TOTAL MAXIMUM DAILY LOAD PLAN

Prepared for:
Avondale Borough,
Chester County, PA

For:
The East Branch of the White Clay Creek, Trout Run,
and The Unnamed Tributary to the East Branch White Clay Creek
in the Christina River Basin

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1.0 Executive Summary

Avondale Borough has been operating under a Municipal Separate Storm Sewer System (MS4) permit issued by the Pennsylvania Department of Environmental Protection (PA DEP) since 2003. The permit needs to be renewed. The permit application requires the Borough to prepare a Total Maximum Daily Load (TMDL) plan that will address the reduction of sediments and nutrients in the streams within the Christina River Basin. The TMDL analysis has determined that the **Existing Sediment Load** is **104,363 lbs./yr.** The Christian River Basin TMDL plan requires Avondale Borough to reduce the existing load by 69.80**%**, therefore, the **TMDL Load Reduction Required** is **71,206 lbs./yr**. of sediment. During the five-year permit term, the Borough must implement a sediment reduction plan by constructing stormwater Best Management Practices (BMPs) to reduce either the full TMDL Load Reduction Required or 10% of the Existing Sediment Load (10,436 lbs./yr.). Two Bioretention/Rain Garden BMPs are proposed which will have a combined calculated sediment load reduction of almost 10,900 lbs./yr. Therefore, the TMDL plan with proposed BMPs will satisfy the short-term TMDL obligation by reducing the Borough's existing sediment load discharged to surface waters by 10%.

2.0 Purpose and Scope

Avondale Borough is currently covered under a Pennsylvania Department of Environmental Protection (PADEP), National Pollutant Discharge Elimination System (NPDES) Permit. This type of permit is required by both PADEP and the US Environmental Protection Agency (EPA) to comply with the Federal Clean Water Act and Pennsylvania's Clean Streams Law. As part of this permit, Avondale Borough is responsible for developing and implementing a Total Maximum Daily Load (TMDL) Plan for all stormwater discharges to local surface waters covered under Municipal Separate Storm Sewer System (MS4) within the White Clay Creek Watershed. The White Clay Creek has been identified in the Christiana River Basin TMDL plan prepared by EPA. That plan assigned a sediment Waste Load Allocation (WLA) to the Borough. Since a WLA was assigned, the Borough is required to develop its own TMDL plan to include methods to reduce sediment and nutrients from stormwater discharges to surface waters in the Borough.

Table 1 presents impairments and corresponding streams described in the "2014 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, (rev. 6/26/17). This plan has been prepared using the most current guidelines available by PADEP. All relevant definitions of regulatory terminology can be referenced in Section 7.0 of this report.

Table 1: MS4 Requirements Table (Municipal) Excerpt

MS4 Name	NPDES ID	Individual Permit Required?	Reason	Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Avondale Borough, Chester County	PAG130079	Yes	TMDL Plan	Christina River Basin Sediment	TMDL Plan Siltation, Suspended Solids (4a)	
				Christina River Basin Nutrients	TMDL Plan-Nutrients, Organic Enrichment/Low D.O. (4a)	
				East Branch White Clay Creek	Appendix B-Pathogens (5)	
				Trout Run	Appendix C-Pesticides (4a)	
				White Clay Creek	Appendix B-Pathogens (5)	

3.0 Permit Requirements

Avondale Borough is required by the PA DEP and Environmental Protection Agency (EPA) to address siltation (sediment) and nutrients in the impaired streams within the Borough identified as the East Branch of the White Clay Creek, the Unnamed Tributary (UNT) to the East Branch of the White Clay Creek, and Trout Run.

According to the PADEP TMDL Plan Instructions (3800-PM-BCW0200d 1/2017), The TDML plan objectives include two key elements; short-term reduction and long-term reduction of pollutant loads to achieve the WLAs assigned in the Christian TDML. The long-term load reduction requirements for the Borough were established by the EPA in "Total Maximum Daily Loads for Bacteria and Sediment in the Christina River Basin, Pennsylvania, Delaware, and Maryland" September 2006. The estimated pollutant loads assigned to Avondale Borough are 140.02 tons/yr. of sediment, 4.58 kg/day of Nitrogen, and 0.135 kg/day of Phosphorus. The load reductions required for Avondale Borough are to be 69.80% for Sediment, 50.00% for Nitrogen, and 58.07% for Phosphorus (Nutrients). Table 2 presents a summary of loads and % reduction required.

Table 2 - MS4 Baseline Load and % Reduction Requirements (Excerpt from Christiana TMDL)

Table 1. Brandywine-Christina Watershed (HUC # 02040205)
EPA TMDL MS4 Baseline Pollutant Loadings, MS4 Allocations, and Reductions

MUNICIPALITIES LISTED IN TMDL REPORTS Brandywine Creek Watershed	Sediment (tons/year)				Total Nitrogen (kg/day)				Total Phosphorus (kg/day)			
	Baseline MS4 Load[1a]	MS4 Load Allocation[1b]	MS4 Load Reduction[1c]	% Reduction[1d]	MS4 Baseline Load[2a]	MS4 Allocation[2b]	MS4 Load Reduction[2c]	% Reduction[2d]	MS4 Baseline Load[3]	MS4 Allocation[3a]	MS4 Load Reduction[3b]	% Reduction[3c]
BIRMINGHAM TWP	310.61	130.35	180.46	58.06%								
COATESVILLE CITY	231.29	79.78	151.53	65.52%	16.06	10.66	5.22	32.48%	3.015	2.031	0.984	32.64%
EAST BRADFORD TWP	1185.00	467.17	717.83	60.58%								
EAST BRANDYWINE TWP					54.19	44.44	9.75	17.99%	0.826	0.677	0.149	18.04%
EAST FALLOWFIELD TWP	803.93	426.42	376.81	46.91%	110.54	75.74	34.80	31.48%	22.365	15.348	7.017	31.37%
EAST MARLBOROUGH TWP	366.79	139.44	227.26	61.98%								
HIGHLAND TWP	384.80	238.88	145.94	37.93%								
HONEY BROOK BORO	20.58	13.23	7.35	35.70%	9.81	5.76	3.85	40.06%	0.184	0.11	0.074	40.22%
HONEY BROOK TWP	813.84	558.76	255.08	31.34%	421.64	279.02	142.62	33.83%	7.599	4.956	2.643	34.78%
KENNETT TWP			0.00		2.58	2.22	0.16	6.72%	0.213	0.198	0.015	7.04%
MODENA BORO	27.96	12.46	15.50	55.43%	4.80	3.25	1.55	32.29%	0.666	0.665	0.31	32.09%
NEWLIN TWP	144.18	59.59	84.59	58.67%	6.53	4.57	1.96	30.02%	1.337	0.936	0.401	29.99%
PARKESBURG BORO	52.11	32.35	19.76	37.93%								
PENNSBURY TWP	113.98	43.48	70.50	61.85%	47.00	43.71	3.29	7.00%	4.206	3.911	0.295	7.01%
POCOPSON TWP	821.21	320.79	500.42	60.94%								
SADSBURY TWP	289.73	172.13	117.60	40.59%	3.05	2.26	0.79	25.90%	0.329	0.205	0.124	37.69%
THORNBURY TWP	82.17	34.48	47.71	58.06%								
UPPER UWCHLAN TWP			0.00		10.92	8.96	1.96	17.95%	0.186	0.137	0.029	17.47%
VALLEY TWP	485.14	184.84	300.50	86.08%	57.57	43.75	13.82	24.01%	6.941	4.726	2.215	31.91%
WALLACE TWP	21.74	17.41	4.33	19.92%	126.53	103.78	22.77	18.00%	1.929	1.582	0.347	17.99%
WEST BRADFORD TWP	283.22	121.6	161.62	57.07%	17.25	12.08	5.17	29.97%	3.532	2.473	1.059	29.98%
WEST BRANDYWINE TWP			0.00		136.01	104.78	31.23	22.96%	9.83	8.544	1.286	13.35%
WEST CALN TWP	68.28	43.07	25.21	36.92%	183.72	149.26	34.46	18.76%	9.95	8.649	1.301	13.08%
WEST GOSHEN TWP	461.32	180.51	280.81	60.87%								

Red Clay Creek Watershed	Sediment (tons/year)				Total Nitrogen (kg/day)				Total Phosphorus (kg/day)			
	Baseline MS4 Load[1c]	MS4 Load Allocation[1e]	MS4 Load Reduction[1e]	% Reduction[1f]	MS4 Baseline Load[2b]	MS4 Allocation[2a]	MS4 Load Reduction[2e]	% Reduction[2f]	MS4 Baseline Load[3]	MS4 Allocation[3a]	MS4 Load Reduction[3b]	% Reduction[3c]
EAST MARLBOROUGH TWP	8791.41	4,193.24	4598.17	52.30%	137.13	68.56	68.57	50.00%	2.742	1.372	1.37	49.96%
KENNETT SQUARE BORO	840.10	405.41	434.69	51.74%	16.26	8.63	8.63	50.00%	0.452	0.151	0.301	66.59%
KENNETT TWP	6751.63	3,312.06	3439.57	50.94%	157.97	97.83	60.14	38.07%	21.517	3.731	17.786	82.66%
NEW GARDEN TWP	4799.65	2,118.72	2680.93	55.91%	77.03	38.52	38.51	49.99%	27.708	2.87	24.838	89.64%
PENNSBURY TWP					4.32	4.32	0.00	0.00%	0.082	0.082	0.00	0.00%

White Clay Creek Watershed	Sediment (tons/year)				Total Nitrogen (kg/day)				Total Phosphorus (kg/day)			
	Baseline MS4 Load[1c]	MS4 Load Allocation[1e]	MS4 Load Reduction[1e]	% Reduction[1f]	MS4 Baseline Load[2b]	MS4 Allocation[2c]	MS4 Load Reduction[2e]	% Reduction[2f]	MS4 Baseline Load[3]	MS4 Allocation[3c]	MS4 Load Reduction[3d]	% Reduction[3c]
AVONDALE BORO	463.65	140.22	323.43	69.76%	9.18	4.59	4.58	50.00%	0.322	0.135	0.187	58.07%
FRANKLIN TWP	4220.43	2,305.87	1914.56	45.36%	122.01	61.01	61	50.00%	15.219	5.557	9.662	63.49%
KENNETT TWP					2.17	2.17	0.00	0.00%	0.056	0.056	0	0.00%
LONDON BRITAIN TWP	2634.66	1,620.44	1014.22	38.50%	96.47	49.9	46.57	48.27%	15.732	7.333	8.399	53.39%
LONDON GROVE TWP	13616.33	4,842.51	8773.82	64.43%	262.75	128.47	134.29	51.11%	25.575	7.965	17.91	69.22%
NEW GARDEN TWP	6746.60	2,988.86	3756.84	55.73%	167.06	83.83	83.23	49.82%	41.916	13.374	28.542	68.09%
NEW LONDON TWP	1913.97	1,008.60	905.37	47.30%	53.56	26.61	26.95	50.32%	0.65	0.292	0.358	55.08%
PENN TWP	3564.76	1,410.29	2174.47	60.65%	71.23	33.36	37.87	53.17%	0.798	0.359	0.439	55.01%
WEST GROVE BORO	567.29	197.53	369.86	65.74%	9.24	4.36	4.88	52.81%	0.117	0.05	0.067	55.36%

The focus of this plan is for the land area within the 2010 Urbanized Area. The Urbanized Area is based on population density from the 2010 US Census. The entire Borough of Avondale is within the 2010 Urbanized Area. This plan is limited to just those lands that drain stormwater, then discharge to impaired streams, or are within 5 miles of impaired streams through conveyance by stormwater sewer system infrastructure, or local road drainage pathways.

