Annual Report Summary

Period Covered by the Report: September 1, 2015 through August 31, 2016
Date of Report: November 10, 2016
EPA Agreement Number: 83582401
Title: Assessment of Stormwater Harvesting via Manage Aquifer Recharge (MAR) to Develop New Water Supplies in the Arid West: The Salt Lake Valley Example
Investigators: R.R. Dupont,
Institution: Utah State University
Research Category: Human and Ecological Health Impacts Associated with Water Reuse and Conservation Practices
Project Period: September 1, 2015 through August 31, 2018

Objective(s) of the Research: The project is designed to test the hypothesis that Managed Aquifer Recharge (MAR) via Green Infrastructure (GI) systems for stormwater harvesting is a technically feasible, socially and environmentally acceptable, economically viable, and permittable option for developing new water supplies for arid Western urban ecosystems experiencing increasing population, and climate change pressures on existing water resources

Progress Summary/Accomplishments (Outputs/Outcomes):
Research Component 1, Monitoring of Existing MAR/GI Stormwater Management Systems – Based on existing MAR/GI system monitoring that has taken place during Year 1, a wide range of pollutant concentrations result when data from a range of rainfall events are combined even at a specific site. Disaggregation of these data will be carried out in Year 2 to evaluate potential relationships between pollutant concentrations and rainfall event return periods. For the two sites treating primarily pavement runoff (300 East in Logan and the Salt Lake City Public Utility parking lot site), overlapping 95% Confidence Intervals of measured runoff pollutant concentrations indicate that the only parameter different between the two sites is Total P, which is significantly higher at the 300 East site, adjacent to landscaped areas, compared to the Public Utilities parking lot site. Monitoring results from the major stormwater discharge channel at 1300 South in Salt Lake City indicate that stormwater channel concentrations are enriched only in DOC, chromium and nickel in response to storm events, and that this stormwater discharge represents a significant contributor of Total P, DOC, and chromium to the Jordan River during wet weather conditions. Monitoring of pollutant generation from various roof materials indicates that both the photovoltaic and metal roofs generate pH values higher than the membrane roof, while for the metal roof, iron and nickel are higher and copper and lead appear lower than the membrane roof. Unexpectedly high lead levels generated by the membrane roof system will be evaluated further in Year 2 through monitoring membrane roof pooled water samples as well as roof discharge to adjacent dry wells to determine if roof drain piping is the source of this lead. Finally, elevated levels of DOC and arsenic were found in 300 East 24-inch deep pore water samples suggesting the biostimulation of arsenic reduction in this bioswale system.
Research Component 2, Integrated Modeling – A wide range of rainfall/runoff, surface water, groundwater and vadose zone models must be used and integrated to model the complex problem of evaluating MAR/GI impacts of stormwater capture and groundwater recharge on surface water/groundwater quality and ecosystem services. Standard model configuration will generally

have to be modified to adequately accommodate small scale MAR/GI systems that might be implemented across a watershed. Snowmelt simulation is important to incorporate into surface flow modeling to effectively capture spring runoff events.
Research Component 3, Social Science Research - There is a growing understanding of and interest using distributed systems to capture stormwater on-site, and although deep dry wells are of most concern to the Key Informants, concerns about potential groundwater contamination from any of the infiltration-oriented MAR/GI systems included in the interviews outweighed perceived advantages relative to boosting scarce potable water supplies.

Publications/Presentations:
Dupont, R. 2016. *DHS, Distributed Harvesting of Stormwater.* Lightning talk presented to the iUTAH Summer Symposium and All-Hands Meeting, NSF-funded iUTAH EPSCoR Project, Salt Lake City, UT, July 15.
Prudencio, L. and S.E. Null. 2016. *Stormwater management effects on ecosystems services: a literature review*. To be presented at the AGU Fall Meeting, San Francisco, CA, December 12-16..
Rife, T., and R. Dupont. 2016. *Green Infrastructure for Stormwater Harvesting and Pollutant Removal*. Workshop presented to the American Public Works Association Fall Conference and Stormwater Expo, American Public Works Association Utah Chapter, Sandy, Utah, October 11 – 12.

Future Activities: Both additional sampling locations at existing sites, and expansion of the system monitoring network with additional sites are planned for the second year of the project. Baseline soil conditions (total arsenic, labile arsenic, etc.) will be quantified in both the 300 East and University of Utah field bioretention site to determine the predictability of potential arsenic mobility in MAR/GI stormwater management system. Disaggregation of pollutant loading data to explore relationships between pollutant concentrations and storm intensity and duration will be carried out using rainfall data available from each of the field sites.
As a result of the first meeting with the Technical Advisory Committee (TAC) at the beginning of Year 2 of the project, the calibration and verification effort for the refined MODFLOW model has been redirected. Simulation of stormwater injection via deep wells has been replaced by prioritization of model development for MAR/GI shallow infiltration systems because of initial concerns expressed about direct deep dry well systems by both municipal government and consulting firm representatives on the TAC.
The development of a WINSLAMM model for the urban portion of the RBC watershed is underway and is to be completed during Year 2 of the project. Three small urban watersheds in Logan, Utah, are being used for initial WINSLAMM pollutant loading calibration. In addition, data being collected from the 1300 South stormwater discharge into the Jordan River provides a data set to enable validation of the calibrated WINSLAMM. Vadose zone simulations will begin during Year 2 of the project with input from WINSLAMM. Baseline ecosystem services for the RBC and Jordan River will also be quantified during Year 2 of the project.
Year 2 activities to be conducted as part of the social science component of the project will involve completion of Key Informant interviews, transcriptions of interview recordings, and systematic coding and analysis of interview transcripts; development and implementation of an on-line survey instrument; and organization of a second SAC meeting in Spring 2017.

Supplemental Keywords: vulnerability, TDS, habitat, indicators, sustainable development, public policy, cost-benefit, engineering, social science, ecology, hydrology, environmental chemistry, Great Basin, agriculture, industry, commercial, residential, stormwater, aquifer recharge, groundwater, green infrastructure, ecosystem services, modeling.

Relevant Web Sites: None to date.