

**Decision Rationale  
Total Maximum Daily Load  
for Sediments and Phosphorus  
Brush Run Watershed  
Allegheny and Washington Counties, Pennsylvania**

**I. Introduction**

This document will set forth the Environmental Protection Agency's (EPA) rationale for *disapproving* the Total Maximum Daily Load (TMDL) for phosphorus and sediment in the Brush Run Watershed in Allegheny and Washington Counties, Pennsylvania. The document was delivered by the Pennsylvania Department of Environmental Protection (PADEP) for final Agency review on March 14, 2003. Our rationale is based on the TMDL document and information contained in attachments to the document to determine if the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety (MOS).
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDL can be met.

**II. Summary**

The Brush Run Watershed encompasses approximately 10.0 square miles. Landuse in the watershed is composed of forested lands (46%), developed lands (28%) and agricultural lands (26%). The entire basin, including its tributaries, is designated as Warm Water Fishes (WWF) as listed in 25 PA Code Chapter 93, Section 93.9f.

The 1996 Section 303(d) list identified 0.7 and 0.6 miles of Brush Run as being impaired by nutrients and suspended solids respectively. The impaired segment of Brush Run was extended on the 1998 Section 303(d) list to 25.2 miles due to siltation, turbidity, and suspended solids. Brush Run was evaluated under Pennsylvania's Unassessed Waters program in 1997, now called Surface Water Assessment Program. Under this assessment the Commonwealth evaluated the benthic macro-invertebrate community and habitat of Brush Run. The Commonwealth also collected data on the Dissolved Oxygen (DO) concentration, water temperature, pH, and conductivity. The benthic macro-invertebrate evaluation identifies these organisms to the family level. Organisms from certain families are viewed as pollutant-tolerant, where as organisms from other families are seen as intolerant of poor water quality. In general, the greater the amount of pollutant-tolerant species the lower the water quality.

Streams and the impairments addressed by the TMDLs for the Brush Run Watershed are listed in Table 1.

<b>TABLE 1. INDICATION OF WATERS FOR WHICH TMDLS WERE DEVELOPED IN THE BRUSH RUN WATERSHED ARE REPRESENTED ON THE 1996 AND 1998 303(D) LISTS.</b>				
Brush Run	1.3	1996	Urban Runoff/Storm Sewer	Nutrients and/or Suspended Solids
Brush Run	25.2	1998	Habitat Modification/ Construction	Turbidity, Siltation, Suspended Solids, and/or Organic Enrichment

Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for attainment of water quality standards. These TMDLs were developed to address the impairments caused by excessive sediment and nutrient loadings to Brush Run.

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Table 2 summarizes the elements of the TMDLs for sediment and phosphorus developed by PADEP. Despite the fact that EPA believes that annual loads are an appropriate measure for these TMDLs, for the sake of consistency we are breaking the annual TMDL loads down into daily loads.

<b>Table 2. TMDL Loading for Brush Run</b>								
Stream	Pollutant	LA (lbs/yr)	WLA (lbs/yr)	MOS (lbs/yr)	TMDL (lbs/yr)	TMDL (lbs/day)	Existing Load	Change
Brush Run	Sediment	201,913	0	22,434	224,348	614	604,360	63%
Brush Run	Phosphorus	708	0	78.7	786.7	2.1	834.2	6%

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. Conditions, available data, and the understanding of the natural processes can change more than anticipated by the MOS. If this occurs, the option is always available to refine the TMDL for resubmittal to EPA for approval. Pennsylvania's Unassessed Waters Protocol, PADEP's method of conducting biological assessments of Pennsylvania's waters, was developed in 1996 with implementation beginning in 1997. PADEP's goal is to achieve a comprehensive, statewide assessment of surface waters in Pennsylvania. After completion of the initial assessments, the long-range goal is to reassess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense

of achieving water quality standards expeditiously, the TMDL may be modified when warranted.

### III. Discussion of Regulatory Conditions

**EPA finds that Pennsylvania has provided sufficient information to meet the eight basic requirements for establishing phosphorus and sediment TMDLs in Brush Run with one exception. Pennsylvania has not developed WLAs for point source discharges. EPA therefore disapproves the TMDLs for phosphorus and sediment in Brush Run.**

EPA's rationale for disapproval is set forth according to the regulatory requirements listed below.

