Developing Credits and Incentives for Innovative Stormwater Management
Collaborative Learning Group Meeting
April 24, 2013, 9:00 am-3:00 pm
Sandusky Central Fire Station, Sandusky, OH

Draft Meeting Summary

Group Members Present: Dan Bogoevski (Ohio EPA), Eric Dodrill (Perkins Township), Alex Etchill (John Hancock & Associates), Ken Fortney (Erie County), Lynette Hablitzel (NW OEPA Office), Clyde Hadden (CT Consultants), John Hancock (John Hancock & Associates), Dave Ritter (NEORSD), Betsy Yingling (NEORSD), Leo Sferra (GPD Group).

Project Team Members Present: Amy Brennan (CRWP), Keely Davidson-Bennett (CRWP), Jay Dorsey (ODNR), Crystal Dymond (Erie SWCD), Heather Elmer (Old Woman Creek NERR / ODNR), Breann Hohman (Erie SWCD/OWCNERR).

Observers and Staff: Ryan Winston (NCSU), Scott Dierks (Cardno-JFNew), Carlo DeMarchi (CWRU), Kevin Grieser (Biohabitats).

Next Steps:

- Next CLG meetings – July 17 (Willoughby Hills Community Center), Sept. 18, 2013 (location TBD).
- CLG members – Let Jay Dorsey know if you'd like to participate in modeling discussions.
- Ryan Winston – Share information on plant rooting depth making a difference in effectiveness of bioretention cells and on the drainage coefficient for DRAINMOD and HyPer Tool.
- Project Team – Let CLG know how long it takes to compile/process data after it is collected from the monitoring sites.

Site Visit: Perkins Township Highway Department Porous Concrete Monitoring Equipment

Crystal Dymond and Eric Dodrill welcomed CLG members to the Perkins Township site and reviewed the site design process and the BMP installations. The site has two areas of pervious concrete (one with a sump and one without a sump) and detention swale. The CLG was split into two groups which rotated between two areas for viewing: a catch basin instrumented to measure the outflow from the pervious concrete and the weather station.

At the catch basin, Ryan Winston explained the design, construction and installation of the weir box. Flow is measured in the catch basin using two non-vented pressure transducers to ensure data quality and provide a back up. A top was placed on the box to prevent non-underdrain flow from being measured, the outlet pipes were grouted to minimize unmonitored flows, and the weir box was leveled for measurement accuracy. The project is also monitoring conductivity at this location, which is useful for determining presence of salt in water. Data will be downloaded every 3-4 weeks.

CLG members asked about safeguards for preventing backflows, box durability and sealing, the rationale for non-vented transducers, and the low-flow monitoring capabilities of the equipment. Ryan answered that there is no real way to prevent the potential of backwater during a heavy storm event, but the data will show the point at which the system is in a backwater condition. Backwater is typically represented

by an extended period of apparently high flow rate during the peak of the storm. The data will typically flat line at this high flow rate, indicating a backwater condition The weir boxes at this site were built from lumber and sealed with heavy duty window caulk and should last for a minimum three years. One advantage of lumber construction is ease of modification at installation post fabrication. A metal box would last substantially longer, however all specs for installation would have to be very exact. Non-vented transducers were chosen for this site because of their low cost and ease of installation. Vented transducers would have required an external data logger box beside the catch basin, which would have been difficult to accommodate in the middle of a parking lot. Flow rates during storm events will be recorded, but some error is introduced at extremely low flows at the end of the storms. However, as a function of the volume of the entire storm, this error is probably negligible. A question was raised about equipment drift. Ryan noted that every time we're at a site, we'll take a water depth measurement to calibrate the loggers against. This will reduce the drift of the sensors.

Kevin Grieser described the weather station equipment, parameters collected, and frequency of collection. The weather station measures wind speed and direction, humidity, and solar radiation. The rain gauge is tipping-bucket style and is attached to a data logger. The rain gauge has a wire around the rim to act as a bird perch to prevent birds from defecating in the gauge and impacting the readings. CLG members asked how long the data would be collected and if every site would have a weather station installed. Weather data will be collected at this site until 2014. All sites will have the same type of weather station except for OWC NERR, which already has a complete NOAA weather station located within 20 feet of the pervious asphalt site.

