



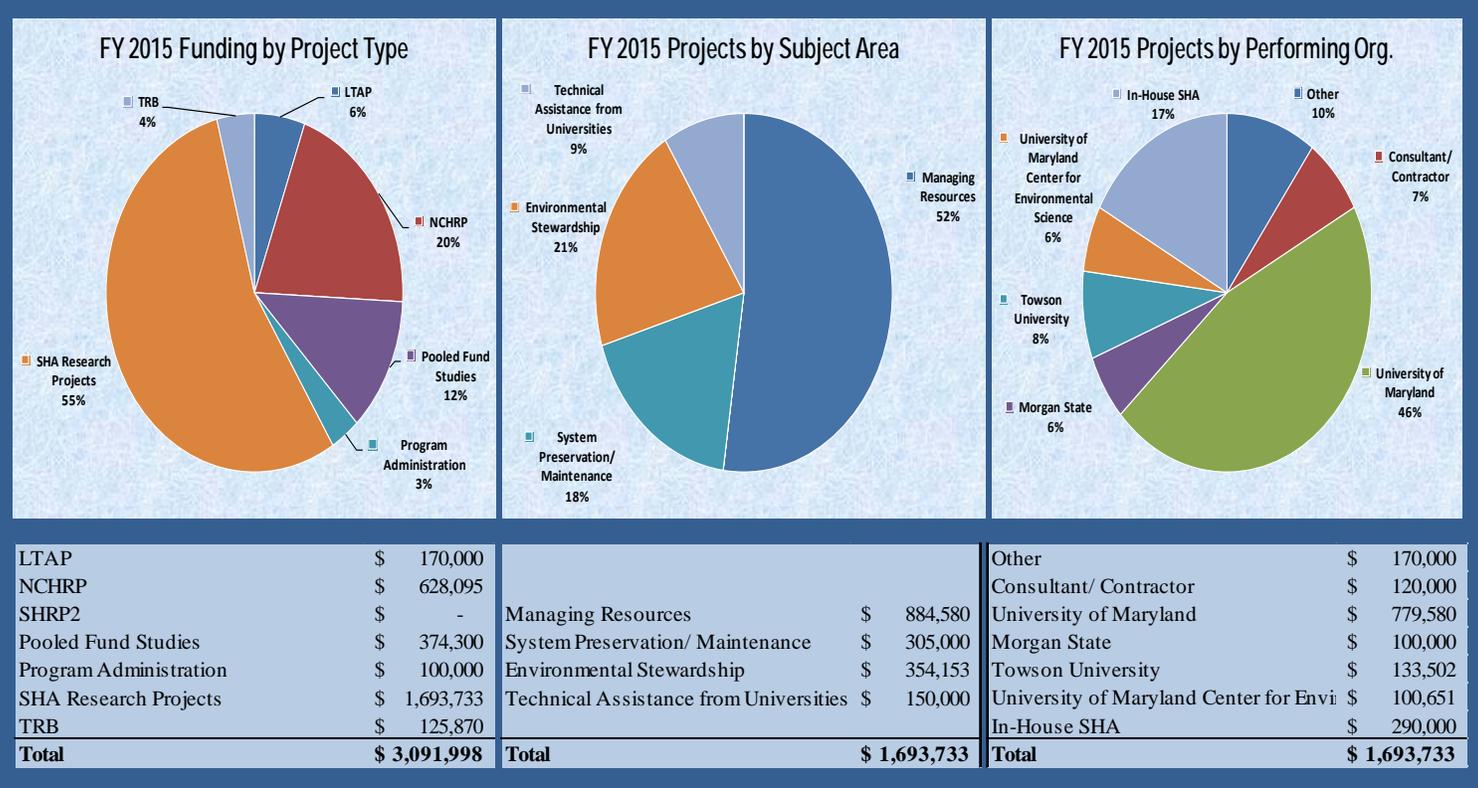
Research Annual Report

STATE PLANNING & RESEARCH PART II PROGRAM

2015 At-A-Glance

JANUARY 1, 2015 – DECEMBER 31, 2015

This report presents a summary of the Maryland State Highway Administration’s State Planning & Research (SPR) Part II Program. The funding statistics are provided for the FY 2015 Research Work Program in the following charts. The tables on pages 2 through 5 list all SHA-funded research projects by subject area that were active or completed during 2015. Two completed projects during the year are highlighted in the third section.



