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Session 1B

Kentucky Water Resources Research Institute, University of Kentucky

UNIVERSITY-HABITAT FOR HUMANITY GREEN INFRASTRUCTURE DEMONSTRATION PROJECT

Nancy Givens, Sustainability Programs Development Coordinator
and Terry Wilson, Director
WKU Center for Environmental Education and Sustainability,
1906 College Heights Blvd., #11098, Bowling Green, KY 42101
270-745-2842 or 270-745-4424
nancy.givens@wku.edu terry.wilson@wku.edu

Western Kentucky University is working in partnership with the local and state Habitat for Humanity to create an integrated green infrastructure statewide demonstration project using Low Impact Development (LID) techniques to manage stormwater as part of a planned medium density green affordable housing community, funded by a 2010 319(h) grant. The site is a 16-acre parcel owned by the local Habitat for Humanity within the Jennings Creek watershed and Bowling Green city limits. The project will promote enhanced water quality and public awareness through Best Management Practices (BMPs), professional and community education and outreach, and cooperation among agencies, citizens, and government. Education and media outreach and professional training are essential to the project. The state Habitat for Humanity will seek building policy revisions with implications for local, state, and potentially international chapters.

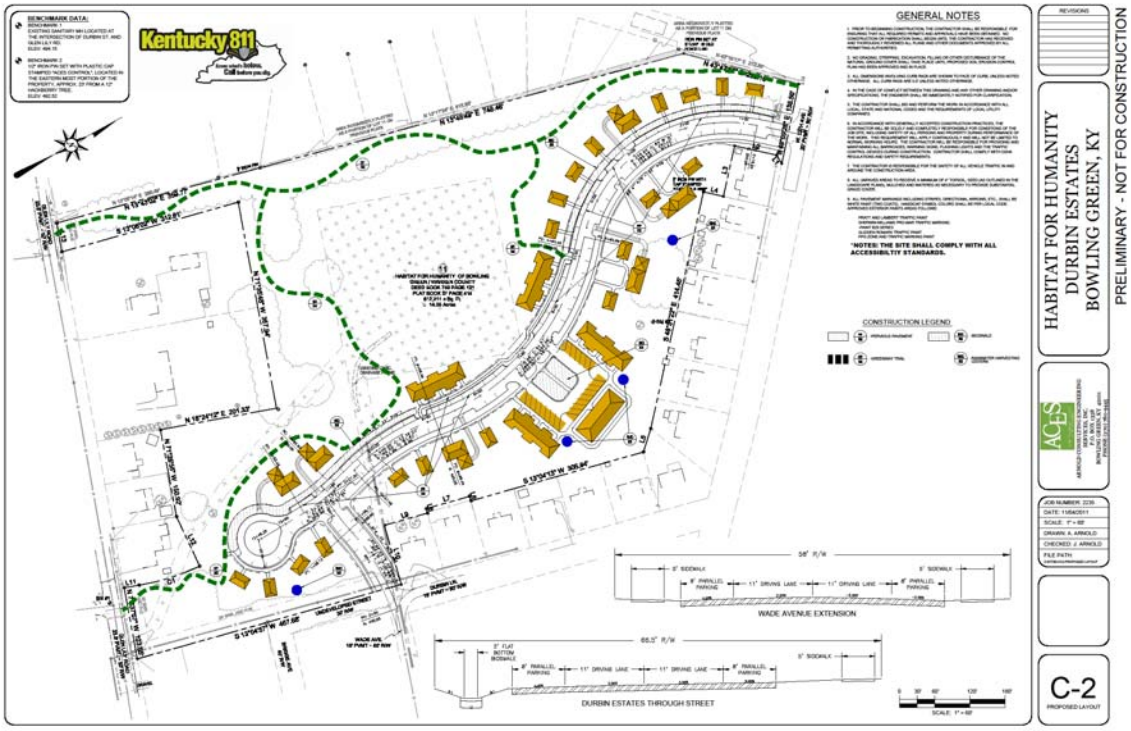
The goal of this project is to demonstrate an integrated green infrastructure model for community development that can be broadly replicated to reduce NPS pollution, educate the public, and improve quality of life for communities. Objectives are to:

1. Create an integrated green infrastructure that retains, filters, and reuses all stormwater at the site
2. provide professional training and community education and outreach on the features of this system and how they reduce NPS pollution and benefit the community and environment
3. involve residents and community in hands-on activities to build a sense of pride and ownership in the project and shared responsibility for stewarding the environment
4. seek building policy revisions for KyHFH and potentially state and local governments.

