East Earl Township

Municipal Separate Storm Sewer System (MS4)

Combined Pollutant Reduction Plan (PRP)

for

Appendix D & Appendix E Requirements

2019 – 2024 MS4 Permit

Original Submission October 2018

Revised December 2023

ARRO Project No. 00010714.95

East Earl Township
Lancaster County
4610 Division Highway
East Earl, PA 17519

ARRO Consulting, Inc.
108 West Airport Road
Lititz, PA 17543

TABLE OF CONTENTS

1. Introduction

East Earl Township (Township), Lancaster County was classified as a small Municipal Separate Storm Sewer System (MS4) based upon the 2010 U.S. Census urbanized area data. The Pennsylvania Department of Environmental Protection (PA DEP) has notified the Township that they are required to apply for coverage under a National Pollutant Discharge Elimination System (NPDES) MS4 individual permit. The requirements for East Earl Township are defined by the PA DEP MS4 Municipal Requirements Table as:

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Lancaster County						
East Earl Township	PAI133519	Yes	SP, IP	Chesapeake Bay Nutrients/Sediment	Appendix D – Nutrients, Siltation (4a)	
				Unnamed Tributaries to Cedar Creek	Appendix E – Siltation (5)	
				Conestoga River	Appendix E – Nutrients, Siltation (5)	
				Cedar Creek	Appendix E – Nutrients (5)	
				Shirks Run	Appendix E – Nutrients (5)	
				Mill Creek	Appendix B – Pathogens (5), Appendix E – Nutrients, Siltation (5)	

PA DEP has published the Municipal Pollutant Aggregation Suggestions for MS4 Requirements Table; per the aggregation instructions, the aggregate total required reduction may be analyzed and stormwater Best Management Practice (BMP) projects outlined in the PA DEP BMP Manual may be implemented in the identified watersheds, tributary to the same Hydrologic Unit Code (HUC) 12 watershed. The aggregated requirements for East Earl Township are:

MS4 Name	Permit Number	HUC 12 Name	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)
Lancaster County				
East Earl Township	PAI133519	Middle Conestoga River, Muddy Creek, Muddy Run-Mill Creek, Upper Conestoga River	Cedar Creek, Chesapeake Bay Nutrients/Sediment, Conestoga River, Mill Creek, Shirks Run, Unnamed Tributaries to Cedar Creek	Appendix D – Siltation/Nutrients, Appendix E – Nutrients, Siltation
		Muddy Run-Mill Creek	Mill Creek	Appendix B - Pathogens
		Middle Conestoga River, Muddy Creek, Muddy Run-Mill Creek, Upper Conestoga River	Cedar Creek, Chesapeake Bay Nutrients/Sediment, Conestoga River, Mill Creek, Shirks Run, Unnamed Tributaries to Cedar Creek	Appendix D – Siltation, Nutrients, Appendix E – Nutrients, Siltation
		Middle Conestoga River, Muddy Run-Mill Creek, Upper Conestoga River	Cedar Creek, Conestoga River, Mill Creek, Shirks Run, Unnamed Tributaries to Cedar Creek	Appendix E – Nutrients, Siltation

This Pollutant Reduction Plan (PRP) has been developed to satisfy the aggregated requirements, as put forward by the PA DEP.

2. Public Participation

The Township's original PRP was submitted in 2018 and was revised in December 2023 to include additional projects after which the Township advertised the update on the municipal website, in print at the municipal office, and during a public Township Board of Supervisors meeting.

East Earl Township encouraged a plan that included public participation and buy in. The Township advertised the PRP for public review and comment for a period of 45 days in the local newspaper on DATE; a copy of the advertisement can be found in Attachment A.I.

The Township posted a copy of the draft PRP on the Township website prior to the public notice. A hard copy was also made available at the Township office during normal business hours. The Township received written comments from DATE; a copy of all written comments is provided in Attachment A.II. A public meeting was held on DATE; a summary of comments received is provided in Attachment A.III.

The Township's record of consideration for all timely comments received is provided in Attachment A.IV. This PRP reflects careful planning of East Earl Township with respect to the impaired waters of the Commonwealth, local flooding, erosion problems, and the financial impact to the residents.

3. Mapping

In accordance with PA DEP guidelines for development of the PRP, East Earl Township completed mapping of the regulated MS4 Storm Sewersheds; the required mapping is provided in Attachment B. Mapping includes the collection and conveyance to the regulated outfalls, identified outlets and outfalls, potential BMP locations, parsing information, and waters of the Commonwealth within the Township's PRP planning area.

4. Pollutants of Concern

East Earl Township, in accordance with the PA DEP Municipal Requirements Table, is subject to an aggregation of Appendix D and Appendix E of the MS4 permit.

<u>Appendix D – Chesapeake Bay</u>

Appendix D is the requirement for development of a Chesapeake Bay Pollutant Reduction Plan (CBPRP). In accordance with the PRP guidelines, the goal of the CBPRP is for the following reductions:

- 3% reduction of Total Nitrogen (TN)
- 5% reduction of Total Phosphorous (TP)
- 10% reduction of Sediment (TSS)

Furthermore, the PA DEP PRP instructions state: “Permittees are encouraged to select appropriate BMPs to achieve the 10% sediment loading reduction objective, as it is expected that, overall within the Bay watershed, the TP (5%) and TN (3%) goals will be achieved when a 10% reduction in sediment is achieved.” The PRP has been prepared to meet the required 10% reduction of sediment.

Appendix E – Conestoga River, Cedar Creek, Shirks Run, Mill Creek

Appendix E is the requirement for development of a PRP for the identified impaired waterway. East Earl Township is responsible for developing a PRP for Appendix E impaired waters to address siltation. In accordance with the PRP guidelines, the goal of the PRP is for the following reductions:

- 3% reduction of Total Nitrogen (TN)
- 5% reduction of Total Phosphorous (TP)
- 10% reduction of Sediment (TSS)

Furthermore, the PA DEP PRP instructions state: “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 impaired is due to both siltation and nutrients, both sediment (10% reduction) and TP (5% reduction) must be addressed.” The PRP has been prepared to meet the required 10% reduction of sediment.

Aggregate Analysis

In accordance with the pollutant aggregation table, the Township may evaluate the aggregate total of the watershed’s tributary to the Appendix D and E impaired water. In accordance with the PRP guidelines, the aggregated goal of the PRP is for the following reduction:

- 10% reduction of Sediment (TSS)

5. Existing Loading for Pollutants of Concern

East Earl Township is subject to the requirements of Appendix D and E, therefore the pollutant loading for the storm sewersheds to the Chesapeake Bay and Appendix E waterbodies were calculated together. Pollutant loadings were calculated with Model My Watershed using 2019 NLCD land use/cover dataset; the calculated pollutant loadings are provided in Attachment C. The calculations are summarized below:

Appendix D - Chesapeake Bay/Appendix E - Cedar Creek, Conestoga River, Shirks Run, Mill Creek

	Model My Watershed		
	TN (lbs/yr)	**TP (lbs/yr)**	**TSS (lbs/yr)**
Muddy Run-Mill Creek	1,880.00	475.00	271,243.00
Muddy Creek	2,742.24	754.47	176,314.40
Upper Conestoga River	7,627.63	2,060.35	1,133,664.74
Total	**12,249.87**	**3,289.82**	**1,581,222.14**
Required Reduction Percent	3%	5%	10%
Required Reduction (lbs/yr)	**367.50**	**164.49**	**158,122.21**

A. Existing BMP Load Reductions

Based upon the mapping provided in Attachment B, East Earl Township identified existing BMPs that would reduce the pollutant loading. Attachment D provides a summary of the existing BMPs. The Township annually inspects BMPs that provide pollutant reduction credit within the Township to ensure they meet design standards, and any noted maintenance is conveyed to the responsible party to ensure proper operation and maintenance is occurring.

The Township parsed state roadways from calculations; additional information on the Township's parsing can be found in Attachment B. The percentage of pollutant reduction provided by each BMP was determined based upon the recommendation reports of the Chesapeake Bay Expert Panel. The updated existing BMP loading with BMP calculations are provided in Attachment E. The existing loading for TSS, TP, and TN was re-calculated for each storm sewershed accounting for the pollutant load reduction from the existing BMPs. The base pollutant loading and required pollutant reduction goal is summarized below:

East Earl Township Base Pollutant Loading with Existing BMPs Summary:

	Model My Watershed		
	TN (lbs/yr)	**TP (lbs/yr)**	**TSS (lbs/yr)**
Muddy Run-Mill Creek	3.40	1.68	1,405.97
Muddy Creek	2.24	1.12	140.66
Upper Conestoga River	42.04	21.55	23,941.77
Total BMP Reductions	**47.68**	**24.35**	**25,488.40**
Base Pollutant Loading with No BMPs	*12,249.87*	*3,289.82*	*1,581,222.14*
Base Pollutant Loading with Existing BMPs	**12,202.19**	**3,265.47**	**1,555,733.74**
Required Reduction Percentage	3%	5%	10%
Required Reduction (lbs/yr)	**366.07**	**163.27**	**155,573.37**

6. Selected BMPs

East Earl Township developed a Selected BMP concept plan to identify potential BMPs to be implemented. The associated pollutant loading reductions for each BMP were calculated and are provided in Attachment F along with a summary description of the Selected BMPs evaluated. The percentage of pollutant reductions provided by each BMP was determined based on the PA DEP BMP Effectiveness Value table. East Earl Township evaluated the following factors in selection of the BMPs to be implemented to achieve the required pollutant load reduction. These factors included:

- Overall BMP cost
- Availability of grant funding
- Feasibility of project
- Local flooding and erosion problems
- Drainage areas associated with identified waterways
- Consistency with economic development initiatives

Based upon the above factors, East Earl Township chose the Selected BMPs to be implemented under the MS4 permit from 2019 – 2024. The Selected BMP pollutant reductions are summarized below and in Attachment E:

	BMP ID	BMP Description	Linear Footage	TN (lbs/yr)	TP (lbs/yr)	TSS (lbs/yr)
Upper Conestoga River	BMP-SR1	Stream Restoration	1,440	276.48	250.56	165,600.00
Upper Conestoga River	BMP-SR2	Stream Restoration	2,640	506.88	459.36	303,600.00
Upper Conestoga River	BMPOF044-BR1	Basin Retrofit	N/A	30.29	5.34	16,585.26
Upper Conestoga River	BMPOF044-BS1	Bioswale	N/A	222.21	65.67	32,294.16
Upper Conestoga River	BMPOP005-BS2	Bioswale	N/A	15.67	3.70	10,149.78
Muddy Run-Mill Creek	BMPOF041-BS3	Bioswale	N/A	28.73	6.91	11,079.86
Total				1,080.26	791.54	539,309.06
Required Reduction				**366.07**	**163.27**	**155,573.37**
Surplus Reduction				+714.19	+628.27	+383,735.69

7. Funding Mechanism

East Earl Township, through the planning phase, evaluated the cost associated with the selected plan; the Selected BMP implementation costs are summarized below:

	Drainage Area ID	BMP Description	Estimated Project Total
BMP-SR1	Cedar Creek	Stream Restoration	$714,015
BMP-SR2	N.A	Stream Restoration	$348,487
BMPOF044-BR1	OF044	Basin Retrofit	$260,459
BMPOF044-BS1	OF044	Bioswale	$383,084
BMPOP005-BS2	OP005	Bioswale	$100,000
BMPOF041-BS3	OF041	Bioswale	$26,932
Total			**$1,832,977**

East Earl Township has received funding through the Lancaster Countywide Action Plan (CAP) and through various other grant opportunities in coordination with Lancaster Clean Water Partners and PA DEP. Any remaining costs will be funded through the Township's General Fund. More information regarding funding is outlined below:

Funding Source	Amount
Countywide Action Plan Implementation Program	BMPOF044-BR1 & BMPOF044-BS1 - $500,000
NFWF/Conservation Foundation of Lancaster County	BMPOF044-BR1 - $95,000 BMPOF044-BS1 - $171,683 BMP-SR1 - $30,000 BMP-SR2 - $30,000
Township's General Fund	All Remaining Costs

8. Responsible Parties for Operation and Maintenance (O&M) of BMPs

East Earl Township will own and operate the BMPs identified in the PRP. Specific requirements for each BMP are identified below:

<u>BMP-SR1: Stream Restoration:</u>

Location: 1060 Springville Rd.

Responsible Party: East Earl Township

O&M Activities:

-Maintenance is necessary every quarter to ensure proper functionality of the stream.

-Any structure that is expected to receive and/or trap debris and sediment shall be thoroughly inspected for excessive debris and clogging. Inspections shall be conducted at a minimum four (4) times per year or immediately following any storm creating greater than one (1) inch of water.

-During the regular inspections the ford stream crossing should be thoroughly inspected for erosion. Erosion should be repaired immediately with native stream bed material or in some cases riprap to ensure proper flow rate.

-Vehicles shall not be parked or driven on the streambed and care shall be taken to avoid excessive compaction by mower if applicable.

-Sediment removed from the site shall be disposed of properly, and any areas that were disturbed shall be stabilized and revegetated immediately.

-Care shall be taken to prevent compaction of in situ soils to promote healthy vegetation growth and to encourage infiltration.

-Inspect the stream and floodplain after runoff events and make sure the stream returns to average water levels within 72 hours.

-Also inspect for damage to erosion control measures, signs of water contamination/spills, and slope stability.

-Upkeep of vegetation including mowing and/or trimming shall be performed as necessary to sustain the system.

- ·Fertilizers and pesticides shall not be used in maintaining the vegetation.
- ·All vegetated areas shall be inspected every year for any erosion.
- ·All vegetated areas shall be inspected every year for unwanted growth of exotic and/or invasive species.
- ·Vegetative cover shall be maintained at a minimum of ninety-five (95) percent. Vegetation shall be reestablished if vegetative cover has been reduced by ten (10)percent.

-If during inspection there are invasive species present, methods to control or reduce them include the following:

- ·Mowing should occur twice each growing season, mowing height should be set between eight and twelve inches.
- ·Remove the plants immediately and replace with native plants as needed.

-An inspection checklist shall be included in the maintenance and shall be completed at a minimum once every year.

-Regular inspection of the stream shall occur to assure proper implementation of BMP's. Operation and maintenance plans shall be inspected by a qualified person, which may include the landowner or owner's designee.

BMP-SR2: Stream Restoration:

Location: 4996 Division Hwy.

Responsible Party: East Earl Township

O&M Activities:

-Maintenance is necessary every quarter to ensure proper functionality of the stream.
-Any structure that is expected to receive and/or trap debris and sediment shall be thoroughly inspected for excessive debris and clogging. Inspections shall be conducted at a minimum four (4) times per year or immediately following any storm creating greater than one (1) inch of water.
-During the regular inspections the ford stream crossing should be thoroughly inspected for erosion. Erosion should be repaired immediately with native stream bed material or in some cases riprap to ensure proper flow rate.
-Vehicles shall not be parked or driven on the streambed and care shall be taken to avoid excessive compaction by mower if applicable.
-Sediment removed from the site shall be disposed of properly, and any areas that were disturbed shall be stabilized and revegetated immediately.
-Care shall be taken to prevent compaction of in situ soils to promote healthy vegetation growth and to encourage infiltration.
-Inspect the stream and floodplain after runoff events and make sure the stream returns to average water levels within 72 hours.
-Also inspect for damage to erosion control measures, signs of water contamination/spills, and slope stability.
-Upkeep of vegetation including mowing and/or trimming shall be performed as necessary to sustain the system.

- Fertilizers and pesticides shall not be used in maintaining the vegetation.
- All vegetated areas shall be inspected every year for any erosion.
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- Remove the plants immediately and replace with native plants as needed.

-An inspection checklist shall be included in the maintenance and shall be completed at a minimum once every year.

-Regular inspection of the stream shall occur to assure proper implementation of BMP's. Operation and maintenance plans shall be inspected by a qualified person, which may include the landowner or owner's designee.

BMPOF044-BR1: Basin Retrofit:

Location: 158 Toddy Dr.

Responsible Party: East Earl Township

O&M Activities:

-Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when >3 inches at any spot or covering vegetation).

-Inspect vegetation on side slopes for erosion and formation of rills and gullies, correct as needed.

-Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade.

-Inspect for litter; remove prior to mowing.

-Remove invasive plants as needed or carefully apply herbicide to invasive plants as needed.

-Inspect for uniformity in cross-section and longitudinal slope, correct as needed.

-Inspect basin inlet (curb cuts, pipes, etc.) and outlet for signs of erosion or blockage, correct as needed.

-Plant alternative grass species in the event of unsuccessful establishment.

-Reseed bare areas; install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.

-Mow and trim vegetation 1-2 times per year outside of the growing season (i.e., only mow in early spring or late fall). Mower height should be set between 8-12 inches. Mow only when basin is dry to avoid rutting.

BMPOF044-BS1: Bioswale:

Location: 1060 Springville Road

Responsible Party: East Earl Township

O&M Activities:
-Any permanent seeded areas that become eroded shall have the topsoil replaced, the grass resown, and mulch reapplied or, at the direction of the owner, sod may be installed.
-Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when >3 inches at any spot or covering vegetation).
-Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed.
-Inspect for litter; remove prior to mowing.
-Remove invasive plants as needed or carefully apply selective herbicide to invasive plants as needed.
-Inspect for uniformity in cross-section and longitudinal slope, correct as needed.
-Inspect swale inlet (curb cuts, pipes, etc.) and outlet for signs of erosion or blockage, correct as needed.
-Plant alternative grass species in the event of unsuccessful establishment.
-Reseed bare areas; install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.
-Mow and trim vegetation 1-2 times per year outside of the growing season (i.e., only mow in early spring or late fall). Mower height should be set between 8-12 inches. Mow only when swale is dry to avoid rutting.

BMPOP005-BS2: Bioswale:

Location: Between Martin St. and East Earl Rd.

Responsible Party: East Earl Township

O&M Activities:
-Any permanent seeded areas that become eroded shall have the topsoil replaced, the grass resown, and mulch reapplied or, at the direction of the owner, sod may be installed.
-Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when >3 inches at any spot or covering vegetation).
-Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed.

-Inspect for litter; remove prior to mowing.
-Remove invasive plants as needed or carefully apply selective herbicide to invasive plants as needed.
-Inspect for uniformity in cross-section and longitudinal slope, correct as needed.
-Inspect swale inlet (curb cuts, pipes, etc.) and outlet for signs of erosion or blockage, correct as needed.
-Plant alternative grass species in the event of unsuccessful establishment.
-Reseed bare areas; install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.
-Mow and trim vegetation 1-2 times per year outside of the growing season (i.e., only mow in early spring or late fall). Mower height should be set between 8-12 inches. Mow only when swale is dry to avoid rutting.

BMPOF041-BS3: Bioswale:

Location: Witmer Rd.

Responsible Party: East Earl Township

O&M Activities:
-Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation (address when >3 inches at any spot or covering vegetation).
-Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed.
-Inspect for pools of standing water; dewater and discharge to an approved location and restore to design grade.
-Inspect for litter; remove prior to mowing.
-Remove invasive plants as needed or carefully apply selective herbicide to invasive plants as needed.
-Inspect for uniformity in cross-section and longitudinal slope, correct as needed.
-Inspect swale inlet (curb cuts, pipes, etc.) and outlet for signs of erosion or blockage, correct as needed.
-Plant alternative grass species in the event of unsuccessful establishment.
-Reseed bare areas; install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.
-Mow and trim vegetation 1-2 times per year outside of the growing season (i.e., only mow in early spring or late fall). Mower height should be set between 8-12 inches. Mow only when swale is dry to avoid rutting.

9. PRP IMPLEMENTATION SCHEDULE

Task	Implementation Date
MS4 Permit Authorization	March 2019
BMPOF041-BS3	October 2022
BMPOF044-BS2	August 2023
BMPOF044-BS1	October 2023
BMP-SR1	Spring 2024
BMP-SR2	Spring 2024
BMPOF044-BR1	Spring 2024
MS4 Permit Expiration	February 2024

ATTACHMENT A: Public Notice Documentation

I. PRP ADVERTISEMENT

II. WRITTEN PUBLIC COMMENTS

III. PUBLIC MEETING COMMENTS

IV. RECORD OF CONSIDERATION OF ALL TIMELY COMMENTS RECEIVED

Judy Muckle

From: legals@lnpnews.com
Sent: Wednesday, December 20, 2023 10:05 AM
To: Judy Muckle
Subject: Legal Ad: 4626819, East Earl Township has revised its P
Attachments: EASTEARLTO-47-4626819-1.pdf

This is scheduled to be published, as requested. The invoice and proof of publication will be mailed out after the final print date.

Please review the attached PDF proof for text and publishing dates, as this is exactly how and when it will print.

Thank you,

Karly Turpin
Classified Support Representative
LNP Media Group, Inc.

