Local Road Research Board
Knowledge Building Priorities
July 2009

LRRB Knowledge-Building Priorities
#KB001
Safety
July 2009

Background
Road safety has been and continues to be an important issue. In-vehicle technology options that assist the driver with space management, speed control, and navigation of roadway features need to be improved to provide drivers with information to reduce crashes. These technologies have been developed and implemented, but further research to develop new and innovative technologies will be beneficial.

Safety audits that identify various safety design measures can create safer roadway environments, but changes aren't always followed. Research has been conducted on the new prismatic sign sheeting to show the effects of increased retroreflectivity. However, questions remain: How bright is too bright? How will this affect pavement markings as new materials are developed? Overlays might be done at the same time as a safety improvement on the road, but is this safe?

Managing higher speeds by enforcing speed limits improves safety, but this approach requires significant time and financial resources to be effective. Speed limits can be effective when the public is made aware of increased enforcement. Speed limits must be a function of the road design, not just the road environment. Today's vehicles give minimal feedback (vibration, road noise, tilt) to the driver, so drivers may not change their speed in poor road or safety conditions. Intelligent transportation systems (ITS) are not yet understood by the driving public, so more attention to ITS technologies is needed.

In addition, the rising number of older drivers is a growing concern. Research indicates that older drivers are self-limiting by driving less frequently in dangerous situations, but their reactions are slower. A driver's perception of the road environment changes with age; older drivers need more light to be able to see. Understanding human factors is critical to safety, and developing in-vehicle technologies to aid the driver is necessary.

Research Opportunities
As previous research has shown, speed reduction is critical to road safety. Investigating criteria for setting the appropriate speed as well as the effectiveness of alternative methods (self-explaining roads, engineering countermeasures, ITS) for reducing speed are needed. New safety devices are critical in reducing crashes. Research to facilitate speed reduction should to be a focus area, similar to previous seat belt and DUI enforcement efforts.

Research efforts should focus on the correlation between roadway features and safety/traffic flow stability. Examples include billboards, VMS, sun glare, median barriers, lane widths, urban canyon vs. open space, parked vehicles, and driveways. Research to establish roadway design standards for various roadway classifications may help support high traffic generators. Safety devices on roads need to address not only average size cars, but also large trucks and small compact vehicles. Studying the brightness of signs and pavement markings, specifically during weather events, will help us understand their effectiveness.

The idea of establishing no-car cities is a potential research topic. Impacts to assess include pedestrian safety, the value of enhanced ambiance, reduced air pollution measures, and effects on businesses. Complete streets, designed to implement safe and accessible urban street systems for all users, should be researched to address the placement and geometric design of sidewalks, raised medians, and various traffic-calming measures.

LRRB Knowledge-Building Priorities
#KB002
Recycled and Alternative Pavement Materials

July 2009

Background

Over the years a significant amount of research has been done in the area of recycled and alternative pavement materials. The research has produced a growing list of materials that can be used in pavements including shingles, slag, recycled asphalt, glass, tire chips, municipal incinerator ash, fly ash, sewage waste, geofoam, and taconite tailings. Past research has yet to determine the long-term environmental impacts of using such materials and the possible performance effects these materials can have.

One of the reasons these materials are so attractive is their cost-effectiveness. To maintain this cost-effectiveness, cities and counties must be able to use, produce, and refine the product close to home, or this efficiency is lost. Quality is also varied with the use of different recycled materials, presenting unique reliability challenges.

A concern expressed by many is the extensive evaluation and implementation periods that exist for use of recycled and alternative materials. Researchers and practitioners find it hard to take a scientific approach to developing new methods and mixtures when the implementation is hindered by continuous testing and evaluation. Thus far, the methods and mixtures that have been developed cannot be applied to all regions due to varied climate change, traffic usage, and other regional variations.

Research Opportunities

A need has arisen to better understand the short- and long-term performance of recycled and alternative pavement materials. A standard process for measuring and quantifying performance is needed. When recycled and alternative pavement materials are used, pavement gradation may be inconsistent. Research is needed to study the impact these inconsistencies have on roadways and how these inconsistencies can be overcome.

A greater understanding of the long-term environmental effects of recycled and alternative pavement materials is needed. Specifically, a standard process for measuring and quantifying these effects should be defined. An investigation to determine the impact these materials are having on the surrounding environment would also address outstanding environmental concerns. For this type of research, it may be necessary to create an inventory of roads that have been constructed using these types of materials.