All the streams in the Borough are in the Christina River Basin and therefore need the TMDL plan to address reduction of sediment and nutrients. Organic Enrichment /Low D.O are surrogates for nutrients and will be address with the reduction of Phosphorus. The other noted requirements in the table include for Appendix B - Pathogens, and Appendix C – Pesticides. The Borough acknowledges these requirements. The Borough is not aware of any sources in the Borough which may be contributing to these impairments. The Borough will continue to follow the MS4 Minimum Control Measure (MCM#3) Illicit Discharge Detection and Elimination BMPs and follow up with any suspicious findings related to Pathogens and Pesticides.

This Plan will identify sediment and nutrient reductions which must occur over the 5-year term of the permit through the implementation of Best Management Practices (BMPs) as provided for in the Stormwater BMP Manual for PA. It will determine the sediment and nutrient loads to the contributing streams within the Borough. The calculation of the loads and the load reductions will become the basis for proposed BMP identified to reduce those loads to satisfy the Borough's obligation for this permit period.

4.0 Background/Setting

Avondale Borough comprises approximately 315 acres or 0.5 square miles located in the southeastern portion of Chester County (Figure 1). The entire Borough is noted to be an Urbanized Area based on data from the 2010 Census. The Trout Run enters the Borough from New Garden Township to the east and flows through the southern part of the Borough. The Unnamed Tributary to the East Branch of the White Clay Creek, sometimes referred to as Indian Run, enters the Borough from London Grove Township in the northwest corner the Borough and flows through the western portion of the Borough. They both discharge into the East Branch of the White Clay Creek which enters the Borough from New Garden Township to the north and basically flows through the center of the Borough.

Figure 1: Avondale Borough Location Map

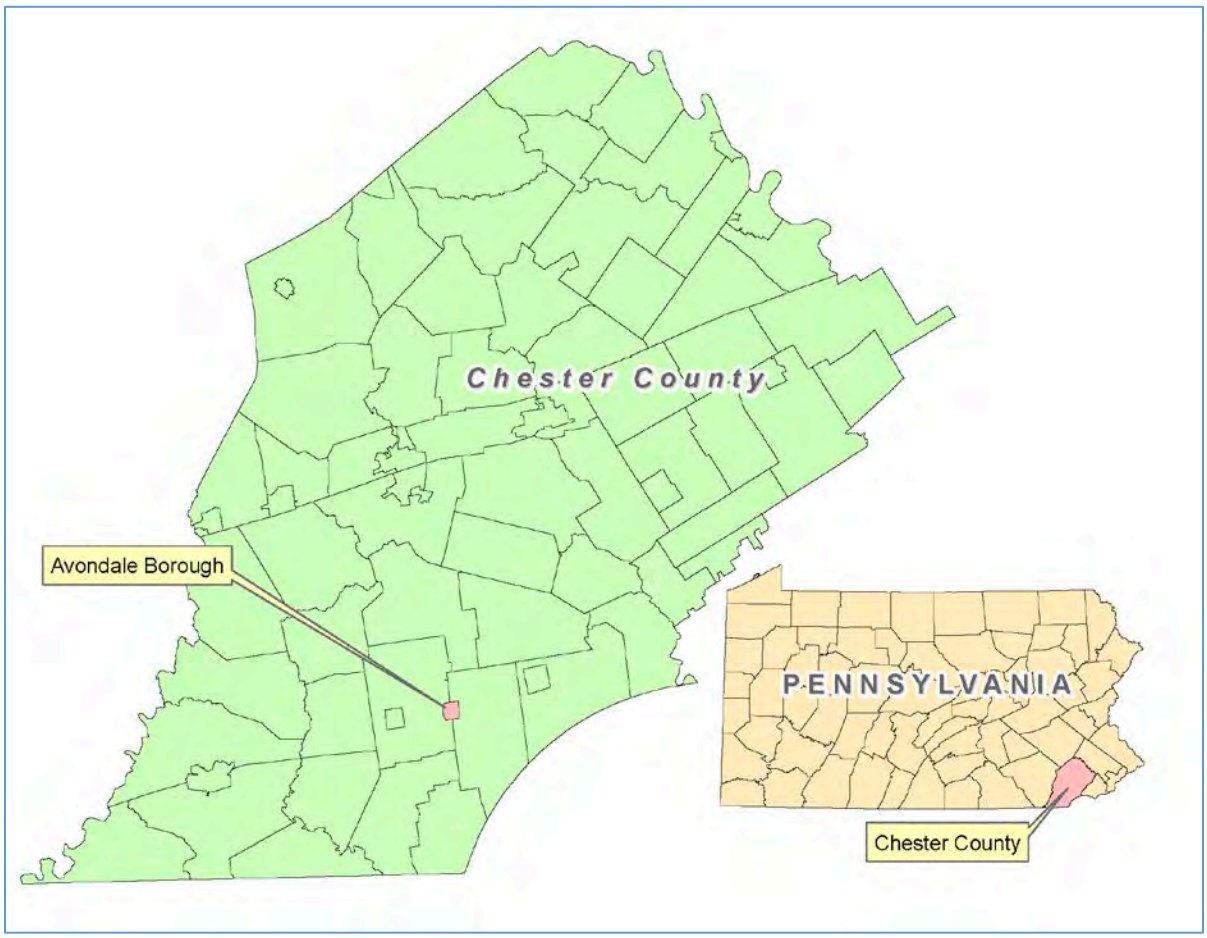
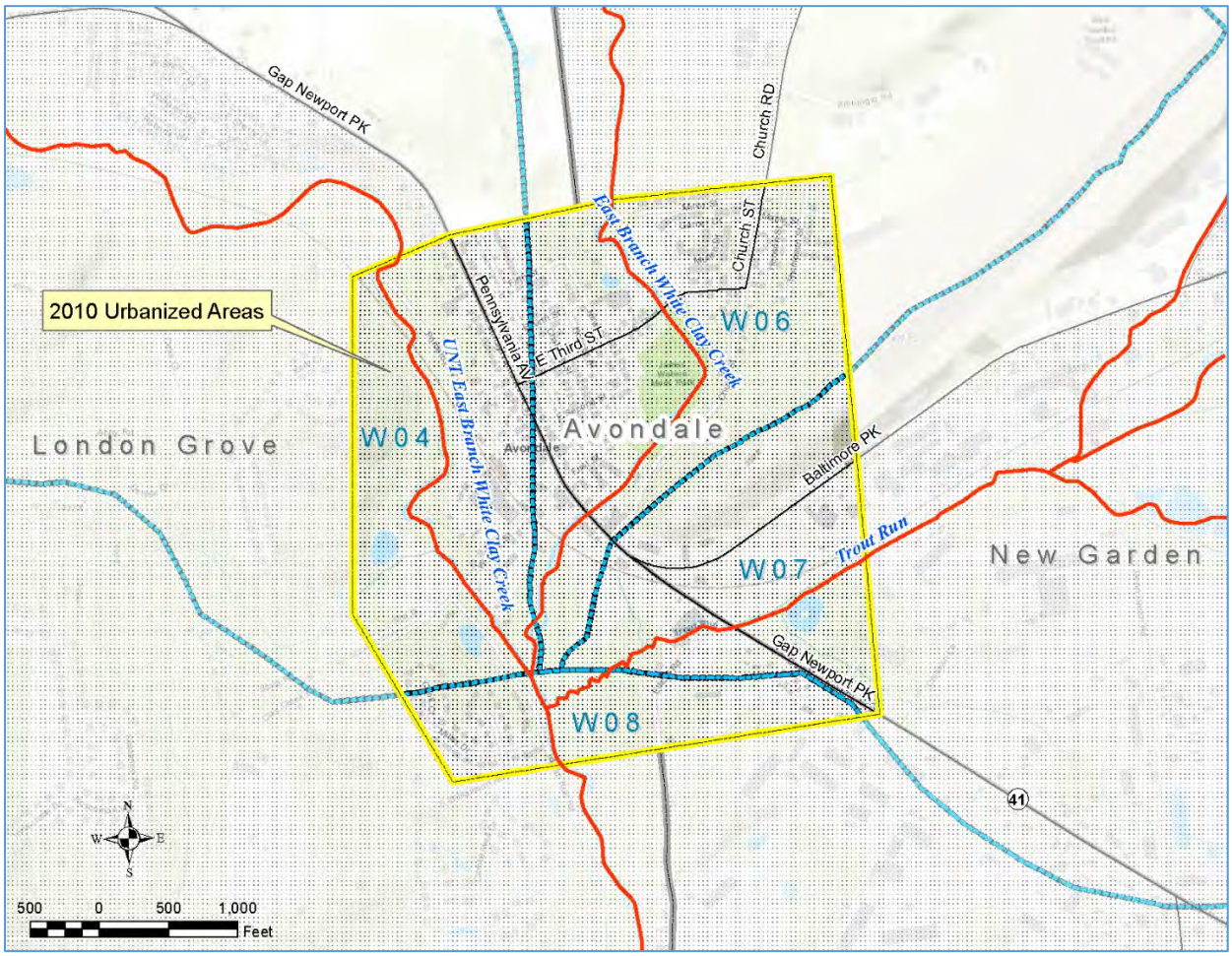


Figure 2 presents the Urbanized Area as a dot pattern which includes the entire Borough. The impaired streams are shown in red. The turquoise-colored lines and labels indicate the watershed boundaries used in the Christina TMDL Plan. The whole Borough of Avondale is within the Christina River Basin. This Basin is currently impaired for sediments and nutrients. There is a total of four (4) MS4 watersheds in the urbanized area that discharge to impaired waterways within Avondale Borough. Refer to the Appendix B for more detailed mapping.