T. 717-291-8723
LNPMediaGroup.com

LNP MEDIA GROUP, Inc., P.O. Box 1328, Lancaster, PA 17608

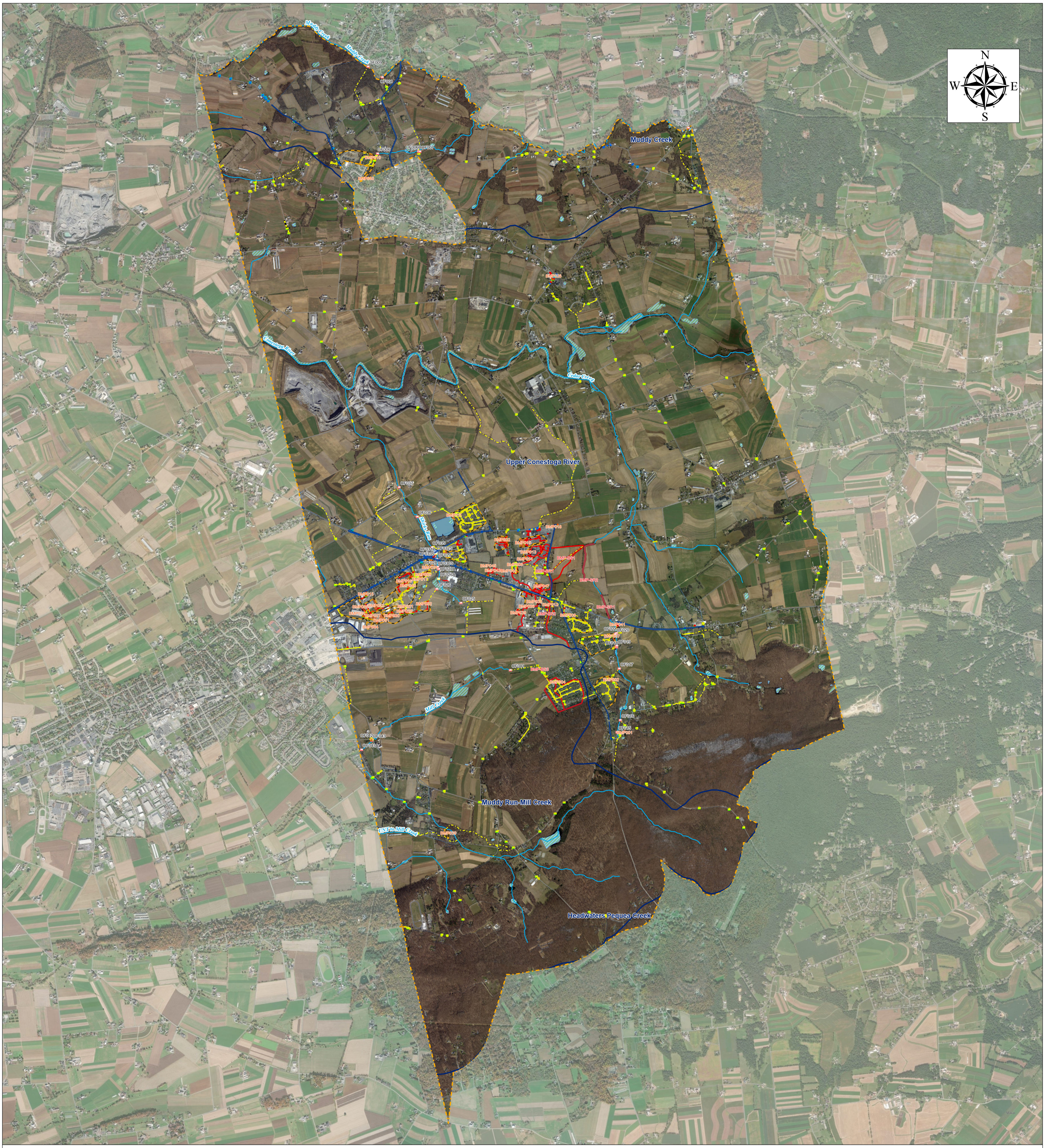
Account:	224096	Ad ID:	4626819
Client Type:	LT	Description:	East Earl Township has revised its P
Name:		Run Dates:	12/22/23 to 12/22/23
Company:	EAST EARL TOWNSHIP	Class:	107
Address:	4610 DIVISION HIGHWAY EAST EARL, PA 17519	Orig User:	KMCKILLIPS
		Lines:	23
Telephone:	(717) 354-5593	Agate Lines:	41
		Inserts:	1

Other Charges:	$15.00	Gross:	$129.08
Discount:	$0.00		
Surcharge:	$0.00	Paid Amount:	- $0.00
Credits:	$0.00		
Bill Depth:	2.958	Amount Due:	$129.08

Notes: 12/22

East Earl Township has revised its Pollution Reduction Plan (PRP) that is required under the Township's Individual Municipal Separate Storm Sewer System (MS4) Permit. A copy of the revised PRP can be accessed by visiting East Earl Township's municipal website, or by contacting the Township Office to receive a physical copy. Comments and/or questions regarding the PRP should be submitted to East Earl Township in the form of a public meeting comment, or via a written letter addressed to the Township Office. Comment will be received for 45 days following the advertisement of this notice.

ATTACHMENT B: Map – East Earl Township MS4 Conveyance System



\\lancfile4\GIS\East Earl Township\MS4 Master\MXD\East_Earl_PRP_Update_2023\East_Earl_PRP_Update_2023.aprx

Legen

- Observation Point
- Sample Point
- Township Outfall
- State Outfall
- Private Outfall
- Adjacent Municipality Outfall
- Township Inlet
- State Inlet
- Private Inlet
- Adjacent Municipality Inlet
- Township Manhole
- Private Manhole
- Township Outlet
- State Outlet
- Private Outlet
- Township Headwall
- Private Headwall
- Township Endwall
- Private Endwall
- Township Stormpipe
- State Stormpipe
- Private Stormpipe
- Adjacent Municipality Stormpipe
- Township Trench Drain
- Private Trench Drain
- Township Culvert
- State Culvert
- Private Culvert
- Adjacent Municipality Culvert
- Township Swale
- State Swale
- Private Swale
- Adjacent Municipality Swale
- NHD Stream
- Exsisting BMPs
- Existing BMPs Drainage Areas
- Proposed BMPs
- Proposed BMPs Drainage Areas
- NWI Wetland
- NHD Waterbody
- PA HUC12
- Urbanized Area 2010
- Township Boundary
- ParsedArea_PairwiseErase

East Earl Township

Pollutant Reduction Plan Map

East Earl Township, Lancaster County, PA

0 0.25 0.5 1 Miles

0 1,000 2,000 4,000 Feet

1:15,000

Published: 11/29/2023 AA
Source Data: ARRO Consulting Inc., Chester County GIS,
Esri, Maxar, Earthstar Geographics, U.S. Census Bureau,
USGS National Hydrography Dataset (NHD)
Imagery Source: PEMA 2020
Projection/Coordinate System: NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

ATTACHMENT C: Existing Pollutants of Concern

Data Entered By: *Raphael Caloia*
Date Data Entered: *10/18/2023*
Source File Name: *Muddy Creek PRP*
Watershed: *Muddy Creek*
Year: *2019*

Model My Watershed OUTPUT DATA

Source	Area	Sediment	Tot N	Tot P
Units	*acres*	*tons/year*	*lbs/year*	*lbs/year*
Hay/Past	2,632.1	143.5	1,450.7	590.1
Cropland	6,103.7	4,976.9	36,588.2	12,642.8
Forest	9,521.0	11.9	547.3	52.3
Wetland	279.0	0.3	120.4	68.4
Disturbed	0.0	0.0	0.0	0.0
Turfgrass	0.0	0.0	0.0	0.0
Open_Land	177.8	3.9	120.2	10.6
Bare_Rock	69.1	0.0	23.8	0.9
Sandy_Areas	0.0	0.0	0.0	0.0
Unpaved_Road	0.0	0.0	0.0	0.0
Ld_Mixed	3,229.6	20.8	1,073.6	114.9
Md_Mixed	558.0	18.5	723.5	73.9
Hd_Mixed	121.0	4.0	157.9	16.1
Ld_Residential	0.0	0.0	0.0	0.0
Md_Residential	0.0	0.0	0.0	0.0
Hd_Residential	0.0	0.0	0.0	0.0
Farm Animals		0.0	103,904.0	26,081.4
Tile Drainage		0.0	0.0	0.0
Stream Bank		2.2	2,784.9	1,223.8
Groundwater		0.0	499,400.1	4,032.1
Point Source		0.0	6,002.0	562.3
Septic Systems		0.0	1,752.3	0.0
Totals	*22,691.4*	*5,182.1*	*654,648.8*	*45,469.3*

STREAM LENGTHS* **KM*** **FEET**

			Sed lb/ft	*TN lb/ft*	*TP lb/ft*
Total Length	56.02	183792.7	0.0	0.02	0.01
Ag Streams	9.59	31463.3			
Non-Ag Streams	46.43	152329.4			

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

FARM ANIMAL DATA

TYPE*	NUMBER*	AVG WT KG	TOTAL KG	TOTAL AEU	KG N/AEU/DAY	KG P/AEU/DAY	TOTAL N/DAY	TOTAL P/DAY
Chickens, Broilers	299377	0.9	269439.3	269.4393	1.07	0.3	288.300051	80.83179
Chickens, Layers	0	1.8	0	0	0.85	0.29	0	0
Cows, Beef	173	360	62280	62.28	0.31	0.09	19.3068	5.6052
Cows, Dairy	3410	640	2182400	2182.4	0.44	0.07	960.256	152.768
Horses	481	500	240500	240.5	0.28	0.06	67.34	14.43
Pigs/Hogs/Swine	10934	61	666974	666.974	0.48	0.15	320.14752	100.0461
Sheep	360	50	18000	18	0.37	0.1	6.66	1.8
Turkeys	6149	6.8	41813.2	41.8132	0.59	0.2	24.669788	8.36264
					Daily Totals		1686.68	363.84
					Poultry Totals		312.97	89.19
					Livestock Totals		1373.71	274.65
					Poultry Fraction		0.2278	0.3248
					Livestock Fraction		0.8144	0.7549

* These values can be obtained from the "Animal" tab in the "Analyze" section of a Model My Watershed run

MMW NLCD Land Cover Categories for Watershed (from "Analyze" csv file)

TYPE	AREA (km^2)	AREA (acres)
Open Water	0.14	34.57
Perennial Ice/Snow	0	-
Developed, Open Space	7.34	1,812.35
Developed, Low Intensity	5.74	1,417.28
Developed, Medium Intensity	2.26	558.02
Developed, High Intensity	0.49	120.99
Barren Land (Rock/Sand/Clay)	0.28	69.14
Deciduous Forest	32.49	8,022.22
Evergreen Forest	0.08	19.75
Mixed Forest	3.7	913.58
Shrub/Scrub	2.29	565.43
Grassland/Herbaceous	0.72	177.78
Pasture/Hay	10.66	2,632.10
Cultivated Crops	24.72	6,103.70
Woody Wetlands	1.07	264.20
Emergent Herbaceous Wetlands	0.06	14.81
Totals	*91.90*	*22,691.36*

Pollutant Load Conversion from Metric to Standard Units (from "Model" csv file)

SOURCE	SEDIMENT (kg)	TOTAL N (kg)	TOTAL P (kg)	SEDIMENT (tons)	TOTAL N (lbs)	TOTAL P (lbs)
Hay/Pasture	130173.6	657.9	267.6	143.5	1450.7	590.1
Cropland	4514220.8	16593.3	5733.7	4976.9	36588.2	12642.8
Wooded Areas	10817.4	248.2	23.7	11.9	547.3	52.3
Wetlands	262.5	54.6	31.0	0.3	120.4	68.4
Open Land	3524.4	54.5	4.8	3.9	120.2	10.6
Barren Areas	40.3	10.8	0.4	0.0	23.8	0.9
Low-Density Mixed	8296.1	213.7	22.9	9.1	471.2	50.5
Medium-Density Mixed	16741.5	328.1	33.5	18.5	723.5	73.9
High-Density Mixed	3655.5	71.6	7.3	4.0	157.9	16.1
Low-Density Open Space	10608.0	273.2	29.2	11.7	602.4	64.4
Farm Animals	0.0	47122.0	11828.3	0.0	103904.0	26081.4
Stream Bank Erosion	1996.3	1263.0	555.0	2.2	2784.9	1223.8
Subsurface Flow	0.0	226485.3	1828.6	0.0	499400.1	4032.1
Point Sources	0.0	2722.0	255.0	0.0	6002.0	562.3
Septic Systems	0.0	794.7	0.0	0.0	1752.3	0.0
Totals		*4,700,336.4*	*296,892.9*	*20,621.0*	*5,182.1*	*654,648.8*	*45,469.3*

Note: The information below is only used for allocation of "urban" loads within a larger watershed boundary

MMW NLCD Land Cover Categories for Urban Area (from second, smaller "Analyze" csv file)

TYPE	AREA (km^2)	AREA (acres)	TN (lb/yr)	TP (lb/yr)	Sediment (lb/yr)
Open Water		-			
Perennial Ice/Snow		-			
Developed, Open Space		-	0.00	0.00	0.00
Developed, Low Intensity		-	0.00	0.00	0.00
Developed, Medium Intensity		-	0.00	0.00	0.00
Developed, High Intensity		-	0.00	0.00	0.00
Barren Land (Rock/Sand/Clay)		-	0.00	0.00	0.00
Deciduous Forest		-	0.00	0.00	0.00
Evergreen Forest		-	0.00	0.00	0.00
Mixed Forest		-	0.00	0.00	0.00
Shrub/Scrub		-	0.00	0.00	0.00
Grassland/Herbaceous		-	0.00	0.00	0.00
Pasture/Hay		-	0.00	0.00	0.00
Cultivated Crops		-	0.00	0.00	0.00
Woody Wetlands		-	0.00	0.00	0.00
Emergent Herbaceous Wetlands		-	0.00	0.00	0.00
Totals	-	-	-	-	-

(Note: The values below only pertain to the smaller target area)

STREAM LENGTH: **KM*** **FEET**

Total Length	0.31	1017.1
Ag Streams	0	0.0
Non-Ag Streams	0.31	1017.1

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

TYPE	AREA (m^2)*	AREA (acres)			
Open Water	0	0.00			
Perennial Ice/Snow	0	0.00			
Developed, Open Space	190211.78	46.97	26.77	6.11	621.81
Developed, Low Intensity	171370.05	42.31	24.12	5.50	560.21
Developed, Medium Intensity	80750.29	19.94	33.70	6.98	1,334.84
Developed, High Intensity	10766.7	2.66	4.86	1.25	180.39
Barren Land (Rock/Sand/Clay)	0	0.00	0.00	0.00	0.00
Deciduous Forest	358890.16	88.61	13.29	4.43	234.89
Evergreen Forest	0	0.00	0.00	0.00	0.00
Mixed Forest	148042.19	36.55	5.48	1.83	96.89
Shrub/Scrub	100489.24	24.81	3.72	1.24	65.77
Grassland/Herbaceous	6280.58	1.55	1.19	0.16	68.01
Pasture/Hay	257503.69	63.58	796.67	206.64	6,942.83
Cultivated Crops	412723.68	101.91	1,831.27	519.73	166,203.83
Woody Wetlands	8972.5	2.22	1.15	0.62	4.92
Emergent Herbaceous Wetlands	0	0.00	0.00	0.00	0.00
Totals	*1746000.86*	*431.11*	*2,742.24*	*754.47*	*176,314.40*

*Only use this input block if land cover distribution is given in square meters (m^2).
This occurs when AOI is less than about 2 square kilometers.

TOTAL LOADS **2,742.24** **754.47** **176,314.40**

Data Entered By: *Raphael Caloia*
Date Data Entered: *10/18/2023*
Source File Name: *Upper Conestoga River PRP*
Watershed: *Upper Conestoga River*
Year: *2019*

Model My Watershed OUTPUT DATA

Source	Area	Sediment	Tot N	Tot P
Units	*acres*	*tons/year*	*lbs/year*	*lbs/year*
Hay/Past	3,639.5	153.9	1,835.2	716.8
Cropland	17,772.8	11,233.4	94,094.2	29,579.2
Forest	8,730.9	7.2	381.0	34.0
Wetland	254.3	0.2	95.9	5.5
Disturbed	0.0	0.0	0.0	0.0
Turfgrass	0.0	0.0	0.0	0.0
Open_Land	276.5	4.0	178.2	12.1
Bare_Rock	409.9	0.1	139.4	4.9
Sandy_Areas	0.0	0.0	0.0	0.0
Unpaved_Road	0.0	0.0	0.0	0.0
Ld_Mixed	5,711.1	37.4	1,958.0	204.8
Md_Mixed	1,481.5	46.5	2,019.6	207.3
Hd_Mixed	659.3	20.7	899.0	92.4
Ld_Residential	0.0	0.0	0.0	0.0
Md_Residential	0.0	0.0	0.0	0.0
Hd_Residential	0.0	0.0	0.0	0.0
Farm Animals		0.0	170,468.6	42,725.4
Tile Drainage		0.0	0.0	0.0
Stream Bank		5,403.1	7,325.0	3,005.4
Groundwater		0.0	811,514.5	6,669.2
Point Source		0.0	8,103.4	443.2
Septic Systems		0.0	4,649.7	0.0
Totals	*38,935.8*	*16,906.5*	*1,103,661.6*	*83,700.3*

STREAM LENGTHS* **KM*** **FEET**

			Sed lb/ft	*TN lb/ft*	*TP lb/ft*
Total Length	103.47	339468.5	31.8	0.02	0.01
Ag Streams	55.51	182119.4			
Non-Ag Streams	47.96	157349.1			

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

FARM ANIMAL DATA

TYPE*	NUMBER*	AVG WT KG	TOTAL KG	TOTAL AEU	KG N/AEU/DAY	KG P/AEU/DAY	TOTAL N/DAY	TOTAL P/DAY
Chickens, Broilers	483865	0.9	435478.5	435.4785	1.07	0.3	465.961995	130.64355
Chickens, Layers	0	1.8	0	0	0.85	0.29	0	0
Cows, Beef	286	360	102960	102.96	0.31	0.09	31.9176	9.2664
Cows, Dairy	5603	640	3585920	3585.92	0.44	0.07	1577.8048	251.0144
Horses	834	500	417000	417	0.28	0.06	116.76	25.02
Pigs/Hogs/Swine	17783	61	1084763	1084.763	0.48	0.15	520.68624	162.71445
Sheep	600	50	30000	30	0.37	0.1	11.1	3
Turkeys	10305	6.8	70074	70.074	0.59	0.2	41.34366	14.0148
				Daily Totals			2765.57	595.67
				Poultry Totals			507.31	144.66
				Livestock Totals			2258.27	451.02
				Poultry Fraction			0.2246	0.3207
				Livestock Fraction			0.8166	0.7572

* These values can be obtained from the "Animal" tab in the "Analyze" section of a Model My Watershed run

MMW NLCD Land Cover Categories for Watershed (from "Analyze" csv file)

TYPE	AREA (km^2)	AREA (acres)
Open Water	0.41	101.23
Perennial Ice/Snow	0	-
Developed, Open Space	12.11	2,990.12
Developed, Low Intensity	11.02	2,720.99
Developed, Medium Intensity	6	1,481.48
Developed, High Intensity	2.67	659.26
Barren Land (Rock/Sand/Clay)	1.66	409.88
Deciduous Forest	30.27	7,474.07
Evergreen Forest	0.07	17.28
Mixed Forest	3.24	800.00
Shrub/Scrub	1.78	439.51
Grassland/Herbaceous	1.12	276.54
Pasture/Hay	14.74	3,639.51
Cultivated Crops	71.98	17,772.84
Woody Wetlands	0.96	237.04
Emergent Herbaceous Wetlands	0.07	17.28
Totals	*157.69*	*38,935.80*

Pollutant Load Conversion from Metric to Standard Units (from "Model" csv file)

SOURCE	SEDIMENT (kg)	TOTAL N (kg)	TOTAL P (kg)	SEDIMENT (tons)	TOTAL N (lbs)	TOTAL P (lbs)
Hay/Pasture	139555.2	832.3	325.1	153.9	1835.2	716.8
Cropland	10188997.2	42673.1	13414.6	11233.4	94094.2	29579.2
Wooded Areas	6525.5	172.8	15.4	7.2	381.0	34.0
Wetlands	169.1	43.5	2.5	0.2	95.9	5.5
Open Land	3633.7	80.8	5.5	4.0	178.2	12.1
Barren Areas	120.6	63.2	2.2	0.1	139.4	4.9
Low-Density Mixed	16162.6	423.0	45.2	17.8	932.7	99.7
Medium-Density Mixed	42171.2	915.9	94.0	46.5	2019.6	207.3
High-Density Mixed	18772.3	407.7	41.9	20.7	899.0	92.4
Low-Density Open Space	17766.7	465.0	47.7	19.6	1025.3	105.2
Farm Animals	0.0	77310.0	19376.6	0.0	170468.6	42725.4
Stream Bank Erosion	4900782.0	3322.0	1363.0	5403.1	7325.0	3005.4
Subsurface Flow	0.0	368033.8	3024.6	0.0	811514.5	6669.2
Point Sources	0.0	3675.0	201.0	0.0	8103.4	443.2
Septic Systems	0.0	2108.7	0.0	0.0	4649.7	0.0
Totals	*15,334,656.1*	*500,526.8*	*37,959.3*	*16,906.5*	*1,103,661.6*	*83,700.3*

Note: The information below is only used for allocation of "urban" loads within a larger watershed boundary

MMW NLCD Land Cover Categories for Urban Area (from second, smaller "Analyze" csv file)

