

QUALITY ASSURANCE/WORK PLAN
WEST BRANCH SUSQUEHANNA RIVER
SMALL WATERSHED STUDY—MORGAN RUN

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I. PROJECT NAME

West Branch Susquehanna River Small Watershed Study

II. PROJECT OFFICER

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III. QUALITY ASSURANCE OFFICER

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IV. DATE OF PROJECT INITIATION

October 2003

V. PROJECT DESCRIPTION

A. Objective and Scope

The Susquehanna River Basin Commission (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. In 1998, the Commission reevaluated its subbasin survey program and added a Year 2 component to better assist local interests and to perform more detailed studies in selected watersheds.

During July–November 2002, Commission staff conducted a survey of the West Branch Susquehanna Subbasin. The data collected during this survey provided a qualitative assessment of conditions in the basin. Commission staff surveyed state and local governmental officials and watershed organizations regarding their suggestions for a follow-up study in a selected watershed. The Commission proposes to perform a small watershed survey on the Morgan Run Watershed in Clearfield County, Pa., during FY-2004. This watershed assessment will provide valuable biological, chemical, and habitat information to the Clearfield County Conservation District and other interested parties. Streams to be sampled include: Morgan Run, James Run, Alberts Run, and Crooked Sewer Run, as well as several abandoned mine drainage (AMD) discharges. Commission staff will perform extensive coordination with the watershed groups, county conservation districts, local citizens, and other interested parties. Figure 1 shows the location of the Morgan Run Study area.

B. Data Usage

Data collected during this survey will be used by the watershed groups and conservation districts to conduct watershed management planning and prepare a restoration plan for the Morgan Run Watershed. The study also will provide information to: (1) assess the chemical, physical, and biological condition of the streams within the watershed; (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.