Figure 2: Avondale Borough Urbanized Area and Impaired Streams



5.0 TMDL Plan

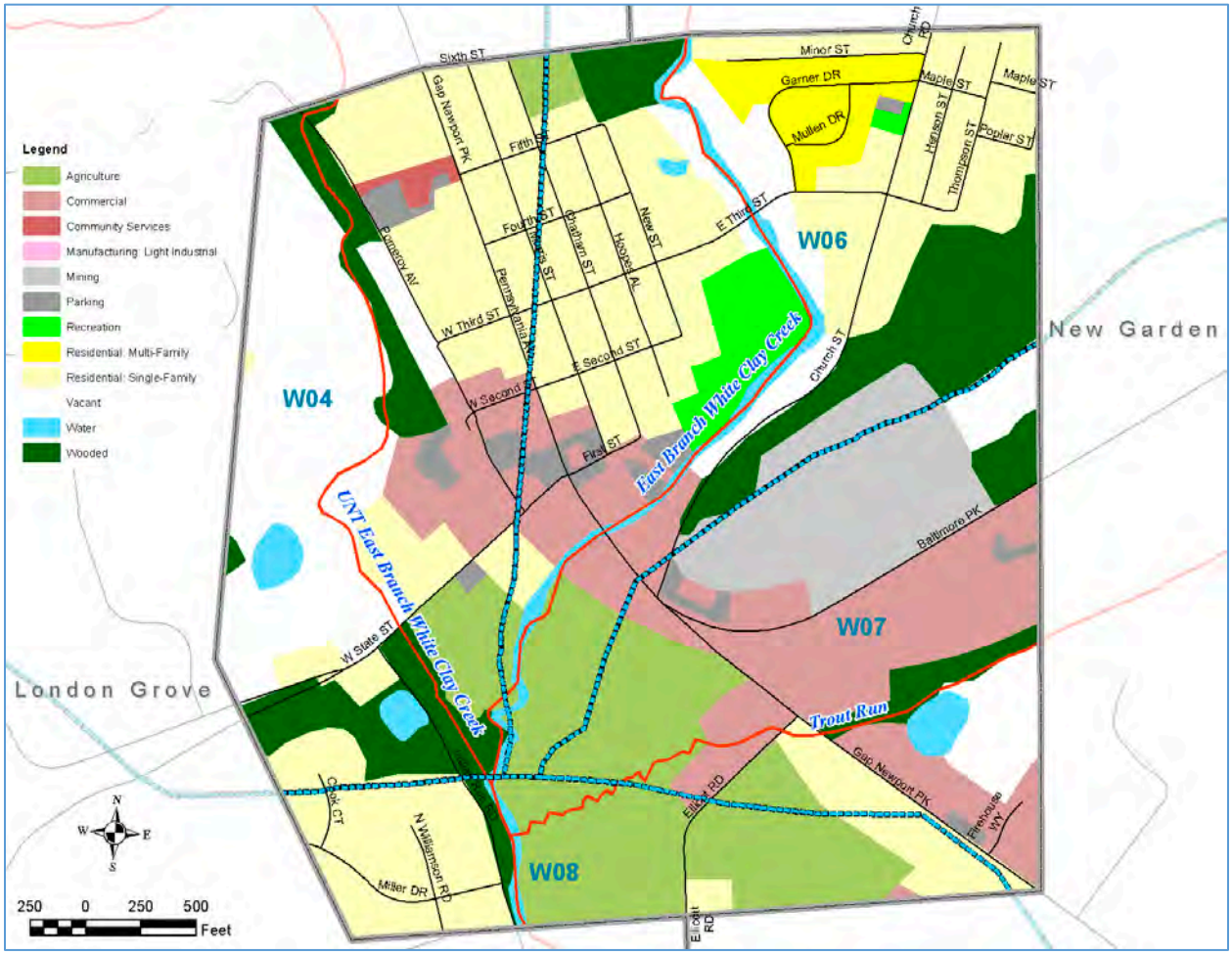
The TDLM Plan includes sections specified in "PADEP TMDL Plan Instructions" (3800-PM-BCW0200d 1/2017). The following sections are considered by PADEP to be key elements which must be included in the plan.

A. Public Participation – The Borough of Avondale shall make this TMDL Plan available to the public for review and comment for thirty (30) days following preliminary approval from PADEP. This will be initiated by publishing a notice in the Daily Local News, a daily paper of general distribution upon approval by Avondale Borough Council. A copy of the public notice will be included in Appendix A. Public Comments will be accepted at a regularly scheduled Borough Council meeting. Avondale Borough shall consider and make a record of the consideration of

each timely comment received from the public during the public comment period concerning the plan, identifying any changes made to the plan in response to the comment. A Public Comment Report will be included in Appendix A.

B. **TMDL Map** - A map (Figure 4) is included here that identifies land use within the TMDL Planning Area.

Figure 4 – Land Use (2015) within the TDML Planning Area



C. **Pollutants of Concern** – Avondale Borough is responsible for both sediment reduction and nutrient reduction. To meet the requirements, a minimum of ten (10) percent sediment reduction is covered in this plan. Per the "PADEP TMDL Plan Instructions" (3800-PM-BCW0200d 1/2017), as well as the "Key Outcomes Report" issued by the CCWRA (5/5/17), "TMDLs may use a presumptive approach in which it is assumed that a 10% sediment reduction will also accomplish a 5% TP reduction." Therefore, this plan covers both the sediment and nutrient reduction requirement. Loading and BMP reduction calculations can be found in Appendix C.

D. **Existing Load for Pollutant of Concern** – In order to determine the existing load for this TMDL plan there are two options. Either use the Baseline Load assigned by the EPA in the Christina River TMDL Report or calculate a Revised Baseline Load using an approved land use analysis of the TMDL Planning Area. The Christina TMDL Baseline Load assigned by EPA is **140.02 tons/yr.** or **280,040 lbs./yr.** of sediment.

The approved land use analysis used here is from "Key Outcomes of CCWRA/PADEP Communications Regarding Christiana Basin TMDL & PRP Calculations Process" (Key Outcomes). This option applies the Christina Basin MapShed (CMS) model results including 1995 watershed specific land use loading rates to calculate a Revised 1995 TMDL Baseline Load. The analysis will follow the 12-step approach provided in the Key Outcomes document.

Step 1 - Calculate the Revised (1995) TMDL Baseline Load. CMS 1995 land use loading rates are provided in the "1995 Land Use Loading Rates Look-Up Tables" (found in the workbook CORRECTEDBrandywineWatershed1995 LoadRates5.12.17.xlsx). The revised (1995) TMDL Baseline Load can be used to REPLACE the baseline load from the Christina TMDL Report. Table 3 present the 1995 land use areas within the TMDL Planning Area.

Table 3 - 1995 Land Use Baseline Load Calculations.

1995 LOAD CALCULATIONS							
SOURCE	**AREA**	**TOTAL SEDIMENT LOADING RATE**	**TOTAL SEDIMENT**	**TOTAL NITROGEN LOADING RATE**	**TOTAL NITROGEN**	**TOTAL PHOSPHORUS LOADING RATE**	**TOTAL PHOSPHORUS**
Units	Acres	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.
Hay/Past	-	181.72	-	0.94	-	0.26	-
Cropland	20.93	1,499.30	31,375.56	5.96	124.72	1.57	32.86
Forest	37.37	111.43	4,164.31	0.15	5.61	0.04	1.49
Wetland	0.17	97.86	16.60	0.48	0.08	0.04	0.01
Disturbed	-	140.64	-	0.19	-	0.08	-
Turfgrass	-	0.00	-	0.00	-	0.00	-
Open_Land	5.13	230.82	1,183.08	1.13	5.79	0.12	0.62
Bare_Rock	-	0.00	-	0.00	-	0.00	-
Sandy_Areas	-	0.00	-	0.00	-	0.00	-
Unpaved_Road	-	0.00	-	0.00	-	0.00	-
Ld_Mixed	-	600.90	-	1.47	-	0.23	-
Md_Mixed	6.53	1,450.93	9,473.81	6.25	40.81	0.81	5.29
Hd_Mixed	2.43	2,055.61	4,991.11	6.83	16.58	0.95	2.31
Ld_Residential	75.32	616.19	46,410.39	1.64	123.52	0.25	18.83
Md_Residential	0.74	1,464.34	1,090.40	6.83	5.09	0.89	0.66
Hd_Residential	1.77	2,067.89	3,654.15	7.49	13.24	1.04	1.84
TOTAL	**150.38**		**102,359.43**		**335.44**		**63.90**

The **Revised (1995) TMDL Baseline Load** is **102,359 lbs./yr.** of sediment, as presented in the table above.

Step 2 - Calculate the TMDL Load Reduction Required. The required reduction according to the EPA Christina River TMDL is **69.80%**, therefore, the **TMDL Load Reduction Required** is **71,206 lbs./yr**. of sediment. (Revised Baseline Load X TMDL % Reduction Assigned = 102,015 X 0.6980 = 71,206 lbs.)

Step 3 – Calculate the 2012 Load using a similar method used above the calculate the Revised (1995) TMDL load using 2012 MapShed land use area data and loading rates. The 2012 Load is the total load calculated using CMS 2012 (without state compiled BMPs) land use loading rates. CMS 2012 land use loading rates are provided in the 2012 Land Use Loading Rates Look-Up Tables (found in the workbook

CORRECTEDBrandywineWatershed2012 LoadRates5.12.17.xlsx). Table 4 present the CMS 2012 land use areas used to calculate the 2012 Load.

