# ANNUAL REPORT

Monitoring and Evaluating Level Spreader Stormwater Best Management Practice in a Subwatershed of Hinkson Creek

**Reporting Period:**

May 1, 2018 – December 5, 2018

**Submitted to:**

Hinkson Creek Collaborative Adaptive Management (CAM)

Funding Partners:
The Curators of the University of Missouri
The City of Columbia, Missouri
Boone County, Missouri

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## PROJECT DESCRIPTION

Hinkson Creek is listed as an impaired water for unknown multiple pollutants and placed on the EPA's 303(d) list. One pollutant that may contribute to the impairment is sediment. Stormwater best management practices that reduce erosion and runoff volume may help to increase the water quality in the creek.

A level spreader, paired with riparian buffer strip, is a stormwater best management practice (BMP) that functions to decrease impacts of urban stormwater on a receiving stream. The level spreader receives water diverted from a stream, construction site or other development and the water is distributed evenly along the length of the structure. The water then flows as sheet flow through the riparian buffer zone, which facilitates infiltration and removal of pollutants. (Knight, Hunt and Winston 2013) The practice has been adopted mainly in east coast states.

The Forum Nature Area level spreader was designed to divert and attenuate peak flows in an unnamed tributary of Hinkson Creek (illustrated in Figure 1). The watershed for the level spreader is about 120 acres and is composed of residential and business use areas, with two large man-made ponds upstream of the level spreader. Before installation of the level spreader system, the tributary was experiencing erosion and bank cutting, and soil loss into the Hinkson, despite influence of the small lakes.

After construction was completed, a monitoring program was put in place at the site, including measurements of volumetric soil water content, water level within the level spreader, and climate data at the site. Monitoring has continued since 2016, with weekly volumetric soil water content readings taken each Monday. Water depth in the level spreader is continuously logged, and this data is available from April through October. Together with climate data, these may be used to characterize the level spreader response to storm events.

Data is shared each month between Lynne Hooper from Boone County and Laura Wiseman at the University to facilitate quicker data analysis.

