. Furthermore, the effect of improving job opportunities in a number of satellite cities within a multinucleated urban area on region-wide transportation fuel consumption and emission is under investigation.

**USE OF SOLAR CHARGING PORTS TO POWER AN ELECTRIC TAXI FLEET  
continued under new title: SOLAR/FUEL CELL CHARGING PORT. (ENV1032)**

*Sponsored by:* New Jersey Department of Transportation. Bureau of Technology Deployment. Trenton, NJ.

*Project Monitor:* Strizki, Mike.

*Performed by:* New Jersey Department of Transportation. Bureau of Technology Deployment. Trenton, NJ.

*Investigator(s):* H-Power, FIRST Fully Independent Residential Solar Technology.

*Status:* Active, *Contract No.:* Project No. 7320.

*Start date:* Sep 1998; *Estimated completion date:* Oct 1999.

The purpose of this project is to determine state-of-the-art technology for solar charging of electric vehicles. With grant funding from the USDOE, a portable electric vehicle charging port will be designed, built, and tested. It will incorporate photovoltaic (PV) cells and a fuel cell system to charge EV batteries when sunlight is insufficient. The charging system will have application for fleets where grid infrastructure is not readily available.

**VALUE PRICING: TESTING PUBLIC ACCEPTANCE AND IDENTIFYING EQUITY  
ISSUES FOR THE CONCEPT OF HIGH OCCUPANCY TOLL (HOT) LANES ON HOV  
FACILITIES. (ENV1192)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Stutts, Liz.

*Performed by:* Center for Urban Transportation Research at the University of South Florida.

*Investigator(s):* Winters, Phillip.

*Status:* Active, *Contract No.:* BB-867 .

*Start date:* 1 Sep 1998; *Estimated completion date:* 1 Dec 1999.

The objective of this project is to evaluate commuter acceptance and equity impacts of the potential programs to convert High Occupancy Vehicle (HOV) lanes into High Occupancy Toll (HOT) lanes.

## Environmental Review Process

### **APPLICATIONS OF EXISTING AND EMERGING TECHNOLOGIES IN IMPROVING THE ENVIRONMENTAL PROCESS (A Circular 469 Environmental Research Needs in Transportation project). (ENV1246)**

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Project Monitor:* Hess, Timothy G.

*Status:* Pending, *Contract No.:* Project 25-22.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

This project has been tentatively selected and a project statement (request for proposals) is expected in February 1999. The project statement will be available on this world wide web site. The problem statement below will be the starting point for a panel of experts to develop the project statement.

The process of integrating social, environmental, and economic considerations with transportation decision making involves the application of multiple disciplines. Current and emerging advancements in electronics, video, radio and computer technology provide the industry with a wide variety of potential tools to enhance this process. However, these tools are not generally integrated into the process primarily because of the lack of clear understanding of how these technologies can be used to support the environmental mission of an agency or unit.

The outcome of this research effort should be a document that would highlight the applications, benefits, and costs associated with the implementation of current and emerging technologies.

The research would involve the following specific tasks: (1) Identify current exemplary practices and applications of the tools, both nationally and internationally; (2) Categorize new and existing techniques and their applicability to environmental management practices; (3) Examine feasibility of implementing these techniques across the broad spectrum of transportation practices; and (4) Recommend integrated training programs for the utilization of these tools and techniques.

### **ASSESSING THE APPLICATION OF TRAVEL SURVEILLANCE DATA DIRECTLY TO THE TRANSPORTATION PLANNING AND MANAGEMENT PROCESS.**

(ENV1224)

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* University of Southern California.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the Web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

This project straddles environment and regional planning, assessing the application of travel surveillance data directly to the transportation planning and management process. Surveillance data, such as traffic counts, congestion levels, etc., will be added to a prototype geographic information system that supports both planning and operations.

**COMMUNITY IMPACT ASSESSMENT. (00742057)**

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Project Monitor:* Cunil, Buddy.

*Performed by:* University of South Florida. Tampa. FL.

*Investigator(s):* Mierzejewski, E.

*Status:* Active.

*Start date:* 1997; *Estimated completion date:* 1 Jul 1999.

The objective of this research is to develop a community impact assessment handbook and training course to better meet the requirements for the National Environmental Protection Agency (NEPA) and to better serve the public.

**COMPUTER ASSISTED PROTOCOL FOR ENVIRONMENTAL REPORTS. (ENV1059)**

*Sponsored by:* New York State Department of Transportation and University Transportation Research Center.

*Project Monitor:* Mary Ivey.

*Performed by:* Rensselaer Polytechnic Institute.

*Investigator(s):* Adler, Jeffrey.

*Status:* Active.

*Start date:* 1 Oct 1995; *Estimated completion date:* Mar 1999.

Preparation of environmental reports for capital projects requires special expertise in scoping environmental issues, determining the specific requirements for analyses, and obtaining permits and approvals. To assist the regions in preparing environmental reports, the New York State Environmental Analysis Bureau has sought to develop a statewide protocol for scoping environmental issues and implementing a computer-based system for streamlining data entry, tracking, and reporting. This research will help the Bureau develop a full-scale software (CAPER 2) that will perform a set of tasks including: a) leading design staff from project proposal to project development; b) interfacing with GIS and project management software; c) providing intelligent user assistance; and d) providing a platform for preparing, tracking, and coordinating reports.

**DEVELOPMENT OF AN INTERACTIVE DYNAMIC SIMULATION MODELLING PACKAGE TO AID THE PROCESS DRIVEN BY THE NATIONAL ENVIRONMENTAL POLICY ACT. (ENV1222)**

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* George Washington University.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

Development of an interactive dynamic simulation modelling package to aid the process driven by the National Environmental Policy Act, highlighting public participation and communication of various stages of environmental assessment in transportation project development.

**GIS SUPPORT FOR OPTIMAL ROAD LOCATION WITH WETLAND IMPACTS.**

(ENV1029)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* North Carolina State University. Institute for Transportation Research and Education. Raleigh. NC.

*Investigator(s):* Holdstock, David A.

*Status:* Active.

*Start date:* 1 Sep 1997; *Estimated completion date:* unknown.

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

The wetland mitigation requirements of the state and federal regulatory agencies are becoming more demanding and more difficult to satisfy. The Division of Coastal Management of the NC Department of Environment, Health, and Natural Resources is developing a database of the wetlands and potential wetland restoration sites in the 20 coastal NC counties regulated by the Coastal Area Management Act. This study proposes to evaluate this database for its use in planning and mitigating wetland impacts caused by transportation development. The end product of this research will be a GIS-based analysis tool to allow transportation planners to quickly analyze the impacts of alternative road projects on wetlands and the relative gains in wetland functions of restoration alternatives. Work on the project began in June 1996. Through August, compiling a literature review was the primary activity, and continues today. The literature review has focused on wetland water quality and habitat, transportation systems, GIS use in natural resources, and mathematical modeling of natural systems. Current activities include formulation of models that will describe road building and wetland interactions. Models are being developed for habitat, water quality, and road construction. The objective of the models is to maximize wetland functional values while minimizing the financial cost of road building associated with construction and mitigation. A paper is currently being prepared which will address the process of model development and possible testing procedures.

**GROUND PENETRATING RADAR (GPR) STUDIES.** (ENV1149)

*Sponsored by:* Missouri Department of Transportation.

*Project Monitor:* Wenzlick, J. D.

*Performed by:* University of Missouri - Rolla.

*Investigator(s):* Anderson, Neil.

*Status:* Active, *Contract No.:* RI98-014 through RI98-020.

*Start date:* Jan 1998; *Estimated completion date:* Dec 1999.

The objective of this research study is to develop applicable uses for GPR technology for locating caves in Karst topography, scour around bridge piers, roadway subsidence, risk assessment of underground mines, locating underground storage tanks, and techniques in archaeological investigations.

**INTEGRATION OF LAND-USE PLANNING WITH MULTIMODAL TRANSPORTATION PLANNING.** (ENV1227)

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Project Monitor:* McCreedy, Ronald D.

*Performed by:* Parsons Brinckerhoff Quade & Douglas, Inc.

*Investigator(s):* Seskin, Samuel N.

*Status:* Active, *Contract No.:* Project 8-32 (3).

*Start date:* 1 Oct 1995; *Estimated completion date:* 31 Dec 1998.

*Publication(s):* Based on panel review and approval, the research team has submitted a revised guidebook entitled, "Land Use Impacts of Transportation: A Guidebook." A decision regarding publication is pending.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Transportation planning at both the state and metropolitan planning organization (MPO) levels requires that the impact of transportation investment decisions on land-use patterns be considered. This implies that every action, from adding capacity to managing access, has some interrelationship with land-use and land development patterns. Much of this implied interrelationship is anecdotal, or, at best, empirical, because there is little available factual and quantifiable information on impacts. Nevertheless, it is clear that transportation policies and their relationship to land-use planning have significantly changed and are continuing to evolve in the post-Interstate era. There is a very critical need to provide land-use impact information and analysis tools to help decision makers meet the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 planning requirements. Decision makers must be able to certify that land-use impacts have been considered in their transportation plans.

ISTEA calls for joint decision making on a metropolitan level in conducting transportation and land-use planning. MPOs and state departments of transportation (DOTs) are required to consider land-use alternatives to transportation solutions such as those required by management systems and major investment studies.

The success of transportation capacity improvements, travel demand reduction measures, and the use of alternative modes all depends in part on the land use. Rural, suburban, and urban land-use patterns including issues such as renewal, sprawl, environmental concerns, and economic growth are all affected by transportation strategies. Better coordination of regional transportation planning with local land-use planning can help to optimize the timing of investments, help to identify transportation facilities and services needed to serve or modify land uses, and help to coordinate the nature and pattern of land development with available transportation modes. As a result, it is essential that these coordination activities be supported by an accurate, consensus-based analytical process. Research is needed to develop analytical tools for use by transportation and land-use planners and decision makers at federal, state, MPO, and local levels of government.

The objective of this research is to provide planners and decision makers with effective analytical tools that describe and measure the interrelationships between transportation facilities and services and land-use on a regional and project-level basis. More specifically, this research will accomplish the following: (1) define appropriate methods and procedures for quantifying transportation and land-use effects; (2) describe how transportation investments (such as, transit and highways) and strategies (for example, Transportation Control Measures and Transportation Demand Management) influence land use; (3) identify the sensitivity of different land-use patterns to transportation; and (4) develop analytical tools to enable transportation planners and land-use planners to jointly implement transportation and land development goals.

To accomplish these objectives, the following tasks will be performed: (1) Conduct a critical literature review that will describe the interrelationships between transportation investments and strategies and land-use decisions. Conduct a state-of-the-practice review and evaluation of available analytical tools for measuring transportation and land-use interrelationships. (The contractor shall include an international perspective as part of this task.) (2) Identify the interrelationships of land-use intensity and mix with various transportation investments and

strategies, both short and long term. Define appropriate methods and procedures for quantifying transportation and land-use effects. Develop a common measurement format to quantify these interrelationships. The contractor will look beyond existing measurement formats for this task. The contractor will submit an interim report within 6 months for NCHRP review. This report will include the results of Tasks 1 and 2 and a revised work plan for Tasks 3, 4, and 5. The panel will meet with the contractor to discuss the interim report and approve the remaining work on this project. (3) Develop analytical tools for use by planning professionals for analysis of transportation investments and strategies and land development goals. (4) Develop a guidance document for federal, state, regional, and local planners and decision makers that identifies the interrelationships between land-use patterns and transportation investment strategies. This document shall also contain analytical tools that can be used to quantify the impacts of the interrelationships. The guidance and tools contained in this document should be usable in the planning process in response to the ISTEA requirements. (5) Develop recommendations and cost estimates for case studies and data that will be needed to test the analytical tools identified. These recommendations will address impacts of transportation on land use and impacts of land use on transportation. These recommendations will also serve as the work plan for an anticipated second phase of this research effort to be done under a separate contract. (6) Prepare a final report on the findings of the research. The report shall also contain recommendations for further research.

The project has fallen behind schedule in the development of the new UrbanSim model (Task 3). A no-cost extension request will be made to extend the contract period to December 31, 1998.

**PERFORMANCE MEASURES (SUBCONTRACT-UTA). (SWUTC 465600)**

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* unknown.

*Performed by:* Texas A&M University.

*Investigator(s):* Burke, Dock.

*Start date:* 31 Aug 1994; *Estimated completion date:* 31 Aug 1997.

In accordance with the ISTEA legislation of 1991, the U.S. Secretary of Transportation has mandated the establishment of a National Transportation System (NTS) that will promote mobility, energy efficiency, improved air quality, minimal environmental impact, and community responsiveness largely through the promotion of intermodalism. The NTS will use the existing infrastructure almost exclusively and will consist of a National Highway System (NHS), a variety of other modes, and the intermodal links between them. State DOTs have submitted proposals for the NHS and will submit candidate components from other modes for review. The review process requires a system for analyzing and measuring the performance of the elements of the NTS. This study will establish a set of performance standards for the NTS that stresses energy efficiency as a means of delivering not only energy savings, but also ISTEA's other requirements for the NTS.

**POLLUTION PREVENTION STUDY. (ENV1308)**

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Fitch, Michael.

*Status:* Active.

*Start date:* 30 Nov 1998; *Estimated completion date:* 1 Dec 1999.

VDOT's Environmental Division has in place a recently developed pollution prevention plan that is administered by the Department of Environmental Quality. As a part of this plan, VDOT has agreed to investigate and develop new ways to decrease pollution. This research effort will look at several of the previously identified areas in which VDOT could potentially reduce pollution as



a result of its normal operations. Specific examples are reducing potential contamination caused by salt ponds and reducing the quantity of used motor oil disposed of by VDOT.

It is anticipated that this research will not only fulfill the regulatory obligations placed on VDOT by DEQ, but will also likely save money normally devoted to these operations.

The work proposal outlining the specific tasks associated with this research effort is under development. The study is scheduled to begin this quarter.

**REVISIONS OF ARTICLES PERTAINING TO TRANSPORTATION  
ENVIRONMENTAL LAW. (ENV1225)**

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Performed by:* Robinson and Cole, LLP. Boston. MA; St. Louis School of Law.

*Investigator(s):* Blaesser, Brian W. and Mandelkar, Daniel.

*Status:* Active, *Contract No.:* Project 20-06, Topic 10-2.

*Notes:* To monitor the status of this project, please see the NCHRP web page at:  
<http://www2.nas.edu/trbcrp/6852.html>, where the status of this research is updated regularly.  
No abstract provided.

## Hazardous Materials Transportation

### **CONTROLLING HIGHWAY RUNOFF POLLUTION IN WATER SUPPLY RESERVOIR WATERSHEDS. (ENV1309)**

*Sponsored by:* Virginia Department of Transportation; Federal Highway Administration.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Yu, Shaw L. and Langan, Thomas.

*Status:* Active.

*Start date:* 1 Dec 1997; *Estimated completion date:* 30 Jun 1999.

Recently, citizens and local water officials have expressed concerns about roadway runoff affecting sources of drinking water, e.g., in the Warrenton and Charlottesville-Albemarle areas. The Rt. 17 Bypass in Warrenton links the Rt. 29 Bypass and Rt. 17. The route, which opened in late 1997, is a dual-lane highway approximately 4.0 km ( 2.5 mi) long with 1.6 km (1 mi) located in the watershed of the Warrenton Reservoir.

The primary focus of this study is to monitor the stormwater facilities constructed by VDOT at the Rt. 17 Bypass site in Warrenton and determine their pollutant removal efficiency. Emphasis will be given to a recently completed "bioretention pond." The purpose is to document the water quality benefits of bioretention as an innovative control device for treating stormwater runoff from highways. The second goal is to assess the potential postconstruction impact of the Rt. 17 Bypass project on the water quality of the Warrenton Reservoir. An appropriate modeling approach will be developed for such an assessment. The objective is to evaluate the adequacy of the stormwater management facilities constructed by VDOT in protecting the Warrenton Reservoir. The source water quality criteria listed under the federal and the state regulations will be used as a guide in the assessment.

This project offers VDOT the unique opportunity to monitor the new stormwater control best management practice, bioretention, and determine its applicability and validity for use in stormwater management control plans. The proposed computer modeling will allow VDOT to analyze the effectiveness of its current control strategies and provide the ability to make proper adjustments to these strategies if deficiencies are discovered. The outcome from the modeling process can be directly applied to the development of stormwater management control plans for similar scenarios, such as the recently proposed Rt. 29 bypass in Charlottesville. The strategy will emphasize the "watershed" approach as promoted by the EPA to controlling pollution of sensitive water bodies such as water supply sources. This approach implies a concerted effort by all stakeholders to control pollution from various sources, such as urban areas, industries, farms, and construction sites. VDOT's role in overall watershed-wide water quality management and, therefore, its fair share of the responsibility should be properly defined.

Four storm events have been monitored at the bioretention facility from May to October of 1998. It is expected that at least one more storm event will be captured before monitoring is completed by the end of November 1998. The process of selecting an appropriate computer model has begun, and a model is expected to be chosen by December of 1998.

### **DEVELOPMENT OF A RISK BASED MANUAL FOR USE OF CONTAMINATED MATERIAL RELATIVE TO HIGHWAY CONSTRUCTION ACTIVITIES. (ENV1167)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Raschke, B.

*Investigator(s):* Crosby, F.C.

*Status:* Active, *Contract No.:* 0-1807.

*Start date:* 1 Sep 1997; *Estimated completion date:* 1 Mar 1999.  
No summary provided.

**DIGITAL MULTISPECTRAL VIDEOGRAPHY FOR THE CAPTURE OF ENVIRONMENTAL SPATIAL DATA SETS. (ENV1300)**

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Anderson, John E. and Fitch, Michael.

*Status:* Active.

*Start date:* 15 Jul 1998; *Estimated completion date:* 30 Jun 1999.

Digital multispectral video DMSV is a remote sensing technology that acquires digital frame coverage in four spectral bands providing real-time panchromatic, natural color, and color infrared imagery. The sensitivity of the spectral bandwidths (<25 nanometers wide) and high spatial fidelity (typically 1 meter pixel ground resolution) permit the discrimination of soil, vegetation, water bodies, and chemically contaminated areas, at very high resolutions. The purpose of this research is to test the applicability of using DMSV for VDOT's environmental data acquisition needs. Specifically, DMSV will be used to capture mitigated wetland sites, archeological sites, and areas known to be affected by the presence of acid soils. Time and cost estimate information will be derived from the test data to help determine the feasibility of using this type of system on an operational basis. More important, results of the study will be analyzed by representatives of the U.S. Army Corps of Engineers (USACE) and the Virginia Department of Environmental Quality (DEQ) to determine whether the data captured are of acceptable quality for regulatory purposes.

Due to advances in CCD-based imaging technology anticipated in the next five years, imagery sources required by VDOT will be captured and archived in a completely digital format. Image based products necessary for analytical photogrammetry and resource monitoring will be collected, stored, and analyzed in "soft copy." If DMSV technology allows for quicker acquisition of vast amounts of spatial data, normally taking many personnel hours to collect, the system could save VDOT substantial time and money. The data collected by this system will allow for automated analysis, thereby reducing the time and cost associated with not only data capture but data reduction and interpretation as well.

A total of three missions have been flown. Both wetland and corridor information have been collected and classified. Additional flights will be made during the remainder of the fall season.

**EVALUATION OF AN ALTERNATIVE SOLVENT FOR EXTRACTION OF ASPHALT TO REDUCE HEALTH HAZARDS. (ENV1186)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Choubane, Bouzid.

*Performed by:* University of Florida.

*Investigator(s):* Tia, Mang.

*Status:* Active, *Contract No.:* BB-881.

*Start date:* 1 Aug 1998; *Estimated completion date:* 1 Nov 2001.

No summary provided.

**GEOGRAPHIC INFORMATION SYSTEMS FOR WATER RESOURCE RISK ASSESSMENT.** (ENV1060)

*Sponsored by:* Mack-Blackwell National Rural Transportation Study.

*Project Monitor:* Mack-Blackwell National Rural Transportation Study.

*Performed by:* University of Arkansas.

*Investigator(s):* Gross, Mark A.

*Status:* Active, *Contract No.:* MBTC 1091.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

Transportation of hazardous material or potential environmental contaminants presents the potential for spills or accidental releases to surface or groundwater resources. The use of a Geographical Information System (GIS) to locate transportation routes as well as springs, wells, and surface water bodies offers the opportunity for tracking and monitoring the effects of accidental releases from transported waste in the case of an overturned truck or railcar. Current GIS programming will be expanded as part of this project to include transportation routes, surface water bodies, wells, and springs in the four-county area of Washington, Benton, Madison, and Carrol counties in northwest Arkansas. The programming will include a feature to allow the user to either "point and click" on a location using a mouse, or to input Universal Transverse Mercator (UTM) coordinates of the point of interest. The program will then draw a radius of a distance specified by the user and locate all of the mapped wells, springs, and surface water bodies within that radius.

**INFORMATION EXCHANGE ON DOE TECHNOLOGY DEVELOPMENT AND HAZARDOUS MATERIALS TRANSPORTATION ACTIVITIES, INCLUDING RADIOACTIVE MATERIALS, AND ON PUBLIC CONCERNS WITH OPPORTUNITIES FOR IDENTIFYING ISSUES AND BEGINNING TO RESOLVE THEM.** (Fed 00196387)

*Sponsored by:* U.S. Department of Energy. Environmental Restoration and Waste Management. Kansas City. MO.

*Project Monitor:* Holm, J.

*Performed by:* Urban Energy and Transportation Corporation.

*Investigator(s):* Burge, J. K.

*Status:* Active, *Contract No.:* DOE/DP-94/FC01-94EW54065.

*Start date:* 14 Mar 1994; *Estimated completion date :* 13 Mar 1999.

This project is divided into two tasks. Task 1 includes networking, communication, and integration for transportation. Task 2 includes the same components for technology development. Tasks 1 and 2 and each of their subtasks and activities increase or improve the U.S. Department of Energy's (DOE) opportunities to exchange information with an active network of local community officials through the following types of activities: (1) regional workshops targeting senior-level local officials, promoting an active exchange of ideals with DOE management; (2) meetings with state municipal league board members and officers providing an opportunity to discuss specific transportation issues with a larger body of both elected and appointed officials; (3) national forums giving DOE the opportunity to update a major portion of the network on current issues; (4) briefings to DOE officials on local concerns as a follow-up to the meetings and workshops; (5) discussion papers analyzing issues of mutual concern to DOE and local communities; (6) improved training materials and delivery systems; (7) newsletters providing accurate information to local communities; (8) computer information network taking advantage of an existing federal telecommunication system already targeting local officials; (9) research report on standards and procedures leading toward elimination of conflicting local rules and regulations; (10) planning committee meetings providing DOE with recommendations, insight, and lessons learned; and (11) at every opportunity, use of techniques that provide an atmosphere

for DOE and local officials to identify issues and begin to resolve problems in a constructive environment, using participatory meeting methods. Some of these methods include modified nominal group technique, role playing, focus group evaluation, panel discussions, and team problem solving. Participation will also include up to two on-site program reviews each year and up to three off-site program integration meetings each year, as required, to update DOE staff and provide interaction between program components. Finally the planning, implementation, and evaluation process ensures that the right audience will be reached with the right material.

**JOINT RESEARCH PROJECT ON TRANSPORTATION OF DANGEROUS GOODS THROUGH ROAD TUNNELS. (00737109)**

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Project Monitor:* O'Fallon, J.

*Performed by:* Organization for Economic Cooperation and Development. Washington. DC.

*Status:* Active.

*Start date:* 16 Apr 1997; *Estimated completion date:* unknown.

A review of the risks and decision-making methods for hazardous cargo routing through or around tunnels may produce significant savings in lives and costs in the us and in many member countries. In view of the potential for savings from this international study, the us has made available the services of FHWA tunnel expert Mr. Anthony Case to the study group and is now pledging funds towards its work.

**LIABILITY AND RISK MANAGEMENT ISSUES FOR USE OF CONTAMINATED MATERIALS IN HIGHWAY CONSTRUCTION ACTIVITIES. (ENV1171)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Trujillo, E. S.

*Investigator(s):* Crosby, E. C.

*Status:* Active, *Contract No.:* 0-1839 .

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 1999.

No summary provided.

**PILOT TEST OF AN ICE BAN PRODUCT AS A PREWETTING AGENT IN SNOW REMOVAL AND ICE CONTROL OPERATIONS. (ENV1302)**

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Research Transportation Council.

*Investigator(s):* Roosevelt, Dan and Fitch, Michael.

*Status:* Active.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Jun 1999.

ICE BAN (Ice Ban) is the registered trade name of a group of agricultural by-products that has been patented for use as roadway deicing/anti-icing agents and corrosion inhibitors. Preliminary tests indicate that Ice Ban products work well as freezing point depressants and corrosion inhibitors and are environmentally friendly. These findings, the cost-effectiveness (life-cycle cost) of using Ice Ban, and operational problems associated with its use required further investigation. Thus, we are conducting a study to answer the following question: Do Ice Ban products offer a cost-effective option for controlling ice and snow that can be adapted to VDOT's snow removal and ice control operations?

Originally, we planned to collect and analyze runoff from the two test sections on I-66 in an effort to determine the environmental impacts of Ice-Ban. This undertaking was to allow for a

comparison of the chemical makeup of the runoff coming from both the salt-treated and the salt/Ice Ban-treated sections. Additionally, we were going to observe roadside vegetation near these two sections to compare the presumably deleterious effects of the different chemicals. However, because of the mild winter, no deicing chemicals were used.

We have completed two lab tests comparing the effects of the deicing chemicals on seed germination and the mortality of fat head minnows.

Expected Benefits: Ice Ban increases the effectiveness of more commonly used deicing chemicals such as NaCl. In addition, Ice Ban is said to be environmentally benign and non-corrosive, causing no adverse effects on roads, infrastructure, or vehicles.

A roadside vegetation test is being conducted during the fall and winter months. A plant fluorescence sensor is being used to measure the stress caused by Ice Ban and other deicing chemicals on typical roadside vegetation. We will expose subject plots to various concentrations throughout the winter months. Plant stress and recovery will be monitored until mid-spring.

## Hazardous Waste

### **APPROPRIATE USE OF WASTE AND RECYCLED MATERIALS IN THE TRANSPORTATION INDUSTRY. (ENV1007)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Harrigan, Edward T.

*Performed by:* Chesner Engineering.

*Investigator(s):* Chesner, Warren.

*Status:* Active, *Contract No.:* Project 4-21, FY '95.

*Start date:* 1 Jun 1995; *Estimated completion date:* 31 May 1999.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Acceptable disposal of wastes such as ash and sludge is a growing problem. A related problem is the recycling of other waste materials such as concrete aggregate, old asphalt pavement, tires, glass, and plastics. Because of its high-volume consumption of bulk materials, the transportation industry is under increasing pressure to use waste and recycled materials. As these are not normal construction materials, there are concerns about their suitability and practicability for use in transportation infrastructures. In particular, more information is needed about the materials' physical, chemical, and engineering properties; design; constructibility; performance; long-term chemical stability; construction quality control; and related environmental issues.

Evaluation of the applicability of existing test methods and acceptance procedures (or their modification), or the development of new test methods and acceptance procedures is needed to test and use waste and recycled materials (WRMs) in a cost-effective manner. The physical properties, short-term behavior during construction, long-term chemical stability, potential environmental problems, recyclability, and eventual disposal problems of WRMs are often unknown and must be well understood before these materials can be used on a routine basis. Other information such as the volume of material available, history of past use and performance, and costs are also needed. Without such information, transportation agencies, consultants, contractors, waste and recycled material suppliers, and health officials cannot properly assess the suitability and practicability of using WRMs in transportation applications.

To help transportation agencies make prudent decisions concerning the use of WRMs, information is needed on the particular WRM being considered and its potential application. The agencies need a process to allow them to screen each WRM; evaluate its potential use, benefits, and costs; develop design procedures, tests, and specifications; and plan for in-service, short-, and long-term evaluation of the application.

The objectives of this research are first, to develop a methodology for (1) assessing the suitability and practicability of specific WRMs in transportation applications, (2) determining appropriate uses, (3) developing design and construction guidelines, and (4) evaluating long-term in-service performance and second, to apply the methodology to a spectrum of WRMs.

The research will include as a minimum the following tasks: (1) Design and develop a comprehensive PC-based database of information on WRMs; the database should include, as a minimum, material and engineering properties; environmental information; legislative, regulatory, and litigation information; history of past use and performance; references to existing specifications and guidelines; information on material generation (source, quantity, existing inventory); and information on ongoing research and demonstration projects. The database should continue to grow throughout the life of the project. (2) Within five months after initiation of the

research, submit a technical memorandum (a) describing the information in the database; (b) identifying WRMs and materials that include WRMs as components that are being used in transportation applications and providing references to their design and construction guidelines; and (c) proposing a methodology for assessing the suitability and practicability of WRMs in transportation applications and determining appropriate applications. The methodology will include tools and procedures to evaluate the environmental, health, safety, economic, recyclability, disposability, and engineering factors for the material. The technical memorandum will include a detailed plan of the work to be performed in Tasks 3 and 4. NCHRP approval will be required before proceeding with Tasks 3 and 4. (3) Develop and test the methodology proposed in Task 2. The panel believes this task will involve considerable laboratory work. Within this task, there is also the potential for modification of existing tests and development of new tests and test methods. (4) Develop a methodology for designing, constructing, and monitoring field trials of WRMs in transportation applications. Consider both short-term (e.g., during construction) and long-term monitoring. (5) Within fifteen months after initiation of the research, submit an interim report describing the methodologies developed in Tasks 3 and 4 and documenting the work that went into their development. Include the proposed WRMs to be investigated in Task 6, along with a detailed plan for that task. Following review of the interim report by the project panel, the research team will be required to make a presentation to the NCHRP.

NCHRP approval will be required before proceeding with the remaining tasks. (6) Using the methodology developed in Task 3, evaluate the WRMs approved in Task 5 for their suitability and practicability in transportation applications and determine the appropriate applications. Develop design criteria and construction guidelines -- including quality control -- for the WRMs that have an appropriate transportation application (this task will include laboratory testing for materials characterization). Also prepare model designs for the construction evaluation and long-term performance monitoring of field trials of selected WRMs. (7) Submit a final report documenting the research effort.

Status: The research agency has developed a database format and entered sample data to show the database is a viable tool. The Task 2 technical memorandum was revised and accepted. The Task 5 interim report and Task 6 work plan were reviewed by the panel at its March 10, 1998 meeting. The panel directed the agency to complete two new work elements (a beta version of the WRM data base and a draft for panel review of the document Monitoring Methodologies for WRM Field Trial) by September 1998. No action has been taken on the interim report; relevant information will likely be incorporated in the agency's final report.

**BIOREMEDIATION DEMONSTRATION PROJECT AT FAIRBANKS INTERNATIONAL AIRPORT. (00672611)**

*Sponsored by:* Alaska Department of Transportation and Public Facilities. Juneau. AK.

*Project Monitor:* Braley, A.

*Performed by:* University of Alaska, Fairbanks. Institute of Northern Engineering. Fairbanks. AK.

*Status:* Active.

*Start date:* 1 Dec 1991; *Estimated completion date:* 30 Dec 1996.

The objective of this project is to evaluate the effectiveness of both land farming and injection wells with fertilization in both, for treating fuel contaminated soils from leaking tanks.



**BIOREMEDIATION OF PETROLEUM WASTE SITES.** (00730390)

*Sponsored by:* Mississippi Department of Transportation. Research Division. Jackson. MS; Federal Highway Administration. Washington, DC.

*Project Monitor:* Crawley, A. B.

*Performed by:* Mississippi State University.

*Investigator(s):* Zappi, M. E.

*Status:* Active.

*Start date :* 18 Jul 1996; *Estimated completion date:* 31 Mar 1999.

*Publication(s):* Draft final report: Zappi, Mark et al. An Evaluation of Process Enhancements for the Bioremediation of Heavy Petroleum Hydrocarbon Contaminated Soil Using Biocell Technology. Mississippi Department of Transportation. Sept. 14, 1998. 147 p. Final report in preparation.

*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

The main objective of this research is to develop a bench-scale protocol to be used in the evaluation of biocells for contaminated soil remediation. This approach will offer a cost effective alternative for site remediation. Although this study was initiated in late July, bench-scale bioreactor systems used in the development of the laboratory protocol have been assembled. Also, after review of various analytical options for tracking total petroleum hydrocarbons in soils, it was decided to use infrared (IR) techniques because of its widespread acceptance within the united states by both federal and state agencies. A portable IR unit is being purchased with other funds for use in this project. The FY97 activities will include refinement of laboratory protocols using a variety of soils containing TPH. Soils from MDOT sites will be solicited for inclusion in the project. Various amendments will be evaluated as to their relative impact of TPH and polycyclic aromatic hydrocarbon (PAH) removals. PAHs will be analyzed using the new high performance liquid chromatography unit to be installed this fall. Once laboratory experiments using the actual site soils. These results will be used to operate a pilot-scale system at the actual site. Funding for pilot-scale study will be obtained via the priority technologies program recently awarded to MDOT and MSU by the Federal Highway Administration.

**COOLSIDE WASTE MANAGEMENT DEMONSTRATION.** (00608970)

*Sponsored by:* Ohio Coal Development Office. Columbus. OH.; Department of Energy. Morgantown, WV.

*Performed by:* University of Kentucky. Kentucky Transportation Center. Lexington. KY.

*Investigator(s):* Burke, F.

*Status:* Active.

*Start date:* 1 Jul 1991; *Estimated completion date:* 30 Jun 1995.

The major objective of this study is to develop and demonstrate disposal and utilization options for coolside and similar SO<sub>2</sub> abatement wastes likely to be generated by technologies which were demonstrated in the state of Ohio and which will be used in the state of Ohio to comply with proposed Clean Air Act revisions. The coolside process is a retrofit dry flue gas desulfurization (FGD) technology for removal of SO<sub>2</sub> in coal-fired power plants. In the process, hydrated lime is pneumatically injected dry into the power plant duct work on the "cool side" of the air preheater. The coolside wastes are relatively unknown as engineering materials. The principal goal of phase I is to ensure that adequate information is developed on the physical and chemical nature of the coolside waste to design and construct safe, economical, and stable landfills. Phase I consists of three major areas: (1) chemical and geotechnical characterization of the waste; (2) field and laboratory lysimeter leaching studies; and (3) fill liner compatibility studies. An extensive series of geotechnical tests will be performed. Utilization of the solid waste produced from SO<sub>2</sub> scrubbing is the objective of phase 2. This phase includes two major study areas: (1) determination of the pelletization characteristics of the material and the production of 40 tons of

pellets, and (2) the assessment of the unconsolidated and pelletized wastes in a prototype highway construction or similar application. The unconsolidated waste will be evaluated as chemical stabilizing admixtures for highway subgrades. Phase 3 consists of operations of the coolside pilot plant to provide a wider range of materials for use in phase 1.

**COST-EFFECTIVE MONITORING DESIGN FOR INTRINSIC BIOREMEDIATION.**  
(ENV1206)

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Performed by:* University of Illinois.

*Investigator(s):* Minsker, Barbara S. and Valocchi, Albert J.

*Status:* Active.

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 2000.

Intrinsic bioremediation can be defined as the coupling of on-site monitoring and regulation with natural biodegradation of contaminants through indigenous microbial activity. It has been shown that the regulated components within petroleum hydrocarbon releases can be naturally biodegraded into the innocuous byproducts of carbon dioxide and water (Borden et al., 1997). The goal of this research is to develop a methodology for designing cost-effective long-term monitoring (LTM) plans for intrinsic bioremediation, which will explicitly address the uncertainties associated with groundwater fate and transport at real sites. The methodology will help regulators and the regulated community in the state and region to develop long-term monitoring plans that are most cost-effective and sufficiently protective of human health and the environment.

This project will develop a rigorous, scientifically sound methodology for LTM design. The methodology will identify sampling networks that are cost-effective and that yield sufficient information to manage uncertainty in predicted contaminant concentrations at compliance wells. Once the methodology is developed, we expect considerable interest from industry and government in applying the methodology to some of the numerous sites in the state and region with petroleum hydrocarbon contamination. Future extensions of the methodology to incorporate more complexity are also planned, including applications to other contaminants such as chlorinated solvents. There is ongoing intensive research on natural biotransformation of halogenated organic compounds, and there is great interest at the state and federal level in using intrinsic bioremediation as part of the treatment train for these ubiquitous and hazardous pollutants.

**DETECTION OF SUBSURFACE CONTAMINANTS USING TIME-DOMAIN  
REFLECTOMETRY.** (00644122)

*Sponsored by:* Virginia Department of Transportation. Richmond. VA; Federal Highway Administration. Washington. DC.

*Performed by:* Virginia Transportation Research Council. Charlottesville. VA.

*Investigator(s):* Hoppe, E. J.

*Status:* Active.

*Start date:* 1 Dec 1993; *Estimated completion date:* 31 Dec 1999.

The objective of this research project is to develop a new field technique for the detection of subsurface contaminants. This study will concentrate on an approach that will improve the efficiency and reduce the costs associated with current detection procedures. The methodology pursued by this study originates from a measurement technique called time-domain reflectometry (TDR). The TDR technology will be adapted to the in-site detection of subsurface contaminants by measuring and analyzing the variation of soil-contaminant dielectric properties as a function of frequency.

**DEVELOPMENT OF A VEHICLE TRAVEL MODEL PROJECTING THE RELATIONSHIP BETWEEN TRAFFIC LEVEL AND MTBE INFILTRATION IN WATERSHED AREAS. (ENV1220)**

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* University of Colorado-Denver.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the Web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

Development of a vehicle travel model projecting the relationship between traffic level and MTBE infiltration in watershed areas.

**DEVELOPMENT OF DESIGN PROTOCOL FOR BIOCELL TREATMENT OF PETROLEUM CONTAMINATED SOILS. (ENV1122)**

*Sponsored by:* Mississippi Department of Transportation.

*Project Monitor:* Albritton, Gayle.

*Performed by:* Mississippi State University.

*Investigator(s):* Zappi, Mark.

*Status:* Active, *Contract No.:* PTP-1996-01.

*Start date:* 1 Oct 1996; *Estimated completion date:* 31 Dec 1998.

The objective of this study is to further develop biocell technology and document a design protocol for implementation of biocell technology for remediation of soils containing total petroleum hydrocarbons (TPH). This protocol must be universal in terms of application because it is being developed for use by various state DOTs within the U.S. The reason for development is that state DOTs during highway construction activities often become responsible for remediating TPH contaminated sites (especially right-of-way activities). Therefore, the developed technology must be able to effectively remediate soils containing a wide variety of TPH types and concentration. Of particular interest is the development of techniques that can be used to remove polycyclic aromatic hydrocarbons (PAHs) from TPH contaminated soils because these compounds tend to be problematic in terms of biodegradation rate.

According to the 1998 progress report, accomplishments include chemical oxidation experiments on PAHs, which indicated that these compounds were very oxidizable using ozone, peroxone, and Fenton's Reagent. Slurry phase oxidation studies yielded interesting results. The soil phases showed dramatic reductions in TPH as measured using the GC; however the aqueous phases showed an increase in TPH (GC Method). This increase likely indicates increased bioavailability. Also, innovative biocells were designed and constructed that are more conducive to applying ozone within static cells. Various dosing strategies were evaluated. Several scenarios were found that indicated promise for adding oxidizers as a process additive during biotreatment. Finally, the Dixie Gas Station soil appears well suited for the pilot study and plans are well under way for performance of the study during Fall 1998.

**ENHANCEMENT OF FUEL OXYGENATE (MTBE) BIODEGRADATION POTENTIAL IN GROUNDWATER. (ENV1209)**

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Investigator(s):* Cunningham, Alfred B., Veeh, Richard, Sturman, Paul J., Kuhn, Jeff, and Jester, Stephen.

*Status:* Active.

*Start date:* 1 Sep 1998; *Estimated completion date:* 30 Sep 2001.

This study will greatly increase our knowledge of the fate and transport of oxygenate gasoline additives in groundwater systems. The project work plan will determine the physical, chemical, and biological processes that limit the rate of MTBE biodegradation. Anticipated results include: (1) field and laboratory identification of primary mechanisms of MTBE natural attenuation, (2) recognition of microbial populations capable of oxygenate degradation, (3) identification of degradation pathways and metabolite recalcitrance, (4) optimization of parameters that limit oxygenate biodegradation to maximize degradation rates, and (5) development of biodegradation enhancement strategies and subsequent plot testing at the Ronan, Montana, field site. The results from this study will help states and municipalities decide what level of remediation is necessary to address MTBE concentrations in drinking water supplies and whether specific groundwater remediation efforts can be undertaken to prevent future MTBE impacts. Development of improved methods for enhancing MTBE biodegradation will clearly also be of use to industrial practitioners responsible for developing remediation strategies for subsurface gasoline release sites.

**FIELD TREATMENT OF SOIL CONTAMINATED WITH LEAD. (ENV1138)**

*Sponsored by:* Connecticut Department of Transportation.

*Project Monitor:* Sime, James M.

*Performed by:* University of Connecticut.

*Investigator(s):* Long, Richard P.

*Status:* Active, *Contract No.:* ConnDOT/UConn Cooperative Research Program Study No. JH 96-1 .

*Start date:* 1 Jun 1996; *Estimated completion date:* 31 Dec 1999.

The objective of this research study is to find the most practical, economical method of applying a laboratory procedure for lead-contaminated soil in the field. The laboratory procedure treats the soil and makes it acceptable for reuse with no danger to the environment. The resultant method would then be a candidate technology on transportation construction projects that encounter lead-contaminated soil on the job site.

**LIABILITY AND RISK MANAGEMENT ISSUES FOR USE OF CONTAMINATED MATERIALS IN HIGHWAY CONSTRUCTION ACTIVITIES. (ENV1171)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Trujillo, E. S.

*Investigator(s):* Crosby, E. C.

*Status:* Active, *Contract No.:* 0-1839 .

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 1999.

No summary provided.

**RISK BASED MANUAL FOR USE OF CONTAMINATED MATERIAL. (SWUTC 418078)**

*Sponsored by:* Texas Department of Transportation.

*Performed by:* Texas Transportation Institute.

*Investigator(s):* Overman, John.

*Status:* Active.

*Start date:* 1 Sep 1997; *Estimated completion date:* 30 Apr 1999.

The discovery of contaminated soil and the inappropriate use of recycled materials on

transportation construction sites affects those projects through project delays, remediation or site clean-up, project redesign, and increased project cost. The appropriate use of contaminated soil as recyclable material, however, although not without risk, offers an opportunity to conserve project costs. Environmental risk-based assessment is currently being used by most states to determine what corrective action to take when contamination is present, but it can also be used to identify and evaluate contaminated and recyclable materials for use as highway construction materials. This project will review existing risk-based methods and develop a risk-based manual that is representative of, and specifically tailored to the transportation industry and, more specifically, TxDOT. The manual will focus on determining whether or not contaminated soils discovered in situ and proposed recyclable materials for construction on transportation sites can be used while protecting human health and ecological receptors.

**ROADSIDE MANAGEMENT OPTIONS. (ENV1159)**

*Sponsored by:* Oregon Department of Transportation.

*Project Monitor:* Hunt, Elizabeth.

*Performed by:* Stormwater Management. Portland. Oregon.

*Investigator(s):* Lenhart, James H.

*Status:* Active.

*Start date:* 1998; *Estimated completion date:* Jun 2000.

*Publication(s):* Phase 1 report published, FHWA-OR-RD-98-21.

*Notes:* On schedule for Phase 2.

The Oregon Department of Transportation is conducting a study to determine roadwaste management options. Phase 1 consisted of a thorough review of regulations and standards, roadwaste characterization, current management practices, and new technology. This report documents the findings from Phase 1, focusing on road sweepings and stormwater vector residuals, though the findings also help to clarify proper management of other roadwaste materials. No one set of regulations was identified that covers roadwaste management. Consequently, hazardous and solid waste, water quality, cleanup and other rules are reviewed. Roadwaste characterization evolved during the 1990s; many tests were run and results varied widely. Total petroleum hydrocarbon (TPH) tests, used at underground storage tank (UST) cleanup sites, are not appropriate for evaluation of roadwaste due to H-C bond interference from natural organic constituents. Now carcinogenic PAHs (seven heavy petroleum compounds) and heavy metals drive evaluation of risk. Fine particles (clays and silts) are more contaminated than coarse fractions. Dissolved contaminants in vector liquids are low; however, high contamination loadings are often adsorbed to suspended solids. Identifying and separating differing roadwastes allows more ready management while requiring less frequent analysis. Practices reviewed address hot load separation, mainstream roadwaste, and vector waste management. Many possibilities are identified for trials; it is expected that Phase 2 (Trial Implementation) will lead to further important finds. The Phase I report recommends that trials lead to the development of Best Management Practices to support statewide plan development by ODOT in Phase 3.

**THE USE OF INCINERATED SEWAGE SLUDGE ASH AS AN ADDITIVE TO ASPHALT CONCRETE. (00617851)**

*Sponsored by :* Minnesota Department of Transportation; Federal Highway Administration. Washington. DC.

*Project Monitor:* Turgeon, C.

*Performed by:* Minnesota Department of Transportation. St Paul. MN.

*Status:* Active.

*Start date:* 31 Dec 1989; *Estimated completion date:* 31 Dec 1995.

*Notes:* Research is on hold during litigation.

To evaluate the use of incinerated sewage sludge ash as mineral filler in asphalt concrete. This would help to alleviate the metropolitan waste control dilemma and possibly improve performance of some asphalt concrete mixes.

## Noise

### **ACOUSTICS OF SOUND TRANSMISSION OVER NOISE BARRIER WALLS.**

(ENV1003)

*Sponsored by:* Illinois Department of Transportation.

*Project Monitor:* Bruns, Mike.

*Performed by:* Southern Illinois University at Edwardsville.

*Investigator(s):* Romick-Allen, Richard K.

*Status:* Active, *Contract No.:* ITRC Project IIIB-H2, FY 97.

*Start date:* 12 Nov 1997; *Estimated completion date:* 11 May 1999.

Noise barrier walls have become a common part of the highway landscape in urban areas as a result of rules and regulations regarding noise abatement. The use of barrier walls as a means of noise abatement has been generally accepted by the public in many areas as the abatement methods of choice. However, while noise energy is blocked, reflected, scattered, or absorbed by the barrier wall, acoustical energy is also transmitted over the top of the wall.

The acoustic energy path diffracts over the top of the wall, creating a shadow zone of maximum effectiveness beyond the wall. The size of this shadow zone increases with additional wall height. However, wall heights in excess of about 3 meters are considered by many to be aesthetically unappealing as well as costly. Recent studies indicate that selected shapes and materials used on the top of the wall may be an effective alternative to additional wall height for increasing the shadow zone. Research is needed to characterize and quantify the effectiveness of noise barrier walls within the shadow zone so that the benefits and limitations of this form of noise abatement can be clarified to the public.

Objectives and benefits: The objectives of this study are to:

1. characterize and quantify the effectiveness of noise barrier walls within the shadow zone,
2. study the effectiveness of changing the shape and/or material used at the top of noise barrier walls as a means of increasing effectiveness without increasing height,
3. make recommendations to the Department regarding the potential cost impacts of alternative top treatments, and
4. develop recommendations for explaining the benefits and costs of noise barrier walls to the public.

Accomplishment of these objectives will permit the Department to make more informed choices among methods for extending the effectiveness of noise barrier walls and also permit better communication of choices to the public.

### **AESTHETIC DESIGN OF PROTOTYPE NOISE BARRIER.** (ENV1034)

*Sponsored by:* New Jersey Department of Transportation. Bureau of Environmental Services. Trenton, NJ.

*Project Monitor:* Marsella, Mark.

*Performed by:* New Jersey Institute of Technology. National Center for Transportation and Industrial Productivity. Newark, NJ.

*Investigator(s):* Golub, Eugene.

*Status:* Active, *Contract No.:* Project No. NC-19 .

*Start date:* 1 Jul 1997; *Estimated completion date:* 31 Dec 1999.

*Notes:* Design details for this project have been finalized, and the construction and evaluation phases are beginning.

The purpose of this project is to design and construct a prototype noise barrier that will be more

aesthetically acceptable than existing barriers and, if possible, utilize recycled plastics or other recyclable material. Various materials will be examined for suitability to prefabricate add-on "fins" to produce changing shadow patterns under varying light conditions. New panel-to-post attachment systems will also be studied. Ease and cost of construction and retrofit, durability, cost of materials, and other factors will be studied. Barrier design itself will proceed through computer modeling, construction of 1/3 scale model, and finally a full-scale prototype.

Accomplishments to date include:

- (1) Construction of the 1/3 scale model;
  - (2) Finalization of the panel attachment system;
  - (3) Finalization of the "fin" material, shape, and color;
  - (4) Finalization of the "fin" attachment method;
  - (5) Arranging for the prefabrication of full-size panels and construction of a prototype barriers.
- Construction will take place early in 1998 at the prefabricator's plant. All activities will be videotaped and notes taken for later analysis.

**BARRIER EFFECTIVENESS VALIDATION. (ENV1188)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Lindeman, Win.

*Performed by:* University of Central Florida.

*Investigator(s):* Wayson.

*Status:* Active, *Contract No.:* BB-852 .

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jan 2001.

The purpose of this research project is to evaluate and measure the insertion loss provided by noise barriers built by FDOT.

**CONSTRUCTION & EVALUATION OF NOISE BARRIER USING RECYCLED PLASTIC. (00726252)**

*Sponsored by:* New York State Department of Transportation. Albany. NY; Federal Highway Administration. Washington. DC.

*Project Monitor:* Hag-Elsafi.

*Performed by:* New York State Department of Transportation. Albany. NY.

*Status:* Active.

*Start date:* Jun 1998; *Estimated completion date:* Mar 1999.

*Notes:* Phase I of this project, construction of the noise barrier, is expected to take approximately two years. Phase II of the project, evaluation and assessment, will be conducted after that time. NYSDOT recently published a report proposing standards for noise barriers using recycled plastic. Following these standards, a noise wall will be constructed to record viable installation techniques, associated costs, monitor material durability and system performance, evaluate wall acoustic effectiveness, and assess public acceptance with respect to aesthetics. Based on this evaluation, the proposed standards will be accordingly modified.

**DEVELOPMENT OF LOW-COST SOUND BARRIERS AND LAND USE ORDINANCES TO MINIMIZE FUTURE ROAD NOISE IMPACTS. (ENV1062)**

*Sponsored by:* Pennsylvania Department of Transportation. U.S. Department of Transportation.

*Project Monitor:* Byers, James.

*Performed by:* West Virginia University.

*Investigator(s):* Martinelli, D.

*Status:* Active.



*Start date:* 11 Apr 1996; *Estimated completion date:* 18 Dec 1998.

Traffic noise has long been regarded as one of the most significant environmental effects associated with both existing and new freeways. Communities located near freeways are most affected negatively by traffic noise. These communities seek relief through the construction of noise abatement devices such as barrier walls. These noise barriers are generally expensive to produce and erect, and the cost of construction often falls on the authorized transportation agency. What is needed is an approach to the problem that simultaneously addresses both the noise problems facing existing communities and the reduction of future problems through proactive prevention methods. MAUTC researchers at West Virginia University have worked with Pennsylvania DOT to investigate and develop low-cost noise abatement systems emphasizing recycled materials. Land use ordinances that minimize exposure to freeway noise while considering ancillary attributes such as aesthetics and constructibility will also be developed.

### **DRILLED SHAFT FOUNDATIONS FOR NOISE BARRIER WALLS AND SLOPE STABILIZATION. (ENV1320)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Geiger, Gene.

*Performed by:* University of Akron.

*Investigator(s):* Liang, Robert.

*Status:* Active, *Contract No.:* 14705(0).

*Start date:* 18 May 1998; *Estimated completion date:* 18 May 2001.

The objectives of this project are:

- (1) To develop a methodology that would allow the use of the SPT results for analysis and design of the laterally loaded drilled shafts.
- (2) To develop a methodology for designing the drilled shafts to stabilize the unstable slopes and embankments.

### **EFFECTS OF PAVEMENT TYPE ON TRAFFIC NOISE LEVELS. (ENV1317)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Pinckney, Elvin.

*Performed by:* Ohio University.

*Investigator(s):* Herman, Lloyd.

*Status:* Active, *Contract No.:* 14677(0).

*Start date:* 5 May 1997; *Estimated completion date:* 5 May 1999.

The objectives of this research are:

- (1) To measure tire/road noise for various ODOT pavement types in the first year of their service.
- (2) To quantify changes in noise levels versus the age of each pavement type.
- (3) To classify pavement types according to tire/noise level categories.
- (4) To develop Reference Energy Mean Emission Levels (REMELs) for each category of pavement for use with the FHWA model.

*Comments or additional information:* Asphalt surfaces only.

### **EVALUATION OF SERVICE LIFE OF NOISE BARRIER WALLS. (ENV1004)**

*Sponsored by:* Illinois Department of Transportation.

*Project Monitor:* Bruns, Mike.

*Performed by:* Southern Illinois University at Edwardsville.

*Investigator(s):* Kay, Diane.

*Status:* Active, *Contract No.:* ITRC Project IIB-H1, FY 97.

*Start date:* 26 Sep 1997; *Estimated completion date:* 25 Dec 1998.

Noise barrier walls are a costly addition to many highway projects in Illinois. Current cost can approach \$1 million per mile for walls installed on one side of the roadway. Several types of materials are currently used in the construction of noise barrier walls, including wood, concrete, and several proprietary products. Designers attempting to make a rational choice between these products, however, are hampered by a current lack of information on possible differences in service lives of these materials.

Research is needed to determine whether the service lives of the available materials are measurably different, how such differences can be quantified, and whether life-cycle cost of barrier walls should be a determining factor in the decision to use a given material. The trade-off between lower lifecycle of a material and the degradation of its aesthetic and acoustical properties must also be addressed. Finally, the list of currently approved materials and the construction/installation methods currently specified by the Department need to be evaluated for potential improvements which could yield benefits for the Department.

Objectives and Benefits: The objectives of this study are to:

- (1) develop methods to evaluate service life of materials used for noise barrier walls in Illinois,
- (2) develop a means of evaluating life-cycle costs with consideration given to service life, aesthetics and acoustics,
- (3) make recommendations regarding the use of life-cycle costing as a determining factor in material choice, and
- (4) make recommendations regarding the Special Provisions used by the Department to specify materials and construction/installation methods.

Accomplishment of these objectives will permit more rational choices among competing materials and may result in significant cost savings.

#### **EVALUATION OF TINING WIDTHS TO REDUCE NOISE OF CONCRETE ROADWAYS.** (00673289)

*Sponsored by:* North Dakota State Highway Department. Bismarck. ND.

*Project Monitor:* Marquart, M.

*Performed by:* Northern Improvement.

*Status:* Active.

*Start date:* 1 Aug 1994; *Estimated completion date:* 1 Aug 1999.

The objective of this experimental project is to evaluate the effectiveness of various tining widths to reduce noise.

#### **FIELD TESTING OF WHEEL/RAIL NOISE CONTROL TECHNOLOGIES .** (00736510)

*Sponsored by:* Transit Cooperative Research Program. Transportation Research Board. Washington. DC; Federal Transit Administration. Washington. DC.

*Project Monitor:* Jenks, Christopher W.

*Performed by:* Wilson, Ihrig & Associates, Inc.

*Investigator(s):* Nelson, James T.

*Status:* Active, *Contract No.:* Project C-3A.

*Start date:* 1 Sep 1997; *Estimated completion date:* 30 Apr 1999.

As part of TCRP Project C-3, Wheel/Rail Noise Mitigation, several recommendations were made for the testing and demonstration of a number of new or emerging wheel/rail noise-control technologies. Specifically, recommendations were made to test (1) several types of wheel and rail

vibration absorbers, (2) nitinol wheel treads, and (3) piezo-ceramic vibration dampers. Based on these recommendations, the objective of TCRP Project C-3A will be to field test several types of wheel and rail vibration absorbers to determine their effectiveness in reducing rolling noise on tangent track as well as wheel squeal on curved track. The project panel has selected PAT (Pittsburgh) and New Jersey Transit as the demonstration sites for the field testing of wheel vibration absorbers. The demonstrations are expected to take place in early Summer 1998. Recommendations for the demonstration of rail vibration absorbers are expected in April.

**GUARDRAIL INSTALLATION NOISE.** (ENV1123)

*Sponsored by:* Oregon Department of Transportation.

*Project Monitor:* Sposito, Brett.

*Performed by:* Oregon Department of Transportation.

*Investigator(s):* Poecker, Rick.

*Status:* Active.

*Start date:* Jun 1998; *Estimated completion date:* Jun 1999.

The research project involves assessing the noise level from pile drivers that drive guardrail posts into the ground. Research evaluates the effect in rural areas on wildlife and seeks to determine whether wildlife are disrupted by the noise. Data on the noise level will be compared to noise standards to determine compliance.

**MULTI-MEDIA PRESENTATION ON NOISE ABATEMENT WALLS.** (SWUTC 439287)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Abusaad, N.

*Performed by:* Texas A&M University.

*Investigator(s):* Larsen, Terry R.

*Status:* Active.

*Start date:* 1 Sep 1996; *Estimated completion date:* 28 Feb 1999.

This project will provide TxDOT with the ability to educate community groups concerning both the positive and negative aspects of standard noise abatement procedures. The first video will focus on sound characteristics, propagation and transmission relevant to the transportation corridor. The second video will provide information about the positive and negative aspects of sound walls, their effectiveness and the general constraints imposed on the design of a typical sound barrier.

**PARALLEL BARRIER EFFECTS FOR DISTANT RECEIVERS.** (ENV1319)

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Pinckney, Elvin.

*Performed by:* Ohio University.

*Investigator(s):* Herman, Lloyd.

*Status:* Active, *Contract No.:* 14687(0).

*Start date:* 1 Dec 1997; *Estimated completion date:* 1 Dec 1999.

To determine the effects of parallel noise barriers as a contributing factor to the perception of increased noise levels by residents located in the range of 180 m to 540 m from I-71. In order to reach this goal, the following objectives have been established: 1) to verify both the existence of and significance of multiple reflections for parallel barrier configurations through field measurements; 2) to ascertain the range in ground attenuation forfeited by the construction of noise barriers by applying noise propagation theory and computer modeling to representative sites; 3) to perform computer modeling to determine both the potential increase in noise levels

due to multiple reflections between parallel barriers, and the potential reduction in noise levels that might be expected by using sound absorptive barriers; 4) to identify modeling procedures to be used on future projects to avoid existing problems and to indicate when absorptive materials should be used; and 5) to develop a database of field measurements for evaluation of any future modifications to existing noise barriers in the project area.

**REASONABLENESS AND ENVIRONMENTAL FEASIBILITY OF NOISE ABATEMENT AT SPECIFIED USE LOCATIONS. (00744194)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Lindeman, Win.

*Performed by:* University of Central Florida. Orlando. FL.

*Investigator(s):* Wayson, R.

*Status :* Active.

*Start date:* 15 Aug 1996; *Estimated completion date:* Oct 1998.

This project reviewed noise abatement methodology used in other states and generated a procedure to be used by FDOT districts and consultants.

**RESEARCH FOR AASHTO STANDING COMMITTEE ON HIGHWAYS. TASK 94. MITIGATION OF NIGHTTIME CONSTRUCTION NOISE, VIBRATION, AND OTHER NUISANCES. (00748042)**

*Sponsored by:* National Cooperative Highway Research Program.

*Performed by:* Arizona State University.

*Investigator(s):* Schexnayder, Cliff J.

*Status:* Active, *Contract No.:* Project 20-07, Task 94.

*Start date:* 15 Jun 1998; *Estimated completion date:* 14 Mar 1999.

*Publication(s):* A draft report has been received and is now under review by the advisory panel.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

This task will produce a summary of innovative techniques that can be used to mitigate adverse effects of nighttime construction, including noise, dust, and vibrations. Information will be obtained on construction practices, including practices outside the field of highway construction and outside of the United States. Research is underway. The agency's principal investigator met with the AASHTO Highway Subcommittee on Construction at the Subcommittee's August 1998 meeting in Portland, Maine.

**ROAD NOISE RESEARCH ON THE EFFECTS OF REMOVING OR REPOSITIONING IN-PLACE SECTIONS OF NOISE WALLS IN VARYING TERRAIN. (ENV1221)**

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* Pennsylvania State University.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

Road noise research on the effects of removing or repositioning in-place sections of noise walls in varying terrain.

## Operations and Maintenance - General

### **THE AMERICAN BOULEVARD: AN HISTORICAL INVESTIGATION OF THE PUBLIC MANAGEMENT, BUILT FORM, AND SOCIAL USE OF OLMSTED'S BROOKLYN PARKWAYS. (ENV1244)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* Institute of Urban and Regional Development. University of California-Berkeley.

*Investigator(s):* Macdonald, Elizabeth.