One CLG member asked if the swale was going to be monitored. The project team is not planning on monitoring the swale at this time because it has not actually accumulated water during most storm events. In later discussion Eric Dodrill noted that the detention swale at Perkins had water in the swale up to the 6 in drawdown orifice after 3 inches of rain. The project team decided not to instrument at this time due to relatively infrequent inflow and concerns about monitoring inflow due to diffuse flow entering the swale along its length. Another CLG member asked if we had considered not maintaining a section of the pervious concrete to see how it performs. The project team thinks that there will be a range of maintenance in the sites that we are planning on monitoring, but is not planning to purposefully alter maintenance on particular sites.

Welcome and Design Lessons Learned

Heather Elmer welcomed everyone and reviewed the meeting objectives. CLG members briefly introduced themselves. All meeting materials and presentations can be found at: [http://www.crwp.org/index.php/projects/research-projects/nerrs-science-collaborative]

Participants then discussed design lessons learned to date through the project. Amy Brennan, Jay Dorsey, and Ryan Winston began this discussion, presenting on what we've learned so far, including a detailed understanding of the sites at the concept stage, engineers' experience, the importance of soils investigation, the importance of choosing a binder for porous asphalt that doesn't melt at high temperatures, the difficulty NEORSD has encountered with getting large washed rock (1s and 2s), and

methods for dealing with slope at sites for pervious pavement installation. PG64-22, a typical porous asphalt binder, melts at temperatures greater than 64° C. PG76-22 is rated for use at temperatures between -22° C and 76° C. However, a bale shredder is needed for PG76-22, and local asphalt plants don't have that piece of equipment. Because of this, the asphalt plant will have to rent the bale shredder for the Old Woman Creek Reserve to break up the polymer fibers and insert them into the asphalt mix, likely resulting in a much higher unit cost for the porous asphalt at OWC than larger projects would have. Other observations from the project team include that redeveloping sites are much more difficult for BMP installation than undeveloped sites and that areas where water ponds are not the best places for bioretention cells.

Two people raised concerns about bioretention installers using "recycled" materials that should not be used in pervious pavement aggregate like slag or foundry sand. They suggested writing the bid specifications to prevent the use of slag or foundry sand, as it is unknown whether these can be safely used in pervious pavement applications. Specifications for this project do not exclude these materials.

There was some discussion about the importance of construction oversight for new and complex designs. Engineers stated that they rarely get paid to supervise construction for their projects, but that some states do require the engineers submit as-builts for their projects. In North Carolina, per Ryan, engineers have to seal, with their P.E. stamp, as-built surveys and other construction documentation to say that stormwater practices have been built to spec. Because of this, engineers in NC are on site at critical junctures. In this case, projects don't get their certificates of occupancy for a site until an engineer has certified that the BMPs have been built correctly. The design-build model has the benefit of having only one entity responsible for the finished product.

Ryan highlighted design lessons learned from a monitoring perspective. These included the need for at least three inches of drop at monitoring points/locations, that catch basins sized three by three feet (rather than smaller) allow more room for installation of equipment, that there need to be ways to collect untreated runoff as a control during water quality sampling, and the importance of grouting outlet pipes in catch basins to minimize unmonitored flows.

Participants discussed the utility of tracking construction costs so bids can be compared and people will know how costs might be impacted by including a BMP in their project. A couple of people said they thought it would be useful to have a comparison of LID costs to traditional infrastructure costs. One person questioned whether collecting detailed cost information was actually useful. Others questioned whether line item prices were realistic, as contractors may want to hide their profits in line items. Some suggested that cost per square foot (per BMP type installed), with details on what is included in that cost, is the most useful cost metric. Others suggested asking contractors who aren't bidding on a project for a cost estimate or asking ODOT about their process for tracking costs. Project team members suggested comparing the cost of monitorable systems to systems not designed to be monitored. They may want to consider tracking BMP size along with cost per square foot (to learn about how scale affects cost) and also to investigate how proximity to suppliers affects costs. Other suggestions included determining how contractor communication and relationships during early

planning stages impacts costs and access to funding for a project, conducting an anonymous survey of contractors to determine real costs, and to account for how site variability can impact overall cost.

