

# Report for Kentucky Division of Water

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Final Project Report for Implementation of Green  
Campus Master Plan on Kenton County School District  
STEM Campus - Caywood Courtyard

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STEM Campus

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**SECTION 1**

**ACKNOWLEDGMENTS**

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## 1.01 ACKNOWLEDGEMENTS

The following list of groups and people were instrumental in the development and implementation of activities associated with the Caywood Courtyard project.

### A. Kenton County School District

- Rob Haney, Director of Support Services
- Chris Baker, Energy Systems Coordinator
- Danny Mann, Construction Manager

### B. Kentucky Division of Water

- Brooke Shireman, Technical Contact
- Daniel Bishop, Grant Administrator
- Lajuanda Haight-Maybriar, Licking River Basin Coordinator

### C. Visioning Committee Members (Previous Planning Phase)

1. Banklick Watershed Council
  - Sherry Carran, President Banklick Watershed Council
2. Duke Energy
  - John Hill
3. Toyota
  - Kevin Butt
4. Sanitation District No. 1
  - Jim Turner, Project Engineer
  - Jamie Holtzapfel
5. PCA Architecture
  - Andrew Piaskowy
  - Mark Perry
6. Kentucky NEED
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7. Turner Construction

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  - Mike Hilton
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  - Debbie Anderson
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- Doug Bowling
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17. OCTE
- Michael Kindred
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- Mary Kathryn Dickerson
19. Gateway Technical & Community College
- Tony Clark
20. Wagstaff, Inc.

- Carol Wicklund

21. City of Edgewood

- Mayor John Link

D. KCSD Faculty

- Larry Tibbs, Dixie Heights High School
- Lisa Dern, Caywood Elementary
- Renee Topmiller, Caywood Elementary
- John Popham, Simon Kenton High School
- Julie Whitis, Simon Kenton High School
- Shane Rogers, Scott High School
- Annette Boehm, Turkey Foot Middle School
- Sara Callahan
- Dwayne Humphrey
- Teresa Wilkins
- D. Terri Cox-Cruey
- Richard Culross
- Tom Pitts, J.D. Patton Area Technical Center
- John Christiansen, J.D. Patton Area Technical Center
- Ray Stanley, J.D. Patton Area Technical Center
- Debbie Obermeyer, Turkey Foot Middle School
- Dwight Raleigh, Caywood Elementary

E. KCSD Student Groups

- Scott High School Focus Group
- Caywood Elementary Students

F. Strand Associates, Inc<sup>®</sup>

- John Lyons, PE
- Kelly Kuhbander, PE, LEED<sup>®</sup> AP
- Christopher Rust, PE

G. Human Nature, Inc.

- David Whittaker, ASLA
- Christopher Manning, ASLA
- Ryan Geismer

## **1.02 DEFINITIONS**

BMP	best management practices
COD	chemical oxygen demand
KCSD	Kenton County School District
KDOW	Kentucky Division of Water
SD1	Sanitation District No. 1 of Northern Kentucky
TKN	total Kjeldahl nitrogen
TSS	total suspended solids
USEPA	United States Environmental Protection Agency

## **SECTION 2**

### **INTRODUCTION AND BACKGROUND**

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## 2.01 PURPOSE, PROJECT GOAL, AND OBJECTIVES

This project was selected to provide a very unique opportunity to enhance and build upon all of the sustainable and environmental practices that Kenton County School District (KCS D) had already been actively pursuing. The campus is already raising the bar and setting new standards for energy efficiency and sustainable education practices; however, the site and the stormwater runoff had not been considered. With the completion of the stormwater master plan, this site became one of the only school campuses in the nation to have accomplished a fully integrated green campus environment that is also integral to the education of the students.

The project goal, as defined in the project application, was to continue the implementation of the sustainable campus master plan which was developed under a 2002 319(h) grant number C9994861-02, see the final project report titled *Stormwater Master Plan for Kenton County Schools* for additional details and information. The objectives of this project are outlined below.

### A. Continue Implementation of Green Campus Master Plan on STEM Campus

This objective was to choose one BMP to represent the vision of the campus and the direction this new master plan was heading. The BMP to be selected needed to be appropriate given the available funding, have a water quality impact, and continue the fulfillment of the campus vision.