*Status:* Active.

*Start date :* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

This is a study of the historical evolution of two exemplary multiple-roadway boulevards-- Eastern Parkway and Ocean Parkway --in Brooklyn, New York, with the objective of identifying an institutional model for public management of multi-functional streets. These parkways carry both fast- and slow-moving traffic as well as provide pedestrian and recreational use on tree-lined malls separating the roadways. Such streets are not built in the United States today because they are considered unsafe. However, urban designers are reconsidering their use as alternatives to standard arterial streets because they can handle large traffic volumes without creating sharp divisions between neighborhoods. The project will contribute substantial new knowledge about Olmsted's contribution to city planning in terms of the long-term functional aspects of his street designs.

### **ASSESSING THE APPLICATION OF TRAVEL SURVEILLANCE DATA DIRECTLY TO THE TRANSPORTATION PLANNING AND MANAGEMENT PROCESS.**

(ENV1224)

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* University of Southern California.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the Web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

This project straddles environment and regional planning, assessing the application of travel surveillance data directly to the transportation planning and management process. Surveillance data, such as traffic counts, congestion levels, etc., will be added to a prototype geographic information system that supports both planning and operations.

### **CULVERT STUDY - ALUMINIZED STEEL TYPE II. (00755317)**

*Sponsored by:* New Brunswick Department of Transportation. Fredericton. Canada.

*Performed by :* New Brunswick Department of Transportation. Fredericton. Canada.

*Investigator(s):* Jackart, M.

*Status:* Active.

*Start date:* 1991; *Estimated completion date:* 2001.

Reinforced concrete is generally used in highway construction and maintenance due to long life and durability. Galvanized corrugated steel pipe is used as an alternate, although increased thicknesses are specified to ensure required durability. Aluminized steel pipe type II is promoted

as a viable alternative economically with certain limitations related to water acidity and soil resistivity.

**DEVELOPMENT OF A RISK BASED MANUAL FOR USE OF CONTAMINATED MATERIAL RELATIVE TO HIGHWAY CONSTRUCTION ACTIVITIES. (ENV1167)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Raschke, B.

*Investigator(s):* Crosby, FC.

*Status:* Active, *Contract No.:* 0-1807.

*Start date:* 1 Sep 1997; *Estimated completion date:* 1 Mar 1999.

No summary provided.

**DRILLED SHAFT FOUNDATIONS FOR NOISE BARRIER WALLS AND SLOPE STABILIZATION. (ENV1320)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Geiger, Gene.

*Performed by:* University of Akron.

*Investigator(s):* Liang, Robert.

*Status:* Active, *Contract No.:* 14705(0).

*Start date:* 18 May 1998; *Estimated completion date:* 18 May 2001.

The objectives of this project are:

- (1) To develop a methodology that would allow the use of the SPT results for analysis and design of the laterally loaded drilled shafts.
- (2) To develop a methodology for designing the drilled shafts to stabilize the unstable slopes and embankments.

**THE EFFECTS OF GEOSYNTHETIC REINFORCEMENT SPACING AND STRENGTH. (00751992)**

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Status:* Active.

*Start date:* 22 Jan 1998; *Estimated completion date:* 2000.

No summary provided.

**ENERGY CONSUMPTION RELATED TO EXCESSIVE USER-DELAY COSTS DURING HIGHWAY CONSTRUCTION. (SWUTC 460058 60058)**

*Sponsored by:* Subcontract with the University of Texas. Office of the Governor of Texas.

*Project Monitor:* Veasey, Renee.

*Performed by:* University of Texas.

*Investigator(s):* McCullough, B. Frank.

*Start date:* 10 Dec 1992; *Estimated completion date:* 31 Aug 1997.

Excess fuel consumption resulting from user-delay and congestion during highway rehabilitation and maintenance activities in urban areas will be quantified. The cost associated with this excess fuel consumption will be compared with the costs of conducting those same highway construction activities at an accelerated rate and at non-peak traffic times, i.e., nighttime and weekends. The feasibility of developing a model that will serve as a tool for engineers to use when considering various construction schedules, phasing options, and allowable construction times will also be explored.

**ENVIRONMENTAL IMPACT OF CONSTRUCTION AND REPAIR MATERIALS ON SURFACE AND GROUND WATERS. (ENV1013)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Harrigan, Edward T.

*Performed by:* Oregon State University.

*Investigator(s):* Eldin, Neil and Huber, Wayne.

*Status:* Active, *Contract No.:* Project 25-09, FY '94.

*Start date:* 1 Mar 1994; *Estimated completion date:* 30 Sep 1999.

*Publication(s):* Reports of Phase I and II research are under review.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

A number of uncertainties exist regarding the effects on ecosystems and human health of constituents that migrate from the roadway through surface water and groundwater. These constituents originate from materials used in construction and repair of the roadway, construction procedures, vehicular operations, maintenance procedures, and atmospheric deposition.

Considerable research has been conducted in the area of water-quality impacts from highway and vehicle operations, maintenance practices, and atmospheric deposition. There is an ongoing FHWA study, based on past research in this area, that will synthesize relevant information on the impacts of highway runoff on receiving water quality. Future research is planned (FHWA's proposed High Priority Area program, Highways and Water Resources -- Improving the Prediction of Impacts and the Effectiveness of Mitigation Techniques) that will extend these efforts to characterize the chemical, physical, and biological contaminants in the roadway storm water runoff and their impacts on receiving waters.

Historically, construction and repair materials have been viewed as being innocuous and hence not of concern to environmental quality. Currently there is a perception that some of these materials may pose an environmental concern. Furthermore, a variety of recycled and waste materials are being considered for use as construction and repair materials, thereby increasing the number of nontraditional materials in contact with surface water and groundwater.

This research project will concentrate on identifying potentially mobile constituents from highway construction and repair materials and their possible impacts on surface water and groundwater. Materials used in construction and repair that are likely to come into contact with the surface water and groundwater include: asphalt, concrete additives, metals, grouts, plastics/synthetics, shredded rubber tires, Styrofoam, creosote and other timber preservatives, and others. Explicitly excluded from consideration in this project are constituents originating from construction processes, vehicular operations, maintenance operations, and atmospheric deposition.

The ultimate objective of this research is to develop a validated methodology for assessing the environmental impact of highway construction and repair materials on surface water and groundwater, and to apply the methodology to a spectrum of materials in representative environments. Accomplishment of this objective will involve several phases. This phase of the research will develop a proposed methodology for assessing the environmental impact of highway construction and repair materials on surface water and groundwater. Additionally, limited testing toward validation will be conducted.

The research will include as a minimum the following phases and tasks:

Phase I: (1) Identify highway construction and repair materials that may have constituents that

could become mobile via chemical, biological, and physical processes through the highway operation and within the operational environment. These constituents may have the potential to negatively impact surface water and groundwater -- thereby affecting human health and aquatic ecosystems. (2) Propose a methodology to assess the potential of highway construction and repair materials to release mobile constituents in the roadway environment. In addition, the methodology must identify the field conditions that affect the transport and persistence of these constituents. Identify sampling, testing, and modeling procedures that can document the distance these constituents can migrate in the roadway environment. (3) Within six months after the start of the contract, submit an interim report that describes the construction and repair materials identified in Task 1 and the methodology developed in Task 2. The interim report will include a work plan for conducting a limited testing program to evaluate the methodology. (4) Conduct a testing program to evaluate the proposed methodology, recommend refinements, and develop a plan for validation of the methodology. The plan should include a proposed budget, timetable, and priority list of materials to be tested. (5) Propose a conceptual model for estimating the portion of contaminants in highway runoff and groundwater that originates from construction and repair materials. (6) Prepare a final report detailing the entire research effort.

Phase II: (7) Reflecting the findings and lessons learned in Phase I, determine the leaching behavior of highway construction and repair materials through chemical and biological testing and analysis of leaching data. (8) Develop and validate a predictive model, which can predict the fate and transport of mobile toxicants resulting from the use of construction and repair materials. (9) Validate and extend the evaluation methodologies developed in Phase I through analysis of the additional biological and chemical testing carried out in Task 7. (10) Prepare a plan for alternative approaches to field testing and validation of the model and evaluation methodology. (11) Prepare and submit a final report detailing the results and conclusions of the Phase I and Phase II research effort.

Phase III: (12) Confirm the Phase II methodology by conducting scaled-up tests of the RRR processes in soil columns. (13) Compare the results of leaching tests from flat surfaces with and without soil confinement. (14) Determine a range of typical absorption and desorption parameters for the C&R materials on sand and gravel typically utilized in unbound pavement layers and shoulders. (15) Prepare a final report that summarizes findings and conclusions of the Phase III research effort.

Status: Phase I was completed on time. A report appropriate for broader public distribution, summarizing the Phase I findings, was prepared, but has not been released by the project panel. Phase II was completed on time. An advance copy of the final report for Phase II was reviewed by the panel and the research agency at a meeting in December 1997. The panel judged that Phase II was completed successfully. At its April 1998 meeting, the panel approved an amplified work plan for Phase III, Tasks 12 -15, scheduled for completion in September 1999. This phase will verify the test methodology and the computer model with field and scaled-up laboratory data.

### **ENVIRONMENTALLY FRIENDLY PASSIVATING COATINGS FOR REBAR.**

(00748083)

*Sponsored by:* National Cooperative Highway Research Program. Washington. DC; American Association of State Highway & Transportation Offices. Washington. DC; Federal Highway Administration. Washington. DC.

*Performed by:* Neely Industries, Incorporated. Butler. PA.

*Investigator(s):* Neely, J. E.

*Status:* Active, *Contract No.:* Project 20-30, IDEA 52.



*Start date: Estimated completion date:* Under negotiation.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

This project will develop and test a new class of non-toxic water-based inorganic polymer passivating coatings for corrosion protection of concrete reinforcing steel rebars for highway applications. The coatings have enhanced integrity because a chemical bond forms between the inorganic polymer and the steel surface and are stable over a broad pH range, including the highly alkaline concrete environment. Tests will be performed in collaboration with the Florida Department of Transportation.

**EVALUATION OF AN ALTERNATIVE SOLVENT FOR EXTRACTION OF ASPHALT TO REDUCE HEALTH HAZARDS. (ENV1186)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Choubane, Bouzid.

*Performed by:* University of Florida.

*Investigator(s):* Tia, Mang.

*Status:* Active, *Contract No.:* BB-881.

*Start date:* 1 Aug 1998; *Estimated completion date:* 1 Nov 2000.

No summary provided.

**EVALUATION OF POLYACRYLAMIDE. (ENV1177)**

*Sponsored by:* Georgia Department of Transportation.

*Project Monitor:* Jared, David.

*Performed by:* Georgia Department of Transportation.

*Investigator(s):* Jared, David.

*Status:* Active, *Contract No.:* SRS 9811.

*Start date:* 10 Aug 1998; *Estimated completion date:* 10 Aug 1999.

Polyacrylamide (PAM) has been used in mining and agricultural applications as a flocculent and soil stabilizer and has been shown to greatly reduce soil loss. PAM has now been introduced to the construction industry. PAM is produced in powder, emulsion, and gel blocks. The powder can be spread on slopes, disturbed areas, and ditches. The emulsion can be sprayed from water trucks or added to hydroseeding operations. The gel blocks are placed in ditches and channels. The objectives of this research study are to 1) determine the optimum grade and brand(s) of PAM emulsion, powder, and gel blocks in various types of soils, 2) determine the cost-effectiveness of PAM application types, and 3) establish guidelines for GDOT specifications concerning the use of PAM for erosion control.

**EVALUATION OF POLYACRYLAMIDES (PAM) TO REDUCE AND CONTROL SOIL EROSION AND TURBIDITY AT HIGHWAY CONSTRUCTION SITES. (ENV1044)**

*Sponsored by:* Washington State Department of Transportation.

*Performed by:* Washington State Department of Transportation.

*Investigator(s):* Molash, Ed.

*Status:* Active, *Contract No.:* FHWA Priority Technology Program PTP-1996 (003).

*Start date:* 1 Mar 1998; *Estimated completion date:* 30 Sep 1999.

*Notes:* See <http://www.wsdot.wa.gov/eesc/environmental/PAM.htm> for additional information about this research project and links to related research.

WSDOT's Water Quality Program is in the process of evaluating polyacrylamide (PAM), an organic polymer flocculant, for its ability to stabilize soils and remove fine suspended sediments from stormwater runoff at highway construction sites. WSDOT will be testing PAM for its ability

to flocculate turbid stormwater runoff within wet detention ponds using a passive, non-mechanical dosing system, and for preventing soil erosion caused by rainfall and concentrated flows over exposed soil surfaces.

PAM has been targeted by WSDOT largely due to the extensive amount of high quality research conducted over the past few years at the USDA/ARS research station in Kimberly, Idaho. USDA/ARS's work demonstrated the impressive benefit to cost performance of PAM for soil stabilization, and it hinted at a best management practice (BMP) to abate turbidity from stormwater runoff at construction sites. Through experience, WSDOT has found that conventional temporary erosion and sediment controls (TESC), such as check dams and detention basins alone are generally ineffective for removing turbidity from stormwater runoff.

Sediment lost from highway construction sites can pollute streams and lakes, fill reservoirs, cover and destroy fish-spawning beds, and reduces the overall quality of water for subsequent beneficial uses. Turbidity in stormwater runoff is caused by organic and inorganic colloidal suspensions, which cannot settle out by gravity separation alone. Washington state has large areas of glacial till soils, which, despite the fact that only 2-6% of the soil is clay-sized, has pervasive turbidity problems in stormwater runoff at construction sites. PAM has been found to reduce soil erosion and turbidity by two separate mechanisms: improving the stability the soil aggregates and flocculating suspended solids, thus aiding deposition. PAM treatment of irrigation water is currently the fastest growing conservation technology in irrigated agriculture. It provides a potent environmental benefit by halting furrow erosion by about half ton of soil per ounce (16 kg/g) of PAM used. It is very efficient at removing most (>90%) sediment, phosphorus and pesticides from return flows, and greatly reduces return flow BOD. It increases infiltration, which results in a reduction of runoff water quantity. Reduced sediment, pesticide, and nutrient loading to riparian areas can ultimately be expected by using PAM to reduce the frequency and intensity of algal blooms and reduce turbidity and sedimentation on stream bottoms.

WSDOT will investigate PAM for two primary uses related to the state highway system:  
(1) Controlling soil erosion at its highway construction sites by direct application of dry granular PAM, PAM-dosed aqueous solutions, PAM/mulch combinations, etc. to exposed soil surfaces, and;  
(2) Flocculation of stormwater runoff in sediment ponds at construction sites to reduce turbidity caused by fine suspended solids using a passive dosing method with polymer gel blocks.

Other potentially beneficial uses for PAM may eventually include abatement of wind erosion, dust control, increasing infiltration rates in stormwater BMPs, dewatering catch basin solids, and clarifying catch basin decant water to increase disposal or reuse options.

All PAMs that will be used in WSDOT's trials are copolymers, manufactured to ANSI/NSF Standard 60 requirements for drinking water treatment, and, whenever practicable, "GRAS" versions of PAM will be used. PAM is one of three polymer flocculants currently regulated by Standard 60 for use in potable water treatment systems for human health concerns.

#### **EVALUATION OF RAMP METERING IMPACTS ON AIR QUALITY. (ENV1179)**

*Sponsored by:* Georgia Department of Transportation.

*Project Monitor:* Deaver, Rick.

*Performed by:* Georgia Institute of Technology.

*Investigator(s):* Guensler, Randall.

*Status:* Active, *Contract No.:* RP 9814.

*Start date:* 31 Aug 1998; *Estimated completion date:* 30 Apr 2000.

Five ramp meters have been installed along the northbound Interstate 75 in metropolitan Atlanta to control the flow of traffic onto the mainline interstate. In addition, detectors on the ramps monitor the vehicles entering the ramps and allow the ramp meters to turn green when vehicles begin to back up onto the adjacent street. The congestion and air quality analyses of these studies will be used to identify the geometric design and ramp timing plan parameters that significantly impact the emissions quality benefits of metered systems.

**EVALUATION OF SLOPE STABILIZATION METHODS. (00735125)**

*Sponsored by:* Colorado Department of Transportation.

*Performed by:* Colorado Department of Transportation. Denver. CO.

*Investigator(s):* Price, David.

*Status:* Active, *Contract No.:* CDOT-DTD-R-96-6.

*Start date:* 1 Feb 1995; *Estimated completion date:* 1 Jan 1999.

*Publication(s):* An interim report is available: Price, David A. March 1996. Evaluation of Slope Stabilization Methods on US 40, Berthoud Pass. Report no. CDOT-DTD-R-96-6.

State Highway 40 west of Berthoud Pass was built in the early 1960s. Erosion control practices that were standard at the time were applied to the cut and fill slopes. These slopes consist of highly erodible and unstable sand soils mixed with large quantities of rocks. Snowmelt runoff and severe spring and summer rainstorms wash away the top layer of soil; vegetation cannot get established. The purpose this project is to test various cost-effective erosion control materials and installation techniques.

**EVALUATION OF WATERBORNE PAVEMENT MARKING PAINTS. (ENV1153)**

*Sponsored by:* North Dakota Department of Transportation.

*Performed by:* North Dakota Department of Transportation.

*Investigator(s):* Dunn, Curt.

*Status:* Active.

*Start date:* 24 Sep 1998; *Estimated completion date:* 1 Apr 1999.

With the implementation of new EPA guidelines, the NDDOT developed a study to determine a cost effective waterborne pavement marking system that will withstand the severe climate, snowplow operations, traffic volume, and maintain an effective reflectivity. Two types of waterborne acrylic latex (E-2706 and E-3427) were placed and are being compared to a solvent borne paint. Both white and yellow are being evaluated. Test sections were placed on an asphalt and a concrete surface. Test strips were placed across the driving lane with and without glass beads.

Early indications show that waterborne E-3427 to be performing better than the E-2706. Also, all of the paints are performing better on the asphalt surface than the concrete surface.

**EXPERIMENTAL MAINTENANCE PROCEDURE FOR BRIDGE CLEANING AND PAINTING. (00674822)**

*Sponsored by:* Wisconsin Department of Transportation.

*Project Monitor:* Rutkowski, T.

*Performed by:* Wisconsin Department of Transportation. Madison. WI.

*Investigator(s):* Bischoff, Deb.

*Status:* Active, *Contract No.:* Study no. 87-07.

*Start date:* *Estimated completion date:* Dec 1999.

*Publication(s):* Rutkowski, Terry. December 1988. Experimental Bridge Cleaning and Painting Systems. 16 p.

The objective of this project is to evaluate different cleaning and painting procedures and materials from an environmental view point.

**FIELD TREATMENT OF SOIL CONTAMINATED WITH LEAD. (ENV1138)**

*Sponsored by:* Connecticut Department of Transportation.

*Project Monitor:* Sime, James M.

*Performed by:* University of Connecticut.

*Investigator(s):* Long, Richard P.

*Status:* Active, *Contract No.:* ConnDOT/UConn Cooperative Research Program Study No. JH 96-1 .

*Start date:* 1 Jun 1996; *Estimated completion date:* 31 Dec 1999.

The objective of this research study is to find the most practical, economical method of applying a laboratory procedure for lead-contaminated soil in the field. The laboratory procedure treats the soil and makes it acceptable for reuse with no danger to the environment. The resultant method would then be a candidate technology on transportation construction projects that encounter lead-contaminated soil on the job site.

**GUIDELINES FOR SELECTION OF PIPE CULVERTS. (00721666)**

*Sponsored by:* Arkansas State Highway and Transportation Department. Planning and Research Division. Little Rock. AR; Federal Highway Administration. Washington. DC.

*Project Monitor:* Sanders, J.

*Performed by:* University of Arkansas-Fayetteville. Department of Chemical Engineering. Fayetteville. AR.

*Investigator(s):* Myers, W. A.

*Status:* Active.

*Start date:* 1 Jul 1995; *Estimated completion date:* 1 Feb 1999.

*Publication(s):* A final report for this project is in preparation.

This project concerns the evaluation of culvert types to determine the appropriate applications for and limitations of each type.

**LOAM SUBSTITUTE. (00737100)**

*Sponsored by:* Maine Department of Transportation.

*Project Monitor:* LaRoche, R.

*Performed by:* Maine Department of Transportation. Augusta. ME.

*Investigator(s):* LaRoche, R.

*Status:* Active, *Contract No.:* 97-3 State Experimental Const.

*Start date:* 30 Apr 1996; *Estimated completion date:* 30 Apr 2001.

This study will compare any erosion beneath the regular mulch areas and the areas utilizing composted materials without mulch. This will also compare growth of grass on areas loamed as in the usual methodology, and grass growth in similar areas utilizing commercially available composted materials. Commercially available composted materials will be utilized in this experiment, combined with waste soils. This project is 97-3 state experimental construction.

**PERFORMANCE OF SOLVENT-FREE EMULSIONS. (ENV1158)**

*Sponsored by:* Oregon Department of Transportation.

*Project Monitor:* Sposito, Brett.

*Performed by:* Transportation Research Institute, Oregon State University.

*Investigator(s):* Leahy, Rita.

*Status:* Active.

*Start date:* Dec 1997; *Estimated completion date:* Jan 2002.

*Notes:* On hold - materials not available.

The purpose of this research is to determine the suitability of solvent-free emulsions in terms of pavement performance. Asphalt emulsions have been widely used in highway construction and maintenance since the 1920s, initially as dust palliatives and spray applications. More recently, they have been used in more diverse paving applications such as base and surface course mixes, surface treatments and maintenance activities. ODOT's annual expenditures on emulsions for construction and maintenance is approximately \$10 million.

For engineering, environmental and economic reasons, the use of emulsions is likely to increase dramatically in the next ten years. The decrease in highway funding and the public's heightened awareness demand innovative technology for roads of the 21st century. Recognizing the opportunities inherent in this challenge, some commercial enterprises have already developed solvent-free emulsions in standard dense- and open-graded emulsified asphalt concrete mixes indicates that mechanical properties are comparable to or exceed those of conventional solvent-loaded emulsions. Field evaluation of solvent-free emulsions has only recently begun in western Europe and South America, but appears promising.

**QUANTIFICATION OF SALT LIABILITY MANAGEMENT. (00755923)**

*Sponsored by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Performed by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Investigator(s):* Snodgrass, W. J.

*Status:* Active.

*Start date:* 1994; *Estimated completion date:* 1999.

This research program is designed to quantify the extent of well water quality protection provided by various management systems and technologies and to define the potential reduction in salt liability to a transportation agency from a big-picture point of view. The various research and development sub-projects include: Project no. 21422, Groundwater Contamination Migration; Project no. 21424.1, Susceptibility of Aquifers to Salt Contamination; Project no. 21423, Salt Levels in Groundwaters below Patrol Yards; Project no. 21423.2, Synthesis of Salt from Relevant Databases,; and Project no.21421, Design Salt Removal System.

**STREAM STABILITY/SCOUR EXPERT SYSTEM. (00640739)**

*Sponsored by:* Washington State Department of Transportation.

*Project Monitor:* Anderson, K.

*Performed by:* Washington State Department of Transportation. Olympia. WA.

*Investigator(s):* Palmer.

*Status:* Incomplete.

*Start date:* *Estimated completion date:* unknown.

*Notes:* Research has been extended.

No summary provided.

**SYNTHESIS OF INFORMATION RELATED TO HIGHWAY PROBLEMS. TOPIC 28-01. BEST MANAGEMENT PRACTICES FOR ENVIRONMENTAL ISSUES RELATED TO HIGHWAY AND STREET MAINTENANCE. (00736769)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Jencks, Crawford F.

*Performed by:* Transportation Research Board.

*Investigator(s):* Liff, Sally and Maher, Stephen F.

*Status:* Active, *Contract No.:* Project 20-05, Topic 28-01.

*Start date:* 23 Aug 1996; *Estimated completion date:* 30 Jun 1998.

*Publication(s):* Final report in progress.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

This synthesis will report on the best management practices (BMPs) in use for maintenance activities as they relate to environmental issues and will include BMPs or innovative approaches to mitigate routine problems or unusual circumstances. In addition to reporting on BMPs for specific maintenance activities, several broader issues will be included, such as cost-effectiveness of BMPs, implementation of BMPs (training, education, and awareness), and innovative resource agency coordination and permitting.

## Operations Maintenance - Snow and Ice Control

### **AUTOMATED BRIDGE DECK ANTI- AND DE-ICING SYSTEM . (ENV1247)**

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Performed by:* University of Utah.

*Investigator(s):* Decker, Rand.

*Status:* Active, *Contract No.:* Project 20-30, IDEA 27.

*Start date:* *Estimated completion date:* 31 Mar 1998.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

This project has been completed and the final report is being revised and updated to incorporate additional data obtained last winter. The project developed and tested a bridge-mounted automated de-icing system for melting snow and ice on bridge decks. The system uses accepted de-icing liquids and conventional spraying techniques coupled with modern roadway weather information system (RWIS) and data communication and process control, and could be initiated remotely using RF or cellular phone modem commands. The system was installed, in collaboration with the Utah DOT, on an I-215 overpass in Salt Lake City, Utah. The NCHRP-IDEA project committee has approved supplemental funding for a follow-on implementation project which will be carried out in a DOT-pooled fund collaboration with Utah and Washington DOTs and FHWA. The follow-on IDEA contract to support the consortium project effort is in process.

### **CLIMATOLOGICAL CHARACTERIZATION OF SNOWFALL AND SNOWDRIFT ALONG MINNESOTA HIGHWAYS AND ROADS AND DEVELOPMENT OF DATABASE. (ENV1211)**

*Sponsored by:* Center for Transportation Studies. University of Minnesota. Minneapolis. MN.

*Project Monitor:* Hay, Steve.

*Performed by:* University of Minnesota. Department of Soil, Water, and Climate.

*Investigator(s):* Seeley, Mark.

*Status:* Active.

*Start date:* FY1999; *Estimated completion date:* FY2001.

This project will use existing digital records (1948-present) of snowfall snow water equivalence and wind parameters to develop a geographical database with reference to Minnesota roads and highways. Other published records of snowfall and wind prior to the 1948 period will be digitized and used in analyses of frequencies and extremes, recognizing that the most long-term records of extreme snow conditions may indicate what the limits are to mitigation and control measures. Previously reported methods for calculating total potential snow transport and snowdrift melting rates in the spring will be used. In areas where snow fences are being considered, this project will evaluate potential snow storage impacts on agricultural production practices.

### **EFFECTS OF HIGHWAY DEICING CHEMICALS ON SHALLOW UNCONSOLIDATED AQUIFERS IN OHIO. (00637425)**

*Sponsored by:* Ohio Department of Transportation. Columbus. OH.

*Project Monitor:* Linkous, Tom.

*Performed by:* U.S. Geological Survey. Water Resources Division.

*Investigator(s):* Jones, Allison L.

*Status:* Active, *Contract No.:* OH-87-092.

*Start date:* 1 Jan 1988; *Estimated completion date:* 30 Sep 2002.

*Publication(s):* Interim publication: A. L. Jones, and B. N. Sroka. 1997. Effects Of Highway Deicing Chemicals On Shallow Unconsolidated Aquifers In Ohio, Interim Report, 1988-93. Water Resources Investigations, 149 p. USGSWRI974027. NTIS Order Number PB97-203020. In Ohio, there is a general lack of detailed knowledge concerning the movement of de-icing salts after they have been applied to roads. The use of road salts has been increasing continuously since about 1940. There is growing indication that all applied salts do not leave the area of application, but that some in fact accumulate. The Ohio Department of Transportation (DOT) needs long-term data on the effects of chlorides on soil and ground water in Ohio. Each site tested will include six multi-level sampling wells and one water-level well. Soil salinity will be monitored by taking actual soil samples several times per year. The wells will be sampled monthly for sodium, calcium, chloride, and specific conductance, and occasionally for dissolved cyanide. Specific conductance will be continually monitored at all sites. Progression of salt through the aquifer with time will be examined at each site.

This is phase one of a two-phased program to determine the impact of highway deicing chemicals upon shallow unconfined aquifers adjacent to roadways. This first phase will develop a detailed research plan to include: an experimental, analytical and implementation plan. This study will include an extensive field monitoring and laboratory analysis program extending over at least five years in phase two.

The objectives of this research are:

- (1) To determine the impacts of highway deicing chemicals, predominantly chloride, on the ground water quality of shallow unconfined aquifers that underlie highways in Ohio.
- (2) To determine those impacts in each of the major soil type and climatic areas of Ohio where shallow unconsolidated aquifers exist.
- (3) To track the movement of chlorides away from the highway to observe seasonal variations in chloride migration.
- (4) To determine yearly changes in impacts caused by annual variation in snowfall.
- (5) To determine the salt concentrations present in the soil and unsaturated zone.

#### **HIGH ALTITUDE SNOW AND ICE CONTROL: EFFECTS ON WATER QUALITY.**

(00735123)

*Sponsored by:* Colorado Department of Transportation.

*Project Monitor:* Hutter, W.

*Performed by:* Colorado Department of Transportation. Denver. CO.

*Investigator(s):* Lewis, W.

*Status:* Active.

*Start date:* 9 Sep 1996; *Estimated completion date:* 1 Jun 1999.

Control of snow and ice at high elevations in Colorado is a unique problem which requires balancing safety, environmental concerns, and commercial interests. CDOT maintenance is beginning to use alternative deicing chemicals, such as magnesium chloride, at high altitudes with little knowledge of their environmental effects. More information is needed on the effects of snow and ice control on high-elevation plant life and water quality. In addition, cost-effect snow and ice control methods need to be identified and tested.



**INTERACTION OF ROAD SALT WITH ENVIRONMENTAL SYSTEMS IN MAINE.**  
(CRIS 0177056)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* University of Maine. Geological Sciences Department. Orono. ME.

*Investigator(s):* Reeve, A. S. and Norton, S. A.

*Status:* Active, *Contract No.:* ME08140.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 2002.

*Notes:* Abstract provided by permission of the U.S. Geological Survey  
(<http://cristel.nal.usda.gov:8080/star/brd.html>).

The overriding objective of this research is to understand the transport and chemical transformation of road salt (NaCl)-polluted surface and groundwater that have been produced from distributed road salt and road-salt storage piles. By using the Cl as an inert tracer, we are enabled to develop a better understanding of the transport (i.e., hydrology) of other conservative solutes in surface and groundwater. By developing geochemical models of the interaction of salt-rich water with soil and bedrock and coupling this model with hydrology, we can assess the development of the pollution and potential remediation of impacted areas.

Preliminary investigations of salt contamination of surface water in a wetland (Alton Bog, Maine-bisected by Route I-95), two permanent streams draining forested watersheds bisected by salted roads, and groundwater systems at three localities “downstream” from salt piles will be continued and investigations extended in breadth as follows. (1) Alton Bog: installation of a grid of hydrologic and chemical monitoring wells, quarterly measurement of head and analysis of water samples from several depths in monitoring wells. (2) Winterport, Maine: continued collection and analysis of groundwater samples from domestic wells; addition of more background and polluted wells to this population of wells; head measurement in as many of the wells as possible; and application of electromagnetic surface geophysics to determine the flow pathways in the surficial material and bedrock.

**PILOT TEST OF AN ICE BAN PRODUCT AS A PREWETTING AGENT IN SNOW REMOVAL AND ICE CONTROL OPERATIONS.** (ENV1302)

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Research Transportation Council.

*Investigator(s):* Roosevelt, Dan and Fitch, Michael.

*Status:* Active.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Jun 1999.

ICE BAN (Ice Ban) is the registered trade name of a group of agricultural by-products that has been patented for use as roadway deicing/anti-icing agents and corrosion inhibitors. Preliminary tests indicate that Ice Ban products work well as freezing point depressants and corrosion inhibitors and are environmentally friendly. These findings, the cost-effectiveness (life-cycle cost) of using Ice Ban, and operational problems associated with its use required further investigation. Thus, we are conducting a study to answer the following question: Do Ice Ban products offer a cost-effective option for controlling ice and snow that can be adapted to VDOT's snow removal and ice control operations?

Originally, we planned to collect and analyze runoff from the two test sections on I-66 in an effort to determine the environmental impacts of Ice-Ban. This undertaking was to allow for a comparison of the chemical makeup of the runoff coming from both the salt-treated and the salt/Ice Ban-treated sections. Additionally, we were going to observe roadside vegetation near these two sections to compare the presumably deleterious effects of the different chemicals. However, because of the mild winter, no deicing chemicals were used.

We have completed two lab tests comparing the effects of the deicing chemicals on seed germination and the mortality of fat head minnows.

Expected Benefits: Ice Ban increases the effectiveness of more commonly used deicing chemicals such as NaCl. In addition, Ice Ban is said to be environmentally benign and non-corrosive, causing no adverse effects on roads, infrastructure, or vehicles.

A roadside vegetation test is being conducted during the fall and winter months. A plant fluorescence sensor is being used to measure the stress caused by Ice Ban and other deicing chemicals on typical roadside vegetation. We will expose subject plots to various concentrations throughout the winter months. Plant stress and recovery will be monitored until mid-spring.

**ROAD SALT (NAC1) MANAGEMENT. (00755977)**

*Sponsored by:* Transportation Association of Canada (TAC). Ottawa. Canada.

*Performed by:* Transportation Association of Canada (TAC). Ottawa. Canada.

*Status:* Active.

*Start date:* 1997; *Estimated completion date:* 1998.

Because of concerns over road salt in the environment, the federal departments of environment and health have placed road salt on the second priority substance list (PS12). Under the Canadian Environmental Protection Act (CEPA), substances on PS12 are required to be assessed by December 2000. In turn, substances deemed to be toxic would be regulated. Regulations could restrict or even ban substance use. Given PS12 and CEPA, it is important that Canada's road authorities are proactive in addressing the environment impacts of salt so as to reduce the likelihood of road salt regulation. In addition, concerns over the environmental effects of road salt are being raised as part of the environmental assessment approval process for roads. Without an acceptable way of addressing salt-related issues, road authorities could have increasing difficulty in obtaining environmental assessment approvals or be forced into costly compensation. The purpose of this study is to produce three documents by the fall 1998 on the management of road salt. The first document is a primer on winter maintenance for the general public that provides information on the importance of salt use to maintaining a safe and efficient transportation system that sustains Canada's economy. The second document is a concise, practical and focused code of practice for salt management. The third document is a longer and more comprehensive salt management guide that provides information on the subject of winter maintenance and salt usage.

**THE SALT EFFECTS ON CRANBERRY SOILS, PLANT GROWTH, AND PRODUCTIVITY. (ENV1125)**

*Sponsored by:* Massachusetts Highway Department.

*Project Monitor:* George Batchelor.

*Performed by:* University of Massachusetts at Lowell.

*Investigator(s):* DeMoranville, Carolyn J.

*Status:* Active.

*Start date:* 29 Oct 1998; *Estimated completion date:* 30 Jun 2000.

This study is being conducted to determine the effects of deicers on cranberry bogs growing along the highway. An objective of the study will be to determine if CMA or magnesium based deicers should be used instead of salt in winter road maintenance. Protection of cranberries is important, since this crop is Massachusetts' number one resource.

## Operations and Maintenance - Vegetation

### **ASSESSMENT OF MARSH VEGETATION RESPONSES TO HYDROLOGICAL RESTORATION IN SHARK SLOUGH, EVERGLADES NATIONAL PARK. (ENV1236)**

*Project Monitor:* Jaffe, Rudolph.

*Performed by:* Southeast Environmental Research Program. Florida International University. Miami. FL.

*Investigator(s):* Ross, Mike, Telesnicki, Guy, and Ruiz, Pablo.

*Status:* Active.

*Start date:* 1 Aug 1996; *Estimated completion date:* 31 Oct 2000.

The objectives of this project are: (a) to assess changes in Shark Slough vegetation since a 1981 survey, (b) to establish a benchmark vegetation monitoring network in the Slough, (c) to examine the association between vegetation and hydrologic variables in Shark Slough marshes, and (d) to describe spatial variation in soil nutrient concentration throughout the Slough.

### **COASTAL CULTIVARS. (CRIS 0174555)**

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* University of Georgia. Horticulture Department. Athens. GA.

*Investigator(s):* Couvillon, G. A. and Wade, G. L.

*Status:* Active, *Contract No.:* GEO-9701220.

*Start date:* 1 Mar 1997; *Estimated completion date:* 31 Aug 1999.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

This project will evaluate new and potential plants, including fruit, vegetables and ornamentals, for their adaptability to coastal Georgia. Goals are: (1) to evaluate carrot varieties and production parameters for southeast Georgia; (2) to evaluate the use of various agricultural chemicals and polyarylamides on the growth and establishment and adaptability of various plant species; (3) to compare different landscape regimes on the total input requirements of landscape plantings; (4) to evaluate the effect of poultry litter on various ornamental species in landscape setting; (5) to determine a propagation method for various difficult to root species of ornamental Ilex; and (6) to determine the best open-celled pavers for roadways to protect historical and rare species of trees and other plants in high traffic areas.

The research team will: (1) establish evaluation plots for fruits, vegetables, conifers, herbs, herbaceous perennials and vegetatively propagated annuals and collect and compile data; (2) establish carrot variety evaluation plots and collect and compile data; (3) establish carrot research plots to determine effect of planting time on yield and to determine effect of plant density on yield and summarize, analyze, and publish data; (4) establish field plots to evaluate the effect of various chemical growth regulators on establishment, post-transplant growth and subsequent performance of annual and perennials; to determine the effect of polyacrylamide on subsequent growth and performance of spring-planted bedding plants in the landscape; and to determine the effect of humate substance on the growth and nutrient uptake on spring-planted bedding plants. The team will also install three landscape regimes in replicate - a turf area, a ground cover area and a mixed landscape area and collect and compile data on input requirements for labor, materials, and equipment; establish field plots testing the effects of both layer and broiler litter and soil nutrient content and growth on summer annuals and collect and compile data; and establish a mist propagation facility for rooting study, begin examining the effects of rooting hormone concentration on the rootability of the holly species, and compile and analyze data. Finally, they will establish 100' of 12' wide of roadway using open celled pavers and irrigations system.

**PROGRESS: 1997/03 TO 1998/02**

During the first year of the project seven objectives were identified. Sixteen investigators, in addition to a project leader, were involved in thirteen research projects. These projects included: an evaluation of new and potential plants, including fruit, vegetables and ornamentals, for their adaptability to coastal Georgia; an evaluation of various agricultural chemicals, including humates and polyacrylamides on the growth, establishment and adaptability of various plant species; an evaluation of various landscape regimes on total input requirements for installation and maintenance; an evaluation of various organic soil amendments on the growth of various ornamental species in a landscape setting; and an evaluation of propagation methods for various difficult-to-root species of ornamental Ilex. All of these studies were initiated during the project year and data is being recorded and analyzed for future research summaries. Three of the proposed projects were terminated in August, 1997 while the remaining ten are intended as three- to five-year studies. One proposed study to evaluate landscape pavers was delayed during the preparation of a site plan to pave roadways within the facility since this study will be incorporated into the roadways on the facility. It is scheduled for installation during the summer of 1998.

Initial publications reporting results from year-1 funding are anticipated during the summer and fall of 1998. An industry field day is set for June 2, 1998, which will allow industry to view research projects.

**COMPARISON OF EROSION CONTROL AND ENGINEERING PROPERTIES OF TURF SOD AND FOUR MIXES OF NATIVE GRASSES, FORBS AND WILD FLOWERS.** (ENV1174)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Hughes, M.

*Investigator(s):* Landphair, H. C.

*Status:* Active, *Contract No.:* 9-1504.

*Start date:* 24 Sep 1997; *Estimated completion date:* 31 Aug 2000.

No summary provided.

**COMPETITIVE GROWTH CHARACTERISTICS OF NATIVE AND EXOTIC GRASSES.** (00638328)

*Sponsored by:* California Department of Transportation. Sacramento. CA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Harper-Lore, B.

*Performed by:* University of California, Davis. Davis. CA.

*Investigator(s):* Rice, K.

*Status:* Active.

*Start date:* 30 Sep 1993; *Estimated completion date:* Jan 1999.

*Publication(s):* A final report is in the draft stage.

This investigation will study the effect of above- and below-ground plant competition factors on the establishment of seedlings, which include perennial grasses on bare sub-surface soils typical of road construction sites. Species which are compatible in mixtures will be identified. Perennial grasses are being used in erosion control seedings with increasing frequency. The prescriptions for these seedings are generally made without knowledge of expected performance. Appropriate species combinations, proportions, and densities should be established to base specifications and thence avoid failures to establish stands and consequently have decreased erosion and revegetation costs.

**CONTROL OF WOODY VEGETATION.** (00622920)

*Sponsored by:* Virginia Department of Transportation. Richmond. VA.

*Project Monitor:* Hagood.

*Performed by:* Virginia Polytechnic Institute and State University.

*Investigator(s):* Hipkins, Lloyd.

*Status:* Active.

*Start date:* 1 Jul 1990; *Estimated completion date:* Nov 1999.

*Notes:* This research is still in progress.

No summary provided.

**DELINEATION AND MANAGEMENT OF SULFIDIC MATERIALS IN VIRGINIA HIGHWAY CORRIDORS.** (ENV1304)

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Polytechnic Institute and State University; Virginia Transportation Research Council.

*Investigator(s):* Daniels, Lee, Orndorff, Zenah, Fitch, Michael, and Lane, Stephen.

*Status:* Active.

*Start date:* 1 Jul 1997; *Estimated completion date:* 30 Jun 2000.

Sulfidic minerals are common in all of Virginia's geologic provinces and have historically posed local threats to water quality, fill stability, concrete/metal structures, and vegetation management. In the past several years, a number of new problem sites have become apparent to local VDOT residencies because of wetland excavation and the ever-deepening nature of road cut designs statewide. It is also becoming obvious that a number of older, poorly understood "problem areas" in statewide rights of way owe their management difficulties and environmental complications to the presence of sulfidic materials. For example, a number of concrete box structures and metal guardrails have been seriously (or completely) degraded by contact with these materials.

The purpose of this research is to develop the database, materials handling plans, and environmental control strategies necessary to deal with potentially acidic materials in the road building and right-of-way environment safely and economically.

This study will benefit VDOT in three ways: (1) the development of a sulfidic hazard potential map will enable VDOT to avoid areas known to contain highly sulfidic soils where large excavations are necessary; (2) in cases where sulfidic materials are encountered, chemical and physical stabilization alternatives and other protection strategies developed will minimize the potential damage of these soils; and (3) the development of water treatment strategies for acid leachates will enable VDOT to comply with existing regulations for water quality standards.

The results of this research effort could potentially save VDOT significant construction, maintenance, and environmental compliance costs. These savings will likely be realized to a greater and greater extent as the effects of sulfidic soils on existing structures become more evident.

All sites originally identified as problem areas by VDOT have been mapped and sampled. Preliminary results for most of these sites have been obtained. Additional work will be conducted for most of these sites over the next year. The development of an acid-sulfate risk map and revegetation experiments will also be initiated within the next year.

**DETERMINATION OF FEASIBILITY, COST EFFECTIVENESS, AND VISUAL QUALITY OF USING TREE SEEDLINGS AND WOODWASTE MULCH TO**

**REFOREST STATE HIGHWAY INTERCHANGES TO REDUCE LANDSCAPE PROBLEMS.** (ENV1136)

*Sponsored by:* Louisiana Transportation Research Center.

*Performed by:* Southern University.

*Investigator(s):* Lorenzo, Alfredo B.

*Status :* Active, *Contract No.:* 98-21SS.

*Start date:* 1 May 1998; *Estimated completion date:* 30 Apr 2001.

Maintaining large interchange areas of the interstate and other highway systems has been an expense for the Louisiana Department of Transportation and Development (DOTD). Landscaping with conventional methods is expensive and can exacerbate maintenance efforts. The proposal investigates the use of forest tree seedlings, ground cover plants, and woodwaste mulch to establish a self-maintaining cover that would meet the requirements of the DOTD Roadside Maintenance Manual, be low in maintenance, and help control erosion.

This research will be a cooperative effort by interested personnel from DOTD, the Department of Agriculture and Forestry, Southern University, Baton Rouge Green, and Georgia Pacific Corporation under the Adopt-A-Spot program.

**DEVELOPMENT OF BIOLOGICAL CONTROLS FOR NOXIOUS PLANT SPECIES.** (00744193)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Caster, Jeff.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville. FL.

*Investigator(s):* Charudatton, R.

*Status:* Active.

*Start date:* 15 Aug 1995; *Estimated completion date:* 30 Nov 1998.

This study collected plant pathogens of selected Florida weeds, determined the controllability against weed hosts, and developed methods to produce bioherbicides for field trials.

**DEVELOPMENT OF SEED STOCKS.** (00722890)

*Sponsored by:* Alaska Department of Transportation and Public Facilities. Juneau. AK.

*Project Monitor:* Reckard, M.

*Performed by:* Alaska Plant Materials Center. Division of Agriculture. Palmer. AK.

*Investigator(s):* Wright, S.

*Status:* Active.

*Start date:* Mar 1995; *Estimated completion date:* Sep 1996.

The state of Alaska lacks a sufficient number of native seed species in commercial production for proper seeding of roadsides to permit specifying seed types which will have the best survival chances. This is especially true for wildflowers and for RS and for D-adapted species. The national trend is indicated by a federal requirement for using native species for seed types where federal funds are involved. Seed collection and species success evaluation studies under this project will be done at or near the Alaska, Steese, Glenn and Nome-Taylor Highways. More than forty species will be evaluated and considered for seed production and potential use in revegetation. The timing of seed collection will be species specific. Following collection the seeds must be cleaned and sorted, followed by germination tests. Seeds will be given to potential commercial growers in the second year of this study, in order to have more seeds produced and their production efforts will be monitored. Those species proving suitable for expanded seed production will be identified and seeding requirements will be prepared as possible specifications.

The investigation of native species of vegetation and seed collection from species favorable for commercial production will be implemented. The benefits of this study will improve roadside vegetation survival, prevent slope erosion problems and will beautify roadsides and highway facilities with wildflowers. Until seed stocks are made available in quantities suitable for wide use, their potential benefits cannot be realized and they cannot even be specified for use in construction revegetation work.

**EROSION CONTROL OF SANDY SOILS.** (ENV1196)

*Sponsored by:* New Jersey Department of Transportation.

*Performed by:* New Jersey Department of Transportation.

*Investigator(s):* Nichnadowicz, Vincent.

*Status:* Active.

*Start date:* *Estimated completion date:* 31 Jul 2000.

Erosion of sandy soils on 2:1 slopes often damage roadsides during and after construction. Reconstruction of these slopes is costly. Typically, these slopes lack adequate fertility and moisture retention qualities to grow and sustain typical roadsides. The objective of this project is to develop specifications for new grass types and methods of using bio-solids to augment soil fertility.

Tasks include the following:

Develop and refine a specification for establishing a stand of weeping lovegrass both for bare soil areas and for partially vegetated areas. Determine the geographic limits of the state road system where weeping lovegrass would be appropriate. Develop and refine a specification for using bio-solids to augment soil fertility. Analyze potential for expanding the use of agreements between various partners to obtain and apply bio-solids. Prepare a cost benefits analysis of converting major areas of turf to weeping lovegrass. Determine possible clean air credits, maintenance cost reductions and reduced need for mowing.

**ESTABLISHMENT AND MAINTENANCE OF TURF.** (CRIS 0165468)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* Auburn University. Agronomy and Soils Department. Auburn. AL.

*Investigator(s):* Guertal, E.

*Status:* Active, *Contract No.:* ALA-03-021.

*Start date:* 1 Oct 1994; *Estimated completion date:* 30 Sep 1999.

*Publication(s):* Liu, W., E. Van Santen and E.A. Guertal. 1997. Spatial patterns of phenotypic variation in tall fescue pastures. *Agronomy Abstracts. ASA/CSSA/SSSA.* p. 74.

Guertal, E.A., R.H. Walker and J.M. Higgins. 1997. Growth and performance differences within bermudagrass cultivars. *Agronomy Abstracts. ASA/CSSA/SSSA.* p. 131.

Xiong, K. et al. 1997. Diversity of rhizobacteria in new USGA putting greens. *Agronomy Abstracts. ASA/CSSA/SSSA.* p. 223.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

This project will determine the most suitable species and/or cultivars of turfgrasses for specific sites and purposes in Alabama and develop turf establishment and maintenance procedures to produce acceptable quality on roadsides and other low maintenance areas.

Field plot experiments will be used to evaluate cultivars and selections of tall fescue, common bermudagrass, and zoysiagrass for use in home lawn and golf course fairway situations. Field experiments will also be established to evaluate selections of bermuda grass maintained under

golf green management on a “USGA type” mixture and on an unmodified sandy loam soil. The grasses will be subjected to stresses such as drought, cold, traffic, excessive moisture and frequent low mowing. Experiments will also be conducted to determine the most effective methods of establishment of the turf-type tall fescues, common bermuda grass and zoysia grass from seed on highway backslopes and medians. Variables will include rates and placement of fertilizer and lime, seeding rates and depths, mulch materials and amounts, and procedures for reducing soil compaction problems created by construction procedures. Field and greenhouse experiments will be conducted to determine the potential of new herbicides and growth regulators for managing weed problems on roadsides and other rough turf areas.

PROGRESS: 1997/01 TO 1997/12

A USGA study that examines microbial diversity in bentgrass putting greens has been established and the first year has been completed. This study also involves leachate collection, which is analyzed for nitrate and ammonium. A study which examines bermudagrass ecotypes has also been completed, and several promising ecotypes have been selected. Those grasses have been planted in new test plots. Three new studies which examine the use of remote sensing for turf have been initiated. Monitoring of water quality of a sod farm is in its first year.

**ESTABLISHMENT OF A NATIVE SEDGE VEGETATION IN CREATED WETLAND BASINS. (ENV1212)**

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Jacobson, Robert and Cassellius, Ron.

*Performed by:* University of Minnesota.

*Investigator(s):* Cushing, Edward J.

*Status:* Active, *Contract No.:* 94-157R.

*Start date:* 1 Jul 1994; *Estimated completion date:* 31 Dec 1998.

No abstract provided.

**ESTABLISHMENT OF BUFFALO GRASS ON MISSOURI HIGHWAYS. (ENV1150)**

*Sponsored by:* Missouri Department of Transportation.

*Project Monitor:* Swanigan, Rand.

*Performed by:* University of Missouri - Columbia.

*Investigator(s):* Bughorara, Suleiman.

*Status:* Active, *Contract No.:* RI98-022.

*Start date:* Apr 1998; *Estimated completion date:* Oct 1999.

The purpose of this research study is to determine the effects of the planting data on establishments of vegetative and seeded buffalo grass cultivars on roadside vegetation in Missouri.

**EVALUATION OF CHANNEL EROSION CONTROL PRODUCTS. (ENV1311)**

*Sponsored by:* Colorado Department of Transportation.

*Project Monitor:* Price, Dave.

*Performed by:* Colorado Department of Transportation.

*Investigator(s):* Banovich, Mike.

*Status:* Active.

*Start date:* Feb 1994; *Estimated completion date:* 1999.

CDOT has used soil retention blankets to stabilize soils and provide a mulch for seed propagation. Blankets can also be used to stabilize areas that contain a concentrated flow. This



study will compare performance of different blankets installed in newly constructed roadside ditches and steeper transition slopes. It will determine if turf reinforcement blankets perform as claimed by the manufacturers and are an alternative to riprap or other structural methods of stabilization.

**EVALUATION OF COMPOSTED MATERIALS TO BE UTILIZED IN ROADSIDE PLANTINGS.** (00744192)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Henry, Gary.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville, FL.

*Investigator(s):* Black, R.

*Status:* Active.

*Start date:* 15 Aug 1995; *Estimated completion date:* 30 Nov 1998.

The Department is required by law to use recyclable materials in construction and maintenance. This project provided the information needed for proper use of the various composted waste materials in roadside plantings.

**EVALUATION OF THE IMPACT OF VEGETATION MANAGEMENT TECHNIQUES ON WATER QUALITY.** (ENV1048)

*Sponsored by:* Oregon Department of Transportation.

*Project Monitor:* Edgar, Rob.

*Performed by:* U.S. Geological Survey.

*Investigator(s):* Wood, Tamara and Waite, Ian.

*Status:* Active.

*Start date:* Nov 1997; *Estimated completion date:* 30 Jun 1998.

*Notes:* On schedule, Phase 1 near completion.

Integrated Vegetation Management (IVM) programs utilize a suite of practices to control roadside vegetation. The effect of these various methods on water quality has not been adequately documented. This hinders the evaluation of the appropriateness of the methods for the different environmental situations encountered in the course of roadside maintenance. Because the use of herbicides is the most controversial aspect of IVM, research is needed to determine the chemical and biological effects of herbicides along highway shoulders in comparison to the least disruptive alternative – mowing. The vulnerable status of Oregon's anadromous fish stocks makes this information even more necessary.

The objective of this study is to determine if the herbicides used in the Oregon Department of Transportation (ODOT) IVM program have an observable biological effect on the receiving waters. This study will be conducted in several phases. The first phase will identify previously performed work, locate relevant run-off information and recommend a work plan to complete the study. The next phase(s) will consist of field and/or laboratory investigations to determine if there are observable effects on the biology or receiving waters from normal herbicide use.

**FLORIDA NATIVE TURFGRASS INVESTIGATION. (00742058)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Henry, Gary.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville, FL.

*Investigator(s):* Gordon, D.

*Status:* Active.

*Start date:* 19 Dec 1997; *Estimated completion date:* Jan 2000.

The objective of the research is to investigate the potential use of two native grasses for use along roadsides within their natural ranges by experimentally testing out-planting methods.

**GENERATION OF WATER STABLE SOIL AGGREGATES FOR IMPROVED EROSION CONTROL AND REVEGETATION SUCCESS. (00735171)**

*Sponsored by:* California Department of Transportation. Project Development MS-28. Sacramento. CA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Haynes, J.

*Performed by:* University of California, Davis. Land, Air, Water Department. Davis. CA.

*Investigator(s):* Claassen, V.

*Status:* Active, *Contract No.:* E95LA08C.

*Start date:* 8 Aug 1995; *Estimated completion date:* Jan 1999.

*Publication(s):* Final report is in preparation.

The exposed earth surface of a new construction project is generally devoid of nutrients, biological activity or organic matter that in normal soils would form stable soil aggregates. We can add chemical nutrients and establish temporary vegetation cover, but the nutrient is lost because of the location exchange capacity, and the vegetation declines. This project will evaluate chemical and organic inputs to determine if they can form less erodible soil aggregates and promote long-term vegetation. This will reduce slope failure, maintenance cleanup, and water pollution.

**HANDLING AND MITIGATION OF ACID PRODUCING SOILS, LANDSCAPE SOIL STUDY PART II. (ENV1195)**

*Sponsored by:* New Jersey Department of Transportation.

*Performed by:* New Jersey Department of Transportation.

*Investigator(s):* Nichnadowicz, Vincent.

*Status:* Active.

*Start date:* *Estimated completion date:* 31 Dec 2000.

Naturally occurring acid producing soils are often uncovered during highway construction. Untreated, these soils can become highly acidic and kill all vegetation. These denuded soils are then susceptible to soil erosion which in turn endangers pavement stability. The objective of this research study is to develop methods, guidelines, and landscape specifications for converting acid producing soils to soils that are able to sustain a vegetative cover. Tasks include continuing to monitor pH levels of the Route 33 test plots to determine if any pH changes occur.

**IMPROVING THE NODULATION AND NITROGEN (N<sub>2</sub>) FIXATION OF PRAIRIE**

**LEGUMES USED IN ROADSIDE REVEGETATION IN MINNESOTA. (ENV1217)**

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Jacobson, Robert and Stenlund, Dwayne.

*Performed by:* University of Minnesota.

*Investigator(s):* Graham, Peter H.

*Status:* Active, *Contract No.:* 97-019R.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Oct 1999.

The goals of this project are: 1) To field test selected rhizobial strains for their efficiency in N<sub>2</sub> fixation with the different prairie legumes currently used in roadside revegetation. 2) To evaluate methods of inoculation and seed pelleting for use with fall and spring-plantings of prairie legumes, and study the effect of such methods on the persistence in soil of the inoculated rhizobia. 3) To examine the contribution of seed scarification and inoculation to the second-year germination, establishment and nodulation of prairie legumes, and to the N status of revegetation sites. 4) To examine variations in nodulation and N<sub>2</sub> fixation among different sources and populations of selected prairie legumes. 5) To develop a manual on the specifications for, and use of, inoculants in the establishment of prairie legumes. The work undertaken in this project combines applied aspects of soil microbiology and agronomy. It will provide and evaluate strains of rhizobia for previously unstudied prairie legumes, and will make recommendations as to appropriate inoculation technologies for use with these legumes in revegetation situations. A manual of methods appropriate to strain selection, conservation, and use will be developed.

**INCREASING URBAN TREE LONGEVITY BY ENGINEERING THE ROOT ZONE.  
(CRIS 0167524)**

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service. NY.C.

*Performed by:* Cornell University. Floriculture and Ornamental Horticulture Department. Ithaca. NY.

*Investigator(s):* Bassuk, N. L.

*Status:* Active, *Contract No.:* NYC-141550.

*Start date:* 1 Feb 1995; *Estimated completion date:* 30 Sep 1999.

*Publication(s):* Grabosky, J. and N.L. Bassuk. 1997. Establishment Techniques for Trees in Compacted Soils. Proceedings from the 8th National Urban Forestry Conference. Atlanta, GA. pp 72-75.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

We are defining a medium that will satisfy both engineers & plant scientists employing standard testing procedures to address both quality tree growth & pavement stability. This medium will consist of a load-bearing stone matrix containing a non-compacted rooting medium within the pores that exist between the stones. Roots will be encouraged to grow deeper in the soil eliminating sidewalk failure by near surface rooting, and wider - so that they can exploit a larger cachement area.

We will identify a stone to soil ratio that will meet the above objective. To do this without getting the soil sieve to the bottom of the matrix, we are “gluing” the soil to the stone with a tackifier, a potassium propenoate-propenamamide copolymer cydrogel. Plant materials will be grown in the compacted test blends while testing the same blends for load bearing capacity. Water & nutrient holding capacity, air-filled voids, and root penetration in these blends after compaction will be measured and evaluated. We intend to test the current tackifier and others to define the best rate for use and to assess its effect on the system during compaction and over time. Promising blends at compaction points will have bearing capacity, frost penetration, and pore size distribution tested. The effects of loading and compaction and the subsequent effects on root

growth will be studied to bid in evaluation of the target stone/soil blend.

**PROGRESS: 1997/01 TO 1997/12**

The objective of this work is to develop a soil medium that can be compacted to meet engineering specification for load-bearing capacity under sidewalks, yet also provide a good growing medium for street tree roots. An extremely gap-graded stone and soil mix has been developed using crushed gravel (3/4" - 1 1/2"), clay loam and a hydrogel to aid in mixing. Its load-bearing capacity derives from the high proportion of stone to soil, where each stone is touching another stone thus transferring weight without compacting the interstitial soil. Hydrogel is used to 'glue' the soil to the stone, which prevents soil sifting through the large voids created by the stone. A stone to soil ratio of between 4.1 and 5.1 (DWT) produces the structural soil which meets engineering requirements for a base course and allows roots to grow through freely.

**INFRARED VEGETATION MANAGEMENT. (00726672)**

*Sponsored by:* Oregon Department of Transportation.

*Project Monitor:* Edgar, Rob.

*Performed by:* IPM Associates//Oregon Department of Transportation.

*Investigator(s):* Prull, Greg and Edgar, Rob.

*Status:* Active, *Contract No.:* 5276.

*Start date:* 22 Mar 1996; *Estimated completion date:* Nov 1998.

*Publication(s):* Final report is in draft form.

The objective of this study is to determine if infrared technology is a biologically, economically and environmentally viable component of an integrated pest management strategy for roadside vegetation management. The Oregon Department of Transportation (ODOT), as well as other highway agencies, use a number of integrated vegetation management methods to control unwanted vegetation. Methods include mechanical (mowing), biological (insects), chemicals (herbicides) and cultural (seeding). Of these, herbicides are the most cost effective but it has been strongly discouraged by environmental groups. To address these concerns, ODOT intends to reduce the quantity of herbicides used on roadside vegetation.

Infrared technology is a new method that needs to be evaluated. It has the potential to become an accepted vegetation management method for ODOT.

**INNOCULATING ROADSIDE PRAIRIES WITH SOIL FUNGI. (ENV1037)**

*Sponsored by:* Minnesota Department of Transportation (Phase I); Legislative Commission on Minnesota Resources and Minnesota Department of Transportation (Phase II).

*Project Monitor:* Jacobson, Bob.

*Performed by:* Center for Transportation Studies. University of Minnesota.

*Status:* Active.

*Start date:* 1994?; *Estimated completion date:* Summer 1998.