In addition to administering the annual Research Work Program, in 2015 the Research Division focused on providing access to SHA research reports and improving the request for proposals process to ensure an open and competitive process for selecting principal investigators. All SHA research reports since Year 2000 can be accessed online: <http://www.roads.maryland.gov/pages/oprreports.aspx?pageid=367>. Subscribe to [OPR's RSS feeds](#) to get notified as soon as a new report is posted on the site.

Maryland SHA 2015 Research

TABLES ARE ORGANIZED BY SUBJECT AREAS:

ABBREVIATIONS:

SHA Maryland State Highway Administration
 FHWA Federal Highway Administration
 MSU Morgan State University
 TU Towson University
 UB University of Baltimore
 UMBC University of Maryland, Baltimore County
 UMCP University of Maryland, College Park
 UMCES University of Maryland Center for Environmental Science

 Cancelled research projects
 Research projects that are still active
 Completed research projects

Safety

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP409B4K	Validation and Guideline Development of Dilemma Zone Protection Systems	UMCP	Hua	FY 2014	\$140,000	50%	\$ 12,892.07	
SP409B4N	Development of Local Calibration Factors for Implementing the Highway Safety Manual Phase II study for Freeway and Ramp Applications	MSU	Hua	FY 2014	\$100,000	100%	\$ 66,941.08	

Mobility/Congestion Relief

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP209B4R	Understanding CHART's Overall Effectiveness and Identification of Areas for Growth	UMCP	Hua	FY 2012	\$100,000	100%	\$ 9,551.21	
SP309B4C	Work Zone Performance Monitoring and Assessment through RITIS	UMCP	Hua	FY 2013	\$100,000	100%	\$ 19,011.84	

Planning

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP209B4P	Measuring Economic Contribution of Freight Industry to the MD Economy	MSU	Allison	FY 2012	\$100,000	100%	\$ 51,666.60	
SP409B4M	Estimating the Economic Impacts of Multimodal Transportation Improvements	UMCP	Hua	FY 2014	\$150,000	100%	\$ 88,398.93	

Administrative

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP509B4Z	Research Program Development and Implementation	In-House SHA	Allison	FY 2015	\$100,000	100%	\$ 53,512.12	

System Preservation/Maintenance

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP209B4H	Geotechnical and Environmental Impacts of Steel and Blast Furnace Slag Use in Highway Construction	UMCP	Hua	FY 2012	\$95,000	100%	\$ 38,026.51	
SP309B4E	Durability Assessment of Prefabricated Bridge Elements and Systems	MSU	Sharon	FY 2013	\$100,000	100%	\$ 23,807.15	
SP409B4F	Validation of Source approval of HMA Surface Mix Aggregates using Spectrometer	MSU	Sharon	FY 2014	\$110,000	100%	\$ 53,447.58	
SP409B4G	Stormwater Infiltration Potential (SIP)/Site Characterization using NASA Public Domain Imagery	MSU	Sharon	FY 2014	\$110,000	100%	\$ 87,735.20	
SP409B4J	Precision monitoring of bridge deck curvature change during replacement	UMCP	Sharon	FY 2014	\$100,000	75%	\$ 31,465.35	
SP509B4S	LTPP Maryland Performance Data Collection/Monitoring	In-House SHA	Allison	FY 2015	\$30,000	100%	\$ 20,064.82	
SP509B4F	Recycled Material Availability in Maryland—A Synthesis Study	UMCP	Hua	FY 2015	\$120,000	90%	\$ 680.16	
SP509B4J	Determination of Asphalt Millings Properties as Related to Stormwater Management Concerns	UMCP	Sharon	FY 2015	\$170,520	60%	\$ 2,148.03	
SP509B4K	Effective Implementation of Ground Penetrating Radar (GPR) - Phase II	UMCP	Hua	FY 2015	\$155,000	50%	\$ 9,001.80	