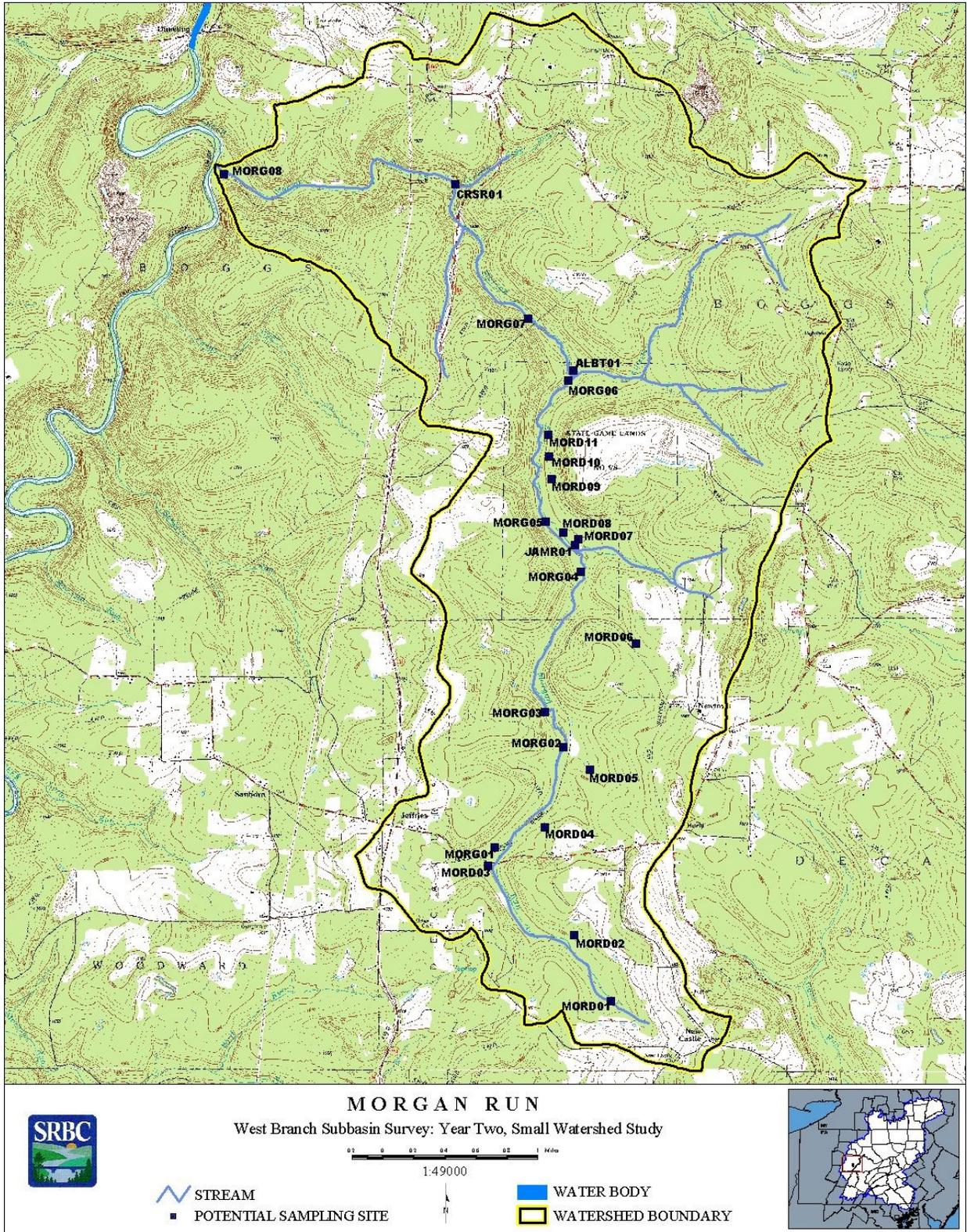


Figure 1. Location of the Morgan Run Study Area

C. Monitoring Network Design and Rationale

Commission staff surveyed state and local government and watershed groups regarding their suggestions for a follow-up assessment within the West Branch Susquehanna Subbasin. The Clearfield County Conservation District and Pennsylvania Department of Environmental Protection (Pa. DEP) Hawk Run District Mining Office suggested the Morgan Run Watershed, due to AMD problems in the watershed. Eventually, the Commission would like to use the data collected during this follow-up survey to assist other entities in developing a restoration plan for the watershed. The sampling sites listed in Table 1 were selected so that all AMD discharges could be sampled, in addition to selected tributaries and main stem Morgan Run points.

D. Monitoring Parameters

Parameters of interest are listed in Table 2. Discharge will be measured manually at all stations using standard U.S. Geological Survey (USGS) equipment and methods (Buchanan and Somers, 1969). Macroinvertebrate data will be comprised of a list of different genera collected and an estimate of population density. Chemical water quality and flow information will be collected quarterly, while physical habitat information and biological samples will be collected once during the spring sampling period.

VI. PROJECT FISCAL INFORMATION

See USEPA grant application.

VII. SCHEDULE

Activity	2003			2004												2005									
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A		
Coordination	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Water Quality Sampling		X			X			X			X														
Macroinvertebrate Sampling								X																	
Identify Macroinvertebrates																							X	X	X
Compile and Evaluate Data																							X	X	X
Report Writing																							X	X	X
Final Report																									X

Table 1. Morgan Run Watershed Station Locations

Station Number	County/State	USGS Quad	Latitude	Longitude	Site Description
MORD01	Clearfield/Pa.	Wallaceton	40.8815	-78.3546	Most upstream discharge on Morgan Run behind new development of Meases Road (T659)
MORD02	Clearfield/Pa.	Wallaceton	40.8877	-78.3593	Discharge located north of new development off of Meases Road (T659)
MORD03	Clearfield/Pa.	Wallaceton	40.8941	-78.3698	Discharge upstream of SR 2012
MORD04	Clearfield/Pa.	Wallaceton	40.8977	-78.3629	Discharge located downstream of SR 2012 along old railroad bed
MORD05	Clearfield/Pa.	Wallaceton	40.9031	-78.3574	Discharge located along old railroad bed near Newtown, Pa.
MORD06	Clearfield/Pa.	Wallaceton	40.9148	-78.3518	Discharge located on Ross Creek along old railroad bed near Newtown, Pa.
MORD07	Clearfield/Pa.	Wallaceton	40.9246	-78.3589	Discharge located near James Run
MORD08	Clearfield/Pa.	Wallaceton	40.9252	-78.3607	Discharge located downstream of James Run confluence with Morgan Run
MORD09	Clearfield/Pa.	Wallaceton	40.9302	-78.3622	Upstream discharge located in State Game Lands No. 98
MORD10	Clearfield/Pa.	Wallaceton	40.9323	-78.3625	Middle discharge located in State Game Lands No. 98
MORD11	Clearfield/Pa.	Wallaceton	40.9343	-78.3626	Downstream discharge located in State Game Lands No. 98
JAMR01	Clearfield/Pa.	Wallaceton	40.9240	-78.3593	Mouth of James Run located south of State Game Lands No. 98, near Newtown, Pa.
ALBT01	Clearfield/Pa.	Wallaceton	40.9403	-78.3596	Mouth of Alberts Run, located north of State Game Lands No. 98
CRSR01	Clearfield/Pa.	Wallaceton	40.9576	-78.3742	Mouth of Crooked Sewer Run, located near Spring Valley, Pa.
MORG01	Clearfield/Pa.	Wallaceton	40.8958	-78.3690	Morgan Run downstream of SR 2012 at abandoned railroad bed crossing
MORG02	Clearfield/Pa.	Wallaceton	40.9051	-78.3607	Morgan Run downstream of MORD04 and upstream of MORD05 discharges
MORG03	Clearfield/Pa.	Wallaceton	40.9084	-78.3629	Morgan Run downstream of MORD05
MORG04	Clearfield/Pa.	Wallaceton	40.9236	-78.3601	Morgan Run upstream of James Run
MORG05	Clearfield/Pa.	Wallaceton	40.9262	-78.3629	Morgan Run downstream of James Run and upstream of State Game Land No. 98 discharges
MORG06	Clearfield/Pa.	Wallaceton	40.9398	-78.3603	Morgan Run downstream of State Game Lands No. 98 discharges and upstream of Alberts Run
MORG07	Clearfield/Pa.	Wallaceton	40.9451	-78.3652	Morgan Run downstream of Alberts Run at power line crossing
MORG08	Clearfield/Pa.	Glen Richey	40.9585	-78.4027	Morgan Run at mouth