*1) The TMDLs are designed to implement the applicable water quality standards.*

Water Quality Standards consist of three components: 1) designated and existing uses; 2) narrative and/or numerical water quality criteria necessary to support those uses; 3) and an anti-degradation statement. The designated use of the entire Brush Run Watershed is Warm Water Fishes (WWF). Pennsylvania does not currently have numeric water quality criteria for sediments or nutrients. Therefore, Pennsylvania utilized its general water quality criteria, which states "water may not contain substances attributable to point or nonpoint source waste discharges in concentrations or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant, or aquatic life,"<sup>1</sup> to establish an endpoint for sediment and nutrients such that the designated uses of the Brush Run Watershed are attained and maintained.

In order to numerically express this endpoint consistent with the general water quality criteria, PADEP uses a Reference Watershed approach in combination with the AVGWLF<sup>2</sup> watershed loading model. The reference watershed is representative of the conditions required for the impaired watershed to meet its designated uses. This representative condition is analyzed to determine an appropriate level of nutrient and sediment loading to the waterbody. The Reference Watershed approach consists of comparing the biologically impaired watershed with a reference watershed that is meeting its designated uses for aquatic life to determine an appropriate level of nutrient and sediment loading to the waterbody. This approach is based on comparing the impaired watershed to an unimpaired watershed with similar designated uses, geology, landuses, physiographic province, land area, soils, and meteorological patterns. The AVGWLF model provides monthly stream flow, soil erosion, and sediment yield values and includes both surface runoff and groundwater sources as well as nutrient loads from point sources and onsite wastewater disposal (septic) systems.<sup>3</sup> Calibration of this model is not

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<sup>1</sup> Pennsylvania Code, Title 25., Environmental Protection, Chapter 93. Water Quality Standards, Section 93.6(a).

<sup>2</sup>Arcview Generalized Watershed Loading Function model, the Environmental Resources Research Institute of Pennsylvania State University's Arcview based version of the GWLF model developed by Cornell

<sup>3</sup> Haith, D.A., R. Mandel and R.S. Wu, Generalized Watershed Loading Functions, Version 2.0, Cornell University, Dec. 15, 1992.

required. However, it has been applied and validated to an 85,000 hectare watershed in upstate New York. The rationale of this method is that achieving sediment loadings in the impaired watershed similar to those loadings of the reference watershed will ensure that the impaired watershed will attain and maintain its designated uses and general water quality criteria.

Deer Creek was used as the reference watershed for the Brush Run Watershed to develop the sediment and nutrient TMDLs. Table 3 below compares these watersheds. EPA finds the use of the Deer Creek Watershed as a reference watershed to be reasonable for this TMDL.

<b>Table 3. Comparison Between Brush Run Watershed and Reference Watershed</b>		
<b>ATTRIBUTE</b>	<b>Brush Run</b>	<b>REFERENCE</b>
<b>Physiographic Province</b>	Appalachian Plateaus Province	Appalachian Plateaus Province
<b>Area (square miles)</b>	10.0	7.1
<b>Predominant Landuse</b>	Agriculture 26% Forested 48% Development 28%	Agriculture 28% Forested 68% Development 4%
<b>Average Precipitation (in)</b>	37.4	39.8

Using the continuous simulation AVGWLF model, PADEP modeled the sediment loads originating from nonpoint sources in the reference watersheds. In order to make these estimates, AVGWLF requires daily precipitation and temperature data, runoff sources and transport and chemical parameters. The AVGWLF model is a combined distributed/lumped parameter watershed model. In terms of surface loading, this means that the model allows the user to distribute multiple landuse/cover scenarios in the watershed. However, the loads originating from the watershed are lumped and spatial routing of sediment loads is not available. In terms of subsurface loading, the load contributions from subsurface areas are not distinct and are considered lumped using a water balance approach. The AVGWLF model relies on the Soil Conservation Service Curve Number (SCS-CN) to estimate surface runoff and the Revised Universal Soil Loss Equation (RUSLE) to estimate erosion and sediment yield. Monthly estimates of sediment loadings, applicable to each watershed, are generated by using watershed-specific local daily weather inputs and USLE factors.<sup>4</sup> The following average existing load values for sediment, illustrated in Table 4, were determined for the Deer Creek reference watershed, and the Brush Run Watershed using watershed-specific data. Table 5 documents the existing phosphorus loading values.