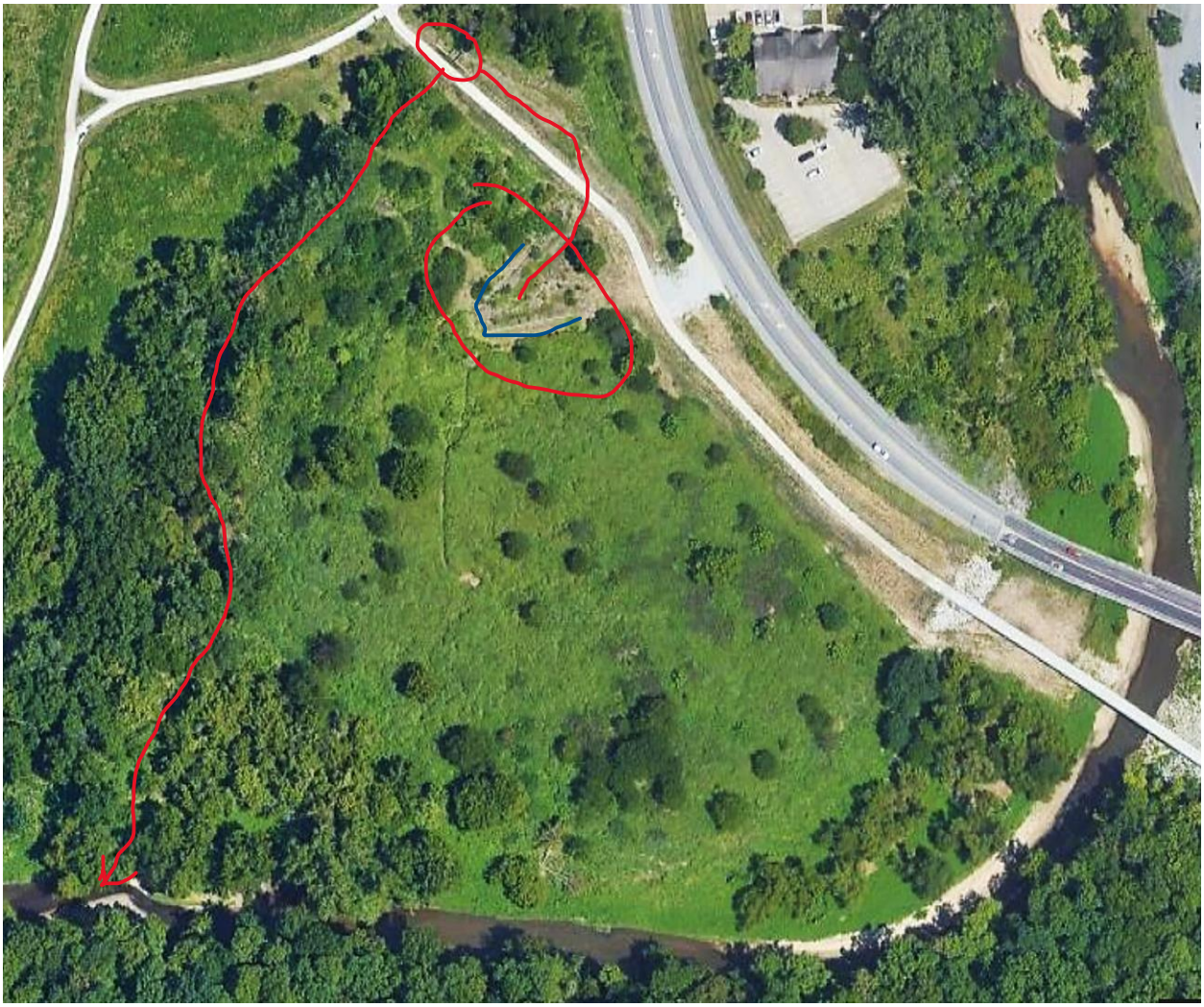

Figure 1: Aerial Image of the Forum Level Spreader and Hinkson Creek

(splitter box at top of image, most of flow diverted to level spreader (circled) and away from unnamed tributary to the left of the image)

## PROJECT GOALS AND OBJECTIVES

The ultimate objective of this project is to evaluate the effectiveness of the level spreader for attenuating peak flows in the tributary and increasing stormwater flow through other pathways into the surrounding environment. One important step to evaluating the structure is through the creation of a water balance. Through use of a water balance, the pathways for water as it enters and leaves the level spreader such as overflow, infiltration and evaporation can be quantified.

## ACCOMPLISHMENTS AND PROGRESS

Data collection continues at the level spreader site mainly through collecting soil moisture data for each rain event. This is illustrated in data from the storm in late June 2018, shown below, with precipitation/temperature measurements (Figure 2) and water level data upstream of the level spreader (Figure 3) for comparison to the soil volumetric water content (soil moisture) data for the seven locations (Figures 4-10):

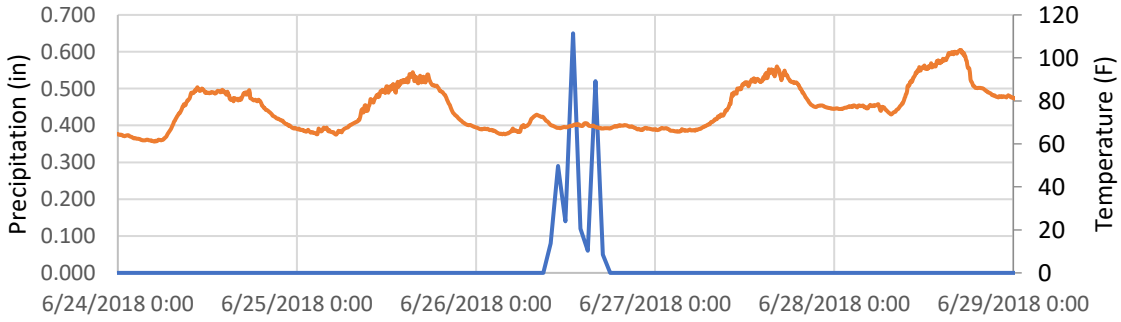


Figure 2: Precipitation and Temperature from Sunrise Estates Climate Station for July 26 rain