Environmental Stewardship

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP209B4S	Sustainable Landscaping Practices for Enhancing Vegetation	UMBC	Sharon	FY 2012	\$100,000	100%	\$ 72,417.93	X
SP309B4N	Informing Nest Site Restoration for the Endangered Northern Map Turtle	TU	Sharon	FY 2013	\$56,000	100%	\$ 6,112.65	
SP409B4D	Are outbreaks of emerging pathogens correlated with construction of wetlands?	TU	Sharon	FY 2014	\$60,000	100%	\$ 8,470.62	
SP409B4E	Evaluation of Waste Concrete Road Materials For Use In Oyster Aquaculture Phase III: Restoration Scale Applications	MSU	Hua	FY 2014	\$97,000	25%	\$ -	
SP409B4H	Evaluating Channel Degradation of Maryland Streams (Phase III- Part 2)	Consultant/ Contractor	Hua	FY 2014	\$100,000	100%	\$ 42,008.09	
SP509B4C	Literature Review and Synthesis of Compost Properties, Sources, Availability and Findings	Consultant/ Contractor	Hua	FY 2015	\$120,000	100%	\$ 16,910.64	
SP509B4D	Balancing the Use of Salt with Safety and Mobility in Winter Maintenance Operations - Amended 2/10/16		Sharon	FY 2015	\$170,000	Project Cancelled*	\$ -	
SP509B4E	Identification of Low Growing, Salt Tolerant Turfgrass Species Suitable for Use Along Highway Right of Way	UMCES	Hua	FY 2015	\$100,651	90%	\$ 39,088.94	
SP509B4M	Effectiveness of Nest Site Restoration for the Endangered Northern Map Turtle – Phase II	TU	Sharon	FY 2015	\$70,000	70%	\$ 1,861.17	
SP509B4N	Are outbreaks of emerging pathogens correlated with construction of wetlands? Phase II surveys	TU	Sharon	FY 2015	\$63,502	30%	\$ 28,594.65	
SP509B4P	TMDL Research - Morgan State UTC - Amended 2/10/16		Hua	FY 2015	\$95,000	Project Cancelled*	\$ -	

* The funding from SP509B4D and SP509B4P was reassigned to two pooled fund research studies: TPF-5(315) "National Accessibility Evaluation" and TPF-5(326) "Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs." The Federal Highway Administration approved the change on February 16, 2016.

Managing Resources

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP309B4D	Updated Regression Equations for Piedmont and Western Maryland	Consultant/ Contractor	Hua	FY 2013	\$100,000	100%	\$ 7,273.52	X
SP309B4G	Stainless Steel Prestressing Strands and Reinforcing bars for Use in Concrete Structural Elements	MSU	Sharon	FY 2013	\$60,000	100%	\$ 10,658.46	
SP309B4M	Serviceability-related Issues for Bridge Live Load Deflection and Construction Closure Pours	UMCP	Sharon	FY 2013	\$99,080	100%	\$ 61,881.06	
SP509B44	Evaluation of Experimental Features	In-House SHA	Allison	FY 2015	\$80,000	100%	\$ 32,924.18	
SP509B46	Technology Transfer Program	Other	Allison	FY 2015	\$50,000	80%	\$ -	
SP509B47	New Products Evaluation	In-House SHA	Allison	FY 2015	\$80,000	100%	\$ 60,021.12	
SP509B48	Project Implementation	In-House SHA	Allison	FY 2015	\$100,000	80%	\$ -	
SP509B4G	Efficient and Effective Implementation of Alternative Project Delivery	UMCP	Sharon	FY 2015	\$164,060	50%	\$ 3,684.13	
SP509B4H	Safe Accommodation of Bicyclists on High Speed Roadways in Maryland	UMCP	Hua	FY 2015	\$120,000	90%	\$ 119.89	

Technical Assistance from Universities

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
SP509B49	Morgan State Summer Internship Program	MSU	Allison	FY 2015	\$50,000	100%	\$ 94.52	
SP509B4A	Support For UTC Research	UMCP, MSU	Allison	FY 2015	\$100,000	50%	\$ -	

