



Policy Analysis

Economic Benefits of Baltimore's Stormwater Management Plan¹ *A preliminary analysis using the Genuine Progress Indicator*



Prepared by

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January 2015

¹ Generous support for this analysis was provided by the Abell Foundation, Town Creek Foundation, and Alex C. Walker Foundation.

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1.0 Overview

In December 2014 the City of Baltimore released an ambitious management plan for reducing stormwater pollution from nearly 24,000 acres of pavement within City limits.² As water flows off of the City’s streets, parking lots, and building rooftops, it picks up all kinds of pollutants like pet waste, sediment, fertilizers, pesticides, oil, and automotive fluids. This runoff includes three major pollutants - nitrogen, phosphorous, and sediment – regulated by the Clean Water Act and responsible for recurring hypoxic “dead zones” in the Chesapeake Bay devoid of fish, crabs, and other aquatic life. Stormwater runoff from cities accounts for 10-20% of the load of these pollutants entering the Bay. Although efforts to control pollution from other sources are beginning to pay off, pollution from urban runoff is still growing. Baltimore’s Stormwater Management Plan (SMP) can play a role in reversing this trend.

Baltimore’s SMP was developed to fulfill requirements of a 2013 National Pollution Discharge Elimination Permit (NPDES) issued by the Maryland Department of Environment under its authority granted by the Clean Water Act. In pertinent part, Baltimore’s 2013 NPDES permit requires the City to “commence and complete the implementation of restoration efforts for twenty percent of the City’s impervious surface area” by 2018 with a variety of best management practices (BMPs) designed to reduce runoff and filter out pollutants. The SMP fulfills this duty by proposing a portfolio of BMPs that together directly or indirectly treat runoff from over 4,240 acres of impervious pavement. Major BMPs include expanded mechanical street sweeping, stream restoration, bioretention ponds, artificial wetlands, and converting impervious pavement to open space and forest. While many have expressed concern over the costs jurisdictions like Baltimore will face implementing their SMPs, from an economics standpoint, the point is not how much it costs but whether or not the benefits generated by these SMPs exceed costs and how they can be configured to maximize net benefits. This preliminary analysis tackles these questions by using Baltimore’s Genuine Progress Indicator (GPI) as a framework.

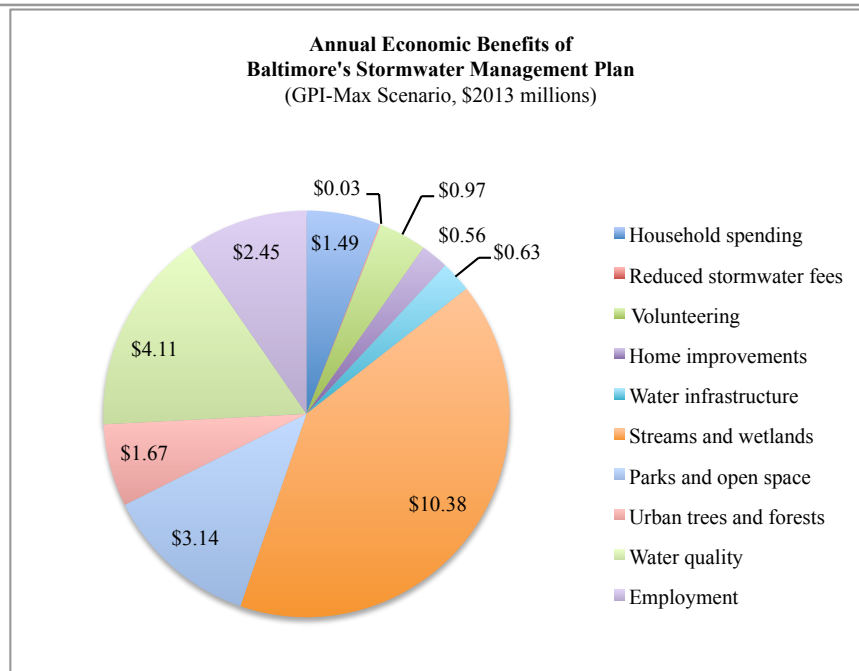
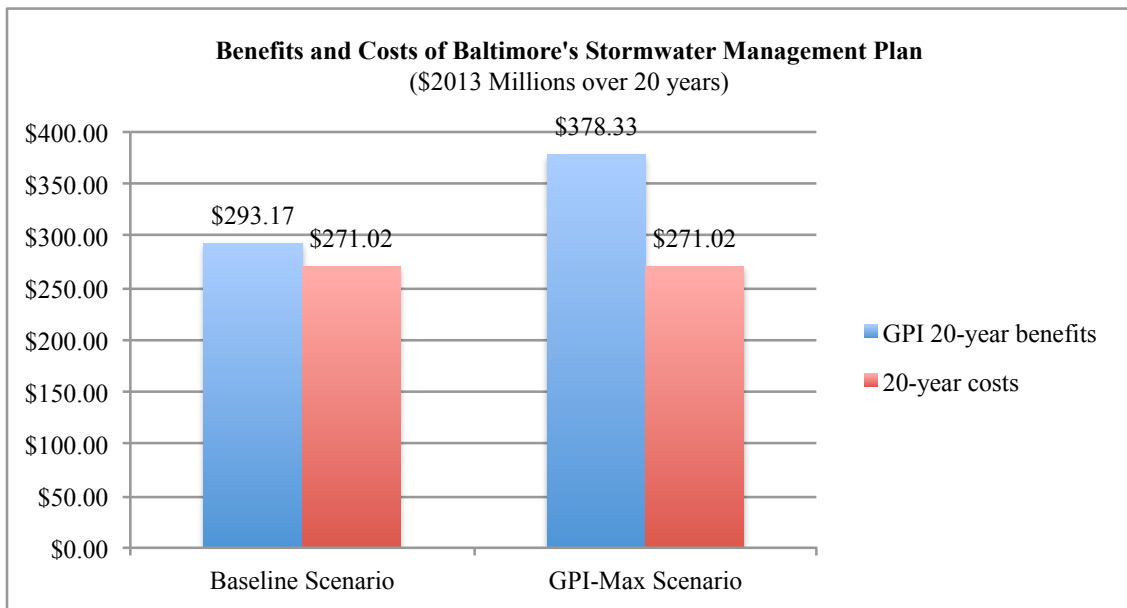
The GPI was first adopted by the State of Maryland in 2010 as a measure of sustainable economic wellbeing, and is now being developed for use at the county and municipal level. The first iteration of Baltimore’s GPI is now available. Baltimore’s GPI accounts for the benefits of household spending, infrastructure, unpaid labor, parks and open space, as well as the costs of income inequality, pollution, and social costs like unemployment and homelessness. After determining all the ways Baltimore’s SMP could enhance the GPI, we quantified those effects that could be with readily available data. By doing this, we found:

- The SMP has the potential to generate nearly \$20 million in economic benefits each year with no special emphasis on GPI-enhancing design features. If those features were added – features like local hiring preference, greater emphasis on green infrastructure, and

² The technical term for this plan is the Baltimore City Municipal Separate Storm Sewer System (MS4) and Total Maximum Daily Load (TMDL) Watershed Implementation Plan (WIP). However, for ease of reference, we refer to it as the Stormwater Management Plan (SMP) in this analysis. The plan can be downloaded online at: http://www.cleanwaterbaltimore.org/upcoming-community-meetings#upcoming_ms4_meetings.

location of BMPs in residential areas – then the SMP’s annual economic contribution would rise by 29% to over \$25 million per year.