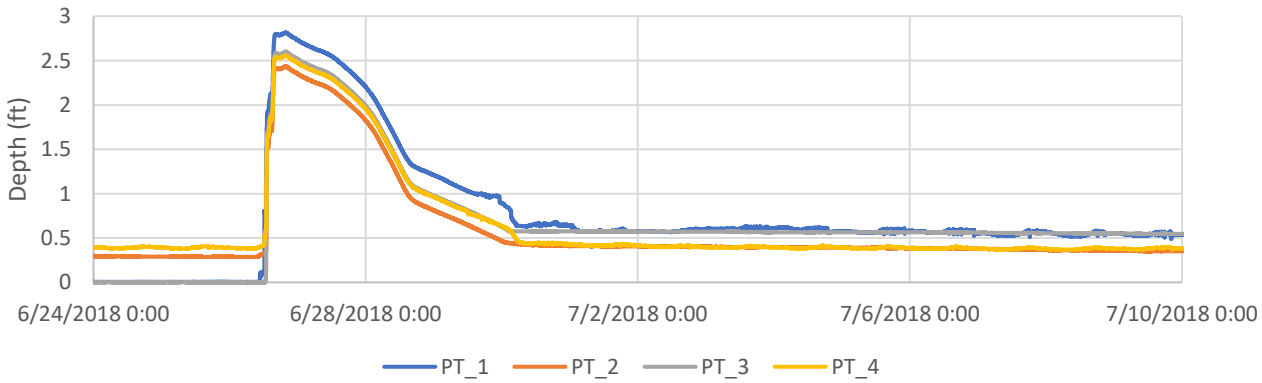


Figure 3: Pressure Transducer Level data for July 26 rain event

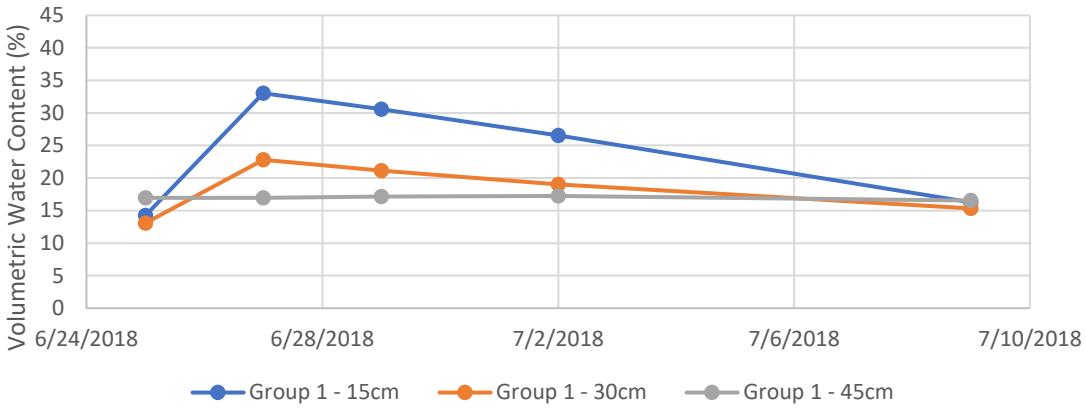


Figure 4: Volumetric Water Content for Sensor Group 1 before and after July 26 rain