The chosen BMP was the Caywood Courtyard transformation project. The core design team met to choose this project, then refined the concept plan, and began full design. The project included rainwater harvesting, downspout disconnections, reforestation, native plantings, and a rain garden/bioinfiltration feature. Once the design drawings were completed and reviewed, the construction of the courtyard project began.

Construction was completed in the Fall of 2013.

### B. Continue To Develop the Vision for the Site as an Educational Tool

The purpose of this objective was to incorporate stormwater education as a key concept in our construction project. It was important for education to be a central component of this new campus vision. As part of this project the STEM coordinator developed educational curriculum that tied in with the proposed courtyard site plan.

## SECTION 3

### MATERIALS AND METHODS

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### 3.01 PROJECT AREA

The three-school campus is located in Kenton County, Kentucky in Bullock Pen Creek of Banklick Creek Watershed. Bullock Pen Creek is a 10.96 square mile (HUC<sub>14</sub>) subwatershed. The runoff from this site eventually drains into the Licking River and then the Ohio River. Both Doe Run Lake and Banklick Creek are on Kentucky's 2008 Integrated Report to Congress Volume II 303(d) List of Impaired Waters. The three-school campus itself is 20 acres and is located adjacent to the heavily traveled five-lane Turkeyfoot Road. An aerial of the campus is shown in Figure 3.01-1, and the location of the site within the Banklick Watershed is indicated by a green asterisk in Figure 3.01-2.

