MANAGING NONPOINT SOURCE WATER POLLUTION USING ENVIORNMENTAL SITE DESIGN IN BALTIMORE'S WESTPORT COMMUNITY

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PROJECT PROPOSAL

Background 1

The Clean Water Act (CWA) of 1972 is the primary Federal law in the U.S. governing water pollution. Of the seven goals and objectives of the CWA, only one is dedicated to nonpoint source pollution.

Goal seven of the CWA states:

> It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act be met through the control of both point and nonpoint sources of pollution.[1]

Why is nonpoint source pollution treated differently under the CWA? The nature of nonpoint source pollution makes it very hard to monitor and control; it is a diffuse sort of pollution stemming from stormwater discharges, irrigation return flows and urban runoff. In nonpoint source pollution, pollutants are carried via rainwater or snow melt and are eventually deposited into our water sources. Sources of this form of pollution are very difficult to identify; there is no way to prove that a certain entity is to blame for the pollution. This source of pollution is also very costly to control; traditional control methods are often not helpful and newer methods are exceptionally expensive in comparison to the amount of water they clean and preserve.

Despite the difficulties inherent in controlling nonpoint source pollution, research since the late 1970's has indicated that nonpoint source pollution is a significant cause of water quality impairment in the U.S. The EPA's Nationwide Urban Runoff Program (1979-1983), a study of stormwater pollution across the United States indicated that, amongst many other elements, heavy metals (copper, lead, and zinc) are by far the most prevalent priority pollutant constituents found in urban runoff.

The state of Maryland and its counties have been conducting stormwater management practices for the control of nonpoint source pollution for years. These practices have taken many forms, including Environmental Site Design (ESD). ESD, as defined by Queen Anne's County's *Environmental Site Design Manual* is:

> A stormwater management strategy concerned with maintaining or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives and fulfill environmental regulatory requirements. ESD employs a variety of natural and built features that reduce the rate of runoff, filter out its pollutants, and facilitate the infiltration of water into the ground. By reducing water pollution/runoff and increasing groundwater recharge, EDS helps improve the quality of receiving surface waters and stabilize the flow rates of nearby streams. [2]

ESD was pioneered in the 1990s in Prince Georges County, Maryland. At the time it was referred to low impact development (LID). Prince Georges County's ESD efforts began with the development and use of bioretention cells and eventually expanded into a full scale effort to incorporate ESD into the County's resource protection program; in 1990, the County's ESD guidelines became a naturally distributed manual.[3]

On April 27, 2007 Governor Martin O'Malley signed the Stormwater Management Act of 2007, which became effective on October 1, 2007; the act requires that environmental site design (ESD), through the use of nonstructural best management practices and other innovative site design techniques be implemented to the maximum extent possible.[4] The Act requires (amongst other things) that:[5]

1. certain local governments update certain zoning ordinances to allow for the implementation of certain environmental site design techniques in certain stormwater management practices

2. requires the Department of the Environment to adopt regulations that specify certain environmental site design techniques as the primary method for managing stormwater under certain circumstances

In response, the City of Baltimore updated the City Code regulations, Article 7, Division II, for stormwater management. It purposes to:

> Protect, maintain, and enhance the public health, safety, and general welfare through the management of stormwater; protect public and private property from damage; reduce the adverse effects of development; reduce stream channel erosion, pollution, siltation, and sedimentation; reduce local flooding; restore, enhance, and maintain the chemical, physical, and biological integrity of streams; and maintain after development, as nearly as possible, pre-development runoff characteristics.[6]

This is done through the management of stormwater using nonstructural environmental site design practices for all new and redevelopment projects to the maximum extent practicable. Further, the City demands that the installed practices meet the requirements of the State's *Environmental Site Design Manual* (*Manual*), Division II of the City Code and the City's Design Guidelines. ESD practices must be designed using sizing, recharge volume, water quality volume, and channel protection storage volume criteria set forth in the *Manual*. The maximum extent practicable standard will be satisfied when "channel stability is maintained, predevelopment groundwater recharge is replicated, nonpoint source pollution is minimized, and structural stormwater management practices or alternative practices are used only if determined to be absolutely necessary".[7]

Statement of Purpose 2

In light of the City's broad intention to manage nonpoint source pollution using ESD practices, it is the intention of this project to review specific environmental site design solutions being considered by Baltimore City for use in developing an ESD project within the Westport community. This project will highlight nonpoint source pollution load reduction strategies, calculate pollutant load reductions, and suggest possible funding options that would be feasible in this low-income community. Further, this project may demonstrate broader applicability of financing options in urban areas.