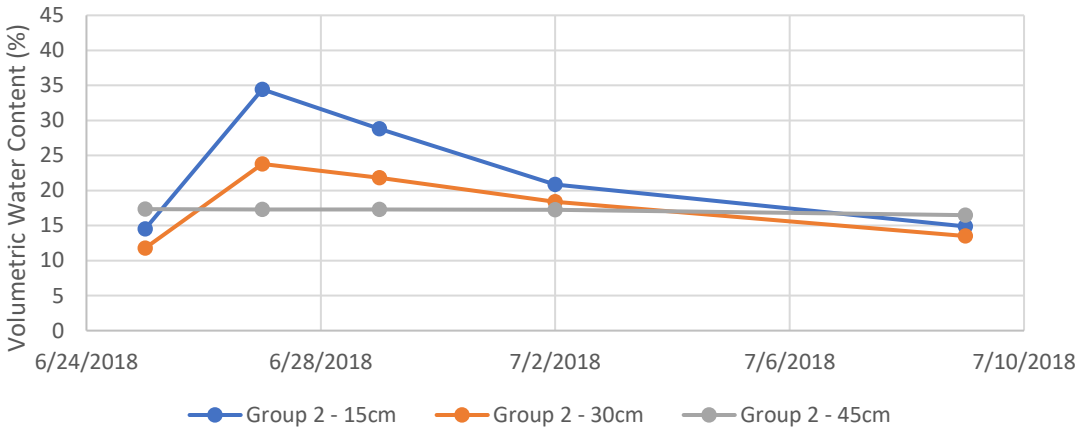


Figure 5: Volumetric Water Content for Sensor Group 2 before and after July 26 rain

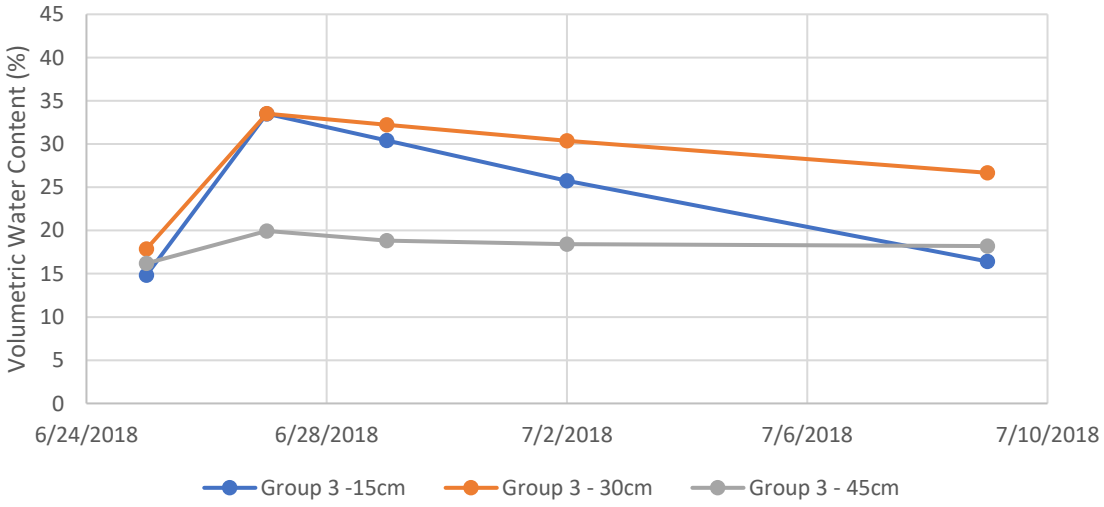


Figure 6: Volumetric Water Content for Sensor Group 3 before and after July 26 rain