- Over a 20-year period, the SMP as currently configured is likely to generate over \$22 million in net benefits with a benefit-cost ratio of 1.08 and a social return on investment of over 8%.
- With GPI-enhancing features added, net benefits could be substantially larger. Our analysis shows that 20-year net benefits could be over \$107 million with a benefit-cost ratio of 1.40 and social a return on investment of nearly 40%. This underscores the importance of paying attention to design features of the SMP as it is implemented on the ground and recognizing that some design features will pay off far better from a social, economic, and environmental perspective than others.



2.0 What is the Genuine Progress Indicator?

The GPI is a measure of economic wellbeing that takes into account the benefits of economic activity as well as the social and environmental costs it creates for households and communities. The GPI was first published in the late 1980s and has been vetted in the scientific literature since that time.³ While the original scope of the GPI was most amenable for use at the national level, new methods and sources of information have now made it possible to calculate the GPI at the state and local level. As such, the GPI can provide a way for governors, mayors, and state and local agencies to monitor economic performance and assess the impacts of budget decisions, land use plans, infrastructure investments, and many other policy decisions. The GPI measures economic wellbeing by considering three major factors, including:

1. Economic benefits we receive from consumption of goods and services.
2. Economic benefits we receive from social and community assets like neighbors helping neighbors, public parks, and infrastructure.
3. Economic costs that are often hidden from view. These include the costs of environmental degradation, social costs like unemployment, homelessness, poverty and crime, and spending on items like insurance that are not actually consumed.

Working in collaboration with the Baltimore Sustainability Commission and other stakeholders, Center for Sustainable Economy (CSE) has completed the first iteration of GPI accounts for the City.⁴ The Baltimore GPI accounts consist of 12 aggregate indicators that fall into each of the three categories of economic wellbeing discussed above. The initial accounts indicate that on a per capita basis, Baltimore's GPI rose by over 5% between 2012 and 2013 and now stands at approximately \$22,000. This is just 36% of the region's per capita GDP, which underscores the fact that GDP greatly overstates economic wellbeing because of its failure to address inequality or the social and economic costs of economic growth.

3.0 How Does Baltimore's Stormwater Management Plan Affect the GPI?

Baltimore's new Stormwater Management Plan (SMP) can affect the GPI in a number of ways. Investments in new stormwater infrastructure and watershed restoration projects will generate new jobs and income for Baltimore City residents that translate into increased household spending on goods and services. Spending will also be enhanced as a result of increased participation in the City's stormwater credit program – a program that reduces stormwater fees for homeowners that implement best management practices on their properties. Participation in this program will free up money that could be spent on consumer goods and services that provide direct benefits to households. New jobs created by the SMP will reduce the costs of underemployment and unemployment.

Baltimore's GPI accounts for the benefits of volunteering and unpaid labor by households. Both of these will be enhanced by BMPs that utilize volunteers or depend on

³ Daly, Herman and John Cobb Jr. 1989. *For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future*. Boston: Beacon Press.

⁴ Talberth, John and Michael Weisdorf. 2014. *Economic Wellbeing in Baltimore: Results from the Genuine Progress Indicator 2012-2013*. Washington, DC: Center for Sustainable Economy. Available online at: <http://sustainable-economy.org/solutions/baltimore-genuine-progress-indicator/>.

homeowner participation. As new water infrastructure is put in place both in public places and in residential neighborhoods, the value of the annual services this infrastructure performs will be enhanced.

Several BMPs will add to the City's endowment of parks, open space, street trees, urban forests, healthy streams and wetlands, collectively known as green infrastructure. Baltimore's GPI accounts recognize that green infrastructure provides "economic benefits in the form of places to recreate, clean air, clean water, and scenic views that enhance property values."⁵ These benefits are known as ecosystem services, and so as the SMP is implemented, the value of ecosystem services provided by the City's green infrastructure will rise.

The GPI will also rise as the SWP helps reduce the costs of water pollution. Baltimore's GPI accounts for the annual costs of water pollution from nitrogen and phosphorous. As SMP BMPs are implemented pollution loads will fall, water pollution costs will fall, and the GPI will rise.

These are just some of the linkages between the SMP and the GPI. They have been highlighted here because there is fairly good data linking specific BMPs with these specific GPI benefit categories. As implementation of the SMP becomes more refined and as quantitative information for BMPs that are presently excluded from this analysis due to lack of data (like the Illicit Discharge Detection and Elimination Program) become available it will be possible to be more comprehensive in our analysis.

4.0 Methods and Data

This section provides a brief overview of the steps CSE used to put preliminary figures on the SMP benefits discussed above. Technical details are available in a spreadsheet posted along with this report on the CSE website. As an overall method, CSE estimated what the GPI would be today if all the proposed SMP BMPs were already in place. What this does is sidestep the economic benefits that may be generated in the short term – such as the new jobs and income associated with constructing new infrastructure. Other researchers have developed models more suitable for quantifying these short-term effects. In general, these models can be used to quantify the short term direct, indirect, and induced income, jobs, and tax revenues associated with initial SMP investments.⁶ Here, we concentrate on more permanent, longer-term effects on a broader set of economic indicators included in the GPI framework.

CSE developed estimates for two broad scenarios: (1) a "Baseline" scenario assuming that SMP BMPs will be implemented without any special design features that could enhance their GPI contributions, and (2) a "GPI-Max" scenario that quantifies annual SMP benefits if a number of GPI-enhancing design features are adopted during the implementation phase. For each of these scenarios, we modeled GPI benefits associated with a distribution of BMPs set forth in Table 1, below, which is based on the preferred mix of BMPs now included in the current SMP version being circulated for public comment. Table 1 expresses implementation of BMPs in terms of impervious surface area treated (IAT). This may differ from actual acres of a given BMP's footprint because a given BMP may have the potential to treat (i.e. by capturing runoff) several additional acres upstream. Where relevant to GPI benefit calculations, we converted IAT

⁵ Talberth and Weisdorf 2014, Note 5.

⁶ See, e.g. Nees, Dan and Sarah Buch. 2013. Stormwater Financing Economic Impact Assessment: Anne Arundel County, MD, Baltimore, MD, and Lychburg, VA. Environmental Finance Center, University of Maryland.

to footprint acres. Table 1 excludes roughly 291 acres of impervious acres treated through development partnerships, preventive inlet cleaning, debris collection and implementation of the Illicit Discharge Detection and Elimination Program because it is not yet possible to quantify the relationship between these measures and the GPI. Thus, our analysis is limited to 3,949.33 acres (93%) of the approximately 4,240 IAT acres included in the SMP.

