

Martin O'Malley, *Governor*
Anthony G. Brown, *Lt. Governor*



Darrell B. Mobley, *Acting Secretary*
Melinda B. Peters, *Administrator*



2012 Annual Research Report

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On the cover:

This bridge is located on I-495 over Northwest Branch in Montgomery County. SHA selected this location to test a low cost, scalable sensor developed by the University of Maryland (pictured on the right) for the real time monitoring of bridges for strain, tilt and inclination, temperature, moisture and humidity, pressure, and crack activity and growth. The project was selected by the AASHTO Subcommittee on Research (RAC) as one of 16 State DOT High Value Research studies in 2012. The results of the study were presented at the AASHTO RAC meeting in Burlington, Vermont, in July, 2012, and at the Transportation Research Board Annual Meeting in Washington, DC, in January, 2013.



FFY 2012 Annual Report

INTRODUCTION

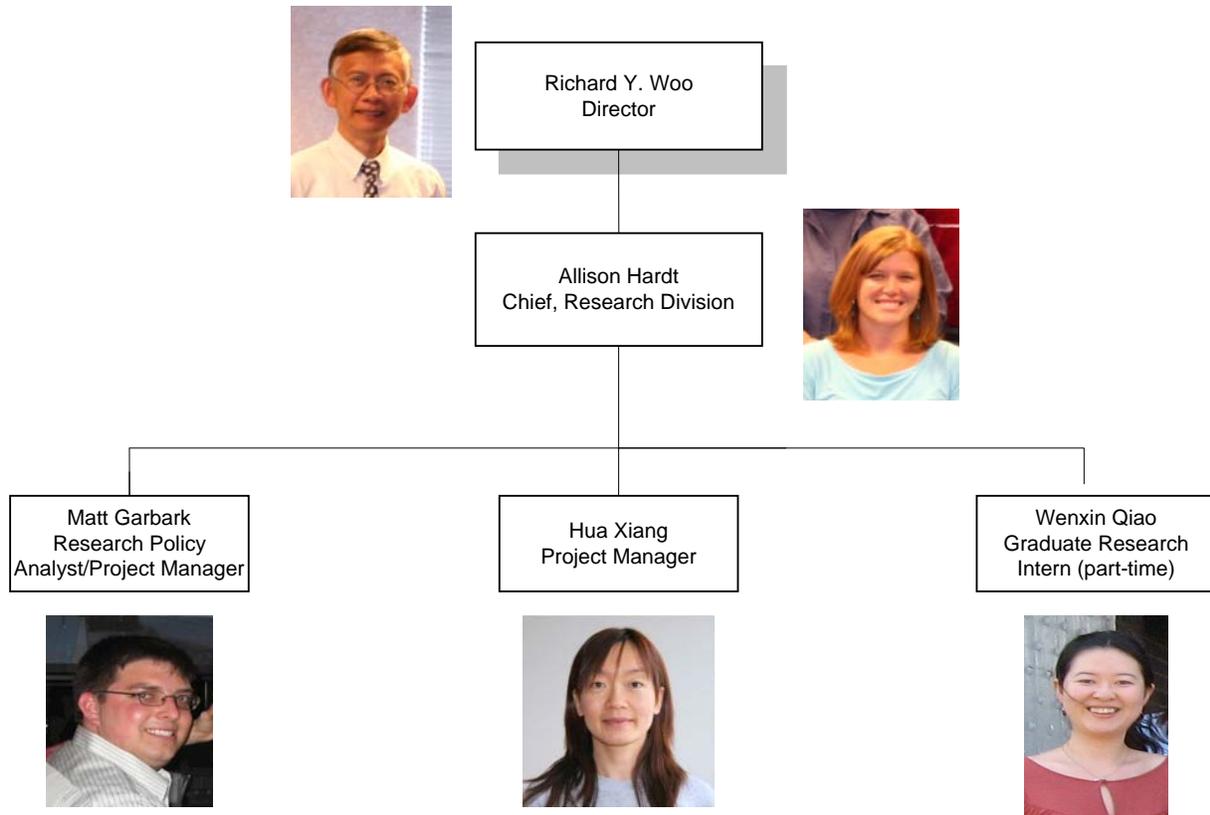
Provisions for State Planning and Research (SPR), Part I and Part II funding are found in Title 23, "Highways," Chapter 5, "Research and Technology," of the US Code. Two percent of the core apportionment categories are to be used exclusively for highway planning and research activities. Of this amount, no less than 25% must be spent on research. The Office of Policy and Research manages the Maryland State Highway Administration's (SHA) SPR research funding. The goal of the program is to support research which is in line with of the objectives identified in SHA's FY 2012 - 2015 Business Plan, to share research results, and to support appropriate technology transfer activities.

Appropriations are based on the Federal Fiscal year (FFY), which begins October 1 and ends September 30. Due to administrative procedures, projects in the Maryland Research Work Program typically begin in December or January. This report reflects Work Program activities during calendar year 2012 beginning January 1 and ending December 31.

Work Program funding for FFY 2012 totaled approximately \$3.4 million. Traditionally, a portion of the Work Program is dedicated to national research activities like the National Cooperative Highway Research Program (NCHRP), participation in national/regional transportation pooled fund studies, and support for Transportation Research Board (TRB) technical activities. It was the same for the 2012 work program where 28% of the total budget was reserved for these programs. The Work Program match for the federal Local Technical Assistance Program (LTAP) apportionment represents 5% of total program funding. Administration of the research program accounted for about 10% of total program funding for FFY 2012 (but represents about the same dollar amount of expenditure as in prior years). The remaining funding, about \$1.9 million (57%) was obligated for SHA sponsored research projects.

Each year, SHA sponsored research projects and transportation pooled fund (TPF) studies are solicited from senior managers, Business Plan Key Performance Area (KPA) councils, and SHA's main university research partners, the University of Maryland and Morgan State University. In calendar year 2012, SHA's Research Advisory Board (RAB) members ranked their "top 10" projects submitted for the draft FFY 2013 research work program. The results of their ratings were tallied and the research priorities identified through this process were reviewed with SHA's Administrator to formulate the draft 2013 program. This draft was subsequently submitted to the DelMar Division of the Federal Highway Administration for approval. SHA's Research Work Program projects typically address a broad spectrum of transportation needs, and support emphasis areas identified in the SHA Business Plan. Projects in 2012 related to managing resources, mobility/congestion relief, safety, system preservation/maintenance, environmental stewardship, technical assistance from universities, and planning.

