Field Performance of Hydrodynamic Separators Phase II

Proposal

Prepared By:

Leon T. Thiem, Ph.D., P.E.
Michael J. DeRotto, P.E.

Department of Civil and Environmental Engineering
University of Rhode Island
Kingston, Rhode Island

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TABLE OF CONTENTS

Description		Page
1	Project Identification	1
2	Problem Statement	1
3	Background and Significance of the Work	2
4	Objectives of the Study	4
5	Implementation	7
6	Work Plan	9
7	Work Schedule	10
8	Budget Estimates	11
9	Deliverables for Partial Lump Sum Payment Plan	12

1 Project Identification

The title of this project is "Field Performance of Hydrodynamic Separator Units – Phase II." The PI for this project is Leon T. Thiem who will be assisted by Michael DeRotta. Leon T. Thiem is an associate professor in the Civil and Environmental Engineering Department at the University of Rhode Island. He has been a PI for several RIDOT grants involving the measurement of roadway runoff as well as the first phase of this study. Michael DeRotta is a principal engineering with the RIDOT and is the "in-house" expert on roadway drainage. He has worked on Phase I of this project. Professor Thiem will assist Michael DeRotta in sampling and in data analysis.

2 Problem Statement

Numerous reports/studies have concluded that urban roadways contribute 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, Bade & Alkhatibe in 1998, showed that cadmium, chromium, copper, lead, nickel and zinc exceeded EPA's acute and/or chronic water quality criteria. Toxic organic compounds bind to soil particles and are washed into water bodies, causing a decrease in overall stream diversity.

As a result of efforts to comply with local and national stormwater quality discharge standards as well as current regulations for environment protection, Rhode Island Department of Transportation (RIDOT) Projects have included the installation of more than twenty stormwater treatment units (hydrodynamic separators) between 1997 and 2002. These structural Best Management Practices (BMP's) were installed in an attempt to lessen pollutant loads to receiving waterways. The majority of these units are typically designed to provide a net annual removal of total suspended solids (TSS) of about 80% for the more frequent rainfall events e.g. the 2-month storm. Unverified manufacturer's data is currently relied upon for "Stormwater Treatment Unit" selection and, as such, is insufficient for science-based selection to address specific applications.

The focus of this project is to select two hydrodynamic separator units and investigate removal efficiencies of specific contaminants such as, toxic heavy metals (e.g. total cadmium, total copper, total iron, total lead, total zinc) and total suspended solids (TSS) and suspended sediment concentrion for the unit tested. The information obtained from this study will assist in developing guidelines for Stormwater Treatment Unit Selection.

3 Background and Significance of the Study

Hydrodynamic Separator Units have been installed in many locations throughout the United States and abroad as Best Management Practices (BMP). Regardless of their location, these units are designed to treat stormwater runoff by capturing floatable debris, oil & grease and reducing Total Suspended Solids (TSS) concentrations. The U.S. Environmental Protection Agency (EPA), through their NPDES (National Pollutant Discharge Elimination System) Phase II program (established through the Clean Water

Act of 1972), requires that each State develop a stormwater management plan for regulating pollution to receiving waterways. One of RIDOT's efforts in working towards establishing such a plan is through their recently completed inspection and inventory of in-place hydrodynamic separator units.

The Rhode Island D.O.T. has installed a number of hydrodynamic separator units based upon unverified manufacturer's data. Hence, before specifying (and subsequently installing) hydrodynamic separators for future stormwater treatment applications, testing and monitoring of their performance/effectiveness needs to be carried out. In order to address current and future stormwater discharge policies in accordance with the Rhode Island Department of Environmental Management (RIDEM) and Coastal Resources Management Council (CRMC), and to insure proper expenditure of tax dollars, it would be prudent for the RIDOT to perform its own independent testing and sampling of existing units.

Recommendations from other "stormwater treatment unit" studies include (a) the need for measuring sediment accumulations within the units to determine if previously captured pollutants were retained (or not), (b) considering a different standard (since 80% TSS cannot be precisely confirmed) and (c) the need to characterize the whole range of contaminants in runoff, accounting for rainfall intensity, antecedent conditions, particle sizes, traffic volumes, impervious areas and flow (Barbaro, 2001). These studies also suggest that source control measures such as catch basin cleaning; street sweeping; the use of more efficient maintenance equipment; reducing the amount of sand used in winter operations and public programs (e.g. litter pick-up) should not be overlooked. This project will make a concerted effort in addressing most of these recommendations.

The purpose of this project is to evaluate the overall performance of one hydrodynamic separator (stormwater treatment units) through manual sampling and associated laboratory analysis of targeted pollutants. A minimum of four (4) storms are to be sampled per unit for a one (2) year period and antecedent conditions (e.g. days without rain & temperature) will be documented between storms. A qualified storm event is one in which rainfall depths are at least 0.1 inch or greater.

4 Objectives of the Study

The objectives are to (a) develop a sampling plan to determine actual BMP field performance and compare the results with manufacturer's documented data for similar storm events (to the extent practicable) and (b) use the field performance data to assist in determining whether hydrodynamic separator use is suitable for environmental applications.

5 Implementation

The overall goal of this work is to provide the tools for RIDOT to evaluate the effectiveness of existing stormwater treatment units and to make recommendations for future use of these units. This project will also provide training for employees of RIDOT in stormwater management. The results from this project will be disseminated by publication of these results in an appropriate journal as well as presentations at conferences and seminars.

contaminants be evaluated. Monetary constraints and current laboratory fees will dictate the number of storms and associated samples for evaluation.

