POLLUTION REDUCTION PLAN

City of Bethlehem
Northampton County, Pennsylvania

In Compliance with the Pennsylvania Department of Environmental Protection's
National Pollutant Discharge Elimination System Phase II MS4 Program
Permit No. PAI 132210

Prepared For:
City of Bethlehem
10 East Church Street
Bethlehem, PA 18018

Prepared By:
T&M Associates

June 2020
Revised: February 2021
Revised by the City of Bethlehem: February 2022
Project No. BLHM 00043

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Foreword

This Pollutant Reduction Plan (PRP) serves to fulfill the requirements of Appendix E of NPDES PAI-132210 for the City of Bethlehem.

This plan has been completed using publicly available data and data supplied by the City of Bethlehem.

While this plan aims to provide guidance towards the construction and implementation of stormwater quality Best Management Practices (BMPs) to provide pollutant loading reductions, it should be noted that this is a fluid document that will be evaluated and updated yearly as specific proposed locations and types of BMPs are analyzed and designed, as new opportunities for partnerships are realized, and as revised regulations and BMPs are developed and implemented.

Some examples of common BMPs are dry extended detention basins, raingardens, infiltration trenches and stream bank restoration.

Section A – Public Participation

PA DEP Requirement: *"The applicant shall make a complete copy of the PRP available for public review*"

A complete copy of the PRP was available for review by the public at the following locations:

- On the City of Bethlehem website at - https://bethlehem-pa.gov/Public-Works/Pollutant-Reduction-Plan
- At the City of Bethlehem offices at 10 E. Church Street, Bethlehem, PA 18018

PA DEP Requirement: "*The applicant shall publish, in a newspaper of general circulation in the area, a public notice containing a statement describing the plan, where it may be reviewed by the public, and the length of time the permittee will provide for the receipt of comments. The public notice must be published at least 45 days prior to the deadline for submission of the PRP to DEP.* ***Attach a copy of the public notice to the PRP"****.*

The required public notice was printed in the Express Times July 10, 2020. A copy of the public notice and proof of publishing is attached in the Appendix.

PA DEP Requirement: *"The applicant shall accept written comments for a minimum of 30 days from the date of public notice.* ***Attach a copy of all written comments received from the public to the PRP****."*

Written comments will be received from July 10, 2020 to August 10, 2020. No comments written were received.

PA DEP Requirement: *"The applicant shall accept comments from any interested member of the public at a public meeting or hearing, which may include a regularly scheduled meeting of the governing body of the municipality or municipal authority that is the permittee."*

Verbal comments will be accepted from the public at a regularly scheduled City Council meeting on August 4, 2020 at 5:30 pm. A copy of the verbal comments and the public meeting minutes will be attached in the Appendix. No verbal comments were received.

PA DEP Requirement: "*The applicant shall consider and make a record of the consideration of each timely comment received from the public during the public comment period concerning the plan, identifying any changes made to the plan in response to the comment.* ***Attach a copy of the permittee's record of consideration of all timely comment received in the public comment period to the PRP****."*

No written or verbal comments were received.

Section B – Map

PA DEP Requirement: "*Attach a map that identifies **land uses and/or impervious/pervious surfaces** and the **storm sewershed boundary** associated with each MS4 outfall that discharges to impaired surface waters, or surface waters draining to the Chesapeake Bay (see note below), and calculate the storm sewershed area that is subject to Appendix D and/or Appendix E. In addition, the map must identify the proposed location(s) of structural BMP(s) that will be implemented to achieve the required pollutant load reductions." "The MS4 may display the storm sewershed for each MS4 outfall or just the PRP Planning Area, at its discretion."*

To calculate the existing loading rates within the City of Bethlehem the City's GIS map was used. This map displays all the inlets, outlets, manholes, pipes, pipe discharge locations and swales within the City of Bethlehem. From this map the City was able to examine how the stormwater runoff was entering its boundaries, collected and discharged from the municipality.

A map showing the PRP planning area and current land covers is included in the Appendix as **Figure 1**. The areas parsed out of the City of Bethlehem's Pollutant Reduction Plan are Penn Dot roads, highways, and right of ways. **Tables 1** and **Table 2** show all Penn Dot roadways within Lehigh County and Northampton County. These Penn Dot roadways are highlighted in yellow on the map outlining the planning area of the City of Bethlehem in **Figure 1**. Penn Dot roads, highway, and right of ways are areas associated with non-municipal stormwater NPDES permit coverage that exists within the urbanized area of a municipality. With the land being removed from the planning area the BMPs located or implemented within these areas cannot be used as credit toward meeting the City's pollutant reduction requirements.

A map showing the PRP planning area and the location of the existing structural BMPs is provided in the Appendix as **Figure 2**. A map showing the planning area and the locations of structural BMPs proposed to meet the minimum required reductions in pollutant loading is provided as **Figure 3** in the Appendix.

The City has also included a GIS map of all the inlets, catch basins within the City's boundaries. To access this map please see the link provided or see **Figure 4** within the appendix, https://bethlehem-pa.maps.arcgis.com/apps/webappviewer/index.html?id=011fb1aabb59498bb3b4764b96526f9a.

Table 1. Lehigh County State Roads

SR#	Description
1001	3rd Avenue – North St. to Union Boulevard
1011	8th Avenue – Route 378 to Eaton Avenue
0987	Airport Road – Route 22 to City Line
3011	Fahy Bridge
0378	Hill to Hill Bridge
1009	Schoenersville Road – Eaton Avenue to City Line
1002	West Union Boulevard – Monocacy Creek to City Line
0378	Route 378 – Entire length
Various	Entrance / Exit ramps for 378

Table 2. Northampton County State Roads

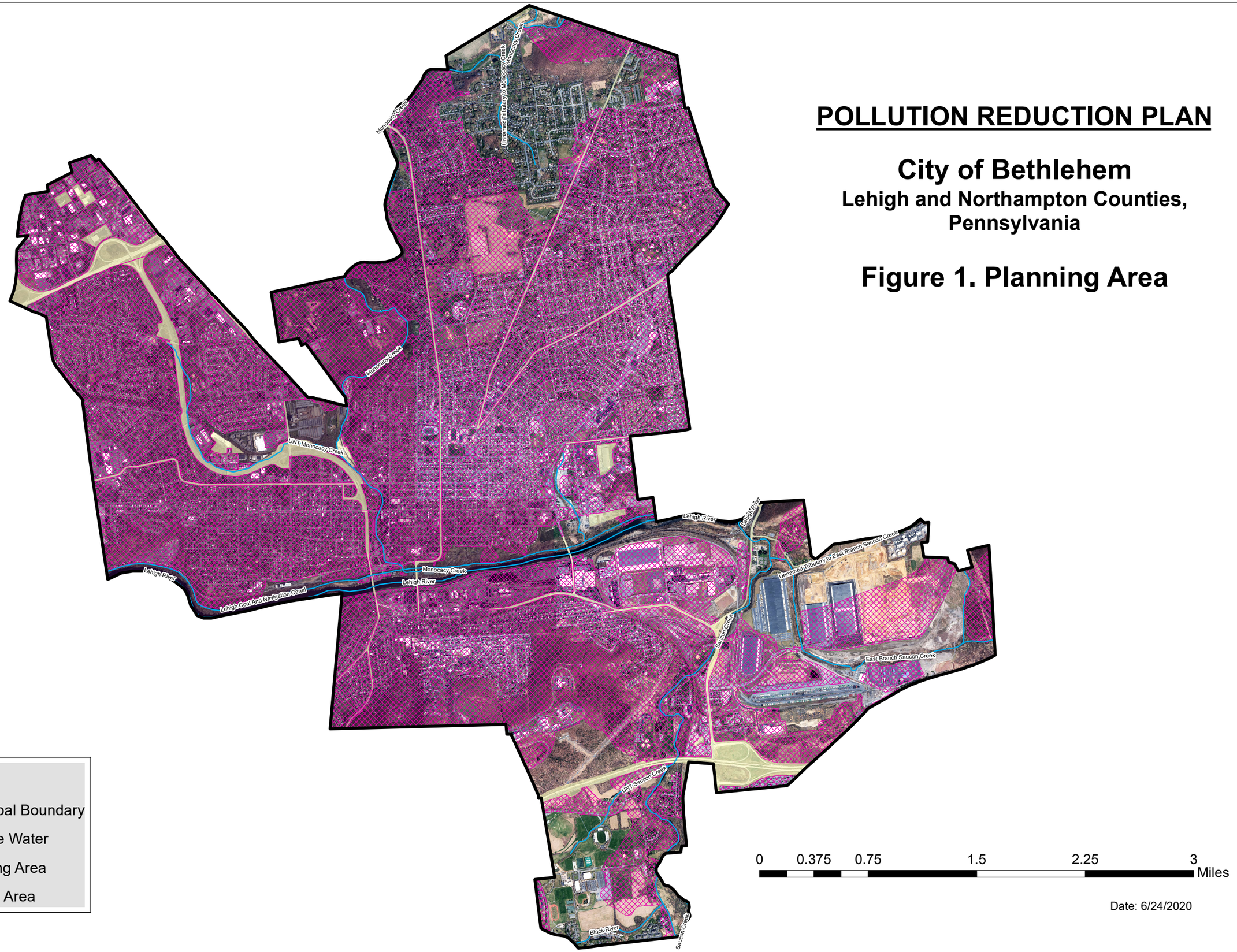
SR#	Description
3022	4th Street – William Street to Daly Avenue
0412	Daly Avenue – Minsi Trail Bridge to 4th Street Bridge
0412	4th Street – Daly Avenue to Hellertown Road
0412	Hellertown Road – Shimersville Road to City Line Road
2012	Applebutter Road – Shimersville Road to City Line Road
3012	Broadway – Wyandotte Street to City Line Road
3011	Center Street – Fahy Bridge to City Line Road
3006	Cherry Lane – Hellertown Road to South Easton Road
2020	Easton Avenue – Linden Street to City Line Road
2006	South Easton Road – Cherry Lane to Ringhoffer Road
3011	Fahy Bridge
3005	Freemansburge Bridge
3004	Friedensville Road – Creek Road to Mountain Drive
0378	Hill to Hill Bridge
3015	Linden Street – Elizabeth Avenue to City Line Road
3007	Minsi Trail Bridge
3011	South New Street – 3rd Street to 4th Street
3007	Pembroke Road – Stefko Boulevard to City Line Road
2014	Shimersville Road – 4th Street to City Line Road
0378	Wyandotte Street – Entire length

POLLUTION REDUCTION PLAN

City of Bethlehem

Lehigh and Northampton Counties, Pennsylvania

Figure 1. Planning Area



POLLUTION REDUCTION PLAN

City of Bethlehem

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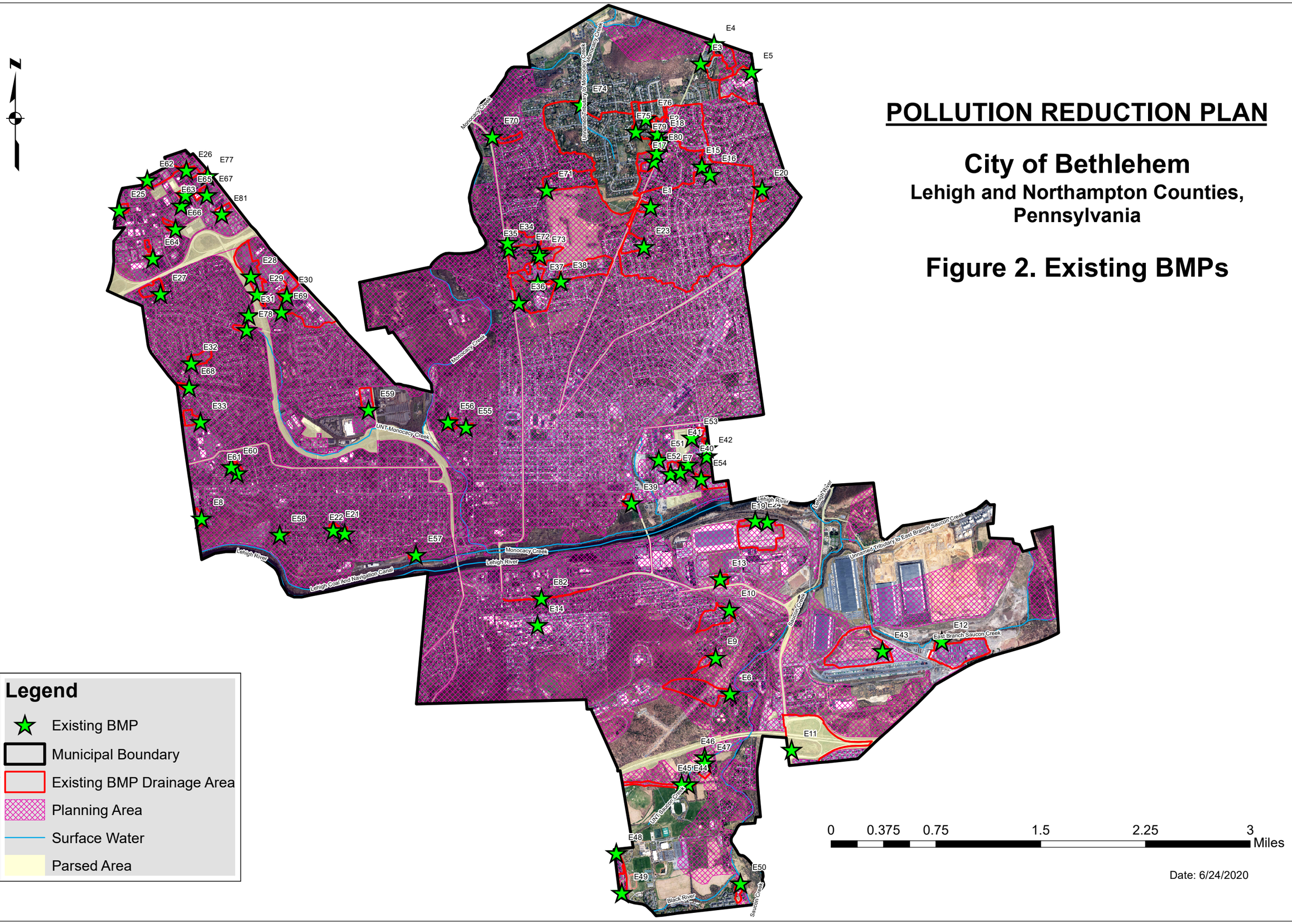
Figure 2. Existing BMPs