Table 2. Monitoring Parameters

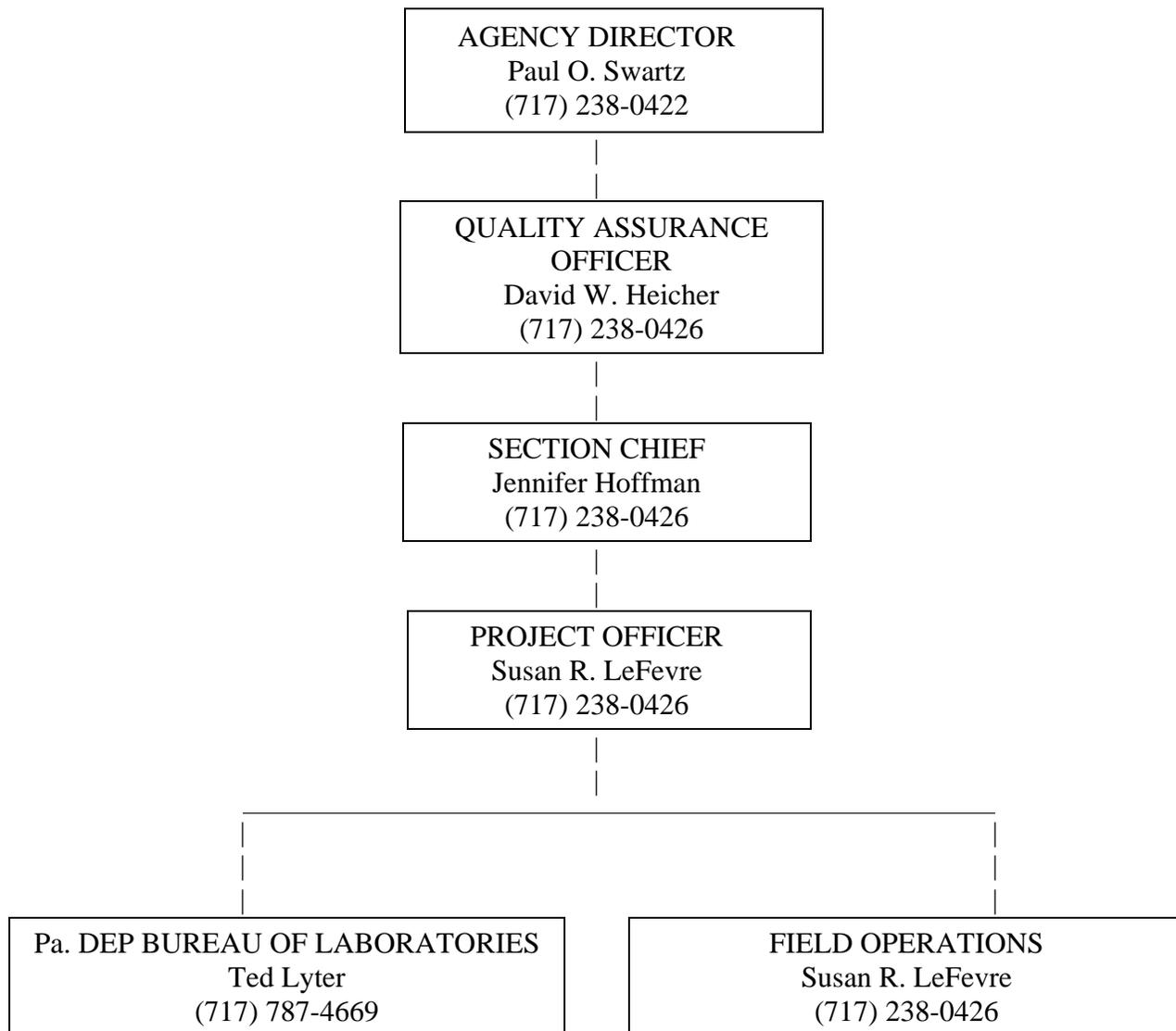
Parameter	Number of Samples	Analytical Sample Matrix	Method Reference	Sample Preservation	Holding Time
Flow	NA	NA	Buchanan and Somers, 1969	NA	NA
Temperature	100	aq.	In situ	none	0
Dissolved Oxygen	100	aq.	In situ	none	0
Conductivity	100	aq.	In situ	none	0
pH	100	aq.	In situ	none	0
Total Suspended Solids	100	aq.	EPA 160.2	cooling to 4 ^o C	24 hours
Alkalinity	100	aq.	EPA 310.1	cooling to 4 ^o C	24 hours
Hot Acidity	100	aq.	EPA 305.1	cooling to 4 ^o C	24 hours
Lab pH	100	aq.	EPA 150.1	cooling to 4 ^o C	24 hours
Total Magnesium	100	aq.	EPA 200.7	preserve w/HNO ₃ to a pH <2	6 months
Total Calcium	100	aq.	EPA 200.7	preserve w/HNO ₃ to a pH <2	6 months
Total Sulfate	100	aq.	EPA 375.2	cooling to 4 ^o C	24 hours
Total Iron	100	aq.	EPA 200.7	preserve w/HNO ₃ to a pH <2	6 months
Total Manganese	100	aq.	EPA 200.7	preserve w/HNO ₃ to a pH <2	6 months
Total Aluminum	100	aq.	200.8 ²	preserve w/HNO ₃ to a pH <2	6 months
Macroinvertebrates	15		Barbour and others, 1999	preserve in denatured alcohol	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