Table 4 - 2012 Land Use Load Calculations.

2012 LOAD CALCULATIONS							
SOURCE	**AREA**	**TOTAL SEDIMENT LOADING RATE**	**TOTAL SEDIMENT**	**TOTAL NITROGEN LOADING RATE**	**TOTAL NITROGEN**	**TOTAL PHOSPHORUS LOADING RATE**	**TOTAL PHOSPHORUS**
Units	Acres	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.
Hay/Past	-	183.12	-	1.12	-	0.33	-
Cropland	16.11	1,491.81	24,031.73	5.84	94.08	1.50	24.16
Forest	29.12	163.18	4,751.36	0.17	4.95	0.05	1.46
Wetland	0.11	148.61	16.68	0.48	0.05	0.05	0.01
Disturbed	14.87	225.70	3,355.25	0.27	4.01	0.12	1.78
Turfgrass	3.88	185.70	720.99	1.32	5.12	0.70	2.72
Open_Land	-	303.30	-	1.40	-	0.14	-
Bare_Rock	-	-	-	-	-	-	-
Sandy_Areas	-	-	-	-	-	-	-
Unpaved_Road	-	-	-	-	-	-	-
Ld_Mixed	0.04	594.85	24.75	1.46	0.06	0.23	0.01
Md_Mixed	5.23	1,353.62	7,075.82	6.83	35.70	0.87	4.55
Hd_Mixed	11.10	1,906.23	21,165.97	7.56	83.94	1.01	11.21
Ld_Residential	69.59	600.45	41,784.88	1.57	109.26	0.24	16.70
Md_Residential	1.07	1,347.59	1,435.94	6.34	6.76	0.82	0.87
Hd_Residential	-	1,905.55	-	7.38	-	0.99	-
TOTAL	**151.11**		**104,363.38**		**343.94**		**63.47**

The **2012 Load** is **104,363 lbs./yr.** of sediment. The calculated sediment load increased between 1995 and 2012, mainly due to an increase of cropland, reduction of forest lands, and changes in residential development patterns during that period.

Step 4 – Calculate the Land Conversion Load Reduction which is the Revised (1995) TMDL Baseline Load minus the 2012 Load (102,359 – 104,363 = -2,004). The **Land Conversion Load Reduction** is -**2,004** In other words, the calculated sediment load increased 2,004 lbs./yr. so the load reduction required increased during the time between 1995 and 2012.

Step 5 – Calculate the Existing BMP Reduction. The Borough of Avondale can calculate reductions for any existing functioning BMPs (with required documentation) installed prior to 2012 that they wish to use to further reduce their 2012 Load. The required documentation that must be included in this TMDL Plan includes the following information:

- A detailed description of the BMP.
- Latitude and longitude coordinates for the BMP.
- Location of the BMP on the storm sewershed map.
- The permit number, if any, that authorized installation of the BMP.
- Calculations demonstrating the pollutant reductions achieved by the BMP.

- The date the BMP was installed and a statement that the BMP continues to serve the function(s) it was designed for.
- The operation and maintenance (O&M) activities of the BMP, O&M frequencies, and party or parties who are responsible for O&M.

The required documentation for existing BMPs is incomplete at the time of this TMDL draft plan. However, the Borough reserves the right to modify this plan to include possible reductions as soon as the documentation is complete. Table 5 lists the existing BMPs within the planning area including latitude and longitude. Figure 5 presents the location of existing BMP within the TMDL Planning area. See Appendix B for more detailed maps showing existing BMP locations. The only BMP located within the Borough planning area is BMP#3 which is an infiltration basin in the Garner Dr. Subdivision. It appears to have been constructed around 2010.

Table 5 – Existing BMP Type and Location Coordinates

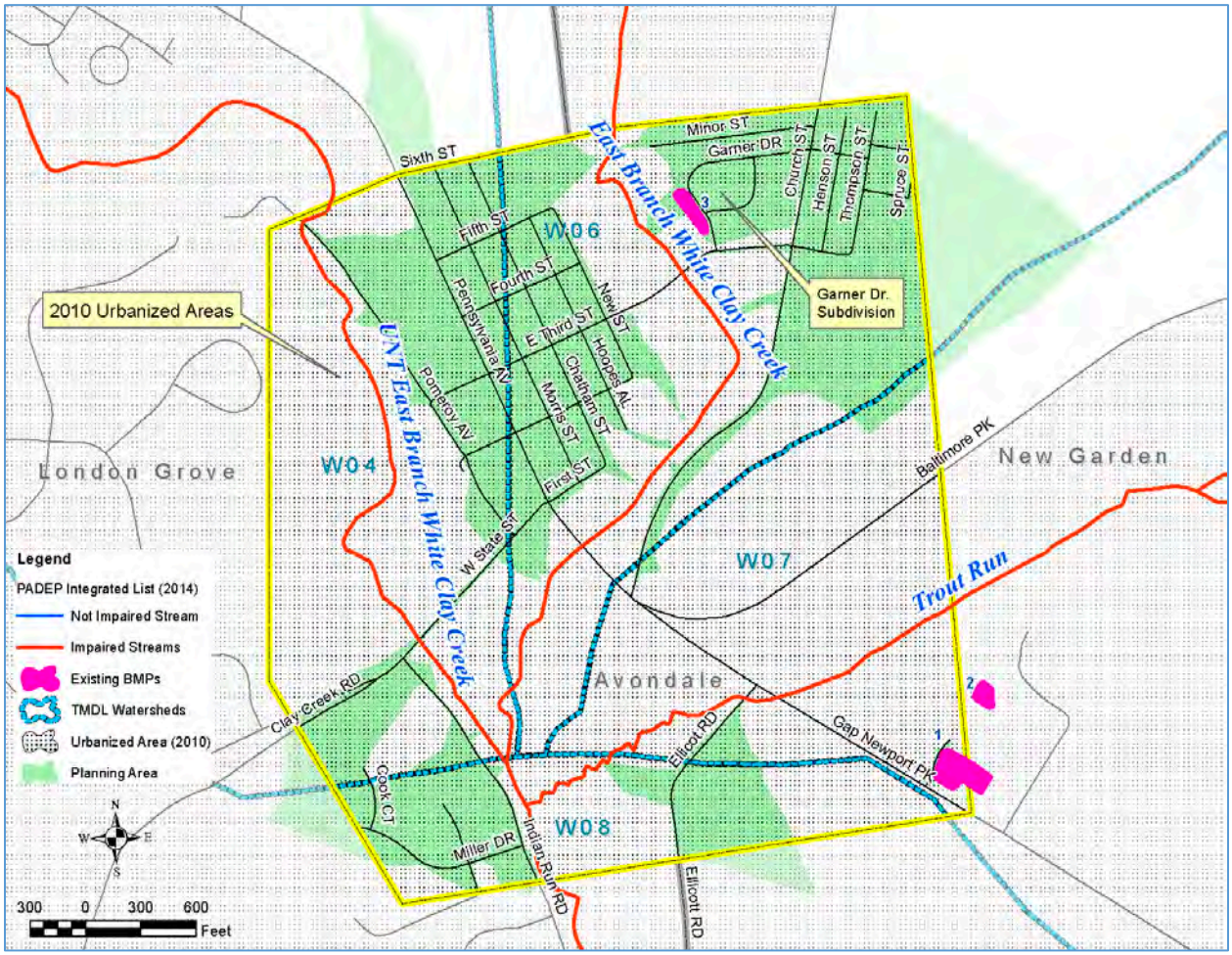
EXISTING BMP TYPE AND LOCATION			
FACILITY_ID	**TYPE**	**Latitude**	**Longitude**
AB_BMP_1	Infiltration - Dry	39° 49' 14.262" N	75° 46' 31.658" W
AB_BMP_2	Inflitration - Dry	39° 49' 18.342" N	75° 46' 29.840" W
AB_BMP_3	Inflitration - Wet	39° 49' 44.582" N	75° 46' 49.405" W

CMS 2012 land use areas, CMS 2012 land use loading rates, and NPDES Stormwater Discharges from Small MS4s BMP Effectiveness Values (3800-PM-BCW0100m, 5/2016, BMP Effectiveness Values) were used to calculate potential BMP load reductions. The existing BMP load reduction potential value was calculated using a similar approach to planning area load calculations. Land Use area within drainage areas, which contribute flow to the BMP, were aggregated for the existing BMP. The area between the existing BMP outlets and ultimate discharge to stream were not included. Table 6 presents the BMP load reduction calculations for the existing BMP within the TDML planning area. When the existing BMP documentation is complete, and comply with the requirements, the sediment load reduction could potentially be reduced by 16,219 lbs./yr.

Table 6 – Existing BMP Load Reduction Calculations.

EXISTING BMP ESTIMATED LOAD AND POTENTIAL REDUCTION										
FACILITY_ID	**TYPE**	**BMP Effectiveness**	**Disturb. (acres)**	**Forest (acres)**	**HD Mixed Res. (acres.)**	**MD Mixed Res. (acres)**	**MD Res. (acres)**	**LD Res. (acres)**	**Total Acres**	
AB_BMP_3	Infiltration Basin	95%	9.34	5.82	0.83	4.22	1.04	8.86	30.11	
		Loading Rate (lbs./ac.)	225.70	163.18	1906.23	1353.62	1347.59	600.45	**Total Load (lbs./yr.)**	**Potential Load Reduction**
		Sediment Load (lbs./ac.)	2108.12	950.14	1581.41	5707.46	1407.22	5318.26	**17,072.60**	**16,218.97**

Figure 5 – Existing BMP Locations



Step 6 - Calculate the Revised 2012 Load. This is done by taking the 2012 Load and subtracting the Existing BMP Reduction. As previously mentioned, documentation of existing BMP is not complete, therefore a **Revised 2012 Load** will not be calculated until the required BMP documentation is complete.

Step 7 – Calculate the Existing Load which equals is the Revised 2012 Load (or 2012 Load). Calculation of the existing load is important for use by the MS4 and PADEP in measuring progress over life of the permit. The existing load is the 2012 Load if BMP reduction is not used to calculate a Revised 2012 Load. Therefore, the **Existing Load** is **104,363 lbs./yr.** of sediment.

