

Strategic Land Management Final Report:

Steps toward the Jordan River Restoration and Related Practices

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Purpose of this Report

- Provide a summary of the current status of the Jordan River Restoration Planning
- Provide resources and information for future interns working on this project
- Summarize the ASLA Sustainable Sites Initiative for water resources
- Highlight use of Best Management Practices at other Universities across the nation and potential application at Indiana University Bloomington

Purpose of the Jordan River Restoration

The restoration of riparian corridors on campus is a central component included as one of the nine planning principles of the Indiana University Campus Master Plan. According to the master plan, restoration of the Jordan River corridor will allow for the better functioning of natural biological stormwater treatment and accommodate natural flood events on campus, while serving as a central natural feature to be used for community gathering and education (JJR/Smithgroup, 2010).

Current Jordan River Restoration Planning and Best Management Practices

The proposal for the feasibility study completed by Smithgroup/J.J.R. has been submitted to the Vice President and Trustees by Director of Sustainability, Bill Brown, to request funding for further development of a work plan. The work plan will include design schematics necessary for planning the large scale restoration effort. Once authorized, a two day charrette will take place on campus that will allow Indiana University operational staff, faculty and students to provide input for final planning efforts on the Jordan River. Strategic development of the restoration effort will require expertise from a diverse set of groups on and off campus to facilitate integration of functional systems that will require major re-development as part of the long term vision for the master plan.

The Jordan River's natural course meanders adjacent to buildings, parking structures and lots, and into manmade culverts that travel beneath parking lots and streets. Restoration of the river corridor not only involves stabilization of in-stream and stream bank habitat, but also requires maximum infiltration of stormwater within an ideal 50 ft.' buffer zone along the entire stream corridor. Most areas along the stream include a significant amount of structures and

hardscape within the 50' buffer zone (Smithgroup/J.J.R., 2010). It is commonly known that water quality increases as infiltration increases (water volume decreases) in stream reaches that have near a 50' buffer zone.

On the bustling and growing campus of Indiana University it is not practical or economical to remove structures and hardscapes to install natural vegetation for restoration. Instead, there are a number of structural and non-structural construction methods known as best management practices (BMP's) that can be implemented on campus that will allow for treatment of stormwater before entering the Jordan River that will maintain intended use of campus facilities and hardscapes. Structural methods include creation or restoration of wetlands, detention and retention ponds, infiltration trenches and catch basins. Non-structural methods may include green roofs and pervious pavement, bioswales and rain gardens. Integration of best management practices into building design can provide opportunity for creative architectural design to improve the aesthetic look of structures while naturally performing ecosystem services that reduce energy and water costs for the University.

Determining the “best” Best Management Practices

Much like evaluating an investment decision, best management practices should be selected based upon the long and short term goals of the University and adopted based on desired performance features of the landscape and architecture. In short, best management practices should be evaluated on a case by case basis, no one method fits all scenarios as no one investment strategy is always most sound. There are a number of options available for the stormwater professional and data is readily available for monitoring their success based on specific goals. The EPA website has access to several resources regarding best management practices for stormwater including the “Urban BMP performance tool.” The urban BMP performance tool is an EPA sponsored database that contains hundreds of results from applied BMP's implemented by numerous groups including public agencies, academic researchers and non-profit groups. This international BMP database is available for reference online (Moeller, 2010).

What is currently required for NPDES Phase II and Non-Point Source Permits?

There are six minimum control measurement requirements that illicit the use of Best Management Practices stipulated by the Environmental Protection Agency and are enforceable under the Clean Water Act (U.S. E.P.A., 2008). These minimum requirements must be satisfied by any entity known as a municipal separate storm sewer system (MS4) as part of the National Pollutant Discharge Elimination System (NPDES) Phase 2 permit requirements. These are the minimum legal requirements that must be satisfied by the University. In addition, the University is required to document all construction related soil erosion control practices that impact stormwater as stipulated by Storm Water Pollution Prevention Plans (SWPPP) required for NPDES under the Clean Water Act. The Indiana Department of Environmental Management (IDEM) must issue permits to MS4's under 327 IAC 15-13, Rule 13 in the Federal Register. A stormwater quality management plan (SWQMP) is required under rule 13 (IN.gov, 2007).