Monitoring Update

Amy gave an overview of the process the Project Team has been going through to determine which of the sites the project is involved with ought to have their BMPs monitored. The team evaluated each site to determine whether monitoring them would provide any unique information. Amy gave an overview of the pros and cons of monitoring at each site. The plan is to monitor Old Woman Creek and Perkins Township for sure, and possibly monitor Willoughby Hills, Orange Village, Pepper Pike and Holden Arboretum. In order to be able to effectively monitor how well a BMP is performing, it needs to be isolated from other treatments. CLG members recommended that the Pepper Pike site, which has a sloped subgrade, be monitored. They also noted that treatments will often be used as a treatment train, which the Project Team agrees with, there just isn't a good way to monitor such situations in an efficient and useful way at this time. Ultimately the CLG recommended that all possible sites be monitored if budget allows.

In addition to monitoring water quantity, the project team is planning to monitor water quality at Willoughby Hills Community Center (pervious pavers) and Old Woman Creek (porous asphalt). The team is still investigating lab services, detection limits, lab capabilities, and equipment.

Ryan described the process of installing monitoring equipment at the Perkins Township site. There is a climatic monitoring location in one of the parking lot islands. Hydrological parameters are being monitored at two catch basins that drain two section of permeable pavement. One section has a sump and the other does not. Equipment took a day and a half to install (April 2-3), and the equipment includes one weir box (each with two depth loggers for redundancy and a conductivity meter) in each catch basin, and a rain gauge and weather station. The goal is to be able to say that a particular practice reduced water volume and peak discharges by X amount - we'll also be able to determine lag time, curve number, volume reduction, and runoff coefficient. All of the depth loggers have temperature sensors. Several CLG members asked for intermediate updates on the monitoring data results between CLG meetings. They asked Project Team members how long it takes to process/compile the data after it is downloaded, and the team committed to get back to the CLG with that information. Bre Hohman also discussed options for online sites to check rainfall in areas of monitoring sites including CoCoRahs rain data and weather underground.

Modeling and Feedback on Parameters

Scott Dierks (Cardno-JFNew) provided an overview of the modeling work plan under this project. Modeling is being undertaken to simultaneously model treatment of water quality and quantity volumes to meet local and state requirements. The modeling will build unit models for stormwater BMPs and perform a sensitivity analysis for varying design criteria to determine critical design criteria for performance of BMPs. The modeling efforts will also build models of monitoring sites that will be calibrated with actual monitoring data to refine and validate the unit model results. Finally these models will be adapted to include rainfall runoff scenarios anticipated as a result of climate change and

characterize climate change adaptation functions of LID BMPs later in this project. Ultimately the project team would like to develop guidance tables and/or new (or adapt existing tools) to translate the modeling results into a more simplified tool for use by development and review engineers. The workplan for the current contract includes the following components:

1. Develop climate data sets based on historical data from Cleveland Hopkins airport
2. Create base models with SWMM for a range of BMPs: bioretention, permeable pavements, grass swales, dry detention basins, soil renovation, grass filter strip, underground detention, infiltration trenches and green roofs
3. Complete model sensitivity analyses.
4. Run scenarios for undeveloped uses (like agriculture, pasture and forest) and developed uses (assuming the BMP as 1-25% of a 1 acre drainage area with 0.5 acres impervious surface and 0.5 acres of grass) for all soil hydrologic groups.

Scott says he views modeling as water accounting. To date, for this project, the Cardno-JFNew team has completed unit models for bioretention, permeable paving and grass swales. Current unit models assume zero evapotranspiration (ET). ET will be accounted for in annual analysis. According to Jay, one of the goals is to determine the ideal BMP to drainage area ratio. The second phase will be to adjust design parameters to determine which design parameters affect performance the most and thus are most critical.

