United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Morgan County, West Virginia

WSR Watershed

May 16, 2012

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

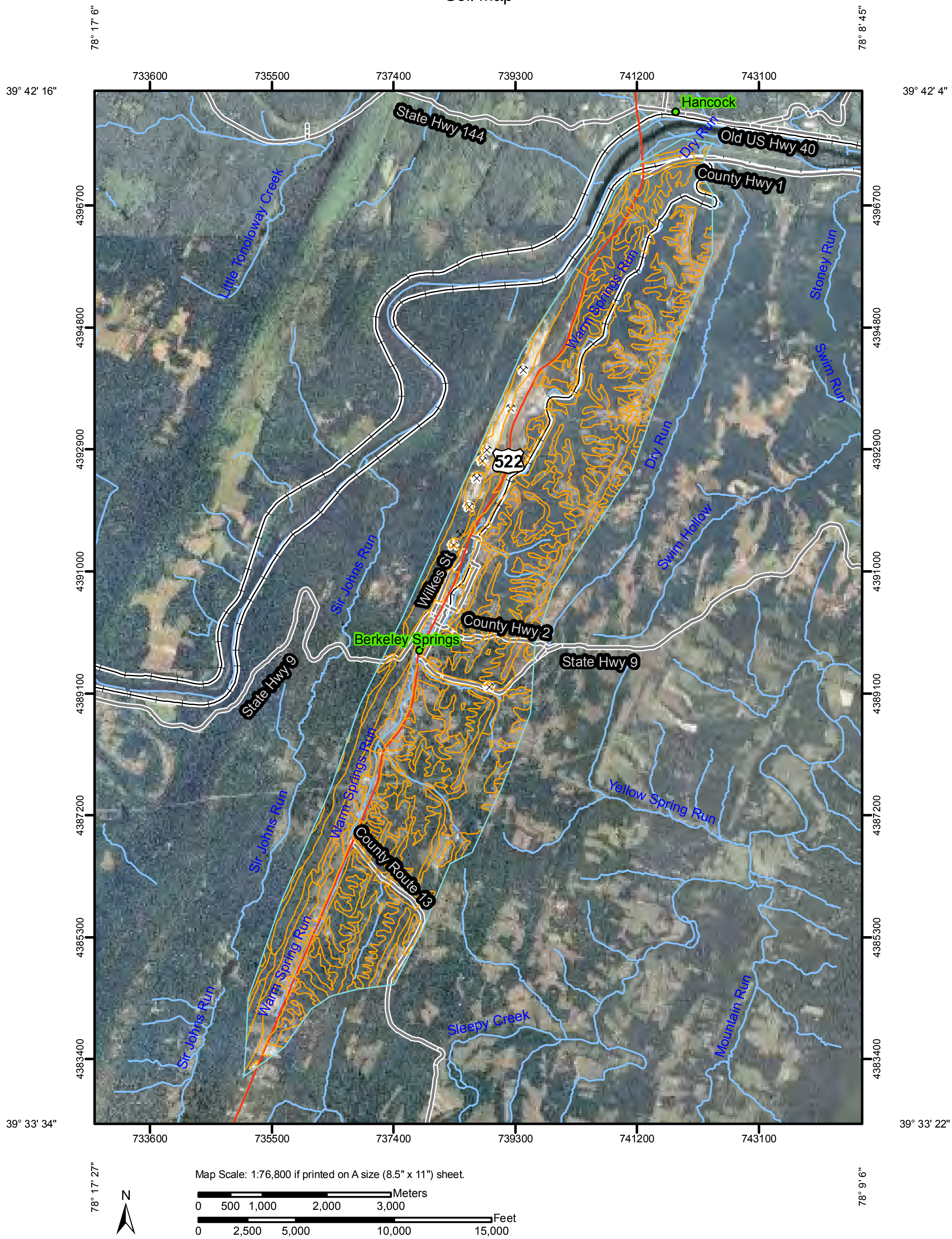
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:76,800 if printed on A size (8.5" x 11") sheet.

Meters: 0, 500, 1,000, 2,000, 3,000

Feet: 0, 2,500, 5,000, 10,000, 15,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Gully

Short Steep Slope

Other

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

MAP INFORMATION

Map Scale: 1:76,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Morgan County, West Virginia (WV065)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	224.4	2.9%
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	72.2	0.9%
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	19.8	0.3%
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	7.0	0.1%
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	34.2	0.4%
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	100.6	1.3%
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	43.3	0.6%
ClD	Caneyville silt loam, 15 to 25 percent slopes	3.8	0.0%
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	2.7	0.0%
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	88.8	1.2%
Cz	Combs fine sandy loam	16.8	0.2%
ErB	Ernest silt loam, 3 to 8 percent slopes	10.2	0.1%
ErC	Ernest silt loam, 8 to 15 percent slopes	12.4	0.2%
Ho	Holly silt loam	138.4	1.8%
Ln	Lindside silt loam	72.8	0.9%
Me	Melvin silt loam	0.2	0.0%
MrC	Murrill gravelly loam, 8 to 15 percent slopes	17.7	0.2%
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	171.4	2.2%
Pg	Philo gravelly loam	42.6	0.6%
Ph	Philo silt loam	10.7	0.1%
Qm	Quarry, limestone	1.2	0.0%
Qo	Quarry, sandstone	162.1	2.1%
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	23.6	0.3%
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly	161.1	2.1%
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	34.9	0.5%
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	295.4	3.9%
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	39.7	0.5%

Morgan County, West Virginia (WV065)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Ua	Udorthents, smoothed	391.1	5.1%
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes	288.5	3.8%
W	Water	13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	21.1	0.3%
WaC	Weikert channery silt loam, 8 to 15 percent slopes	340.0	4.4%
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	802.6	10.5%
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	1,709.5	22.3%
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	2,294.1	29.9%
Totals for Area of Interest		**7,667.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Morgan County, West Virginia

BeC—Berks-Clearbrook channery silt loams, 8 to 15 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Berks and similar soils: 55 percent
Clearbrook and similar soils: 40 percent
Minor components: 5 percent

Description of Berks

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Dry Uplands (DU2)

Typical profile

0 to 7 inches: Channery silt loam
7 to 21 inches: Very channery silt loam
21 to 25 inches: Extremely channery silt loam
25 to 29 inches: Bedrock

Description of Clearbrook

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.1 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Dry Uplands (DU2)

Typical profile

0 to 8 inches: Channery silt loam
8 to 19 inches: Very channery silty clay loam
19 to 22 inches: Extremely channery silty clay
22 to 26 inches: Bedrock

Minor Components

Cavode

Percent of map unit: 5 percent

BkB—Berks-Weikert channery silt loams, 3 to 8 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Berks and similar soils: 45 percent
Weikert and similar soils: 40 percent
Minor components: 15 percent

Description of Berks

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Dry Uplands (DU2)

Typical profile

0 to 7 inches: Channery silt loam
7 to 21 inches: Very channery silt loam
21 to 25 inches: Extremely channery silt loam
25 to 29 inches: Bedrock

Description of Weikert

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Droughty Shales (SD2)

Typical profile

0 to 6 inches: Channery silt loam
6 to 14 inches: Very channery silt loam
14 to 18 inches: Extremely channery silt loam
18 to 22 inches: Bedrock

Minor Components

Clearbrook

Percent of map unit: 10 percent

Cavode

Percent of map unit: 5 percent

BqF—Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Blackthorn and similar soils: 80 percent
Minor components: 20 percent

Description of Blackthorn

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Gravelly colluvium derived from sandstone over clayey residuum weathered from limestone

Properties and qualities

Slope: 35 to 55 percent
Surface area covered with cobbles, stones or boulders: 35.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Other vegetative classification: Not Suited (NS)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 2 inches: Very bouldery highly decomposed plant material
2 to 7 inches: Very gravelly sandy loam
7 to 47 inches: Very gravelly sandy loam
47 to 65 inches: Silty clay

Minor Components

Caneyville

Percent of map unit: 10 percent

Dekalb

Percent of map unit: 5 percent

Schaffenaker

Percent of map unit: 5 percent

BuB—Buchanan gravelly loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 370 to 2,210 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 120 to 180 days

