QUALITY ASSURANCE/WORK PLAN

WATER QUALITY AND BIOLOGICAL SURVEY OF THE MIDDLE SUSQUEHANNA SUBBASIN

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I. PROJECT NAME: Water Quality and Biological Survey of the Middle Susquehanna River Subbasin

II. PROJECT OFFICER: Dana Diehl
Biologist

III. QUALITY ASSURANCE OFFICER: David W. Heicher, Chief
Division of Water Quality
and Monitoring Programs

IV. DATE OF PROJECT INITIATION: July 2001

V. PROJECT DESCRIPTION:

A. Objective and Scope

The Susquehanna Riverm Basin Commission has been conducting water quality and biological surveys on selected streams within each major subbasin on a 10- to 12-year cycle, as part of the Commission's continuing program for assessment of water quality in the Susquehanna River Basin.

Commission staff proposes to conduct a survey of the Middle Susquehanna Subbasin. The data collected during this survey will provide a qualitative assessment of conditions in the basin. Figure 1 shows the general location of the study area. The sampling sites on the Middle Susquehannna River will be located upstream and downstream of major tributaries and major point sources. Sampling sites on tributaries will be located near the mouth and at some point upstream, depending on the character of the watershed. The sites sampled during surveys conducted in 1982 and 1993 will be resampled for comparison.

B. Data Usage

The study will provide information to: (1) assess the chemical and biological condition of the streams within the subbasin; (2) document changes in stream quality over time; and (3) identify major sources of pollution and lengths of stream impacted. Data collected during the survey also will be used in completing the Section 305(b) Water Quality Assessment Report, and in reviewing projects affecting water quality in the basin.

C. Monitoring Network Design and Rationale

The Commission has established long-term water quality monitoring stations on the Susquehanna River at Towanda and Danville, Pa., located at the northern and sounthern ends of the subbasin. Biological data are not collected routinely at these sites. Data collection from this reach of the river and its tributaries has been limited. Comprehensive studies were conducted by LaBuy (1967), Malione and others (1984) and Susquehanna River Basin Commission (1997). No other studies have been conducted since 1993. The sampling sites listed in Table 1 were selected so that data collected during this survey can be compared with data collected by the Commission in 1993. Additional sites have been added on tributary streams to provide better coverage of the subbasin. The Susquehanna River sites were located so that the effects of major tributaries could be evaluated, as well as to document water quality variation along this reach of the river due to acid mine drainage and the urban setting of the