Rationale 3

For nearly 40 years, the U.S. has been managing pollution loading though the control of point source loading. While this has largely been effective, evidence indicates that additional attention is needed in regards to nonpoint source loading if the U.S. is to be successful in reducing total water pollution and restoring chemical, physical, and biological integrity of the Nation’s waters.

Recently, low impact development and environmental site design practices have proven to be effective for lowering nonpoint source pollution and restoring a sites natural hydrologic function. The success of this project will illustrate that broad applications will prove to be effective for reducing significant quantities of pollution loading. Moreover, it is hoped that innovative financing options will illustrate that not only are these projects “doable” but that in this troubled economy, they can be financed in a manner that does not put additional pressure on already strained resources.

Project Outline 4

This project has four major sections. Section one & two look at some of the research and design applications and highlight some of the best practices that may be applicable to the Westport project. Section three examines pollution calculation reduction strategies, including benchmarks for calculating project cost using various approaches. Finally, section four highlights some of the financing options and their potential application toward the Westport NPS project. The outline below indicates what will be done at each step of the project.

1. Research – As it is the intention of this project to review specific environmental site design solutions for use in developing an ESD project in the Westport community it will first be necessary to complete research on (1) the requirements of the City Code, (2) design standards and requirements in Maryland's *Environmental Site Design Manual*, and (3) context information on the Westport community that will inform/influence the project design.
   a. Article 7, Division II of the City Code
      i. 21-4 Purpose and Goal
      ii. 21-6 Scope and Exemptions
      iii. 22-2 Design and Construction
      iv. 22-3 Minimum Control Requirements
      v. 23-7 Redevelopment Provisions
   b. Maryland's *Environmental Site Design Manual*
      i. 5.3 Alternative Surface Practices
         1. Green Roofs
         2. Permeable Pavers
         3. Reinforced Turf
      ii. 5.4.2 Nonstructural Practices
         1. Disconnection of Rooftop Runoff
         2. Disconnection of Non-Rooftop Runoff
         3. Sheetflow to Conservation Areas
      iii. 5.4.3 Micro-scale Practices
         1. Rain Water Harvesting
         2. Submerged Gravel Wetlands
         3. Landscape Infiltration
         4. Infiltration Berms
         5. Dry Wells
         6. Micro-Bioretention
         7. Rain Gardens
         8. Swales
         9. Enhanced Filters
   c. Westport Community
      i. History
      ii. Demographic study
      iii. Turner's Westport Waterfront and Community Revitalization Initiative
2. Project Design – This project will highlight nonpoint source pollution reduction strategies through the development of a community wide site design plan that will focus on the redevelopment of impervious

areas as the primary method for managing stormwater runoff. As in a traditional architectural design project, this site design plan will be developed following a study of (1) existing and proposed site conditions, and (2) programmatic requirements outlined in the City Code and *Environmental Site Design Manual*. Deliverables will include a site design plan/map, sections, vignettes, and precedent studies illustrating certain points where necessary.

a. Inventory and Analysis – A graphic representation of current and proposed site conditions that will inform/influence/constrain the design. A base map of the Westport community will be developed using MERLIN Online - a collection of spatial data maintained by Maryland Department of Natural Resources that allows users to create a customized map of any site in the state of Maryland. Data layers used to create the base map will include streets, parcel boundaries, and satellite imagery. Topographic data will be taken from ESRI's ArcGIS Explorer USA Topo Maps and Westport Neighborhood Association/Neighborhood Design Center's topographic studies. Google Earth may also be used for satellite imagery and distance calculations. As in traditional architectural studies, the base map will be redrawn by hand using trace/sketch paper and ink to create clean/blank maps whereby a series of selected specific elements/conditions can be represented.
    i. Compile a series of site maps showing existing site conditions.
        1. Hydrology
            a. Rivers and Streams
            b. Overland Flow
            c. Slope and Elevations
            d. USGS Groundwater and Surfacewater Monitoring Sites
        2. Streets
            a. Street Names
            b. Street length, width, and calculated areas
        3. Vegetation and Soils
            a. Green Spaces
            b. Overstory and Understory
            c. Soil Classes
        4. Development Projects
            a. Turner's Westport Waterfront Development
            b. Westport Neighborhood Association and Neighborhood Design Center's designs for Main Street and Gateway Design Plan for Annapolis Road
b. Programmatic Requirements – In managing stormwater runoff the state of Maryland and Baltimore City recognize that there must be a reasonable, easily recognized and reproducible standard that can be applied without opportunity for misinterpretation. Specifically, there are two programmatic requirements that *must* be followed in order for this project to receive approval from various reviewing agencies; without agency approval, this project would not be allowed for development and construction.
    i. Article 7, Division II of the City Code requires that any individual construction, grading, or development project that disturbs over 5,000 square feet of land area is required to implement an ESD practice.
        1. This project will develop a community wide site design plan that will focus on the redevelopment of impervious areas as the primary method for managing stormwater runoff. This will be accomplished on a street by street approach. Therefore any project on any street that disturbs more than 5,000 square feet must