**Table 1:
BMPs and Levels of Implementation Included in the Analysis**

ID Number	Description	Impervious acres treated
BMP1	Restoring stream banks and stabilize failing outfalls	785.00
BMP2	Installing ponds, bioretention, and structural filtration practices	183.00
BMP3	Retrofitting existing stormwater ponds	126.00
BMP4	Installing micro-practices	63.10
BMP5	Creating new green spaces from vacant lots and schools	102.82
BMP6	Planting street trees/reforestation/afforestation	104.31
BMP7	Expanded City-wide mechanical street sweeping	2,551.00
BMP8	Green roofs	0.00
BMP9	Small rain garden	13.00
BMP10	Large rain garden	13.00
BMP11	Household tree planting	7.60
BMP12	Rainwater harvesting	0.50
<i>Total:</i>		3,949.33

Analyzing the currently preferred mix of BMPs naturally raises the question of whether or not a different BMP mix could achieve a greater GPI impact. This is an issue for supplemental research, but in general, it would require more detailed information about the availability of certain BMPs – i.e. is it realistic to assume that greater number of acres could be allocated to raingardens installed by homeowners? With that information it may be possible to propose an “optimal” level of BMP implementation that is designed to minimize costs, maximize GPI impact, maximize pollution reduction, or achieve several objectives simultaneously. But for now, we take the SMP BMP allocation as a given.

It should also be noted that without more precise implementation data for the SMP – such as the location and composition of certain measures like bioretention structures – the analysis is by necessity based on City-wide averages for various factors. For example, reforestation may have significantly different annual ecosystem service values depending on where it takes place simply because of differences in underlying use patterns or nearby property values. These can be refined in a subsequent phase of this research.

For the 12 BMPs included in Table 1, the following section provides details of the benefit calculations per IAT under both the Baseline and GPI-Max scenarios. The results are presented in Appendix Tables A1 and A2. Since a given BMP can influence several GPI benefit categories, it made most sense to organize this discussion in terms of the major GPI benefit categories identified in Section 3.0:

4.1 Household budget expenditures (GPI-1)

The largest benefit category included in Baltimore’s GPI is the value (or utility) of household budget expenditures on welfare enhancing goods and services (HBE). HBE is, of

course, largely dependent upon household income. The SMP has the potential to enhance household income and thus HBE both in the short term and long term as public money is spent on BMP installation and subsequently on operations and maintenance costs associated with these BMPs. As previously noted, there are already models and analyses completed that document the short-term gain in jobs, income, and taxes as stormwater management in Baltimore ramps up. In particular, Nees and Buch (2013) found that for each \$100 million invested in stormwater BMPs roughly \$24 million in short term labor income would be generated.⁷ While this short-term boost in income and HBE is important, this analysis concentrates on long-term benefits generated by annual operations and maintenance cost expenditures once BMPs are installed.

For all but one BMP, operations and maintenance costs per IAT were derived from King and Hagan (2011) updated to 2013 dollars since this is the latest iteration of the Baltimore GPI.⁸ The only exception was green roofs. For green roofs, we relied on annual operations and maintenance cost figure of roughly \$0.26 per square foot (above and beyond conventional black roofs) from the General Services Administration (2013) or \$11,326 per acre.⁹ Operations and maintenance costs for homeowner practices (BMPs 9-12) are not relevant for this analysis since they are completed with unpaid labor (discussed below).

To derive the HBE impact from these annual operations and maintenance cost expenditures, we first assume that the materials and equipment portion of the expenditures would be minimal (less than 5%) and that the remainder would be paid as labor income. But there is a complicating factor to consider: recipients of that labor income may or may not actually live within Baltimore City limits, and so we had to make assumptions with respect to the proportion of this income that would stay within its boundaries. For operations and maintenance expenditures, Nees and Buch (2013) found this proportion to be roughly 26% to 58% for the jurisdictions they analyzed, a range we generally used in the Baseline scenario with some modifications based on an analysis of relative labor supply and demand using the jobs openings and labor turnover (JOLTS) rate for professions specific to each BMP.

The JOLTS rate is a ratio of the number of job openings for a given profession to the sum of current employment plus job openings, and is a standard metric of labor scarcity.¹⁰ Higher rates indicate that more jobs are going unfilled, and that recruitment from outside the analysis area is more likely. For each BMP, we assigned a probability that labor income would stay within the City based on a comparison of Baltimore City's JOLTS ratio for each relevant profession to that of Maryland as a whole. Job openings data forecasted through 2020 were provided by the Department of Labor, Licensing and Regulation (DLLR).¹¹

⁷ Nees and Buch (2013), note 10.

⁸ King, Dennis and Patrick Hagen. 2011. Costs of Stormwater Management Practices in Maryland Counties. Solomons, MD: University of Maryland, Center for Environmental Science.

⁹ General Services Administration. 2013. GSA Green Roofs Benefits and Challenges. Washington, DC: General Services Administration. Incremental operations and maintenance costs were used rather than total because we assume that green roofs would only be installed as an upgrade to existing roofing plans (new or retrofits). Thus, to be consistent with the overall "with and without" framework, we need to net out operations and maintenance costs that would be incurred in the absence of the SMP.

¹⁰ See, e.g. Belman, Dale L. 2013. Skilled Labor Shortage in the Construction Industry? It's Not Demonstrated in the Numbers. Lansing, MI: School of Human Resources and Labor Relations, Michigan State University.

¹¹ DLLR job openings data is available online at: <http://www.dllr.state.md.us/lmi/iandoproj/baltimorecity/>.

Based on the Nees and Buch (2013) analysis and our analysis of the JOLTS ratio, we assigned each BMP a “local income factor” that represents the proportion of operations and maintenance expenditures staying within City limits. For the Baseline scenario, the range of values for this local income factor was .25 to .75, with four BMPs assigned a factor of .5 (BMPs 1-4), three a factor of .75 (BMPs 5-7) and one a factor of .25 (BMP 8). Coupled with operations and maintenance cost data for each BMP, this translates into an HBE impact value ranging from \$318 to \$2,536 per IAT (Appendix Table A1).

For the GPI-Max scenario we assume that the City more aggressively implements its local hiring preference policy as set forth in City Council Bill 12-0159. While the enforceability 12-0159 is still in question, the City Law Department has described a number of approaches for achieving its goals that would not raise legal complications.¹² These include job linkage and training programs, focusing hiring preference on income level, focusing hiring preference on the unemployed and leveraging federal authority in situations where at least some federal funding is applied. Under the GPI-Max scenario we assume that some combination of these are used more aggressively in allocating funding for SMP operations and maintenance contracts and that as a result, those BMPs with local income factors assumed to be .5 or less under the Baseline scenario are raised by .25. This results in seven BMPs having a local income factor of .75 (BMPs 1-7) and one with a local income factor of .5 (BMP8).

