Amendment to the Tri-County, Mercer and Monmouth Counties Water Quality Management Plans

Total Maximum Daily Loads for Phosphorus to Address 4 Stream Segments

Annaricken Brook, Barkers Brook North Branch and Doctors Creek

Drainage Area Identifications: HUC

02040201100010-01, 02040201100020-01, 02040201060030-01, 02040201060020-01, 02040201060010-01

Lower Delaware Water Region
WMA 20

Proposed:	February 5, 2007
Established:	July 25, 2007
Approved:	October 1, 2007
Adopted:	

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1.0 Executive Summary

In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (Department) developed the 2004 Integrated List of Waterbodies addressing the overall water quality of the State's waters and, in Sublist 5, identifying the list of impaired waterbodies. On October 4, 2004, (36 NJR 4523(a)) the Department adopted the 2004 Integrated List of Waterbodies as an amendment to the Statewide Water Quality Management Plan, pursuant to the Water Quality Planning Act at N.J.S.A.58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). In the Lower Delaware Water Region, the 2004 Integrated List of Waterbodies Sublist 5 identifies the waterbodies identified in Table 1 as impaired with respect to phosphorus, as indicated by the presence of phosphorus concentrations in excess of standards.

The Department has recently proposed the New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report, including the 2006 Integrated List, which identifies impairments based on HUC 14 Assessment Units rather than discrete monitoring locations. This change in assessment methodology allows establishment of a stable base of assessment units for which the attainment or non-attainment status of all designated uses within each subwatershed or assessment unit will be identified. Tables 1 and 2 below show pertinent listings as they appeared on both the 2004 and the proposed 2006 Integrated List. A TMDL is required to be developed for each impairment listed on Sublist 5. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. This report establishes four TMDLs to address the phosphorus impairment for the waterbodies identified in Tables 1 and 2. Other listed parameters will be addressed in subsequent TMDL evaluations.

Table 1 Phosphorus impaired stream segments identified on the *2004 Integrated List of Waterbodies* to be addressed in this TMDL report.

Impairment Number	WMA	Station Name/Waterbody	Site ID	Sublist	Proposed Action
1	20	Annaricken Brook near Jobstown	01464578	5	Establish TMDL
2	20	Barkers Brook N Br near Jobstown	01464583	5	Establish TMDL
3	20	Doctors Creek at Allentown	01464515	5	Establish TMDL
4	20	Doctors Creek at Route 539 in Upper Freehold	3	5	Establish TMDL

Table 2 Impaired Waterbodies as identified on the proposed 2006 *Integrated List* affected by Phosphorus TMDLs proposed to be established

Assessment Unit Name	Assessment Unit ID	Station Name/Waterbody	Station ID	Use Impairment	Impaired Parameters
02040201100010-01	Assiscunk Creek (above Rt 206)	Annaricken Brook near Jobstown	01464578	Aquatic Life (general)	pH, TP
02040201100020-01	Barkers Brook (above 40d02m30s)	Barkers Brook N Br near Jobstown	01464583	Aquatic Life (general)	pH, TP
02040201060030-01	Doctors Creek (below Allentown)	Doctors Creek at Allentown	01464515	Aquatic Life (general)	TP
02040201060020-01	Doctors Creek (Allentown to 74d28m40s)	Doctors Creek at Route 539 in Upper Freehold	3	Aquatic Life (general)	pH, TP
02040201060010-01	Doctors Creek (above 74d28m40s)	Doctors Creek at Route 539 in Upper Freehold	3	None	

*Although not listed as impaired on the proposed 2006 Integrated List, this HUC 14 includes the impaired stream segment associated with Station ID 3 from the 2004 Integrated List; load reductions are assigned to this HUC 14 drainage area as part of the 2004 segment, impairment 4 in Table 1 above.

This TMDL report includes implementation strategies to achieve SWQS for phosphorus. The TMDLs in this report are established and will be adopted by the Department as amendments to the appropriate areawide water quality management plans in accordance with N.J.A.C. 7:15-3.4(g). This TMDL report was developed consistent with the United States Environmental Protection Agency's (USEPA's) May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Sutfin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs.

2.0 Introduction

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet SWQS after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. The *Integrated Water Quality Monitoring and Assessment Report* combines these two assessments and in the *Integrated List of Waterbodies* assigns waterbodies to one of five sublists. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), are impaired due to pollution rather than pollutants or have had a TMDL or other enforceable management measure approved by EPA (Sublist 4). Sublist 5 constitutes the traditional 303(d) list for waters impaired or threatened by one or more pollutants, for which a TMDL may be required.

In the New Jersey 2004 *Integrated Water Quality Monitoring and Assessment Report* the water quality impairments were identified by segment name and pollutant(s) or non-attained designated use responsible for the finding that the segment was impaired. Each segment was assessed using the data from one or more discrete monitoring locations that were determined to be representative of the water quality in that segment. This impaired segment delineation method was changed in 2006.

The proposed *New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report* identifies impairments based on designated use attainment and then lists the parameters responsible for the non-attainment of the designated use. The assessments are conducted for each of the seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. As shown in Table 2 above, the *2006 Integrated Water Quality Monitoring and Assessment Report* identifies the aquatic life as the designated use for which there is non-attainment status for the Assessment Units addressed in this report. The parameters that resulted in this non-attainment status were total phosphorus and pH. The assessment units did not meet the established Surface Water Quality Standards set for each noted parameter.

A TMDL represents the assimilative or carrying capacity of a waterbody; taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that loading capacity to known point and nonpoint sources in the form of Waste Load Allocations (WLAs) for point sources, Load Allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

This report establishes 4 TMDLs that address phosphorus impairment in 39.4 river miles with respect to the waterbodies identified in Tables 1 and 2. These TMDLs include management approaches to reduce loadings of phosphorus from various sources in order to attain applicable surface water quality standards for phosphorus.

As a result of addressing total phosphorus impairment through these TMDLs, phosphorus will no longer be a basis for inclusion of the subject waterbodies on Sublist 5. The HUCs 02040201100010-01, 02040201100020-01, 02040201060020-01 and 02040201060010-01 will remain on Sublist 5 with respect to the pH impairments, which will be addressed in future TMDLs.

EPA guidance (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. The Department believes that the TMDLs in this report address the following items in the May 20, 2002 guideline document:

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.
2. Description of applicable water quality standards and numeric water quality target(s).
3. Loading capacity – linking water quality and pollutant sources.
4. Load allocations.
5. Waste load allocations.
6. Margin of safety.
7. Seasonal variation.
8. Reasonable assurances.
9. Monitoring plan to track TMDL effectiveness.
10. Implementation (USEPA is not required to and does not approve TMDL implementation plans).
11. Public Participation.

3.0 Pollutant of Concern and Area of Interest

Pollutant of Concern

The pollutant of concern for these TMDLs is phosphorus. For the segments in the Lower Delaware Water Region identified in Table 3, phosphorus concentrations were found to exceed New Jersey's SWQS, found at N.J.A.C. 7-9B. All 4 impaired segments are identified as medium priority on the 2004 Integrated List of Waterbodies and high priority on the proposed 2006 Integrated List of Waterbodies.

Table 3 Waterbodies listed for phosphorus impairment as they appear on the 2004 Integrated List for which TMDLs are established

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
1	20	Annaricken Brook near Jobstown	01464578	Burlington	3.69
2	20	Barkers Brook N Br near Jobstown	01464583	Burlington	4.8
3	20	Doctors Creek at Allentown	01464515	Mercer/ Monmouth	16.05
4	20	Doctors Creek at Route 539 in Upper Freehold	3	Monmouth	14.9
Total River Miles:					**39.4**

Table 4 Waterbodies listed for Phosphorus Impairment as they appear on the proposed 2006 *Integrated Water Quality Monitoring and Assessment Report:*

TMDL Number	WMA	Assessment Unit ID	Assessment Unit Name	HUC area (acres)
1	20	02040201100010-01	Assiscunk Creek (above Rt 206)	5269
2	20	02040201100020-01	Barkers Brook (above 40d02m30s)	7855
3	20	02040201060030-01	Doctors Creek (below Allentown)	5596
4	20	02040201060020-01	Doctors Creek (Allentown to 74d28m40s)	7793
*	20	02040201060010-01	Doctors Creek (above 74d28m40s)	3214
Total Impaired HUC area (acres):				**29,727**

* This HUC 14 is not listed as impaired using the HUC 14 assessment methodology but includes the 2004 Integrated List impaired segment, see Table 2 above.

Applicable Water Quality Standards

All the impaired segments addressed in this document are classified as Fresh Water 2 (FW2), Non-Trout (NT). Annaricken Brook is classified as Category 1 (C1) as well as a portion of Doctors Creek (see Figures 18 and 19). As stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters, the standards for phosphorus are as follows:

Phosphorus, Total (mg/l):

i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.

ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where site-specific criteria are developed pursuant to N.J.A.C. 7:9B1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated

that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Also as stated in N.J.A.C. 7:9B-1.5(g)2:

> Nutrient policies are as follows:
>
> Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

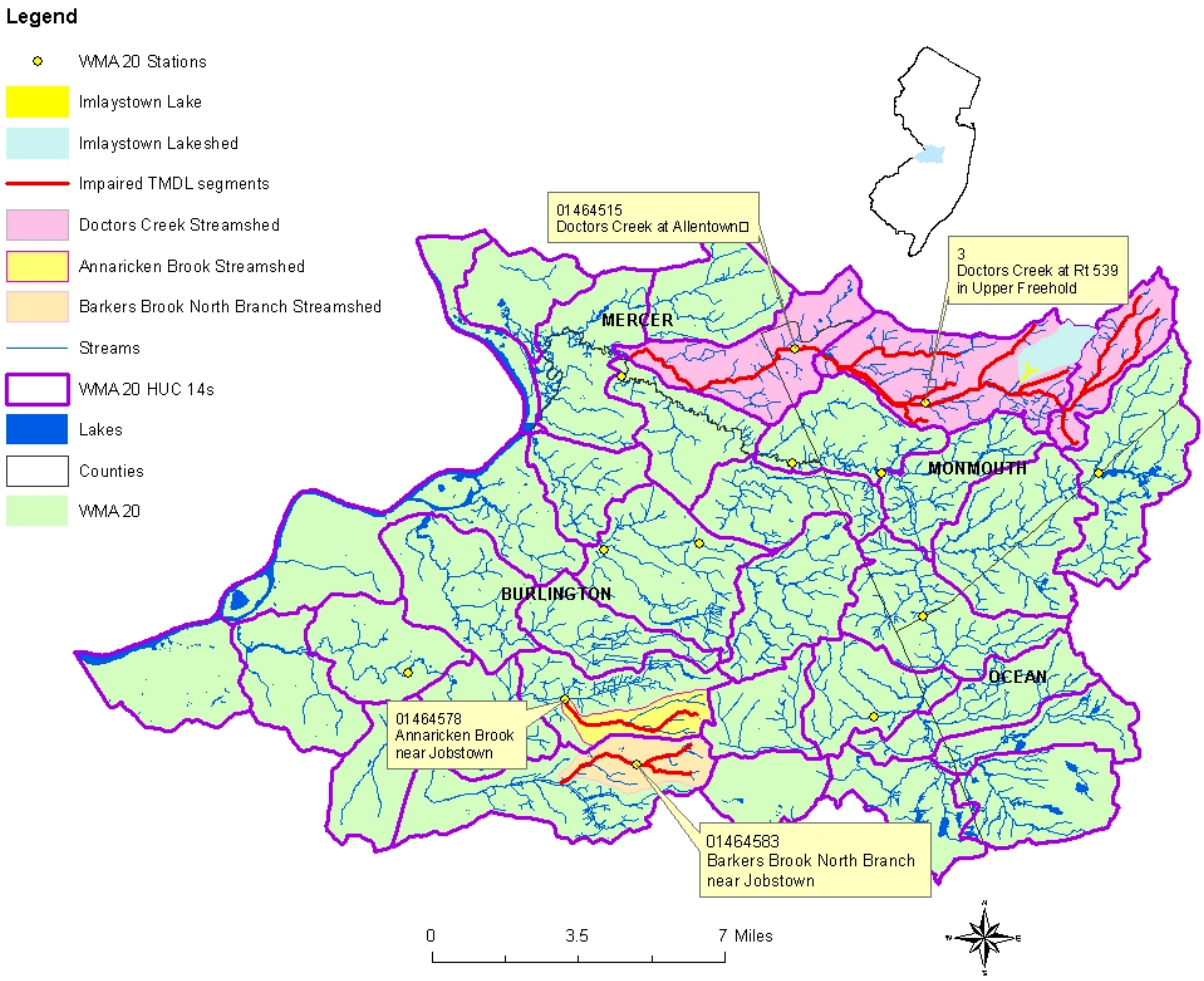
In all FW2 waters, the designated uses are (NJAC 7:9B-1.12):

> 1. Maintenance, migration and propagation of the natural and established aquatic biota;
> 2. Primary and secondary contact recreation;
> 3. Industrial and agricultural water supply;
> 4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
> 5. Any other reasonable uses.

Area of Interest

These TMDLs will address 39.4 impaired river miles within the Lower Delaware Water Region. Based on the detailed county hydrography stream coverage, 103.3 overall stream miles are affected by the TMDLs due to the fact that the implementation plans cover entire watersheds, not just impaired waterbody segments. The spatial extents of the impaired segments, as well as the affected HUC 14 assessment unit drainage areas, are depicted in Figure 1. The new HUC 14 spatial extent methodology employed in the 2006 *Integrated Water Quality Monitoring and Assessment Report* will allow New Jersey to meet EPA's most recent guidance on establishing a stable number of waterbodies to be assessed thus, allowing for a more reliable means to determine the overall condition of all waters of the state; to assess changes over time; and to better measure progress toward attaining the "fishable-swimmable goal" of the Clean Water Act.

Figure 1 Spatial extent of impaired segments, HUC 14 Assessment Units and affected drainage area: WMA 20



WMA 20:

Watershed Management Area 20 includes the Assiscunk, Blacks, Crafts, Crosswicks, Doctors, Duck and Mill Creeks. This management area includes 26 municipalities spanning four counties: Burlington, Mercer, Monmouth and Ocean encompassing 253 square miles.

Crosswicks Creek is 25 miles long and drains an area of 146 square miles to the Delaware River at Bordentown. Major tributaries include Jumping Brook, Lahaway Creek, North Run and Doctors Creek. Tides affect this stream up to the Crosswicks Mill Dam. Allentown Lake, Oxford Lake, Prospertown Lake and Imlaystown Lake are major impoundments in the Crosswicks Creek Watershed. Annaricken Brook and Barkers Brook are tributaries to the Assiscunk Creek. The Assiscunk is approximately 17 miles long and drains an area of 60 square miles. Important land uses in this watershed include agriculture, forest, residential/commercial and military installations. Land use in the affected drainage area is

presented in Table 5 and depicted in Figures 2, 3 and 4. The affected drainage area for Annaricken Brook and Barkers Brook addressed by these TMDLs includes the watersheds of the impaired segments but does not encompass the entire associated HUC 14 drainage areas.