In order to take a proactive role in minimizing negative impacts of deleterious watershed practices and neglected waterbodies, many voluntary project certification programs are available to recognize parties that responsibly manage stormwater and other resources. A newer exemplary program was created that can be useful for riparian corridor projects such as the Jordan River. This program is known as the Sustainable Sites Initiative created by the American Society of Landscape Architects and other various partners.

American Society of Landscape Architects (ASLA) – The Sustainable Sites Initiative

The Sustainable Sites initiative (SITES) is a voluntary certification program for sustainable building projects modeled after the US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) certification program. Sustainable Sites is unique in that it accounts for numerous site types and focuses on a landscape-systems based approach integrating man-made structures and natural land features into the planning process. The following sections, “site types” and “what makes sustainable sites unique” are quoted from the Sustainable Sites website.

“Site types

The benchmarks apply nationwide on a site-by-site basis, accommodating regional differences and the variations inherent in different site types, whether urban or rural, already developed or undeveloped. In so doing, many benchmarks allow for a site's existing condition and function in arriving at recommended performance criteria.

The benchmarks apply to sites of new construction as well as to projects that include major renovations to an existing site. They can apply to sites both with and without buildings, including but not limited to:

- Open spaces, local, state and national parks, conservation easements, buffer zones, utility corridors, and transportation rights-of-way.
- Sites with buildings including industrial, retail and office parks, military complexes, airports, botanical gardens, streetscapes and plazas, residential and commercial developments, and public and private campuses.”

What makes Sustainable Sites Unique?

The Sustainable Sites committee members completed a series of weighting exercises to establish a ranking system for the 51 credits based on the Initiative's Guiding Principles (see page 7). This resulted in the development of a 250-point system as outlined below. It reflects committee members current consensus regarding the potential level of impact that given benchmarks may have on improving site sustainability. Prerequisites are required and therefore are not assigned a point value. Credits are assigned a point value and in many cases they offer a range of points, providing projects additional flexibility in selecting the level (or benchmark) that is appropriate and achievable for them. (See Sustainable Sites Pilot Program, below, for a discussion on revising the rating system). Landscapes are dynamic, regenerative systems. Vegetation grows and matures, maintenance practices evolve, and, as adjacent land uses change over time, so too does the relationship of a given site to its surroundings. The Initiative's certification process requires projects to incorporate appropriate long-term maintenance plans, along with

continuing communication among members of the project’s integrated design team. In addition, the Initiative will reward projects for monitoring the performance of their sustainable practices. During the pilot project phase, the Sustainable Sites Initiative will recognize projects that have achieved all the prerequisites and at least 40 percent of total points as achieving one “Star.” Beyond this basic certification level, projects may implement practices to improve site sustainability by completing additional credits, thereby earning additional points toward achieving higher levels of pilot certification. Projects that have achieved a level of certification by the end of the program will be recognized as certified pilot projects (ASLA, 2009)”

The Sustainable Sites Initiative anticipates refining the 2009 rating system after the completion of the pilot project program.

2009 Rating System: 250 Points Total

One Star: 100 points (40% of total points)

Two Stars: 125 points (50% of total points)

Three Stars: 150 points (60% of total points)

Four Stars: 200 points (80% of total points)

Currently projects can be certified under the Pilot Program. Specifically, the pilot program will evaluate the appropriateness of the point system and of credit weights in a variety of climate zones, geographic areas, and project types —e.g., public, private, greenfield, brownfield, greyfield, urban, suburban, rural, commercial, residential, cultural/historical, small and large sizes. During the pilot program, the Initiative will be testing, evaluating, and potentially adjusting not only the point system but also the performance benchmarks themselves. The sustainable sites program will use feedback from these projects and the other selected developments during the pilot phase, which runs through June 2012, to revise the final rating system and reference guide by early 2013.

The following pilot projects are educational institutions and groups across the nation that will be evaluated over the next two years as part of the Sustainable Sites certification Program (ASLA, 2008).