Before computing how this translates into HBE impact, we addressed one additional complexity. For some BMPs (BMP1, BMP5, BMP6) there are opportunities for recruiting volunteers from the community to participate in their upkeep and maintenance. In fact, this is encouraged as part of the City’s stormwater credit program. The benefits of this increase in unpaid labor are discussed below. But with respect to HBE impact, what this increase in volunteer hours does is to lower the overall expenditures needed and income generated. We assume that for the three relevant BMPs, volunteer hours will lead to a 50% cost savings under the GPI-Max scenario. As data on actual volunteering patterns becomes available, this assumption can be revisited. Taking operations and maintenance cost data, local income factors, and volunteering assumptions into account results in a HBE impact value ranging from \$314 to \$5,072 per IAT under the GPI-Max scenario (Appendix Table A2).

4.2 Reduced costs of household pollution abatement expenditures (GPI-2)

The GPI counts as a cost the money households spend on pollution abatement in the form of waste disposal and recycling fees, sewer fees, water softening services, septic tank cleaning, vehicle exhaust system repairs, stormwater fees, and expenditures on items like water and air filters. The reason is that these expenditures do not directly add to welfare, but rather reflect the externalized costs of economic activity that generates pollution and waste that society then has to clean up. The SMP will help reduce these expenditures by increasing homeowner participation in Baltimore’s stormwater fee credit program. That program allows homeowners to reduce their stormwater fees by participating in public projects like stream clean up, tree planting, or de-paving and by implementing one or more BMPs on their properties: small raingardens (BMP9), large raingardens (BMP10), tree planting (BMP11), and rainwater harvesting (BMP12).¹³ The

¹² Memorandum from Ashlea H. Brown, Assistant Solicitor to the City Council, City Council Bill 12-0159 Finance and Procurement – Local Hiring Supplemental Bill Report, January 9th, 2013.

¹³ Cleanwater Baltimore. 2014. Maryland Stormwater Fee Reductions: Baltimore City Customer Guidance Document: Single Family Property. Available online at: www.cleanwaterbaltimore.org.

fee reduction associated with each of these ranges from \$6 to \$24 per year. There is an option to implement more sophisticated BMPs, but since data on homeowner implementation of these is not presently available we exclude them from the analysis.

For BMPs 9,10 and 12, the City's credit guidance specifies a treatment area ranging from 500 to 1000 square feet. For tree planting, we assume that the two trees treat an area of 100 square feet. After converting these values to IAT equivalents (i.e. treating an acre of impervious surface would require roughly 43 large rain gardens) and applying the per-practice fee reduction rates we then calculated the reduced costs of household pollution abatement for each acre of the BMP implemented. The resulting GPI impact per IAT ranges from \$616 to \$1,166 (Appendix Table A1). There were no obvious ways to enhance these impacts under the GPI-Max scenario so the values for Appendix Table A2 are identical.

4.3 Value of unpaid labor (GPI-3)

Baltimore's GPI recognizes the economic value of volunteering and work performed by homeowners as they raise families and care for their homes and properties. The general method for quantifying the economic value of these activities is to ask what it would cost to replace that unpaid labor with services provided by those we would hire as domestic workers, childcare providers, landscapers, grounds keepers, or social service specialists. The SMP seeks to engage volunteers in community projects as well as homeowners implementing BMPs on their own properties. All of this labor has value in the GPI framework.

There are three public BMPs for which unpaid labor may play a significant role in maintaining: stream restoration (BMP1), creation of green space from vacant lots and schools (BMP5), and tree planting (BMP6). Maintaining these BMPs by monitoring, trash clean up, and tree pruning and planting are among activities now being facilitated by organizations such as Blue Water Baltimore.¹⁴ The City's credit guidance for homeowners also identifies these BMPs as eligible practices for participation. In addition, all of the homeowner-based BMPs (BMPs 9-12) will require unpaid labor to maintain.

To estimate GPI impacts of this unpaid labor for the Baseline scenario, we assume that there will be no significant volunteer efforts associated with maintaining BMPs 1, 5 and 6. Instead, all unpaid labor benefits arise from implementation of homeowner BMPs, which are assumed to be maintained in the long term with 100% unpaid labor provided by households.¹⁵ The value of this unpaid labor is estimated as per the overall GPI method as a function of the number of hours required each year for maintenance activities and the value of a volunteer hour. For each BMP, we consulted several best practices manuals to identify the annual hours required. The value of a volunteer hour in both the Maryland and Baltimore GPI accounts is taken from Independent Sector estimates (based on replacement cost) and currently stands at \$25.43.¹⁶ This translates into a GPI impact per IAT of \$254 - \$3,051 (Appendix Table A1).

Under the GPI-Max scenario, we assumed that 50% of the hours needed for long-term operations and maintenance activities associated with BMPs 1, 5 and 6 would be covered by volunteers. To estimate the number of requisite volunteer hours, we divided the total operations and maintenance cost estimates per IAT developed for the HBE impact calculation by the current

¹⁴ See Blue Water Baltimore's Volunteering page at: <http://www.bluewaterbaltimore.org/get-involved/>.

¹⁵ Even if some of this labor were contracted out, the GPI impacts would be similar.

¹⁶ See Independent Sector's state-by-state estimates for 2013 at: https://www.independentsector.org/volunteer_time.

wage rate for relevant occupations (i.e. landscaper, environmental engineering technician, grounds maintenance) for each BMP as reported by DLLR. We then multiplied 50% of these hours by the going value of a volunteer hour, as before. Household BMP calculations were not changed. The resulting GPI impact per IAT under the GPI-Max scenario for the public BMPs range from \$839 to \$925 (Appendix Table A2).

4.4 Services from household capital (GPI-4)

The GPI framework assigns value to the services provided by household capital. Household capital includes any and all improvements made to a home's structure or landscaping – improvements that leave a clear market signal in the form of higher property values, higher market value, and, most importantly, greater levels of homeowner satisfaction with the condition of their homes and land. It also includes the stock of consumer durables in the form of appliances, air conditioning units, vehicles, and computers. In the GPI framework, the annual benefits generated by this household capital are equivalent to 20% of the net stock in any one year after taking depreciation into account.

To the extent that homeowners participate in the stormwater fee credit program, there will be substantial new investments in household capital and the annual services rendered by that capital. For each homeowner BMP, and in accordance with the overall GPI methodology, we assume that the value of these household capital additions to be more or less the cost of installing them. Installation costs for each household BMP were derived from a number of published sources and were assumed to be: small raingardens (BMP9 - \$11 per square foot); large raingardens (BMP10 - \$11 per square foot), tree planting (BMP11 - \$40 per tree) and rainwater harvesting (BMP12 - \$4.50 per gallon).¹⁷

Baseline GPI impact values were derived by converting these to per-IAT equivalent costs and then by taking 20% to reflect the value of annual services. The resulting impact range for BMPs 9-12 was \$6,970 to \$96,030 per IAT (Appendix Table A1). For the GPI-Max scenario, we assume that 25% of the investments in BMPs 4 (micro-practices) and BMP8 (green roofs) would take place in residential areas and that these practices would thus contribute to household capital formation and, ultimately annual services from that capital. Installation costs for BMP4 were taken from King and Hagen (2011) and for BMP8 from GSA.¹⁸ The resulting annual GPI impact for these two BMPs under the GPI-Max scenario were estimated to be \$3,184 (BMP4) and \$8,625 (BMP8). The GPI impact from household BMPs was not changed (Appendix Table A2).

