

Developing Credits and Incentives for Innovative Stormwater Management

Collaborative Learning Group Meeting

May 7, 2014, 9:00 am - 3:30 pm

Site visit of Ursuline College bioretention cell, meeting held at Ursuline College Mullen Academic Center

Meeting Summary

Group Members Present: Dan Bogoevski (Ohio EPA), Carlo DeMarchi (CWRU), Ken Fortney (Erie County), Lynette Hablitzel (OEPA), Dave Ritter (NEORS), Rachel Webb (NEORS), Scott Wood (CT Consultants), Betsy Yingling (NEORS).

Project Team Members & Staff Present: Amy Brennan (CRWP), Kristen Buccier (CRWP), Craig Cawrse (Cawrse & Associates), Keely Davidson-Bennett (CRWP), Scott Dierks (Cardno-JFNew), Jay Dorsey (ODNR), Crystal Dymond (Erie SWCD), Heather Elmer (Old Woman Creek NERR), Maggie Finch (OWC), Kevin Grieser (Biohabitats), Breann Hohman (Erie SWCD/OWCNERR), Shawn Kennedy (NCSU), Frank Lopez (Old Woman Creek NERR), Ryan Winston (NCSU), Cheryl Wolfe-Cragin (OWC).

Next Steps:

- The next CLG Meeting is scheduled for August 20 at Old Woman Creek NERR.

Site Visit: Ursuline College Bioretention Cell

Kristen Buccier and Craig Cawrse (the designer) introduced participants at the site visit to Ursuline College's 2,800 square foot bioretention cell, which incorporates internal water storage and treats 1.3 acres of parking lot. At this site, water quality and quantity will be monitored and a new 3-foot by 3-foot catch basin and weir, and an inlet sheet flow plume will be installed to allow for better monitorability of the site. At the time of the site visit, the gravel and soil mix were being installed. Following the meeting, 1,450 native plant plugs were installed in the cell and several woody shrubs were planted along the top of the slope to provide additional stabilization.

The only change to the parking lot needed to allow treatment of runoff by the new bioretention cell was adding covers to the tops of two existing catch basins in the parking lot. The catch basin in the bioretention cell was modified to exclude an existing outlet pipe from entering the catch basin because it was not clear whether other locations of the campus discharged to this pipe. The catch basin was also enlarged to better accommodate the installation of monitoring equipment. Osorb, a silicate product that binds hydrocarbons, was incorporated into a six inch layer of the soil media to enhance water quality treatment.

CLG members pointed out that many of the 12 proposed curb cuts would be ineffective because the slope of the parking lot directs the water towards the center of the cell. In response to this CLG feedback, the contractor modified the design such that a single larger curb cut with rock for erosion protection was used. CLG members also expressed concerns about the bioretention soil appearing darker than it should and possibly containing foundry sand and/or having high nutrient loads. Kurtz Brothers, the soil supplier, sent test results that indicate the soil meets *Rainwater and Land Development* specifications. North Carolina State University is also analyzing a soil sample for comparison. At the next CLG meeting, the team should have information to share regarding whether any leaching is taking place from the cell. The group discussed organic matter thresholds in Ohio's new bioretention design specification, including potential tradeoffs between minimizing leaching of

phosphorus and nutrients and supporting plant establishment. Ryan Winston explained this cell will be monitored for water quality and water quantity. Combined overflow and underdrain flow will be measured using a 60-degree V-notch weir. Treated water quality samples will also be taken from this location. A flume will capture untreated runoff from the parking lot for control water quality samples. A water table well was installed within the bioretention cell to measure drawdown between storms, and a temperature sensor was placed in the receiving stream.

Welcome, Introductions and Meeting Overview

Participants convened for the meeting portion of the day. Materials from the meeting, including presentations and this summary can be found at the project website:

<http://crwp.org/index.php/projects/research-projects/nerrs-science-collaborative>.

Design and Construction Update for Old Woman Creek National Estuarine Research Reserve

The team provided design and construction updates for Old Woman Creek NERR. Because the porous asphalt originally proposed for the small area at the Old Woman Creek NERR parking lot was going to be very expensive to construct, Ryan Winston redesigned the area using permeable interlocking concrete pavers (PICP) instead. The new design also incorporates two cisterns that will collect underdrain flow from the PICP. The pavers and cisterns are being donated by Oldcastle. Ryan Winston demonstrated NCSU's rainwater harvesting calculator¹ for cistern sizing and cost analyses.