RESEARCH DIVISION ORGANIZATION CHART



RESEARCH DIVISION ACCOMPLISHMENTS – 2012

In addition to administering the annual Research Work Program, in 2012 the Research Division focused on providing access to SHA research reports, encouraging SHA employees' technology transfer activities, and on improving existing programs and processes. A summary of accomplishments are listed below.

Customer Service Initiatives:

- Continued to make improvements to and update OPR's Intranet site to ensure that the information provided is up-to-date.
- Continued to facilitate information dissemination and research results sharing.
 - Posted active project quarterly progress reports on the S drive.
 - Developed a webpage on SHA's Internet site to post final reports and summaries of research projects from year 2000 to present.
 - The links to final reports and summaries were sent to the Research Advisory Board and TRB for posting in the TRID database. Several projects were highlighted in the weekly TRB E-Newsletter.
- Continued to offer survey assistance to SHA offices through an annual subscription to Survey Monkey, a web-based survey tool. Because there is no training or users' manual for the site, this includes maintaining a list of tips on how to create a survey on OPR's Intranet to help first time users.

National Research Activities:

- Submitted two problem statements for consideration in the FY 14 National Cooperative Highway Research Program (NCHRP) in September, 2012. The submissions were made on behalf of the Office of Planning and Preliminary Engineering and the Office of Materials Technology.
- Coordinated and held the annual TRB State Visit on November 28, 2012. Tom Palmerlee, Associate Director of TRB's Technical Activities Division, met with several teams from the Office of Planning and Preliminary Engineering, with a focus on SHA's data and information systems. Topics included travel forecasting and demand modeling, regional planning, highway information systems, and enterprise GIS.
- Coordinated and held a SHRP2 Implementation meeting with SHA managers on December 13, 2012. Neil Pedersen, Deputy Director, Implementation and Communications, TRB, visited SHA to provide an overview of the SHRP2 implementation program areas and the products that would potentially be of interest to SHA. SHA will have the opportunity to apply for implementation funding for a wide variety of SHRP2 products beginning in 2013.
- Coordinated the nomination of nine SHA employees to eleven FY 13 NCHRP project panels.
- Participated in monthly AASHTO Research Advisory Committee conference calls.
- Continued to serve as the TRB State Representative, SHRP II coordinator, and Vice Chair of the AASHTO Research Advisory Committee (RAC) Region 1. (Allison Hardt)
- Presented the results of SHA's "Bridge Health Monitoring System" project at a session on High Value Research Results at the AASHTO RAC meeting in Burlington, Vermont, in July and at the TRB Annual Meeting in Washington D.C. in January, 2013. The project was completed by the University of Maryland for the Office of Structures. (Allison Hardt)

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- Served as a panel member for NCHRP Project 20-89 – Intellectual Property Management Guide for Public-Sector Transportation Agencies (Allison Hardt) and NCHRP 03-107 - Guidance on Work Zone Capacity Estimation and Simulation (Hua Xiang).
 - Provided support to Richard Woo, Director of Policy and Research in his role as a representative to the AASHTO Standing Committee on Research (SCOR), which selects projects for the NCHRP, approximately \$35 million/year. This includes coordination of the annual NCHRP ballot.

Process/Program Improvements:

- Created an End-of-Project Check List to document significant results and lessons learned from a completed research project.
- Developed a webpage on SHA's Internet site to post final reports and summaries of research projects from year 2000 to present, and created a knowledge management document for preparing and publishing a research report to the webpage.

Technology Transfer (T2) Activities:

- Applied for and received \$15,000 from FHWA's Technology and Innovation funding to provide training on the Maryland Manual on Uniform Traffic Control Devices Update to SHA and local transportation agencies. The Maryland T2 Center administered the training.
- Provided funding for SHA's participation in the following AASHTO Technical Services Programs (TSP): Climate Change Technical Assistance Program, Environmental Technical Assistance Program, Load and Resistance Factor Design Bridges and Structures Specification Maintenance, Safe, Reliable, and Secure Transportation Operations (SAFETY), AASHTO Product Evaluation Listing, National Transportation Product Evaluation Program, Equipment Management, Transportation System Preservation, Snow and Ice Cooperative Program, and Technology Implementation Group. Total cost for participation was \$84,200.

University Partnerships:

- Continued the Morgan State University Summer Internship Program. Eight interns worked at SHA in the Offices of Materials Technology, Information Technology, Highway Development, Planning and Preliminary Engineering, CHART and ITS Development, Customer Relations and Information, and District Four. Six of the internships were extended for the fall and spring semesters.
- Continued the University of Maryland graduate research assistant and Johns Hopkins Policy Internship programs. One graduate student from each program worked in OPR.
- Served on the National Transportation Center Advisory Board at Morgan State University. (Richard Woo)
- Served on the University of Maryland T2 Center Advisory Board. (Allison Hardt)
- Served as a member of the Mid-Atlantic University Transportation Center (UTC) Advisory Board. The Center is located at Penn State University and the University of Maryland and Morgan State University are regional members. (Allison Hardt)
- Served as a member of Virginia Tech's UTC Advisory Board. Morgan State University is a partner in the UTC. (Richard Woo)

RESEARCH RESULTS AND BENEFITS

2012 Research Reports:

Eleven research reports were published in 2012, as shown in the following table. The results of each project are listed in the next section:

Table 1 Research Reports Released in 2012

Project Number	Month Published	Project Title
SP909B4D	February	Bluetooth Traffic Detectors for use as Permanently Installed Travel Time Instruments
SP109B4K	April	Evaluating Channel Degradation of MD Streams (Phase II)
SP009B4Q	May	Assessment of Benefits from FITM Plan Deployment
SP109B4M	May	Low Cost Structural Health Monitoring of Bridge Using Wireless Sensors
SP009B4H	May	Traffic Data Collection and Anonymous Vehicle Detection Using Wireless Sensor Networks
SP109B4F	June	Addressing State Requirement and Establishing a Foundation for Secure Information at SHA (not published due to confidential information from other states and SHA)
SP109B4B	July	Experimental Traffic Control Device Testing at Fort McHenry Tunnel: Purple Dots
SP009B4U	July	Review and Enhancement of CHART Operations Strategies to Maximize Benefits of Incident Response and Management
SP708B4J	September	Dilemma Zone Monitoring/Warning System for Intersection Safety
SP009B4T	September	Development of Beneficial Biological Agents for Invasive Species Control
SP109B4N	December	Theoretical and Field Experimental Evaluation of Skewed Modular Slab Bridges

SHA employees can obtain a copy of all final reports on the S drive at <S:\SHA\Policy & Research\SHA Research Reports> and the public can access the final reports from 2000 to present on SHA's website at <http://www.roads.maryland.gov/pages/oprreports.aspx?pageid=367>.