POLLUTION REDUCTION PLAN

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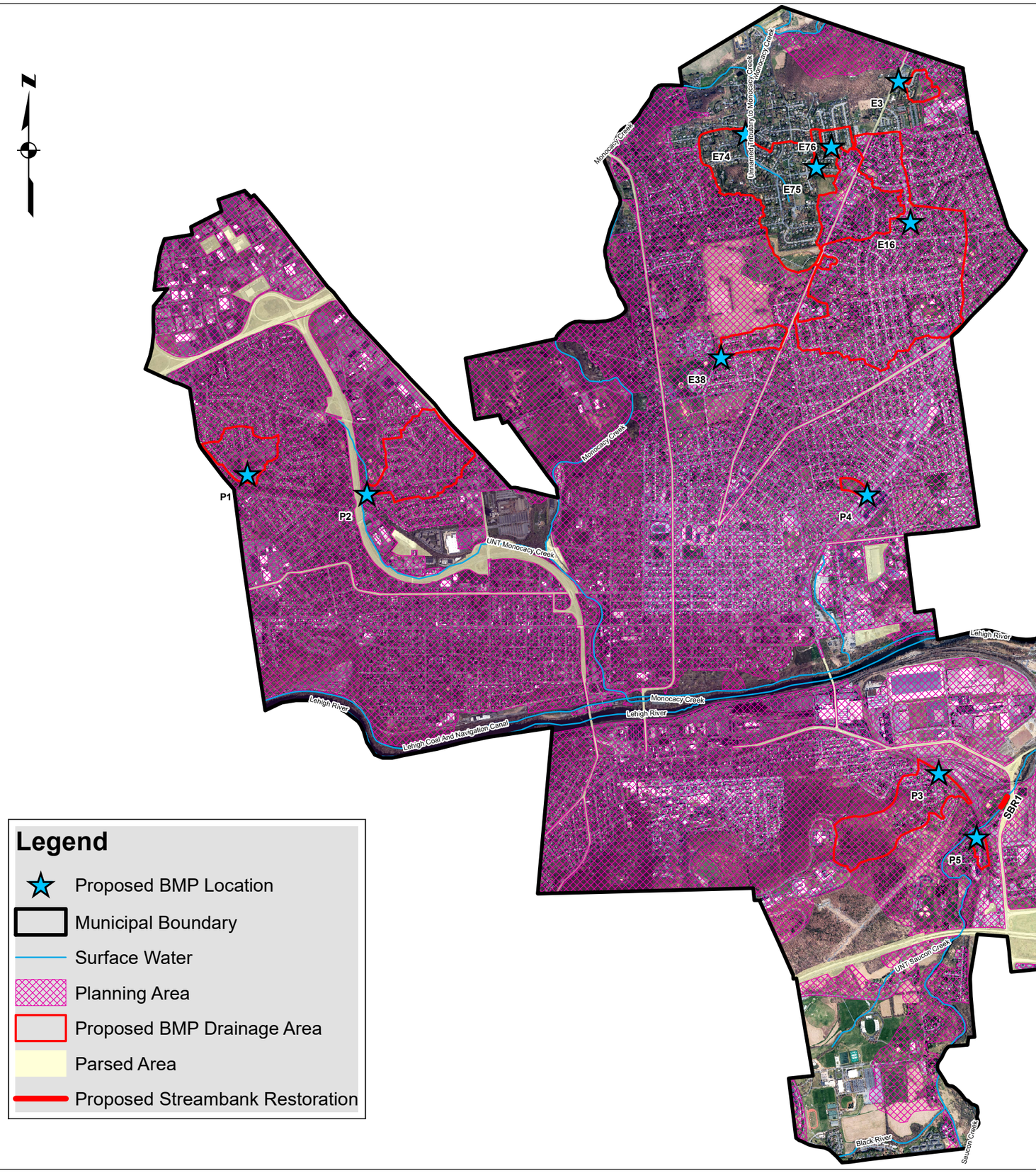
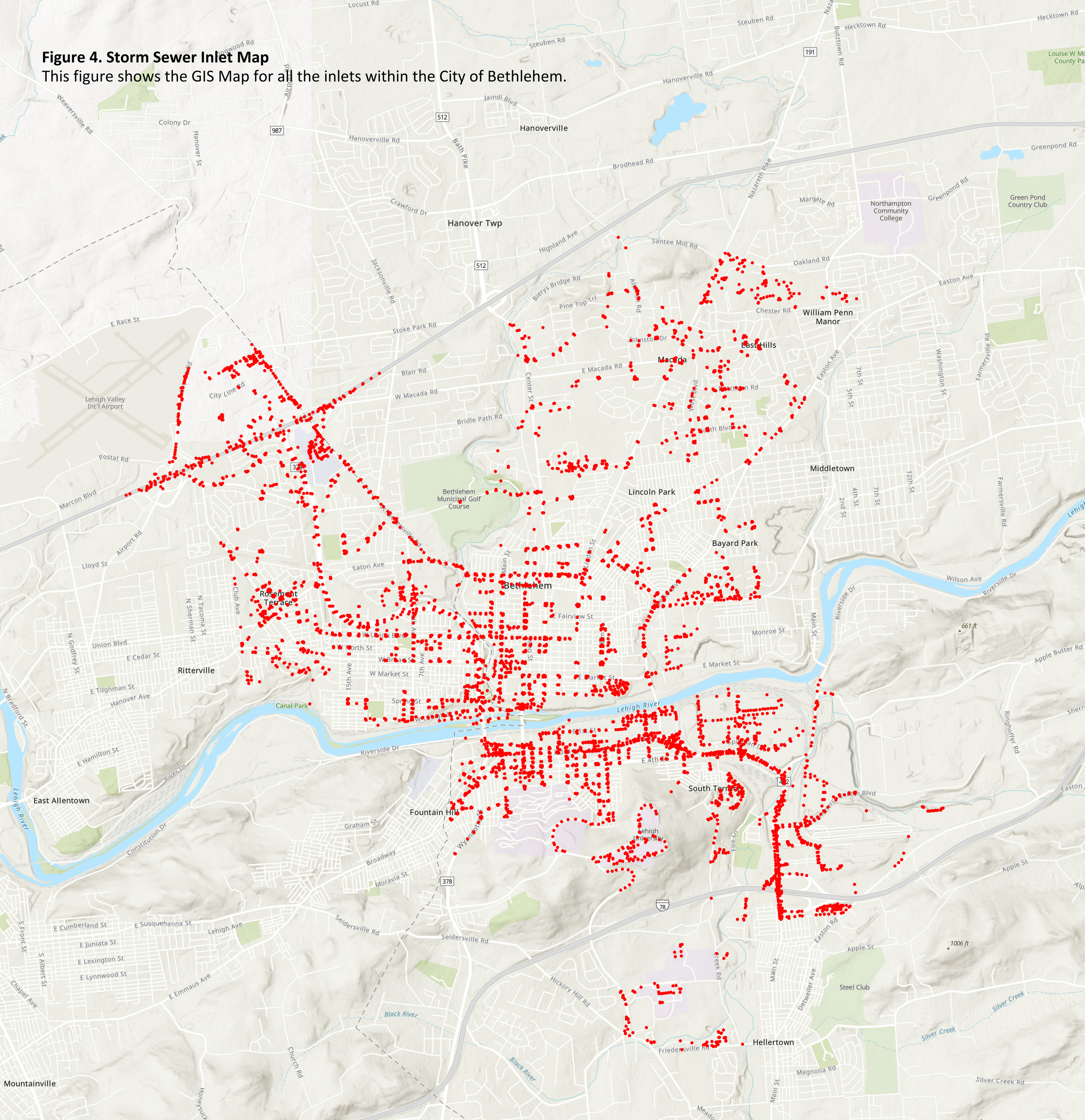
Figure 3. Proposed BMPs



Date: 6/24/2020

Figure 4. Storm Sewer Inlet Map
This figure shows the GIS Map for all the inlets within the City of Bethlehem.



Section C – Pollutants of Concern

PA DEP Requirement: "*Identify the pollutants of concern for each storm sewershed or the overall PRP Planning Area (see Section I.B of these instructions).*"

Within form 3800-PM-BCW0100k PRP Instructions it states, "For PRPs developed for impaired waters (Appendix E), the pollutant(s) are based on the impairment listing, as provided in the MS4 Requirements Table. If the impairment is based on siltation only, a minimum 10% sediment reduction is required. If the impairment is based on nutrients only or other surrogates for nutrients (e.g., "Excessive Algal Growth" and "Organic Enrichment/Low D.O."), a minimum 5% TP reduction is required. If the impairment is due to both siltation and nutrients, both sediment (10% reduction) and TP (5% reduction) must be addressed."

Since this PRP is being developed for impaired waters, the pollutants are based on the impairment listing provide in PA DEPs MS4 Requirements Table which references "siltation" for each of the City's impaired watercourse. The pollutant of concern for siltation is Total Suspended Solids (TSS). Total Suspended Solids are "silt and clay particles, plankton, algae, fine organic debris, and other particulate matter. These are particles that will not pass through a 2-micron filter," as defined by the EPA.

The PA DEP's MS4 Requirements Table also lists Organic Enrichment/Low D.O. for the Lehigh River. However, per Section 1.B of PADEP's "PRP Instructions", permittees that select appropriate BMPs to achieve the 10% sediment loading reduction, will (incidentally) achieve the required reductions for the pollutants associated with organic enrichment.

Table 3: DEP MS4 Requirements Table

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)
Northampton County					
BETHLEHEM CITY	PAI132210	Yes	SP, IP	Saucon Creek	Appendix E-Siltation (5)
				East Branch Saucon Creek	Appendix E-Siltation (5)
				Unnamed Tributaries to Lehigh Coal And Navigation Canal	Appendix E-Siltation (5)
				Unnamed Tributaries to East Branch Saucon Creek	
				Nancy Run	Appendix E-Siltation (5)
				Monocacy Creek	Appendix E-Siltation (5)
				Lehigh River	Appendix C-PCB (5), Appendix E-Organic Enrichment/Low D.O., Siltation, Suspended Solids (5)

Section D – Determine Existing Loading for Pollutants of Concern

PA DEP Requirement: *"Identify the date associated with the existing loading estimate (see Section I.C of these instructions)"*

The date of the development of this PRP is January 31, 2020.

PA DEP Requirement: "*Calculate the existing loading, in lbs. per year, for the pollutant(s) of concern in the PRP Planning Area."*

The planning area assessed in this PRP consists of the urbanized area in the City of Bethlehem which drains to the impaired watercourses (Saucon Creek, East Branch Saucon Creek, Nancy Run, Monocacy Creek and Lehigh River) excluding PennDOT right-of-ways. The loading rates for pervious and impervious cover for the City of Bethlehem are provided in the PADEPs "PRP Instructions" in Attachment B, "Developed Land Loading Rates for PA Counties" under the "Other Counties" Section.

Table 4. "Other Counties" Pollutant Loading Rates

Pollutant and Source	Loading rate (lbs/ac/yr)
TP Impervious Developed	2.28
TP Pervious Developed	0.84
TSS Impervious Developed	1,839.00
TSS Pervious Developed	264.96

The impervious and pervious developed areas covered by the planning area were derived using the "High-Resolution Land Cover, Commonwealth of Pennsylvania, Chesapeake Bay Watershed and Delaware River Basin, 2013" as publicly available from PASDA.

The land covers within the planning area were compiled into impervious and pervious surfaces as shown in **Table 5**. As defined by the National Land Cover Database 2019 (NLCD 2019) Legend the different land covers used are described as:

"Developed, Open Space- areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.

Developed, Low Intensity- areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.

Developed, Medium Intensity -areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.

Developed High Intensity-highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.