Map Unit Composition

Buchanan and similar soils: 85 percent
Minor components: 15 percent

Description of Buchanan

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability (nonirrigated): 2e
Other vegetative classification: Acid Loams (AL2)

Typical profile

0 to 8 inches: Gravelly loam
8 to 33 inches: Gravelly loam

33 to 65 inches: Gravelly loam

Minor Components

Andover
Percent of map unit: 5 percent
Landform: Drainageways

Cavode
Percent of map unit: 5 percent

Calvin
Percent of map unit: 5 percent

BuC—Buchanan gravelly loam, 8 to 15 percent slopes

Map Unit Setting
Elevation: 370 to 2,210 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 120 to 180 days

Map Unit Composition
Buchanan and similar soils: 85 percent
Minor components: 15 percent

Description of Buchanan

Setting
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and shale

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups
Land capability (nonirrigated): 3e
Other vegetative classification: Acid Loams (AL2)

Typical profile

0 to 8 inches: Gravelly loam
8 to 33 inches: Gravelly loam
33 to 65 inches: Gravelly loam

Minor Components

Berks

Percent of map unit: 5 percent

Calvin

Percent of map unit: 5 percent

Andover

Percent of map unit: 4 percent
Landform: Drainageways

Litz

Percent of map unit: 1 percent

BxC—Buchanan loam, 3 to 15 percent slopes, extremely stony

Map Unit Setting

Elevation: 370 to 2,210 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 120 to 180 days

Map Unit Composition

Buchanan and similar soils: 85 percent
Minor components: 15 percent

Description of Buchanan

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and shale

Properties and qualities

Slope: 3 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 30 inches
Frequency of flooding: None

Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups
Land capability (nonirrigated): 7s
Other vegetative classification: Very Rocky, Acid Soils (RA2)

Typical profile
0 to 3 inches: Slightly decomposed plant material
3 to 4 inches: Moderately decomposed plant material
4 to 5 inches: Loam
5 to 33 inches: Gravelly loam
33 to 65 inches: Gravelly loam

Minor Components

Andover
Percent of map unit: 10 percent
Landform: Drainageways

Rubble land
Percent of map unit: 3 percent

Cavode
Percent of map unit: 1 percent

Udifluvents
Percent of map unit: 1 percent

BxE—Buchanan loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting
Elevation: 370 to 2,210 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition
Buchanan and similar soils: 85 percent
Minor components: 15 percent

Description of Buchanan

Setting
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and shale

Properties and qualities
Slope: 15 to 35 percent

Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 16 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.4 inches)

Interpretive groups
Land capability (nonirrigated): 7s
Other vegetative classification: Very Rocky, Acid Soils (RA2)

Typical profile
0 to 2 inches: Slightly decomposed plant material
2 to 4 inches: Loam
4 to 30 inches: Gravelly loam
30 to 65 inches: Gravelly loam

Minor Components

Rubble land
Percent of map unit: 10 percent

Hazleton
Percent of map unit: 2 percent

Berks
Percent of map unit: 1 percent

Calvin
Percent of map unit: 1 percent

Dekalb
Percent of map unit: 1 percent

ClD—Caneyville silt loam, 15 to 25 percent slopes

Map Unit Setting
Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition
Caneyville and similar soils: 85 percent
Minor components: 15 percent

Description of Caneyville

Setting
Landform: Hillslopes

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum weathered from limestone

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: Limy Uplands (LU2)

Typical profile

0 to 4 inches: Silt loam
4 to 12 inches: Gravelly silt loam
12 to 24 inches: Silty clay
24 to 28 inches: Bedrock

Minor Components

Opequon

Percent of map unit: 5 percent

Murrill

Percent of map unit: 5 percent

Blackthorn

Percent of map unit: 3 percent

Litz

Percent of map unit: 2 percent

Caneyville

Percent of map unit:
Other vegetative classification: Limy Uplands (LU1)

CrC—Clarksburg gravelly silt loam, 8 to 15 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Clarksburg and similar soils: 80 percent
Minor components: 20 percent

Description of Clarksburg

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Mixed loamy colluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Fertile Loams (FL2)

Typical profile

0 to 12 inches: Gravelly silt loam
12 to 29 inches: Silty clay loam
29 to 60 inches: Clay loam

Minor Components

Sideling

Percent of map unit: 8 percent

Murrill

Percent of map unit: 8 percent

Litz

Percent of map unit: 4 percent

CvB—Clearbrook-Cavode silt loams, 0 to 8 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches

Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Clearbrook and similar soils: 50 percent
Cavode and similar soils: 35 percent
Minor components: 15 percent

Description of Clearbrook

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.6 inches)

Interpretive groups

Land capability (nonirrigated): 3w
Other vegetative classification: Dry Uplands (DU2)

Typical profile

0 to 8 inches: Silt loam
8 to 19 inches: Very channery silty clay loam
19 to 22 inches: Extremely channery silty clay
22 to 26 inches: Bedrock

Description of Cavode

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Clayey residuum weathered from shale

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 40 to 72 inches to paralithic bedrock
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None

Frequency of ponding: None
Available water capacity: Moderate (about 8.0 inches)

Interpretive groups

Land capability (nonirrigated): 3w
Other vegetative classification: Acid Loams (AL2)

Typical profile

0 to 12 inches: Silt loam
12 to 51 inches: Silty clay loam
51 to 62 inches: Very channery silty clay loam
62 to 66 inches: Bedrock

Minor Components

Berks

Percent of map unit: 5 percent

Buchanan

Percent of map unit: 5 percent

Dunning

Percent of map unit: 5 percent
Landform: Flood plains

Cz—Combs fine sandy loam

Map Unit Setting

Elevation: 370 to 700 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Combs and similar soils: 85 percent
Minor components: 15 percent

Description of Combs

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Recent coarse-loamy alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 42 to 72 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: High (about 9.6 inches)

Interpretive groups
Land capability (nonirrigated): 2w
Other vegetative classification: Moist Loams (ML2)

Typical profile
0 to 20 inches: Fine sandy loam
20 to 53 inches: Fine sandy loam
53 to 65 inches: Fine sandy loam

Minor Components

Lindside
Percent of map unit: 10 percent

Typic udipsamments
Percent of map unit: 4 percent

Melvin
Percent of map unit: 1 percent
Landform: Flood plains

ErB—Ernest silt loam, 3 to 8 percent slopes

Map Unit Setting
Elevation: 300 to 3,000 feet
Mean annual precipitation: 34 to 55 inches
Mean annual air temperature: 46 to 59 degrees F
Frost-free period: 120 to 214 days

Map Unit Composition
Ernest and similar soils: 85 percent
Minor components: 15 percent

Description of Ernest

Setting
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 12 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability (nonirrigated): 2e
Other vegetative classification: Acid Loams (AL2)

Typical profile

0 to 7 inches: Silt loam
7 to 27 inches: Channery silty clay loam
27 to 43 inches: Channery silty clay loam
43 to 65 inches: Channery silt loam

Minor Components

Berks

Percent of map unit: 5 percent

Brinkerton

Percent of map unit: 5 percent
Landform: Depressions

Clearbrook

Percent of map unit: 3 percent

Holly

Percent of map unit: 1 percent
Landform: Flood plains

Philo

Percent of map unit: 1 percent

ErC—Ernest silt loam, 8 to 15 percent slopes

Map Unit Setting

Elevation: 300 to 1,300 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 120 to 214 days

Map Unit Composition

Ernest and similar soils: 80 percent
Minor components: 20 percent

Description of Ernest

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and shale

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 36 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 12 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.0 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Acid Loams (AL2)

Typical profile

0 to 6 inches: Silt loam
6 to 26 inches: Channery silty clay loam
26 to 42 inches: Channery silty clay loam
42 to 65 inches: Channery silt loam

Minor Components

Berks

Percent of map unit: 7 percent

Clearbrook

Percent of map unit: 6 percent

Brinkerton

Percent of map unit: 4 percent
Landform: Depressions

Rushtown

Percent of map unit: 3 percent

Ho—Holly silt loam

Map Unit Setting

Elevation: 370 to 700 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F

Frost-free period: 131 to 170 days

Map Unit Composition

Holly and similar soils: 80 percent
Minor components: 20 percent

Description of Holly

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Recent loamy alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: Occasional
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability (nonirrigated): 3w
Other vegetative classification: Wetlands (W2)