National Initiatives

Project Number	Project Title	Performing Organization	Research Manager	Work Program	Funding	% Complete as of 12/31/2015	FY 2015 Expenditures	Spotlight
NCHRP	National Cooperative Highway Research Program	Other	Allison	FY 2015	\$628,095	100%	\$523,126.00	
SP509B41	Local Technical Assistance Program (LTAP)	UMCP	Allison	FY 2015	\$170,000	100%	\$ 38,023.48	
SP509B43	TRB Technical Activities Service	Other	Allison	FY 2015	\$125,870	100%	\$117,996.00	
SP509B4B	AASHTO Technical Services Programs	Other	Allison	FY 2015	\$120,000	100%	\$ 99,200.00	

Transportation Pooled Fund Studies

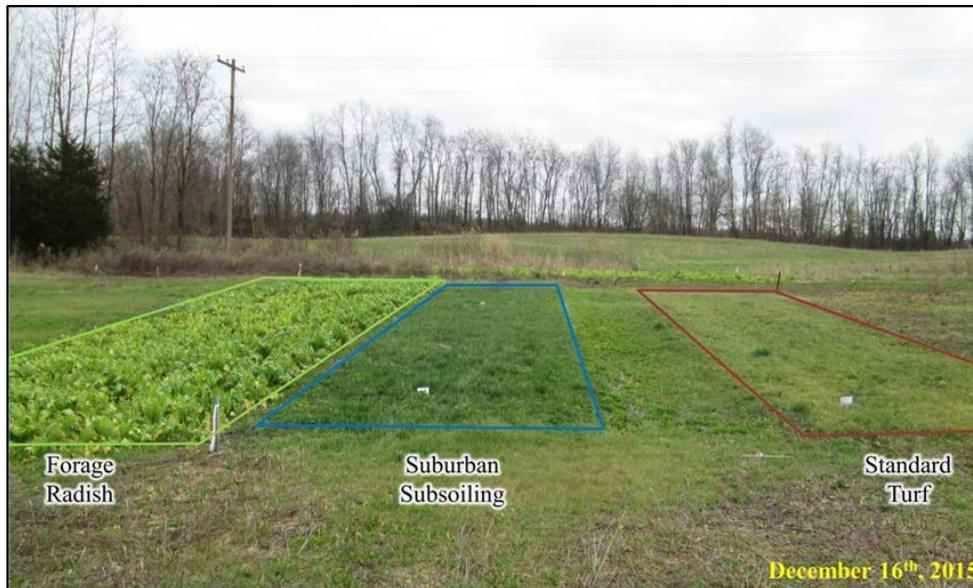
Project Number	Project Title	Lead Agency	Research Manager	Work Program	Funding	Transfer Completed?	FY 2015 Expenditures	Spotlight
TPF-5(054)	Maintenance Decision Support System (MDSS)	SD	Sharon	FY 2015	\$25,000	Y	\$25,000	
TPF-5(065)	Traffic Control Device (participation revisited on annual basis)	FHWA	Sharon	FY 2015	\$10,000	Y	\$10,000	
TPF-5(099)	Evaluation of Low Cost Safety Improvements (participation revisited on an annual basis)	FHWA	Sharon	FY 2015	\$30,000	Y	\$30,000	
TPF-5(198)	Urban Mobility Study	TX	Sharon	FY 2015	\$25,000	Y	\$25,000	
TPF-5(230)	Evaluation of Plant Produced High Percentage RAP Mixtures in the Northeast (last funded in FFY 13, this provides one final year)	NH	Sharon	FY 2015	\$14,300	Y	\$14,300	
TPF-5(279)	High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics (2nd year of a 3-year commitment)	FHWA	Sharon	FY 2015	\$15,000	Y	\$15,000	
TPF-5(285)	Standardizing the Lightweight Deflectometer (LWD) equipment for measuring the Modulus/Stiffness of Unbounded Soils and Aggregate tool as Compaction Quality Assurance Measures (QA)	MD	Sharon	FY 2014	\$25,000	Y	\$144,853	
TPF-5(299)	Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis	FHWA	Sharon	FY 2015	\$15,000	Y	\$15,000	
TPF-5(305)	Regional and National Implementation and Coordination of ME Design	FHWA	Sharon	FY 2015	\$10,000	Y	\$10,000	
TPF-5(315)	National Accessibility Evaluation - Added 2/10/16	MN	Sharon	FY 2015	\$200,000	N	\$0	
TPF-5(326)	Develop and Support Transportation Performance Management Capacity Development Needs for State DOTs - Added 2/10/16	RI	Sharon	FY 2015	\$30,000	N	\$0	