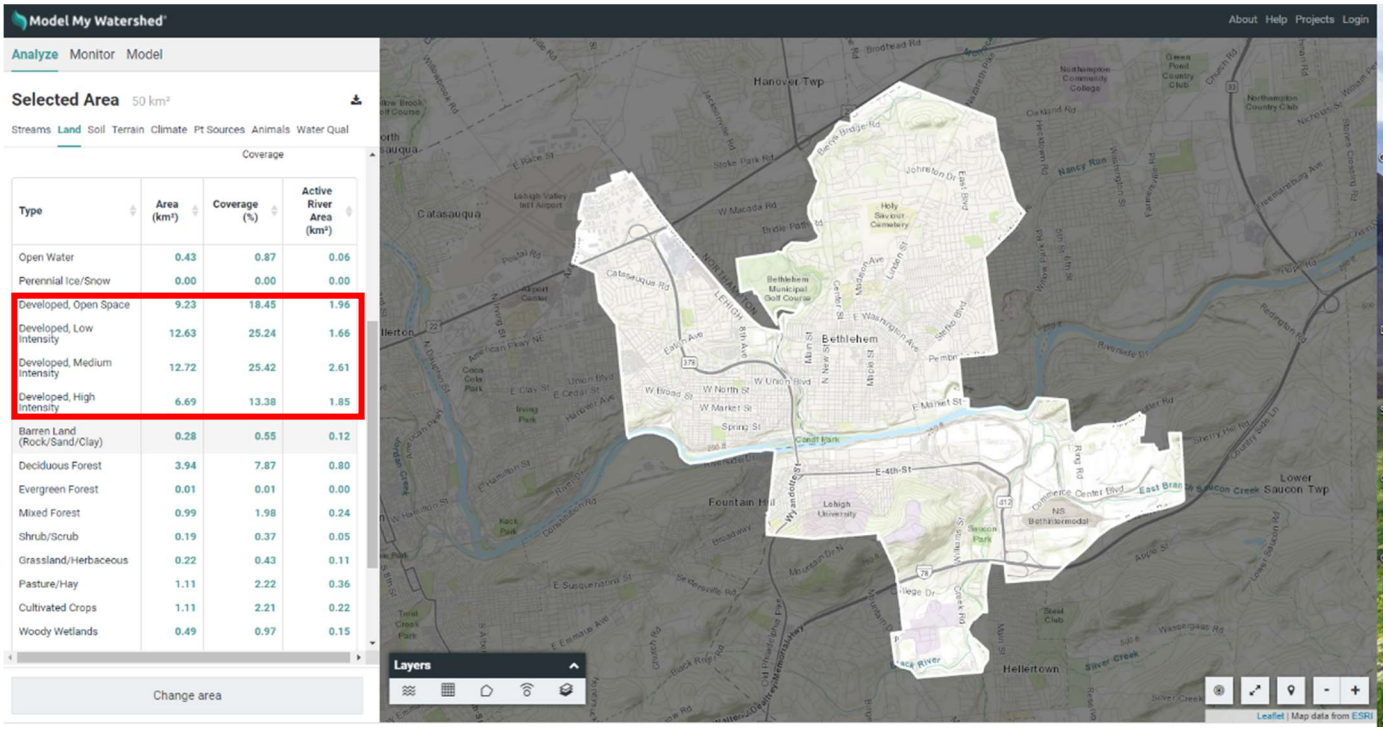
Pasture/Hay-areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.

Cultivated Crops -areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled."

The appropriate impervious percentages are as follows: Developed, Open Space is 19% impervious, developed, low intensity is 49% impervious, develop, medium intensity is 79% impervious and developed, high intensity is 100% impervious as stated by the classification system used by NLCD2019 is modified from the Anderson Land Cover Classification System.

Table 5 shows the breakdown of the different land covers within the PRP planning area, and the sum of the impervious and pervious areas. Figure 5 shows the 2019 National Land Cover Database (NLCD 2019) model where these numbers were derived.

Figure 5: City of Bethlehem NLCD 2019



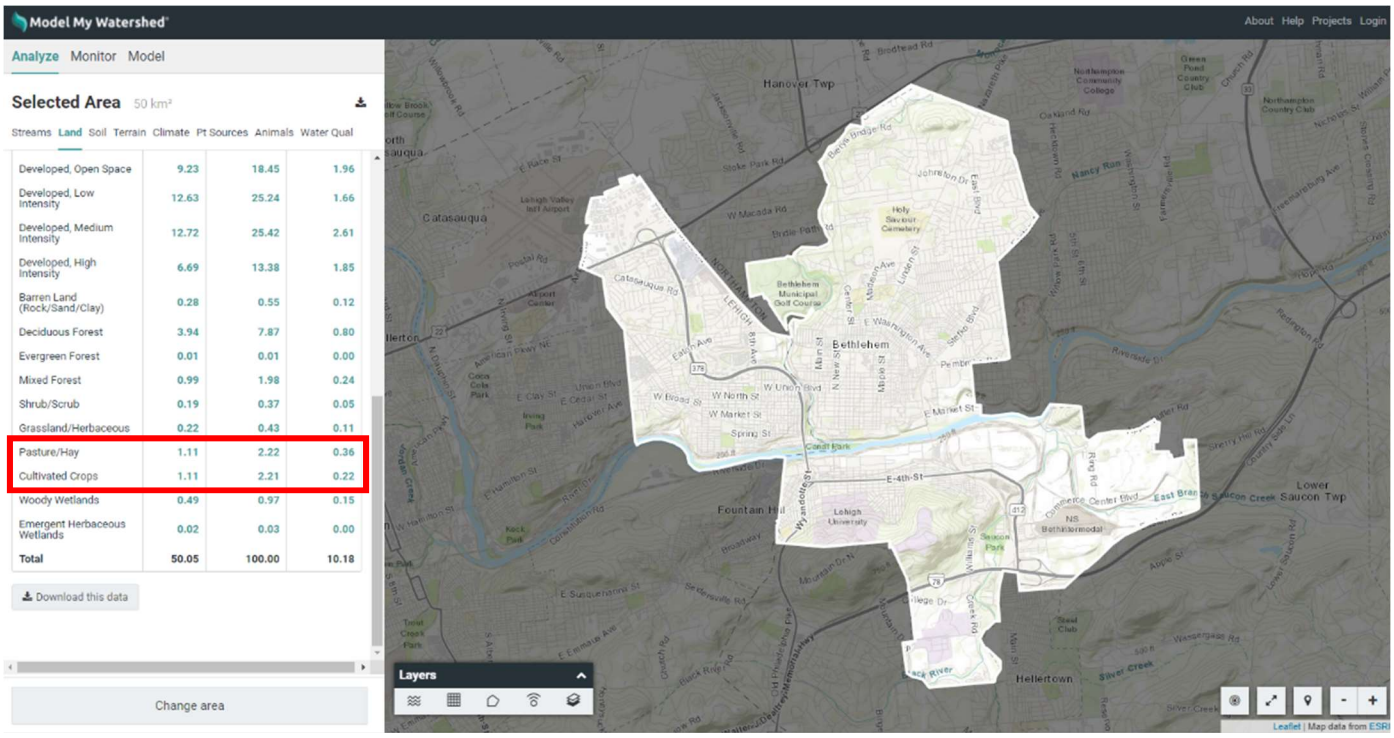


Table 5. Land Cover within the Planning Area Conversion from NLCD 2019 Land Use Designation and Pervious Acres

Land Use	Area (km^2)	Area (Acres)	% Impervious	Impervious Area (Acres)	% Pervious	Pervious Area (Acres)
Developed, Open Space	9.23	2,280.78	19.00	433.35	81.00	1,847.43
Developed, Low Intensity	12.63	3,120.94	49.00	1,529.26	51.00	1,591.68
Developed, Medium Intensity	12.72	3,143.18	79.00	2,483.11	21.00	660.07
Developed High Intensity	6.69	1,653.13	100.00	1,653.13	0.00	-
Pasture/ Hay	1.11	274.29	-	-		274.29
Cultivated Crops	1.11	274.29	-	-		274.29
Total		**10,746.60**		**6,098.85**		**4,647.75**

The existing loading of TSS for the planning area was calculated in **Table 6**.

Table 6. Existing Pollutant Loading of TSS

Pollutant and Source	Loading rate (lb/ac/yr)	Area (Ac)	Annual Load (lbs)
TSS Impervious developed	1,839.00	6,098.85	11,215,785.15
TSS Pervious Developed	264.96	4,647.75	1,231,467.84
		Total TSS Load	**12,447,252.99**

In accordance with PADEP's "PRP Instructions", the City may claim 'credit' for existing structural BMPs to reduce the existing sediment load estimate. Please find attached in the Appendix, Figure 2, which shows the location of existing structural BMPs within the PRP planning area. The drainage area treated by each existing BMP was delineated and the amount of pervious and impervious land cover in each drainage area was determined in the same manner as the planning area. **Table 7** (attached in the Appendix) provides the required information for existing structural stormwater BMPs within the planning area and the pollutant reduction they provide. The total annual credit generated by the existing BMP's equals 245,532 lbs/yr.

Taking the annual credit for existing basins into account, the existing TSS load from the planning area is calculated as:

12,447,253 lbs/yr– 245,532 lbs/yr = **12,201,721 lbs/yr**

As part of the City's ongoing MS4 program, inspections of the existing stormwater BMPs will be completed by the City to verify that each BMP listed in **Table 7** continues to serve the function(s) it was designed for. If it is determined during these inspections that any of the existing BMPs are not functioning properly, maintenance will be performed to correct the problem(s) or this BMP will be removed from the credit calculations and the proposed BMPs and reduction calculations will be revised accordingly.

The City's ongoing MS4 program will also include research to determine which existing BMP's were authorized through a permit and the date each BMP was installed. **Table 7** will then be updated to include these permit numbers and installation dates.

Operation and Maintenance (O&M) for the different types of <u>existing</u> BMPs is as follows:

<u>Dry Basins and Dry Extended Detention Basins</u>

Maintenance is necessary to ensure proper functionality of the extended detention basin and should take place on a quarterly basis. A basin maintenance plan should be developed which includes the following measures:

- All basin structures expected to receive and/or trap debris and sediment should be inspected for clogging and excessive debris and sediment accumulation at least four times per year, as well as after every storm greater than 1 inch.
- Structures include basin bottoms, trash racks, outlets structures, riprap or gabion structures, and inlets.
- Sediment removal should be conducted when the basin is completely dry. Sediment should be disposed of properly and once sediment is removed, disturbed areas need to be immediately stabilized and revegetated.
- Mowing and/or trimming of vegetation should be performed as necessary to sustain the system, but all detritus should be removed from the basin.
- Vegetated areas should be inspected annually for erosion.
- Vegetated areas should be inspected annually for unwanted growth of exotic/invasive species.

- Vegetative cover should be maintained at a minimum of 95 percent. If vegetative cover has been reduced by 10%, vegetation should be reestablished.

Raingarden

Properly designed and installed rain gardens require regular maintenance. A maintenance plan should be developed to include the following measures:

- While vegetation is being established, pruning and weeding may be required.
- Detritus should be removed every year. Perennial plantings may be cut down at the end of the growing season.
- Mulch should be re-spread when erosion is evident and be replenished as needed. Mulch should be replaced in the whole area once every 2 to 3 years.
- Rain gardens should be inspected at least two times per year for sediment buildup, erosion, vegetative conditions, etc.
- During periods of extended drought, rain gardens may require watering.
- Trees and shrubs should be inspected two times per year to evaluate health.

Wet Ponds

Wet Ponds should have a maintenance plan and privately-owned facilities should have an easement, deed restriction, or other legal measure to prevent neglect or removal. Once established, properly designed and installed Wet Ponds should require little maintenance, which includes the following procedures:

- During the first growing season or until established, vegetation should be inspected every 2 to 3 weeks.
- WPs should be inspected at least 4 times per year and after major storms (greater than 2 inches in 24 hours) or rapid ice breakup. Inspections should access the vegetation, erosion, flow channelization, bank stability, inlet/outlet conditions, embankment, and sediment/debris accumulation.
- The pond drain should also be inspected and tested 4 times per year. Problems should be corrected as soon as possible.
- Wet Pond and buffer vegetation may need support (watering, weeding, mulching, replanting, etc.) during the first 3 years. Undesirable species should be carefully removed and desirable replacements planted if necessary.
- Vegetation should maintain at least an 85 percent cover of the emergent vegetation zone and buffer area. Annual harvesting of vegetation may increase the nutrient removal of WPs; if performed it should generally be done in the summer so that there is adequate regrowth before winter. Care should be taken to minimize disturbance, especially of bottom sediments, during harvesting. The potential disturbance from harvesting may outweigh its benefits unless the WP receives a particularly high nutrient load or discharges to a nutrient sensitive waterbody.
- Sediment should be removed from the forebay before it occupies 50 percent of the forebay, typically every 5 to 10 years.

Infiltration Basin

Infiltration basins require regular maintenance to ensure proper functionality. A basin maintenance plan should include the following:

- Catch Basins and Inlets (upgradient of infiltration basin) should be inspected and cleaned on an annual basis.
- The vegetation along the surface of the Infiltration basin should be maintained in good condition, and any bare spots immediately revegetated.
- Vehicles should not be parked or driven on an Infiltration Basin, and care should be taken to avoid excessive compaction by mowers.
- Inspect the completed basin and make sure that runoff drains down within 72 hours.

- Also inspect for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability in the berms.
- Mosquito's should not be a problem if the water drains in 72 hours. Mosquitoes require a considerably long breeding period with relatively static water levels.
- Mow only as appropriate for vegetative cover species.
- Remove sediment from basin accumulations. Restore original cross section and infiltration rate. Properly dispose of sediment.

Section E – Select BMPs to Achieve the Minimum Required Reductions in Pollutant Loading

PA DEP Requirement: *"Identify the minimum required reductions in pollutant loading" "If the impairment is due to both siltation and nutrients, both sediment (10% reduction) and nutrients (5% reduction) must be addressed. PRPs may use a presumptive approach in which it assumes that a 10% sediment reduction will also accomplish a 5% TP reduction."*

As stated above, PA DEPs MS4 Requirements Table references "siltation" and "organic enrichment/ low D.O." for the City's impaired watercourses. Therefore, the City's minimum required sediment reduction is 10%.