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<sup>4</sup> Local daily weather inputs include temperature and precipitation. The USLE factors are KLSCP; K=changes in soil loss erosion, LS=length slope factor, C=vegetation cover factor, P=conservation practices factor.

<b>Table 4. Existing sediment loading values for the reference watershed and the Brush Run Watershed</b>			
	<b>Area (Acres)</b>	<b>Sediment Load lbs/yr</b>	<b>Unit Area Sediment Loading Rate lbs/acre/yr</b>
<b>Brush Run Watershed</b>	6,397	604,360	94
<b>Deer Creek Watershed</b>	4,568	160,220	35

<b>Table 5. Existing phosphorus loading values for the reference watershed and the Brush Run Watershed</b>			
	<b>Area (Acres)</b>	<b>Phosphorus Load lbs/yr</b>	<b>Unit Area Sediment Loading Rate lbs/acre/yr</b>
<b>Brush Run Watershed</b>	<b>6,397</b>	<b>834</b>	<b>0.13</b>
<b>Deer Creek Watershed</b>	<b>4,568</b>	<b>562</b>	<b>0.12</b>

The final step in the process is to determine the appropriate pollutant loading for each water. For the Brush Run Watershed, the values generated for sediment and phosphorus loading were based on those found in the Deer Creek Watershed. In the process of determining the total phosphorus and sediment loadings in the reference watersheds, a unit-area loading coefficient for the parameter of concern was calculated. Those aerial loading coefficients were applied to the Brush Run Watershed to determine the allowable (TMDL) sediment and phosphorus loadings. EPA finds this application reasonable to implement the applicable water quality standards.

Table 6 illustrates the sediment TMDL calculations. The target TMDL value for sediment is determined by multiplying the unit area loading value of the reference watershed by the total area in acreage of the impaired watershed.

<b>Table 6. Sediment TMDL Calculations</b>			
<b>Watershed</b>	<b>Unit area loading rate in Reference Deer Creek Watershed (lbs/acre/year)</b>	<b>Total watershed area in Impaired Brush Run Watershed (acres)</b>	<b>TMDL value for sediment (lbs/year)</b>
<b>Brush Run</b>	35	6,397	224,348

Table 7 illustrates the phosphorus TMDL calculations. The target TMDL value for phosphorus is determined by multiplying the unit area loading value of the reference watershed by the total area in acreage of the impaired watershed.

<b>Table 7. Phosphorus TMDL Calculations</b>			
<b>Watershed</b>	<b>Unit area loading rate in Reference Deer Creek Watershed (lbs/acre/year)</b>	<b>Total watershed area in Impaired Brush Run Watershed (acres)</b>	<b>TMDL value for sediment (lbs/year)</b>
<b>Brush Run</b>	0.12	6,397	786

2) *The TMDLs include a total allowable load as well as individual WLAs and LAs.*

Tables 2, 6, and 7 indicate the total allowable loads for sediment and phosphorus as determined using the Reference Watershed approach and the AVGWLF model.

#### Wasteload Allocations

Pennsylvania indicates that there are no known point source discharges of sediment or phosphorus in the Brush Run Watershed. Therefore, the WLA is set at zero for both the sediment and phosphorus TMDLs. There are, however, several point sources within the watershed. The point sources are Upper Saint Clair, Bethel Park, Peters Township, and the Brush Run Sewage Treatment Plant (STP, PA0028711 ). Upper Saint Clair, Bethel Park, Peters Township are all designated by Pennsylvania as having Municipal Separate Storm Sewer Systems designated for inclusion in the NPDES Storm Water Phase II Program and therefore were required to apply for permit coverage under the NPDES General Permit (PAG13) for Storm Water Discharges From Small Municipal Separate Storm Sewer Systems (MS4s) by March 10, 2003.