Typical profile

0 to 3 inches: Silt loam
3 to 24 inches: Silt loam
24 to 39 inches: Loam
39 to 65 inches: Gravelly sandy loam

Minor Components

Philo

Percent of map unit: 10 percent

Tygart

Percent of map unit: 7 percent

Brinkerton

Percent of map unit: 2 percent
Landform: Coves

Ernest

Percent of map unit: 1 percent

Ln—Lindside silt loam

Map Unit Setting

Elevation: 370 to 700 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Lindside and similar soils: 80 percent
Minor components: 20 percent

Description of Lindside

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Recent fine-silty alluvium derived from limestone

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: High (about 11.6 inches)

Interpretive groups

Land capability (nonirrigated): 2w
Other vegetative classification: Moist Loams (ML2)

Typical profile

0 to 7 inches: Silt loam
7 to 48 inches: Silty clay loam
48 to 60 inches: Stratified gravelly sandy loam to silt loam to silty clay loam

Minor Components

Tioga

Percent of map unit: 10 percent

Melvin

Percent of map unit: 5 percent
Landform: Flood plains

Dunning

Percent of map unit: 5 percent
Landform: Flood plains

Me—Melvin silt loam

Map Unit Setting

Elevation: 370 to 700 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Melvin and similar soils: 90 percent
Minor components: 10 percent

Description of Melvin

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Recent fine-silty alluvium derived from limestone, sandstone, and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: Occasional
Available water capacity: Very high (about 12.3 inches)

Interpretive groups

Land capability (nonirrigated): 3w
Other vegetative classification: Wetlands (W2)

Typical profile

0 to 10 inches: Silt loam
10 to 36 inches: Silty clay loam
36 to 68 inches: Sandy loam
68 to 72 inches: Silt loam

Minor Components

Lindside

Percent of map unit: 7 percent

Ernest

Percent of map unit: 3 percent

MrC—Murrill gravelly loam, 8 to 15 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Murrill and similar soils: 90 percent
Minor components: 10 percent

Description of Murrill

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone over residuum weathered from limestone

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Fertile Loams (FL2)

Typical profile

0 to 9 inches: Gravelly loam
9 to 55 inches: Gravelly clay loam
55 to 72 inches: Silty clay loam

Minor Components

Clarksburg

Percent of map unit: 5 percent

Buchanan

Percent of map unit: 2 percent

Caneyville

Percent of map unit: 2 percent

Litz

Percent of map unit: 1 percent

MsE—Murrill loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Murrill and similar soils: 85 percent
Minor components: 15 percent

Description of Murrill

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone over residuum weathered from limestone

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.0 inches)

Interpretive groups

Land capability (nonirrigated): 7s

Other vegetative classification: Very Rocky, Limy Soils (RL2)

Typical profile

0 to 9 inches: Loam
9 to 43 inches: Gravelly loam
43 to 60 inches: Silty clay

Minor Components

Buchanan

Percent of map unit: 10 percent

Caneyville

Percent of map unit: 3 percent

Litz

Percent of map unit: 2 percent

Pg—Philo gravelly loam

Map Unit Setting

Elevation: 370 to 700 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Philo and similar soils: 75 percent
Minor components: 25 percent

Description of Philo

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Recent coarse-loamy alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: Moderate (about 8.4 inches)

Interpretive groups
Land capability (nonirrigated): 2w
Other vegetative classification: Acid Loams (AL2)

Typical profile
0 to 9 inches: Gravelly loam
9 to 48 inches: Gravelly loam
48 to 65 inches: Stratified sand to gravelly loam

Minor Components

Pope
Percent of map unit: 10 percent

Melvin
Percent of map unit: 5 percent
Landform: Flood plains

Holly
Percent of map unit: 5 percent
Landform: Flood plains

Ernest
Percent of map unit: 3 percent

Tygart
Percent of map unit: 2 percent

Ph—Philo silt loam

Map Unit Setting
Elevation: 370 to 700 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition
Philo and similar soils: 75 percent
Minor components: 25 percent

Description of Philo

Setting
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Recent coarse-loamy alluvium derived from sandstone and shale

Properties and qualities
Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups
Land capability (nonirrigated): 2w
Other vegetative classification: Acid Loams (AL2)

Typical profile
0 to 10 inches: Silt loam
10 to 53 inches: Silt loam
53 to 65 inches: Stratified sand to very gravelly sandy loam

Minor Components

Pope
Percent of map unit: 10 percent

Melvin
Percent of map unit: 5 percent
Landform: Flood plains

Holly
Percent of map unit: 5 percent
Landform: Flood plains

Ernest
Percent of map unit: 3 percent

Tygart
Percent of map unit: 2 percent

Qm—Quarry, limestone

Map Unit Setting
Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition
Quarry, limestone: 97 percent
Minor components: 3 percent

Description of Quarry, Limestone

Properties and qualities
Slope: 0 to 200 percent

Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups
Other vegetative classification: Not Suited (NS)

Typical profile
0 to 60 inches: Bedrock

Minor Components

Caneyville
Percent of map unit: 1 percent

Murrill
Percent of map unit: 1 percent

Opequon
Percent of map unit: 1 percent

Qo—Quarry, sandstone

Map Unit Setting
Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition
Quarry, sandstone: 95 percent
Minor components: 5 percent

Description of Quarry, Sandstone

Properties and qualities
Slope: 0 to 200 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups
Other vegetative classification: Not Suited (NS)

Typical profile
0 to 60 inches: Bedrock

Minor Components

Schaffenaker
Percent of map unit: 2 percent

Vanderlip

Percent of map unit: 2 percent

Dekalb

Percent of map unit: 1 percent

ShC—Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery

Map Unit Setting

Elevation: 800 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Schaffenaker and similar soils: 80 percent
Minor components: 20 percent

Description of Schaffenaker

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy residuum weathered from sandstone

Properties and qualities

Slope: 3 to 15 percent
Surface area covered with cobbles, stones or boulders: 2.1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Other vegetative classification: Very Rocky, Acid Soils (RA2)

Typical profile

0 to 0 inches: Slightly decomposed plant material
0 to 1 inches: Moderately decomposed plant material
1 to 4 inches: Loamy sand
4 to 18 inches: Gravelly loamy sand
18 to 24 inches: Gravelly loamy sand
24 to 28 inches: Bedrock

Minor Components

Lithic quartzipsamments

Percent of map unit: 7 percent

Vanderlip

Percent of map unit: 5 percent

Dekalb

Percent of map unit: 5 percent

Aquic quartzipsamments

Percent of map unit: 2 percent

Rock outcrop

Percent of map unit: 1 percent

SkF—Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly

Map Unit Setting

Elevation: 800 to 1,200 feet
Mean annual precipitation: 27 to 44 inches
Mean annual air temperature: 36 to 56 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Schaffenaker and similar soils: 45 percent
Rock outcrop: 40 percent
Minor components: 15 percent

Description of Schaffenaker

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy residuum weathered from sandstone

Properties and qualities

Slope: 35 to 65 percent
Surface area covered with cobbles, stones or boulders: 40.0 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability (nonirrigated): 8s
Other vegetative classification: Not Suited (NS)

Typical profile

0 to 0 inches: Slightly decomposed plant material
0 to 1 inches: Moderately decomposed plant material
1 to 4 inches: Loamy sand
4 to 18 inches: Gravelly loamy sand
18 to 24 inches: Gravelly loamy sand
24 to 28 inches: Bedrock

Description of Rock Outcrop

Properties and qualities

Slope: 100 to 200 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)

Interpretive groups

Land capability (nonirrigated): 8s

Typical profile

0 to 60 inches: Bedrock

Minor Components

Lithic quartzipsamments

Percent of map unit: 8 percent

Vanderlip

Percent of map unit: 5 percent

Dekalb

Percent of map unit: 2 percent

Schaffenaker

Percent of map unit:
Other vegetative classification: Not Suited (NS)