TYPE	AREA (km^2)	AREA (acres)	TN (lb/yr)	TP (lb/yr)	Sediment (lb/yr)
Open Water	0	-			
Perennial Ice/Snow	0	-			
Developed, Open Space	0.92	227.16	147.65	34.07	92,091.24
Developed, Low Intensity	0.95	234.57	152.47	35.19	95,094.21
Developed, Medium Intensity	0.64	158.02	293.93	60.05	143,691.62
Developed, High Intensity	0.38	93.83	190.47	45.98	125,634.20
Barren Land (Rock/Sand/Clay)	0.01	2.47	1.19	0.17	515.56
Deciduous Forest	0.06	14.81	2.67	0.89	3,108.19
Evergreen Forest	0	-	0.00	0.00	0.00
Mixed Forest	0.06	14.81	2.67	0.89	3,108.19
Shrub/Scrub	0.02	4.94	0.89	0.30	1,036.06
Grassland/Herbaceous	0	-	0.00	0.00	0.00
Pasture/Hay	0.51	125.93	1,082.96	284.59	36,859.06
Cultivated Crops	1.74	429.63	5,752.74	1,598.22	632,526.42
Woody Wetlands	0	-	0.00	0.00	0.00
Emergent Herbaceous Wetlands	0	-	0.00	0.00	0.00
Totals	*5.29*	*1,306.17*	*7,627.63*	*2,060.35*	*1,133,664.74*

(Note: The values below only pertain to the smaller target area)

STREAM LENGTH **KM*** **FEET**

Total Length	2.87	9416.0
Ag Streams	1.5	4921.3
Non-Ag Streams	1.38	4527.6

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

Data Entered By: *Raphael Caloia*
Date Data Entered: *10/18/2023*
Source File Name: *Muddy Run Mill Creek PRP*
Watershed: *Muddy Run-Mill Creek*
Year: *2019*

Model My Watershed OUTPUT DATA

Source	Area	Sediment	Tot N	Tot P
Units	*acres*	*tons/year*	*lbs/year*	*lbs/year*
Hay/Past	4,409.9	191.0	2,187.6	751.2
Cropland	17,602.5	10,178.9	89,150.1	23,842.7
Forest	3,481.5	2.5	137.2	11.5
Wetland	22.2	0.0	6.8	0.4
Disturbed	0.0	0.0	0.0	0.0
Turfgrass	0.0	0.0	0.0	0.0
Open_Land	39.5	0.5	22.5	1.3
Bare_Rock	7.4	0.0	2.0	0.0
Sandy_Areas	0.0	0.0	0.0	0.0
Unpaved_Road	0.0	0.0	0.0	0.0
Ld_Mixed	6,990.1	43.0	2,318.3	246.1
Md_Mixed	2,155.6	64.9	2,948.7	303.2
Hd_Mixed	1,229.6	37.0	1,682.0	172.9
Ld_Residential	0.0	0.0	0.0	0.0
Md_Residential	0.0	0.0	0.0	0.0
Hd_Residential	0.0	0.0	0.0	0.0
Farm Animals		0.0	192,006.5	48,203.9
Tile Drainage		0.0	0.0	0.0
Stream Bank		6,903.3	10,209.2	3,415.5
Groundwater		0.0	869,762.9	6,828.0
Point Source		0.0	53,698.4	2,983.4
Septic Systems		0.0	6,760.1	0.0
Totals	*35,938.3*	*17,421.2*	*1,230,892.3*	*86,760.1*

STREAM LENGTHS* **KM*** **FEET**

			Sed lb/ft	*TN lb/ft*	*TP lb/ft*
Total Length	99.19	325426.5	42.4	0.03	0.01
Ag Streams	57.91	189993.4			
Non-Ag Streams	41.28	135433.1			

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

FARM ANIMAL DATA

TYPE*	NUMBER*	AVG WT KG	TOTAL KG	TOTAL AEU	KG N/AEU/DAY	KG P/AEU/DAY	TOTAL N/DAY	TOTAL P/DAY
Chickens, Broilers	575731	0.9	518157.9	518.1579	1.07	0.3	554.428953	155.44737
Chickens, Layers	0	1.8	0	0	0.85	0.29	0	0
Cows, Beef	291	360	104760	104.76	0.31	0.09	32.4756	9.4284
Cows, Dairy	6474	640	4143360	4143.36	0.44	0.07	1823.0784	290.0352
Horses	924	500	462000	462	0.28	0.06	129.36	27.72
Pigs/Hogs/Swine	20994	61	1280634	1280.634	0.48	0.15	614.70432	192.0951
Sheep	633	50	31650	31.65	0.37	0.1	11.7105	3.165
Turkeys	12492	6.8	84945.6	84.9456	0.59	0.2	50.117904	16.98912
					Daily Totals		3215.88	694.88
					Poultry Totals		604.55	172.44
					Livestock Totals		2611.33	522.44
					Poultry Fraction		0.2315	0.3301
					Livestock Fraction		0.8120	0.7518

* These values can be obtained from the "Animal" tab in the "Analyze" section of a Model My Watershed run

MMW NLCD Land Cover Categories for Watershed (from "Analyze" csv file)

TYPE	AREA (km^2)	AREA (acres)
Open Water	0.09	22.22
Perennial Ice/Snow	0	-
Developed, Open Space	13.88	3,427.16
Developed, Low Intensity	14.43	3,562.96
Developed, Medium Intensity	8.73	2,155.56
Developed, High Intensity	4.98	1,229.63
Barren Land (Rock/Sand/Clay)	0.03	7.41
Deciduous Forest	9.16	2,261.73
Evergreen Forest	0.19	46.91
Mixed Forest	4.01	990.12
Shrub/Scrub	0.74	182.72
Grassland/Herbaceous	0.16	39.51
Pasture/Hay	17.86	4,409.88
Cultivated Crops	71.29	17,602.47
Woody Wetlands	0.04	9.88
Emergent Herbaceous Wetlands	0.05	12.35
Totals	*145.55*	*35,938.27*

Pollutant Load Conversion from Metric to Standard Units (from "Model" csv file)

SOURCE	SEDIMENT (kg)	TOTAL N (kg)	TOTAL P (kg)	SEDIMENT (tons)	TOTAL N (lbs)	TOTAL P (lbs)
Hay/Pasture	173211.3	992.1	340.7	191.0	2187.6	751.2
Cropland	9232574.8	40430.9	10813.0	10178.9	89150.1	23842.7
Wooded Areas	2294.1	62.2	5.2	2.5	137.2	11.5
Wetlands	16.4	3.1	0.2	0.0	6.8	0.4
Open Land	467.2	10.2	0.6	0.5	22.5	1.3
Barren Areas	2.7	0.9	0.0	0.0	2.0	0.0
Low-Density Mixed	19866.9	536.0	56.9	21.9	1181.9	125.5
Medium-Density Mixed	58876.1	1337.3	137.5	64.9	2948.7	303.2
High-Density Mixed	33582.0	762.8	78.4	37.0	1682.0	172.9
Low-Density Open Space	19102.6	515.4	54.7	21.1	1136.5	120.6
Farm Animals	0.0	87077.8	21861.2	0.0	192006.5	48203.9
Stream Bank Erosion	6261506.0	4630.0	1549.0	6903.3	10209.2	3415.5
Subsurface Flow	0.0	394450.3	3096.6	0.0	869762.9	6828.0
Point Sources	0.0	24353.0	1353.0	0.0	53698.4	2983.4
Septic Systems	0.0	3065.8	0.0	0.0	6760.1	0.0
Totals	*15,801,500.1*	*558,227.8*	*39,347.0*	*17,421.2*	*1,230,892.3*	*86,760.1*

Note: The information below is only used for allocation of "urban" loads within a larger watershed boundary

MMW NLCD Land Cover Categories for Urban Area (from second, smaller "Analyze" csv file)

TYPE	AREA (km^2)	AREA (acres)	TN (lb/yr)	TP (lb/yr)	Sediment (lb/yr)
Open Water		-			
Perennial Ice/Snow		-			
Developed, Open Space		-	0.00	0.00	0.00
Developed, Low Intensity		-	0.00	0.00	0.00
Developed, Medium Intensity		-	0.00	0.00	0.00
Developed, High Intensity		-	0.00	0.00	0.00
Barren Land (Rock/Sand/Clay)		-	0.00	0.00	0.00
Deciduous Forest		-	0.00	0.00	0.00
Evergreen Forest		-	0.00	0.00	0.00
Mixed Forest		-	0.00	0.00	0.00
Shrub/Scrub		-	0.00	0.00	0.00
Grassland/Herbaceous		-	0.00	0.00	0.00
Pasture/Hay		-	0.00	0.00	0.00
Cultivated Crops		-	0.00	0.00	0.00
Woody Wetlands		-	0.00	0.00	0.00
Emergent Herbaceous Wetlands		-	0.00	0.00	0.00
Totals	-	-	-	-	-

(Note: The values below only pertain to the smaller target area)

STREAM LENGTH: **KM*** **FEET**

Total Length	1.51	4954.1
Ag Streams	0.41	1345.1
Non-Ag Streams	1.11	3641.7

* These values can be obtained from the "Stream" tab in the "Analyze" section of a Model My Watershed run

TYPE	AREA (m^2)*	AREA (acres)	TN (lb/yr)	TP (lb/yr)	Sediment (lb/yr)
Open Water	0	0.00			
Perennial Ice/Snow	0	0.00			
Developed, Open Space	220719.88	54.50	37.06	8.17	25,083.79
Developed, Low Intensity	284423.59	70.23	47.76	10.53	32,323.42
Developed, Medium Intensity	80751.18	19.94	39.28	6.98	17,993.90
Developed, High Intensity	115743.35	28.58	63.16	12.57	36,449.68
Barren Land (Rock/Sand/Clay)	0	0.00	0.00	0.00	0.00
Deciduous Forest	40375.59	9.97	2.49	0.70	2,886.95
Evergreen Forest	1794.47	0.44	0.11	0.03	128.31
Mixed Forest	41272.82	10.19	2.55	0.71	2,951.11
Shrub/Scrub	54731.35	13.51	3.38	0.95	3,913.43
Grassland/Herbaceous	17944.71	4.43	3.46	0.44	1,392.19
Pasture/Hay	172269.18	42.54	401.11	103.36	15,939.79
Cultivated Crops	370558.18	91.50	1,280.03	330.30	132,180.80
Woody Wetlands	0	0.00	0.00	0.00	0.00
Emergent Herbaceous Wetlands	0	0.00	0.00	0.00	0.00
Totals	*1400584.3*	*345.82*	*1,880.37*	*474.75*	*271,243.37*

*Only use this input block if land cover distribution is given in square meters (m^2).
This occurs when AOI is less than about 2 square kilometers.

TOTAL LOADS **1,880.37** **474.75** **271,243.37**

ATTACHMENT D: Existing BMP Pollutant Reductions

Urban BMP Load Reduction Calculation Table Muddy Creek

INSTRUCTIONS: Each row in the table below can represent either different areas of land use/cover within a single planning area (e.g., municipality), or different BMP drainage areas within a given planning area.
If an individual planning area has multiple "developed land" types, each type can be represented in separate rows, with each row having the same "Project Name". If it is assumed that the planning area is being treated by one BMP system, then the "Treatment Depth" should be the same for each row.
Similarly, a given planning area can have multiple "BMP drainage areas" (i.e., areas treated by different BMP systems). If a BMP drainage area has multiple "developed land" types, separate "land use areas" can be represented on separate rows, with each row having the same "Project Name". Also, in the case of "RR" and "ST" BMP types, the treatment depth should be the same for any row associated with the same Project Name.
If runoff from a land use/cover type with NO impervious cover (e.g., Cropland) is treated by a BMP system (either existing or proposed), use the Manual Override (column R) to type in the treatment depth instead of column Q as would normally be done.
Examples of various options for characterizing different types of project areas are provided in the "Example" spreadsheet that is also available for downloading from the Model My Watershed site.

Project Name	BMP Name	BMP Type	Existing or Proposed	Year Installed	BMP Surface Area (Square Feet)	BMP Surface Area (Acres)	MapShed Land Cover of Drainage Area	Drainage Area Treated by BMP (Acres)	Impervious Area (ac)	BMP Loading Ratio1 (Impervious Area / BMP Surface Area)	BMP Loading Ratio2 (BMP Water Vol / Runoff Vol from 2.5" Rain)	Treatment Depth (in/imp. ac)	Treatment Depth (in/ac) for Manual Override - use if no impervious area	Effective Treatment Depth (in/imp. ac)	Impervious Surface (%)	TSS Load (lbs/yr)	TP Load (lbs/yr)	TN Load (lbs/yr)	TSS Reduction (%)	TP Reduction (%)	TN Reduction (%)	TSS Reduction (lbs/yr)	TSS Reduction (tons/yr)	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)
BMP010	BMP010	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00	Ld_Mixed	7.32	1.10	#N/A	0.00	0.00		0.00	15.0%	96.91	0.95	4.17	10.0%	10.0%	5.0%	9.69	0.00	0.10	0.21
BMP010	BMP010	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00	Md_Mixed	5.54	2.88	#N/A	0.00	0.00		0.00	52.0%	370.89	1.94	9.36	10.0%	10.0%	5.0%	37.09	0.02	0.19	0.47
BMP010	BMP010	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00	Hd_Mixed	0.22	0.19	#N/A	0.00	0.00		0.00	87.0%	14.93	0.10	0.40	10.0%	10.0%	5.0%	1.49	0.00	0.01	0.02
BMP010	BMP010	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00	Forest	4.88	0.00	#N/A	#N/A	#N/A		#N/A	0.0%	12.94	0.24	0.73	10.0%	10.0%	5.0%	1.29	0.00	0.02	0.04
BMP010	BMP010	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00	Hay/Past	1.77	0.00	#N/A	#N/A	#N/A		#N/A	0.0%	193.28	5.75	22.18	10.0%	10.0%	5.0%	19.33	0.01	0.58	1.11
BMP010	BMP010	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00	Cropland	0.44	0.00	#N/A	#N/A	#N/A		#N/A	0.0%	717.61	2.24	7.91	10.0%	10.0%	5.0%	71.76	0.04	0.22	0.40

NOTE: the above table is an Excel Table, which has special features https://support.office.com/en-us/article/overview-of-excel-tables-7ab0bb7d-3a9e-4b56-a3c9-6c94334e492c

ADD ROWS by right-clicking a row number inside the Table, and chosing "Insert". This will automatically copy formulas and update links throughout this workbook.

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Cells requiring user input for BMP efficiencies calculated using Performance Standard approach (i.e., RR and ST BMP Types). Drainage Area not needed for Stream Restoration BMP. Also, Treatment Depth not needed for all "non-Performance Standard" BMPs
Cells requiring user input for non-Performance Standard BMPs except for Stream Restoration, Street Sweeping and Forest Buffers. .
Cell values calculated based on user input
Optional user input for treatment depth in non-developed areas (e.g., cropland)
Optional user input of descriptive information

Special Notes for Non-Performance Standard BMPs

1) Surface Area is only used for Forest Buffers and "infiltration" BMPs (see Tech Docs tab)

2) Water Volume is used for other "non-infiltration" BMPs (see Tech Docs tab)

3) Stream Restoration BMPs require input values for stream length

4) Street Sweeping BMPs require input values for Road Length Swept

	Streambank Erosion	Calculated	Default
	Sed Load Rate (lb/ft/yr)	0.02	115.00
	TN Load Rate (lb/ft/yr)	0.02	0.19
	TP Load Rate (lb/ft/yr)	0.01	0.17

Land Use/Cover Distribution for the Smaller Urban Planning Area (Note: If this tab is being used for MS4 reductions, the total acres of developed land used should not exceed those given below).

SOURCE	AREA (acres)
Hay/Pasture	-
Cropland	-
Wooded Areas	-
Wetlands	-
Open Land	-
Barren Areas	-
Low-Density Mixed	-
Medium-Density Mixed	-
High-Density Mixed	-
Total	-

STREAM LENGTHS	KM*	FEET
Total Length	0.31	1,017.1
Ag Streams	0	0.0
Non-Ag Streams	0.31	1,017.1

TOTAL LBS REDUCED		140.66	0.07	1.12	2.24
Existing TOTAL LBS REDUCED		140.66	0.07	1.12	2.24
Proposed TOTAL LBS REDUCED		-	-	-	-
Project Name					
BMP010	LBS REDUCED	140.66	0.07	1.12	2.24
		-	-	-	-
		-	-	-	-
		-	-	-	-
		-	-	-	-
		-	-	-	-
		-	-	-	-

152329.4 Available stream length (ft) in Non-Ag Areas in the entire watershed (from MMW Output tab)
1017.1 Available stream length (ft) in Non-Ag Areas in the smaller target area (from MMW Output tab)

Note: The use of the "Stream Restoration" BMP type in this tab is only for streams associated with developed land areas.

Urban BMP Load Reduction Calculation Table Upper Conestoga River

INSTRUCTIONS: Each row in the table below can represent either different areas of land use/cover within a single planning area (e.g., municipality), or different BMP drainage areas within a given planning area.
If an individual planning area has multiple "developed land" types, each type can be represented in separate rows, with each row having the same "Project Name". If it is assumed that the planning area is being treated by one BMP system, then the "Treatment Depth" should be the same for each row.
Similarly, a given planning area can have multiple "BMP drainage areas" (i.e., areas treated by different BMP systems). If a BMP drainage area has multiple "developed land" types, separate "land use areas" can be represented on separate rows, with each row having the same "Project Name". Also, in the case of "RR" and "ST" BMP types, the treatment depth should be the same for any row associated with the same Project Name.
If runoff from a land use/cover type with NO impervious cover (e.g., Cropland) is treated by a BMP system (either existing or proposed), use the Manual Override (column R) to type in the treatment depth instead of column Q as would normally be done.
Examples of various options for characterizing different types of project areas are provided in the "Example" spreadsheet that is also available for downloading from the Model My Watershed site.

Project Name	BMP Name	BMP Type	Existing or Proposed	Year Installed	BMP Surface Area (Square Feet)	BMP Surface Area (Acres)	Water Volume Captured by BMP (Cubic Feet)	MapShed Land Cover of Drainage Area	Drainage Area Treated by BMP (Acres)	Stream Restoration length (feet) - Qualified projects only	Impervious Area (ac)	BMP Loading Ratio1 (Impervious Area / BMP Surface Area)	BMP Loading Ratio2 (BMP Water Vol / Runoff Vol from 2.5" Rain)	Treatment Depth (in/imp. ac)	Treatment Depth (in/ac) for Manual Override - use if no impervious area	Effective Treatment Depth (in/imp. ac)	Impervious Surface (%)	TSS Load (lbs/yr)	TP Load (lbs/yr)	TN Load (lbs/yr)	TSS Reduction (%)	TP Reduction (%)	TN Reduction (%)	TSS Reduction (lbs/yr)	TSS Reduction (tons/yr)	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)
Project_name	BMP_name	BMP_type	Existing?	YearInstalled	SquareFeet	Acres	CubicFeet	drainageLandCoverClass	drainageArea_ac	lengthTreatedStream_ft	impervArea_ac	LoadRatio1	LoadRatio2	treatmentDepthNormalli	treatmentDepthNorm	treatmentDepthNorm	impervsFraction	TSS_Load_lbPer	TP_Load_lbPer	TN_Load_lbPer	TSS_Reduction	TP_Reduction	Efficiency_percent	TN_Reduction	Efficiency_percent	TSS_Reduction_lbPerY	TSS_Reduction_tonPe	TP_Reduction_lbPer	TN_Reduction_lbPer
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Ld_Mixed	6.43		0.96	#N/A	0.00	0.00		0.00	15.0%	2,606.73	0.96	4.18	50.0%	10.0%	15.0%			1,303.37	0.65	0.10	0.63
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Md_Mixed	6.87		3.57	#N/A	0.00	0.00		0.00	52.0%	6,246.88	2.61	12.78	50.0%	10.0%	15.0%			3,123.44	1.56	0.26	1.92
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Hd_Mixed	7.98		6.94	#N/A	0.00	0.00		0.00	87.0%	10,685.19	3.91	16.20	50.0%	10.0%	15.0%			5,342.59	2.67	0.39	2.43
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Hay/Past	7.54		0.00	#N/A	#N/A	0.00		0.00	0.0%	2,206.99	17.04	64.84	50.0%	10.0%	15.0%			1,103.50	0.55	1.70	9.73
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Cropland	7.76		0.00	#N/A	#N/A	#N/A		#N/A	0.0%	11,424.74	28.87	103.91	50.0%	10.0%	15.0%			5,712.37	2.86	2.89	15.59
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Ld_Mixed	3.33		0.50	#N/A	0.00	0.00		0.00	15.0%	1,349.99	0.50	2.16	80.0%	75.0%	70.0%			1,079.99	0.54	0.37	1.52
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Md_Mixed	2.66		1.38	#N/A	0.00	0.00		0.00	52.0%	2,418.73	1.01	4.95	80.0%	75.0%	70.0%			1,934.99	0.97	0.76	3.46
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Hd_Mixed	2.22		1.93	#N/A	0.00	0.00		0.00	87.0%	2,972.57	1.09	4.51	80.0%	75.0%	70.0%			2,378.06	1.19	0.82	3.15
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Cropland	22.84		0.00	#N/A	#N/A	#N/A		#N/A	0.0%	33,626.41	84.96	305.83	80.0%	75.0%	70.0%			26,901.13	13.45	63.72	214.08
BMPBS2	BMPBS2	Bioswale	Proposed			0.00		Ld_Mixed	13.75		2.06	#N/A	0.00	0.00		0.00	15.0%	5,574.27	2.06	8.94	80.0%	75.0%	70.0%			4,459.42	2.23	1.55	6.26
BMPBS2	BMPBS2	Bioswale	Proposed			0.00		Md_Mixed	5.54		2.88	#N/A	0.00	0.00		0.00	52.0%	5,037.51	2.11	10.30	80.0%	75.0%	70.0%			4,030.01	2.02	1.58	7.21
BMPBS2	BMPBS2	Bioswale	Proposed			0.00		Hd_Mixed	1.55		1.35	#N/A	0.00	0.00		0.00	87.0%	2,075.44	0.76	3.15	80.0%	75.0%	70.0%			1,660.36	0.83	0.57	2.20
BMPSR1	BMPSR1	Stream Restoration	Proposed			0.00				1440	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	0.00	0.00	165,600.00	82.80	250.56	276.48
BMPSR2	BMPSR2	Stream Restoration	Proposed			0.00				2640	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	0.00	0.00	303,600.00	151.80	459.36	506.88

NOTE: the above table is an Excel Table, which has special feature:https://support.office.com/en-us/article/overview-of-excel-tables-7ab0bb7d-3a9e-4b56-a3c9-6c94334e492c
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Cells requiring user input for BMP efficiencies calculated using Performance Standard approach (i.e., RR and ST BMP Types). Drainage Area not needed for Stream Restoration BMP. Also, Treatment Depth not needed for all "non-Performance Standard" BMPs.
Cells requiring user input for non-Performance Standard BMPs except for Stream Restoration, Street Sweeping and Forest Buffers. .
Cell values calculated based on user input
Optional user input for treatment depth in non-developed areas (e.g., cropland)
Optional user input of descriptive information

Special Notes for Non-Performance Standard BMPs

1) Surface Area is only used for Forest Buffers and "infiltration" BMPs (see Tech Docs tab)

2) Water Volume is used for other "non-infiltration" BMPs (see Tech Docs tab)

3) Stream Restoration BMPs require input values for stream length
4) Street Sweeping BMPs require input values for Road Length Swept

	Streambank Erosion Sed Load Rate	Calculated	Default
	(lb/ft/yr)	31.83	115.00
	TN Load Rate (lb/ft/yr)	0.02	0.19
	TP Load Rate (lb/ft/yr)	0.01	0.17

157349.1 Available stream length (ft) in Non-Ag Areas in the entire watershed (from MMW Output tab)
4527.6 Available stream length (ft) in Non-Ag Areas in the smaller target area (from MMW Output tab)

Note: The use of the "Stream Restoration" BMP type in this tab is only for streams associated with developed land areas.
Stream Restoration activities in agricultural areas should be addressed separately in the "Agricultural BMPs" tab.