conform to ESD standards outlined in Maryland's *Environmental Site Design Manual*.

ii. Chapter 5.2 of the *Environmental Site Design Manual* addresses unified sizing criteria for all ESD practices. The criteria for sizing ESD practices are based on capturing and retaining enough rainfall so that the runoff leaving a site is reduced to a level equivalent to a wooded site in good condition. The goal is to provide enough treatment using ESD practices to address channel protection volume requirements by replicating a runoff curve number for woods in good condition for a 1-year event.

1. Determine ESD Implementation Goals
    a. Determine soil conditions and RCNs (runoff curve number) for woods in good conditions. Develop composite RCN when necessary.
    b. Determine Target P_E (rainfall) using table 5.3 (Runoff Curve Number Reductions used for ESD).
    c. Compute Q_E (runoff depth).
    d. Choose ESD strategies outlined in Chapter 5.3 of the *Environmental Site Design Manual* that meet these targets.
2. Determine Stormwater Management Requirements After Using ESD to determine if any additional stormwater management is required
    a. Calculate Reduced RCN.
    b. Calculate Cp_v (channel protection volume) requirements.

c. Deliverables – At the conclusion of the design phase, certain deliverable documents are required to properly illustrate the implementation of the various ESD strategies. Deliverable documents will illustrate location, size, and extent of the strategies. It may also be necessary to include cut views and detail sketches to properly illustrate the installation of the ESD strategies.

i. Site plan
ii. Sections
iii. Vignettes
iv. Precedent study

3. Calculating Reductions and Project Costs – Viability of any ESD project lies in its ability to reduce significant pollution loading in relationship to the project cost. This project will calculate pollutant load reductions, estimate development costs, and calculate the cost per pound of pollution reduction in order to determine whether or not the project is feasible.

a. Calculate pollution load reductions

i. The EPA's Pollution Load Reduction Worksheet (STEPL) calculates nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices. It computes watershed surface runoff, nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand and sediment delivery based on various land uses and management practices. The sediment and pollution load reductions that result from the implementation of best management practices are computed using the practices known efficiencies

ii. STEPL is often applied on a watershed basis and may too broad for a neighborhood scale application. Should this be the case the Maryland Department of the Environment's Nonpoint Source Reduction Calculator will be utilized. This worksheet calculates nutrient and sediment load reduction that result from the implementation of specific best management practices. Like STEPL it calculates nutrient loads, including nitrogen, phosphorus, and suspended solids (sediment), loading after reduction, and the savings resulting from the known efficiencies of specific best management practices.

b. Calculate project costs
    i. The Green Values National Stormwater Management Calculator compares the performances costs and benefits of various ESD projects to conventional practices. This calculator provides estimated construction cost, maintenance costs, and life cycle costs for programmed ESD projects and compares them to conventional projects. Construction, maintenance, and lifecycle costs are gathered from available data and literature for both ESD and conventional practices; low, middle, and high estimates for each cost and each ESD practice is compiled, however the calculator uses the middle cost in its reporting.

c. Calculate cost per pound of pollution reduction
    i. Annual operating costs / pollutant removal
        1. Utilize the Capitol Region Watershed District, St. Paul MN presentation on BMP performance and cost effectiveness to guide calculations.

d. Determine project feasibility
    i. The feasibility of a project is often largely determined by a valuation of project costs versus realized benefits (in this case pollution reduction). The cost per reduction calculation may indicate a significantly high cost versus actual pound pollution reduction. Going on this value alone may be highly misleading however. If, for example, this cost is broken down per resident receiving the benefit, it may show that the cost is significantly less. It will be therefore necessary to include a discussion on various interpretations of costs versus realized benefits; this will lead to a broader understanding of the costs versus the benefits, which may increase the viability of the project.