*Publication(s):* Interim report: Charvat, Iris D., Teresa Pawlowska, Michael Smith, Dwayne Stenlund, and Kristine Nichols. December 1995. Re-introduction of Soil Mycorrhizae Into a Roadside Prairie Planting. Minnesota Department of Transportation. Report no. MN/RC-96/16. The Phase II final report is under review.

*Notes:* For more information, see the Minnesota DOT website at <http://www.dot.state.mn.us/engserv/environment/Research/research.htm>.

The health of roadside plantings is important for a variety of reasons, such as controlling soil erosion and preventing polluted runoff from reaching surface waters. One of Mn/DOT's goals is to establish native prairie grasses – which are able to compete with noxious weeds and withstand harsh roadside conditions – along many roadside right-of-ways.

In a project titled “Re-Introduction of Soil Mycorrhizae into Roadside Prairie Planting,” Professor Iris Charvat of the Department of Plant Biology led a team that explored one soil characteristic – the presence of fungi – that is important to the survival of newly established prairies. Arbuscular mycorrhizal fungi (AMF) are symbiotic fungi that form mutually beneficial relationships with the roots of many prairie and some wetland plants. AMF serve as biofertilizer by facilitating the uptake of nutrients for the plant; the plant provides carbohydrates to the fungus. In addition, mycorrhizal plants have greater tolerance to stressful environmental conditions (including salt) than nonmycorrhizal plants.

In the project, the researchers:

(1) surveyed arbuscular mycorrhizal (AM) fungi from soils collected from prairies, wetlands, and Mn/DOT experimental sites; (2) produced AM inoculum; and (3) placed this inoculum into a Mn/DOT restoration site near Cambridge in the spring of 1995.

The results reveal a significant difference in AM fungal spore numbers among prairies of different ages. The lowest spore numbers were found at the newly restored prairies, and the highest were found at those restored about ten years ago. If further studies show similar results, AM spore number could become a useful indicator of a prairie restoration's below-ground health. Follow-up research could also answer long-term questions about the possible benefits of inoculating disturbed roadway plantings with mycorrhizal fungi.

The Mn/DOT-funded project was the first year of a three-year study; the second phase is being funded in part by the Legislative Commission on Minnesota Resources and Mn/DOT.

#### **INPUTS AND MAINTENANCE FOR REVEGETATION WITH NATIVE AND HERBACEOUS SPECIES. (00735165)**

*Sponsored by:* California Department of Transportation. Office of Structural Foundations. Sacramento. CA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Haynes, J.

*Performed by:* California Department of Transportation. Office of Structural Foundations. Sacramento. CA.

*Investigator(s):* Haynes, J.

*Status:* Active.

*Start date:* 1 Jun 1996; *Estimated completion date:* 30 Jun 1999.

The research objective is to investigate the following: 1) differential responses of individual species, 2) mixture dynamics in response to fertilizer, mulch and management treatments, 3) manage practices for cost effective long term maintenance of established native herbaceous plant communities, 4) the effects of amount and type of fertilizer and mulch of herbaceous species establishment, and 5) compare seedings methods. Our goal is to include district 3 environmental, design and maintenance personnel in the planning and execution of the experiment to develop long term monitoring and maintenance program for native vegetation on CalTrans rights-of-ways.

#### **INV725: EFFICACY OF EROSION CONTROL BLANKETS AND SOIL STABILIZER. (ENV1214)**

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor :* Stenlund, Dwayne and Cassellius, Ron.

*Performed by:* University of Minnesota.

*Investigator(s):* Biesboer, David.

*Status:* Active, *Contract No.:* 96-311R.

*Start date:* 1 Nov 1996; *Estimated completion date:* 31 Dec 1998.

The overall goal of the proposed research is to determine the impacts of erosion control blankets

and soil stabilizers on the germination and growth of native seed mixes and the effectiveness of these blankets/stabilizers in controlling soil erosion. The specific research objectives are: 1) To determine the impact of erosion control blankets and soil stabilizers on the germination of native grasses in indoor greenhouses. This objective will consider a relatively large number of different types of blankets and stabilizers. 2) To determine the impact of erosion control blankets on the germination and growth of native grasses at a Mn/DOT construction site. A subset of the best blankets of Objective 1 will be used for the field work. 3) To determine the effectiveness of the blankets in controlling erosion using natural rainfall events. Runoff and erosion data will be collected for the plots of Objective 4) To determine the effectiveness of the blankets in controlling erosion using events obtained from a rainfall simulator. This objective will obtain runoff and erosion data at important stages of erosion control.

Although they may be more difficult to establish, native species, once established, provide better erosion control than non-native grasses because their root systems penetrate more deeply and widely in soils. Additionally, native species prosper in poor, saline soils; compete effectively with weeds; and ultimately form diverse, but stable, low-maintenance communities. In this study, the establishment of native grasses under erosion control mats, blankets, or soil stabilizers will be determined. Many claims are made for these products in terms of their ability to control erosion and the possibility of establishing vegetation through them. The efficacy of various erosion control products, both to control erosion and to allow good establishment of vegetation through them, will be systematically examined.

**LOW MAINTENANCE TURFGRASS AND CULTURAL MAINTENANCE SCHEMES.**  
(ENV1260)

*Sponsored by:* North Carolina State Department of Transportation.

*Project Monitor:* Khosla, Paul.

*Performed by:* Center for Transportation Engineering Studies. North Carolina State University.

*Investigator(s):* Bruneau.

*Status:* Active, *Contract No.:* HWY-97-5.

*Start date:* 1 Jul 1998; *Estimated completion date:* 30 Jun 1999.

No abstract provided.

**MYCORRHIZAL/PLANT FACTORS INVOLVED IN ROADSIDE RECLAMATION.**  
(ENV1216)

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Stenlund, Dwayne and Cassellius, Ron.

*Performed by:* University of Minnesota.

*Investigator(s):* Charvat, Iris D.

*Status:* Active, *Contract No.:* 97-003R.

*Start date:* 3 Mar 1997; *Estimated completion date:* 31 May 2000.

One objective is to produce AMF inocula by the most efficient methods available. A nutrient hydroponic system will be used to grow native plants inoculated with mycorrhizae for introduction into restoration plots selected in consultation with the Mn/DOT Technical Liaison. The second objective is to test combinations of soil amendments and mycorrhizal inocula in potted greenhouse trials to determine which treatments confer the greatest benefits to the native plants. The third goal is to test the most productive greenhouse soil amendments and AM inocula in Mn/DOT experimental plots. The fourth objective is to continue the mycorrhizal diversity studies of undisturbed Minnesota prairies for comparisons with restoration sites. Finally, plant colonization at the restored JES wetland/prairie complex will be monitored to determine species composition and to provide recommendations for future plantings.

In an attempt to improve soil fertility, plant germination and establishment, Mn/DOT adds soil amendments along roadsides. At the Shakopee wetland/prairie site, biosolids have recently been added to part of the area and appear to promote mycorrhizal/plant interactions. Incorporation of AM fungi into native plantings was shown to be beneficial to plants at the JES site near Cambridge. In Fall 1996, Mn/DOT incorporated sulfur into certain plots along the Highway 280 corridor; mycorrhizal inoculum will be added to plantings in Spring 1997. All of these sites need to be monitored to identify the best treatments.

**NATIVE SANDHILL SPECIES REVEGETATION TECHNIQUES. (ENV1190)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Caster, Jeff.

*Performed by:* University of Florida.

*Investigator(s):* Jones, David.

*Status:* Active, *Contract No.:* BB-937.

*Start date:* 25 Sep 1998; *Estimated completion date:* 1 Dec 2000.

The objectives of this project are to investigate site preparation, sowing methods, and management treatments for effectiveness in the establishment and growth of native species.

**ROADSIDE DEVELOPMENT AND MANAGEMENT FIELD LABORATORY:  
EROSION CONTROL MATERIAL TESTING. (SWUTC 419148)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Northcutt, Paul E.

*Performed by:* Texas A&M University.

*Investigator(s):* McFalls, Jett A.

*Status:* Active, *Contract No.:* none.

*Start date:* 1 Sep 1989; *Estimated completion date:* 31 Aug 1998.

The initial phase of this multi-year project provides for the construction of a state-of-the-art field laboratory for testing erosion control materials and technologies. It will include: approximately one thousand linear feet of embankment, water storage and control facilities, test channels, sedimentation collection devices, rainfall generation equipment, and other instrumentation. When complete, the facility will be capable of testing approximately thirty-six materials (blankets, mats, and other geotextiles) per year to determine their effectiveness in controlling erosion, their strength and durability, and their effectiveness in establishing vegetative cover. Test channels will be capable of testing flexible channel lining materials in controlled field conditions to determine soil- material interaction, strength, and effectiveness in establishing and maintaining vegetative cover. The 1992 program included testing of mulches, erosion control blankets, and temporary flexible channel lining materials.

**ROADSIDE MANAGEMENT OF NATIVE PLANTS. (00744195)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Caster, Jeff.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville. FL.

*Investigator(s):* Gordon, D.

*Status:* Active.

*Start date:* 7 Nov 1996; *Estimated completion date:* 15 Dec 1999.

This research examined restoration techniques for native plant species and maintaining the

vegetation along highways. The project will generate maintenance strategies for propagating these plants.

**ROADSIDE VEGETATION MANAGEMENT. (ENV1063)**

*Sponsored by:* Pennsylvania Department of Transportation.

*Project Monitor:* Peda, Robert.

*Performed by:* Pennsylvania State University.

*Investigator(s):* Arnold, Dean.

*Status:* Active.

*Start date:* 19 May 1998; *Estimated completion date:* 18 May 2003.

*Publication(s):* An initial report is in preparation.

As part of its mission to maintain the Commonwealth's highways, the Pennsylvania Department of Transportation Bureau of Maintenance and Operations is responsible for the maintenance of the roadsides. Though it is not always obvious, the roadside plays an integral role in the function of the roadway as an engineering system, and preventive maintenance of this part of the system is essential for motorist utility and safety. Although it is a part of a system that is dominated by the physical sciences and engineering, the roadside is an interface of the structural and the biological. The purpose of this research is to maximize the utility and safety of the roadside through the application of sound plant and environmental science that will complement the engineering of the roadway system. This research will evaluate available vegetation management techniques and systems and will provide an outreach function to assist in the implementation of improved methods.

**ROADSIDE VEGETATION MANAGEMENT. (ENV1127)**

*Sponsored by:* Oklahoma Department of Transportation.

*Performed by:* Oklahoma State University.

*Investigator(s):* Martin, Dennis.

*Status:* Active, *Contract No.:* 21-30.

*Start date:* 1 Oct 1996; *Estimated completion date:* Sep 1999.

No summary provided.

**SEED APPLICATION ON NEW CONSTRUCTION SITES. (ENV1152)**

*Sponsored by:* Missouri Department of Transportation.

*Performed by:* Missouri Department of Transportation.

*Investigator(s):* Swanigan, Rand.

*Status:* Active, *Contract No.:* RI97-040.

*Start date:* Oct 1997; *Estimated completion date:* Apr 1999.

The objective of this research study is to determine the best method of placing seed to soil for erosion control on construction projects. Methods include drilled, hydro seed then roll, rolled hydroseed rolled, tracked with dozer, and control method per current specification.



**SELECTED WEED CONTROL ALONG HIGHWAYS.** (00637363)

*Sponsored by:* Virginia Department of Transportation. Richmond. VA.

*Project Monitor:* Bingham.

*Performed by:* Virginia Polytechnic Institute and State University.

*Investigator(s):* Hipkins, Lloyd.

*Status:* Active.

*Start date:* 1 Jul 1991; *Estimated completion date:* Sep 1999.

*Publication(s):* Booze-Daniels, J.N. and R.E. Schmidt. October 1, 1997. The Use of Slow Release Nitrogen Fertilizers on the Roadside: a Literature Review. 22 p.

*Notes:* Under contract with Virginia Polytechnic Institute and State University. This project is part of an ongoing series.

No summary provided.

**SOIL AMENDMENTS FOR ROADSIDE FLOWER PLANTINGS IN VIRGINIA.**

(ENV1161)

*Sponsored by:* Virginia Department of Transportation.

*Project Monitor:* Baker, Phil.

*Performed by:* Virginia Polytechnic Institute and State University.

*Investigator(s):* Booze, Jody N., Daniels, Lee, and Evanylo, Greg.

*Status:* Active, *Contract No.:* 98-7384-03.

*Start date:* 1 Jul 1998; *Estimated completion date:* 30 Jun 1999.

The objective of this research study is to evaluate and compare different organic amendments for their relative effectiveness at stabilizing roadside soil properties and enhancing wildflower growth and quality. A second objective is to study the differences achieved in soil conditioning and wildflower growth response when an organic amendment (yard waste) is incorporated as a stabilized compost versus non-composted material (fresh) into roadside soils. A third objective is to compare and contrast the use of organic amendments with conventional roadside practices (e.g. inorganic fertilizers/mulch) and a promising new UF foam soil amendment that we have shown greatly enhances soil physical/chemical properties.

**STRATEGIES FOR PROBLEM WEED CONTROL ON GRASS ROADSIDES .**

(00665411)

*Sponsored by:* Georgia Department of Transportation. Atlanta. GA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Harper-Lore, B.

*Performed by:* University of Georgia, Athens. Athens. GA.

*Investigator(s):* Murphy, Tim.

*Status:* Active.

*Start date:* 15 Jan 1995; *Estimated completion date:* 15 Jan 1999.

*Publication(s):* The final report is expected to be issued in February 1999. A January 1998 interim report is available.

Develop control programs for new problem weeds, develop roadside vegetation management programs that cause minimal injury to Bermuda grass, and provide consultation to Georgia DOT on roadside vegetation management programs and issues. In FY 1995 summer and winter months identify weed species not controlled by current vegetation management programs. Then initiate experiments on the management of summer and winter weeds such as Wild Poinsettia, Florida Paspalum, and thistles.

**SUSTAINABLE VEGETATION MANAGEMENT. (00739099)**

*Sponsored by:* Maine Department of Transportation.

*Performed by:* Maine Department of Transportation.

*Status:* Active.

Crown Vetch is a proven low maintenance grounder for roadsides. With correct site compatibility, it requires no mowing or re-fertilizing and can suppress up to 80% of woody brush seeding in roadside safety clear zones. This is promising technology that can help move the Department away from total dependence on mowing, hand cutting, and herbicides by replacing them with a sustainable system. Research is required to be able to successfully hydroseed on existing grassland sites.

**TURF CULTURE ALONG VIRGINIA HIGHWAYS. (00628561)**

*Sponsored by:* Virginia Department of Transportation. Richmond. VA.

*Project Monitor:* Schmidt, Richard.

*Performed by:* Virginia Polytechnic Institute and State University.

*Investigator(s):* Daniels, Jody.

*Status:* Active.

*Start date:* 1 Jul 1990; *Estimated completion date:* Sep 1999.

*Publication(s):* Booze-Daniels, J.N. and R.E. Schmidt. Evaluation and Management of Turfgrass on Virginia Roadsides.

*Notes:* Under contract with Virginia Polytechnic Institute. This project is part of an ongoing series, with annual reports from 1995, 1996, and 1997

No summary provided.

**VEGETATION MANAGEMENT PRACTICES FOR SOIL STABILITY, EROSION CONTROL AND SLOPE MAINTENANCE. (ENV1160)**

*Sponsored by:* Idaho Transportation Department.

*Project Monitor:* Kingery, James L.

*Performed by:* University of Idaho.

*Investigator(s):* Kingery, James L.

*Status:* Pending.

*Start date:* Oct 1998; *Estimated completion date:* Oct 1999.

Surface erosion, sedimentation, and shallow-seated slope failures in Idaho present a significant challenge to roadway construction and maintenance. Soil losses from such slopes deplete an important natural resource, induce excessive maintenance such as ditch and culvert clean-outs, and may cause adverse effects on the quality of surface waters in the state. Road construction and maintenance activities throughout the state are requiring greater attention to erosion and sediment control concerns due to environmental and economic pressures. This project is designed to evaluate existing and new revegetation technologies on areas affected by highway construction for purposes of topsoil utilization, erosion control, and slope stabilization. The proposed research will help ITD address specific revegetation site requirements and to determine the most effective ways to reduce surface erosion and sedimentation. The objectives of this project are to investigate revegetation techniques for erosion and sediment control through an integrated research program with Idaho Transportation Department.

**WEED WIPER APPLICATION PROJECT FOR ROADSIDE VEGETATION CONTROL. (ENV1181)**

*Sponsored by:* Delaware Department of Transportation.

*Project Monitor:* Rosan, Eugene.

*Performed by:* Delaware Transportation Institute.

*Investigator(s):* Ritter, W. F.

*Status:* Active.

*Start date:* 1 Jul 1998; *Estimated completion date:* 30 Jun 2000.

This project will look at the feasibility of using weed wiper technology to control roadside vegetation.

## Operations and Maintenance - Waste Products

### **ACCELERATED PAVEMENT TESTING OF CRUMB RUBBER MODIFIED ASPHALT.** (00744256)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL; Federal Highway Administration. Washington. DC.

*Performed by:* Florida Department of Transportation. Tallahassee. FL.

*Investigator(s):* Armaghani, J.

*Status:* Active, *Contract No.:* SPR-2(174).

*Notes:* This record is questionable; status could not be determined.

This study will examine performance data on crumb rubber-modified asphalt pavements and will recommend structural design methods and performance prediction models.

### **ASPHALT RUBBER HOT MIX - LOWELL/WESTFIELD VT100.** (ENV1199)

*Sponsored by:* Vermont Agency of Transportation. Montpelier. VT; Federal Highway Administration.

*Project Monitor:* Graham, Craig.

*Performed by:* Vermont Agency of Transportation.

*Investigator(s):* Graham, Craig.

*Status:* Active, *Contract No.:* F029-2(11).

*Start date:* Jun 1994.

*Publication(s):* Interim reports include 94-9, U96-11 and U97-16.

In the interest of finding a solution to the problem of growing stockpiles of used tires, the state of Vermont is evaluating asphalt rubber hot mix (ARHM) technology. The wet-process, terminal-blend ARHM liquid binder used on the Lowell-Westfield Project was manufactured by Bitumar of Montreal, Quebec. Mix production, testing, and paving operations for this project were relatively trouble free. Evaluations of performance factors will continue.

### **ASSESSMENT OF WATER POLLUTANTS FROM ASPHALT PAVEMENTS CONTAINING RECYCLED RUBBER IN RHODE ISLAND.** (ENV1142)

*Sponsored by:* Rhode Island Department of Transportation.

*Performed by:* University of Rhode Island. Department of Civil and Environmental Engineering and Graduate School of Oceanography. Kingston. RI.

*Investigator(s):* Wright, Raymond M.

*Status:* Active, *Contract No.:* ME-534.

*Publication(s):* Interim report: Wright, Raymond M., K. Wayne Lee, James T. Quinn, Pradeep Vashisth and Christopher Reddy. Assessment of Water Pollutants from Asphalt Pavements Containing Recycled Rubber in Rhode Island. Rhode Island Department of Transportation. July 15, 1997. 124 p.

Final report under review.

Use of recycled rubber in asphalt pavement is widely accepted on the basis it provides a means for disposal of scrap tires and also provides advantages, e.g. saving in quantity and cost of construction materials. In this study hot mix asphalt (HMA) specimens with or without crumb rubber modifier (CRM) were analyzed for different environmental conditions. The CRM was added to HMA through both the wet and dry process. The CRM was procured from two different sources to prepare specimens (one source for each process). Cylindrical specimens were tested in the Particle Entrainment System (PES) at two different temperatures and three different pH levels. Runoff was also tested from slab and chip seal specimens subjected to light, wear and simulated rainfall.

Water samples were collected in three phases: (1) water quality extraction of individual CRM samples, (2) water quality evaluation for cylindrical HMA specimens at varying environmental conditions (pH and temperature); and (3) water quality evaluation for slab HMA and chip seal specimens under simulated rainfall. Collected water samplers were tested for trace metals and organics. A total of six metals were analyzed in the laboratory, i.e., CR,Pb, Ni, Cu,Cd, and Zn. A general trend for these metals shows that Zn had the highest concentrations of all metals and at the extreme environmental conditions, i.e., maximum asphalt pavement temperature and lowest pH, i.e., 2.0 The benzothiazoles had the highest concentrations for the organic compounds studied. The highest benzothiazole concentrations occurred at the highest temperature and at the highest pH, i.e., 12.0 conditions. Finally, based on the limited scope of this effort and comparison with water quality criteria, it appears that there is no evidence in this study that there will be a detrimental effect on the environment or to human health.

**BLENDING OF FLY ASHES. (00742092)**

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Project Monitor:* Brown, R.

*Performed by:* University of South Florida. Tampa. FL.

*Investigator(s):* Zayed, A.

*Status:* Active.

*Start date :* 4 Sep 1997; *Estimated completion date:* 1 Apr 2000.

The objective of the research is to investigate the as-received properties of single source fly ashes and their as-received properties after blending.

**COLD MIX RECYCLING OF BITUMINOUS PAVEMENTS. (00740280)**

*Sponsored by:* Federal Highway Administration.

*Performed by:* New Hampshire University. Department of Mechanical Engineering. Durham. NH.

*Status:* Active.

*Start date:* 1 Jul 1997; *Estimated completion date:* 31 Jul 1999.

No summary provided.

**COLD RECYCLED BITUMINOUS PAVEMENT. (00721670)**

*Sponsored by:* Vermont Agency of Transportation.

*Project Monitor:* Graham, Craig and Carter, Phil.

*Performed by:* Vermont Agency of Transportation. Montpelier. VT.

*Investigator(s):* Brunelle, R. E.

*Status:* Active, *Contract No.:* Report 94-3.

*Start date:* 22 Jul 1992; *Estimated completion date:* Jul 2002.

This research focuses on the cold recycle process for bituminous concrete pavement, which was utilized on VT 105 for the Troy-Newport project F034-2(10).

**COLD RECYCLED BITUMINOUS PAVEMENT DERBY CHARLESTON, VERMONT. (00721673)**

*Sponsored by:* Vermont Agency of Transportation.

*Project Monitor:* Graham, Craig and Carter, Phil.

*Performed by:* Vermont Agency of Transportation. Montpelier. VT.

*Investigator(s):* Brunelle, R. E.

*Status:* Active, *Contract No.:* Report 94-6.

*Start date:* 14 Jun 1993; *Estimated completion date:* Jun 2003.

This research investigates the process for cold recycled bituminous pavement as performed on the Derby-Charleston project STP9248(1).

**COLD RECYCLED BITUMINOUS PAVEMENT, VERMONT ROUTE 11. (00721668)**

*Sponsored by:* Vermont Agency of Transportation.

*Project Monitor:* Graham, Craig and Carter, P.

*Performed by:* Vermont Agency of Transportation. Montpelier. VT.

*Investigator(s):* Brunelle, R. E.

*Status:* Active, *Contract No.:* Report 94-1.

*Start date:* 1 Jun 1993; *Estimated completion date:* Mar 2002.

This research investigates the cold recycle process for bituminous concrete pavement that was utilized by Whitcomb Construction Company of Walpole, NH. This process was used on five continuous projects on VT Route 11 in the towns of Chester and Springfield from early June to late August 1993.

**COMBINATIONS OF POZZOLANS AND GRANULATED IRON BLAST-FURNACE SLAG FOR DURABLE HYDRAULIC CEMENT CONCRETE. (00722841)**

*Sponsored by:* Virginia Department of Transportation. Richmond. VA.

*Performed by:* Virginia Transportation Research Council. Charlottesville. VA.

*Investigator(s):* Lane, D. S.

*Status:* Active.

*Start date:* 15 May 1996; *Estimated completion date:* 30 Jun 1999.

The objective of this project is to develop guidelines for the optimization of mixture proportioning for concretes containing various combinations of Portland cement, pozzolans, and slags with respect to durability issues, mechanical properties, and construction concerns.

**COMPARISON OF CONVENTIONAL AND CRUMB RUBBER MODIFIED ASPHALT MIXTURES. (00734699)**

*Sponsored by:* Indiana Department of Transportation. Indianapolis. IN.

*Project Monitor:* Nantung, T.

*Performed by:* Purdue University/Indiana Department of Transportation JHRP. School of Civil Engineering. Purdue University. West Lafayette. IN.

*Investigator(s):* Ward, D. R.

*Status:* Active.

*Start date:* 11 Jul 1995; *Estimated completion date:* Nov 2000.

Research is needed to assess the performance and cost-effectiveness of asphalt rubber in open graded hot mix asphalt courses. Initial construction difficulties and long-term performance need to be evaluated. This research project will address those objectives by monitoring construction and performance of an ongoing construction project. Cost information will be analyzed and compared to performance to allow estimation of the cost-effectiveness of the use of CRM in this application.

**A COMPREHENSIVE PLAN FOR WASTE UTILIZATION IN HIGHWAY CONSTRUCTION AND MAINTENANCE.** (00639627)

*Sponsored by:* Kentucky Transportation Cabinet. Bureau of Highways. Division of Research. Lexington. KY.

*Project Monitor:* Hunsucker, D. Q.

*Performed by:* Kentucky Transportation Cabinet. Frankfort. KY.

*Status:* Active.

*Start date:* 1 Jul 1992; *Estimated completion date:* 1998.

*Notes:* In progress. Scheduled to be completed in summer 1998.

The objective of this research project will be to develop an expert system for development and utilization of a multiple disciplinary database that will appraise all aspects of waste utilization.

**CRUMB RUBBER MODIFIER IN ASPHALT CONCRETE PAVEMENTS.** (00642857)

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Project Monitor:* Hunt, Elizabeth.

*Performed by:* Oregon Department of Transportation. Salem. OR.

*Investigator(s):* Hunt, Elizabeth and Brooks, Eric.

*Status:* Active.

*Start date:* 1 Jan 1994; *Estimated completion date:* 1 Jun 1999.

*Publication(s):* Interim report in draft.

The objective of this research is to determine the most cost-effective type of crumb rubber-modified asphalt concrete (e.g. PBA-6GR, International Surfacing, PlusRide, or METRO RUMAC) that should be recommended for use on Oregon highways. The study will include two phases: 1) synthesizing information from a literature review and compiling information on existing projects; and 2) long-term monitoring of the ODOT crumb rubber modified asphalt concrete projects.

The research will allow ODOT staff to provide information regarding rubberized asphalt concrete pavements to the Oregon Legislature, as required. Additional benefits include identifying the cost-effectiveness of various crumb rubber modifiers in asphalt concrete for future use. Once a superior process (or processes) is identified and implemented, savings can be expected in long-term pavement costs. The savings could be realized in reduced maintenance costs due to improved pavement performance. The cost-effectiveness would be measured using a lifecycle cost analysis of the pavements.

**DEMONSTRATION PROJECT-FEASIBILITY OF USING FLY ASH AS ROADWAY EMBANKMENT AND FLOWABLE FILL.** (00714117)

*Sponsored by:* Michigan Department of Transportation.

*Project Monitor:* Smiley, D.

*Performed by:* Michigan Department of Transportation. Lansing. MI.

*Status:* Active.

*Start date:* 28 Jul 1993; *Estimated completion date:* unknown.

The objective of this project will be to demonstrate the feasibility of using fly ash to construct highway embankments and as a flowable fill (backfill) behind bridge abutments.

**DEVELOP SPECIFICATIONS RECYCLED PLASTIC IN HIGHWAY APPLICATIONS IN NEW YORK STATE.** (00726249)

*Sponsored by:* New York State Department of Transportation. Albany. NY; Federal Highway Administration. Washington. DC.

*Performed by:* New York State Department of Transportation. Albany. NY.

*Investigator(s):* Hag-Elsafi.

*Status:* Pending.

*Start date:* May 1998; *Estimated completion date:* May 1999.

*Notes:* Original project title: “DEVELOP SPECIFICATIONS RECYCLED PLASTIC IN HYWAY APPLICATIONS IN NEW YORK STATE.”

Using recycled plastic is beneficial due to its structural characteristics, such as durability, versatility, corrosion resistivity, and strength comparable to wood. The objective of this project is to identify potential highway applications in New York State for use of recycled plastic, and to develop material specifications for these applications.

**DEVELOPING A DECISION TOOL TO PREDICT THE ECOTOXICOLOGICAL IMPACTS OF TRANSPORTATION-RELATED CHEMICALS.** (ENV1210)

*Sponsored by:* Center for Transportation Studies. University of Minnesota. Minneapolis. MN.

*Project Monitor:* Hay, Steve.

*Performed by:* University of Minnesota. Department of Botany.

*Investigator(s):* Biesboer, David.

*Status:* Active.

*Start date:* FY1999; *Estimated completion date:* FY2000.

Estimating potential toxicity to human and ecosystem receptors of compounds used or released by transportation-related activities requires first estimating the compound's multi-media distribution and concentrations, from which comparisons can be made with toxicity benchmarks through and exposure assessment and risk characterization. The decision tool proposed here builds on the Indesing method detailed by Pratt et al., 1994, Chemosphere, in which concentrations estimated by a level III fugacity/aquivalence model are compared to concentration to toxicity-based concentrations. This project will expand and make key improvements to this system to improve the reliability and information content of model estimates.

The tool that will be developed in this project will connect emissions, leakage, leaching, etc., of transportation-related compounds with potential adverse effects to the surrounding ecosystem. This decision tool will ultimately provide staff at the Minnesota Department of Transportation with a user-friendly computer version of the tool.

**DEVELOPING SPECIFICATIONS FOR USING RECYCLED ASPHALT PAVEMENT AS BASE, SUBBASE OR GENERAL FILL MATERIALS.** (ENV1185)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Ho, Robert.

*Performed by:* Florida Institute of Technology.

*Investigator(s):* Cossentino, Paul.

*Status:* Active, *Contract No.:* BB-892 .

*Start date:* 1 Aug 1998; *Estimated completion date:* 1 Nov 2000.

The objectives of this project are to develop specifications for the use of RAP material in highway applications. The material's engineering properties will be investigated and guidelines will be presented for the possible use of the material as a base, sub-base, and general highway fill.



**DEVELOPMENT OF A PREDICTIVE APPROACH FOR LONG TERM ENVIRONMENTAL PERFORMANCE OF WASTE UTILIZATION IN PAVEMENTS.**  
(00740281)

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Performed by:* New Hampshire University. Department of Mechanical Engineering. Durham. NH.

*Status:* Active.

*Start date:* 15 Aug 1997; *Estimated completion date:* 30 Nov 1999.

No summary provided.

**DEVELOPMENT OF COMBINATION GLARE SCREEN/PEDESTRIAN FENCE FOR CENTER.** (ENV1040)

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Chawla, R.

*Performed by:* New Jersey Institute of Technology. Civil and Environmental Engineering.

*Investigator(s):* Saadeghvaziri, M. Ala.

*Status:* Active.

*Start date:* *Estimated completion date:* Dec 2000.

The objective of this study is to develop new designs of glare screen/pedestrian fence for the top of concrete median barriers using composite plastic posts and plastic glare screen mesh. The new design will also include an alternate design using the standard steel or aluminum glare mesh with the composite posts. The study will produce specifications and standard details for the construction of the glare screen/pedestrian fencing.

**DEVELOPMENT OF LOW-COST SOUND BARRIERS AND LAND USE ORDINANCES TO MINIMIZE FUTURE ROAD NOISE IMPACTS.** (ENV1062)

*Sponsored by:* Pennsylvania Department of Transportation. U.S. Department of Transportation.

*Project Monitor:* Byers, James.

*Performed by:* West Virginia University.

*Investigator(s):* Martinelli, D.

*Status:* Active.

*Start date:* 11 Apr 1996; *Estimated completion date:* 18 Dec 1998.

Traffic noise has long been regarded as one of the most significant environmental effects associated with both existing and new freeways. Communities located near freeways are most affected negatively by traffic noise. These communities seek relief through the construction of noise abatement devices such as barrier walls. These noise barriers are generally expensive to produce and erect, and the cost of construction often falls on the authorized transportation agency. What is needed is an approach to the problem that simultaneously addresses both the noise problems facing existing communities and the reduction of future problems through proactive prevention methods. MAUTC researchers at West Virginia University have worked with Pennsylvania DOT to investigate and develop low-cost noise abatement systems emphasizing recycled materials. Land use ordinances that minimize exposure to freeway noise while considering ancillary attributes such as aesthetics and constructibility will also be developed.

**ENVIRONMENTAL & ECONOMICAL EFFECTS OF RECYCLED MATERIALS  
HIGHWAY CONSTRUCTION. (ENV1043)**

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Baker, Robert.

*Performed by :* New Jersey Department of Transportation.

*Investigator(s):* Baker, Robert.

*Status:* Active.

*Start date: Estimated completion date:* Jun 2000.

*Notes:* Project number 7380.

The objective of this study is to continue the evaluation of recycled materials in highway construction begun under the study “Use of Recycled Materials in Highway Construction,” in cooperation with the New Jersey Department of Environmental Protection and Energy, and to evaluate the long term pavement durability, environmental concerns, and the cost effectiveness of the recycled materials in bituminous concrete pavements and in highway construction.

**EVALUATION OF COLD ASPHALTIC CONCRETE PAVEMENT RECYCLING.  
(00617729)**

*Sponsored by:* Wisconsin Department of Transportation.

*Project Monitor:* Sharma, A.

*Performed by:* Wisconsin Department of Transportation. Madison. WI.

*Investigator(s) :* Wilson, Joe.

*Status:* Active, *Contract No.:* Study no. 91-02.

*Start date: 1 May 1991; Estimated completion date:* Dec 1999.

Goals of this project are: (1) To document construction procedures for cold recycled surface courses; (2) To develop design standards and construction specifications; and (3) To develop test methods/procedures and criteria to evaluate performance.

**EVALUATION OF COMPOSTED MATERIALS TO BE UTILIZED IN ROADSIDE  
PLANTINGS. (00744192)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Henry, Gary.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville. FL.

*Investigator(s):* Black, R.

*Status:* Active.

*Start date: 15 Aug 1995; Estimated completion date:* 30 Nov 1998.

The Department is required by law to use recyclable materials in construction and maintenance. This project provided the information needed for proper use of the various composted waste materials in roadside plantings.

**EVALUATION OF FIELD PROJECTS USING CRUMB RUBBER MODIFIED  
ASPHALT CONCRETE. (ENV1133)**

*Sponsored by:* Louisiana Transportation Research Center.

*Performed by:* Louisiana Transportation Research Center.

*Investigator(s):* Abadie, Chris.

*Status :* Active, *Contract No.:* 95-5B.

*Start date: 1 Jun 1996; Estimated completion date:* 30 Jun 2005.

Because of the ISTEA mandate to use crumb rubber materials in asphalt concrete, Louisiana will

examine various technologies to determine the best alternative from the perspective of cost, construction, and performance. The objective of this study is to evaluate the field performance of five construction projects using six different crumb rubber-modified asphalt concrete technologies. All projects have control sections consisting of a 3.5-inch overlay with conventional materials. Five field evaluations will be conducted on each project over a ten-year period to include: pavement distress survey, rideability, and structural strength. In addition, roadway cores will be taken and evaluated in the lab for densification, aggregate gradation and binder properties. Field evaluations are planned for 1, 2, 4, 7, and 10 years after construction.

**EVALUATION OF GROUND, GRANULATED BLAST FURNACE SLAG.** (ENV1134)

*Sponsored by:* Louisiana Transportation Research Center.

*Performed by:* Louisiana Transportation Research Center.

*Investigator(s):* Duos, Craig.

*Status:* Active, *Contract No.:* 96-3C.

*Start date:* 1 Dec 1995; *Estimated completion date:* 30 Jun 1999.

The purpose of this study is to investigate the properties of ground, granulated blast furnace slag as a cement substitute for use in structural and paving concrete. This material has been proposed for use under EPA guidelines. Use of this material has been limited to several states in the northeast US due to plant location and economic constraints. A plant has recently been established in Louisiana. Documentation filed in support of the EPA guidelines indicates that this material demonstrates slow set and strength gain properties. This study will determine suitability for use in Louisiana.

**EVALUATION OF PORTLAND CEMENT CONCRETES CONTAINING GROUND GRANULATED BLAST FURNACE SLAG.** (ENV1313)

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Keeran, Keith.

*Performed by :* University of Akron.

*Investigator(s):* Sehn, Allen.

*Status:* Active, *Contract No.:* 14559(0).

*Start date:* 16 Aug 1993; *Estimated completion date:* 16 Feb 1999.

The objectives of this research are:

- (1) To investigate the strength, durability and workability of several concretes containing different percentages of ground granulated blast furnace slag (GGBFS) as a partial replacement for Portland cement;
- (2) To evaluate the strength, durability and workability of concretes with 15% of the Portland-GGBFS combination replaced with Class C fly ash and with Class F fly ash; and
- (3) To evaluate the strength, durability and workability of standard ODOT Class S and Micro-silica concretes.

**EVALUATION OF RECYCLED MATERIALS FOR ROADSIDE APPURTENANCES.** (00744248)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Performed by:* Florida Department of Transportation. Tallahassee. FL.

*Investigator(s):* Kessler, R.

*Status:* Active, *Contract No.:* HPR-2(158).

*Notes:* This record is questionable; status could not be determined.

The objective of this study is to evaluate composite materials such as plastics that could be used

for roadside safety hardware.

**EVALUATION OF RECYCLED RUBBER MULCH PRODUCTS BY GDOT. (ENV1176)**

*Sponsored by:* Georgia Department of Transportation.

*Performed by:* Georgia Department of Transportation.

*Investigator(s):* Jared, David.

*Status:* Active, *Contract No.:* SRS 9808.

*Start date:* 24 Aug 1997; *Estimated completion date:* 24 Aug 2000.

No summary provided.

**EVALUATION OF SHREDDED TIRE EMBANKMENT. (ENV1135)**

*Sponsored by:* Louisiana Transportation Research Center.

*Performed by:* Louisiana Transportation Research Center.

*Investigator(s):* Morvant, Mark.

*Status:* Active, *Contract No.:* 98-1GT.

*Start date:* 1 Dec 1998; *Estimated completion date:* 1 Dec 2000.

This research proposal includes a laboratory program to determine the engineering properties of shredded tire chip embankment materials for use a lightweight embankment. The laboratory program will include: 1) large direct shear testing to determine the mechanical properties of the tire chips; 2) a series of short duration geotechnical centrifuge model tests in which chip gradation, embankment height, and chip zone geometry are varied to obtain settlement data; 3) large diameter one-dimensional laboratory compression tests; 4) long-duration geotechnical centrifuge tests simulating a high embankment to explore whether pyrolosis or fire can be induced; and 5) pressurized insulated long term lysimeter tests to attempt to initiate fire or pyrolosis. The analysis will include development of an analytical/numerical model to predict consolidation parameters for design purposes. A cost/benefit analysis will be performed to determine the competitive benefits for alternative recyclable applications.

**EVALUATION OF SOURCE SEPARATED COMPOST FOR CONNDOT PROJECTS. (ENV1139)**

*Sponsored by:* Connecticut Department of Transportation.

*Project Monitor:* Sime, James M.

*Performed by:* University of Connecticut.

*Investigator(s):* Demars, Kenneth R. and Long, Richard P.

*Status:* Active, *Contract No.:* ConnDOT/UConn Cooperative Research Program Study No. JH 96-5.

*Start date:* 31 Dec 1997; *Estimated completion date:* 31 Jan 1999.

*Publication(s):* Final report anticipated by the end of the first quarter, 1999.

*Notes:* Evaluation is in final stages.

The objective of this research study is to perform laboratory and field testing of the physical and chemical properties and behavior of source-separated compost for use on ConnDOT construction projects. The two applications of interest are the use of compost as erosion-control mulch on slopes and as an erosion-control filter berm. Results are used to verify the CONEG Model Procurement Specifications for Source-Separated Compost.

**FIELD APPLICATION AND EVALUATION OF ASH RESIDUE AS HIGHWAY SUBBASE AND ASPHALT ADMIXTURE IN ROADWAY CONSTRUCTION.**

(00742085)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Ho, Bob.

*Performed by:* University of Central Florida. Orlando. FL.

*Investigator(s):* Fadiora, T.

*Status:* Active.

*Start date:* 15 May 1997; *Estimated completion date:* 15 May 1999.

The objective of the research is to evaluate the performance of ash residue from municipal waste incinerator in a field application to study the implementation of results of previously funded research and to demonstrate the potential use of the residue as a sub-base material.

**FIELD STUDY OF A SHREDDED TIRE EMBANKMENT.** (00644127)

*Sponsored by:* Virginia Department of Transportation. Richmond. VA; Federal Highway Administration. Washington. DC.

*Performed by:* Virginia Transportation Research Council. Charlottesville. VA.

*Investigator(s):* Hoppe, E. J.

*Status:* Active.

*Start date:* 17 Jun 1993; *Estimated completion date:* 31 Dec 1999.

The objective of this research project is to compare settlements, soil pressures, construction methods, and costs of a shredded tire embankment with those of a conventional embankment. The embankments will be approximately 25 feet high. The shredded tire embankment will consist of a 50/50 volumetric ratio of tires to soil and the data will be collected by an electronic datalogger hooked up to earth pressure cells and settlement sensors.

**GLASPHALT PAVEMENT CONSTRUCTION.** (ENV1198)

*Sponsored by:* Vermont Agency of Transportation.

*Project Monitor:* Graham, Craig.

*Performed by:* Vermont Agency of Transportation.

*Investigator(s):* Graham, Craig.

*Status:* Active.

*Start date:* Summer 1994; *Estimated completion date:* Summer 2000.

*Publication(s):* Interim reports include V92-4, V93-8, and V97-1.

This research study documents the use of waste crushed glass as a portion of the coarse aggregate in a bituminous concrete pavement surface course on Vermont Route 12 in Handland, Vermont.

**IMPACTS OF SIGNIFICANT WASTE MATERIALS UTILIZED IN HIGHWAY CONSTRUCTION MODIFICATIONS.** (Fed 00164600)

*Sponsored by:* Federal Highway Administration. Turner-Fairbank Highway Research Center. McLean. VA.

*Project Monitor:* Banks, Fred.

*Performed by:* Orange State University.

*Investigator(s):* Eldin, Neil and Huber, Wayne.

*Status:* Active, *Contract No.:* DTFH61-96-X-00020.

*Start date:* 15 Jul 1996; *Estimated completion date:* 31 Dec 1999.

No summary provided.

**INCINERATOR ASH AS A SUBSTITUTE AGGREGATE IN BITUMINOUS CONCRETE. (ENV1129)**

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor :* Vitillo, Nicholas.

*Performed by:* Chesner Engineering.

*Investigator(s):* Chesner, Warren.

*Status:* Active.

*Start date:* Jun 1995; *Estimated completion date :* Jun 1991.

*Notes:* Monitored by a task force which includes NJDEP, Port Authority of NY/NJ, NJDOT, Long Island Planning Board and NYSEKDA.

The purpose of this project is to evaluate, through laboratory and full-scale field testing, the engineering properties of municipal solid waste incinerator ash for use as a substitute aggregate in bituminous concrete. The environmental stability of the material to contain leachates will also be determined.

**INCORPORATION OF RECLAIMED ASPHALT PAVEMENT IN THE SUPERPAVE SYSTEM. (ENV1228)**

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board, Washington. DC.

*Project Monitor:* Harrigan, Edward.

*Performed by:* North Central Superpave Center. Purdue University.

*Investigator(s):* McDaniel, Rebecca.

*Status:* Active, *Contract No.:* Project 9-12.

*Start date :* 1 Apr 1997; *Estimated completion date:* 31 Mar 1999.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>). Copies of the Phase I report are available for loan. Although there is widespread use of reclaimed asphalt pavement (RAP), research performed under the Strategic Highway Research Program (SHRP) did not address the issues associated with use of RAP in hot-mix asphalt mixtures. Consequently, the Superpave system developed under SHRP did not provide guidelines to characterize asphalt binders extracted from RAP and recycled hot-mix asphalts. Because Superpave is gradually becoming the sole means for design and analysis of asphalt mixtures, research is needed to develop guidelines and procedures that will incorporate RAP in the Superpave system.

The objectives of this research are to (1) develop guidelines for incorporating RAP in the Superpave system and (2) prepare a manual that can be used by laboratory and field technicians.

Accomplishment of these objectives will require at least the following tasks:

Phase I: (1) Review and evaluate literature dealing with specifications, test procedures, and design methods for use of RAP. (2) Review and evaluate research related to the use of RAP within the Superpave system currently underway by FHWA, state departments of transportation, industry groups, and other organizations. (3) Review and evaluate results of NCHRP Project 9-7, "Field Procedures and Equipment to Supplement SHRP Asphalt Specifications," to determine adaptability of the recommended field quality control and quality assurance (QC/QA) procedures for RAP mixtures. (4) Review and evaluate binder extraction and recovery procedures and recommend an appropriate method for use in the Superpave system. (5) Review and evaluate SUPERPAVE binder test methods relative to the characterization of recovered asphalt. (6) Based on the results of Tasks 1 through 5, develop a plan, to be executed in Task 8, to develop, evaluate, and validate guidelines for incorporating RAP in the Superpave system. The plan shall describe the proposed laboratory and field testing program. (7) Prepare an interim report that (a)

documents the research performed in Tasks 1 through 6 and (b) provides an updated work plan for Phase II based on the work performed in Task 6. Following review of the interim report by the NCHRP, the research team will be required to make a presentation to the project panel. Work on Phase II of the project will not begin until the interim report is approved by the NCHRP.

Phase II: (8) Execute the plan approved in Task 7. (9) Based on the results of Task 8, recommend guidelines for incorporating RAP in the Superpave system. The guidelines shall include processes for mixture design and field quality control and be suitable for use by paving and materials engineers. (10) Prepare a manual that provides a step-by-step procedure for incorporating RAP in the Superpave system. The manual shall be suitable for use by laboratory and field technicians. (11) Develop an implementation plan for moving the results of this research into practice. The implementation plan must discuss the applicability of the research results to highway practice, the expected benefits to the using agency, and the actions that need to be taken to ensure the use of the research results. (12) Submit a final report that documents the entire research effort. The guidelines and manual shall be prepared as stand-alone documents.

Status: Phase I, which includes Tasks 1 through 6, was completed in August 1997. Results were reported in the first interim report, which also included the Phase II work plan. At its meeting in October 1997, the project panel approved the work plan and authorized the research agency to begin work on Phase II.

At present, Phase II is 4 to 5 months behind schedule. The agency experienced difficulty obtaining the materials required for the Phase II experiments and significant equipment problems. A panel meeting to assess progress on Phase II was scheduled for August 31, 1998.

**INVESTIGATION OF THE USE OF RECYCLED POLYMER MODIFIED ASPHALT IN ASPHALTIC CONCRETE PAVEMENTS. (ENV1137)**

*Sponsored by:* Louisiana Transportation Research Center.

*Performed by:* Louisiana Transportation Research Center.

*Investigator(s):* Mohammad, Louay N.

*Status:* Active.

*Start date:* 1 Jul 1998; *Estimated completion date:* 30 Jun 2001.

The Board of Regents, through its Louisiana Education Quality Support Funds (LEQSF) has recommended funding the proposal "Investigation of the Use of Recycled Polymer Modified Asphalt in Asphaltic Concrete Pavements" submitted by Dr. Louay N. Mohammad. The project is funded for \$221,250 of which LADOTD will be providing \$41,250 as cost sharing. The objective of the LEQSF study is to evaluate the fundamental properties of recycled asphalt pavements containing polymer modified asphalt cement. To achieve this goal, chemical properties and engineering (rheological) properties of aged polymer modified asphalt cements (PMAC) will be evaluated using chemical analytical methods and Superpave binder tests. Different proportions of reclaimed polymer modified asphalt pavement mixtures will be characterized by a suite of fundamental engineering tests including the Superpave Shear Tester protocols. The results of this research will give a practical guide to design quality hot asphalt mixtures that utilize the maximum amount of polymer modified recycled asphalt pavements (PMRAP).

**INVESTIGATION OF WASTE TIRES IN LANDSCAPING APPLICATIONS.** (ENV1163)

*Sponsored by:* South Carolina Department of Transportation.

*Project Monitor:* Sanders, Michael R.

*Performed by:* South Carolina Department of Transportation.

*Investigator(s):* Sanders, Michael R.

*Status:* Active, *Contract No.:* Research project no. 580 .

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 2000.

This study evaluates the performance of scrap tires used as landscaping materials at test sites in South Carolina. The performance and economic value of using shredded tires in this application will be determined. Recommendations will be made on future use of this material.

**A LABORATORY AND FIELD EVALUATION OF THE USE OF WASTE MATERIALS IN CONSTRUCTION OF A REST AREA.** (ENV1164)

*Sponsored by:* South Carolina Department of Transportation.

*Project Monitor:* Swygert, Terry.

*Performed by:* Clemson University.

*Investigator(s):* Amir Khanian, Serji.

*Status:* Active, *Contract No.:* SPR 586.

*Start date:* 3 Sep 1998; *Estimated completion date:* 2 Sep 1999.

This study was developed as a field evaluation for waste materials investigated by Research Project No. SPR 577. The objective of this project is to conduct a field evaluation of asphalt containing waste shingles, recycled plastic used as fence posts, sign posts, etc., and use of clearing and grubbing debris at a rest area in South Carolina.

**A LABORATORY AND FIELD EVALUATION OF THE USE OF WASTE MATERIALS IN HIGHWAY CONSTRUCTION.** (ENV1162)

*Sponsored by:* South Carolina Department of Transportation.

*Project Monitor:* Swygert, Terry.

*Performed by:* Clemson University.

*Investigator(s):* Amir Khanian, Serji.

*Status:* Active, *Contract No.:* SPR 577.

*Start date:* 1 Jun 1996; *Estimated completion date:* 31 Dec 1998.

*Publication(s):* Final report in preparation.

The objective of the study is to investigate the use of five waste materials in highway construction applications. The materials are waste tires in applications other than asphalt; shingles; plastic; glass; and clearing and grubbing debris. The study includes an extensive literature search and laboratory testing. Originally, the project included field tests of some of the materials in various applications. However, due to problems locating suitable test sections in the time frame of this project, the scope of the study was modified to delete field testing.

**LASER REMOVAL OF PAINT ON PAVEMENT.** (ENV1248)

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Investigator(s):* Pew, Hans.

*Status:* Active, *Contract No.:* Project 20-30, IDEA 16.

*Start date:* *Estimated completion date:* 30 Sep 1998.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).



This project is developing a mobile highway paint removing system based on pulsed laser. An experimental system using a neodymium doped yttrium aluminum garnet (Nd:YAG) laser was fabricated and evaluated to optimize various operating parameters (laser energy, wavelength, pulse duration, heating rate, etc.). The results demonstrated the system's potential to provide an environmentally safe paint removal technology, but it lacked adequate power to achieve paint removal at rates comparable to that achieved by sandblasting. The contractor has now acquired a new high power laser system that produces the desired short (12 ns) pulses at a wavelength of 1.06  $\mu\text{m}$ . This new laser is rugged, compact (25 lb), safe, and easy to operate and maintain. The contractor is currently working with industrial partners to build a prototype mobile unit using the new laser. The laser has been modified to meet the required specifications. Optical components of the system have been procured, and two types of laser scanners have been built to move across the painted stripe in a manner to obtain adequate coverage. Drawings of the laser and its associated equipment have been provided to a manufacturer to assemble the field prototype. After laboratory testing, initial road tests will be performed in Las Vegas, NV. This will be followed by a field demonstration in collaboration with Nevada DOT.

**MAGNITUDE ASSESSMENT OF FREE AND HYDRATED LIMES PRESENT IN RPCC AGGREGATES. (ENV1316)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Morse, Aric.

*Performed by:* University of Toledo.

*Investigator(s):* Gupta, Jiwan.

*Status:* Active, *Contract No.:* 14676(0).

*Start date:* 31 Mar 1997; *Estimated completion date:* 30 Sep 1999.

The objectives of this research are:

(1) To document the primary source of aggregate for the Portland cement concrete (PCC) pavement in the State of Ohio; (2) To characterize recycled PCC (RPCC) for tufa potential and establish the role of aggregates in RPCC for tufa forming potential; (3) To study the formation of  $\text{Ca}(\text{OH})_2$  and  $\text{CaCO}_3$  in the RPCC in the course of leaching by utilizing thermogravimetric (TG) analysis process and differential scanning calorimeter (DSC) unit; (4) To perform kinetic analysis of the hydration process of cement paste in the production of free lime and portlandite; (5) To study under controlled conditions the leaching of various ions, especially  $\text{CA}^{2+}$  from the RPCC. This can be achieved using atomic absorption spectrometry or associated techniques; and (6) To develop a simple test to determine tufa potential of recycled Portland cement concrete aggregate.

**MONITORING PROGRAM FOR NORTH YARMOUTH TIRE CHIP FIELD TRIAL.**

(00739100)

*Sponsored by:* Maine Department of Transportation.

*Project Monitor:* Peabody, Dale.

*Performed by:* Maine Department of Transportation.

*Investigator(s):* Humphrey, Dana N.

*Status:* Active, *Contract No.:* 96-4.

*Start date:* Aug 1993; *Estimated completion date:* Jul 1999.

*Publication(s):* Interim report being prepared.

A field trial using tire chips as conventional embankment fill was constructed on the approach fill for the Route 231 bridge over the Maine Central Railroad in North Yarmouth. The Field Trial was constructed in late August 1993, under the MDOT research project titled, "Field Trial Using Tire Chips in a Conventional Embankment Fill." The purpose of the field trial was twofold: (1) to evaluate roadway performance and the support characteristics of a road underlain by tire chips;

and (2) to investigate the effect on water quality of tire chip fills located above the groundwater table. The construction and short term evaluation of the support characteristics of the field trial is being carried out under Research Project No. 92-2. However, to assess the long-term performance of this field trial it is necessary to monitor the project for five years.

**MONITORING PROGRAM FOR TWO TIRE CHIP FILLS ON THE TOPSHAM-BRUNSWICK BYPASS PROJECT. (ENV1124)**

*Sponsored by:* Maine Department of Transportation.

*Project Monitor:* Peabody, Dale.

*Performed by :* University of Maine.

*Investigator(s):* Humphrey, Dana N.

*Status:* Active, *Contract No.:* 95-22.

*Start date:* *Estimated completion date:* Jun 2002.

*Publication(s):* Interim report being prepared.

In the first project tire shreds were used as a compressible inclusion to reduce pressures on a rigid frame bridge. Earth pressures were reduced by more than 50 percent. In the second project, a 4.3-m thick zone of tire shreds was used as lightweight fill to improve global stability of a bridge approach fill founded on weak clay. In addition, the tire shreds reduced horizontal pressure on the bridge abutment. These were the first projects to incorporate design features to minimize internal self-heating of tire shred fills. Measured temperatures showed that no deleterious self-heating occurred. These projects demonstrate that tire shreds can be used as lightweight fill for retaining walls and embankments. Moreover, properly designed tire shred fills do not experience a deleterious self-heating reaction.

**OHIO DEPARTMENT OF TRANSPORTATION WASTEWATER TREATMENT PLANT TELEMETRY MONITORING PILOT PROJECT. (ENV1315)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Tatman, Bob.

*Performed by:* Sharp Technologies.

*Investigator(s):* Bloch, Raymond.

*Status:* Active, *Contract No.:* 14657(0).

*Start date:* 1 Jul 1996; *Estimated completion date:* 1 Jan 1999.

The objective of this research is to install a state-of-the-art telemetry system at District 9 - Pike County, rest area WWTP. The telemetry system will provide access to operational process parameters via on-site process computer with software, process instrumentation, modem and phone line at the remote site. Remote monitoring is a system of sensors and electronic controls that provide the ability to view and modify the action of various valves and devices via a phone and computer. ODOT is interested in monitoring of WWTPs at remotely located rest areas because it may prove less costly than sending WWTP personnel to site daily.

**PERFORMANCE EVALUATION OF CRUMB RUBBER MODIFIED ASPHALT PAVEMENTS. (00744253)**

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL; Federal Highway Administration. Washington. DC.

*Performed by:* Florida Department of Transportation. Tallahassee. FL.

*Investigator(s):* Musselman, J.

*Status:* Active, *Contract No.:* HPR-2(166).

*Notes:* This record is questionable; status could not be determined.

The objectives of this investigation are to develop CRM mix design procedures, construction guidelines, and long-term performance data.

**PERFORMANCE OF CONSTRUCTION FEATURES INCORPORATING RECYCLED MATERIALS.** (00610509)

*Sponsored by:* North Carolina Department of Transportation. Division of Highways. Raleigh. NC; Federal Highway Administration. Washington. DC.

*Project Monitor:* Strong, M. P.

*Performed by:* North Carolina Department of Transportation. Division of Highways.

*Investigator(s):* Stanley, M. T.

*Status:* Active.

*Start date :* 1 Mar 1991; *Estimated completion date:* 30 Jun 1999.

*Publication(s):* Interim Report: Padgett, T.H. and M.T. Stanley. Performance of Construction Features Incorporating Recycled Materials. April 1996. North Carolina Department of Transportation. Report No. NC-170-3(26)-01.

*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

The Department is investigating the in-service performance of construction products, materials, and features that incorporate either recycled or recyclable materials. Elements to be monitored include a tire retaining wall, shredded tire embankment material, plastic fencing and posts, roadway delineators and barricades, traffic signal housings, and rubber filled bituminous concrete mixtures.

**PHYSICAL AND MECHANICAL PROPERTIES OF RECYCLED PCC AGGREGATE CONCRETE.** (Fed 00164222)

*Sponsored by:* Federal Highway Administration. Turner-Fairbank Highway Research Center. McLean. VA.

*Project Monitor:* Forster, S.

*Performed by:* University of Minnesota. Minneapolis. MN.

*Status:* Active, *Contract No.:* DTFH61-93-C-00133.

*Start date:* 1 Nov 1993; *Estimated completion date:* 30 Jun 1998.

Objectives of this project are to gather data on the physical and mechanical behavior of recycled PCC aggregate and PCC containing this aggregate; and based on this data develop guidelines for using these materials in terms of evaluation tests, mix design procedures, and mixing and construction procedures.

**RECYCLABILITY OF RUBBER MODIFIED ASPHALT PAVEMENTS.** (00674872)

*Sponsored by:* Wisconsin Department of Transportation. Madison. WI; Federal Highway Administration Washington. DC.

*Project Monitor:* Johnson, K.

*Performed by:* Wisconsin Department of Transportation. Madison. WI.

*Investigator(s):* Wilson, Joe.

*Status:* Active, *Contract No.:* Study no. 93-01a.

*Start date:* 1 Apr 1993; *Estimated completion date:* Dec 1999.

The objective of this research is to determine recyclability of rubber modified asphalt pavements with respect to design, construction, performance, cost, and environmental impacts.

**RECYCLABILITY OF RUBBER MODIFIED ASPHALT PAVING.** (00633206)

*Sponsored by:* Mississippi Department of Transportation.

*Project Monitor:* Crawley, A. B.

*Performed by:* Mississippi State Highway Department. Jackson. MS.

*Investigator(s):* Albritton G.A.

*Status:* Active, *Contract No.:* MS-DOT-RD-96-115.

*Start date:* 2 Jun 1993; *Estimated completion date:* 30 Sep 1999.

*Publication(s):* Interim Report: Albritton, Gayle E. and Glynn R. Gatlin. 1996. Construction and Testing of Crumb Rubber Modified Hot Mix Asphalt Pavement. Mississippi Department of Transportation. 75 p. Report no. FHWA/MS-DOT-RD-96-115.

*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

The primary objective of this study is to determine the engineering characteristics and to monitor the performance of HMA containing CRMHMA RAP when used as a surface course. A secondary objective is to further document the construction, engineering characteristics, and performance of CRMHMA RAP.

Investigators will design and construct 3½ -mile sections of crumb rubber modified asphalt pavements, a 1½ -mile section of full depth pavement, and a 1½ -mile section of control pavement; mill and recycle the pavements after limited service life; and incorporate rap into new paving materials. Research involves both performance monitoring and environmental testing of recycled materials containing crumb rubber modifier.

**RECYCLABLE PLASTIC DITCH CHECKS.** (ENV1151)

*Sponsored by:* Missouri Department of Transportation.

*Performed by:* Missouri Department of Transportation.

*Investigator(s):* Imhoff, Vince.

*Status:* Active, *Contract No.:* PD96-013.

*Start date:* Mar 1997; *Estimated completion date:* Jun 1998.

This research study involves field tests on multiple projects to determine if silt stopper ditch checks by Panel Products, Inc., will perform adequately as an acceptable alternative to traditional straw bale ditch checks for controlling erosion sediment during the life of the project or until permanent erosion control is established and functioning. Acceptability will be based on guidelines and testing requirements of the Missouri Department of Natural Resources. The product has been accepted for use. Observations and further field evaluations are ongoing.

**RECYCLED CONCRETE USED AS A BASE MATERIAL.** (00617821)

*Sponsored by:* Minnesota Department of Transportation; Federal Highway Administration.