VIII. PROJECT ORGANIZATION AND RESPONSIBILITY

A. Project Organization



B. Project Responsibility

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

IX. DATA QUALITY REQUIREMENTS AND ASSESSMENTS

Table 3. Data Quality Requirements and Assessments

Parameter	Detection Limit (mg/l)	Accuracy ¹	Precision ²
Total Suspended Solids	2.0	+/-10%	+/-10%
Total Alkalinity	1.0	+/-10%	+/-10%
Hot Acidity	2.0	+/-10%	+/-10%
Lab pH (Standard Units)	0.1	+/-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%
Macroinvertebrates	NA	NA	+/- 10%

1. Calculate Accuracy using the formulas:

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

%R = percent recovery

S = measured concentration in spiked aliquot

U = measured concentration in unspiked aliquot

C_{sa} = actual concentration of spike added

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

%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

C₁ = larger of two observed values

C₂ = smaller of two observed values

A. Data Representativeness

Water samples are collected at six 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.

Sampling stations are placed at specific locations, such as the mouths of streams, headwater areas, below significant tributaries, and below AMD discharges to accurately determine the extent and amplitude of AMD pollution in the watershed. Additionally, macroinvertebrate sampling will occur in riffle/run habitats to help ensure that the samples are representative of the best available habitat conditions.

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. One field crew is used to collect samples at all sites to reduce variability in sampling.

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 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, six vertical samples are collected, composited in a churn splitter, and churned while the sample bottle is filled.

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 20 samples, whichever is more frequent.