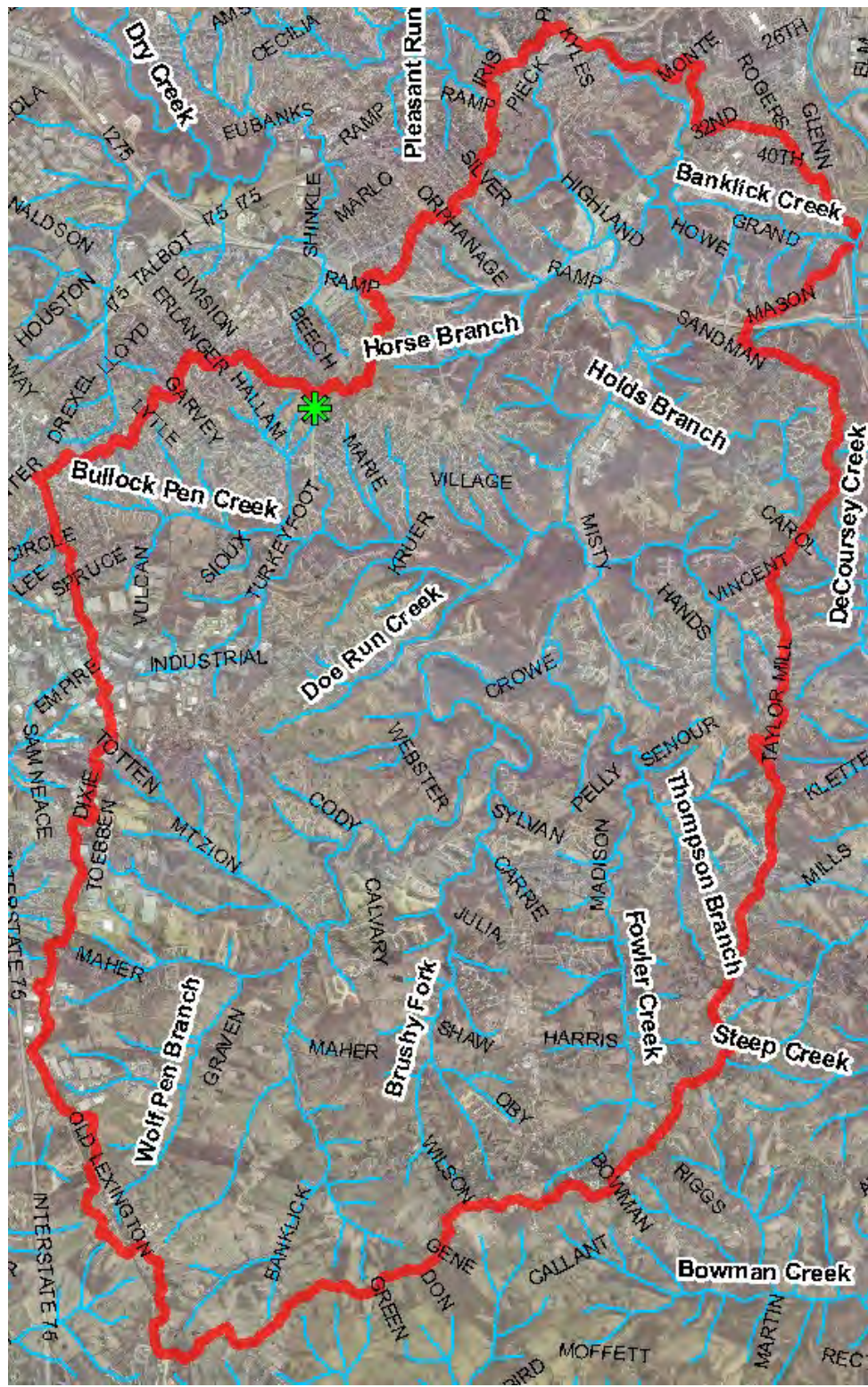


The three schools located on the campus include James. A. Caywood Elementary School, Turkey Foot Middle School, and J.D. Patton Area Technology Center (ATC).

**FIGURE 3.01-2**

**LOCATION OF CAMPUS WITHIN BANKLICK WATERSHED**





### 3.02 SELECT BEST MANAGEMENT PRACTICES IMPLEMENTATION

Moving this project forward was extremely efficient and smooth, because the team was able to pick up where they left off with the previous phase of the master planning project which already included a significant amount

of detailed planning for the courtyard. The goal of this phase was to move quickly through design and construction based on all of the input that was previously received from the stakeholder groups during the master planning phase. It was also important to be efficient in the design phase of the project to allow as much of the grant money as possible for the construction of the features. The core design team included the following representatives:

- Kelly Kuhbander, PE, LEED AP, Design Engineer, Strand Associates
- John Lyons, PE, Design Engineer, Strand Associates
- David Whittaker, Principal, Human Nature
- Kelly Connor, Principal of Caywood Elementary
- Rob Haney, Facilities Director of Kenton County School District
- Danny Mann, Acting as General Contractor, Kenton County School District
- Courtney Lawson, Caywood Teacher, Gardening Club Director

The core design team met formally 3 times prior to the start of construction. The three meetings included selection of the BMPs to be designed, as well as review and revisions to plan sets during the design phase. All parties were encouraged to provide input throughout the design process. Outside of formal meetings the design team utilized email to communicate and share information on a more frequent basis.

In the initial meeting, the core design team evaluated the various possible BMPs that could be installed with the grant funds. It was important to ensure the chosen BMP was representative of the campus vision and encompassed all the following important characteristics:

1. Demonstrated water quality improvement.
2. Affordable within the constraints of the grant.
3. Included various educational components.

After consideration, the core group determined the Caywood courtyard area BMPs would be most appropriate. The core design team met to refine and finalize the concept plan before moving the project into full design. Throughout the design process, the design team ensured all the important characteristics were taken into consideration and were incorporated into the design. A final meeting of the core group was held to review and revise the plan set prior to start of construction. As the acting general contractor, Danny Mann provided insights into how he would construct each component, and which companies he would work with to get quotes for materials. As the design engineers and architects, Strand and Human Nature provided design guidance, engineering, and vision. The KCSD staff provided insights and input on logistics, timing, safety, curriculum, educational elements, student artwork, etc.

A more detailed discussion of the design of this BMP can be found in Section 4 of this report, as well as design drawings in Appendix E.

The Caywood Courtyard site prior to construction was an under-utilized, muddy, grassed area that provided little stormwater benefit, and little educational value. A photo of the pre-construction Courtyard conditions is included in figure 3.02-1.



#### SECTION 4

#### RESULTS AND DISCUSSION

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## 4.01 RESULTS

The vision for Caywood Courtyard was to take an unused space at the center of an elementary school and turn it into a learning opportunity and an outdoor classroom space the students could use and enjoy. A sketch of this vision is shown in Figure 4.01-1.