*Performed by:* Minnesota Department of Transportation. St Paul. MN.

*Investigator(s):* Hagen, M.

*Status:* Active.

*Start date:* 1 Aug 1989; *Estimated completion date:* 1 Aug 1999.

The goal of this project is to determine if recycled concrete and bituminous pavements can be used as base material in new pavements. Much of this material is presently disposed of in landfills.

**RECYCLED MATERIALS IN PORTLAND CEMENT CONCRETE. (ENV1042)**

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Chmiel, Anthony.

*Performed by:* New Jersey Institute of Technology. Civil and Environmental Engineering.

*Investigator(s):* Ansari, Farhad and Maher, M.

*Status:* Active, *Contract No.:* Project number 7330.

*Start date:* *Estimated completion date:* Feb 1999.

*Publication(s):* Final report is in preparation.

The objective of this study is to develop Portland cement concrete mixes using recycled materials as additives to enhance the properties of the concrete and to eliminate the need to landfill such resources. The study will develop specifications for the use of street sweepings, slag cement, and other recycled materials in concrete curbing, sidewalks, and other concrete construction.

**RECYCLED MATERIALS IN ROADSIDE SAFETY DEVICES. (SWUTC 414588)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Pankey, Chris.

*Performed by:* Texas A&M University.

*Investigator(s):* Bligh, Roger P.

*Status:* Completed.

*Start date:* 1 Sep 1994; *Estimated completion date:* 30 Aug 1998.

*Publication(s):* Final report in progress

The objectives of this study are to: (a) determine fundamental properties of recycled materials that may be suitable for use in roadside safety systems or components therein, and to determine the availability, cost, and potential suppliers of these materials; (b) identify existing or commercially available roadside safety system products manufactured in part or in whole from recycled materials; (c) conceptualize new roadside safety system designs using recycled materials; and (d) develop recommended standards and specifications for acceptable designs.

**RECYCLED PLASTIC FIBERS FOR ASPHALT MIXTURES. (ENV1041)**

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Chmiel, Anthony.

*Performed by:* New Jersey Institute of Technology. Civil and Environmental Engineering.

*Investigator(s):* Labib, M.

*Status:* Active.

*Start date:* *Estimated completion date:* Dec 1998.

*Publication(s):* Final report is in preparation.

The major objectives of the proposed research are:

(1) To define various high volume plastic fibers waste materials that can be used in asphalt pavement applications; (2) To develop innovative processing to use plastic fibers in asphalt mixture, stabilized base course, and pothole patching materials; (3) To develop mix design to incorporate plastic fibers into mixtures to produce improved and superior properties; and (4) To use several testing methods to identify SHRP mix design parameters for these new materials.

**RECYCLED PLASTICS FOR HIGHWAY APPURTENANCES. (ENV1039)**

*Sponsored by:* New Jersey Department of Transportation.

*Project Monitor:* Chawla, R.

*Performed by:* New Jersey Institute of Technology. Civil and Environmental Engineering.

*Investigator(s):* Saadeghvaziri, M. Ala.

*Status:* Active, *Contract No.:* Project number 7630.

*Start date:* *Estimated completion date:* Dec 1998.

*Publication(s):* Draft final report: Saadeghvaziri, M. Ala. and Keith M. MacBain. 1998. *Recycled Plastics for Highway Appurtenances.* 100 p.

The objective of this study is to develop the use of co-mingled recycled plastics for highway appurtenances such as noise walls and guiderail components. Through analytical studies, mechanical properties will be identified to satisfy the performance and geometric requirements of the developed appurtenances. Wind tunnel and impact tests will be performed on the critical structure components. Using CAD and expert systems techniques, noise analysis and design of noise and guiderail will be developed for the noise wall and guiderail specifications.

**RECYCLED TIRES IN VIRGIN ASPHALT CONCRETE PAVEMENT.** (00617863)

*Sponsored by:* Wisconsin Department of Transportation.

*Project Monitor:* Schmiedlin, R.

*Performed by:* Wisconsin Department of Transportation. Madison. WI.

*Investigator(s):* Bischoff, D. L.

*Status:* Active, *Contract No.:* Study no. 89-04.

*Start date:* 1 Jul 1990; *Estimated completion date:* Dec 1999.

To improve pavement performance by reducing reflective cracking and water proofing pavement surfaces also to reduce the amount of discarded tires going into landfills.

**RECYCLING OF MIXED GLASS.** (ENV1219)

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Ruiz, Micky M.

*Performed by:* Center for Transportation Studies. University of Minnesota.

*Investigator(s):* Trenda, Cheri.

*Status:* Active, *Contract No.:* 98-034C.

*Start date:* 1 Jun 1998; *Estimated completion date:* 30 Nov 1999.

The primary objective is to expand implementation of local recycling of mixed glass into road construction projects such that the actual recycling rate increases throughout Minnesota. As a result of this project, glass will be used by local public works departments on an ongoing basis as a partial substitute for traditional aggregate in a way that: 1) reduces costs; 2) maintains, if not improves, aggregate performance in road construction; and 3) conserves supplies of natural aggregates. Material specifications will be developed based on variable research data that will allow for clear communication between users such as public works departments and glass suppliers.

The primary audiences for this project will be county and city engineers and their road construction contractors. Secondary audiences include: a) county solid waste administrators and their private sector recycling contractors; b) Mn/DOT engineering and environmental staff; c) general contractors, consulting engineers, and entrepreneurs; and d) other state agency staff such as MOEA, Minnesota Pollution Control Agency (MPCA), and the Department of Natural Resources (DNR).

Results of this project should lead directly to greater local recycling of glass to serve as an economically competitive aggregate supplement. Recycled glass product specifications will be made more precise so that producers can better design glass processing systems. Once more counties implement this type of recycling system, mixed glass will be continuously produced as an environmentally safe and cost-effective supplement to traditional aggregate.

Benefits will include improved understanding by local officials and their contractors about the potential uses of mixed glass, the specifications for use of mixed glass in road construction projects, and the processing technologies available. This project will also result in improved communication between local suppliers and local users, as well as improved interagency coordination for technology transfer in the use of waste products in road construction.

**RECYCLING PROCESS WATER IN READY-MIXED CONCRETE OPERATIONS.**  
(00742091)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Project Monitor:* Bergin, Michael.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville. FL.

*Investigator(s):* Chini, A. S.

*Status:* Active.

*Start date:* 1997; *Estimated completion date:* 1 Jan 1999.

The objective of the research is to develop water-quality standards that address reuse of batch plant process water in the production of fresh concrete, with specific limits of chemical constituents that would affect concrete durability or other physical/chemical properties.

**REVIEW OF PENNDOT PUBLICATION 408 SPECIFICATIONS FOR THE USE OF RECYCLED AND CO-PRODUCT MATERIALS.** (ENV1132)

*Sponsored by:* Pennsylvania Department of Transportation.

*Project Monitor:* Zimmerman, Doug.

*Performed by:* Pennsylvania State University.

*Investigator(s):* Tikalsky, Paul.

*Status :* Active.

*Start date:* 2 Feb 1998; *Estimated completion date:* 1 Feb 1999.

As part of PennDOT's commitment to make the highway infrastructure compatible with the environment and responsive to the need to conserve and reuse high-quality materials, PennDOT seeks reliable methods to use these materials in construction materials that will improve the quality or life-cycle cost of constructed projects. The purpose of this research is to review PennDOT Publication 408 for technically sound uses or recycled and co-products materials in the highway infrastructure. This includes institutional or perceived institutional barriers for the use of these materials (glass, tires, slag, foundry sand, and fry ash).

**RISK BASED MANUAL FOR USE OF CONTAMINATED MATERIAL.** (SWUTC 418078)

*Sponsored by:* Texas Department of Transportation.

*Performed by:* Texas Transportation Institute.

*Investigator(s):* Overman, John.

*Status:* Active.

*Start date:* 1 Sep 1997; *Estimated completion date:* 30 Apr 1999.

The discovery of contaminated soil and the inappropriate use of recycled materials on transportation construction sites affects those projects through project delays, remediation or site clean-up, project redesign, and increased project cost. The appropriate use of contaminated soil as recyclable material, however, although not without risk, offers an opportunity to conserve project costs. Environmental risk-based assessment is currently being used by most states to determine what corrective action to take when contamination is present, but it can also be used to

identify and evaluate contaminated and recyclable materials for use as highway construction materials. This project will review existing risk-based methods and develop a risk-based manual that is representative of, and specifically tailored to the transportation industry and, more specifically, TxDOT. The manual will focus on determining whether or not contaminated soils discovered in situ and proposed recyclable materials for construction on transportation sites can be used while protecting human health and ecological receptors.

**SOIL STABILIZATION USING RECYCLED PLASTIC.** (ENV1148)

*Sponsored by:* Missouri Department of Transportation.

*Project Monitor:* Fritz, Mike.

*Performed by:* University of Missouri - Columbia.

*Investigator(s):* Bowder, John and Loehr, Erik.

*Status:* Pending.

*Start date:* 15 Jan 1999; *Estimated completion date:* 15 Apr 2000.

*Notes:* Phase I - Further phases anticipated.

The objective of this research study is to develop recycled plastic pin technology for use in stabilizing earth slopes or remediation of highway slopes and embankments.

**TIRE CHIPS IN THE BASE COURSE OF A LOCAL ROAD.** (ENV1197)

*Sponsored by:* Vermont Agency of Transportation.

*Project Monitor:* Graham, Craig.

*Performed by:* Vermont Agency of Transportation.

*Investigator(s):* Graham, Craig.

*Status:* Active.

*Start date:* Jul 1990.

*Publication(s):* Interim reports include Research Report 94-2 and update U91-6.

This research details the use of shredded tires (tire chips) as both a drainage layer and barrier to prevent contamination between a wet silty sand subgrade and a gravel base. The test area is located in Georgia, Vermont and is on a road with a gravelcourse.

**TIRE RUBBER IN PAVEMENT FILLS.** (00722895)

*Sponsored by:* Alaska Department of Transportation and Public Facilities. Juneau. AK.

*Project Monitor:* Reckard, M.

*Performed by:* University of Alaska, Fairbanks. School of Engineering. Fairbanks. AK.

*Investigator(s):* Raad, L.

*Status:* Active.

*Start date:* Jul 1993; *Estimated completion date:* Jul 1994.

Under the current highway funding act (ISTEA), used tires must be recycled in some other way or combined into highway pavements in increasing amounts, commencing in 1994 at about 250 tons and culminating in 1997 in the annual use of about 1,000 tons per year for the state of Alaska. The only exception made to using used tires in pavement comes when all available tires are being recycled in other ways. Alternative highway construction use should therefore be examined. The Department of Transportation has placed a variety of rubber modified pavements at twelve different sites, but has not adequately followed their performance by regular evaluations, or by field sampling and testing to compare the benefits of the rubber. Also since insulation layers are frequently used for permafrost and for heave control, and since ground tire rubber is lightweight and low in thermal conductivity, the potential for use of ground rubber for these purposes seems high. In addition, the common presence of studs in tires may make them



unsuitable for the fine grinding processes needed to the most appropriate uses. The objective of this study will measure the benefits of past field installations and use them as guides to future use of rubber in pavements as required by ISTEA. Evaluations will include the rut resistance, thermal cracking resistance, and fatigue properties of rubberized mixes in comparison of normal paving mixes. The study will also explore the alternative use as an insulating layer beneath embankments and over buried utilities. The scope of work is to evaluate the engineering properties of Alaska's existing rubber modified pavements by field sampling and laboratory testing; and measure the thermal properties of various rubber granulations for use in engineering design work.

**THE USE OF INCINERATED SEWAGE SLUDGE ASH AS AN ADDITIVE TO ASPHALT CONCRETE. (00617851)**

*Sponsored by:* Minnesota Department of Transportation; Federal Highway Administration. Washington. DC.

*Project Monitor:* Turgeon, C.

*Performed by:* Minnesota Department of Transportation. St Paul. MN.

*Status:* Active.

*Start date:* 31 Dec 1989; *Estimated completion date:* 31 Dec 1995.

*Notes:* Research is on hold during litigation.

To evaluate the use of incinerated sewage sludge ash as mineral filler in asphalt concrete. This would help to alleviate the metropolitan waste control dilemma and possibly improve performance of some asphalt concrete mixes.

**USE OF LIGHTWEIGHT SLAG BACKFILL FOR REINFORCED EARTH WALLS AT THE INTERCHANGE OF HIGHWAYS 400 AND 407. (00755296)**

*Sponsored by:* Reinforced Earth Company, Ltd. Rexdale. Canada.

*Performed by:* Reinforced Earth Company, Ltd. Rexdale. Canada.

*Investigator(s):* Brockbank, B.

*Status:* Active.

*Start date:* 1993; *Estimated completion date:* 2005.

The project involves extraction of galvanized steel test strips over a period of twelve years of service life to confirm that the slag does not produce any accelerated corrosion.

**USE OF RAP MILLINGS TO IMPROVE THE STRUCTURAL CHARACTERISTICS AND REDUCE FROST HEAVING OF LOW VOLUME ROADS. (00645472)**

*Sponsored by:* New Hampshire Department of Public Works & Highways.

*Project Monitor:* Roberts, Glenn.

*Performed by:* New Hampshire Department of Public Works & Highways. Concord. NH.

*Investigator(s):* Roberts, Glenn.

*Status:* Proposed.

*Start date:* Jul 1998; *Estimated completion date:* Jul 2000.

*Notes:* This project was originally scheduled to begin in 1995.

The objective of this project is to evaluate the effectiveness of placing reclaimed asphalt pavement millings over existing pavements to improve the performance of low volume roads. Following placement of the RAP, the roadway will receive one of several surface treatments. Surface distresses and rideability characteristics will be monitored.

**USE OF WASTE TIRES FOR LIGHTWEIGHT FILL IN SWAMPS. (00637021)**

*Sponsored by:* Minnesota Department of Transportation.

*Performed by:* Minnesota Department of Transportation. St Paul. MN.

*Investigator(s):* Kosobud, K.

*Status:* Active.

*Start date:* 11 Oct 1990; *Estimated completion date:* 31 Dec 1999.

Efforts to phase out the environmentally and economically costly practice of landfilling have stimulated the pursuit of non-landfilling disposal or reuse of waste products. Due to the continuous and high volume of materials it requires, the highway industry is often looked upon as a potential consumer of waste products. Since most transportation network construction in Minnesota is done under specs drafted by DOT, MNDOT has been sought to define uses for several waste products.

**WASTE PRODUCT UTILIZATION. (00617864)**

*Sponsored by:* Minnesota Department of Transportation; Federal Highway Administration. Washington. DC.

*Project Monitor:* Turgeon, C.

*Performed by:* Minnesota Department of Transportation. St Paul. MN.

*Status:* Active.

*Start date:* 1 Jan 1990; *Estimated completion date:* 31 Dec 1999.

Efforts to phase out the environmentally and economically costly practice of landfilling have stimulated pursuit of nonlandfill disposal or reuse of waste products. Due to the continuous high volume of material it requires, the highway industry is often looked upon as a potential customer of waste products. Since most transportation network construction in Minnesota is done under specifications drafted by the DOT, MNDOT has been sought to define uses for several waste products.

## Social and Economic Impacts

### **THE AMERICAN BOULEVARD: AN HISTORICAL INVESTIGATION OF THE PUBLIC MANAGEMENT, BUILT FORM, AND SOCIAL USE OF OLMSTED'S BROOKLYN PARKWAYS. (ENV1244)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* Institute of Urban and Regional Development. University of California-Berkeley.

*Investigator(s):* Macdonald, Elizabeth.

*Status:* Active.

*Start date :* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

This is a study of the historical evolution of two exemplary multiple-roadway boulevards -- Eastern Parkway and Ocean Parkway -- in Brooklyn, New York, with the objective of identifying an institutional model for public management of multi-functional streets. These parkways carry both fast- and slow-moving traffic as well as provide pedestrian and recreational use on tree-lined malls separating the roadways. Such streets are not built in the United States today because they are considered unsafe. However, urban designers are reconsidering their use as alternatives to standard arterial streets because they can handle large traffic volumes without creating sharp divisions between neighborhoods. The project will contribute substantial new knowledge about Olmsted's contribution to city planning in terms of the long-term functional aspects of his street designs.

### **CIVIL RIGHTS ISSUES IN PROJECT SITINGS (Meets some of the criteria of a Circular 469 Environmental Research Needs in Transportation statement.). (ENV1226)**

*Sponsored by:* National Cooperative Highway Research Program. Transportation Research Board. Washington. DC.

*Performed by :* North Carolina Central School of Law.

*Investigator(s):* Smith, Charles.

*Status:* Active, *Contract No.:* Project 20-06, Topic 10-6.

*Notes:* To monitor the status of this project, please see the NCHRP web page at:

<http://www2.nas.edu/trbcrp/6852.html>, where the status of the research is updated regularly.

This research will explore the civil rights issues implicated by transportation siting decisions, including issues that arise under Executive Order 12898 (President's Environmental Justice Order), Title VI of the Civil Rights Act of 1964, as amended, and implementing regulations (49 U.S.C. 134 and 135). A survey of Court treatment of this issue will be conducted.

### **CONSUMER RESPONSE TO CONGESTION PRICING ON HIGH OCCUPANCY/TOLL LANES. (ENV1240)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Irvine. Department of Economics.

*Investigator(s):* Brownstone, David and Golob, Thomas.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

High Occupancy/Toll (HOT) lanes have been proposed to provide funds for highway and transit improvements and to increase use of carpool lanes. Congestion pricing has also been proposed as

a way to influence traffic demand and optimize flow. We use panel survey data on an eight-mile segment of the I-15 corridor in San Diego to build models of commuter-response; the survey includes attitudes to fairness and effectiveness of HOT lanes. Our choice models also use measurements of means and variations in travel times on both free and HOT lanes; we will test hypotheses about how attitudes are related to exposure and mode choice. Resulting models can be used to forecast demand and opinions about future projects. This research will be closely coordinated with an ongoing evaluation of the I-15 Congestion Pricing Project by San Diego State University for the San Diego Association of Governments, FHWA, FTA, and Caltrans.

**COST OF TRANSPORTING PEOPLE IN NEW JERSEY. (00748011)**

*Sponsored by:* New Jersey Department of Transportation. Trenton. NJ;. University Transportation Research Center. New York. NY.

*Project Monitor:* Weed, Richard.

*Performed by:* Rutgers University, New Brunswick. New Brunswick. NJ.

*Investigator(s):* Ozbay, K.

*Status:* Active.

*Start date:* unknown; *Estimated completion date:* Oct 1999.

This project is concerned with the assessment of the generalized costs of passenger transportation in New Jersey and the application of these cost estimates to policy decisions. The first objective will be to develop a generic cost model that will estimate the generalized economic costs of various modes of passenger transportation. The second objective is to use the model to analyze policy decisions concerning different modes of passenger transportation. It is important to use the concept of social marginal cost, which incorporates users and external costs in measuring the cost of transporting people in a particular area. It is also important to develop a dynamic cost model that represents the relationship between the various cost categories for different modal mixes as they change over time. The model will be capable of adjusting its parameters based on the possible changes in the modal mix. The "dynamic" aspect of the model will allow policy makers to change the modal mixes and determine the prevailing costs for different combinations of modal mixes. The model will be able to express the additional cost of transporting another unit of users and express the effects of modal mix change by automatically recalibrating its parameters to take into account changes in demand and behavior.

**ECONOMIC IMPLICATIONS OF CONGESTION. (ENV1005)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Performed by:* Cambridge Systematics, Inc.

*Investigator(s):* Cohen, Harry S.

*Status:* Active, *Contract No.:* Project 2-21, FY '97.

*Start date:* 1 Apr 1997; *Estimated completion date:* 31 Jul 1999.

*Publication(s):* A Phase I report has been submitted to the panel for review.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Congested transportation facilities raise the cost of moving people and goods into, within, and out of regions and states. Costs associated with transportation continue to increase in importance as the challenges and opportunities of the global marketplace compel companies to change their business methods. Congestion, especially within metropolitan regions, is perceived to be reaching critical proportions and is imposing costs on business that are detrimental to economic efficiency, productivity, and competitiveness.

Despite increasing concerns about congestion, not enough is known about the impacts of congestion in terms of either economic efficiency or the expected economic effects of transportation investments designed to reduce congestion. Little is known about the consequences of congestion on the magnitude of business costs or the significance of such costs to industries. Although it is generally agreed that reducing congestion and its costs will increase economic productivity, the degree and manner of productivity improvements remain unclear.

State DOTs will never have sufficient capital to fully address all of the deficiencies in their transportation systems. Therefore, projects will continue to be prioritized and selected carefully. This research will assist state and metropolitan decision makers to design and implement congestion strategies that make sense for economic development and make the most effective use of scarce resources. The following will be addressed: 1. Analysis of the nature of the costs that congestion imposes on businesses and other users of the transportation system, 2. Analysis of the relative impacts of predictable and unpredictable congestion on costs of doing business, and 3. Quantitative estimates of the effects of congestion reduction on the economic productivity and cost structures of businesses in metropolitan regions.

The objective of this project is to quantify the impacts of congestion on the costs of production for a range of economic sectors within metropolitan areas. The intent is to estimate the elasticity of business costs with respect to congestion levels within metropolitan areas. Based on these cost relationships, an assessment methodology will be developed which will allow states and metropolitan planning organizations (MPOs) to estimate those direct economic benefits that can be expected to result from various transportation strategies designed to reduce congestion. This research should provide decision makers with an understanding of the implications of congestion on economic activities and should provide practitioners with the tools to analyze the costs of congestion on businesses.

Phase I--Project design, will consist of the following tasks: (1) Critically review relevant research, literature, and methodologies on the relationships between congestion and economic performance. (2) Assess alternative methods of defining and measuring congestion and recommend an approach for use in this project. Consideration should include highway access to intermodal facilities. (3) Develop a conceptual framework that links congestion levels to cost structures and other aspects of business operations. Consideration should be given to using cost function analysis, but other approaches will be entertained. (4) Design an analysis framework to estimate the impacts on congestion and economic activity for a range of congestion alleviation strategies. (5) Develop a proposed sample design for a range of metropolitan areas (in terms of size and congestion severity) and business sectors for the study. Identify sources of data for both manufacturing and non-manufacturing sectors. (6) Prepare an interim report and obtain approval to proceed to Phase II. Incorporate in the report a discussion of how the analysis framework developed in Task 4 relates to those identified in the literature and ongoing research reviewed in Task 1. Upon approval of the interim report, prepare a briefing paper that presents the Phase I findings on the impacts of congestion that is appropriate for the use by state DOTs during consideration of ISTEA reauthorization.

Phase II--Congestion impact analysis, will consist of the following tasks: (7) Secure and analyze data for selected metropolitan regions, sufficient to develop estimates of congestion impacts within the Phase I framework (Task 3), with special attention to the cost of congestion dimensions impacting selected business sectors. (8) Prepare an interpretation of the results through summary indicators such as cost elasticities and rates of return, etc. Indicators should be presented in terms of confidence intervals as well as point estimates. (9) Describe the economic significance of these indicators in terms of expected cost savings and other regional economic

impacts from congestion reduction. (10) Prepare an interim report covering the Phase II activities and obtain approval to proceed to Phase III.

Phase III--Evaluation methodology, will consist of the following tasks: (11) Given the cost functions developed in Phase II for differing business sectors at varying levels of congestion, develop a practical methodology that decision makers can use to determine the costs of congestion in their metropolitan areas and assess the anticipated economic implications of changes in congestion levels. (12) Using the results of the previous tasks, assess the economic effects of alternative congestion reduction strategies. (13) Prepare a final report documenting the entire research effort. Include a description of additional research needed to develop improved understanding and approaches for managing congestion at the state and metropolitan levels. Provide specific recommendations for implementation and development of the results of this project.

**EQUITABLE CONGESTION PRICING SCHEMES.** (ENV1241)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Berkeley. Civil Engineering Department.

*Investigator(s):* Daganzo, Carlos F.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

The advent of new technologies opens the door for traffic management strategies not possible a few years ago, in particular, the ability to sort masses of data in real time in order to institute discriminating pricing schemes that are both time- and vehicle- dependent. This project examines advanced schemes of this type with a focus on equity issues. We are looking for pricing approaches that would benefit original users of a transportation facility (before pricing), even if collected revenues are not returned to them, and where most of the original non-users would benefit as well. We will examine a pricing approach that encourages people to take turns. Similar approaches have shown benefits to everyone in the steady- state case, independent of income, trip purpose, and availability of alternative transport modes.

**EVALUATION OF METHODS, TOOLS, AND TECHNIQUES TO ASSESS THE SOCIAL AND ECONOMIC IMPACTS OF TRANSPORTATION PROJECTS (Circular 469 Environmental Research Needs in Transportation research needs statement).** (ENV1096)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Status:* Proposed, *Contract No.:* Project 25-19.

*Start date:* *Estimated completion date:* Contract duration: 20 months.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Transportation planning practitioners have found it difficult to accurately assess the social and economic effects of transportation investments on communities. This difficulty stems from a lack of available methods, tools, and techniques that are appropriate for the scale, context, and complexity of the project. The result is that planners and decision makers have limited information and understanding of the full range of effects that may be attributed to a transportation project's development. This has made it difficult for state DOTs, MPOs, and other agencies to fully meet the intent of requirements for Federal-Aid Highway funding recipients to conduct social and economic analyses of their programs and projects. Title VI of the Civil Rights Act of 1964 and the Federal-Aid Highway Act of 1970 (23 USC 109[h]) provide the basis for

requiring these types of impact assessments. In 1991, the Intermodal Surface Transportation Efficiency Act further emphasized the need to address social and economic issues within state and metropolitan planning as well as during project development. In 1994, Executive Order 12898 on environmental justice elevated the emphasis on assessing impacts on minority and low-income populations and communities. In 1996, the Federal Highway Administration (FHWA), with the support of the American Association of State Highway and Transportation Officials (AASHTO), published a Community Impact Assessment reference booklet that describes steps for, and emphasizes the importance of, evaluating community impacts within the FHWA process for meeting the requirements of the National Environmental Policy Act (NEPA).

In order for the states and MPOs to more effectively meet federal requirements, a need exists to identify methods, tools, and techniques that will aid practitioners in assessing the social and economic implications of transportation projects for their surrounding communities.

The objective of this research project is to develop a handbook that identifies, describes, and evaluates existing methods, tools, and techniques that will aid practitioners in assessing the social and economic effects (positive and negative) of transportation projects. The social and economic effects shall include, but not necessarily be limited to, primary, secondary, and cumulative effects on the following: community cohesion; mobility; safety; accessibility; aesthetics; relocation; employment; community facilities; land use; property values; construction effects; and previous actions intended to mitigate adverse project impacts. The purpose of the handbook is to help practitioners satisfy NEPA and other requirements for consideration of social and economic effects of transportation projects. Appropriate analytical detail will be provided for different phases of project planning, development, and implementation. The research objectives will be accomplished through the following tasks: (1) Conduct a search for existing or prospective methods, tools, and techniques that may be suitable for estimating the social and economic effects of transportation projects. (2) Conduct a survey to determine what methods, tools, and techniques are currently employed by federal agencies, states, MPOs, transit agencies, and local jurisdictions to estimate the social and economic effects of transportation projects. Prepare a technical memorandum for panel review summarizing the results of Tasks 1 and 2. Include in the technical memorandum an annotated bibliography of all sources. (3) Establish a classification system of the existing methods, tools, and techniques. The system should record areas of current application, data required, outputs produced, algorithms and processes employed, and areas of potential application. The research may include other attributes that the researcher determines are essential to support the Task 4 evaluation. The researcher should catalog the methods, tools, and techniques in accordance with this system. (4) Perform a critical evaluation of the classified methods, tools, and techniques. The researcher should assess and document the advantages and disadvantages of each method, tool, and technique for use in estimating the social or economic effects of transportation projects in each phase of project planning, development, and implementation. Identify important gaps and research needs. (5) Prepare an interim report summarizing Tasks 1 through 4 and include a detailed outline for the handbook to be developed in Task 6. Present findings and the outline to the panel members for approval before proceeding to Task 6. (6) Prepare an initial draft of a handbook of current practices and applications for practitioners. Recommend those methods, tools, and techniques that should be employed in each phase of project planning, development, and implementation. Submit the draft handbook for panel review. (7) Conduct focus group sessions during various transportation organization meetings (e.g., AASHTO and Association of Metropolitan Planning Organizations), to obtain feedback on the content of the draft handbook and information on gaps and additional research needs. Prepare a technical memorandum summarizing the results of the focus group sessions and discuss the results with the panel in a teleconference. (8) Based on panel input, prepare a final report and handbook that reflect the research findings, identify gaps and research needs, suggest

sources of information, and provide guidance to practitioners for conducting accurate assessments of economic and social effects associated with transportation projects.

**IMPACT OF MODE AND MODE TRANSFER ON COMMUTER STRESS.** (00748014)

*Sponsored by:* New Jersey Department of Transportation. Trenton. NJ; University Transportation Research Center. New York. NY.

*Project Monitor:* Roberts, Mike.

*Performed by:* Rensselaer Polytechnic Institute. Troy. NY;. Cornell University. Ithaca. NY.

*Investigator(s):* Wener, R.

*Status:* Active.

*Start date:* *Estimated completion date:* 1 Oct 1998.

The commute to work can consume a considerable amount of time and effort. There is both anecdotal and experimental evidence to suggest that commuter satisfaction and stress can be significantly affected by important trip dimensions, the most critical of which seems to be the number of modes and mode transfers involved in the trip. The research will involve the study of the psychological and psychophysiological effects of the commuting experience for the mass transit user. The research will also examine the number of mode transfers and travel time of thousands of daily commuters. This project will take advantage of the natural experiment provided by the implementation of the forthcoming "Kearny Connection."

**INFORMATION EXCHANGE ON DOE TECHNOLOGY DEVELOPMENT AND HAZARDOUS MATERIALS TRANSPORTATION ACTIVITIES, INCLUDING RADIOACTIVE MATERIALS, AND ON PUBLIC CONCERNS WITH OPPORTUNITIES FOR IDENTIFYING ISSUES AND BEGINNING TO RESOLVE THEM.** (Fed 00196387)

*Sponsored by:* U.S. Department of Energy. Environmental Restoration and Waste Management. Kansas City. MO.

*Project Monitor:* Holm, J.

*Performed by:* Urban Energy and Transportation Corporation.

*Investigator(s):* Burge, J. K.

*Status:* Active, *Contract No.:* DOE/DP-94/FC01-94EW54065.

*Start date:* 14 Mar 1994; *Estimated completion date :* 13 Mar 1999.

This project is divided into two tasks. Task 1 includes networking, communication, and integration for transportation. Task 2 includes the same components for technology development. Tasks 1 and 2 and each of their subtasks and activities increase or improve the U.S. Department of Energy's (DOE) opportunities to exchange information with an active network of local community officials through the following types of activities: (1) regional workshops targeting senior-level local officials, promoting an active exchange of ideals with DOE management; (2) meetings with state municipal league board members and officers providing an opportunity to discuss specific transportation issues with a larger body of both elected and appointed officials; (3) national forums giving DOE the opportunity to update a major portion of the network on current issues; (4) briefings to DOE officials on local concerns as a follow-up to the meetings and workshops; (5) discussion papers analyzing issues of mutual concern to DOE and local communities; (6) improved training materials and delivery systems; (7) newsletters providing accurate information to local communities; (8) computer information network taking advantage of an existing federal telecommunication system already targeting local officials; (9) research report on standards and procedures leading toward elimination of conflicting local rules and regulations; (10) planning committee meetings providing DOE with recommendations, insight, and lessons learned; and (11) at every opportunity, use of techniques that provide an atmosphere



for DOE and local officials to identify issues and begin to resolve problems in a constructive environment, using participatory meeting methods. Some of these methods include modified nominal group technique, role playing, focus group evaluation, panel discussions, and team problem solving. Participation will also include up to two on-site program reviews each year and up to three off-site program integration meetings each year, as required, to update DOE staff and provide interaction between program components. Finally the planning, implementation, and evaluation process ensures that the right audience will be reached with the right material.

**IS ACCESSIBILITY THE SOLUTION FOR ALL? SEGMENTING THE MARKET FOR MOBILITY AND ACCESSIBILITY POLICIES. (ENV1242)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Davis. Civil & Environmental Engineering Department.

*Investigator(s):* Mokhtarian, Patricia L. and Salomon, Ilan.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

Improvements in accessibility are increasingly suggested as strategies to reduce vehicle travel, congestion, and related impacts. This approach assumes that individuals will reduce their travel if given the opportunity, as well as assuming that land-use changes will increase non-motorized trips; however, there are many indications that people travel more than needed and are not inclined to reduce trips. This study will test several hypotheses about the reasons for excess travel and the relationship between attitudes to travel and response to access-enhancing strategies across different travel categories. The study assumes different market segments will respond to policies in different ways, and suggests that if a large segment of population prefers mobility over reduced travel, then policies to reduce travel will be less effective than hoped. Data from two Bay Area communities will be analyzed.

**LONG TERM ECONOMIC IMPACT OF HIGHWAY IMPROVEMENTS ON SMALL TOWNS. (00730386)**

*Sponsored by:* Arkansas State Highway and Transportation Department. Planning and Research Division. Little Rock. AR; Federal Highway Administration. Washington. DC.

*Project Monitor:* Sanders, J.

*Performed by:* Arkansas State University. State University. AR.

*Investigator(s):* Horsley, J.

*Status:* Active.

*Start date:* 1 Jul 1996; *Estimated completion date:* 15 May 1999.

Widening existing routes or by-passing small towns causes changes but it is not known by an objective study what the economic impact is.

**LOS CAMINOS ANTIGUOS SCENIC AND HISTORIC BYWAYS. (CRIS 0177300)**

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service. Arizona Forestry Station.

*Performed by:* Northern Arizona University. School of Forestry. Flagstaff. AZ.

*Investigator(s):* Lee, M. E.

*Status:* Active, *Contract No.:* ARZZ-NAU-FOR394Q.

*Start date:* 24 Oct 1997; *Estimated completion date:* 24 Oct 1999.

*Notes:* Abstract provided by permission of the U.S. Geological Survey

(<http://cristel.nal.usda.gov:8080/star/brd.html>).

The purpose of this project is to determine the individual, household, community, and environmental benefits and disbenefits provided by the Los Caminos Antiguos Scenic and Historic Byway as perceived by five groups: residents, members of local governments, private-sector recreation and tourism service providers, public land managers, and non-local recreation users of the byway. This information will be gathered using focus groups and surveys administered on site and via mail. Questionnaires are being designed during winter-spring 1998 to be administered in the summer and fall 1998.

**NEEDS IN COMMUNICATING THE ECONOMIC IMPACTS OF TRANSPORTATION INVESTMENT.** (ENV1006)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Performed by:* Hagler Bailly Services, Inc. (formerly Apogee Research, Inc.).

*Investigator(s):* Ostria, Sergio J.

*Status:* Active, *Contract No.:* Project 2-22, FY '97.

*Start date:* 3 Feb 1997; *Estimated completion date:* 31 Dec 1998.

*Publication(s):* A technical memorandum on the results of the national public survey is available.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The American Association of State Highway and Transportation Officials (AASHTO), through its Special Committee on Economic Expansion and Development and through its support of NCHRP research, continues to develop a body of knowledge on the relationships between transportation investments and economic vitality. There is little understanding on how to communicate these relationships to decision makers and the general public. Moreover, there is little understanding of what linkages decision makers and the general public perceive between transportation investments and economic performance. This project aims to assist state DOTs and other transportation agencies in improving the communication of the economic rationales for transportation investments by soliciting and assessing stakeholder inputs and by tailoring support information to the need. Without improved communication about the economic impacts of transportation, improvements may be delayed or neglected or transportation resources may be lost to competing programs.

The objective of this project is to use market research to develop a guide to assist state DOTs and other transportation agencies in more effectively and proactively communicating--to decision makers and the public--transportation's importance and contributions to the economy.

Phase I--Project design, will consist of the following tasks: (1) Review and summarize relevant recent research, literature, and methodologies that best evaluate and describe the relationships between the economy and transportation investment. Review and summarize the most significant recent advances in public sector communication applications. (2) Identify key elements of economic vitality that can be related to transportation investments and plans. (3) Develop a market research design for Task 5 that identifies methods, sources, expected information, and key participants to support the development of the communications guide for transportation agencies in Task 9. (4) Submit an interim report summarizing the results and findings in Tasks 1 through 3 and obtain approval to proceed to Phase II.

Phase II--Market research and analysis, will consist of the following tasks: (5) Conduct market research to assess awareness of the relationships between transportation and economic vitality. This market research should identify the depth of knowledge, basis of understanding, sources of

information, general beliefs, and perceptions and misperceptions of decision makers, interest groups, and the public regarding those relationships. (6) Analyze the results of the market research, on each participant group, regarding the main transportation-related economic issues (such as international competitiveness, job creation, economic growth, and freight productivity). (7) Based on the findings in Tasks 5 and 6, identify the communication approaches, identified by each participant group, that most effectively demonstrate positive relationships between economic vitality and transportation investment. (8) Submit an interim report that presents the findings and recommendations developed in Phase II and recommends the plan for and outline of the communications guide to be prepared in the next phase. Meet with the NCHRP panel and obtain approval to proceed to Phase III.

Phase III--Development of the guide, will consist of the following tasks: (9) Draft a communications guide that includes a summary of key issues of importance to each participant group, an outline and discussion of methods for most effectively communicating to each participant group transportation investment choices and their expected economic implications, suggestions for more effectively integrating improved communications practices into agency planning and decision-making processes, and needs for data or research to support more effective communications. The market research design, analysis, and findings shall be included as appendixes to the communications guide. (10) Submit the draft communications guide to NCHRP for initial panel review and comments. (11) Prepare a final report that documents the entire project and presents the recommended plan for implementation, additional needed research, and opportunities for further development of the guide. Include the revised communications guide as a stand-alone appendix.

Status: The research team has completed Phase I work, and submitted an interim report for panel review. Phase II is proceeding with focus group sessions in four locations around the nation. The research team completed a technical memorandum for the AASHTO member departments regarding the results of the initial public survey of nearly 1,500 people on general and detailed perceptions of the importance of transportation to economic vitality.

Report Availability: The technical memorandum on the results of the national public survey is available from the NCHRP.

#### **QUANTIFYING AIR-QUALITY AND OTHER BENEFITS AND COSTS OF TRANSPORTATION CONTROL MEASURES.** (ENV1009)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Derr, B. Ray.

*Performed by:* Cambridge Systematics, Inc.

*Investigator(s):* Suhrbier, John H.

*Status:* Active, *Contract No.:* Project 8-33, FY '95 .

*Start date:* 1 Jul 1995; *Estimated completion date:* 31 Oct 1998.

*Publication(s):* A World Wide Web site has been developed that includes all of the project documents at <http://webservices.camsys.com/NCHRP833/index.htm>. The individual task reports are available for viewing at the above website and for loan from the NCHRP. NCHRP Research Results Digest 217 and NCHRP Research Results Digest 223 are available for purchase from TRB.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The Clean Air Act Amendments (CAAA) of 1990 identify transportation control measures (TCMs) that are expected to provide emission-reduction benefits and, depending on the area's

nonattainment status, mandate implementation of some of them. The CAAA also identifies other measures intended to modify motor vehicle use. States and MPOs require specific, quantitative information on the benefits, costs, and expected air-quality improvements of various TCMs in order to select those that will best meet their needs.

The objective of this research is to develop a framework for analyzing the air-quality and other environmental, social, and economic effects of TCMs.

The research consists of the following tasks:

Phase I: (1) Identify completed and ongoing research and other activities related to the effects of TCMs. Identify the users of TCM analysis techniques as well as other stakeholders. Conduct a workshop to assess the knowledge and needs of current TCM analysis techniques and assumptions. (2) Identify how current analysis techniques and assumptions could be reasonably and effectively strengthened. (3) Prepare performance criteria and a preliminary outline of the analysis framework to be developed in Task 6. Prepare preliminary plans for validating the framework in Tasks 7 and 9. (4) Examine the relationships among implemented TCMs, their calculated emissions, and measured pollutant levels. Identify major gaps in knowledge and areas needing research. Develop a plan for future work to better understand the impact of TCMs on measured air pollutant concentrations, being sure to consider the costs and expected contributions to the body of knowledge. (5) Prepare a Phase I Interim Report documenting the findings of Tasks 1 through 4 and providing a revised work plan for Phases II and III.

Phase II: (6) Develop a comprehensive framework that is suitable for analyzing TCMs recognizing that they are part of a total transportation system. TCMs to be analyzed include those designed to produce mode shifts, operational traffic changes, and reductions in motor vehicle usage. The framework must include the synergistic effects of employing various combinations of TCMs. Key variables will include number of trips, trip chaining, elasticity, vehicle miles traveled, delay, and vehicle modal activity (acceleration, deceleration, idling, etc.). Key outputs will be the effect on air pollutant emissions and the social, economic, and environmental effects. The research will evaluate the feasibility of including the effect on air pollutant levels as a key output. The framework should be compatible with federal requirements such as CAAA State Implementation Plans and ISTEA Management Systems. (6.1) Develop speed-correction factors to assess the emissions impact of ramp metering. (6.2) Document assumptions employed in emission factor models, particularly MOBILE5b and MVEI7G. (6.3) Evaluate the feasibility of using advanced air-quality monitoring systems to quantify the air-quality effects of transportation control measures. (6.4) Analyze transportation and air-quality monitoring data collected during the Atlanta Olympics to identify the air-quality impacts of transportation control measures. (7) Conduct a pilot validation study of the framework using the validation plan developed in Task 3 and presented in the Phase I interim report. This study has been completed using information from Sacramento, California. (8) Prepare a Phase II interim report documenting the findings of Tasks 6 and 7 and any needed changes in the Phase III work plan.

Phase III: (9) Validate and refine the framework. The following aspects of the framework should be evaluated: ease of use, accuracy, applicability to various urban areas, data and monitoring requirements, approach to estimating synergistic effects, and cost to implement. The validation could include case studies of existing TCMs and combinations of TCMs, before-and-after studies, and hypothetical scenarios. Use of actual data for validation is preferred. Based on the contractor's recommendation, Portland, Oregon will be used for this work. (9.1) Investigate the use of remote sensing techniques to directly measure changes in vehicle emissions and the use of personal monitors to measure changes in individual exposure to air pollutants. (9.2) Conduct

additional validation testing in cooperation with the Sacramento Area Council of Governments. The primary intent of this additional validation is to identify specific causes for some of the results from Task 7. (10) Prepare a user's manual. The manual should be designed to enable state DOTs and MPOs to use the analysis framework developed in this project. It should include a summary of the strengths and limitations of the methodology, guidance on the analysis of combinations of TCMs, and recommendations on communicating the results to the public and elected officials. (11) Submit a final report documenting the research effort and including the user's manual as a self-contained appendix.

Based on the results of Phase I, the panel added four new tasks to Phase II, which are described above as Tasks 6.1 through 6.4. Phase II is complete, and reports have been submitted for each of the Phase II tasks. The report from Task 6.2 will be published as a research results digest in 1998.

Based on the results of Phase II, the panel added two new tasks to Phase III, which are described above as Tasks 9.1 and 9.2. Phase III is almost complete with work well underway on the user's manual and final report.

**STREAMSIDE REFORESTATION: AN ANALYSIS OF ECOLOGICAL BENEFITS AND SOCIETAL PERCEPTIONS.** (Fed 00178835)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington, DC.

*Project Monitor:* Firth, Penelope L.

*Performed by:* Academy of Natural Sciences. Philadelphia. Stroud Water Research Center. Avondale, PA.

*Investigator(s):* Sweeney, Bernard W., Bott, Thomas L., Jackson, John K., Horwitz, Richard J., and Hession, William C.

*Status:* Active, *Contract No.:* 9613588.

*Start date:* 1 Jan 1997; *Estimated completion date:* 31 Dec 1999.

Streamside forests are recommended as a land use practice to protect aquatic ecosystems by removing inputs of nutrients, sediments, and toxic contaminants. This project views streamside forests as the primary regulator of stream width: small forested streams are wider than meadow reaches. The alteration of stream width that results from deforestation profoundly influences the stream ecosystem, both locally and downstream, through effects on habitat and water quality. Policies to restore streamside forests will require both documentation of ecological benefits and an understanding of societal factors affecting their implementation. Objectives are: 1) to understand the relationship between forest buffers, width, and stream ecosystem condition; 2) to develop databases that can help guide forest restoration policies; and 3) to quantify social and economic issues affecting streamside forest restoration.

**SYNTHESIS OF INFORMATION RELATED TO HIGHWAY PROBLEMS:  
SYNTHESIS PROJECT - Topic 30-05. ASSESSING ECONOMIC DEVELOPMENT  
BENEFITS FROM MAJOR TRANSPORTATION INVESTMENTS (A TRB Circular 469**

*Environmental Research Needs in Transportation project).* (ENV1249)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Jencks, Crawford F.

*Performed by:* Transportation Research Board.

*Investigator(s):* Godwin, Stephen R., Maher, Stephen F., and Vlasak, Donna.

*Status:* Active, *Contract No.:* Project 20-05, Topic 30-05.

*Start date:* 1998.

*Notes:* To monitor the status of this project, please see the NCHRP web page at <http://www2.nas.edu/trbcrp/6852.html>, where the status of the research is updated regularly. No abstract provided.

**TASK 3D - ECONOMIC AND SOCIAL IMPACTS ANALYSIS FOR LBJ (IH 635)  
PROJECT OFFICE.** (SWUTC 406027-00006)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* MacGregor, Matthew.

*Performed by:* Texas A&M University.

*Investigator(s):* Buffington, Jesse L. and Vidali, Sharada.

*Status:* Active.

*Start date:* 1 Sep 1995; *Estimated completion date:* 31 Aug 1999.

This Task 3D of the "Transportation Planning and Operations for Dallas District, Phase 4" study will estimate the economic, social, and environmental impacts of one or more design alternates for increasing the capacity of two sections of the IH 635 (LBJ) Freeway in Dallas from the IH 35E intersection on the west of Dallas to the US Highway 80 intersection on the east side of Dallas. More specifically, land value, tax revenue, and visual impacts will be estimated. Also, selected types of social, economic, and environmental impacts using the latest benefit-cost methodologies will be estimated. The design alternatives evaluated will likely include elevated main lanes and/or express lanes, capacity increases to reduce congestion, and access changes, such as adding or removing entrance and exit ramps. Varying right-of-way requirements and "during" reconstruction impacts will have to be estimated. The findings of this research will be used for preparation of an Environmental Impact Statement (EIS) of the final design alternative proposed to increase the capacity of IH 635 on the north and east side of Dallas. Also, some of the findings may be presented at public hearings.

**TRANSPORTATION AND LAND USE: ENERGY AND AIR QUALITY IMPACTS.**  
(00755276)

*Sponsored by:* Natural Sciences and Engineering Research Council of Canada.

*Performed by:* Carleton University. Department of Civil and Environmental Engineering.  
Ottawa. Canada.

*Investigator(s):* Khan, A. M.

*Status:* Active.

*Start date:* 1994; *Estimated completion date:* 1999.

The objective of this research is to investigate urban transportation and land use structures for reducing energy consumption in transportation and improving air quality. In addition to the study of efficient compact urban structures, this research is examining the effect of improving job opportunities in a subregion on region-wide transportation fuel consumption and emissions. Furthermore, the effect of improving job opportunities in a number of satellite cities within a multinucleated urban area on region-wide transportation fuel consumption and emission is under investigation.

**THE VIEW FROM THE ROAD: COSTS AND BENEFITS OF URBAN FORESTS FOR  
BUSINESS DISTRICTS.** (CRIS 0177499)

*Sponsored by:* OCI WN.Z (Other Cooperating Institutions, that report research to U.S. Dept. of Agriculture).

*Performed by:* University of Washington. Ecosystems, Horticulture, and Conservation  
Department. Seattle. WA.

*Investigator(s):* Wolf, K. L.

*Status:* Active, *Contract No.:* WNZ-EHC-776.

*Start date:* 1 Aug 1997; *Estimated completion date:* 30 Jul 1999.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

Objectives of this project are to gain information about public preferences and perceptions regarding the benefits and costs of trees on urban roadsides. By means of surveys, elicit response from business owners and highways regarding the benefits and values of urban forests for roadside business districts. Conduct project initially in the Pacific Northwest, then expand nationally. Research results will be reported to business and commerce organizations, as well as to urban forestry professionals and managers.

## Water Quality and Hydrology

### **ACCUMULATION MECHANICS OF FLOATING WOODY DEBRIS ON HIGHWAY STRUCTURES.** (ENV1068)

*Sponsored by:* Mid-America Transportation Center. University of Nebraska-Lincoln.

*Project Monitor:* Gnirk, Barbara.

*Performed by:* University of Missouri-Kansas City. Department of Civil Engineering.. Kansas City. MO.

*Investigator(s) :* Richardson, J. R.

*Status:* Active, *Contract No.:* MATC/UMC98-2.

*Start date:* 1 Feb 1998; *Estimated completion date:* 28 Feb 1999.

Any bridges or other transportation structures located in the vicinity of rivers are susceptible to debris loading. Accumulation of floating woody debris (FWD) increases the risk of failure due to lateral forces and foundation erosion. According to Chang and Shen (1979), more than 1.1 million dollars was expended by the states of Oregon and California between 1969 and 1978 for maintenance of bridges with accumulation of floating debris. They also document cases in which accumulation of floating debris has led to bridge failure. This study indicates that all of the states composing the Mid-America Transportation Center have a moderate to severe risk of debris-related problems at bridges.

The transport and accumulation mechanics of FWD are to be conducted in a ridged-bed flume at the University of Missouri. A model river with channel, overbank, and bridge is to be constructed and tested using steady flow and unsteady flow hydrographs. Simulated woody debris is to be introduced into the channel and tracked using video and still imagery. Surficial flow velocities will be determined using floater tracer and dye techniques. The combination of FWD motion and surficial velocities will be used to analyze debris travel path and rotation of the FWD particles.

### **ADDITIVES FOR HIGH TRANSMISSIVITY OF SOIL (FOR STORMWATER INFILTRATION BMPs).** (ENV1088)

*Sponsored by :* Washington State Department of Transportation.

*Performed by:* Washington State Department of Transportation.

*Investigator(s):* Molash, Ed.

*Status:* Active.

*Start date:* 1 Mar 1998; *Estimated completion date:* 1 Sep 1999.

Soils with high rates of infiltration are ideal for the construction of infiltration ponds and trenches; however, facilities built in extremely high transmissivity soils (greater than 9 inches per hour) exceed regulatory standards and could have an adverse effect on the quality of groundwater. This study would evaluate various mixtures of inexpensive soil additives with high transmissivity soils. Additives and mixtures that demonstrate the most reliable and predictable performance would be used in existing infiltration facilities to evaluate performance in field conditions.

### **ASSESSMENT AND MODELING OF STREAM MITIGATION PROCEDURES.** (ENV1121)

*Sponsored by:* Kentucky Transportation Cabinet. Frankfort. KY.

*Project Monitor:* Crim, Keith.

*Performed by:* University of Kentucky. Civil Engineering Department.

*Investigator(s):* Hopwood, Theo, Ormsbee, Lindell, and Yost, Scott.



*Status:* Active, *Contract No.:* KYSPR99-193.

*Start date:* 30 Jul 1998; *Estimated completion date:* 31 Dec 1999.

This research project focuses on how effective past stream mitigation efforts have been. Sites are analyzed to determine how well areas have recovered. This study also evaluates mitigation techniques used in other states. Based on the findings, recommendations will be made for a DOT manual outlining future mitigation efforts.

**ASSESSMENT OF MARSH VEGETATION RESPONSES TO HYDROLOGICAL RESTORATION IN SHARK SLOUGH, EVERGLADES NATIONAL PARK. (ENV1236)**

*Project Monitor:* Jaffe, Rudolph.

*Performed by:* Southeast Environmental Research Program. Florida International University. Miami. FL.

*Investigator(s):* Ross, Mike, Telesnicki, Guy, and Ruiz, Pablo.

*Status:* Active.

*Start date:* 1 Aug 1996; *Estimated completion date:* 31 Oct 2000.

The objectives of this project are: (a) to assess changes in Shark Slough vegetation since a 1981 survey, (b) to establish a benchmark vegetation monitoring network in the Slough, (c) to examine the association between vegetation and hydrologic variables in Shark Slough marshes, and (d) to describe spatial variation in soil nutrient concentration throughout the Slough.

**ASSESSMENTS OF IMPACTS OF BRIDGE DECK RUNOFF CONTAMINANTS ON RECEIVING WATERS. (ENV1016)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCready, Ronald D.

*Performed by:* CH2M HILL, Inc. (Milwaukee Office).

*Investigator(s):* Dupuis, Thomas V.

*Status:* Active, *Contract No.:* Project 25-13, FY '97.

*Start date:* 15 Mar 1997; *Estimated completion date:* 14 Jun 1999.

*Publication(s):* A Phase I report has been submitted to the panel.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Data and analytical methods are available to predict the runoff constituents and concentrations for highway and waterway scenarios; however, there are no guidelines on how to use these data and methods to make comprehensive assessments of the impacts of bridge runoff on receiving waters. As a result, to comply with permits and regulations, some projects have been required to include installation of costly enclosed drainage systems on bridges.

There is a need for a process to assist practitioners in making decisions on the need for, and the extent of, control of bridge deck runoff in both new and retrofit applications. It is envisioned that this process will encompass consideration of runoff constituents (e.g., metals, sediments, and nutrients), types of bridge runoff-management designs, impacts on receiving waters and aquatic biota, and other potential runoff impacts. The process should also include risk assessment for special potential problems, benefit/cost-effectiveness assessments, and other elements of a strong management process that streamlines and normalizes consideration of runoff concerns within the project development process.

This research is intended to integrate known technology applicable to the quality of runoff water, the background quality of the receiving water, and the water quality criteria applicable to the receiving water. The research will determine the best application procedures and quality criteria

for data associated with runoff and receiving water interaction. It will also address reasonable treatments and proper disposal systems if and when warranted.

The objective of this research is to develop a rational process to identify, assess, and manage bridge deck runoff that may adversely impact the beneficial uses of receiving waters. Where warranted, the process should address a range of mitigation alternatives that may include on-site control of bridge deck runoff, off-site watershed-based mitigation, or pollution trade-off opportunities. Where on-site control is proposed, appropriate new bridge design parameters for runoff and opportunities for existing bridge retrofits should be considered along with non-structural best management practices. The process must be appropriate for both coastal and inland settings and must permit consideration of direct impacts on a project basis, as well as cumulative impacts to the receiving water.

Phase I consists of the following tasks: (1) Critically review U.S. and international published and unpublished literature and completed and ongoing research on impact methodologies and data related to bridge runoff quality and quantity. (2) Survey representative management, maintenance, and operational practices and costs as they relate to bridge runoff and receiving waters. Prior to initiating the survey, obtain panel review and approval. (3) Based on the results of Tasks 1 and 2, design the preliminary process. Identify additional data and information needs and submit an updated work plan for field work to be carried out in Task 5. (4) Prepare an interim report covering the activities in Tasks 1 through 3. Present the findings to the panel and obtain approval to proceed.

Phase II consists of the following tasks: (5) Apply the process to selected sites where mitigation is and is not required (include at least one past case study, a new construction site, and a retrofit situation). As needed, collect additional data to support evaluation. Obtain feedback from users, resource agencies, and other stakeholders. (6) Document the lessons learned and the input received during Task 5. (7) Refine the process and recommendations for implementation within state DOTs. Present the process and an accompanying commentary in the form of a practitioner handbook. (8) Submit a final report documenting the results and findings of this research, recommendations for additional research, unresolved issues, and recommendations for implementation of the resulting process. Develop, as a stand-alone appendix to the final report, the practitioner handbook that also includes graphic materials to support communication and implementation.

A continuation project has been approved to do additional field testing of bridge runoff impacts on receiving waters. Because of the success of the project to date, the panel asked the research team to prepare a proposal to carry out the continuation research. The research team will prepare a new schedule that incorporates the continuation work within the project.

**BENCH SCALE DEVELOPMENT AND FIELD TESTING OF A PARTIAL EXFILTRATION TRENCH (PET) FOR CONTROLLING HIGHWAY RUNOFF QUALITY. (ENV1318)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* White, Kevin.

*Performed by:* University of Cincinnati.

*Investigator(s):* Sansalone, John.

*Status:* Active, *Contract No.:* 14684(0).

*Start date:* 20 Oct 1997; *Estimated completion date:* 20 Oct 2022.

The objectives of this research are:

(1) To evaluate runoff event loadings for metal elements, solids, chlorides, and water quality parameters including hardness, pH, ORP, and conductivity; (2) To compare event mean concentrations (EMC) results to USEPA and OEPA criteria for both dissolved total metal elements; (3) To investigate pollutant transport, residence time and first flush for pavement sheet flow; (4) To determine solids particle size distributions (PSD's) and specific surface areas (SSA's); (5) To correlate pollutant loadings to traffic indices (traffic counts) such as ADT or VDS; (6) To investigate transport of solids through the PET using bench scale column simulations; (7) To develop a predictive model based on bench scale experiments which can evaluate particle capture, clogging and eventual breakthrough from the PET; (8) To investigate performance and economy of 2 sorbent backfill materials for the PET; (9) To evaluate performance of PET design alternatives to provide improved pollutant trapping, improved resistance to clogging and economy to install/maintain PET; and (10) To publish and present results at TRB meetings and publish in peer-reviewed journals.

**CAREER: HYDROLOGIC REGULATION OF WETLAND BIOGEOCHEMISTRY AND ECOLOGY AND THE IMPACTS OF CLIMATE CHANGE.** (Fed 00184840)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington. DC.

*Project Monitor:* Shaver, Gaius R.

*Performed by:* Michigan State University. W.K. Kellogg Biological Station. Hickory Corners. MI.

*Investigator(s):* Hamilton, Stephen K.

*Status:* Active, *Contract No.:* 9701714.

*Start date:* 15 Aug 1997; *Estimated completion date:* 31 Jul 1999.

The aims of this research are to investigate linkages between hydrology, biogeochemistry, and ecology of wetlands in glacial landscapes, with the long-term aim of developing a predictive understanding of the relative sensitivity of different wetlands to climate change. The research plan involves monitoring of a large number of different wetlands in relation to annual variation in climate, and as part of the NSF career program it includes significant student participation through class projects and independent research. The wetlands to be studied are all in central Michigan.

**CHANNEL STABILITY.** (ENV1143)

*Sponsored by:* Nebraska Department of Roads.

*Project Monitor:* Beacham, Mike.

*Performed by:* U.S. Geological Service; U.S. Army Corps of Engineers.

*Investigator(s):* Soenksen, Philip and Brey, Debbie.

*Status:* Active, *Contract No.:* SPR-PL-1(36) P505.

*Start date:* 1 Oct 1995; *Estimated completion date:* 31 Mar 1999.

Hundreds of miles of stream channels in the loess (a blanket deposit of buff-colored homogeneous silt that is porous, crumbly, and generally of low cohesive strength) area of eastern Nebraska and the other parts of the Midwestern United States were dredged and straightened near the turn of the 20th century to increase the capacity of stream channels and to alleviate cropland-flooding problems. This practice reduces stream lengths, increases channel gradient and stream power, and increases the ability of the flow to erode channel sediments. As a result, the modified channels and adjacent tributaries of eastern Nebraska have experienced headward-progressing degradation, which has heightened and steepened channel banks causing channel widening by bank failures.

The objective of this research is to evaluate and to quantify past, present, and future channel instabilities in the 23-county loess area of eastern Nebraska. To accomplish these objectives, the study is separated into two levels of investigations: a detailed evaluation of channel conditions to identify severely eroding stream reaches and endangered bridged structures and intensive data-collection activities to provide sufficient data to apply computational methods for predicting future changes in channel geometry.

**COMPARISON OF EROSION CONTROL AND ENGINEERING PROPERTIES OF TURF SOD AND FOUR MIXES OF NATIVE GRASSES, FORBS AND WILD FLOWERS.** (ENV1174)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Hughes, M.

*Investigator(s):* Landphair, H. C.

*Status:* Active, *Contract No.:* 9-1504.

*Start date:* 24 Sep 1997; *Estimated completion date:* 31 Aug 2000.

No summary provided.

**COMPREHENSIVE WATERSHED MANAGEMENT: A SPATIAL WATER QUALITY ASSESSMENT SYSTEM (SWQAS).** (Fed 00189892)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington, DC.

*Project Monitor:* Firth, Penelope L.

*Performed by:* Pennsylvania State University. Department of Geography. University Park. PA.

*Investigator(s):* Knight, C. Gregory, McDonnell, Archie J., Petersen, Gary W., Hamlett, James M., and Evans, Barry M.

*Status:* Active, *Contract No.:* 9726863.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 1998.

