

**INSTALLATION OF STORMWATER
MANAGEMENT AND TREATMENT
DEMONSTRATION FACILITY**

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Introduction

Roadway runoff contributes large amounts of suspended solids/sediment, heavy metals, petroleum hydrocarbons, deicing chemicals, bacteria and other constituents to receiving waterways. The EPA National Urban Runoff Program (NURP) indicated that lead, zinc and copper were the pollutants most likely to be found in urban stormwater runoff. The occurrence of toxic heavy metals from Rhode Island highways, verified in a report completed by Thiem et al. in 1998, showed that cadmium, chromium, copper, lead, nickel and zinc exceeded EPA's acute and/or chronic water quality criteria. Besides toxic metals, stormwater also contains petroleum hydrocarbons, nutrients, and microbial matter as well as many other chemical compounds (Goebel et al., 2007). These toxic stormwater constituents are easily washed into water bodies, causing a decrease in overall water quality and stream diversity. In addition, toxic compounds often bind to soil particles and, upon entering drainage and runoff treatment structures, have to be removed and safely disposed of.

To comply with local and national stormwater quality discharge standards, as well as current regulations for environment protection, the Rhode Island Department of Transportation (RIDoT) has installed many structural Best Management Practices (BMP's) in an attempt to lessen pollutant loads to receiving waterways. For instance, between 1997 and 2007 more than 70 hydrodynamic separator units were installed by RI DOT. The selection of the various, commercially available BMP systems relies mostly on unverified manufacturer's data or is based on performance reports from other parts of the country where local environmental conditions are much different than those in Rhode Island. In general, there is insufficient data for science-based selection of the most appropriate BMP in Rhode Island. This project was meant to provide RI DOT and the URI transportation community with a new facility where BMP structures can be evaluated against the manufacturer's claims and under environmental conditions prevailing in our state. This facility has been named the "*Rhode Island Stormwater Technology Demonstration facility*" (RI STD).

The RI STD is a long-term commitment to stormwater studies at URI. The following describes which goals and objectives were achieved by constructing the RI STD and what can be expect from it in the future.

Goals and Objectives

The RI STD was conceived as a demonstration facility for testing innovative stormwater treatment systems and best management practices (BMP). In the past, University of Rhode Island students and faculty were forced to conduct stormwater studies off-campus, along heavily traveled roads or in places unsafe to work during nighttime. Also, timing the field tests to storm events has been extremely difficult and logistically challenging. The field studies, therefore, were often plagued by incomplete coverage of storm events or data gaps between sampling campaigns because of difficulties mobilizing man power and field equipment in time for a rain storm. These logistical challenges can now be minimized because at this time we have immediate access to the field equipment and have the man power available near to where the field tests are conducted. Hence, having built the RI STD facility on the campus of URI in Kingston provides the stormwater research community with a safe and highly instrumented test ground for evaluating commercial or innovative in-situ BMP technologies. The data generated by RI STD can, for example, be used to address *Phase II* water quality requirements. We anticipate that this will lead to the realization of more sophisticated field studies and better, larger data sets with greater impact on the state's and nation's stormwater management research. .

Another important reason for constructing the RI STD was to enable testing and demonstrating conventional BMPs and novel stormwater runoff treatment strategies under the environmental conditions prevalent in Rhode Island. RI has a unique climate that sets itself apart from the other states in New England and the rest of the nation. Rhode Island's unique climate setting, plus the impacts resulting from a changing climate, made it necessary to design a test site and test conditions that truly reflect the environmental conditions in our state.

Finally, the RI STD ties into an existing catch basin structure on Flagg Road (Figure 1). Also, a recent expansion of parking space and access roads further down from RI STD lead to the installation of several large stormwater control structures, including permeable asphalt pavement surfaces. This construction presented a unique opportunity because its completion coincides with the start of the research activities at RI STD. This permits a direct comparison of conventional treatment approaches to other more innovative ones to be tested at the RI STD site.

All major construction and equipment purchases have now been completed and we are now preparing the site for field research projects. The research at RI STD will focus on the treatment of suspended solids, metals and petroleum hydrocarbons, nutrients, pathogens and other constituents commonly found in roadway runoff. Special emphasis will be paid to investigating the "first flush" performance, i.e. the runoff resulting from the first inch of rain. Also, we are committed to the long-term performance monitoring and seasonal performance evaluation of BMPs, including testing of treatment technologies under extreme weather conditions. In addition, the RI STD will promote research focused on exploring the potential reuse of treated stormwater for domestic, agricultural and commercial uses and generic water resources protection. In particular, URI researchers will independently evaluate BMP systems based on parameters such as:

Implementation, operation, and maintenance: simple, sustainable solutions that do not requiring massive maintenance are preferred.