2015 Research Highlights

SP209B4S – SUSTAINABLE LANDSCAPING PRACTICE FOR ENHANCING VEGETATION ESTABLISHMENT

Compacted soils within highway medians and roadsides result in limited capacity to support healthy vegetation, storm water infiltration, and afforestation efforts. The Maryland State Highway Administration (SHA) has begun to explore the use of alternative, sustainable practices to improve soil structure within existing medians and former project staging areas along the roadside.

This research supports the integration of new practices and procedures to improve soil structure that will help turf, meadow, forest and landscape plantings to thrive. The project established experimental test plots in Taneytown, Maryland, and field-scale soil decompaction and amendment practices were evaluated alongside standard SHA practices for turf establishment. The Taneytown site was heavily compacted in the old MD 853 roadbed, and has been identified for a future afforestation project. Replicate treatments with suburban subsoiling (the combination of deep soil ripping and compost amendment) were compared to standard SHA turf establishment. Replicate plots were also treated by planting forage radish to explore the feasibility of bio-drilling to loosen and improve compacted soils on the site. Plots were prepared and planted in Fall 2014 and reseeded in Summer 2015. Soil characteristics including texture, bulk density, organic matter, soil strength as measured with a cone penetrometer, and infiltration capacity, were evaluated both prior to and after treatment.



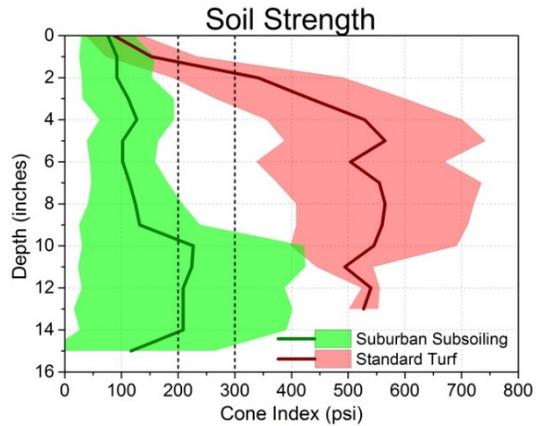
Test Plot in Taneytown, Maryland

Results and Implementation

The results demonstrated significant improvements to the compacted soils on the project site, resulting in more successful turf establishment and dramatic increases in storm water infiltration.

(1) Suburban subsoiling resulted in a permeable soil profile with higher organic matter and infiltration compared to standard turf establishment practices. The median soil strength (a surrogate for compaction) with depth for the two treatments was shown in below figure. A soil strength above 200 PSI is generally considered to be limiting and above 300 PSI restrictive for vegetation growth. Suburban subsoiling improved stormwater infiltration and the success of vegetation and afforestation efforts.

	Standard Turf	Suburban Subsoiling
<i>Bulk Density (g/cc)</i>	1.56	1.11
<i>Organic Matter (%)</i>	3.50	6.40
<i>Infiltration (in./hr)</i>	0.04	8.43



- (2) The mature deer compost used in this project provided stable soil carbon with nutrients and minimized the risk of nutrient losses or leaching when properly applied and soil-incorporated.
- (3) The significant radish development on plots with successful germination demonstrated the potential for biodrilling as a multi-year strategy to mitigate compaction.

These findings are appropriate to apply to SHA projects as a low cost, low risk approach to revitalizing compacted soils. Abandoned roadbeds of sufficient size and scale will benefit from subsoiling and biodrilling techniques to ameliorate soil compaction prior to planting or revegetating the site. Application of forage radishes will be more suitable for existing meadows and other appropriate roadside landscape management areas.