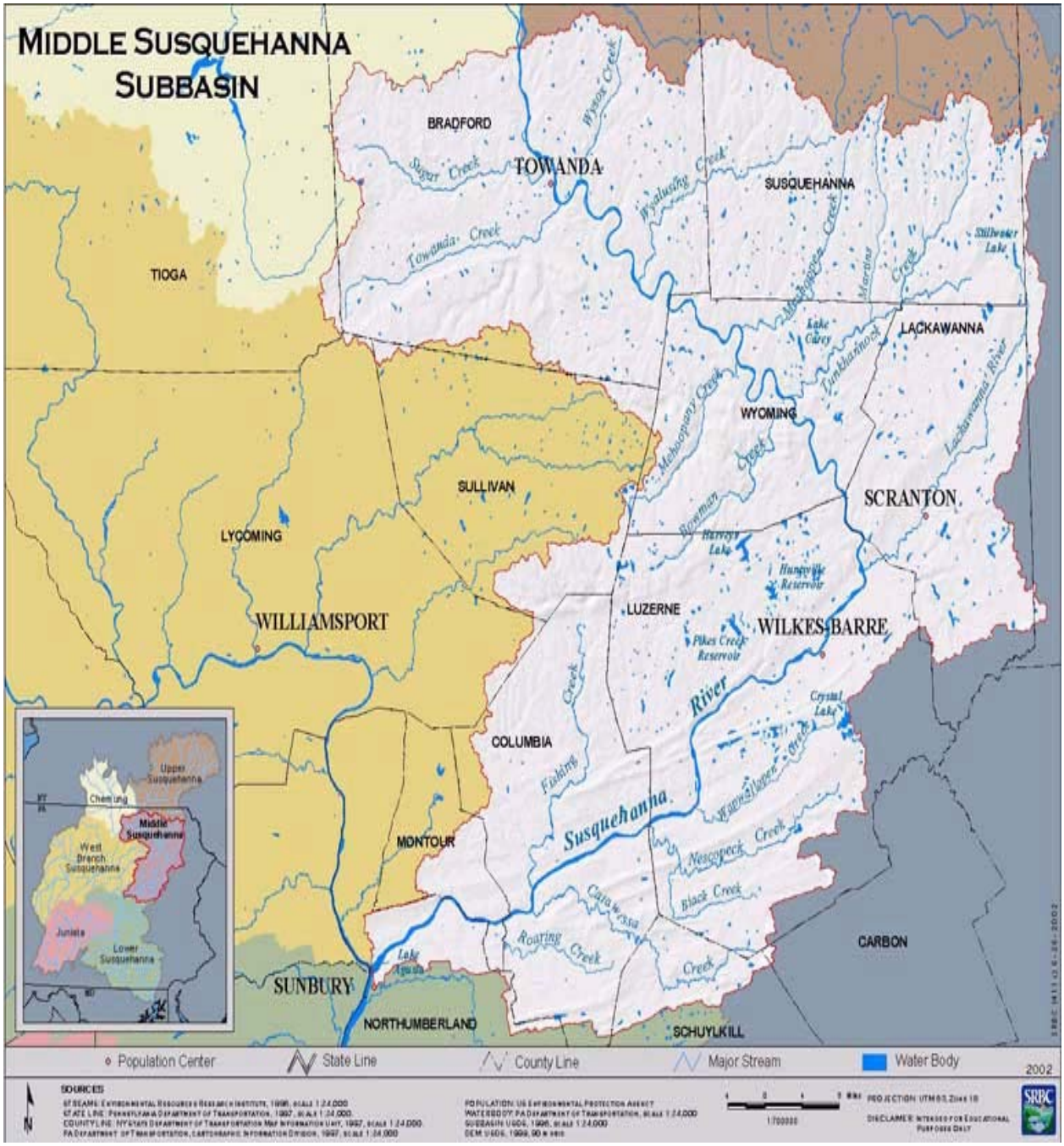


Figure 1. Map Showing General Location of Study Area

Table 1. Sample Locations for the Middle Susquehanna Subbasin

Stream	Station ID	County/State	Lat./Long.	Location
Abrahams Creek	ABRA0.1	Luzerne/Pa.	411933/755106	Upstream SR 1021 bridge near West Wyoming
Black Creek	BLK0.1	Luzerne/Pa.	410026/761003	Black Creek Twp. above SR 3016 bridge
Black Creek	BLK9.3	Luzerne/Pa.	405828/760043	Hazle Twp, SR 0093 bridge
Bowman Creek	BOW0.1	Wyoming/Pa.	413108/755717	0.1 mile above mouth
Bowman Creek	BOW12.5	Wyoming/Pa.	412514/760254	Noxen Village, off SR 0029
Briar Creek	BRR0.4	Columbia/Pa.	410243/761707	Briar Creek Borough, SR 0011 bridge
Catawissa Creek	CAT0.2	Columbia/Pa.	405657/762753	Catawissa Borough SR 3014
Catawissa Creek	CAT13.0	Columbia/Pa.	405706/761836	Beaver Twp., ST 0339 bridge
Catawissa Creek	CAT25.0	Schuylkill/Pa.	410039/760425	Upstream T-818 bridge near Sheppton
East Br. Briar Creek	EBRR4.7	Columbia/Pa.	410429/761746	Briar Creek Twp, SR 1017 bridge
East Br. Lackawanna R.	ELWR0.1	Susquehanna/Pa.	414308/752848	Upstream T-609 bridge near Forest City
East Br. Tunkhannock Creek	ETNK10.0	Susquehanna/Pa.	414057/753314	Upstream SR 2027 bridge at Elkdale
East Br. Tunkhannock Creek	ETNK0.1	Susquehanna/Pa.	413849/754211	Upstream Route 407 bridge
East Branch Fishing Creek	EFSH0.5	Columbia/Pa.	411723/762157	Upstream covered bridge near Jamison City
East Fork Harveys Creek	EHRV0.1	Luzerne/Pa.	411506/755956	Upstream Route 29 bridge
Fishing Creek	FSH1.5	Columbia/Pa.	410008/762749	Upstream SR 4003 bridge
Fishing Creek	FSH15.6	Columbia/Pa.	410909/762209	Fishing Creek Twp., upstream SR 0487 bridge
Green Creek	GREN0.5	Columbia/Pa.	410528/762449	Upstream SR 4020 bridge
Harveys Creek	HRV6.8	Luzerne/Pa.	411823/760328	Lehman Twp., below Spring Brook Reservoir
Harveys Creek	HRV0.1	Luzerne/Pa.	411315/760056	At mouth
Hunlock Creek	HNL0.2	Luzerne/Pa.	411220/760358	Above SR 0011 bridge
Hunlock Creek	HNL4.5	Luzerne/Pa.	411450/760550	Hunlock Twp., off SR 4003
Huntington Creek	HNT0.2	Columbia/Pa.	410625/762127	Fishing Creek Twp., upstream SR 1020 bridge
Huntington Creek	HNT5.0	Luzerne/Pa.	411127/761404	Upstream Route 239 bridge at Huntington Mills
Lackawanna River	LWR0.3	Luzerne/Pa.	412045/754655	Near Pittston City 0.3 miles above mouth
Lackawanna River	LWR15.0	Lackawanna/Pa.	412629/753833	Above Leggetts Creek
Lackawanna River	LWR36.0	Lackawanna/Pa.	413854/752741	Near Forest City Borough
Lackawanna River	LWR4.0	Luzerne/Pa.	412133/754503	4.0 miles upstream of mouth
Leggetts Creek	LGT0.1	Lackawanna/Pa.	412641/753841	At mouth
Little Fishing Creek	LFSH0.1	Columbia/Pa.	410109/762838	Hemlock Twp., 0.1 mile above mouth
Little Fishing Creek	LFSH10.0	Columbia/Pa.	411146/762823	Upstream Arden Hill road bridge
Little Nescopeck Creek	LNSK0.1	Luzerne/Pa.	410035/760428	At mouth
Little Shickshinny Creek	LSHK0.1	Luzerne/Pa.	410914/760925	At Shickshinny
Little Wapwallopen Creek	LWWP0.1	Luzerne/Pa.	410542/760723	Conyngham Twp., 100 feet above mouth
Little Wapwallopen Creek	LWWP6.7	Luzerne/Pa.	410651/760233	Dorance Twp., upstream T-387 bridge
Mahoning Creek	MAH0.8	Montour/Pa.	405754/763705	Danville Borough, adjacent to park
Mahoning Creek	MAH5.0	Montour/Pa.	410038/773741	Upstream Route 642 bridge