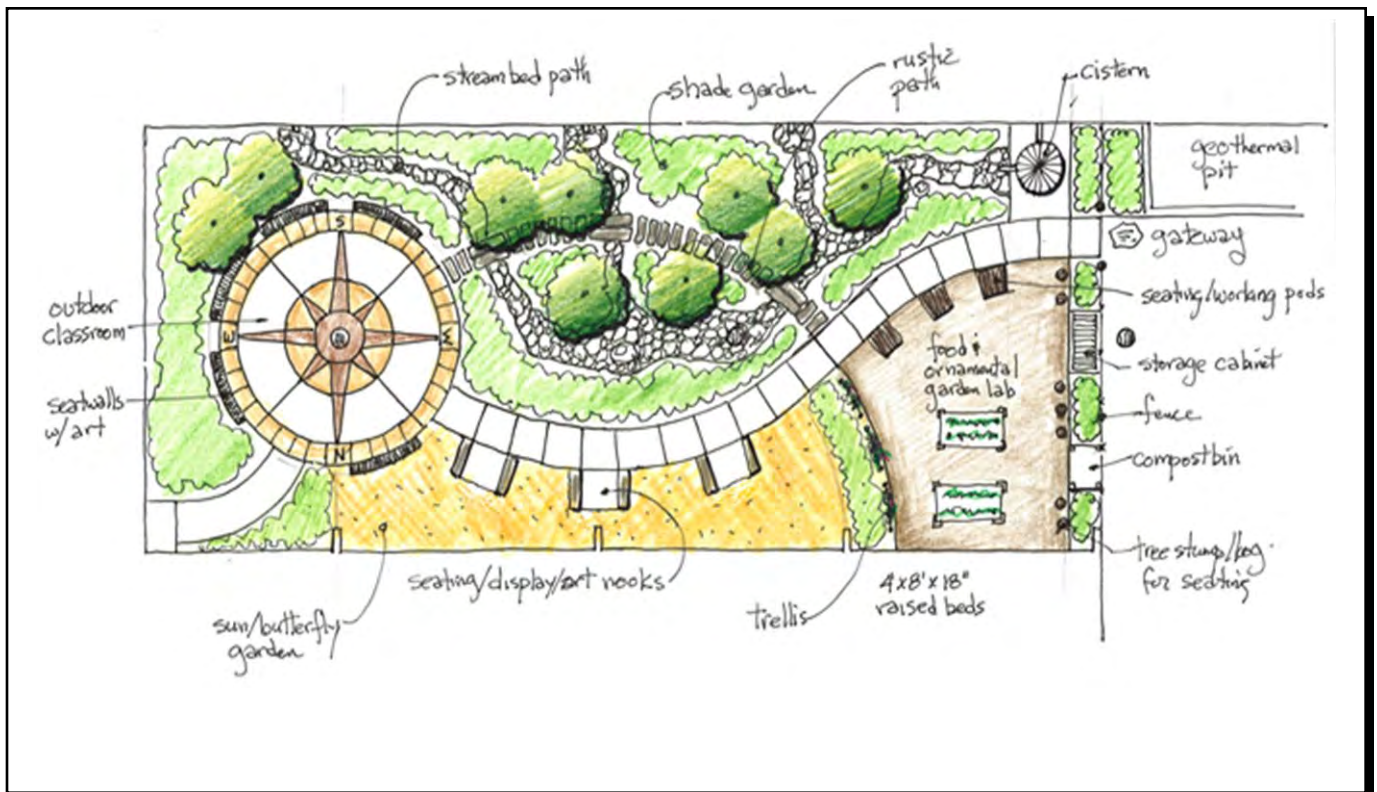
Some of the elements incorporated into the Caywood Courtyard vision include:

- Circular outdoor classroom/lab.
- Rain garden lab.
- Student-made artwork.
- Cistern.
- Raised planting beds.
- Interpretive signage.
- Outdoor tool/storage shed with green roof.

- Enhanced play area with natural play elements.
- Water feature/fountain.
- Famous quotes in pavers.
- Birdhouses and bat houses.
- Formal and informal paths through garden.
- Connection to campus-wide trail system.

#### 4.02 RESULTS OF BEST MANAGEMENT PRACTICES IMPLEMENTATION

The Caywood Courtyard transformation included various BMPs in one compact, cost-effective, highly educational project. Shown in Figure 4.02-1 is the refined plan view concept for the Courtyard, a full size concept is included in Appendix D.



The plan for the courtyard was to not only treat the runoff generate by the site, but to disconnect the downspouts, and treat a large amount of roof runoff from the school building itself. The Courtyard BMP features included downspout disconnection, rainwater harvesting and re-use, rain garden/bioinfiltration features, reforestation, native plantings, an educational stream bed path, an outdoor gathering space, a garden lab, a compost area and a variety of educational components.