Indiana: *Super Street for the Super Bowl, Indianapolis*
Purdue Research Park, West Lafayette

Michigan: *Grand Valley State University*

California: *UC Merced, UC Santa Barbara*

Texas: *University of Texas at Arlington (water), Botanical Research Center,*
Museum of Nature. Lone Star College, Cypress campus

Louisiana: *Early Learning Village*

Georgia: *Smartsville Gardens, Gainesville*

Virginia: *Virginia tech*

New York: *Garden City, Cornell University, Ithaca*

Massachusetts: *U Mass-Dartmouth-Office of Sustainability, Elementary School*

Sustainable Sites- Water Category, credits and point measuring system

In order to best reach goals for stormwater management in the campus “master plan”, Indiana University can model future policies after the “water” credits available through the sustainable sites initiative. The main goal of the “water” category under the sustainable sites initiative is to protect and restore processes and systems associated with a site’s hydrology. There are 44 possible points that can be achieved under this category. The following is a brief

overview of the credits and is in no way intended to be comprehensive, please consult the Sustainable Sites Initiative 2009 document for more information. Where appropriate, opportunities for implementation at the IU-Bloomington campus are suggested below each credit description.

Prerequisite- 3.1: Reduce potable water use for landscape irrigation by 50% from established baseline

Potable water is water fit for human consumption. Reducing the amount of potable water, natural surface water and groundwater withdrawals used for irrigation will conserve current water resources that could be used as drinking water without the need for treatment. Municipal water and waste treatment facilities account for up to 50% of city electricity use in the United States. Percent reduction of potable water should be measured after initial plant establishment on the project site. Flow meters should be used to measure water volume used in areas with irrigation. Any combination of the following practices can be implemented to assist in reaching the 50% reduction (ASLA, 2009).

- Plant species factor
- Irrigation efficiency
- Use of captured rainwater
- Use of air-conditioner condensate
- Use of recycled greywater
- Use of recycled wastewater
- Use of blowdown water from boilers and cooling towers
- Use water treated and conveyed by a public agency specifically for non-potable uses.

Calculations for reductions must include long term water use and cannot include the following.

- Water used during establishment phase. The maximum establishment phase is considered three years for trees, two years for shrubs, and one year for herbaceous cover.

- Water used to irrigate non-commercial food production gardens. Irrigation used on edible plants should not harm human health.
- Water used as required by local regulations in fire-prone areas for fire-suppression systems (ASLA, 2009).

Credit 3.2: Reduce potable water use for landscape irrigation by 75% or more from established baseline

Credit 3.2 is an extension of 3.1 and points are awarded within a range of 2-5 points based on meeting at least the minimum requirement for a 75% reduction in the use of potable water. By achieving a 75% reduction in potable and other natural source water use after the plant establishment phase a total of 2 points can be earned. The use of no potable water or natural water sources after the plant establishment phase can earn 3 points. The use of no potable or natural water sources during and after the plant establishment phase can earn a maximum of 5 points.

Credits 3.3 and 3.4 involve restoring and protecting streams, wetlands, shorelines and riparian buffer zones. These credits match well with the Jordan River Restoration (ASLA, 2009).

Credit 3.3: Protect and restore riparian, wetland, and shoreline buffers

The preservation of riparian buffer zones along streams, wetlands, and shorelines can improve flood plain function, reduce and control erosion by stabilizing soil, improve water quality by providing better infiltration and create habitat for wildlife. Improved water quality from the use of riparian buffers has been shown to increase waterside property by as much as 15% while creating more desirable habitat for animal and human use (ASLA, 2009). Water body habitats that have been rehabilitated as a result of implementing credit 3.4 are eligible for credit 3.3. Buffer areas must be preserved and designated as “soil and vegetation protection zones.”

Restoration of these areas must include stream or shoreline back stabilization and native plant establishment. Bank stabilization may not be achieved through the use of bulkheads. Points for this credit are achieved on a sliding scale based on the difference between the initial average buffer zone and final average buffer zone (ASLA, 2009). Vegetation and soil protection sites must meet specific requirements that are outlined in detail in the Sustainable Sites document (ASLA, 2009).

Credit 3.4: Rehabilitate lost streams, wetlands, and shorelines

This credit applies to streams, wetlands or shorelines that have been artificially modified. Artificial modifications may include water environments that are buried, drained, piped, channelized, bulkheaded or armored.

A total of up to 5 points may be awarded for restoration of 90% of the stream channel or wetland. 3 points may be awarded for 60% restoration and 2 points for 30% restoration.

Option 1: Rehabilitate 30/60/90 percent of the full length of a stream channel or shoreline within the property boundary to a stable condition using geomorphological and vegetative methods. Rehabilitation must provide native plant communities, appropriate aquatic habitat, floodplain connection, water quality improvements, and stable geomorphological conditions.