Table 1. Sample Locations for the Middle Susquehanna Subbasin—Continued

Stream	Station ID	County/State	Lat./Long.	Location
Mehoopany Creek	MHO0.1	Wyoming/Pa.	413334/760405	Mehoopany Twp., 0.1 miles above mouth
Mehoopany Creek	MHO6.5	Wyoming/Pa.	413159/760725	Forkston Twp., off SR 0087 near township line
Mehoopany Creek	MHO15.0	Wyoming/Pa.	412759/760936	Adjacent to SR 3001 upstream of Kasson Brook
Meshoppen creek	MSH0.1	Wyoming/Pa.	413650/760248	0.1 miles above mouth
Meshoppen Creek	MSH5.3	Wyoming/Pa.	413739/755640	Lemon Twp., off SR 0029, upstream of White Cr.
Meshoppen Creek	MSH12.0	Susquehanna/Pa.	414459/755103	Upstream SR 2024 bridge near Brooklyn
Mill Creek	MILL0.1	Luzerne/Pa.	411537/755204	Upstream SR 2004 bridge
Nanticoke Creek	NTK0.4	Luzerne/Pa.	411232/755908	At mouth
Nescopeck Creek	NSK0.7	Luzerne/Pa.	410236/761322	Nescopeck Borough, upstream SR 0339 bridge
Nescopeck Creek	NSK13.2	Luzerne/Pa.	410029/760607	Sugarloaf Twp., upstream T-338 bridge
Nescopeck Creek	NSK13.9	Luzerne/Pa.	410039/760425	Sugarloaf Twp., upstream T-340 bridge
Nescopeck Creek	NSK25.0	Luzerne/Pa.	410215/755711	Upstream Route 309 bridge near Edgewood
Newport Creek	NPT0.1	Luzerne/Pa.	411247/760029	At mouth
North Br. Mehoopany Creek	NMHO1.0	Wyoming/Pa.	413205/760853	Upstream SR 4027 bridge near Forkston
Roaring Brook	RRB0.1	Lackawanna/Pa.	412403/754020	0.1 mile above mouth
Roaring Brook	RRB10.0	Lackawanna/Pa.	412235/753242	Upstream Route 435 bridge at Elmhurst
Roaring Creek	RRC1.1	Montour/Pa.	405608/763136	Mayberry Twp., off T-313
Roaring Creek	RRC10.7	Columbia/Pa.	405453/762551	Locust Twp., upstream SR 0042 bridge
Roaring Creek	RRC20.0	Columbia/Pa.	405258/762109	Upstream SR 2003 bridge at Mill Grove
Schrader Creek	SCH0.2	Bradford/Pa.	414217/763020	Upstream Masontown Road bridge at Powell
Schrader Creek	SCH12.0	Bradford/Pa.	413732/763924	At Laguin
Shickshinny Creek	SHK0.1	Luzeren/Pa.	410906/760854	Shickshinny Borough, 50 feet upstream of mouth
Shickshinny Creek	SHK4.5	Luzerne/Pa.	411203/761113	Union Twp., upstream SR 4007 bridge
Solomon Creek	SOL0.9	Luzerne/Pa.	411336/755611	Hanover Twp., first road bridge over stream
South Br. Roaring Creek	SBRC0.5	Columbia/Pa.	405402/763044	Franklin Twp., upstream T-369 bridge
South Br. Towanda Creek	STWN0.1	Bradford/Pa.	414200/762751	Upstream Brocktown Road bridge
South Br. Towanda Creek	STWN10.0	Bradford/Pa.	413429/762506	Upstream SR 2008bridge at Laddsburg
South Br. Tunkhannock Creek	STNK1.0	Wyoming/Pa.	413334/755129	Upstream Route 6 bridge at Bardwell
South Br. Tunkhannock Creek	STNK10.0	Lackawanna/Pa.	413423/754000	Upstream Lackawanna Dam, upstream T-445 bridge near East Berlin
Spring Brook	SPR0.1	Lackawanna/Pa.	412024/754220	Upstream Route 502 bridge near Duryea
Sugar Creek	SRC0.8	Bradford/Pa.	414728/762746	North Towanda Twp., upstream SR 3022 bridge
Sugar Creek	SRC16.4	Bradford/Pa.	414537/764032	West Burlington Village, upstream SR 3019 bridge
Sugar Creek	SGR25.0	Bradford/Pa.	414725/764628	Upstream bridge below confluence at Troy
Sugar Run	SGRR0.3	Bradford/Pa.	413830/761355	Sugar Run Village, upstream SR 2002 bridge
Susquehanna River	SUSQ125.0	Northumberland/ Pa.	405406/764559	Sunbury City, at Conrail bridge
Susquehanna River	SUSQ134.5	Northumberland/ Pa.	405724/763933	Riverside Borough, below Merck discharge
Susquehanna River	SUSQ136.0	Montour/Pa.	405725/763715	Danville Borough, upstream SR 0054 bridge

Table 1. Sample Locations for the Middle Susquehanna Subbasin—Continued

Stream	Station ID	County/State	Lat./Long.	Location
Susquehanna River	SUSQ146.2	Columbia/Pa.	405816/762804	Bloomsburg, at RR bridge below Fishing Creek
Susquehanna River	SUSQ148.5	Columbia/Pa.	405929/762631	Bloomsburg, upstream SR 0487 bridge
Susquehanna River	SUSQ156.0	Columbia/Pa.	410220/761719	Mifflinville, upstream SR 2028 bridge
Susquehanna River	SUSQ163.0	Luzerne/Pa.	410351/761042	Beech Haven Village, 3mi above SR 0093 bridge
Susquehanna River	SUSQ171.0	Luzerne/Pa.	410907/760845	Shickshinny Borough, upstream SR 0239 bridge
Susquehanna River	SUSQ181.0	Luzerne/Pa.	411253/760020	Nanticoke Borough, upstream RR bridge
Susquehanna River	SUSQ190.0	Luzerne/Pa.	411515/755247	Wilkes-Barre City, upstream SR 0309 bridge
Susquehanna River	SUSQ198.0	Luzerne/Pa.	412100/754803	Coxton RR bridge above Lackawanna River
Susquehanna River	SUSQ207.0	Wyoming/Pa.	412737/755112	Falls Village, upstream SR 0092 bridge
Susquehanna River	SUSQ219.0	Wyoming/Pa.	413207/755700	Tunkhannock Borough, upstream SR 0029 bridge
Susquehanna River	SUSQ228.0	Wyoming/Pa.	413358/760418	Mehoopany Twp., upstream SR 0087 bridge
Susquehanna River	SUSQ230.0	Wyoming/Pa.	413432/760331	N. Mehoopany Village, upstream SR 0087 bridge
Susquehanna River	SUSQ254.0	Bradford/Pa.	414103/761630	Wyalusing Borough, upstream of Wyalusing Creek
Susquehanna River	SUSQ269.0	Bradford/Pa.	414600/762349	Wysox Twp., upstream of Wysox Creek
Susquehanna River	SUSQ271.0	Bradford/Pa.	414548/762624	Towanda Borough. upstream SR 0006 bridge
Susquehanna River	SUSQ280.0	Bradford/Pa.	415054/762947	Ulster Twp, 1.5 miles upstream of Ulster Village
Toby Creek	TBY0.2	Luzerne/Pa.	411513/755440	Edwardsville Borough, upstream SR 0011 bridge
Toby Creek	TBY6.7	Luzerne/Pa.	411825/755603	Trucksville Village near SR0309
Tomhicken Creek	TOM1.0	Schuylkill/Pa.	405443/761146	Upstream T-796 bridge near Zion Grove
Towanda Creek	TWN0.1	Bradford/Pa.	414422/762605	0.1 mile above mouth
Towanda Creek	TWN16.9	Bradford/Pa.	414049/764038	Woodruff Corners, upstream T- 328 bridge
Towanda Creek	TWN25.0	Bradford/Pa.	413904/765101	Upstream Route 154 bridge at Canton
Tunkhannock Creek	TNK0.3	Wyoming/Pa.	413214/755615	0.3 mi above mouth
Tunkhannock Creek	TNK11.3	Wyoming/Pa.	413616/754926	Starkville Village, off SR 0092
Tunkhannock Creek	TNK20.0	Susquehanna/Pa.	413854/754306	Upstream Route 374 bridge
Unnamed Tributary	UNTA0.1	Luzerne/Pa.	411321/760640	Upstream SR 4016 bridge
Wapwallopen Creek	WWP0.1	Luzerne/Pa.	410417/760804	Nescopeck Twp., upstream new SR 0239 bridge
Wapwallopen Creek	WWP6.4	Luzerne/Pa.	410409/760315	Hollenback Twp. upstream T-392 bridge
Wapwallopen Creek	WWP12.0	Luzerne/Pa.	410953/755151	Upstream Route 437 bridge at Mountain Top
West Br. Briar Creek	WBRR2.4	Columbia/Pa.	410345/761907	North Centre Twp., upstream T- 730 bridge
West Br. Lackawanna R.	WLWR0.1	Susquehanna/Pa.	414258/752920	Upstream SR 2042 bridge near Forest City
West Br. Meshoppen Creek	WMSH0.5	Wyoming/Pa.	413753/760006	Near SR 4027 upstream of mouth
West Branch Fishing Creek	WFSH0.5	Columbia/Pa.	411732/762218	Upstream SR 4049 bridge
Wyalusing Creek	WYL0.4	Bradford/Pa.	413954/761543	0.4 miles above mouth
Wyalusing Creek	WYL16.2	Bradford/Pa.	414714/760651	16.2 miles above mouth
Wysox Creek	WSX0.2	Bradford/Pa.	414640/762309	Wysox Twp., 0.2 miles upstream of mouth
Wysox Creek	WSX6.6	Bradford/Pa.	415121/762028	Near Rome Borough, upstream T-699 bridge

