**MEMORANDUM**

**TO:** Wissahickon Clean Water Partnership Water Quality Advisory Team and Management Committee

**FROM:**  Environmental Finance Center, University of Maryland

**RE:** Preliminary WQIP Implementation Budget Estimates and Example Funding Formulas

**DATE:** July 11, 2019

**Introduction**

A project team led by the Pennsylvania Environmental Council and including the Wissahickon Valley Watershed Association, Temple University, and the Montgomery County Planning Commission has successfully facilitated 13 municipalities and several wastewater treatment plants in the Wissahickon Creek watershed through the process of developing a Total Maximum Daily Load (TMDL) Alternative to address water quality issues in the watershed. The partnership among all the stakeholders is called the Wissahickon Clean Water Partnership (WCWP).

The Environmental Finance Center (EFC) has offered assistance to project team members and municipalities focusing on how best to plan, manage and pay for watershed improvements. This support has taken the form of meeting individually with each municipality several times to discuss funding and financing issues, providing information about existing multi-municipal collaborations, and developing information about potential funding formulas to support implementation of the Water Quality Improvement Plan (WQIP).

The draft final WQIP focuses on managing stormwater by reducing flows and treating runoff for water quality in the Wissahickon Creek watershed. The plan envisions a multi-phase 20-year implementation period. It includes a Phase 1 goal of implementing enough stormwater management projects to treat the first inch of stormwater runoff from approximately 1000 acres in the watershed. While any appropriate stormwater management practices can be implemented, the plan emphasizes three kinds of projects – new green stormwater infrastructure (GSI), stormwater basin retrofits, and impervious cover reduction/removal. The plan also addresses the need for stream restoration projects to account for in-stream issues related to streambank erosion and road-stream crossing, as well as riparian buffer and open space protection projects that can also help increase the amount of tree canopy cover in the watershed. Full implementation of the WQIP would result in having stormwater management practices in place throughout the watershed that would treat the first inch of stormwater runoff on about one quarter the land area in the watershed, resulting in significant reductions in flow and improved infiltration that will be beneficial to the watershed’s overall hydrology as well as water quality.

Now that a draft final WQIP has been developed, the WCWP must consider more specifically how to implement the activities outlined in the plan. This memo is designed to facilitate the discussion about how to fund and finance implementation. Because information about the City of Philadelphia in the Wissahickon Creek watershed is incomplete, this memo focuses mostly on the participating municipalities in Montgomery County.

**Wissahickon Community Characteristics**

Table 1 presents a snapshot of information that can help inform our understanding of community financial capacity across the watershed. In a multi-municipal collaboration, this information is helpful in developing funding and financing structures that are considered affordable and equitable by the participating municipalities.

Some variability exists among the municipalities in the Wissahickon Creek watershed. In general, these indicators show that the municipalities in Montgomery County together may have better capacity to fund and finance the water quality improvement work outlined in the WQIP than Philadelphia or the state more generally. The three watershed boroughs have lower median household incomes. Lansdale Borough and North Wales Borough have two of the three highest percentages of population with income below the poverty level. Interestingly, Lower Gwynedd has a relatively high median household income, but also relatively high levels of poverty and population over 65 years old. The percent of population over 65 years old is higher than the city and state levels, an important consideration given that more of this population group is often on fixed incomes than other population groups.