4.5 Services from water infrastructure (GPI-5)

Baltimore's GPI takes into account the many economic benefits generated each year by the City's stock of water infrastructure, including stormwater management structures. These benefits are calculated as a fixed percentage (7.5%) of the value of the stock at any given time after deducting depreciation and based on data compiled for each state by the Bureau of

¹⁷ These cost estimates represent averages across at least four point estimates per practice published by universities and both state and federal agencies.

¹⁸ See notes 13 and 14.

Economic Analysis.¹⁹ SMP investments will add to this stock, the services it provides, and thus the GPI.

The value of water infrastructure stock additions per IAT was calculated as the capital installation costs of BMPs 1-4 multiplied by the percentage of each BMP represented by gray infrastructure components (i.e. outfalls) and percentage of each IAT area for each BMP located on public or commercial rather than residential lands. The reason for concentrating on the share of gray rather than green infrastructure included in each BMP is that GPI contributions from green infrastructure are accounted for elsewhere. Likewise, the reason for concentrating on public rather than residential stock additions is that stock additions that enhance household capital are also calculated elsewhere.

For the Baseline scenario, we assume that 100% of BMPs 1-4 will be located in public areas and that 50% of the expenditures for BMPs 1 and 2 and 80% of the expenditures for BMPs 3 and 4 will be for gray infrastructure components. Combining these assumptions with updated capital installation cost data provided by King and Hagen (2011) the GPI impacts per IAT for the Baseline scenario range from \$896 to \$3,821 (Appendix Table A1). For the GPI-Max scenario, we assume that practices are modified to emphasize their green infrastructure components (20% gray for BMPs 1,3 and 4; 60% gray for BMP3) and that 25% of the IAT by BMP4 falls in a largely residential area. This lowers the range of GPI impacts for these BMPs (because of the green infrastructure effect) to \$358 to \$1,025 per IAT (Appendix Table A2).

4.6 Services from streams and wetlands (GPI-6)

Several BMPs will enhance the ecosystem services provided by streams and wetlands. BMP1 is most direct, as it focuses on stream restoration. BMPs 2,3 and 4 also have the ability to enhance ecosystem services to the extent that they are built on green infrastructure design criteria that mimic natural streams and wetlands.

To calculate the potential GPI impact of BMPS 1-4, we first had to calculate the required stream and wetland area created to achieve 1 acre of IAT. To do this, we rely on conversion factors provided by the Maryland Department of Environment (MDE).²⁰ For stream restoration, the conversion factor is .01 per linear foot, meaning that for each linear foot of stream restoration implemented, .01 acre of impervious surface area is considered treated. But stream restoration is not limited to the streambed – by necessity, it includes adjacent wetland or riparian vegetation. Statewide, the importance of buffers of at least 100 feet wide has been recognized for all streams and shorelines, and so if this guidance is followed it means that effective restoration of a linear foot of stream would generally require a restoration footprint of 100 square feet.²¹

An acre is 43,560 square feet, so it would take 435.6 such 100 by 1 square foot restoration units to achieve an acre of stream restoration. Using the .01 conversion factor means that this acre of stream restoration would be equivalent to 4.36 (rounding up) acres of IAT. Conversely, 1 acre of IAT for stream restoration can be achieved by restoring 1/4.36 (.2294)

¹⁹ BEA. Current Cost Net Stock of Government Fixed Assets, Table 7.1B. Water and Sewer Systems, State and Local Government.

²⁰ Maryland Department of Environment (MDE). 2014. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated. Guidance for National Pollution Discharge Elimination System Stormwater Permits. Baltimore: MDE.

²¹ See, e.g. Maryland's Stream Health Program website online at: <http://streamhealth.maryland.gov/forested-stream-buffers/>.

acres of streams. We use this conversion factor for BMPS 1-4 under the assumption that BMPs 2,3, and 4 would function more or less like created or restored streambeds and associated wetlands if green infrastructure components were emphasized. But there is one additional complication. As noted in Section 4.5, not all expenditures on BMPS 1-4 will be for green infrastructure. Thus, only the green infrastructure components of these BMPs should count towards stream or wetland creation. Because of this, we backed out the percentage of each BMP assumed to be allocated to gray infrastructure components under each scenario. So for BMP1 under the Baseline scenario we assume that only 50% of the expenditures are for green infrastructure components (the rest for outfalls and other gray components) and so to achieve .5 acres of IAT .1147 acres of stream restoration would need to occur. Under the GPI-Max scenario, the percent allocated to green infrastructure rises to 80%, and thus to achieve .8 acres of IAT with .1835 acres of stream restoration would need to occur.

After converting IAT figures into stream and wetland footprint acres, we then multiplied these acres by the Baltimore GPI's calculation of ecosystem services per acre for streams and wetlands, which stands at \$51,723.31 in 2013 dollars. For the Baseline scenario, this translates into a GPI impact of \$2,373 - \$5,932 per IAT for BMPS 1-4 (Appendix Table A1). This rises to a range of \$4,745 - \$9,491 per IAT under the GPI-Max scenario if green infrastructure components are emphasized (Appendix Table A2).

4.7 Services from parks and open space (GPI-7)

The SMP will also add to Baltimore City's current endowment of parks and open space. These land uses also generate annual ecosystem service benefits to City residents – ranging from \$19,726 to \$34,119 per acre depending on whether recreational features are included.

BMP5 is the sole contributor to this benefit category. To estimate the GPI impact, we again relied on MDE guidance with respect to translating IAT into acres of required BMP footprint. In this case, the conversion factor was 0.75 meaning that to achieve an acre of IAT 1.33 acres (1/.75) of new open space would have to be created. As for the value of this new open space under the Baseline scenario, we assume that the recreation emphasis would be relatively low – 25% of open space created under this BMP. Using a weighted average for ecosystem service values, this translates into a GPI impact of \$23,351 per IAT (Appendix Table A1). Under the GPI-Max scenario, we assume that recreation features are included on 75% of the open space treated, which translates into a weighted average GPI impact of \$30,530 per IAT (Appendix Table A2).

4.8 Services from planted urban trees and urban forests (GPI-8)

Baltimore's GPI accounts for the ecosystem service benefits provided by urban forests and those provided by planted urban trees. BMPs 6 and 11 will enhance these benefits by planting urban trees on public and residential lands and by reforesting suitable sites. For BMP6, the overall GPI impact will depend on what component is emphasized and whether treatment occurs on pervious or impervious surface. For both BMP6 and 11, the GPI impact will also depend on the density of trees planted. Citywide that density has been estimated at 50.8 trees per acre.²² MDE guidance for BMP6, however, calls for a minimum density of 100 trees per acre on

²² USDA Forest Service. 2007. Assessing Urban Forest Effects and Values. Resource Bulletin NRS-9. Newtown Square, PA: USDA Forest Service Northern Research Station.

land targeted for reforestation.²³ On many urban sites, it may not be possible to attain this higher density.