**Federal regulations require NPDES-regulated storm water discharges be addressed by the WLA component of a TMDL (40 CFR part 130.2(h)) and, conversely, requires that NPDES-regulated storm water discharges not be addressed by the LA component of a TMDL (40 CFR 130.2 (g) & (h)). A Memorandum issued by EPA on November 22, 2002, titled “Establishing TMDL WLAs for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs,” clarifies these existing EPA regulatory requirements.**

**The approach taken by PADEP regarding TMDL LAs for NPDES regulated storm water discharges in the watershed is to assign LAs to these discharges. PADEP expects that the sediment and phosphorus allocations will be achieved through the State voluntary nonpoint source program, in this case. This approach is not in accordance with Federal regulations.**

**The Commonwealth of Pennsylvania also failed to provide a wasteload allocation for the Brush Run Sewage Treatment Plant. EPA regulations require that an approvable TMDL include individual Wasteload Allocations (WLAs) for each point source. According to 40 CFR 122.44(d)(1)(vii)(B). Failure to provide a WLA for the Brush Run STP is not in accordance with Federal Regulations.**

#### Load Allocations

The TMDLs for Brush Run include LAs for nonpoint sources. According to Federal regulations, 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. The AVGWLF process enables the LA to be distributed to sources based on landuse type.

The process of allocating sediment loads to distinct landuses in the Brush Run Watershed begins by subtracting 10% from the TMDL value for the MOS. For example, the allocable load for sediment in the Brush Run Watershed of 224,348 lbs/year is reduced by 22,435 lbs/year to 201,913 lbs/year. See below for further discussion on the application of an MOS safety in TMDLs.

To determine the distribution of the sediment and phosphorus LAs between contributing land-based sources, PADEP uses a method called the Equal Marginal Percent Reduction (EMPR).<sup>5</sup> This method equitably assigns the largest contributing source, the greater reduction requirements. Tables 8 and 9 show the LAs of sediment and phosphorus in the Brush Run Watershed. The table shows the overall average reductions in sediment for each landuse and is useful in demonstrating the EMPR method employed by PADEP to distribute the allocable loads of sediment in this TMDL.

The total allocable load of sediment is 201,910 lbs/year after subtracting the MOS. The EMPR method is then used to distribute the remaining sediment load and works in the following manner. PADEP allocated certain landuse loadings similar to their existing loads. In the Brush Run Watershed, those landuses are low and high intensity development, forested lands, and quarries. Reasons that the loads for these landuse types remain constant include an extremely limited ability to affect the sediment loading processes or insufficient reasonable assurance to make substantial reductions. This is appropriate because sediment loading from intact forest lands represent the natural condition that would be expected to exist. Therefore, the allocable load for sediment of 201,910lbs/yr is further reduced by 12,020 lbs/yr to 189,890 lbs/yr to account for those sources which are not being addressed. The EMPR is then used to evaluate the remaining sources against the allowable loading.

<b>Table 8. Load Allocations for Sediment in Brush Run Watershed</b>					
	Acres	Existing Load	TMDL Load Allocation	Reduction	% Reduction
Hay/pasture	813	15,260	7,335	7,925	52
Cropland	835	194,320	91,277	103,040	53
Forests	2,935	6,980	6,980	0	0
Low Intensity Development	1,744	780	780	0	0
High Intensity Development	59	0	0	0	0
Streambank erosion	--	382,760	91,277	291,480	76
Quarry	10	4,260	4,260	0	0
<b>Total</b>	<b>6,395</b>	<b>604,360</b>	<b>201,910</b>	<b>402,450</b>	<b>67</b>

<b>Table 9. Load Allocations for Phosphorus in Brush Run Watershed</b>					
	Acres	Existing Load	TMDL Load Allocation	Reduction	% Reduction
Hay/pasture	813	44.07	28.54	15.53	35
Cropland	835	163.12	52.47	110.65	68
Forests	2,935	9.2	9.2	0	0

<sup>5</sup> Pennsylvania Department of Environmental Protection. June 1986. Implementation Guidance for the Water Quality Analysis Model 6.3. Document 391-2000-007.

Low Intensity Development	1,744	73.1	73.1	0	0
High Intensity Development	59	0.4	0.4	0	0
Streambank erosion	--	88.8	88.8	0	0
Quarry	10	2.0	2.0	0	0
Septic Systems	--	7.5	7.5	0	0
Groundwater	--	447.7	447.7	0	0
<b>Total</b>	<b>6,395</b>	<b>835</b>	<b>709</b>	<b>126</b>	<b>15</b>

EPA finds that PADEP appropriately applied the EMPR method for the phosphorus and sediment TMDLs for Brush Run. According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. While it is not necessary to specifically approve an allocation method, EPA believes that the EMPR method used by PADEP is acceptable because it supports 3 main objectives:

1) to assure compliance with the applicable water quality standard; 2) to minimize the overall cost of compliance; and 3) to provide maximum equity among competing discharges.