Research Benefits:

- Dilemma Zone Monitoring/Warning System for Intersection Safety** – The study was the third phase of a nine-year effort led by the Office of Traffic and Safety in addressing signal yellow phase and crash rates. The first two phases focused on identifying critical factors affecting a driver's decision when encountering a yellow phase. The second phase started the development of a dynamic dilemma-zone protection system based on field observations. This current phase, the final phase of the study, designed and evaluated the dynamic dilemma-zone protection system through a field test at the intersection of US 40 and Red Toad Road in Cecil County. The designed system proved to function effectively and its effectiveness in preventing a potential side-collision accident was observed in the video captured at the site.

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- **Bluetooth Traffic Detectors for Use as Permanently Installed Travel Time Instruments** – The University of Maryland's CATT Center through a partnership with Traffax Inc., designed, deployed, and tested six prototype units on a corridor along I-95 and I-495 between Baltimore and Washington, DC. The design of permanently installed Bluetooth sensors met the demanding environment along roadways, continuous and sustainable power sub-systems, and robust wireless cellular communications. Concurrently real-time central processing was established to handle continuous traffic reporting in support operations. The flexibility in placing Bluetooth sensors proved extremely cost effective, not only taking advantage of existing structures, but the speed of installation and ability to mount anywhere allows selection of safe locations that do not require a high degree of Maintenance of Traffic, further decreasing installation and life-cycle costs.
 - **Traffic Data Collection and Anonymous Vehicle Detection Using Wireless Sensor Networks** – An inexpensive and energy self-sufficient traffic sensor that can be adapted for a range of traffic management applications was developed. Five sensors were deployed on the Intercounty Connector (MD 200) and lane-by-lane traffic data was analyzed. The results indicated that the wireless vehicle sensing architecture can be adapted for a range of traffic management applications. SHA can take advantage of this scalable technology to increase data granularity by increasing points of detection on the highway system at a relatively low cost. The sensor can also be used for work zone monitoring and data collection for performance measurement.
 - **Assessment of Benefits from FITM Plan Deployment** – This research developed a multi-criteria decision-support system for determining the necessity of detour operations during incident management from an overall socio-economic benefit perspective. The developed system enables decision makers to consider all associated critical factors with preferred weights, which include the direct benefits and operational costs, safety and reliability, accessibility of detour, and acceptability by travelers. This research is part of an integrated incident management system developed for Maryland that has various functions, ranging from prediction of incident duration to estimation of operational benefits.
 - **Development of Beneficial Biological Agents for Invasive Species Control** – As a result of this project SHA has a more sustainable and cost effective method of using biological control (i.e. using a natural predator, in this case two species of beetles) for dealing with noxious and invasive weeds on highway rights-of-way. This will save herbicide, labor, equipment and fuel costs associated with traditional weed management methods. (See Page 12 for more details.)
 - **Review and Enhancement of CHART Operations Strategies to Maximize Benefits of Incident Response and Management** – This study identified critical factors affecting the Office of CHART and ITS Development's efficiency in incident response and clearance and produced reliable models to improve its performance in incident traffic management. Incorporating the models into practice will enhance CHART's operational quality and increase its effectiveness in minimizing non-recurrent congestion in the region.