Land Use/Cover Distribution for the Smaller Urban Planning Area (Note: If this tab is being used for MS4 reductions, the total acres of developed land used should not exceed those given below).

SOURCE	AREA (acres)
Hay/Pasture	125.93
Cropland	429.63
Wooded Areas	34.57
Wetlands	-
Open Land	-
Barren Areas	2.47
Low-Density Mixed	461.73
Medium-Density Mixed	158.02
High-Density Mixed	93.83
Total	1,306.17

STREAM LENGTHS	KM*	FEET
Total Length	2.87	9,416.0
Ag Streams	1.5	4,921.3
Non-Ag Streams	1.38	4,527.6

TOTAL LBS REDUCED		552,170.98	276.09	806.18	1,093.57
Existing TOTAL LBS REDUCED		23,941.77	11.97	21.55	42.04
Proposed TOTAL LBS REDUCED		528,229.21	264.11	784.63	1,051.53
Project Name					
BMP002	LBS REDUCED	1,139.54	0.57	2.55	4.79
BMP005	LBS REDUCED	502.39	0.25	0.20	0.47
BMP006	LBS REDUCED	146.07	0.07	0.20	0.40
BMP007	LBS REDUCED	917.39	0.46	1.49	2.90
BMP008	LBS REDUCED	751.93	0.38	0.35	0.79
BMP009	LBS REDUCED	1,920.44	0.96	2.36	4.53
BMP011	LBS REDUCED	1,373.33	0.69	0.54	1.24
BMP012	LBS REDUCED	1,248.72	0.62	0.48	1.10
BMP013	LBS REDUCED	947.15	0.47	0.41	0.87
BMP015	LBS REDUCED	118.64	0.06	0.04	0.10
BMP016	LBS REDUCED	473.88	0.24	0.19	0.43
BMP019	LBS REDUCED	935.49	0.47	0.70	1.36
BMP020	LBS REDUCED	849.11	0.42	1.43	2.66
BMP021	LBS REDUCED	215.64	0.11	0.08	0.19
BMP022	LBS REDUCED	237.31	0.12	0.81	1.56
BMP023	LBS REDUCED	718.02	0.36	0.27	0.61
BMP024	LBS REDUCED	7,345.36	3.67	2.14	4.28
BMP027	LBS REDUCED	194.22	0.10	0.69	1.32
BMP031	LBS REDUCED	107.70	0.05	0.19	0.37
BMP032	LBS REDUCED	482.39	0.24	1.09	1.98

Urban BMP Load Reduction Calculation Table Muddy Run Mill Creek

INSTRUCTIONS: Each row in the table below can represent either different areas of land use/cover within a single planning area (e.g., municipality), or different BMP drainage areas within a given planning area.
If an individual planning area has multiple "developed land" types, each type can be represented in separate rows, with each row having the same "Project Name". If it is assumed that the planning area is being treated by one BMP system, then the "Treatment Depth" should be the same for each row.
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If runoff from a land use/cover type with NO impervious cover (e.g., Cropland) is treated by a BMP system (either existing or proposed), use the Manual Override (column R) to type in the treatment depth instead of column Q as would normally be done.
Examples of various options for characterizing different types of project areas are provided in the "Example" spreadsheet that is also available for downloading from the Model My Watershed site.

Project Name	BMP Name	BMP Type	Existing or Proposed	Year Installed	BMP Surface Area (Square Feet)	BMP Surface Area (Acres)	Water Volume Captured by BMP (Cubic Feet)	MapShed Land Cover of Drainage Area	Drainage Area Treated by BMP (Acres)	Treatment Depth (inches of rainfall)	Stream Restoration length (feet) - Qualified projects only	Impervious Area (ac)	BMP Loading Ratio1 (Impervious Area / BMP Surface Area)	BMP Loading Ratio2 (BMP Water Vol / Runoff Vol from 2.5" Rain)	Treatment Depth (in/imp. ac)	Treatment Depth (in/ac) for Manual Override - use if no impervious area	Effective Treatment Depth (in/imp. ac)	Impervious Surface (%)	TSS Load (lbs/yr)	TP Load (lbs/yr)	TN Load (lbs/yr)	TSS Reduction (%)	TP Reduction (%)	TN Reduction (%)	TSS Reduction (lbs/yr)	TSS Reduction (tons/yr)	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)
Project_name	BMP_name	BMP_type	Existing?	YearInstalled	SquareFeet	Acres	CubicFeet	drainageLandCoverClass	drainageArea_ac	treatmentDepth_in	lengthTreatedStream_ft	impervArea_ac	LoadRatio1	LoadRatio2	treatmentDepthNormal	treatmentDepthNormo	treatmentDepthNorm	imperv Fraction	TSS_Load_lbPerY	TP_Load_lbPerY	TN_Load_lbPerY	TSS_Reduction	TP_Reduction	TN_Reduction	TSS_Reduction_lbPerY	TSS_Reduction_tonPe	TP_Reduction_lbPerY	TN_Reduction_lb
BMP004	BMP004	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00		Ld_Mixed	17.29			2.59	#N/A	0.00	0.00		0.00	15.0%	7,957.96	2.59	11.76	10.0%	10.0%	5.0%	795.80	0.40	0.26	0.59
BMP004	BMP004	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00		Md_Mixed	2			1.04	#N/A	0.00	0.00		0.00	52.0%	1,804.93	0.70	3.94	10.0%	10.0%	5.0%	180.49	0.09	0.07	0.20
BMP004	BMP004	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00		Forest	0.89			0.00	#N/A	#N/A	#N/A		#N/A	0.0%	257.73	0.06	0.22	10.0%	10.0%	5.0%	25.77	0.01	0.01	0.01
BMP004	BMP004	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00		Hay/Past	2.22			0.00	#N/A	#N/A	#N/A		#N/A	0.0%	831.92	5.39	20.93	10.0%	10.0%	5.0%	83.19	0.04	0.54	1.05
BMP004	BMP004	Dry Detention Ponds and Hydrodynamic Structures	Existing			0.00		Cropland	2.22			0.00	#N/A	#N/A	#N/A		#N/A	0.0%	3,207.16	8.01	31.06	10.0%	10.0%	5.0%	320.72	0.16	0.80	1.55

NOTE: the above table is an Excel Table, which has special feature:https://support.office.com/en-us/article/overview-of-excel-tables-7ab0bb7d-3a9e-4b56-a3c9-6c94334e492c

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1) Surface Area is only used for Forest Buffers and "infiltration" BMPs (see Tech Docs tab)

2) Water Volume is used for other "non-infiltration" BMPs (see Tech Docs tab)

3) Stream Restoration BMPs require input values for stream length

4) Street Sweeping BMPs require input values for Road Length Swept

	Streambank Erosion Sed Load Rate (lb/ft/yr)	Calculated	Default
	TN Load Rate (lb/ft/yr)	0.03	0.19
	TP Load Rate (lb/ft/yr)	0.01	0.17

Land Use/Cover Distribution for the Smaller Urban Planning Area (Note: If this tab is being used for MS4 reductions, the total acres of developed land used should not exceed those given below).

SOURCE	AREA (acres)	
Hay/Pasture		-
Cropland		-
Wooded Areas		-
Wetlands		-
Open Land		-
Barren Areas		-
Low-Density Mixed		-
Medium-Density Mixed		-
High-Density Mixed		-
Total		-

STREAM LENGTHS	KM*	FEET
Total Length	1.51	4,954.1
Ag Streams	0.41	1,345.1
Non-Ag Streams	1.11	3,641.7

TOTAL LBS REDUCED		12,485.83	6.24	8.58	32.12
Existing TOTAL LBS REDUCED		1,405.97	0.70	1.68	3.40
Proposed TOTAL LBS REDUCED		11,079.86	5.54	6.91	28.73
Project Name					
BMP004	LBS REDUCED	1,405.97	0.70	1.68	3.40

135433.1 Available stream length (ft) in Non-Ag Areas in the entire watershed (from MMW Output tab)
3641.7 Available stream length (ft) in Non-Ag Areas in the smaller target area (from MMW Output tab)

Note: The use of the "Stream Restoration" BMP type in this tab is only for streams associated with developed land areas.
Stream Restoration activities in agricultural areas should be addressed separately in the "Agricultural BMPs" tab.

BMP No.	BMP Name	DA (ac)	Entity Responsible for O&M	Latitude	Longitude	Date Installed	O&M Requirements	NPDES Permit No.
BMP002	314 Deerfield Dr. Detention Basin	20.73	Private	40.103806	-76.021175	2005	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP003	142 Toddy Dr. Detention Basin	24.32	Private	40.116557	-76.030918	2005	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP004	1266 Sheep Hill Rd. Detention Basin	20.32	Private	40.103746	-76.029223	Pre-1992	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP005	Granite Dr. Detention Basin	7.88	Main St. 1148 LLC	40.118986	-76.045638	2005	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP006	4610 Division Hwy. Detention Basin	2.28	East Earl Township	40.117347	-76.035236	2010	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP007	Farm View Dr. Detention Basin	20.35	Private	40.108868	-76.021010	1999-2004	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP008	1401 Earl Ave. Detention Basin	11.85	Private	40.111440	-76.027355	2004	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP009/017	123 & 138 Rancks Church Rd. Detention Basin	23.3	Private	40.116453	-76.048908	2015	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP010	53 Gentle Dr. Detention Basin	19.81	Private	40.164497	-76.055404	2008	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	PAI033608006
BMP011	33 Dawkins Dr. Detention Basin	25.13	Cheltenham HOA	40.123126	-76.044248	2008	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP012	4801 Division Hwy. Detention Basin	20.93	East Earl Township	40.112876	-76.029852	1992-1999	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP013/014	129 Toddy Dr. Detention Basin 1, 2	8.57	Weaver Realty Co. II LP	40.118775	-76.033246	2004	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP015	976 Main St. Detention Basin	1.42	Blue Ball Land Co. LLC	40.114331	-76.057731	2005	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP016	114 Rancks Church Rd. Detention Basin	4.99	Revelations of Freedom Ministry	40.115713	-76.051878	1999	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP019	1324 Main St. Detention Basin	8.27	Weaver Realty Co. I LP	40.119743	-76.033925	1992-1999	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP020	301 Twin Springs Ct. Detention Basin	7.66	Twin Springs LLC	40.111685	-76.053738	2016	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP021/028	170 Rancks Church Rd. Detention Basin 1, 2	2.15	Private	40.112320	-76.051822	2016	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP022	126 Ewell Rd. Detention Basin	5.97	Eastern Lancaster County School	40.120234	-76.036861	1999-2004	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP023	250 Earland Dr. Detention Basin	6.07	Herr Group	40.112916	-76.056255	1999-2004	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP024/025	165 Earland Dr. Detention Basin 1, 2	15.9	BMH Associates LP	40.111915	-76.057757	2005	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP027/051	Earland Dr. Detention Basin 1, 2	6.2	Horst Realty	40.111545	-76.056662	2005	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP031	4201 Division Hwy. Detention Basin	1.98	Triple Acres LLC	40.117823	-76.047726	1999-2004	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	
BMP032	173 Rancks Church Rd. Detention Baisn	3.47	Private	40.113042	-76.049036	Pre-1992	Outlined in O&M agreement, design plans, and/or the PA DEP BMP Manual	

East Earl

DATE

PROPERTY OWNER
PROPERTY OWNER MAILING ADDRESS

Re: East Earl Township Stormwater Management (SWM) Facility Evaluation

Dear Property Owner,

You are receiving this notice because there is an SWM facility located on or adjacent to your property located at __BMP ADDRESS__. These facilities include, but are not limited to:

- Bioretention/Rain Garden
- Wet Pond/Retention Basin
- Infiltration Bed/Basin
- Dry Extended Detention Basin
- Vegetated Swale/Dry Swale
- Constructed Wetland
- Ecosystem Restoration
- Inflow/Outflow Drain

Township staff will be conducting inspections on SWM facilities throughout the Township from **January 1** to **June 30, 202**_. These efforts are to ensure compliance with the Township's Municipal Separate Storm Sewer System (MS4) Permit through the PA Department of Environmental Protection (DEP).

During this time, you may notice someone on or adjacent to your property for a short period of time. These inspections usually take between ten to fifteen minutes and include a Township employee or representative walking around defined stormwater utilities to document any required maintenance at each location. The following points below list some of the common issues the Township will be assessing during this time (this is not an exhaustive list of all possible structural deficiencies):

- Clogged inlets or outlets
- Trash or debris accumulation
- Sediment buildup
- Lack of vegetation establishment
- Invasive or overgrown vegetation
- Erosion to the facility basin or walls
- Failing structural conveyances

A copy of the form that Township will be using to conduct inspections (3800-FM-BCW0531a and 3800-FM-BCW0521) can be found through the DEP website: **http://www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=2696.**

If the SWM facility is your responsibility and has any of the above noted deficiencies or any other conflicts outlined in the Township's stormwater management ordinance, you may receive further notice from the Township.

If you have any questions, you may contact the Township's Stormwater Coordinator, Amanda Fetterman. You may also read the Township's Stormwater Management Ordinance on the Township website.

Respectfully,

Amanda Fetterman
ARRO Consulting
Stormwater Coordinator for East Earl Township
484.999.6348
Amanda.Fetterman@arroconsulting.com

DATE

East Earl

PROPERTY OWNER
PROPERTY OWNER MAILING ADDRESS

RE: Stormwater Management (SWM) Facility Evaluation Summary

Dear Property Owner,

East Earl Township is required to evaluate all stormwater management (SWM) facilities as part of its Municipal Separate Storm Sewer System (MS4) permit issued by the Pennsylvania Department of Environmental Protection. East Earl Township's Stormwater Management Ordinance outlines the requirements of responsible parties specific to stormwater management facilities.

In the spring of 202_, the Township conducted visual evaluations of all stormwater management facilities within the Township. This evaluation was complete by the Township's stormwater engineer, ARRO Consulting. Upon evaluation of a SWM facility located upon a property (BMP ADDRESS) for which you are listed as the owner and/or responsible party, the Township's engineer noted structural deficiencies and/or required maintenance items related to the stormwater management facility.

Please reference the attached information which contains the inspection results summary along with photographs taken during the evaluation. Please provide East Earl Township with a description and photographic documentation of the actions that were taken to address the inspector's comments within (# Days for Remediation) days of receiving this letter by emailing the requested information to Amanda.Fetterman@arroconsulting.com. The Township reserves the right to conduct a re-evaluation of this facility after this period and may enforce additional penalties/violations as applicable. Please ensure if you are responsible for a stormwater management facility, the facility is up to the standard outlined in the property's approved design plans and/or operation and maintenance agreement.

If you have any questions regarding the evaluation, how to resolve the noted issues at your facility, or if you believe you have received this correspondence in error, please contact Amanda Fetterman at 484.999.6349; a full inspection report is available upon request.

Thank you for your help,

Amanda Fetterman
ARRO Consulting, Inc.
Stormwater Coordinator for East Earl Township
Amanda.Fetterman@arroconsulting.com

East Earl

Stormwater Facility Evaluation Result Summary

Facility Type:

Location: Lat: Lon:

Field Observations:

Remediation Due By:

Photos:

ATTACHMENT E: Existing Loading with BMPs for Pollutants of Concern

Muddy Creek	Entire Watershed			Urban Area*		
	Sediment (lbs/yr)	**TN (lbs/yr)**	**TP (lbs/yr)**	**Sediment (lbs/yr)**	**TN (lbs/yr)**	**TP (lbs/yr)**
Initial MMW Loads	10,364,242	654,649	45,469	176,314	2,742	754
Loads Removed w/Existing Urban BMPs	141	2	1	141	2	1
Loads Removed w/Proposed Urban BMPs	-	-	-	-	-	-
Loads Removed w/Existing Agricultural BMPs	-	-	-	-	-	-
Loads Removed w/Proposed Agricultural BMPs	-	-	-	-	-	-
Loads Removed w/Existing Floodplain Restoration BMPs	-	-	-	-	-	-
Loads Removed w/Proposed Floodplain Restoration BMPs	-	-	-	-	-	-
Total Loads Removed	141	2	1	141	2	1
New Reduced Load	10,364,101	654,647	45,468	176,174	2,740	753
Percent Reduction (0-100)	*0.0%*	*0.0%*	*0.0%*	*0.1%*	*0.1%*	*0.1%*
Total Baseline Load (1)	10,364,101	654,647	45,468	176,174	2,740	753
Total Loads Removed from Baseline (2)	-	-	-	-	-	-
Percent Reduction from Baseline Load	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

(1) After existing BMPs have been accounted for
(2) After proposed BMPs have been accounted for

Upper Conestoga River

	Entire Watershed			Urban Area*		
	Sediment (lbs/yr)	**TN (lbs/yr)**	**TP (lbs/yr)**	**Sediment (lbs/yr)**	**TN (lbs/yr)**	**TP (lbs/yr)**
Initial MMW Loads	33,812,917	1,103,662	83,700	1,133,665	7,628	2,060
Loads Removed w/Existing Urban BMPs	23,942	42	22	23,942	42	22
Loads Removed w/Proposed Urban BMPs	528,229	1,052	785	528,229	1,052	785
Loads Removed w/Existing Agricultural BMPs	-	-	-	-	-	-
Loads Removed w/Proposed Agricultural BMPs	-	-	-	-	-	-
Loads Removed w/Existing Floodplain Restoration BMPs	-	-	-	-	-	-
Loads Removed w/Proposed Floodplain Restoration BMPs	-	-	-	-	-	-
Total Loads Removed	552,171	1,094	806	552,171	1,094	806
New Reduced Load	33,260,746	1,102,568	82,894	581,494	6,534	1,254
Percent Reduction (0-100)	*1.6%*	*0.1%*	*1.0%*	*48.7%*	*14.3%*	*39.1%*
Total Baseline Load (1)	33,788,975	1,103,620	83,679	1,109,723	7,586	2,039
Total Loads Removed from Baseline (2)	528,229	1,052	785	528,229	1,052	785
Percent Reduction from Baseline Load	*1.6%*	*0.1%*	*0.9%*	*47.6%*	*13.9%*	*38.5%*

(1) After existing BMPs have been accounted for
(2) After proposed BMPs have been accounted for

Muddy Run-Mill Creek

	Entire Watershed			Urban Area*		
	Sediment (lbs/yr)	**TN (lbs/yr)**	**TP (lbs/yr)**	**Sediment (lbs/yr)**	**TN (lbs/yr)**	**TP (lbs/yr)**
Initial MMW Loads	34,842,308	1,230,892	86,760	271,243	1,880	475
Loads Removed w/Existing Urban BMPs	1,406	3	2	1,406	3	2
Loads Removed w/Proposed Urban BMPs	11,080	29	7	11,080	29	7
Loads Removed w/Existing Agricultural BMPs	-	-	-	-	-	-
Loads Removed w/Proposed Agricultural BMPs	-	-	-	-	-	-
Loads Removed w/Existing Floodplain Restoration BMPs	-	-	-	-	-	-
Loads Removed w/Proposed Floodplain Restoration BMPs	-	-	-	-	-	-
Total Loads Removed	12,486	32	9	12,486	32	9
New Reduced Load	34,829,822	1,230,860	86,752	258,758	1,848	466
Percent Reduction (0-100)	*0.0%*	*0.0%*	*0.0%*	*4.6%*	*1.7%*	*1.8%*
Total Baseline Load (1)	34,840,902	1,230,889	86,758	269,837	1,877	473
Total Loads Removed from Baseline (2)	11,080	29	7	11,080	29	7
Percent Reduction from Baseline Load	*0.0%*	*0.0%*	*0.0%*	*4.1%*	*1.5%*	*1.5%*

(1) After existing BMPs have been accounted for
(2) After proposed BMPs have been accounted for

ATTACHMENT F: Selected BMP Pollutant Loading Reduction

Selected BMP Pollutant Loading Reduction - BMP Description

Upper Conestoga River:

BMP-SR1: Stream Restoration

The analysis evaluated a stream restoration project and buffer along Cedar Creek located east of Springville Rd. at 1060 Springville Rd. Construction activities include: 1440 linear feet of streambank restoration; vegetative stabilization; establishment of 70 feet of riparian buffer.

