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FHWA and USGS Cooperate to Provide Environmental Engineering/Science Curricula Developed for the Stochastic Empirical Loading and Dilution Model (SELDM) to Universities and Colleges

Abstract

Managers and engineers at the Federal Highway Administration (FHWA) and State Departments of Transportation (DOTs) indicate that they need researchers, employees, consultants, and regulators who understand the unique challenges involved in managing and mitigating stormwater runoff and water quality for transportation projects. The U.S. Geological Survey (USGS), in cooperation with the FHWA developed the Stochastic Empirical Loading and Dilution Model (SELDM) and the tools and training to use the model for highway research, planning, analysis, and environmental review. SELDM is nominally a highway-runoff model, but it also can be used to model urban runoff quality. Although many colleges have civil-environmental engineering departments, the environmental-engineering curricula commonly are focused on municipal and industrial wastewater treatment and complex modeling methods. Research indicates that it may take 3 to 10 hours of curricula-development time to deliver one hour of classroom instruction. The FHWA and USGS currently (2017) are cooperating to provide SELDM training materials for use in upper-level undergraduate and graduate environmental engineering and science courses.

What is SELDM?

SELDM is a stormwater model designed to estimate storm-event flows, loads and concentrations in stormflows from upstream basins, a site of interest (a highway or urban area), best management practice (BMP) outfalls, and in the receiving water downstream of the site of interest. SELDM transforms complex scientific data into meaningful information about the risk of adverse effects from stormwater runoff on receiving waters, the potential need for mitigation measures, and the effectiveness of management measures. SELDM uses Monte Carlo methods to produce the random combinations of input variable values needed to generate the stochastic population for each input and output variable. SELDM has an easy-to-use graphical user interface and comes pre-loaded with precipitation, stormflow, and water-quality statistics for the conterminous United States. Input values for SELDM are based on site characteristics and representative statistics for each hydrologic variable. Users can quickly model different sites, assess those risks and evaluate different options.

New stormwater researchers, scientists and engineers are needed by DOTs.

Government agencies from across the country indicate that they need knowledgeable stormwater professionals. The USGS, in cooperation with the FHWA developed and delivered a series of three-day training classes on SELDM in CO, DC, MA, OR and TX for staff from the FHWA, State DOTs, Federal and State regulatory agencies, and resource management agencies. The American Association of State Highway and Transportation Officials (AASHTO) in cooperation with the FHWA sponsored attendance of DOT engineers from about 20 other states. The consistent message from State DOT staff and regulators who attended these classes was that this training was needed.

Most of these SELDM-class attendees also said that they needed researchers, employees, consultants, and regulators who understand the unique challenges involved in managing and mitigating stormwater runoff and water quality for transportation projects. Discussions at these classes and at recent FHWA–AASHTO practitioners meetings indicate that engineers

commonly are moved into environmental sections with little if any formal training on stormwater in the highway environment and many of the problems that they face with regulators and resource management agencies stem from a lack of understanding of the unique characteristics of highways as a source of runoff. Efforts to build an expert user base of working professionals are hampered by the nature of adult learners, distractions of their current job, and the need to compress a semester of material into a one-week class. Therefore, outreach to colleges and universities is needed to train upcoming students and to inform future research efforts.

The best time to educate environmental engineers and scientists on the unique nature of the transportation system, the methods to quantify the quality and quantity of highway runoff, and the potential effects on receiving waters is likely during upper level undergraduate classes and in graduate classes. Application and use of water quality models and their results depend on the user's understanding of the model theory and application to real world and unique situations (Feldman, 1988). Although many colleges have civil/environmental engineering departments, the environmental-engineering curricula commonly are focused on municipal and industrial wastewater treatment and complex modeling methods for large rivers, lakes, and estuaries.

Training materials are difficult and time consuming to develop.

In a review of the state of classes on hydrology, Wagener and others (2007, 2012) noted that the contents of available and commonly outdated textbooks set the curricula for many professors. They note that development of new curricula is hampered by the amount of time needed to develop teaching materials. Most respondents to a survey done by Wagener and others (2007, 2012) reported that 3-5 hours were needed do develop one hour of class material and many reported that they needed 6 to 10 hours to prepare one hour of class material. Furthermore, most respondents reported that 1-2 hours were required to prepare for each hour of class time once a course has been established. Therefore, adoption of SELDM training materials will help civil/environmental engineering professors develop new curricula that include recent research focused on highway hydrology. This information will help prepare students to meet DOT research and staffing needs.

The SELDM project has available data, software, and teaching materials.

The USGS, in cooperation with the FHWA has developed data, software, and teaching materials that can be used in the analysis of highway runoff, urban runoff, and other water-resources investigations. These products include:

- SELDM (USGS TM-4C3);
- The highway-runoff database with more than 117 sites, 4,186 storms, and 54,384 concentration values (FHWA-HEP-09-004 & USGS-SIR-2009-5269);
- The Kendal-Theil Robust Line Software, a multi-segment nonparametric regression program for water-quality and hydrologic analysis (USGS TM-4C3 & FHWA-HEP-09-003);
- The streamflow data-mining and analysis programs (USGS-OFR-2008-1362);
- The Site-Storm database with precipitation, runoff, and site characteristics data for 306 study sites (FHWA-HEP-09-005);
- Software tools and data hydraulic and hydrograph analysis (USGS-SIR-2012-5110); and
- Software tools and data for stochastic BMP performance analysis (USGS-SIR-2014-5037)

Training materials include:

- More than 24 hours of power-point presentations on basin properties, precipitation, streamflow, runoff coefficients, runoff quality, BMPs, Monte Carlo methods, statistics, risk analysis and related material;
- Narrated Adobe Captivate™ and Presenter™ training modules; and
- Class exercises

How to Learn More?

Please visit our website at:
http://webdmamrl.er.usgs.gov/g1/FHWA/SELDM.htm
Contact Susan Jones (susan.jones@dot.gov) or Gregory Granato (ggranato@usgs.gov).

References

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The Federal Highway Administration's Office of Planning, Environment, and Realty produced this fact sheet as part of its mission to improve transportation decision making and promote efficiency while protecting communities and the environment.