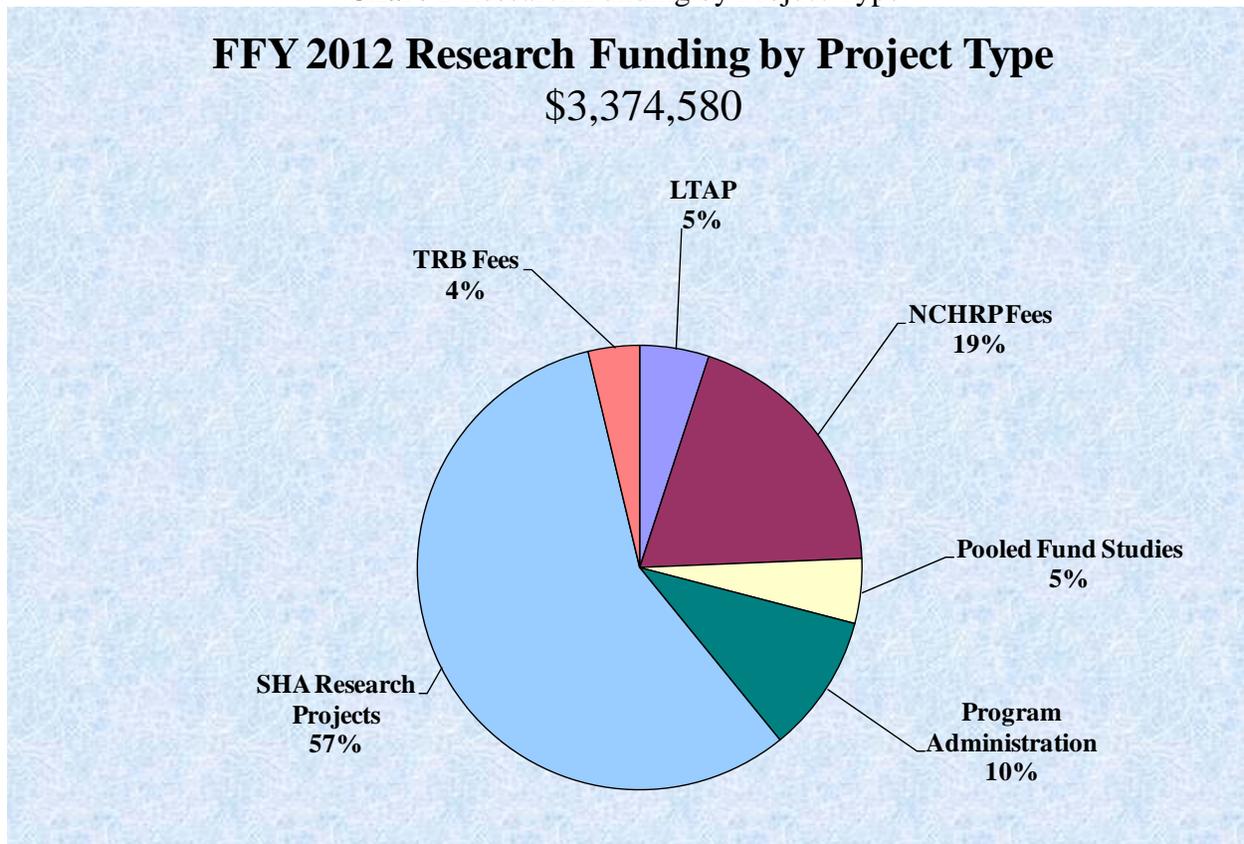
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- **Experimental Traffic Control Device Testing at Fort McHenry Tunnel: Purple Dots** – The results of this study indicate that the purple dots reduced lane changing by E-ZPass® customers. Additionally, the purple dots appear to improve safety by reducing crashes on the approach to the toll plaza. (See Page 13 for more details.)
 - **Addressing State Requirements and Establishing a Foundation for Secure Information at SHA** – This project included a review of current data classification practices within the State DOTs. The findings show that most DOTs are using Federal Information Processing Standards/National Institute of Standards and Technology as the basis for their data classification program. Based on current practices it seems that it is reasonable to use three levels of classification related to confidentiality: public, internal, and confidential. The MD Department of Information Technology currently requires a minimum of two levels (public and confidential). The classification of data at SHA will begin by using a combination of the methodologies used by other State DOTs.
 - **Evaluating Channel Degradation of MD Streams – Phase II** – The first phase of this study was completed by RK&K in 2011 for 26 sites in streams of three western Maryland counties: Garrett, Allegany and Washington. This Phase 2 study selected 30 sites in three additional Maryland counties: Frederick, Carroll, and Montgomery. Six factors that may influence a site’s risk of LTBD were identified. The relation between valley slope and LTBD was recommended to estimate LTBD for streams with slopes of less than 0.027 ft/ft. This relation and the database of LTBD field measurements will serve as a basis for SHA’s decisions related to both design and planning projects involving foundations for waterway crossings, depth of utility crossings, culvert replacements requiring fish passage, and mitigation projects involving stream restoration and/or stream stability.
 - **Low Cost Structural Health Monitoring of Bridge Using Wireless Sensors** – This study demonstrated that sensors developed by the University of Maryland are able to reliably transmit data and that it is feasible to use them for real time remote monitoring in a cost effective way. The sensors are also lightweight (20-25g), small (1.3inx3.5inx1.3in) and self adhesive. The average installation time is only 1-2 minutes per sensor and the current production cost is about \$150 - \$200 per device. The cost is expected to drop below \$50 per device once they are manufactured in high volumes. (Please see Page 1 for a picture of the sensor.)
 - **Theoretical and Field Experimental Evaluation of Skewed Modular Slab Bridges** – This study showed that as a bridge’s skew angle increases and the length-to-width ratio decreases, the likelihood greatly increases of reflective cracking occurring due to the introduction of alternate load paths. Reflective cracking is probably initiated due to thermal strains, but vehicle loads play a large part in crack propagation. The study results indicate that transverse post-tensioning placed close to the abutments and oriented parallel to the skew angle is very effective at reducing the transverse stress in this type of bridge.

MARYLAND SHA FFY 2012 RESEARCH WORK PROGRAM

SHA's research program is comprised of a mix of on-going support for national transportation research activities (i.e. NCHRP and TRB), pooled fund studies, support for Maryland's Local Technical Assistance Program (LTAP), program administration and SHA sponsored research projects. Chart 1 presents an illustration of the breakdown of research funding for the FFY 2012 program.

Projects Funded

Chart 1 Research Funding by Project Type



Research Funding by Project Type

LTAP	\$ 170,000
NCHRP Fees	\$ 651,421
Pooled Fund Studies	159,178
Program Administration	340,000
SHA Research Projects	1,928,111
TRB Fees	125,870
Total	\$ 3,374,580

In 2012, SHA continued its annual support of the National Cooperative Highway Research Program (NCHRP) at its longstanding contribution rate of 5.5% of the total SPR apportionment. NCHRP is administered by the Transportation Research Board (TRB) and sponsored by the member departments (i.e., individual state departments of transportation) of the American Association of State Highway and Transportation Officials (AASHTO), in cooperation with the Federal Highway Administration (FHWA).

As noted in the list of accomplishments on page four, SHA submitted two research problem statements to NCHRP for funding consideration in the FY 2014 program. The Research Division coordinated SHA's review and prioritization of all problem statements submitted to NCHRP and used the feedback to develop Maryland's priorities for the national program. The Research Division also solicited participants to represent Maryland on project panels to oversee NCHRP studies. Nine employees were nominated to eleven panels.

SHA's level of financial support for technical activities of the TRB is based upon a triennial agreement. In 2012 Maryland's portion was \$125,870.

Pooled Fund Studies

The research program typically includes funding to honor commitments which will support multi-year national and regional transportation pooled fund studies, as well as funding for support of new transportation pooled fund studies. The Federal Highway Administration (FHWA) sponsors the Transportation Pooled Fund Program as a means for interested States, FHWA, and other organizations to partner when significant or widespread interest is shown in solving transportation-related problems. The FFY 2012 research program supported five continuing pooled fund studies. The expenditures for transportation pooled fund studies represented 5% of the total budget.

LTAP and T2

The SHA provides a match to the federal allocation of funding for the Local Technical Assistance Program (LTAP) operated by the Technology Transfer Center at the University of Maryland. In 2012, the federal allocation was \$140,000 and for the fifth year, SHA maintained its match funds at \$170,000 so that the center could continue to function at its current levels.

SHA Research Projects

The majority of funding available for SHA's research program was for SHA managed (sponsored) research projects. In FFY 2012, these projects represented 57%, or \$1.9 million, of the total research work program budget. Of this amount, eight were for research projects funded on a routine basis, e.g. Evaluation of Experimental Features, New Products Evaluation, Data collection for Long Term Pavement Performance (LTPP) study, etc. The remainder represented new research projects identified through our annual solicitation and project selection process.