BMP-SR2: Stream Restoration

The analysis evaluated a stream restoration project and buffer along Cedar Creek located north of Division Hwy. at 4996 Division Hwy. Construction activities include: 2640 linear feet of streambank restoration; vegetative stabilization; establishment of 70 feet of riparian buffer.

BMPOF044-BR1: Basin Retrofit

The analysis evaluated the construction of a basin retrofit at a pre-existing basin located between Toddy Dr. and Springville Rd. The basin will be retrofitted from a detention basin to a dry extended detention basin. Construction activities include: lowering and leveling the basin bottom, increasing the berm height, modifying basin grading, upgrading the outlet structure and pipe, and increasing the spillway invert.

BMPOF044-BS1: Bioswale

The analysis evaluated the construction of a bioswale. The BMP is perpendicular to Springville Rd. on private property at 1060 Springville Rd. and drains into Cedar Creek (State Waterbody ID: PA-SCR-57462463). Construction activities include: re-grading; installing amended soils; bioswale plantings; and stabilization of existing storm outlets.

BMPOP005-BS2: Bioswale

The analysis evaluated the retrofit of a swale to a bioswale. The BMP is located between East Earl Rd. and Martin St. on private property and drains into Cedar Creek (State Waterbody ID: PA-SCR-57462463). Construction activities include: re-grading; installing amended soils; bioswale plantings; and stabilization of existing storm outlets.

Muddy Run-Mill Creek:

BMPOF041-BS3: Bioswale

The analysis evaluated the construction of a bioswale. The BMP is located at 252 Witmer Rd. and runs parallel to the road on private property. Construction activities include: re-grading; installing ballast and amended soils; bioswale plantings; and stabilization of existing storm outlets.

Urban BMP Load Reduction Calculation Table Upper Conestoga River

INSTRUCTIONS: Each row in the table below can represent either different areas of land use/cover within a single planning area (e.g., municipality), or different BMP drainage areas within a given planning area.
If an individual planning area has multiple "developed land" types, each type can be represented in separate rows, with each row having the same "Project Name". If it is assumed that the planning area is being treated by one BMP system, then the "Treatment Depth" should be the same for each row.
Similarly, a given planning area can have multiple "BMP drainage areas" (i.e., areas treated by different BMP systems). If a BMP drainage area has multiple "developed land" types, separate "land use areas" can be represented on separate rows, with each row having the same "Project Name". Also, in the case of "RR" and "ST" BMP types, the treatment depth should be the same for any row associated with the same Project Name.
If runoff from a land use/cover type with NO impervious cover (e.g., Cropland) is treated by a BMP system (either existing or proposed), use the Manual Override (column R) to type in the treatment depth instead of column Q as would normally be done.
Examples of various options for characterizing different types of project areas are provided in the "Example" spreadsheet that is also available for downloading from the Model My Watershed site.

Project Name	BMP Name	BMP Type	Existing or Proposed	Year Installed	BMP Surface Area (Square Feet)	BMP Surface Area (Acres)	Water Volume Captured by BMP (Cubic Feet)	MapShed Land Cover of Drainage Area	Drainage Area Treated by BMP (Acres)	Stream Restoration length (feet) - Qualified projects only	Impervious Area (ac)	BMP Loading Ratio1 (Impervious Area / BMP Surface Area)	BMP Loading Ratio2 (BMP Water Vol / Runoff Vol from 2.5" Rain)	Treatment Depth (in/imp. ac)	Treatment Depth (in/ac) for Manual Override - use if no impervious area	Effective Treatment Depth (in/imp. ac)	Impervious Surface (%)	TSS Load (lbs/yr)	TP Load (lbs/yr)	TN Load (lbs/yr)	TSS Reduction (%)	TP Reduction (%)	TN Reduction (%)	TSS Reduction (lbs/yr)	TSS Reduction (tons/yr)	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)
Project_name	BMP_name	BMP_type	Existing?	YearInstalled	SquareFeet	Acres	CubicFeet	drainageLandCoverClass	drainageArea_ac	lengthTreatedStream_ft	impervArea_ac	LoadRatio1	LoadRatio2	treatmentDepthNormalli	treatmentDepthNorm	treatmentDepthNorm	imperviousFraction	TSS_Load_lbPer	TP_Load_lbPer	TN_Load_lbPer	YTSS_ReductionE	TP_ReductionEfficiency_percent	TN_ReductionEfficiency_percent	TSS_Reduction_lbPerY	TSS_Reduction_tonPe	TP_Reduction_lbPer	TN_Reduction_lbPer
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Ld_Mixed	6.43		0.96	#N/A	0.00	0.00		0.00	15.0%	2,606.73	0.96	4.18	50.0%	10.0%	15.0%	1,303.37	0.65	0.10	0.63
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Md_Mixed	6.87		3.57	#N/A	0.00	0.00		0.00	52.0%	6,246.88	2.61	12.78	50.0%	10.0%	15.0%	3,123.44	1.56	0.26	1.92
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Hd_Mixed	7.98		6.94	#N/A	0.00	0.00		0.00	87.0%	10,685.19	3.91	16.20	50.0%	10.0%	15.0%	5,342.59	2.67	0.39	2.43
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Hay/Past	7.54		0.00	#N/A	#N/A	0.00		#N/A	0.0%	2,206.99	17.04	64.84	50.0%	10.0%	15.0%	1,103.50	0.55	1.70	9.73
BMPBR1P	BMP003	Dry Extended Detention Ponds	Proposed			0.00		Cropland	7.76		0.00	#N/A	#N/A	#N/A		#N/A	0.0%	11,424.74	28.87	103.91	50.0%	10.0%	15.0%	5,712.37	2.86	2.89	15.59
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Ld_Mixed	3.33		0.50	#N/A	0.00	0.00		0.00	15.0%	1,349.99	0.50	2.16	80.0%	75.0%	70.0%	1,079.99	0.54	0.37	1.52
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Md_Mixed	2.66		1.38	#N/A	0.00	0.00		0.00	52.0%	2,418.73	1.01	4.95	80.0%	75.0%	70.0%	1,934.99	0.97	0.76	3.46
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Hd_Mixed	2.22		1.93	#N/A	0.00	0.00		0.00	87.0%	2,972.57	1.09	4.51	80.0%	75.0%	70.0%	2,378.06	1.19	0.82	3.15
BMPBS1	BMPBS1	Bioswale	Proposed			0.00		Cropland	22.84		0.00	#N/A	#N/A	#N/A		#N/A	0.0%	33,626.41	84.96	305.83	80.0%	75.0%	70.0%	26,901.13	13.45	63.72	214.08
BMPBS2	BMPBS2	Bioswale	Proposed			0.00		Ld_Mixed	13.75		2.06	#N/A	0.00	0.00		0.00	15.0%	5,574.27	2.06	8.94	80.0%	75.0%	70.0%	4,459.42	2.23	1.55	6.26
BMPBS2	BMPBS2	Bioswale	Proposed			0.00		Md_Mixed	5.54		2.88	#N/A	0.00	0.00		0.00	52.0%	5,037.51	2.11	10.30	80.0%	75.0%	70.0%	4,030.01	2.02	1.58	7.21
BMPBS2	BMPBS2	Bioswale	Proposed			0.00		Hd_Mixed	1.55		1.35	#N/A	0.00	0.00		0.00	87.0%	2,075.44	0.76	3.15	80.0%	75.0%	70.0%	1,660.36	0.83	0.57	2.20
BMPSR1	BMPSR1	Stream Restoration	Proposed			0.00				1440	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	165,600.00	82.80	250.56	276.48
BMPSR2	BMPSR2	Stream Restoration	Proposed			0.00				2640	#N/A	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	0.0%	303,600.00	151.80	459.36	506.88

NOTE: the above table is an Excel Table, which has special feature:https://support.office.com/en-us/article/overview-of-excel-tables-7ab0bb7d-3a9e-4b56-a3c9-6c94334e492c
ADD ROWS by right-clicking a row number inside the Table, and chosing "Insert". This will automatically copy formulas and update links throughout this workbook.

Cells requiring user input for all BMPs
Cells requiring user input for BMP efficiencies calculated using Performance Standard approach (i.e., RR and ST BMP Types). Drainage Area not needed for Stream Restoration BMP. Also, Treatment Depth not needed for all "non-Performance Standard" BMPs.
Cells requiring user input for non-Performance Standard BMPs except for Stream Restoration, Street Sweeping and Forest Buffers. .
Cell values calculated based on user input
Optional user input for treatment depth in non-developed areas (e.g., cropland)
Optional user input of descriptive information

Special Notes for Non-Performance Standard BMPs

1) Surface Area is only used for Forest Buffers and "infiltration" BMPs (see Tech Docs tab)

2) Water Volume is used for other "non-infiltration" BMPs (see Tech Docs tab)

3) Stream Restoration BMPs require input values for stream length
4) Street Sweeping BMPs require input values for Road Length Swept

	Streambank Erosion Sed Load Rate	Calculated	Default
	(lb/ft/yr)	31.83	115.00
	TN Load Rate (lb/ft/yr)	0.02	0.19
	TP Load Rate (lb/ft/yr)	0.01	0.17

157349.1 Available stream length (ft) in Non-Ag Areas in the entire watershed (from MMW Output tab)
4527.6 Available stream length (ft) in Non-Ag Areas in the smaller target area (from MMW Output tab)

Note: The use of the "Stream Restoration" BMP type in this tab is only for streams associated with developed land areas.
Stream Restoration activities in agricultural areas should be addressed separately in the "Agricultural BMPs" tab.

Land Use/Cover Distribution for the Smaller Urban Planning Area (Note: If this tab is being used for MS4 reductions, the total acres of developed land used should not exceed those given below).

SOURCE	AREA (acres)
Hay/Pasture	125.93
Cropland	429.63
Wooded Areas	34.57
Wetlands	-
Open Land	-
Barren Areas	2.47
Low-Density Mixed	461.73
Medium-Density Mixed	158.02
High-Density Mixed	93.83
Total	1,306.17

STREAM LENGTHS	KM*	FEET
Total Length	2.87	9,416.0
Ag Streams	1.5	4,921.3
Non-Ag Streams	1.38	4,527.6

TOTAL LBS REDUCED	552,170.98	276.09	806.18	1,093.57
Existing TOTAL LBS REDUCED	23,941.77	11.97	21.55	42.04
Proposed TOTAL LBS REDUCED	528,229.21	264.11	784.63	1,051.53

Project Name				
BMPBR1P	LBS REDUCED	16,585.26	8.29	5.34	30.29
BMPBS1	LBS REDUCED	32,294.16	16.15	65.67	222.21
BMPBS2	LBS REDUCED	10,149.78	5.07	3.70	15.67
BMPSR1	LBS REDUCED	165,600.00	82.80	250.56	276.48
BMPSR2	LBS REDUCED	303,600.00	151.80	459.36	506.88

Urban BMP Load Reduction Calculation Table Muddy Run Mill Creek

INSTRUCTIONS: Each row in the table below can represent either different areas of land use/cover within a single planning area (e.g., municipality), or different BMP drainage areas within a given planning area.
If an individual planning area has multiple "developed land" types, each type can be represented in separate rows, with each row having the same "Project Name". If it is assumed that the planning area is being treated by one BMP system, then the "Treatment Depth" should be the same for each row.
Similarly, a given planning area can have multiple "BMP drainage areas" (i.e., areas treated by different BMP systems). If a BMP drainage area has multiple "developed land" types, separate "land use areas" can be represented on separate rows, with each row having the same "Project Name". Also, in the case of "RR" and "ST" BMP types, the treatment depth should be the same for any row associated with the same Project Name.
If runoff from a land use/cover type with NO impervious cover (e.g., Cropland) is treated by a BMP system (either existing or proposed), use the Manual Override (column R) to type in the treatment depth instead of column Q as would normally be done.
Examples of various options for characterizing different types of project areas are provided in the "Example" spreadsheet that is also available for downloading from the Model My Watershed site.

Project Name	BMP Name	BMP Type	Existing or Proposed	Year Installed	BMP Surface Area (Square Feet)	BMP Surface Area (Acres)	Water Volume Captured by BMP (Cubic Feet)	MapShed Land Cover of Drainage Area	Drainage Area Treated by BMP (Acres)	Treatment Depth (inches of rainfall)	Stream Restoration length (feet) - Qualified projects only	Impervious Area (ac)	BMP Loading Ratio1 (Impervious Area / BMP Surface Area)	BMP Loading Ratio2 (BMP Water Vol / Runoff Vol from 2.5" Rain)	Treatment Depth (in/imp. ac)	Treatment Depth (in/ac) for Manual Override - use if no impervious area	Effective Treatment Depth (in/imp. ac)	Impervious Surface (%)	TSS Load (lbs/yr)	TP Load (lbs/yr)	TN Load (lbs/yr)	TSS Reduction (%)	TP Reduction (%)	TN Reduction (%)	TSS Reduction (lbs/yr)	TSS Reduction (tons/yr)	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)
Project_name	BMP_name	BMP_type	Existing?	YearInstalled	SquareFeet	Acres	CubicFeet	drainageLandCoverClass	drainageArea_ac	treatmentDepth_in	lengthTreatedStream_ft	impervArea_ac	LoadRatio1	LoadRatio2	treatmentDepthNormal	treatmentDepthNormOverride	treatmentDepthNorm	imperv	TSS_Load_lbPerY	TP_Load_lbPerY	TN_Load_lbPerY	TSS_Reduction	TP_Reduction	TN_Reduction	TSS_Reduction_lbPerY	TSS_Reduction_tonPerY	TP_Reduction_lbPerY	TN_Reduction_lbPerY
BMPOF041-BS3	BMPOF041-BS3	Bioswale	Proposed			0.00		Ld_Mixed	8.87			1.33	#N/A	0.00	0.00		0.00	15.0%	4,082.54	1.33	6.03	80.0%	75.0%	70.0%	3,266.03	1.63	1.00	4.22
BMPOF041-BS3	BMPOF041-BS3	Bioswale	Proposed			0.00		Md_Mixed	1.11			0.58	#N/A	0.00	0.00		0.00	52.0%	7,162.16	2.33	11.17	80.0%	75.0%	70.0%	5,729.73	2.86	1.75	7.82
BMPOF041-BS3	BMPOF041-BS3	Bioswale	Proposed			0.00		Forest	0.22			0.00	#N/A	#N/A	#N/A		#N/A	0.0%	1,624.44	0.63	3.74	80.0%	75.0%	70.0%	1,299.55	0.65	0.47	2.62
BMPOF041-BS3	BMPOF041-BS3	Bioswale	Proposed			0.00		Hay/Past	0.22			0.00	#N/A	#N/A	#N/A		#N/A	0.0%	231.96	0.06	0.21	80.0%	75.0%	70.0%	185.57	0.09	0.05	0.15
BMPOF041-BS3	BMPOF041-BS3	Bioswale	Proposed			0.00		Cropland	0.89			0.00	#N/A	#N/A	#N/A		#N/A	0.0%	748.73	4.86	19.89	80.0%	75.0%	70.0%	598.98	0.30	3.65	13.92

NOTE: the above table is an Excel Table, which has special feature:https://support.office.com/en-us/article/overview-of-excel-tables-7ab0bb7d-3a9e-4b56-a3c9-6c94334e492c

ADD ROWS by right-clicking a row number inside the Table, and chosing "Insert". This will automatically copy formulas and update links throughout this workbook.

Cells requiring user input for all BMPs
Cells requiring user input for BMP efficiencies calculated using Performance Standard approach (i.e., RR and ST BMP Types). Drainage Area not needed for Stream Restoration BMP. Also, Treatment Depth not needed for all "non-Performance Standard" BMPs.
Cells requiring user input for non-Performance Standard BMPs except for Stream Restoration, Street Sweeping and Forest Buffers. .
Cell values calculated based on user input
Optional user input for treatment depth in non-developed areas (e.g., cropland)
Optional user input of descriptive information

Special Notes for Non-Performance Standard BMPs

1) Surface Area is only used for Forest Buffers and "infiltration" BMPs (see Tech Docs tab)

2) Water Volume is used for other "non-infiltration" BMPs (see Tech Docs tab)

3) Stream Restoration BMPs require input values for stream length

4) Street Sweeping BMPs require input values for Road Length Swept

	Streambank Erosion Sed Load Rate (lb/ft/yr)	Calculated	Default
	TN Load Rate (lb/ft/yr)	0.03	0.19
	TP Load Rate (lb/ft/yr)	0.01	0.17

135433.1 Available stream length (ft) in Non-Ag Areas in the entire watershed (from MMW Output tab)
3641.7 Available stream length (ft) in Non-Ag Areas in the smaller target area (from MMW Output tab)

Note: The use of the "Stream Restoration" BMP type in this tab is only for streams associated with developed land areas.
Stream Restoration activities in agricultural areas should be addressed separately in the "Agricultural BMPs" tab.

Land Use/Cover Distribution for the Smaller Urban Planning Area (Note: If this tab is being used for MS4 reductions, the total acres of developed land used should not exceed those given below).

SOURCE	AREA (acres)
Hay/Pasture	-
Cropland	-
Wooded Areas	-
Wetlands	-
Open Land	-
Barren Areas	-
Low-Density Mixed	-
Medium-Density Mixed	-
High-Density Mixed	-
Total	-

STREAM LENGTHS	KM*	FEET
Total Length	1.51	4,954.1
Ag Streams	0.41	1,345.1
Non-Ag Streams	1.11	3,641.7

TOTAL LBS REDUCED		12,485.83	6.24	8.58	32.12
Existing TOTAL LBS REDUCED		1,405.97	0.70	1.68	3.40
Proposed TOTAL LBS REDUCED		11,079.86	5.54	6.91	28.73
Project Name					
BMPOF041-BS3	LBS REDUCED	11,079.86	5.54	6.91	28.73

ATTACHMENT G: Selected BMP Reduction Justification

ARRO Consulting, Inc.
Corporate Headquarters
108 West Airport Road
Lititz, PA 17543
P: (717) 569-7021

Memo

To: Pennsylvania Department of Environmental Protection

From: ARRO Consulting, Inc. on behalf of East Earl Township

Date: December 12, 2023

Subject: Cedar Creek Catchment Bioswale – Springville Road
Loading Ratio Justification

The Cedar Creek Catchment bioswale is a designed and constructed BMP for the East Earl Township Pollution Reduction Plan (PRP) located on a farm along Springville Road. This bioswale was approved as a project in the Township PRP, with design and construction occurring in the summer of 2023. The bioswale was designed meeting the requirements of the PA Stormwater BMP Manual, with exception to the recommended loading ratio requirements of Appendix C (8:1 total and 5:1 impervious loading ratios). This memorandum is to serve as justification to the large drainage area tributary to the facility and the facilities ability to adequately treat stormwater runoff prior to it reaching downstream Waters of the Commonwealth.

To preface the justification, it should be noted that the 5:1 and 8:1 loading ratio recommendations are generally more applicable for storage facilities and not conveyance facilities. The fact of the matter is, conveyance facilities, such as vegetated swales and bioswales, generally have larger drainage areas because by nature they are built to convey stormwater from other BMPs, neighborhoods, roads, and other components of the municipality towards Waters of the Commonwealth. Since stormwater is conveyed in these facilities versus stored, both hydraulic depths and drawdown times are significantly less than in a storage facility so loading ratios are not comparable. Additionally, bioswales provide significant water quality treatment through the filtering of sediment laden stormwater as it is conveyed through the vegetation and media and not mostly through infiltration, like most infiltration BMPs.

Upstream BMPs and Pretreatment

The upstream drainage area to the bioswale is complex and involves one large surface BMP and five smaller infiltration basins, as well as an extensive vegetated swale conveyance system prior to entering into the bioswale. There is the potential for additional BMPs in the upstream area that are not documented on the MS4 system mapping. There is only one conveyance

system that is not pretreated prior to its entrance into the bioswale. This is the direct runoff from stormwater that is draining from Springville Road to the east and sheet-flows into the bioswale

Both storage facilities and functional vegetated swales provide significant pre-treatment to stormwater as it relates to suspended solids. Appendix A of the PA Stormwater Manual documents numerous grass channels and vegetated swales of significantly less length, but similar slope and drainage area characteristics as having 68-87% reduction of Total Suspended Solids concentration when comparing inflow and outflow. With that said, pollution and sediment loading on the facility will be significantly less than what loading ratio recommendations consider. The upstream BMPs also have rate control aspects that will help reduce the flowrate and lower the depth in the bioswale while also reducing the potential for erosion.