B. Water Samples

Three-quarters of a liter of water will be collected at each station for laboratory analysis. Nalgene bottles will be used. The samples consist of one 250-ml bottle for metals analysis, and one 500-ml bottle for all additional parameters. The samples for metals analyses will be acidified to pH 2 or less with 1 N nitric acid. Duplicate samples will be collected at a frequency of one per day, or one per 10 samples, whichever is more frequent. The samples will be chilled on ice, and shipped within 24 hours to the Pa. DEP Lab. 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 H₂SO₄. (See SOP, Attachment A.) Acidity is measured in the field by titrating a known volume of sample water to pH 8.3 with 0.02 N 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

At all stations, flow measurements are made by field personnel using a pygmy, AA, or a Marsh-McBirney flow meter and standard USGS procedures (Buchanan and Somers, 1969).

E. Macroinvertebrates

Macroinvertebrate assessments are adapted from Rapid Bioassessment Protocol (RBP) III, described by Barbour and others (1999). Macroinvertebrate sampling is conducted in the best available riffle/run habitats at each station. Sampling is conducted by placing a 600 micron, 1-square-meter kick screen perpendicular to the current and raking the substrate so dislodged macroinvertebrates are carried into the screen. Two kick screens are composited into one sample at each site. Duplicate samples are collected at 10 percent of the sites (or one site per day). All collected specimens are preserved in 95 percent ethanol and returned to the Commission office for identification and enumeration. Subsampling and sorting procedures are based on the 1999 RBP document (Barbour, and others, 1999). In the laboratory, composite samples are sorted into 200-organism subsamples using a gridded pan and a random numbers table. The organisms contained in the subsamples are identified to genus (except Chironomidae and Oligochaeta), when possible, and enumerated. Benthic macroinvertebrates are identified by professional biologists, with a Master-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, W. Va., and the annual Pennsylvania State Biologist Workshop. Work is supervised by Mr. David W. Heicher, who was formerly Assistant Benthos Section Leader for Ichthyological 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. Additional organisms that are found on examination are placed into the sample containers.

F. Physical Habitat Assessment

Physical habitat conditions at each station are assessed using a slightly-modified version of the habitat assessment procedure outlined by Barbour and others (1999). Eleven habitat parameters are field-evaluated at each site and used to calculate a site-specific habitat assessment score. Physical habitat assessments are performed for riffle/run or glide/pool areas, depending on stream type. Figure 2 and Table 4 show habitat assessment forms and the criteria used to evaluate habitat in riffle/run streams and Figure 3 and Table 5 show forms and criteria used to evaluate habitat in glide/pool stream types.

G. Training Records

Training records will be maintained in the Watershed Assessment and Protection Division files by the Quality Assurance Coordinator.

Figure 2. Rifle/Run Habitat Assessment Sheet

Rifle/Run Habitat Assessment Sheet

Stream		Date				
Station ID		Time				
Sample #		Crew				
Location Description:						
Stream type: Limestone Sandstone Valley Headwater Large River Glacial Other _____						
Habitat Assessment		Weather Conditions				
Parameter	Score	Air Temperature © _____				
1. Epifaunal Substrate		Current Conditions: Sunny Cloudy Partly Cloudy				
		Present Precipitation: None Rain Snow Mixed Precip.				
		Heavy? (> 1 inch) Yes No				
2. Instream Cover		Precip. Within Last 24 Hours: None Rain Snow Mixed Precip.				
		Heavy? (> 1 inch) Yes No				
		Ice Present at Site? Yes No				
3. Embeddedness		Functionally Important Stream Characteristics				
4. Velocity/Depth Regimes						
5. Sediment Deposition						
6. Channel Flow Status						
7. Channel Alteration						
8. Frequency of Riffles						
9. Condition of Banks (Score each bank)		Predominant Substrate Material (circle one)				
		Bedrock (> 160 inches in diameter)				
		Boulder (10 – 160 inches in diameter)				
		Cobble (2.5 – 10 inches in diameter)				
Left Bank		Gravel (0.1 – 2.5 inches in diameter)				
		Sand/Silt/Clay (< 0.1 inches in diameter)				
Right Bank		Residential	Commercial			
		Industrial	Cropland			
Left Bank		Nursery	Pasture			
		Abd. Mining	Old Fields			
Right Bank		Forest	Other			
		Comments:				
10. Vegetative Protective Cover (score each bank)						
				Left Bank		
Right Bank						
11. Riparian Vegetative Zone Width (score each bank)				Temp.	Cond.	D.O.
				Left Bank	pH	Acid.
Right Bank						