Or

Option 2: Rehabilitate 30/60/90 percent of the full area of an existing degraded or lost wetland. Rehabilitation must provide wetland hydrology, hydric soils, native plant communities, and habitat improvements (ASLA, 2009).

Removing physical obstructions to existing water environments and removing or addressing stormwater features that may degrade water quality, compromise channel stability and morphology are all strategies that can be useful for achieving this credit (ASLA, 2009).

Restoration of the Jordan River per recommendations in the campus master plan will allow for many opportunities to earn credits and achieve many of the environmental and economic benefits as a result of achieving credits 3.3 and 3.4.

Credit 3.5: Manage stormwater onsite

The purpose of this credit is to replicate the hydrologic ecosystem function (infiltration, run-off and evapotranspiration) of the site by maintaining or restoring landscape features modeled after historic, natural or undeveloped landscapes in the area. Hydraulic modeling is typically used to determine hydrodynamics of a specific site in order to design the proper stormwater management system appropriate to maintain site water balance. The Stormwater Management Model (SWMM) was used to develop a scale comparing initial site water storage potential versus final site water storage potential. In developing the model, the purpose of modeling exercises was to design sites and runoff management systems that reduce the number of minutes that streams are exposed to erosive flows discharged from the development or redevelopment project. Separate scales were developed for various climate types and are labeled using a curve number indicating a rating for water storage capacity before and after site development. Points for this credit are determined using a color coded table that indicate points earned based on reduction of runoff volume before and after development. Each climate type humid, semi-arid and arid and land-use type, greenfield, greyfield and brownfield each has separate tables to calculate points earned. For definitions of these categories and more details about this credit please see the sustainable sites document (ASLA, 2009).

Application at IU

Any stormwater BMP method that reduces runoff volume and improves runoff water quality can be integrated into the campus “master plan” as part of the Jordan River restoration to achieve this credit. Examples would include the following options listed below

- Install pervious pavement on all walkways and parking lot areas adjacent to the Jordan River.

- Consider installation of green roofs on flat roof structures such as the IMU and Eigenmann Hall.
- Install native vegetation within specified buffer zones along Jordan replacing turf grass where possible.
- Trap Jordan Lane parking lot runoff with use of integrated rain harvesting methods such as rain gardens or rain barrels.
- Install retention ponds and bioswales where possible to slow runoff flow velocity to reduce erosion and stream bank cutting in addition to removing pollutants by infiltration.

Credit 3.6: Protect and enhance on-site water resources and receiving water quality

This credit targets trapping and limiting the spread of common stormwater pollutants to receiving water bodies by limiting direct discharges and discharges into stormwater drains. Requirements to earn points for this credit include 1) Ensuring construction materials do not contribute to runoff pollutant load. 2) Include in the long term site maintenance plan, maintenance activities that reduce pollutant exposure to stormwater including upkeep of BMP's requiring regular pollutant removal. 3) Provide stormwater treatment for common stormwater pollutants and specific pollutants of concern by achieving a minimum average discharge concentration of less than or equal to 25 milligrams/liter total suspended solids (TSS), for the volume treated. Points (3 for 80%, 5 for 90% and 8 for 95%) are earned based upon the percentage of average annual runoff volume from the developed portion of the site that receives treatment of pollutants of specific concern.

Application at IU

Potential Strategies listed below can be implemented in several areas along the Jordan River and can applied to projects across campus. The below is directly from the Sustainable Sites document.

- “ • Implement strategies to reduce the volume of stormwater runoff, such as:
- Reduce impervious cover

- Disconnect impervious cover
- Provide depression storage in the landscape
- Convey stormwater in swales to promote infiltration
- Use biofiltration to provide vegetated and soil filtering
- Evapotranspire (e.g., use engineered soils and vegetation on green roofs or in biofiltration areas/landscaping to maximize evapotranspiration potential)
- Infiltrate stormwater (infiltration basins and trenches, permeable pavement, etc.)

Materials used in building, hardscape, and landscape materials that can be a source of pollutants in stormwater include:

- Copper and zinc roofs, roof gutters and downspouts, and siding
- Galvanized materials (fences, guardrails, signposts)
- Treated lumber
- Parking lot coal tar sealants
- Fertilizers
- Pesticides.