Table 5 River miles, Watershed size, and Area by Anderson Land Use Classification

SITE ID/NAME	01464578	01464583	01461515	3
River miles and drainage area				
Sublist 5 impaired river miles	3.69	4.8	16.05	14.9
Total river miles within watershed and included in the implementation plan	8.31	10.31	46.4	38.3
Watershed size (acres)	1740	2330	9497	7104
Landuse/Landcover (acres)				
agriculture	821	1003	3809	3384
medium / high density residential	5.28	2.44	517.6	3.15
low density / rural residential	145.7	56	852.7	686.8
commercial	1.56	34.1	111.7	24.4
industrial	0	3.14	103.1	1.32
mixed urban / other urban	13.9	60	601.6	224
barren	5.52	62.3	185.5	29.7
forest	188.3	321.6	945.3	1615
wetlands	557.5	784	2228.2	1011.6
water	1.13	3.6	141.7	123.8
Total	1740	2330	9497	7104

Figure 2 Land Use in the Annaricken Brook Streamshed

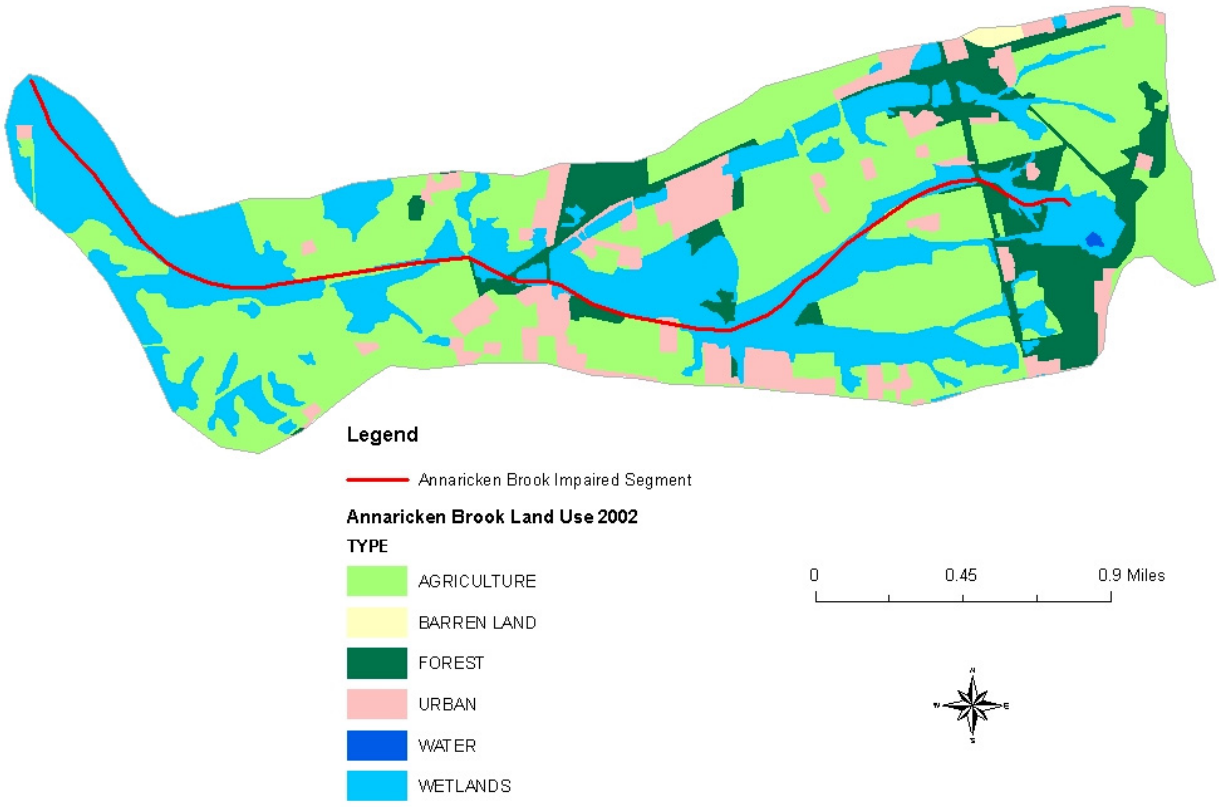


Figure 3 Land Use in the Barkers Brook North Branch Streamshed

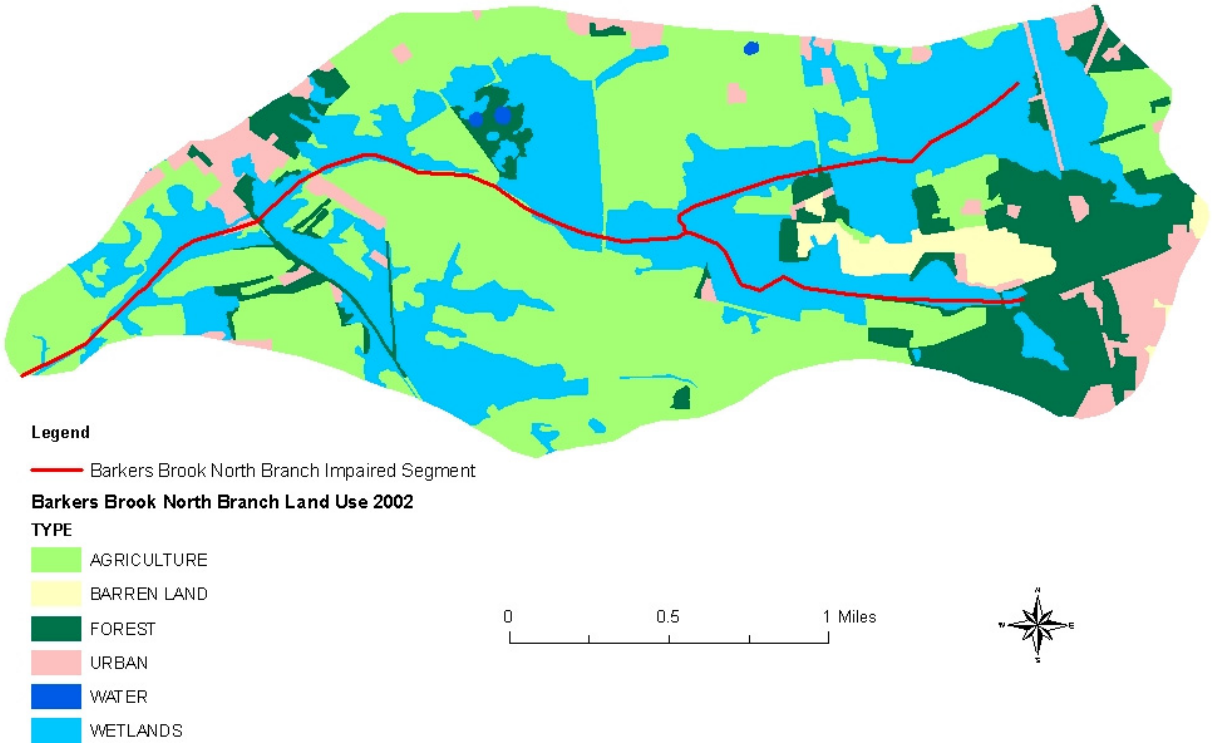
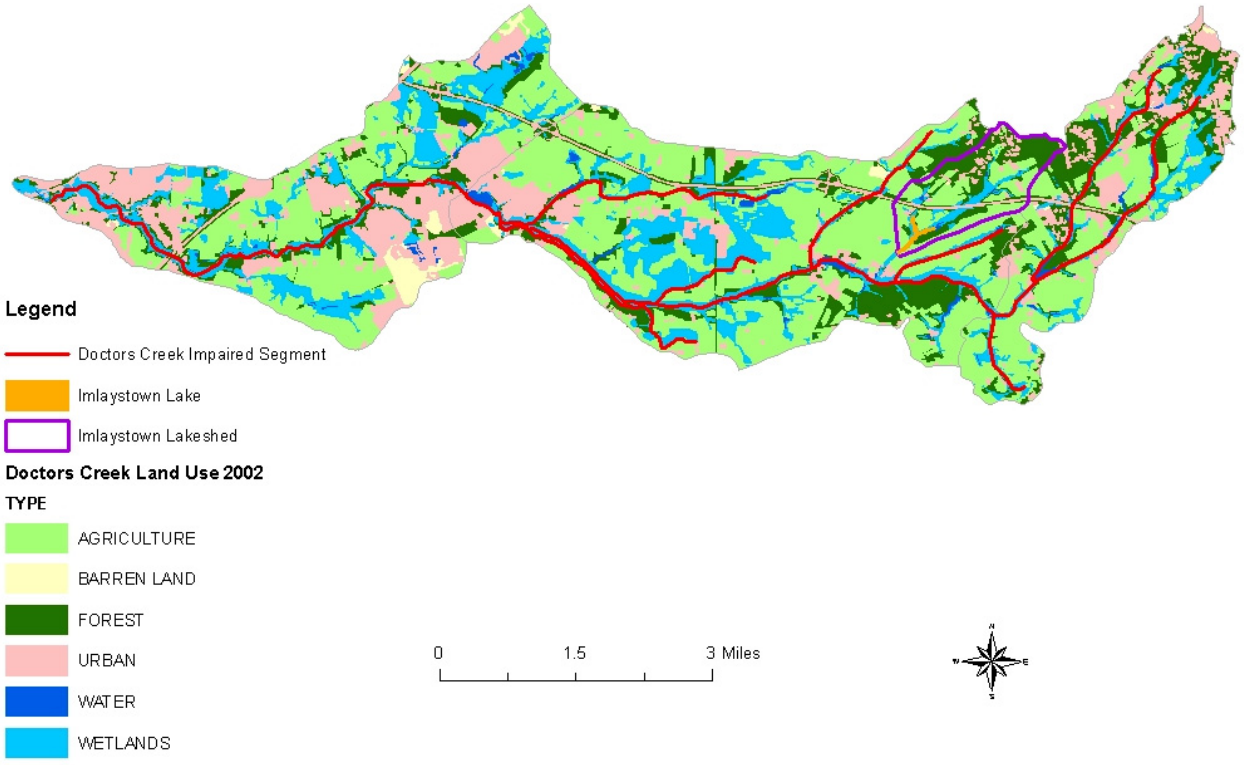


Figure 4 Land Use in the Doctors Creek Streamshed



The Department's Geographic Information System (GIS) was used to describe characteristics of the affected drainage area. The following is general information regarding the data used:

- Draft NJDEP 2006 Integrated Report Results HUC 14, NJDEP, Watershed Assessment Group (WAT), Unpublished.

- Land use/Land cover was taken from: "NJDEP 2002 Land use/Land cover Update for New Jersey (DRAFTS)", published 03/08/2005 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS), and delineated by watershed management area.

- "NJDEP 2004 Integrated Report Results for Non-Tidal Rivers", published 6/2004 by NJDEP, Watershed Assessment Group (WAT). Online at: http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_river_conventionals2004.gif

- "NJDEP Streams of New Jersey (1:24000)", published 11/01/1998 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). Online at: http://www.state.nj.us/dep/gis/strmshp.html

- "NJDEP 14 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC14)", published 4/5/2000 by NJDEP, New Jersey Geological Survey (NJGS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

- "NJDEP 11 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC11)", published 4/5/2000 by NJDEP, New Jersey Geological Survey (NJGS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc11.zip

- "NJDEP 2004 Integrated Report Stations on Non-Tidal Rivers (Conventionals and Toxics)", published 6/2004 by NJDEP, Water Assessment Team (WAT). Online at: http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_stations_river2004.gif

- "NJDEP Digital Elevation Grid for New Jersey (10 meter)", published 10/1/2004 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.nj.gov/dep/gis/wmalattice.html

- "Dams in New Jersey", created 6/2003 by NJDEP, Division of Watershed Management (DWM). Unpublished.

- "NJDEP County Boundaries for the State of New Jersey", published 01/23/2003 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic

Information and Analysis (BGIA), Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip

- "NJDEP Municipality Boundaries for the State of New Jersey", published 01/23/2003 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stmun.zip

- "NJDEP Head of Tide Points for Watercourses of New Jersey", published 1986 by NJDEP, Office of Environmental Analysis (OEA), Coast Survey Ltd. (CTD). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/hot.zip

4.0 Source Assessment

In order to evaluate and characterize phosphorus loadings in the waterbodies of interest in these TMDLs, and thus propose proper management responses, source assessments are needed. Source assessments include identifying the types of sources and their relative contributions to phosphorus loadings, in both time and space variables.

Assessment of Point Sources

For the purposes of TMDL development, point sources include domestic and industrial wastewater treatment plants that discharge to surface water, as well as stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater regulation program. Point sources contributing phosphorus loads within the Barkers Brook and Doctors Creek affected drainage areas include the wastewater dischargers identified as the Springfield Elementary School and Allentown Boro WTP in Table 6 and stormwater point sources, identified as the Tier A municipalities listed in Appendix B. Stormwater point sources, like nonpoint sources, derive their pollutant load from runoff from land surfaces and load reduction is accomplished through BMPs. The distinction is that stormwater point sources are regulated under the Clean Water Act.

Table 6 Point Source Dischargers

NJPDES Permit Number	Facility Name	Discharge Type	Receiving Waterbody	Actual Average Flow (MGD)	Permit Flow (MGD)	Actual Monthly Average TP (mg/l)	TP Effluent Limit (mg/l)
NJ0021571	Springfield BOE-Elementary School	Minor municipal	Barkers Brook	0.00174	0.0075	2.38	Report only
NJ0020206	Allentown Boro STP	Minor municipal	Doctors Creek	0.194	0.238	0.321	1.0

Assessment of Nonpoint Sources

For the purposes of TMDL development, potential nonpoint sources include stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities, which are regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces, as well as malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. Tier B municipalities within the drainage areas are identified in Appendix B.

To a great extent, the phosphorus loads in the affected watersheds are contributed by stormwater point sources and nonpoint sources. These loads are effectively estimated using loading coefficients for land uses present in the watersheds. Therefore, watershed loads for total phosphorus were estimated using the Unit Areal Load (UAL) methodology, which applies pollutant export coefficients obtained from literature sources to the land use patterns within the watershed, as described in USEPA's Clean Lakes Program guidance manual (Reckhow, 1979b). Land use was determined using the Department's GIS system from the 2002 draft land use coverage. The Department reviewed phosphorus export coefficients from an extensive database, found in Appendix A, and selected the land use categories and values shown in Table 7.

Table 7 Phosphorus export coefficients (Unit Areal Loads)

land use / land cover	LU/LC codes*	UAL (kg TP/ha/yr)
Mixed density residential	1100	1.2
medium / high density residential	1110, 1120, 1150	1.6
low density / rural residential	1130, 1140	0.7
Commercial	1200	2.0
Industrial	1300, 1500	1.7
mixed urban / other urban	other urban codes	1.0
Agricultural	2000	1.5
forest, wetland, water	1750, 1850, 2140, 2150, 4000, 6000, 5000, 8000	0.1
barren land	7000	0.5

Units: 1 hectare (ha) = 2.47 acres
1 kilogram (kg) = 2.2 pounds (lbs)
1 kg TP/ha/yr = 0.89 lbs/acre/yr

*LU/LC code is an attribute of the land use coverage that provides the Anderson classification code for the land use. The Anderson classification system is a hierarchical system based on four digits. The four digits represent one to four levels of classification, the first digit being the most general and the fourth digit being the most specific description.

5.0 Water Quality Analysis

Table 8 describes the data used for the analysis of the affected drainage areas. The raw data is provided in Appendix C. The United States Geological Survey (USGS) in collaboration with NJDEP collected monitoring data on Annaricken Brook near Jobstown from 1997-2004; on Barkers Brook North Branch near Jobstown from 1997-2000; and on Doctors Creek at Allentown from 1975-2004. Monmouth County Health Department collected data on Doctors Creek at Route 539 in Upper Freehold from 1999-2006. For the purpose of this TMDL document, data prior to 1990 for Doctors Creek at Allentown were deemed to be outdated and not used.