BMP Design

The bioswale was designed and constructed with water quality in mind. The facility is a trapezoidal swale (8’ bottom width) at a low longitudinal slope (ranging between 1% and 2.85%). Additionally, a deep-rooted Ernst bioswale mix were planted in the facility bottom. During construction, the facility was built with decompaction in mind. The facility was excavated, scarified, and 3 feet of amended soils were placed at the bottom of the channel. Also, a 16” x 16” clean stone trench with perforated pipe was installed in the bottom of the amended soils to provide additional storage and capacity for filtered runoff. The combination of these components makes this facility ideal for the frequent small storm events, treating and infiltrating runoff as it goes through the facility. In the 2-year storm event (assuming one upstream rate control BMPs and full amended soil & trench storage) the bioswale has an average hydraulic depth of 0.59 feet and an average non-erosive velocity of 4.22 ft/sec. This information is provided in the attached HydroCAD calculations. The 2-year hydraulic depth is significantly less than the recommended maximum of two feet to avoid excessive pressure and potential sealing of the bioswale bottom.

Site Evidence After Construction

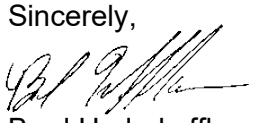
The bioswale was recently completed in Fall of 2023 and the Township has been hit by two storms of approximately 2” in less than 24 hours since installment. The bioswale has shown to be able to handle the flow and there is minimal evidence of sediment deposition or erosion occurring in the system. This fact justifies that the upstream system does a proper job of pretreating the runoff prior to its conveyance through the bioswale.

Summary

The pretreatment combined with the bioswales design is the justification for the large drainage area. This is evident by the minimal amount of sediment that has been seen in visual inspections of the facility after larger rainfall events. ARRO believes that the facility has been designed and constructed per the PA Stormwater Manual requirements contingent upon the variation to the loading ratio recommendations being approved by DEP. In conclusion, the bioswale and treatment train are affectively preventing ~32,294.16 lbs/yr of TSS from being produced and conveyed to Cedar Creek through filtration, infiltration, storage, and rate reduction.

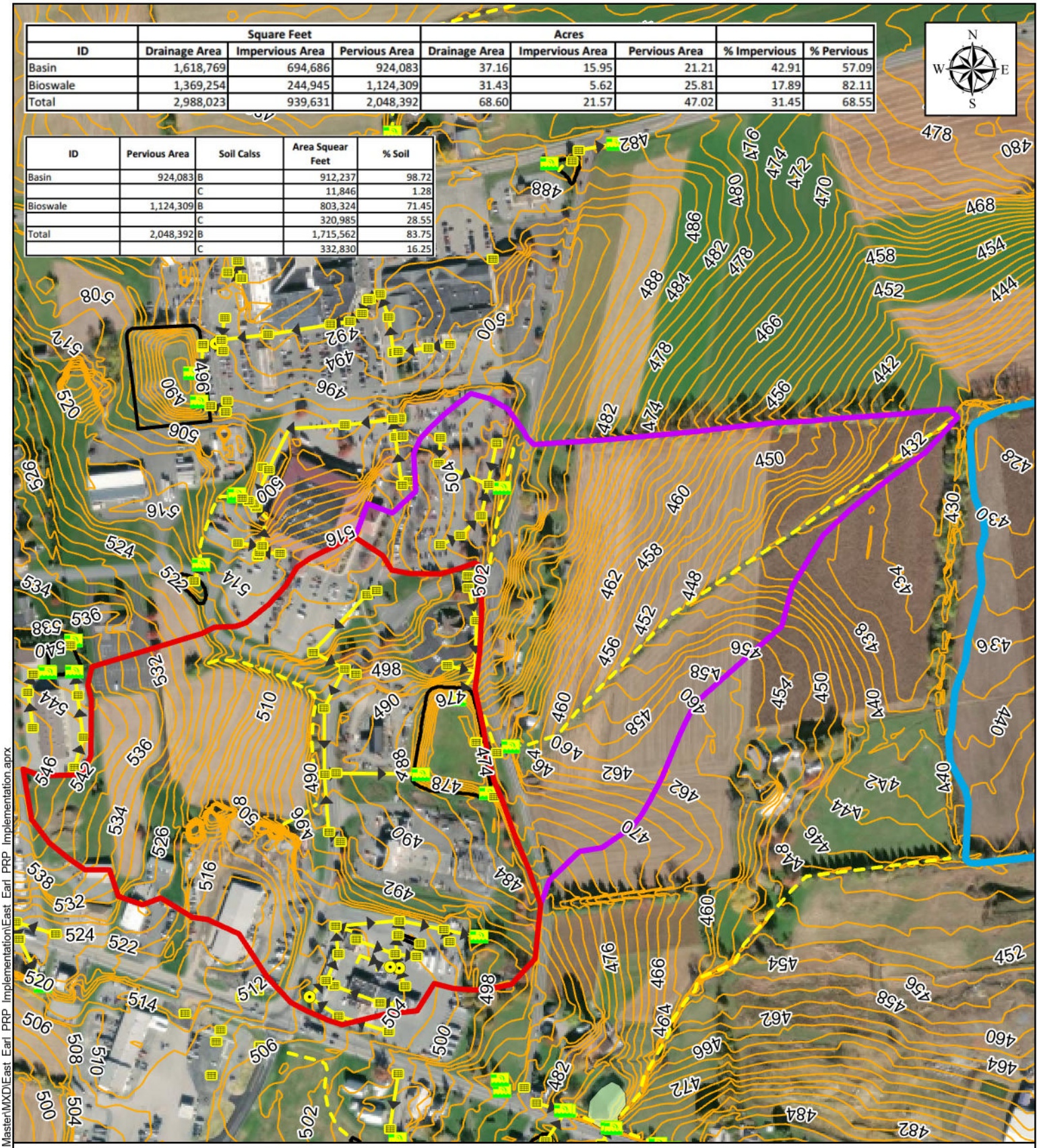
If you have any questions regarding this matter, please email me at brad.underkoffler@arroconsulting.com.

Sincerely,



Brad Underkoffler, P.E.
Project Manager

Enclosures



	Square Feet			Acres				
ID	Drainage Area	Impervious Area	Pervious Area	Drainage Area	Impervious Area	Pervious Area	% Impervious	% Pervious
Basin	1,618,769	694,686	924,083	37.16	15.95	21.21	42.91	57.09
Bioswale	1,369,254	244,945	1,124,309	31.43	5.62	25.81	17.89	82.11
Total	2,988,023	939,631	2,048,392	68.60	21.57	47.02	31.45	68.55

ID	Pervious Area	Soil Calss	Area Squear Feet	% Soil
Basin	924,083	B	912,237	98.72
		C	11,846	1.28
Bioswale	1,124,309	B	803,324	71.45
		C	320,985	28.55
Total	2,048,392	B	1,715,562	83.75
		C	332,830	16.25

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Legend

- Outfall
- Inlet
- Manhole
- Outlet
- Storm Pipe
- Swale
- Contour Lines (2ft)
- BMP
- NHD Stream
- NWI Wetland
- NHD Waterbody
- Basin Drainage Area
- Bioswale Drainage Area

PRP Implementation

Basin & Bioswale

East Earl Township

Lancaster County, PA

0 250 500 Feet

1:5,000

Date Produced/Author:
5/9/2023 RWC
Projection/Coordinate System:
NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet
Data Source:
World Imagery: Maxar

ARRO

Summary for Reach PS1: Section 1 Proposed

Inflow Area = 1,618,865 sf, 42.92% Impervious, Inflow Depth > 1.18" for 2-yr event
Inflow = 2.96 cfs @ 14.09 hrs, Volume= 158,522 cf
Outflow = 2.96 cfs @ 14.11 hrs, Volume= 158,521 cf, Atten= 0%, Lag= 1.3 min
Routed to Reach PS2 : Section 2 Proposed

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.07 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.76 fps, Avg. Travel Time= 1.4 min

Peak Storage= 138 cf @ 14.10 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 6.65'
Bank-Full Depth= 1.40' Flow Area= 16.8 sf, Capacity= 171.31 cfs

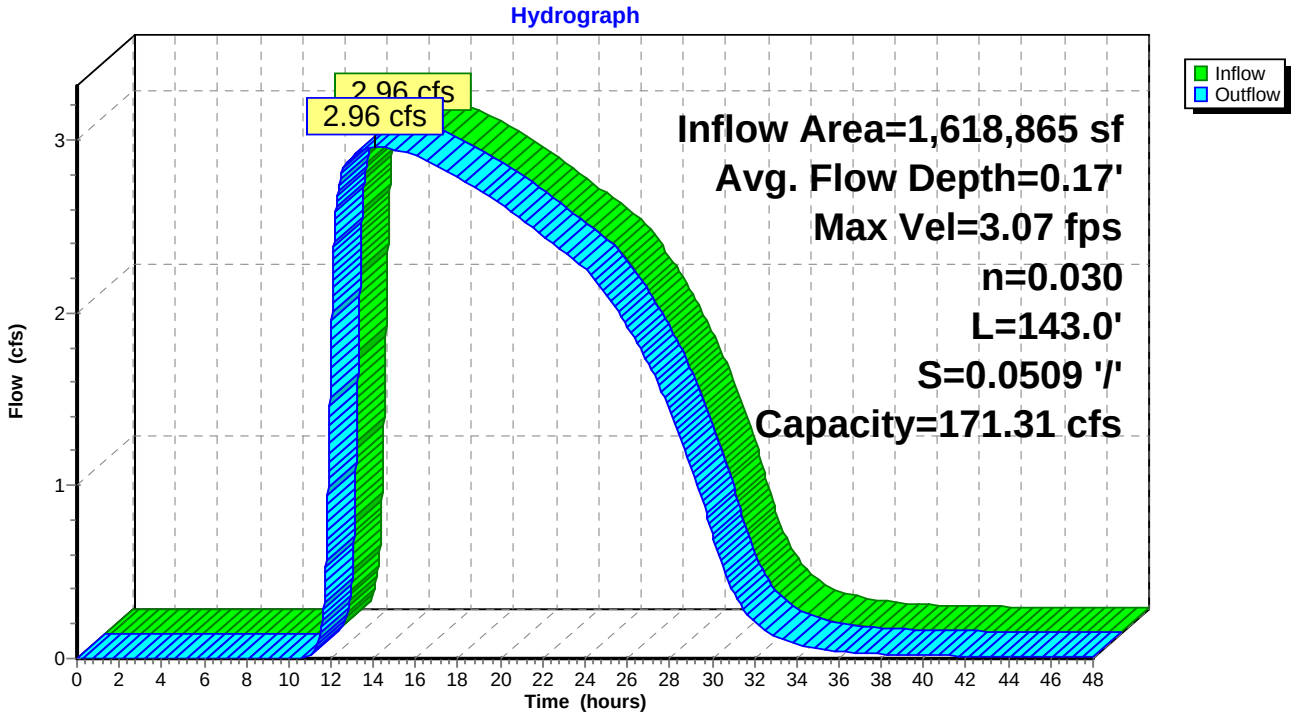
Custom cross-section, Length= 143.0' Slope= 0.0509 '/' (101 Elevation Intervals)
Constant n= 0.030 Earth, grassed & winding
Inlet Invert= 463.94', Outlet Invert= 456.66'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-2.00	465.34	0.00
0.00	464.94	0.40
5.00	463.94	1.40
10.00	463.94	1.40
15.00	464.94	0.40
17.00	465.34	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Width (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	5.0	0.0	0	0.00
1.00	10.0	15.2	15.0	1,430	84.55
1.40	16.8	19.3	19.0	2,402	171.31

Reach PS1: Section 1 Proposed



Hydrograph for Reach PS1: Section 1 Proposed

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	463.94	0.00
1.00	0.00	0	463.94	0.00
2.00	0.00	0	463.94	0.00
3.00	0.00	0	463.94	0.00
4.00	0.00	0	463.94	0.00
5.00	0.00	0	463.94	0.00
6.00	0.00	0	463.94	0.00
7.00	0.00	0	463.94	0.00
8.00	0.00	0	463.94	0.00
9.00	0.00	0	463.94	0.00
10.00	0.00	0	463.94	0.00
11.00	0.02	3	463.94	0.01
12.00	1.86	100	464.06	1.74
13.00	2.91	136	464.10	2.91
14.00	**2.96**	**138**	**464.11**	**2.96**
15.00	**2.95**	**137**	**464.10**	**2.95**
16.00	2.91	136	464.10	2.91
17.00	2.85	134	464.10	2.85
18.00	2.79	132	464.10	2.79
19.00	2.71	130	464.10	2.71
20.00	2.63	127	464.09	2.63
21.00	2.54	124	464.09	2.54
22.00	2.44	121	464.09	2.45
23.00	2.35	118	464.08	2.35
24.00	2.26	115	464.08	2.26
25.00	2.10	110	464.08	2.11
26.00	1.92	104	464.07	1.92
27.00	1.70	96	464.06	1.70
28.00	1.43	86	464.05	1.44
29.00	1.11	73	464.03	1.12
30.00	0.72	56	464.01	0.73
31.00	0.38	37	463.99	0.39
32.00	0.21	26	463.97	0.21
33.00	0.12	19	463.97	0.13
34.00	0.08	14	463.96	0.08
35.00	0.06	11	463.96	0.06
36.00	0.04	9	463.95	0.04
37.00	0.03	6	463.95	0.03
38.00	0.02	6	463.95	0.02
39.00	0.02	5	463.95	0.02
40.00	0.02	4	463.95	0.02
41.00	0.02	4	463.95	0.02
42.00	0.01	3	463.94	0.01
43.00	0.01	3	463.94	0.01
44.00	0.01	2	463.94	0.01
45.00	0.01	2	463.94	0.01
46.00	0.01	2	463.94	0.01
47.00	0.01	2	463.94	0.01
48.00	0.01	1	463.94	0.01

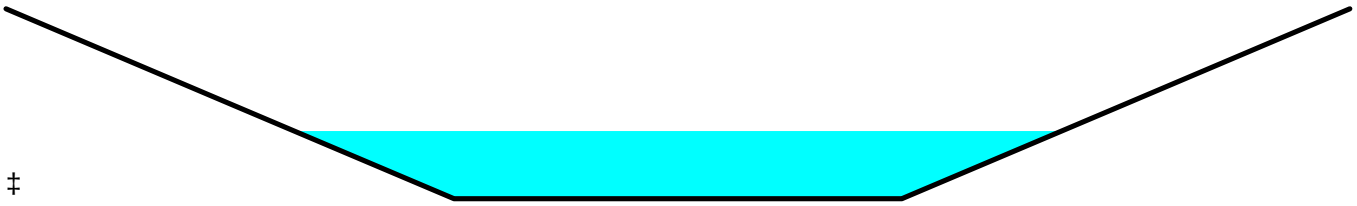
Summary for Reach PS2: Section 2 Proposed

Inflow Area = 2,987,999 sf, 31.45% Impervious, Inflow Depth > 1.03" for 2-yr event
Inflow = 38.12 cfs @ 12.05 hrs, Volume= 255,294 cf
Outflow = 36.88 cfs @ 12.11 hrs, Volume= 255,286 cf, Atten= 3%, Lag= 3.7 min
Routed to Reach PS3 : Section 3 Proposed

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.77 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.33 fps, Avg. Travel Time= 7.8 min

Peak Storage= 4,799 cf @ 12.08 hrs
Average Depth at Peak Storage= 0.71' , Surface Width= 13.71'
Bank-Full Depth= 2.00' Flow Area= 32.0 sf, Capacity= 269.30 cfs

Custom cross-section, Length= 620.0' Slope= 0.0202 '/'
Constant n= 0.030 Earth, grassed & winding
Inlet Invert= 456.66', Outlet Invert= 444.13'

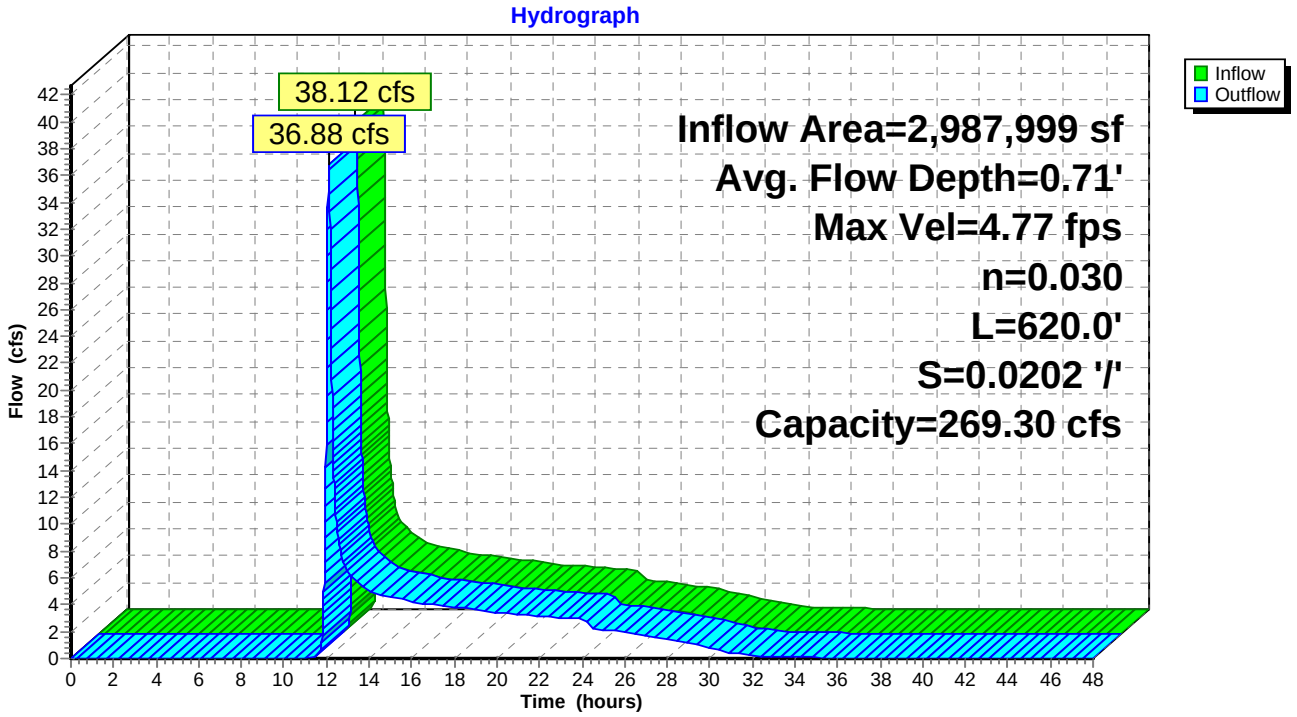


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	458.66	0.00
4.00	457.66	1.00
8.00	456.66	2.00
16.00	456.66	2.00
20.00	457.66	1.00
24.00	458.66	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Width (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	8.0	0.0	0	0.00
1.00	12.0	16.2	16.0	7,440	69.05
2.00	32.0	24.5	24.0	19,840	269.30

Reach PS2: Section 2 Proposed



Hydrograph for Reach PS2: Section 2 Proposed

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	456.66	0.00
1.00	0.00	0	456.66	0.00
2.00	0.00	0	456.66	0.00
3.00	0.00	0	456.66	0.00
4.00	0.00	0	456.66	0.00
5.00	0.00	0	456.66	0.00
6.00	0.00	0	456.66	0.00
7.00	0.00	0	456.66	0.00
8.00	0.00	0	456.66	0.00
9.00	0.00	0	456.66	0.00
10.00	0.00	0	456.66	0.00
11.00	0.01	6	456.66	0.00
12.00	**33.02**	**3,891**	**457.26**	**19.61**
13.00	**6.29**	**1,477**	**456.92**	**6.46**
14.00	5.03	1,273	456.89	5.10
15.00	4.59	1,198	456.88	4.62
16.00	4.22	1,134	456.87	4.25
17.00	4.01	1,096	456.86	4.02
18.00	3.82	1,063	456.86	3.84
19.00	3.62	1,027	456.85	3.64
20.00	3.40	988	456.84	3.42
21.00	3.27	962	456.84	3.28
22.00	3.15	940	456.83	3.16
23.00	3.03	917	456.83	3.05
24.00	2.92	894	456.83	2.93
25.00	2.11	730	456.80	2.12
26.00	1.92	689	456.79	1.94
27.00	1.70	640	456.78	1.73
28.00	1.44	578	456.77	1.47
29.00	1.12	497	456.76	1.16
30.00	0.73	387	456.74	0.78
31.00	0.39	263	456.71	0.43
32.00	0.21	184	456.70	0.24
33.00	0.13	131	456.69	0.14
34.00	0.08	104	456.68	0.09
35.00	0.06	80	456.68	0.07
36.00	0.04	56	456.67	0.05
37.00	0.03	39	456.67	0.03
38.00	0.02	32	456.67	0.03
39.00	0.02	27	456.67	0.02
40.00	0.02	24	456.66	0.02
41.00	0.02	21	456.66	0.02
42.00	0.01	18	456.66	0.01
43.00	0.01	16	456.66	0.01
44.00	0.01	14	456.66	0.01
45.00	0.01	12	456.66	0.01
46.00	0.01	10	456.66	0.01
47.00	0.01	9	456.66	0.01
48.00	0.01	8	456.66	0.01

Summary for Reach PS3: Section 3 Proposed

Inflow Area = 2,987,999 sf, 31.45% Impervious, Inflow Depth > 1.03" for 2-yr event
Inflow = 36.88 cfs @ 12.11 hrs, Volume= 255,286 cf
Outflow = 36.59 cfs @ 12.14 hrs, Volume= 255,282 cf, Atten= 1%, Lag= 1.7 min
Routed to Reach PS4 : Section 4 Proposed