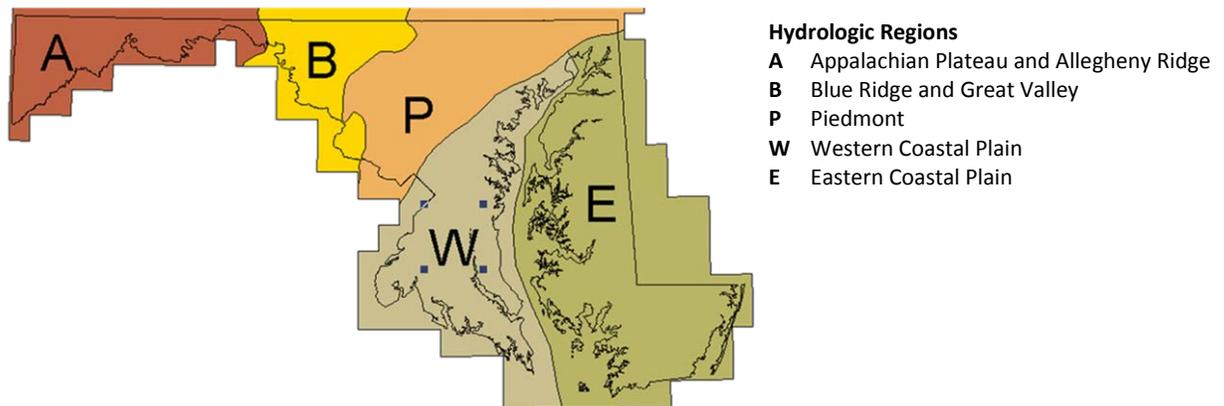
Cultivating deep permeable organic soil profiles by adapting these land development practices will result in reduced life-cycle costs for green asset maintenance. SHA can include these techniques in the designer’s toolbox for consideration on a site by site basis to promote long term landscape sustainability.

The final report of this project will be posted on the SHA research projects page:

<http://www.roads.maryland.gov/pages/oprreports.aspx?pageid=367>

SP309B4D – REGRESSION EQUATIONS FOR ESTIMATING FLOOD DISCHARGES FOR THE PIEDMONT, BLUE RIDGE, AND APPALACHIAN PLATEAU REGIONS IN WESTERN MARYLAND

Regression equations for estimating flood discharges are needed in Maryland for the design of bridges and culverts and estimation of bridge scour. These equations are updated whenever additional data are available to improve the existing equations. For the three hydrologic regions in western Maryland, there are now 13 additional years of annual peak data at gaging stations in these regions and an additional 26 gaging stations with 10 or more years of record. Many of the additional gaging stations were on urban streams and the updated regression equations provide more accurate estimates of flood discharges for urban streams.



The objective of the study was to develop updated regression equations for estimating the 1.25-, 1.50-, 2-, 5-, 10-, 25-, 50-, 100-, 200- and 500-year flood discharges for the Piedmont, Blue Ridge and Appalachian Plateau Regions in western Maryland. The updated regression equations are based on additional data that improve the applicability of the equations.

Flood discharges were updated for 133 gaging stations in western Maryland using Bulletin 17B, Guidelines for Determining Flood Flow Frequency. A regional skew analysis was performed and a regional mean skew of 0.43 with a standard error of 0.42 was determined to be applicable for rural watersheds in the study area. The station and regional skew were weighted to provide the final estimates of flood discharges at the gaging stations. Regression equations were developed using the Statistical Analysis System (SAS) regression procedures.

The regression equations for estimating the T-year flood discharges applicable to the Piedmont and Blue Ridge Region were based on data from 96 stations (64 rural and 32 urban stations) and drainage area, in square miles; impervious area, in percent of the watershed; limestone, in percent of the watershed; and forest cover, in percent of the watershed. The regression equations for estimating the T-year flood discharges applicable to the Appalachian Plateau Region were based on data from 24 rural stations and drainage area, in square miles and land slope, in feet per foot. The updated regression equations will be used by the Maryland State Highway Administration in the design of bridges and culverts. These equations will also be included in the Fourth Edition of the Maryland Hydrology Panel report entitled "Application of Hydrologic Methods in Maryland" that provides guidance on estimating flood discharges in Maryland.

Link to the final report: http://www.roads.maryland.gov/OPR_Research/MD-16-SP309B4D_Regression-Equations_Report.pdf

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To access SHA research reports: <http://www.roads.maryland.gov/pages/oprreports.aspx?pageid=367>

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