

# Engineering Design Procedures and Standard Drawings for Highway Construction Sediment Basins

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## Synopsis of the Research Problem

Engineering design criteria and guidelines for sediment basins at highway construction sites is needed by TDOT. The basic design and standard drawings for a construction site sediment basin is shown in TDOT's Design Division, Chapter 10 of the Drainage Manual, however better design guidance and information on basin performance is needed. Sediment basins are one erosion prevention and sediment control (EPSC) measures used to meet environmental regulations associated with stormwater runoff. TDEC required a NPDES General Permit (TNR100000) for *Stormwater Discharges from Construction Activities* to address water quality from construction sites greater than 1 acre of disturbed land surface with exposed soil to rainfall. Currently, this permit does not require numerical limits, rather relies on visual criteria stated as: "stormwater discharges must not cause an objectionable color contrast in the receiving stream." Meeting the visual water quality limits can be problematic for large highway construction projects. Another regulatory change from TDEC related to TDOT operations has been the reissuance of a NPDES General Permit (TNS775850) for Municipal Separate Storm Sewer System (MS4). Although TDOT is not a MS4, stormwater discharges from highway surfaces are being regulated under this general permit.

Funded by TDOT's Research Program during FY2011-2012, the first phase of addressing this issue needing improvements for construction sediment basin design criteria was a modeling effort. With the use of HydroCAD and SEDCAD, uncalibrated hydrological and sediment transport/pond settling models were developed for the input parameters: drainage area size from 1 to 50 acres, land slope (2-12%), and soil types (i.e., silt-loam, clay-loam-silt, etc.). Within these input parameter ranges, a set of basin design criteria was developed with a range of performance targets, summarized into a practitioner's usable table. With uncalibrated models there is uncertainty in model outputs and thus the developed design criteria since the model results have not been verified with field data. Field data are needed to verify the original sediment model outputs, and test on-site sediment basin performance, which constitutes the proposed Phase 2 research of this project. If model-field data differ significantly beyond field measurement variability, hydrologic and sediment modeling will be redone using the newly collected field data to calibrate the models. Our research team is considering the use of WinSLAMM, which may be an applicable sediment model for stormwater control measures.



Basin photo provided by Green Source Environmental

Benefits of this research for TDOT include: 1) improving design criteria and guidelines for the design of sediment basins, in order to meet TDEC effluent limits for construction site runoff discharges, and 2) reducing design costs by increased efficiency utilizing design tables rather than having to use hydrologic and sediment models for each site design.

### Project Objectives

The objectives of the Phase 2 research project are to: 1) collect field data at TDOT constructed sediment basins and monitor flow/sediment inputs/outputs to estimate performance as % reductions in sediment, and 2) compare field measurements with the design criteria developed during Phase 1 to confirm hydrologic and sediment transport modeling results, and if they differ adjust design criteria based on field measurements.

### Project Description and Current Outcomes

The Phase 2 effort will monitor flow/sediment inputs/outputs at three sediment basins at TDOT construction sites, selected and approved by TDOT staff. Each site will vary among three key modeling input parameters noted above to the best possible (drainage area size, slope, and soil type), dependent on what construction sites are available during the study period. Inlet and outlet flow measurement devices with stage recorders will be installed where each device's design will vary based on site topographic conditions. A modified version of the Pinson-type flow/sediment collector will be installed at basin inlet and outlet. At each site a continuously recording weather station will be installed measuring air temperature, wind speed, relative humidity, and rainfall intensity/volumes. Water samples will be collected at each sediment basin inlet and outlet with the goal to obtain approximately five to ten rainfall events on varying intensity/volumes (weather dependent).

### Project Status

Finding construction sites to install sediment basins has been challenging. Mr. Ali Hangul (Assistant Director, HQ Roadway Design & Office of Aerial Survey) has worked with Regions 1 and 2 to locate field sites. Assistance was also provided by Mr. Danny Oliver (Region 1, Director of Project Development). One site has been located in Morgan County, SR29, has been identified after several sites visits and a meeting with Deidera White and Chris Ponder, TDOT Operations, and the contractor. The proposed site at STA. 329+50, RT adjacent to the intersection of Hanging Rock Road and SR-29. See photo to the right including the cut slopes up gradient near STA. 340+00 that drain towards this location. Revised construction documents have been completed by Mr. Jeff Hoilman from Arcadis, and a change order for the construction contractor is in progress with TDOT. A second proposed site will be located on the Alcoa Highway Project in Knox County. A third site will remains to be determined.