The City's minimum required reduction is:

12,201,721 lbs/yr x 0.10 = **1,220,172.1 lbs/yr**

Tables 8 lists the BMPs proposed to meet the required reduction. Their locations are shown on Figure 3 attached in the Appendix. The proposed BMPs are as follows:

1. Storm Sewer System Solids Removal
    a. This will consist of vacuum cleaning existing inlets along City Roads and within City owned parking lots located within the PRP Planning Area. The City will document the actual weight of sediment vacuumed during the first year of the permit and the PRP plan will then be updated accordingly.
2. Street Sweeping
    a. This consists of using sweeping equipment on a programmed basis to remove larger debris material and smaller particulate pollutants from the surface of City streets. The removal of these pollutants prevents the material from clogging the stormwater management system and washing into receiving waters. The City will document the actual weight of sediment removed via street sweeping during the first permit year in order to update the PRP accordingly.
3. Retrofitting existing Dry Detention Basins into Dry Extended Detention Basins
    a. This consists of converting existing dry detention basins into dry extended detention basins. This will increase the BMP effectiveness from 10% to 60%. If it is determined during the design process that retrofitting a particular basin is not feasible, the PRP will be updated accordingly to achieve the minimum required TSS reduction.
4. Infiltration Basin
    a. This consists of implementing a shallow, impounded area designed to temporarily store and infiltrate stormwater runoff in existing open space. It will act to reduce stormwater runoff volume and to reduce pollution to the City's storm sewer.
5. Raingarden
    a. This consists of planting a shallow excavated surface with native vegetation that is tolerant of hydrologic variability, salts and environmental stress. The garden will allow runoff to pool on the surface and create pollution reduction by filtering sediment at the mulch layer. Incorporating rain gardens will help enhance the aesthetics of the City while providing effective pollution reduction.
6. Streambank Restoration
    a. This consists of projects to restore one section (360 feet in length) of Saucon Creek to reverse the effects of erosion.
7. Constructed Wetland
    a. This consists of creating shallow marsh systems and planting with emergent vegetation to treat stormwater runoff. It will act to reduce stormwater runoff volume and to reduce pollution to the City's storm sewer.

Section F – Identify Funding Mechanisms

PA DEP Requirement: "*Applicants must identify all project sponsors and partners and probable funding sources for each BMP.*"

The proposed BMPs will be funded through grant and financing programs available at the time of each project. The following is a list of current funding sources for the types of BMPs currently proposed.

Pennsylvania Infrastructure Investment Authority (PENNVEST) and Pennsylvania Department of Environmental Protection | Green Initiatives

PENNVEST actively funds green initiatives that promote and encourage environmental responsibility and enhance water quality. Solutions include riparian buffers, rain gardens, and floodplain and wetland restorations.

URL: http://www.pennvest.pa.gov/Information/Funding-Programs/Pages/default.aspx
Contact: Brion Johnson | bjohnson@pa.gov | 717-783-6798
Steven Anspach | sanspach@pa.gov | 717-783-6589

Department of Community & Economic Development | Commonwealth Financing Authority (CFA)

The DCED-CFA was established as an independent agency of the Commonwealth to administer Pennsylvania's economic stimulus packages. DCED-CFA holds fiduciary responsibility over a variety of funding sources some of which provide funding for stormwater and stormwater-related projects, including:

- Watershed Restoration and Protection Program (riparian buffers, stream restorations, water quality basins, floodplain restoration)
- Greenways, Trails and Recreation Program (installation of green infrastructure at parks)
- Local Share Account programs

URL: http://dced.pa.gov/programs-funding/
Contact: http://dced.pa.gov/download/regional-contact-information/?wpdmdl=61870

Department of Conservation and Natural Resources | Community Conservation Partnerships Program (C2P2)

DCNR grants can be used for green/sustainable park, riparian buffers, and implementing recommendations of Rivers Conservation Plans.

URL: http://www.dcnr.state.pa.us/brc/grants/
Contact: http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/d_001184.pdf

Department of Environmental Protection | Growing Greener Watershed Protection Grants

Funding for protection and restoration of Pennsylvania's water resources, including stream restorations and installation of stormwater BMPs in urban areas.

URL: http://www.dep.pa.gov/Citizens/GrantsLoansRebates/Growing-Greener/Pages/default.aspx
Contact: GrowingGreener@pa.gov | 717-705-5400

Department of Transportation | Transportation Alternatives – Set Aside Grants

Funds stormwater projects that decrease the negative impact of stormwater runoff from roads, including detention and sediment basins and stream channel stabilization.

URL: https://spportal.dot.pa.gov/Planning/AppReg/TAP/Pages/default.aspx
Contact: Chris Metka | cmetka@pa.gov | 717-787-8065

The City is also in the process of developing a stormwater fee to address funding needs.

Section G – Identify Responsible Parties for Operation and Maintenance (O&M) of BMPs

PA DEP Requirement: "*Applicants must identify the following for each selected BMP:*

- *The party(ies) responsible for ongoing O&M;*
- *The activities involved with O&M for each BMP; and*
- *The frequency at which O&M activities will occur."*

The following parties will be responsible for O&M of the new BMP's once they are implemented:

1. The City of Bethlehem's Public Works Department will be responsible for the O&M associated with the storm sewer system solids removal.
2. The City's Public Works will also be responsible for performing any O&M associated with the street sweeping program.
3. O&M for the basin retrofits will be determined on a case-by-case basis depending on the existing or proposed O & M agreements attached to the existing basins. It should be noted that even if the property owner or Homeowner's Association (HOA) is responsible for O&M of the basin, the City will ultimately have the responsibility should the property owner/HOA neglect to maintain the BMP so that it functions as designed.
4. O&M for infiltration basins will be determined on a case to case basis depending on the property owner. However, even if the property owner or Homeowner's Association (HOA) is responsible for O&M of the basin, the City will ultimately have the responsibility should the property owner/HOA neglect to maintain the BMP so that it functions as designed.
5. The O&M responsibilities for new rain gardens will be determined on a case by case basis depending on the property owner. In the case that a property owner should neglect to maintain the BMP, the City will ultimately the responsibility to upkeep the O&M.
6. the City will ultimately have the responsibility to upkeep the O&M for streambank restoration.

O&M activities for the <u>proposed/new</u> BMPs are as follows:

<u>Dry Extended Detention Basins</u>

Maintenance is necessary to ensure proper functionality of the extended detention basin. A basin maintenance plan should be developed which includes the following measures:

- All basin structures expected to receive and/or trap debris and sediment should be inspected for clogging and excessive debris and sediment accumulation at least four times per year, as well as after every storm greater than 1 inch.
- Structures include basin bottoms, trash racks, outlets structures, riprap or gabion structures, and inlets.
- Sediment removal should be conducted when the basin is completely dry. Sediment should be disposed of properly and once sediment is removed, disturbed areas need to be immediately stabilized and revegetated.
- Mowing and/or trimming of vegetation should be performed as necessary to sustain the system, but all detritus should be removed from the basin.
- Vegetated areas should be inspected annually for erosion.
- Vegetated areas should be inspected annually for unwanted growth of exotic/invasive species.
- Vegetative cover should be maintained at a minimum of 95 percent. If vegetative cover has been reduced by 10%, vegetation should be reestablished.

Infiltration Basin

Regular inspection and maintenance are necessary for the infiltration basin to function properly. A maintenance plan should be developed to include the following measures:

- Catch basins and any inlets draining to the basin should be inspected and cleaned at least twice per year and after runoff events.
- The vegetation along the surface of the infiltration basin should be maintained in good condition, and any bare spots revegetated as soon as possible.
- Vehicles should not be parked or driven on an infiltration basin, and care should be taken to avoid excessive compaction by mowers.
- Inspect the basin after runoff events and make sure that runoff drains down within 72 hours.
- Inspect for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability in the berms.
- Mow only as appropriate for vegetative cover species.
- Remove and properly dispose of any sediment that accumulates in the basin. Restore original cross section and infiltration rate.

Raingarden

Properly designed and installed rain gardens require regular maintenance. A maintenance plan should be developed to include the following measures:

- While vegetation is being established, pruning and weeding may be required.
- Detritus should be removed every year. Perennial plantings may be cut down at the end of the growing season.
- Mulch should be re-spread when erosion is evident and be replenished as needed. Mulch should be replaced in the whole area once every 2 to 3 years.
- Rain gardens should be inspected at least two times per year for sediment buildup, erosion, vegetative conditions, etc.
- During periods of extended drought, rain gardens may require watering.
- Trees and shrubs should be inspected two times per year to evaluate health.

Streambank Restoration

Streambank restoration projects must have a maintenance plan that will address the condition of the channel through the monitoring of the survivability of the planting plan implemented with the restoration project. Vegetation establishment is paramount to the stability of streambanks. Vegetation established along the streambanks should maintain a minimal 85% survival rate, which should be documented through the implementation of a monitoring plan.

Monitoring of the streambank restoration should coincide with the regulatory requirements established by the state and federal regulatory agencies. These monitoring requirements are typically established as a condition of the issuance of a permit to authorize restoration activities.

Weeds and invasive plants limit buffer growth and survival of native plants; therefore, weeds and invasive plants should be controlled by either herbicides, mowing, or weed mats. These techniques may need to be implemented after the first growing season and may need to continue into the fourth year after the implementation of the streambank restoration.

Herbicides are a short-term (two to three years) maintenance technique that is generally less expensive and more flexible than mowing and will result in a quicker establishment of the buffer. Herbicide use is regulated by

the Pennsylvania Department of Agriculture. Proper care should be taken to ensure that proximity to water features is considered.

Mowing controls the height of the existing grasses yet increases nutrient uptake; therefore, competition for nutrients will persist until the canopy closure shades out lower layers. Mowing could occur twice each growing season. Mower height should be set between eight and 12 inches.

Weed mats are geo-textile fabrics that are used to suppress weed growth around newly planted vegetation by providing shade and preventing seed deposition. Weed mats are installed after planting, and should be removed once the trees have developed a canopy that will naturally shade out weeds. Once established, the floodplain restoration project should require little to no long-term maintenance.

Constructed Wetland

Constructed Wetlands must have a maintenance plan and privately-owned facilities should have an easement, deed restriction, or other legal measure to prevent neglect or removal. Once established, properly designed and installed Constructed Wetlands should require little maintenance which include:

- During the first growing season, vegetation should be inspected every 2 to 3 weeks.
- During the first 2 years, CWs should be inspected at least 4 times per year and after major storms (greater than 2 inches in 24 hours). Inspections should access the vegetation, erosion, flow channelization, bank stability, inlet/outlet conditions, and sediment/debris accumulation. Problems should be corrected as soon as possible.
- Wetland and buffer vegetation may require support – watering, weeding, mulching, replanting, etc. – during the first 3 years. Undesirable species should be removed and desirable replacements planted if necessary.
- They should be inspected at least semiannually and after major storms as well as rapid ice breakup.
- Vegetation should maintain at least an 85 percent cover of the emergent vegetation zone.
- Annual harvesting of vegetation may increase the nutrient removal of CWs; it should generally be done in the summer so that there is adequate regrowth before winter. Care should be taken to minimize disturbance, especially of bottom sediments, during harvesting. The potential disturbance from harvesting may outweigh its benefits unless the CWs receives a particularly high nutrient load or discharges to a nutrient sensitive waterbody.
- Sediment should be removed from the forebay before it occupies 50 percent of the forebay, typically every 3 to 7 years.

APPENDIX

TABLE 7 - CITY OF BETHLEHEM - EXISTING STORMWATER MANAGEMENT BMPs

DATE: 6/24/2020

BMP ID	Address	Description of the BMP	Lattitude	Longitude	Impervious Area (acres)	Pervious Area (acres)	TSS Impervious Loading rate (lbs/ac/yr)	TSS Pervious Loading rate (lbs/ac/yr)	TSS (lbs/year)	BMP Effectiveness	Annual Credit (lbs/yr)
E1	1112 Westbury Drive	Dry Detention Basin	40.65159988	-75.35690308	1.1	2.7	1,839.0	264.96	2,798.6	10%	279.9
E2	1100 Johnston Drive	Dry Detention Basin	40.65909958	-75.35569763	1.7	2.0	1,839.0	264.96	3,577.8	10%	357.8
E3	1707 Falcon Drive	Dry Detention Basin	40.66630173	-75.34960175	0.6	6.4	1,839.0	264.96	2,836.4	10%	283.6
E4	2804 Oakland Road	Dry Detention Basin	40.66830063	-75.34770203	3.8	6.7	1,839.0	264.96	8,786.1	10%	878.6
E5	Santee Road	Dry Detention Basin	40.66529846	-75.34269714	13.4	16.2	1,839.0	264.96	29,001.4	10%	2,900.1
E6	1639 Finches Garden Road	Dry Extended Detention Basin	40.60089874	-75.34790039	3.5	27.2	1,839.0	264.96	13,719.0	60%	8,231.4
E7	1098 Win Drive	Dry Extended Detention Basin	40.62379837	-75.35520172	2.4	1.3	1,839.0	264.96	4,789.7	60%	2,873.8
E8	313 Central Park Avenue	Dry Extended Detention Basin	40.62049866	-75.41919708	0.8	2.6	1,839.0	264.96	2,122.6	60%	1,273.6
E9	1546 Crest Park Court	Dry Extended Detention Basin	40.60469818	-75.34970093	2.1	2.6	1,839.0	264.96	4,624.9	60%	2,774.9
E10	1677 E 6th Street	Dry Detention Basin	40.60960007	-75.34770203	10.3	7.7	1,839.0	264.96	21,007.8	10%	2,100.8
E11	1700 Main Street	Dry Extended Detention Basin	40.59489822	-75.33979797	1.8	0.7	1,839.0	264.96	3,477.4	60%	2,086.5
E12	2240 Easton Road	Dry Extended Detention Basin	40.60570145	-75.31890106	37.6	1.1	1,839.0	264.96	69,371.8	60%	41,623.1
E13	1671 E 4th Street	Rain Garden	40.6128006	-75.34889984	0.2	3.9	1,839.0	264.96	1,392.7	55%	766.0
E14	300 E Packer Avenue	Rain Garden	40.60860062	-75.37390137	0.3	0.1	1,839.0	264.96	655.1	80%	524.1
E15	1698 Angela Drive	Dry Detention Basin	40.6556015	-75.34980011	29.6	49.1	1,839.0	264.96	67,475.3	10%	6,747.5
E16	1600 Hastings Road	Dry Detention Basin	40.65480042	-75.34870148	189.5	242.2	1,839.0	264.96	412,585.2	10%	41,258.5
E17	1078 E Macada Road	Dry Detention Basin	40.6563	-75.35635	3.3	0.7	1,839.0	264.96	6,258.1	10%	625.8
E18	1100 Johnston Drive	Dry Detention Basin	40.65857	-75.35564	1.4	1.6	1,839.0	264.96	3,057.5	10%	305.8
E19	7 Emery Street	Dry Extended Detention Basin	40.61859	-75.34222	0.1	6.0	1,839.0	264.96	1,729.5	60%	1,037.7
E20	2683 Melina Court	Dry Extended Detention Basin	40.65311	-75.34169	1.0	2.2	1,839.0	264.96	2,451.1	60%	1,470.7
E21	336 11th Avenue	Dry Detention Basin	40.61859	-75.39979	0.4	0.5	1,839.0	264.96	828.2	10%	82.8
E22	362 13th Avenue	Dry Detention Basin	40.61862	-75.39979	1.2	1.4	1,839.0	264.96	2,486.4	10%	248.6
E23	1001 North Boulevard	Dry Detention Basin	40.64746	-75.358	4.5	6.3	1,839.0	264.96	9,942.1	10%	994.2
E24	7 Emery Street	Dry Extended Detention Basin	40.61884	-75.344247	0.0	3.8	1,839.0	264.96	1,035.6	60%	621.3
E25	2300 City Line Rd	Dry Detention Basin	40.652739	-75.429355	2.1	0.6	1,839.0	264.96	3,991.7	10%	399.2
E26	2031 Avenue C	Dry Extended Detention Basin	40.656808	-75.419684	2.7	0.8	1,839.0	264.96	5,237.8	60%	3,142.7
E27	2180 Motel Drive	Dry Detention Basin	40.644038	-75.423876	6.4	2.7	1,839.0	264.96	12,416.7	10%	1,241.7
E28	2545 Schoenersville Rd	Dry Detention Basin	40.645696	-75.411939	9.9	12.6	1,839.0	264.96	21,552.7	10%	2,155.3
E29	2545 Schoenersville Rd	Dry Detention Basin	40.643597	-75.410843	1.6	0.8	1,839.0	264.96	3,250.9	10%	325.1
E30	2199 Westgate Drive	Dry Detention Basin	40.643449	-75.406722	7.6	1.4	1,839.0	264.96	14,394.3	10%	1,439.4
E31	1818 Catasaqua Road	Dry Detention Basin	40.641601	-75.412062	0.4	0.2	1,839.0	264.96	824.8	10%	82.5
E32	2173 Abington Rd	Dry Detention Basin	40.636699	-75.419893	3.3	4.9	1,839.0	264.96	7,469.4	10%	746.9

