Research Need Statement 596

Date		5/3/19	
Need Statement Champion			
Name	**Agency**	**E-mail**	**Phone**
Ross Bintner	Edina	rbintner@edinaMN.gov	952-903-5713
Idea Submitted by:		LRRB via Priority Process (3/19/19 Mtg)	
Idea Originated from:		2019 LRRB Idea Solicitation Process (*Pre-Screen Board mtgs*)	

Select Program:

☐ MnDOT OR ☑ Local Road Research Board (LRRB)

☑ Research OR ☐ Implementation

Need Statement Title:

Evaluate Effectiveness of Storm Ponds for Water Quality

Need Statement: Describe the problem or the opportunity. Include background and objective.

In 2009 the LRRB-RIC produced a report Stormwater Maintenance BMP Resource Guide where stormwater ponds were listed as one of the tools within the best practice toolkit. Then in 2011, the LRRB-RIC developed the Decision Tree for Stormwater BMPs, which again listed stormwater ponds as a BMP. However, in recent studies like, Urban Stormwater Ponds can be a Source of Phosphorous, it's been suggested that stormwater ponds may not offer the best long-term solution. Pond modeling may not be accurate and sediment removal can be difficult due to contaminated material. Besides stormwater ponds, what other BMPs act in a similar capacity and should they be used or considered?

An online manual for assessing BMP treatment performance was developed in 2010 by the University of Minnesota and St. Anthony Falls Hydraulic Laboratory. The manual advises on a four-level process to assess the performance of a Best Management Practice.

- Level 1: Visual Inspection. This includes assessments for infiltration practices and for filtration practices. The website includes links to a downloadable checklist.
- Level 2: Capacity Testing. Level 2 testing can be applied to both infiltration and filtration practices.
- Level 3: Synthetic Runoff Testing for infiltration and filtration practices. Synthetic runoff test results can be used to develop an accurate characterization of pollutant retention or removal but can be limited by the need for an available water volume and discharge.
- Level 4: Monitoring for infiltration or filtration practices for water volume and pollutant removal.

This research project should:

- Study stormwater ponds and determine both their cost effectiveness and long-term effectiveness as a BMP.
    - For existing stormwater ponds what can be done to make them more effective?

- Based on the past 10+ years (and knowing what we know now), determine if stormwater ponds should still be considered a viable BMP? If so, what is the best context for them as a BMP?
- If not viable, what is an alternative BMP(s)?

- Review and update both the 2009 Stormwater Maintenance BMP Guide and the 2011 Decision Tree for Stormwater BMPS; ensure both are compatible with the MPCA Stormwater Manual.
- Develop a "high-level" fact sheet that helps agencies understand what they should be evaluating (and budgeting/staffing for) on an annual basis.
- Examine what BMPs besides stormwater ponds, act in a similar capacity and should they be used or considered

How does this project build upon previous research (include title or reference to a completed research effort)?

Stormwater maintenance BMP resource guide
Source: TD656 .M37 **Date:** 2009

Decision tree for stormwater BMPs
Source: TD656 .M37 **Date:** 2011

Wet Pond Maintenance for Phosphorus Retention – 2018-060

Provide names to consider for a technical advisory panel:

Name	Agency	E-mail	Phone
Paul Oehme - TL	Lakeville	poehme@lakevillemn.gov	952-985-2701
Mark Maloney	Shoreview	mmaloney@shoreviewmn.gov	651-490-4650
Ross Bintner	Edina	rbintner@edinaMN.gov	952-903-5713
Michael Thompson	Plymouth	mthompson@plymouthmn.gov	763-509-5500
Patrick Sejkora	Eden Prairie	psejkora@edenprairie.org	952-949-8300
John Gulliver	U of M	gulli003@umn.edu	612-625-4080

Literature Search: Evaluate Effectiveness of Storm Ponds for Water Quality
Thu, April 11, 2019

Prepared for: Nicole Buehne

Prepared by: Qin Tang

Resources searched: Transport Database, Research in Progress, MnDOT Library Catalog, OCLC WorldCat, Web.

Summary: The following results were from the sources listed above.

Water quality performance of dry detention ponds with under-drains
Source: TD665 .W38
Date: 2006
Access Online: http://www.lrrb.org/PDF/200643.pdf

Stormwater maintenance BMP resource guide
Source: TD656 .M37
Date: 2009
Access Online: http://www.lrrb.org/media/reports/2009RIC12.pdf

Decision tree for stormwater BMPs
Source: TD656 .M37
Date: 2011
Access Online: http://www.lrrb.org/pdf/2011RIC01.pdf

Long-term performance and life-cycle costs of stormwater best management practices
Source: NCHRP 792
Access Online: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_792.pdf

Minnesota stormwater manual, Overview for stormwater ponds
Access Online: https://stormwater.pca.state.mn.us/index.php?title=Overview_for_stormwater_ponds

Minnesota stormwater manual, Stormwater wet pond fact sheet
Access Online: https://stormwater.pca.state.mn.us/index.php?title=Stormwater_wet_pond_fact_sheet

Stormwater wet pond and wetland management guidebook.
Access Online: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1006MDW.PDF
https://www3.epa.gov/npdes/pubs/pondmgmtguide.pdf

Assessment of stormwater best management practices
Access Online: http://hdl.handle.net/11299/181358

Assessment of a Countywide Stormwater Pond Improvement Project: Impacts of the Hillsborough County Adopt-A-Pond Program
Access Online: https://search.proquest.com/globalnews/docview/861883833

A Comparative Analysis of Two Residential Stormwater Ponds and Their Ability to Reduce Contaminants,

Source: Thesis, St. Cloud State University, 2013.