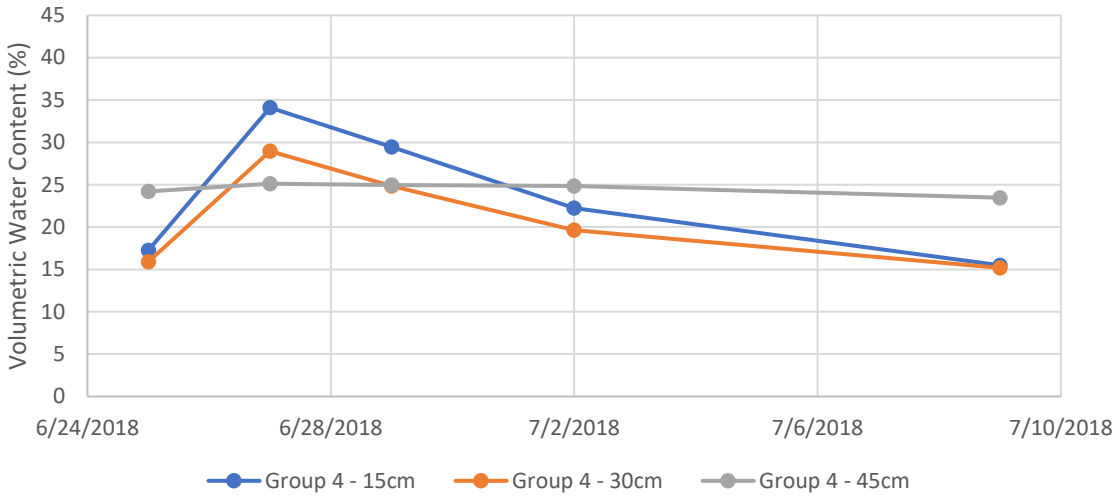


Figure 7: Volumetric Water Content for Sensor Group 4 before and after July 26 rain

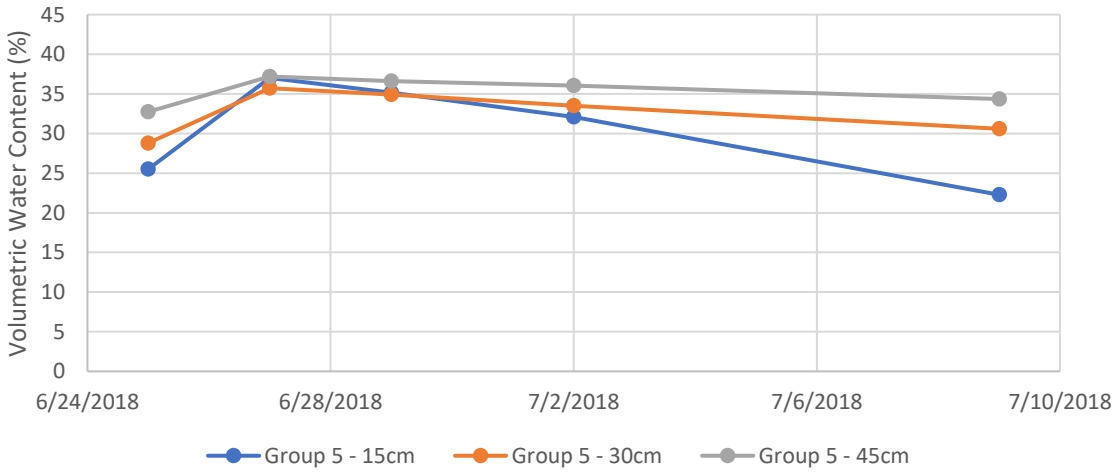


Figure 8: Volumetric Water Content for Sensor Group 5 before and after July 26 rain

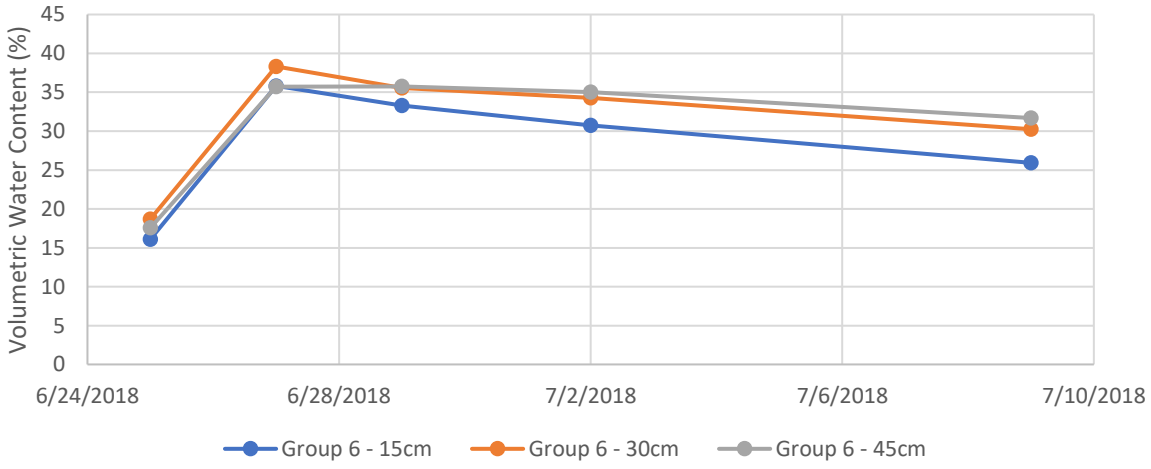


Figure 9: Volumetric Water Content for Sensor Group 6 before and after July 26 rain