Plan for and implement maintenance activities designed to reduce the exposure of pollutants to stormwater, such as:

- Minimizing exposure to rainfall of stored materials that could contribute pollutants
- Developing and implementing a spill response plan
- Avoiding non-stormwater discharges (e.g., wash water)
- Minimizing the use of salt for deicing
- Avoiding routine maintenance of construction equipment on site to reduce pollutant loadings of oils, grease, hydraulic fluids, etc.
- Avoiding fueling of vehicles on site to the maximum extent practicable (ASLA, 2009).”

Credit 3.7: Design rainwater/stormwater features to provide a landscape amenity

The intention of this credit to integrate visibly and physically accessible rainwater/stormwater management features into landscapes that are aesthetically pleasing to users of the site.

Requirements for this credit require integration into the long term site maintenance plan, maintenance measures to reduce impacts on aquatic life and water quality by not using chemicals such as chlorine or bromine and ensuring areas do not become habitat for mosquitos. Points are awarded based on percentage of rainwater/stormwater features that are designed as site amenities and are visible from high use areas of the site and whether the amenity allows for human contact.

1 point is awarded for including 50% of rainwater/stormwater features as visible amenities and visible from high use areas of the site.

2 points are awarded based on 75% of rainwater/stormwater features as visible amenities and visible from high use areas of the site and atleast one rainwater/stormwater feature is visible from the sidewalk and human contact is allowed.

3 points are awarded based on 100% of rainwater/stormwater features as visible amenities and visible from high use areas of the site and atleast one rainwater/stormwater feature is intended for full human contact (ASLA, 2009).

Application at IU

The Jordan River Restoration Project integrating high use pedestrian walkway areas could provide ample opportunity for creative engineering and architecture of BMP's that are easily visible and accessible to the public. Rain Barrels can be connected to buildings near the Jordan and specially engineered aesthetically pleasing conveyances to rain gardens and stormwater drains could be developed to achieve this credit. Making rain/stormwater features visible and

aesthetically pleasing draw public attention and provide opportunities to educate students about the use of these features.



Japanese Rain Chain- downspout alternative
(<http://greenupgrader.com/tag/rainwater-harvesting/>)

Credit 3.8: Maintain water features to conserve water and other resources

This credit requires design and maintenance of landscape water features to limit or eliminate the use of potable or natural surface or subsurface water resources. Points are earned based upon the percentage of water used to maintain the feature that is derived from sustainable water sources and/or limits the amount of annual potable water use.

Requirements for the credit include documenting that water features will not negatively affect receiving water bodies by changing the sites water balance (i.e.: rain harvested upstream should not deplete areas downstream of sufficient moisture to support soil-vegetative zones). A second requirement requires incorporating as part of the long term site maintenance plan details about a maintenance program for features that do not use harmful chemicals that will harm aquatic life. Lastly any of the following combinations of applications are required for earning the respective points towards the credit (ASLA, 2009).

“Water feature(s) has/have limited make-up water from potable sources or other natural surface or subsurface water resources.

1 point: 50 percent of annual make-up water for water feature(s) comes from sustainable water sources

OR site water feature(s) require(s) 10,000 gallons or less of potable water annually, whichever is less. Initial filling may be derived from potable water if under 37,500 gallons (approximately 5,000 cubic feet).

2 points: 75 percent of annual make-up water for water feature(s) comes from sustainable water sources

OR site water feature(s) require(s) a total of 5,000 gallons or less of potable water, whichever is less.

3 points: 100 percent of annual make-up water for water feature(s) comes from sustainable water sources.

Additional point: All water features use gravity for water movement or recirculation and require no purchased electricity. Features that use energy-efficient pumps and/or renewable energy sources for water features are covered under other credits (ASLA, 2009).”

What are other Universities doing?

The following information was collected from various university sustainability websites and the Association for the Advancement of Sustainability in Higher Education (AASHE), Sustainability Tracking Assessment and Rating System (STARS) website. These are only a few examples of universities taking measures to prioritize stormwater management on college campuses. For a more complete list of institutions please visit the STARS website (AASHE, 2010).

Delta College

Delta, located in mid-Michigan, utilizes the integration of multiple storm water management practices to reduce parking lot pollutants and flow volume to stormwater conveyances and receiving water bodies. The following was summarized from the delta college sustainability website.