Table 8 Summary of Total Phosphorus sampling data

Water Quality Sample Locations	Site Number	# of samples	Average (mg/L)	% exceeding 0.1 mg/L
Annaricken Brook near Jobstown	01464578	13	0.135	77%
Barkers Brook N Br near Jobstown	01464583	12	0.147	58.3%
Doctors Creek at Allentown	01464515	69	0.11	36.2%
Doctors Creek at Route 539 in Upper Freehold	3	14	0.127	21.4%

Figure 5 Location of the Monitoring Site on Annaricken Brook

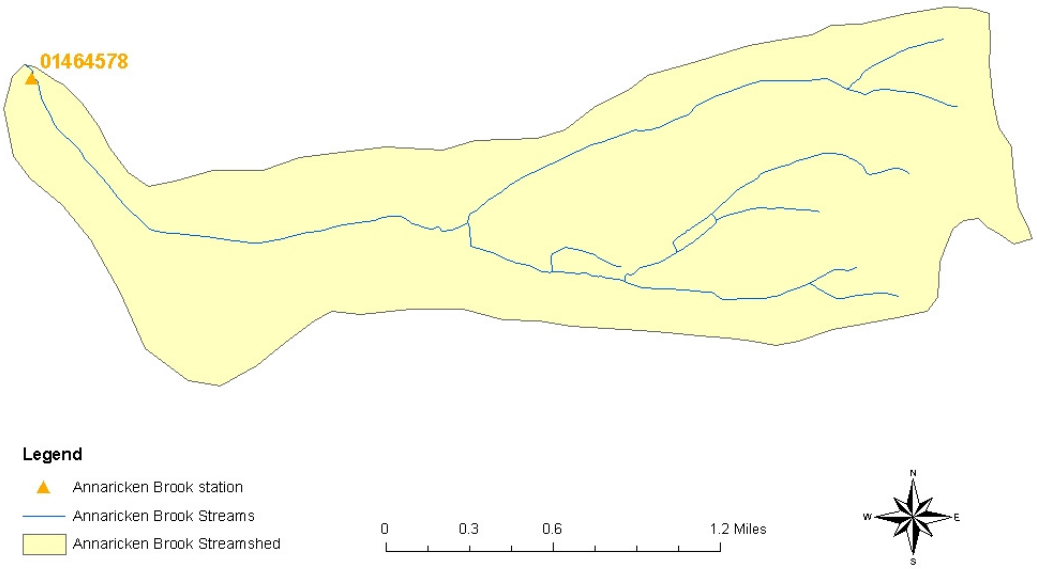


Figure 6 Location of the Monitoring Site on Barkers Brook North Branch

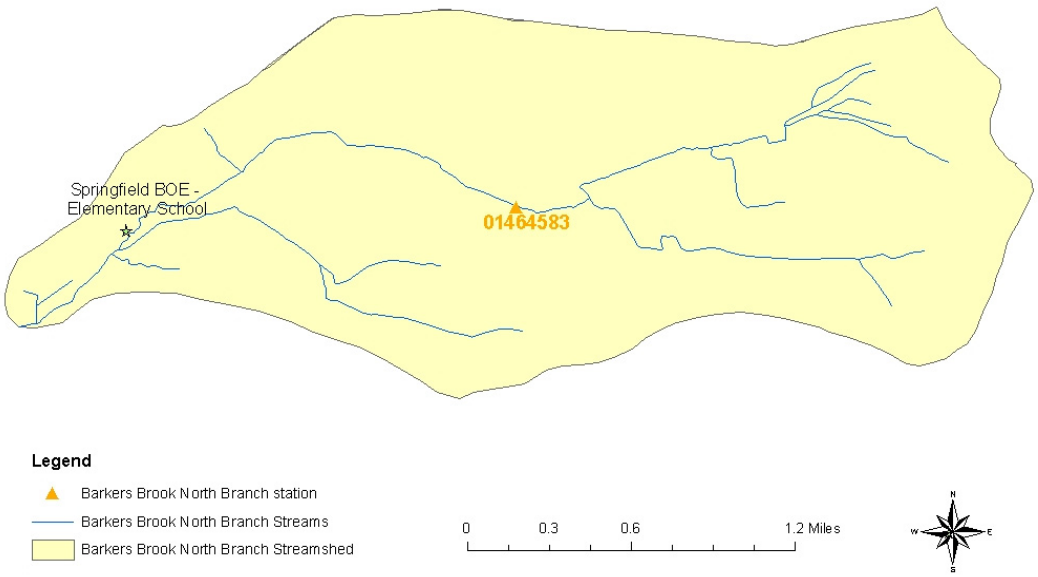
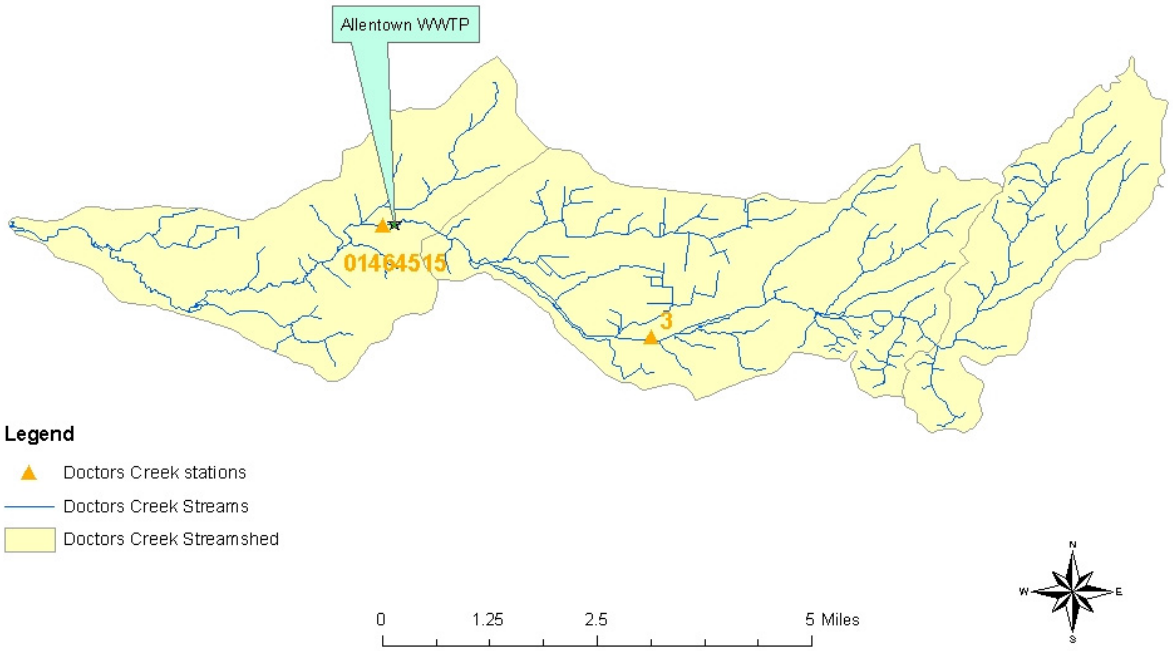


Figure 7 Location of the Monitoring Sites on Doctors Creek



Seasonal Variation/Critical Conditions

The application of a flow-integrated regression technique for determining loading reductions for impaired segments works well in watersheds that exhibit most of the loading exceedances from nonpoint and stormwater point sources of pollution. The analytical technique used to calculate these TMDLs represents the entire range of flows and all seasons for which the total phosphorus data were collected. Since the technique uses data from annual monitoring programs, seasonal variation and critical conditions are incorporated into the analysis by assessing the loadings over the entire range of flows. Therefore, the method implicitly represents all seasonal meteorological and hydrological conditions. The loading reduction calculated to attain SWQS will do so under all conditions, according to the data available.

The flow-integrated regression technique could not be applied to Doctor's Creek at Route 539 in Upper Freehold due to the lack of instantaneous flow data. The data collected at this site represents a range of seasons as well as flow conditions.. Additionally, the load reduction needed to attain SWQS was calculated based on the highest recorded data point. In this way, both TMDL methods address seasonal variation and critical conditions.

6.0 TMDL Calculations

A regression technique, derived from a load duration method (Stiles 2002), was developed by the Department for data-limited TMDLs where nonpoint and stormwater point sources are predominant. For this technique, linear regression is used to develop a flow-integrated relationship between measured pollutant concentrations and the associated flows at a single monitoring site. The method, known as the Flow-Integrated Reduction of Exceedances (FIRE), provides an accurate estimation of the load that will not cause an exceedance of the water quality standard. The FIRE method is applied over the entire range of flows, eliminating the need to establish a single target flow to estimate an average annual loading reduction. For this approach, calculated phosphorus loads based on actual data are plotted against corresponding flows. The regression relationship between the load and flow for exceedances of the SWQS is established and the regression line drawn. The target load line corresponding with the target TP concentration of 0.1 mg/L is plotted on the same graph with the linear exceedance regression line (Equation 1, 4 & 7). For this technique, a zero-intercept for the regression line is assumed. The zero intercept is within the 95 percent confidence interval, so the zero intercept cannot be rejected as the point of origin. In addition, given the predominance of nonpoint sources, at zero flow there would be zero load. Given lines with a common intercept, the difference between the slopes of the two lines provides the percent load reduction needed to attain SWQS (Equation 2, 5 & 8). The resultant percent reduction is the same whether the y-axis is expressed as pounds per day, pounds per year, or as metric units of kilograms per day or per year.

For Doctors Creek at Rt 539 in Upper Freehold, the FIRE method could not be applied because of the lack of flow data. The load reduction that would be needed to attain compliance in the stream was based on assuming a linear relationship exists between load reduction and in-stream concentration. The load reduction needed to attain the SWQS for streams was calculated, by comparing the highest recorded data point with a target concentration . Data for this station is presented in Figure 11.

A Margin of Safety (MOS) must be provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). A MOS accounts for uncertainty in the loading estimates, physical parameters and the model itself. The MOS, as described in USEPA guidance (Sutfin, 2002), can be either explicit or implicit (i.e., addressed through conservative assumptions used in establishing the TMDL). For this TMDL calculation, an explicit MOS has been incorporated as described below.

The margin of safety when applying FIRE is calculated by taking the difference between the exceedance regression line and the 95 percent confidence limit for the regression (Equation 3, 6 & 9). For Doctors Creek at Rt 539 in Upper Freehold, a 5 percent explicit margin of safety was added. The percent load reduction needed to attain the SWQS is applied to the existing load to obtain the target load. The load associated with margin of safety is then reserved and the remaining load is allocated to the various land-use source categories (Appendix D).

The regression results for Annaricken Brook near Jobstown, Barkers Brook North Branch near Jobstown and Doctors Creek at Allentown are presented in Tables 9, 10 and 11 and Figures 8, 9 and 10.

Annaricken Brook TMDL Calculations

Figure 8 Estimated Percent Reduction for Annaricken Brook near Jobstown using a Regression Method

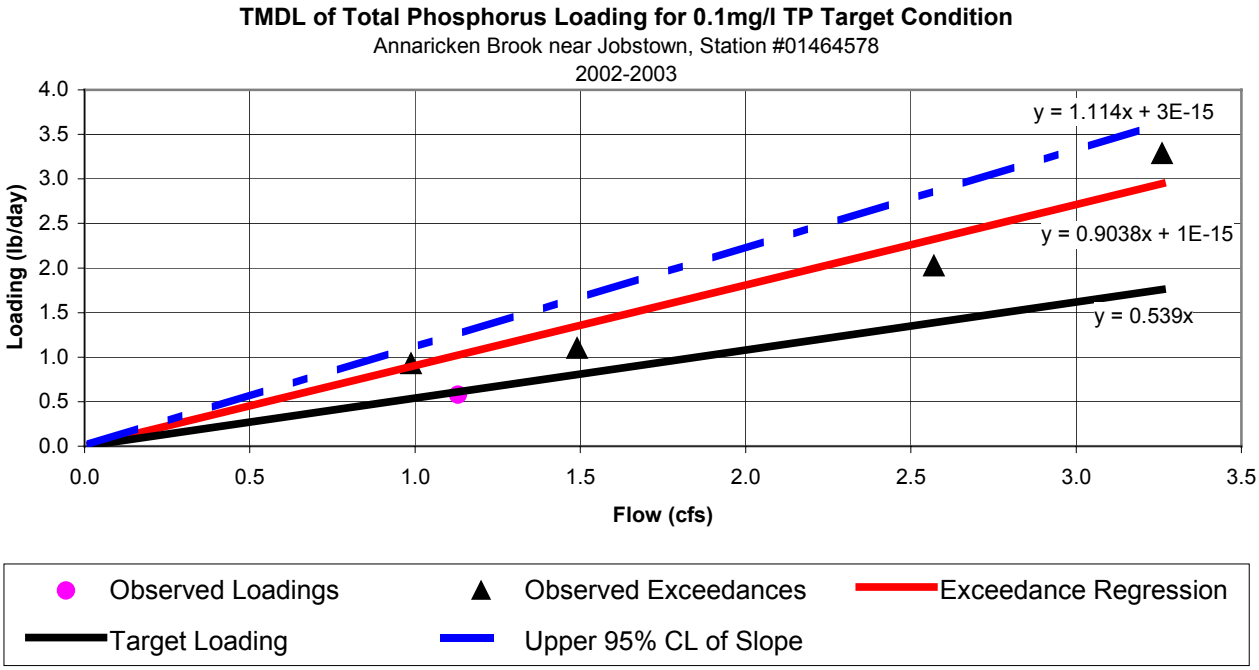


Table 9 Annaricken Brook near Jobstown (01464578)

Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	0.9038
Upper 95% Confidence Limit of Slope	=	1.1140

To achieve SWQSs within the impaired Annaricken Brook near Jobstown segment, the required reductions are as follows:

Equation 1
Target Load (lb/day) for the given TP SWQS:

Target Load (lb/day) = flow (cfs) * 0.539

Equation 2
Required TP Load Reduction based on the regression line:

$$(1-\frac{0.539}{0.9038})x100\% = 0.4036x100\% = 40.36\%$$

Equation 3
The portion of the reduction attributed to MOS is calculated as follows:

$$\text{MOS} = (1-\frac{0.9038}{1.114})x100\% = 0.1887x100\% = 18.87\%$$

Barkers Brook TMDL Calculations

Figure 9 Estimated Percent Reduction for Barkers Brook North Branch near Jobstown using a Regression Method

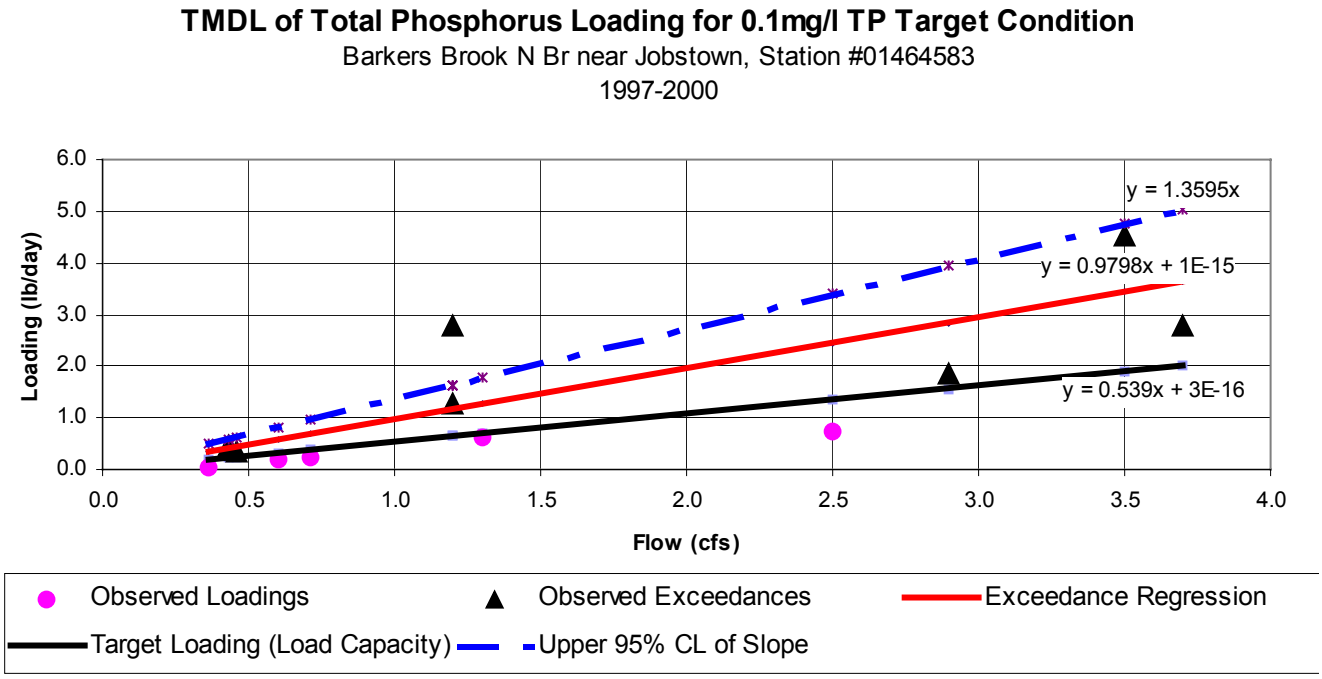


Table 10 Barkers Brook N Br near Jobstown (01464583)