Committed partnerships are a strength of this project. Principle partners include Western Kentucky University (WKU) and the state and local Habitat for Humanity. Additional partners include the Bowling Green Mayor's office and Department of Public Works, WKYU-PBS, Bowling Green City Schools, BGGreen Partnership for a Sustainable Community, Bluegrass PRIDE, Arnold Consulting and Engineering Service (A-CES), and the Warren County Division of Stormwater Management. The project will work closely with the River Basin Coordinator and River Basin Team in the project area. An Advisory Board will include representation from each of the principle partners.

Mechanisms to be included in the infrastructure design and examples of LID techniques include:

- Stormwater Control (e.g., pervious pavement, thick gravel sub-base, arced headwall, rain garden)
- Water Runoff Control (e.g., broad outlet structure, modified drainage channels, landscaping/vegetation)
- Sediment/Trash Control (e.g., stilling basin, filtration fence)
- Pollution/Irrigation Control (e.g., drought tolerant and native species plantings to reduce pesticide and water use; subsurface cisterns, rain barrels, above ground water features, and irrigation piping)



Preliminary grade and drainage plan

EFFECTIVENESS OF POLLUTANT REMOVAL IN THE MCCONNELL SPRINGS STORMWATER QUALITY WETLAND POND AND THE GAINESWAY POND RETROFIT PROJECT, YEAR TWO

David J. Price, Ph.D. and Susan L. Plueger, P.E.
Lexington-Fayette County Government, Division of Water Quality
301 Lisle Industrial Avenue, Lexington, KY 40511
(859) 425-2415
dprice@lexingtonky.gov

In December 2009, the Lexington-Fayette Urban County Government (LFUCG) completed construction of the McConnell Springs Stormwater Quality Wetland Pond. The facility has a "treatment train" of 3 components: a pre-treatment gross debris trap, a three-cell settling forebay, and the main pond with 0.2 acres of deep pool and 0.5 acres of shallow marsh/littoral shelf area. The main purpose of this facility is to reduce non-point source pollution entering McConnell Springs and neighboring streams Wolf Run, Town Branch, and South Elkhorn Creek, all designated as impaired streams by the Kentucky Department for Environmental Protection. The project's secondary purpose is to demonstrate to the public the benefits that natural environments provide to water quality and quantity control. In Spring 2009, LFUCG remediated Gainesway Pond at Centre Parkway. The renovations were part of the Gainesway Retention Basin Water Quality and Environmental Education Project. The goal of this project was to retrofit the existing Gainesway Pond to increase pollutant removal through addition of constructed wetlands, aquatic plantings, an aerator, and upstream biofiltration and gross debris traps. The Gainesway project also provides the community with environmental educational opportunities. Both of these projects were funded in part through a §319(h) grant provided by the U.S. Department of Environmental Protection and administered by the Kentucky Division of Water.

To monitor pollutant reduction performance, LFUCG Division of Water Quality collected water samples in 2010-2011, with emphasis on runoff samples during storm events. At McConnell Springs, the Friends of Wolf Run Inc. provided training to community volunteers who assisted with sample collection. As a public outreach and education component, McConnell Springs Nature Center staff set up a mechanism for science students to help augment field data. At McConnell Springs, five sampling sites were identified: sites M1-M3 were located in the pre-treatment and forebay cells prior to the main pond (M4-M5). Gainesway Pond samples were collected from the following sites: upstream, mid-stream, wetland area, Pond A, and Pond B (i.e., GP1-GP5). A total of 13 sampling events were conducted at McConnell Springs and 8 sampling events at Gainesway Pond in 2010-2011. On-site measurements included: temperature, pH, ORP, dissolved oxygen (DO), conductivity, and total dissolved solids (TDS). Additional analysis included: alkalinity, hardness, carbonaceous biological oxygen demand ($CBOD_5$), total suspended solids (TSS), total ammonia, nitrate, nitrite, total phosphorus, orthophosphate, and bacterial enumeration (fecal coliforms, *E. coli*, and other coliforms). Metal analyses of water samples from McConnell Springs were conducted in 2010 by the Kentucky Geological Survey (KGS) Laboratory.