To calculate the ecosystem service value associated with the reforestation component of this BMP we import the per-acre ecosystem service value of \$14,208 from the Baltimore GPI accounts. We also rely on MDE conversion factors of .38 for reforestation on pervious surface areas and 1.0 for conversion of impervious urban surface to forest. This means that it takes between 1 and 2.63 acres of reforestation to achieve an acre of IAT depending on the composition of the existing surface area. Under the Baseline scenario, we assume that 25% of the areas treated by BMPs 6 and 11 will occur on existing impervious surface area and be targeted for restoring urban forests and 75% will occur on pervious surface and be considered general tree planting. Under the GPI Max scenario, the allocation is reversed for BMP6 but kept as is for BMP11 since it is unlikely that homeowners have capacity to engage in urban forest restoration beyond the minimal level assumed under the Baseline.

To calculate the ecosystem service value associated with planted urban trees on both public and residential lands, the GPI relies on the Tree Benefit Calculator developed by Casey Trees.²⁴ Averaged across the species and sizes of trees emphasized by Baltimore's existing tree planting program, ecosystem service benefits are estimated to be \$89.67 per tree per year. For treatments on impervious surface, we assume the 100 trees per acre density would apply as per MDE guidance. For general tree planting on pervious surface, we assume that tree density would mirror the City average (50.8 per acre). Under the Baseline scenario, the density is weighted towards that of general tree planting (weighted average of 63.10 trees per acre). Under the GPI-Max scenario, the density is weighted towards that required for successful urban forest restoration (weighted average of 87.70 trees per acre) for BMP6, but maintained at the lower value for BMP11 for the reasons previously discussed.

Under the Baseline scenario, all this translates into a GPI impact per IAT of \$14,571 for both BMP6 and BMP11 (Appendix Table A1). Under the GPI-Max scenario, this value is unchanged for BMP11 but increases to \$14,937 for BMP6 (Appendix Table A2).

4.9 Reduced costs of water pollution (GPI-9)

The primary goal of the SMP is to reduce levels of harmful nutrient and sediment contamination entering waters of the Chesapeake Bay. The GPI calculates the costs of water pollution in terms of what society is willing to pay to clean it up. As discussed in the Baltimore GPI report, this restoration cost approach suggests an average cost of \$132.51 per ton per year for total nitrogen (TN) and total phosphorous (TP) entering the Bay watershed from Baltimore's impervious surfaces. The SMP will reduce this pollution, and thus reduce the overall costs of water pollution tabulated in Baltimore's GPI accounts.

The amount of water pollution cost reduction achieved by the SMP is a function of the average cost of pollution per ton (\$135.51) multiplied by the total number of tons of TN and TP reduced for each BMP per IAT. Pollution reduction levels per implementation acre or IAT were derived from two primary sources: (1) a spreadsheet of TN, TP, and TSS efficiencies provided by City staff²⁵, and (2) Maryland Department of Environment's 2014 guidance document.²⁶ All

²³ MDE 2014, Note 26.

²⁴ Available online at: <http://www.treebenefits.com/calculator/>.

²⁵ "Baltimore City Stormwater BMP Effectiveness" spreadsheet, obtained from City staff in July of 2014.

²⁶ MDE (2014), note 26.

values expressed in terms of pollution reduction per acre implemented were converted to IAT equivalents based on MDE conversion factors.

For the Baseline scenario and for BMPs 2,3,4,9 and 10 we used an average pollution reduction value for a variety of configurations of each BMP. Average values were taken from efficiencies contained in the City's spreadsheet. For BMPs 1,5,6,7 and 11, we relied on MDE 2014 guidance after accounting for the IAT conversions and BMP configuration assumptions discussed in earlier sections. For example, for BMP1 we had to account for the share of expenditures on this BMP going to outfalls and other gray infrastructure components versus stream restoration (see discussion under section 4.6). For the GPI-Max scenario, we used the upper end of the ranges for BMP efficiencies for BMPs 2,3,4,9 and 10; the logic being that when implemented, the City has the flexibility for configuring BMPs to maximize their nutrient reduction efficiency. For BMPs 1 and 6, we took into account the GPI enhancing features discussed in Sections 4.6 (greater share of BMP1 to stream restoration) and 4.8 (greater share of BMP6 to urban forest restoration) and adjusted the pollution reduction efficiencies accordingly. For the Baseline scenario, GPI impacts range from \$278 to \$1,662 per IAT (Appendix Table A1). For the GPI-Max scenario, GPI impacts range from \$490 to \$1,662 (Appendix Table A2).

4.10 Reduced costs of underemployment (GPI-10)

Baltimore's SMP has the potential to lessen the costs of underemployment as new jobs and income are generated from both short-term installation of stormwater infrastructure and long-term operations and maintenance needs. In the GPI framework, these costs represent the "psychic" costs of being idle rather than working, and are a function of unprovided hours and the prevailing wage rate. While the most significant job-creating effects of the SMP will be in the short term, ongoing operations and maintenance expenditures will help support at least some new full time jobs and thus help reduce the costs of underemployment tracked by the GPI.

The GPI benefit of each BMP was calculated first by estimating the number of hours per year required for operations and maintenance activities. This was approximated by multiplying each BMP's net operations and maintenance cost figure (after deducting the share provided by volunteers) by the local income factor discussed in Section 4.1, and then dividing by occupation-specific hourly wages discussed in Section 4.3 under the assumption that the vast majority if not all of these expenditures will be for labor costs and that most new hours put in will be from the pool of those now underemployed. The resulting figure represents the reduction in unprovided hours. We then multiplied these hours by the prevailing (not occupation-specific) wage rate as a proxy for the "psychic" benefits of employing new labor. Under the Baseline scenario, the GPI benefits range from \$471 to \$3,545 per IAT (Appendix Table A1). Under the GPI-Max scenario the range is \$471 to \$7,091 per IAT. The upper end of the range is extended under this scenario because of the greater emphasis on local hiring.

5.0 Results

This section presents results of the analysis in terms of GPI benefits per impervious acre treated (IAT) for each BMP, annual GPI benefits for the SMP as a whole, and 20-year net benefits taking into account the costs of implementation.

5.1 GPI benefits per IAT

For each BMP, the total GPI benefit per IAT for the Baseline scenario is shown in Appendix Table A1. The total GPI benefit per IAT for the GPI-Max scenario is shown in Appendix Table A2. Table A2 also indicates the percent change over the Baseline. As design features that enhance GPI benefits are added, GPI benefits could increase substantially. The biggest gains would be associated with BMP1 (stream restoration, +51%), BMP3 (stormwater pond retrofits, +54%), BMP4 (micro practices, 89%) and BMP8 (green roofs, +242%). Modest increases would also accompany GPI-enhancing features added to BMP2 (bioretention, +29%) and BMP5 (green spaces, +28%). As discussed above, such GPI-enhancing features would include an increased emphasis on green infrastructure components, increased participation by volunteers, location within residential areas (especially green roofs), enhanced nutrient reduction design, and a hiring pattern for long term operations and maintenance jobs that favors Baltimore residents.