As these materials become more popular, concerns arise about their cost-effectiveness and life-cycle costs. Much can be gained from the evaluation of the overall process of using these materials. By studying the overall process, one could conclude whether or not use of these materials is cost-efficient, taking into account transport, refining, maintenance, etc. Currently, it is only efficient to use these materials in close proximity to their native source, in order to minimize the cost of hauling. Alternative and efficient ways of transporting these materials are important areas in which further research is needed. Questions arise regarding the ability to economically transport these materials across the state/country to regions where material shortages exist.

LRRB Knowledge-Building Priorities
#KB003
Decision Making for Pavement Planning

July 2009

Background

The tradeoff between construction costs and future maintenance costs is universally recognized. Spending more during the construction phase increases quality and reduces maintenance costs, while spending less during initial construction decreases quality and increases maintenance costs in future years. Many studies have been conducted to find a preventive maintenance approach that is the most cost-effective with the lowest life-cycle costs, but no conclusions have been reached.

Recent years have seen an aggressive trend toward proactive (versus reactive) pavement maintenance activities. However, no substantial data has indicated that proactive maintenance is better than reactive maintenance.

Many agree that maintenance in lieu of reconstruction may affect roadway user safety. Reconstruction is also a more costly option when compared to maintenance. The idea of perpetual pavement technology arises when discussing pavement maintenance versus reconstruction. By building better embankment foundations, less maintenance is needed and reconstruction intervals are less frequent, thus reducing costs.

Some research has been conducted on life-cycle cost analysis, design-build, and alternate bid decision-making models. The life-cycle cost analysis has a unique disadvantage, as it does not include road user costs.

Research Opportunities

The need for clean, understandable, long-term data on our roadway system is needed. Research could be done to develop measurements and standards for future data recording and entry to ensure consistency. A database could be developed where this information is stored and is accessible to researchers and practitioners.

Thus far, no substantial data has indicated that proactive maintenance is better than reactive maintenance. A long-term, in-depth investigation is needed to study proactive and reactive maintenance to determine the measurable benefits of one or the other.

As budgets grow tighter across all sectors, it is important to determine road surface types (asphalt, concrete, gravel, etc.) that can be sustained long term in the network. Both construction and maintenance costs should be considered when making these decisions. Research in this area could include developing measures for determining the appropriate surface type for the various systems (TH, CSAH, county roads, city streets, etc.). Another important topic includes accurate measurement of traffic levels to decide whether a gravel surface should be paved.

In regards to contractor performance, standards for how to measure and pay for contractor performance (performance measures) need to be developed. Also, expectations among different contract models should be developed (i.e., how much is reasonable to output with alternative bids?).

LRRB Knowledge-Building Priorities
#KB004
Funding and the Public's Role in Transportation

July 2009

Background

A growing challenge for transportation professionals is how to fund improvements and maintenance of transportation systems. Transportation departments find themselves with diminishing purchasing power, rising maintenance and construction costs, and high public expectations. The costs of roads are not adequately linked to what users pay, and current transportation funding sources, such as the gas tax, are not sufficient to meet the needs of the system. Also, as demonstrated during the escalation in gas prices in 2008, higher gas prices influence consumers to use more fuel-efficient vehicles, thereby lowering tax revenue.

User perceptions of the costs of maintaining transportation systems are also an issue. Users view the system as either a completely free resource or as a service they pay for once at the time of the road's construction. Maintenance costs are often not considered by the public. Additionally, there is very little understanding of the costs of operating road systems or the mechanisms in place to fund them. This lack of knowledge presents a barrier to discussion and implementation of new potential funding sources. The public may be unreceptive to funding systems that require them to pay per use of the system, since they see it as free. They would also likely have privacy concerns with any system that would require tracking mechanisms in vehicles.

Research Opportunities

New options for transportation funding need to be explored, including mileage-based fees and congestion pricing, to better allow users to be charged for their road use. This could potentially provide revenue more closely aligned with the resource needs of transportation systems, especially as the public shifts away from gas-powered vehicles toward hybrid, hybrid-electric, or electric vehicles. These new revenue systems might be costly to develop, implement, and administer, and a cost/benefit analysis is warranted to ensure that they will actually be worth the cost.