Some people expressed a desire to have soil renovation modeling results. People asked about the end product, which may be a guidance table, with or without some spreadsheet tools if/when volume reduction comes to Ohio. Scott confirmed that they will look at a treatment train after looking at practices individually, which someone indicated could be valuable to designers. Participants discussed soil renovation and difficulties in both modeling the renovation, but also developing standards for methods of completing soil renovation to improve infiltration capacity and bulk density. The Project Team welcomes any CLG members who are interested in modeling to help give input and guidance on this portion of the project. Clyde Hadden, Lynette Hablitzel, Dan Bogoevski, and Leo Sferra indicated their interests in participating in this.

Bioretention: with DRAINMOD and HyPer Tool Overview and Demonstration

Ryan provided background on the use of DRAINMOD for modeling the water quantity benefits of bioretention. DRAINMOD is a long-term agricultural drainage model created by USDA for flat-land, shallow water table applications. The inputs are drainage configuration, contributing area, soils, weather, drainage intensity, drainage type, and vegetation. DRAINMOD predicts water stored in media/soil based on water table depth & soil-water, and its outputs are evapotranspiration drainage (underdrain/treated volume), runoff (overflow volume) and seepage (exfiltration). It does a good job of predicting long-term bioretention hydrologic performance. It does not model nutrient or sediment reduction, however.

Next, Ryan gave an overview of the HyPer Tool for modeling bioretention. It is a macro-embedded excel spreadsheet model (a large table), which has much simpler, more user-friendly results than DRAINMOD.

HyPer is not yet being used by regulators in North Carolina to look at load reduction; however, it will be by the end of 2013. Ryan went through the various inputs, assumptions and outputs of the tool.

CLG members practiced using the HyPer Tool to solve practice problems. Several CLG members indicated that they liked the HyPer Tool, saying it is potentially a useful tool to give credit for exfiltration/runoff reduction from multiple bioretention designs and is relatively simple to utilize. Questions were raised about plant selection and if this makes a difference in function. Once CLG member noted that Case has done some research whose model results indicate that plants don't make a difference in bioretention cells. Ryan disagreed and noted that he thinks plant rooting depth does make a difference (Monash University, among others, has done work on this). Jay requested specific data on that. Scott Dierks asked if IWS changes the plant selection? Ryan indicated no we're still using the same plants. NCSU does not recommend IWS in D soils because the effect on the water balance is so small, and the soil in the IWS remains saturated indefinitely. Some worry about the possibility for designers to adjust coefficients (such as drainage coefficient) in inappropriate ways to get misleading results. A CLG member stated that acceptance of the use of a tool by regulators makes all the difference to both district and municipal design engineers – once accepted, they can use the tool, prior to that it is harder to do. Others suggested that approved tools need to be in the rainwater manual, and that there is a need for a tool to calculate runoff reductions. Someone suggested there should be a way to check model inputs with a secondary source to confirm they are accurate. There was also a bit of discussion about the importance of maintenance over time to ensure levels of performance. Someone noted that that is hard to get people to maintain traditional stormwater practices, and that people who have some enthusiasm for BMPs may be more likely to follow through on maintenance. Apparently many municipal codes say the municipality can charge people for maintenance completed by the community, but that rarely occurs.

Training and Technical Assistance

Project Team members are engaged in talking about this project, what we're learning, and sharing our lessons throughout the region and have been doing this since the start. Northeast Ohio Stormwater Training Council (NEOSWTC) will hold trainings for Landscape Professionals on residential BMPs on July 9th and for commercial scale BMPs on October 1st http://www.crwp.org/index.php/component/gcalendar/event/1/gi3n4gr7jcie9vehicr2mgaiqs?Itemid=266. Erie County is working with the Ohio Balanced Growth program to improve codes to be more LID friendly.

CLG Business

The other two CLG meetings this year will take place on July 17 and September 18. Project Team members will let the CLG know when there are opportunities to visit sites during BMP construction and monitoring installation. Several CLG members indicated interest in participating in modeling discussions.