Results from Regression Analysis		
Target Loading Slope (Load Capacity)	=	0.5390
Exceedance Regression Slope	=	0.9798
Upper 95% Confidence Limit of Slope	=	1.3595

To achieve SWQSs within the impaired Barkers Brook North Branch near Jobstown segment, the required reductions are as follows:

Equation 4
Target Load (lb/day) for the given TP SWQS:

$$\text{Target Load (lb/day)} = \text{flow (cfs)} * 0.539$$

Equation 5
Required TP Load Reduction based on the regression line:

$$(1-\frac{0.539}{0.9798})x100\% = 0.4499x100\% = 44.99\%$$

Equation 6
The portion of the reduction attributed to MOS is calculated as follows:

$$\text{MOS} = (1-\frac{0.9798}{1.3595})x100\% = 0.2793x100\% = 27.93\%$$

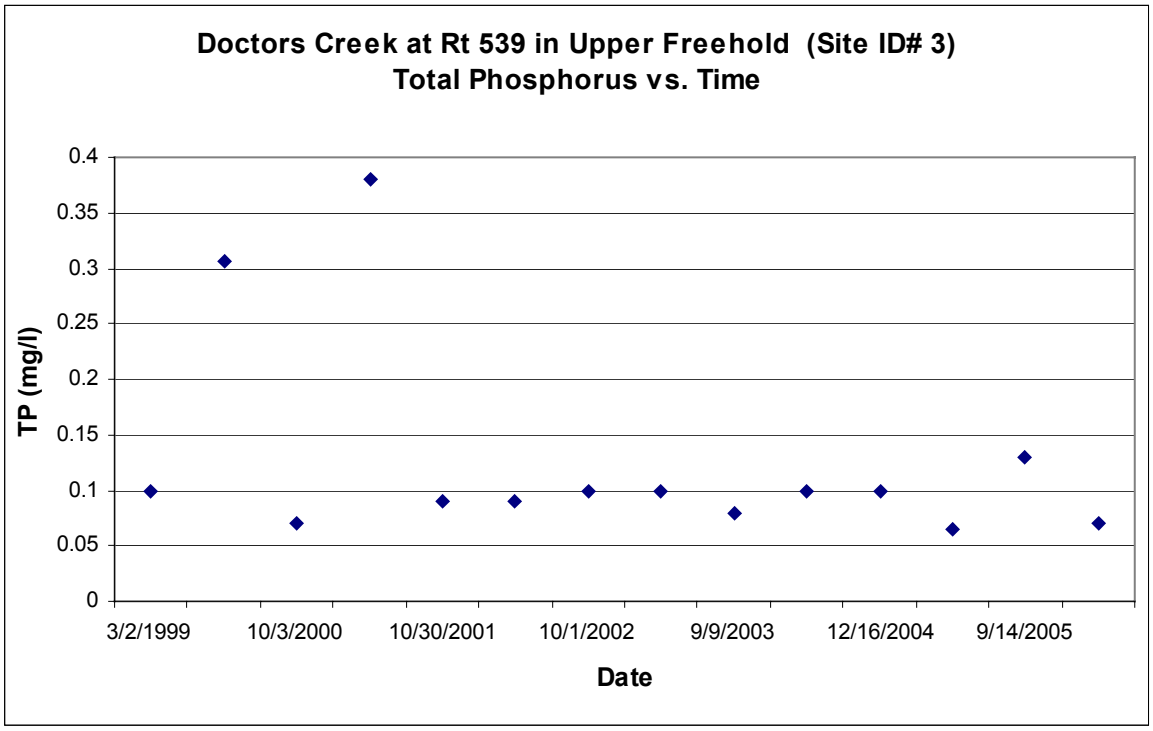
Doctors Creek TMDL Calculations

As identified in Figure 7, there are two discreet water quality monitoring stations within the Doctors Creek watershed; Doctors Creek at Route 539 in Upper Freehold (Site 3) and Doctors Creek at Allentown (Site 0146515). TMDL calculations were performed for each station as follows:

Doctors Creek at Route 539 in Upper Freehold

For this stream segment, the FIRE method could not be applied because of the lack of flow data. The load reduction that would be needed to attain compliance in the stream was based on assuming that a linear relationship exists between load reduction and in-stream concentration. The load reduction needed to attain the SWQS for streams was calculated, based on comparing the highest recorded data point to the target concentration. Data for this station is presented in Figure 11.

Figure 10 Doctors Creek at Route 539 in Upper Freehold Estimated Percent Reduction Using an Alternative Method



The overall reduction required, including a 5 percent MOS, to achieve a SWQS of 0.1 mg/l based on the highest TP concentration recorded (0.38 mg/l) is 75.0 %. This is calculated using the equation:

Percent Reduction = (1 – TMDL target conc./max conc.) x 100
= (1 – 0.1/0.38) x 100
= 73.7%

MOS = 0.05 x (1-73.7%) = 1.3%

Overall Reduction = 73.7% + 1.3% = 75.0%

Doctors Creek at Allentown

Figure 11 Estimated Percent Reduction for Doctors Creek at Allentown using a Regression Method

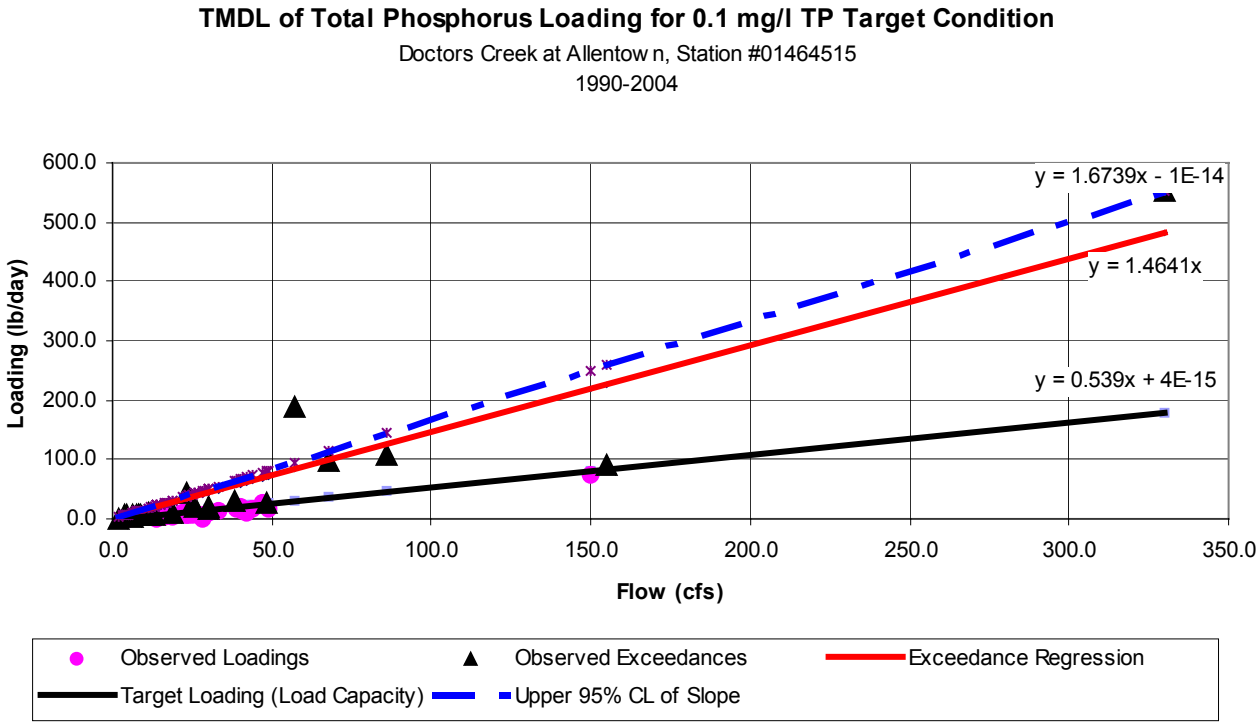


Table 11 Doctors Creek at Allentown (01464515)

Results from Regression Analysis		
Target Loading Slope (Load Capacity)	=	0.5390
Exceedance Regression Slope	=	1.4641
Upper 95% Confidence Limit of Slope	=	1.6739

To achieve SWQSs within the impaired Doctors Creek at Allentown segment, the required reductions are as follows:

Equation 7
Target Load (lb/day) for the given TP SWQS:

$$\text{Target Load (lb/day)} = \text{flow (cfs)} * 0.539$$

Equation 8
Required TP Load Reduction based on the regression line:

$$(1-\frac{0.539}{1.4641})x100\% = 0.6318x100\% = 63.18\%$$

Equation 9
The portion of the reduction attributed to MOS is calculated as follows:

$$\text{MOS} = (1-\frac{1.4641}{1.6739})x100\% = 0.1253x100\% = 12.53\%$$

To determine the TMDL for each stream segment, the target load is calculated as shown above. The load that corresponds to the MOS is calculated and then subtracted from the target load. The result is the allocable load. Loads from some land uses, specifically forest, wetland, water and barren land, are generally not adjustable. There are few measures that can reasonably be applied to runoff from these sources to reduce the loads generated. As a result, existing loads from these sources are set equal to the future loads. Therefore, in order to achieve the TMDL, the load reduction from land uses for which reduction measures can more reasonably be applied must be increased proportionally, as presented below. Additional detail on the method used to derive load reductions that are assigned to each land use from the FIRE outputs is provided in Appendix D.

Wasteload Allocations and Load Allocations

Waste Load Allocations (WLAs) are established for all point sources, while Load Allocations (LAs) are established for nonpoint sources, as these terms are defined in Source Assessment. For point sources other than stormwater, individual WLAs are assigned. There is one wastewater treatment facility in the Doctors Creek watershed (Allentown Boro WTP) and one in the Barkers Brook North Branch watershed (Springfield BOE – Elementary School). The current phosphorus loading associated with each of the discharges was calculated using the data provided for each facility in the Daily Monitoring Reports (DMR). Potential future loading scenarios were also calculated and compared to the land use loading. Based on this analysis a future loading was established. These facilities will both be assigned WLAs.

For stormwater sources, both WLAs and LAs are expressed as percent reductions based on land use for particular stream segments, and are differentiated between point and nonpoint sources as discussed below.

Stormwater discharges can be a point source or a nonpoint source, depending on NPDES regulatory jurisdiction, yet the suite of measures to achieve reduction of loads from stormwater discharges is the same, regardless of this distinction. Stormwater point sources

receiving a WLA are distinguished from stormwater generating areas receiving a LA on the basis of land use. This distribution of loading capacity between WLAs and LAs is consistent with recent EPA guidance that clarifies existing regulatory requirements for establishing WLAs for stormwater discharges (Wayland, November 2002). Stormwater discharges are captured within the runoff sources quantified according to land use, as described previously. Distinguishing between regulated and unregulated stormwater is necessary in order to express WLAs and LAs numerically; however, "EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability within the system" (Wayland, November 2002, p.1). Therefore allocations are established according to source categories as shown in Table 12. This demarcation between WLAs and LAs based on land use source categories is not perfect, but it represents the best estimate defined as narrowly as data allow. The Department acknowledges that there may be stormwater sources in the residential, commercial, industrial and mixed urban runoff source categories that are not NJPDES-regulated. Nothing in these TMDLs shall be construed to require the Department to regulate a stormwater source under NJPDES that would not already be regulated as such, nor shall anything in these TMDLs be construed to prevent the Department from regulating a stormwater source under NJPDES.

Table 12 Distribution of WLAs and LAs among stormwater source categories

Source category	TMDL allocation
medium / high density residential	WLA
low density / rural residential	WLA
commercial	WLA
industrial	WLA
Mixed urban / other urban	WLA
agricultural	LA
forest, wetland, water	LA
barren land	LA

Annaricken Brook near Jobstown

Wasteload allocations and load allocations for sources within the drainage area of the impaired Annaricken Brook near Jobstown segment are presented in Table 13 and Figures 12 and 13.

Table 13 TMDL calculations for Annaricken Brook near Jobstown

	Current Load	Load Capacity			
	kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	kg TP/day (lbs TP/day*)	% of LC	% reduction
Allocation of Loading Capacity					
Point Sources other than Stormwater	NA				
Nonpoint and Stormwater Sources					
Medium / high density residential	3.42 (7.524)	1.55 (3.41)	0.0042 (0.0093)	0.45	54.6%
Low density / rural residential	41.28 (90.838)	18.74 (41.228)	0.051 (0.11)	5.41	54.6%
Commercial	1.27 (2.794)	0.58 (1.276)	0.0016 (0.0035)	0.17	54.6%
Industrial	0 (0)	0 (0)	0 (0)	0	n/a
Mixed urban / other urban	5.63 (12.386)	2.56 (5.632)	0.0070(0.015)	0.74	54.6%
Agricultural	498.53 (1096.766)	226.55 (498.41)	0.62(1.37)	65.3	54.6%
Forest, wetland, water	30.226 (66.497)	30.23 (66.506)	0.083 (0.18)	8.72	0%
Barren land	1.12 (2.464)	1.12 (2.464)	0.0031 (0.0068)	0.32	0%
Margin of Safety	N/A	65.42 (143.924)	0.18(0.39)	18.9	n/a
Total:	581.48 (1279.3)	346.75 (762.85)	0.95 (2.09)	100	

*Daily TMDLs were calculated by dividing the annual load values by 365 days/year. The daily loads are based on the TMDL not exceeding the calculated annual load.