During sampling at McConnell Springs Wetland Pond, pH ranged from 7.0 to 9.8 in 2010, and from 7.53 to 9.85 in 2011, which were within expected parameters. No distinct trends in DO concentrations were observed in 2010, with DO levels ranging from 3.03 to 8.4 mg/L. In 2011, DO ranged from 1.61 to 11.86 mg/L with levels increasing through the system and sites M4-M5 having the highest DO. Initially, both total alkalinity and hardness were elevated, but concentrations decreased as the system became established. For 2010 collections, TSS concentrations at sites M1-M3 averaged 29 mg/L, whereas sites M4-M5 averaged 12 mg/L, indicating an initial settling of suspended solids. TSS levels were observed to increase in the summer-fall and decrease in the winter. Reductions of TSS in the system were more evident in 2011. Overall ammonia levels in 2010 decreased at sites M4-M5, except for an increase in 8/27/10, attributed to low-flow conditions. As with TSS, ammonia reductions were more evident in 2011. Similar reductions were found for nitrate and nitrite. Concentrations of total phosphorous and orthophosphate decreased through the system for 2010 and 2011. Testing for fecal coliforms began in 2011 with counts generally highest at sites M1-M3. The 2010 geometric mean for *E. coli* was 674 MPN/100 mL and decreased to 344 MPN/100 mL in 2011. In general, *E. coli* counts were highest at sites M1-M3, with reductions at sites M4 and M5. The geometric mean for other coliforms in 2010 was 16210 MPN/100 mL and decreased to 4911 MPN/100 mL in 2011. For the 30 metals tested in 2010, the following were not detected in any of the sites: antimony, beryllium, cadmium, chromium, gold, lead, selenium, silver, thallium, strontium, and vanadium. Concentrations of aluminum, copper, iron, nickel, sulfur and zinc decreased through the stormwater facility.

pH levels in Gainesway Pond samples collected in 2010 were fairly constant, ranging from 7.23 to 8.85, and in 2011 the pH ranged from 7.17 to 9.20. DO levels in 2010 were elevated during high-flow conditions (4/2/10 and 12/2/10), but decreased in the summer. In 2011, lowest DO levels were observed at the wetland site (GP3), but increased in the downstream ponds (GP4-5). For both years, total alkalinity and hardness concentrations were lower in the ponds as compared to upstream stations. TSS values from 2010 were initially lower in the ponds, but the levels increased in subsequent collections (12/2/10; GP1= 2 mg/L, GP4= 8 mg/L). This trend was more evident in 2011, with highest TSS values at the ponds (GP4-5). Average ammonia concentrations did not vary between 2010 and 2011, ammonia levels for 2011 were elevated in the spring, but decreased through the system during the rest of the year. Total phosphorous and orthophosphate increased during in spring-summer 2011, but remained somewhat constant during fall-winter. Except for the April 2011 collection, *E. coli* counts were highest upstream and decreased in the ponds. Numbers for other coliforms decreased in the ponds during summer-fall, but were elevated in April and December 2011. As with McConnell Springs, fecal coliform testing began in 2011, with counts generally highest at upstream sites and decreasing in the ponds.

Based on the two year data, the structures appear to be performing as expected, with the systems becoming established and providing more consistent results. Pollutant reductions were observed at both systems. As part of their management, LFUCG will continue to monitor water quality as the systems further become established. In particular, close monitoring of ammonia, total phosphorous and bacterial counts will aid in preventing detrimental impacts to the facilities and receiving waters.

COCA-COLA STORMWATER REPLENISH PROJECT

Eric Dawalt, P.E.
Ridgewater, LLC
908 Woodglen Ct.
Lexington, KY 40515
(859) 806-1089
edawalt@insightbb.com

Russ Turpin
EcoGro
P.O. Box 22273
Lexington, KY 40522
(859) 231-0500
russ@ecogro.net

In 2010, the Lexington-Fayette Urban County Government (LFUCG) initiated a stormwater utility fee to provide funding for measures to reduce the negative impacts of stormwater runoff and non-point source pollution in our local waterways. Spurred by the EPA Consent Decree, our community began to realize the daunting task of rehabilitating the urban landscape so that our waterways can support their designated uses. It was obvious that upgrading city stormwater infrastructure alone could not accomplish this task. The city of Lexington needed its citizens and businesses to make changes on their own properties.