Scalability and transferability: systems ideally can be used at different scales from residential to commercial.

Resiliency: systems must be able to survive and perform well under severe conditions (e.g. hurricanes, flooding, snow and ice, changing weather patterns).

Materials: most of the construction materials should be produced using "green engineering" principles to minimize environmental impact and enhance sustainability.

Cost: implementation, operational, and disposal cost associated with the technologies have to be known.

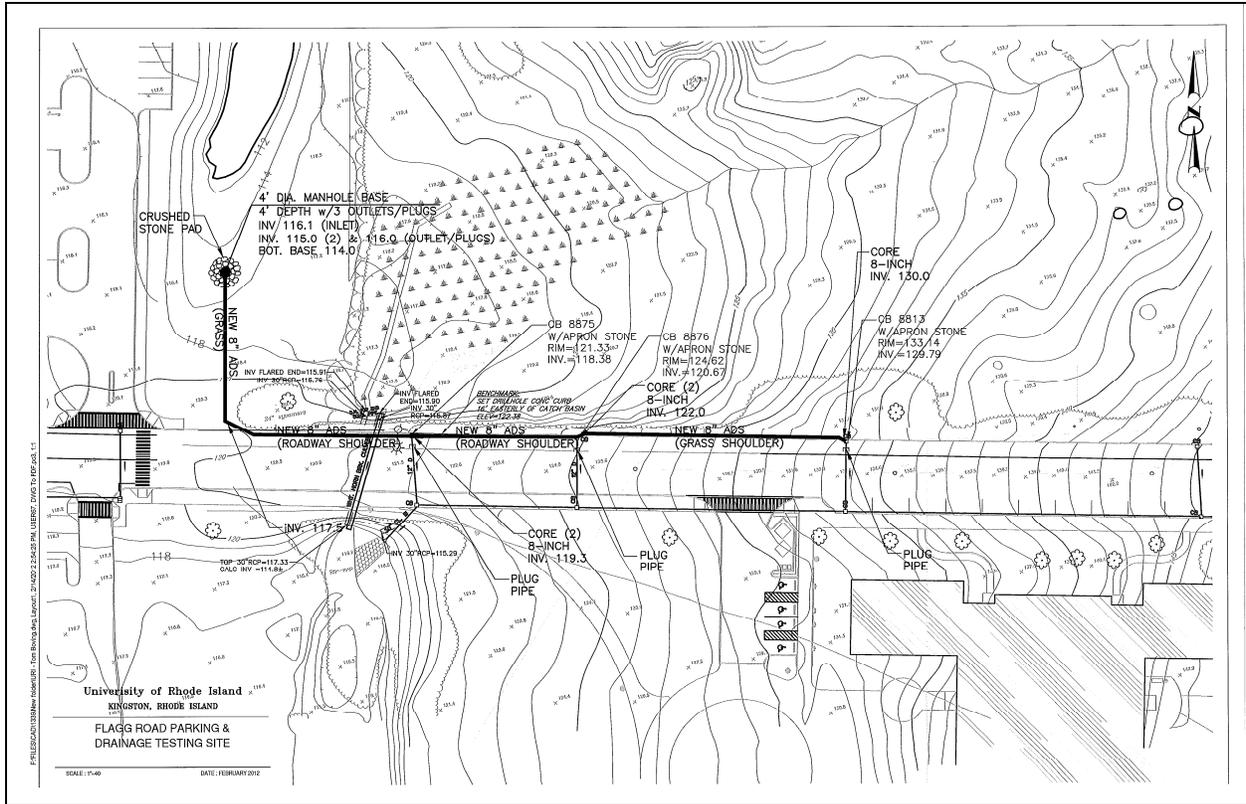


Figure 1: Schematic of the RI STD stormwater management and treatment demonstration facility on the URI campus in Kingston, RI. A pipe connection was constructed that connects our test site with the Flag Road drainage system. Stormwater runoff can now be diverted to a 4' manhole base located in a detention pond east of the Flag Road parking lot.

Accomplishments

The RI STD is located on the main campus of the University of Rhode Island in Kingston. It is adjacent to a parking lot on Flag Road between the Plains Road intersection and downhill from Green House Road. This site was selected because minimal construction and modification were required to prepare the site for our purposes. In addition, the proximity to the URI laboratories ensures quick access to sample storage facilities (e.g. refrigerators) and permits students and visitors to tour the site.