HIGHLIGHTS OF SELECTED PROJECTS

Development of Beneficial Biological Control Agents for Invasive Species Control

Principal Investigator: *Robert B. Trumbule, Maryland Department of Agriculture*

The objective of this study was to develop methods for the use of biological control (i.e. use of a natural predator) that would provide SHA with a sustainable and cost effective method for dealing with noxious and invasive weeds on SHA rights-of-way (ROW). The research team at the Maryland Department of Agriculture (MDA) propagated and released two beneficial biological agents, *Galerucella* leaf beetles and *Rhinoncomimus latipes* (a weevil or small beetle), for the control of two invasive plant species (purple loosestrife and mile-a-minute weed) at strategic locations. The research team then monitored their effects on weed populations over the course of two growing seasons. Other biological agents were also monitored for their potential to aid in the management of Canada thistle, *Cirsium arvense*.



Beetle release at a purple loosestrife infestation at SHA's Hanover Complex in June 2010

Rearing protocols developed by the New Jersey Department of Agriculture (NJDA) Beneficial Insect Laboratory were adapted for use at the MDA Insect Rearing Facility. Refinements were made over the two season timeframe and the numbers of insects reared significantly increased during the course of the study. The result of this work is a year-round weevil-rearing process where colony numbers can be increased quickly. MDA also developed a method for holding weevils in cold storage (similar to hibernation) for several days prior to release to ensure that sufficient numbers are collected.

During the study period high levels of activity of the Canada thistle bud weevil, *Larinus planus*, were found in Canada thistle populations in Maryland. However, the impact of this weevil could not be determined. Due to the widespread distribution and abundance of this herbivore, it is likely that the impact on seed development is significant, although not enough to eliminate populations of Canada thistle. It may however, reduce colonization of new sites due to the reduction in spread of viable seed.

The numbers of the leaf beetle, *Cassida rubiginosa*, while high in certain areas, remained relatively low overall. The research team speculated that the impact of the leaf beetle on Canada thistle is low, as many plants still are able to flower and set seed after early season leaf beetle herbivory. However, coupled with other biocontrol agents, additional stressors, including the leaf beetle, may have a long term impact on Canada thistle populations.

Based on site visits, the disease causing apical chlorosis in Canada thistle continued to spread in Maryland. The disease is of interest because it appears to delay and/or reduce flowering and viable seed production. The research team hypothesized that mechanical means of transmission and spread of the disease, including feeding by certain insects and human activities (e.g. mowing), may help spread the disease.

What SHA Learned:

Biological control can provide a sustainable method for dealing with noxious and invasive weeds. It can also save herbicide, labor, equipment, and fuel costs associated with traditional weed management methods.

Experimental Traffic Control Device Testing at Maryland Toll Plazas

Conducted by: *Maryland Transportation Authority (MDTA)*

In 2005, the Federal Highway Administration (FHWA) approved MUTCD Experiment Number 3-181(Ex) to test the use of purple pavement marking “dots” as a traffic control device to improve guidance of E-ZPass® transponder holders into the dedicated transponder lanes at the Fort McHenry Tunnel toll plaza on I-95 in Maryland. The “dots” were also intended to reduce the incidence of sudden lane changes and/or stopped cash paying toll customers within the dedicated transponder lanes. An evaluation by MDTA found that the experimental purple dot markings provided operational benefits at the Fort McHenry Tunnel toll plaza. The reduction in lane changes with the dots in place indicated a strong potential for safety benefits and there was a high level of customer satisfaction. In 2008, FHWA advised MDTA that continuation of the experiment would require enhanced crash data collection.



The objective of this project was to collect enhanced toll plaza crash (type and location) data with and without the purple “dot” markings. Six operational measures of effectiveness (MOEs) were identified, and data were analyzed for an after period (August/September 2011) and compared to before data collected prior to the Phase II installation of the purple dots. Data was aggregated by time of day and week, resulting in a number of before/after comparisons for each MOE.

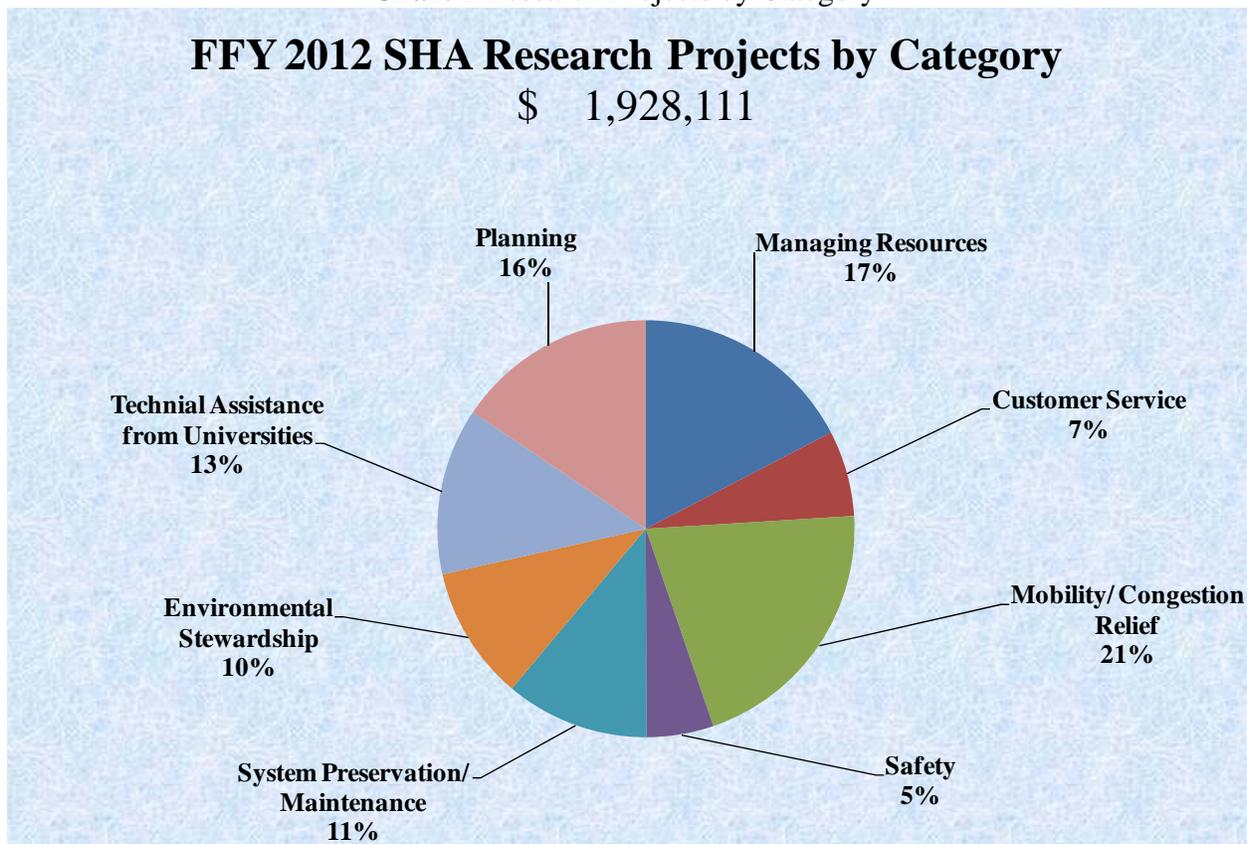
The results indicated that the purple dots reduced lane changing by E-ZPass® customers (approximately 70% of toll plaza user) and are the group of drivers which the purple dots are intended to assist. Additionally, the purple dots appear to improve safety by reducing crashes on the approach to the toll plaza. The results of other operational MOEs were mixed, including toll violation rates, approach lane volumes and toll lane volumes. Lane changes by cash customers from Lanes 6 and 7 (dedicated E-ZPass® lanes) to Lanes 5 and 8 (mixed cash/ E-ZPass® toll collection lanes) increased.