Figure 12 Current Total Phosphorus Load for Annaricken Brook near Jobstown

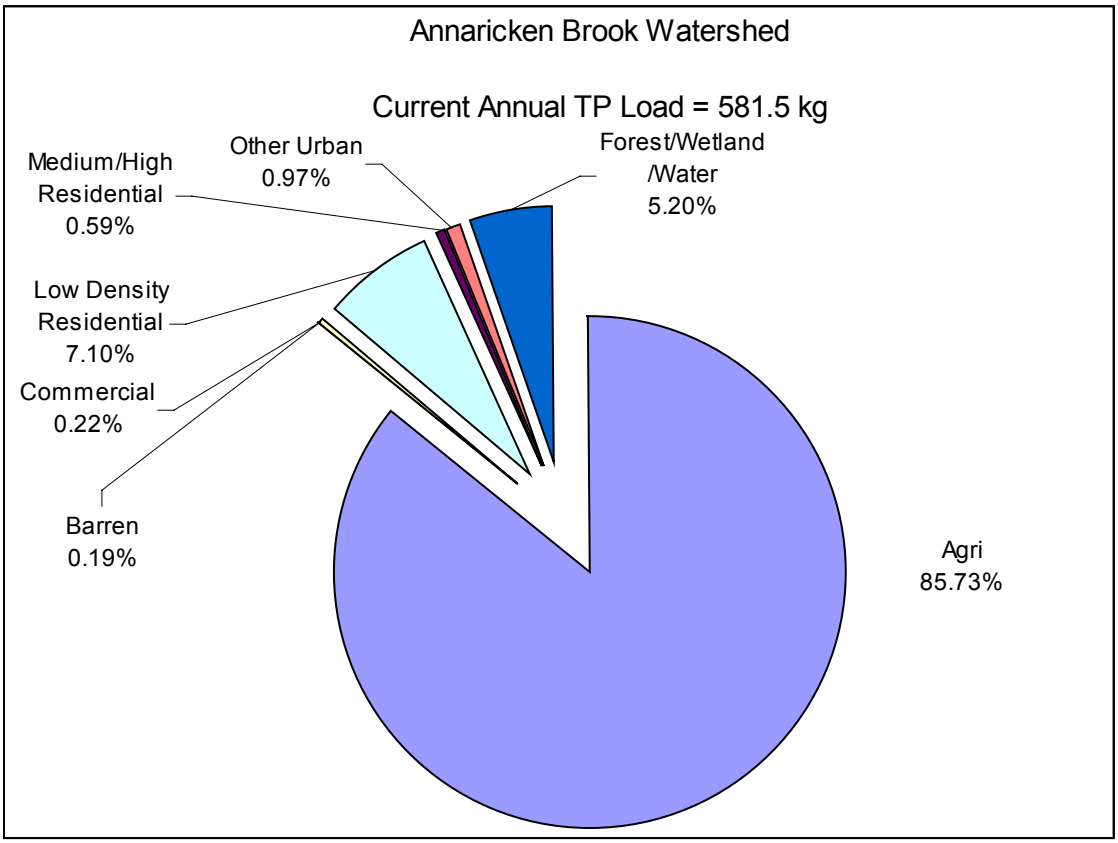
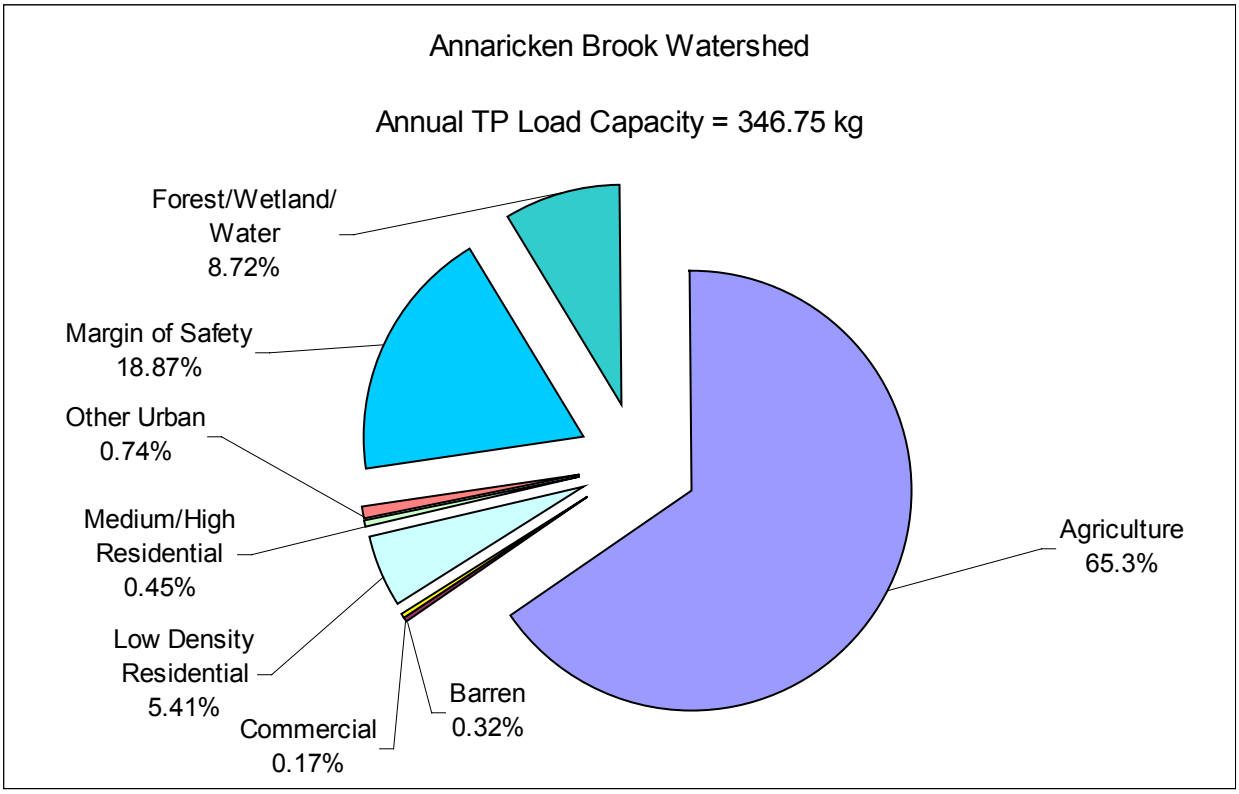


Figure 13 Future Total Phosphorus Load for Annaricken Brook near Jobstown



Barkers Brook North Branch Near Jobstown

Wasteload allocations and load allocations for sources within the drainage area of the impaired Barkers Brook North Branch near Jobstown segment are presented in Table 14 and Figures 14 and 15. Springfield Elementary does not currently have a permit limit for total phosphorus. Future load for the facility was calculated by allowing that the future load would remain the same as the current load. This results in a permit limit of 0.55 mg/l. This limit was selected because the load contributed by the STP is very small. No treatment improvements will be needed provided the flows remain the same, thus avoiding a cost on a public facility with no environmental benefit.

Table 14 TMDL calculations for Barkers Brook North Branch near Jobstown

	Current Load	Load Capacity			
	kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	kg TP/day (lbs TP/day*)	% of LC	% reduction
Allocation of Loading Capacity					
Point Sources other than Stormwater					
Springfield Elem. Discharge	5.73 (12.61)	5.73 (12.61)	0.016 (0.035)	1.4	N/A
Nonpoint and Stormwater Sources					
Medium / high density residential	1.58 (3.48)	0.54 (1.19)	0.0015 (0.0033)	0.13	66.0 %
Low density / rural residential	15.86 (34.89)	5.39 (11.86)	0.015 (0.032)	1.32	66.0 %
Commercial	27.6 (60.7)	9.38 (20.64)	0.026 (0.057)	2.29	66.0 %
Industrial	2.16 (4.75)	0.73 (1.61)	0.002 (0.0044)	0.18	66.0%
Mixed urban / other urban	24.3 (53.46)	8.26 (18.17)	0.023 (0.051)	2.02	66.0 %
Agricultural	608.9 (1339.58)	207.27 (455.99)	0.57 (1.25)	50.67	66.0 %
Forest, wetland, water	44.89 (98.76)	44.89 (98.76)	0.12 (0.26)	10.97	0%
Barren land	12.6 (27.7)	12.6 (27.72)	0.035 (0.076)	3.08	0%
Margin of Safety	N/A	114.26 (251.37)	0.31 (0.68)	27.93	N/A
Total:	**743.6 (1635.9)**	**409.1 (900)**	**1.1 (2.4)**	**100**	

*Daily TMDLs were calculated by dividing the annual load values by 365 days/year. The daily loads are based on the TMDL not exceeding the calculated annual load.

Figure 14 Current Total Phosphorus Load for Barkers Brook North Branch near Jobstown

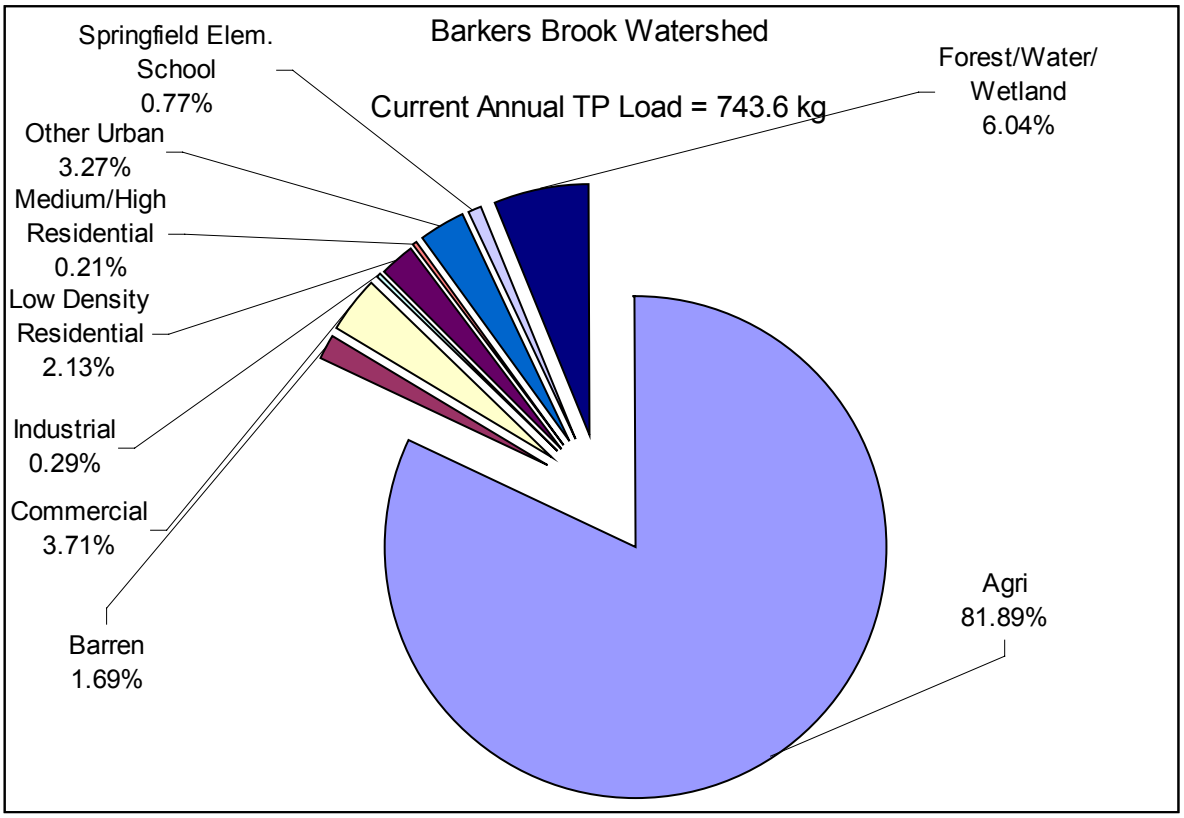
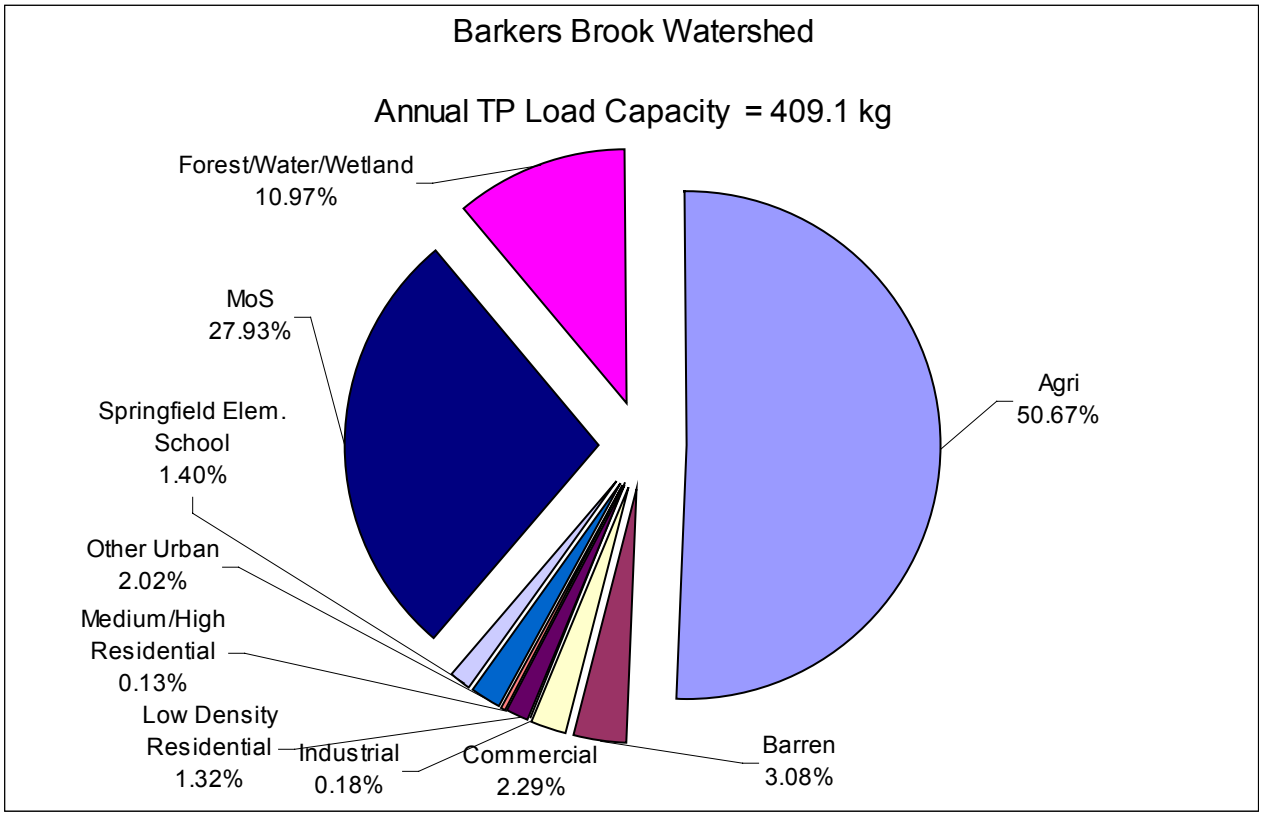


Figure 15 Future Total Phosphorus Load for Barkers Brook North Branch near Jobstown



Doctors Creek

Wasteload allocations and load allocations for sources within the drainage area of Doctors Creek at Route 539 in Upper Freehold are presented in Table 15 and Figures 16 and 17 and Doctors Creek at Allentown are presented in Table 16 and Figures 18 and 19.

This watershed includes Imlaystown Lake for which a TMDL was approved on 9/30/2003. The loading capacity of the lake in the approved 2003 TMDL was calculated using the Reckhow model. The Reckhow model required no load reduction of the exsisting landuse to achieve the load capacity. Based on the evaluation of downstream water quality data and the 2002 landuse data for the Doctors Creek TMDL a loading reduction is required to achieve SWQS downstream of Imlaystown Lake. Therefore, a loading reduction will be applied to the Imlaystown Lakeshed.

Allentown Boro WTP has a current total phosphorus permit limit of 1.0 mg/l with a current monthly average concentration of 0.321 mg/l. The future load for the Allentown wastewater facility was calculated using a permit limit of 0.7 mg/l, which represents a statistically based representation of existing effluent quality. This permit limit was chosen because the majority of the total phosphorus load in this watershed is attributed to non-point sources; the discharger represents less than 4 percent of the overall load.

Table 15 TMDL calculations for Doctors Creek at Rt 539 in Upper Freehold

	Current Load	Load Capacity			
	kg TP/yr (lbs/yr)	**kg TP/yr (lbs/yr)**	**kg TP/day (lbs TP/day*)**	**% of LC**	**% reduction**
Allocation of Loading Capacity					
Point Sources other than Stormwater					
Nonpoint and Stormwater Sources					
Medium / high density residential	2.04 (4.49)	0.43 (0.95)	0.0012 (0.0026)	0.07	78.7%
Low density / rural residential	194.6 (428.12)	41.39 (91.1)	0.11 (0.25)	6.34	78.7%
Commercial	19.8 (43.56)	4.21 (9.26)	0.012 (0.025)	0.65	78.7%
Industrial	0.91 (2.00)	0.19 (0.418)	0.00052 (0.011)	0.03	78.7%
Mixed urban / other urban	90.6 (199.32)	19.29 (42.44)	0.053 (0.12)	2.96	78.7%
Agricultural	2054.3 (4519.46)	437.05 (961.51)	1.2 (2.6)	66.98	78.7%
Forest, wetland, water	111.3 (244.86)	111.33 (244.93)	0.31 (0.67)	17.06	0%
Barren land	6.00 (13.2)	6.00 (13.2)	0.016 (0.036)	0.92	0%
Margin of Safety	n/a	32.63 (71.79)	0.089 (0.20)	5	n/a
Total:	**2479.56 (5455)**	**652.52 (1436)**	**1.79 (3.9)**	**100**	

*Daily TMDLs were calculated by dividing the annual load values by 365 days/year. The daily loads are based on the TMDL not exceeding the calculated annual load.