TABLE 7 - CITY OF BETHLEHEM - EXISTING STORMWATER MANAGEMENT BMPs

DATE: 6/24/2020

BMP ID	Address	Description of the BMP	Lattitude	Longitude	Impervious Area (acres)	Pervious Area (acres)	TSS Impervious Loading rate (lbs/ac/yr)	TSS Pervious Loading rate (lbs/ac/yr)	TSS (lbs/year)	BMP Effectiveness	Annual Credit (lbs/yr)
E33	1195 Pennsylvania Avenue	Dry Detention Basin	40.630542	-75.419055	3.0	3.4	1,839.0	264.96	6,364.9	10%	636.5
E34	2540 Center Street	Dry Detention Basin	40.648311	-75.376525	2.0	11.4	1,839.0	264.96	6,628.3	10%	662.8
E35	2540 Center Street	Dry Detention Basin	40.647551	-75.376326	2.4	17.6	1,839.0	264.96	9,005.5	10%	900.6
E36	2133 Madison Avenue	Dry Detention Basin	40.641785	-75.374541	7.6	28.8	1,839.0	264.96	21,534.0	10%	2,153.4
E37	33 Kirkland Village Circle	Dry Detention Basin	40.644037	-75.372575	6.4	4.9	1,839.0	264.96	13,031.7	10%	1,303.2
E38	2428 Madison Avenue	Dry Detention Basin	40.644209	-75.369418	11.0	15.8	1,839.0	264.96	24,374.9	10%	2,437.5
E39	526 Wood Street	Dry Detention Basin	40.620887	-75.36064	1.5	1.8	1,839.0	264.96	3,247.1	10%	324.7
E40	1120 Win Drive	Dry Detention Basin	40.624777	-75.352851	1.1	0.2	1,839.0	264.96	2,052.5	10%	205.2
E41	1220 Win Drive	Dry Detention Basin	40.626393	-75.350137	0.2	1.1	1,839.0	264.96	574.3	10%	57.4
E42	1210 Win Drive	Dry Detention Basin	40.625548	-75.350251	0.3	0.4	1,839.0	264.96	631.3	10%	63.1
E43	3000 Commercial Center Boulevard	Wet Pond	40.604877	-75.327017	44.4	7.7	1,839.0	264.96	83,640.8	60%	50,184.5
E44	College Drive	Dry Detention Basin	40.591554	-75.354813	2.4	3.5	1,839.0	264.96	5,333.3	10%	533.3
E45	College Drive	Dry Detention Basin	40.591594	-75.353947	0.3	0.5	1,839.0	264.96	649.0	10%	64.9
E46	College Drive	Dry Detention Basin	40.59433	-75.351704	0.2	0.4	1,839.0	264.96	533.5	10%	53.4
E47	College Drive	Dry Detention Basin	40.59378	-75.351705	0.8	3.5	1,839.0	264.96	2,331.8	10%	233.2
E48	1908 Carriage Knoll Drive	Dry Extended Detention Basin	40.584774	-75.36404	1.7	2.8	1,839.0	264.96	3,920.1	60%	2,352.1
E49	1992 Carriage Knoll Drive	Dry Extended Detention Basin	40.58061	-75.363371	1.8	3.7	1,839.0	264.96	4,201.3	60%	2,520.8
E50	2026 Penstock Circuit	Dry Extended Detention Basin	40.581123	-75.347216	1.5	0.8	1,839.0	264.96	2,921.3	60%	1,752.8
E51	824 Jennings Street	Dry Extended Detention Basin	40.62532	-75.356687	0.8	0.2	1,839.0	264.96	1,546.9	60%	928.2
E52	1100 Win Drive	Dry Detention Basin	40.624154	-75.353942	1.5	0.7	1,839.0	264.96	3,032.4	10%	303.2
E53	1230 Win Drive	Dry Detention Basin	40.62755	-75.352185	2.1	1.2	1,839.0	264.96	4,202.7	10%	420.3
E54	1000-1098 E Market Street	Dry Extended Detention Basin	40.62328	-75.350762	6.1	2.8	1,839.0	264.96	12,026.6	60%	7,216.0
E55	1107 Main Street	Underground Infiltration Basin	40.629195	-75.382995	0.4	0.3	1,839.0	264.96	775.9	95%	737.1
E56	242 W Laurel Street	Underground Infiltration Basin	40.629609	-75.384912	0.0	3.3	1,839.0	264.96	939.6	95%	892.6
E57	565 W Lehigh Street	Dry Detention Basin	40.616181	-75.390167	0.6	0.2	1,839.0	264.96	1,175.9	10%	117.6
E58	1837 Calypso Avenue	Dry Detention Basin	40.61865	-75.408698	0.1	0.8	1,839.0	264.96	393.9	10%	39.4
E59	1417 8th Avenue	Dry Extended Detention Basin	40.631439	-75.39596	7.4	0.7	1,839.0	264.96	13,787.9	60%	8,272.7
E60	815 Pennsylvania Avenue	Rain Garden	40.625775	-75.414937	0.2	0.5	1,839.0	264.96	417.8	55%	229.8
E61	815 Pennsylvania Avenue	Rain Garden	40.625134	-75.414229	1.4	0.8	1,839.0	264.96	2,862.9	55%	1,574.6
E62	2176 Avenue C	Dry Detention Basin	40.655754	-75.425477	7.6	5.8	1,839.0	264.96	15,444.4	10%	1,544.4
E63	2115 City Line Road	Dry Detention Basin	40.653073	-75.42096	0.4	0.4	1,839.0	264.96	740.9	10%	74.1
E64	2255 Avenue A	Dry Detention Basin	40.657639	-75.424952	2.4	0.1	1,839.0	264.96	4,536.8	10%	453.7

TABLE 7 - CITY OF BETHLEHEM - EXISTING STORMWATER MANAGEMENT BMPs

DATE: 6/24/2020

BMP ID	Address	Description of the BMP	Lattitude	Longitude	Impervious Area (acres)	Pervious Area (acres)	TSS Impervious Loading rate (lbs/ac/yr)	TSS Pervious Loading rate (lbs/ac/yr)	TSS (lbs/year)	BMP Effectiveness	Annual Credit (lbs/yr)
E65	2136 City Line Road	Dry Detention Basin	40.654213	-75.419949	0.0	0.1	1,839.0	264.96	59.5	10%	5.9
E66	3020 Avenue B	Dry Detention Basin	40.650672	-75.421695	1.8	1.0	1,839.0	264.96	3,631.2	10%	363.1
E67	2015 City Line Drive	Dry Extended Detention Basin	40.654045	-75.417291	1.4	1.8	1,839.0	264.96	2,956.7	60%	1,774.0
E68	1442 Pennsylvania Avenue	Dry Detention Basin	40.63417	-75.42036	0.6	1.3	1,839.0	264.96	1,374.7	10%	137.5
E69	2104 Westgate Drive	Dry Detention Basin	40.641825	-75.407559	25.5	12.0	1,839.0	264.96	50,002.7	10%	5,000.3
E70	3172 Apollo Drive	Dry Detention Basin	40.659295	-75.3783	1.2	4.0	1,839.0	264.96	3,223.1	10%	322.3
E71	420 Barclay Drive	Dry Detention Basin	40.65362	-75.371122	6.2	20.4	1,839.0	264.96	16,843.0	10%	1,684.3
E72	5000 Kirkland Village Circle	Dry Extended Detention Basin	40.64717	-75.37254	0.0	1.4	1,839.0	264.96	370.0	60%	222.0
E73	5001 Kirkland Village Circle	Dry Extended Detention Basin	40.646889	-75.372276	0.8	7.0	1,839.0	264.96	3,301.6	60%	1,980.9
E74	500 Pine Top Drive	Dry Detention Basin	40.6624	-75.3662	45.7	162.3	1,839.0	264.96	127015.18	0%	0.0
E75	1095 Johnston Drive	Dry Detention Basin	40.6594	-75.3587	5.5	10.4	1,839.0	264.96	12817.56	0%	0.0
E76	3299 Chenault Drive	Dry Detention Basin	40.6608	-75.3573	6.0	7.7	1,839.0	264.96	13073.69	0%	0.0
E77	3201 Schoenersville Road	Underground Infiltration Basin	40.656	-75.4171	1.9	0.3	1,839.0	264.96	3,505.7	95%	3,330.4
E78	1835 Catasauqua Road	Underground Infiltration Basin	40.64	-75.4124	1.4	0.8	1,839.0	264.96	2,800.1	95%	2,660.1
E79	3055 Linden Street	Underground Infiltration Basin	40.6582	-75.3552	0.0	1.1	1,839.0	264.96	368.3	95%	349.8
E80	3001 Linden Street	Underground Infiltration Basin	40.6571	-75.3559	0.2	1.6	1,839.0	264.96	782.8	95%	743.6
E81	2002 Industrial Drive	Underground Infiltration Basin	40.652	-75.4154	3.4	1.6	1,839.0	264.96	6,610.0	95%	6,279.5
E82	South Bethlehem Greenway	Infiltration trench	40.6113	-75.3732	0.9	0.0	1,839.0	264.96	1,636.7	95%	1,554.9

Subtotal Existing Annual Reduction = 245,531.6

Sample Sediment Load Reduction Calculation for Existing BMP E3

Impervious Area that drains to E3 x Impervious Loading rate = 0.6 acres x 1,839 lbs/acre/year = 1,142 lbs/year
Pervious Area that drains to E3 x Pervious Loading rate = 6.4 acres x 264.96 lbs/acre/year = 1,694 lbs/year
Total Sediment Load that drains to BMP E3 = 1,142 + 1,694 = 2,836 lbs/year

The amount of sediment that E3 'captures' per year = total sediment load to E2 x the BMP effectiveness for a 'dry detention basin' (10%) = 2,836 lbs/year x 0.10 = 283.6 lbs/year
Therefore, the total sediment load credit that existing basin E3 provides per year = 283.66 lbs/year