Step 8 – Calculate the Remaining TMDL Reduction Required after Land Conversion. This is accomplished by taking the Load Reduction Required (step 2) minus the Land Conversion Load Reduction (Step 4)- Existing BMP Reduction (Step 5 – none taken) equals the remaining load reduction required. The Remaining TMDL Reduction Required after land use conversion and credit for Existing BMP Load Reductions is calculated as follows:

- TMDL Load Reduction Required (**71,447 lbs./yr**.) – Load Reduction from Land Conversion (-**2,004**) – Existing BMP Reduction (0.0) = **Remaining TMDL Load Reduction Required** still to be achieved = **73,451 lbs./yr.**

Table 7 present the remaining TMDL reduction required after land use conversion.

Table 7 – Revised Required Load Reduction Calculation

Revised Load Reduction Calculation					
1995 Baseline Load	**Required Reduction**	**Revised Baseline Load**	**2012 Load**	**Land Conversion reduction**	**TMDL Reduction Required after Land Conversion**
lbs./yr.	percent	lbs./yr.	lbs./yr.	lbs./yr.	lbs./yr.
102,359.43	**69.80%**	**71,446.88**	**104,363.38**	**-2,003.95**	**73,450.83**

Step 9 - Calculate the TMDL Load Reduction Required this Permit Period. There are two options to derive this value, as follows:

- Achieve 100% reduction of Remaining TMDL Reduction Required (73,451 lbs.)
- Or the following reductions from the **Existing Load** (2012 Load) are required
    1. 10% reduction for sediment.
    2. 5% reduction for phosphorus.
    3. 3% reduction for nitrogen.

The presumptive approach can be applied, which allows for the 5% phosphorus and 3% nitrogen reductions to be presumed to be achieved if the 10% sediment reduction is achieved.

To achieve 100% of the remaining TMDL reduction **73,451 lbs./yr**. of sediment would need to be removed by proposed BMPs constructed over the five-year permit cycle. If that is not possible, then 10% of the Existing Load (104,363 lbs./yr.) or **10,436 lbs./yr**. of sediment would need to be removed by proposed BMPs constructed over the five-year permit cycle. According to values found in Table 4 above, the Existing Total Nitrogen (TN) Load is 344 lbs./yr., and the Existing Total Phosphorous (TP) Load is 63 lbs./yr. The required reduction for TN is **10.32 lbs./yr**. and **3.15 lbs./yr**. for TP over the 5-year permit cycle. Both approaches are less than the load assigned in the Christina TMDL Report (**280,040 lbs./yr.**)

Step 10 – Remaining Long-term Reduction Required to be Achieved. TMDL Reduction Required after Land Conversion minus the sediment reduction to be achieved in first 5-year permit period, equals the reduction achieved in future permit terms. (73,451 – 10,436 = 63,015 lbs./yr.)

Step 11 – Proposed Urban BMP Load Reduction Calculations: (see Section G below for a description of proposed BMPs). Two Bioretention – Raingarden (C/D soils w/ underdrain) are proposed. Table 8 presents the expected sediment load reduction.

Table 8 – Proposed BMP Load Reduction Calculations.

PROPOSED BMP ESTIMATED LOAD AND POTENTIAL REDUCTION										
FACILITY_ID	**TYPE**	**BMP Effectiveness**	**Cropland**	**Disturb. (acres)**	**Forest (acres)**	**HD Mixed Res. (acres.)**	**MD Mixed Res.**	**LD Res. (acres)**	**Total Acres**	
pBMP-1	**Rain Garden**	55%	0.00	0.42	0.05	0.44	0.00	4.93	5.84	
	Loading Rate (lbs./ac.)		1491.81	225.70	163.18	1906.23	1353.62	600.45	**Total Load (lbs./yr.)**	**Load Reduction**
	Sediment Load (lbs./ac.)		0.00	94.92	8.43	844.52	0.00	2960.02	**3,907.89**	**2,149.34**
pBMP-2	**Rain Garden**	55%	4.78	0.09	0.18	1.02	1.01	9.01	16.09	
	Loading Rate (lbs./ac.)		1491.81	225.70	163.18	1906.23	1353.62	600.45	**Total Load (lbs./yr.)**	**Load Reduction**
	Sediment Load (lbs./ac.)		7129.64	20.73	28.77	1953.52	1368.34	5409.00	**15,909.99**	**8,750.50**
								Total Reduction		**10,899.84**

Step 12 Summary of Calculations –

A. Revised 1995 Baseline Load = 102,359 lbs./yr. sediment
B. TMDL Load Reduction Required = 71,447 lbs./yr.
C. Existing Load = 104,363 lbs./yr.
D. Remaining TMDL Load Reduction Required = 73,451 lbs./yr.
E. TMDL Reduction Required this 5-year period = 73,451 lbs./yr. Or, if that cannot be achieved, then 10% of the existing load = 10,436 lbs./yr. sediment

E. Waste Load Allocation (WLA). As mentioned above (Table 2), the MS4 Load Allocation assigned to Avondale Borough is 140.02 tons/yr**.** of sediment. The Borough has elected to use the "presumptive approach, so this analysis is limited to sediment WLA. The load percent reduction required for Avondale has been establish by DEP to be 69.8% for Sediment. These numbers are based on a PADEP/EPA Baseline MS4 Load of 463.65 tons/yr. as an average annual sediment allocation for Avondale Borough which is in the White Clay Creek Watershed.

F. Analysis of TMDL Objectives.

Long-Term Reduction – According to the analysis above the long-term reduction requirement equals **73,451 lbs./yr**. That is not possible to achieve in the first 5-year permit cycle.

Short-Term Reduction – Avondale Borough has determined that 73,451 lbs./yr. of sediment cannot be reduced during the next permit period, so it elects to pursue BMPs for the reduction of 10,436 lbs./yr. as its short term TMDL Objective. The required reduction, 10% of the Existing Load (104,363 lbs./yr.) or **10,436 lbs./yr**. of sediment, would need to be removed by proposed BMPs constructed over the five-year permit cycle.

G. Select BMPs to Achieve the Minimum Required Reduction in Pollutant Load.

This section is divided into two parts: 1) short-term reductions for the permit term, and 2) long-term reductions to meet the WLA(s).

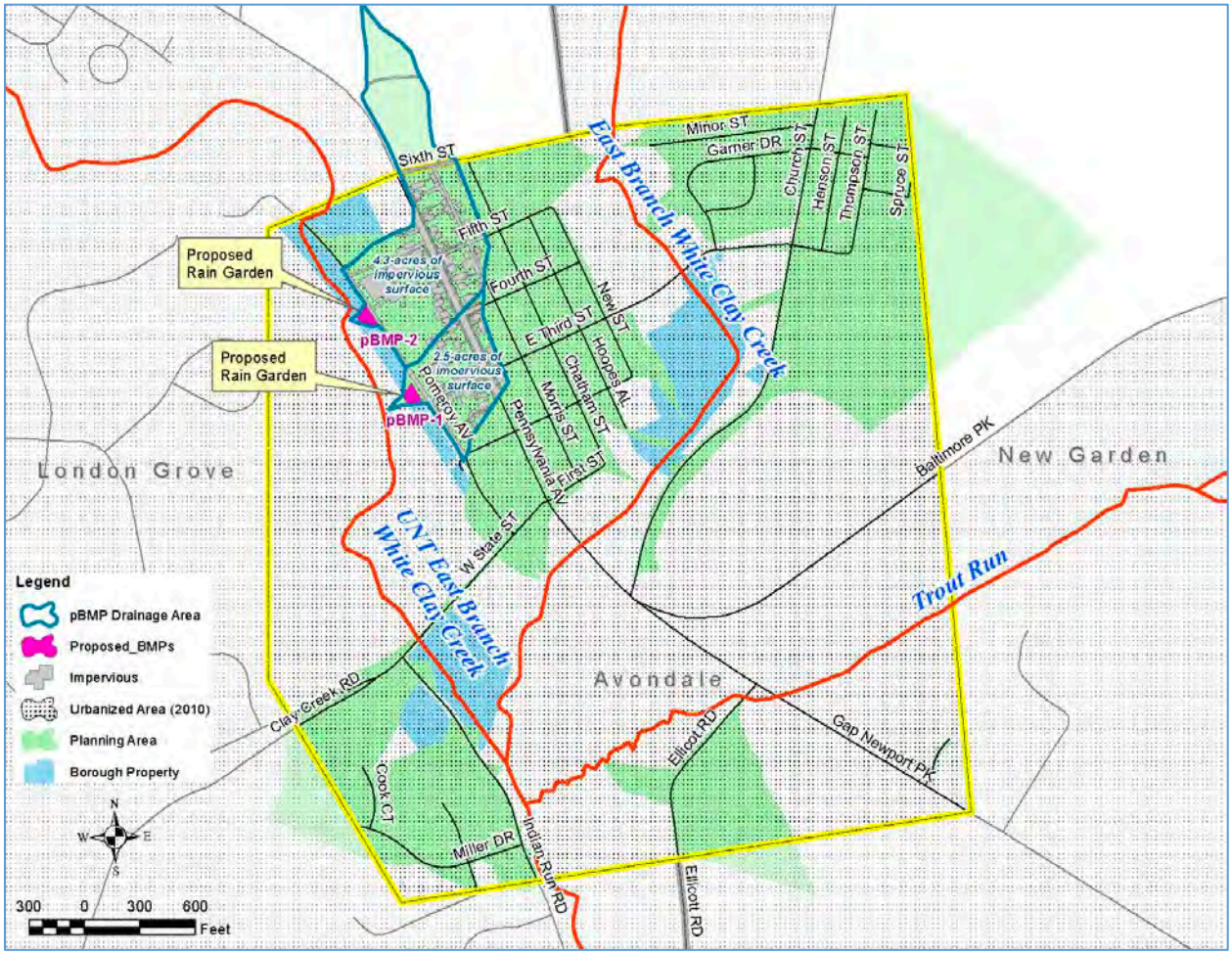
1. Short-term Reductions for the Permit Term.