SnE—Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery

Map Unit Setting

Elevation: 800 to 1,200 feet
Mean annual precipitation: 27 to 44 inches
Mean annual air temperature: 36 to 56 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Schaffenaker and similar soils: 45 percent
Vanderlip and similar soils: 40 percent
Minor components: 15 percent

Description of Schaffenaker

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy residuum weathered from sandstone

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 2.1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Other vegetative classification: Very Rocky, Acid Soils (RA2)

Typical profile

0 to 0 inches: Slightly decomposed plant material
0 to 1 inches: Moderately decomposed plant material
1 to 4 inches: Loamy sand
4 to 18 inches: Gravelly loamy sand
18 to 24 inches: Gravelly loamy sand
24 to 28 inches: Bedrock

Description of Vanderlip

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy residuum weathered from sandstone

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 2.1 percent
Depth to restrictive feature: 96 to 120 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Interpretive groups
Land capability (nonirrigated): 7s
Other vegetative classification: Very Rocky, Acid Soils (RA2)

Typical profile
0 to 2 inches: Slightly decomposed plant material
2 to 6 inches: Loamy sand
6 to 26 inches: Very cobbly loamy sand
26 to 50 inches: Sand
50 to 65 inches: Very bouldery sand

Minor Components

Dekalb
Percent of map unit: 5 percent

Hazleton
Percent of map unit: 5 percent

Lithic quartizpsamments
Percent of map unit: 2 percent

Sideling
Percent of map unit: 2 percent

Rock outcrop
Percent of map unit: 1 percent

Vanderlip
Percent of map unit:
Other vegetative classification: Very Rocky, Acid Soils (RA1)

Schaffenaker
Percent of map unit:
Other vegetative classification: Very Rocky, Acid Soils (RA1)

SnF—Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery

Map Unit Setting
Elevation: 800 to 1,200 feet
Mean annual precipitation: 27 to 44 inches
Mean annual air temperature: 36 to 56 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition
Schaffenaker and similar soils: 40 percent

Vanderlip and similar soils: 40 percent
Minor components: 20 percent

Description of Vanderlip

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy residuum weathered from sandstone

Properties and qualities

Slope: 35 to 65 percent
Surface area covered with cobbles, stones or boulders: 2.1 percent
Depth to restrictive feature: 96 to 120 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Other vegetative classification: Not Suited (NS)

Typical profile

0 to 2 inches: Slightly decomposed plant material
2 to 6 inches: Loamy sand
6 to 26 inches: Very cobbly loamy sand
26 to 50 inches: Sand
50 to 65 inches: Very bouldery sand

Description of Schaffenaker

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy residuum weathered from sandstone

Properties and qualities

Slope: 35 to 65 percent
Surface area covered with cobbles, stones or boulders: 2.1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups
Land capability (nonirrigated): 7s
Other vegetative classification: Not Suited (NS)

Typical profile
0 to 0 inches: Slightly decomposed plant material
0 to 1 inches: Moderately decomposed plant material
1 to 4 inches: Loamy sand
4 to 18 inches: Gravelly loamy sand
18 to 24 inches: Gravelly loamy sand
24 to 28 inches: Bedrock

Minor Components

Dekalb
Percent of map unit: 5 percent

Hazleton
Percent of map unit: 5 percent

Sideling
Percent of map unit: 5 percent

Lithic quartzipsamments
Percent of map unit: 4 percent

Rock outcrop
Percent of map unit: 1 percent

Vanderlip
Percent of map unit:
Other vegetative classification: Very Rocky, Acid Soils (RA1)

Schaffenaker
Percent of map unit:
Other vegetative classification: Not Suited (NS)

SxE—Sideling gravelly loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting
Elevation: 370 to 2,500 feet
Mean annual precipitation: 34 to 55 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 180 days

Map Unit Composition
Sideling and similar soils: 80 percent
Minor components: 20 percent

Description of Sideling

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvium derived from sandstone and siltstone; loamy colluvium derived from shale and siltstone

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 60 to 96 inches to paralithic bedrock
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Other vegetative classification: Very Rocky, Acid Soils (RA2)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 3 inches: Moderately decomposed plant material
3 to 5 inches: Gravelly loam
5 to 35 inches: Gravelly loam
35 to 50 inches: Channery clay
50 to 62 inches: Very flaggy clay loam

Minor Components

Hazleton

Percent of map unit: 10 percent

Buchanan

Percent of map unit: 5 percent

Berks

Percent of map unit: 2 percent

Calvin

Percent of map unit: 2 percent

Andover

Percent of map unit: 1 percent
Landform: Drainageways

Ua—Udorthents, smoothed

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Udorthents and similar soils: 95 percent
Minor components: 5 percent

Description of Udorthents

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Other vegetative classification: Not Suited (NS)

Minor Components

Berks

Percent of map unit: 1 percent

Weikert

Percent of map unit: 1 percent

Urban land

Percent of map unit: 1 percent

Ernest

Percent of map unit: 1 percent

Clearbrook

Percent of map unit: 1 percent

Uu—Urban land-Udorthents complex, 0 to 25 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches

Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Urban land: 45 percent
Udorthents and similar soils: 45 percent
Minor components: 10 percent

Description of Udorthents

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Other vegetative classification: Not Suited (NS)

Typical profile

0 to 6 inches: Variable

Description of Urban Land

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: 10 inches to
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)

Interpretive groups

Other vegetative classification: Not Suited (NS)

Typical profile

0 to Variable

Minor Components

Berks

Percent of map unit: 2 percent

Philo

Percent of map unit: 2 percent

Weikert

Percent of map unit: 2 percent

Buchanan

Percent of map unit: 1 percent

Ernest

Percent of map unit: 1 percent

Clearbrook

Percent of map unit: 1 percent

Vanderlip

Percent of map unit: 1 percent

W—Water

Map Unit Setting

Elevation: 370 to 2,210 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Water: 100 percent

WaB—Weikert channery silt loam, 3 to 8 percent slopes

Map Unit Setting

Elevation: 370 to 1,600 feet
Mean annual precipitation: 27 to 50 inches
Mean annual air temperature: 36 to 57 degrees F
Frost-free period: 120 to 200 days

Map Unit Composition

Weikert and similar soils: 85 percent
Minor components: 15 percent

Description of Weikert

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.3 inches)

Interpretive groups

Land capability (nonirrigated): 3e
Other vegetative classification: Droughty Shales (SD2)

Typical profile

0 to 6 inches: Channery silt loam
6 to 11 inches: Very channery silt loam
11 to 14 inches: Extremely channery silt loam
14 to 18 inches: Bedrock

Minor Components

Rough

Percent of map unit: 9 percent

Clearbrook

Percent of map unit: 5 percent

Rock outcrop

Percent of map unit: 1 percent

WaC—Weikert channery silt loam, 8 to 15 percent slopes

Map Unit Setting

Elevation: 370 to 1,600 feet
Mean annual precipitation: 27 to 50 inches
Mean annual air temperature: 36 to 57 degrees F
Frost-free period: 120 to 200 days

Map Unit Composition

Weikert and similar soils: 85 percent
Minor components: 15 percent

Description of Weikert

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Available water capacity: Very low (about 1.2 inches)

Interpretive groups

Land capability (nonirrigated): 4e
Other vegetative classification: Droughty Shales (SD2)

Typical profile

0 to 5 inches: Channery silt loam
5 to 10 inches: Very channery silt loam
10 to 13 inches: Extremely channery silt loam
13 to 17 inches: Bedrock

Minor Components

Rough

Percent of map unit: 9 percent

Clearbrook

Percent of map unit: 5 percent

Rock outcrop

Percent of map unit: 1 percent

WbC—Weikert-Berks channery silt loams, 8 to 15 percent slopes

Map Unit Setting

Elevation: 370 to 1,200 feet
Mean annual precipitation: 34 to 44 inches
Mean annual air temperature: 51 to 55 degrees F
Frost-free period: 131 to 170 days

Map Unit Composition

Weikert and similar soils: 45 percent
Berks and similar soils: 40 percent
Minor components: 15 percent