TABLE 8 - CITY OF BETHLEHEM - PROPOSED STORMWATER MANAGEMENT BMPs

DATE: 11/19/2021

BMP ID	Address	Description of the BMP	Lattitude	Longitude	Impervious Area (acres)	Pervious Area (acres)	TSS Impervious Loading rate (lbs/ac/yr)	TSS Pervious Loading rate (lbs/ac/yr)	TSS (lbs/year)	Existing BMP Effectiveness	Proposed BMP Effectiveness	Proposed Annual Reduction (lbs/yr)
P1	Clearview Park, East of pool, connect to E32	Constructed Wetland	40.6356	-75.4206	19.8	33.5	1,839.0	264.96	45,201.1	N/A	0.68	30,736.7
P2	Hal Fenicle Park, Southern most portion	Constructed Wetland	40.6338	-75.4078	52.3	64.5	1,839.0	264.96	113,270.5	N/A	0.63	71,360.4
P3	700 Argus Street, along the greenway	Bioretention	40.6094	-75.3468	21.8	96.0	1,839.0	264.96	65,533.6	N/A	0.48	31,456.1
P4	1399 Stefko Boulevard	Bioretention	40.6327	-75.3553	1.0	6.1	1,839.0	264.96	3382.6	N/A	0.54	1,826.6
P5	Traveler & Millside Drive	Bioretention	40.6041	-75.3436	1.8	6.4	1,839.0	264.96	4973.7	N/A	0.45	2,984.2
E3	1707 Falcon Drive	Basin Retrofit	40.6663	-75.3496	0.6	6.4	1,839.0	264.96	2,836.4	0.10	0.60	1,418.2
E16	1600 Hastings Road (East BLVD)	Basin Retrofit	40.6548	-75.3487	189.5	242.2	1,839.0	264.96	412,585.2	0.10	0.60	165,034.1
E38	2428 Madison Avenue	Basin Retrofit	40.6442	-75.3694	11.0	15.8	1,839.0	264.96	24,374.9	0.10	0.60	12,187.4
E74	500 Pine Top Drive	Basin Retrofit	40.6624	-75.3662	45.7	162.3	1,839.0	264.96	127,015.2	0.00	0.60	76,209.1
E75	1095 Johnston Drive	Basin Retrofit	40.6594	-75.3587	5.5	10.4	1,839.0	264.96	12,817.6	0.00	0.60	7,690.5
E76	3299 Chenault Drive	Basin Retrofit	40.6608	-75.3573	6.0	7.7	1,839.0	264.96	13,073.5	0.00	0.60	7,844.1
SS	Streets located in the Planning Area	Street Sweeping**										1,863,087.6
SSSR	Stormwater sewers in Planning Area	Storm Sewer System Solids Removal ***										2,405.7
SBR1	Saucon Creek along Southside Little League	Streambank Restoration 360 LF	40.6071	-75.3404							44.88 lb/ft	16,156.8

Subtotal Proposed Annual Reduction 2,290,397.5

* All BMPs are proposed on City Property, BMP types and effectiveness are provided at a planning level. They should be revised as result of site specific feasibility analyses and engineering design.
** City to clean select city streets within the planning area. Each selected street will be swept a minimum 24 times per year.
*** City to clean existing storm sewer system and measure the weight of material collected. The City will then convert the annual wet weight captured per the BMP Effectiveness Values chart until an amount of 427,600 lbs is obtained. This amount must be achieved annually. Inlets and storm pipe must be located within the PRP Planning Area.

Sample Sediment Load Reduction Calculation for Proposed BMP E3 (converting existing "dry detention basin" E3 to a "dry extended detention basin")
Impervious Area that drains to E3 x Impervious Loading rate = 0.6 acres x 1,839 lbs/acre/year = 1,14 lbs/year
Pervious Area that drains to E3 x Pervious Loading rate = 6.4 acres x 264.96 lbs/acre/year = 1,694 lbs/year
Total Sediment Load that drains to BMP E3 = 1,142 + 1,694 = 2,836 lbs/year

The amount of sediment that E3 'captures' per year before retrofit = total sediment load to E2 x the BMP effectiveness for a 'dry detention basin' (10%) = 2,836 lbs/year x 0.10 = 283.6 lbs/year
The amount of sediment that E3 'captures' per year after retrofit = total sediment load to P2 x the BMP effectiveness for an 'dry extended detention basin' (60%) = 2,836 lbs/year x 0.60 = 1,701.6 lbs/year
Therefore, the total sediment load reduction that converting existing basin E3 from a 'dry detention basin' to an 'dry extended detention' provides per year = 1,701.6 - 283.6 = 1,418.2 lbs/year

Sample Calculation: Calculations for Proposed BMP Effectiveness

TABLE 9: Calculations for Proposed BMP Effectiveness

	P1: Constructed Wetland	P2: Constructed Wetland	P3: Bioretention	P4: Bioretention	P5: Bioretention
P=	1.91	1.91	1.91	1.91	1.91
C=	0.18	0.18	0.5	0.5	0.5
DA=	53.3	116.8	117.8	7.1	8.2
RS=	1.527045	3.34632	9.374916667	0.565041667	0.6525833
V=	0.925481818	0.753392871	0.430042049	0.565041667	0.3262917
Sediment Removal %:	**68%**	**63%**	**48%**	**54%**	**45%**

The percentages calculated for sediment removal were calculated using the "Basic Approach" within Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects, Section 4 Protocol for Determining Retrofit Removal Rates. The equation for runoff volume given is $= \frac{(\mathrm{RS})(12)}{IA}$.

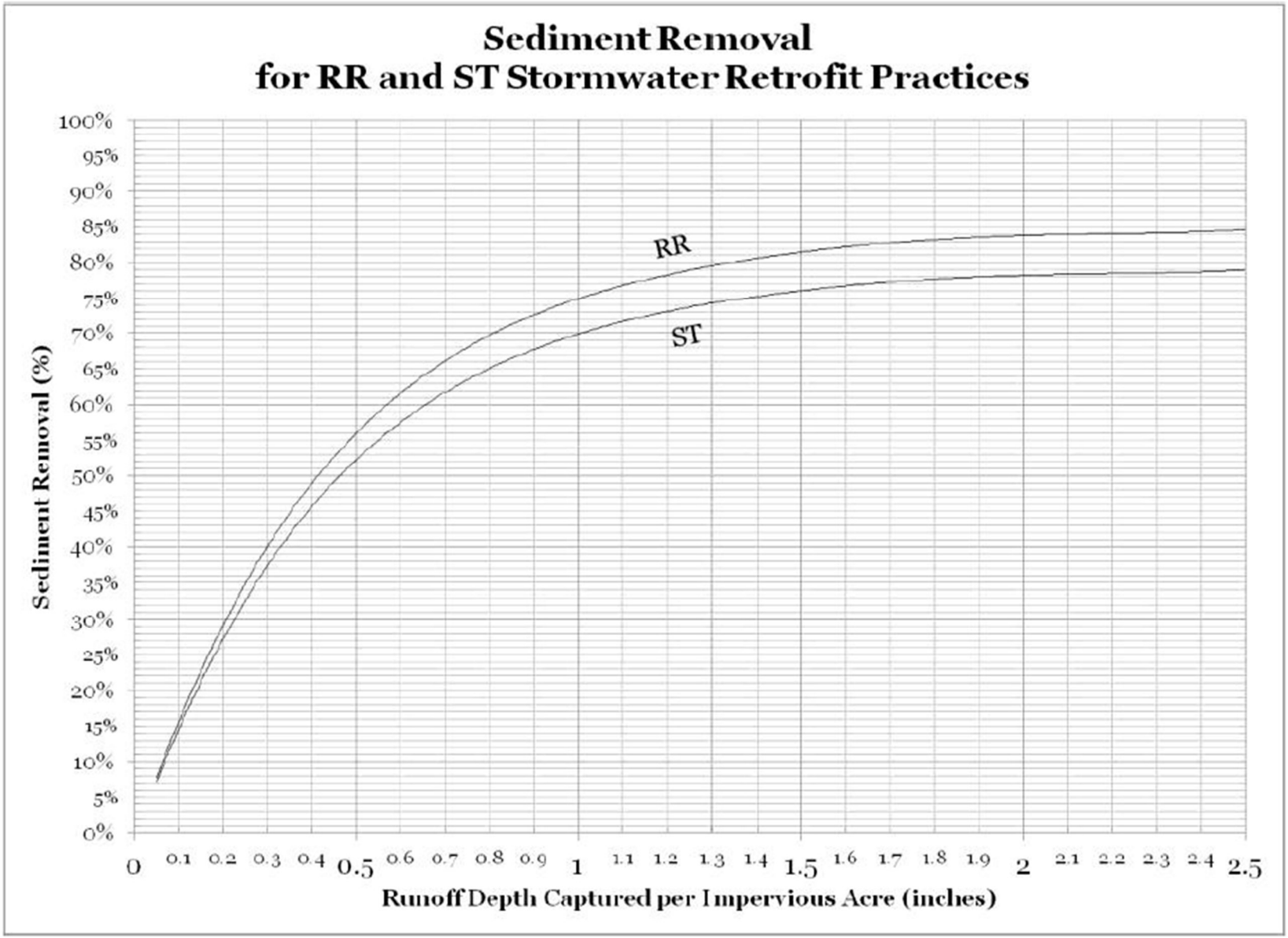
P is the rainfall intensity for a 1hour 10 year storm, 1.91 inches/hour.
C is the runoff coefficient calculates using the equation,

$$C = 0.05 + 0.009i$$

i, is the percentage of impervious area
DA is equal to the drainage area
RS is the retrofit storage and
V is the runoff volume.

Once the runoff volumes were calculated the graph provided within the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects, Section 4 Protocol for Determining Retrofit Removal Rates was used to determine the sediment removal rates.

Figure 6: Retrofit Removal Adjustor Curve for Sediment



Sample Calculation: Inlet Sediment Load Reduction

TABLE 10: Inlet Sediment Load Reduction				
Inlets cleaned/ year	**Loading Rate (lbs/acre)**	**Drainage Area (acres)**	**Efficiency**	**Yearly Sediment Load Reduction Calculation**
1,100	4,234.29	0.50	0.80	**1,863,087.6**
Loading Rate (lbs/acre)				
$1y^3$ of Sediment = 1944 lbs				
4,813.5 y^3 = 9,357,444 lbs/yr = **4,234.29 lbs/ac**				

The tables provided below show the values used to calculate the annual sediment reduction load for the City of Bethlehem. Table 14 shows the street sweeping schedule for the year of 2021 with the width and length of the streets. This information provided the acreage of what was cleaned. With this information we used the 2021 Street Sweeping collection table created by the Streets Department to track all the sediment collected throughout the year, to calculate the sediment collected per acreage per year. The table is separated by the amount of mechanical brooms used by the City: 713, 708, 190, and 717. The W within each mechanical broom column represents the water weight collected and the D represents the amount of dumps. Each dump for the mechanical brooms are multiplied by the amount of cubic yards each can hold. Mechanical broom 713 holds 4 cubic yards, 708 holds 3.5 cubic yards, 190 holds 5 cubic yards, and 717 holds 3.5 cubic yards. These values are collected monthly and added together to get the total sediment collected throughout the year. Only the month of November was included within this report due to it being the last month of street sweeping and the other months being added in to give the total.

For the year 2021 a total of 5,803.5 cubic yards of sediment was collected. The amount collected from the vacuum trucks, 154 and 152, was 990 cubic yards. This was subtracted from the total 5,803.5 cubic yards of sediment, since this value corresponds with the Storm Sewer Systems Removal (SSSR). Converting that value to pounds gave the City a total of 9,357,444 pounds per year. This number was then divided by the total impervious area from the street sweeping schedule, 2,209.92 acres, to give the City a total loading rate of 4,234.29 pounds per acre. In order to calculate the yearly sediment load the number of catch basins the City plans to clean a year was multiplied by the loading rate, the drainage area of each inlet (0.5 acres as specified in the PRP instructions), and the efficiency. This can be seen in the sample calculation above.

The City is in the process of purchasing a regenerative air sweeper to upgrade the BMP implemented in the past. Form 3800-PM-BCW0100k PRP Instructions states, "MS4 may not claim credit for street sweeping and other non-structural BMPs implemented in the past," however, by upgrading the street sweeping equipment the City of Bethlehem can take credit for the street sweeping done because it is considered different from past BMPs. As of information gathered from *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices*, "*Regenerative-Air Sweepers (RAS):* Sweeper is equipped with a sweeping head which creates suction and uses forced air to transfer street debris into the hopper… For purposes of this report, the RAS and VAS sweepers both qualify as Advanced Sweeper Technologies (AST) and achieve higher pollutant removal rates, whereas MBS sweepers do not, and do not provide any pollutant removal." Please see the table referenced from *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices* to see the difference in sediment load collected.

TABLE 11: Street Sweeping Schedule

Street:	Direction:	Length (miles)	Width (miles)	Acres:	Times cleaned a Year	Acres/ Year
Fourth Street	Hayes- Wyandotte	0.8	0.00378788	1.92	52	99.84
New Street	3rd- Morton	0.1	0.00378788	0.2	52	10.4
Broadway	Brodhead- Bishopthrop	0.5	0.00378788	1.19	52	61.88
Third Street	Wyandotte- William	1.7	0.00378788	4.12121344	52	214.3030989
Fourth Street	William- Hayes	0.6	0.00378788	1.45	52	75.4
Lynn Avenue	Lynnfield- 4th	0.4	0.00378788	0.89	52	46.28
Fourth Street	Wyandotte- Hayes	4	0.00378788	9.6969728	52	504.2425856
William Street	4th-8th	0.3	0.00378788	0.72727296	52	37.81819392
Sixth Street	Lynn- Edwards	0.4	0.00378788	0.96969728	52	50.42425856
Lynn Avenue	4th- Lynnfield	0.4	0.00378788	0.96969728	52	50.42425856
Broad Street	Club- Stefko	3.3	0.00378788	8.00000256	52	416.0001331
Guetter Street	Broad- Walnut	0.05	0.00378788	0.12121216	52	6.30303232
Walnut Street	Guetter- New	0.1	0.00378788	0.24242432	52	12.60606464
Main Street	Church- Elizabeth	0.9	0.00378788	2.18181888	52	113.4545818
New Street	Elizabeth- Church	0.9	0.00378788	2.18181888	52	113.4545818
Morton Street	Brodhead- Webster	0.3	0.00378788	0.72727296	26	18.90909696
Fifth Street	State- Filmore	0.4	0.00378788	0.96969728	26	25.21212928
Sixth Street	Hayes- Buchanan	0.2	0.00378788	0.48484864	26	12.60606464
Seventh Street	Hayes- Hillside	0.2	0.00378788	0.48484864	26	12.60606464
Hayes Street	8th- 4th	0.4	0.00378788	0.96969728	26	25.21212928
Fiot Avenue	Wyandotte- Broadway	0.3	0.00378788	0.72727296	26	18.90909696
Alaska Street	Broadway- Sioux	0.2	0.00378788	0.48484864	26	12.60606464
Ontario Street	Wyandotte- Broadway	0.3	0.00378788	0.72727296	26	18.90909696
Center Street	Church- Elizabeth	0.9	0.00378788	2.18181888	26	56.72729088
Linden Street	Elizabeth- Church	0.8	0.00378788	1.93939456	26	50.42425856
Union Boulevard	Linden- Main	0.6	0.00378788	1.45454592	26	37.81819392
Market Street	Main- Linden	0.6	0.00378788	1.45454592	26	37.81819392
Goepp Street	Mauch Chunk - Maple	0.9	0.00378788	2.18181888	26	56.72729088
Spruce Street	Main-New	0.2	0.00378788	0.48484864	26	12.60606464