The complex distribution of physical, chemical, biological, and human forces in space and time exerts significant effects on the magnitude and location of pollution impacts. This project will develop a decision support system linking ecological, hydrological/geochemical/engineering, and social science research to address two questions: (1) how can multiple goals for improvement of river water quality and ecosystem integrity be accomplished under various scenarios of present and future climatic variability and socioeconomic change? and (2) how do different geographical patterns of water quality inform potential societal decisions affecting water pollution abatement? The project incorporates community-based decision making and the role of cities, emerging suburbs and rural areas as pollution sources using the Yantra River basin in Bulgaria as a case study.

**CONTROLLING HIGHWAY RUNOFF POLLUTION IN WATER SUPPLY RESERVOIR WATERSHEDS.** (ENV1309)

*Sponsored by:* Virginia Department of Transportation; Federal Highway Administration.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Yu, Shaw L. and Langan, Thomas.

*Status:* Active.

*Start date:* 1 Dec 1997; *Estimated completion date:* 30 Jun 1999.

*Purpose:* Recently, citizens and local water officials have expressed concerns about roadway runoff affecting sources of drinking water, e.g., in the Warrenton and Charlottesville-Albemarle areas. The Rt. 17 Bypass in Warrenton links the Rt. 29 Bypass and Rt. 17. The route, which

opened in late 1997, is a dual-lane highway approximately 4.0 km ( 2.5 mi) long with 1.6 km (1 mi) located in the watershed of the Warrenton Reservoir.

The primary focus of this study is to monitor the stormwater facilities constructed by VDOT at the Rt. 17 Bypass site in Warrenton and determine their pollutant removal efficiency. Emphasis will be given to a recently completed "bioretention pond." The purpose is to document the water quality benefits of bioretention as an innovative control device for treating stormwater runoff from highways. The second goal is to assess the potential postconstruction impact of the Rt. 17 Bypass project on the water quality of the Warrenton Reservoir. An appropriate modeling approach will be developed for such an assessment. The objective is to evaluate the adequacy of the stormwater management facilities constructed by VDOT in protecting the Warrenton Reservoir. The source water quality criteria listed under the federal and the state regulations will be used as a guide in the assessment.

This project offers VDOT the unique opportunity to monitor the new stormwater control best management practice, bioretention, and determine its applicability and validity for use in stormwater management control plans. The proposed computer modeling will allow VDOT to analyze the effectiveness of its current control strategies and provide the ability to make proper adjustments to these strategies if deficiencies are discovered. The outcome from the modeling process can be directly applied to the development of stormwater management control plans for similar scenarios, such as the recently proposed Rt. 29 bypass in Charlottesville. The strategy will emphasize the "watershed" approach as promoted by the EPA to controlling pollution of sensitive water bodies such as water supply sources. This approach implies a concerted effort by all stakeholders to control pollution from various sources, such as urban areas, industries, farms, and construction sites. VDOT's role in overall watershed-wide water quality management and, therefore, its fair share of the responsibility should be properly defined.

Four storm events have been monitored at the bioretention facility from May to October of 1998. It is expected that at least one more storm event will be captured before monitoring is completed by the end of November 1998. The process of selecting an appropriate computer model has begun, and a model is expected to be chosen by December of 1998.

**CULVERT STUDY - ALUMINIZED STEEL TYPE II. (00755317)**

*Sponsored by:* New Brunswick Department of Transportation. Fredericton. Canada.

*Performed by :* New Brunswick Department of Transportation. Fredericton. Canada.

*Investigator(s):* Jackart, M.

*Status:* Active.

*Start date:* 1991; *Estimated completion date:* 2001.

Reinforced concrete is generally used in highway construction and maintenance due to long life and durability. Galvanized corrugated steel pipe is used as an alternate, although increased thicknesses are specified to ensure required durability. Aluminized steel pipe type II is promoted as a viable alternative economically with certain limitations related to water acidity and soil resistivity.

**DELINEATION AND MANAGEMENT OF SULFIDIC MATERIALS IN VIRGINIA HIGHWAY CORRIDORS.** (ENV1304)

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Polytechnic Institute and State University; Virginia Transportation Research Council.

*Investigator(s):* Daniels, Lee, Orndorff, Zenah, Fitch, Michael, and Lane, Stephen.

*Status:* Active.

*Start date:* 1 Jul 1997; *Estimated completion date:* 30 Jun 2001.

Sulfidic minerals are common in all of Virginia's geologic provinces and have historically posed local threats to water quality, fill stability, concrete/metal structures, and vegetation management. In the past several years, a number of new problem sites have become apparent to local VDOT residencies because of wetland excavation and the ever-deepening nature of road cut designs statewide. It is also becoming obvious that a number of older, poorly understood "problem areas" in statewide rights of way owe their management difficulties and environmental complications to the presence of sulfidic materials. For example, a number of concrete box structures and metal guardrails have been seriously (or completely) degraded by contact with these materials.

The purpose of this research is to develop the database, materials handling plans, and environmental control strategies necessary to deal with potentially acidic materials in the road building and right-of-way environment safely and economically.

This study will benefit VDOT in three ways: (1) the development of a sulfidic hazard potential map will enable VDOT to avoid areas known to contain highly sulfidic soils where large excavations are necessary; (2) in cases where sulfidic materials are encountered, chemical and physical stabilization alternatives and other protection strategies developed will minimize the potential damage of these soils; and (3) the development of water treatment strategies for acid leachates will enable VDOT to comply with existing regulations for water quality standards.

The results of this research effort could potentially save VDOT significant construction, maintenance, and environmental compliance costs. These savings will likely be realized to a greater and greater extent as the effects of sulfidic soils on existing structures become more evident.

All sites originally identified as problem areas by VDOT have been mapped and sampled. Preliminary results for most of these sites have been obtained. Additional work will be conducted for most of these sites over the next year. The development of an acid-sulfate risk map and revegetation experiments will also be initiated within the next year.

**DEMONSTRATION OF LOW-COST METHODS TO CONTROL EROSION AND RUNOFF FROM DIRT AND GRAVEL ROADS.** (ENV1258)

*Sponsored by:* Pennsylvania Cooperative Fish and Wildlife Research Unit. University Park. PA.  
*Project Monitor:* Carline, Robert F.

*Investigator(s):* Arnold, Dean E., Colbert, Woodrow J., Vandegrift, Bruce V., Murin, Kenneth, and Delcorso, Elynn J.

*Status:* Active, *Contract No.:* 201.

*Start date:* 1 Apr 1997; *Estimated completion date:* 31 Mar 2020.

In Pennsylvania there are more than 27,000 miles of unpaved roads, under the control of at least six government agencies. Many clean, high-value streams are paralleled through all or part of their length by such roads. Such stream segments are vulnerable to adverse effects of siltation and other components of runoff from the unpaved roads. Such pollution to the waters of our

Commonwealth, and several authorities have found the situation to be similar nationwide. The effects of sediment pollution on streams have been well documented. Scientists agree that excessive siltation hurts all stream life. It leads to degraded populations of sport fish, and thus to substantial losses in recreational opportunities. The objectives of this project are to demonstrate low-cost techniques for erosion and runoff control that can be easily carried out by township and forest district road crews, and to produce printed, illustrated guidelines and videotapes for training these persons. The investigators are members of the Pennsylvania Interagency Task Force on Dirt and Gravel Roads, which has been working with the problem in quarterly meetings for three years, and has proposed the basic ideas from which we have developed the demonstrations. The Task Force has sponsored one earlier demonstration project in which study techniques to be used in this project were developed and tested. The Pine Creek watershed was chosen for this project due to the presence there of serious, yet typical problems of roads located on public land. This location, and the current existence of other pollution control programs in the watershed, led to the willingness of several government bodies to take active roles in the project.

We will organize the physical road work and conduct monitoring operations: physical, chemical, and biological, before and after the work. This data, together with photographic records, will document the success (or failure) of the various techniques demonstrated. Where possible, fish and wildlife values will be carefully included in the evaluation. Written training materials, videotapes, and photographic/information displays will be produced for use in training road maintenance crews, and for public information.

#### **DESIGN FOR PREVENTION OF DITCH EROSION ON VIRGINIA HIGHWAYS.** (ENV1301)

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Polytechnic Institute and State University.

*Investigator(s):* Duncan, Michael, Mitchell, James, Diplas, Panos, Smith, Charles, Coffey, James, and Stallings, Sheila.

*Status:* Active.

*Start date:* May 1998; *Estimated completion date:* 1 Jul 1999.

The goal of this research is to improve the methods of analysis and design for preventing erosion of soil in roadside ditches. In some areas of the state, such as Lynchburg and Fredericksburg, ditch erosion has occurred frequently enough to indicate that it may be desirable to modify current design procedures. Specific problems undergoing investigation include soil type; mechanisms of erosion; precipitation, topography, and runoff; hydraulic design; method of analysis; and design.

Potential deliverables for this project include updated or revised software and process and timing recommendations. Additional items to be addressed include the use of mica content and plasticity as additional parameters to be considered when ditch-lining requirements are determined.

Progress to date includes partial completion of a literature review, a summary of VDOT's experiences, a partial survey of surrounding states, and general data gathering. From the work completed thus far, several conclusions can be drawn:

1. The rational method for determining runoff is not being applied in the same way in all districts.
2. Project right-of-way limitations often dictate ditch geometries that can lead to erosion.
3. Many districts modify prescribed maximum allowable water velocities based on local conditions and experience, whereas others use default values without consideration of site-specific information.

4. Soil type is usually not a significant factor in ditch design.
5. Roadside ditch performance is adversely affected by inadequate enforcement of stormwater management on adjacent land.

**DETERMINATION AND TREATMENT OF SUBSTANCES IN RUNOFF IN A CONTROLLED HIGHWAY SYSTEM (CROSS LAKE). (ENV1120)**

*Sponsored by:* Louisiana Department of Transportation & Development; Baton Rouge, LA; National Cooperative Highway Research Program.

*Project Monitor:* Skip Paul.

*Performed by:* Louisiana Tech University.

*Investigator(s):* Dixie M. Griffin, Jr.

*Status:* Active, *Contract No.:* 96-5GT.

*Start date:* 1 May 1996; *Estimated completion date:* 30 Jun 1999.

The primary purpose of this study is to: 1) Investigate the type and quantity of substances found in highway stormwater runoff in worst case situations on the Louisiana highway system; and 2) To evaluate and improve the efficiency of stormwater treatment technologies for targeted substances found in part 1. According to the biannual research progress report, traffic monitoring equipment for all of the Cross Lake Bridge Lanes is in place. Flowmeters and samplers, along with a rain gauge and pH probe are in place and working properly. The project monitor reports that the research has been very productive in that the interim report indicated that contaminants released by the road surface is a function of rainfall intensity rather than the volume or duration of a rainfall event. The research has not progressed far enough to indentify any strategies as yet, the report states. This study should provide insight into Best Management Practices for highway runoff.

**DEVELOPMENT OF A VEHICLE TRAVEL MODEL PROJECTING THE RELATIONSHIP BETWEEN TRAFFIC LEVEL AND MTBE INFILTRATION IN WATERSHED AREAS. (ENV1220)**

*Sponsored by:* Federal Highway Administration. Transportation Environmental Research Program.

*Project Monitor:* Koontz, Mike.

*Performed by:* University of Colorado-Denver.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

*Notes:* When these projects are completed or near completed, the status will be posted on the Web at: [www.fhwa.dot.gov/terp](http://www.fhwa.dot.gov/terp).

Development of a vehicle travel model projecting the relationship between traffic level and MTBE infiltration in watershed areas.

**ECOLOGICAL EFFECTS OF L-31E FLOW REDISTRIBUTION. (ENV1238)**

*Project Monitor:* JaffeRudolph.

*Performed by:* Southeast Environmental Research Program. Florida International University. Miami. FL.

*Investigator(s):* Ross, Mike, Meeder, Jack, Telesnicki, Guy, Ruiz, Pablo, Byrnes, Mike, Alvord, Jen, and Atlas, Zack.

*Start date:* 1 Aug 1993; *Estimated completion date:* 31 Oct 1998.

The objective of this pilot project is to determine the effects on water quality and other ecosystem characteristics when canal waters, which would otherwise flow directly into Biscayne Bay, are



distributed into the coastal wetlands.

**THE EFFECTIVENESS OF COMMON BEST MANAGEMENT PRACTICES IN REDUCING TOTAL SUSPENDED SOLID CONCENTRATIONS IN HIGHWAY RUNOFF ALONG THE SOUTHEAST EXPRESSWAY, BOSTON, MASSACHUSETTS.**

(ENV1126)

*Sponsored by:* Massachusetts Highway Department.

*Project Monitor:* Barbaro, Henry.

*Performed by:* U.S. Geological Society.

*Status:* Active, *Contract No.:* 617-973-7419 PM.

*Start date:* 2 Oct 1998; *Estimated completion date:* 30 Nov 2001.

This study seeks to determine the cost-effectiveness of a catch basin in the Southeast Expressway. The catch basin was installed in order to mitigate runoff, but it is expensive to install in the ground and maintain. This study should compile more accurate data on the effective of this catch basin.

**EFFECTIVENESS OF “LOW END” STORM WATER RUNOFF MITIGATION EFFORTS.** (ENV1169)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Concienne, R.

*Investigator(s):* Landphair, H. C.

*Status:* Active, *Contract No.:* 0-1837.

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 2000.

No summary provided.

**EFFECTS OF HIGHWAY DEICING CHEMICALS ON SHALLOW UNCONSOLIDATED AQUIFERS IN OHIO.** (00637425)

*Sponsored by:* Ohio Department of Transportation. Columbus. OH.

*Project Monitor:* Linkous, Tom.

*Performed by:* U.S. Geological Survey. Water Resources Division.

*Investigator(s):* Jones, Allison L.

*Status:* Active, *Contract No.:* OH-87-092.

*Start date:* 1 Jan 1988; *Estimated completion date:* 20020930.

*Publication(s):* Interim publication: A. L. Jones, and B. N. Sroka. 1997. Effects Of Highway Deicing Chemicals On Shallow Unconsolidated Aquifers In Ohio, Interim Report, 1988-93. Water Resources Investigations, 149 p. USGSWRI974027. NTIS Order Number PB97-203020. In Ohio, there is a general lack of detailed knowledge concerning the movement of de-icing salts after they have been applied to roads. The use of road salts has been increasing continuously since about 1940. There is growing indication that all applied salts do not leave the area of application, but that some in fact accumulate. The Ohio Department of Transportation (DOT) needs long-term data on the effects of chlorides on soil and ground water in Ohio. Each site tested will include six multi-level sampling wells and one water-level well. Soil salinity will be monitored by taking actual soil samples several times per year. The wells will be sampled monthly for sodium, calcium, chloride, and specific conductance, and occasionally for dissolved cyanide. Specific conductance will be continually monitored at all sites. Progression of salt through the aquifer with time will be examined at each site.

This is phase one of a two phased program to determine the impact of highway deicing chemicals

upon shallow unconfined aquifers adjacent to roadways. This first phase will develop a detailed research plan to include: an experimental, analytical and implementation plan. This study will include an extensive field monitoring and laboratory analysis program extending over at least five years in phase two.

The objectives of this research are:

To determine the impacts of highway deicing chemicals, predominantly chloride, on the ground water quality of shallow unconfined aquifers that underlie highways in Ohio.

To determine those impacts in each of the major soil type and climatic areas of Ohio where shallow unconsolidated aquifers exist.

To track the movement of chlorides away from the highway to observe seasonal variations in chloride migration.

To determine yearly changes in impacts caused by annual variation in snowfall.

To determine the salt concentrations present in the soil and unsaturated zone.

### **ENHANCEMENT OF FUEL OXYGENATE (MTBE) BIODEGRADATION POTENTIAL IN GROUNDWATER. (ENV1209)**

*Sponsored by* : U.S. Geological Survey. Water Resources Research Institute.

*Investigator(s)*: Cunningham, Alfred B., Veeh, Richard, Sturman, Paul J., Kuhn, Jeff, and Jester, Stephen.

*Status*: Active.

*Start date*: 1 Sep 1998; *Estimated completion date*: 30 Sep 2001.

This study will greatly increase our knowledge of the fate and transport of oxygenate gasoline additives in groundwater systems. The project work plan will determine the physical, chemical, and biological processes that limit the rate of MTBE biodegradation. Anticipated results include: (1) field and laboratory identification of primary mechanisms of MTBE natural attenuation, (2) recognition of microbial populations capable of oxygenate degradation, (3) identification of degradation pathways and metabolite recalcitrance, (4) optimization of parameters that limit oxygenate biodegradation to maximize degradation rates, and (5) development of biodegradation enhancement strategies and subsequent plot testing at the Ronan, Montana, field site. The results from this study will help states and municipalities decide what level of remediation is necessary to address MTBE concentrations in drinking water supplies and whether specific groundwater remediation efforts can be undertaken to prevent future MTBE impacts. Development of improved methods for enhancing MTBE biodegradation will clearly also be of use to industrial practitioners responsible for developing remediation strategies for subsurface gasoline release sites.

### **ENVIRONMENTAL IMPACT OF CONSTRUCTION AND REPAIR MATERIALS ON SURFACE AND GROUND WATERS. (ENV1013)**

*Sponsored by*: National Cooperative Highway Research Program.

*Project Monitor*: Harrigan, Edward T.

*Performed by*: Oregon State University.

*Investigator(s)*: Eldin, Neil and Huber, Wayne.

*Status*: Active, *Contract No.*: Project 25-09, FY '94.

*Start date*: 1 Mar 1994; *Estimated completion date*: 30 Sep 1999.

*Publication(s)*: Reports of Phase I and II research are under review.

*Notes*: Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

A number of uncertainties exist regarding the effects on ecosystems and human health of

constituents that migrate from the roadway through surface water and groundwater. These constituents originate from materials used in construction and repair of the roadway, construction procedures, vehicular operations, maintenance procedures, and atmospheric deposition.

Considerable research has been conducted in the area of water-quality impacts from highway and vehicle operations, maintenance practices, and atmospheric deposition. There is an ongoing FHWA study, based on past research in this area, that will synthesize relevant information on the impacts of highway runoff on receiving water quality. Future research is planned (FHWA's proposed High Priority Area program, Highways and Water Resources -- Improving the Prediction of Impacts and the Effectiveness of Mitigation Techniques) that will extend these efforts to characterize the chemical, physical, and biological contaminants in the roadway storm water runoff and their impacts on receiving waters.

Historically, construction and repair materials have been viewed as being innocuous and hence not of concern to environmental quality. Currently there is a perception that some of these materials may pose an environmental concern. Furthermore, a variety of recycled and waste materials are being considered for use as construction and repair materials, thereby increasing the number of nontraditional materials in contact with surface water and groundwater.

This research project will concentrate on identifying potentially mobile constituents from highway construction and repair materials and their possible impacts on surface water and groundwater. Materials used in construction and repair that are likely to come into contact with the surface water and groundwater include: asphalt, concrete additives, metals, grouts, plastics/synthetics, shredded rubber tires, Styrofoam, creosote and other timber preservatives, and others. Explicitly excluded from consideration in this project are constituents originating from construction processes, vehicular operations, maintenance operations, and atmospheric deposition.

The ultimate objective of this research is to develop a validated methodology for assessing the environmental impact of highway construction and repair materials on surface water and groundwater, and to apply the methodology to a spectrum of materials in representative environments. Accomplishment of this objective will involve several phases. This phase of the research will develop a proposed methodology for assessing the environmental impact of highway construction and repair materials on surface water and groundwater. Additionally, limited testing toward validation will be conducted.

The research will include as a minimum the following phases and tasks:

Phase I: (1) Identify highway construction and repair materials that may have constituents that could become mobile via chemical, biological, and physical processes through the highway operation and within the operational environment. These constituents may have the potential to negatively impact surface water and groundwater -- thereby affecting human health and aquatic ecosystems. (2) Propose a methodology to assess the potential of highway construction and repair materials to release mobile constituents in the roadway environment. In addition, the methodology must identify the field conditions that affect the transport and persistence of these constituents. Identify sampling, testing, and modeling procedures that can document the distance these constituents can migrate in the roadway environment. (3) Within six months after the start of the contract, submit an interim report that describes the construction and repair materials identified in Task 1 and the methodology developed in Task 2. The interim report will include a work plan for conducting a limited testing program to evaluate the methodology. (4) Conduct a testing program to evaluate the proposed methodology, recommend refinements, and develop a

plan for validation of the methodology. The plan should include a proposed budget, timetable, and priority list of materials to be tested. (5) Propose a conceptual model for estimating the portion of contaminants in highway runoff and groundwater that originates from construction and repair materials. (6) Prepare a final report detailing the entire research effort.

Phase II: (7) Reflecting the findings and lessons learned in Phase I, determine the leaching behavior of highway construction and repair materials through chemical and biological testing and analysis of leaching data. (8) Develop and validate a predictive model, which can predict the fate and transport of mobile toxicants resulting from the use of construction and repair materials. (9) Validate and extend the evaluation methodologies developed in Phase I through analysis of the additional biological and chemical testing carried out in Task 7. (10) Prepare a plan for alternative approaches to field testing and validation of the model and evaluation methodology. (11) Prepare and submit a final report detailing the results and conclusions of the Phase I and Phase II research effort.

Phase III: (12) Confirm the Phase II methodology by conducting scaled-up tests of the RRR processes in soil columns. (13) Compare the results of leaching tests from flat surfaces with and without soil confinement. (14) Determine a range of typical absorption and desorption parameters for the C&R materials on sand and gravel typically utilized in unbound pavement layers and shoulders. (15) Prepare a final report that summarizes findings and conclusions of the Phase III research effort.

Status: Phase I was completed on time. A report appropriate for broader public distribution, summarizing the Phase I findings, was prepared, but has not been released by the project panel. Phase II was completed on time. An advance copy of the final report for Phase II was reviewed by the panel and the research agency at a meeting in December 1997. The panel judged that Phase II was completed successfully. At its April 1998 meeting, the panel approved an amplified work plan for Phase III, Tasks 12 -15, scheduled for completion in September 1999. This phase will verify the test methodology and the computer model with field and scaled-up laboratory data.

### **EROSION CONTROL OF SANDY SOILS. (ENV1196)**

*Sponsored by:* New Jersey Department of Transportation.

*Performed by:* New Jersey Department of Transportation.

*Investigator(s):* Nichnadowicz, Vincent.

*Status:* Active.

*Start date:* *Estimated completion date:* 31 Jul 2000.

Erosion of sandy soils on 2:1 slopes often damage roadsides during and after construction. Reconstruction of these slopes is costly. Typically, these slopes lack adequate fertility and moisture retention qualities to grow and sustain typical roadsides. The objective of this project is to develop specifications for new grass types and methods of using bio-solids to augment soil fertility.

Tasks include the following:

(1) Develop and refine a specification for establishing a stand of weeping lovegrass both for bare soil areas and for partially vegetated areas; (2) Determine the geographic limits of the state road system where weeping lovegrass would be appropriate; (3) Develop and refine a specification for using bio-solids to augment soil fertility; (4) Analyze potential for expanding the use of agreements between various partners to obtain and apply bio-solids; (5) Prepare a cost benefits analysis of converting major areas of turf to weeping lovegrass; and (6) Determine possible clean air credits, maintenance cost reductions and reduced need for mowing.

**ESTIMATION OF IMPERVIOUS CURVE NUMBERS.** (ENV1183)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* McLemore, Shawn.

*Performed by:* Florida Institute of Technology.

*Investigator(s):* Pandit, Ashok.

*Status:* Active, *Contract No.:* BB-908.

*Start date:* 24 Aug 1998; *Estimated completion date:* 25 Nov 1999.

This project will collect runoff data from 100% impervious surfaces, representative of Florida's highways, to determine the CN value and the initial abstraction of these impervious surfaces under Florida's weather conditions.

**EVALUATION OF POLYACRYLAMIDES (PAM) TO REDUCE AND CONTROL SOIL EROSION AND TURBIDITY AT HIGHWAY CONSTRUCTION SITES.** (ENV1044)

*Sponsored by:* Washington State Department of Transportation.

*Performed by:* Washington State Department of Transportation.

*Investigator(s):* Molash, Ed.

*Status:* Active, *Contract No.:* FHWA Priority Technology Program PTP-1996 (003).

*Start date:* 1 Mar 1998; *Estimated completion date:* 30 Sep 1999.

*Notes:* See <http://www.wsdot.wa.gov/eesc/environmental/PAM.htm> for additional information about this research project and links to related research.

WSDOT's Water Quality Program is in the process of evaluating polyacrylamide (PAM), an organic polymer flocculant, for its ability to stabilize soils and remove fine suspended sediments from stormwater runoff at highway construction sites. WSDOT will be testing PAM for its ability to flocculate turbid stormwater runoff within wet detention ponds using a passive, non-mechanical dosing system, and for preventing soil erosion caused by rainfall and concentrated flows over exposed soil surfaces.

PAM has been targeted by WSDOT largely due to the extensive amount of high quality research conducted over the past few years at the USDA/ARS research station in Kimberly, Idaho. USDA/ARS's work demonstrated the impressive benefit to cost performance of PAM for soil stabilization, and it hinted at a best management practice (BMP) to abate turbidity from stormwater runoff at construction sites. Through experience, WSDOT has found that conventional temporary erosion and sediment controls (TESC), such as check dams and detention basins alone are generally ineffective for removing turbidity from stormwater runoff.

Sediment lost from highway construction sites can pollute streams and lakes, fill reservoirs, cover and destroy fish-spawning beds, and reduces the overall quality of water for subsequent beneficial uses. Turbidity in stormwater runoff is caused by organic and inorganic colloidal suspensions, which cannot settle out by gravity separation alone. Washington state has large areas of glacial till soils, which, despite the fact that only 2-6% of the soil is clay-sized, has pervasive turbidity problems in stormwater runoff at construction sites. PAM has been found to reduce soil erosion and turbidity by two separate mechanisms: improving the stability the soil aggregates and flocculating suspended solids, thus aiding deposition. PAM treatment of irrigation water is currently the fastest growing conservation technology in irrigated agriculture. It provides a potent environmental benefit by halting furrow erosion by about half ton of soil per ounce (16 kg/g) of PAM used. It is very efficient at removing most (>90%) sediment, phosphorus and pesticides from return flows, and greatly reduces return flow BOD. It increases infiltration, which results in a reduction of runoff water quantity. Reduced sediment, pesticide, and nutrient loading to riparian areas can ultimately be expected by using PAM to reduce the frequency and intensity of algal blooms and reduce turbidity and sedimentation on stream bottoms.

WSDOT will investigate PAM for two primary uses related to the state highway system:

- (1) Controlling soil erosion at its highway construction sites by direct application of dry granular PAM, PAM-dosed aqueous solutions, PAM/mulch combinations, etc. to exposed soil surfaces, and;
- (2) Flocculation of stormwater runoff in sediment ponds at construction sites to reduce turbidity caused by fine suspended solids using a passive dosing method with polymer gel blocks.

Other potentially beneficial uses for PAM may eventually include abatement of wind erosion, dust control, increasing infiltration rates in stormwater BMPs, dewatering catch basin solids, and clarifying catch basin decant water to increase disposal or reuse options.

All PAMs that will be used in WSDOT's trials are copolymers, manufactured to ANSI/NSF Standard 60 requirements for drinking water treatment, and, whenever practicable, "GRAS" versions of PAM will be used. PAM is one of three polymer flocculants currently regulated by Standard 60 for use in potable water treatment systems for human health concerns.

#### **EVALUATION OF THE IMPACT OF VEGETATION MANAGEMENT TECHNIQUES ON WATER QUALITY. (ENV1048)**

*Sponsored by:* Oregon Department of Transportation.

*Project Monitor:* Edgar, Rob.

*Performed by:* U.S. Geological Survey.

*Investigator(s):* Wood, Tamara and Waite, Ian.

*Status:* Active.

*Start date:* Nov 1997; *Estimated completion date:* 30 Jun 1998.

*Notes:* On schedule, Phase 1 near completion.

Integrated Vegetation Management (IVM) programs utilize a suite of practices to control roadside vegetation. The effect of these various methods on water quality has not been adequately documented. This hinders the evaluation of the appropriateness of the methods for the different environmental situations encountered in the course of roadside maintenance. Because the use of herbicides is the most controversial aspect of IVM, research is needed to determine the chemical and biological effects of herbicides along highway shoulders in comparison to the least disruptive alternative--mowing. The vulnerable status of Oregon's anadromous fish stocks makes this information even more necessary.

The objective of this study is to determine if the herbicides used in the Oregon Department of Transportation (ODOT) IVM program have an observable biological effect on the receiving waters. This study will be conducted in several phases. The first phase will identify previously performed work, locate relevant run-off information and recommend a work plan to complete the study. The next phase(s) will consist of field and/or laboratory investigations to determine if there are observable effects on the biology or receiving waters from normal herbicide use.

#### **EVALUATION OF WATER QUALITY MONITORING EQUIPMENT FOR MEASUREMENTS: CONSTITUENTS OF HIGHWAY STORMWATER RUNOFF.**

(00677038; Fed 00164323)

*Sponsored by:* Federal Highway Administration. Washington. DC.

*Project Monitor:* Banks, Fred.

*Performed by:* Woodward-Clyde Federal Services. Gaithersburg. MD.

*Investigator(s):* Strecker, Eric.

*Status:* Active.

*Start date:* 14 Mar 1994; *Estimated completion date:* 31 Dec 1999.

Evaluation of equipment for analyses and measurements of highway runoff water quality and related laboratory analyses of samples. Consideration and evaluation of all conceivable equipment and instrumentation will be given but only laboratory and field testing will be done on commercially available off-the-shelf equipment with at most minimum modifications. Equipment will be tried at four (4) locations in the United States, preferably where other measurements are already being or will be done. Sites have been found in Oregon, Texas, Wisconsin, and Pennsylvania. The U.S. Geological Survey, under an added related contract, is assisting in recommendations and evaluations of equipment.

**FEASIBILITY STUDY OF A ROCK-PLANT FILTER WASTEWATER TREATMENT SYSTEM FOR LADOTD REST AREAS. (ENV1119)**

*Sponsored by:* Louisiana Department. of Transportation & Development. Baton Rouge, LA.

*Project Monitor:* Harold Paul.

*Performed by:* Louisiana Tech University.

*Investigator(s):* Dixie M. Griffin, Jr.

*Status:* Active, *Contract No.:* 91-8GT.

*Start date:* 1 Mar 1996; *Estimated completion date:* 30 Jun 1999.

*Publication(s):* The dye testing procedures and results were presented at an ASCE Seminar in Baton Rouge. A paper is being prepared on the dye testing procedures for publication in an ASCE Journal.

The performance of extended aeration package plants currently treating LADOTD rest areas are sometimes unsatisfactory. A promising alternative is the rock-plant filter (RPF) system which may be simple to maintain and may be able to buffer inconsistent loadings. This research will assess both the feasibility and the design parameters of such a system for treating rest area wastewater. A full scale RPF has been constructed and is in operation at the Grand Prairie rest area.

According to the Biannual Research Progress Report, the system was working very well until the cold weather hit. The project monitor reports that the weather has affected the efficiency of the filter in ways that were totally unexpected and in ways that had not been reported in any other rock-plant filter. A chart shows that the rate of biochemical reactions is cut in half with each ten degree drop in temperature.

The report indicates that the system was in compliance using only cells 1 and 2 until the weather got cold. The temperature of the effluent is affecting the use of chlorine tablets because the tablets are not dissolving enough to kill the coliform. The problem is being evaluated. Ammonia detected in the system indicates a potential future permit problem. The reason probably has to do with the extremely limited amount of water used in the rest rooms because of the automated systems. The ammonia problem will be evaluated using various simple and low maintenance ways of introducing oxygen into the system. The project monitor reports that the research has been very productive in increasing their knowledge about distribution manifolds, flow meters, size of rock needed, porosity and harelike conductivity of the rock filter, and the effect of rainfall runoff on the flow rates in the filter.

**FLOOD FREQUENCY EQUATIONS. (ENV1145)**

*Sponsored by:* Nebraska Department of Roads.

*Project Monitor:* Jisa, Don and Beacham, Mike.

*Performed by:* U.S. Geological Service.

*Investigator(s):* Soenksen, Philip.

*Status:* Active, *Contract No.:* SPR-PL-1(36) P492.

*Start date:* 1 Oct 1994; *Estimated completion date:* 30 Sep 1998.

The objectives of this research are: 1) Using annual peak flow data, update flood frequency computations for all gauged sites in Nebraska according to National Resources Council guidelines. 2) Develop best possible estimators of flood-frequency (peak-flow) characteristics at gauged sites. 3) Develop regional peak-flow estimating equations for ungauged sites in Nebraska using significant basin and climatic variables and the generalized least squares regression technique. 4) Investigate the effects of changes in land development on flood-peak discharges at selected locations in Nebraska. 5) Identify regions of the state where additional peak-low data are required to better define flood-frequency equations.

**GENERATION OF WATER STABLE SOIL AGGREGATES FOR IMPROVED EROSION CONTROL AND REVEGETATION SUCCESS. (00735171)**

*Sponsored by:* California Department of Transportation. Project Development MS-28. Sacramento. CA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Haynes, J.

*Performed by:* University of California, Davis. Land, Air, Water Department. Davis. CA.

*Investigator(s):* Claassen, V.

*Status:* Active, *Contract No.:* E95LA08C.

*Start date:* 8 Aug 1995; *Estimated completion date:* Jan 1999.

*Publication(s):* Final report is in preparation.

The exposed earth surface of a new construction project is generally devoid of nutrients, biological activity or organic matter which in normal soils would form stable soil aggregates. We can add chemical nutrients and establish temporary vegetation cover, but the nutrient is lost because of the location exchange capacity, and the vegetation declines. This project will evaluate chemical and organic inputs can form less erodible soil aggregates and promote long-term vegetation. This will reduce slope failure, maintenance clean-up and water pollution.

**GEOGRAPHIC INFORMATION SYSTEMS FOR WATER RESOURCE RISK ASSESSMENT. (ENV1060)**

*Sponsored by:* Mack-Blackwell National Rural Transportation Study.

*Project Monitor:* Mack-Blackwell National Rural Transportation Study.

*Performed by:* University of Arkansas.

*Investigator(s):* Gross, Mark A.

*Status:* Active, *Contract No.:* MBTC 1091.

*Start date:* 1 Jan 1998; *Estimated completion date:* 30 Dec 1998.

Transportation of hazardous material or potential environmental contaminants presents the potential for spills or accidental releases to surface or groundwater resources. The use of a Geographical Information System (GIS) to locate transportation routes as well as springs, wells, and surface water bodies offers the opportunity for tracking and monitoring the effects of accidental releases from transported waste in the case of an overturned truck or railcar. Current GIS programming will be expanded as part of this project to include transportation routes, surface water bodies, wells, and springs in the four-county area of Washington, Benton, Madison, and Carrol counties in northwest Arkansas. The programming will include a feature to allow the user



to either “point and click” on a location using a mouse, or to input Universal Transverse Mercator (UTM) coordinates of the point of interest. The program will then draw a radius of a distance specified by the user and locate all of the mapped wells, springs, and surface water bodies within that radius.

**GUIDELINES FOR SELECTION OF PIPE CULVERTS. (00721666)**

*Sponsored by:* Arkansas State Highway and Transportation Department. Planning and Research Division. Little Rock. AR; Federal Highway Administration. Washington. DC.

*Project Monitor:* Sanders, J.

*Performed by:* University of Arkansas-Fayetteville. Department of Chemical Engineering. Fayetteville. AR.

*Investigator(s):* Myers, W. A.

*Status:* Active.

*Start date:* 1 Jul 1995; *Estimated completion date:* 1 Feb 1999.

*Publication(s):* A final report for this project is in preparation.

This project concerns the evaluation of culvert types to determine the appropriate applications for and limitations of each type.

**HANDLING AND MITIGATION OF ACID PRODUCING SOILS, LANDSCAPE SOIL STUDY PART II. (ENV1195)**

*Sponsored by:* New Jersey Department of Transportation.

*Performed by:* New Jersey Department of Transportation.

*Investigator(s):* Nichnadowicz, Vincent.

*Status:* Active.

*Start date:* *Estimated completion date:* 31 Dec 2000.

Naturally occurring acid producing soils are often uncovered during highway construction. Untreated, these soils can become highly acidic and kill all vegetation. These denuded soils are then susceptible to soil erosion which in turn endangers pavement stability. The objective of this research study is to develop methods, guidelines, and landscape specifications for converting acid producing soils to soils that are able to sustain a vegetative cover. Tasks include continuing to monitor pH levels of the Route 33 test plots to determine if any pH changes occur.

**HIGH ALTITUDE SNOW AND ICE CONTROL: EFFECTS ON WATER QUALITY. (00735123)**

*Sponsored by:* Colorado Department of Transportation.

*Project Monitor:* Hutter, W.

*Performed by:* Colorado Department of Transportation. Denver. CO.

*Investigator(s):* Lewis, W.

*Status:* Active.

*Start date:* 9 Sep 1996; *Estimated completion date:* 1 Jun 1999.

Control of snow and ice at high elevations in Colorado is a unique problem which requires balancing safety, environmental concerns, and commercial interests. CDOT maintenance is beginning to use alternative deicing chemicals, such as magnesium chloride, at high altitudes with little knowledge of their environmental effects. More information is needed on the effects of snow and ice control on high-elevation plant life and water quality. In addition, cost-effect snow and ice control methods need to be identified and tested.

**HYDRAULIC PERFORMANCE OF STORMWATER FACILITY OUTFALL STRUCTURES.** (00742051)

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Project Monitor:* Hack, Chris.

*Performed by:* University of South Florida. Tampa. FL.

*Investigator(s):* Kranc, S. C.

*Status:* Active.

*Start date:* 1 Nov 1997; *Estimated completion date:* 1 Feb 1999.

The objective of the research is to examine the hydraulic performance characteristics of an outfall structure that combines a "U" endwall and traversible grate with a skimmer and a control opening.

**HYDRAULIC PERFORMANCE OF VARIOUS CURB AND BARRIER WALL INLETS.** (ENV1182)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* McLemore, Shawn.

*Performed by:* University of South Florida.

*Investigator(s):* Kranz, Stan.

*Status:* Active, *Contract No.:* BB-895.

*Start date:* 1 Nov 1998; *Estimated completion date:* 1 Feb 2000.

This project will examine the hydraulic performance characteristics of various curb and gutter inlet structures used by the FDOT roadway design section.

**HYDRODYNAMIC AND TRANSPORT MODELS OF COASTAL WATERS FOR USE IN THE DESIGN AND MANAGEMENT OF HIGHWAY STRUCTURES.** (00636808)

*Sponsored by:* Connecticut Department of Transportation. Wethersfield. CT.

*Project Monitor:* Sime, James.

*Performed by:* Institute of Water Resources. University of Connecticut-Storrs. Storrs. CT.

*Investigator(s):* Lin, J. D. and Lefor, M. W.

*Status:* Active, *Contract No.:* SPR-2214.

*Start date:* 1 Jan 1993; *Estimated completion date:* 30 Jun 1999.

To develop a system of hydrodynamic and transport models of coastal waters for use in CONNDOT engineering designs and for quantitative assessment of environmental impacts of coastal highway structures.

**INTERACTION OF ROAD SALT WITH ENVIRONMENTAL SYSTEMS IN MAINE.** (CRIS 0177056)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* University of Maine. Geological Sciences Department. Orono. ME.

*Investigator(s):* Reeve, A. S. and Norton, S. A.

*Status:* Active, *Contract No.:* ME08140.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 2002.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

The overriding objective of this research is to understand the transport and chemical transformation of road salt (NaCl)-polluted surface and groundwater that have been produced from distributed road salt and road-salt storage piles. By using the Cl as an inert tracer, we are enabled to develop a better understanding of the transport (i.e., hydrology) of other conservative

solutes in surface and groundwater. By developing geochemical models of the interaction of salt-rich water with soil and bedrock and coupling this model with hydrology, we can assess the development of the pollution and potential remediation of impacted areas.

Preliminary investigations of salt contamination of surface water in a wetland (Alton Bog, Maine-bisected by Route I-95), two permanent streams draining forested watersheds bisected by salted roads, and groundwater systems at three localities "downstream" from salt piles will be continued and investigations extended in breadth as follows. (1) Alton Bog: installation of a grid of hydrologic and chemical monitoring wells, quarterly measurement of head and analysis of water samples from several depths in monitoring wells. (2) Winterport, Maine: continued collection and analysis of groundwater samples from domestic wells; addition of more background and polluted wells to this population of wells; head measurement in as many of the wells as possible; and application of electromagnetic surface geophysics to determine the flow pathways in the surficial material and bedrock.

**INTERDISCIPLINARY APPROACHES TO IDENTIFICATION AND MITIGATION OF NPS WATER QUALITY IMPACTS.** (Fed 00167249)

*Sponsored by:* National Science Foundation. Division of Graduate Education. Washington. DC.

*Project Monitor:* Jennings, Paul W.

*Performed by:* University of Wyoming. Department of Civil and Architectural Engineering. Laramie. WY.

*Investigator(s):* Smith, James L. and Stednick, John D.

*Status:* Active, *Contract No.:* 9354864.

*Start date:* 15 Sep 1994; *Estimated completion date:* 31 Aug 1998.

Throughout the United States, non-point sources of water pollution are responsible for contamination of more miles of stream than any other source and also contribute substantially to groundwater degradation. Non-point sources of water pollution include municipalities, industries, agriculture, mine drainage, energy production, and recreation. This training program, which is supported by a strong and successful interdisciplinary research team, combines water quantity and water quality analysis with control and remediation of non-point source water pollution. Emphasis will be on expanding basic scientific knowledge with applications to identification and quantification of non-point sources of water pollution and selection of the most suitable alternative for mitigation of a particular problem. There is capacity for the program, which is expected to expand. Innovative structural components in the training program include: 1) a consortial arrangement between Colorado State University and the University of Wyoming (EPSCOR University); 2) an interdisciplinary effort between watershed sciences, civil engineering, range science, and agronomy (water chemistry); 3) an active recruiting program for women and minorities, including Native Americans and those with disabilities; and 4) implementation of a "project management" approach to improve communications among participants and improve trainee retention.

**INV725: EFFICACY OF EROSION CONTROL BLANKETS AND SOIL STABILIZER.** (ENV1214)

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor :* Stenlund, Dwayne and Cassellius, Ron.

*Performed by:* University of Minnesota.

*Investigator(s):* Biesboer, David.

*Status:* Active, *Contract No.:* 96-311R.

*Start date:* 1 Nov 1996; *Estimated completion date:* 31 Dec 1998.

The overall goal of the proposed research is to determine the impacts of erosion control blankets and soil stabilizers on the germination and growth of native seed mixes and the effectiveness of these blankets/stabilizers in controlling soil erosion. The specific research objectives are: 1) To determine the impact of erosion control blankets and soil stabilizers on the germination of native grasses in indoor greenhouses. This objective will consider a relatively large number of different types of blankets and stabilizers. 2) To determine the impact of erosion control blankets on the germination and growth of native grasses at a Mn/DOT construction site. A subset of the best blankets of Objective 1 will be used for the field work. 3) To determine the effectiveness of the blankets in controlling erosion using natural rainfall events. Runoff and erosion data will be collected for the plots of Objective 4) To determine the effectiveness of the blankets in controlling erosion using events obtained from a rainfall simulator. This objective will obtain runoff and erosion data at important stages of erosion control.

Although they may be more difficult to establish, native species, once established, provide better erosion control than non-native grasses because their root systems penetrate more deeply and widely in soils. Additionally, native species prosper in poor, saline soils; compete effectively with weeds; and ultimately form diverse, but stable, low-maintenance communities. In this study, the establishment of native grasses under erosion control mats, blankets, or soil stabilizers will be determined. Many claims are made for these products in terms of their ability to control erosion and the possibility of establishing vegetation through them. The efficacy of various erosion control products, both to control erosion and to allow good establishment of vegetation through them, will be systematically examined.

#### **INVESTIGATION OF OPTIMUM SAMPLE NUMBER AND TIMING FOR DETERMINING POLLUTION LOADS. (ENV1200)**

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Performed by:* University of Arkansas. Fayetteville. AR.

*Investigator(s):* Nelson, Marc A., Soerens, Thomas S., Steele, Kenneth F., and Vendrell, Paul F.  
*Status:* Active.

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 1999.

Accurate measurements of pollution loads in streams is critical for determining the impacts of non-point source (NPS) pollution in the Arkansas and Southeast U.S. regions. Many researchers are currently attempting to determine these impacts. There are, however, few consistent rules or guidelines for determining the best sampling technique to be used. The ideal technique is to continuously measure stream flow and the concentration of the pollutants of interest (typically solids and nutrients). Pollutant loads may then be calculated with a high degree of precision and accuracy. If flow measurements are available in real time and an automatic sampler can be properly programmed, then flow-weighted composites can be collected. However, these techniques are often not realistic due to economic and/or technical restraints.

The solution to water sampling for determining pollution loads is frequently to continuously monitor flow and intermittently collect water samples. Pollutant loads are then calculated by assuming a uniform pollutant concentration between samples. Many researchers have identified possible sources of errors using this technique, particularly during storm runoff events when the concentrations may change rapidly between samples (Richards and Holloway, 1987; Lowrance and Leonard, 1988). These errors may occur because the samples were not close enough together to detect fluctuations in the concentrations (Lathrop, 1986), or because the samples were not taken during the critical portion of a hydrograph (Baker, 1988). Research has shown that different pollutants may reach their peaks at different times during a storm and they may or may not be directly related to the flow (Montgomery and Kennedy, 1986). Inadequate sampling times

can cause load calculations to either over or underestimate the actual value. Any errors in measuring pollution loads makes determining trends in water quality very difficult (Baker, 1988).

This database will be unique in its sampling intensity and range of coverage and will be a valuable resource for data analysis. The three flow conditions: base flow, rising stormflow, and falling stormflow, will be sampled and compared separately. Statistical methods will be used to compare the data sets with various subsets of the data to determine the optimum number and timing of samples required to determine pollutant loads with high confidence and low bias. This study will be unique since the sampling scheme will be designed to take many more samples during each portion of a hydrograph than would normally be economically feasible, giving enough data points for statistical analysis techniques to be effective for optimizing sampling numbers and strategies.

### **ISLAND KARST HYDROLOGY OF GUAM AND ITS INCORPORATION INTO A GENERAL CARBONATE ISLAND KARST MODEL (CIKM). (ENV1205)**

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Investigator(s):* Jenson, John, Mylroie, John, Carew, James, and Gill, Ivan.

*Status :* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 1999.

Geologists on Guam are frequently asked to advise utilities, regulatory agencies, and the private sector on sites for new well installation, stormwater and sewage overflow disposal, and groundwater monitoring and protection strategies. More accurate analyses can be made at lower costs if local geologists are equipped with (1) a detailed inventory of the island's karst features classified according to their hydrologic properties, and (2) a more complete general model to enable reliable inferences of hydrologic properties to be made by comparison with analogous features of known characteristics documented elsewhere. A clear understanding of the general anatomy of the aquifer increases the reliability of interpretations and predictions made on the basis of test drilling and geophysical exploration, thereby reducing the need for additional drilling or geophysical testing. Specific kinds of information expected from the proposed research include: (1) an improved understanding of groundwater storage and flow, (2) lower well-field development costs and more effective well-field protection practices, (3) more appropriate storm water and sewer overflow management practices, (4) more accurate predictions of the effects of engineering modifications, such as filling and paving large sinkholes, on infiltration and water quality, (5) more informed solid waste disposal siting and more judicious sewer line and septic tank installation, and (6) identification of more appropriate sites for monitoring wells.

Because of the rapid rate of development and human modification of the landscape, answers to these and similar questions are urgently needed on Guam and without a doubt, no less on other carbonate islands experiencing similar growth. The CIKM will provide specific, tested criteria for systematic comparison and classification of karst features based on analogous features whose properties have been documented in the Atlantic-Caribbean. The reciprocal benefit is that we will simultaneously have the first opportunity to test the limits of the applicability of the CIKM against islands with significantly different tectonic, climatic, and perhaps karstigenetic histories. The general model can thus be more rigorously evaluated, and modifications made as necessary. Hydrogeologists and hydrologists working on carbonate islands everywhere will thus be equipped with a more reliable model from which to make more confident assessments and predictions to support more effective groundwater exploration, monitoring, and protection practices.

**MANAGEMENT OF RUNOFF FROM SURFACE TRANSPORTATION FACILITIES - SYNTHESIS AND RESEARCH PLAN (Circular 469 Environmental Research Needs in Transportation research needs statement). (ENV1097)**

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Jencks, Crawford F.

*Status:* Proposed, *Contract No.:* Project 25-20.

*Start date:* *Estimated completion date:* Contract duration: 15 months.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

The effect of polluted runoff on water quality is an important concern for federal, state, and local agencies with a stake in the planning, design, construction, and maintenance of transportation facilities. The National Pollutant Discharge Elimination System (NPDES) regulations (40 CFR 122 & 123) require the management of sources and impacts of contamination from runoff on municipal stormwater systems. In addition, highway runoff management techniques must be consistent with the objectives of nonpoint source control programs under Section 319 of the Clean Water Act and state coastal nonpoint pollution control plans developed under Section 6217 of the Coastal Zone Act Reauthorization Amendments. Therefore, water-quality information and data are needed to manage runoff and comply with the NPDES and other regulations.

Many studies, during the 1980s and 1990s, have addressed water-quality and runoff issues, but results are often difficult to find and obtain. Consequently, critical information is not readily available to practitioners and researchers. Duplication of effort consumes a significant portion of the money spent on investigating water-quality problems.

The fields of water quality, watershed management, and runoff control continue to advance. New and innovative techniques are being developed to perform assessments, measure the impacts, and manage the source. Technologies for best management practices (BMPs) are evolving. Improvements to modeling techniques are occurring. Databases for performance measures are being created. And regulations are changing.

Accordingly, existing information, knowledge, and practice must be critically reviewed and then synthesized, integrated, and made available in a form usable to practitioners. Where there are gaps in existing knowledge, a prioritized plan of research that is financially attainable is needed. There is also a need to sustain a continuing exchange of information to be of value to practitioners and others interested in water-quality and runoff issues.

The objectives of this research, on the management of the quality and quantity of runoff waters from surface transportation facilities, are to (1) synthesize existing knowledge and practice into a form usable by practitioners; (2) develop a strategic research plan to address gaps in existing knowledge; and (3) recommend a system for continued exchange of information between practitioners and others interested in water-quality and runoff issues.

To accomplish the project objectives, the following tasks are envisioned: (1) Review Attachment A for completeness and revise as necessary to provide a comprehensive listing of topic areas appropriate for a synthesis of knowledge and practice and for a strategic research plan. (2) Critically review published and unpublished literature, databases, and information systems to identify the present states of practice and knowledge related to the topic areas identified in Task 1. Consider research carried out by NCHRP; FHWA; EPA; AASHTO (namely, the Environmental Technical Assistance Program -- ETAP); the U.S. Navy; other federal, state, and local agencies; and universities. Synthesize the relevant findings in a form that is useful for planning, designing, constructing, and maintaining transportation facilities. Prepare an annotated

bibliography and identify shortcomings, weaknesses, and gaps in understanding. (3) Identify present sources and levels of funding for current research relevant to the management of runoff, and assess each source's potential in continuing this activity. (This information will be used by the NCHRP and others to determine opportunities for partnering in future research efforts.) (4) Develop a draft strategic research plan. The plan shall include a prioritized program of serial and concurrent research to meet the critical and important needs related to runoff management. Individual projects shall be described with a title, brief scope and objective, and estimated costs and time. (5) Within 6 months of contract initiation, submit draft report no. 1 that includes the results of Tasks 1 through 4. The Task 2 synthesis and Task 4 research plan will each be included as stand-alone appendices. Research will be suspended for approximately 1 month to allow for panel review of the report before Task 6. (6) Participate in a 2-day contractor-panel meeting to discuss and refine draft report no. 1. (Likely sites for the meeting will be the National Research Council facilities in Washington, DC or Irvine, CA. The NCHRP will provide the facility and cover the costs for the travel and subsistence of the responsible project panel.) (7) Based on the contractor-panel interaction, produce draft report no. 2. (8) In cooperation with NCHRP staff, disseminate the synthesis and strategic research plan portions of draft report no. 2 to state DOTs and other interested organizations to obtain input and determine interest in partnering and financing portions of the research plan. Consider the input and revise the draft report accordingly. (9) Analyze the feasibility of creating an electronic repository and exchange system for information on management of runoff from surface transportation facilities. Contact potential organizations with the capability and interest to sustain such an effort and evaluate cost and financing strategies. Recommend options for further consideration in the implementation of the system. (10) Submit the final report with references to the synthesis and strategic research plan as separate stand-alone documents.

**MANAGEMENT OF THE DISCHARGE AND QUALITY OF HIGHWAY RUNOFF IN KARST AREAS TO CONTROL IMPACTS TO GROUND WATER. (00744254)**

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.

*Performed by:* Florida Department of Transportation. Tallahassee. FL.

*Investigator(s):* McLemore, S.

*Status:* Active, *Contract No.:* HPR-2(168).

General impacts of highway stormwater on ground water are highly variable. This study looks at ways to minimize stormwater runoff and keep leachates at acceptable levels.

**MANAGEMENT OF THE DISCHARGE AND QUALITY OF HIGHWAY RUNOFF IN KARST AREAS TO CONTROL IMPACTS TO GROUND WATER. (Fed 00164305)**

*Sponsored by:* Federal Highway Administration. Turner-Fairbank Highway Research Center. McLean. VA.

*Project Monitor:* Banks, Fred.

*Performed by:* P.E. Lamoreaux and Assoc., Inc. Tuscaloosa. AL.

*Investigator(s):* Beck, Barry.

*Status:* Active, *Contract No.:* DTFH61-94-C-00043.

*Start date:* 25 Apr 1994; *Estimated completion date:* 31 Dec 1999.

The effects of highway stormwater runoff on ground water need to be determined. For ordinary highway stormwater runoff, exploring groundwater impacts in Karst areas and developing remedial measures should provide answers for other types of areas. Pooled-fund support from 15 appropriate states and the Federal Highway Administration are supporting this effort. At least two sites are being explored in detail to determine the ground water contamination both before and after remedial measures of siltation basin and anchored permeable filtration basin are

installed in collaboration with local highway agencies.

**MANAGEMENT OF THE DISCHARGE OF HIGHWAY RUNOFF IN KARST AREAS TO CONTROL GROUND WATER.** (00644181)

*Sponsored by:* Tennessee Department of Transportation.

*Project Monitor:* Petty, F.

*Performed by:* Tennessee Department of Transportation. Nashville. TN.

*Status:* Active.

*Start date:* *Estimated completion date:* Jul 1999.

*Publication(s):* Interim and progress reports are available.

*Notes:* This project is in the implementation stage, and is expected to continue until approximately spring 1999.

To evaluate runoff quality from highway construction, maintenance, and management practices of treatment of surface water runoff.

**MANAGEMENT PRACTICES FOR STORMWATER RUNOFF IN CONFINED SPACES.** (00721686)

*Sponsored by:* Washington State Department of Transportation. Olympia. WA; Federal Highway Administration. Washington. DC.

*Project Monitor:* Nelson, M.

*Performed by:* Washington State University-Pullman. Department of Civil Engineering. Pullman. WA.

*Investigator(s):* Barber, Michael.

*Status:* Active.

*Start date:* 1 Dec 1995; *Estimated completion date:* 30 Jun 1997.

*Publication(s):* Draft report: Barber, Michael E. WSDOT BMP's for Stormwater Runoff in Confined Spaces. Report no. WA-RD 451.1. Report is under review.

The overall objective of this project is to provide data concerning performance and operation and maintenance requirements on confined area BMPs that will allow WSDOT personnel to specify stormwater quality improvement projects which satisfy the water quality goal at the least cost and with the highest likelihood of success and with the highest environmental benefit.

**METHODOLOGY FOR PREDICTING CHANNEL MIGRATION.** (00748060)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Hess, Timothy.

*Status:* Contract pending, *Contract No.:* Project 24-16.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Rivers prone to channel migration may be spanned by static structures and paralleled by fixed highway alignments and appurtenances. Channel migration (alluvial river meander, planform deformation) is a major consideration in designing bridge crossings and other transportation facilities in affected areas; it causes the channel alignment and approach conditions present during construction to deteriorate as the upstream channel location changes. Channel migration can result in the following: (a) excess bridge pier and abutment scour; (b) threats to bridge approaches and other highway infrastructure; (c) worsened debris problems; and (d) obstructed conveyance through bridge openings.

Channel migration is typically an incremental process. On meandering streams, the problem at a



bridge site may become apparent two or three decades after the bridge is constructed. Channel migration is often evident throughout large sections of a drainage basin; it is not localized in the vicinity of a bridge. It is a natural phenomenon that occurs in the absence of specific disturbances, but it may be exacerbated by such basin-wide factors as land use changes, gravel mining, dam construction, and removal of vegetation. Remedial action such as constructing guide banks or installing bank protection becomes increasingly expensive or difficult as the channel migrates. A methodology is needed to evaluate the potential for channel movement and predict future channel migration with and without the installation of appropriate countermeasures.

Channel migration includes lateral channel shift (expressed in terms of distance moved perpendicular to the channel center line, per year) and down valley migration (expressed in distance moved along the valley, per year). Engineers are concerned about predicting channel migration as it moves through the bridge elements (piers and abutments) or endangers other highway infrastructure during design life. The role of multiple reaches and subwatersheds in predicting factors affecting the rates of lateral channel shift and down valley migration is also important to the understanding of evolving channel migration in the vicinity of transportation facilities, as is the impact the transportation infrastructure itself has on those rates. A hierarchy of spatial and temporal considerations may provide one unifying approach that affects the rates of channel migration. In addition, any methodology for predicting channel migration rates will need to consider factors that affect natural channel migration rates such as the size and frequency of formative river flows, and past, present, and possible future disturbances to that channel migration.

The objective of this research is to develop a practical methodology to predict the rate and extent of channel migration (i.e., lateral channel shift and down valley migration) in proximity to transportation facilities. The methodology should enable practicing engineers to evaluate and determine bridge and other highway facility locations and sizes and ascertain the need for countermeasures.

To accomplish this objective, the following tasks are recommended:

(1) conduct a critical review of published and unpublished literature to determine the existing state of knowledge and to identify sources of data pertaining to channel migration; (2) contact state, federal, and other appropriate agencies to develop a list of documented case histories and to collect information on channel migration throughout North America; (3) assemble a data set on channel migration in North America, insuring that the amount and type of data collected is commensurate with the proposed methodology; (4) prepare and submit an interim report within nine months of contract award, including a detailed outline of the proposed methodology for NCHRP review, documentation of the results of Tasks 1 through 3, and an update of the work plan for completing the project (the work plan should be a stand-alone document); (5) develop the appropriate methodology to achieve the stated objective; (6) test the methodology using independent data sets, recalibrate as appropriate, evaluate the accuracy of the methodology, and discuss the implications for application; (7) provide the methodology to five states for their independent assessment, report results, and modify methodology as appropriate; and (8) submit a final report documenting the entire research effort. The methodology should be a stand-alone appendix to the final report.

**MONITORING PROGRAM FOR NORTH YARMOUTH TIRE CHIP FIELD TRIAL.**

(00739100)

*Sponsored by:* Maine Department of Transportation.

*Project Monitor:* Peabody, Dale.

*Performed by:* Maine Department of Transportation.

*Investigator(s):* Humphrey, Dana N.

*Status:* Active, *Contract No.:* 96-4.

*Start date:* Aug 1993; *Estimated completion date:* Jul 1999.

*Publication(s):* Interim report is in preparation.

A field trial using tire chips as conventional embankment fill was constructed on the approach fill for the Route 231 bridge over the Maine Central Railroad in North Yarmouth. The Field Trial was constructed in late August, 1993, under the MDOT research project entitled, "Field Trial Using Tire Chips in a Conventional Embankment Fill." The purpose of the field trial was two fold: (1) to evaluate roadway performance and the support characteristics of a road underlain by tire chips; and (2) to investigate the effect on water quality of tire chip fills located above the groundwater table. The construction and short term evaluation of the support characteristics of the field trial is being carried out under Research Project No. 92-2. However, to assess the long-term performance of this field trial it is necessary to monitor the project for 5 years.

**OCCURRENCE OF GASOLINE OXYGENATES IN STORMWATER RUNOFF .**

(ENV1087)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* North Carolina State University. Department of Civil Engineering.

*Investigator(s):* Borden, Robert C.

*Status:* Active.

*Notes:* Pre-award status, no start/end dates defined yet.