Table 1. Wissahickon Community Characteristics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Municipality | Population (2016) | Median Household Income (2015 dollars) | Percent Population Below Poverty Level (2015) | Percent of population 65 Years and Over (2011–2015) | Total Households (2010) |
| Abington Township | 55,557 | $77,014 | 6.4 | 17.5 | 21,382 |
| Ambler Borough | 6,500 | $57,108 | 6.6 | 15.4 | 2,604 |
| Cheltenham Township | 37,103 | $76,521 | 8.2 | 17.5 | 14,468 |
| Lansdale Borough | 16,521 | $58,678 | 9.6 | 14 | 6,655 |
| Lower Gwynedd Township | 11,558 | $92,292 | 8.6 | 26.9 | 4,692 |
| Montgomery Township | 26,143 | $101,369 | 3.9 | 13.8 | 9,207 |
| North Wales Borough | 3,242 | $63,970 | 8.5 | 12.3 | 1,290 |
| Springfield Township | 19,685 | $85,000 | 5.9 | 20.9 | 7,550 |
| Upper Dublin Township | 26,225 | $110,065 | 2.7 | 17.3 | 9,397 |
| Upper Gwynedd Township | 15,975 | $86,064 | 3.6 | 21.1 | 6,237 |
| Whitemarsh Township | 17,795 | $114,954 | 3.9 | 17.6 | 6,744 |
| Whitpain Township | 19,308 | $119,815 | 3.7 | 19.4 | 7,462 |
| Philadelphia |  | $39,759 | 26 | 14 |  |
| Pennsylvania |  | $56,951 | 13 | 18 |  |

*Source: U.S. Census Bureau, 2011–2015 American Community Survey 5-Year Estimates.*

**Funding Needed to Implement the Wissahickon Creek WQIP**

Implementing the WQIP will require resources to support the following activities:

* Administration;
* Public education and outreach;
* Private landowner program development;
* Stormwater management project implementation;
* Stormwater management practice operation and maintenance; and
* Monitoring and modeling.

There are proposed lead organizations for most of these activities and cost estimates have been or are being developed by those proposed leads. One exception is stormwater management practice operations and maintenance. These activities are not as thoroughly researched and documented as those for practice implementation. The literature available includes ranges from 1% to 20% of construction costs. The variability depends a great deal on the kind of practices implemented. The other exception is stormwater management project implementation, the most costly activity. This discussion will focus on cost estimates for this element during the first phase (years 1-5) of WQIP implementation.

As mentioned above, the WQIP sets out a goal of implementing projects that treat the first inch of stormwater runoff from about 1000 acres in the first five years. The plan does not indicate where the projects should be located nor does it proscribe the kinds of projects that can be implemented.

There is some existing experience with estimating stormwater management project costs based on area treated. Not surprisingly, these costs vary greatly depending on whether the project is a stormwater basin retrofit or a new GSI project. Whitpain Township has significant local experience implementing stormwater basin retrofits and estimates that full project costs range between $4000 and $8000 per acre treated (Jim Blanch, Whitpain Township Engineer, personal communication, June 11, 2019).

Costs estimates for construction of new GSI are included in Table 4-5 of the WQIP. There are five practices listed. The costs range from $12.54 to $36 per square foot with an average cost of $22 per square foot. Using a conversion factor of 10 square feet of area treated for each area of stormwater practice, the average cost is $2.20 per square foot treated, with a range of $1.25 to $3.60. Since there are 43,560 square feet in one acre, the average cost is $95,832 per acre treated, with a range of $54,450 to $156,816 per acre treated.

*Table 2. New GSI Construction Costs*

|  |  |  |  |
| --- | --- | --- | --- |
| **New GSI Practice** | **Construction cost per sq ft** | **Area treated cost sq ft** | **Conversion from cost per sq ft to cost per acre** |
| Construct a rain garden/bioretention | $17.34 | $1.73 | $75,359 |
| Construct a bioswale | $29.42 | $2.94 | $128,066 |
| Construct a vegetated swale | $12.54 | $1.25 | $54,450 |
| Construct a new wet pond or wetland | $14.60 | $1.46 | $63,598 |
| Construct an infiltration trench/bed | $36.00 | $3.6 | $156,816 |
| Average | $21.98 | $2.20 | $95,832 |

As a result of its Clean Water, Green City Initiative, the Philadelphia Water Department (PWD) has significant local experience implementing new GSI and estimates the costs for projects on private land to range between $90,000 and $100,000 per acre treated (Jason Cruz, PWD, personal communication, June 11, 2019). Because both the cost estimates included in the WQIP and the PWD estimates cover only construction costs that do not include design and engineering, permitting or land acquisition costs, full project costs will likely be higher.