The rain garden at Caywood Courtyard is intended to provide water quantity and water quality benefits of the tributary stormwater runoff. The drainage area upstream from the rain garden is approximately 10,000 square feet, and consists of over 60 percent impervious surfaces of rooftops and sidewalks. The drainage area generates approximately 150,000 gallons of stormwater runoff during a typical year of rainfall.

Water quantity reductions can be achieved through a combination of infiltration into the native soil, absorption in the amended soil, and evapotranspiration through the plants. Despite the presence of clay soil, the rain garden is anticipated to reduce the amount of stormwater runoff volume by approximately 10 percent during a typical year of rainfall. Based on modeling results using the Source Loading and Management Model (WinSLAMM ), the rain garden is expected to capture the stormwater runoff from all storm events up to a 1-inch rainfall event. Larger events will be partially captured by the rain garden, but also “bypass” the rain garden through an overflow structure.

Water quality benefits will occur as stormwater runoff passes through the amended soil of the rain garden. A number of water quality parameters can be evaluated for these types of green infrastructure projects. Based on simulations using the WinSLAMM program, the table below summarizes the approximate water quality benefits of the rain garden. Conservative values were included as input files in the model to estimate conservative water quality benefits.

	Before (lbs)	After (lbs)	Difference (lbs)	Reduction
Phosphorous	0.58	0.19	0.38	66.6%
TKN	5.15	4.80	0.36	6.9%
COD	157.10	105.90	51.20	32.6%
Copper	0.01	0.00	0.01	54.7%

Lead	0.16	0.05	0.11	66.5%
Zinc	0.22	0.17	0.05	22.9%
Solids	69.75	23.48	46.27	66.3%

**Table 4.02-1 - Water Quality Benefits**

The following figures show before and after photos. Additional photos can be found in Appendix I.







**4.03 LONG-TERM RESULTS FOR THE SCHOOL DISTRICT**

This project has produced a lot of immediate results on this campus in the form of various BMPs installed today. However, the long-term results of this project are much more far-reaching. The KCSD is now one of the greenest schools in the country. Not only does it have a showcase energy efficient green school building and a sustainable stormwater plan for the campus, it has various educational and functional BMPs installed throughout the campus, including the Caywood Courtyard. As the implementation of the master plan continues in future years as funding becomes available, more and more of the vision for the campus will be complete:

1. Students will now have opportunities to interact with green stormwater BMPs from elementary school through high school.
2. Universities will partner with the school district to conduct research and collect local performance data on the BMP elements.
3. Residents and community members will interact with the campus and become educated by the features on the site.
4. All stormwater falling on the site will be treated through some BMP. Water quality leaving the site will be improved and volume of water leaving the site will be reduced.
5. Teachers will utilize the outdoor classrooms as inspirational learning opportunities.
6. The features on the campus will be integrated into the curriculum of various grade levels so the future students will have the same opportunities to interact with and learn from the site as the current students do. Specific curriculum was developed for the campus by the KCSD staff, and is included as Appendix J.

These are just a few of the potential long-term results the KCSD can expect to see from this project.

## **SECTION 5**

### **CONCLUSIONS**

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## 5.01 CONCLUSIONS

This section provides an overview of the measures of success as outlined in the project application.

### A. Select BMPs for implementation

#### 1. Documentation of planning meetings.

- Planning Meetings were documented through the process.

#### 2. Approval from KDOW of BMP Implementation Plan.

- BMP Implementation Plan was submitted to KDOW and approved in 2013 - see appendix B for the approved plan.

### B. Complete Engineering Designs of BMPs to Be Constructed

#### 1. Documentation of all design and planning meetings via meeting minutes.

- Meetings were documented through the process, some of the meeting notes are included in Appendix J.

#### 2. Completion of preliminary design drawings for each BMP.

- A refined concept plan was developed for the Courtyard prior to start of design, see Appendix D.

#### 3. Completion of final design plans for each BMP.

- Final design drawings were completed for the courtyard and are included in Appendix E.

#### 4. Approval of plans from Kentucky Division of Water.

- KDOW approved the final design plans in Summer of 2013.

#### 5. Provide projected stormwater pollutant removal and quantity reduction.

- WinSLAMM modeling was completed to provide pollutant removal and quantity reduction, see appendix H.