Funding models in other countries should be studied, including the potential for using revenue sources that are not related to user fees. Public perception and support of such measures must be studied, and sources of opposition need to be researched. Investigation of ways to protect privacy in data collection is also needed.

The effects of changes in road use, such as placing a greater emphasis on transit and converting more lanes to congestion pricing, should also be investigated. Another area where costs could be contained is right-of-way acquisition. Studying the effects of amending regulations that complicate right-of-way acquisition and increase costs would be beneficial.

The public’s lack of understanding of transportation finance is an opportunity for education and outreach, as well as research. Decision makers and the general public need to be made aware of how transportation systems are funded and the fact that roads have costs attached throughout their entire service life. The hidden costs of *not* adequately funding road maintenance need to be better communicated to policymakers and the public. It would be helpful to explore ways to communicate the value of transit. Research is also needed to determine more effective ways to engage the public on these issues.

LRRB Knowledge-Building Priorities
#KB005
Sustainable Planning and Design
July 2009

Background
Engineers and planners encounter numerous expectations and constraints regarding sustainable planning and design. Political and legal mandates can counter professional expertise, rendering designs unable to meet project needs. Meanwhile, the public brings high expectations of service and accessibility but has little long-term vision, which means they are often not concerned with sustainability. Because public perception of sustainability varies to a great degree, involving the public in applicable processes could increase understanding.

Minnesota faces additional challenges in balancing sustainable solutions for numerous audiences that require different answers. Both the Twin Cities metro area and Greater Minnesota must find optimum efficiencies of scale to meet the needs of their dissimilar demands. The state is also seeing demographic shifts, including an aging population and new trends in how young people work, socialize, and shop. Engineers and planners have to find a balance that is able to meet numerous contradictory needs.

Research Opportunities
Planners and engineers need better tools for managing public expectations and educating the public on transportation plans and concepts. A goal of research on sustainable planning and design is to instigate the innovative and aggressive thinking this topic requires.

With demographic changes, future needs and trends need to be studied so that transportation plans can account for aging baby boomers and changing behaviors of younger age groups. How will the behaviors of various age cohorts challenge current designs? How can engineers and planners design now for their future needs?

A better understanding of how sustainable designs affect child health and family activity would be beneficial in creating designs that increase community health and create family capital. There is a need for research on how development patterns instigate or support systems of social inequity. Typically, sustainability is researched at a city or regional level, which leaves out exploration of social equity at the neighborhood level.

It is assumed by some that stabilization in a community means stagnation, raising the question of whether sustainable designs promote unwanted outcomes. There are many research questions that could address this dilemma. What is the appropriate size of cities and communities? Where in Minnesota should growth occur? Given that government money is budgeted based on formulas and not necessarily needs, is the state dedicating its resources in the best way to create a sustainable state? Where is the proper balance point between high quality versus appropriate quality (i.e., when is “good enough” good enough)? What is the appropriate size of government offices to create efficiencies of scale? Research to show the best way in which the government—be it city, county, or state—could provide services would be beneficial.

Research on the overall environmental impacts of alternative plans is needed to assist engineers and planners in making the best decisions for the future. Research needs to begin with a baseline look at the “do nothing” plan—determining what will happen if transportation development and infrastructure expansion continue to follow the general path of the last several decades. Research can also compare the “carbon footprints” of various design plans, both public and private, made within the transportation industry. New concepts in sustainability, such as “complete streets,” can be examined for effectiveness and efficiency. MASDAR-type plans that neutralize energy use and plans that include “no fossil fuel” scenarios can also be examined.

LRRB Knowledge-Building Priorities
#KB006
Innovative Construction Methods and Contracting

July 2009

Background

A number of innovative construction methods exist and are discussed in the literature, but they are not frequently used or applied. Their implementation depends heavily on acceptance by contractors and manufacturers, but new technologies frequently have additional costs that can deter contractors who want to realize an economic benefit from innovation. In addition, it is often hard to justify the economic benefit on small, local projects.

Proprietary issues also arise with the use of new methods and products. For instance, when a new product is discovered but not listed on a certified product list, it cannot be written into a specification.

Performance-based contracts are an attractive alternative to traditional low-bid awards; however, they come with some concern. Standard performance measures often do not exist, and the definition of "performance" is not clearly defined. These types of contracts also raise the issue of warranties as contractors generally only agree to short warranties (less than five years) for catastrophic failure. Questions also surface regarding the appropriate amount of risk to pass on to the contractor, discrepancies in what is considered a long-term warranty, and the potential consequences of the contractor agreeing to take on a large amount of risk.