Using a portion of the funds generated from the stormwater utility fee, the LFUCG Division of Water Quality established the Stormwater Quality Projects Incentive Grant Program to assist land owners in improving stormwater runoff quality from their properties. The grants were competitive and scored based on the project's overall effect to improve stormwater quality. One of the first projects funded by the program was the Coca-Cola Stormwater Replenish project at the Lexington Coca-Cola facility on Leestown Road.

As part of the Replenish Project, Coca-Cola installed stormwater quality Best Management Practices (BMP's) that include an 8,500 square foot rain garden (one of the largest in Lexington), a 12,500 gallon underground infiltration chamber system and a parking lot water quality sump drop inlet. It also includes a 10,000 gallon rain water harvesting system that stores rooftop stormwater runoff for beneficial use in non-potable applications such as vehicle washing, toilets, and irrigation. It is anticipated that the BMP's will treat and infiltrate up to 1.5 million gallons of stormwater each year and that Coca-Cola will be able to use over 120,000 gallons of rain water each year in non-potable applications.

In addition, Coca-Cola is partnering with two University of Kentucky (UK) groups to educate others about stormwater quality BMP's. The UK Tracy Farmer Institute for Sustainability and the Environment is using the project as a case study for water educators, K-12 teachers, and professional development courses for engineers. The UK Biosystems and Agricultural Engineering Department is utilizing it as a research project, monitoring the project for its performance and providing real data that LFUCG, facility managers, and others can use in the design of future BMP's.

NOTES

ITEST AND LFUCG STORMWATER PROFESSIONAL DEVELOPMENT

Carol D. Hanley, Ed.D.
Environmental and Natural Resources Initiative, College of Agriculture
Associate Director, Tracy Farmer Institute for Sustainability and the Environment
200 E Kentucky Tobacco Research & Development Center
1401 University Drive
Lexington, KY, 40546-0236
(859) 257-3780
chanley@email.uky.edu

Brian Radcliffe
Environmental and Natural Resources Initiative, College of Agriculture
Tracy Farmer Institute for Sustainability and the Environment
(859) 608-5258
brian.radcliffe@uku.edu

The College of Agriculture of the University of Kentucky through the Environmental and Natural Resources Initiative (ENRI) and the Tracy Farmer Institute for Sustainability and the Environment (TFISE) has provided professional development for K – 12 teachers and learning experiences for students across Kentucky in Community Based Science projects involving water quality and geospatial technologies for the past several years. Funding has been provided through grants from the National Science Foundation's Innovative Technology Experiences for Students and Teachers (ITEST) and, more recently, through the Lexington-Fayette Urban County Government Stormwater Initiative.

Through the ITEST grant, all projects were driven by individual community concerns of particular schools and teachers for water quality in their localities. Curriculum was designed around local watersheds in various counties (Fayette, Woodford, Marion, Scott, Robertson, Madison, Grant, and Floyd counties). Professional Development for teachers and students was provided at summer workshops and lessons were conducted in classes on a myriad of topics including nature of science, experimental design, science communications, GPS and geospatial topics (GIS mapping and data analysis), stormwater runoff, watersheds, chemical and biological water quality indicators, riparian vegetation and invasive species, data collection at local streams, and analysis and presentation of data using GIS mapping. The funding through LFUCG Stormwater Initiative is much the same though concentrating on professional development of teachers in five Fayette County elementary and middle schools.

The results of these on-going Community Based Science projects include several hundreds of hours of in class lessons for students and teachers as well as several thousands of hours of student contact time in field trips to local streams and ponds for data collection, reflection, and analysis. Ongoing professional development through the

LFUCG Stormwater Initiative has included or will include basic properties of water, watersheds, chemical and biological indicators of water quality, riparian vegetation, bacterial contamination of water, stormwater runoff and retention, rain gardens, point and nonpoint source pollution, GPS and GIS instruction, and karst topography. The intention is for teachers to use lessons in their classrooms to engage students in authentic and relevant science activities.