Methyl tert-butyl ether (MTBE) is commonly added to gasoline to increase octane and control air pollution. Recent research indicates that MTBE and possibly other oxygenates released from gasoline are entering drinking water supplies through stormwater runoff and ground water. This is a major concern because MTBE: (1) is very soluble, (2) does not adsorb to sediment or biodegrade, (3) has a very unpleasant taste and odor, and (4) is a known animal carcinogen and a suspected human carcinogen. In this research, the project team will collect and analyze stormwater runoff samples from a variety of locations to answer the following questions: (1) how frequently are MTBE and other fuel oxygenates present in stormwater runoff and at what concentrations? (2) are elevated oxygenate concentrations associated with specific land uses or management practices? and (3) are oxygenates removed or attenuated in common surface water quality BMPs?

**POLLUTANT LOADINGS TO STORM WATER RUN-OFF FROM HIGHWAYS: THE IMPACT OF A SWEEPING PROGRAM. (00735144)**

*Sponsored by:* Wisconsin Department of Transportation. Madison. WI.; Federal Highway Administration Washington. DC.

*Project Monitor:* Martinelli, Tom.

*Performed by:* Wisconsin Department of Transportation.

*Investigator(s):* Martinelli, Tom.

*Status:* Active, *Contract No.:* 0092-45-82.

*Start date:* Mar 1998; *Estimated completion date:* Sep 2000.

Background monitoring is underway this fall through spring, with monitoring of the effectiveness of street sweeping starting in spring 1999.

**PROCESSES CONTROLLING THE EXPORT OF TRACE METALS FROM CONTRASTING WATERSHEDS.** (Fed 00182650)

*Sponsored by:* National Science Foundation. Division of Earth Sciences. Washington. DC.

*Project Monitor:* James, L. Douglas.

*Performed by:* University of Wisconsin-Madison. Water Science and Engineering Laboratory. Madison. WI.

*Investigator(s):* Armstrong, D. E., Shafer, M. M., and Hurley, J. P.

*Status:* Active, *Contract No.:* 9630277.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1999.

Watersheds have a major influence on water quality. Concern over the effects of metals on receiving waters emphasizes the need for information on the factors controlling the forms and amounts of metals exported from watersheds and the influences of extreme hydrologic events and changes in land use. Our premise is that the forms, concentrations, and loadings of metals in streams can be used to discern the watershed processes controlling metal export. We also postulate that the nature and amounts of dissolved organic carbon (DOC) and suspended particulate matter (SPM) transported from watersheds are the main geochemical factors controlling metal export. Our goal is to identify and quantify key geochemical and hydrologic processes controlling the forms and amounts of trace metals exported from watersheds representing diverse geology, hydrology, soil type, and land use/cover. Specific objectives are to determine (1) the importance of hydrologic events in controlling metal export from watersheds of contrasting geology and land use; (2) factors controlling within-watershed differences between base flow and event periods in metal levels, partition, and yields; (3) relationships controlling metal speciation in dissolved and particulate phases; and (4) factors and processes controlling delivery of key metal transport phases from watersheds.

**QUANTIFICATION OF SALT LIABILITY MANAGEMENT.** (00755923)

*Sponsored by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Performed by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Investigator(s):* Snodgrass, W. J.

*Status:* Active.

*Start date:* 1994; *Estimated completion date:* 1999.

This research program is designed to quantify the extent of well water quality protection provided by various management systems and technologies and to define the potential reduction in salt liability to a transportation agency from a big-picture point of view. The various research and development sub-projects include: Project no. 21422, Groundwater Contamination Migration; Project no. 21424.1, Susceptibility of Aquifers to Salt Contamination; Project no. 21423, Salt Levels in Groundwaters below Patrol Yards; Project no. 21423.2, Synthesis of Salt from Relevant Databases,; and Project no.21421, Design Salt Removal System.

**REGIONAL APPLICATIONS FOR BIOTECHNICAL METHODS OF STREAMBANK STABILIZATION IN TEXAS.** (ENV1168)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Jenkins, K. R.

*Investigator(s):* Landphair, H. C.

*Status:* Active, *Contract No.:* 0-1836.

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 2002.

No summary provided.

**ROADSIDE DEVELOPMENT AND MANAGEMENT FIELD LABORATORY: EROSION CONTROL MATERIAL TESTING.** (SWUTC 419148)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Northcutt, Paul E.

*Performed by:* Texas A&M University.

*Investigator(s):* McFalls, Jett A.

*Status:* Active, *Contract No.:* none.

*Start date:* 1 Sep 1989; *Estimated completion date:* 31 Aug 1998.

The initial phase of a this multi-year project provides for the construction of a state-of-the-art field laboratory for testing erosion control materials and technologies. It will include: approximately one thousand linear feet of embankment, water storage and control facilities, test channels, sedimentation collection devices, rainfall generation equipment, and other instrumentation. When complete, the facility will be capable of testing approximately thirty-six materials (blankets, mats, and other geotextiles) per year to determine their effectiveness in controlling erosion, their strength and durability, and their effectiveness in establishing vegetative cover. Test channels will be capable of testing flexible channel lining materials in controlled field conditions to determine soil- material interaction, strength, and effectiveness in establishing and maintaining vegetative cover. The 1992 program includes testing of mulches, erosion control blankets, and temporary flexible channel lining materials.

**RPG: ASSESSMENT OF GROUND WATER FLUXES IN SEMIARID SOUTHWESTERN COASTAL WETLANDS.** (Fed 00172760)

*Sponsored by:* National Science Foundation. Division of Earth Sciences. Washington. DC.

*Project Monitor:* Mayhew, Michael A.

*Performed by:* San Diego State University Foundation. Department of Geological Sciences. San Diego. CA.

*Investigator(s):* Thorbjarnarson, Kathryn W.

*Status:* Active, *Contract No.:* 9508031.

*Start date:* 1 Sep 1995; *Estimated completion date:* 28 Feb 1998.

Two major categories of wetlands found in the coastal southwestern United States are lagoonal fringe wetlands and riparian wetlands. The hydrology of these has been little studied, and direct quantification of the groundwater contribution to most wetlands is even less well understood. The goal of this planning grant is to assess the feasibility of particular field techniques in the evaluation of groundwater fluxes in these two major wetland categories. The ultimate goal is a full research proposal to quantify the various contributors, with a significant emphasis on groundwater, to the water budget of a semiarid wetland. The proposed preliminary research entails hydrogeologic and geochemical study of two field sites, the Tijuana Estuary and the lower Santa Margarita River, and assessment of various hydraulic and tracer techniques to quantify the surface- and ground-water interactions.

**RUI: IMPACTS OF SEDIMENT DEPOSITION ON WETLAND FUNCTIONS.** (Fed 00182456)

*Sponsored by:* National Science Foundation. Division of Environmental Biology.

*Project Monitor:* Callahan, James T.

*Performed by:* Franklin Pierce College. Department of Natural Science. Rindge. NH.

*Investigator(s):* Owen, Catherine R.

*Status:* Active, *Contract No.:* 9629363.

*Start date:* 15 Aug 1996; *Estimated completion date:* Dec 1999.

This project will address the impacts of sediment deposition on the functions of non-tidal freshwater wetlands. Non-point source pollution such as stormwater runoff is often directed into wetland areas, sometimes resulting in changes in water quality and hydrology of the wetland. Although this stormwater may contain many types of pollutants, the focus of this stage of research is on the physical impacts of sediments in stormwater runoff on wetland processes. Sediment from construction sites, parking lots, roads, and farms may alter the ecological processes of wetlands. Wetlands are recognized for their ability to filter out sediments and improve water quality, however, there may be some point at which so much sediment is deposited in the wetland that the wetland is degraded, and its ability to perform some or all of its ecological functions is diminished. The general hypothesis of this study is that sediment deposited in a wetland will alter the wetland soil's natural characteristics, such as capillarity, porosity, and hydraulic conductivity. Highly organic soil is often very porous in the top layers, and as a result may be open to settling and compaction by sediment deposited in runoff; if the result of this sediment deposition is a significant change in soil moisture retention, hydraulic conductivity, or other soil characteristics, then water flow and biological processes in the wetland may be altered. The ultimate goal of the study is to identify sustainable loads of sediment for a wetland.

**SAFETY SLOPE AND ECOLOGY DITCH MONITORING AND ASSESSMENT.** (00721681)

*Sponsored by:* Washington State Department of Transportation. Olympia. WA.

*Project Monitor:* Nelson, M.

*Performed by:* Washington State University-Pullman. Department of Civil Engineering. Pullman. WA.

*Investigator(s):* Yonge, David R.

*Status:* Active.

*Start date:* 16 Aug 1995; *Estimated completion date:* 31 May 1999.

*Notes:* Research has been extended.

The primary objective of this project is to generate a data base regarding the fate and transport of stormwater contaminants through highway vegetative strips and ecology ditches. This information would be used to assess the contaminant removal potential of these highway appurtenances, to gain a better understanding of contaminant removal mechanisms in vegetative strips and to supply data that can be used in assessing applicability to NPDES criteria.

**THE SALT EFFECTS ON CRANBERRY SOILS, PLANT GROWTH, AND PRODUCTIVITY.** (ENV1125)

*Sponsored by:* Massachusetts Highway Department.

*Project Monitor:* George Batchelor.

*Performed by:* University of Massachusetts at Lowell.

*Investigator(s):* DeMoranville, Carolyn J.

*Status:* Active.

*Start date:* 29 Oct 1998; *Estimated completion date:* 30 Jun 2000.

This study is being conducted to determine the effects of deicers on cranberry bogs growing along the highway. An objective of the study will be to determine if CMA or magnesium based deicers should be used instead of salt in winter road maintenance. Protection of cranberries is important, since this crop is Massachusetts' number one resource.

**SAMPLING AND TESTING OF STORMWATER RUNOFF FROM NORTH CAROLINA HIGHWAYS. (ENV1261)**

*Sponsored by:* North Carolina State Department of Transportation.

*Performed by:* University of North Carolina-Charlotte.

*Investigator(s):* Wu, Jy.

*Status:* Active, *Contract No.:* HWY-99-6.

*Start date:* 1 Oct 1998; *Estimated completion date:* 30 Jun 1999.

No abstract provided.

**SHORELINE MONITORING AT OREGON INLET TERMINAL GROIN. (00618279)**

*Sponsored by:* North Carolina Department of Transportation. Division of Highways. Raleigh. NC.

*Project Monitor:* Hankins, A.

*Performed by:* North Carolina State University. Department of Civil Engineering. Raleigh. NC.

*Status:* Active.

*Start date:* 14 Sep 1989; *Estimated completion date:* 30 Jun 1999.

*Publication(s):* Interim reports are available, the latest from October 1996 (#13).

*Notes:* This is an ongoing project.

This study involves three phases: 1) establishment of a comprehensive monitoring program to determine effectiveness of groin and revetment, 2) monitoring and data analysis, and 3) preparation of data to determine, together with the Dept. of Interior, the "historical rate of erosion" for the study area shoreline.

**STORM WATER DETENTION POND ANALYSIS. (ENV1144)**

*Sponsored by:* Nebraska Department of Roads.

*Project Monitor:* Donahoo, Kevin.

*Performed by:* University of Nebraska.

*Investigator(s):* Hotchkiss, Roland and Moore, Raymond.

*Status:* Active, *Contract No.:* SPR-PL-1(36) P502.

*Start date:* 20 Aug 1997; *Estimated completion date:* 20 Mar 1999.

Increasingly, designers at the Nebraska Department of Roads are required to consider stormwater detention as part of the hydraulic design for roadway projects or are involved in reviewing designs from outside developers. Detention is most often considered when facing a complex drainage situation for which there is currently no guidance for design procedures.

Research tasks will include a literature review and field visits to existing NDOR detention ponds, most of which have been designed using different procedures. The project will evaluate effective use, siltation, maintenance problems and performance. It will also evaluate the design procedures used for sizing the facilities. Storm, hydrograph, and sizing procedures will be examined to develop relationships that will optimize the detention pond storage volume for consistent and well-founded results. Based on the survey of currently available procedures and the optimization research, the study will develop design procedures that provide consistent results across Nebraska.

**STORMWATER RESEARCH PROGRAM. (00755924)**

*Sponsored by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Performed by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Investigator(s):* Snodgrass, W. J.

*Status:* Active.

*Start date:* 1993; *Estimated completion date:* 1998.

Some of the research and development subprojects include: Project no. 21460.11, Environmental Monitoring of Highway 404 Lane Addition; Project no. 21460.2, Measurement of Impacts of Highway Runoff on Stream Ecosystems; Project no. 21450.1, Model Development; Project no. 22250, Stormwater Quality Research Project; and Project no. 22250.1, Toxicity of Highway Stormwater Runoff.

**STORMWATER TECHNOLOGY EVALUATION. (00755968)**

*Sponsored by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Performed by:* Ontario Ministry of Transportation. Research and Development Branch. Downsview. Canada.

*Investigator(s):* Snodgrass, W. J.

*Status:* Active.

*Start date:* 1994; *Estimated completion date:* 1998.

A performance assessment of the Rouge River Pond is being instigated; pond operation will be optimized; and maintenance requirements evaluated. The performance of oil-water-interceptor technologies is being evaluated for patrol yard and stormwater applications. The role of stream canopy, groundwater inflows, and vegetated BMPs in cooling stream temperatures is being modeled. The Rouge River Treatment Pond data will be incorporated along with research level monitoring data from three or four wet ponds and dry ponds in the United States into a design guideline document.

**STREAM CATCHMENT INTERACTION CONTROLLING DOC CONCENTRATION AND COMPOSITION UNDER VARYING FLOW REGIMES IN ROCKY MOUNTAIN. (Fed 00182257)**

*Sponsored by:* National Science Foundation. Division of Earth Sciences. Washington. DC.

*Project Monitor:* James, L. Douglas.

*Performed by:* University of Virginia Department of Environmental Sciences. Charlottesville. VA.

*Investigator(s):* Hornberger, George M.

*Status:* Active, *Contract No.:* 9628368.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1999.

In many catchment-stream systems, the concentration and composition of dissolved organic material (DOM) is a critical water quality characteristic. Examples of processes controlled by DOM interactions are: (1) complexation of trace metals by the humic fractions of DOM which control both trace metal transport and bioavailability; (2) enhancement of the solubility of hydrophobic organic contaminants; (3) formation of trihalomethanes in drinking water as a result of interactions between chlorine and components of the DOM during water treatment; and (4) absorption of visible and UV radiation by DOM and generation of photoproducts. The DOM also can have indirect effects on water quality by influencing internal processes of aquatic ecosystems, e.g., photosynthesis and heterotrophic activity. In this proposal, we advance a plan of study to

investigate in-stream processes and their interaction with catchment processes in determining the spatial and temporal patterns of quantity and quality of DOC in streams in the Rocky Mountains. The research tasks will include experimental additions of DOC-enriched water to stream segments to quantify interactions in the hyporheic zone, field monitoring to determine synoptic spatial patterns along stream channels and in hillslope lysimeters of amounts and composition of DOC, and the extension of mathematical models to interpret the results.

**STREAM STABILITY/SCOUR EXPERT SYSTEM.** (00640739)

*Sponsored by:* Washington State Department of Transportation.

*Project Monitor:* Anderson, K.

*Performed by:* Washington State Department of Transportation. Olympia. WA.

*Investigator(s):* Palmer.

*Status:* Incomplete.

*Start date:* *Estimated completion date:* unknown.

*Notes:* Research has been extended.

No summary provided.

**STREAMSIDE REFORESTATION: AN ANALYSIS OF ECOLOGICAL BENEFITS AND SOCIETAL PERCEPTIONS.** (Fed 00178835)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington. DC.

*Project Monitor:* Firth, Penelope L.

*Performed by:* Academy of Natural Sciences. Philadelphia. Stroud Water Research Center. Avondale. PA.

*Investigator(s):* Sweeney, Bernard W., Bott, Thomas L., Jackson, John K., Horwitz, Richard J., and Hession, William C.

*Status:* Active, *Contract No.:* 9613588.

*Start date:* 1 Jan 1997; *Estimated completion date:* 31 Dec 1999.

Streamside forests are recommended as a land use practice to protect aquatic ecosystems by removing inputs of nutrients, sediments, and toxic contaminants. This project views streamside forests as the primary regulator of stream width: small forested streams are wider than meadow reaches. The alteration of stream width that results from deforestation profoundly influences the stream ecosystem, both locally and downstream, through effects on habitat and water quality. Policies to restore streamside forests will require both documentation of ecological benefits and an understanding of societal factors affecting their implementation. Objectives are: 1) to understand the relationship between forest buffers, width, and stream ecosystem condition; 2) to develop databases that can help guide forest restoration policies; and 3) to quantify social and economic issues affecting streamside forest restoration.

**SUSTAINABILITY OF SURFICIAL AQUIFER RESOURCES ON ENDMEMBER (URBANIZED AND PRISTINE) BARRIER ISLANDS NEAR BRUNSWICK, GEORGIA.** (ENV1204)

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Performed by:* Georgia Institute of Technology. Atlanta. GA.

*Investigator(s):* Ruppel, Carolyn.

*Status:* Active.

*Start date:* FY1998.

This project will couple noninvasive environmental geophysical methods and standard



piezometric studies to establish a baseline for monitoring future changes in the physical and chemical characteristics of surficial aquifers on two barrier islands that represent end members in the spectrum from pristine to highly urbanized:

(1) Sapelo Island, a relatively pristine island where surficial aquifer dynamics are largely controlled by natural recharge/discharge and tidal forcing, is almost wholly administered by government entities, including the NOAA (Natural Estuarine Research Reserve Program) and the State of Georgia (Department of Natural Resources). The proposed work on Sapelo Island will provide a much-needed baseline for the nearly undisturbed hydrologic state of Pleistocene-Holocene composite barrier islands in the Georgia Bight. Fundamentally, it will never be possible to quantify the impact human habitation has already had on other Georgia barrier islands to the standards determined by regulators and the public until such a baseline can be established.

(2) St. Simons Island, a heavily urbanized island where the hydrologic cycle is disturbed by septic systems, pumping, irrigation, and disruptions of natural drainages and recharge/discharge zones, is the next major barrier island south of Sapelo Island and lies just to the south of the Altamaha River outlet. Research on St. Simons Island will quantify how the hydrologic state has already been altered (relative to the Sapelo baseline and local baselines established at relatively undeveloped sites on St. Simons) by human habitation and how continued development during the study period affects the local state of the surficial aquifer.

Note that the term “baseline” is used here in two senses: First, the Sapelo Island data sets serve as a baseline for the pre-development hydrologic state of many of the Pleistocene-Holocene islands in the Georgia Bight, including St. Simons Island. Second, the 1998-1999 St. Simons data will serve as a baseline for measuring the changes in the surficial aquifer during continued urbanization in the next few years and beyond.

#### **TECHNOLOGY FOR REDUCING WATER QUALITY IMPACTS FROM FOREST ROAD STREAM CROSSINGS. (CRIS 0175872)**

*Sponsored by:* U.S. Department of Agriculture. Competitive Research Grants Office.

*Performed by:* Auburn University. Agri Engineering Department. Auburn. AL.

*Investigator(s):* Taylor, S. E., Yoo, K. H., and Rummer, R. B.

*Status:* Active, *Contract No.:* 97-35103-4764.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 2000.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

The research objectives are to quantify and compare the water quality impacts resulting from both traditional and alternative types of stream crossings; quantify net sediment production resulting from the road approaches to stream crossing sites; and document life-cycle costs of each of the crossings studied.

Several ford, culvert, and temporary bridge stream crossings will be installed on forest roads and then monitored to determine the quantity of sediment introduced into streamflow by each crossing throughout the life of the crossing. Tests also will be conducted on new stream crossing alternatives such as portable bridge systems, pipe fascine systems, and constructed fords. Automated equipment will be used to collect water samples at locations upstream and downstream from the crossings. Then, water samples will be analyzed to determine sediment production at the crossings. Also, devices will be installed at the crossings to measure sediment produced by the road approaches. When the information on sediment production from road approaches is compared with stream crossing sediment production, we can determine whether

more efforts should be devoted to reducing sediment production from the crossing structure itself or from the road approaches to the crossing. In addition to gathering information on sediment production, the researchers will document life-cycle costs of each of the stream crossings studied.

#### **TREATING STORMWATER IN CONFINED SITUATIONS**

**New title: CONFINED SPACE STORMWATER BMPS.** (ENV1089)

*Sponsored by:* Washington State Department of Transportation.

*Project Monitor:* Schaeffer, Jim.

*Performed by:* Washington State University. Department of Civil Engineering. Pullman. WA.

*Investigator(s):* Barber, Michael.

*Status:* Active.

*Start date:* 1 Dec 1995; *Estimated completion date:* 1 Jun 1998.

*Publication(s):* Final report is in preparation.

The goal of this research is to develop, test, and evaluate methods for BMPs that are most effective where limited right-of-way is available. The most effective BMPs for treating stormwater in urban areas, including ferry dock and terminal areas, have a number of product and design options that are used mostly based on the claims of the product manufacturer. This research will look at various designs along with promising products and develop a systematic evaluation methodology. Such a methodology will make it easier to select BMPs that effectively protect water quality.

#### **USE OF KSDOT STORM ANALYSIS SYSTEM TO IMPROVE FLOOD DISCHARGE ESTIMATES.** (00737087)

*Sponsored by:* Kansas Department of Transportation. Bureau of Design. Topeka. KS.

*Project Monitor:* Reynolds, R.

*Performed by:* University of Kansas. Department of Civil Engineering. Lawrence. KS.

*Investigator(s):* McEnroe, B. M.

*Status:* Active, *Contract No.:* K-TRAN KU-98-1.

*Start date:* 16 May 1997; *Estimated completion date:* 15 Aug 1998.

The detailed precipitation data obtained from the storm analysis system (developed in K-TRAN project KU-96-7) will be used to improve the methods used by KSDOT engineers to estimate design discharges for bridges and culverts and to analyze historic floods.

#### **USE OF STABILIZER AGENTS IN MIXER DRUM WASH WATER.** (ENV1184)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Bergin, Michael.

*Performed by:* University of Florida.

*Investigator(s):* Chini, Abdol.

*Status:* Active, *Contract No.:* BB-889.

*Start date:* 24 Aug 1998; *Estimated completion date:* 24 Nov 1999.

The objectives of this project are to develop water quality standards which address use of stabilized mixer drum wash water in the production of fresh concrete, while also, providing specification limits of chemical characteristics that would affect concrete durability or other physical/chemical properties.

**USE OF WASTE TIRES FOR LIGHTWEIGHT FILL IN SWAMPS. (00637021)**

*Sponsored by:* Minnesota Department of Transportation.

*Performed by:* Minnesota Department of Transportation. St Paul. MN.

*Investigator(s):* Kosobud, K.

*Status:* Active.

*Start date:* 11 Oct 1990; *Estimated completion date:* 31 Dec 1999.

Efforts to phase out the environmentally and economically costly practice of landfilling have stimulated the pursuit of non-landfilling disposal or reuse of waste products. Due to the continuous and high volume of materials it requires, the highway industry is often looked upon as a potential consumer of waste products. Since most transportation network construction in Minnesota is done under specs drafted by DOT, MNDOT has been sought to define uses for several waste products.

**UTILIZATION OF PRECIPITATION ESTIMATES DEVELOPED FROM COMPOSITE RESEARCH. (00714267)**

*Sponsored by:* Kansas Department of Transportation. Topeka. KS.

*Project Monitor:* Younger, J. T.

*Performed by:* University of Kansas. Lawrence. KS.

*Investigator(s):* McEnroe, B. M.

*Status:* Active.

*Start date:* 16 May 1995; *Estimated completion date:* 15 May 1997.

*Publication(s):* Research has been completed, and a final report is under review. (Report no. KU-96-7.)

The objective of this research project will be to meet KSDOT's ongoing need for high-quality precipitation data in a cost effective manner.

**VEGETATION MANAGEMENT PRACTICES FOR SOIL STABILITY, EROSION CONTROL AND SLOPE MAINTENANCE. (ENV1160)**

*Sponsored by:* Idaho Transportation Department.

*Project Monitor:* Kingery, James L.

*Performed by:* University of Idaho.

*Investigator(s):* Kingery, James L.

*Status:* Pending.

*Start date:* Oct 1998; *Estimated completion date:* Oct 1999.

Surface erosion, sedimentation, and shallow-seated slope failures in Idaho present a significant challenge to roadway construction and maintenance. Soil losses from such slopes deplete an important natural resource, induce excessive maintenance such as ditch and culvert clean-outs, and may cause adverse effects on the quality of surface waters in the state. Road construction and maintenance activities throughout the state are requiring greater attention to erosion and sediment control concerns due to environmental and economic pressures. This project is designed to evaluate existing and new revegetation technologies on areas affected by highway construction for purposes of topsoil utilization, erosion control, and slope stabilization. The proposed research will help ITD address specific revegetation site requirements and to determine the most effective ways to reduce surface erosion and sedimentation. The objectives of this project are to investigate revegetation techniques for erosion and sediment control through an integrated research program with Idaho Transportation Department.

**WET DETENTION POND DESIGN FOR HIGHWAY RUNOFF POLLUTION CONTROL.** (ENV1015)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* Harrington, Edward T.

*Performed by :* Washington State University - Pullman. Department of Civil Engineering. Pullman. WA.

*Investigator(s):* Yonge, David R.

*Status:* Active, *Contract No.:* Project 25-12, FY '96.

*Start date:* 15 Apr 1996; *Estimated completion date:* 14 Apr 1999.

*Publication(s):* A Phase I interim report is available.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Research has identified pollutants normally found in highway runoff. Among the sources of these pollutants are vehicles using the highway and land use adjacent to the highway. Regulations, both current and proposed, typically require some type of on-site storm water control to reduce the amount and concentration of potential pollutants from these sources in storm water runoff.

There is an assortment of best management practices (BMPs) that provide various degrees of contamination control as well as other environmental benefits in different highway settings. Currently, the most often recommended control systems are dry or wet detention ponds and vegetative strips. Vegetative strips have shown some effectiveness in decreasing the pollutants in storm water runoff, but existing land area and topography, particularly slope, do not always meet design requirements. Dry detention pond design has not proven satisfactory; ponds designed for large storms do not effectively treat runoff from small storms and those designed for small flows are subject to clogging. The use of wet detention ponds has proven effective to a limited degree.

However, wet detention ponds are one of the less documented pollutant control systems in highway settings. Although wet detention ponds have proven useful for reducing the amount and concentration of potential pollutants in some highway applications, they have exhibited widely varying degrees of efficiency.

Research is needed to quantify the effectiveness of wet detention ponds and to compare their performance to that of dry ponds; to update and verify design methodologies, especially in areas where right-of-way is limited; and to provide a reliable database for designing efficient, low-maintenance wet detention ponds in the highway environment. Wet ponds in this research project will be those having a permanent pool of water.

The objective of this research is to develop a methodology for designing efficient wet detention ponds in the highway environment. This methodology shall include performance characteristics, design guidelines, conditions, limitations, and applications for use. A comparison will be made between wet detention ponds and dry detention ponds in order to show the advantages and disadvantages of each system.

To accomplish the project objective, the following phases and tasks are envisioned:

Phase I: (1) Critically review the published and unpublished literature to document the performance of detention pond systems in achieving reductions of pollutants found in highway runoff. Where available, document the capital and maintenance costs of wet ponds. Also identify methodologies available for designing wet detention ponds and describe their applicability for use in highway storm water runoff treatment. (2) Analyze the Task 1 data to correlate the varying effectiveness of wet detention ponds with methodology, design variables, and sampling program

design, as they would apply to a highway setting and under highway regulations. Outline the strengths and deficiencies of wet detention ponds and compare to dry detention ponds. (3) Identify existing wet detention pond sites suitable for gathering additional performance data during Phase II. Specify the deficiencies in existing data that would be addressed by these field studies. (4) Prepare an interim report documenting Tasks 1 through 3 within six months. Include a detailed work plan for Phase II as an appendix to the interim report. The cost for Phase I shall not exceed \$100,000.

Phase II: (5) Gather and analyze new data from selected test sites to compensate for the deficiencies identified in Phase I. (6) Evaluate existing methodologies with data gathered in this project and from the literature. Establish design guidelines and procedures for wet pond systems in a highway setting. (7) Submit a final report that documents the entire research effort and includes the Task 6 guidelines as a stand-alone document.

The contractor has completed Tasks 1 through 4. Major effort in this and the next reporting period is on the collection and analysis of field data, Tasks 5 and 6.

## Wetlands

### **ASSESSING WETLAND SEED BANKS USING CS137.** (ENV1234)

*Performed by:* Penn State Cooperative Wetlands Center. Forest Resources Laboratory. Pennsylvania State University. University Park. PA.

*Investigator(s):* Reinhardt, Carrie H., Cole, Charles A., and Brooks, Robert P.

*Status:* Active.

*Start date: Estimated completion date:* 31 Dec 1999.

Wetlands are often depositional environments and are thus susceptible to stress resulting from earth disturbance and surrounding land use. Assessing historic succession of plant communities is one way to examine the response of a wetland to this disturbance. A seed bank profile in a depositional environment can be an historic record of how a community has changed over time. Dating and characterizing the seed bank at different depths can provide a temporal analysis of community structure. This study will use Cs137 as a radioactive marker to date wetland soils (and, therefore, the seed bank) of eleven of the PSU Cooperative Wetland Center's reference wetlands in central Pennsylvania. The seed bank composition will be determined by germination studies and floatation studies. For germination studies, samples will be subjected to chill treatments and planted in an emergent germination regime. In order to separate seed from soil for a direct count, samples will be floated in a sugar water solution, and seeds will be decanted onto filter paper, extracted and identified. With the histories of vegetation communities provided by both methods, it will be possible to determine what forces are involved in the succession of Appalachian wetlands. Also, because sampling will be done on a disturbance gradient, observations of how succession in impacted wetlands differs from succession in pristine wetlands will be possible.

### **ASSIST IN THE DEVELOPMENT OF HGM REGIONAL MODELS.** (ENV1115)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Status:* Active.

*Start date : FY98; Estimated completion date:* ongoing.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

USGS acts as overseer of production of regional models. States report their models to the USGS. The goal of this project is to provide incentives to states for their involvement in regional HGM model development. In our efforts to encourage and support the development of technology to carry out the flexibility provisions of the 1995 Farm Bill, the institute is providing guidance, training, and incentives to states to develop HGM-based functional assessment procedures. Incentives are in the form of funding for the collection and analysis of data that will lead to the development of HGM regional models or support the interim HGM procedures with reference. A more comprehensive and consistent set of HGM models on which to base decisions for minimal effect and mitigation will be the result of this project.

### **CAREER: HYDROLOGIC REGULATION OF WETLAND BIOGEOCHEMISTRY AND ECOLOGY AND THE IMPACTS OF CLIMATE CHANGE.** (Fed 00184840)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington. DC.

*Project Monitor:* Shaver, Gaius R.

*Performed by:* Michigan State University. W.K. Kellogg Biological Station. Hickory Corners.

MI.

*Investigator(s)*: Hamilton, Stephen K.

*Status*: Active, *Contract No.*: 9701714.

*Start date*: 15 Aug 1997; *Estimated completion date*: 31 Jul 1999.

The aims of this research are to investigate linkages between hydrology, biogeochemistry, and ecology of wetlands in glacial landscapes, with the long-term aim of developing a predictive understanding of the relative sensitivity of different wetlands to climate change. The research plan involves monitoring of a large number of different wetlands in relation to annual variation in climate, and as part of the NSF career program it includes significant student participation through class projects and independent research. The wetlands to be studied are all in central Michigan.

**CONTINUE TO REFINE AND FIELD TEST MARSH (COMPUTER-ASSISTED WETLAND PLANT IDENTIFICATION GUIDE). (ENV1104)**

*Sponsored by*: U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor*: Teels, Billy.

*Performed by*: U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s)*: Melvin, Norman.

*Status*: Active.

*Start date*: FY98.

*Notes*: Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

MARSH is a computerized plant identification key for wetland plants. This plant key greatly simplifies the process of identification and contains a database with common names, color photographs, line drawings, distribution maps, and plant descriptions. This effort is approximately one-half complete. The institute is assisting the development of this plant key and facilitating its field applicability by partially funding the effort, field testing the keys, and training field staff on its use. The current software edition of MARSH has recently (FY97) been distributed to all NRCS state offices. This project will result in improved accuracy and efficiency in identifying wetland plants for determinations of hydrophytic vegetation.

**CRB: HABITAT QUALITY: A HIDDEN COMPONENT OF WETLAND FRAGMENTATION. (Fed 00170577)**

*Sponsored by*: National Science Foundation. Division of Environmental Biology. Washington. DC.

*Project Monitor*: Brooks, Lisa D.

*Performed by*: University of Nevada-Reno. Environmental and Resource Sciences. Reno. NV.

*Investigator(s)*: Oring, Lewis W.

*Status*: Active, *Contract No.*: 9424375.

*Start date*: 1 Sep 1995; *Estimated completion date*: 31 Aug 1998.

The study of habitat fragmentation has been built on an understanding of how lost habitat, isolation of habitat patches, and increased habitat edge lead to declines in populations. This understanding has, in turn, formed the foundation for principles of reserve design in conservation biology. In order to design reserves in the future, traditional studies of fragmentation must be augmented to include: (1) the effect of variation in patch quality in the habitat remaining on individuals in the population, and (2) how these effects over time affect population growth or decline. In the arid West and throughout much of the world, several factors, including irrigation

and domestic water use, have combined to result in a general trend toward salinization of water available for wildlife. High salt levels have been shown to pose serious health threats to wildlife, especially young birds. This project will determine the capacity of young water birds to withstand various salt loads. The results will allow water management to predict the costs to wildlife of increased salinization. Eventually, results can be integrated into population models as factors affecting survival.

**DESIGN AND PERFORMANCE OF CREATED WETLANDS.** (ENV1147)

*Sponsored by:* South Dakota Department of Transportation.

*Project Monitor:* Ormesher, Daris.

*Performed by:* South Dakota State University.

*Investigator(s):* Berry, Charles.

*Status:* Active, *Contract No.:* SD95-08.

*Start date:* 1 May 1995; *Estimated completion date:* 30 Jun 2000.

Wetlands that are unavoidably impacted because of construction by the department are required to be replaced. There are different ways to mitigate wetlands impacted by construction projects. The department has used three types of compensation: 1) excavation, 2) creation of small dams and 3) restoration of areas that are degraded wetlands. Different designs for compensation areas have been tried to improve the quality of the created wetlands. The differences in the environment from southeastern South Dakota to northwestern South Dakota could mean that different designs based upon the environment of the area might be needed. Analyses of the designs used by the department in regard to quality of wetlands created has not been done. Other states have developed criteria for wetlands design. Guidelines that could point out do's and don'ts of wetlands compensation and design methods by physiographic regions of the state could ease the problems associated with wetland mitigation.

Research Objectives:

- 1) To evaluate existing compensation areas to determine the quality of wetlands created
- 2) To develop guidelines for design of excavation type (borrow pits) compensation areas.
- 3) To develop guidelines for design of small dam compensation areas. These areas could include borrow areas in their design.
- 4) To develop guidelines for restoration of degraded wetlands.
- 5) To construct a prototype wetland compensation area that uses the guidelines developed in the previous objectives.

**DEVELOP AND REFINE WETLAND FUNCTIONAL ASSESSMENT PROCEDURES.**

(ENV1113)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service.

Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Status:* Active.

*Start date:* FY98; *Estimated completion date:* ongoing.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

The goal of this project is to extend the HGM prairie pothole reference domain. The objective is to statistically analyze from more than 200 wetlands throughout the PPR to calibrate HGM assessment models. Currently the Prairie Pothole HGM regional guidebook is limited to reference sites in only a few North Dakota counties. While the reference data collected is enough to build a draft model, it is not large enough to apply to the entire prairie pothole region. A final



HGM regional guidebook will be created based on reference data from the entire prairie pothole region.

**DEVELOP HYDRIC SOIL INDICATORS FOR WESTERN PLAYAS. (ENV1099)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Investigator(s):* Huddleston, Herb.

*Status:* Active.

*Start date:* FY98; *Estimated completion date:* ongoing.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

The hydric soil properties of playa lakes are very poorly understood. Because most playa soils are listed as hydric, but not all are still wet, hydrologic analyses, rather than hydric soil indicators, are most often relied on to make wetland determinations in these natural depressions. This study examines the hydromorphic processes and the redoximorphic features in playa ecosystems and will help identify soil features that are indicative of current hydrology. This project will result in a report on field indicators of hydric soils that are indicative of current, rather than relic, hydrologic conditions in playa lakes.

**DEVELOP SEED MIXTURES AND HYDROPERIOD TOLERANCES FOR NATIVE MID-ATLANTIC WOODY SPECIES (INCLUDING OAKS). (ENV1108)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Status:* Not active.

*Start date:* FY98.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

The institute and staff from the National Plant Material Center are identifying native woody species and developing planting recommendations based on tolerances of hydrology and hydroperiod for use in the restoration of forested wetlands in the mid-Atlantic region. The basic research will also identify proper planting techniques, planting dates, collection and storage protocols, and provide guidance on planting strategies (direct seeded and seedlings). Project products include improved instructions in the form of reports and technical guides on the planting and establishment of mid-Atlantic woody species.

**DEVELOPMENT OF A MECHANISM TO COMPARE ON-SITE VERSUS OFF-SITE WETLAND MITIGATION. (ENV1165)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Nielsen, D.

*Investigator(s):* Ward, GH.

*Status:* Active, *Contract No.:* 0-1740.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Dec 1999.

No summary provided.

**DEVELOPMENT OF EFFECTIVE STRATEGIES/NON-TIDAL WETLANDS/VDOT.**  
(00622927)

*Sponsored by:* Virginia Department of Transportation. Richmond. VA.

*Project Monitor:* Daniel.

*Performed by:* Virginia Transportation Research Council. Charlottesville. VA.

*Status:* Active.

*Start date:* 1 Jul 1991; *Estimated completion date:* Sep 1999.

No summary provided.

**DIGITAL MULTISPECTRAL VIDEOGRAPHY FOR THE CAPTURE OF ENVIRONMENTAL SPATIAL DATA SETS.** (ENV1300)

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Transportation Research Council.

*Investigator(s):* Anderson, John E. and Fitch, Michael.

*Status:* Active.

*Start date:* 15 Jul 1998; *Estimated completion date:* 30 Jun 1999.

Digital multispectral video DMSV is a remote sensing technology that acquires digital frame coverage in four spectral bands providing real-time panchromatic, natural color, and color infrared imagery. The sensitivity of the spectral bandwidths (<25 nanometers wide) and high spatial fidelity (typically 1 meter pixel ground resolution) permit the discrimination of soil, vegetation, water bodies, and chemically contaminated areas, at very high resolutions. The purpose of this research is to test the applicability of using DMSV for VDOT's environmental data acquisition needs. Specifically, DMSV will be used to capture mitigated wetland sites, archeological sites, and areas known to be affected by the presence of acid soils. Time and cost estimate information will be derived from the test data to help determine the feasibility of using this type of system on an operational basis. More important, results of the study will be analyzed by representatives of the U.S. Army Corps of Engineers (USACE) and the Virginia Department of Environmental Quality (DEQ) to determine whether the data captured are of acceptable quality for regulatory purposes.

Due to advances in CCD-based imaging technology anticipated in the next five years, imagery sources required by VDOT will be captured and archived in a completely digital format. Image based products necessary for analytical photogrammetry and resource monitoring will be collected, stored, and analyzed in "soft copy." If DMSV technology allows for quicker acquisition of vast amounts of spatial data, normally taking many personnel hours to collect, the system could save VDOT substantial time and money. The data collected by this system will allow for automated analysis, thereby reducing the time and cost associated with not only data capture but data reduction and interpretation as well.

A total of three missions have been flown. Both wetland and corridor information have been collected and classified. Additional flights will be made during the remainder of the fall season.

**ECOLOGICAL ASSESSMENT OF A WETLANDS MITIGATION BANK IN WESTERN NORTH CAROLINA.** (ENV1019)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* University of North Carolina at Asheville. Environmental Studies Program. Asheville. NC.

*Investigator(s)*: Moorhead, Kevin, Rossell, Irene, Rossell, C. Reed Jr., and Petranka, James W.

*Status*: Active.

*Start date*: 1 Apr 1997; *Estimated completion date*: 30 Jun 1999.

*Notes*: List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

This is a continuation of a previously funded project by this UNC-Asheville team. In Phase I, the project team collected baseline data on hydrology, soils, vegetational communities, and animal populations for an NCDOT-purchased site in Graham County, NC, that will be used to mitigate wetland losses associated with highway projects in western North Carolina. In this project (Phase II), the project team will evaluate the effectiveness of several restoration strategies across the site in order to provide a comprehensive ecological assessment of the mitigation bank. This mitigation bank is the first of its kind in western North Carolina and the first large-scale wetland restoration project in the Blue Ridge province. The project work utilizes a holistic approach for evaluating a wetlands mitigation bank based on intensive field research coupled with GIS analysis. Overall objectives include assessing the ecological conditions of impacted, restored, and natural areas of the mitigation bank site, and developing a GIS database to enhance the ecological assessment of the site. This research will provide important information on the ecology of mountain floodplain forests and bogs, both of which are disappearing from western North Carolina at an alarming rate.

### **ECOLOGICAL ASSESSMENT OF THE RESTORED WETLANDS OF THE TULULA MITIGATION BANK (PHASE III). (ENV1085)**

*Sponsored by*: Center for Transportation and Environment. North Carolina State University. Raleigh, NC.

*Project Monitor*: Martin, James.

*Performed by*: University of North Carolina at Asheville. Environmental Studies Program.

*Investigator(s)*: Moorhead, Kevin K.

*Status*: Active.

*Start date*: *Estimated completion date*: unknown.

This is a continuation of a project to restore a 95-ha site in Graham County, North Carolina, purchased by the North Carolina State DOT, to establish a wetland mitigation bank for surface transportation projects in western North Carolina. The restoration will be complete in the fall of 1999, when water will be released into the new channel and 15 ha of riverine swamp forest will be revegetated. The project continues the team's holistic approach for evaluating a wetlands mitigation bank based on intensive field research coupled with GIS analysis. This approach includes monitoring and evaluating changing ecological conditions at the site as restoration activities are implemented. The project will provide important information on the ecology of mountain floodplain forests and bogs, both of which are disappearing at an alarming rate in western North Carolina.

### **ECOLOGICAL EFFECTS OF L-31E FLOW REDISTRIBUTION. (ENV1238)**

*Project Monitor*: Jaffe, Rudolph.

*Performed by*: Southeast Environmental Research Program. Florida International University. Miami, FL.

*Investigator(s)*: Ross, Mike, Meeder, Jack, Telesnicki, Guy, Ruiz, Pablo, Byrnes, Mike, Alvord, Jen, and Atlas, Zack.

*Start date*: 1 Aug 1993; *Estimated completion date*: 31 Oct 1998.

The objective of this pilot project is to determine the effects on water quality and other ecosystem characteristics when canal waters, which would otherwise flow directly into Biscayne Bay, are

distributed into the coastal wetlands.

**ECOLOGY AND GENETICS OF AMBYSTOMA MACULATUM POPULATIONS ON THE PENN STATE BEHREND CAMPUS. (ENV1131)**

*Sponsored by:* Pennsylvania Department of Transportation; Pennsylvania State University at Behrend.

*Project Monitor:* Petit, Bill.

*Performed by:* Pennsylvania State University, Behrend Campus.

*Investigator(s):* Botts, Pamela.

*Status:* Active.

*Start date:* 8 Dec 1997; *Estimated completion date:* 7 Aug 1999.

The purpose of this research is designed to provide information to PennDOT regarding the best way to mitigate wetlands so as to maximize the continued success of large populations of amphibians currently using the Penn State Behrend wetlands as a breeding habitat. The college campus supports large, reproductively successful populations of a number of amphibians, but one species of particular concern is *Ambystoma maculatum*, the spotted salamander. Concern for this species is rooted in the fact that it migrates from forested upland habitat into vernal forested wetlands for reproduction during the early spring. Adults leave the wetlands quickly and newly metamorphosed juveniles leave by July to return to forested uplands. Therefore, both wetland destruction and mitigation on campus and alteration of the upland landscape affect the spotted salamander.

The research associated with this project is designed to 1) assess the existing genetic structure of populations of *Ambystoma maculatum* on the basis of mitochondrial DNA markers, 2) continue to build a solid, long-term data set consisting of demographic parameters (population size, age structure, reproductive success, and movement patterns of *Ambystoma maculatum* on the Behrend campus), and 3) determine how the salamanders utilize upland habitat during the non-breeding season.

**ECOSYSTEM DEVELOPMENT IN MITIGATION WETLANDS OF NORTHWESTERN NEW YORK. (ENV1233)**

*Performed by:* Penn State Cooperative Wetlands Center. Forest Resources Laboratory. Pennsylvania State University. University Park. PA; Public Works/Environmental Division. West. Fort Drum. NY.

*Investigator(s):* Urban, Christopher A., Cole, Charles A., Brooks, Robert P., Morgan, John J., and Hoyt, David K.

*Status:* Active.

*Start date:* *Estimated completion date:* 31 Dec 1999.

There seems to be little understanding of wetland structure and function, pertinent information which could prove invaluable when designing "successful" mitigation wetlands. The objectives in this study are twofold: 1) To study plant and macroinvertebrate colonization and succession rates in newly created and restored wetlands, and 2) To assess mitigation wetland design and performance. The employed monitoring program incorporates standard methods of examining hydrology, soils, vegetation, and macroinvertebrates at 20 gridpoints in each of six wetlands. Emphasis was placed on comparing the ecosystem attributes in regard to their successional development across three wetland types (created, restored, and natural). Preliminary results suggest that colonization and succession rates are greater in restored wetlands than created wetlands. Restored wetlands appear to have an advantage in successional development because of their inherent seed banks, but they also appear to provide more organic structure, thereby

rendering more refugia for colonizing and existing plants as well as macroinvertebrate assemblages. Reference wetlands exhibited attributes characteristic of mature ecosystems (e.g. higher degrees of niche specialization, greater biomass and organic matter, stable water levels). Cluster analysis was used to show that the herbaceous species diversity were similar, but their species assemblages were not. Mitigation design and performance were greatest in the restored wetlands which more closely mimicked the ecosystem attributes of reference wetlands (ie. hydrology, soils, and spatial complexity). The results of this work underscore the concept that comparing structure and function between mitigation and local reference wetlands are essential to determining success in wetland mitigation.

**EFFECT OF MODIFIED WATER DELIVERIES IN THE C-111 CANAL BASIN ON THE EVERGLADES WETLAND TRANSITION ZONE: A PILOT STUDY FOR PRE-LEVEE REMOVAL ANALYSIS. (ENV1239)**

*Project Monitor:* Jaffe, Rudolph.

*Performed by:* Southeast Environmental Research Program. Florida International University. Miami. FL.

*Investigator(s):* Childers, Dan and Parker, Frank.

*Start date:* 1 Sep 1997; *Estimated completion date:* 31 Dec 1997.

One key goal of current Everglades Restoration efforts is to restore the environmental health of the region south of the C-111 canal, which is known as the Panhandle area of Everglades National Park. To address this goal, the Department of the Army Corps of Engineers and the South Florida Water Management District began a joint project in 1995 to remove the spoil mounds along a five-mile long, [roughly] east-west portion of the C-111 canal that bounds the ENP Panhandle area. The C-111 canal levee removal project is currently underway. As of July 1, the easternmost 50% of the levee had already been removed, with work progressing ahead of schedule to the west. At the current rate of progress, the entire levee removal project is expected to be completed by December 1997.

In this project, we are quantifying a host of ecological parameters along a transect set normal to the western portion of the C-111 canal. Our sampling here, prior to the levee removal, will permit us to directly quantify the influence of levee removal on environmental processes in ENP Panhandle wetlands. We will use this pilot study in conjunction with a longer term project titled "The effects of modified water delivery in the C-111 canal basin on the wetland transition zone: Ecological effects of changes in marsh inundation regimes" to provide both a priori and a posterior information on increased C-111 basin freshwater flow. We will emphasize the mechanistic link between freshwater flow, materials exchanges, ecologically-important processes, and environmental forcing. Specifically, we are working at the three northernmost sites of our western transect (of the five total, those located just north of the ENP boundary). At these sites, we are quantifying nutrient concentrations in the overlying water both intensively (every three hours for 48 hours, once every six weeks) and extensively (with a replicated sample taken every 48 hours). We are nondestructively quantifying the above ground biomass and productivity of sawgrass in triplicate long-term quadrats set up at each site. In these quadrats, we are quantifying soil salinity, soil pore water nutrients, soil Eh, and soil pH. Water level recorders continuously track inundation depths and water table depths. Additionally, we have quantified soil carbon processes at each site of this western transect by measuring CO<sub>2</sub> efflux, methanogenesis, and sulfate reduction rates. This work will be expanded in both scope and space in January, when the longer-term project begins.

**EFFECTS OF CATTAILS ON WETLANDS**

**Project extended under new title: WHY DO CATTAILS INVADE MARSH WETLANDS.**  
(ENV1050)

*Sponsored by:* Colorado Department of Transportation.

*Project Monitor:* Hutter, Werner.

*Performed by:* Colorado State University, Fort Collins.

*Investigator(s):* Cooper, David J.

*Status:* Active, *Contract No.:* RX HAA 98HQ0000172.

*Start date:* Oct 1997; *Estimated completion date:* 30 Jun 1999.

To identify the hydrologic regime and plant communities which cattails can successfully invade in created wetlands. The results of this study could ensure survival of nursery stock planted to satisfy regulatory requirements in implementing wetland mitigation projects.

**ESTABLISHMENT OF A NATIVE SEDGE VEGETATION IN CREATED WETLAND BASINS.** (ENV1212)

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Jacobson, Robert and Cassellius, Ron.

*Performed by:* University of Minnesota.

*Investigator(s):* Cushing, Edward J.

*Status:* Active, *Contract No.:* 94-157R.

*Start date:* 1 Jul 1994; *Estimated completion date:* 31 Dec 1998.

No abstract provided.

**EVALUATE AND IMPROVE BOTTOMLAND HARDWOOD ESTABLISHMENT TECHNIQUES.** (ENV1105)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* Mississippi State University; U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Schoenberger and Melvin, Norman.

*Status:* Active.

*Start date:* FY98; *Estimated completion date:* 2001.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

The WLI, in partnership with Ducks Unlimited and the Wildlife Habitat Management Institute, is funding portions of Mississippi State University research, which is evaluating the success of bottomland hardwood wetland restoration efforts with special reference to vegetative establishment techniques, maintenance of establishing vegetation stands, and overall success. The institute will develop technical and informational bulletins for distribution to the field as results from this research become available.

**EXAMINE REDOXIMORPHIC FEATURES IN PROBLEMATIC PRAIRIE SOILS ALONG THE EAST TEXAS GULF COAST.** (ENV1103)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service.

Wetland Science Institute.

*Investigator(s)*: Pringle, Russell.

*Status*: Active.

*Start date*: *Estimated completion date*: ongoing.

*Notes*: Source of information: Wetland Science Institute web page,  
<http://159.189.24.10/wetsci.htm>

The project goal is to gather information on the levels of soluble organic carbon and the presence of ferrous iron and manganese in two east Texas gulf coast prairie soils. Currently the ability to distinguish between the hydric and non-hydric dark prairie soils is difficult where the features typically relied on to make the distinction are masked by the dark colors. This study will result in the ability to better quantify important parameters used in determining the hydric properties of these problematic soils. The study will also explain the relationship between soil wetness, redoximorphic features, and the presence of ionic iron and manganese concentrations in these seasonally wet soil systems.

### **FACTORS AFFECTING BIOLOGICAL RECOVERY OF WETLAND RESTORATION - PHASE I. (ENV1213)**

*Sponsored by*: Minnesota Department of Transportation.

*Project Monitor*: Koski, Jay and Kovach, Brad.

*Performed by*: University of Minnesota.

*Investigator(s)*: Galatowitsch, Susan.

*Status*: Active, *Contract No.*: 96-308R.

*Start date*: 16 Dec 1996; *Estimated completion date*: 31 Dec 1998.

Wetland restoration success will be evaluated on Mn/DOT projects (and one University of Minnesota project) that are to be completed within the next few years. Some sites will be selected that are connected to nearby natural wetlands; some will be selected that are isolated from other wetlands. Half of the isolated sites will be revegetated by seed during the first year of restoration and the remaining sites will be allowed to recolonize through natural processes. All of the restoration sites will be Class III-IV depressional basins that have been cultivated and artificially drained (rather than only grazed). Relatively unaltered natural wetlands will be located to serve as references for the restored wetlands. Each basin will be surveyed once to determine basin morphology. Biological recovery will be considered here to represent restoration success. Aspects of ecosystem function and structure will be used to characterize recovery rates. Organic matter cycling will be the primary measure of ecosystem function. Indices of biotic integrity for plants, invertebrates, birds, and amphibians will be used to track ecosystem structure.

Creating conditions that promote accumulation of organic matter in restored wetlands is likely to be a critical factor in the biological recovery of these systems. Artificial drainage has resulted in decay of much of the organic matter substrate that had been present. Depressed organic matter levels may limit community development in restored wetlands because unfavorable soil structure hinders establishment of plants and some invertebrates and because nutrient dynamics are likely altered. In other restored wetland systems, depressed organic matter has been implicated in reduced revegetation success because organic matter is not present as a slow-release source of nitrogen. The first step towards understanding limitations to organic matter accretion in restored wetlands is to compare their soil and litter characteristics with natural wetlands. Soil characteristics to be measured include bulk density, fiber content, carbon percentage, nitrogen percentage, phosphorus percentage, and lignin. Litter characteristics to be measured include biomass, and the contents of carbon, nitrogen, phosphorus and lignin.

Indices of biotic integrity (IBI) are currently being developed for Minnesota wetlands by the

research team working on this project. IBIs for each series are being constructed based on plant, invertebrate, bird, and amphibian surveys that are being conducted as part of an ecological survey. Each series includes a disturbance gradient reflecting what exists in the landscape -- from least impacted to most disturbed. The sampling protocol developed for a biotic integrity assessment for Minnesota wetlands includes relevé sampling for vegetation, circular plot sampling for birds, larval sampling for amphibians, and activity traps for invertebrates. The sampling strategy is efficient (no more than two field visits for any organismal group) and should provide a good assessment of site biodiversity. To estimate biological recovery in the restored wetlands, the biotic integrity assessment will be repeated each of the four years after construction to compare to the selected reference wetlands.

**FUNCTIONAL ASSESSMENT OF THE EFFECTS OF HIGHWAY CAUSEWAY CONSTRUCTION ON WETLANDS: COMPARISONS OF EFFECTS BEFORE, DURING, AND AFTER CONSTRUCTION. (ENV1021)**

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* Duke University Wetlands Center. Nicholas School of the Environment. Durham. NC.

*Investigator(s):* Richardson, Curtis and Flanagan, Neal.

*Status:* Active.

*Start date:* 1 Apr 1996; *Estimated completion date:* 31 Mar 1998.

*Publication(s):* Richardson, Curtis J. and Neal E. Flanagan. Duke University, Duke Wetland Center, Durham. NC. *Functional Assessment of the Effects of Highway Construction on Coastal North Carolina Wetlands: Comparison of Effects before, during and after Construction* (Phase 1), Progress report. (1997)

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

This study is a continuation of a previous project to use comparisons of previously constructed highway crossings with reference areas to develop functional assessment indicators. This project proposes a baseline functional wetland assessment of three sites where highway crossings will be constructed in eastern North Carolina. One site serves as the highway impact site, and the other two are control sites. During a later phase of the study, changes in the functions of these wetlands caused by highway construction and the resulting permanent hydrologic modifications will also be assessed. This "before and after" approach will enable the project team to (1) illustrate the application of a functional assessment of wetland ecosystem response to highway construction and operations; (2) classify temporary results of actual construction versus permanent effects of hydrologic modification; (3) recommend road construction techniques which can actually be shown in the field to result in the least impact to wetland functions; and (4) quantify wetland mitigation requirements due to effects of highway activities on functional wetland loss. Currently, the team is collecting pre-impact baseline data prior to highway construction.

**FUNCTIONAL ASSESSMENT OF THE EFFECTS OF HIGHWAY CONSTRUCTION ON COASTAL NORTH CAROLINA WETLANDS: COMPARISON OF EFFECTS BEFORE, DURING, AND AFTER CONSTRUCTION (PHASE II). (ENV1086)**

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* Duke University Wetlands Center. Nicholas School of the Environment.



Durham. NC.

*Investigator(s):* Richardson, Curtis J.

*Status:* Active.

*Start date:* 1 Apr 1996; *Estimated completion date:* 31 Mar 1998.

This is a continuation of a project to develop a quantitative assessment methodology based on a few key indicators for each of five broad categories of ecosystem functions, including hydrology, biochemistry, productivity, community support, and decomposition. The proposed method is based on a modification of the Before After Control Impact (beyond BACI) design (Underwood, 1992), in which multiple samples are taken simultaneously from the assessed site and two reference sites both before and after highway construction. The planned US 17 bypass of Jacksonville, North Carolina, will cross a brackish tidally influenced wetland area in the Edwards Creek watershed. During Phase I, pre-construction data were collected from Edwards Creek and two reference wetlands that are unaffected by highway construction. During Phase II, monitoring will continue throughout highway construction. Data will be analyzed and an assessment model will be finalized. The model will be compared to the HGM model (Brinson et al., 1995) for its ability to quantify the spatial extent of potential impacts to wetlands.

### **GIS SUPPORT FOR OPTIMAL ROAD LOCATION WITH WETLAND IMPACTS.**

(ENV1029)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* Institute for Transportation Research and Education. North Carolina State University. Raleigh. NC.

*Investigator(s):* Holdstock, David A.

*Status:* Active.

*Start date:* 1 Sep 1997; *Estimated completion date:* unknown.

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

The wetland mitigation requirements of the state and federal regulatory agencies are becoming more demanding and more difficult to satisfy. The Division of Coastal Management of the NC Department of Environment, Health, and Natural Resources is developing a database of the wetlands and potential wetland restoration sites in the 20 coastal NC counties regulated by the Coastal Area Management Act. This study proposes to evaluate this database for its use in planning and mitigating wetland impacts caused by transportation development. The end product of this research will be a GIS-based analysis tool to allow transportation planners to quickly analyze the impacts of alternative road projects on wetlands and the relative gains in wetland functions of restoration alternatives. Work on the project began in June 1996. Through August, compiling a literature review was the primary activity, and continues today. The literature review has focused on wetland water quality and habitat, transportation systems, GIS use in natural resources, and mathematical modeling of natural systems. Current activities include formulation of models which will describe road building and wetland interactions. Models are being developed for habitat, water quality, and road construction. The objective of the models is to maximize wetland functional values while minimizing the financial cost of road building associated with construction and mitigation. A paper is currently being prepared which will address the process of model development and possible testing procedures.

**GUIDANCE FOR SELECTING COMPENSATORY WETLAND MITIGATION OPTIONS (Circular 469 Environmental Research Needs in Transportation research needs statement).** (ENV1093)

*Sponsored by:* National Cooperative Highway Research Program.

*Project Monitor:* McCreedy, Ronald D.

*Status:* Proposed, *Contract No.:* Project 25-16.

*Start date:* *Estimated completion date:* Contract duration: 24 months.

*Notes:* Abstract provided by permission of National Cooperative Highway Research Program (<http://www2.nas.edu/trbcrp/nchrp5.html>).

Wetland banking is one of the alternatives for compensatory mitigation of unavoidable losses of wetlands as required by regulations established pursuant to Section 404 of the Clean Water Act. The Transportation Equity Act for the 21st Century (TEA-21) states that wetland banking will be given first consideration for mitigation of wetland losses caused by Federal-Aid Highway projects. Appropriate implementation of wetland banking can help agencies meet the national goal of "no overall net loss" of wetland functional capacity. Although federal agencies have published guidelines for the establishment, use, and operation of mitigation banks, issues need to be clarified and evaluated to ensure the selection of the most effective choice from among a wide range of mitigation approaches. For example, there is no agreed-upon basis for selecting between small-scale, dispersed mitigation versus consolidated mitigation approaches (of which wetland banking is one option).

Consolidated mitigation has the potential to improve the quality and effectiveness of wetland mitigation efforts; however, the degree to which these improvements can or have been attained is unknown, because there has not been adequate investigation into the use and results of mitigation banks and other consolidated applications. In addition, existing data on the results of compensatory mitigation for wetland impacts associated with highway projects have not been analyzed.

Some important potential benefits associated with consolidated mitigation (including wetland banks) are lower costs, higher wetland functional capacity per acre, improved sustainability, and easier management. Potential disbenefits associated with the use of consolidated mitigation include habitat alteration, landscape fragmentation, loss of functions, and watershed impacts. Transportation agencies need information about the relative benefits of consolidated mitigation versus small-scale, dispersed mitigation. Agencies also need to know when different alternatives will be more effective in meeting goals for wetland management and highway project development.