Table 4. Riffle/Run Habitat Assessment Criteria

Habitat Parameter	Category			
	Optimal (20-16)	Suboptimal (15-11)	Marginal (10-6)	Poor (5-0)
1. Epifaunal Substrate	Well-developed riffle/run; riffle is as wide as stream, and length extends 2 times the width of stream; abundance of cobble	Riffle is as wide as stream, but length is less than 2 times width; abundance of cobble; boulders and gravel common	Run area may be lacking; riffle not as wide as stream, and its length is less than 2 times the stream width; some cobble present	Riffle or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking
2. Instream Cover	>50% mix of boulders, cobble, submerged logs, undercut banks or other stable habitat	30–50% mix of boulder, cobble, or other stable habitat; adequate habitat	10–30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable	<10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious
3. Embeddedness	Gravel, cobble, and boulder particles are 0–25% surrounded by fine sediments	Gravel, cobble, and boulder particles are 25–50% surrounded by fine sediments	Gravel, cobble, and boulder particles are 50–75% surrounded by fine sediments	Gravel, cobble, and boulder particles are >75% surrounded by fine sediments
4. Velocity/Depth Regimes	All 4 velocity/depth regimes present (slow/deep, slow/shallow, fast/deep, fast/shallow)	Only 3 of 4 regimes present (if fast/shallow is missing, score lower than if missing other regimes)	Only 2 of 4 regimes present (if fast/shallow or slow/shallow are missing, score low)	Dominated by 1 velocity/depth regime
5. Sediment Deposition	Little or no enlargement of islands or point bars, and <5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from coarse gravel; 5–30% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, coarse sand on old and new bars; 30–50% of the bottom affected; sediment deposits at obstructions; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; >50% of the bottom changing frequently; pools almost absent due to sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted

Table 4. Riffle/Run Habitat Assessment Criteria (continued)

Habitat Parameter	Category			
	Optimal (20-16)	Suboptimal (15-11)	Marginal (10-6)	Poor (5-0)
8. Frequency of Riffles	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the stream width is between 15-25	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is >25
9. Condition of Banks (score each bank 0-10)	Banks stable; no evidence of erosion or bank failure; little potential for future problems; <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over; 5-30% of bank in reach has areas of erosion	Moderately unstable, 30-60% of banks in reach have areas of erosion; high erosion potential during floods	Unstable; many eroded areas; “raw” areas frequent along straight sections and bends; on side slopes, 60-100% of bank has erosional scars
10. Vegetative Protective Cover (score each bank 0-10)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less
11. Riparian Vegetative Zone Width (score each bank 0-10)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities

Figure 3. Glide/Pool Habitat Assessment

Glide/Pool Habitat Assessment Sheet

Stream		Date			
Station ID		Time			
Sample #		Crew			
Location Description:					
Stream Type: Limestone Sandstone Valley Headwater Large River Glacial Other __					
Habitat Assessment			Weather Conditions		
Parameter		Score	Air Temperature (°C)		
1. Epifaunal Substrate			Current Conditions: Sunny Cloudy Partly Cloudy		
			Present Precipitation: None Rain Snow Mixed Precip.		
			Heavy? (> 1 inch) Yes No		
2. Instream Cover			Precip. within last 24 Hours: None Rain Snow Mixed Precip.		
			Heavy? (>1 inch) Yes No		
			Ice Present at Site? Yes No		
3. Pool Substrate Characterization			Functionally Important Stream Characteristics		
4. Pool Variability					
5. Sediment Deposition					
6. Channel Flow Status					
7. Channel Alteration					
8. Channel Sinuosity					
9. Condition of Banks (Score each bank)			Predominant Substrate Material (circle one)		
Left Bank			Bedrock (>160 inches in diameter)		
Right Bank			Boulder (10-160 inches in diameter)		
			Cobble (2.5 – 10 inches in diameter)		
			Gravel (0.1 – 2.5 inches in diameter)		
			Sand/Silt/Clay (<0.1 inches in diameter)		
Left Bank			Residential	%	Commercial %
Right Bank			Industrial	%	Cropland %
			Nursery	%	Pasture %
			Abd. Mining	%	Old Fields %
10. Vegetative Protective Cover (score each bank)			Forest	%	Other %
Left Bank			Comments:		
Right Bank					
11. Riparian Vegetative Zone Width (score each bank)					
Left Bank			Temp.	Cond.	D.O.
Right Bank			pH	Acid.	Alk.