4. Financing - Poor countries, communities, and individuals are likely to express less "willingness to pay" to avoid environmental harms, simply because they have fewer (financial) resources. With this in mind, this project will suggest possible funding options that will be feasible in Westport's low-income community.
    a. Traditional Financing options
        i. TIF Districts – A financing method used for redevelopment and community improvement projects. TIF uses future gains to finance current improvement projects that should theoretically create conditions for said future gains; essentially it is borrowing against future revenues. TIF is often used to channel funding for improvements in distressed areas where development nay not otherwise occur.
        ii. National non-point source program (EPA) – Authorizes the EPA to provide grant money that supports activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.
        iii. Clean Water State Revolving Fund – A loan program used to fund water quality projects covering nonpoint source pollution, watershed protection, and/or restoration, municipal wastewater treatment projects and estuary management projects. The CWSRF offers low interest rates, flexible terms, and partnerships wit other funding sources.
    b. Innovative Financing options – In speculating on Maryland's General Assembly's 2011 session, the *Baltimore Sun* (1/9/2011) indicates environmental advocates intent to revive a bill that would require Maryland counties and municipalities to raise funds for management of local stormwater. In light of today's economic woes and significant gaps in state and municipal operating budgets,

financing options that do not place additional stress on municipalities or residents must be explored.

i. Stormwater Utility Fee – A user fee attached to monthly utility bills used to pay for a City's stormwater management programs and their associated costs. This charge could be calculated a number of different ways. The City of Minneapolis calculates the fee as gross lot size * land use runoff coefficient, divided by an established level of impervious area on a single property. The City of Lewiston establishes a flat rate up to a certain area of impervious area; should the property have a greater impervious area, then the bill increases by a set amount per square foot. Bend, OR established its fee program as an enterprise fund where the stormwater service charge could only be used to pay for stormwater services including operation and maintenance, loan repayment, capital improvement projects, water quality management, and engineering management.
ii. 1% for Green – Adopted by the Portland (OR) City Council in 2007 to pay for green street facilities, the 1% for Green Fund collects one percent of the construction budget of any city funded development, redevelopment, or enhancement project that requires a street opening permit or occurs within the city's right-of-way. While Portland's program prohibit funding of projects that simply meet stormwater management requirements, this stipulation does not necessarily have to be included in Maryland's program.

Anticipated Outcomes 5

Regarding the design portion of the project, it is anticipated that the majority of ESD practices implemented will be alternative surface practices and micro-scale practices, with the majority likely trending towards permeable paving, infiltration berms, dry wells, and swale practices. This is largely due to the fact that these practices can be applied on broad scales, work in confined areas (as this project focuses on redevelopment of impervious surfaces), have high efficiencies and require little maintenance.

In calculating project cost versus realized pollution load reductions, it is anticipated that the project cost will be significantly high in comparison to the reduction in pollutant loading. That being said, a broader perspective of the actual costs and realized benefits will be required in order to rationalize the project's capital investment. Calculations beyond simple cost per pound (ex. per capita investment) and increases in previously unaccounted elements (ex. Property value, community revenue) will likely work in favor for rationalizing funding that will allow the project to move forward.

In examining financing options those that are most likely to be successful in funding this project include TIF districts, Clean Water State Revolving Funds, One Percent for Green Funding, and the implementation of a Stormwater Utility Fee. In light of current economic conditions it is anticipated that these funding programs will provide the least burden to the municipality and community residents while still generating significant funds.

Timeline 6

January 2011

- 24th – Semester Opens
- 29th – Submit Section I Research write up to editor (Kory Dodd) for first review. This is a fairly lengthy section which is why it is submitted for edit review before it is submitted to Dr. Sawyers. Make recommended changes and submit to Dr. Sawyers by2/5/2011.

February 2011

- 5th – Submit Section I Research write up to Dr. Sawyers.
- 12th – Inventory and Analysis Complete
- 26th – Sizing Criteria Calculations Complete

March 2011

- 12th – Design Deliverable Package Complete. Submit to Dr. Sawyers with narrative where necessary. Also submit narrative to Kory Dodd for edit review.
- 26th – Reduction and Cost Calculations Complete. Submit to Dr. Sawyers with narrative on project feasibility. Also submit narrative to Kory Dodd for edit review.

April 2011

- 9th – Submit Section IV Financing to Dr. Sawyers. Also submit narrative to Kory Dodd for edit review.
- 15th Draft Report Due. The remainder of the three weeks will be spent on making recommended changes and compiling the individual sections into a presentation quality document.

May 2011

- 7th Final Report Due

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