The objective of this research is to develop guidance for evaluating and selecting specific compensatory wetland mitigation options associated with development of transportation projects. The intent is (1) to evaluate and describe the relative effectiveness of small-scale, dispersed mitigation versus consolidated mitigation, including mitigation banks, and other compensatory mitigation options, and (2) to develop recommended criteria, performance expectations, and other guidance for their selection. The guidance should assist transportation- and resource-management agencies in evaluating the implications of specific mitigation options and should include criteria for considering an array of management issues (e.g., costs and wetland functions).

This will be done through the following tasks:

Phase I. Project Design and Analysis: (1) Literature Search--Conduct a review of recent relevant literature and other documentation. The search should focus on small-scale, dispersed mitigation options as well as consolidated mitigation, including wetland banks. (2) Data Search--Identify,

gather, and analyze available monitoring data, monitoring reports, and other information on wetland mitigation from state and federal agencies, resource management agencies, regulatory entities, local utilities, and other sources. (3) Agency Survey--Design, for panel approval, a national survey to obtain information on the performance and results of compensatory mitigation options. Include a broad distribution of wetland types and mitigation approaches. The survey results should refine and expand on the results of the data search (Task 2). Carry out the approved survey and analyze the results. (4) Interim Report and Panel Meeting--Submit an interim report summarizing the results of the analysis carried out in Phase I and a detailed outline of the decisionmaking process and guidance to be developed in Task 6. Provide more details on and recommend modifications to the Phase II work plan. Present the interim report findings at a meeting of the panel and obtain NCHRP approval to initiate Phase II.

Phase II. Process and Guidance Development: (5) Digest of Research in Progress--Under the direction of the NCHRP panel, prepare for publication a digest covering the results and findings of Phase I work. (6) Process Development--Using the data collected in Phase I, develop decisionmaking guidance, including criteria and procedures for selecting wetland mitigation options. (7) Final Report--Prepare a final report presenting the recommended decisionmaking guidance, criteria, and procedures. The report shall summarize the findings of Phase I and clearly document the basis for all conclusions and recommendations.

#### **HYDROGEOLOGICAL GUIDELINES FOR WETLAND RESTORATION AND CREATION. (00602415)**

*Sponsored by:* Wisconsin Department of Transportation. Federal Highway Administration. Washington. DC.

*Project Monitor:* Jackson, John.

*Performed by:* Wisconsin Department of Transportation. Madison. WI.

*Investigator(s):* Krohelski, J.

*Status:* Active, *Contract No.:* 0092-45-37.

*Start date:* 1 Nov 1989; *Estimated completion date:* Dec 1998.

*Publication(s):* Interim report written. Final report in preparation.

Examine the hydrology of restoring and creating wetlands adjacent to a natural wetland. Monitor and evaluate changes to both types of sites during and after modifications. Compare geochemical processes occurring in natural, restored, and created wetlands. Examine key design parameters for wetland creation by conducting experiments on test plots. Comparisons will be made between mitigation methods; natural, restored, and created wetlands; and experimental plots. Site hydrology will be defined. Biogeochemical processes will be sampled. Changes due to site modifications will be evaluated and water table levels will be observed. Guidelines for wetland restoration and creation will be formulated.

#### **THE HYDROGEOMORPHIC FUNCTIONAL ASSESSMENT OF WETLANDS: THE CHARACTERIZATION OF REFERENCE DOMAIN OF REFERENCE SET WETLANDS OF WETLANDS OF THE NORTHERN ROCKY MOUNTAIN REGION. (ENV1128)**

*Sponsored by:* Montana Department of Transportation.

*Project Monitor:* Urban, Larry.

*Performed by:* University of Montana.

*Investigator(s):* Haver, Richard.

*Status:* Active, *Contract No.:* 03306.

*Start date:* 1 Apr 1996; *Estimated completion date:* 31 Dec 1998.

The purpose of this project is to further develop three regionally based models for the hydrogeomorphic (HGM) functional assessment of wetlands in the Northern Rocky Mountain Region: one for riverine wetlands, one for herbaceous depression (pothole) wetlands, and one for slope wetlands.

**HYDROGEOMORPHIC METHODOLOGY FOR WETLAND FUNCTIONAL ANALYSIS.** (ENV1080)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Boan, Josh.

*Performed by:* Hillsborough Community College. Tampa. FL.

*Investigator(s):* Ehringer, Nick and Uranowski, Christina.

*Status:* Active.

*Start date:* Fall 1996; *Estimated completion date:* 14 Nov 1999.

The purposes of this grant are to: (1) evaluate the hydrogeomorphic (HGM) wetlands evaluation system for future use of the Florida Department of Transportation; (2) establish a reference library of HGM articles, documents, and materials; (3) assess which types of wetlands are most critical for the department; (4) conduct analyses of depressional wetlands in Florida using the HGM system; (5) establish an "A" team to evaluate riverine wetlands in the state of Florida and to create an HGM model for riverine wetlands; (6) establish a teaching program of HGM for the department; and (7) write a glossary of HGM terminology.

**INTERACTION OF ROAD SALT WITH ENVIRONMENTAL SYSTEMS IN MAINE.** (CRIS 0177056)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service.

*Performed by:* University of Maine. Geological Sciences Department. Orono. ME.

*Investigator(s):* Reeve, A. S. and Norton, S. A.

*Status:* Active, *Contract No.:* ME08140.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 2002.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

The overriding objective of this research is to understand the transport and chemical transformation of road salt (NaCl)-polluted surface and groundwater that have been produced from distributed road salt and road-salt storage piles. By using the Cl as an inert tracer, we are enabled to develop a better understanding of the transport (i.e., hydrology) of other conservative solutes in surface and groundwater. By developing geochemical models of the interaction of salt-rich water with soil and bedrock and coupling this model with hydrology, we can assess the development of the pollution and potential remediation of impacted areas.

Preliminary investigations of salt contamination of surface water in a wetland (Alton Bog, Maine-bisected by Route I-95), two permanent streams draining forested watersheds bisected by salted roads, and groundwater systems at three localities "downstream" from salt piles will be continued and investigations extended in breadth as follows. (1) Alton Bog: installation of a grid of hydrologic and chemical monitoring wells, quarterly measurement of head and analysis of water samples from several depths in monitoring wells. (2) Winterport, Maine: continued collection and analysis of groundwater samples from domestic wells; addition of more background and polluted wells to this population of wells; head measurement in as many of the wells as possible; and application of electromagnetic surface geophysics to determine the flow pathways in the surficial material and bedrock.

**LEAD THE DEVELOPMENT OF A MID-ATLANTIC DEPRESSIONAL WETLAND REGIONAL GUIDEBOOK.** (ENV1114)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Brown, Leander.

*Status:* Active.

*Start date:* FY98.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

Due to the extensive data set that the institute has accumulated on depressional wetlands in the mid-Atlantic, much of the baseline information is currently available for the development, calibration, and testing of an HGM model for the region. The project will collect HGM data on sites previously sampled in the wetland IBI study and expand on that base to include other depressional wetlands in the region that span the gradient of human disturbance from least to most impaired, with the goal of creating a regional guidebook for mid-Atlantic depressional wetlands.

**MONITOR HYDROLOGY/REDOX FOR CALCIAQUOLLS IN NORTH DAKOTA/SOUTH DAKOTA.** (ENV1100)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Whited, Michael.

*Status:* Active.

*Start date:* *Estimated completion date:* ongoing.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

The goal of this project is to acquire reference data on hydrology and redox potential for Calciaquolls in North and South Dakota. The result of the project will be calibration of HGMA functional assessment models to determine hydric soil status of these soils and the development of approved field indicators for consistent, defensible field determinations.

**MYCORRHIZAL/PLANT FACTORS INVOLVED IN ROADSIDE RECLAMATION.** (ENV1216)

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Stenlund, Dwayne and Cassellius, Ron.

*Performed by:* University of Minnesota.

*Investigator(s):* Charvat, Iris D.

*Status:* Active, *Contract No.:* 97-003R.

*Start date:* 3 Mar 1997; *Estimated completion date:* 31 May 2000.

One objective is to produce AMF inocula by the most efficient methods available. A nutrient hydroponic system will be used to grow native plants inoculated with mycorrhizae for introduction into restoration plots selected in consultation with the Mn/DOT Technical Liaison. The second objective is to test combinations of soil amendments and mycorrhizal inocula in

potted greenhouse trials to determine which treatments confer the greatest benefits to the native plants. The third goal is to test the most productive greenhouse soil amendments and AM inocula in Mn/DOT experimental plots. The fourth objective is to continue the mycorrhizal diversity studies of undisturbed Minnesota prairies for comparisons with restoration sites. Finally, plant colonization at the restored JES wetland/prairie complex will be monitored to determine species composition and to provide recommendations for future plantings.

In an attempt to improve soil fertility, plant germination and establishment, Mn/DOT adds soil amendments along roadsides. At the Shakopee wetland/prairie site, biosolids have recently been added to part of the area and appear to promote mycorrhizal/plant interactions. Incorporation of AM fungi into native plantings was shown to be beneficial to plants at the JES site near Cambridge. In Fall 1996, Mn/DOT incorporated sulfur into certain plots along the Highway 280 corridor; mycorrhizal inoculum will be added to plantings in Spring 1997. All of these sites need to be monitored to identify the best treatments.

**NUTRIENT EXCHANGE BETWEEN FLORIDA BAY AND THE EVERGLADES' SALINITY TRANSITION ZONE. (ENV1237)**

*Project Monitor:* Jaffe, Rudolph.

*Performed by:* Southeast Environmental Research Program. Florida International University. Miami. FL.

*Investigator(s):* Childers, Dan, Day, J., Davis, Steve, and Oehm, Nicholas.

*Status:* Active.

*Start date:* 1 Aug 1995; *Estimated completion date:* 31 Jan 1999.

The purpose of this project is to quantify the exchange of water and nutrients between the mangrove wetlands along the north shore of Florida Bay and the bay itself (downstream) and the freshwater Everglades marshes (upstream). Our goal is to understand the processes that influence this exchange. This information will help us to understand and predict the effect of changing freshwater inflow to Florida Bay on the status of the mangrove wetland and the availability of nutrients in Florida Bay.

The research group is currently quantifying a number of wetland flux processes. We are using wholesystem enclosures (flumes and mangrove island corrals) to quantify gross wetland-water column exchanges. We are using in situ *Rhizophora* prop root isolation experiments, conducted over a short time span, to quantify nutrient exchange at the level of individual mangroves. Our experimental emphasis here is on the hypothesis that root epibiont communities enhance nutrient flux by red mangroves. We are quantifying carbon turnover rates in mangrove soils at a number of locations by measuring CO<sub>2</sub> efflux, methanogenesis, and sulfate reduction rates. Additionally, we are adding phosphorus and nitrogen to soil samples to investigate the effects of nutrient limitation, and enrichment, on carbon dynamics in these mangrove soils. We are using water mixing experiments to create waters of differing estuarine salinities, and time-series serial filtration experiments of these incubated waters, to investigate the hypothesis that dissolved organics flocculate into particulate-sized organic matter in the mesohaline zone of the mangroves, making these organics available to the rich epibiont communities colonizing red mangrove prop roots.

And finally, we are quantifying the exchange of total phosphorus and total nitrogen between the mangrove zone and Florida Bay on a daily basis throughout the 3 year study.

**REFINE AND UPDATE HYDROLOGY TOOLS DOCUMENT. (ENV1101)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Rodrigue, Paul.

*Status:* Active.

*Start date: Estimated completion date:* ongoing.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

With the Conservation Engineering Division, print a national document, "Hydrology Tools for Wetland Determination." The procedures in this document will provide timely and valuable information regarding the long-term hydrology of potential wetland sites and is expected to set the standard for analyzing and predicting the hydrology of wetlands, especially those with altered hydrology. The tools also can be used to predict the hydrology for wetland restoration and mitigation projects and to monitor their success after construction.

**REFINE HYDRIC SOIL INDICATORS IN MID-SOUTH. (ENV1098)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* Louisiana State University.

*Investigator(s):* Hudnell, Wayne.

*Status:* Active.

*Start date:* FY98.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

Currently wetland determinations are made based on the frequency and duration of inundation and/or saturation of soils during the "growing season." This study will evaluate the use of soil temperature data to help establish estimates of the growing season. The study will improve the procedure for characterizing soil temperature to estimate growing season length, which in turn will improve wetland delineations.

**RESPONSE OF SPRING-FEN PLANT COMMUNITIES TO SILTATION. (ENV1215)**

*Sponsored by:* Minnesota Department of Transportation.

*Project Monitor:* Busacker, Greg and Lund, Steve.

*Performed by:* University of Minnesota.

*Investigator(s):* Lawrenz, Ron.

*Status:* Active, *Contract No.:* 96-349R.

*Start date:* 16 Oct 1996; *Estimated completion date:* 31 Dec 1998.

No abstract provided.

**REVISE AND FINALIZE HGM NORTHERN PRAIRIE REGIONAL MODEL.**

(ENV1111)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Whited, Michael.

*Status:* Active.

*Start date:* FY98; *Estimated completion date:* FY99.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

The goal of this project is to collect data to refine and calibrate the HGM Northern Prairie Regional Model. The project will result in a published regional guidebook containing calibrated and peer reviewed reference data and functional assessment procedures for field application throughout the Prairie Pothole Region.

**RPG: ASSESSMENT OF GROUND WATER FLUXES IN SEMIARID SOUTHWESTERN COASTAL WETLANDS.** (Fed 00172760)

*Sponsored by:* National Science Foundation. Division of Earth Sciences. Washington. DC.

*Project Monitor:* Mayhew, Michael A.

*Performed by:* San Diego State University Foundation. Department of Geological Sciences. San Diego. CA.

*Investigator(s):* Thorbjarnarson, Kathryn W.

*Status:* Active, *Contract No.:* 9508031.

*Start date:* 1 Sep 1995; *Estimated completion date:* 28 Feb 1998.

Two major categories of wetlands found in the coastal southwestern United States are lagoonal fringe wetlands and riparian wetlands. The hydrology of these has been little studied, and direct quantification of the groundwater contribution to most wetlands is even less well understood. The goal of this planning grant is to assess the feasibility of particular field techniques in the evaluation of groundwater fluxes in these two major wetland categories. The ultimate goal is a full research proposal to quantify the various contributors, with a significant emphasis on groundwater, to the water budget of a semiarid wetland. The proposed preliminary research entails hydrogeologic and geochemical study of two field sites, the Tijuana Estuary and the lower Santa Margarita River, and assessment of various hydraulic and tracer techniques to quantify the surface- and ground-water interactions.

**RUI: IMPACTS OF SEDIMENT DEPOSITION ON WETLAND FUNCTIONS.** (Fed 00182456)

*Sponsored by:* National Science Foundation. Division of Environmental Biology.

*Project Monitor:* Callahan, James T.

*Performed by:* Franklin Pierce College. Department of Natural Science. Rindge. NH.

*Investigator(s):* Owen, Catherine R.

*Status:* Active, *Contract No.:* 9629363.

*Start date:* 15 Aug 1996; *Estimated completion date:* Dec 1999.

This project will address the impacts of sediment deposition on the functions of non-tidal freshwater wetlands. Non-point source pollution such as stormwater runoff is often directed into wetland areas, sometimes resulting in changes in water quality and hydrology of the wetland. Although this stormwater may contain many types of pollutants, the focus of this stage of



research is on the physical impacts of sediments in stormwater runoff on wetland processes. Sediment from construction sites, parking lots, roads, and farms may alter the ecological processes of wetlands. Wetlands are recognized for their ability to filter out sediments and improve water quality, however, there may be some point at which so much sediment is deposited in the wetland that the wetland is degraded, and its ability to perform some or all of its ecological functions is diminished. The general hypothesis of this study is that sediment deposited in a wetland will alter the wetland soil's natural characteristics, such as capillarity, porosity, and hydraulic conductivity. Highly organic soil is often very porous in the top layers, and as a result may be open to settling and compaction by sediment deposited in runoff; if the result of this sediment deposition is a significant change in soil moisture retention, hydraulic conductivity, or other soil characteristics, then water flow and biological processes in the wetland may be altered. The ultimate goal of the study is to identify sustainable loads of sediment for a wetland.

### **STUDIES IN FOREST RESOURCES MANAGEMENT SCIENCE/OPERATIONS RESEARCH.** (CRIS 0172838)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service. North Carolina Forestry Station.

*Performed by:* North Carolina State University. Forestry Department. Raleigh. NC.

*Investigator(s):* Roise, J. P.

*Status:* Active, *Contract No.:* NCZ04164.

*Start date:* 1 Oct 1996; *Estimated completion date:* 30 Sep 2001.

*Publication(s):* Roise, J.P. and L.H. Hayden. 1997. The Pipeline Problem: Scheduling Project Plans. *Analysis Notes*, vol. 7, no. 2. pp. 16-21.

Gainey, K. and J.P. Roise. 1997. Optimal Road Location with Wetland Impacts. *Proceedings of the 1997 Symposium on System Analysis in Forest Resources*. May 26-29, 1997.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

The approach that this project will use is that of management science: problem definition, literature review, formulate problem, model development, data preparation, model solution and report generation. Use theory of hierarchical levels of planning and management and decision theory techniques and structural review. An emphasis will be given to tactical level planning, to provide a bridge between strategic and operational project planning. Additional emphasis on analyzing locations of road systems within wetlands and creation of wetland mitigation banks.

### **PROGRESS: 1997/01 TO 1997/12**

Special emphasis area 2: Locating roads within wetlands and the creation of wetland mitigation banks was the second area of management science research being investigated. This area is still a work in progress. However, several significant steps have been taken. The first major problem was developing quantitative relationships between wetland characteristics and wetland functions. First we evaluated the ArcInfo AML program 'North Carolina Coastal Region Evaluation of Wetland Significance' (NC-CREWS). The information in this program is extensive and very valuable. However in its current state, NC-CREWS, is limited in its usability. It is not easily portable between computer systems. In addition, run time can be from half a day to four days to calculate the functional ratings for wetlands within one watershed. Thus, one aspect of our research has been to improve the usability of NC-CREWS.

Special Emphasis Area 1: Tactical Level Planning. A specific instance of forest plan implementation was studied and an approach was developed to link the outputs established by the strategic forest plan to the activities required for operational project plans. The analysis method used was an 'Integer Goal Program'. Where the goals were to minimize deviations from strategic

plan outputs (typically but not exclusively volume targets). The constraints were the labor resources available to conduct the required project plans. The purpose of the tactical plan was to determine which areas on the forest should be evaluated for developing operational plans. The solution contains both a quantitative element (the integer goal program) and a qualitative element (the knowledge and experience of the forest's staff). The results of the analysis will be monitored over the next ten years as the forest plans at the strategic, tactical and operational level are implemented.

**THE USE OF SUBSURFACE IRRIGATION TO RESTORE DEGRADED GROUNDWATER-FED WETLANDS. (ENV1232)**

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Performed by:* University of Wisconsin-Madison.

*Investigator(s):* Potter, Kenneth W. and Bahr, Jean M.

*Status:* Active.

*Start date:* 1 Aug 1998; *Estimated completion date:* 31 Jul 2001.

Wetland restoration efforts have been undertaken more frequently in recent years as society in general has recognized the value of wetland functions lost due to human impact. Unfortunately, these projects have often been less than successful in restoring the conditions conducive to the development of natural wetland communities. This is especially true for groundwater-fed systems because of the difficulty in establishing an appropriate hydrologic regime. Because of this difficulty, most groundwater-fed wetlands harmed by the effects of development have either been replaced with systems fed by surface water, which often results in completely different wetland communities, or have not been replaced at all. The net result is that the groundwater-fed wetlands that were major constituents of the pre-settlement lowlands in Wisconsin and much of the rest of the Midwest are steadily declining.

By developing a means to restore groundwater-fed wetlands using water sources such as stormwater or wastewater effluent, future wetland degradation may be minimized, historical degradation reversed, and water that would otherwise be quickly flushed out of the watershed would be used to maintain important biological communities. This project should provide information in three areas vital to the field of wetland restoration. First, the project should show whether or not subsurface irrigation is a viable means to restore wetlands. An inability to restore groundwater-fed wetlands may have vast implications regarding the effectiveness of efforts to preserve wetland functions (Bedford, 1996). Second, the project should provide information relating to the importance of nutrients in wetland restoration. Finally, this type of subsurface flooding could be an effective way of controlling reed canary grass. The combination of isolation and subsurface flooding has apparently not been attempted to this point, and surface flooding without isolation has been only mildly successful at removing the species. Developing a method to control this species would be a significant achievement in and of itself.

**USING WETLANDS FOR STORM WATER MANAGEMENT. (ENV1314)**

*Sponsored by:* Ohio Department of Transportation.

*Project Monitor:* Linkous, Tom.

*Performed by:* Ohio University.

*Investigator(s):* Mitchell, Gayle.

*Status:* Active, *Contract No.:* 14636(0).

*Start date:* 1 Nov 1995; *Estimated completion date:* 1 Dec 1998.

*Publication(s):* Final report in preparation.

The objectives of this research are:

- (1) To study the ability of constructed wetlands and/or vegetated channels to treat storm water discharge both during and after highway construction;
- (2) To determine performance standards of constructed wetlands and vegetated channels receiving highway storm water discharge; and
- (3) To determine the advantages of other BMPs used in conjunction with wetlands and vegetated channels.

**WATERSHEDS AND WETLANDS: LARGE SCALE DISTURBANCES AND SMALL SCALE RESPONSES.** (ENV1081)

*Sponsored by:* U.S. Environmental Protection Agency.

*Performed by:* Pennsylvania State Cooperative Wetlands Center. Forest Resources Laboratory. Pennsylvania State University. University Park. PA.

*Investigator(s):* Cole, C. A., Brooks, R. P., and Wardrop, D. H.

*Status:* Active, *Contract No.:* R824905.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1999.

The purposes of this project are to: (1) assess characteristics of natural reference wetlands and created wetlands by watershed, disturbance, and hydrogeomorphic category in order to determine improved design characteristics for created wetlands implemented for mitigation purposes; (2) assess natural succession in reference wetlands using seed banks and soil dating; (3) assess characteristics of created wetlands of different ages to begin to determine successional pathways; (4) compare created wetlands with the reference sites to see if the created wetlands are “successful” in any sense; and (5) use disturbance theory to evaluate the impacts of the surrounding landscape on both reference and created wetland and their successional trajectories. The project will build on a large data set already collected by the Penn State Cooperative Wetlands Center, which covers hydrology, sedimentation, soils, vegetation, and wildlife habitat. We will intensively focus upon site hydrology as this impacts wetland character to the greatest extent. We will examine historic wetland communities through an analysis of the seed bank in soil layers dated using Cs137. These data, in conjunction with the analysis of historic aerial photography (to show land use), will enable us to evaluate how natural wetlands have changed in response to disturbance factors in their immediate watershed. We will examine created wetlands using the same approach, but instead substituting space for time in an effort to assess successional tendencies of the created wetlands. We will attempt to determine if created wetlands are moving towards some model exhibited by the reference wetlands or if the created sites form a unique population of wetlands. If so, then we will use design criteria derived from the natural sites to propose changes in how, and where, created sites are implemented into the landscape. Our preliminary evidence shows that landscape position, in addition to construction technique, is a prime determinant of function in created wetlands. We expect that the project will deliver both basic and applied information. We expect to learn much about the processes of succession in wetlands, and primary succession in created wetlands. We also expect to improve on the design concepts for wetland mitigation such that new mitigation projects will begin to approach the replacement of function rather than just creating a wet spot on the ground.

**WETLAND MITIGATION BANKING.** (ENV1310)

*Sponsored by:* Utah Department of Transportation.

*Project Monitor:* Sam Musser.

*Investigator(s):* SWCA, Inc.

*Status:* Active, *Contract No.:* 81 FR 9864.

*Start date:* Oct 1998; *Estimated completion date:* Oct 1999.

The objective of this study is to develop a conceptual statewide comprehensive wetland

mitigation plan. Other objectives are to create a memorandum of agreement with the Corps of Engineers and other agencies, to develop a detailed wetland mitigation program statewide, and to implement a wetland mitigation program.

**WETLANDS WATER BALANCE STUDIES. (ENV1303)**

*Sponsored by:* Virginia Department of Transportation.

*Performed by:* Virginia Polytechnic Institute and State University; United States Geological Survey; Virginia Transportation Research Council.

*Investigator(s):* Daniels, Lee, Persaud, Naraine, Speiran, Gary, Facazio, Mike, and Fitch, Michael.

*Status:* Active.

*Start date:* 1 Jul 1995; *Estimated completion date:* 30 Jun 1999.

Previous field results indicate that the development of a workable approach to estimating the annual water budgets for proposed and constructed mitigation sites is one of the most pressing research issues for VDOT and the wetlands research community in general. Water loss caused by evapotranspiration is not only one of the largest variables in a water budget calculation but is also one of the most difficult to determine. Prior to land purchase and grading of a designated wetland compensation site, the soil wetness regime across the site after the final grade is attained needs to be predicted. Specific values for evapotranspiration are a major part of this estimate. Although several approaches to this problem have been evaluated, an acceptable approach applicable to VDOT mitigation sites has not been identified.

This research effort will allow for the comparison of a number of evapotranspiration estimate methods. Site-specific evapotranspiration estimates are being developed for two sites in Virginia: the Manassas Airport emergent wetland and the forested wetland mitigation site at Fort Lee. Measurement approaches for actual evapotranspiration from the study sites in the field include energy budget, eddy correlation, mass transfer, profile methods, the Thornthwaite method, and estimates from diurnal ground water fluctuations. Methods are being compared to each other in order to make final determinations of daily evapotranspiration rates throughout the period of monitoring.

More accurate water budget estimates for wetland mitigation sites will help ensure more successful site construction and maturation. This ultimately reduces site maintenance and alteration costs associated with mitigation site development.

Water budget development is complete for the Manassas wetland site. A detailed site-specific water budget is being developed at Fort Lee. This effort includes continuous onsite weather data collection, evapotranspiration estimation using four different methods, groundwater flux estimations, and surface water flux estimations.

**WITH ARS, NATIONAL SEDIMENTATION LABORATORY, DEVELOP A PC-BASED WETLAND MANAGEMENT TOOL FOR WETLAND EVALUATION WITHIN WATERSHEDS. (ENV1117)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Rodrigue, Paul.

*Status:* Active.

*Start date:* FY98.

*Notes:* Source of information: Wetland Science Institute web page,  
<http://159.189.24.10/wetsci.htm>

The identification of potential wetland areas within a watershed is important in developing a wetland management system. Hydrologic and physical characteristics of a watershed are needed to determine potential wetland areas. Many tools have been developed by USDA-NRCS to aid in the evaluation of the hydrology of potential wetlands and their impact on the entire watershed system. Many of these tools are analytical techniques used to supplement the documentation of a wetland determination, often requiring accessing extensive database information. The acquisition of this information can be difficult and tedious for even typical hydrologic applications, such as obtaining parameters needed from a climatic, soils, or land use database. Computer-based technological tools have aided in the determination of potential wetland hydrologic characteristics. A long-term objective of the project would be the development of enhancements to the USDA-ARS watershed model, AGNPS, to incorporate wetland hydrologic and water quality processes. In cooperation with the wetlands hydrologist, Paul Rodrigue, and the Water Quality and Ecological Processes Research Unit and NSL, the Mississippi Delta MSEA (MDMSEA) site will be used to develop and validate the enhanced AGNPS program. From the application of AGNPS, users would have the capability of imposing best management practices affecting wetland areas within a watershed. This would produce evaluations of management-imposed conditions on the performance of wetland areas to control the hydrological processes and water quality of a watershed.

#### **WORK WITH COFFEEVILLE, MS, PLANT MATERIALS CENTER TO EVALUATE HERBACEOUS PLANTINGS IN WRP WETLAND RESTORATION PROJECTS.**

(ENV1107)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Rodrigue, Paul and Douglas, Joel L.

*Status:* Active.

*Start date:* FY98; *Estimated completion date:* 2000.

*Notes:* Source of information: Wetland Science Institute web page,  
<http://159.189.24.10/wetsci.htm>

The NRCS in Mississippi has a high number of WRP contracts in the state. Bottomland hardwood planting has been the primary focus with integrated shallow water areas for waterfowl and moist soil areas. There has been an increased interest in herbaceous wetland plants as part of the revegetation plan. NRCS Mississippi has requested that the Coffeerville Plant Material Center conduct a field evaluation planting of different herbaceous wetland plants on a WRP site in Quitman County, Mississippi. To provide as complete of an evaluation as possible, the institute will monitor the hydrology of the site to evaluate both hydrology restoration success and planting success based on a known hydrology regime.

## Wildlife and Ecosystems

### **ANALYSIS OF BIOLOGICAL DIVERSITY CONSERVATION IN IOWA USING GEOGRAPHICAL INFORMATION SYSTEMS AND GAP ANALYSIS. (ENV1259)**

*Sponsored by:* Iowa Cooperative Fish and Wildlife Research Unit. Ames. IA.

*Project Monitor:* Klaas, Erwin E.

*Performed by:* Iowa State University.

*Investigator(s):* Klaas, Erwin E. and Kane, Kevin.

*Status:* Active.

*Start date:* 14 Mar 1997; *Estimated completion date:* 31 Dec 1999.

**OBJECTIVES:** 1) Prepare a base map of vegetation communities for Iowa derived from recent remote sensed land cover data and an accepted vegetative classification system that is at least 80% accurate in predicting vegetation type present at a statistically valid random sample of points, 2) Delineate current distribution of each native vertebrate and selected invertebrate species that are at least 80% accurate in predicting recent species occurrence at a statistically valid random sample of areas stratified by vegetative community type, 3) Update federal, state, county, private, and tribal land ownership boundaries categorized by level or extent of conservation provisions associated with land parcels, 4) Consolidate component data in a GIS and perform analysis of patterns of natural community and animal species diversity relative to various types of land management and landscape physiognomy.

**APPROACH:** Information on vegetative community structure, selected associated animal-habitat associations, and land ownership categories in Iowa can be organized in a Geographic Information System (GIS) with sufficient resolution to delineate areas of high biological diversity that are gaps in conservation provisions within current land stewardship processes. The project will include all of the state of Iowa. Much of the proposed work will consist of information synthesis in a laboratory, but the ground-truthing of site characteristics will necessitate field work statewide. Procedures will closely follow the USDI Handbook for GAP analysis (Version 1), including mandatory standards for proper documentation of all information sources (metadata) used to assemble GAP analysis data layers. Objective 1: Prepare a statewide vegetative community map. Objective 2: Identify the most inclusive list of vertebrates and invertebrate mammals that may realistically be included in the data compilation. Objective 3: The Iowa DNR land ownership databases will be expanded to include land owned by counties, tribal, and non-government organizations. Objective 4: Following expert review and revision of vegetation and species distribution maps, final organization of GIS databases will be completed. Final consolidation will be compatible with inclusion with databases maintained by the Geological Survey Bureau and other divisions of the Iowa DNR.

#### **PROGRESS: 1997/01 TO 1997/12**

The Iowa Gap Analysis Project (IGAP) began in April 1997 with receipt of the first incremental funding from the National Gap Analysis Program. Satellite images (thematic mapper data, mostly from 1992) were acquired for the entire state. Coverage includes 12 scenes for each of 3 dates in spring, summer, and fall seasons. The TM data are first classified by scene into six general land cover classes: forest, grassland, cropland, water, bare ground, and urban. This phase of the work is about 50 percent complete. More detailed classification of forest, grassland, and wetland will start in January 1998. Requests for ancillary data on vegetative cover were sent to about 250 land management agencies in all 99 counties of the state. Information gathered from ground surveys will be used to link reflectance values in clustered pixel groups with vegetation alliances. A panel of botanists was asked to lend advice on compiling a list of vegetation alliances for the state. Historical and current data bases for vertebrate distributions in Iowa were identified and work

began on compiling species lists and assigning codes. Work also started on assembling locations, boundaries, ownership, and management status of stewardship lands. IGAP has joined Missouri, Kansas and Nebraska in forming the Mid- America Remote Sensing Consortium to facilitate cooperation and standardization of procedures in mapping vegetation. Each state in the Consortium received supplementary funding from the U.S. Environmental Protection Agency (Region 7) to help achieve 2- hectare resolution for land cover in the four-state region. IGAP completed a Quality Assurance Project Plan following EPA guidelines and National Gap Analysis standards. Information on IGAP is now available on the world wide web at <http://www.ag.iastate.edu/centers/cfwru/iowagap/>.

#### **ASSESSMENT AND MANAGEMENT OF ROADSIDE WILDLIFE ON I-40 IN NORTH CAROLINA.** (ENV1025)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Performed by:* University of North Carolina at Wilmington. Department of Biological Sciences. Wilmington. NC.

*Investigator(s):* Bolen, Eric G.

*Status:* Active.

*Start date:* 1 Jan 1997; *Estimated completion date:* 31 Dec 1998.

*Notes:* Research is complete and a final report is being compiled.

List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

The North Carolina Department of Transportation has designated selected sites along U.S. Interstate 40 as wildlife areas. The objectives of this study are to: (1) inventory and assess the current status of six of these sites; (2) develop prescriptions for managing these locations for wildlife, while considering the safety of motorists; and (3) develop criteria for locating future sites for roadside wildlife areas. This study will address an assortment of species, including plants, insects, birds, and mammals, to develop an integrated management plan. The areas selected will be 50m in length on either side of the sign designating the area for wildlife (100m total). The width of the plot will be determined after selection. With each wildlife area, a control area will be paired. The control areas will be located no less than 50m adjacent to the wildlife areas and will be of similar habitat. The control areas will also be 100m in length, with the width to be determined after selection. Once plots are selected, they will be sampled to determine the species composition of plants, insects, birds, and mammals. Following censusing of the wildlife and control plots, a management plan will be developed to enhance wildlife habitat at each area. Management activities may include mowing, controlled burning, and plantings of native vegetation. In addition, structures such as blue bird boxes, kestrel boxes, and butterfly boxes may also be utilized. Following management activities (i.e., treatments), the plots will again be censused to determine the effects of the treatments. At this time, the project team is engaged in Phase I activities, which include primarily data collection of the wildlife and control areas.

#### **ASSESSMENT AND MODELING OF STREAM MITIGATION PROCEDURES.** (ENV1121)

*Sponsored by:* Kentucky Transportation Cabinet. Frankfort. KY.

*Project Monitor:* Crim, Keith.

*Performed by:* University of Kentucky. Civil Engineering Department.

*Investigator(s):* Hopwood, Theo, Ormsbee, Lindell, and Yost, Scott.

*Status:* Active, *Contract No.:* KYSPR99-193.

*Start date:* 30 Jul 1998; *Estimated completion date:* 31 Dec 1999.

This research project focuses on how effective past stream mitigation efforts have been. Sites are analyzed to determine how well areas have recovered. This study also evaluates mitigation techniques used in other states. Based on the findings, recommendations will be made for a DOT manual outlining future mitigation efforts.

**ASSESSMENT, EVALUATION, AND POSSIBLE METHODS FOR REDUCING DEER-VEHICLE ACCIDENTS ON IOWA HIGHWAYS. (ENV1256)**

*Sponsored by:* Iowa Cooperative Fish and Wildlife Research Unit. Ames. IA.

*Project Monitor:* Klaas, Erwin E.

*Investigator(s):* Danielson, Brent J. and Hubbard, Michael W.

*Status:* Active, *Contract No.:* IA DNR .

*Start date:* 1 Mar 1998; *Estimated completion date:* 28 Feb 1999.

In North America, deer numbers have increased substantially during the last century. Today, the population is estimated to be in excess of 20 million. At the same time, transportation networks have increased and the volume and speed of traffic on public right-of-ways has also increased. As a result, deer-vehicle collisions have become a problem of major significance. The estimated cost, in property damage and human injury, is \$1.2 billion/year nationwide. In the past 10 years in Iowa, the number of deer killed annually on roadways has increased by 75%. Property damage to Iowa motorists was in excess of \$22.5 million in 1995. In the past, a number of methods for reducing collisions have been studied, but most of the studies have been correlational in nature, and, thus, lack the cause-and-effect results necessary to accept or reject the usefulness of the various approaches. Objectives for this study are divided into three phases. Phase 1: Examine and report on the success of other methods currently in use across the country, and especially the agricultural Midwest, to reduce deer-vehicle collisions; and evaluate current status, availability and feasibility of the use of motion detectors to reduce deer-vehicle collisions. Phase 2: Implement a pilot project to evaluate and attempt to identify landscape features and patterns that may increase deer-vehicle collisions; and identify and design an improved method of data collection at deer-vehicle accident sites. Phase 3: Using the results from phase 1 and 2, we will design an extensive and well-controlled experimental field study.

The evaluation of landscape effects on deer-vehicle accidents may provide the Iowa Department of Transportation (IDOT) with the ability to identify those areas along public roadways that have a higher probability of deer-motorist encounters. The ability to identify these high-risk areas would also provide IDOT with the information necessary to maximize the benefit of monetary expenditures designed to reduce deer-vehicle collisions and increase motorist safety. The information regarding deer-vehicle collisions obtained during this study may also benefit other states with landscape features and patterns similar to Iowa.

**AN ASSESSMENT OF THE TRANSFERABILITY OF HABITAT SUITABILITY CRITERIA FOR BROWN TROUT IN SOUTHERN NEW ENGLAND STREAMS.**

(ENV1203)

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Performed by:* University of Connecticut. Department of Natural Resources Management and Engineering. Storrs. CT; Department of Environmental Protection. Fisheries Division. Hartford. CT.

*Investigator(s):* Neumann, Robert M. and Jacobson, Richard A.

*Status:* Active.

*Start date:* 1 Jan 1999; *Estimated completion date:* 31 Dec 2001.

Concerns have been expressed regarding the transferability of species-specific HSC (habitat



suitability criteria) among streams and regions; thus, the use of previously developed HSC should be used with great care. Only HSC developed for streams of similar size and morphometry, and in the same geographic area as the candidate stream, should be used. Further, the transferability of these HSC should be tested before they are used to assess discharge and microhabitat relationships. This has never been done in New England; in each application of PHABSIM (physical habitat simulation), previously developed HSC were used. These criteria were not developed using direct underwater observations, and were based on professional speculations on habitat use of fishes in streams of western states. Further, the transferability of these HSC were never tested.

This study will result in the first set of HSC developed from direct observations in New England. It will provide the first assessment of the transferability of HSC between New England streams. The HSC developed can be used in assessments of PHABSIM outputs on the instream flow study conducted pursuant to designation of the Farmington River as a Wild and Scenic River. They can also be used to improve confidence in the instream flow studies being conducted on the Housatonic River. Finally, the criteria and transferability test results will be used by managers throughout New England to improve confidence in future instream flow studies.

**CHINESE TALLOW (*SAPIUM SEBIFERUM*) CONTROL RESEARCH AND HABITAT ENFORCEMENT.** (ENV1173)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Smith, P.

*Investigator(s):* Whisenant, S. G.

*Status:* Active, *Contract No.:* 7-4928.

*Start date:* 23 Jun 1998; *Estimated completion date:* 31 Aug 2000.

No summary provided.

**COASTAL ROADWAY LIGHTING IMPACTS ON NESTING ENDANGERED AND THREATENED MARINE TURTLES AND THEIR HATCHLINGS.** (ENV1321)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Broadwell, Ann.

*Performed by:* Florida Atlantic University.

*Investigator(s):* Salmon.

*Status:* Active, *Contract No.:* BB-850.

*Start date:* 13 Jul 1998; *Estimated completion date:* 15 Apr 2000.

The purpose of this research project is to identify and establish "Sea Turtle Lighting Zones" on coastal roadways that are adjacent to sea turtle nesting beaches and to develop alternative lighting standards that can be used when designing lighting systems within these zones.

**CRB: HABITAT QUALITY: A HIDDEN COMPONENT OF WETLAND FRAGMENTATION.** (Fed 00170577)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington, DC.

*Project Monitor:* Brooks, Lisa D.

*Performed by:* University of Nevada-Reno. Environmental and Resource Sciences. Reno. NV.

*Investigator(s):* Oring, Lewis W.

*Status:* Active, *Contract No.:* 9424375.

*Start date:* 1 Sep 1995; *Estimated completion date:* 31 Aug 1998.

The study of habitat fragmentation has been built on an understanding of how lost habitat, isolation of habitat patches, and increased habitat edge lead to declines in populations. This understanding has, in turn, formed the foundation for principles of reserve design in conservation biology. In order to design reserves in the future, traditional studies of fragmentation must be augmented to include: (1) the effect of variation in patch quality in the habitat remaining on individuals in the population, and (2) how these effects over time affect population growth or decline. In the arid West and throughout much of the world, several factors, including irrigation and domestic water use, have combined to result in a general trend toward salinization of water available for wildlife. High salt levels have been shown to pose serious health threats to wildlife, especially young birds. This project will determine the capacity of young water birds to withstand various salt loads. The results will allow water management to predict the costs to wildlife of increased salinization. Eventually, results can be integrated into population models as factors affecting survival.

**CRB: LOCAL MECHANISMS THAT GENERATE LANDSCAPE-LEVEL PATTERNS: RELATIVE HABITAT SUITABILITY OF FRAGMENTED (title incomplete).** (Fed 00170610)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington, DC.

*Project Monitor:* Courtney, Mark W.

*Performed by:* Dartmouth College Environmental Studies Program. Hanover, NH.

*Investigator(s):* Bolger, Douglas.

*Status:* Active, *Contract No.:* 9424559.

*Start date:* 15 Sep 1995; *Estimated completion date:* 31 Aug 1998.

*Notes:* Incomplete title - could not be verified.

Understanding the ecological effects of habitat fragmentation is essential to preserving biodiversity. The rufous-crowned sparrow is relatively common in large habitat patches but uncommon in smaller patches in the human modified landscape of Southern California. The hypothesis to be tested in this conservation and restoration biology research is that rarity of the rufous-crowned sparrow in small fragments is attributable to one or more demographic, behavioral, community, or ecosystem-level changes that occur as a consequence of habitat fragmentation. This hypothesis will be addressed through comparative studies in matched plots of coastal sage scrub in relatively small patches and in patches embedded in a larger undeveloped area. Relevant demographic parameters will be measured in each patch. Resource abundance and depletion rates will be measured. This study is an attempt to interpret landscape-scale distribution of a single species within the context of an entire suite of changing ecological conditions. The research is being conducted on a species and at a spatial scale that are immediately relevant to the practical conservation of biodiversity in a rapidly changing landscape. It has long been known that inbreeding, the mating of closely related individuals, is unhealthy to both individual offspring and the population as a whole. Theoretical studies show this conclusively, as do domestic animal matings, where inbred cows or dogs or horses are much less healthy, or much less fit, than outbred animals. Further, inbreeding causes a population to lose genetic variation, which means its ability to adapt genetically to a changing environment may be impaired. Today, conservation biologists are often responsible for managing small, threatened populations of native species, which may be susceptible to inbreeding and resultant loss of genetic variation. Unfortunately, little is known about the relationship of genetic variation and fitness (longevity, disease resistance, reproductive success) in the wild. To analyze this problem Dr. Soule will study naturally occurring populations of an animal that is particularly well-suited for this research -- pocket gophers -- small, burrowing rodents that are common throughout California. Earlier studies of different gopher populations showed that some have

unusually high levels of genetic variation, while some have extremely low levels. But do these genetic differences affect fitness? The physiological vigor of animals will be measured in two ways -- metabolic rate during normal activity (burrowing) and by determining which animals assimilate and use food most efficiently. Dr. Soule will also determine which animals survive and reproduce best in nature. He will then determine if the animals that are the most fit are the ones that have the most genetic variation within their population, or if animals from genetically variable populations are generally more fit than animals from less variable populations.

**CRB: THE EFFECT OF HABITAT FRAGMENTATION ON BIODIVERSITY AND TROPHIC LINKAGES IN EXPERIMENTAL FRACTAL LANDSCAPES.** (Fed 00178465)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington.

*Project Monitor:* Frost, Thomas M.

*Performed by:* Bowling Green State University. Department of Biological Sciences. Bowling Green. OH.

*Investigator(s):* With, Kimberly A. and Pavuk, Daniel M.

*Status:* Active, *Contract No.:* 9610159.

*Start date:* 15 Aug 1997; *Estimated completion date:* 31 Jul 1999.

Habitat fragmentation is one of the biggest threats to biodiversity. Yet conservation biology has no formal theory to predict at what point landscapes are likely to become fragmented, and thus when populations are at risk of extinction. Neutral landscape models provide quantitative predictions about when habitat fragmentation occurs and how species respond to habitat fragmentation. Neutral landscapes are grid maps in which a habitat is generated using a theoretical spatial distribution. These theoretical models predict that habitat fragmentation occurs suddenly across a very small range of habitat loss. As a consequence, species may abruptly go extinct at this critical threshold in habitat loss, even though suitable habitat is still available on the landscape. Exactly where the threshold occurs depends on the spatial arrangement of habitat and the dispersal abilities of the species. For example, a species with poor dispersal abilities will be affected by habitat fragmentation sooner than a species with good dispersal abilities. The potential for threshold effects in habitat fragmentation and the subsequent extinction of populations have been identified as major unsolved problems facing conservationists. The investigators will test neutral landscape theory by assessing the effects of fragmentation on biodiversity and trophic interactions. Because the principles and predictions of neutral landscape theory should apply at any scale, the investigators will develop an experimental model system consisting of microlandscape plots. These plots will represent a range of habitat abundance and fragmentation severity. The plots will be constructed using the habitat distributions predicted by the theory. The investigators intend to examine the response of insect herbivores and their natural enemies within these experimental landscapes. Specifically, they will explore how species with different life-history strategies and dispersal abilities are affected by fragmentation. They will also study how habitat fragmentation affects the ability of natural enemies (predators, parasitoids) to control their prey or host species.

**CULVERT DESIGN FOR JUVENILE SALMON.** (00722882)

*Sponsored by:* Alaska Department of Transportation and Public Facilities. Juneau. AK (Work funded in cooperation with the Federal Highway Administration.).

*Project Monitor:* Reckard, M.

*Performed by:* Alaska Department of Fish and Game. Juneau. AK.

*Investigator(s):* McLean, R.

*Status:* Active.

*Start date:* 1 Jan 1996; *Estimated completion date:* 30 Sep 1996.

In-culvert evaluations of juvenile salmon swimming behavior and power energy capabilities using VCR recording devices with painted grids for scale and distance analysis.

**DEMONSTRATION OF LOW-COST METHODS TO CONTROL EROSION AND RUNOFF FROM DIRT AND GRAVEL ROADS. (ENV1258)**

*Sponsored by:* Pennsylvania Cooperative Fish and Wildlife Research Unit. University Park. PA.

*Project Monitor:* Carline, Robert F.

*Investigator(s):* Arnold, Dean E., Colbert, Woodrow J., Vandegrift, Bruce V., Murin, Kenneth, and Delcorso, Ellyn J.

*Status:* Active, *Contract No.:* 201.

*Start date:* 1 Apr 1997; *Estimated completion date:* 31 Mar 2020.

In Pennsylvania there are more than 27,000 miles of unpaved roads, under the control of at least six government agencies. Many clean, high-value streams are paralleled through all or part of their length by such roads. Such stream segments are vulnerable to adverse effects of siltation and other components of runoff from the unpaved roads. Such pollution to the waters of our Commonwealth, and several authorities have found the situation to be similar nationwide. The effects of sediment pollution on streams have been well documented. Scientists agree that excessive siltation hurts all stream life. It leads to degraded populations of sport fish, and thus to substantial losses in recreational opportunities. The objectives of this project are to demonstrate low-cost techniques for erosion and runoff control that can be easily carried out by township and forest district road crews, and to produce printed, illustrated guidelines and videotapes for training these persons. The investigators are members of the Pennsylvania Interagency Task Force on Dirt and Gravel Roads, which has been working with the problem in quarterly meetings for three years, and has proposed the basic ideas from which we have developed the demonstrations. The Task Force has sponsored one earlier demonstration project in which study techniques to be used in this project were developed and tested. The Pine Creek watershed was chosen for this project due to the presence there of serious, yet typical problems of roads located on public land. This location, and the current existence of other pollution control programs in the watershed, led to the willingness of several government bodies to take active roles in the project.

We will organize the physical road work and conduct monitoring operations: physical, chemical, and biological, before and after the work. This data, together with photographic records, will document the success (or failure) of the various techniques demonstrated. Where possible, fish and wildlife values will be carefully included in the evaluation. Written training materials, videotapes, and photographic/information displays will be produced for use in training road maintenance crews, and for public information.

**DETERMINATION OF THE EFFECTIVENESS OF WILDLIFE BARRIERS AND UNDERPASSES ON US HIGHWAY 441 ACROSS 441 PAYNES PRAIRIE PRESERVE, ALACHUA COUNTY, FLORIDA. (ENV1191)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Evink, Gary.

*Performed by:* U.S. Geological Survey.

*Investigator(s):* Dodd.

*Status:* Active, *Contract No.:* BB-854.

*Start date:* 1 Aug 1998; *Estimated completion date:* 1 Sept 2001.

The objectives of this project are to determine if wildlife barriers reduce the level of roadkills through the quantification of pre- and postconstruction, as well as, determine the number and the various types of animals utilizing the boxculvert for the pre- and postconstruction of the barrier

wall across US 441 Paynes Prairie.

**DETERMINATION OF THE EFFECTIVENESS OF WILDLIFE BARRIERS AND UNDERPASSES ON US HIGHWAY 441 ACROSS PAYNES PRAIRIE STATE PRESERVE, ALACHUA COUNTY, FLORIDA. (ENV1255)**

*Sponsored by:* Florida Caribbean Science Center. Gainesville. FL.

*Project Monitor:* Hall, Russell J.

*Investigator(s):* Dodd, C. Kenneth Jr.

*Status:* Active, *Contract No.:* 100-36.

*Start date:* 1 Jul 1998; *Estimated completion date:* 31 Jul 2001.

On 11 June 1997, a meeting was held to discuss research methodologies that might be used to determine the effectiveness of a barrier wall/underpass system proposed for construction along US Highway 441 where it crosses Paynes Prairie State Preserve, Alachua County, Florida. Details of the barrier/underpass system are presented in the Florida Department of Transportation Draft Preliminary Engineering Report, State Project Number 26010-1526. Massive wildlife road kills have occurred on the 1.8 mile section of highway in question, and the high levels of mortality have adversely affected wildlife populations, created safety concerns, and detracted from the beauty of the prairie. This research seeks to determine the pre-construction levels of road mortality and the post-construction effectiveness of the wildlife barrier/underpass system, based on a consensus among meeting participants as to study design. Ideally, a research study testing the effectiveness of such barriers and underpasses should include monitoring wildlife populations in the adjacent prairie. However, such sampling/ monitoring would substantially increase project costs and be logistically difficult. Research will include road surveys (pre-and post-construction of the wildlife barrier), assessment of wildlife use of existing culverts, and assessment of wildlife use of culverts built in connection with the barrier wall system.

Our research objectives are as follows: 1) To determine if the wildlife barrier reduces the level of road kills, and to quantify differences pre- and post-construction; 2) To determine how many and what types of animals use the box culverts (already present on site) prior to construction; 3) To determine if animal use of the box culverts changes after the wildlife barrier is installed and retrofitted to the culverts, and to quantify differences; 4) To determine differences in the effectiveness of box culverts and (to-be-installed) pipe culverts. The research should provide the Florida Department of Transportation a scientifically reliable assessment of the effect of barriers and underpasses on wildlife along this section of US Highway 441.

**DEVELOPING A MODEL FOR WATERSHED MANAGEMENT THROUGH DETERMINING WATER QUALITY AND LAND-USE IMPACTS ON THE ENDANGERED TOPEKA SHINER (*Notropis topeka*). (ENV1208)**

*Sponsored by:* U.S. Geological Survey. Water Resources Research Institute.

*Performed by:* University of Missouri-Columbia. Fisheries and Wildlife Department. Columbia. MO.

*Investigator(s):* Noltie, Douglas B. and Nilon, Charles H.

*Status :* Active.

*Start date:* 1 Sep 1998; *Estimated completion date:* 31 Aug 1999.

By modeling historic land-use change in a watershed that has experienced Topeka Shiner population extirpations (a basin where information exists on formerly occupied sites) we will derive a model that is potentially applicable on a regional level that we can use to assist in species recovery. We will then test this model on selected watersheds in Iowa that are also experiencing Topeka Shiner extirpations. This model will integrate spatial information (through reliance on

GIS-related technologies) concerning land-use, water quality, and currently occupied and unoccupied sites where Topeka Shiners had previously been found, and spatial information on landowner attitudes. It will include information gathered on a spatial scale that included the entire watershed upstream from a site, as this has been found to be the best predictor of site-to-site variation (Roth et al., 1996). Landowner attitudes will also be considered within a spatial framework. Because landowners own the land on which management techniques would need to be implemented, it is crucial to integrate their attitudes toward land-use changes (as outlined by the Missouri Department of Conservation's Topeka Shiner Action Plan) into a species recovery model.

Due to the increasing influence of urban and agricultural land-uses in developing watersheds on species' habitats, especially as regards endangered species such as the Topeka Shiner, we feel that a project that addresses these impacts, through modeling watershed processes and analyzing land-use decisions, is highly relevant at this time. We will develop specific models that represent people's attitudes and practices that are the cause of the Topeka Shiner depletion, which could lead to future successful watershed remediation projects.

**DEVELOPMENT OF A METHODOLOGY FOR DETERMINING OPTIMUM LOCATIONS FOR WILDLIFE CROSSINGS ON STATE HIGHWAYS USING A GEOGRAPHIC INFORMATION SYSTEMS APPROACH, WITH APPLICATION TO KEY DEER ON BIG PINE KEY, FLORIDA. (00742059)**

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Owen, Catherine.

*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville. FL.

*Investigator(s):* Grist, B.

*Status:* Active.

*Start date:* 16 May 1997; *Estimated completion date:* 15 Dec 1998.

The objective of the research is to develop a protocol for investigating wildlife corridors as related to highways and test this protocol on the Florida Key Deer.

**ECOLOGICAL EFFECTS OF L-31E FLOW REDISTRIBUTION. (ENV1238)**

*Project Monitor:* Jaffe, Rudolph.

*Performed by:* Southeast Environmental Research Program. Florida International University. Miami. FL.

*Investigator(s):* Ross, Mike, Meeder, Jack, Telesnicki, Guy, Ruiz, Pablo, Byrnes, Mike, Alvord, Jen, and Atlas, Zack.

*Start date:* 1 Aug 1993; *Estimated completion date:* 31 Oct 1998.

The objective of this pilot project is to determine the effects on water quality and other ecosystem characteristics when canal waters, which would otherwise flow directly into Biscayne Bay, are distributed into the coastal wetlands.

**ECOLOGY AND GENETICS OF AMBYSTOMA MACULATUM POPULATIONS ON THE PENN STATE BEHREND CAMPUS. (ENV1131)**

*Sponsored by:* Pennsylvania Department of Transportation; Pennsylvania State University at Behrend.

*Project Monitor:* Petit, Bill.

*Performed by:* Pennsylvania State University, Behrend Campus.

*Investigator(s):* Botts, Pamela.

*Status:* Active.

*Start date:* 8 Dec 1997; *Estimated completion date:* 7 Aug 1999.

The purpose of this research is designed to provide information to PennDOT regarding the best way to mitigate wetlands so as to maximize the continued success of large populations of amphibians currently using the Penn State Behrend wetlands as a breeding habitat. The college campus supports large, reproductively successful populations of a number of amphibians, but one species of particular concern is *Ambystoma maculatum*, the spotted salamander. Concern for this species is rooted in the fact that it migrates from forested upland habitat into vernal forested wetlands for reproduction during the early spring. Adults leave the wetlands quickly and newly metamorphosed juveniles leave by July to return to forested uplands. Therefore, both wetland destruction and mitigation on campus and alteration of the upland landscape affect the spotted salamander.

The research associated with this project is designed to 1) assess the existing genetic structure of populations of *Ambystoma maculatum* on the basis of mitochondrial DNA markers, 2) continue to build a solid, long-term data set consisting of demographic parameters (population size, age structure, reproductive success, and movement patterns of *Ambystoma maculatum* on the Behrend campus), and 3) determine how the salamanders utilize upland habitat during the non-breeding season.

#### **EFFECTIVENESS OF BIG GAME HIGHWAY CROSSING STRUCTURES.** (ENV1257)

*Sponsored by:* Utah Cooperative Fish and Wildlife Research Unit. Logan. UT.

*Project Monitor:* Bissonette, John A.

*Investigator(s):* Bissonette, John A.

*Status:* Active, *Contract No.:* UT102-98 .

*Start date:* 30 Sep 1997; *Estimated completion date:* 30 Mar 2000.

An estimated 538,000 deer were involved in collisions with vehicles in 1991 according to a nationwide survey. In Utah, an average of 3,115 mule deer are killed on highways annually. Auto insurance claims during 1992 averaged \$1,200 per accident; it is higher now. The Federal Highway Administration places a monetary loss of \$1.5 million on each human fatality. Approximately four people are killed in Utah each year in deer vehicle collisions. Two recent studies have addressed deer-highway mortality in Utah. One analyzed mortality rates along newly constructed roads and the second evaluated the effectiveness of across-the-road deer crosswalk structures. These structures reduced deer mortality about 40%. Because of safety issues, it was thought that underpasses with deer fencing provided the 100% solution to the problem. Recently, in northern Utah, we documented over 55 deer killed in the winter of 1996-97 in areas with fencing and underpasses. Certainty is elusive in field situations. The goal of this study is to compare the relative effectiveness of the crosswalks versus underpasses. We will attempt to establish what constitutes baseline mortality. We will also evaluate the effectiveness of earthen ramps that allow deer to escape from the road right-of-way.

Because crosswalk structures are much less costly (\$25,000-30,000) versus \$750,000+ for constructing underpasses, our purpose is to establish what baseline mortality is under the two scenarios and to compare the relative effectiveness of each in an economic sense, as well as their contribution to reducing deer mortality.

**EVALUATION OF DEER GUARDS FOR KEY DEER, BIG PINE KEY.** (ENV1189)

*Sponsored by:* Florida Department of Transportation.

*Project Monitor:* Owen, Catherine.

*Performed by:* Texas A&M Research Foundation.

*Investigator(s):* Silvy, Nova.

*Status:* Active, *Contract No.:* BB-851.

*Start date:* 6 Oct 1998; *Estimated completion date:* 15 Jan 2000.

This research project will focus on the design of various deer guards and then will test their effectiveness in preventing or deterring Key Deer from crossing US 1.

**FERRY TERMINAL NEARSHORE IMPACT.** (ENV1092)

*Sponsored by:* Washington State Department of Transportation.

*Project Monitor:* Wagner, Paul.

*Performed by:* University of Washington.

*Investigator(s):* Simenstad, Charles.

*Status:* Active.

*Start date:* 1 Jan 1998; *Estimated completion date:* 1 Feb 1999.

Resource agencies and others assume that the presence of ferry docks has a negative impact on desirable fish species and aquatic resources, and require time consuming and expensive mitigation. A study is needed to analyze conditions at several ferry terminal and characterize their ecological impact on the surrounding areas, both positive and negative; if impacts can be verified, appropriate mitigation measures can then be developed.

**IMPACTS OF ROADS ON THE SUSTAINABILITY OF NORTHERN FOREST LANDS.**  
(CRIS 0175733)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service. Vermont.

*Performed by:* University of Vermont. Botany Department. Burlington. VT.

*Investigator(s):* Hughes, J. W.

*Status:* Active, *Contract No.:* VT-BO-00570.

*Start date:* 1 Oct 1997; *Estimated completion date:* 30 Sep 2000.

*Notes:* Abstract provided by permission of the U.S. Geological Survey  
(<http://cristel.nal.usda.gov:8080/star/brd.html>).

An independent body (the Northern Forest Lands Council) of leaders from environmental non-profits, special interest groups, academia, and governmental agencies reached consensus in setting a goal of economic and ecological sustainability for the 26 million acres of Northern Forest Lands that span northern New England and New York. The region's forest-based economy is mainly driven by forest products, but recreation use is also important, especially in Vermont. As much as 20% of the region's land area is in roads. We are evaluating the ecological effects of these roads on the surrounding Vermont forest by quantifying changes in species composition, growth, and diversity at increasing distances from the three types of roads that predominate. We also are quantifying changes in wildlife browse and soils at different distances to determine how far into the surrounding forest the effects of roads extend.

The purpose of our study is to evaluate the effects of three different types of roads on the surrounding spruce-fir, Northern Forest ecosystem, and to determine how far into the forest the ecological effects of roads extend. We are focusing our study on this forest type because of its economic importance in northern Vermont. In addition to quantifying road coverage in Vermont's Northern Forest, we also shall compare (1) species composition, regeneration, species browse by white-tailed deer and moose in roadside and interior forest; and (3) selected soil properties (pH,



bulk density, organic content, calcium) along five replicate stretches of road, of each road type, that pass through intact, mature red spruce-balsam fir forest. Data will be collected in three randomly placed sets of study plots (each 4 x 20m, with the longer axis parallel to the road), established at distances of 100m, 50m, 25m, 10m, 5m, and 0m from the edge of the road along each of the stretches of road. Differences related to distance from road, and comparisons of best-fit slopes of the data (to evaluate if distance-related trends are similar for different variables), will be determined using analysis of covariance.