Table 5. Glide/Pool Habitat Assessment Criteria

Habitat Parameter	Category			
	Optimal (20-16)	Suboptimal (15-11)	Marginal (10-6)	Poor (5-0)
1. Epifaunal Substrate	Preferred benthic substrate abundant throughout stream site and at stage to allow full colonization (i.e., log/snags that are not new fall and not transient)	Substrate common, but not prevalent or well-suited for full colonization potential	Substrate frequently disturbed or removed	Substrate unstable or lacking
2. Instream Cover	>50% mix of snags, submerged logs, undercut banks or other stable habitat; rubble, gravel may be present	30-50% mix of stable habitat; adequate habitat for maintenance of populations	10-30% mix of stable habitat; habitat availability less than desirable	Less than 10% stable habitat; lack of habitat obvious
3. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present	All mud or clay or sand bottom; little or no root mat; no submerged vegetation	Hard-pan clay or bedrock; no root mat or vegetation
4. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of island or point bars	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial movement during storm events	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to substantial sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools

Table 5. Glide/Pool Habitat Assessment Criteria (continued)

Habitat Parameter	Category			
	Optimal (20-16)	Suboptimal (15-11)	Marginal (10-6)	Poor (5-0)
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted
8. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long time.
9. Condition of Banks (score each bank 0-10)	Banks stable; no evidence of erosion or bank failure; side slopes generally <30%; little potential for future problems; <5% of bank affected	Moderately stable; infrequent, small areas of erosion mostly healed over; side slopes up to 40% on one bank; slight erosion potential in extreme floods; 5-30% of bank in reach has areas of erosion	Moderately unstable; moderate frequency and size of erosional areas; side slopes up to 60% on some banks; high erosion potential during extremely high flow; 30-60% of bank in reach has areas of erosion	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; on side slopes; side slopes >60% common; 60-100% of bank has erosional scars
10. Vegetative Protective Cover (score each bank 0-10)	>90% of the streambank surfaces covered by vegetation; vegetative disruption through grazing or mowing minimal	70-90% of the streambank surfaces covered by vegetation; disruption evident but not affecting full plant growth potential to any great extent	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation	<50% of the streambank surfaces covered by vegetation; disruption is very high; vegetation removed to 5 cm or less
11. Riparian Vegetative Zone Width (score each bank 0-10)	Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally	Width of riparian zone 6-12 meters; human activities have impacted zone only minimally	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities

XI. SAMPLE CUSTODY PROCEDURES

Water quality samples are delivered to the laboratory by the collectors or shipped to the Pa. DEP Lab by overnight courier service. A sample submission sheet, provided by Pa. DEP Lab, is included for each sample sent to the Pa. DEP Lab by Commission staff. This submission sheet contains all relevant information about the sample, including collector, date, time, location, and method of preservation (if needed). Sample numbers, as well as field chemistry and flow data, are stored in a field logbook and checked against sample numbers received from Pa. DEP Lab. For macroinvertebrate samples, a logbook is kept containing information regarding the collection, preservation, subsampling, and identification of the macroinvertebrates. The station identification data are recorded on each macroinvertebrate sample and entered into a logbook in the field. This logbook is used to track the macroinvertebrate sample through the laboratory process. Commission staff members are responsible for entering the date and their initials for each sample during processing and identification of the sample.

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. This calibration test is repeated in the event of a membrane replacement or other maintenance that may affect the accuracy of the meter.

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 are made after every 10 samples. Results are recorded in the calibration log, and new rating curves are generated, as necessary.

<u>Acceptable Criteria</u>	
Standards (<1000 $\mu\text{mhos/cm}$)	$\pm 4\%$
(>1000 $\mu\text{mhos/cm}$)	$\pm 3\%$

C. pH Meters

The meter is calibrated against three buffers daily, before and after use. Calibration checks are made after every 10 samples. These checks are recorded in the calibration log.

D. Flow Meter

Current meters are sent to the manufacturer for calibration, as necessary. Spin tests are performed before and after each day of use.

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, date, and time, and whether any fixatives were added to the sample. This information is recorded on laboratory analysis forms. 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 an Excel spreadsheet. 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 and, subsequently, archived. Excel spreadsheets containing all information are retained on the Commission's server for ready access. Additionally, all data will be entered into STORET.

Databases for all water quality, physical habitat, field chemistry, and macroinvertebrate data consist of Excel spreadsheets developed for in-house needs. The databases are located on the Commission's server. Back-up copies are retained by the project manager in addition to a copy kept in the filing system with hard copies of the data sheets. Additionally, all data will be entered into STORET.