*3) The TMDLs consider the impacts of background pollutant contributions.*

The state has included natural background as a component of the LAs, as required by 40 CFR §130.2(g). There are two separate considerations of background pollutants within the context of these TMDLs. First, there is the inherent assumption of the Reference Watershed approach that, because of the similarities between the reference and impaired watershed, the background pollutant contributions will be similar. Therefore, the background pollutant contributions will be considered when determining the loads for the impaired watershed which are consistent with the loads from the reference watershed. Secondly, the AVGWLF model implicitly considers background pollutant contributions through the groundwater component of the model process.

*4) The TMDLs consider critical environmental conditions.*

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to take into account critical conditions for streamflow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Brush Run is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be

undertaken to meet water quality standards.<sup>6</sup> In specifying critical conditions in the waterbody, an attempt is made to use a reasonable “worst case” scenario condition. Critical conditions are the combination of environmental factors (e.g., flow, temperature) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence. For example, stream analysis often uses a low-flow (7Q10) design condition as critical because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

Within the context of the Reference Watershed approach, the assumption is that the reference watershed is achieving its designated use even during critical environmental conditions. Thus, achieving sediment and phosphorus loadings in the impaired watershed consistent with that of the reference watershed will effectively consider critical conditions. To account for different flow conditions, the AVGWLF model uses daily average temperature, daily time step and total precipitation values for each year simulated. PADEP modeled each watershed for a period of up to 20 years to develop the existing loading values for each watershed. The length of the model time period will also effectively consider critical environmental conditions. EPA finds that Pennsylvania adequately considered critical conditions in the TMDL analysis of the Brush Run basin.

*5) The TMDLs consider seasonal environmental variations.*

Seasonal variations involve changes in streamflow as a result of hydrologic and climatological patterns. In the continental United States, seasonal high flow normally occurs during the colder period of winter and in early spring from snowmelt and spring rain, while seasonal low flow typically occurs during the warmer summer and early fall drought periods.<sup>7</sup> The model considers seasonal changes requiring specifications of the growing season, hours of daylight for each month, the months in which manure is applied to the land and by using daily time steps for weather data and water balance calculations. EPA finds that both the AVGWLF model and the assumptions of the Reference Watershed approach effectively consider seasonal environmental variations.

*6) The TMDLs include an MOS.*

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. An MOS may be implicit, built into the modeling process, or explicit, taken as a percentage of the WLA, LA, or TMDL.

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<sup>6</sup> EPA Memorandum regarding EPA Actions to Support High Quality TMDLS from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Water Management Division Directors, August 9, 1999.

<sup>7</sup> U.S. EPA. 1997. Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1, Section 2.3.3. EPA 823-B-97-002.

PADEP reserves 10% of the TMDL value for both phosphorus and sediments as the MOS. This accounts for uncertainty in the data and computational methodology used in the analysis. Table 2 indicates the actual value of the MOS for each TMDL. EPA finds this explicit MOS acceptable.

7) There is reasonable assurance that the TMDL can be met.

The proposed reductions in phosphorus and sediment loadings come from agricultural areas and developed areas. PADEP believes that the implementation of Best Management Practices (BMPs) throughout the Brush Run Watershed will allow the TMDL to be achieved. **EPA does not concur with this belief since a WLA was not generated for either the MS-4 or the STP.**

8) *The TMDLs have been subject to public participation.*

Pennsylvania published a notice of availability for the Brush Run TMDL for public review and comment in the *Pennsylvania Bulletin* on December 14, 2003. A public meeting was held on January 15, 2003, at 7 p.m. in Chartiers Valley High School, in Bridgeville, PA.

Written comments as well as comments during the public meeting were received. Responses from PADEP to those comments were provided in the TMDL submittal in Attachment H. **EPA finds that PADEP has not addressed the comments associated with these TMDLs by failing to provide WLAs for either the MS-4 or STP.**

Although not specifically stated in the TMDL Report, PADEP routinely posts the approved TMDL report their web site: [www.dep.state.pa.us/watermanagement\\_apps/tmdl/](http://www.dep.state.pa.us/watermanagement_apps/tmdl/)