**IMPROVING TRAFFIC SAFETY AND RESOURCE PROTECTION (AKA HABITAT CONNECTIVITY ANALYSIS). (ENV1091)**

*Sponsored by:* Washington State Department of Transportation.

*Project Monitor:* Carey, Marion.

*Performed by:* U.S. Forest Service.

*Investigator(s):* Lemkuhl, John.

*Status:* Active.

*Start date:* 1 Feb 1998; *Estimated completion date:* 1 Dec 1999.

Collisions with large animals, such as deer and elk, are one of the biggest safety issues faced by WSDOT today. More than 3,000 collisions with deer were reported on WSDOT facilities in 1994, with an estimated cost of from \$6 to \$12 million in damages. This study, in partnership with the U.S. Forest Service, will produce a methodology to characterize improved crossings and to correct current problems in the I-90 Snoqualmie Pass corridor.

**KENT COUNTY DEER-VEHICLE ACCIDENT REDUCTION STUDY: ADDRESSING DEER-VEHICLE ACCIDENTS WITH AN ECOLOGICAL LANDSCAPE GIS APPROACH. (ENV1045)**

*Sponsored by:* Michigan Office of Highway Safety Planning; U.S. Department of Transportation, Federal Highway Administration.

*Performed by:* White Water Associates, Inc.; Kent County Road Commission.

*Investigator(s):* Hindelang, Mary, Premo, Dean B., and Byle, Tom.

*Status:* Active, *Contract No.:* RS-97-08.

*Start date:* 1 Jul 1997; *Estimated completion date:* 1 Oct 1998.

Deer-vehicle crashes in 1996 numbered over 68,000, showing an annual increase each of the past several years, according to Michigan State Police Crash Statistics. Kent County has had a consistently higher number of deer accidents than any other county in Michigan, with 2,223 in 1996. In order to ameliorate this growing problem, the Kent County Deer-Vehicle Accident Reduction Study was undertaken (Hindelang and Premo 1997). This study represents action toward implementing recommendations delineated by a report prepared for Michigan Department of Transportation, Investigating Methods to Reduce Deer-Vehicle Accidents in Michigan (Premo and Premo 1995).

Our study is taking an ecological landscape perspective of the interface of human population density and activity with deer population density and activity. Using information gathered from the Kent County Road Commission, Michigan Department of State Police Office of Highway Safety Planning, Grand Valley State University Water Resources Institute, Michigan Department of Natural Resources, and the current literature, we have the capability of identifying temporal and spatial patterns of deer-vehicle collisions at the landscape level in Kent County. These data will enable us to create predictive models of high risk areas for deer-vehicle collisions and identify areas of focus where accidents could be significantly reduced. Specific locations of deer-vehicle collisions have been incorporated as a thematic layer into an ArcView™ software based

geographic information system (GIS).

Designing successful accident reduction techniques requires understanding deer and human movement patterns and behaviors. Our efforts will more closely examine deer behavior and habitat use in areas of high deer-vehicle collisions interfaced with examination of changes in human population density and road use. Analysis of land use/land cover, topography, vegetation, roadways, waterways, and recent development will illuminate site specific characteristics for which particular mitigative techniques or combinations of techniques are appropriate. Interactions between people and white-tailed deer are increasing in Kent County as populations of both deer and humans are on the rise. As humans move into historic deer habitat and deer invade human-dominated landscapes, conflicts are more likely to occur. Using the information gathered from the analysis and synthesis of data, high risk locations will be identified for intensive public awareness efforts to reduce accidents.

**LOW LIGHT IMPEDIMENT TO FISH MIGRATION WITH PARTICULAR EMPHASIS ON RIVER HERRING.** (ENV1038)

*Sponsored by:* North Carolina Department of Transportation.

*Performed by:* University of North Carolina at Wilmington. Department of Biology. Wilmington. NC.

*Investigator(s):* Moser, Mary.

*Status:* Active, *Contract No.:* Project No. Hwy-98-3.

*Start date:* 1 Jul 1997; *Estimated completion date:* 30 Sep 1999.

No summary provided.

**LTREB: LONG-TERM STUDIES OF POPULATION AND COMMUNITY ECOLOGY IN AN EXPERIMENTALLY FRAGMENTED LANDSCAPE.** (Fed 00165929)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington. DC.

*Project Monitor:* Collins, Scott.

*Performed by:* University of Kansas. Department of Systematics and Ecology. Lawrence. KS.

*Investigator(s):* Holt, Robert D., Price, Kevin P., Rich, Paul M., Pierotti, Raymond J., and Debinski, Diane M.

*Status:* Active, *Contract No.:* 9308065.

*Start date:* 1 Sep 1993; *Estimated completion date:* 28 Feb 1999.

A long-term experiment on habitat fragmentation is underway in the prairie-forest ecotone in eastern Kansas. An archipelago of patches, representing different levels of fragmentation, was arrayed within a period of six years. During the first six years of the study, fragmentation influenced consumer population dynamics and the local persistence of herbaceous plant species with clonal life cycles but did not affect measures of local species richness or the overall rates of succession. It is expected that during the next five, substantial effects of fragmentation upon successional dynamics should begin to appear, because: (1) there is a transition underway from species present in the original seed pool to species colonizing from external source pools, particularly trees and shrubs, and (2) the stature of the dominant plants is increasing, thereby enhancing microenvironmental differences between patch interiors and the surrounding interstitial habitats, and hence edge effects. It is also expected that small mammals may be dominant driving factors in woody species establishment, and so fragmentation effects observed in plant succession may be indirect manifestations of fragmentation effects on the small mammal community.

**SEASONAL MOVEMENT EVALUATION OF COHO SALMON PARR IN STREAMS OF NORTHERN CALIFORNIA.** (CRIS 0178664)

*Sponsored by:* U.S. Department of Agriculture. Cooperative State Research Service. California Forestry Station.

*Performed by:* Humboldt State University. Fisheries Department. Arcata. CA.

*Investigator(s):* Roelofs, T. D.

*Status:* Active, *Contract No.:* CALZ-00-125.

*Start date:* 15 Jul 1998; *Estimated completion date:* 10 Jun 2002.

*Notes:* Abstract provided by permission of the U.S. Geological Survey (<http://cristel.nal.usda.gov:8080/star/brd.html>).

Objectives of this project are: 1) to determine whether juvenile Coho make upstream movements during the Fall season; 2) to evaluate whether the presence/absence of either coast range or prickly sculpins above culverts might be an indicator of barriers to juvenile Coho; and 3) to field test the "FishXing" software.

Seasonal movements of Coho salmon parr will be monitored through a combination of direct observation, fish trapping, mark-recapture sampling and backpack electrofishing. Monitoring will occur in streams with and without culverts for comparison purposes. Direct observation will be carried out by mask and snorkel surveys. Trapping will be done on fish moving both down- and upstream following the Washington Department of Fish and Wildlife protocol. Mark-recapture sampling will be used to monitor fish movement and to estimate trapping efficiencies. Electrofishing will be conducted to determine distribution of Coho and non-salmonid species, estimation of direct observation efficiency and aid in mark-recapture sampling.

**SPATIAL MODELING OF FOREST ECOSYSTEM LANDSCAPES AND BIRD SPECIES DIVERSITY.** (Fed 00166568)

*Sponsored by:* National Science Foundation. Division of Environmental Biology. Washington. DC.

*Project Monitor:* Martin, Joel W.

*Performed by:* University of Minnesota. Twin Cities Department of Fisheries and Wildlife. St. Paul. MN.

*Investigator(s):* Cohen, Yosef, Niemi, Gerald J., and Pastor, John J.

*Status:* Active, *Contract No.:* 9317971.

*Start date:* 1 May 1994; *Estimated completion date:* 31 Oct 1998.

Current scientific and resource policy problems revolve around the spatial dynamics of ecosystems and landscapes. For example, global climate change will not be equal everywhere, and the responses of ecosystems to it depend on their distribution relative important spatial components, including seed dispersal, which determines migration of plant species across the landscape, and habitat structure for birds, which disperse those seeds. Until recently, computational tools for analyzing spatial dynamics have been lacking. Recent developments in supercomputers and video display technology make the interfacing of population, ecosystem, and landscape models feasible, thus providing solutions to large-scale ecological problems. We propose to incorporate mechanisms of seed dispersal and bird habitat suitability into an existing forest ecosystem model, develop visualization techniques for two- and three-dimensional display of simulated landscapes, and further develop mathematical techniques for analyzing model output. This work takes advantage of the new power in supercomputing and will develop tools for use on parallel architectures. Software will be made available through Internet, workshops, etc.

**A STUDY OF OCELOT AND BOBCAT POPULATIONS IN THE US 281 LIVE OAK COUNTY PROJECT SITE AND THEIR PREFERENCE FOR HIGHWAY CROSSINGS. (ENV1175)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Potter, D.

*Investigator(s):* Hewitt, D.

*Status:* Active, *Contract No.:* 7-3927.

*Start date:* 5 Mar 1997; *Estimated completion date:* 31 Aug 1999.

No summary provided.

**TEXAS FIRE ANT RESEARCH AND TREATMENT PROGRAM. (ENV1172)**

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Northcut, P. E.

*Investigator(s):* Frisbie, R.

*Status:* Active, *Contract No.:* 7-3932.

*Start date:* 15 Nov 1996; *Estimated completion date:* 31 Aug 1999.

No summary provided.

**WILDLIFE CONTROL ALONG THE HIGHWAY. (00755247)**

*Sponsored by:* Alberta Transportation and Utilities. Technical Standards Branch. Edmonton. Canada.

*Performed by:* Alberta Transportation and Utilities. Technical Standards Branch. Edmonton. Canada.

*Investigator(s):* Lo, A.

*Status:* Active.

*Start date:* 1993; *Estimated completion date:* 1998.

As a continuation project on wildlife controls, a consultant has been contracted to research possible deterrents to help keep animals from licking salt along the highways. A successful pilot was carried out on some caribou at the Calgary zoo. The consultant's report on the findings is available. A wider scope involving many more captive animals at several locations will be started later in 1997. Depending on budgets and timing, there is an opportunity to join up with Parks Canada to perform an actual on-road evaluation of the deterrents. Parks staff will be able to monitor animal activities and behavior during the 1997/98 winter.

## Appendix A - Completed Research

### **AESTHETIC AND EFFICIENT NEW SUBSTRUCTURES DESIGN FOR STANDARD BRIDGE SYSTEM.** (00673595)

*Sponsored by:* Texas Department of Transportation. Austin. TX.

*Project Monitor:* Vanlanduyt, Dean.

*Performed by:* University of Texas. Transportation Research Center. Austin, TX.

*Investigator(s):* Breen, John.

*Status:* Complete.

*Start date:* 1 Sep 1993; *Estimated completion date:* 31 Aug 1997.

*Publication(s):* Final report is under review.

### **ALTERNATIVES TO SILT FENCE FOR STORMWATER MANAGEMENT.** (SWUTC 417377)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Swonke, Carlos.

*Performed by:* Texas A&M University.

*Investigator(s):* Landphair, Harlow C.

*Status:* Complete.

*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1997.

*Publication(s):* Landphair, H. C.; McFalls, J. A.; Peterson, B. E.; Li, M. H. (Texas Transportation Inst., College Station, TX) *Alternatives to Silt Fence for Temporary Sediment Control at Highway Construction Sites - Guidelines for TxDOT.* Report No. FHWA/TX98/1737-5 (Oct. 1997). NTIS Order Number: PB98-153257INZ.

### **AQUATIC TOXICITY OF RECYCLED ASPHALT CONCRETE, POROUS PAVEMENT AND ASPHALT COATED CULVERTS.** (00640250)

*Sponsored by:* California Department of Transportation. Sacramento. CA.

*Project Monitor:* Hunt, Harold.

*Performed by:* California Department of Transportation. Sacramento. CA.

*Investigator(s):* Cooper.

*Status:* Complete.

*Start date:* 1 Feb 1994; *Estimated completion date:* 31 Dec 1997.

*Publication(s):* Final report is in preparation.

### **BEST MANAGEMENT PRACTICES FOR HIGHWAY STORM WATER RUNOFF.** (00640643)

*Sponsored by:* Washington State Department of Transportation. Olympia. WA.

*Project Monitor:* Lemke, A.

*Performed by:* Washington State University. Pullman. Department of Agricultural Economics. Pullman. WA.

*Investigator(s):* Hathway.

*Status:* Complete.

*Start date:* 1 Jul 1993; *Estimated completion date:* 30 Jun 1995.

*Publication(s):* Hathhorn, Wade E. and David R. Yonge. January 1996. *The Assessment of Groundwater Pollution Potential Resulting from Stormwater Infiltration BMPs* (Technical and Final). Report nos.: Technical report--WA-RD 389.2 and Final report--WA-RD 389.1. 57 pgs (Technical) and 181 pgs (Final).

**BRIDGING THE GAP BETWEEN TRANSPORTATION AND AIR QUALITY MODELING: DEVELOPMENT OF EMISSION INVENTORY TOOLS AND IMPACT ANALYSIS.** (ENV1026)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Performed by:* University of North Carolina at Chapel Hill. Department of Environmental Sciences and Engineering. Chapel Hill. NC.

*Investigator(s):* Jeffries, Harvey E., Amaral, Deborah, and Keating, Terry.

*Status:* Complete.

*Start date:* 1 May 1994; *Estimated completion date:* 31 Aug 1997.

*Publication(s):* Final report in progress

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**BROKEN BACK CULVERTS.** (ENV1146)

*Sponsored by:* Nebraska Department of Roads.

*Project Monitor:* Donahoo, Kevin.

*Performed by:* University of Nebraska.

*Investigator(s):* Hotchkiss, Rollin.

*Status:* Complete, *Contract No.:* SPR-PL-1(36) P498.

*Start date:* 9 Nov 1995; *Estimated completion date:* 28 Feb 1998.

*Publication(s):* Hotchkiss, Rollin. January 1998. *Broken Back Culverts.* Nebraska Department of Roads. 81 p.

**CHARACTERIZATION OF ROADWAY RUNOFF PRIOR TO TREATMENT.** (ENV1141)

*Sponsored by:* Rhode Island Department of Transportation.

*Performed by:* University of Rhode Island. Civil & Engineering Department. Kingston. RI.

*Investigator(s):* Thiem, Leon T.

*Status:* Complete, *Contract No.:* SPR-223-2223.

*Start date:* *Estimated completion date:* Jul 1998.

*Publication(s):* Thiem, Leon T., Eid A. Alkhatib, Sampath K. Bade and Arvind Panganamamula. *Characterization of Roadway Runoff Prior to Treatment.* Rhode Island Department of Transportation. July 1998. Report no. FHWA-RI-RD-98-01. 108 p.

**COLD-IN-PLACE RECYCLING USING CALCIUM CHLORIDE.** (00645261)

*Sponsored by:* Maine Department of Transportation; Federal Highway Administration. Washington. DC.

*Project Monitor:* Peabody, Dale.

*Performed by:* Maine Department of Transportation. Materials and Research Division. Bangor. ME.

*Investigator(s):* Colson, Steve.

*Status:* Complete, *Contract No.:* 93-01.

*Start date:* 1 Jun 1993; *Estimated completion date:* 1 Jun 1998.

*Publication(s):* Colson, Stephen W. *Cold In-Place Recycling Using Calcium Chloride.* 1998. Maine Department of Transportation. Experimental Construction 93-01.

**A COMPARISON OF NEW FREEWAY TRUCK-ONLY LANES, HOV LANES, AND HOT (HOV PLUS TOLLED SOV) LANES IN THE SACRAMENTO REGION.**

(ENV1082)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley, CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Davis.

*Investigator(s):* Johnston, Robert A.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**CONCEPTUAL FEASIBILITY STUDY FOR CENTRALIZED TREATMENT OF PETROLEUM CONTAMINATED SOIL.** (ENV1031)

*Sponsored by:* New Jersey Department of Transportation. Bureau of Project Support and Engineering; Bureau of Environmental Services. Trenton, NJ.

*Project Monitor:* Marsella, Mark.

*Performed by:* New Jersey Institute of Technology. Hazardous Substance Management Research Center. Newark, NJ.

*Investigator(s):* Librizzi, William.

*Status:* Complete, *Contract No.:* Project No. 7060.

*Start date:* 1 May 1997; *Estimated completion date:* Jan 1999.

*Publication(s):* Interim report: Librizzi, William and Thomas Boland. 1997. *Conceptual Feasibility Study for Centralized Treatment of Petroleum Contaminated Soils.* Report no. FHWA/NJ-97-007-7060. 20 p.

Final report is being printed.

**CONSTRUCTED WETLANDS/STORMWATER MANAGEMENT.** (00681418)

*Sponsored by:* Virginia Department of Transportation.

*Project Monitor:* Fitch, M.

*Performed by:* Virginia Transportation Research Council. Charlottesville. VA.

*Status:* Complete.

*Start date:* 15 Dec 1994; *Estimated completion date:* 15 Dec 1996.

*Publication(s):* Yu, Shaw L. G. M. Fitch, and T. A. Earles (G. M. Fitch, Editor). Virginia Transportation Research Council. *Constructed wetlands for stormwater management.* Final report. Report No. VTRC 98-R35; Project 1459-030. (1998).

**COST ANALYSIS AND SERVICE STATION PLANNING FOR ALTERNATIVELY FUELED VEHICLE USE IN KANSAS CITY AREA AND WITCHITA, KS.** (ENV1065)

*Sponsored by:* Mid-America Transportation Center. University of Nebraska-Lincoln.

*Project Monitor:* Gnirk, Barbara.

*Performed by:* University of Kansas.

*Investigator(s):* Suppes, G. J.

*Status:* Complete, *Contract No.:* MATC/KU97-1.

*Start date:* 1 Oct 1996; *Estimated completion date:* 30 Sep 1997.

*Publication(s):* Final report in preparation

**COST ANALYSIS AND SERVICE STATION PLANNING FOR FLEXIBLE FUEL VEHICLE USE IN KANSAS CITY AND WICHITA.** (00731066)

*Sponsored by:* Kansas Department of Transportation. Topeka. KS.

*Project Monitor:* Cunningham, T.

*Performed by:* University of Kansas. Department of Civil Engineering. Lawrence. KS.

*Investigator(s):* Suppes.

*Status:* Complete, *Contract No.:* RE-0113-01.

*Start date:* *Estimated completion date:* unknown.

*Publication(s):* Final report is in preparation. (Report number KU-97-7.)

**A DECISION SUPPORT SYSTEM FOR HIGHWAY CONSTRUCTION CONSIDERING ENVIRONMENTAL IMPACTS.** (ENV1027)

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Performed by:* North Carolina State University. Department of Civil Engineering. Raleigh. NC.

*Investigator(s):* Roushail, Nagui.

*Status:* Complete.

*Start date:* 1 Aug 1995; *Estimated completion date:* 31 Dec 1997.

*Publication(s):* El Dessouki, W., Roushail, N., Ranjithan, R., and M. Beja. "Multiperiod Highway Improvement Scheduling: Model Development and Application." Transportation Research Board (in preparation). Washington, D.C.: Transportation Research Board, National Academy of Sciences. 1998.

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**DESIGN AND EVALUATION OF COLD-MIX RECYCLED PAVEMENTS.** (00665552)

*Sponsored by:* North Carolina Department of Transportation. Division of Highways. Raleigh. NC.

*Project Monitor:* Strong, P.

*Performed by:* North Carolina State University. Department of Civil Engineering. Raleigh. NC.

*Investigator(s):* Khosla, Paul.

*Status:* Complete.

*Start date:* 1 Jul 1994; *Estimated completion date:* 30 Jun 1996.

*Publication(s):* Khosla, N. Paul and M.E. Bienvenu. September 1996. *Design and Evaluation of Cold In-Place Recycled Pavements.* North Carolina Department of Transportation. 104 p. Report No. FHWA/NC/97-006.

*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email [teris@ncsu.edu](mailto:teris@ncsu.edu) or call 919-515-8587 or 919-515-8581.

**DESIGN AND PERFORMANCE OF DRY DETENTION POND AND UNDERDRAIN SYSTEMS.** (00744189)

*Sponsored by:* Florida Department of Transportation.

*Performed by:* University of Central Florida. Orlando. FL.

*Investigator(s):* Nnadi, F.

*Status:* Complete, *Contract No.:* B-A514.

*Publication(s):* Nnadi, F.N.; Ashe, K. W. and Sharek, R.C. (University of Central Florida, Department of Civil and Environmental Engineering, P.O. Box 162450, Orlando, FL, 32816-2450) *Design and Performance of Dry Detention Ponds with Underdrain Systems*, Report No.



WPI 0510791; State Job 99700-3358-010. (1997) 272 p. (TRIS No. 00746738; National Technical Information Service (PB98-110430)

**DESIGNING TRANSPORTATION PROJECTS FOR THE ENVIRONMENT:  
CAPSTONE PROJECTS FOR CIVIL ENGINEERING STUDENTS. (00716748)**

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* North Carolina State University. Department of Civil Engineering. Raleigh. NC.

*Investigator(s):* Stone, J. R.

*Status:* Complete.

*Start date:* May 1995; *Estimated completion date:* unknown.

*Publication(s):* Stone, J.R. CE 400 - Transportation Engineering Projects: Sketch Environmental Analysis and Highway Design for the Proposed Duraleigh Road Connector. Workbook for Civil Engineering Students. CTE, North Carolina State University. 1997

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**DEVELOP A HYDRIC SOIL STANDARD. (ENV1102)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* Louisiana State University.

*Investigator(s):* Faulkner, Stephen and Pringle, Russell.

*Status:* Complete.

*Publication(s):* Final report in progress

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

**DEVELOP MONITORING PROTOCOLS AND REPORT ON WETLAND  
MANAGEMENT RECOMMENDATIONS FROM MISSOURI RIVER STUDY.  
(ENV1109)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Teels, Billy.

*Status:* Complete.

*Start date:* FY98.

*Publication(s):* Final report in progress

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

**DEVELOP MONITORING PROTOCOLS AND WETLAND HEALTH INDICATORS FOR MID-ATLANTIC WETLANDS WITH CHESAPEAKE BAY PARTNERS.**

(ENV1112)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Teels, Billy.

*Status:* Complete.

*Start date:* FY98.

*Publication(s):* Report in progress

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

**DEVELOPMENT OF DEMONSTRATION PROJECTS WITH SCRAP TIRE RUBBER IN HIGHWAY PAVEMENTS WITHIN THE STATE OF MARYLAND. (00636947)**

*Sponsored by:* Maryland Department of Transportation. State Highway Administration. Baltimore. MD.

*Project Monitor:* Witczak, M. W.

*Performed by:* Maryland University-College Park. Department of Civil Engineering. College Park. MD.

*Status:* Complete.

*Start date:* 16 Oct 1992; *Estimated completion date:* 15 Apr 1995.

*Publication(s):* Final report is in preparation.

**DEVELOPMENT OF EFFECTIVE MITIGATION TECHNIQUES FOR NORTHERN AND CENTRAL VALLEY VERNAL POOLS. (00640217)**

*Sponsored by:* California Department of Transportation. Sacramento. CA.

*Project Monitor:* Hunt.

*Performed by:* California State University-Long Beach. Long Beach. CA.

*Investigator(s):* Northen, Philip.

*Status:* Complete.

*Start date:* 21 Aug 1992; *Estimated completion date :* 30 Dec 1997.

*Publication(s):* Northen, Philip; Susan Holve-Hensill; Doug Eakins. *Techniques for Mitigating Loss of Vernal Pools and Experimental Approach.* California Department of Transportation. April 15, 1998. Report no. FHWA/CA/TL-98-10. 264 pp.

**ECONOMIC ANALYSIS OF AND INSTITUTIONAL MECHANISMS FOR WETLANDS MITIGATION AND BANKING IN NORTH CAROLINA. (ENV1020)**

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor:* Martin, James.

*Performed by:* North Carolina State University. Department of Forestry. Raleigh. NC.

*Investigator(s):* Cubbage, Frederick and Abt, Robert.

*Status:* Complete.

*Start date:* 1 Apr 1996; *Estimated completion date:* 31 Mar 1998.

*Publication(s):* Cubbage, Frederick W. and Deborah A. Gaddis. Economic Analyses of and

Institutional Mechanisms for Wetlands Mitigation and Banking in North Carolina. Final Report Summary. CTE, North Carolina State University. June 1998. 6 pp.

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**ENERGY AND AIR QUALITY BENEFITS OF FREEWAY BOTTLENECK IMPROVEMENTS.** (SWUTC 460039 60039)

*Sponsored by:* Office of the Governor of Texas.

*Project Monitor:* Turnbull, Katherine F.

*Performed by:* Texas A&M University.

*Investigator(s):* Walters, Carol H.

*Status:* Complete, *Contract No.:* none.

*Start date:* 1 Aug 1992; *Estimated completion date:* 31 Aug 1997.

*Publication(s):* Walters, Carol H.; Middleton, Mark D.; and Wiles, Poonam B. Energy and Air Quality Benefits of Freeway Bottleneck Improvements. Texas A&M University. Research Report SWUTC/96/60039-1. August 1996

**ESTIMATING PM EMISSIONS FROM IN-USE HEAVY-DUTY DIESEL VEHICLES.** (ENV1075)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley, CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Davis.

*Investigator(s):* Chang, D. P. Y.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**EVALUATE WETLAND MITIGATION IN CEDAR RUN WATERSHED, VIRGINIA.** (ENV1116)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s):* Teels, Billy.

*Status:* Complete.

*Start date:* FY98; *Estimated completion date:* FY99.

*Publication(s):* Final report in progress

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

**EVALUATE WETLAND RESTORATION ON A LANDSCAPE BASIS.** (ENV1118)

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Investigator(s)*: Whited, Michael.

*Status*: Complete.

*Start date*: FY98.

*Publication(s)*: Final report in progress

*Notes*: Source of information: Wetland Science Institute web page,  
<http://159.189.24.10/wetsci.htm>

**EVALUATION OF FISH PASSAGE STRUCTURES. (00722892)**

*Sponsored by*: Alaska Department of Transportation and Public Facilities. Juneau. AK.

*Project Monitor*: Reckard, M.

*Performed by*: Alaska Department of Transportation and Public Facilities. Juneau. AK;  
University of Alaska, Fairbanks.

*Investigator(s)*: Miles, M. and Kane, Douglas.

*Status*: Complete.

*Start date*: Feb 1995; *Estimated completion date*: Dec 1996.

*Publication(s)*: Kane, Douglas L. and Charles E. Behlke. (Water and Environmental Research Center. Institute of Northern Engineering. University of Alaska Fairbanks. Fairbanks, AK 99775-5900) Field evaluation of engineered culverts, Final report. Report No. INE/TRC 97.02. (1998). "Prepared For: State of Alaska, Department of Transportation and Public Facilities."

**EVALUATION OF RECYCLED ASPHALT PAVING MATERIAL AND VOLUMETRIC MIXES, REQUIRED PROCESS CONTROL AND LONG TERM PERFORMANCE.**

(SWUTC 405621-00001)

*Sponsored by*: Florida Department of Transportation; Florida Concrete and Products Association.

*Performed by*: Texas A&M University.

*Investigator(s)*: Little, Dallas N.

*Status*: Complete.

*Start date*: 1 Jan 1996; *Estimated completion date*: 1 Jun 1998.

*Publication(s)*: Final report in progress

**EVALUATION OF RECYCLED MATERIALS FOR ROADSIDE SAFETY DEVICES.**

(Fed 00164182)

*Sponsored by*: Federal Highway Administration. Turner-Fairbank Highway Research Center. McLean. VA.

*Project Monitor*: McDevitt, C.

*Performed by*: Southwest Research Institute. San Antonio. TX.

*Investigator(s)*: Strybos, John W.

*Status*: Complete, *Contract No.*: DTFH61-93-C-00017.

*Start date*: 1 Feb 1993; *Estimated completion date*: 31 May 1998.

*Publication(s)*: Strybos, John W. 1998. Evaluation of Recycled Materials for Roadside Safety Devices. FHWA Report #FHWA-RD-98-083.

**EVALUATION OF RECYCLED PROJECTS FOR PERFORMANCE. (00677217)**

*Sponsored by*: Louisiana Department of Transportation & Development. Baton Rouge. LA.

*Project Monitor*: Paul, H.

*Performed by*: Louisiana Transportation Research Center. Baton Rouge. LA.

*Status:* Complete.

*Start date:* 1 Sep 1982; *Estimated completion date:* 30 Oct 1994.

*Publication(s):* Paul, Harold R. 1995. *Evaluation of Recycled Projects for Performance*. Louisiana Transportation Research Center. 63 p. Report No. FHWA/LA-95-216.

*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

**AN EVALUATION OF THE IMPACT OF TEXAS' MANDATED ALTERNATIVE FUEL REQUIREMENTS.** (SWUTC 460054 60054)

*Sponsored by:* Subcontract with Texas Southern University. Office of the Governor of Texas.

*Project Monitor:* Veasey, Renee.

*Performed by:* Texas Southern University.

*Investigator(s):* Godazi, Khosro.

*Status:* Complete.

*Start date:* 28 May 1993; *Estimated completion date:* 31 Aug 1997.

**EXAMINATION OF THE LIFECYCLE OF VANPOOLS AND CARPOOLS AND THE IMPACT OF RIDESHARING PROGRAMS.** (SWUTC 466000)

*Sponsored by:* Subcontract with Texas Southern University. Office of the Governor of Texas.

*Project Monitor:* Otto, Robert.

*Performed by:* Texas Southern University.

*Investigator(s):* Godazi, Khosro.

*Status:* Complete.

*Start date:* 1 Sep 1993; *Estimated completion date:* 31 Aug 1997.

**FEASIBILITY OF USING COMPOSITE MATERIALS IN THE CONSTRUCTION.** (Fed 00164064)

*Sponsored by:* Federal Highway Administration. Turner-Fairbank Highway Research Center. McLean. VA.

*Project Monitor:* McDevitt, C.

*Performed by:* U.S. Army Corps of Engineers. Hanover. NH.

*Investigator(s):* Dutta, Piyush K.

*Status:* Complete, *Contract No.:* DTFH61-90-Y-00035.

*Start date:* 8 Mar 1990; *Estimated completion date:* 28 Feb 1998.

*Publication(s):* Dutta, Piyush K. 1998. *Investigation of Plastic Composite Materials for Roadside Safety Devices*. FHWA Report #FHWA-RD-98-060.

**FEASIBILITY STUDY OF A LOW-COST CRASH CUSHION SYSTEM USING AUTO TIRES.** (00714257)

*Sponsored by:* Kansas Department of Transportation. Topeka. KS.

*Project Monitor:* Seitz, R. J.

*Performed by:* Kansas State University. Department of Civil Engineering. Manhattan. KS.

*Investigator(s):* Hossain, M.

*Status:* Complete, *Contract No.:* KU-96-8.

*Start date:* 1 Oct 1995; *Estimated completion date:* 30 Sep 1998.

*Publication(s):* Final report under review.

**GROUNDWATER CONTAMINATION BY FOUNDRY SAND. (00680033)**

*Sponsored by:* Wisconsin Department of Transportation. Division of Highways, Research Division. Madison. WI.

*Project Monitor:* Rutkowski, T.

*Performed by:* Wisconsin Department of Transportation. Natural Resources Division. Madison. WI.

*Status:* Terminated.

*Start date:* 6 Oct 1983; *Estimated completion date:* unknown.

**HERBICIDE, MOWING AND SEEDINGS TO REDUCE FUTURE ROADSIDE MAINTENANCE. (00644867)**

*Sponsored by:* Colorado Department of Transportation.

*Project Monitor:* Hunt, T.

*Performed by:* Colorado Department of Transportation. Denver. CO.

*Investigator(s):* Meiring, K. and Banovich, M.

*Status:* Complete.

*Start date:* 15 Sep 1993; *Estimated completion date:* Apr 1998.

*Publication(s):* No final report will be issued.

**HYDRAULIC PERFORMANCE OF DRAINAGE STRUCTURES: PHASE I AND II. (00744188)**

*Sponsored by:* Florida Department of Transportation.

*Performed by:* University of South Florida. Tampa. FL.

*Investigator(s):* Kranc, S.

*Status:* Complete, *Contract No.:* B-A034.

*Publication(s):* Kranc, S. C.; Romano, F.; Droz, E.; Deavers, R.; Wilmot, J.; Ethier, S.; Rabens, G. (University of South Florida, Department of Civil and Environmental Engineering, Tampa, FL) *Hydraulic Performance of Structures for Bridge Drainage*, Report No. WPI 0510747. (1997) 37 p. (TRIS No. 00746711, National Technical Information Service Order No. PB97-188684).

**HYDROLOGIC AND HYDRAULIC DESIGN OF CULVERTS. (00711861)**

*Sponsored by:* Nebraska Department of Roads. Lincoln. NE.

*Project Monitor:* Watson, T.

*Performed by:* University of Nebraska, Lincoln. College of Engineering and Technology. Lincoln. NE.

*Investigator(s):* Hotchkiss, R.

*Status :* Complete.

*Start date:* 10 May 1991; *Estimated completion date:* 31 Dec 1997.

*Publication(s):* 1. Riley, Tom. February 1988. Hydrologic and Hydraulic Design of Culverts. Nebraska Department of Roads.

2. McCullam, Brian and Roland Hotchkiss. November 1992. Hydrologic and Hydraulic Design of Culverts II. Nebraska Department of Roads.

3. Cordes, Kent and Roland Hotchkiss. December 1993. Design Discharge of Culverts. Nebraska Department of Roads.

*Notes:* Three reports were published in conjunction with the formal research project. An additional five years of monitoring has recently been completed, and a report is in preparation.

**IN-STREAM EFFECTS OF STREAMSIDE UNPAVED ROAD IMPROVEMENTS.**

(ENV1083)

*Sponsored by:* Pennsylvania State University; U.S. Department of Transportation.*Performed by:* Pennsylvania State University.*Investigator(s):* Arnold, D.*Status:* Complete.*Start date:* 14 Jun 1994; *Estimated completion date:* 30 Jun 1996.*Publication(s):* Final report in progress.**INLET GRATE CAPACITIES. (ENV1067)***Sponsored by:* Mid-America Transportation Center. University of Nebraska-Lincoln.*Project Monitor:* Gnirk, Barbara.*Performed by:* University of Missouri-Rolla.*Investigator(s):* Morris, C. D.*Status:* Complete, *Contract No.:* MATC/UMR96-3.*Start date:* 1 Oct 1995; *Estimated completion date:* 15 Jan 1998.*Publication(s):* Final report in preparation**INVESTIGATION OF CLIVUS MULTRUM DIGESTER SYSTEM. (00731871)***Sponsored by:* New Mexico State Highway & Transportation Department. Albuquerque. NM; Federal Highway Administration. Washington. DC.*Project Monitor:* Barringer, W. L.*Performed by:* New Mexico State University-Las Cruces. Waste-Management Education & Research Consortium. Las Cruces. NM.*Investigator(s):* Ghassemi, A.*Status:* Complete, *Contract No.:* CO3425--SPR 97-03.*Start date:* 29 Jan 1997; *Estimated completion date:* 30 Sep 1998.**JUVENILE FISH PASSAGE THROUGH ARTIFICIALLY ROUGHENED PIPE.**

(ENV1090)

*Sponsored by:* Washington State Department of Transportation.*Project Monitor:* Wagner, Paul.*Performed by:* University of Washington.*Investigator(s):* Quinn, Tom.*Status:* Complete.*Start date:* 1 Dec 1997; *Estimated completion date:* 1 Jul 1998.*Publication(s):* Kahler, Thomas H. and Thomas P. Quinn. July 1998. *Juvenile and Resident Salmonid Movement and Passage Through Culverts.* Washington State Department of Transportation. Report no. WA-RD 457.1. 39 p.**OPTIMAL ROAD LOCATION WITH WETLAND IMPACTS. (ENV1022)***Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.*Performed by:* North Carolina State University. Department of Forestry. Raleigh. NC.*Investigator(s):* Roise, Joseph and Shear, Ted.*Status:* Complete.*Start date:* 1 Apr 1996; *Estimated completion date:* 31 Mar 1998.

*Publication(s)*: Final report in progress

*Notes*: List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**PARTICLE SIZE DETERMINATION USING A PARTICLE SIZE ANALYZER.**

(00675783)

*Sponsored by*: Georgia Department of Transportation; Federal Highway Administration. Washington. DC.

*Project Monitor*: Santha, Lanka.

*Performed by*: Georgia Department of Transportation. Atlanta. GA.

*Status*: Complete.

*Start date*: 1 Apr 1994; *Estimated completion date*: 31 Dec 1995.

*Publication(s)*: A final report has not been issued.

**PARTICULATE MATTERS FROM ROADWAYS/PM10. (00735127)**

*Sponsored by*: Colorado Department of Transportation.

*Project Monitor*: Hutter, W.

*Performed by*: Midwest Research Institute. Kansas City. MO.

*Investigator(s)*: Cowherd, C.

*Status*: Complete.

*Start date*: 15 Jan 1996; *Estimated completion date* : 30 Jun 1998.

*Publication(s)*: Cowherd C. *Particulate Matter from Roadways*. June 1998. Report no. CDOT-DTD-98-8.

**PERFORMANCE AND DURABILITY OF CLASS C FLY ASH CONCRETE . (00744219)**

*Sponsored by*: Florida Department of Transportation. Tallahassee. FL.

*Project Monitor*: Bergin, Michael.

*Performed by*: University of South Florida. Tampa. FL.

*Investigator(s)*: Zayed, A.

*Status*: Complete.

*Start date*: 14 Aug 1995; *Estimated completion date*: Oct 1998.

*Publication(s)*: Zayad, Abla M., Craig Toth and Maria Garibaldi. (University of South Florida. College of Engineering. 4202 Fowler Ave. Tampa, FL 33620-5350) *Performance and Durability of Class C Fly Ash Concrete*. Final report. Florida Department of Transportation. Tallahassee, FL. June 1998. Report no. 0510754. 55 pp.

*Notes*: TERIS owns a copy of this report and will lend it to agencies. To borrow it, email [teris@ncsu.edu](mailto:teris@ncsu.edu) or call 919-515-8587 or 919-515-8581.

**PERFORMANCE EVALUATION OF A HIGHWAY EMBANKMENT CONSTRUCTED USING FOUNDRY SAND. (00731867)**

*Sponsored by*: Indiana Department of Transportation. West Lafayette. IN; Federal Highway Administration. Washington. DC.

*Project Monitor*: Nantung, Tommy.

*Performed by*: Purdue University. School of Mechanical Engineering. West Lafayette. IN.

*Investigator(s)*: Alleman, J.

*Status*: Complete, *Contract No.*: HPR-2136.

*Start date*: 1 Sep 1995; *Estimated completion date*: 1 Jan 1999.



*Publication(s)*: Draft final report: Partridge, Barry K. and James E. Alleman. Field Demonstration of Highway Embankment Construction Using Waste Foundry Sand. Indiana Department of Transportation and Federal Highway Administration. 1998. Report no. FHWA/IN/JTRP-98/8. 195 p.

*Notes*: TERIS owns a copy of this report and will lend it to agencies. To borrow it, email [teris@ncsu.edu](mailto:teris@ncsu.edu) or call 919-515-8587 or 919-515-8581.

**PERFORMANCE OF KSDOT TEMPORARY EROSION CONTROL MEASURES.**  
(00731062)

*Sponsored by*: Kansas Department of Transportation. Topeka. KS.

*Project Monitor*: Younger, J.

*Performed by*: University of Kansas. Department of Civil Engineering. Lawrence. KS.

*Investigator(s)*: McEnroe, B. M.

*Status*: Complete, *Contract No.*: RE-108-01 & C-940.

*Start date*: *Estimated completion date*: unknown.

*Publication(s)*: McEnroe, B. M. and Treff, B. J. (Kansas University, Department of Civil and Environmental Engineering, Lawrence, KS, 66045) *Performance of KDOT Temporary Erosion Control Measures*, Report No. K-TRAN: KU-97-2 (1997). 67 p. (TRIS No. 00750949; National Technical Information Service Order No. PB98-149537)

**PERMEABILITY CHANGES IN SOILS DUE TO FILL LOADING AND ITS EFFECTS ON THE GROUNDWATER FLOW REGIME.** (00640392)

*Sponsored by*: Nevada Department of Transportation. Carson City. NV.

*Performed by*: University of Nevada-Reno. Civil Engineering Department. Reno. NV.

*Investigator(s)*: Norris, G.

*Status*: Complete, *Contract No.*: P464-93-028.

*Start date*: 1 Oct 1993; *Estimated completion date*: 1 Feb 1997.

*Publication(s)*: Norris, Gary, Sherif Elfass, and Rob Valceschini. (Department of Civil Engineering. University of Nevada, Reno) 1997. *Permeability Changes in Soil Due to Fill Loading and Its Effect on the Groundwater Flow Regime*. Nevada Department of Transportation. 280 p.

*Notes*: TERIS owns a copy of this report and will lend it to agencies. To borrow it, email [teris@ncsu.edu](mailto:teris@ncsu.edu) or call 919-515-8587 or 919-515-8581.

**PLANT COMMUNITY DISTRIBUTION ACROSS SOIL, WATER, AND NUTRIENT GRADIENTS IN A SOUTHERN APPALACHIAN BOG: A PRE-RESTORATION STUDY FOR DEVELOPMENT OF A MITIGATION BANK FOR TRANSPORTATION PROJECTS.** (ENV1023)

*Sponsored by*: Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Project Monitor*: Martin, James.

*Performed by*: North Carolina State University. Department of Forestry. Raleigh. NC.

*Investigator(s)*: Shear, Ted.

*Status*: Complete.

*Start date*: 1 Apr 1996; *Estimated completion date*: 31 Mar 1998.

*Publication(s)*: Final report in progress

*Notes*: List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**PLANTING FOR SUSTAINABLE ROADSIDES: DEVELOPING GUIDELINES FOR PLANT SELECTION, SOIL PREPARATION, AND LANDSCAPE DESIGN.** (00721685)

*Sponsored by:* Washington State Department of Transportation. Olympia. WA.

*Project Monitor:* Nelson, M.

*Performed by:* University of Washington-Seattle. Center for Urban Horticulture. Seattle. WA.

*Investigator(s):* Hamilton, Clement.

*Status:* Complete.

*Start date:* 1 Jan 1996; *Estimated completion date:* 30 Jun 1996.

*Publication(s):* Hamilton, Clement W.; Robert Bell; David Giblin; Kathleen Wolf; and Kern Ewing. July 1998. *Planting for Sustainable Roadsides: Empirical and Experimental Studies and Recommendations for Western Washington.* Washington State Department of Transportation. Report no. WA-RD 439.1. 304 p.

**PLANTS ESTABLISHING ON MONTANA ROADSIDES: CANDIDATES FOR REVEGETATION.** (00673280)

*Sponsored by:* Montana Department of Highways. Helena. MT.

*Project Monitor:* Garber, R.

*Performed by:* Montana State University, Bozeman. Agricultural Experiment Station. Bozeman. MT.

*Investigator(s):* Weaver, T.

*Status:* Complete.

*Start date:* 15 Jul 1994; *Estimated completion date:* 31 Jan 1997.

*Publication(s):* Meier, Gretchen and T. Weaver. December 1997. *Desirables and Weeds for Roadside Management--A Northern Rocky Mountain Catalogue.* Montana Department of Transportation. Report no. FHWA/MT-97/8115. 145 p.

*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

**THE POLITICS OF CONGESTION PRICING: CASE STUDIES OF TWO CALIFORNIA PROJECTS.** (ENV1074)

*Sponsored by :* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California Transportation Center.

*Investigator(s):* Wachs, M.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**RECYCLED MATERIALS IN ROADSIDE SAFETY DEVICES.** (SWUTC 414588)

*Sponsored by:* Texas Department of Transportation.

*Project Monitor:* Pankey, Chris.

*Performed by:* Texas A&M University.

*Investigator(s):* Bligh, Roger P.

*Status:* Complete.

*Start date:* 1 Sep 1994; *Estimated completion date:* 30 Aug 1998.

*Publication(s):* Final report in progress

**RESTORATION POTENTIAL FOR SMALL STREAMS OF THE INNER COASTAL PLAIN OF NORTH CAROLINA. (ENV1024)**

*Sponsored by:* Center for Transportation and Environment. North Carolina State University. Raleigh. NC.

*Performed by:* East Carolina University. Department of Biology. Greenville. NC.

*Investigator(s):* Rheinhardt, Richard and Brinson, Mark.

*Status:* Complete.

*Start date:* 1 Feb 1996; *Estimated completion date:* 31 Dec 1997.

*Publication(s):* Rheinhardt, Richard D., Rheinhardt, Martha Craig, Brinson, Mark M., and Karl Faser. "Forested Wetlands of Low Order Streams in the Inner Coastal Plain of North Carolina." Wetlands (Vol. 18, No. 3). Society of Wetland Scientists. September 1998. pp. 365-378

*Notes:* List of publications and presentations is available at <http://itre.ncsu.edu/cte/cterip.htm> or by contacting Katie McDermott at 919-515-8034.

**REVISE AND DEVELOP WETLAND RESTORATION STANDARDS. (ENV1110)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Status:* Complete.

*Start date:* FY98; *Estimated completion date:* 1 Oct 1998.

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>

**ROADSIDE VEGETATION MANAGEMENT. (ENV1061)**

*Sponsored by:* Pennsylvania Department of Transportation. U.S. Department of Transportation.

*Performed by:* Pennsylvania State University.

*Investigator(s):* Watshke, Thomas L.

*Status:* Complete.

*Start date:* 14 Apr 1994; *Estimated completion date:* 31 Dec 1996.

*Publication(s):* Final report in preparation.

**ROLE OF GOVERNMENT IN ADVANCED TECHNOLOGY RESEARCH AND DEVELOPMENT. (ENV1072)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Davis.

*Investigator(s):* Sperling, D.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**THE ROLE OF STREET DESIGN AND TRAFFIC MANAGEMENT IN SUPPORTING TRANSIT AND LIVABLE COMMUNITIES. (00736529)**

*Sponsored by:* Transit Cooperative Research Program. Transportation Research Board. Washington. DC; Federal Transit Administration. Washington. DC.

*Project Monitor:* Schwager, Dianne S.

*Performed by:* Project for Public Spaces, Incorporated. New York. NY.

*Investigator(s):* Kent, Fred I. and Davies, Steve.  
*Status:* Complete, *Contract No.:* Project H-4D.  
*Start date:* 1 Jul 1996; *Estimated completion date:* 31 Jul 1997.  
*Publication(s):* Final report in progress.

**ROUTE 6 SCENIC BYWAY DOCUMENTARY.** (ENV1130)

*Sponsored by:* Pennsylvania Department of Transportation; Pennsylvania State Public Broadcasting.  
*Project Monitor:* Yearick, Rebecca Rosser.  
*Performed by:* Pennsylvania State University.  
*Investigator(s):* Smukler, Mark.  
*Status:* Complete.  
*Start date:* 16 Dec 1997; *Estimated completion date:* 15 Dec 1998.  
*Publication(s):* *Pennsylvania's Route 6: A Grand Highway.* Producer Greg Peterson. PennState University. 1998. (video)  
*Notes :* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

**SALT TOLERANCE IN SHORT STATURE GRASSES.** (00711998)

*Sponsored by:* Minnesota Department of Transportation. St Paul. MN.  
*Project Monitor:* Biesboer, D.  
*Performed by:* University of Minnesota - St Paul. Center for Transportation Studies. St Paul. MN.  
*Status:* Complete, *Contract No.:* 72276.  
*Start date:* 11 Jul 1994; *Estimated completion date:* 31 Jul 1997.  
*Publication(s):* Biesboer, David D., Stephanie Neid and Bettina Darveaux. *Salt Tolerance in Short-Statured Native Grasses.* St. Paul, Minn.: Minnesota Department of Transportation, 1998. Report no. MN/RC-1998/16. 91 p.  
*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

**SECONDARY AND CUMULATIVE ENVIRONMENTAL IMPACTS OF TRANSPORTATION PROJECTS.** (00744198)

*Sponsored by:* Florida Department of Transportation.  
*Performed by:* Florida Atlantic University. Boca Raton. FL.  
*Investigator(s):* DeGrove, J.  
*Status:* Complete, *Contract No.:* BA517.  
*Publication(s):* York, M. L.; Spitzer, A. (Florida Atlantic University/Florida International University, Joint Center for Environmental and Urban Problems, P.O. Box 25000, Boca Raton, FL, 33431). *Secondary and Cumulative Environmental Impacts of Transportation Projects,* Report No. WPI 0510788; State Job 99700-3355-119. (1998) 280 p. (TRIS No. 00748808).

**THE SOCIAL COSTS OF ELECTRIC-DRIVE VEHICLES IN LOS ANGELES AND WASHINGTON, D.C.** (ENV1079)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.  
*Performed by:* University of California.  
*Investigator(s):* Lipman, T. E.  
*Status:* Complete.  
*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**SOIL INFILTRATION RATES FOR SEPTIC TANK EFFLUENT.** (00637450)

*Sponsored by:* California Department of Transportation. Sacramento. CA; Federal Highway Administration. Washington. DC.  
*Project Monitor:* Jongedyk, H.  
*Performed by:* California Department of Transportation. Sacramento. CA.  
*Investigator(s):* Danielsen, L.  
*Status:* Terminated.  
*Start date:* 6 Jan 1988; *Estimated completion date:* 30 Jun 1995.

**SPECIFICATIONS FOR WASTE GLASS, WASTE-TO-ENERGY BOTTOM ASH, AND WASTE TIRES FOR USE AS HIGHWAY FILL MATERIALS.** (00744298)

*Sponsored by:* Florida Department of Transportation.  
*Project Monitor:* Ho, Bob.  
*Performed by:* Florida Institute of Technology.  
*Investigator(s):* Cosentino, P.  
*Status:* Complete, *Contract No.:* B-9940.  
*Start date:* 16 Oct 1995; *Estimated completion date:* Apr 1998.  
*Publication(s):* Cosentino, P. J.; Kalajian, E. H.; Shieh, C. S.; Heck, H. H. (Florida Institute of Technology, Civil Engineering Program, 150 West University Boulevard, Melbourne, FL, 32901-6988, USA) *Developing Specifications for Waste Glass, Municipal Waste Combustor Ash and Waste Tires as Highway Fill Materials (Continuation)*, Vol 1: Municipal Waste Combustor Ash; Vol 2.: Waste Glass; Vol. 3 OF 3 Waste Tires. Report No. FL/DOT/RMC-06650-7754. (1998). (TRIS No.s. 00749922, 00749923, 00749924).  
*Notes:* TERIS owns a copy of this report and will lend it to agencies. To borrow it, email teris@ncsu.edu or call 919-515-8587 or 919-515-8581.

**STATEWIDE DETERMINATION OF THE EXTENT OF ADVERSE EFFECTS UNPAVED ROADS HAVE ON "EXCEPTIONAL VALUE" AND "HIGH QUALITY" STREAMS.** (ENV1064)

*Sponsored by:* Pennsylvania Department of Transportation.  
*Performed by:* Pennsylvania State University.  
*Investigator(s):* Arnold, Dean.  
*Status:* Complete.  
*Start date:* Dec 1995; *Estimated completion date:* 14 Feb 1997.

**STRATEGIES FOR USING STABILIZED WASTES IN CONNECTICUT.** (00644991)

*Sponsored by:* Connecticut Department of Transportation. Wethersfield. CT.  
*Project Monitor:* Sime, James.  
*Performed by:* University of Connecticut. Storrs. Institute of Water Resources. Storrs. CT.  
*Investigator(s):* Grasso, Domenic and Long, Richard P.  
*Status:* Complete.

*Start date:* 1 Jun 1993; *Estimated completion date:* 1 May 1996.

*Publication(s):* Grasso, Domenic and Richard P. Long. May 1996. *Strategies for Using Stabilized Wastes in Connecticut.* Report no. JHR96-249.

**STUDY OF SIDE DITCH LINERS FOR HIGHWAY APPLICATIONS - PHASE 1.**

(00731860)

*Sponsored by:* Indiana Department of Transportation; Federal Highway Administration.

*Project Monitor:* Nantung, Tommy.

*Performed by:* Purdue University. School of Mechanical Engineering. West Lafayette. IN.

*Investigator(s):* Bourdeau, P.

*Status:* Complete, *Contract No.:* HPR-2132.

*Start date:* 1 Dec 1995; *Estimated completion date:* 1 Jul 1997.

*Publication(s):* Calderon, A. S.; Bourdeau, P. L. (Purdue Univ., Lafayette, IN). *Study of Side Ditch Liners for Highway Applications, Phase 1.* Report No. FHWA/IN/JTRP97/6. (Dec. 1997). NTIS Order Number: PB98-123573INZ.

**STUDY OF WETLAND MITIGATION PROJECTS IN KANSAS AND DEVELOPMENT OF COST-EFFECTIVE METHODS AND PROCEDURES FOR FUTURE PROJECTS.**

(ENV1066)

*Sponsored by:* Mid-America Transportation Center. University of Nebraska-Lincoln.

*Project Monitor:* Gnirk, Barbara.

*Performed by:* University of Kansas.

*Investigator(s):* Kindscher, K. and Pogge, E. C.

*Status:* Complete, *Contract No.:* MATC/KU96-3.

*Start date:* 1 Oct 1995; *Estimated completion date:* 30 Jun 1998.

*Publication(s):* Final report in progress

**TECHNOLOGY ASSESSMENT OF REFUELING-CONNECTION DEVICES FOR CNG, LNG, AND PROPANE.** (00736512)

*Sponsored by:* Transit Cooperative Research Program. Transportation Research Board.

Washington. DC; Federal Transit Administration. Washington. DC.

*Project Monitor:* Jenks, C. W.

*Performed by:* Science Applications International Corporation. VA.

*Investigator(s):* Friedman, David M.

*Status:* Complete, *Contract No.:* Project C-7.

*Start date:* 15 Mar 1996; *Estimated completion date:* 14 Sep 1997.

*Publication(s):* A revised final report has been submitted. The results of this project will be published as a TCRP Research Results Digest in 1998.

**TESTING AND EVALUATION OF RECYCLED RUBBER ROADSIDE BARRIERS.**

(SWUTC 404151)

*Sponsored by:* Baatz Tire Rebuilders Ltd.

*Performed by:* Texas A&M University.

*Investigator(s):* Bligh, Roger P.

*Status:* Complete.

*Start date:* 23 May 1997; *Estimated completion date:* 31 Jan 1998.

*Publication(s):* Bligh, Roger P. December 1997. Testing and Evaluation of Canadian Recycled

Rubber Roadside Barriers. Texas Transportation Institute. Research Report 404151-1.

**TIRE/SOIL EMBANKMENT.** (00668872)

*Sponsored by:* Kentucky Transportation Cabinet. Frankfort. KY.

*Performed by:* University of Kentucky. Kentucky Transportation Center. Lexington. KY.

*Investigator(s):* Meade, B.

*Status:* Complete.

*Start date:* 1 Oct 1994; *Estimated completion date:* 30 Sep 1998.

*Publication(s):* Final report in progress

**TRANSIT DEPENDENCE, CIVIL RIGHTS, AND THE EVOLVING ROLE OF PUBLIC TRANSIT IN US CITIES.** (ENV1073)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Los Angeles.

*Investigator(s):* Taylor, B.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**TRANSPORT ACCESS, NEIGHBORHOOD EXTERNALITIES, AND MINORITY YOUTH EMPLOYMENT.** (ENV1070)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California-Berkeley.

*Investigator(s):* Quigley, J. M.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**TRANSPORTATION IN THE BORDER ENVIRONMENT.** (ENV1193)

*Sponsored by:* New Mexico State Highway & Transportation Department.

*Project Monitor:* Skrupskis, Michelle.

*Performed by:* Alliance for Transportation Research Institute.

*Investigator(s):* Cockerill, Kristan.

*Status:* Complete, *Contract No.:* 3437.

*Start date:* Feb 1997; *Estimated completion date:* Feb 1998.

*Publication(s):* Cockerill, Kristan and Judith Espinosa. *Transportation in the Border Environment*. ATR Institute. Albuquerque, New Mexico. February 1998. 60 pp.

*Notes:* First phase completed. TERIS owns a copy of this report and will lend it to agencies. To borrow it, email [teris@ncsu.edu](mailto:teris@ncsu.edu) or call 919-515-8587 or 919-515-8581.

**TRAVEL BEHAVIOR ON A CONGESTION PRICING PROJECT: ROUTE 91 EXPRESS.** (ENV1071)

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.  
*Performed by:* University of California-Irvine.  
*Investigator(s):* Small, K. A.  
*Status:* Complete.  
*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**TRAVEL SURVEY DATA ANALYSIS FOR TRANSPORTATION AND AIR QUALITY STUDIES IN CIUDAD JUAREZ, MEXICO AND EL PASO, TEXAS. (SWUTC 467408)**

*Sponsored by:* State of Texas.  
*Project Monitor:* unknown.  
*Performed by:* Texas A&M University.  
*Investigator(s):* Williams, Thomas A.  
*Status:* Complete.  
*Start date:* 1 Sep 1996; *Estimated completion date:* 31 Aug 1997.  
*Notes:* New contact at Texas A & M: Jim Benson (512) 467-0946 about TTI research. T. Williams no longer works at this location.

**USE OF RECLAIMED AGGREGATES FOR PAVEMENT. (00744227)**

*Sponsored by:* Florida Department of Transportation. Tallahassee. FL.  
*Project Monitor:* Armaghani, Jamshid.  
*Performed by:* Transportation Research Center. Florida University-Gainesville. Gainesville. FL.  
*Investigator(s):* Chini, A. S.  
*Status:* Complete.  
*Start date:* 29 Aug 1996; *Estimated completion date:* Sep 1998.

**WATER QUALITY EFFECTS OF TIRE FILLS LOCATED BELOW THE GROUNDWATER TABLE. (00739092)**

*Sponsored by:* Maine Department of Transportation.  
*Project Monitor:* Peabody, Dale.  
*Performed by:* University of Maine.  
*Investigator(s):* Humphrey, Dana N.  
*Status:* Complete, *Contract No.:* 94-1.  
*Start date:* *Estimated completion date:* Aug 1996.  
*Publication(s):* Downs, Lisa, Dana Humphrey, Lynn Katz, and Chet Rock. 1996. *Water Quality Effects of Using Tire Chips Below the Groundwater Table.* Maine Department of Transportation.

**WETLAND GROUNDWATER MONITORING RESEARCH. (ENV1001)**

*Sponsored by:* Delaware Department of Transportation; Federal Highway Administration.  
*Project Monitor:* Kleinburd, Robert.  
*Performed by:* Louis Berger & Associates, Inc.  
*Investigator(s):* Rodregas, Mehendra.  
*Status:* Complete.  
*Start date:* Nov 1996; *Estimated completion date:* Jul 1998.  
*Publication(s):* *DelDOT Pollack Wetland Mitigation Site: Experimental Groundwater Monitoring Study.* Prepared by Louis Berger & Associates, Inc. for Federal Highway Administration and Delaware Department of Transportation. July 1998.



*Notes:* While the official research project has ended, further informal investigations are planned. TERIS owns a copy of this report and will lend it to agencies. To borrow it, email [teris@ncsu.edu](mailto:teris@ncsu.edu) or call 919-515-8587 or 919-515-8581.

**WHERE DO PEOPLE WALK? THE IMPACTS OF NEIGHBORHOOD DIFFERENCES IN URBAN FORM ON PEDESTRIAN ACTIVITY. (ENV1078)**

*Sponsored by:* University of California Transportation Center. University of California. Berkeley. CA.

*Project Monitor:* University of California Transportation Center.

*Performed by:* University of California.

*Investigator(s):* Lamont, J.

*Status:* Complete.

*Start date:* 1 Aug 1997; *Estimated completion date:* 31 Jul 1998.

**WORK WITH PLANT MATERIALS CENTERS, DUCKS UNLIMITED, AND OTHERS TO DEVELOP IMPROVED PLANT MATERIALS FOR WETLAND RESTORATION. (ENV1106)**

*Sponsored by:* U.S. Department of Agriculture. Natural Resources Conservation Service. Wetland Science Institute.

*Project Monitor:* Teels, Billy.

*Performed by:* University of Maryland.

*Investigator(s):* Meyer, Gwen.

*Status:* Complete.

*Start date:* FY98.

*Publication(s):* Final report in progress

*Notes:* Source of information: Wetland Science Institute web page, <http://159.189.24.10/wetsci.htm>



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