Total: 2,209.921825 Acres

Table 12: Sediment Collected in 2021

DATE	713		GALS	CY	708		GALS	CY	190		GALS	CY	717		GALS	CY	152		154				TOTALS	
November	W	D			W	D			W	D			W	D			W	GALS	W	GALS	D	CY	GALS	CY
11/1/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/2/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/3/2021			0	0		4	0	14		4	0	20		8	0	28		0		0		0	0	62
11/4/2021			0	0		4	0	14		5	0	25		6	0	21		0		0		0	0	60
11/5/2021			0	0		5	0	17.5		8	0	40		8	0	28		0		0		0	0	85.5
11/8/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/9/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/10/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/11/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/12/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/15/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/16/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/17/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/18/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/19/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/22/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/23/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/24/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/25/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
11/26/2021			0	0			0	0			0	0			0	0		0		0		0	0	0
			0	0			0	0			0	0			0	0		0		0		0	0	0
			0	0			0	0			0	0			0	0		0		0		0	0	0
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			0	0			0	0			0	0			0	0		0		0		0	0	0
			0	0			0	0			0	0			0	0		0		0		0	0	0
TOTALS			0	0			0	45.5			0	85			0	77		0		0		0	0	207.5
2021 TOTALS			9280	804			8480	672			16080	1675			24560	1662.5		374000		216000		990	**439900**	**5803.5**

Table 13: Pollutant Reductions Associated with Different Street Cleaning Practices

Pollutant Reductions Associated with Different Street Cleaning Practices					
Practice #	Description [1]	Approx Passes/Yr [2]	TSS Removal (%)	TN Removal (%)	TP Removal (%)
SCP-1	AST- 2 PW	~100	21	4	10
SCP-2	AST- 1 PW	~50	16	3	8
SCP-3	AST- 1 P2W	~25	11	2	5
SCP-4	AST- 1 P4W	~10	6	1	3
SCP-5	AST- 1 P8W	~6	4	0.7	2
SCP-6	AST- 1 P12W	~4	2	0	1
SCP-7	AST- S1 or S2	~15	7	1	4
SCP-8	AST- S3 or S4	~20	10	2	5
SCP-9	MBT- 2PW	~100	0.7	0	0
SCP-10	MBT- 1 PW	~50	0.5	0	0
SCP-11	MBT- 1 P4W	~10	0.1	0	0

AST: Advanced Sweeping Technology MBT: Mechanical Broom Technology

[1] See Table 15 for the codes used to define street cleaning frequency

[2] Depending on the length of the winter shutdown, the number of passes/yr may be 10 to 15% lower than shown

ATTACHMENT B

DEVELOPED LAND LOADING RATES FOR PA COUNTIES[1,2,3]

County	Category	Acres	TN lbs/acre/yr	TP lbs/acre/yr	TSS (Sediment) lbs/acre/yr
Adams	impervious developed	10,373.2	33.43	2.1	1,398.77
	pervious developed	44,028.6	22.99	0.8	207.67
Bedford	impervious developed	9,815.2	19.42	1.9	2,034.34
	pervious developed	19,425	17.97	0.68	301.22
Berks	impervious developed	1,292.4	36.81	2.26	1,925.79
	pervious developed	5,178.8	34.02	0.98	264.29
Blair	impervious developed	3,587.9	20.88	1.73	1,813.55
	pervious developed	9,177.5	18.9	0.62	267.34
Bradford	impervious developed	10,423	14.82	2.37	1,880.87
	pervious developed	23,709.7	13.05	0.85	272.25
Cambria	impervious developed	3,237.9	20.91	2.9	2,155.29
	pervious developed	8,455.4	19.86	1.12	325.3
Cameron	impervious developed	1,743.2	18.46	2.98	2,574.49
	pervious developed	1,334.5	19.41	1.21	379.36
Carbon	impervious developed	25.1	28.61	3.97	2,177.04
	pervious developed	54.2	30.37	2.04	323.36
Centre	impervious developed	7,828.2	19.21	2.32	1,771.63
	pervious developed	15,037.1	18.52	0.61	215.84
Chester	impervious developed	1,838.4	21.15	1.46	1,504.78
	pervious developed	10,439.8	14.09	0.36	185.12
Clearfield	impervious developed	9,638.5	17.54	2.78	1,902.9
	pervious developed	17,444.3	18.89	1.05	266.62
Clinton	impervious developed	7,238.5	18.02	2.80	1,856.91
	pervious developed	11,153.8	16.88	0.92	275.81
Columbia	impervious developed	7,343.1	21.21	3.08	1,929.18
	pervious developed	21,848.2	22.15	1.22	280.39
Cumberland	impervious developed	8,774.8	28.93	1.11	2,065.1
	pervious developed	26,908.6	23.29	0.34	306.95
Dauphin	impervious developed	3,482.4	28.59	1.07	1,999.14
	pervious developed	9,405.8	21.24	0.34	299.62
Elks	impervious developed	1,317.7	18.91	2.91	1,556.93
	pervious developed	1,250.1	19.32	1.19	239.85
Franklin	impervious developed	13,832.3	31.6	2.72	1,944.85
	pervious developed	49,908.6	24.37	0.76	308.31
Fulton	impervious developed	3,712.9	22.28	2.41	1,586.75
	pervious developed	4,462.3	18.75	0.91	236.54
Huntington	impervious developed	7,321.9	18.58	1.63	1,647.53
	pervious developed	11,375.4	17.8	0.61	260.15
Indiana	impervious developed	589	19.29	2.79	1,621.25
	pervious developed	972	20.1	1.16	220.68
Jefferson	impervious developed	21.4	18.07	2.76	1,369.63
	pervious developed	20.4	19.96	1.24	198.60
Juniata	impervious developed	3,770.2	22.58	1.69	1,903.96
	pervious developed	8,928.3	17.84	0.55	260.68
Lackawana	impervious developed	2,969.7	19.89	2.84	1,305.05
	pervious developed	7,783.9	17.51	0.76	132.98
Lancaster	impervious developed	4,918.7	38.53	1.55	1,480.43
	pervious developed	21,649.7	22.24	0.36	190.93
Lebanon	impervious developed	1,192.1	40.58	1.85	1,948.53
	pervious developed	5,150	27.11	0.4	269.81
Luzerne	impervious developed	5,857	20.43	3	1,648.22
	pervious developed	13,482.9	19.46	0.98	221.19
Lycoming	impervious developed	10,031.7	16.48	2.57	1,989.64
	pervious developed	19,995.5	16	0.84	277.38

County	Category	Acres	TN lbs/acre/yr	TP lbs/acre/yr	TSS (Sediment) lbs/acre/yr
McKean	impervious developed	38.7	20.93	3.21	1,843.27
	pervious developed	5.3	22.58	1.45	249.26
Mifflin	impervious developed	5,560.2	21.83	1.79	1,979.13
	pervious developed	16,405.5	21.13	0.71	296.07
Montour	impervious developed	5,560.2	21.83	1.79	1,979.13
	pervious developed	16,405.5	21.13	0.71	296.07
Northumberland	impervious developed	8,687.3	25.73	1.54	2,197.08
	pervious developed	25,168.3	24.63	0.54	367.84
Perry	impervious developed	5,041.1	26.77	1.32	2,314.7
	pervious developed	9,977	23.94	0.51	343.16
Potter	impervious developed	2,936.3	16.95	2.75	1,728.34
	pervious developed	2,699.3	17.11	1.09	265.2
Schuylkill	impervious developed	5,638.7	30.49	1.56	1,921.08
	pervious developed	14,797.2	29.41	0.57	264.04
Snyder	impervious developed	4,934.2	28.6	1.11	2,068.16
	pervious developed	14,718.1	24.35	0.4	301.5
Somerset	impervious developed	1,013.6	25.13	2.79	1,845.7
	pervious developed	851.2	25.71	1.14	293.42
Sullivan	impervious developed	3,031.7	19.08	2.85	2,013.9
	pervious developed	3,943.4	21.55	1.31	301.58
Susquehanna	impervious developed	7,042.1	19.29	2.86	1,405.73
	pervious developed	14,749.7	20.77	1.21	203.85
Tioga	impervious developed	7,966.9	12.37	2.09	1,767.75
	pervious developed	18,090.3	12.22	0.76	261.94
Union	impervious developed	4,382.6	22.98	2.04	2,393.55
	pervious developed	14,065.3	20.88	0.69	343.81
Wayne	impervious developed	320.5	18.69	2.89	1,002.58
	pervious developed	509	21.14	1.31	158.48
Wyoming	impervious developed	3,634.4	16.03	2.53	2,022.32
	pervious developed	10,792.9	13.75	0.7	238.26
York	impervious developed	10,330.7	29.69	1.18	1,614.15
	pervious developed	40,374.8	18.73	0.29	220.4
All Other Counties	impervious developed	-	23.06	2.28	1,839
	pervious developed	-	20.72	0.84	264.96

Notes:

1 These land loading rate values may be used to derive existing pollutant loading estimates under DEP's simplified method for PRP development. MS4s may choose to develop estimates using other scientifically sound methods.

2 Acres and land loading rate values for named counties in the Chesapeake Bay watershed are derived from CAST. (The column for Acres represents acres within the Chesapeake Bay watershed). For MS4s located outside of the Chesapeake Bay watershed, the land loading rates for "All Other Counties" may be used to develop PRPs under Appendix E; these values are average values across the Chesapeake Bay watershed.

3 For land area outside of the urbanized area, undeveloped land loading rates may be used where appropriate. When using the simplified method, DEP recommends the following loading rates (for any county) for undeveloped land:

- TN – 10 lbs/acre/yr
- TP – 0.33 lbs/acre/yr
- TSS (Sediment) – 234.6 lbs/acre/yr

These values were derived by using the existing loads for each pollutant, according to the 2014 Chesapeake Bay Progress Run, and dividing by the number of acres for the unregulated stormwater subsector.

VIDEO NOTE: *This meeting is video recorded and can be viewed on the City's website at www.bethlehem-pa.gov*
For the video, go to: City Government/ City Council Meetings/ View Live Stream Council Meeting.
Please turn off mobile phones during the meeting.

BETHLEHEM CITY COUNCIL MEETING AGENDA
TUESDAY, AUGUST 4, 2020 – 5:30 PM
TOWN HALL – 10 EAST CHURCH STREET – BETHLEHEM, PA

Invocation

Pledge to the Flag.

1. Roll Call.

PUBLIC HEARING

Prior to the consideration of the regular Agenda items, City Council will conduct a Public Hearing to accept public comment on the City's Pollutant Reduction Plan (PRP). The purpose of the PRP is to identify Water Quality Stormwater Best Management Practices (BMPs) to reduce sediment loading to impaired local surface waters over a five (5) year time period.

2. Approval of Minutes – June 16, 2020

3. Public Comment. (on any subject not being voted on this evening – 5 Minute Time Limit)

4. Public Comment. (on Ordinances and Resolutions to be voted on this evening – 5 Minute Time Limit)

5. Old Business.

5 A. Old Business – Members of Council
5 B. Tabled Items
5 C. Unfinished Business

6. Communications.

6 A. City Solicitor – Highway Safety Project Police Traffic Services Grant Proposal and Resolution
6 B. Assistant City Solicitor – Proposed Ordinance Amending Article 721 (Streets and Sidewalks)

7. Reports.

7 A. President of Council

7A1. Councilmanic Appointment – Veronica H. Moore – Human Relations Commission

7 B. Mayor

7 C. Public Works Committee (Ms. Crampsie Smith)

8. Ordinances for Final Passage.

None.

9. New Ordinances.

   9 A. Bill 07-2020 – Zoning Text Amendment – Hotels and Short Term Lodging
   9 B. Bill 08-2020 – Repealing and Restating Article 1741 – Short Term Lodging Facilities
   9 C. Bill 15-2020 – Zoning Text Amendment – Definition of Bed and Breakfast Home

10. Resolutions.

   10 A. Approve Records Destruction – Solicitor's Office
   10 B. Approve Highway Safety Project Police Traffic Services Grant Resolution
   10 C. Certificate of Appropriateness – 733 East Fourth Street
   10 D. Certificate of Appropriateness – 325 Broadway
   10 E. Certificate of Appropriateness – 327 Broadway (signs) (Seven Sirens Brewing Company)
   10 F. Certificate of Appropriateness – 327 Broadway (guardrail) (Seven Sirens Brewing Company)
   10 G. Certificate of Appropriateness – 327 Broadway (metal panel cladding) (Seven Sirens Brewing Company)

11. New Business.

12. Adjournment.

CITY OF BETHLEHEM

DEPARTMENT OF PUBLIC WORKS
INTEROFFICE MEMORANDUM

SUBJECT: Request to Include Time for Public Comment on the Pollutant Reduction Plan at the August 4, 2020 City Council Meeting

Project or Contract Reference: Pollutant Reduction Plan Preparation
SW-19-W03

TO: City Council, all members, and Council Solicitor

FROM: Michael Alkhal, P.E., Director of Public Works / City Engineer

DATE: July 24, 2020

As part of the City's Municipal Separate Storm Sewer System (MS-4) Permit, we are required to prepare and implement a Pollutant Reduction Plan (PRP). The purpose of the PRP is to identify Water Quality Stormwater Best Management Practices (BMPs) to reduce sediment loading to impaired local surface waters over a five (5) year time period.