As a result of meeting MS4 obligations that include targets for impervious area treated, counties in Maryland have implemented a substantial number of stormwater management projects. A draft report from 2011 entitled *Costs of Stormwater Management Practices for Maryland Counties[[1]](#footnote-1)*, provides project costs on an area treated basis, including land costs. The estimates are based on actual project costs and literature review information. The study includes estimates for projects comparable to those included in the WQIP. The average full cost for this set of practices is $49,477 per acre treated. Given inflation, the average costs today would be $56,329 per acre treated. These estimates do not appear to differentiate between private and public landownership, presumably because land costs are included where necessary.

*Table 3. Excerpt from King and Hagan report, 2011*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **New GSI Practice** | **Pre-construction costs** | **Construction costs** | **Land costs** | **Total initial costs** |
| Wetland ponds and wetlands | $5,565 | $18,550 | $2,000 | $26,115 |
| Dry Detention Ponds | $9,000 | $30,000 | $5,000 | $44,000 |
| Hydrodynamic Structures | $7,000 | $35,000 |  | $42,000 |
| Dry Extended Detention Ponds | $9,000 | $30,000 | $5,000 | $44,000 |
| Infiltration Practices w/o Sand, Veg | $16,700 | $41,750 | $5,000 | $63,450 |
| Infiltration Practices w/ Sand, Veg | $17,500 | $43,750 | $5,000 | $66,250 |
| Filtering Practices (sand, above ground) | $14,000 | $35,000 | $5,000 | $54,000 |
| Filtering Practices (sand, below ground) | $16,000 | $40,000 |  | $56,000 |
| Average |  |  |  | $49,477($56,329 adjusted for inflation) |

As mentioned above, the goal for the first phase of WQIP implementation is to implement projects that treat the first one inch of stormwater runoff from approximately 1000 acres. Estimating costs is challenging because we do not know the mix of projects that will be implemented to meet this goal, the costs vary widely, and we do not know the extent of land costs – a potentially significant additional cost. The range of costs could be as low as $4 million (if all of the goal was met by implementing stormwater basin retrofits that fall in the low end of Whitpain Township’s full cost estimate) to a high end of $173 million (if the goal is met constructing new infiltration trenches on private land using the WQIP costs and adding in 10% for other project costs). Because of this significant uncertainty, cost estimates at this point in the process should be used to help determine the order of magnitude of needed resources and to guide initial decision-making only.

The draft final WQIP includes a table of potential projects. These are conceptual in nature, though all of these projects are feasible.

*Table 4. Potential WQIP Phase 1 Projects*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Municipality | Projects | Ownership: Public | Ownership: Private | BMP BMP BMP Type: BMP Type: BMPType: Type: Impervious Stream, Type: Retrofit New Reduction riparian UnknownGSI Restoration |
| **Abington** | 5 | 4 | 1 | 5 |
| **Ambler** | 4 | 3 | 1 | 4 |
| **Cheltenham** | 3 |  | 3 | 3 |
| **Lansdale** | 4 | 2 | 2 |  | 3 | 1 | 1 | 1 |
| **Lower****Gwynedd** | 11 | 4 | 7 | 5 | 4 |  | 3 | 1 |
| **Montgomery** | 4 | 2 | 2 |  | 1 |  | 1 | 2 |
| **North Wales** | 10 | 7 | 3 |  | 8 | 1 | 1 |  |
| **Springfield** | 12 | 9 | 3 | 5 | 4 |  | 3 |  |
| **Upper****Dublin** | 11 | 7 | 4 | 7 | 5 |  | 2 |  |
| **Upper Gwynedd** | 5 | 3 | 2 | 4 | 1 |  |  |  |
| **Whitemarsh** | 3 | 2 | 1 | 1 | 1 |  | 1 |  |
| **Whitpain** | 3 |  | 3 | 3 |
| **Philadelphia** | 5 | 5 |  | 5 |
| **Total\*** | 80 | 48 | 32 | 25 | 39 | 2 | 17 | 4 |