C. Construct BMPs as outlined in the Master Plan

1. Complete BMP Implementation plans for the selected BMPs.

- BMP Implementation Plan was submitted to KDOW and approved in 2013.

2. Completed implementation of selected BMPs.

- Caywood Courtyard BMPs were constructed in the summer of 2013.

D. Inform and Involve project partners, student groups, community groups, local businesses and other stakeholders throughout the project.

1. Number of students and other stakeholders engaged in meetings, field days, and projects.

- It is estimated that nearly 100 students and stakeholders were engaged in some phase of the development and completion of this project.

2. Number of project partners willing to further the vision of the campus through monetary or time donations.

- Time donations for this project were provided by a variety of KCSD Faculty, Strand Associates and Human Nature, students of the campus, and guests of the campus.

3. Number of attendees at field days held during construction.

- A maintenance training for the BMPs was hosted by Human Nature to review the prepared maintenance manual and demonstrate to the KSCD faculty how to care for the site BMPs. Although the exact number of attendees were not tracked, the garden club was present on the site frequently, and the teachers were invited to take their students out to see the site as construction was being completed in the first days of school.

E. Continue development of curriculum that incorporates the site BMPs into the learning process.

1. Level of curriculum development completed for the site BMPs.

- Various stormwater curricula was developed and integrated into the Caywood Courtyard project design and construction, curricula included in Appendix K.

2. Approval of educational materials by KDOW.

- KDOW was present at several key meetings where the integration of curricula was discussed and planned. KDOW approved of the planned use of curricula in the project concept plan.

## 5.02 RECOMMENDATIONS AND LESSONS LEARNED

Throughout the duration of this project, our team was able to identify methods that worked really well, as well as some methods that were not as effective. This section outlines our recommendations based on what we have learned through this project.

A. Designer Input and Review During Construction

One shortcoming our team identified was not allowing for enough input from the Design team during the construction process. Because of the unique nature of BMP construction, it is very important to monitor the construction process and ensure all elements are installed properly and all materials are appropriate. Our team has learned it is important to plan and scope adequate time for the designers to visit the site throughout construction to allow for these inspections.

B. Budget Management

Our team learned that with a fixed grant budget it is important to make the final project come in right on budget. This is a challenging task, and to accomplish this task, it was important for our group to have several alternative materials that could be swapped out as costs allowed. We also had a few additional items that we wanted to complete as budget allowed, such as funding maintenance on the entry raingarden which was completed in 2011.

C. Match Management

Our team had identified a source of match, but the match was a consistent source over the course of 2 years (faculty salaries) as opposed to a lump sum match up front. We found that it was important to be able to pay our invoices as work was completed, so we waited a year to begin the construction of the courtyard so that we could build up the match to have sufficient funds to pay the contractors.

D. Maintenance Manual

As part of this project, our team developed a maintenance manual, and hosted field training to teach the faculty and staff of KCSD how to properly maintain the BMPs on the campus. This manual is included in Appendix I. KCSD is assuming full responsibility for the maintenance of the green infrastructure features on the campus. The KCSD Turkeyfoot campus grounds crew were trained on the maintenance during the field training, and were also introduced and familiarized with the maintenance manual. The grounds crew will be working to keep the features maintained on a weekly basis. Also, the Caywood gardening club may take it upon themselves to assist with some of the courtyard maintenance. Should additional maintenance support be needed, KCSD may contract with professional landscapers to assist with the maintenance. Gary Treadway, Plant Manager for the campus, should be contacted if there is a maintenance need that has not been addressed so that he can coordinate the needed maintenance. Gary can be contacted by email at [gary.treadway@kenton.kyschools.us](mailto:gary.treadway@kenton.kyschools.us) or by phone at (859) 669-9373.

**SECTION 6**

**LITERATURE CITED**

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## 6.01 LITERATURE CITED

- <sup>1</sup> EPA Menu of Stormwater BMPs, *Pollutant Removal Effectiveness of Two Bioretention Areas in Maryland*, <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm> (May 16, 2007).
- <sup>2</sup> North Carolina State University Cooperative Extension, *Urban Waterways. Bioretention Performance, Design, Construction, and Maintenance*. [www.bae.ncsu.edu/stormwater/PublicationFiles/DesigningRainGardens2001.pdf](http://www.bae.ncsu.edu/stormwater/PublicationFiles/DesigningRainGardens2001.pdf)