Description of Weikert

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.6 inches)

Interpretive groups
Land capability (nonirrigated): 4e
Other vegetative classification: Droughty Shales (SD2)

Typical profile
0 to 6 inches: Channery silt loam
6 to 14 inches: Very channery silt loam
14 to 18 inches: Extremely channery silt loam
18 to 22 inches: Bedrock

Description of Berks

Setting
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups
Land capability (nonirrigated): 4e
Other vegetative classification: Dry Uplands (DU2)

Typical profile
0 to 7 inches: Channery silt loam
7 to 12 inches: Channery silt loam
12 to 21 inches: Very channery silt loam
21 to 25 inches: Extremely channery silt loam
25 to 29 inches: Bedrock

Minor Components

Clearbrook
Percent of map unit: 9 percent

Ernest
Percent of map unit: 3 percent

Cavode
Percent of map unit: 2 percent

Rushtown

Percent of map unit: 1 percent

WbD—Weikert-Berks channery silt loams, 15 to 25 percent slopes

Map Unit Setting

Elevation: 300 to 1,600 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 217 days

Map Unit Composition

Weikert and similar soils: 50 percent
Berks and similar soils: 35 percent
Minor components: 15 percent

Description of Weikert

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.4 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: Shale Hills (SH2)

Typical profile

0 to 4 inches: Channery silt loam
4 to 12 inches: Very channery silt loam
12 to 16 inches: Extremely channery silt loam
16 to 20 inches: Bedrock

Description of Berks

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.8 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: Dry Uplands (DU2)

Typical profile

0 to 5 inches: Channery silt loam
5 to 10 inches: Channery silt loam
10 to 19 inches: Very channery silt loam
19 to 23 inches: Extremely channery loam
23 to 27 inches: Bedrock

Minor Components

Ernest

Percent of map unit: 5 percent

Rough

Percent of map unit: 4 percent

Philo

Percent of map unit: 2 percent

Cavode

Percent of map unit: 1 percent

Rock outcrop

Percent of map unit: 1 percent

Clearbrook

Percent of map unit: 1 percent

Rushtown

Percent of map unit: 1 percent

Berks

Percent of map unit:
Other vegetative classification: Dry Uplands (DU1)

Weikert

Percent of map unit:
Other vegetative classification: Shale Hills (SH1)

WkF—Weikert-Berks very channery silt loams, 25 to 70 percent slope

Map Unit Setting

Elevation: 300 to 1,600 feet
Mean annual precipitation: 34 to 50 inches
Mean annual air temperature: 46 to 57 degrees F
Frost-free period: 120 to 217 days

Map Unit Composition

Weikert and similar soils: 50 percent
Berks and similar soils: 35 percent
Minor components: 15 percent

Description of Weikert

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.5 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Not Suited (NS)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 3 inches: Very channery silt loam
3 to 14 inches: Very channery silt loam
14 to 18 inches: Bedrock

Description of Berks

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Gravelly residuum weathered from sandstone and shale

Properties and qualities

Slope: 25 to 70 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.4 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Not Suited (NS)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 3 inches: Very channery silt loam
3 to 13 inches: Very channery loam
13 to 25 inches: Very channery silt loam
25 to 29 inches: Bedrock

Minor Components

Ernest

Percent of map unit: 6 percent

Rough

Percent of map unit: 4 percent

Philo

Percent of map unit: 2 percent

Rock outcrop

Percent of map unit: 1 percent

Pope

Percent of map unit: 1 percent

Rushtown

Percent of map unit: 1 percent

Berks

Percent of map unit:
Other vegetative classification: Dry Uplands (DU1)

Weikert

Percent of map unit:
Other vegetative classification: Shale Hills (SH1)

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

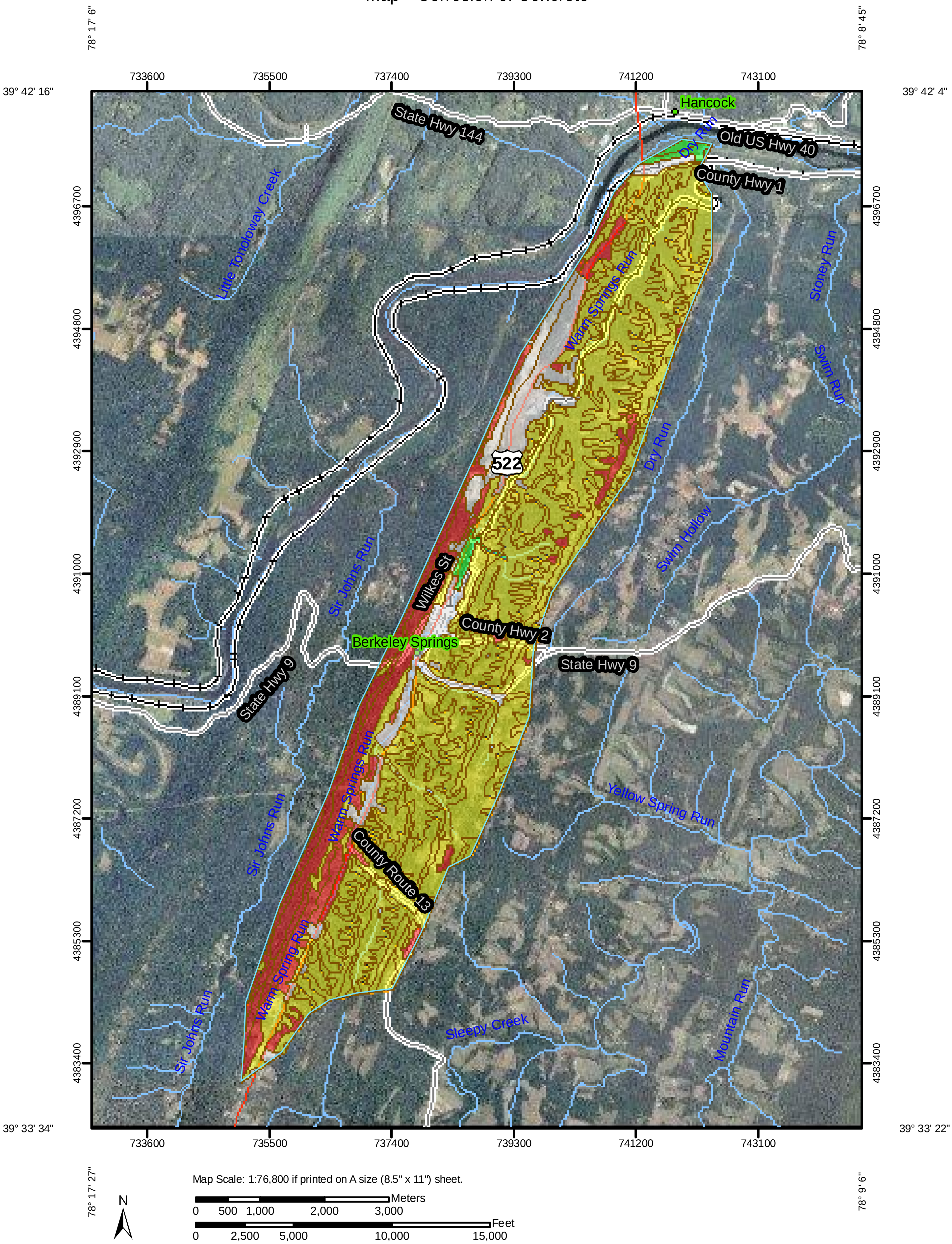
Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Corrosion of Concrete