Given the measurable safety benefits noted in this report and that motorist response has been positive, MDTA is requesting approval from FHWA to keep the dots in place.

RESEARCH FOCUS AREAS

The research projects funded in FFY 2012 were related to all six Key Performance Areas in SHA's Business Plan. The full spectrum of research focus areas illustrates the diversity in the program. In FFY 2012, the distribution was 21% to Mobility/Congestion Relief, 17% to Managing Resources, 16% to Planning, 13% to Technical Assistance from Universities, 11% to System Preservation/Maintenance, 10% to Environmental Stewardship, 7% to Customer Service, and 5% to Safety (as shown in Chart 2).

Chart 2 Research Projects by Category

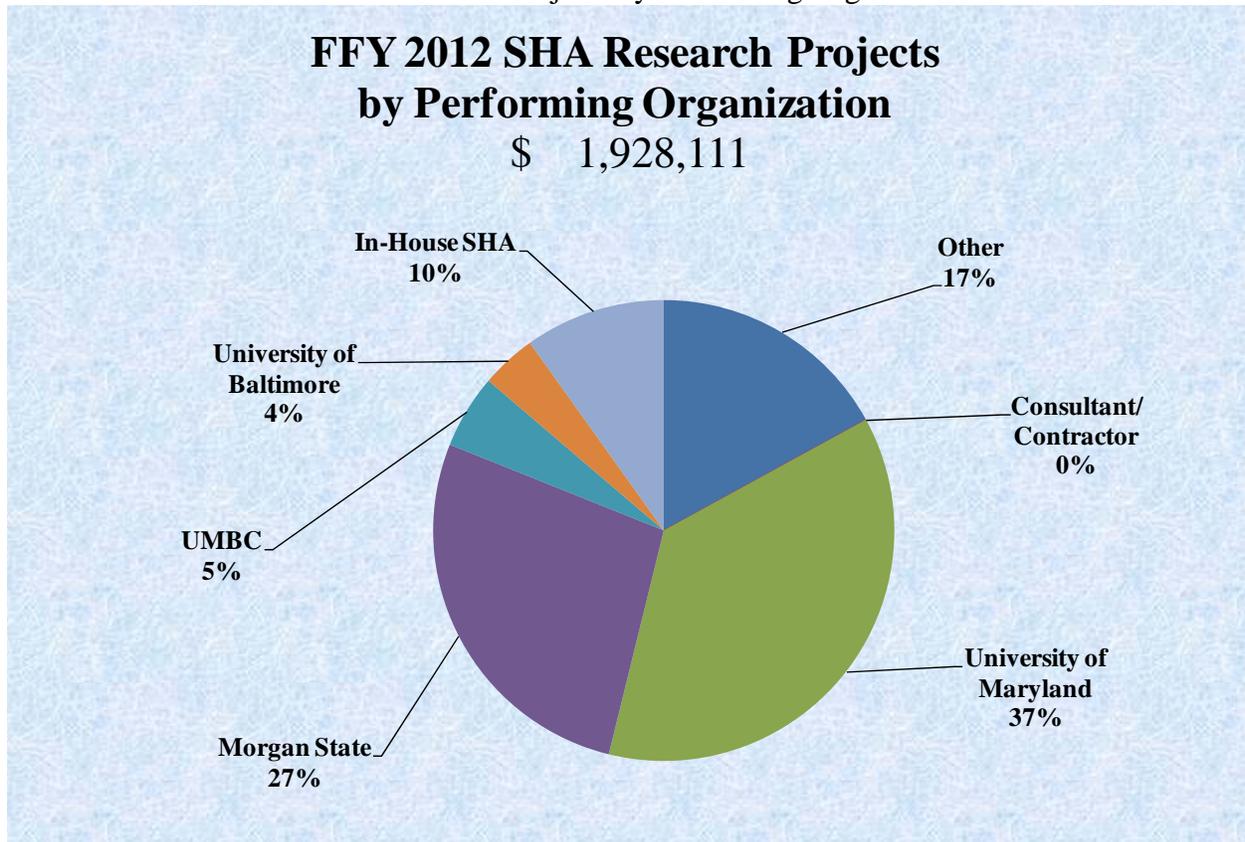


SHA Research Projects by Research Category

Managing Resources	\$ 335,000
Customer Service	128,111
Mobility/ Congestion Relief	400,000
Safety	100,000
System Preservation/ Maintenance	215,000
Environmental Stewardship	200,000
Technical Assistance from Universities	250,000
Planning	300,000
Total	\$ 1,928,111

Chart 3 shows the distribution of the SHA sponsored research projects by the entity performing the research. Thirty-seven percent (37%) are being completed by the University of Maryland, 27% by Morgan State University, 10% by In-House (SHA) staff, 5% by UMBC, 4% by the University of Baltimore, and 10% by others (e.g. support for Technology Transfer activities, projects completed by other government agencies, etc.). There were no consultant/contractor conducted research projects in FFY 2012.

Chart 3 Research Projects by Performing Organization



SHA Research Projects by Performing Organization

Other	\$ 328,111
Consultant/ Contractor	\$ -
University of Maryland	\$ 710,000
Morgan State	\$ 525,000
UMBC	\$ 100,000
University of Baltimore	\$ 75,000
In-House SHA	\$ 190,000
Total	\$ 1,928,111

Note: “Other” includes projects where the P.I. has not yet been determined and line items such as “Technology Transfer” where funding is used to cover the cost of training, participating in national conferences, peer exchanges, etc.