Macroinvertebrate bottles are labeled with the station and date. A logbook is kept for all sites, containing information on the macroinvertebrate sample collection, such as station number, stream name, date, the number of bottles, and the person who collected the sample. Identification is conducted by staff biologists at the Commission office, where additional information such as dates of subsampling and identification and the personnel associated with each activity is added to the logbook. Log sheets (Figure 4) are used to record the number of specimens for each genus identified. This information is transcribed into Excel spreadsheets and verified. The data will be entered into STORET at a later date.

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 (Barbour and others, 1999). The data for each station are reduced to the following metrics: (1) taxa richness; (2) modified Hilsenhoff Biotic Index; (3) percent Ephemeroptera; (4) percent contribution of dominant taxon; (5) number of Ephemeroptera/Plecoptera/Trichoptera taxa; (6) percent Chironomidae; and (7) Shannon Weiner Diversity Index. These metrics are quantified and compared to a reference station with the best available conditions based on physical habitat, water quality, and macroinvertebrate information.

The subsample data are used to generate scores for each of the seven macroinvertebrate metrics listed above. Each metric score is then converted to a biological condition score, based on the percent similarity of the metric score, relative to the metric score of the reference site. The sum of the biological condition scores constitutes the total biological score for the sample site, and total biological scores are used to assign each site to a biological condition category. A sampling site that scores 83 percent or greater, as compared to the reference site, is designated nonimpaired. A score of 79 to 54 percent is termed slightly impaired; moderately compared conditions are characterized as 50 to 21 percent of the reference site; and a score of less than 17 percent is designated severely impaired.

Habitat assessment scores of sample sites are compared to those of the reference sites to classify each sample site into a habitat condition category. Habitat parameters for riffle-run and glide-pool habitat types are listed in Tables 4 and 5, respectively. A site that scores 90 percent or greater as compared to the reference score is designated excellent (comparable to reference). A habitat score of 75 to 89 percent is designated supporting; partially supporting conditions are characterized as 60 to 74 percent of the reference score; and a score of less than 60 percent is determined to be nonsupporting.

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 database.

Five percent of the macroinvertebrate samples identified by one biologist are validated by a second biologist and recorded in the logbook. A biologist also spot-checks five percent of the samples picked by laboratory personnel during subsampling and records the samples in the logbook.

XVI. PERFORMANCE AND SYSTEMS AUDITS

A. Laboratory Analyses

Analytical and quality assurance procedures for the Pa. DEP Lab are detailed in the QA plan submitted by the laboratory. The laboratory 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 10 samples).

Figure 4. Benthic Macroinvertebrate Enumeration Sheet

MACROINVERTEBRATE ENUMERATION LIST

SITE _____
IDENTIFIED BY: _____

DATE SAMPLED _____
DATE IDENTIFIED: _____

FAMILY/GENUS	NUMBER OF INDIVIDUALS
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	
26.	

B. Field Procedures

Yearly, field operator techniques are tested for pH, specific conductance, and alkalinity with USGS standard samples. Additionally, Commission staff is tested yearly in the collection of flow measurements. The project officer is responsible for insuring that all field personnel are competent in measurement and collection techniques prior to fieldwork. The project officer also is responsible for insuring the quality of all equipment and reagents. The quality assurance officer also performs a field audit near the beginning of sampling. The field audit for this project is scheduled for February 2004.

Duplicate tests are performed on alkalinity and acidity in the same proportion as other duplicate analyses and results with a relative percent difference of 10 percent is acceptable. Temperature readings from the dissolved oxygen meter are checked against a standard laboratory thermometer. These checks are performed prior to fieldwork.

C. Biological Sampling

A second biologist verifies the identifications on five 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 a description of the methods and data analysis. Conclusions and recommendations will be made, as appropriate. The data will be available on the Commission's website (www.srbc.net). In addition, the data are utilized by Commission staff for project review and for inclusion in the Commission's 305(b) report. The data collected for this project will be instrumental in determining a restoration plan for the Morgan Run Watershed.

REFERENCES

- Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.
- Buchanan, T.J. and W.P. Somers. 1969. Discharge Measurements at Gaging Stations. USGS Techniques of Water-Resources Investigations, Book 3, Chapter A8.

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 H₂SO₄

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 H₂SO₄ into sample in increments of 0.5 ml or less until the pH in the sample approaches 4.5 then add H₂SO₄, 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 H₂SO₄ 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 H₂SO₄ used

N = normality of H₂SO₄

Quality Control and Quality Assurance

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

Reference

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

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 percent.

Reference

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