5.2 Annual GPI benefits by BMP and GPI benefit category

Table 2 combines the per-IAT figures in Tables A2 and A3 with the SMP allocation shown in Table 1 to present the total annual GPI benefits associated with implementation of the SMP under each scenario. As shown in Table 2, the SMP has the potential to generate nearly \$20 million in economic benefits each year for the BMPs modeled with no special emphasis on GPI-enhancing design features. If those features were added, then the annual economic contribution of these BMPs would rise by 29% to over \$25 million per year. The largest annual contributions would be associated with stream restoration (BMP1), which makes sense given the numerous ways this BMP contributes to economic wellbeing. The second largest benefit is associated with street sweeping (BMP7), which of course makes sense since this is where most (65%) of the IAT included in this analysis is concentrated. Other significant annual benefits are associated with bioretention, street trees and reforestation.

Table 2:
Annual GPI Impact of Baltimore's SMP by BMP

ID Number	Description	Impervious acres treated	Baseline (\$2013/yr)	GPI Max (\$2013/yr)
BMP1	Restoring stream banks and stabilize failing outfalls	785.00	\$6,680,886	\$10,120,789
BMP2	Installing ponds, bioretention, and structural filtration practices	183.00	\$2,135,739	\$2,761,098
BMP3	Retrofitting existing stormwater ponds	126.00	\$676,844	\$1,044,717
BMP4	Installing micro-practices	63.10	\$602,267	\$1,137,905
BMP5	Creating new green spaces from vacant lots and schools	102.82	\$2,638,736	\$3,378,575
BMP6	Planting street trees/reforestation/afforestation	104.31	\$1,894,642	\$1,903,349
BMP7	Expanded City-wide mechanical street sweeping	2,551.00	\$4,476,362	\$4,476,362
BMP8	Green roofs	0.00	\$0	\$0
BMP9	Small rain garden	13.00	\$168,887	\$172,160
BMP10	Large rain garden	13.00	\$187,199	\$190,472
BMP11	Household tree planting	7.60	\$233,176	\$233,176
BMP12	Rainwater harvesting	0.50	\$11,216	\$11,216
<i>Total:</i>		3,949.33	\$19,705,955	\$25,429,818

Table 3 breaks down the annual GPI benefit in terms of benefit categories. The ecosystem services provided by streams and wetlands represents by far the largest category of benefit. Economic benefits associated with improvements in water quality, new employment, parks, and open space would also be significant and contribute over \$2 million each year to Baltimore's economy.

**Table 3:
Annual GPI Impact of Baltimore's SMP by Benefit Category**

GPI Benefit	Description	Baseline (\$2013/yr)	GPI Max (\$2013/yr)
GPI-1	Household spending	\$1,530,894	\$1,490,167
GPI-2	Reduced stormwater fees	\$25,559	\$25,559
GPI-3	Volunteering	\$62,354	\$970,160
GPI-4	Home improvements	\$356,117	\$557,040
GPI-5	Water infrastructure	\$1,553,560	\$630,486
GPI-6	Streams and wetlands	\$6,190,426	\$10,383,573
GPI-7	Parks and open space	\$2,400,998	\$3,139,086
GPI-8	Urban trees and forests	\$1,630,675	\$1,668,858
GPI-9	Water quality	\$3,454,032	\$4,112,516
GPI-10	Employment	\$2,501,338	\$2,452,373
Total:		\$19,705,955	\$25,429,818

5.3 Net SMP benefits over 20 years

How well do these benefits stack up against implementation costs? As an analytical framework, the U.S. Environmental Protection Agency (EPA) recommends a "two stage" discounting process to evaluate water infrastructure investments in terms of present value costs, net present value and the benefit-cost ratio.²⁷ The two stage discounting model involves three key steps: (1) annualizing capital costs over the analysis period; (2) adding annual operating and maintenance costs; (3) discounting the resulting cost stream back to the present. The benefit stream is first estimated nominally (as we did in Tables 2 and 3) and then discounted back to the present with the consumption rate of interest serving as the discount rate.

The analysis period is typically pegged to the expected life of the water resources technology under consideration. Alternatively, it may be pegged to the payback term on bonds or any other financing instrument. Annualized capital costs are inflated to reflect the opportunity cost of capital. The consumption rate of interest is used to discount the cost and benefit stream back to the present. EPA recommends a rate of 7% for the opportunity cost of capital and 3% for the consumption rate of interest.

The results of applying this method to the SMP are presented in detail in Appendix B. For each BMP and for the SMP as a whole we estimate 20-year present value costs, 20-year discounted benefit and the overall social return on investment (ROI). For each scenario, the results are reported in Table 4, below. Over a 20-year period, the SMP as currently configured is likely to generate over \$22 million in net benefits with a benefit-cost ratio of 1.0817 and a social

²⁷ U.S. EPA, 1999. OAQPS economic analysis resource document. Office of Air Quality Planning and Standards, Innovative Strategies and Economics Group. Available online at: <http://www.epa.gov/tneecas1/econdata/Rmanual2/8.3.html>.

return on investment of over 8%. But with GPI-enhancing features added, net benefits could be substantially larger. Our analysis shows that under the GPI-max scenario, 20-year net benefits could be over \$107 million with a benefit-cost ratio of 1.3959 and social a return on investment of nearly 40%. This underscores the importance of paying attention to design feature of the SMP as it is implemented on the ground – some design features will pay off far better from a social and environmental perspective than others.

**Table 4:
20-Year Net GPI Benefits**

Aggregate indicator	Baseline	GPI-Max
Present value GPI benefits	\$293,174,854	\$378,331,483
Present value costs	\$271,021,655	\$271,021,655
Present value net benefits	\$22,153,199	\$107,309,827
Benefit-cost ratio	1.0817	1.3959
Social return on investment	8.17%	39.59%

Discussion and Concluding Thoughts

In this analysis, we demonstrated how Baltimore’s Genuine Progress Indicator could be used to quantify the economic benefits of major policy initiatives – in this case, the City’s new Stormwater Management Plan (SMP). Although the analysis is preliminary and limited to only those SMP measures that have been developed with enough specificity to warrant inclusion, the figures are encouraging, demonstrating that the large portfolio of measures the SMP will implement over the next several years are not only a tools for reducing stormwater pollution reaching the Chesapeake Bay but for promoting genuine economic progress.

As we demonstrated, the SMP will help boost incomes and household spending, enhance the services from water and green infrastructure, help reduce the costs of underemployment, reduce the costs of water pollution and increase the value of volunteering and unpaid labor provided by households. These benefits are likely to exceed implementation costs by a significant margin, more so if a number of features are included in the design of best management practices to enhance their GPI impact.