Research Opportunities

The development of a risk-assessment program for innovative construction methods and warranties is needed to obtain the best value on large capital investments, given the small rate of application and implementation. More information regarding the obstacles surrounding the use of innovative construction methods, and why they are not used more routinely, is needed.

Prequalification as an alternative to low-bid contract awards warrants further study. The effect of prequalification on the selection process and the role this would play on reduced competition are other important components. An investigation of low-bid versus most-qualified contractor selection could provide useful insight into innovative contracting methods.

Research could also be conducted to develop best practices for inspection of projects with new methods/contracting to ensure a standard level of quality.

A need has arisen to better understand the impacts of using performance specifications versus prescriptive specifications. Research is needed to develop methods for using performance specifications without losing quality and consistency. When using performance specifications, the long-term performance effects are also relatively unknown, presenting another area where information is needed.

LRRB Knowledge-Building Priorities
#KB007
Innovations in Maintenance and Operations
July 2009

Background
Innovations in roadway maintenance and operations can improve overall quality and reduce long-term costs. Intelligent transportation systems (ITS) safety solutions are slowly gaining acceptance and prevalence in roadway systems; major next steps will involve communication between vehicles and infrastructure to improve safety and reduce congestion. Less is known about the long-term effects of adaption to ITS over time. Various ITS strategies are effective in controlling speeds near work zones, yet little data has been collected to assist in understanding traffic dynamics in these areas.

Self-explaining roads (roads with less signage) are a newer innovation that can help improve operations. Self-explaining roads have been shown to decrease driver confusion in Europe. Such an approach uses simplicity and consistency of design to reduce driver stress and driver error.

Research has shown that intersection lighting dramatically reduces nighttime crashes. Solar-powered street crossing lights, which require less maintenance, have been highly effective in other parts of the world. Using LED lights on vehicles, signals, and in other applications can save electricity, provide better brightness, and improve light longevity. Another innovation, proposed in an American Disabilities Act guideline, is a pedestrian crossing with auditory signals to help visually impaired individuals cross the street.

Research Opportunities
Because ITS technologies can be costly to implement, measures are needed to evaluate the effects (long and short term) of ITS on safety. In addition, developing guidelines on when it is beneficial to upgrade to newer ITS technologies will help in the long term. Certain ITS technologies can become standards, but they sometimes become less effective in improving safety and traffic operations over time; looking at the long-term effectiveness of ITS technologies will provide information to sustain the benefits of these technologies. Impacts of traffic operations and ITS could be studied by collecting and analyzing actual data to validate changing behaviors.

Road maintenance can be affected by variables such as weather and traffic volume. Research is needed on snow and ice control measures for low-volume roads, as well as alternative options for snow removal that use environmentally friendly chemicals. In addition, salt reclaimed from water softeners and other sources could aid in reducing costs associated with road salt usage.

The development of new lighting techniques and fixtures is an area for continued innovative research. Investigation of the cost-effectiveness of solar-powered street lights versus LEDs in remote locations will provide insight into the long-term cost/benefit of these applications. Investigating the effects of changing light sources on driving behavior and safety will help with visibility. Finally, light captured from the headlights of vehicles and transmitted to an intersection through fiber optics or other transfer methods would be another research opportunity.

LRRB Knowledge-Building Priorities
#KB008
Maintaining Road Systems Economically
July 2009

Background
One of the greatest challenges for transportation professionals across the state is how to use limited resources to meet rising costs and high public expectations for road system maintenance. The costs and benefits of road maintenance are not well understood by the public. New policies and regulations are subject to greater scrutiny to determine whether resources are being used most effectively.

Two strategies employed by agencies to improve efficiencies are public-private partnerships (PPPs) and cross-jurisdictional sharing of equipment, services, and expertise. In the United States, roads are largely managed by public entities, while in Canada and Europe, many transportation agencies contract with the private sector for maintenance activities. Outsourcing routine maintenance tasks to private contractors generally results in short-term cost savings, but it isn't known whether this savings is sustained. There are fewer examples of cross-jurisdictional sharing of resources, and regulatory and organizational barriers prevent greater sharing of resources and expertise between jurisdictions.