Figure 16 Current Total Phosphorus Load for Doctors Creek at Rt 539 in Upper Freehold

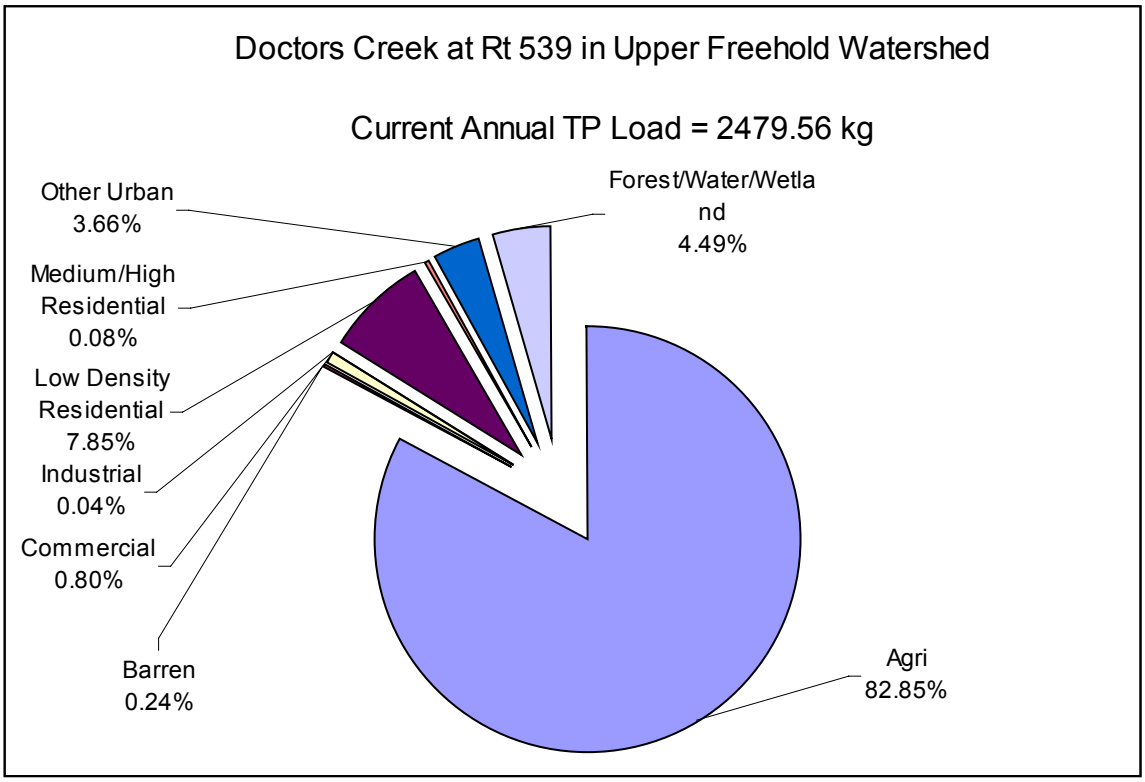


Figure 17 Future Total Phosphorus Load for Doctors Creek at Rt 539 in Upper Freehold

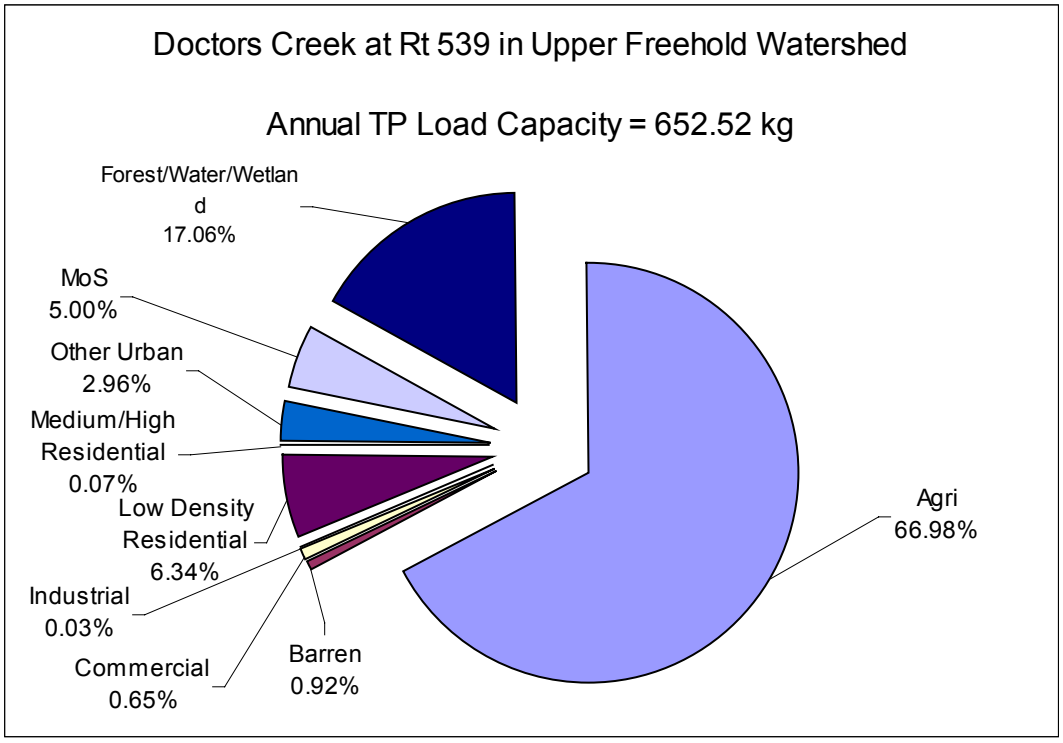


Table 16 TMDL calculations for Doctors Creek at Allentown

	Current Load+	Load Capacity			
	kg TP/yr (lbs/yr)	kg TP/yr (lbs/yr)	kg TP/day (lbs TP/day*)	% of LC	% reduction
Allocation of Loading Capacity					
Point Sources other than Stormwater					
Allentown WWTP Discharge	75.07 (165.15)	227 (499.4)	0.62 (1.4)	17.4	n/a
Nonpoint and Stormwater Sources					
Medium / high density residential	335.14 (737.31)	75.43 (165.95)	0.21 (0.45)	5.8	77.5 %
Low density / rural residential	241.57 (531.45)	54.37 (119.61)	0.15 (0.33)	4.2	77.5 %
Commercial	90.4 (198.88)	20.35 (44.77)	0.06 (0.12)	1.6	77.5 %
Industrial	70.93 (156)	15.96 (35.1)	0.04 (0.10)	1.2	77.5 %
Mixed urban / other urban	243.5 (535.7)	54.8 (120.56)	0.15 (0.33)	4.2	77.5 %
Agricultural	2312.5 (5087.5)	520.46(1145)	1.4 (3.1)	39.9	77.5 %
Forest, wetland, water	134.2(295.24)	134.2 (295.15)	0.37 (0.81)	10.3	0%
Barren land	37.54 (82.59)	37.54 (82.59)	0.10(0.27)	2.9	0%
Margin of Safety	n/a	163.31 (359.28)	0.45(0.98)	12.5	n/a
Total:	**3540.83(7789.8)**	**1303.38(2867.44)**	**3.6 (7.9)**	**100**	

*Daily TMDLs were calculated by dividing the annual load values by 365 days/year. The daily loads are based on the TMDL not exceeding the calculated annual load.
+Represent the load for the local watershed of Doctors Creek at Allentown

Figure 18 Current Total Phosphorus Load for Doctors Creek at Allentown

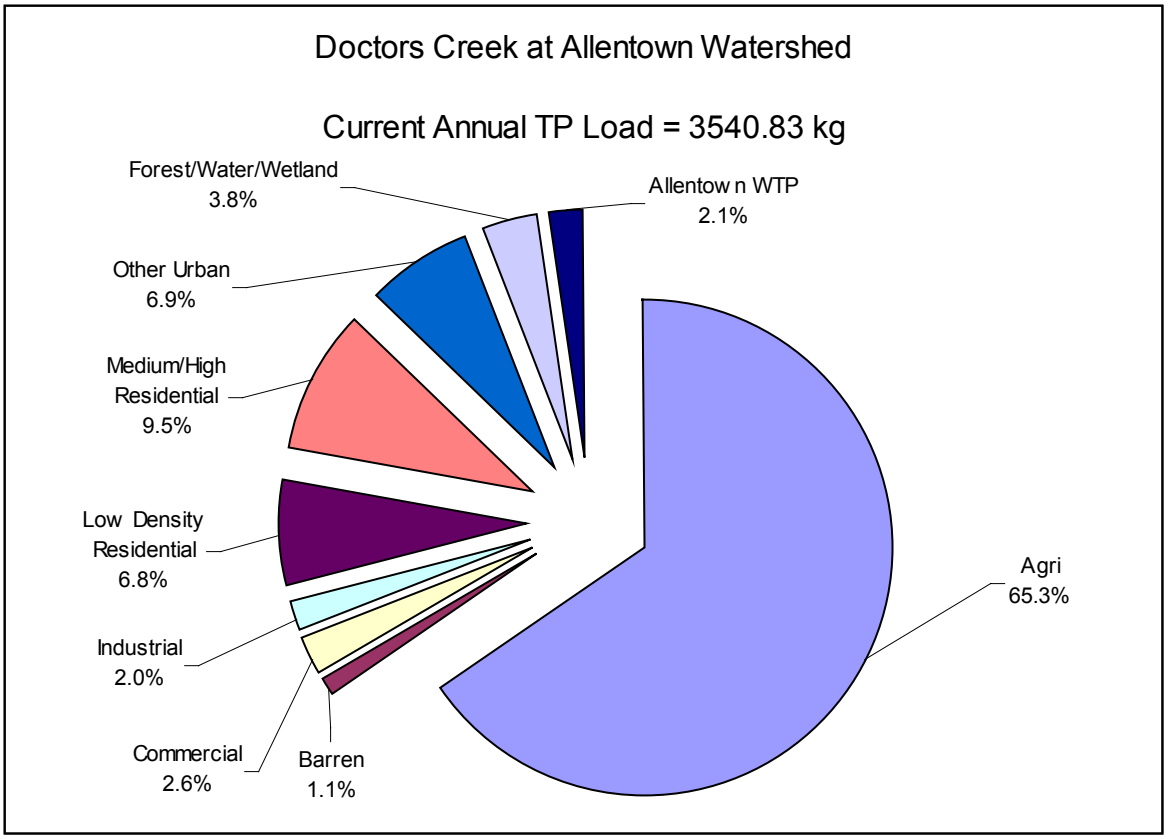
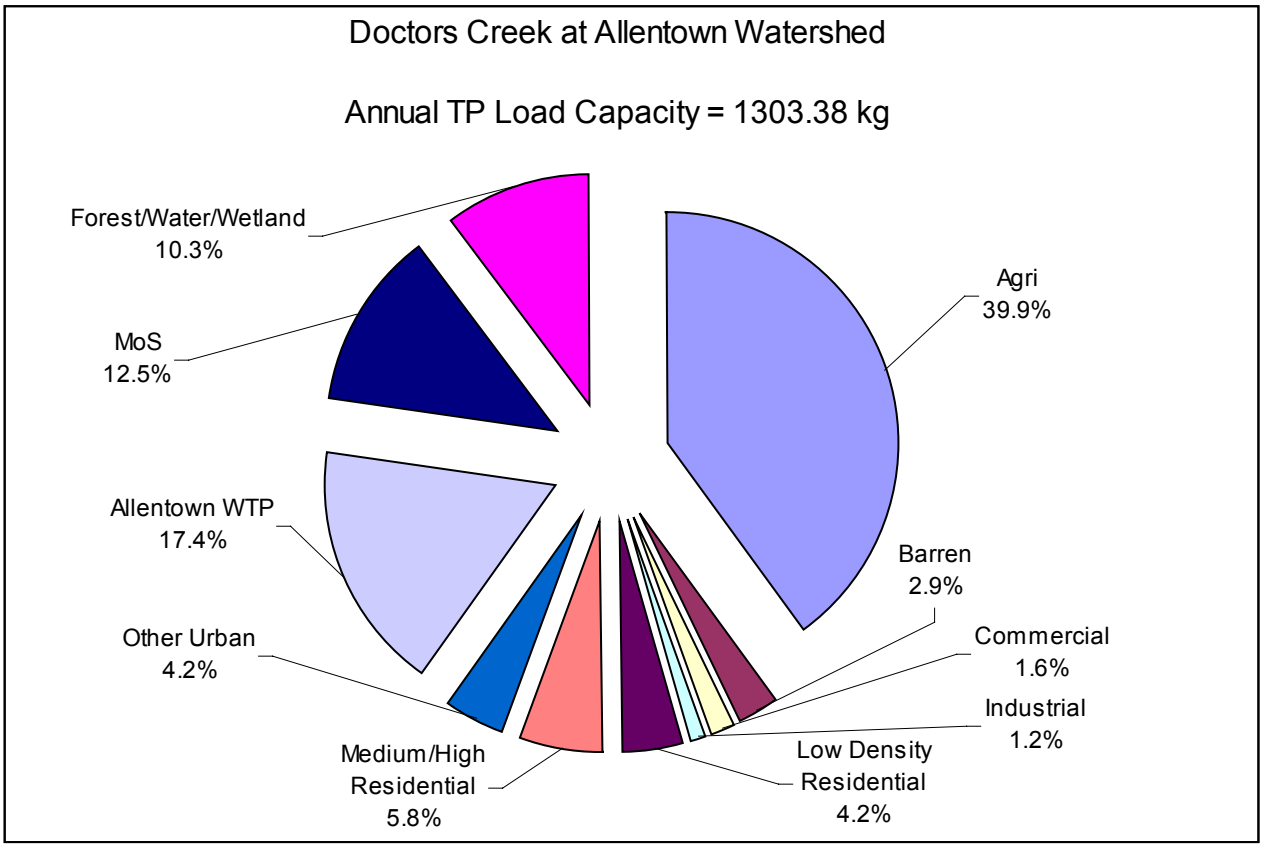

Doctors Creek at Allentown Watershed
Current Annual TP Load = 3540.83 kg
Forest/Water/Wetland
3.8%
Allentow n WTP
2.1%
Other Urban
6.9%
Medium/High
Residential
9.5%
Low Density
Residential
6.8%
Agri
65.3%
Industrial
2.0%
Commercial
2.6%
Barren
1.1%

Figure 19 Future Total Phosphorus Load for Doctors Creek at Allentown



Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. Reserve capacities are not included at this time. The loading capacity of each stream is expressed as a function of the current load, and both WLAs and LAs are expressed as percentage reductions for particular stream segments. Therefore, the percent reductions from current levels must be attained in consideration of any new or expanded sources that may accompany future development.

7.0 Follow-up Monitoring

The Water Resources Division of the U.S. Geological Survey and the Department have cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. A second ambient monitoring network, the Department's Supplemental Ambient Surface Water Network (100 stations), has improved spatial coverage for water quality monitoring in New Jersey. The data from this these networks have been used to assess the quality of freshwater streams for the purpose of identifying impairments. The ambient networks will be the means to determine the effectiveness of TMDL implementation and the need for additional management strategies.