Opportunities for new BMP construction have been identified. Land ownership was considered first. Borough owned lands provide the most control and ease of construction and permitting process. Homeowner Association (HOA) lands may be desirable especially if maintenance programs have not been adequate. Figure 6 presents the location and type of proposed BMP to meet the short-term reduction requirement. Borough owned lands are shown in light blue.

Two bioretention raingarden BMPs are proposed. The BMPs will capture stormwater runoff at outlets on the west side of Pomeroy Ave. Drainage area contributing runoff to the raingardens total 22 acres. The raingardens will include an excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around

the root zones of the plants. These BMPs will have underdrains and are expected to be in C or D soil. The Soils Survey list the soils as either urban or C/D. The proposed BMP estimated sediment load and expected reduction presented in Table 8 above includes an estimated sediment load reduction of approximately 10,900 lbs./yr. This will satisfy the Borough's short-term reduction obligation of 10,436 lbs./yr.

Figure 6 – Proposed BMP Locations



2. Long-term Reduction to Meet the WLA.

The Borough's previous TMDL Plan submission dated September 11, 2017 suggested that the Stream Restoration Project implemented on the East Branch of the White Clay Creek in 2005 from Pennsylvania Avenue to the E. Third Street Bridge and from West State Street to the Borough Line along Indian Run Road had resulted in the removal of enough sediment to allow the Borough to meet the required reduction. PADEP provided a final decision regarding whether to allow the Borough to claim credit for the existing BMP in an email dated July 13, 2022. For various reason PADEP felt that no credit for the project should be permitted.

The proposed long-term reduction plan then would include a Stream Restoration Verification Survey. This would include a two-stage inspection process by a trained stream restoration professional as outlined in the Chesapeake Bay Program Expert Panel Guide for Crediting Stream

and Floodplain Restoration Projects. The first stage involves a rapid inspection of the project reach to assess BMP condition. The project will be graded on a pass/action needed/fail basis. The guiding rule is that inspectors are looking for significant departures from its original design that may be compromising pollutant reduction function. Should a project appear to fail, a second forensic inspection will be undertaken to diagnose the nature and cause(s) of the problem, and whether project functions can be recovered by additional work. The additional work will be completed to restore functionality as originally designed. Once final post construction verification is complete, credit based on reduction values calculated using Protocols 1 and 3 within the Expert Panel guidelines will be compared to the Borough's WLA.

H. Identify Funding Mechanism

The Cost for the raingarden BMPs is based on the impervious area treated. The combined drainage area which will contribute stormwater runoff to the raingardens is estimated to be 22 acres. The combined impervious surface area treated is 6.8-acres. According to the Chesapeake Assessment Scenario Tool (CAST) cost profiles for Pennsylvania, the average rain garden total capital cost is approximately $50,000 per acre treated. That equals a total cost of $340,000. Grant applications will be made to various funding agencies including but not limited to American Rescue Plan (ARP) Funds, Bipartisan Infrastructure Law (BIL) funding, The National Municipal Stormwater Alliance (NMSA), PennVest and Commonwealth Financing Authority (CFA). CFA was established in 2004 as an independent agency of the Department of Community and Economic Development (DCED) and includes the PA Small Water and Sewer Program. The White Clay Watershed Association Wild and Scenic Program has recently made a grant application submission recently to fund one of the raingardens (pBMP-1) through the PA Growing Greener program.

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

Avondale Borough would be responsible for the Operations and Maintenance (O&M) of the proposed BMPs. According to the Pennsylvania BMP Manual, properly designed and installed Bioretention areas require some regular maintenance including:

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

6.0 Conclusion

Based upon the analysis of the sediment loads being generated from the sewersheds to the designated MS4 outfalls, it has been determined that the required 10% sediment reduction will be achieved through the implementation of the proposed BMPs.

7.0 Definitions

Best Management Practices (BMPs) *means schedules of activities, prohibitions of practices, maintenance procedures and other management practices to prevent or reduce pollutant loading to surface waters of this Commonwealth. The term includes treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. The term includes activities, facilities, measures, planning or procedures used to minimize accelerated erosion and sedimentation and manage stormwater to protect, maintain, reclaim and restore the quality of waters and the existing and designated uses of waters within this Commonwealth before, during and after earth disturbance activities. (25 Pa. Code § 92a.2)*

Clean Water Act (CWA) *means the Federal Water Pollution Control Act, as amended, 33 U.S.C.A. §§ 1251 - 1387.*

Cleaning Agent *means any product, substance or chemical other than water that is used to clean the exterior surface of vehicles.*

Designated Uses *are those uses specified in 25 Pa. Code §§ 93.4(a) and 93.9a – 93.9z for each water body or segment whether or not they are being attained. (25 Pa. Code § 93.1)*

Dry Weather *means a condition in which there are no precipitation, snowmelt, drainage or other events producing a stormwater discharge for more than 48 consecutive hours.*

Existing Permittee *means any entity that has been designated as a regulated small MS4 and has previously obtained permit coverage under the PAG-13 General Permit or obtained an Individual NPDES MS4 Permit.*

Existing Uses *are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. (25 Pa. Code § 93.1)*

Illicit Connection *means any physical connection to a municipal separate storm sewer system that can convey illicit discharges into the system and/or is not authorized or permitted by the permittee.*

Illicit Discharge *means any discharge to a municipal separate storm sewer that is not composed entirely of stormwater, except non-stormwater discharges as described in the "Discharges Authorized by this General Permit" section of this General Permit. Examples of illicit discharges include dumping of motor vehicle fluids, household hazardous wastes, grass clippings, leaf litter, animal wastes, or unauthorized discharges of sewage, industrial waste, restaurant wastes, or any other non-stormwater waste into a municipal separate storm sewer system. Illicit discharges can be accidental or intentional.* ***3800-PM-BCW0100d 5/2016 Permit***

Impaired Waters *means surface waters that fail to attain one or more of its designated uses under 25 Pa. Code Chapter 93 and as listed in Categories 4 and 5 of Pennsylvania's Integrated Water Quality Monitoring and Assessment Report.*

Integrated Water Quality Monitoring and Assessment Report *means the report published every other year by DEP to report on the conditions of Pennsylvania's surface waters to satisfy sections 305(b) and 303(d) of the CWA.*

Intermittent Stream *means a body of water flowing in a channel or bed composed primarily of substrates associated with flowing water, which, during periods of the year, is below the local water table and obtains its flow from both surface runoff and groundwater discharges. (25 Pa. Code § 92a.2)*

Load Allocation *means the portion of a surface water's loading capacity that is assigned or allocated to existing and future nonpoint sources and natural quality. (25 Pa. Code § 96.1)*

Low Impact Development (LID*) means site design approaches and small-scale stormwater management practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater. LID can be applied to new development, urban retrofits, and revitalization projects. LID utilizes design techniques that infiltrate, filter, evaporate, and store runoff close to its source. Rather than rely on costly large-scale conveyance and treatment systems, LID addresses stormwater through a variety of small, cost-effective landscape features located on-site.*

MS4 Requirements Table *is a compilation of information regarding Pennsylvania MS4s, surface waters that receive stormwater discharges from MS4s, surface water impairments and TMDLs that is posted to DEP's website, www.dep.pa.gov/MS4. The MS4 Requirements Table has been assembled by DEP to assist MS4 permittees in determining applicable requirements for the development of plans and implementation of BMPs, as well as eligibility for the PAG-13 General Permit. In general, the MS4 Requirements Table will be updated prior to each renewal of this General Permit based on DEP's latest published Integrated Water Quality Monitoring and Assessment Report.*

Municipal separate storm sewer *means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to surface waters; (ii) Designed or used for collecting or conveying stormwater; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2. (25 Pa. Code § 92a.32(a) and 40 CFR § 122.26(b)(8))*

Municipal Separate Storm Sewer System (MS4) *means all separate storm sewers that are defined as "large" or "medium" or "small" municipal separate storm sewer systems pursuant to 40 CFR §§ 122.26(b)(4), (b)(7), and (b)(16), respectively, or designated under 40 CFR § 122.26(a)(1)(v). (25 Pa. Code § 92a.32(a) and 40 CFR § 122.26(b)(18))*

Municipality *means a city, town, borough, county, township, school district, institution, authority or other public body created by or pursuant to State law and having jurisdiction over disposal of sewage, industrial wastes or other wastes. (25 Pa. Code § 92a.2)*

New Permittee *means any entity that has been designated as a regulated small MS4 and has not previously obtained permit coverage under the PAG-13 General Permit or obtained an Individual NPDES MS4 Permit.*

NOI *means the Notice of Intent for coverage under the NPDES General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems.*

Non-Municipal Permittee *means a regulated small MS4 that is not a municipality, e.g., military bases, large hospital or prison complexes, and highways and other thoroughfares.* ***3800-PM-BCW0100d 5/2016 Permit***

Non-Structural BMPs *means actions that involve management and source controls such as: (1) policies and ordinances that provide requirements and standards to direct growth to identified areas, promote redevelopment, protect areas such as wetlands and riparian areas, maintain and/or increase open space, provide buffers along water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation; (2) education programs for developers and the public about minimizing water quality impacts; (3) measures such as minimizing the percentage of impervious area after development, use of measures to minimize directly connected impervious areas, street sweeping, and source control measures such as good housekeeping, maintenance, and spill prevention; and other BMPs as referenced in Chapter 5 of the Pennsylvania Stormwater BMP Manual (363-0300-002).*

Ordinance *means a law enacted by the government of a municipality.*

Outfall means a point source as defined by 40 CFR § 122.2 at the point where a municipal separate storm sewer discharges to surface waters and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream or other surface waters and are used to convey surface waters. (25 Pa. Code § 92a.32(a) and 40 CFR § 122.26(b)(9))

Owner or Operator *means the owner or operator of any "facility" or "activity" subject to regulation under the NPDES program. (25 Pa. Code § 92a.3(b)(1) and 40 CFR § 122.2)*

Permittee *means the owner or operator of a regulated small MS4 authorized to discharge under the terms of this General Permit.*

Point Source *means a discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, Concentrated Aquatic Animal Production Facility (CAAP), Concentrated Animal Feeding Operation (CAFO), landfill leachate collection system, or vessel or other floating craft from which pollutants are or may be discharged. (25 Pa. Code § 92a.2)*