Wyoming Valley (Scranton-Wilkes Barre region). The tributary sites were selected because of differences in geologic setting between and within the tributary watershed and known sources of pollution such as acid mine drainage and point source discharges.

D. Monitoring Parameters

Parameters of interest are listed in Table 2. Discharge will be measured manually at most stations using standard U.S. Geological Survey (USGS) equipment and methods. Discharge at sites adjacent to USGS gaging stations will be obtained from USGS rating tables. Macroinvertebrate data are comprised of a list of different genera collected and an estimate of population density. Samples will be collected once during the summer low-flow period.

Table 2. Monitoring Parameters

Parameter	Number of Samples	Analytical Sample Matrix	Method Reference	Sample Preservation	Holding Time
Flow	NA	NA		NA	NA
Temperature	45	aq.		none	0
Dissolved Oxygen	45	aq.		none	0
Conductivity	45	aq.		none	0
pH	45	aq.		none	0
Alkalinity	45	aq.		none	0
Acidity	45	aq.		none	0
Total Residue	45	aq.	EPA 160.3	cooling to 4° C	24 hours
Tot Suspended Solids	45	aq.	EPA 160.2	cooling to 4° C	24 hours
Tot. Organic Carbon	45	aq.	EPA 415.2	cooling to 4° C H_2SO_4 to pH <2	24 hours
Total NH_3-N	45	aq.	EPA 350.1	cooling to 4° C H_2SO_4 to pH <2	24 hours
Total NO_2-N	45	aq.	EPA 353.2	cooling to 4° C	24 hours
Total NO_3-N	45	aq.	EPA 353.2	cooling to 4° C	24 hours
Total Nitrogen	45	aq.	Std Method 4500-N-D[1]	cooling to 4° C	24 hours
Total Phosphorus	45	aq.	EPA 365.3	cooling to 4° C H_2SO_4 to pH <2	24 hours
Total Orthophosphate	45	aq.	EPA 365.1	cooling to 4° C	24 hours
Total Hardness	45	aq.	EPA 130.1	cooling to 4° C HNO_3	6 months
Total Sodium	45	aq.	EPA 200.7	preserve w/HNO_3 to a pH <2	6 months
Total Potassium	45	aq.	EPA 200.7	preserve w/HNO_3 to a pH <2	6 months
Total Magnesium	45	aq.	EPA 200.7	preserve w/HNO_3 to a pH <2	6 months
Total Calcium	45	aq.	EPA 200.7	preserve w/HNO_3 to a pH <2	6 months
Total Chloride	45	aq.	EPA 325.2	cooling to 4°C	24 hours
Total Sulfate	45	aq.	EPA 375.2	cooling to 4°C	24 hours
Total Iron	45	aq.	EPA 200.7	preserve w/HNO_3 to a pH <2	6 months
Total Manganese	45	aq.	EPA 200.7	preserve w/HNO_3 to a pH <2	6 months
Total Aluminum	45	aq.	200.8[2]	preserve w/HNO_3 to a pH <2	6 months
Total Lead	45	aq.	200.8[2]	preserve w/HNO_3 to a pH <2	6 months
Total Copper	45	aq.	200.8[2]	preserve w/HNO_3 to a pH <2	6 months
Total Zinc	45	aq.	200.8[2]	preserve w/HNO_3 to a pH <2	6 months
Total Nickel	45	aq.	200.8[2]	preserve w/HNO_3 to a pH <2	6 months
Macroinvertebrates	45			preserve in denatured alcohol with glycerin	1 year

1. Standard Methods, 19th edition
2. Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma - Mass Spectrometry. Version 4, September 1989