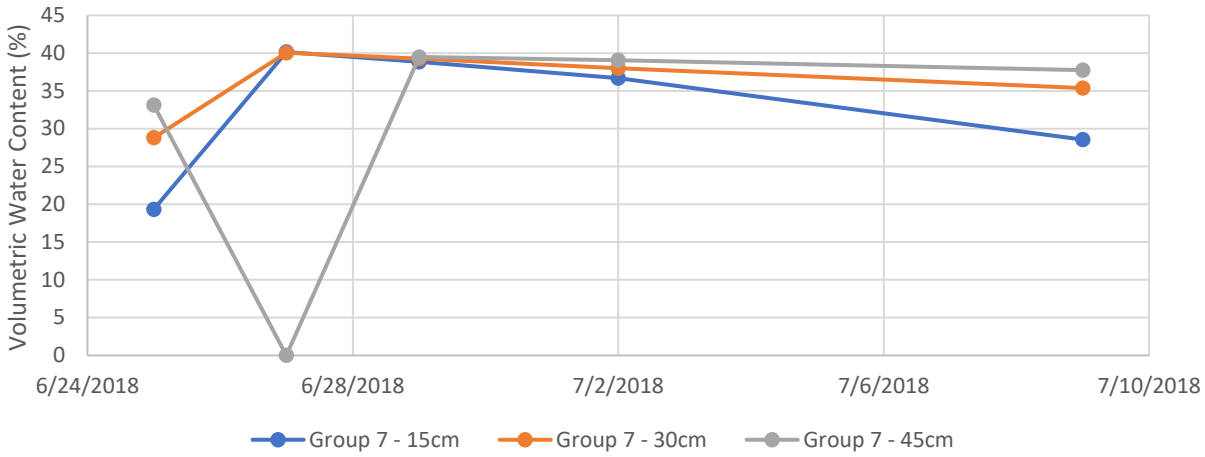


Figure 10: Volumetric Water Content for Sensor Group 7 before and after July 26 rain

1. A shorter interval of time (2-3 days) between soil moisture readings during and after the rain event increases the amount of data available to work with and will help when analyzing site performance and calculating water balance. A poster containing information about the site was created in the spring of 2018 by Peter Brandsgaard, an undergraduate researcher under Dr. Inniss. The poster was exhibited at the University of Missouri's Spring Undergraduate Research and Creative Achievements Forum.

Two presentations were given on this project by Laura Wiseman, both having the same title and abstract:

Title: Monitoring of an Urban Level Spreader as Part of the CAM Process

Laura M. Wiseman, University of Missouri

Co-Authors: Lynne Hooper, Boone County, MO; Dr. Enos C. Inniss, University of Missouri; Tom Wellman, City of Columbia, MO

Abstract: Irregular flows, such as the high flows caused by stormwater runoff after a rain event are a major cause of stream impairment in urbanized watersheds. The Hinkson Creek CAM (Collaborative Adaptive Management) approach is doing long-term monitoring of a level spreader system in the Hinkson Creek watershed to determine the effectiveness of this stormwater best management practice (BMP) as a method to regulate flow in a small tributary to Hinkson Creek by forcing more infiltration and evaporation of urban stormwater runoff. Monitoring equipment placed at the site measures 1) the level of water upstream of the level spreader, 2) volumetric soil water content at multiple depths and in locations near the level spreader as well as farther from and closer to Hinkson Creek, and 3) climate data including precipitation, temperature and solar radiation. Measurements taken by the equipment are used together to characterize behavior of water as it moves through the level spreader system after a rain event, and to begin to define the water balance into and out of the level spreader. Based on measurements collected from 2016 to the present, the level spreader functions well to increase evaporation, transpiration and infiltration of stormwater. By diverting water from the stream and into the level spreader, higher flows in the stream during rain events are reduced. We will present

the study design, the premise of the project in comparison to what the data is suggesting, and how the results of this study may inform where "urban" level spreaders may be used to improve hydraulics of a watershed.