Hence, evaluation of the subject BMP's will be based on a minimum of six (4) rainfall events having at least 0.1 inch of total rainfall and a minimum inter-event period of at least 6 hours. After meeting the requirements of a rainfall event (through rain gauge monitoring), influent and effluent flow-weighted (and, perhaps, time-proportion (for comparison)) samples will be collected from both units and will be taken to a laboratory for testing of targeted pollutants (e.g. total cadmium, total copper, total iron, total lead, total zinc and total suspended solids (TSS)) where EPA approved analytical methods shall be closely followed. After each rainfall event, the sample bottles will be cleaned in accordance with procedures as described in the EPA's Title 40—Protection of the Environment, Part 136 of the Code of Federal Regulations (40 CFR Part 136) and returned to the reprogrammed samplers for the next storm event.

Sediment sampling (grab samples within the sumps) shall also be conducted at each site in order to provide a typical particle-size profile. Incidental information including, but not limited to, weather, inspection and maintenance of the units as well as monitoring equipment malfunction shall also be documented.

The following analytical methods will be used for constituent analysis:

Pollutant	Analytical Method	Sampling Protocol
Total Lead (Pb)	200/7000 Series	Manual sampling
Total Zinc (Zn)	200.7/6010B	Manual sampling
Total Iron (Fe)	200.7/6010B	Manual sampling
Total Copper (Cu)	200.7/6010B	Manual sampling
Total Cadmium (Cd)	200.7/6010B	Manual sampling
TSS	160.2	Manual sampling
Sediment Analysis	ASTM D 422	Manual sampling

The following tasks are part of the work plan. Even though they are listed in order, most of the tasks will be worked on in parallel.

Task Description
Site selection
Watershed delineation
Unit preparation
Laboratory preparation
Sampling
Data analysis and draft report preparation
Final report submission

7 Work Schedule

This work schedule has been developed based upon a two year study duration. Quarterly progress reports will be submitted when due. Due to the nature of wet weather sampling, (required antecedent dry period, rainfall duration and intensity) sampling dates cannot be predicted far in advance. The sampling of rainfall events in the summer months as well as the winter months are planned to highlight differences in water quality.

Task Description	Beginning Month	Ending Month	Duration, mo.
Site selection	January 2009	February 2009	2
Watershed delineation	February 2009	April 2009	3
Unit preparation	March 2009	April 2009	2
Laboratory preparation	March 2009	June 2009	4
Sampling	June 2009	October 2010	17
Data analysis and draft report preparation	June 2009	November 2010	18
Final report submission	October 2010	December 2010	3

8 Budget Estimates

Required resources will include pertinent technical reports from the National Transportation Research Board (NTRB), Federal Highway Administration (FHWA), U.S. Environmental Protection Agency (USEPA) and various State D.O.T.'s as well as previously completed monitoring studies. The protocols mentioned earlier in this Proposal will be used as guides in the development and completion of this Sampling and Analysis Report.

The following equipment and materials will be required for this research project:

- American Sigma Model 2459 Rain Logger data logging rain gauge
- Telogers Professional Software for downloading rainfall data
- Swing Sampler with bottle attachment for grab sampling
- Survey rod for measuring sediment depth
- Non-phosphorous based soap for washing sample bottles
- Standard cooler for transporting samples
- Catch basin pick for opening manhole covers
- Flashlights
- Work/Rubber Gloves

- Reflective safety vests
- Rain wear
- Safety items (respirators, first-aid kit, goggles, insect repellant, etc.)

In addition the above equipment laboratory supplies such as compressed gases, standards, sampling containers, acids, measurement devices and labels will need to be purchased.

	Year 1 Request	Year 2 Request	Total Request
A. Personnel			-
Leon Thiem	7,500	7,600	15,100
1 Graduate Student Level II hourly, A/Y	7,175	7,462	14,637
2 Graduate Student Level II hourly, Summer	2,790	2,902	5,692
			-
			-
			-
			-
TOTAL PERSONNEL COSTS	17,465	17,964	35,429
			-
B. Fringe Benefits			-
			-
			-
			-
			-
			-
			-
TOTAL FRINGE BENEFITS	-	-	-
			-
C. Equipment	-	-	-
	-	-	-
			-
			-
TOTAL EQUIPMENT	-	-	-
			-
D. Travel	3,000	3,000	6,000
			-
			-
TOTAL TRAVEL	3,000	3,000	6,000
			-
E. SUPPLIES	23,320	23,250	46,570
			-
			-
TOTAL SUPPLIES	23,320	23,250	46,570
			-
F. OTHER COSTS			-
			-
			-
TOTAL OTHER COSTS	-	-	-
			-
TOTAL DIRECT COSTS	43,785	44,214	87,999
			-
TOTAL MODIFIED DIRECT COSTS	43,785	44,214	87,999
			-
INDIRECT COST 25% (MTDC)	10,946	11,053	22,000
			-
TOTAL REQUESTED FROM AGENCY	54,731	55,267	109,998

9 Deliverables

Number	Task Description	Percentage
1	Site selection	5
2	Watershed delineation	10
3	Unit preparation	10
4	Laboratory preparation	15
5	Sampling	30
6	Data analysis and draft report preparation	20
7	Final report submission	10

Literature Cited in the Proposal

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