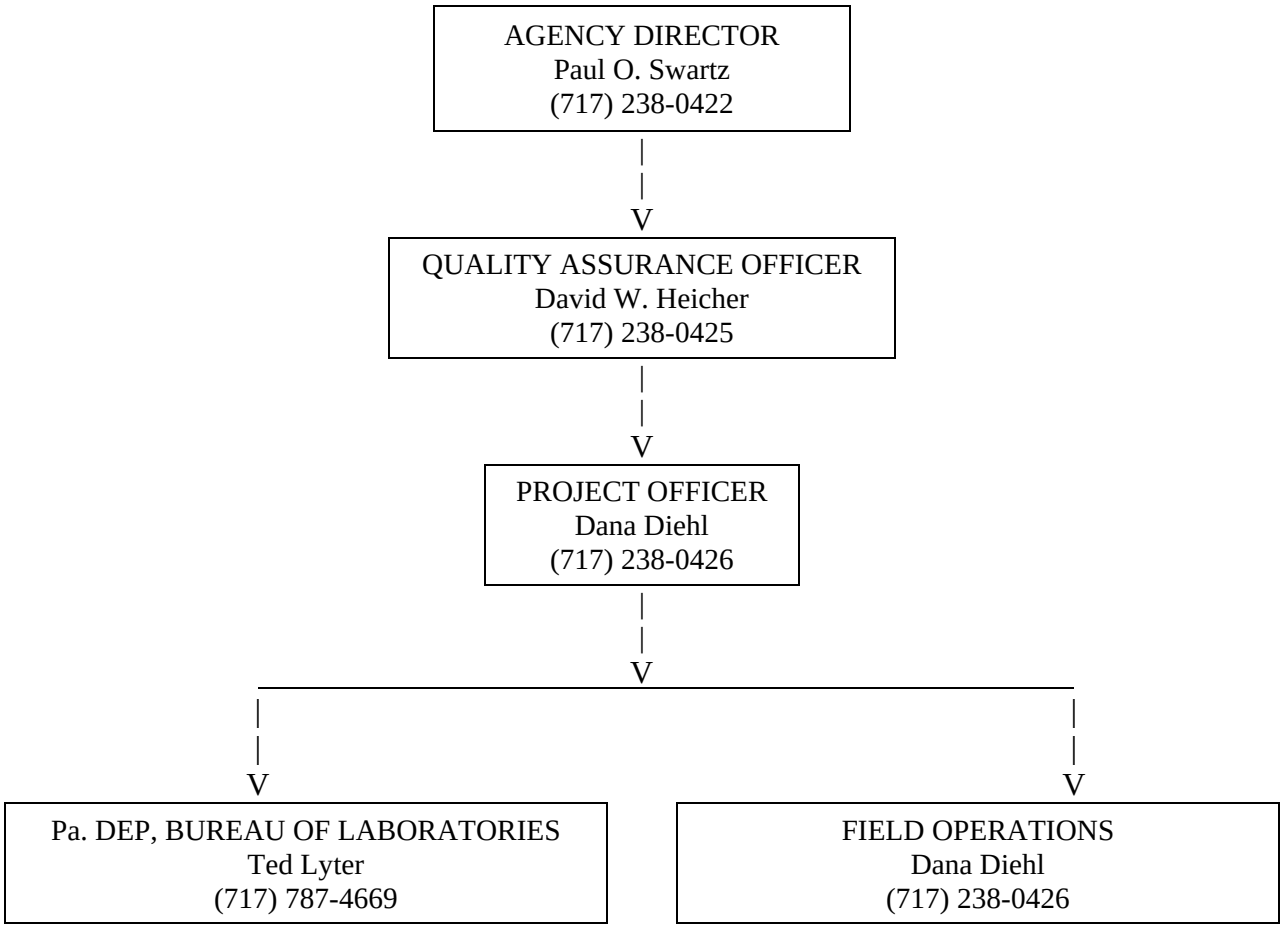
VI. PROJECT FISCAL INFORMATION (See USEPA grant application.)

VII. SCHEDULE

	2001												2002											
Activity	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Water Quality Sampling							X	X																
Macroinvertebrate Sampling							X	X																
Identify Macroinvertebrates									X	X	X													
Compile and Evaluate Data												X	X	X	X									
Report Writing															X	X	X	X						
Final Report																		X						

VIII. PROJECT ORGANIZATION AND RESPONSIBILITY

A. Project Organization



B. Project Responsibility

1. Sampling operations—D. Diehl, SRBC
2. Sampling QC—D. Diehl, SRBC
3. Laboratory analysis—T. Lyter, Pa. DEP
4. Laboratory QC—T. Lyter, Pa. DEP
5. Data processing activities—D. Diehl, SRBC
6. Data processing QC—D. Diehl, SRBC
7. Data quality review—D. Diehl, SRBC
8. Performance auditing—C. Takita, SRBC
9. Systems auditing—D. Diehl, SRBC
10. Overall QA—D. Heicher, SRBC
11. Overall project coordination—D. Heicher, SRBC

IX. DATA QUALITY REQUIREMENTS AND ASSESSMENTS (Table 3)

Parameter	Detection Limit (mg/l)	Accuracy[1]	Precision[2]
Total Organic Carbon	1	**+/-10%**	+/-10%
Total Residue	2.0	**+/-10%**	+/-10%
Tot Suspended Solids	2.0	**+/-10%**	+/-10%
Total NH_3-N	0.02	**+/-10%**	+/-10%
Total NO_2-N	0.004	**+/-10%**	+/-10%
Total NO_3-N	0.04	**+/-10%**	+/-10%
Total Nitrogen	0.04	**+/-10%**	+/-10%
Total Phosphorus	0.01	**+/-10%**	+/-10%
Total Orthophosphate	0.002	**+/-10%**	+/-10%
Total Hardness	3.0	**+/-10%**	+/-10%
Total Sodium	0.2	**+/-10%**	+/-10%
Total Potassium	2.0	**+/-10%**	+/-10%
Total Magnesium	0.01	**+/-10%**	+/-10%
Total Calcium	0.03	**+/-10%**	+/-10%
Total Chloride	0.001	**+/-10%**	+/-10%
Total Sulfate	0.01	**+/-10%**	+/-10%
Total Iron	0.01	**+/-10%**	+/-10%
Total Manganese	0.01	**+/-10%**	+/-10%
Total Aluminum	0.035	**+/-10%**	+/-10%
Total Lead	0.004	**+/-10%**	+/-10%
Total Copper	0.004	**+/-10%**	+/-10%
Total Zinc	0.005	**+/-10%**	+/-10%
Total Nickel	0.004	**+/-10%**	+/-10%

1 Calculate Accuracy using the formulas:

For matrix spikes: $\%R = 100 \times \frac{S - U}{C_{sa}}$

%R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

For standard reference material: $\%R = 100 \times \frac{C_m}{C_{rm}}$

%R = percent recovery
C_m = measured concentration of standard reference material
C_{rm} = actual concentration of standard reference material

2 Calculate precision using the formula: $RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100$

RPD = relative percent difference
C_1 = larger of two observed values
C_2 = smaller of two observed values

A. Data Representativeness

Water samples are collected at eight points along a transect across the stream with depth-integrating samplers. The depth-integrating sampler provides a composite of the whole water column. Vertical samples are then composited in a churn, where the final sample is withdrawn. This provides a composite sample representing average stream quality.

B. Data Comparability

The purpose of this QA plan is to eliminate factors in sampling and analysis that reduce the comparability of data collected at different points in space and time. All sampling, analysis and processing procedures are standardized to ensure comparability.