The list includes 12 stream restoration projects that will address 9,638 linear feet of stream. The WQIP uses a cost estimate for these projects of $200 per linear foot. The current composition of other projects is close to a 50%/50% mix of new GSI and stormwater basin retrofits. If we were to assume this ratio, the costs for these projects could range between $34 and $59 million.

|  |  |  |  |
| --- | --- | --- | --- |
| **Project Type** | **Amount** | **Cost per unit** | **Total** |
| Stream Restoration | 9,638 linear feet | $200/linear ft | $1,927,600 |
| Stormwater basin retrofits | 500 acres | $8000/acre treated | $4,000,000 |
| New GSI | 500 acres | $56,329 - $95,832 (includes 10% for addtl costs) | $,28,164,500 - $52,707,500 |
| Total cost range for Phase 1 |  |  | $34,092,100 - $58,635,100 |

This level of estimated financial commitment may not be acceptable to the participating municipalities. Fortunately, there are several strategies that can be employed to reduce potential costs. One strategy is to complete as many projects as possible on publicly owned lands or on lands where the owner has assumed any land costs. Land costs are a significant consideration for projects on private land and for new GSI projects. Another strategy is to be cognizant of the cost impacts of practice selection. New GSI costs can double depending on the practice selected. Municipalities should be encouraged to prioritize using those GSI practices that are most cost-efficient for the site.

The most significant cost-reduction strategy is to heavily emphasize stormwater basin retrofits. The Wissahickon Creek Watershed Act 167 Plan resulted in a review of potential stormwater basin retrofit projects that would result, if completed, in over 14,000 acres treated. A fair portion of these projects may no longer be viable and some may have been completed. Even so, there are a substantial number of viable projects on that list that, if realized, could meet the total area treated goal for full WQIP implementation over 20 years. Project costs would be in line with the $4000 - $8000 per acre treated figure that Whitpain Township has experienced, substantially lower than new GSI costs. Focusing on stormwater basin retrofits can bring the Phase 1 project estimates within the $10 – 30 million range, as demonstrated below.

Example Project Mix 1: Stream restoration $1.9 million

100% retrofits $8 million

 Total $10 million

Example Project Mix 2: Stream restoration $1.9 million

90% retrofits $7.2 million

10% new GSI $5.6 - 10 million

 Total $14.7 - $19.1 million

Example Project Mix 3: Stream restoration $1.9 million

80% retrofits $6.4 million

20% new GSI $11 - $21 million

 Total $19.3 – 29.3 million

Project mix is an important consideration for the partnering municipalities to address individually and collectively. The WCWP also needs to address how to distribute costs.

**Sample of Existing Stormwater Collaboratives in Pennsylvania**

Several municipal collaborations have formed in Pennsylvania over the last few years with the goal of addressing water quality impacts related to stormwater runoff. In general, they have focused on reducing sediment loads as a result of implementation of sediment TMDLs in various watersheds coupled with the regulatory requirements of the MS4 (municipal separate storm sewer system) program.

Table 5 below provides some information about a set of these collaborations. The first three collaborations involve counties covered by the Chesapeake Bay Sediment TMDL. The last one is in the Delaware River watershed.

*Table 5. Comparison of Stormwater Collaborations in Pennsylvania*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **No. of munis** | **Sediment Load Reduction Target (lbs/yr)** | **No. of Projects** | **Total Funds under Agrmt** | **Cost Share formula** | **Term of Agrmt** |
| York County Stormwater Consortium | 45 | 2,443,984 (10% of TMDL reduction requirement) | 77 | $13 million(based on project cost estimates reduced by 20% assumed savings) | 20% impaired stream miles30% population50% impervious | 5 years |
| Blair County Intergovernmental Stormwater Committee | 11 | 1,409,613 (10% of TMDL reduction requirement) | 43 | $200,000 (based on agreed upon amount) | 20 % stream length in UA30% population50% impervious cover | 2 years |
| Lebanon County Stormwater Consortium | 6 | 476,801 (10% of TMDL reduction requirement) | 60 | $5 million (based on agreed upon amount; project estimates included in plan) | 20% impaired stream miles30% population50% impervious | 5 years |
| Wyomissing Creek Watershed Coalition | 8 | 372,986(10% of existing load)\* | 7 | $1,522,600 (based on estimates of project costs) | Under review | 5 years |