Old Woman Creek NERR would like to use the water collected in these cisterns for irrigation and to flush toilets. The state plumbing inspector referred OWCNERR to Ohio EPA, indicating the effluent from the system is considered "contaminated water." Per Ohio EPA, because the building is connected to a public water supply, Ohio EPA Division of Drinking and Ground water regulations apply. The RWH system is considered an auxiliary water supply. Requirements will include backflow prevention, maintaining physical separation between the RWH and public water system, supplying make-up water through an air gap and labeling requirements including color-coded piping and dye. Water may be re-used for non-potable purposes only such as irrigation and toilet flushing. There may also be requirements to filter or disinfect harvested water prior to distribution into plumbing under jurisdiction of plumbing code. EPA suggests contacting the water purveyor (if receive drinking water from a public water system) for further local requirements. Entities receiving potable water from a private well or supply are considered private water systems and should contact the local health department for their requirements. EPA also suggests contacting local building code or plumbing authorities for further direction as local ordinances may also apply.² All of the plumbing from the cistern will be at a four foot depth so it doesn't freeze during the winter.

CLG and project team members discussed their disparate experiences regarding approvals and permitting requirements for water reuse. It was suggested that this may be due to different applications and development contexts (roof versus parking lot runoff, well versus public drinking water source). Old Woman Creek NERR and OEPA will continue to look into requirements for RWH re-use options and update the group as the project progresses.

¹ <http://www.bae.ncsu.edu/topic/waterharvesting/model.html>

² Contact: Maria Lucente, P.E. Ohio EPA Division of Drinking and Groundwaters (614) 728-1231
maria.lucente@epa.ohio.gov Web resource: epa.ohio.gov/ddagw/rules.aspx

Design and Construction Lessons Learned & Stormwater Control Measure Cost Analysis

Project Team members shared some of the design and construction lessons that the team has learned to date from this project. Among their reflections were a few key observations by Jay Dorsey and Ryan Winston. Jay said he's found good agreement between infiltration predictions from the Soil Water Characteristics Calculator and single-ring infiltration tests. Designers can use this tool to size BMPs to meet water quality volume requirements in greenfield development. The tool generally works well with soil survey descriptions, but there are some discrepancies. The tool works very well if the actual textural breakdown (% sand, % silt, % clay) is manually entered. In combination with soil tests, this calculator is useful for preliminary site planning for greenfield developments. On redevelopment sites, single ring infiltration tests should be completed in several locations to accurately characterize soil conditions and infiltration rates.

Ryan told a cautionary tale of a PICP retrofit in Durham, NC. Monitoring revealed that there were unmapped storm sewers and an unknown abandoned junction box to which the permeable system was unwittingly connected. Designers need to consider the potential for cross-connections to legacy infrastructure for retrofit locations. Discovering an unknown pipe during SCM construction warrants further investigation. Having plumbers investigate pipes costs a couple hundred dollars.

Keely Davidson-Bennett presented LID construction cost information collected by CRWP for NERRS SC sites and SWIF projects. Nearly all of these data are from retrofit sites. Costs from the NERRS SC project sites ranged from \$13.05 to \$21.13 per square foot for bioretention, \$16.13 to \$33.95 per square foot for permeable pavers, and were \$8.08 per square foot for the pervious concrete installed at Perkins Township. CLG members suggested that costs be tracked in terms of cost per volume of water treated, that the median would be a more useful summary statistic than the mean, and that this analysis would make a good project for a statistics class. Scott Dierks commented that his firm estimates bioretention is cheaper than permeable pavement, but CRWP averages indicate that the reverse is true. CRWP had anticipated LID installation costs would decline as contractors became more familiar with these SCMs but that has not been the case, possibly because practices are getting deeper due to increased runoff reduction and water quality performance requirements. Keely cautioned that there is still a lot of variability in this data set.

Monitoring Update

Ryan Winston gave an update on demonstration site monitoring efforts. CLG members had requested that some monitoring be done over the winter. Now that that has been completed, we've learned that the surface flow, underdrain, and precipitation monitoring data collected over the winter were unreliable. In addition to freeze-thaw impacts, snowplows moving precipitation among watersheds complicated data interpretation. The monitoring well data did teach us that the aggregate did not freeze over the winter, which a CLG member suggested would be worth presenting at the Ohio Stormwater Conference (because many people still think that the aggregate beneath permeable pavers freezes in the winter). This was all worthwhile and helped the team learn more about what can and cannot be well monitored in the Northern Ohio winter.

Ryan is conducting quarterly infiltration tests on permeable pavement surfaces at Perkins Township, Orange Village, and Willoughby Hills to determine maintenance needs. Thus far, the data indicate that

areas near curbs and at the permeable-impermeable interface clog more quickly than other areas of the permeable pavement. It is possible that vacuuming these higher-clogging risk areas with walk-behind vacuums may be more efficient than vacuuming the entire permeable pavement surface. So far, none of the Ohio test sites has clogged enough for Ryan to recommend maintenance.