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Map—Corrosion of Concrete



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

High

Moderate

Low

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

MAP INFORMATION

Map Scale: 1:76,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Concrete

Corrosion of Concrete— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	High	224.4	2.9%
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	High	72.2	0.9%
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	High	19.8	0.3%
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	High	7.0	0.1%
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	High	34.2	0.4%
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	High	100.6	1.3%
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	High	43.3	0.6%
ClD	Caneyville silt loam, 15 to 25 percent slopes	Moderate	3.8	0.0%
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	Moderate	2.7	0.0%
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	Moderate	88.8	1.2%
Cz	Combs fine sandy loam	Low	16.8	0.2%
ErB	Ernest silt loam, 3 to 8 percent slopes	Moderate	10.2	0.1%
ErC	Ernest silt loam, 8 to 15 percent slopes	Moderate	12.4	0.2%
Ho	Holly silt loam	Moderate	138.4	1.8%
Ln	Lindside silt loam	Low	72.8	0.9%
Me	Melvin silt loam	Low	0.2	0.0%
MrC	Murrill gravelly loam, 8 to 15 percent slopes	High	17.7	0.2%
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	High	171.4	2.2%
Pg	Philo gravelly loam	High	42.6	0.6%
Ph	Philo silt loam	High	10.7	0.1%
Qm	Quarry, limestone		1.2	0.0%
Qo	Quarry, sandstone		162.1	2.1%
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	High	23.6	0.3%
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly	High	161.1	2.1%
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	High	34.9	0.5%

Corrosion of Concrete— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	High	295.4	3.9%
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	Moderate	39.7	0.5%
Ua	Udorthents, smoothed		391.1	5.1%
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes		288.5	3.8%
W	Water		13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	Moderate	21.1	0.3%
WaC	Weikert channery silt loam, 8 to 15 percent slopes	Moderate	340.0	4.4%
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	Moderate	802.6	10.5%
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	Moderate	1,709.5	22.3%
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	Moderate	2,294.1	29.9%
Totals for Area of Interest			**7,667.9**	**100.0%**

Rating Options—Corrosion of Concrete

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

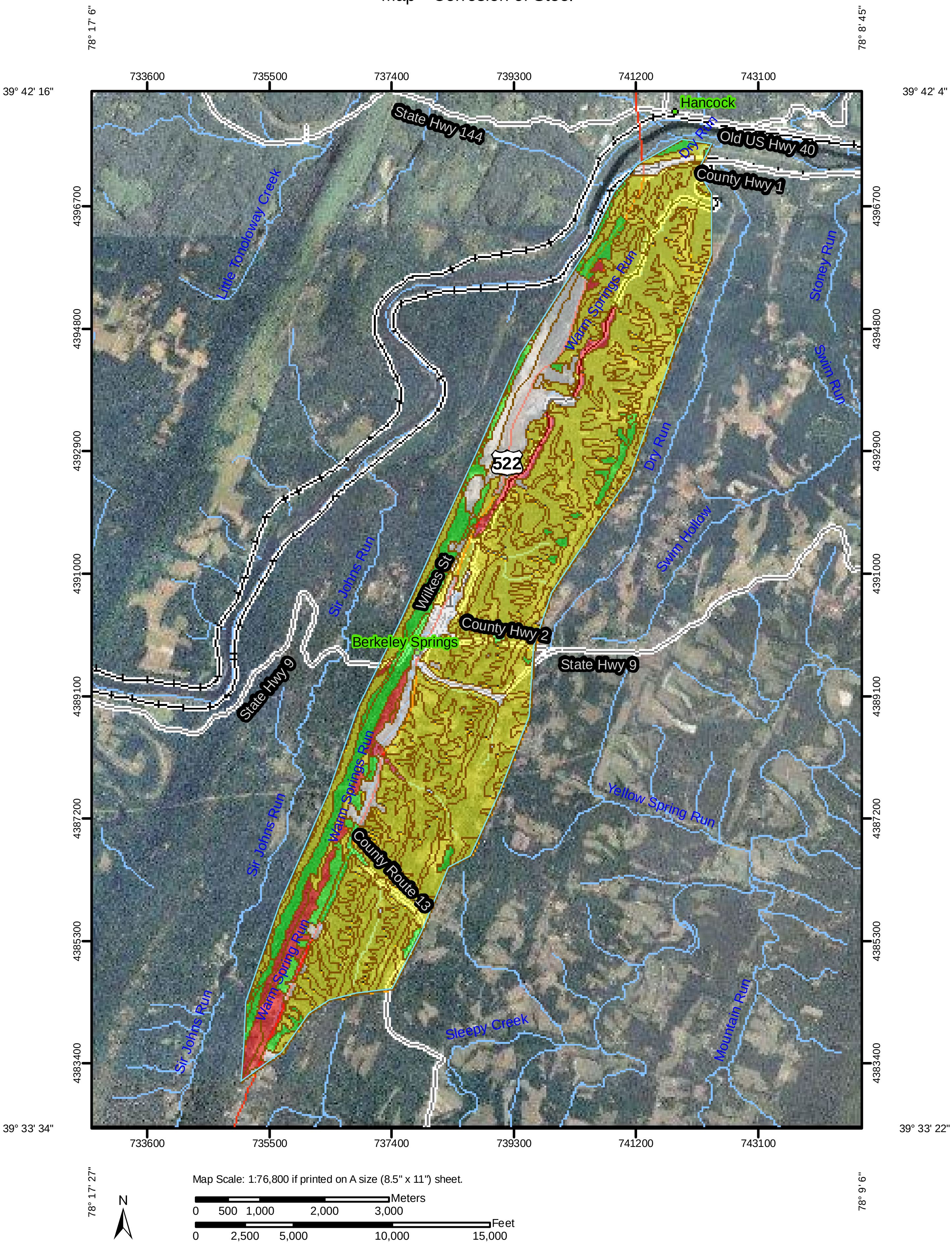
Tie-break Rule: Higher

Corrosion of Steel

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Map—Corrosion of Steel



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- High
- Moderate
- Low
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:76,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Corrosion of Steel

Corrosion of Steel— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	Low	224.4	2.9%
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	Low	72.2	0.9%
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	Moderate	19.8	0.3%
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	High	7.0	0.1%
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	High	34.2	0.4%
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	High	100.6	1.3%
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	High	43.3	0.6%
ClD	Caneyville silt loam, 15 to 25 percent slopes	High	3.8	0.0%
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	Moderate	2.7	0.0%
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	High	88.8	1.2%
Cz	Combs fine sandy loam	Low	16.8	0.2%
ErB	Ernest silt loam, 3 to 8 percent slopes	Moderate	10.2	0.1%
ErC	Ernest silt loam, 8 to 15 percent slopes	Moderate	12.4	0.2%
Ho	Holly silt loam	High	138.4	1.8%
Ln	Lindside silt loam	Moderate	72.8	0.9%
Me	Melvin silt loam	High	0.2	0.0%
MrC	Murrill gravelly loam, 8 to 15 percent slopes	Moderate	17.7	0.2%
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	Moderate	171.4	2.2%
Pg	Philo gravelly loam	Low	42.6	0.6%
Ph	Philo silt loam	Low	10.7	0.1%
Qm	Quarry, limestone		1.2	0.0%
Qo	Quarry, sandstone		162.1	2.1%
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	Low	23.6	0.3%
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly	Low	161.1	2.1%
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	Low	34.9	0.5%

Corrosion of Steel— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	Low	295.4	3.9%
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	High	39.7	0.5%
Ua	Udorthents, smoothed		391.1	5.1%
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes		288.5	3.8%
W	Water		13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	Moderate	21.1	0.3%
WaC	Weikert channery silt loam, 8 to 15 percent slopes	Moderate	340.0	4.4%
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	Moderate	802.6	10.5%
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	Moderate	1,709.5	22.3%
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	Moderate	2,294.1	29.9%
Totals for Area of Interest			**7,667.9**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Land Management

Land management interpretations are tools designed to guide the user in evaluating existing conditions in planning and predicting the soil response to various land management practices, for a variety of land uses, including cropland, forestland, hayland, pastureland, horticulture, and rangeland. Example interpretations include suitability for a variety of irrigation practices, log landings, haul roads and major skid trails, equipment operability, site preparation, suitability for hand and mechanical planting, potential erosion hazard associated with various practices, and ratings for fencing and waterline installation.

Erosion Hazard (Road, Trail)

The ratings in this interpretation indicate the hazard of soil loss from unsurfaced roads and trails. The ratings are based on soil erosion factor K, slope, and content of rock fragments.