The Pennsylvania Department of Environmental Protection’s (PA DEP) TMDL plan requirements for areas outside the Chesapeake Bay watershed gave municipalities the choice of addressing either 10% of the existing sediment load to the stream or addressing the municipal sediment waste load allocation (WLA) as set out in the TMDL. Because the Chesapeake Bay TMDL does not include WLAs by municipality, the only choice for Chesapeake Bay municipalities was to address 10% of the existing sediment load.

**Implementation Funding Structure**

Through a resolution adopted in May 2019, all of the municipal entities engaged in the WCWP to date committed to continuing to develop a collaborative approach to WQIP implementation. However, neither the WQIP nor the WCWP will direct municipalities as to how they will generate the needed funds to pay for implementation activities. Each municipality will make that decision on its own.

Collaborating on implementation will make it more likely that the partners will have successful results regarding one important source of funding – government and private grant programs. For example, Pennsylvania’s Keystone Principles, which inform the Growing Greener grant program review, explicitly support regional, multi-municipal planning processes (<http://www.phmc.state.pa.us/bhp/pkp.pdf> at 3, 5 - 6). Collaborating across multiple municipalities also increases the amount of local match that can be generated and leveraged, providing access to a larger number of grant programs. Grant funding is important to initiate new programs and pilot different stormwater management practices. However, grant funding is not a reliable, sustained, or sufficient source of funding for implementation of a 20-year plan.

The WCWP municipal partners will need to agree on how to distribute the implementation burden among the partners of implementing the stormwater management practices to meet the WQIP goals. EFC constructed some funding scenarios around a five-year budget of $15 million as a starting point for consideration of different funding arrangements. As outlined above, this is a feasible budget to meet the Phase 1 target of 1000 acres treated. This discussion does not address the other WQIP activities that need to be implemented, mostly because cost estimates for those activities are outstanding and they will not represent a substantial portion of the overall costs. However, the WCWP partners will need to address whether the costs related to those activities would be included in the funding structure for project implementation or whether a different funding structure would be used for those activities.

There are two general approaches to funding group activities – equal shares or weighted shares. To date, all WCWP activities have been paid for on an equal-share basis, meaning that each participating municipal entity, including the waste water treatment plants, has paid an equal amount. If that arrangement were to be applied to the implementation of projects with an estimated budget of $15 million, each of the 13 entities currently participating (including Philadelphia) would pay approximately $1.2 million over 5 years, $240,000 annually.

When considering a weighted funding structure, again there are two approaches – a single parameter or a combination of parameters used to determine each partners share of the overall costs. In discussions with municipal representatives in the Wissahickon Creek watershed, the following potential parameters have been proposed for consideration:

* Population in the watershed
* Land area in the watershed
* Impervious cover in the watershed
* Impaired streams in the watershed
* Wastewater treatment flow that is discharged to the Wissahickon Creek

EFC has collected data on each of the other parameters and calculated each municipalities’ share of a $15 million first phase budget. This information is included in the accompanying spreadsheets. It is important to note that all of the data collected about each parameter is preliminary; confirmation of all data would be required before using them to develop any final funding structure. The WCWP partners could chose to use any one or combination of these parameters to determine a weighted share of the total project costs. Another potential parameter that would be related to affordability would be median household income by municipality. This information is included in Table 1 above.