Research Opportunities
Research is needed to determine the optimal life-cycle durability of roads, considering both construction and maintenance costs, and accounting for variations in pavement type. For example, the introduction of porous pavements may increase some maintenance costs. Research on the potential advantages of "over-building" roads to optimize durability may also be warranted; a life-cycle cost-benefit analysis would ultimately show whether the initial cost investment of building thicker pavements would lead to worthwhile long-term savings. The effects of declining vehicle-miles traveled on infrastructure maintenance needs should be measured and evaluated. An examination of the costs and benefits of policies that limit vehicle use on certain roads by day or time could be helpful.

Research is needed to find out whether the cost reductions from outsourcing routine maintenance tasks to private contractors are sustained over the long term. Ways to ensure a competitive market and accountability for long-term results need to be identified. The readiness capacity of government agencies compared to the private sector should be examined. Study is also needed to determine how to structure contracts and bid parameters, how to evaluate service and develop performance measures, and how to properly align contractor incentives.

There is some evidence that larger service areas are able to achieve economies of scale. This needs to be supported with research quantifying unit costs for varying district sizes. Examination of whether other organizational structures such as regional service entities or quasi-public organizations could facilitate more cost-effective maintenance is warranted. Another model to explore is the merger of road and transit funding sources, and ways to make better use of the road system to improve transit.

There are many research opportunities in the area of cross-jurisdictional cooperation. Wisconsin's model of counties maintaining trunk highways should be studied. Studies are needed to determine the regulatory constraints for cross-jurisdictional sharing of resources, as well as the organizational and cultural differences that inhibit cooperation across jurisdictions. Exploration of the methods and costs of removing these barriers and encouraging cross-jurisdictional sharing of resources is needed.

LRRB Knowledge-Building Priorities
#KB009
Environmental Sustainability
July 2009

Background
Given diminishing resources, transportation planning and land use planning need to be linked to expand capacity, mobility, and accessibility. In addition, the construction and use of roadways and other transportation structures need to be "greener."

Carbon emission and greenhouse gas standards have been largely politicized, but most transportation professionals believe that a reduction in vehicle-miles traveled (VMT) is beneficial for all. As there are multiple reasons why a reduction is desired, there are also multiple solutions. The public is more likely to accept solutions that do not diminish travelers' access to destinations. Many current strategies focus on increasing vehicle efficiency and reducing the costs of inefficiencies, but they do not address possible technical solutions or alternative land use designs.

Policy-related research often addresses environmental issues from one-dimensional perspectives that fail to recognize the multiple constraints within which engineers and planners work. Engineers and planners, who rarely have the expertise or experience to make decisions based on environmental sustainability, work within numerous inflexible constraints, including local, state, and federal mandates. To create sustainable designs, tools need to be developed that assist engineers and planners in balancing objectives with solutions.

Research Opportunities
From a systems perspective, engineers and planners face numerous challenges from mandates at multiple levels. Environmental sustainability can provide one such constraint. New or better tools, concepts, and measurements for balanced decision making would be useful. Tools could also be developed to assess environmental impacts of land use and transit changes and to conduct scenario analyses.

Green construction has become a popular industry in which further research would be beneficial. Areas of interest include the use of waste materials, more efficient equipment, processes that use less energy, and life-cycle reviews on roadways and structures that include efficiency, recyclability, material hauling costs, and long-term environmental impacts. Furthermore, measurements are needed to assess the costs and benefits of these areas in community or regional transportation plans in ways that account for long-term impacts, as opposed to only immediate costs.

The effects of environmentally sustainable planning and design on health and well-being are still not fully researched. Research of cities and regions with designs oriented around bicycling, walking, and/or transit could show the health effects of such orientation, if any.

Research on the most economically efficient ways to move freight is needed. Issues for further study include increasing the use of rail and truck-only roads. Researchers could also compare and contrast various methods of freight transportation by looking at its cost per unit of energy used.

It is known that personal choice trends are affected by many variables, including cost. More research is needed on how personal choice in transportation and housing location affects the environment and what policies can affect personal choice. For example, how does policy influence demand? Furthermore, planners and engineers need better tools on how to manage public expectations, when and how to involve the public in the process, and how to educate them on transportation plans and concepts.