C. Data Completeness

Collection of 95 percent of the total programmed samples will be deemed as fulfilling the project objectives**.**

Completeness can be calculated using the formula: $\%C = 100 \times \frac{V}{N}$

%C = percent completeness
V = number of measurements judged valid
N = total number of measurements necessary to achieve a specific statistical level of confidence in decision making

X. SAMPLING PROCEDURES

A. Sample Collection

Water samples are collected using depth-integrating samplers. Samples are collected using a hand-line sampler from a boat or bridge, or a hand sampler by wading. The sampler is faced upstream into the current to prevent collection of sediments kicked up by the sampler or field personnel. At each station, eight vertical samples are collected, composited in a churn splitter and churned while the sample bottle is filled.

All equipment will be cleaned and rinsed with 5 percent HCl before and after each sampling. An equipment blank will be collected by processing distilled water through the precleaned sampler and churn splitter, and preserved in the same manner as the sample. Equipment blanks will be collected at a frequency of one per day, or one per twenty samples, whichever is more frequent. The equipment will be rinsed with HCl, distilled water, and river water between each sample collection.

B. Water Samples

One liter of water will be collected at each station for laboratory analysis. Nalgene bottles, provided by the Pennsylvania Department of Environmental Protection (Pa. DEP) Central Laboratory, will be used. The samples consist of one 500-ml bottle for nutrients and one 500-ml bottle for metals analysis. The samples for metals analyses will be acidified to pH 2 or less with nitric acid. Samples for total ammonia, total hardness, total phosphorus, and TOC will be preserved in the field with preservatives listed in Table 2. Duplicate samples will be collected at a frequenay of one per day, or one per twenty samples, whichever is more frequent. The samples will be chilled on ice, and shipped within 24 hours to

the Pa. DEP, Bureau of Laboratories, Harrisburg, Pennsylvania. A temperature blank will be included for measuring the temperature in the shipping container at the laboratory in addition to the laboratory requirement that ice must be visible in the shipping container.

C. Field Chemistry

Temperature and dissolved oxygen are measured using a YSI dissolved oxygen meter. Conductivity is measured using a VWR conductivity meter. A Cole-Parmer meter is used to measure pH. Alkalinity and acidity are measured using field titrations. Alkalinity is measured in the field by titrating a known volume of sample water to pH 4.5 with 0.02N H_2SO_4. (See SOP, Attachment A) Acidity is measured in the field by titrating a known volume of sample water to pH 8.3 with 0.02N NaOH. (See SOP, Attachment B**)** Titrations are measured using syringes. Separate syringes will be used for sulfuric acid and for sodium hydroxide. Magnetic stirring bars and beakers will be thoroughly rinsed with distilled water and with sample water to be tested before titrations are conducted. Personnel conducting field titrations will be required to undergo six months of on-the-job training with an experienced field person.

D. Discharge Measurements

Discharge at sites near USGS gaging stations will be obtained from the USGS database. At other stations, flow measurements are made by field personnel using standard USGS equipment and procedures.

E. Macroinvertebrates

Macroinvertebrate assessments are adapted from Rapid Bioassessment Protocols, described by Plafkin (1989). Field data sheets for assessment of physical characteristics and habitat (Attachments C and D) will be completed prior to sampling for macroinvertebrates. Macroinvertebrate sampling is conducted in riffle/run habitats at each station. Sampling is conducted by placing a kick screen perpendicular to the current and raking the substrate so dislodged macroinvertebrates are carried into the screen. A quantitative assessment is performed by rinsing a composited kick screen into a gridded white bottom pan. Specimens are picked out, grid by grid, until at least 100 specimens are collected.

All collected specimens are preserved and returned to SRBC offices for identification and enumeration. Benthic macroinvertebrates are identified by professional biologists**,** with a minimum of a Bachelor-of-Science degree in biology, skilled at recognizing most benthos to the family level by sight, and to the genus level with appropriate keys. Biologists also attend the annual Mid-Atlantic Water Pollution Biology Workshop in Berkley Springs, WV and the annual Pennsylvania State Biologist Workshop. Work is supervised by Mr. Heicher, who was formerly Assistant Benthos Section Leader for Icthyological Associates, Inc. in Stamford, N.Y. Mr. Heicher has 15 graduate level credits in courses related to macroinvertebrate identification, including Entomology, Aquatic Insect Ecology, Identification and Quantification of Invertebrates, and his M.S. thesis research.

After sampling has been completed at a given site, all equipment that has come in contact with the sample will be rinsed thoroughly, examined carefully and picked free of algae or debris before sampling at the next site.

F. Training Records

Training records will be maintained in the Water Quality and Monitoring Programs Division files by the Quality Assurance Coordinator.

XI. SAMPLE CUSTODY PROCEDURES

Samples are delivered to the laboratory by the collectors or shipped to the Pa. DEP laboratory by overnight courier service. Since the water samples collected are not used for enforcement purposes, no sample custody procedures are performed.

XII. CALIBRATION PROCEDURES AND PREVENTATIVE MAINTENANCE

A. Dissolved Oxygen (DO) Meter

A YSI model dissolved oxygen meter is calibrated using the air-saturated chamber technique prior to use each day. An additional calibration check is performed prior to beginning the field work using the Winkler test. This calibration test is repeated in the event of a membrane replacement or other maintenance that may affect the accuracy of the meter. Calibration of the zero using Na_2SO_3 solution, and the temperature at three points is performed every three months. These data are recorded in a calibration log.

	Acceptable Criteria
Winkler	$\pm$ 0.4 mg/l
Air saturated water	$\pm$ 0.3 mg/l
Zero	less than 0.2 mg/l
Temperature	$\pm$ 0.5^{o}C

B. Specific Conductance Meter

The VWR conductivity meter is calibrated prior to sampling by checking the meter readings against three fresh specific conductance standards. Calibration checks will be made after every ten samples. Results are recorded in the calibration log, and new rating curves are generated, as necessary.

	Acceptable Criteria
Standards (<1,000 μmhos/cm)	± 4%
(>1,000 μmhos/cm)	± 3%

C. pH Meters

The meter is calibrated against three buffers daily, before and after use. Calibration checks will be made after every ten samples. This check is recorded in the calibration log.

XIII. DOCUMENTATION

Water and macroinvertebrate sample bottles are labeled at the time of collection. Water samples are labeled with a seven-digit identification number, the station name, date, and time, whether the sample is filtered or raw, and any fixatives added to the sample. This information and the name of the collector is recorded on laboratory analysis forms. A copy of the laboratory analysis form is attached (Attachment E). One copy is submitted to the laboratory with the sample, while another is retained as a record. Results of field chemistry are recorded on this form.