Pollutant *means any contaminant or other alteration of the physical, chemical, biological, or radiological integrity of surface water which causes or has the potential to cause pollution as defined in section 1 of the Pennsylvania Clean Streams Law, 35 P.S. § 691.1. (25 Pa. Code § 92a.2)*

Qualifying *Development or Redevelopment Project means an earth disturbance activity that requires an NPDES permit for stormwater discharges associated with construction activity per 25 Pa. Code Chapter 102.*

Regulated Small MS4 *means any small MS4 that is covered by the federal Phase II stormwater program, either through automatic nationwide designation under 40 CFR § 122.32(a)(1) (via the Urbanized Area criteria) or by designation on a case-by-case basis by DEP pursuant to 40 CFR § 122.32(a)(2). "Regulated small MS4s" are a subset of "small MS4s" as defined in this section.*

Riparian Forest Buffer *means an area of permanent vegetation consisting of native trees, shrubs, forbs and grasses along surface water that is maintained in a natural state or sustainably managed to protect and enhance water quality, stabilize stream channels and banks, and buffer land use activities from surface waters.*

Small Municipal Separate Storm Sewer System (Small MS4) *means an MS4, as defined in this section, which is not a large or medium MS4 pursuant to 40 CFR §§ 122.26(b)(4) and 122.26(b)(7). The term small MS4 includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings. (25 Pa. Code § 92a.32(a) and 40 CFR § 122.26(b)(16))*

Standard Operating Procedure (SOP) *means a policy or set of procedures that are enacted by a non-municipal permittee to implement a stormwater management program.*

Storm Sewershed *means the land area that drains to an individual MS4 outfall from within the jurisdiction of the MS4 permittee. The term "combined storm sewershed" means the drainage areas of all MS4 outfalls that discharge to a specific surface water or to waters within the Chesapeake Bay watershed.* ***3800-PM-BCW0100d 5/2016 Permit***

Stormwater *means runoff from precipitation, snow melt runoff and surface runoff and drainage. "Stormwater" has the same meaning as "storm water." (25 Pa. Code § 92a.2)*

Structural BMPs *means stormwater storage and management practices including, but not limited to, wet ponds and extended detention outlet structures; filtration practices such as grassed swales, sand filters and filter strips; infiltration practices such as infiltration basins and infiltration trenches; and other BMPs as referenced in Chapter 6 of the Pennsylvania Stormwater BMP Manual (363-0300-002).*

Surface Waters *means perennial and intermittent streams, rivers, lakes, reservoirs, ponds, wetlands, springs, natural seeps and estuaries, excluding water at facilities approved for wastewater treatment such as wastewater treatment impoundments, cooling water ponds and constructed wetlands used as part of a wastewater treatment process. (25 Pa. Code § 92a.2)*

Total Maximum Daily Load (TMDL) *means the sum of individual waste load allocations for point sources, load allocations for nonpoint sources and natural quality and a margin of safety expressed in terms of mass per time, toxicity or other appropriate measures. (25 Pa. Code § 96.1)*

Urbanized Area (UA) *means land area comprising one or more places (central place(s)) and the adjacent densely settled surrounding area (urban fringe) that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile, as defined by the*

United States Bureau of the Census and as determined by the latest available decennial census. The UA outlines the extent of automatically regulated areas. UA maps are available at: http://www.epa.gov/npdes/stormwater/urbanmaps, or at: http://www.epa.gov/enviro/html/em/index.html. [PAG-13]

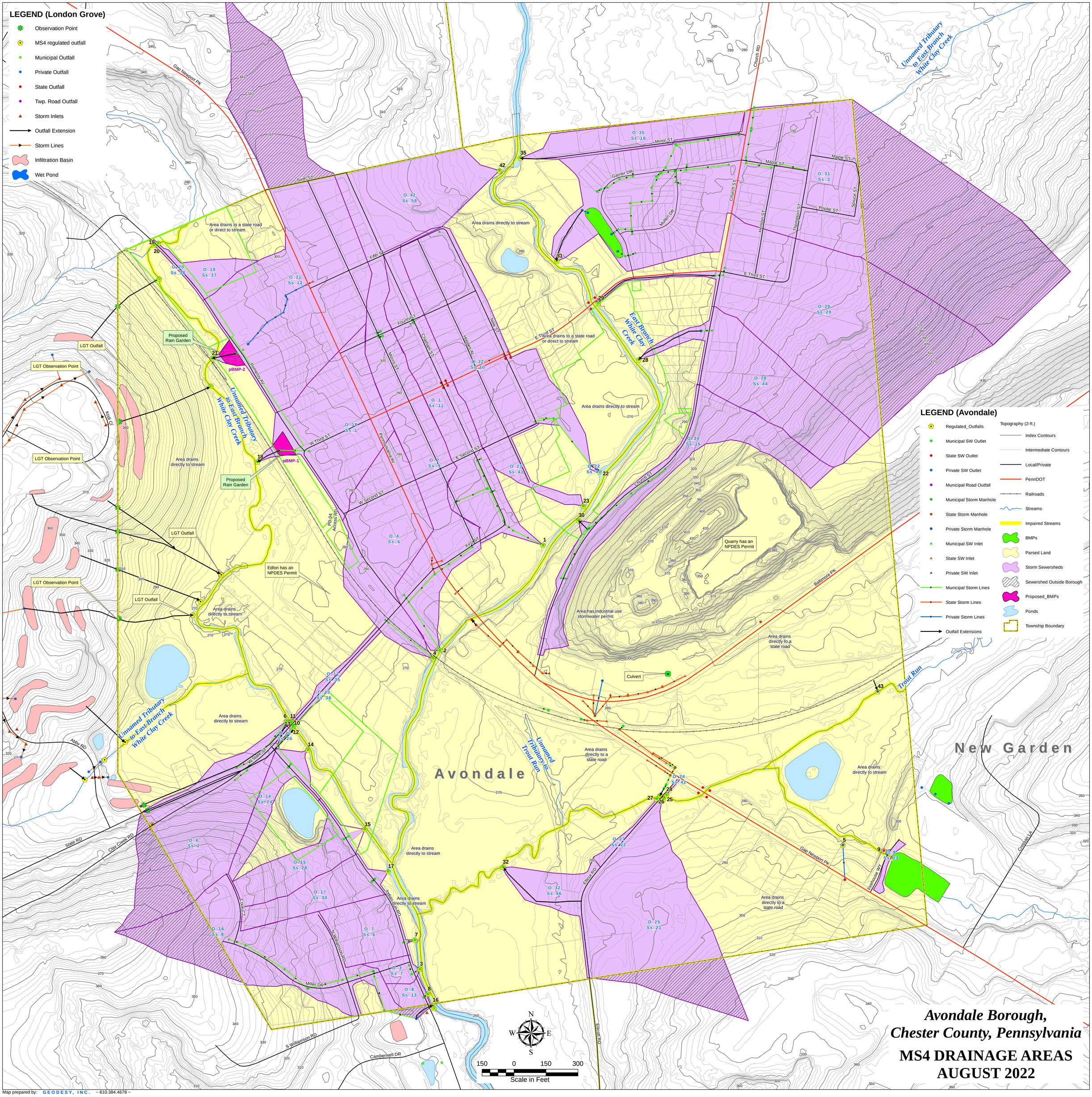
***Waste load Allocation (WLA)** means the portion of a surface water's loading capacity that is allocated to existing and future point source discharges. (25 Pa. Code § 96.1)*

***Water Quality Criteria** means numeric concentrations, levels or surface water conditions that need to be maintained or attained to protect existing and designated uses. (25 Pa. Code § 93.1)*

***Water Quality** Standards means the combination of water uses to be protected and the water quality criteria necessary to protect those uses. (25 Pa. Code § 92a.2)*

Appendix A: Published Notice & Public Comment Report

Appendix B: Storm Sewershed/Planning Area Map



Map prepared by: GEODESY, INC. ~ 610.384.4678 ~

Appendix C: Supporting Calculations

Table 1. Brandywine-Christina Watershed (HUC # 02040205)
EPA TMDL MS4 Baseline Pollutant Loadings, MS4 Allocations, and Reductions

MUNICIPALITIES LISTED IN TMDL REPORTS	Sediment (tons/year)				Total Nitrogen (kg/day)				Total Phosphorus (kg/day)			
Brandywine Creek Watershed	Baseline MS4 Load[1b.]	MS4 Load Allocation[1b.]	MS4 Load Reduction[1e.]	% Reduction[1b.]	MS4 Baseline Load[2g.]	MS4 Allocation[2a.]	MS4 Load Reduction[2m.]	% Reduction[2m.]	MS4 Baseline Load[2j.]	MS4 Allocation[2d.]	MS4 Load Reduction[2m.]	% Reduction[2m.]
BIRMINGHAM TWP	310.81	130.35	180.46	58.06%								
COATESVILLE CITY	231.29	79.76	151.53	65.52%	16.08	10.86	5.22	32.46%	3.015	2.031	0.984	32.64%
EAST BRADFORD TWP	1185.00	467.17	717.83	60.58%								
EAST BRANDYWINE TWP					54.19	44.44	9.75	17.99%	0.826	0.677	0.149	18.04%
EAST FALLOWFIELD TWP	803.23	426.42	376.81	46.91%	110.54	75.74	34.80	31.48%	22.365	15.348	7.017	31.37%
EAST MARLBOROUGH TWP	366.70	139.44	227.26	61.98%								
HIGHLAND TWP	384.80	238.86	145.94	37.93%								
HONEY BROOK BORO	20.58	13.23	7.35	35.70%	9.61	5.76	3.85	40.06%	0.184	0.11	0.074	40.22%
HONEY BROOK TWP	813.84	558.76	255.08	31.34%	421.64	279.02	142.62	33.83%	7.599	4.956	2.643	34.78%
KENNETT TWP			0.00		2.38	2.22	0.16	6.72%	0.213	0.198	0.015	7.04%
MODENA BORO	27.96	12.46	15.50	55.43%	4.80	3.25	1.55	32.29%	0.966	0.656	0.31	32.09%
NEWLIN TWP	144.18	59.59	84.59	58.67%	6.53	4.57	1.96	30.02%	1.337	0.936	0.401	29.99%
PARKESBURG BORO	52.11	32.35	19.76	37.93%								
PENNSBURY TWP	113.98	43.48	70.50	61.85%	47.00	43.71	3.29	7.00%	4.206	3.911	0.295	7.01%
POCOPSON TWP	821.21	320.79	500.42	60.94%								
SADSBURY TWP	289.73	172.13	117.60	40.59%	3.05	2.26	0.79	25.90%	0.329	0.205	0.124	37.69%
THORNBURY TWP	82.17	34.46	47.71	58.06%								
UPPER UWCHLAN TWP			0.00		10.92	8.96	1.96	17.95%	0.166	0.137	0.029	17.47%
VALLEY TWP	485.14	164.64	320.50	66.06%	57.57	43.75	13.82	24.01%	6.941	4.726	2.215	31.91%
WALLACE TWP	21.74	17.41	4.33	19.92%	126.53	103.76	22.77	18.00%	1.929	1.582	0.347	17.99%
WEST BRADFORD TWP	283.22	121.6	161.62	57.07%	17.25	12.08	5.17	29.97%	3.532	2.473	1.059	29.98%
WEST BRANDYWINE TWP			0.00		136.01	104.78	31.23	22.96%	9.63	8.344	1.286	13.35%
WEST CALN TWP	68.28	43.07	25.21	36.92%	183.72	149.26	34.46	18.76%	9.95	8.649	1.301	13.08%
WEST GOSHEN TWP	461.32	180.51	280.81	60.87%								