ADJUSTMENTS TO THE RESEARCH WORK PROGRAM

Below is a summary of adjustments to the research work program during calendar year 2012:

- The FFY 2012 Work Program estimated the cost of NCHRP to be \$651,421. The actual cost was \$600,167 (Funding is based on 5.5% of actual SPR apportionment).

Change in Work Program Amount: **(\$51,254)**

FFY 2012 PROJECT STATUS

Six of the twenty-five research projects (24%) funded in the FFY 2012 work program were completed as of December 31, 2012. One project, “Evaluation of Native Meadow for Chesapeake Bay TMDL/Watershed Implementation Plan,” was cancelled, based on an internal decision that SHA would no longer pursue this research. Table 2 on the next page shows the status of all projects.

Table 2 Status of FY 2012 Research Work Program Projects

Project Number	Project Title	Funding	Research Manager	Project Status (as of December 31, 2012)
SP209B41	Local Technical Assistance Program (LTAP)	\$170,000	Allison	➤ 100% Complete◀
SP209B42	Research Program Administration (with overhead)	\$340,000	Allison	➤ 100% Complete◀
SP209B43	TRB Technical Activities Service	\$125,870	Allison	➤ 100% Complete◀
SP209B44	Evaluation of Experimental Features	\$80,000	Allison	➤ 100% Complete◀
SP209B45	LTPP Maryland Performance Data Collection/Monitoring	\$30,000	Allison	➤ 100% Complete◀
SP209B46	Technology Transfer Program	\$75,000	Allison	➤ 75% Complete◀
SP209B47	New Products Evaluation	\$80,000	Allison	➤ 100% Complete◀
SP209B48	University of Maryland Technical Assistance	\$75,000	Allison	➤ 75% Complete◀
SP209B49	Morgan State Technical Assistance	\$75,000	Allison	➤ 75% Complete◀
SP209B4A	Support for the University of Maryland UTC	\$100,000	Allison	➤ 75% Complete◀
SP209B4B	AASHTO Technical Services Programs	\$100,000	Allison	➤ 100% Complete◀
SP209B4C	SHA External Customer Survey	\$75,000	Richard	➤ 100% Complete◀
SP209B4D	Development of Customer Service Improvement Initiatives	\$53,111	Richard	➤ 0% Complete ◀
SP209B4E	Evaluation of Native Meadow for Chesapeake Bay Total Maximum Daily Load /Watershed Implementation Plan Benefits	\$100,000	Hua	➤ Canceled ◀
SP209B4F	An Integrated Framework for Modeling Freight Mode, and Route Choice	\$100,000	Hua	➤ 90% Complete◀
SP209B4G	Using Bar Codes and Electronic Chips to Track and Store Sample and Structure Data	\$90,000	Matt	➤ 32 % Complete◀
SP209B4H	Geotechnical and Environmental Impacts of Steel and Blast Furnace Slag Use in Highway Construction	\$95,000	Hua	➤ 25% Complete◀
SP209B4J	The Development of Local Calibration Factors for Implementing the Highway Safety Manual in Maryland	\$100,000	Hua	➤ 90% Complete◀
SP209B4K	Travelers' Response to DMS Using a Driving Simulator	\$100,000	Hua	➤ 85% Complete◀
SP209B4M	Real-Time Truck Parking Information System	\$100,000	Hua	➤ 75% Complete◀
SP209B4N	Developing a Framework and Models for Transit-Oriented Development (TOD) Analysis	\$100,000	Matt	➤ 90 % Complete◀
SP209B4P	Measuring Economic Contribution of Freight Industry to the MD Economy	\$100,000	Matt	➤ 60 % Complete◀
SP209B4R	Understanding CHART's Overall Effectiveness and Identification of Areas for Growth	\$100,000	Matt	➤ 30% Complete◀
SP209B4S	Sustainable Landscaping Practices for Enhancing Vegetation	\$100,000	Matt	➤ 0% Complete◀
SP209B4T	Exploring Travelers' Behavior in Response to Variable Message Signs (VMS) Using an Integrated Driving Simulator/Traffic Simulator (additional funding to expand SP209B4K)	\$100,000	Hua	➤ 85% Complete◀

PROGRESS OF PROJECTS CARRIED INTO 2012

In addition to the projects funded in the 2012 work program, a number of projects were carried over for completion from prior work programs. Table 3 provides the status of those projects.