Natural habitat, a wet meadow, and bioswales reduce the amount of unfiltered storm water from Delta College campus parking lots. With the government placing more stringent mandates on the discharge and filtering of storm water, Delta College took the pro-active role to sustainably manage landscapes. The college has taken advantage of their natural land assets to create a peaceful learning environment, and also to provide guidelines for maintenance and land stewardship. The project incorporates proactive measures for responsible storm water management by adopting new approaches to collecting, cleaning, and returning the runoff water to the natural environment.



How it works

Simulating a natural hydrologic process, rainwater is conveyed from parking lot bioswale islands into detention ponds. Eventually the water passes into an adjacent wet meadow before discharge into the regional drainage system. Native seed and aquatic plantings aid in attracting aquatic amphibians and insects creating a living laboratory for Delta College students. For a more detailed description of functionality of the below schematic, please refer to the following link (Delta, 2010). (<https://stars.aashe.org/institutions/delta-college-mi/report>)



Application at IU

A similar system could be designed to divert runoff from parking lots and other hardscape areas for treatment and storage prior to conveyance into the Jordan River and/or stormwater system at Indiana University, Bloomington.

American University

American University located in Washington D.C. incorporates stormwater management practices into campus including a rain cistern (re-used for bathroom greywater), bio-retention ponds, green roofs, rain gardens and beginning use of pervious pavement (AASHE, 2010).

Portland State University

PSU was the first campus to receive Salmon Safe Campus Certification due to stormwater management BMP implementation. This award illustrates the campus commitment to least and non-toxic pesticide and chemical applications on campus.

Stormwater management policy and future goals

Sustainable stormwater management principles have been adopted at Portland State University (PSU). These principles will continue to be a part of planning and retrofitting of the current and future campus development projects with the goal of managing all stormwater on site within a 50-100 year time period.

PSU Stormwater Goals:

“• Decrease impervious surfaces and/or increase stormwater surfaces which allow for water reuse on the Portland State University campus, especially through methods which continue to allow urban density.

- Improve water quality, decrease water runoff peak rate, increase and improve natural habitat systems.
- Decrease resource usage including pesticides, fertilizers and irrigation water.
- Implement designs which allow for stormwater to be reused on-site.
- Decrease sediment losses through sustainable erosion control.
- Implement consistent monitoring and auditing of systems.
- Implement all levels of the Stormwater Management Plan and Integrated Pest Management Plan.

- Become a leader in the research, development and successful implementation of sustainable stormwater management in the Pacific Northwest (AASHE, 2010).”

Eco-roofs

Eco-roofs are an aesthetically pleasing option to increase roof lifespan by reducing building stormwater runoff and energy consumption by counteracting rooftop heat loss in cold weather and mitigating radiant heat moderating indoor temperatures during the warm season. Portland State University is home to five diverse eco-roofs. The Broadway Housing Building has an 18,000 sq. ft. eco-roof (the largest in Portland), the Native American Student Center features a native plants rooftop garden, and three small eco-roofs are located in other buildings on campus. PSU has been awarded the 2005 BEST Award for the Broadway Housing Building's eco-roof. PSU has also installed grasscrete (pavers with grass) located near the Research Greenhouse and the University Presidents' house.

Bioswales

In Summer 2005, the Portland Bureau of Environmental Services (BES) installed a series of four bioswales on 12th Street bordering the PSU campus. These bioswales were installed as part of BES stormwater management goals. As rainwater hits the paved roads and sidewalks on the street, polluted runoff is conveyed to gutters which channel the water into the bioswales. Each swale looks like a planter box containing soil and wetland plants. Water that enters a swale is absorbed into the soil. The bioswales slows the water flow rate before entering Portland's Combined Sewer system, effectively reducing the risk of combined sewer overflows and simultaneously improving water quality by natural infiltration. A series of bioswales allows treatment for even significant storm events that may pass through all four swales before entering the city sewer system. The 12th Street project was awarded a 2006 Professional Award of Honor by the ASLA. This flow through bioswale design has been replicated effectively in other areas of the PSU campus. This is a creative and aesthetically desirable BMP method that could be successfully implemented on the Indiana University campus (AASHE, 2010).