Based on a year of data from the Perkins Township pervious concrete installation, we have observed a reduction in peak flow across all rainfall intensities and a 50.5% reduction in runoff volume compared to what would be expected for an impervious parking lot. We have measured two outflow events from the PICP at Orange Village since monitoring equipment was installed in February. Minimal curtain drain flow has occurred from the Orange Village site. Neither bioretention cell at Holden has overflowed yet. A CLG member asked how internal water storage would affect root depth at Holden. Ryan stated that there is enough soil depth above the internal water storage zone that the rooting depth should be sufficient. Drawdown rates of SCMs with water table wells range from 0 to 0.062 in/hr and are generally similar to pre-construction infiltration rates.

Project Modeling

Scott Dierks, who is responsible for the modeling work on this project, drafted a technical memo summarizing the results of the SWMM unit models and annual runs completed by Cardno JFNew. Scott presented the results at this meeting, and CLG members had two weeks prior to and following the CLG meeting to provide feedback on the draft document. Cardno JFNew's results indicate that well-designed bioretention cells, permeable pavements, dry detention ponds, and underground storage areas are able to infiltrate the water quality volume. Green roofs, grassed swales, and filter strips do not meet water quality standards.

According to Scott, weaknesses of the SWMM model include that underdrains cannot be modeled at the bottom of the practice without a small offset and the drainage coefficient needs to be manipulated to provide realistic underdrain rates. Through manipulating the drainage coefficient Cardno JFNew was able to obtain underdrain rates consistent with NCSU's measured rates at project monitoring sites. A CLG member asked how many of these problems resulted from model choice. Scott and Ryan replied that SWMM is a user-friendly model that does a good job of simulating urban runoff and does an acceptable job of ranking SCMs based on changes in design parameters. DRAINMOD is useful for research quality point modeling of SCMs with underdrains. NCSU is developing DRAINMOD models for some project sites that will be used to project how SCMs will perform under current and projected future climate and precipitation patterns.

One CLG member indicated that he would use the unit models Cardno JFNew created and a supplementary SWMM users guide if they were available online. Another stressed that any presentation of modeling results must be simple, suggesting simplified communication using a table or excel spreadsheet with design parameters. Ohio EPA staff indicated that the agency is waiting for scientific recommendations from this and other efforts to evaluate the runoff reduction performance of LID systems. Once this guidance becomes available, Ohio EPA will use it in regulatory decisions.

Training Plans and Model Code Updates

One of the ongoing areas of work in this project is the advancement of sound stormwater codes. Project team members and CLG members discussed current efforts to promote such codes. Crystal Dymond reported that Erie County is working on updating and adopting county stormwater regulations, Perkins

Township is reviewing code recommendations made by the Ohio Balanced Growth program, and the City of Sandusky is reviewing draft stormwater ordinances. Keely Davidson-Bennett said CRWP revised its model parking code this winter and is currently revising its conservation development model codes. Contact Keely³ for copies of the codes. CRWP will update its model erosion and sediment control and comprehensive stormwater ordinances after the new MS4 permit is issued.

Heather Elmer distributed a draft report containing case studies of four project monitoring sites. The report is intended to serve as a technical and educational resource for stormwater professionals and others seeking to learn about the performance of LID stormwater practices in Ohio. It synthesizes key information about design, construction, and monitoring from the first two years of the project. The report was developed by Will Brown (the TIDES intern from the University of New Hampshire who assisted the NERRS SC project last summer and fall), with assistance from the project team and includes case studies of design, construction and monitoring for the Perkins Township, Holden Arboretum, Willoughby Hills, and Orange Village sites. CLG input is welcome through May 21, 2014. The Project Team would like CLG feedback on appropriate trainings that could be developed based on project results. The Team is considering hosting a workshop on bioretention and permeable pavement for construction contractors and a training on bioretention and pervious pavement design for engineers, particularly in the western end of the project area. Jay Dorsey also mentioned that some people have expressed an interest on a training focused on the hydraulic properties of permeable pavement. Some CLG members expressed interest in participating in such a training or a modeling tools exercise.

Project Business

Amy Brennan is leaving CRWP to become The Nature Conservancy's Lake Erie Conservation Director. Keely Davidson-Bennett of CRWP will be the new project lead. Please contact Keely with any questions about this project. Rebecca Jacobson, the new TIDES intern from UNH, will assist the project team this summer and fall.

The NERRS SC team is presenting on several aspects of this project at the Ohio Stormwater Conference.

³ kdauidson-bennett@crwp.org