LRRB Knowledge Building Priorities
#KB010
Reducing Environmental Impacts
July 2009

Background

Storm Water Management

There is an increased interest in new best management practices (BMPs) for storm water quality management, but little is known about options available for water quality management on transportation facilities beyond traditional ponding techniques. Larger solids are easier to remove from runoff than fine and dissolved contaminants, but few options currently exist for controlling this problem. It's also clear that cold climate adversely affects storm water BMP performance, although more research is needed to investigate specifics of this phenomenon. Advanced storm water treatment techniques (i.e., using storm water runoff as a source of renewable energy) are also in development, but these techniques have not been widely implemented and do not yet have proven results.

Vegetation

There is a growing need for vegetation that requires less maintenance, such as sod-bobber vegetation types that require less water, and low-mow grass breeds. Different plants and trees have varying tolerance levels for cold climates and road salts, and there are a number of species that may be a better option than more traditional vegetation. Strategic vegetation practices can remove storm water contaminants effectively, but little is known about specific techniques. Maintenance techniques vary greatly with climate as well as setting (urban vs. rural), so BMP information is needed in this area.

Safety and Innovation

Finally, environmental impact BMPs are constantly changing. Many innovative practices exist, but these may be limited by decreasing budgets and limited resources and knowledge at the local level. With each new innovation, it's important to consider cost as well as the impacts on safety and the environment.

Research Opportunities

Storm Water Management

Study new ways to treat storm water runoff beyond the use of ponds. Examine the effects of cold weather on the functionality and maintenance of storm water BMPs. Research the indicators of storm water pollutants; for example, is there a relationship between total suspended solids (TSS) and metals? Explore alternative runoff treatments and examine the effectiveness of subsurface drainage options. Complete an accurate analysis of storm water solids loading and research innovative approaches to remove dissolved contaminants from storm water. Perform cost/benefit analyses of onsite water treatment vs. centralized water treatment options. Study the impact of infiltration effects on groundwater quality.

Vegetation

Assess deicing salt tolerance levels of vegetation used in Minnesota and explore options for vegetation that actually thrives in an environment where salt is used. Develop new clusters of turf grass that exhibit high levels of salt tolerance. Investigate factors that influence the performance of vegetative filters and buffers, and develop design tools to use these. Study the effects of permeable roads and sidewalks for root growth and the relationship between shade trees and thermal pollution. Evaluate prairie restoration tactics and CO2 sequestration impacts in relation to right-of-way (ROW) vegetation. Examine ROW vegetation as a way to create renewable energy. Investigate cap-and-trade systems for carbon credits and examine BMPs for reducing the carbon footprint and improving credits.

Safety and Innovation

Perform extensive cost/benefit analyses; for example, investigate salt usage per mile in relation to crash reduction—is it worth the cost? Explore differences between urban and rural environmental education/tolerance levels.

LRRB Knowledge Building Priorities
#KB011
Environmental Permitting and Policy Considerations
July 2009

Background

Permitting

Several regulatory authorities have a role in permitting, and they have different agendas. Each agency has a number of (often changing) requirements that are difficult to keep track of; staying updated on these requirements is often time-consuming and confusing. Case studies exist of successful steamlining (through innovations in data management and stakeholder management), but it's hard to replicate these practices. There's a belief that understanding and adhering to permitting requirements will only get more difficult as environmental preservation receives more attention.

Policy

Confusion exists about the role of road agencies in environmental policy. Many social interest groups are attempting to influence policy, but many have competing interests and specific processes that don't always match up. It's important but difficult to balance the desires of these groups with the goals of the general public. Many low-impact development policies aren't effective, and there are unintended results and consequences to many policies.

Research Opportunities

Permitting

Investigate the benefits and disadvantages of multiple permitting authorities and processes. Evaluate the effects of environmental streamlining practices in terms of time, cost, stakeholder perceptions, and environmental impacts. Explore existing innovative streamlining examples and evaluate these in relation to resources (time and money) available in Minnesota. Identify conflicting requirements and develop an inventory of redundancies. Establish and use a specific process to address the needs of competing agencies. Study how permitting processes have potentially impaired the environment.

Policy

Identify ways to balance the desires of competing special interest groups and general public goals. Evaluate the effectiveness of educational programs for the implementation of best management practices (BMPs) for transportation projects. Develop effective approaches to engage public and private stakeholders early in the planning stage rather than during the project stage. Examine how to best incorporate transportation planning into comprehensive community planning and engagement. Develop a way to quantify social goals vs. transportation goals. Explore opportunities for engaging residents in transportation planning.