University of Northern Iowa

Similar to Indiana University, the University of Northern Iowa (UNI) as is considered an independent MS4, which requires the University to comply with the Phase II NPDES stormwater regulations. Storm water runoff from UNI is conveyed to Dry Run Creek and its tributaries and ultimately to the City of Cedar Falls 'storm sewer system. UNI has two vegetated roofs associated with athletic complexes. Pervious pavement is utilized near the McLeod Center and the Wellness Recreation center on campus. A retention pond/treatment wetland is in place on Dry Run Creek, just north of the Wellness Recreation Center. Vegetated swales are in place adjacent to parking lots in designated areas. A stream bank stabilization project was implemented on Dry Run Creek. Low Impact Development (LID), rain gardens and reduction of impervious surfaces are strategies used at UNI to reduce impact from residential zones on waterways (AASHE, 2010).

University of North Carolina at Chapel Hill

The University of North Carolina Chapel Hill has a recently created a document outlining stormwater performance criteria, design standards and procedures for all projects utilizing best management practices used on campus (UNC, 2010).

Yale

The Yale Environmental Health & Safety Department has created an informational document about stormwater best management practices that may be able to be used as a great training manual for maintenance workers and campus environmental planners and other members of the campus community who are not familiar with basic methods to control stormwater (Yale, 2011).

Dickinson College

Dickinson College in Carlisle, Pennsylvania works to educate the public about stormwater management through its educational organization known as the Alliance for Aquatic

Resource Monitoring (ALLARM). This group partners with the Borough of Carlisle to educate the public according to requirements of the Borough's MS4 permit requirement. ALLARM provides technical assistance to volunteer stream monitors, hosts skill building training workshops in the community, and increases the scientific capacity of community watershed associations to address water quality questions by implementing monitoring studies (Dickinson, 2011).

University of Colorado Boulder

The University of Colorado Boulder requires every construction project on the campus be reviewed to both minimize stormwater runoff as well as incorporating water quality control features into all projects. The University has incorporated numerous storm water BMPs into campus projects ranging from porous pavements to infiltration trenches. As a result, almost all of our capital construction projects on the campus have achieved LEED sustainable site credits 6.1 and 6.2, which involve management of stormwater quantity and quality (AASHE, 2010). The University of Colorado Boulder has many useful links for policies at their campus referenced in the appendix of this report.

Recommendations

Indiana University, being motivated to be a world leader in sustainability, should strive to integrate smart land management practices that utilize landscape value to attract the best students, faculty and staff from around the globe. The Jordan River Project provides a unique opportunity to serve as a focal point and symbol of smart sustainability to University campuses around the world. Once restored, the Jordan River corridor will serve as a natural educational tool, not only for the student body but also for landscape managers and leaders of academic institutions who seek to improve environmental quality while practicing sound fiscal sustainability. Projects such as these should be viewed as long term investment opportunities for the University which will naturally increase revenue for the institution in the form of long term cost savings and increased enrollment (greater willingness to pay) from students who are interested in receiving a better value and quality of life from their educational experience on

campus. In order for the University to successfully approach these goals, policies need to be shifted towards a top-down approach, where policies provide authorization to various sub-groups to manage and maintain sustainable projects. This will allow for more efficient functioning of sustainable projects by reducing time delays and eliminate inertia involved with awaiting authorization from upper management.

All new capital projects and building/landscape renovation should include minimum requirements that are above and beyond environmental statute stormwater permit requirements. For example, the University landscape architects could designate strategic no-mow zones and native planting regions that will protect riparian waterbodies on the Bloomington campus and affiliate campuses. Policies such as these have overlapping benefits that also reduce water demand and maintenance labor upkeep. Distributing the responsibility of maintenance and policy enforcement to a group like the Environmental Health and Safety Department can reduce workload burden on groups with more of a more widespread management focus such as the Landscape Architects Office and the Capital Projects division.

If sub-contractors are hired for new construction and renovations projects they should be evaluated on site to ensure that the construction actually includes the sustainable features that were originally included in the project plans. When managing a large campus like IU Bloomington, it can be quite common to have policies on paper never enforced due to budgetary concerns and deadlines. Adequate staffing and follow up inspections are integral for sustainable projects to become successful and are a top priority within the ASLA- Sustainable Sites Initiative (ASLA, 2009).

Just like the decentralization of energy costs on campus can incentivize groups to reduce energy demand, the same can be accomplished for water consumption and reuse. If individual budgets exist for various groups on campus, it is beneficial to maintain a direct link between water use and expenses to incentivize individual budgetary groups to reduce water consumption. Otherwise, in order to improve efficient use of water, policies must be implemented and strictly enforced by the University. Common areas such as open space and riparian corridors should be paid for by an independent fund due to the common use and benefits of the geographic areas by all groups. I was unable to determine the current status of the University budget in regard to water use, so the above is a speculative recommendation.