Table 3 Progress of Projects Carried into 2012

Project Number	Project Title	Work Program Year	Funding	Research Manager	Project Status
SP708B4D	Maryland Motor Carrier Program Performance Measures	2007	\$100,000	Allison	Active
SP708B4J	Development and Testing of An Intelligent Dilemma Zone Monitoring and Warning System for Intersection Safety Improvement	2007	\$127,000	Hua	Completed
SP808B4P	Line-Striping Life-Cycle Analysis Phase II	2008	\$120,000	Allison	Completed
SP909B48	University of Maryland Technical Assistance	2009	\$100,000	Allison	Completed
SP909B4E	Design and Evaluation of Foamed Asphalt Base Course	2009	\$225,000	Hua	Active
SP909B4K	Material Quality Assurance Risk Assessment	2009	\$145,500	Hua	Completed
SP909B4P	Geoenvironmental Impacts of using High Carbon Fly Ash in Structural Fill Applications	2009	\$137,500	Allison	Completed
SP009B4A	Support for the University of Maryland UTC	2010	\$100,000	Allison	Completed
SP009B4B	Policy Research Support	2010	\$50,000	Richard	Completed
SP009B4D	Evaluation of Condition of All SHA Bridge Rocker Type Bearings	2010	\$100,000	Allison	Active
SP009B4E	Integrated Corridor Planning for Transportation and Environmental Improvement	2010	\$100,000	Matt	Completed
SP009B4F	Development of High Quality Pervious Concrete Specifications for Maryland Conditions	2010	\$98,000	Hua	Completed
SP009B4G	Innovative Contracting Strategies for Combating Climate Change	2010	\$100,000	Hua	Completed
SP009B4H	Traffic Data Collection and Anonymous Vehicle Detection using Wireless Sensor Networks	2010	\$100,000	Hua	Completed
SP009B4J	Evaluation of Drainage Troughs under Bridge Movable Roadway Joints	2010	\$100,000	Allison	Canceled
SP009B4K	Examine Impact to Highways/Structures – Vehicles Equipped With Lift Axles	2010	\$100,000	Matt	Completed
SP009B4M	Determining Sinkhole Susceptibility for the Hagerstown Valley: Phase II	2010	\$136,924	Allison	Active
SP009B4N	Soil Slope Failure Investigation Management System	2010	\$125,000	Hua	Active
SP009B4Q	Assessment of Resulting Benefits from FITM Plan Deployment	2010	\$100,000	Matt	Completed
SP009B4R	Cumulative Impact of Development on the Surrounding Roadways' Traffic	2010	\$150,000	Allison	Completed
SP009B4T	Development of Beneficial Biological Agents for Invasive Species Control	2010	\$100,000	Matt	Completed
SP009B4U	Review and Enhancement of CHART Operational Strategies to Maximize the Benefits of Incident Response and Management	2010	\$100,000	Matt	Completed
SP009B4W	Evaluation of the Effectiveness of the ALP Program	2010	\$20,000	Allison	Canceled
SP009B4X	Assessment and Evaluation of SHA's Junkyard Control and Regulations	2010	\$20,000	Matt	Canceled
SP109B48	University of Maryland Technical Assistance	2011	\$75,000	Allison	Completed
SP109B49	Morgan State Technical Assistance	2011	\$75,000	Allison	Completed
SP109B4A	Support for the University of Maryland UTC	2011	\$100,000	Allison	Completed
SP109B4B	Experimental Traffic Control Device Testing at MD Toll Plazas - Purple Dot Markings for E-ZPass Lanes at Tollbooths - Phase II	2011	\$100,000	Matt	Completed
SP109B4C	Understanding the Potential Impact of Various DMS Messages on Traffic Flow	2011	\$150,000	Hua	Active
SP109B4D	Identification of Techniques to Meet pH Standards During In-Stream Construction	2011	\$100,000	Hua	Active
SP109B4E	Evaluation of Waste Concrete Road Materials for Use in Oyster Aquaculture	2011	\$91,000	Hua	Completed
SP109B4F	Addressing State Requirements and Establishing a Foundation for Secure Information at SHA	2011	\$99,517	Matt	Completed
SP109B4G	Development of Design Guidelines for Proper Selection of Graded Aggregate Base in MD Highways	2011	\$95,000	Hua	Active
SP109B4H	Geographic Information System Based Subsurface Database Interface	2011	\$100,000	Hua	Active
SP109B4K	Evaluating Channel Degradation of MD Streams (Phase II)	2011	\$100,000	Hua	Completed
SP109B4M	Bridge Health Monitoring System Based on Flexible, Wireless, and Batteryless Patch Sensors	2011	\$50,000	Allison	Completed
SP109B4N	Theoretical and Field Experimental Evaluation of Skewed Modular Slab Bridges	2011	\$83,500	Matt	Completed
SP109B4P	Developing a Data and Modeling Framework for Integrated Transportation Operations and Planning	2011	\$100,000	Hua	Active
SP109B4Q	Sustainability Impact of Multimodal Corridor Improvements in Urbanized Area	2011	\$100,000	Matt	Active
SP109B4R	Greenhouse Gas Emissions Tools to Support Emissions Estimation in On-Road Transport along Freeways and Arterials	2011	\$100,000	Allison	Completed

UNIVERSITY AGREEMENTS

Because the Research Division has master agreements for research and technical assistance with the University of Maryland, Morgan State University, University of Maryland Center for Environmental Science, and the University of Baltimore, on occasion and as appropriate, other offices may be allowed to include tasks under these agreements for small research studies not funded through the research program (i.e. paid for by the office or another funding source). This has helped reduce the overall number of agreements, made the process more efficient, and made it easier to track work completed by SHA's university partners. When the Research Division issues a task for another office, the Chief of Research becomes the Contract Administrator for the task and assumes the administrative burden for the project. This includes reviewing the proposal, issuing notice-to-proceed, approving and processing invoices, and reviewing no-cost extension requests if necessary. In 2012, the Research Division served as the Contract Administrator for the following tasks for other SHA offices:

Task	Office
Inclusion of Time Dependent Networks in MSTM – University of Maryland	Office of Planning and Preliminary Engineering
ICC Before and After Study: Transition Phase – University of Maryland	
Enhancements for N& P Removal for <u>New</u> Stormwater Management Facilities – University of Maryland	Office of Highway Development – Highway Hydraulics Division
Enhancements for N& P Removal for <u>Existing</u> Stormwater Management Facilities – University of Maryland	
FY 13 Stream Restoration Assessment – University of Maryland Center for Environmental Science	
GISHydro Maintenance and Upgrade – University of Maryland	Office of Structures
Maryland MUTCD Update Training – Maryland T2 Center at the University of Maryland	Office of Traffic and Safety
UMCP Undergraduate Engineering Summer Internship Program for 2012 – University of Maryland	Office of Highway Development
National Summer Transportation Institute – Morgan State University	Office of Equal Opportunity
Strategic Planning Training – University of Baltimore	Performance Excellence Division

LOOKING INTO THE FUTURE

In 2013 the Research Division will focus on the following initiatives:

1. **Strategic Highway Research Program (SHRP2) Implementation** –Over the next two years the states will have the opportunity to apply for implementation assistance funding to help deploy TRB’s SHRP2 solutions. These solutions include new technologies, processes and innovations developed through the program that are now ready for implementation by the states. Because this is a new initiative with a significant amount of funding available, the Research Division will disseminate information on opportunities to apply for funding to appropriate offices, help identify appropriate solutions for deployment, help coordinate the submission of applications, and track SHA participation in the program. A summary of activities will be provided in the 2013 Research Annual Report.
2. **Research Program Customer Survey** – The Research Division will conduct a customer survey to help identify future focus areas and opportunities for improvement. Similar to the 2009 survey, the questions will be administered using Survey Monkey, a web-based tool. While many questions will remain the same, a few may be updated to reflect program changes.
3. **University Agreements** – The Research Division will continue to develop and execute agreements for SHA’s research and technical assistance activities. In 2013 the Division will develop its first open-end (task based) agreements with Towson University and the University of Maryland Baltimore County (UMBC). Agreements to continue partnership relationships with the University of Baltimore, University of Maryland Center for Environmental Science, and Morgan State University will also need to be developed in the coming year.