Results of laboratory analyses are entered into a computer database. Data entries are verified, and reductions are performed using computer files to eliminate transcription errors. Field chemistry and laboratory analysis sheets are retained for a period of two years.

Macroinvertebrate bottles are labeled with the station name and date. Identification is conducted by staff biologists at the SRBC office. Log sheets (Figure 2) are used to record the number of specimens for each genus identified. This information is transcribed onto computer files and verified.

Susquehanna River Basin Commission

	Taxa	#		Taxa	#
1.			23.		
2.			24.		
3.			25.		
4.			26.		
5.			27.		
6.			28.		
7.			29.		
8.			30.		
9.			31.		
10.			32.		
11.			33.		
12.			34.		
13.			35.		
14.			36.		
15.			37.		
16.			38.		
17			39.		
18.			40.		
19.			41.		
20.			42.		
21.			43.		
22.			44.		
23.			45.		
24.			46.		

Figure 2. Benthic Macroinvertebrate Enumeration Sheet

XIV. DATA REDUCTION

Water quality data are formatted into tables by station. The data are compared to state standards. A simple water quality index is computed by averaging the percentile rank of the observations for each station. Only the data collected during this monitoring program are used to determine percentile. This index gives a simple comparison of overall water quality between monitoring stations.

Data reduction procedures are similar to those described in Rapid Bioassessment Protocol III (Plafkin and others, 1989). The data for each station are reduced to the following metrics: (1) taxa richness; (2) modified Hilsenhoff Biotic Index; (3) ratio of scrapers to filterers/collectors; (4) ratio of Ephemeroptera/Plecoptera/Trichoptera to Chironomidae; (5) percent contribution of dominant taxon; (6) Ephemeroptera/Plecoptera/Trichoptera Index; (7) Community Loss Index; and (8) Shannon Weiner Diversity Index. Metrics 1 through 7 are taken directly from Plafkin. Metric 8 is substituted for the recommended ratio of shredders to total macroinvertebrates, which required specialized sampling protocols. These metrics are quantified and compared to a reference station that is impact free.

XV. DATA VALIDATION

Primary responsibility for data validation lies with the project officer. The collector may assist the project officer in determining the acceptability of the data based on his knowledge of the stream conditions. Field collections are conducted according to the above methodology to insure accurate data. The use of duplicates, reviewed by the project officer, also validates the water quality analyses. The data also go through a series of validations as they are entered into the STORET database. Data with concentrations less than five times the equipment or method blanks will be qualified “B”.

A percentage of the macroinvertebrate samples identified by one biologist are validated by a second biologist.

XVI. PERFORMANCE AND SYSTEMS AUDITS

A. Laboratory Analyses

Analytical and quality assurance procedures for the Pa. DEP laboratory are detailed in the QA plan submitted by the laboratory. The labotatory analyzes a matrix spike/matrix spike duplicate at a frequency of one per ten samples per matrix. Duplicate samples and blanks will be submitted to the laboratory (at least one per 20 samples)

B. Field Procedures

Twice a year field instruments are calibrated by USGS, and field operator techniques are tested for pH and specific conductance with USGS standard samples. The project officer is responsible for insuring that all field personnel are competent in measurement and collection techniques prior to field work. The project officer also is responsible for insuring the quality of all equipment and reagents. Duplicate tests are performed on alkalinity and acidity in the same proportion as other duplicate analyses. Results with a relative percent difference of ten percent are acceptable. Temperature readings by the dissolved oxygen meter are checked against a standard laboratory thermometer. Dissolved oxygen measurements are checked against a titration test. These checks are performed prior to field work.

C. Biological Sampling

A second biologist will verify the identifications on 5 percent of the sorted samples.

XVII. CORRECTIVE ACTION

Implementation of corrective action involving any of the sampling procedures, equipment, or data reduction and processing is the responsibility of the project officer. The QA officer is responsible for seeing that such corrective action is done. Implementation of corrective action involving laboratory analyses is the responsibility of the laboratory analysis officer, with oversight by the laboratory quality control officer.

The results of any corrective actions taken will be documented by the individual(s) taking the necessary actions.

XVIII. REPORTS

A report describing the results of the monitoring program will be published. This report will include the data and the results of data analysis. Conclusions and recommendations will be made, as appropriate. In addition, the data are utilized by staff for project review. A discussion of data quality, significant QA problems that may have occurred, and results of performance and system audits will be included in the report.

REFERENCES

LaBuy, James L. 1967. Biological Survey of the Susqueahnna River and Its Tributaries Between Cooperstown, N.Y. and Northumberland Pa. CB-SRP Working Document No. 2.

Malione, M.R., C.P. McMorran, and S.E. Rudisill. 1984. Water Quality and Biological Survey of the Susquehanna River Basin from Waverly, N.Y. to Sunbury, Pa. Susquehanna River Basin Commission, Publication No.89, 290 p.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Uses in Streams and Rivers, Benthic Macroinvertebrates and Fish. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C., EPA/444/4-89-001.

Susquehanna River Basin Commission. 1997. Water Quality and Biological Survey for the Middle Susquehanna Subbasin, 1993. Publication No. 186, 108 pp.

ATTACHMENT A

SUSQUEHANNA RIVER BASIN COMMISSION

STANDARD OPERATION PROCEDURE (SOP)
FOR DETERMINATION OF ALKALINITY

Prepared by: Charles S. Takita Date: September 15, 2000
WQ Program Specialist

Reviewed by: David W. Heicher Date: September 18, 2000
Quality Assurance Coordinator

Procedural Section

1.0 Scope & application

1.1 This method is applicable to surface waters, sewage and industrial wastes.
1.2 The method is applicable for all ranges of alkalinity.

2.0 Summary of method

2.1 The alkalinity of a sample is its quantitative capacity to react with a strong acid to a certain pH. The pH of the unaltered sample is determined and a measured amount of standard acid is added to lower the pH to an endpoint of 4.5..

3.0 Interference

3.1 The sample must be analyzed as soon as practical; preferably, within a few hours.
3.2 Substances, such as salts of weak organic and inorganic acids present in large amounts, may cause interference in the electrometric pH measurements.
3.3 Oil and grease, by coating the pH electrode, may also interfere, causing sluggish response.