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.37 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 3.6 min

Peak Storage= 2,238 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.65' , Surface Width= 13.16'
Bank-Full Depth= 2.00' Flow Area= 32.0 sf, Capacity= 320.52 cfs

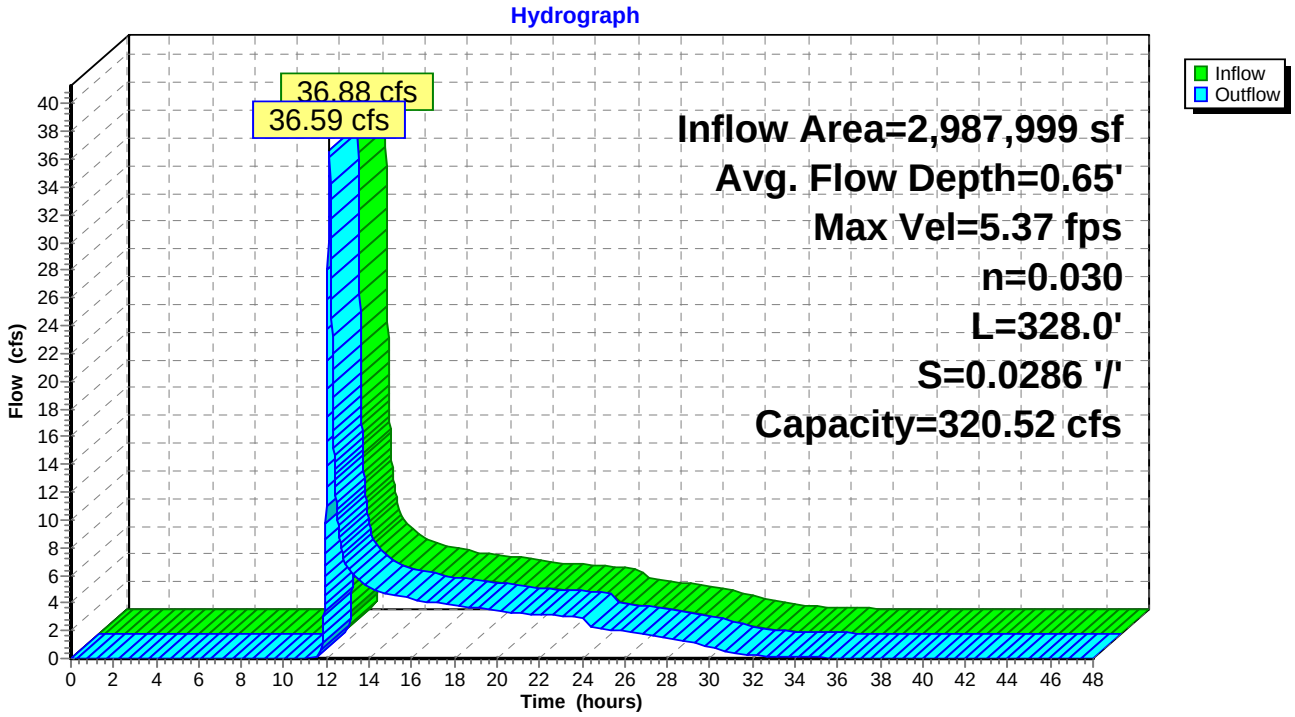
Custom cross-section, Length= 328.0' Slope= 0.0286 '/'
Constant n= 0.030 Earth, grassed & winding
Inlet Invert= 444.13', Outlet Invert= 434.74'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	446.13	0.00
4.00	445.13	1.00
8.00	444.13	2.00
16.00	444.13	2.00
20.00	445.13	1.00
24.00	446.13	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Width (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	8.0	0.0	0	0.00
1.00	12.0	16.2	16.0	3,936	82.18
2.00	32.0	24.5	24.0	10,496	320.52

Reach PS3: Section 3 Proposed



Hydrograph for Reach PS3: Section 3 Proposed

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	444.13	0.00
1.00	0.00	0	444.13	0.00
2.00	0.00	0	444.13	0.00
3.00	0.00	0	444.13	0.00
4.00	0.00	0	444.13	0.00
5.00	0.00	0	444.13	0.00
6.00	0.00	0	444.13	0.00
7.00	0.00	0	444.13	0.00
8.00	0.00	0	444.13	0.00
9.00	0.00	0	444.13	0.00
10.00	0.00	0	444.13	0.00
11.00	0.00	1	444.13	0.00
12.00	**19.61**	**1,323**	**444.55**	**13.93**
13.00	**6.46**	**707**	**444.37**	**6.54**
14.00	5.10	606	444.34	5.14
15.00	4.62	568	444.33	4.64
16.00	4.25	539	444.32	4.27
17.00	4.02	520	444.31	4.03
18.00	3.84	504	444.31	3.84
19.00	3.64	487	444.30	3.64
20.00	3.42	469	444.29	3.43
21.00	3.28	456	444.29	3.28
22.00	3.16	446	444.29	3.17
23.00	3.05	435	444.28	3.05
24.00	2.93	424	444.28	2.93
25.00	2.12	347	444.25	2.13
26.00	1.94	328	444.25	1.95
27.00	1.73	305	444.24	1.74
28.00	1.47	277	444.23	1.48
29.00	1.16	239	444.22	1.18
30.00	0.78	188	444.20	0.81
31.00	0.43	129	444.18	0.44
32.00	0.24	89	444.16	0.25
33.00	0.14	65	444.15	0.15
34.00	0.09	51	444.15	0.10
35.00	0.07	38	444.14	0.07
36.00	0.05	27	444.14	0.05
37.00	0.03	19	444.14	0.04
38.00	0.03	14	444.14	0.03
39.00	0.02	12	444.13	0.02
40.00	0.02	11	444.13	0.02
41.00	0.02	9	444.13	0.02
42.00	0.01	8	444.13	0.02
43.00	0.01	7	444.13	0.01
44.00	0.01	6	444.13	0.01
45.00	0.01	5	444.13	0.01
46.00	0.01	5	444.13	0.01
47.00	0.01	4	444.13	0.01
48.00	0.01	4	444.13	0.01

Summary for Reach PS4: Section 4 Proposed

Inflow Area = 2,987,999 sf, 31.45% Impervious, Inflow Depth > 1.03" for 2-yr event
Inflow = 36.59 cfs @ 12.14 hrs, Volume= 255,282 cf
Outflow = 34.56 cfs @ 12.23 hrs, Volume= 255,268 cf, Atten= 6%, Lag= 5.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.67 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 1.05 fps, Avg. Travel Time= 10.5 min

Peak Storage= 6,247 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.83' , Surface Width= 14.63'
Bank-Full Depth= 2.00' Flow Area= 32.0 sf, Capacity= 189.47 cfs

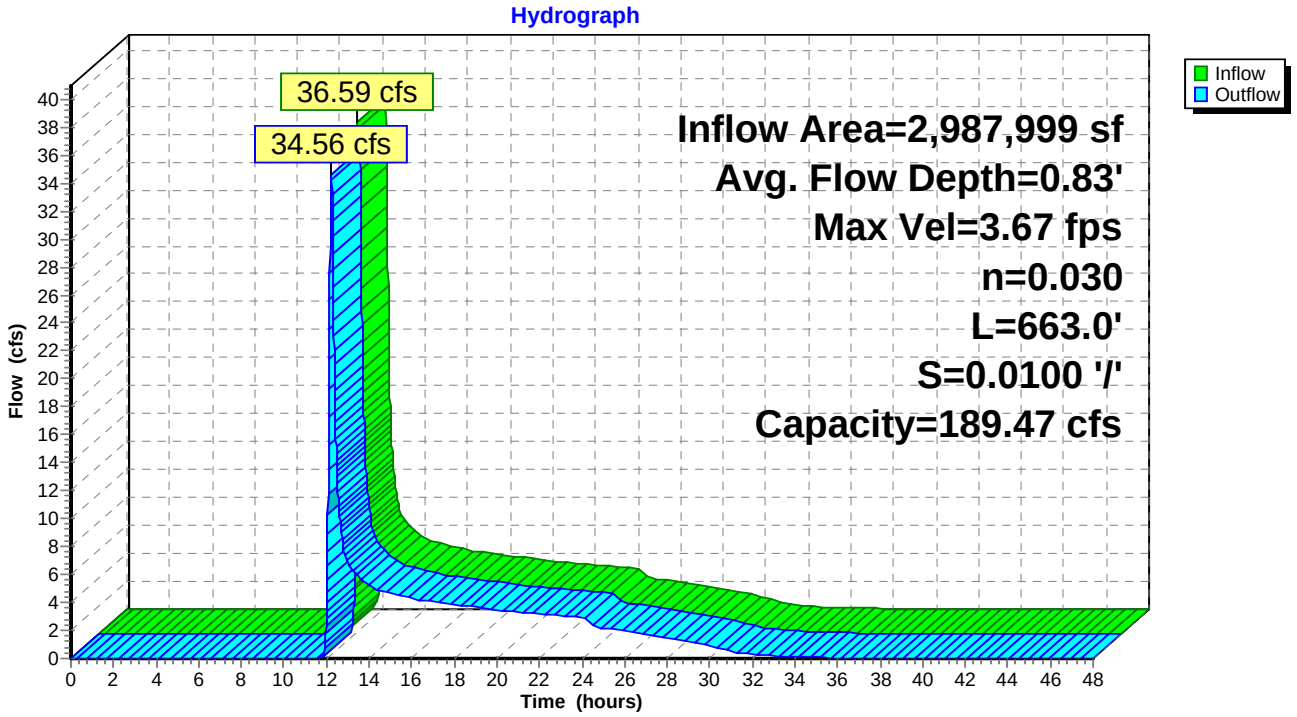
Custom cross-section, Length= 663.0' Slope= 0.0100 '/' (101 Elevation Intervals)
Constant n= 0.030 Earth, grassed & winding
Inlet Invert= 434.74', Outlet Invert= 428.08'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	436.74	0.00
4.00	435.75	0.99
8.00	434.74	2.00
16.00	434.74	2.00
20.00	435.74	1.00
24.00	436.74	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Width (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	8.0	0.0	0	0.00
1.00	12.0	16.2	16.0	7,943	48.62
1.01	12.1	16.3	16.0	8,049	49.54
2.00	32.0	24.5	24.0	21,189	189.47

Reach PS4: Section 4 Proposed



Hydrograph for Reach PS4: Section 4 Proposed

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)
0.00	0.00	0	434.74	0.00
1.00	0.00	0	434.74	0.00
2.00	0.00	0	434.74	0.00
3.00	0.00	0	434.74	0.00
4.00	0.00	0	434.74	0.00
5.00	0.00	0	434.74	0.00
6.00	0.00	0	434.74	0.00
7.00	0.00	0	434.74	0.00
8.00	0.00	0	434.74	0.00
9.00	0.00	0	434.74	0.00
10.00	0.00	0	434.74	0.00
11.00	0.00	1	434.74	0.00
12.00	**13.93**	**2,251**	**435.10**	**3.43**
13.00	**6.54**	**2,047**	**435.07**	**6.84**
14.00	5.14	1,734	435.03	5.24
15.00	4.64	1,615	435.01	4.67
16.00	4.27	1,533	435.00	4.31
17.00	4.03	1,473	434.99	4.05
18.00	3.84	1,430	434.98	3.87
19.00	3.64	1,381	434.97	3.67
20.00	3.43	1,329	434.97	3.46
21.00	3.28	1,291	434.96	3.30
22.00	3.17	1,261	434.95	3.18
23.00	3.05	1,231	434.95	3.06
24.00	2.93	1,200	434.95	2.95
25.00	2.13	981	434.91	2.16
26.00	1.95	929	434.90	1.98
27.00	1.74	865	434.89	1.77
28.00	1.48	786	434.88	1.52
29.00	1.18	684	434.86	1.23
30.00	0.81	550	434.84	0.87
31.00	0.44	385	434.81	0.50
32.00	0.25	268	434.79	0.28
33.00	0.15	198	434.78	0.17
34.00	0.10	146	434.77	0.11
35.00	0.07	122	434.76	0.08
36.00	0.05	103	434.76	0.06
37.00	0.04	77	434.75	0.04
38.00	0.03	57	434.75	0.03
39.00	0.02	47	434.75	0.03
40.00	0.02	40	434.75	0.02
41.00	0.02	35	434.75	0.02
42.00	0.02	30	434.75	0.02
43.00	0.01	26	434.74	0.01
44.00	0.01	23	434.74	0.01
45.00	0.01	20	434.74	0.01
46.00	0.01	17	434.74	0.01
47.00	0.01	15	434.74	0.01
48.00	0.01	13	434.74	0.01

ARRO Consulting, Inc.
Corporate Headquarters
108 West Airport Road
Lititz, PA 17543
P: (717) 569-7021

Memo

To: Pennsylvania Department of Environmental Protection

From: ARRO Consulting, Inc. on behalf of East Earl Township

Date: December 12, 2023

Subject: Witmer Road Bioswale
Loading Ratio Justification

The Witmer Road Bioswale is a designed and constructed BMP for the East Earl Township Pollution Reduction Plan (PRP) located on a farm along Witmer Road. This bioswale was approved as a project in the Township PRP, with design and construction occurring in 2020. The bioswale was designed meeting the requirements of the PA Stormwater BMP Manual, with exception to the recommended loading ratio requirements of Appendix C (8:1 total and 5:1 impervious loading ratios). This memorandum is to serve as justification to the large drainage area tributary to the facility and the facilities ability to adequately treat stormwater runoff prior to it reaching downstream Waters of the Commonwealth.

To preface the justification, it should be noted that the 5:1 and 8:1 loading ratio recommendations are generally more applicable for storage facilities and not conveyance facilities. The fact of the matter is, conveyance facilities, such as vegetated swales and bioswales, generally have larger drainage areas because by nature they are built to convey stormwater from other BMPs, neighborhoods, roads, and other components of the municipality towards Waters of the Commonwealth. Since stormwater is conveyed in these facilities versus stored, both hydraulic depths and drawdown times are significantly less than in a storage facility so loading ratios are not comparable. Additionally, bioswales provide significant water quality treatment through the filtering of sediment laden stormwater as it is conveyed through the vegetation and media and not mostly through infiltration, like most infiltration BMPs.

Upstream BMPs and Pretreatment

The upstream drainage area to the bioswale involves one large surface BMP well as an extensive vegetated swale conveyance system prior to entering into the bioswale. There is the potential for additional BMPs in the upstream area (single lot residential BMPs) that are not documented on the MS4 system mapping. There is only a small portion of the tributary drainage area that is not pretreated prior to its entrance into the bioswale.

Both the storage facility and functional vegetated swales provide significant pre-treatment to stormwater as it relates to suspended solids. Appendix A of the PA Stormwater Manual documents numerous grass channels and vegetated swales of significantly less length, but similar slope and drainage area characteristics as having 68-87% reduction of Total Suspended Solids concentration when comparing inflow and outflow. With that said, pollution and sediment loading on the facility will be significantly less than what loading ratio recommendations consider. The upstream BMPs also have rate control aspects that will help reduce the flowrate and lower the depth in the bioswale while also reducing the potential for erosion.

BMP Design

The bioswale was designed and constructed with water quality in mind. The facility is a trapezoidal swale (4' bottom width) at a low longitudinal slope of 0.70%. Additionally, a deep-rooted Ernst bioswale mix was planted in the facility bottom. During construction, the facility was built with decompaction in mind. The facility was excavated, scarified, and 1.5 feet of amended soils were placed at the bottom of the channel. The combination of these components makes this facility ideal for the frequent small storm events, treating and infiltrating runoff as it goes through the facility. In the 2-year storm event (assuming no upstream BMPs are present) the bioswale has an average hydraulic depth of 1.74 feet and an average non-erosive velocity of 2.52 ft/sec. This information is provided in the attached Hydroflow calculations. The 2-year hydraulic depth is less than the recommended maximum of two feet to avoid excessive pressure and potential sealing of the bioswale bottom.

Site Evidence After Construction

The bioswale was recently completed in the Fall of 2020 and the Township has monitored its performance since. The bioswale has shown to be able to handle the flow and there is no evidence of sediment deposition or erosion occurring in the system. This fact justifies that the upstream system does a proper job of pretreating the runoff prior to its conveyance through the bioswale.

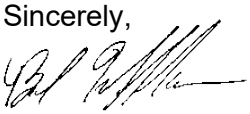
Summary

The pretreatment combined with the bioswales design is the justification for the large drainage area. This is evident by the minimal amount of sediment that has been seen in visual inspections of the facility after larger rainfall events. ARRO believes that the facility has been designed and constructed per the PA Stormwater Manual requirements contingent upon the variation to the loading ratio recommendations being approved by DEP. In conclusion, the bioswale and treatment train are affectively preventing ~11,079.86 lbs/yr of TSS from being

produced and conveyed to the headwaters of Mill Creek through filtration, infiltration, storage, and rate reduction.

If you have any questions regarding this matter, please email me at brad.underkoffler@arroconsulting.com.

Sincerely,



Brad Underkoffler, P.E.
Project Manager

Enclosures

East Earl Township

Witmer Road Bioswales

N

ARRO

Bioswale B (Fig. 3 & 4)

Bioswale A (Fig. 1 & 2)

OF041

WITMER RD

FARMVIEW DR

SHETLAND CIR

STAUFFER RD

SHEEP HILL RD

WUNDERLY LN

EDGEWOOD DR

MATTERS RD

SPRINGVILLE RD

Legend

- Inlet
- Manhole
- Outlet
- Outfall
- Observation Point
- Storm Pipe
- Culvert
- Bioswale
- Swale
- 2 Foot Contour
- MS3 Drainage Area

0 100 200 400 Feet

Fig. 1 (A) Facing North

Fig. 2 (A) Facing South

Fig. 3 (B) Facing North

Fig. 4 (B) Facing South

TR55 Tc Worksheet

Hyd. No. 1

Witmer drainage A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.060		0.400		
Flow length (ft)	= 150.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.15		0.00		0.00		
Land slope (%)	= 14.00		0.00		0.00		
Travel Time (min)	**= 13.75**	**+**	**0.00**	**+**	**0.00**	**=**	**13.75**
Shallow Concentrated Flow							
Flow length (ft)	= 1000.00		616.00		0.00		
Watercourse slope (%)	= 21.00		14.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=7.39		7.61		0.00		
Travel Time (min)	**= 2.25**	**+**	**1.35**	**+**	**0.00**	**=**	**3.60**
Channel Flow							
X sectional flow area (sqft)	= 7.07		0.00		0.00		
Wetted perimeter (ft)	= 4.71		0.00		0.00		
Channel slope (%)	= 5.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=29.14						
			0.00				
					0.00		
Flow length (ft)	({0})1445.0		0.0		0.0		
Travel Time (min)	**= 0.83**	**+**	**0.00**	**+**	**0.00**	**=**	**0.83**

Total Travel Time, Tc ..... 18.00 min

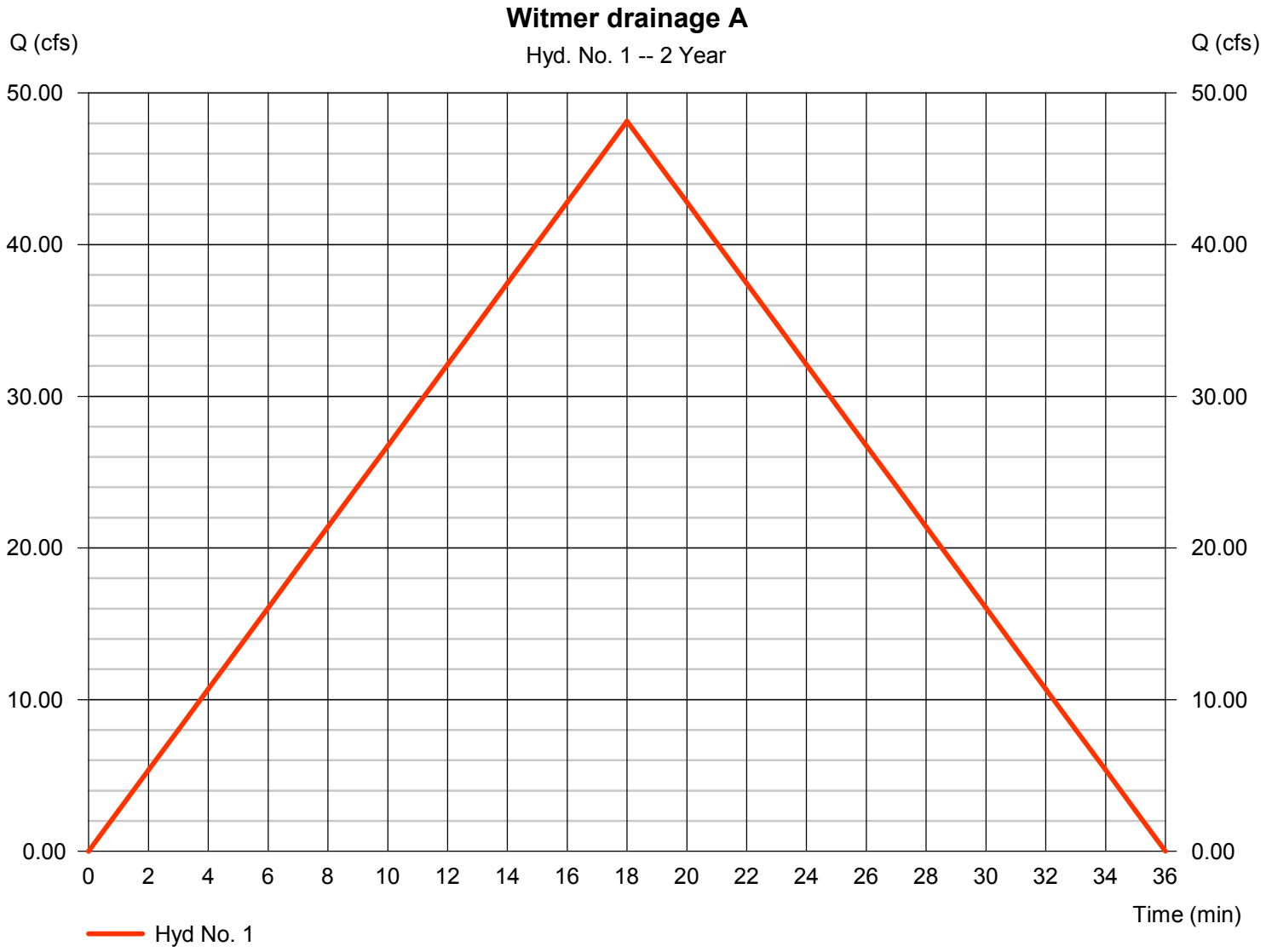
Hydrograph Report

Hyd. No. 1

Witmer drainage A

Hydrograph type	= Rational	Peak discharge	= 48.14 cfs
Storm frequency	= 2 yrs	Time to peak	= 18 min
Time interval	= 1 min	Hyd. volume	= 51,995 cuft
Drainage area	= 65.590 ac	Runoff coeff.	= 0.25*
Intensity	= 2.936 in/hr	Tc by TR55	= 18.00 min
IDF Curve	= E.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(7.400 x 0.26) + (25.600 x 0.31) + (32.590 x 0.20)] / 65.590