A major part of this project was to construct a pipe-connection to the existing Flag Road stormwater runoff system and divert runoff into the RI STD facility (Figure 1). The diverted stormwater will feed into BMP units that we intend to test at the site. Briefly, in March 2013 a trench was opened on the northern side of Flag Road and a 8 inch pipe was connected to two existing manholes up-gradient from the test site. The connection permits closure of either the “new” pipe or the existing drainage pipe. Currently, both pipes are open. Because the “new” pipe inlet is located deeper down the manhole, the stormwater preferentially flows towards the RI STD. The upper pipe only flows during the strongest storms, thus preventing flooding of the road and the RI STD site. The pipe terminates in a concrete structure within the existing Flag Road catchment basin (Figure 2). From there the stormwater exits through one of three outlets. At this time, the stormwater drains into the detention pond. In the future, these outlets will be connected to one or more BMP systems.



Figure 2: A 4' manhole base was installed in the Flagg Road parking lot detention pond. Shown immediately after installation (left) and after vegetation was reestablished (right).

In addition, in May 2013 a wooden shed was erected at the northern end of the Flagg Road detention pond (Figure 3). The shed serves the researchers as shelter during sampling events and is housing field equipment, such as data loggers, a computer, field test equipment, samplers and other research materials. The shelter has been outfitted with a 450 W solar power module, which made it unnecessary to connect the shed to the electric grid. For security reasons, the shed was fenced-in and is accessible through a locked gate only.



Figure 3: A wooden shed was constructed at the northern end of the Flagg Road parking lot. It houses field equipment, a 450 W solar power system (not visible) and a student work space.

Technology Transfer

We are currently working with the RI DOT Traffic Sign shop to fabricate an approximately 5 by 6 ft permanent sign. This sign will be erected on the RI STD site where it is clearly visible from the road. It will advertise the facility and highlight our funding sources.

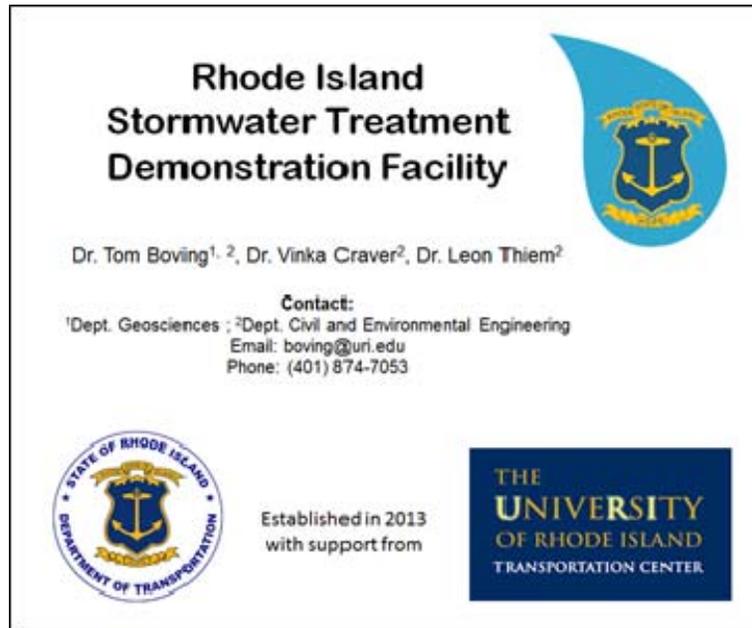


Figure 4: Signage to be posted at the RI STD site (approximately 5' by 6').

Besides construction activities, our team has started to actively promote and utilize the RI STD facility. For example, in July we installed a stormwater sample system beneath the permeable asphalt parking lot adjacent to the RI STD facility. In August 2013, in cooperation with StormTree LLC, Providence RI, we installed three tree filter system on the site. Also, Boving and Craver have integrated the new facility into their classes. For example, in Fall 2013 Honor Program students will be tasked to use the RI STD facility to explore how electric energy can be harvested from stormwater runoff and/or how stormwater runoff can be put to beneficial use (HPR 411; 15 students).

References

Gobel P., Dierkes C., Coldewey W.G. (2007) Storm water runoff concentration matrix for urban areas. *Journal of Contaminant Hydrology* 91, 26-42

Thiem, Leon T., Alkhatibe, Eid A., Bade, Sampath K., Panganamamula, Arvind.
Characterization of Roadway Runoff Prior to Treatment. Kingston, Rhode Island, University of Rhode Island. Department of Civil and Environmental Engineering. July, 1998.