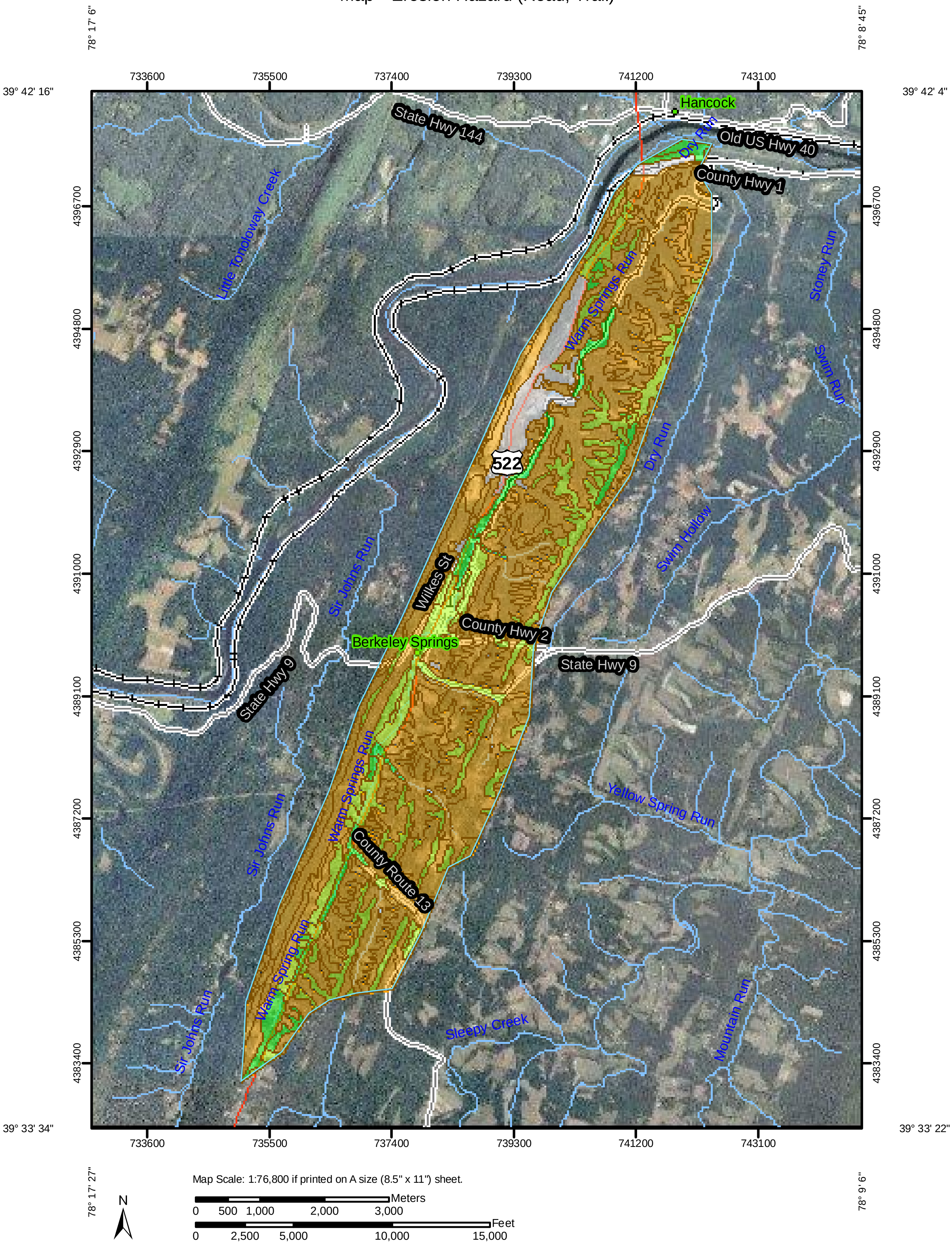
The ratings are both verbal and numerical. The hazard is described as "slight," "moderate," or "severe." A rating of "slight" indicates that little or no erosion is likely; "moderate" indicates that some erosion is likely, that the roads or trails may require occasional maintenance, and that simple erosion-control measures are needed; and "severe" indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Map—Erosion Hazard (Road, Trail)



Map Scale: 1:76,800 if printed on A size (8.5" x 11") sheet.

Meters: 0, 500, 1,000, 2,000, 3,000

Feet: 0, 2,500, 5,000, 10,000, 15,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

Very severe

Severe

Moderate

Slight

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

MAP INFORMATION

Map Scale: 1:76,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Erosion Hazard (Road, Trail)

Erosion Hazard (Road, Trail)— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	Moderate	Berks (55%)	Slope/erodibility (0.50)	224.4	2.9%
			Clearbrook (40%)	Slope/erodibility (0.50)		
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	Slight	Berks (45%)		72.2	0.9%
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	Severe	Blackthorn (80%)	Slope/erodibility (0.95)	19.8	0.3%
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	Moderate	Buchanan (85%)	Slope/erodibility (0.50)	7.0	0.1%
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	Severe	Buchanan (85%)	Slope/erodibility (0.95)	34.2	0.4%
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	Severe	Buchanan (85%)	Slope/erodibility (0.95)	100.6	1.3%
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	Severe	Buchanan (85%)	Slope/erodibility (0.95)	43.3	0.6%
ClD	Caneyville silt loam, 15 to 25 percent slopes	Severe	Caneyville (85%)	Slope/erodibility (0.95)	3.8	0.0%
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	Severe	Clarksburg (80%)	Slope/erodibility (0.95)	2.7	0.0%
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	Slight	Clearbrook (50%)		88.8	1.2%
Cz	Combs fine sandy loam	Slight	Combs (85%)		16.8	0.2%
ErB	Ernest silt loam, 3 to 8 percent slopes	Moderate	Ernest (85%)	Slope/erodibility (0.50)	10.2	0.1%
			Brinkerton (5%)	Slope/erodibility (0.50)		
ErC	Ernest silt loam, 8 to 15 percent slopes	Severe	Ernest (80%)	Slope/erodibility (0.95)	12.4	0.2%
			Brinkerton (4%)	Slope/erodibility (0.95)		
Ho	Holly silt loam	Slight	Holly (80%)		138.4	1.8%
Ln	Lindside silt loam	Slight	Lindside (80%)		72.8	0.9%
Me	Melvin silt loam	Slight	Melvin (90%)		0.2	0.0%
			Lindside (7%)			
MrC	Murrill gravelly loam, 8 to 15 percent slopes	Severe	Murrill (90%)	Slope/erodibility (0.95)	17.7	0.2%

Erosion Hazard (Road, Trail)— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	Severe	Murrill (85%)	Slope/erodibility (0.95)	171.4	2.2%
Pg	Philo gravelly loam	Slight	Philo (75%)		42.6	0.6%
Ph	Philo silt loam	Slight	Philo (75%)		10.7	0.1%
Qm	Quarry, limestone	Severe	Quarry, limestone (97%)	Slope/erodibility (0.95)	1.2	0.0%
				Slope/erodibility (0.95)		
Qo	Quarry, sandstone	Severe	Quarry, sandstone (95%)	Slope/erodibility (0.95)	162.1	2.1%
				Slope/erodibility (0.95)		
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	Moderate	Schaffenaker (80%)	Slope/erodibility (0.50)	23.6	0.3%
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly	Severe	Schaffenaker (45%)	Slope/erodibility (0.95)	161.1	2.1%
			Rock outcrop (40%)	Slope/erodibility (0.95)		
				Slope/erodibility (0.95)		
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	Severe	Schaffenaker (45%)	Slope/erodibility (0.95)	34.9	0.5%
			Vanderlip (40%)	Slope/erodibility (0.95)		
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	Severe	Vanderlip (40%)	Slope/erodibility (0.95)	295.4	3.9%
			Schaffenaker (40%)	Slope/erodibility (0.95)		
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	Moderate	Sideling (80%)	Slope/erodibility (0.50)	39.7	0.5%
			Hazleton (10%)	Slope/erodibility (0.50)		
Ua	Udorthents, smoothed	Not rated	Udorthents (95%)		391.1	5.1%
			Weikert (1%)			
			Urban land (1%)			
			Ernest (1%)			
			Clearbrook (1%)			
			Berks (1%)			
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes	Moderate	Udorthents (45%)	Slope/erodibility (0.50)	288.5	3.8%
				Slope/erodibility (0.50)		
			Urban land (45%)	Slope/erodibility (0.50)		
				Slope/erodibility (0.50)		
W	Water	Not rated	Water (100%)		13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	Moderate	Weikert (85%)	Slope/erodibility (0.50)	21.1	0.3%
			Rough (9%)	Slope/erodibility (0.50)		
			Clearbrook (5%)	Slope/erodibility (0.50)		