4.0 Apparatus

4.1 Analog field pH meter
4.2 Syringe with 0.2 ml graduation
4.3 Magnetic stirrer
4.4 Stirring bars
4.5 Glass beaker, 100 ml
4.6 Graduated cylinder, 50 ml

5.0 Reagent

5.1 0.02N H_2SO_4

6.0 Procedure

6.1 Measure 50 ml of sample with graduated cylinder and pour into the 100 ml beaker.
6.2 Measure the pH of the sample.
6.3 Using the syringe, drop 0.02N H_2SO_4 into sample in increments of 0.5 ml or less until the pH in the sample approaches 4.5 then add H_2SO_4, dropwise, pausing between drops to allow the pH to stabilize until a pH of 4.5 is reached.
6.4 Determine the amount of 0.02N H_2SO_4 added to sample.

7.0 Calculation

7.1 Calculate alkalinity, as mg/l, using the following formula:

$$\text{Alkalinity, mg/l as } CaCO_3, = \frac{A \times N \times 50{,}000}{\text{ml of sample}}$$

where:

A = ml of H_2SO_4used
N = normality of H_2SO_4

Quality Control and Quality Assurance

1.0 Choose one sample from the set of analyses and run a duplicate. Results should be within 10%.

Reference

1.0 Standard Methods for Examination of Water and Wastewater, 17th Edition

ATTACHMENT B

SUSQUEHANNA RIVER BASIN COMMISSION

STANDARD OPERATION PROCEDURE (SOP)
FOR DETERMINATION OF ACIDITY

Prepared by: Charles S. Takita Date: September 15, 2000
WQ Program Specialist

Reviewed by: David W. Heicher Date: September 18, 2000
Quality Assurance Coordinator

Procedural Section

1.0 Scope & application

1.1 This method is applicable to surface waters, sewage and industrial wastes, particularly mine drainage and receiving streams, and other wastes containing ferrous iron and other polyvalent ions in a reduced state.

1.2 The method is applicable for samples with acidities less than 1,000 mg/l using a 50 ml sample.

2.0 Summary of method

2.1 The acidity of a sample is its quantitative capacity to react with a strong base to a certain pH. The pH of the sample is determined and a measured amount of standard alkali is added to raise the pH to 8.3.

3.0 Interference

3.1 Suspended matter present in the sample or precipitates formed during the titration may cause a sluggish electrode response. This may be offset by allowing a 15-20 second pause between additions of titrant or by slow dropwise addition of titrant as the endpoint is approached.

4.0 Apparatus

4.1 Analog field pH meter
4.2 Syringe with 0.2 ml graduation
4.3 Magnetic stirrer
4.4 Stirring bars
4.5 Glass beaker, 100 ml
4.6 Graduated cylinder, 50 ml

5.0 Reagent

5.1 0.02N NaOH

6.0 Procedure

6.1 Measure 50 ml of sample with graduated cylinder and pour into the 100 ml beaker.
6.2 Measure the pH of the sample.
6.3 Using the syringe, drop 0.02N NaOH into sample in increments of 0.5 ml or less until the pH in the sample approaches 8.3 then add NaOH, dropwise, pausing between drops to allow the pH to stabilize until a pH of 8.3 is reached.
6.4 Determine the amount of 0.02N NaOH added to sample.

7.0 Calculation

7.1 Calculate acidity, as mg/l, using the following formula:

$$\text{Acidity, mg/l as } CaCO_3, = \frac{A \times N \times 50{,}000}{\text{ml of sample}}$$

where:

A = ml of NaOH used
N = normality of NaOH

Quality Control and Quality Assurance

1.0 Choose one sample from the set of analyses and run a duplicate. Results should be within 10%.

Reference

1.0 Standard Methods for Examination of Water and Wastewater, 17th Edition

ATTACHMENT C

PHYSICAL CHARACTERISTICS - RIPARIAN ZONE/INSTREAM FEATURES

LANDUSE:

____% Woodland
____% Agriculture
____% Residential
____% Commercial
____% Industrial
____% Institutional
____% Other

SEDIMENT/SUBSTRATE:

ODORS: Normal Sewage Petroleum Chemical Anaerobic Other
OILS: Absent Slight Moderate Profuse
DEPOSITS: Sludge Sawdust Paper Fiber Sand Relict Shells Coaldust Other

WATER QUALITY

ODORS: Normal Sewage Petroleum Chemical None Other
OILS: Slick Sheen Globs Flecks None Other
TURBIDITY: Clear Slight Turbid Opaque Water Color

NOTES:

Alkalinity: _____ mls of sample water
_____ pH of water
if <4.5, then ALK = 0

Add 0.02N H2SO4 (Tritrant) to sample
_____ if pH <8.3 then 0 mls , else Titrate sample to pH of 8.3
_____ Titrate sample to 4.5

Alkalinity in mg/l = mls of Tritrant X 20, if sample water is 50 mls
= mlsof Tritrant X 10, if sample water is 100 mls

ATTACHMENT D

HABITAT ASSESSMENT FIELD DATA SHEET

SITE ID _____ WATERBODY NAME _____
DATE _____ AQUATIC ECOREGION _____
TIME _____ STREAM DESIGNATION _____

HABITAT SCORING SHEET

Score

BOTTOM SUBSTRATE ..... _____

Substrate Type	Diameter	Percent
Bedrock	solid	_____
Boulder	> 10 in	_____
Cobble	2.5-10 in	_____
Gravel	0.1-2.5 in	_____
Sand	gritty	_____
Silt		_____
Clay	slick	_____
Detritus	sticks, leaves	_____
Muck	organic black	_____

EMBEDDEDNESS ..... _____
Are underside of rocks black? Y or N

CANOPY COVER ..... _____
Stream shading _____ %

CHANNEL ALTERATION ..... _____
Type mod/obstruct _____

BOTTOM SCOURING & DEPOSITION ..... _____

POOL-RIFFLE AND RUN-BEND RATIO ..... _____
Pool/Riffle _____ft/_____ft

LOWER BANK CHANNEL CAPACITY ..... _____

UPPER BANK STABILITY ..... _____

BANK VEGETATIVE PROT. OR DISRUPTION ..... _____

STREAMSIDE COVER ..... _____
Left Bank _____
Right Bank _____
(Right and Left looking upstream based on dominant vegetation)

RIPARIAN VEGETATIVE ZONE WIDTH ..... _____

TOTAL SCORE ..... _____

ATTACHMENT E