8.0 Implementation Plan

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives" (USEPA, 1993).

The Department recognizes that TMDLs alone are not sufficient to restore impaired stream segments. The TMDL establishes the required pollutant reduction targets while the implementation plan identifies some of the regulatory and non-regulatory tools to achieve the reductions, matches management measures with sources, and suggests responsible entities for non-regulatory tools. This provides a basis for aligning available resources to assist with implementation activities. Projects proposed by the State, local government units and other stakeholders that would implement the measures identified within the impaired watershed are a priority for available State (for example, CBT) and federal (for example, 319(h)) funds. In addition, the Department's ongoing watershed management initiative will develop detailed watershed restoration plans for impaired stream segments in a priority order that will identify more specific measures to achieve the identified load reductions.

Urban and agricultural land use sources are the focus for implementation of load reductions. Urban land use will be addressed primarily by stormwater regulation. Agricultural land uses will be addressed by implementation of conservation management practices tailored to each farm. These and other proposed measures are discussed further below.

Stormwater measures

The stormwater facilities subject to regulation under NPDES in this watershed must be assigned WLAs. The WLAs for these point sources are expressed in terms of the required percent reduction for nonpoint sources and are applied to the land use categories that correspond to the areas regulated under industrial and municipal stormwater programs. The BMPs required through stormwater permits, including the additional measure discussed below, are generally expected to achieve the required load reductions. The success of these measures will be assessed through follow up monitoring. As needed through adaptive management, other additional measures may need to be identified and included in stormwater permits. Follow up monitoring or watershed restoration plans may determine that other additional measures are required, which would then be incorporated into municipal stormwater permits. Additional measures that may be considered include, for example, more frequent street sweeping and inlet cleaning, or retrofit of stormwater management facilities to include nutrient removal. A more detailed discussion of stormwater source control measures follows.

On February 2, 2004 the Department promulgated two sets of stormwater rules: The Phase II New Jersey Pollutant Discharge Elimination System (NJPDES) Stormwater Rules, N.J.A.C.

7:14A also known as the Municipal Stormwater Regulation Program, and the Stormwater Management Rules, N.J.A.C. 7:8

The NJPDES rules for the Municipal Stormwater Regulation Program require municipalities, highway agencies, and regulated "public complexes" to develop stormwater management programs consistent with the NJPDES permit requirements. The stormwater discharged through "municipal separate storm sewer systems" (MS4s) also regulated under the Department's stormwater rules. Under these rules and associated general permits, Tier A municipalities are required to implement various control measures that should substantially reduce phosphorus loadings in the impaired watersheds. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, street sweeping, cleaning catch basins, performing good housekeeping at maintenance yards, and providing related public education and employee training. These basic requirements will provide for a measure of load reduction from existing development.

Where the affected watershed contains a high percentage of agricultural land uses, a significant reduction in nonpoint sources of phosphorus can be achieved through the implementation of agricultural BMPs. Where the affected watershed contains a small percentage of agricultural land uses, and a high percentage of urban land uses, an additional measure to reduce the phosphorus load from landscape maintenance in the form of a fertilizer management ordinance will be required in order to effectively reduce the phosphorus load originating from the urban land uses.

For all municipalities with contributory drainage area into the impaired stream segments it was determined that the fertilizer management ordinance is required based on the guidelines provided above. Therefore, all municipalities with contributory drainage area into the impaired stream segments will be required to adopt an ordinance as an additional measure consistent with a model ordinance provided by the Department. This model ordinance has been posted on www.njstormwater.org. The additional measure is as follows:

Fertilizer Management Ordinance

Minimum Standard – Municipalities identified in Appendix B shall adopt and enforce a fertilizer management ordinance, consistent with a model ordinance provided by the Department, available at http://www.nj.gov/dep/watershedmgt/

Measurable Goal - Municipalities identified in Appendix B shall certify annually that they have met the Fertilizer Management Ordinance minimum standard.

Implementation - Within 6 months from adoption of the TMDL, municipalities identified in Appendix B shall have fully implemented the Fertilizer Management Ordinance minimum standard.

Agricultural and other measures

Generic management strategies for nonpoint source categories, beyond those that will be implemented under the Phase II stormwater management program, and responses are summarized below.

Table 17 Nonpoint source management measures

Source Category	Responses	Potential Responsible Entity	Possible Funding options
Human Sources	Septic system management programs	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Non-Human Sources	Goose management programs, riparian buffer restoration	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Agricultural practices	Develop and implement conservation plans or resource management plans	Property owner	EQIP, CRP, CREP

Human and Non-Human measures

Where septic system service areas are located in close proximity to impaired waterbodies, septic surveys should be undertaken to determine if there are improper effluent disposal practices that need to be corrected. Septic system management programs should be implemented in municipalities with septic system service areas to ensure proper design, installation and maintenance of septic systems. Where resident goose populations are excessive, community based goose management programs should be supported. Through stewardship programs, areas such as commercial/corporate lawns should be converted to alternative landscaping that minimizes goose habitat and areas requiring intensive landscape maintenance. Where existing developed areas have encroached on riparian buffers, riparian buffer restoration projects should be undertaken where feasible.

Agricultural measures

Several programs are available to assist farmers in the development and implementation of conservation management plans and resource management plans. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

The Environmental Quality Incentive Program (EQIP) is designed to provide technical, financial, and educational assistance to farmers/producers for conservation practices that address natural resource concerns, such as water quality. Practices under this program include integrated crop management, grazing land management, well sealing, erosion control systems, agri-chemical handling facilities, vegetative filter strips/riparian buffers, animal waste management facilities and irrigation systems.

The Conservation Reserve Program (CRP) is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water quality and to maintain and improve wildlife habitat. CRP practices include the establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

Conservation Reserve Enhancement Program (CREP) The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, signed a $100 million CREP agreement. This program matches $23 million of State money with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP will be part of the USDA's Conservation Reserve Program (CRP). There will be a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program to make these leases permanent easements. The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland.

Current Implementation Projects

There are no implementation projects in these watersheds at this time.

9.0 Reasonable Assurance

Commitment to carry out the activities described in the implementation plan to reduce phosphorus loads provides reasonable assurance that the SWQS will be attained for phosphorus in the Doctors Creek, Annaricken Brook and Barkers Brook North Branch Watersheds. Reasonable assurance for the implementation of these TMDLs has been considered for point and nonpoint sources for which phosphorus load reductions are necessary. Moreover, stormwater sources for which WLAs have been established will be regulated as NJPDES point sources. Follow-up monitoring will identify if the strategies implemented are completely, or only partially successful. It will then be determined if other management measures can be implemented to fully attain the SWQS or if it will be necessary to consider other approaches, such as other additional measures that would be required under the municipal stormwater regulation program.

With regard to nonpoint sources from future development, the Stormwater Management rules establish statewide minimum standards for stormwater management in new development, and the ability to analyze and establish region-specific performance standards targeted to the impairments and other stormwater runoff related issues within a particular drainage basin through regional stormwater management plans. The Stormwater Management Rules are currently implemented through the Residential Site Improvement Standards (RSIS) and the Department's Land Use Regulation Program (LURP) in the review of permits such as freshwater wetlands, stream encroachment, CAFRA, and Waterfront Development.

The Stormwater Management Rules focus on the prevention and minimization of stormwater runoff and pollutants in the management of stormwater. The rules require every project to evaluate methods to prevent pollutants from becoming available to stormwater runoff and to design the project to minimize runoff impacts from new development through better site design, also known as low impact development. Some of the issues that are required to be assessed for the site are the maintenance of existing vegetation, minimizing and disconnecting impervious surfaces, and pollution prevention techniques. In addition, performance standards are established for recharge of stormwater to address existing groundwater that contributes to baseflow and aquifers, to prevent increases to flooding and erosion, and to provide water quality treatment through stormwater management measures for TSS and nutrients.

As part of the requirements under the municipal stormwater permitting program, municipalities are required to adopt and implement municipal stormwater management plans and stormwater control ordinances consistent with the requirements of the stormwater management rules. As such, in addition to changes in the design of projects regulated through the RSIS and LURP, municipalities will also be updating their regulatory requirements to provide the additional protections in the Stormwater Management Rules.

Furthermore, the New Jersey Stormwater Management Rules establish a 300-foot special water resource protection area (SWRPA) around Category One (C1) waterbodies and their intermittent and perennial tributaries, within the HUC 14 subwatershed. In the SWRPA, new

development is typically limited to existing disturbed areas to maintain the integrity of the C1 waterbody. C1 waters receive the highest form of water quality protection in the state, which prohibits any measurable deterioration in the existing water quality. Figures 18 and 19 show the category one (C1) waterways in the Annaricken Brook and Doctors Creek Watersheds. Definitions for surface water classifications, detailed segment description, and designated uses may be found in various amendments to the Surface Water Quality Standards at www.state.nj.us/dep/wmm/sgwqt/sgwqt.html.

Figure 20 Category One Waterways in the Annaricken Brook Watershed

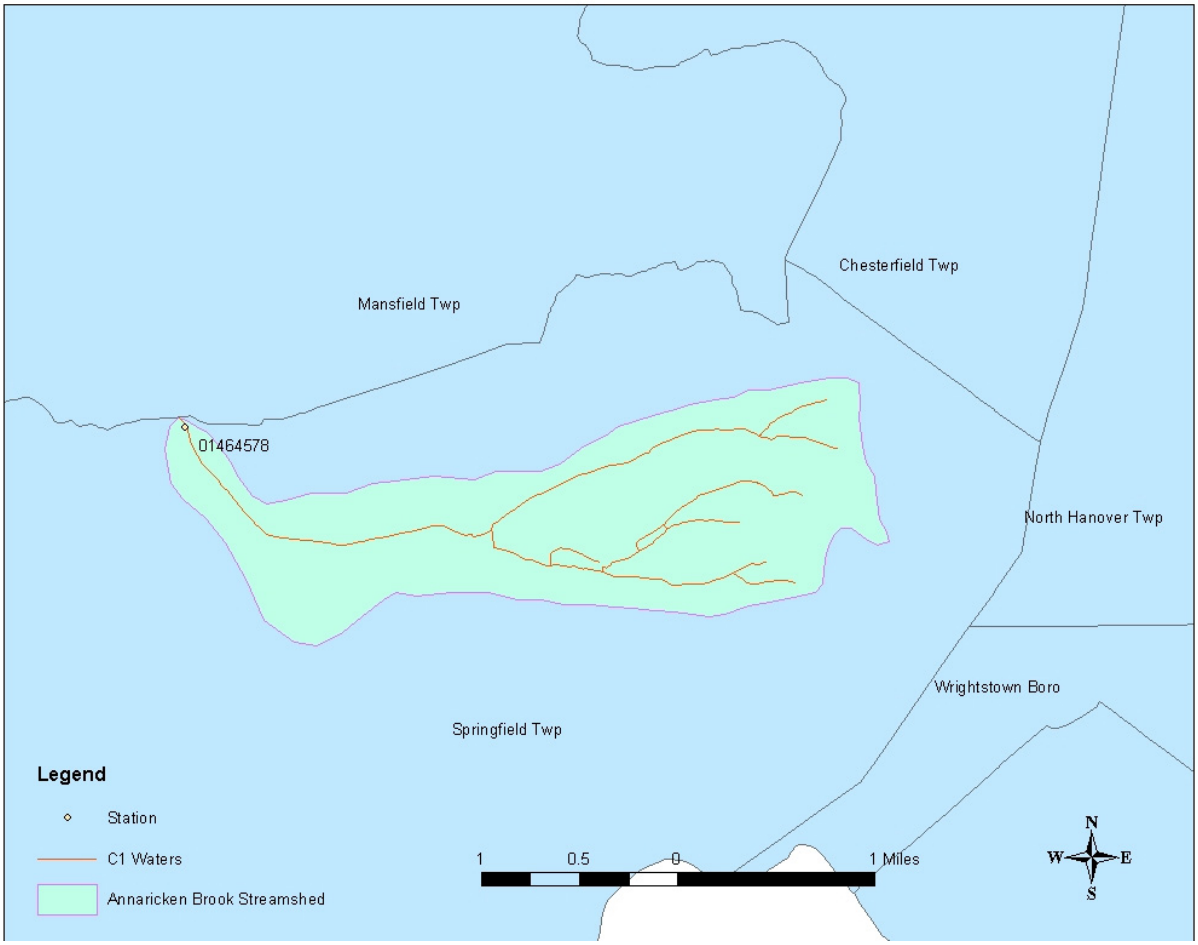
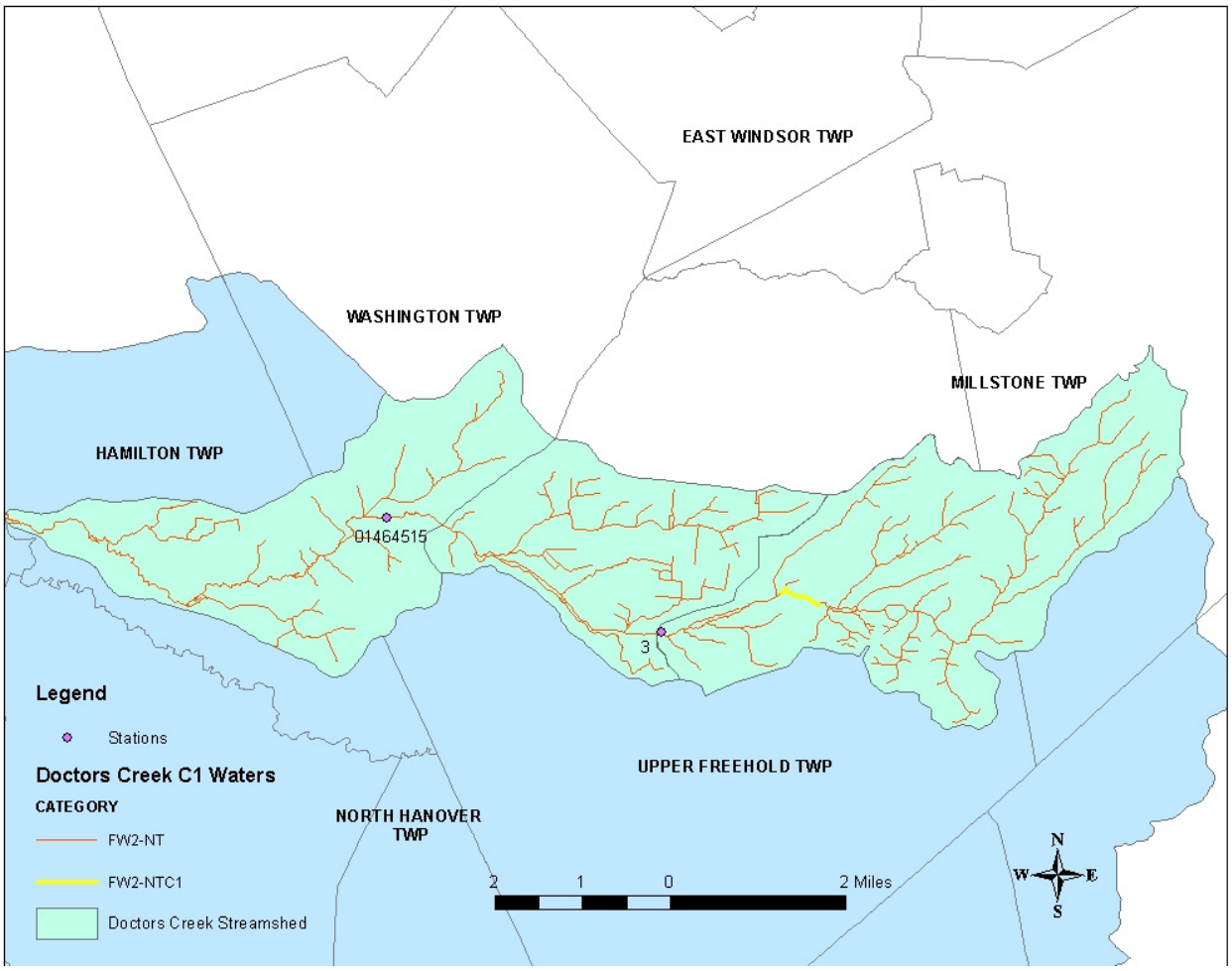


Figure 21 Category One Waterways in the Doctors Creek Watershed



10.0 Public Participation

The Water Quality Management Planning Rules at NJAC 7:15-7.2 require the Department to initiate a public process prior to the development of each TMDL and to allow public input to the Department on policy issues affecting the development of the TMDL. Further, the Department shall adopt each TMDL as an amendment to the appropriate area-wide water quality management plan in accordance with procedures at N.J.A.C. 7:15-3.4(g). Electronic maps showing the spatial extent of the impaired segments were posted online at http://www.state.nj.us/dep/watershedmgt/tmdl_segments.htm in January 2006 and public comment was solicited.