Probabilistic Stormwater Runoff and Water Quality Modeling of a Highway in Suburban Maryland.
Author: Wang Jing; Forman Barton A; Davis Allen P
Source: Journal of Hydrologic Engineering. 23(2) Content ID 05017034
Publisher: Publisher American Society of Civil Engineers
Date: Feb 2018
Abstract: The U.S. Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) was used to simulate upland runoff production and the subsequent performance of a downstream, ponded infiltration basin installed adjacent to a highway in suburban Maryland. The SWMM's performance was evaluated with a unique, rich suite of in situ flow and water quality observations. The availability of these in situ observations creates a novel opportunity to explore the performance of SWMM across small scales in space and time. In order to systematically explore the ability of SWMM to leverage these observations, an automatic Monte Carlo-based calibration framework was developed and a multiparameter sensitivity analysis was conducted. As expected, the calibrated model showed better skill in terms of reproducing water quantity observations relative to water quality observations. An uncertainty analysis showed model predictions (flow and water quality) were consistent in the sense that the model was able to encapsulate the observations between 5 and 95% confidence intervals. Example code for use by other researchers to employ the techniques discussed in this paper is made publicly available with this manuscript.
Access Online:
https://gcc01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fdx.doi.org%2F10.1061%2F(ASCE)HE.1943-5584.0001600&data=02%7C01%7Cqin.tang%40state.mn.us%7C5df74af955974cfc0d5308d6bdbce69f%7Ceb14b04624c445198f26b89c2159828c%7C0%7C1%7C636905016366146458&sdata=b%2FuCANZRlt83mCgj5CifBB1ALBxs1DE1R%2F7gmSuaAN0%3D&reserved=0

Road Runoff Management Using Improved Infiltration Ponds.
Author: Mrowiec Maciej
Source: 6th Transport Research Arena (TRA2016). Location: Warsaw.Sponsored by: European Commission.Held: 20160418-20160421.Transportation Research Procedia. 2016. 14 pp 2659-2667
Publisher: Elsevier
Date: 2016

Abstract: The paper presents research focused on the development of the improved infiltration pond that: a) reduces runoff volume, b) keeps the required quality of soaking water, c) reduces maintenance needs. The paper presents the construction and hydraulic principles of the infiltration pond that can be applied to manage the runoff from roads and highways. It restores the natural hydrology and improves water quality by reducing the volume and frequency of flows that cause pollution and physical disturbance. Firstly the stormwaters are conveyed by the inlet channel to the settling chamber designed to settle out coarse sediments and floating debris (oil separators can also be mounted depending on the local law requirements). Settling chamber and infiltration chamber are connected by the filtration column filled with sand or other soil material to remove pollutants from the water. Stormwater flows through the porous media and then flows over the weir to the infiltration chamber. The filtration column is designed to cause reverse flow during emptying phase - it allows to rinse the pollutants from filter to settling chamber. Selection of the optimal grain size in the filter to get better efficiency of treatment is currently developed in laboratory tests. A hydrodynamic model of the proposed construction is presented to show its hydraulic efficiency. The presented infiltration basin provides an effective management of runoff

generated from roads, highways and from parking lots considering both quantity (reduction of volumes) as well as quantity aspects (reduction of pollutant loads).
Access Online:
https://gcc01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fdx.doi.org%2F10.1016%2Fj.trpro.2016.05.435&data=02%7C01%7Cqin.tang%40state.mn.us%7C5df74af955974cfc0d5308d6bdbce69f%7Ceb14b04624c445198f26b89c2159828c%7C0%7C1%7C636905016366146458&sdata=8yMKCoqtIdkL%2B4Fu9k2AgwKHc6QPZ%2FsaJlYvZ4gxEyA%3D&reserved=0

Green Infrastructure for Highway Stormwater Management: Field Investigation for Future Design, Maintenance, and Management Needs.
Author: Li Houng
Source: Journal of Infrastructure Systems. 2015/3. Content ID 05015001
Publisher: American Society of Civil Engineers
Date: 2015
Abstract: Many types of structural stormwater best management practice (BMP) have been employed since the late 1990s in the hope of mitigating the impervious surface hydrology (indicated by, e.g., high runoff volume and peak flow rates, sewer and ditch runoff conveyance, and short time to peak flow) and deteriorating water quality due to land development and human activities. It is time to examine the status of the BMP deployment from an infrastructure perspective and reflect the best strategies for low-impact development (LID). This paper presents a 22-month field investigation for 279 structural BMPs and 227 major outfalls (defined as storm drain outfall pipes with an equivalent diameter of 91 cm or larger) along highways in Prince George's County, Maryland, an area that has LID BMP research and employment history for decades. This study offers a snapshot about the state and effectiveness of structural BMPs in mitigating highway runoff in this region. The results indicate that the majority of structural BMPs deployed along the regional highway system are infiltration trenches and stormwater ponds, both of which need extensive maintenance.
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https://gcc01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fascelibrary.org%2Fdoi%2Fabs%2F10.1061%2F%2528ASCE%2529IS.1943-555X.0000248&data=02%7C01%7Cqin.tang%40state.mn.us%7C5df74af955974cfc0d5308d6bdbce69f%7Ceb14b04624c445198f26b89c2159828c%7C0%7C1%7C636905016366156462&sdata=3PPrk4ywNskjj4Y7rjQpcOlrfW%2Bq0BvM%2BClu6pUkDY4%3D&reserved=0