Public Notice of the PRP was advertised on July 10, 2020 and the Plan is available for viewing at City Hall and on the City's website at www.bethlehem-pa.gov/Public-Works/Pollutant-Reduction-Plan. Written comments are being accepted for thirty (30) days from the date of the Public Notice. The City will also accept comments from the public at a public meeting. We request time be allotted for public comment on the PRP at the City Council Meeting on August 4, 2020. All public comments, whether received orally at a public meeting, or written, will be considered in the City's Final PRP submitted to the PA DEP. A copy of the written comments will be attached to the Final PRP submitted to the PA DEP by the City.

Copies To: Mayor
Director of Administration
Director of Budget and Finance
Law Bureau
Public Works Deputy Director
File/xc

By: _____
Title: Public Works Director/City Engineer

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CLEAN WATER

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
STORMWATER DISCHARGES FROM
SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS
BMP EFFECTIVENESS VALUES

This table of BMP effectiveness values (i.e., pollutant removal efficiencies) is intended for use by MS4s that are developing and implementing Pollutant Reduction Plans and TMDL Plans to comply with NPDES permit requirements. The values used in this table generally consider pollutant reductions from both overland flow and reduced downstream erosion, and are based primarily on average values within the Chesapeake Assessment Scenario Tool (CAST) (www.casttool.org). Design considerations, operation and maintenance, and construction sequences should be as outlined in the Pennsylvania Stormwater BMP Manual, Chesapeake Bay Program guidance, or other technical sources. The Department of Environmental Protection (DEP) will update the information contained in this table as new information becomes available. Interested parties may submit information to DEP for consideration in updating this table to DEP's MS4 resource account, RA-EPPAMS4@pa.gov. Where an MS4 proposes a BMP not identified in this document or in Chesapeake Bay Program expert panel reports, other technical resources may be consulted for BMP effectiveness values. Note – TN = Total Nitrogen and TP = Total Phosphorus.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Wet Ponds and Wetlands	20%	45%	60%	A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal.
Dry Detention Basins and Hydrodynamic Structures	5%	10%	10%	Dry Detention Ponds are depressions or basins created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Hydrodynamic Structures are devices designed to improve quality of stormwater using features such as swirl concentrators, grit chambers, oil barriers, baffles, micropools, and absorbent pads that are designed to remove sediments, nutrients, metals, organic chemicals, or oil and grease from urban runoff.
Dry Extended Detention Basins	20%	20%	60%	Dry extended detention (ED) basins are depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry ED basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. As such, they are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Infiltration Practices w/ Sand, Veg.	85%	85%	95%	A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil, they are not constructed on poor soils, such as C and D soil types. Engineers are required to test the soil before approval to build is issued. To receive credit over the longer term, jurisdictions must conduct yearly inspections to determine if the basin or trench is still infiltrating runoff.
Filtering Practices	40%	60%	80%	Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance to receive pollutant reduction credit.
Filter Strip Runoff Reduction	20%	54%	56%	Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.4 design ratio of filter strip length to impervious flow length is recommended for runoff reduction urban filter strips.
Filter Strip Stormwater Treatment	0%	0%	22%	Urban filter strips are stable areas with vegetated cover on flat or gently sloping land. Runoff entering the filter strip must be in the form of sheet-flow and must enter at a non-erosive rate for the site-specific soil conditions. A 0.2 design ratio of filter strip length to impervious flow length is recommended for stormwater treatment urban filter strips.
Bioretention – Raingarden (C/D soils w/ underdrain)	25%	45%	55%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in C or D soil.
Bioretention / Raingarden (A/B soils w/ underdrain)	70%	75%	80%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has an underdrain and is in A or B soil.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Bioretention / Raingarden (A/B soils w/o underdrain)	80%	85%	90%	An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants. This BMP has no underdrain and is in A or B soil.
Vegetated Open Channels (C/D Soils)	10%	10%	50%	Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in C or D soil.
Vegetated Open Channels (A/B Soils)	45%	45%	70%	Open channels are practices that convey stormwater runoff and provide treatment as the water is conveyed, includes bioswales. Runoff passes through either vegetation in the channel, subsoil matrix, and/or is infiltrated into the underlying soils. This BMP has no underdrain and is in A or B soil.
Bioswale	70%	75%	80%	With a bioswale, the load is reduced because, unlike other open channel designs, there is now treatment through the soil. A bioswale is designed to function as a bioretention area.
Permeable Pavement w/o Sand or Veg. (C/D Soils w/ underdrain)	10%	20%	55%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in C or D soil.
Permeable Pavement w/o Sand or Veg. (A/B Soils w/ underdrain)	45%	50%	70%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, no sand or vegetation and is in A or B soil.
Permeable Pavement w/o Sand or Veg. (A/B Soils w/o underdrain)	75%	80%	85%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, no sand or vegetation and is in A or B soil.
Permeable Pavement w/ Sand or Veg. (A/B Soils w/ underdrain)	50%	50%	70%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in A or B soil.

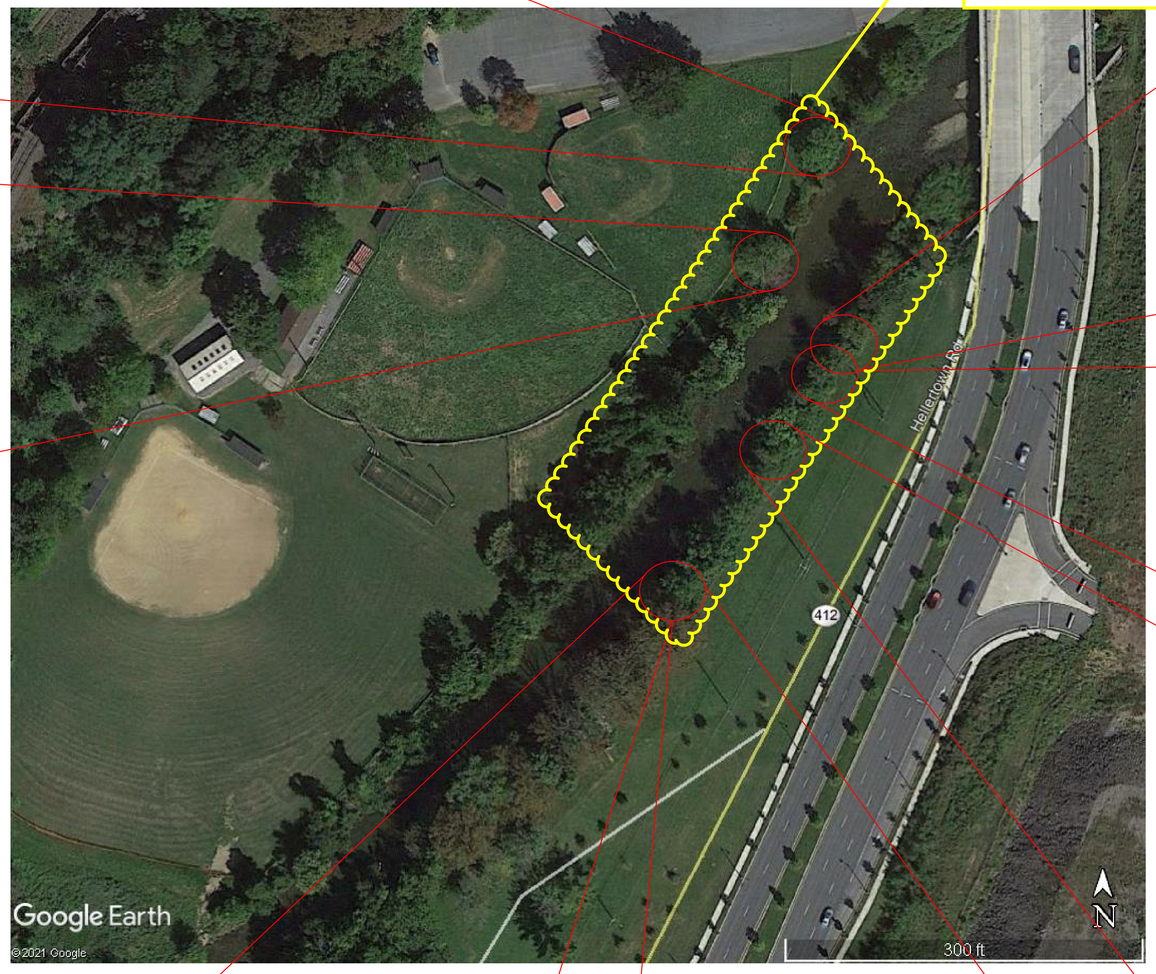
BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Permeable Pavement w/ Sand or Veg. (A/B Soils w/o underdrain)	80%	80%	85%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has no underdrain, has sand and/or vegetation and is in A or B soil.
Permeable Pavement w/ Sand or Veg. (C/D Soils w/ underdrain)	20%	20%	55%	Pavement or pavers that reduce runoff volume and treat water quality through both infiltration and filtration mechanisms. Water filters through open voids in the pavement surface to a washed gravel subsurface storage reservoir, where it is then slowly infiltrated into the underlying soils or exits via an underdrain. This BMP has an underdrain, has sand and/or vegetation and is in C or D soil.
Stream Restoration	0.075 lbs/ft/yr	0.068 lbs/ft/yr	44.88 lbs/ft/yr	An annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that otherwise would be delivered downstream from an actively enlarging or incising urban stream. Applies to 0 to 3rd order streams that are not tidally influenced. If one of the protocols is cited and pounds are reported, then the mass reduction is received for the protocol.
Forest Buffers	25%	50%	50%	An area of trees at least 35 feet wide on one side of a stream, usually accompanied by trees, shrubs and other vegetation that is adjacent to a body of water. The riparian area is managed to maintain the integrity of stream channels and shorelines, to reduce the impacts of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals. Effectiveness credit for TN is for 4 upslope acres for each acre of buffer (4:1), and 2 upslope acres for TP and sediment (2:1). Additional credit is gained by converting land use from current use to forest. (Note – the values represent pollutant load reductions from stormwater draining through buffers).
Tree Planting	10%	15%	20%	The BMP effectiveness values for tree planting are estimated by DEP. DEP estimates that 100 fully mature trees of mixed species (both deciduous and non-deciduous) provide pollutant load reductions for the equivalent of one acre (i.e., one mature tree = 0.01 acre). The BMP effectiveness values given are based on immature trees (seedlings or saplings); the effectiveness values are expected to increase as the trees mature. To determine the amount of pollutant load reduction that can credited for tree planting efforts: 1) multiply the number of trees planted by 0.01; 2) multiply the acreage determined in step 1 by the pollutant loading rate for the land prior to planting the trees (in lbs/acre/year); and 3) multiply the result of step 2 by the BMP effectiveness values given.
Street Sweeping	3%	3%	9%	Street sweeping must be conducted 25 times annually. Only count those streets that have been swept at least 25 times in a year. The acres associated with all streets that have been swept at least 25 times in a year would be eligible for pollutant reductions consistent with the given BMP effectiveness values.

BMP Name	BMP Effectiveness Values			BMP Description
	TN	TP	Sediment	
Storm Sewer System Solids Removal	0.0027 for sediment, 0.0111 for organic matter	0.0006 for sediment, 0.0012 for organic matter	1 – TN and TP concentrations	This BMP (also referred to as "Storm Drain Cleaning") involves the collection or capture and proper disposal of solid material within the storm system to prevent discharge to surface waters. Examples include catch basins, stormwater inlet filter bags, end of pipe or outlet solids removal systems and related practices. Credit is authorized for this BMP only when proper maintenance practices are observed (i.e., inspection and removal of solids as recommended by the system manufacturer or other available guidelines). The entity using this BMP for pollutant removal credits must demonstrate that they have developed and are implementing a standard operating procedure for tracking the material removed from the sewer system. Locating such BMPs should consider the potential for backups onto roadways or other areas that can produce safety hazards. To determine pollutant reductions for this BMP, these steps must be taken: 1) Measure the weight of solid/organic material collected (lbs). Sum the total weight of material collected for an annual period. Note – do not include refuse, debris and floatables in the determination of total mass collected. 2) Convert the annual wet weight captured into annual dry weight (lbs) by using site-specific measurements (i.e., dry a sample of the wet material to find its weight) or by using default factors of 0.7 (material that is predominantly wet sediment) or 0.2 (material that is predominantly wet organic matter, e.g., leaf litter). 3) Multiply the annual dry weight of material collected by default or site-specific pollutant concentration factors. The default concentrations are shown in the BMP Effectiveness Values columns. Alternatively, the material may be sampled (at least annually) to determine site-specific pollutant concentrations. DEP will allow up to 50% of total pollutant reduction requirements to be met through this BMP. The drainage area treated by this BMP may be no greater than 0.5 acre unless it can be demonstrated that the specific system proposed is capable of treating stormwater from larger drainage areas. For planning purposes, the sediment removal efficiency specified by the manufacturer may be assumed, but no higher than 80%.

Pollution Reduction Plan
City of Bethlehem, Northampton County, Pennsylvania
BMP ID: SBR1

The erosion in this area will be restored with plantings.

The erosion in this area will be addressed with plantings.



The erosion in these areas will be restored with plantings and grading if feasible.

Location Map

This is the same area photographed from different angles. The erosion in here will be restored with plantings and the pipe will be repaired.

The erosion in this area will be restored with plantings and the pipe will be repaired.