Notice proposing these TMDLs was published on February 5, 2007 in the New Jersey Register and in a newspaper of general circulation in the affected area in order to provide the

public an opportunity to review the TMDLs and submit comments. In addition, a public hearing was held on March 9, 2007 for the proposed TMDLs from 1 to 4pm in the 1st Floor Public Hearing Room, 401 East State Street, Trenton, New Jersey. Notice of the proposal and the hearing was provided to affected municipalities, DPAs and dischargers. Following the close of the public comment period, the Department considered all timely comments, as described below, prior to making a decision to establish these TMDLs.

Commenters are identified below. The comments made and the Department's response follow. The number in parentheses following each comment refer to the number of the commenter that submitted the comment.

1. Barry Seymour, Executive Director,
Delaware Valley Regional Planning Commission
190 N. Independence Mall West
8th Floor
Philadelphia, PA 19106-1520

2. J. Paul Keller, Township Manager
Springfield Township
2159 Jacksonville-Jobstown Road
P.O. Box 119
Jobstown, New Jersey 08041-0119

3. Honorable Stephen J. Fleischacker, Mayor
Upper Freehold Township
314 Route 539
P.O. Box 89
Cream Ridge, New Jersey 08514-0089

Department initiated changes to the document include the following:

1. The Doctors Creek watershed was given two separate load reductions based on the data for each station; no reduction from the upstream watershed is applied downstream. Previously, the overall watershed reduction required was 79.8 percent. The upstream sub-watershed (Upper Freehold) now requires a reduction of 78.7 percent while the downstream portion (Allentown) requires a reduction of 77.5 percent. The two TMDLs in the Doctors Creek watershed establish the TP reductions necessary to assure that all waters within the Doctors Creek watershed meet the applicable phosphorus water quality standards.

2. In 2003 EPA approved the Imlaystown Lake Phosphorus TMDL. This TMDL did not require a reduction in existing loading to achieve load capacity for the lake. The reduction required by the Doctors Creek at Route 539 in Upper Freehold TMDL supercedes that which was established for Imlaystown Lake.

Comment 1: The TMDLs proposed as amendments to the Tri-County Water Quality Management Plan were approved by the DVRPC board on May 24, 2007. (1)

Response: The Department acknowledges the approval and appreciates the support.

Comment 2: The proposed phosphorus fertilizer ordinance should be revised to provide an exemption for agricultural uses and activities in order to avoid detrimental effects that might otherwise occur. (2)

Comment 3: The proposed TMDL is opposed in that it includes a requirement to adopt a low phosphorus fertilizer ordinance. Such an ordinance would place an undue hardship on the agricultural community and could drive farmland to development. The ordinance requirement should be revised to include an exemption for agricultural operations. (3)

Response to Comments 2 and 3: The Department agrees that the fertilizer ordinance should not be applied to agricultural operations. The most appropriate means to minimize the impacts of agricultural operations on phosphorus loads is the development and implementation of Conservation Management plans or Resource Management Plans developed by and with the Natural Resources Conservation Service. While the exemption of agricultural operations is included in the full text of the model ordinance, this provision was not clear in the excerpt provided in the proposed TMDL text. The TMDL has been revised to refer to the full text of the ordinance available on the Department's website.

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Appendices

Appendix A: Database of Phosphorus Export Coefficients

In December 2001, the Department concluded a contract with the USEPA, Region 2, and a contracting entity, TetraTech, Inc., the purpose of which was to identify export coefficients applicable to New Jersey. As part of that contract, a database of literature values was assembled that includes approximately four-thousand values accompanied by site-specific characteristics such as location, soil type, mean annual rainfall, and site percent-impervious. In conjunction with the database, the contractor reported on recommendations for selecting values for use in New Jersey. Analysis of mean annual rainfall data revealed noticeable trends, and, of the categories analyzed, was shown to have the most influence on the reported export coefficients. Incorporating this and other contractor recommendations, the Department took steps to identify appropriate export values for these TMDLs by first filtering the database to include only those studies whose reported mean annual rainfall was between 40 and 51 inches per year. From the remaining studies, total phosphorus values were selected based on best professional judgment for eight land uses categories.

The sources incorporated in the database include a variety of governmental and non-governmental documents. All values used to develop the database and the total phosphorus values in this document are included in the below reference list.

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Appendix B : MS4 designations

Table 1 : Municipal Stormwater Permits and Identification of Tier A or B Classification for the impaired streamsheds

NJPDES Permit Number	Municipality	Discharge Type	Stream Segment	Additional Measures
NJG0148393	Springfield Twp	Tier B Municipal Stormwater General Permit	Annaricken Brook/Barkers Brook North Branch	Fertilizer Management Ordinance
NJG0152196	Wrightstown Boro	Tier B Municipal Stormwater General Permit	Barkers Brook North Branch	Fertilizer Management Ordinance
NJG0150258	Hamilton Twp	Tier A Municipal Stormwater General Permit	Doctors Creek	Fertilizer Management Ordinance
NJG0149004	Washington Twp	Tier A Municipal Stormwater General Permit	Doctors Creek	Fertilizer Management Ordinance
NJG0149799	Allentown Boro	Tier A Municipal Stormwater General Permit	Doctors Creek	Fertilizer Management Ordinance
NJG0153532	Millstone Twp	Tier A Municipal Stormwater General Permit	Doctors Creek	Fertilizer Management Ordinance
NJG0151963	Upper Freehold Twp	Tier B Municipal Stormwater General Permit	Doctors Creek	Fertilizer Management Ordinance

Appendix C : Total Phosphorus Sampling Data

Water Quality Sample Locations	Site ID	Date	Result (mg/L)	Flow (cfs)
Annaricken Brook near Jobstown	01464578	12/23/97	1.35	
		03/18/98	0.13	
		05/28/98	0.16	
		09/09/98	0.12	
		12/04/02	0.1	
		12/04/02	0.095	1.13
		02/20/03	0.146	2.57
		05/22/03	0.137	1.49
		08/19/03	0.174	0.988

		11/24/03	0.187	3.26
		02/23/04	0.139	
		05/11/04	0.073	
		08/12/04	0.186	
Barkers Brook N Br near Jobstown	01464583	12/23/1997	0.43	1.2
		3/4/1998	0.12	2.9
		5/26/1998	0.2	1.2
		8/18/1998	0.14	0.46
		11/18/1998	0.2	0.43
		2/8/1999	0.14	3.7
		5/5/1999	0.06	0.71
		8/23/1999	0.09	1.3
		11/15/1999	0.064	0.6
		2/16/2000	0.055	2.5
		5/16/2000	0.027	0.36
		8/3/2000	0.24	3.5
Doctors Creek near Allentown	01464515	1/25/1990	0.09	40
		4/2/1990	0.06	24
		6/28/1990	0.13	9
		7/17/1990	0.08	8
		8/15/1990	0.15	38
		10/22/1990	0.11	19
		1/17/1991	0.23	86
		3/25/1991	0.12	30
		5/30/1991	0.2	7.5
		8/6/1991	0.27	4.5
		10/3/1991	0.2	6.4
		1/27/1992	0.04	42

		4/2/1992	0.04	25
		6/18/1992	0.07	4.6
		8/12/1992	0.61	57
		10/28/1992	0.07	7
		1/26/1993	0.07	24
		4/1/1993	0.31	330
		6/3/1993	0.17	11
		7/29/1993	0.08	3.1
		10/20/1993	0.34	23
		2/15/1994	0.07	26
		3/30/1994	0.09	150
		6/22/1994	0.24	4
		8/24/1994	0.27	68
		11/3/1994	0.11	30
		1/19/1995	0.07	33
		4/4/1995	0.06	14
		5/17/1995	0.04	19
		7/25/1995	0.06	5
		11/21/1995	0.07	44
		2/15/1996	0.06	49
		4/16/1996	0.11	155
		6/13/1996	0.09	23
		8/8/1996	0.06	23
		11/7/1996	0.07	30
		1/16/1997	0.06	41
		4/9/1997	0.04	29
		6/9/1997	0.21	25
		6/12/1997	0.12	12
		7/31/1997	0.12	13

		12/16/1997	0.15	8.4
		2/4/1998	0.14	26
		6/1/1998	0.08	39
		8/17/1998	0.05	3.9
		11/16/1998	0.17	8
		2/3/1999	0.1	47
		5/18/1999	0.12	6
		8/5/1999	0.09	17
		11/8/1999	0.059	13
		2/9/2000	0.039	16
		5/1/2000	0.052	14
		8/9/2000	0.07	14
		11/21/2000	0.046	11
		2/15/2001	0.045	27
		5/14/2001	0.084	7.3
		8/13/2001	0.069	15
		11/15/2001	0.049	4.4
		2/19/2002	0.06	7.5
		6/3/2002	0.057	6
		8/7/2002	0.127	1.7
		11/13/2002	0.11	48
		2/10/2003	0.055	15
		6/11/2003	0.081	26
		8/18/2003	0.09	22
		11/6/2003	0.008	28
		2/2/2004	0.004	14
		5/10/2004	0.06	23
		8/5/2004	0.057	13

Doctors Creek at Route 539 in Upper Freehold	3	3/2/1999	0.1	
		10/15/1999	0.307	
		3/7/2000	0.72*	
		10/3/2000	0.07	
		3/14/2001	0.38	
		10/30/2001	0.09	
		3/5/2002	0.09	
		10/1/2002	0.1	
		3/18/2003	0.1	
		9/9/2003	0.08	
		6/10/2004	0.1	
		12/16/2004	0.1	
		3/16/2005	0.064	
		9/14/2005	0.13	
		2/23/2006	0.07	

* This data point was not used in calculations because it is an outlier as determined by the 95 and 99% confidence intervals (see Appendix E)

Appendix D : Methodology for Applying Percentage reductions to Land Use Loadings

The outputs of the FIRE method establish a percent reduction needed to meet the target load (that which will attain the applicable SWQS) and a margin of safety. These values are then applied to the existing land use loadings within the impaired streamshed to determine the load allocations for various land uses.

Existing loads are determined as follows. GIS is used to determine the area in acres of each of the land uses in the impaired watershed. The loading coefficients identified in the TMDL report are applied to the acres of land use to calculate an existing load for each land use in the impaired streamshed. Existing loads for point sources, other than stormwater point sources (essentially, wastewater treatment plants), if any, in the impaired streamshed are calculated using the average flow and concentration data from the discharge monitoring reports for the facilities. This load is added to the existing TP load calculated from land use.

To calculate the overall target load the percent reduction (the difference between the target load and the exceedance regression) as determined through FIRE is applied to the total existing load. The load associated with the margin of safety as determined through FIRE (the difference between the 95% confidence interval and the exceedance regression) is then

removed from the overall target load (target loading line), leaving a reduced amount of loading now available to allocate. The load from any point source discharge, is calculated utilizing the full permitted flow and assigning an effluent concentration (represented below as Discharger X). This load is also removed from the potential allocable load leaving a further reduced amount of allocable load for land uses.

There are a number of land uses from which a reduction in current load has not been taken because there are few measures reasonably available to reduce loads from these land uses. These land uses include Forest, Water, Wetlands, and Barren land. The current loads for these land uses as calculated for existing load are carried over entirely as a component of the future load allocations. Therefore, for these land uses, the existing load and future load are equal. The sum of the unreduced land use loads is then removed from the reduced allocable land use load leaving the final allocable land use load to be allocated among the land uses that are amenable to load reduction (urban and agricultural). This final allocable land use load is then applied to each land use category in proportion to the amount of each land use in the watershed.

The final percent reduction is calculated by comparing the final WLA or LA for each land use to the existing loads of those land uses. Because of the adjustments made in removing the loads associated with the MOS, the unreduced land uses, and discharges, the percent reduction associated with the final allocable land use load is higher than that which appears as an output to FIRE.

Example:

Land- Use	Existing Load	Percent Reduction	Allocation
Agriculture	100	88.85%	11.15
Barren	15	0%	15.00
Commercial	300	88.85%	33.45
Forest	125	0%	125.00
Low Density	40	88.85%	4.46
High Density	250	88.85%	27.88
Other Urban	15	88.85%	1.67
Water	100	0%	100.00
Wetlands	30	0%	30.00
Discharger X	25	0%	25.00
MOS			95.87
TOTAL	**1000**		**469.5**

Output from FIRE

Margin of Safety		**= 20.42%**
Target Loading		**= 46.95%**

Target Load

Target Load = 0.4695 * Existing Load
= 0.4695 * 1000
Target Load = 469.5 lb/yr

Margin of Safety

MOS = 0.2042* Target Load
= 0.2042* 469.5 lb/yr
= 95.87 lb/yr

Allocable Load

AL = Target Load – MOS
= 469.5 –95.87
= 373.63 lb/yr

Allocable Land Use Load

ALUL = AL- Discharger X Load
= 373.6 – 25
= 348.63 lb/yr

SUM of Unreduced Land Use Loads

Unreduced Land use Load = Existing Forest + Water & Wetlands Load + Barren Land Load
= 125 + 100 + 30 + 15
= 270 kg/yr

Final Allocable Land use Load

Final Allocable Land use Load = Allocable Land use Load – Unreduced Land use Load
= 348.6 – 270
= 78.6 lb/yr

Final Percent Reduction

Final Percent Reduction = 1 – (Final allocable Land use load / Sum of existing load of reduced land uses)
= 1 – (78.6/ 15+250+40+300+100)
= 1 – (78.6/705)
= 0.8885
= 88.85 %

Appendix E : Outlier Calculation for Doctors Creek at Route 539 in Upper Freehold

The inverse of the Student's t-distribution for the degrees of freedom of the examined data set was calculated at the specified confidence level (95% and 99%) (TINV function in MicroSoft Excel). This t-value is multiplied by the standard deviation of the examined data set and added to the mean value. The resultant value is set as the upper limit. Any value higher than the upper limit is excluded as an outlier of the data set at the specified level of confidence. Rainfall data were also examined around the dates prior to the TP value in question. No unusual high flow events were found.

Doctors Creek at Route 539 in Upper Freehold

Site ID	Date	TP	Reduction
3	3/2/1999	0.1	
3	10/15/1999	0.307	
3	3/7/2000	0.72	
3	10/3/2000	0.07	
3	3/14/2001	0.38	73.7%
3	10/30/2001	0.09	
3	3/5/2002	0.09	
3	10/1/2002	0.1	
3	3/18/2003	0.1	
3	9/9/2003	0.08	
3	6/10/2004	0.1	
3	12/16/2004	0.1	
3	3/16/2005	0.064	
3	9/14/2005	0.13	
3	2/23/2006	0.07	

Average =	0.166733
Standard Dev =	0.177974
t value 95% =	2.144789
t value 99% =	2.976849
Upper 95% CL =	0.548449
Upper 99% CL =	0.696534

Statistical measurements of Upper 95% and Upper 99% confidence limits shows the TP value of 0.72 mg/l to be an outlier, since the measured TP value is outside the confidence limits.