Budgetary disbursements need to include appropriations for sustainable marketing and outreach. One example may include the newly created wetland near the educational building. This project is a great example of the restorative capacity of the Jordan River and IU's ability to successfully carry out a sustainable project in a timely manner. This project should be clearly highlighted by visible signage so that students and staff are aware of the sustainable efforts being made by the University. The responsible party should be allocated a small budget and the independent authority to make this sustainable project more visible on campus. Many sustainable efforts on campus go unnoticed unless an individual has a specific interest to seek out information rather than discover the project from marketing in the form of signage or other publicity on campus. Given the University budget constraints in light of the economic crisis, this is likely to continue to be a concern.

While many ecological and engineering recommendations could be made, this is primarily the role of experts within the University and various professionals that will be hired to carry out future land management projects as part of the Indiana University Campus Master Plan. A primary concern should continue to be the priority of sustainable land management on the IU Bloomington campus, in order to compete with the sustainable evolution of academic institutions across the globe. Sustainability in all college campus operations and curriculum will continue to grow within Universities across the globe and in time those talking about sustainability will be distinct from those "doing" sustainability. In the private sector, "greenwashers" are companies that appear to be operating sustainably but in actuality are not. This term was adopted by educated consumers who saw through false sustainable practices. To a University, the consumers are the potential student body, who evaluate an educational institution before they attend it and purchase an education. So "doing" sustainability on the IU Bloomington campus is clearly a way to enhance the institutions' ability to perform the job of providing higher education by attracting the most sustainably aware students. The funding and execution of truly sustainable projects on campus such as the Jordan River Restoration and others outlined in the Campus Master Plan will ensure the sustainability of Indiana University's great name, reputation and tradition.

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Appendix

Throughout the research process, I came across numerous useful links for stormwater management standards, practices and policies that could be useful for managers at IU. A contact list is also provided below. I have submitted all related documents to the office of sustainability via the IUOS web server.

California website

http://www.waterboards.ca.gov/water_issues/programs/stormwater/murp.shtml

Center for watershed protection

<http://www.cwp.org/your-watershed-101/stormwater-management.html>

EPA six minimum BMP's

<http://cfpub.epa.gov/npdes/stormwater/menuofbmps/>

EPA non-point source guidelines

<http://water.epa.gov/polwaste/nps/urban/index.cfm>

EPA BMP links for stormwater management

<http://www.cabmphandbooks.com/Municipal.asp>

Harvard Green Building support site based on LEED practices and projects

<http://green.harvard.edu/theresource/>

<http://green.harvard.edu/theresource/guidelines/documents/green-building-standards-2010.pdf>

http://green.harvard.edu/theresource/new-construction/integrated-design/documents/ID_checklist.pdf

LEED higher education group

http://communicate.usgbc.org/newsletters/Higher_Ed-LEED/1108_long.html

New Jersey Stormwater BMP (pervious pavement)

http://www.state.nj.us/dep/stormwater/bmp_manual/NJ_SWBMP_9.7.pdf

Stormwater Management in Indianapolis

<http://www.sustainindy.org/assets/uploads/4.2%20Permeable%20Pavement%20Systems.pdf>

Includes model reference and cost estimates.

Stormwater Managers Resource Center (SMRC)

<http://www.stormwatercenter.net/>

SWPPPS

<http://cfpub.epa.gov/npdes/stormwater/swppp.cfm>

Stormwater Management – U of Colorado Boulder

<http://www.colorado.edu/facilitiesmanagement/pdc/construction/standards/documents/u02722.pdf>

University Environmental Policies - U of Colorado Boulder

<http://ecenter.colorado.edu/greening-cu/campus-environmental-policies>

<http://www.colorado.edu/facilitiesmanagement/pdc/construction/standards/documents/ConstructionActivityRequirementsonCampus.pdf>

Xeriscaping - U of Colorado Boulder

http://envs.colorado.edu/uploads/undergrad/ENVS3001_2006_3_Xeriscape.pdf

Educational Ads for Water Issues

<http://www.evergreen.edu/facilities/ehs/stormwater.htm>

<http://sustainability.yale.edu/campaign-materials>

<http://www.dickinson.edu/about/sustainability/allarm/content/Healthy-Stream-Habits/>

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