Other multi-municipal collaborations addressing water quality issues have decided to distribute the costs using formulas related to the causes of water quality problems. One set of calculations included in the accompanying spreadsheets plays out a potential weighted funding formula using multiple factors as an example. The sample formula is similar to the York County’s formula. It distributes the municipalities’ total cost share so that 20% is related to impaired streams in the watershed, 30% is related to WWTP flow that discharges into the Wissahickon Creek and 50% is related to its impervious cover in the watershed.

Sample funding formula:

30% WWTP flow + 20% impaired stream length + 50% impervious cover

 = 100% municipal share

Another approach to distributing the implementation burden would allocate the area treated goal among municipalities as opposed to a budget amount. An equal share approach would result in each of the municipalities, including Philadelphia, being responsible for implementing projects to treat 77 acres during Phase 1. One of the attached spreadsheets includes information about each municipality’s share of Phase 1 target of 1000 acres treated using several individual parameters.

**Financing WQIP Implementation**

There is a difference between funding and financing implementation of the activities outlined in the WQIP. The term “funding” generally refers to identifying the sources of capital to pay for needed goods or services, while “financing” refers to the mechanisms used to generate the needed capital if it is not readily available. In a municipal setting, common financing tools include municipal bonds and loans that provide access to a larger amount of capital than a municipality may have available on hand in exchange for regular repayment of that borrowed capital with interest.

The WCWP partners, in whole or in part, could decide that they would like to collaborate on financing the implementation costs of stormwater management practices. The advantages to collaborative financing allows for aggregation of projects, providing access to a larger group of potential financing vehicles. Aggregation also generally reduces price as it makes the package of projects more attractive to a larger set of potential implementers and creating a more competitive bidding environment. In addition, collaborative financing drives down costs for the municipalities that would seek financing individually because, instead of each municipality having to pay for the costs of issuing a municipal bond, for example, that cost can be shared across the partner municipalities.

Municipalities seeking to implement stormwater management practices on a regional basis will have access to a new financing program through Pennsylvania’s Infrastructure Investment Authority (PENNVEST). As set out in the PA DEP’s most recent proposal to meet the Chesapeake Bay TMDL by 2025, PENNVEST is initiating regional revolving loan fund program that will provide low-interest loans to finance the implementation of best management practices to meet water quality standards based on regional plans ([https://www.dep.pa.gov/Business/Water/Pennsylvania%E2%80%99s%20Chesapeake%20Bay%20Program%20Office/WIP3/Pages/Draft-Plan.aspx at 57](https://www.dep.pa.gov/Business/Water/Pennsylvania%E2%80%99s%20Chesapeake%20Bay%20Program%20Office/WIP3/Pages/Draft-Plan.aspx%20at%2057)). While envisioned to assist municipalities in the Chesapeake Bay watershed, the program will be available to all parts of the state. Based on initial discussions with PENNVEST staff, the amount of financing would be based on a 1-3 year capital project plan submitted by the partnering entities. The WQIP 5-year phases fit well within this approach, with time for prioritization, planning, and project implementation during each phase.

**Conclusion**

The draft final WQIP sets out targets for implementing a variety of stormwater management practices that will improve hydrology and water quality in the Wissahickon Creek watershed. The municipalities in the watershed have committed to seeking a collaborative structure for implementation the WQIP. Part of that collaborative structure needs to address the role that each partner will play in providing financial support for the activities needed to be implemented. As set out in this memo, the following questions at a minimum need to be addressed by the WCWP:

* What WQIP activities will be jointly funded?
* Will there be different funding structures for different activities?
* How will each municipal entities’ share be determined?

This memo is designed to provide the project team and the management committee with initial information that could be used to facilitate the WCWP’s consideration of these questions. Again, all municipal data needs to be confirmed and all estimates should only be viewed as general guidelines.

1. D. King and P. Hagan. (2011). *Cost of Stormwater Management Practices in Maryland Counties*, University of Maryland Center for Environmental Sciences, Technical Report Series No. TS-626-11, found at <https://mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/King_Hagan_Stormwater%20Cost%20Report%20to%20MDE_Final%20Draft_12Oct2011.pdf>. [↑](#footnote-ref-1)