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Dec 5 2019

Witmer Bio Swale A

Trapezoidal

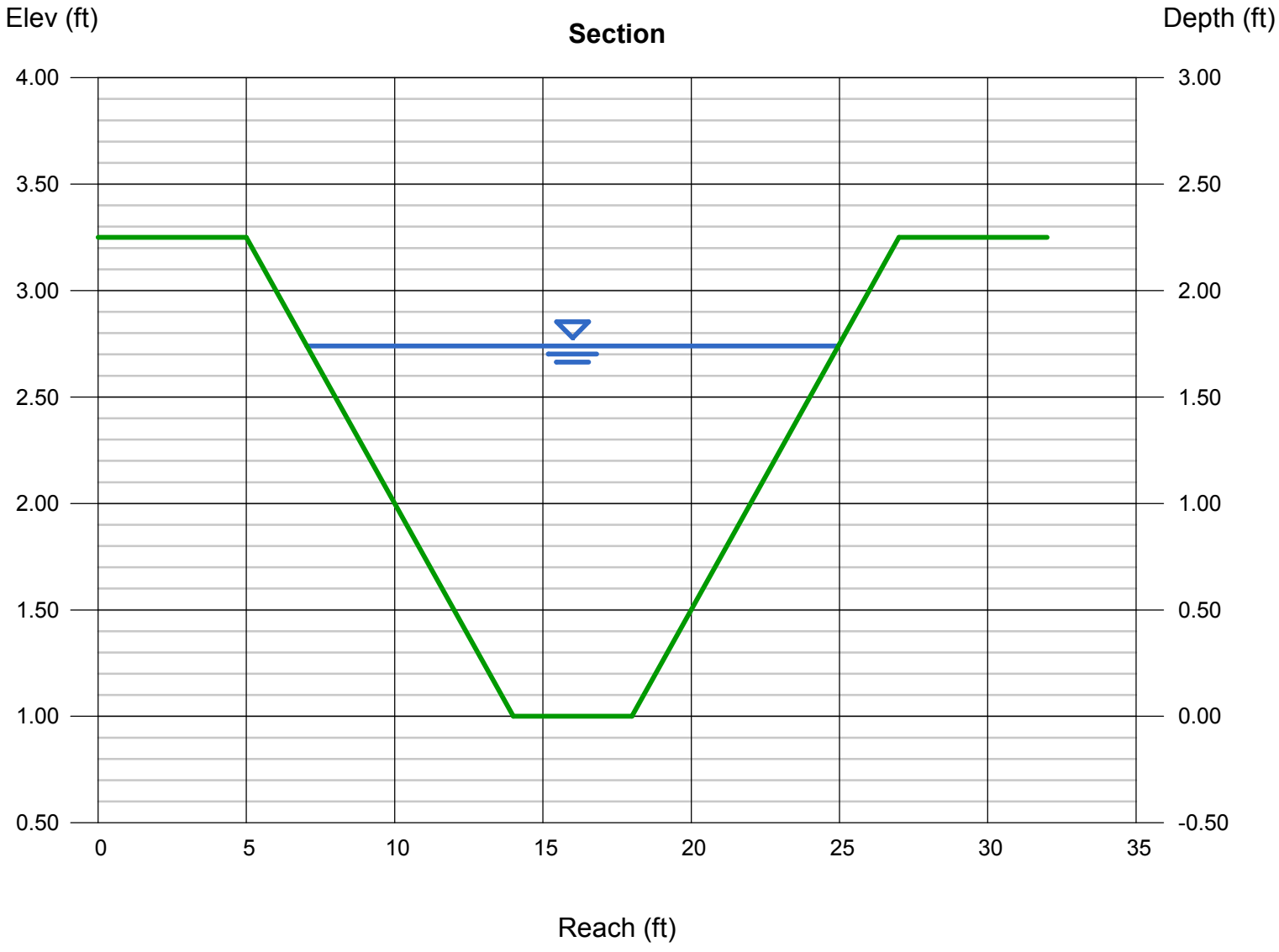
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.70
N-Value	= 0.050

Calculations

Compute by:	Known Q
Known Q (cfs)	= 48.14

Highlighted

Depth (ft)	= 1.74
Q (cfs)	= 48.14
Area (sqft)	= 19.07
Velocity (ft/s)	= 2.52
Wetted Perim (ft)	= 18.35
Crit Depth, Yc (ft)	= 1.15
Top Width (ft)	= 17.92
EGL (ft)	= 1.84



ARRO Consulting, Inc.
Corporate Headquarters
108 West Airport Road
Lititz, PA 17543
P: (717) 569-7021

Memo

To: Pennsylvania Department of Environmental Protection

From: ARRO Consulting, Inc. on behalf of East Earl Township

Date: December 13, 2023

Subject: Martin Street Vegetated Open Channel
Loading Ratio Justification

The Martin Street Vegetated Open Channel is a designed and constructed BMP for the East Earl Township Pollution Reduction Plan (PRP) located in a residential area adjacent to Martin Street. This vegetated open channel was designed and constructed in 2022. The channel was designed meeting the requirements of the PA Stormwater BMP Manual, with exception to the recommended loading ratio requirements of Appendix C (8:1 total and 5:1 impervious loading ratios). Another reason for the construction of this channel was to reduce significant erosion and standing water in the back yards of the residential area. This memorandum is to serve as justification to the large drainage area tributary to the facility and the facilities ability to adequately treat stormwater runoff prior to it reaching downstream Waters of the Commonwealth.

To preface the justification, it should be noted that the 5:1 and 8:1 loading ratio recommendations are generally more applicable for storage facilities and not conveyance facilities. The fact of the matter is, conveyance facilities, such as vegetated channels and bioswales, generally have larger drainage areas because by nature they are built to convey stormwater from other BMPs, neighborhoods, roads, and other components of the municipality towards Waters of the Commonwealth. Since stormwater is conveyed in these facilities versus stored, both hydraulic depths and drawdown times are significantly less than in a storage facility so loading ratios are not comparable. Additionally, vegetated channels provide significant water quality treatment through the filtering of sediment laden stormwater as it is conveyed through the vegetation and media and not mostly through infiltration, like most infiltration BMPs.

Upstream BMPs and Pretreatment

The upstream drainage area to the vegetated channel has two large surface BMPs, two large subsurface stormwater BMPs, one pond, as well as an extensive vegetated swale conveyance system prior to entering into the channel. There is the potential for additional BMPs in the upstream area (single lot residential BMPs) that are not documented on the MS4 system

mapping. There is only a small portion of the tributary drainage area that is not pretreated prior to its entrance into the channel and that is the residential area along Martin Street to the east of the channel.

Both the storage facilities and functional vegetated swales provide significant pre-treatment to stormwater as it relates to suspended solids. Appendix A of the PA Stormwater Manual documents numerous grass channels and vegetated swales of significantly less length, but similar slope and drainage area characteristics as having 68-87% reduction of Total Suspended Solids concentration when comparing inflow and outflow. With that said, pollution and sediment loading on the facility will be significantly less than what loading ratio recommendations consider. The upstream BMPs also have rate control aspects that will help reduce the flowrate and lower the depth in the vegetated channel while also reducing the potential for erosion.

BMP Design

The vegetated open channel was designed and constructed with water quality in mind. The facility is a trapezoidal channel (6' bottom width) at a low longitudinal slope (between 1.6% and 2.15%). Additionally, a deep-rooted Ernst bioswale mix was planted in the facility bottom. During construction, the facility was built with decompaction in mind. The facility was excavated and lightly scarified prior to placement of the topsoil, seeding, and matting. The combination of these components makes this facility ideal for the frequent small storm events, treating and infiltrating runoff as it goes through the facility. In the 1-year storm event the channel has an average hydraulic depth of 0.72 feet and an average non-erosive velocity of 3.82 ft/sec. This information is provided in the attached HydroCAD calculations. The 1-year hydraulic depth is significantly less than the recommended maximum of two feet to avoid excessive pressure and potential sealing of the channel bottom.

Site Evidence After Construction

The channel was recently completed in the Summer of 2023 and the Township has monitored its performance since. The vegetated channel has shown to be able to handle the flow and there is no evidence of sediment deposition or erosion occurring in the system. This fact justifies that the upstream system does a proper job of pretreating the runoff and slowing down runoff rates prior to its conveyance through the channel.

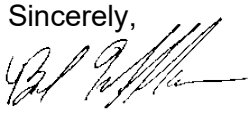
Summary

The pretreatment combined with the vegetated channel design is the justification for the large drainage area. This is evident by the minimal amount of sediment that has been seen in visual

inspections of the facility after larger rainfall events. ARRO believes that the facility has been designed and constructed per the PA Stormwater Manual requirements contingent upon the variation to the loading ratio recommendations being approved by DEP. In conclusion, the vegetated open channel and treatment train are affectively preventing ~10,149.78 lbs/yr of TSS from being produced and conveyed to the headwaters of Cedar Creek through filtration, infiltration, storage, and rate reduction.

If you have any questions regarding this matter, please email me at brad.underkoffler@arroconsulting.com.

Sincerely,



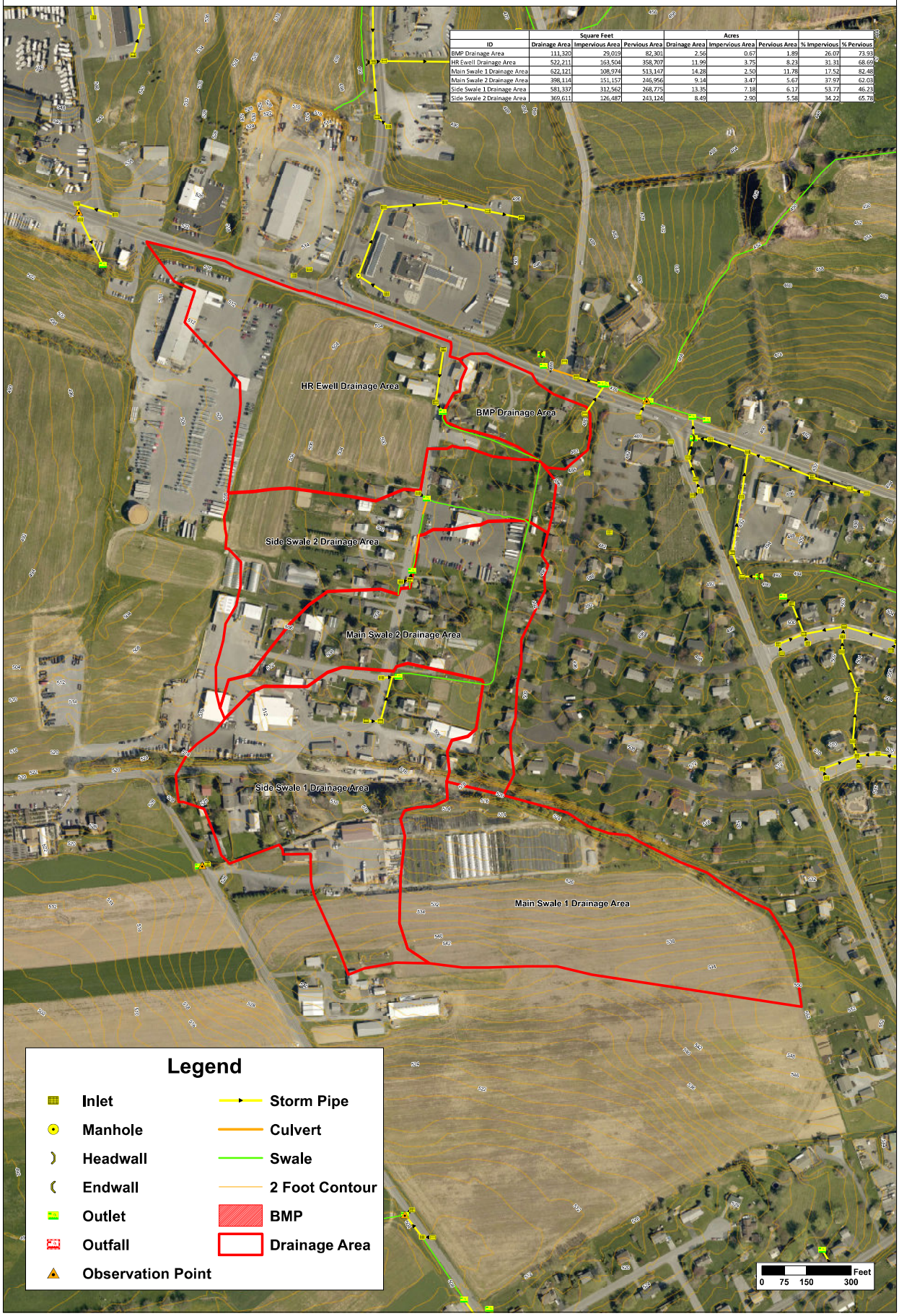
Brad Underkoffler, P.E.
Project Manager

Enclosures

East Earl Township

Martin Street Swale Drainage Areas

	Square Feet			Acres				
ID	Drainage Area	Impervious Area	Pervious Area	Drainage Area	Impervious Area	Pervious Area	% Impervious	% Pervious
BMP Drainage Area	111,320	29,019	82,301	2.56	0.67	1.89	26.07	73.93
HR Ewell Drainage Area	522,211	163,504	358,707	11.99	3.75	8.23	31.31	68.69
Main Swale 1 Drainage Area	622,121	108,974	513,147	14.28	2.50	11.78	17.52	82.48
Main Swale 2 Drainage Area	398,114	151,157	246,956	9.14	3.47	5.67	37.97	62.03
Side Swale 1 Drainage Area	581,337	312,562	268,775	13.35	7.18	6.17	53.77	46.23
Side Swale 2 Drainage Area	369,611	126,487	243,124	8.49	2.90	5.58	34.22	65.78



Summary for Reach 3R: Swale Section 1

Inflow Area = 1,601,701 sf, 21.87% Impervious, Inflow Depth = 0.78" for 1-yr event
Inflow = 21.12 cfs @ 12.02 hrs, Volume= 103,816 cf
Outflow = 19.70 cfs @ 12.06 hrs, Volume= 103,816 cf, Atten= 7%, Lag= 2.7 min
Routed to Reach 5R : Swale Section 2

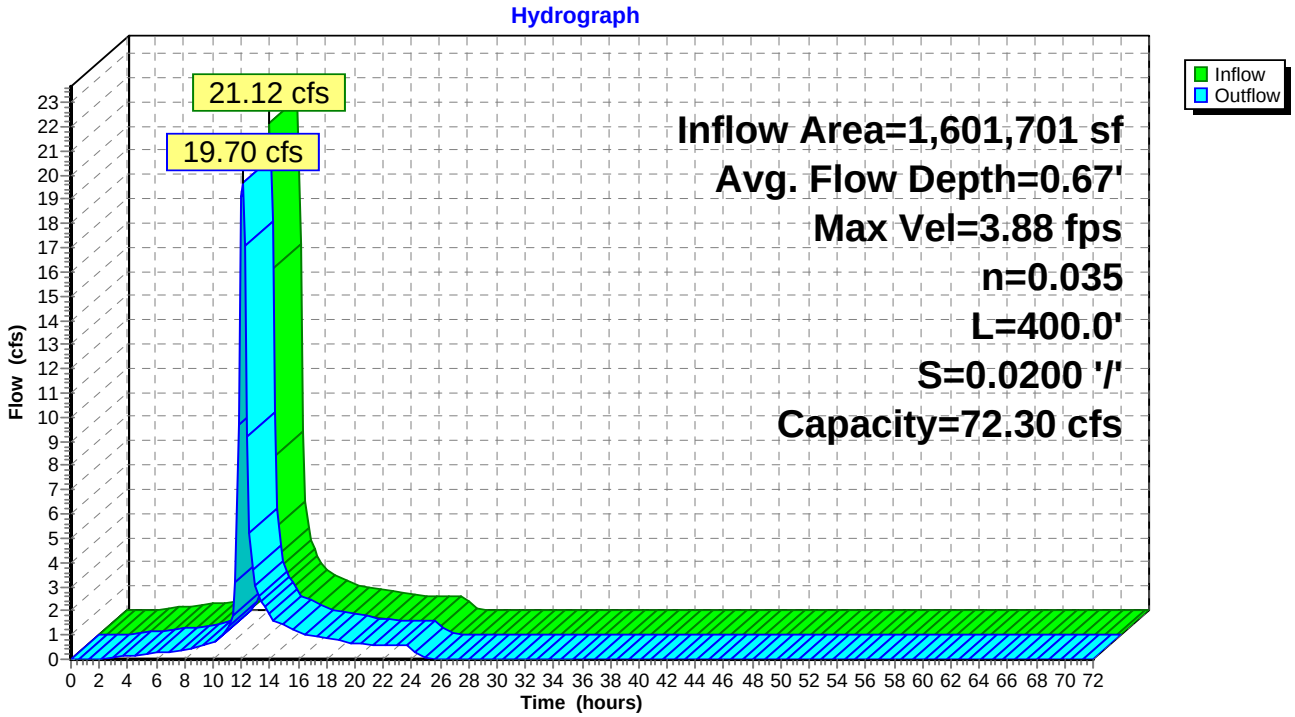
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.20 hrs
Max. Velocity= 3.88 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 0.85 fps, Avg. Travel Time= 7.8 min

Peak Storage= 2,140 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.67' , Surface Width= 10.01'
Bank-Full Depth= 1.30' Flow Area= 12.9 sf, Capacity= 72.30 cfs

6.00' x 1.30' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 13.80'
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 496.00', Outlet Invert= 488.00'

‡

Reach 3R: Swale Section 1



Summary for Reach 5R: Swale Section 2

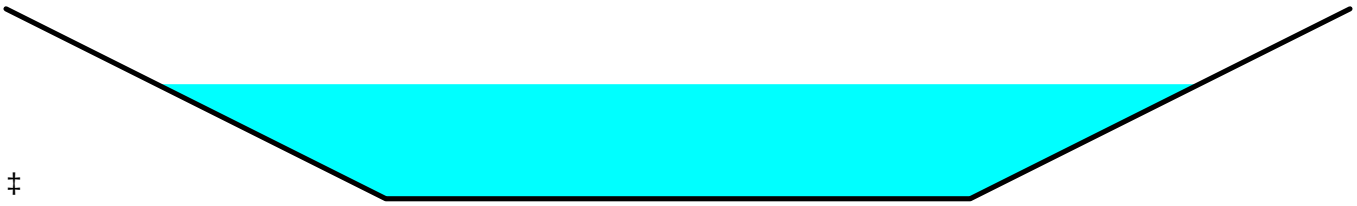
[62] Hint: Exceeded Reach 3R OUTLET depth by 0.17' @ 12.20 hrs

Inflow Area = 1,971,090 sf, 23.25% Impervious, Inflow Depth = 0.79" for 1-yr event
Inflow = 25.49 cfs @ 12.07 hrs, Volume= 130,398 cf
Outflow = 24.15 cfs @ 12.14 hrs, Volume= 130,398 cf, Atten= 5%, Lag= 3.9 min
Routed to Link 2L : Total to BMP

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.20 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.84 fps, Avg. Travel Time= 7.3 min

Peak Storage= 2,414 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.78' , Surface Width= 10.70'
Bank-Full Depth= 1.30' Flow Area= 12.9 sf, Capacity= 65.10 cfs

6.00' x 1.30' deep channel, n= 0.035 Earth, dense weeds
Side Slope Z-value= 3.0 '/' Top Width= 13.80'
Length= 370.0' Slope= 0.0162 '/'
Inlet Invert= 488.00', Outlet Invert= 482.00'



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Reach 5R: Swale Section 2