	Sediment (tons/year)				Total Nitrogen (kg/day)				Total Phosphorus (kg/day)			
Red Clay Creek Watershed	Baseline MS4 Load[1c.]	MS4 Load Allocation[1c.]	MS4 Load Reduction[1e.]	% Reduction[1c.]	MS4 Baseline Load[2h.]	MS4 Allocation[2b.]	MS4 Load Reduction[2m.]	% Reduction[2m.]	MS4 Baseline Load[2k.]	MS4 Allocation[2e.]	MS4 Load Reduction[2m.]	% Reduction[2m.]
EAST MARLBOROUGH TWP	8791.41	4,193.24	4598.17	52.30%	137.13	68.56	68.57	50.00%	2.742	1.372	1.37	49.96%
KENNETT SQUARE BORO	840.10	405.41	434.69	51.74%	13.26	6.63	6.63	50.00%	0.452	0.151	0.301	66.59%
KENNETT TWP	6751.63	3,312.06	3439.57	50.94%	157.97	97.83	60.14	38.07%	21.517	3.731	17.786	82.66%
NEW GARDEN TWP	4709.65	2,118.72	2590.93	55.01%	77.03	38.52	38.51	49.99%	27.708	2.87	24.838	89.64%
PENNSBURY TWP					4.32	4.32	0.00	0.00%	0.082	0.082	0.00	0.00%

	Sediment (tons/year)				Total Nitrogen (kg/day)				Total Phosphorus (kg/day)			
White Clay Creek Watershed	Baseline MS4 Load[1d.]	MS4 Load Allocation[1d.]	MS4 Load Reduction[1e.]	% Reduction[1d.]	MS4 Baseline Load[2i.]	MS4 Allocation[2c.]	MS4 Load Reduction[2m.]	% Reduction[2m.]	MS4 Baseline Load[2l.]	MS4 Allocation[2f.]	MS4 Load Reduction[2m.]	% Reduction[2m.]
AVONDALE BORO	463.65	140.02	323.63	69.80%	9.16	4.58	4.58	50.00%	0.322	0.135	0.187	58.07%
FRANKLIN TWP	4220.43	2,305.87	1914.56	45.36%	122.01	61.01	61	50.00%	15.219	5.557	9.662	63.49%
KENNETT TWP					2.17	2.17	0.00	0.00%	0.055	0.055	0	0.00%
LONDON BRITAIN TWP	2634.66	1,620.44	1014.22	38.50%	96.47	49.9	46.57	48.27%	15.732	7.333	8.399	53.39%
LONDON GROVE TWP	13616.33	4,842.81	8773.52	64.43%	262.76	128.47	134.29	51.11%	25.875	7.965	17.91	69.22%
NEW GARDEN TWP	6746.50	2,986.66	3759.84	55.73%	167.06	83.83	83.23	49.82%	41.916	13.374	28.542	68.09%
NEW LONDON TWP	1913.97	1,008.60	905.37	47.30%	53.56	26.61	26.95	50.32%	0.65	0.292	0.358	55.08%
PENN TWP	3584.76	1,410.29	2174.47	60.66%	71.23	33.36	37.87	53.17%	0.798	0.359	0.439	55.01%
WEST GROVE BORO	562.29	192.63	369.66	65.74%	9.24	4.36	4.88	52.81%	0.112	0.05	0.062	55.36%

1995 LOAD CALCULATIONS							
SOURCE	**AREA**	**TOTAL SEDIMENT LOADING RATE**	**TOTAL SEDIMENT**	**TOTAL NITROGEN LOADING RATE**	**TOTAL NITROGEN**	**TOTAL PHOSPHORUS LOADING RATE**	**TOTAL PHOSPHORUS**
Units	Acres	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.
Hay/Past	-	181.72	-	0.94	-	0.26	-
Cropland	20.93	1,499.30	31,375.56	5.96	124.72	1.57	32.86
Forest	37.37	111.43	4,164.31	0.15	5.61	0.04	1.49
Wetland	0.17	97.86	16.60	0.48	0.08	0.04	0.01
Disturbed	-	140.64	-	0.19	-	0.08	-
Turfgrass	-	0.00	-	0.00	-	0.00	-
Open_Land	5.13	230.82	1,183.08	1.13	5.79	0.12	0.62
Bare_Rock	-	0.00	-	0.00	-	0.00	-
Sandy_Areas	-	0.00	-	0.00	-	0.00	-
Unpaved_Road	-	0.00	-	0.00	-	0.00	-
Ld_Mixed	-	600.90	-	1.47	-	0.23	-
Md_Mixed	6.53	1,450.93	9,473.81	6.25	40.81	0.81	5.29
Hd_Mixed	2.43	2,055.61	4,991.11	6.83	16.58	0.95	2.31
Ld_Residential	75.32	616.19	46,410.39	1.64	123.52	0.25	18.83
Md_Residential	0.74	1,464.34	1,090.40	6.83	5.09	0.89	0.66
Hd_Residential	1.77	2,067.89	3,654.15	7.49	13.24	1.04	1.84
TOTAL	**150.38**		**102,359.43**		**335.44**		**63.90**

2012 LOAD CALCULATIONS							
SOURCE	**AREA**	**TOTAL SEDIMENT LOADING RATE**	**TOTAL SEDIMENT**	**TOTAL NITROGEN LOADING RATE**	**TOTAL NITROGEN**	**TOTAL PHOSPHORUS LOADING RATE**	**TOTAL PHOSPHORUS**
Units	Acres	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.	lbs./acre/yr.	lbs./yr.
Hay/Past	-	183.12	-	1.12	-	0.33	-
Cropland	16.11	1,491.81	24,031.73	5.84	94.08	1.50	24.16
Forest	29.12	163.18	4,751.36	0.17	4.95	0.05	1.46
Wetland	0.11	148.61	16.68	0.48	0.05	0.05	0.01
Disturbed	14.87	225.70	3,355.25	0.27	4.01	0.12	1.78
Turfgrass	3.88	185.70	720.99	1.32	5.12	0.70	2.72
Open_Land	-	303.30	-	1.40	-	0.14	-
Bare_Rock	-	-	-	-	-	-	-
Sandy_Areas	-	-	-	-	-	-	-
Unpaved_Road	-	-	-	-	-	-	-
Ld_Mixed	0.04	594.85	24.75	1.46	0.06	0.23	0.01
Md_Mixed	5.23	1,353.62	7,075.82	6.83	35.70	0.87	4.55
Hd_Mixed	11.10	1,906.23	21,165.97	7.56	83.94	1.01	11.21
Ld_Residential	69.59	600.45	41,784.88	1.57	109.26	0.24	16.70
Md_Residential	1.07	1,347.59	1,435.94	6.34	6.76	0.82	0.87
Hd_Residential	-	1,905.55	-	7.38	-	0.99	-
TOTAL	**151.11**		**104,363.38**		**343.94**		**63.47**

EXISTING BMP ESTIMATED LOAD AND POTENTIAL REDUCTION										
FACILITY_ID	**TYPE**	**BMP Effectiveness**	**Disturb. (acres)**	**Forest (acres)**	**HD Mixed Res. (acres.)**	**MD Mixed Res. (acres)**	**MD Res. (acres)**	**LD Res. (acres)**	**Total Acres**	
AB_BMP_3	Infiltration Basin	95%	9.34	5.82	0.83	4.22	1.04	8.86	30.11	
		Loading Rate (lbs./ac.)	225.70	163.18	1906.23	1353.62	1347.59	600.45	**Total Load (lbs./yr.)**	**Potential Load Reduction**
		Sediment Load (lbs./ac.)	2108.12	950.14	1581.41	5707.46	1407.22	5318.26	**17,072.60**	**16,218.97**

PROPOSED BMP ESTIMATED LOAD AND POTENTIAL REDUCTION										
FACILITY_ID	**TYPE**	**BMP Effectiveness**	**Cropland**	**Disturb. (acres)**	**Forest (acres)**	**HD Mixed Res. (acres.)**	**MD Mixed Res.**	**LD Res. (acres)**	**Total Acres**	
pBMP-1	**Rain Garden**	55%	0.00	0.42	0.05	0.44	0.00	4.93	5.84	
	Loading Rate (lbs./ac.)		1491.81	225.70	163.18	1906.23	1353.62	600.45	**Total Load (lbs./yr.)**	**Load Reduction**
	Sediment Load (lbs./ac.)		0.00	94.92	8.43	844.52	0.00	2960.02	**3,907.89**	**2,149.34**
pBMP-2	**Rain Garden**	55%	4.78	0.09	0.18	1.02	1.01	9.01	16.09	
	Loading Rate (lbs./ac.)		1491.81	225.70	163.18	1906.23	1353.62	600.45	**Total Load (lbs./yr.)**	**Load Reduction**
	Sediment Load (lbs./ac.)		7129.64	20.73	28.77	1953.52	1368.34	5409.00	**15,909.99**	**8,750.50**
								Total Reduction		**10,899.84**