As more precise economic data on both costs and benefits of projects and programs to implement the SMP become available, this preliminary analysis can also be refined and updated. So too can the list of GPI-enhancing measures. Doing so will help decision makers implementing the SMP to choose options that maximize its social and economic returns – an important goal recognized by the Environmental Protection Agency in its new Integrated Municipal Stormwater and Wastewater Planning Approach Framework, adopted last summer.²⁸ That framework recognizes that communities can “manage stormwater as a resource, and support other economic benefits and quality of life attributes that enhance the vitality of communities.” As shown here, the GPI provides a useful analytical tool for achieving this goal.

²⁸ EPA. 2014. June 5th Memorandum from Nancy Stoner, Acting Assistant Administrator to EPA Regional Administrators and Regional Permit and Enforcement Division Directors. RE: Integrated Municipal Stormwater and Wastewater Planning Approach Framework.

**Appendix A – Table A1
GPI Impact per Impervious Acre Treated – Baseline Scenario**

GPI Variable	Best Management Practice											
	BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8	BMP9	BMP10	BMP11	BMP12
1	\$419	\$720	\$469	\$720	\$624	\$854	\$318	\$2,536	\$0	\$0	\$0	\$0
2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$623	\$616	\$1,166	\$1,161
3	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,526	\$3,052	\$254	\$1,831
4	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$9,570	\$9,460	\$13,027	\$19,440
5	\$896	\$2,388	\$1,367	\$3,821	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
6	\$5,932	\$5,932	\$2,373	\$2,373	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
7	\$0	\$0	\$0	\$0	\$23,351	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8	\$0	\$0	\$0	\$0	\$0	\$14,571	\$0	\$0	\$0	\$0	\$14,571	\$0
9	\$473	\$1,272	\$278	\$1,272	\$511	\$1,662	\$965	\$0	\$1,272	\$1,272	\$1,662	\$0
10	\$791	\$1,359	\$885	\$1,359	\$1,177	\$1,076	\$471	\$3,545	\$0	\$0	\$0	\$0
Total:	\$8,511	\$11,671	\$5,372	\$9,545	\$25,664	\$18,164	\$1,755	\$6,082	\$12,991	\$14,400	\$30,681	\$22,432

**Appendix A – Table A2
GPI Impact per Impervious Acre Treated – GPI Max Scenario**

GPI Variable	Best Management Practice											
	BMP1	BMP2	BMP3	BMP4	BMP5	BMP6	BMP7	BMP8	BMP9	BMP10	BMP11	BMP12
1	\$314	\$1,080	\$703	\$1,080	\$312	\$427	\$318	\$5,072	\$0	\$0	\$0	\$0
2	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$623	\$616	\$1,166	\$1,161
3	\$925	\$0	\$0	\$0	\$918	\$839	\$0	\$0	\$1,526	\$3,052	\$254	\$1,831
4	\$0	\$0	\$0	\$3,184	\$0	\$0	\$0	\$8,625	\$9,570	\$9,460	\$13,027	\$19,440
5	\$358	\$955	\$1,025	\$716	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
6	\$9,491	\$9,491	\$4,745	\$9,491	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
7	\$0	\$0	\$0	\$0	\$30,530	\$0	\$0	\$0	\$0	\$0	\$0	\$0
8	\$0	\$0	\$0	\$0	\$0	\$14,937	\$0	\$0	\$0	\$0	\$14,571	\$0
9	\$1,212	\$1,524	\$490	\$1,524	\$511	\$1,505	\$965	\$0	\$1,524	\$1,524	\$1,662	\$0
10	\$593	\$2,038	\$1,327	\$2,038	\$589	\$538	\$471	\$7,091	\$0	\$0	\$0	\$0
Total:	\$12,893	\$15,088	\$8,291	\$18,033	\$32,859	\$18,247	\$1,755	\$20,788	\$13,243	\$14,652	\$30,681	\$22,432
% +/-	51.49%	29.28%	54.35%	88.94%	28.04%	0.46%	0.00%	241.82%	1.94%	1.75%	0.00%	0.00%

Appendix B – Table B1
20-year Benefit/Cost Analysis by BMP and for the SMP as a Whole

Baltimore Stormwater Analysis
Benefit-Cost Analysis

Constants: Consumption rate of interest 3.00%
Opportunity cost of capital 7.00%
Analysis period 20

		<u>Installation</u>		<u>O&M</u>	<u>Total</u>	<u>NPV-total</u>	<u>PV benefits</u>	<u>PV benefits</u>	<u>ROI</u>	<u>ROI GPI-</u>
	<u>Treatment Acres</u>	<u>costs/IAT</u>	<u>Land costs/IAT</u>	<u>costs/IAT</u>	<u>cost/IAT</u>	<u>costs</u>	<u>Baseline</u>	<u>GPI-Max</u>	<u>Baseline</u>	<u>Max</u>
BMP1	785.00	\$67,731	\$0	\$936	\$7,329	\$85,597,877	\$99,394,713	\$150,571,781	16.12%	75.91%
BMP2	183.00	\$192,982	\$3,151	\$1,608	\$20,122	\$54,782,536	\$31,774,397	\$41,078,165	-42.00%	-25.02%
BMP3	126.00	\$68,743	\$3,676	\$1,047	\$7,883	\$14,776,873	\$10,069,737	\$15,542,756	-31.85%	5.18%
BMP4	63.10	\$192,982	\$3,151	\$1,608	\$20,122	\$18,889,497	\$8,960,217	\$16,929,146	-52.57%	-10.38%
BMP5	102.82	\$101,086	\$52,512	\$929	\$15,428	\$23,599,576	\$39,257,733	\$50,264,660	66.35%	112.99%
BMP6	104.31	\$34,658	\$157,536	\$1,271	\$19,413	\$30,126,059	\$28,187,492	\$28,317,021	-6.43%	-6.00%
BMP7	2,551.00	\$6,353	\$0	\$474	\$1,074	\$40,748,708	\$66,596,970	\$66,596,970	63.43%	63.43%
BMP8	0.00	\$172,279	\$0	\$11,326	\$27,588	\$0	\$0	\$0	0.00%	0.00%
BMP9	13.00	\$47,850	\$0	\$0	\$4,517	\$873,562	\$2,512,611	\$2,561,305	187.63%	193.20%
BMP10	13.00	\$47,300	\$0	\$0	\$4,465	\$863,522	\$2,785,051	\$2,833,745	222.52%	228.16%
BMP11	7.60	\$65,136	\$0	\$0	\$6,148	\$695,195	\$3,469,070	\$3,469,070	399.01%	399.01%
BMP12	0.50	\$97,200	\$0	\$0	\$9,175	\$68,250	\$166,864	\$166,864	144.49%	144.49%
						\$271,021,655	\$293,174,854	\$378,331,483	8.17%	39.59%

Total 20 year costs:	\$271,021,655
Total 20 year benefits (Baseline)	\$293,174,854
Net 20 year benefits (Baseline)	\$22,153,199
Total 20 year benefits (GPI-Max):	\$378,331,483
Net 20 year benefits (GPI-Max):	\$107,309,827
Benefit/cost ratio (Baseline):	1.0817
Benefit/cost ratio (GPI-Max):	1.3959
Social ROI (Baseline):	8.17%
Social ROI (GPI-Max):	39.59%