Conferences:

2. September 11, 2018: MWEA Annual Stormwater and Watershed Management Conference
3. October 20, 2018: Mid-American Environmental Engineering Conference

## PROJECT CHANGES

A program is in place with cooperation from Columbia Parks and Recreation to control and eventually eliminate invasive species at the Forum site. The program includes planting of native grasses and vegetation, as well as carefully planned herbicide application to remove the invasive plants.

During the growing season, grasses at the level spreader can get very tall, making access to the equipment difficult. The Columbia Parks Department mows and maintains paths to the equipment at this time, though scheduling regular path maintenance has been a challenge.

Tom Wellman from Columbia Public Works has installed a new orifice plate on the diverter box of the level spreader. This allows less flow to pass through the diverter box and down the tributary to the Hinkson. After the orifice plate was installed, water ponded at a higher depth behind the diverter box during large rain events and the level spreader performs more as it was intended.

As the volumetric water content sensors have been buried for two years at the site, the need for maintenance has arisen. In late October, one group of sensors, Group 4, was removed from the site and tested to determine if they are still reading accurately. The sensors appear to be functioning normally, but due to their age and some instances where they failed to take readings, it would be beneficial to purchase several replacements.

## CHANGES IN PERSONNEL

Beginning in June 2018, the University of Missouri has brought on Laura Wiseman, a graduate student, to be in charge of monitoring and data analysis for the site, as her master's thesis research.

## EQUIPMENT PURCHASED

No new equipment was purchased over the period, but a need has arisen for equipment maintenance at the site, specifically repairs to the Campbell Scientific's Hydrosense reader for soil moisture measurements, as well as several new soil moisture probes. Other equipment needed includes a backup battery for the pressure transducer datalogger, and an external hard drive for data integrity. These will be quantified and finalized within the next several months.

## BUDGET STATUS

The are currently in Fiscal Year 4 of a 6-year, $62,250 project. This is the year that "major" maintenance was planned in the project budget. From a budget perspective, 46% of the project budget has been invoiced with another 38% encumbered as labor (e.g., the stipend for supporting the graduate student Laura Wiseman). The remaining 16% unencumbered budget is intended for maintenance of the monitoring equipment.

## UPCOMING ACTIVITIES

Shortly after the end of the Fall 2018 semester (ending mid-December 2018), a watershed model will be created using the SWAT program or one that is similar. This will help to characterize the response of the watershed, including the ponds upstream of the level spreader, and give some idea of how much water flows into the level spreader for a given storm event.

Collaboration may begin on the site with Dr. Alba Argerich from the School of Natural Resources. As part of this, she may dig small wells at the site for the installation of piezometers to measure groundwater. This would contribute to the amount of data gathered at the site and lead to the development of a more accurate model of its water balance.

## LITERATURE CITED

Bongard, P., and Wyatt, G. (2010). "Benefits of Riparian Forest Buffers." *Agroforestry*, University of Minnesota Extension, <http://www.extension.umn.edu/environment/agroforestry/riparian-forest-buffers-series/benefits-of-riparian-forest-buffers/> (May 28, 2018).

Flournoy, K. A. (2011). *Region 7 Total Maximum Daily Load*. *US EPA*, Columbia, Missouri.

Hathaway, J. M., and Hunt, W. F. (2008). "Field Evaluation of Level Spreaders in the Piedmont of North Carolina." *Journal of Irrigation & Drainage Engineering*.

Knight, E. M., Hunt, W. F., and Winston, R. J. (2013). “Side by Side Evaluation of Four Level Spreader-Vegetated Filter Strips and a Swale in Eastern North Carolina.” *Journal of Soil and Water Conservation*, 68(1).