Erosion Hazard (Road, Trail)— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
WaC	Weikert channery silt loam, 8 to 15 percent slopes	Severe	Weikert (85%)	Slope/erodibility (0.95)	340.0	4.4%
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	Moderate	Weikert (45%)	Slope/erodibility (0.50)	802.6	10.5%
			Berks (40%)	Slope/erodibility (0.50)		
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	Severe	Weikert (50%)	Slope/erodibility (0.95)	1,709.5	22.3%
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	Severe	Weikert (50%)	Slope/erodibility (0.95)	2,294.1	29.9%
			Berks (35%)	Slope/erodibility (0.95)		
Totals for Area of Interest					**7,667.9**	**100.0%**

Erosion Hazard (Road, Trail)— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Severe	5,404.2	70.5%
Moderate	1,417.0	18.5%
Slight	442.6	5.8%
Null or Not Rated	404.2	5.3%
Totals for Area of Interest	**7,667.9**	**100.0%**

Rating Options—Erosion Hazard (Road, Trail)

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Sanitary Facilities

Sanitary Facilities interpretations are tools designed to guide the user in site selection for the safe disposal of sewage and solid waste. Example interpretations include septic tank absorption fields, sewage lagoons, and sanitary landfills.

Septic Tank Absorption Fields

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

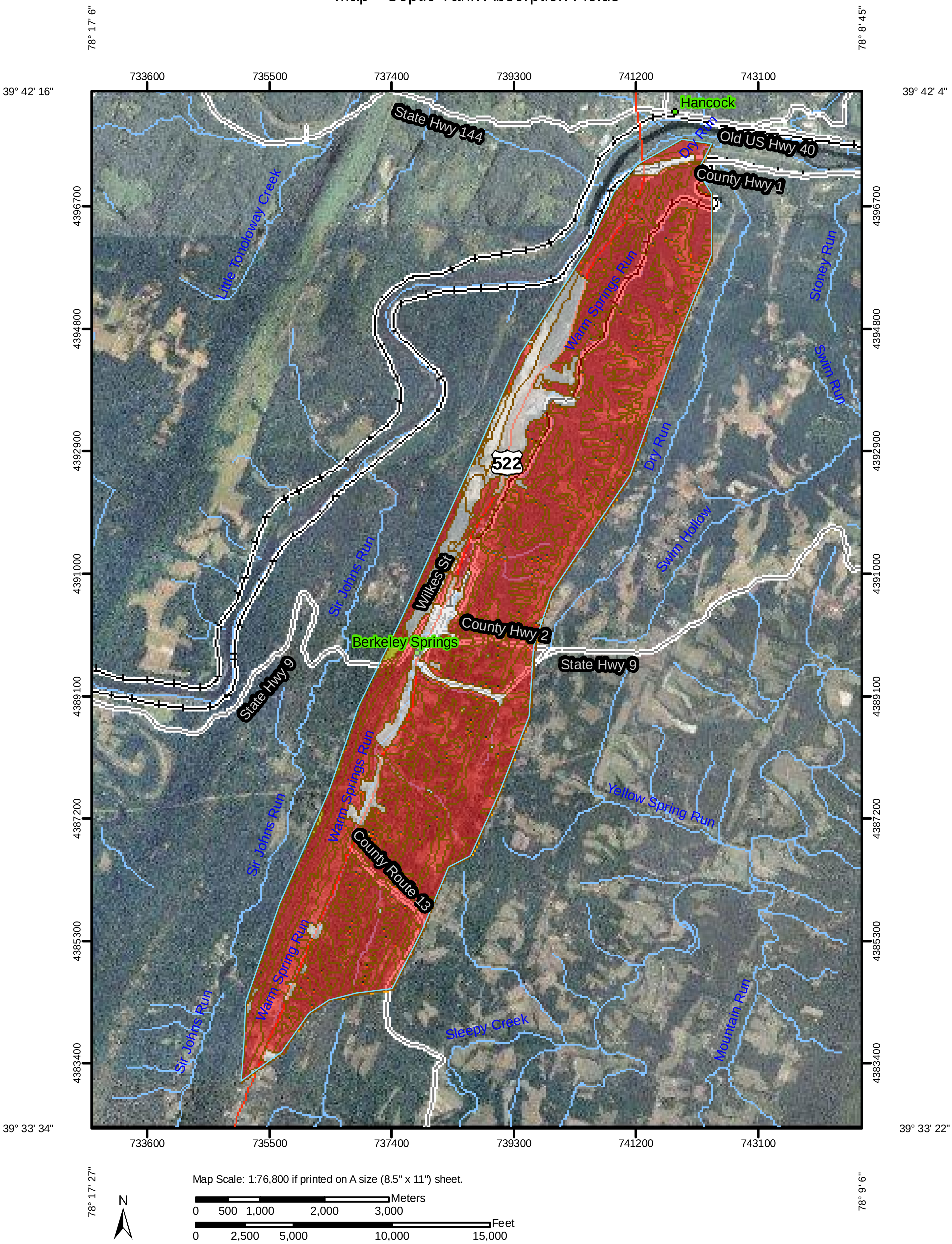
The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Map—Septic Tank Absorption Fields



Map Scale: 1:76,800 if printed on A size (8.5" x 11") sheet.

Meters: 0, 500, 1,000, 2,000, 3,000

Feet: 0, 2,500, 5,000, 10,000, 15,000

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Very limited
- Somewhat limited
- Not limited
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:76,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables—Septic Tank Absorption Fields

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	Very limited	Berks (55%)	Seepage, bottom layer (1.00)	224.4	2.9%
				Depth to bedrock (1.00)		
				Slope (0.63)		
			Clearbrook (40%)	Depth to saturated zone (1.00)		
				Depth to bedrock (1.00)		
				Slope (0.63)		
				Large stones (0.00)		
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	Very limited	Berks (45%)	Seepage, bottom layer (1.00)	72.2	0.9%
				Depth to bedrock (1.00)		
			Weikert (40%)	Depth to bedrock (1.00)		
				Seepage, bottom layer (1.00)		
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	Very limited	Blackthorn (80%)	Too steep (1.00)	19.8	0.3%
				Slow water movement (0.72)		
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	Very limited	Buchanan (85%)	Slow water movement (1.00)	7.0	0.1%
				Depth to saturated zone (1.00)		
			Andover (5%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	Very limited	Buchanan (85%)	Slow water movement (1.00)	34.2	0.4%
				Depth to saturated zone (1.00)		
				Slope (0.63)		
			Andover (4%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	Very limited	Buchanan (85%)	Slow water movement (1.00)	100.6	1.3%
				Depth to saturated zone (1.00)		
				Slope (0.04)		
			Andover (10%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	Very limited	Buchanan (85%)	Slow water movement (1.00)	43.3	0.6%
				Depth to saturated zone (1.00)		
				Too steep (1.00)		
ClD	Caneyville silt loam, 15 to 25 percent slopes	Very limited	Caneyville (85%)	Too steep (1.00)	3.8	0.0%
				Slow water movement (1.00)		
				Depth to bedrock (1.00)		
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	Very limited	Clarksburg (80%)	Depth to saturated zone (1.00)	2.7	0.0%
				Slow water movement (1.00)		
				Slope (0.63)		

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	Very limited	Clearbrook (50%)	Depth to saturated zone (1.00)	88.8	1.2%
				Depth to bedrock (1.00)		
			Cavode (35%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Depth to bedrock (0.18)		
Cz	Combs fine sandy loam	Very limited	Combs (85%)	Flooding (1.00)	16.8	0.2%
				Seepage, bottom layer (1.00)		
				Depth to saturated zone (0.84)		
ErB	Ernest silt loam, 3 to 8 percent slopes	Very limited	Ernest (85%)	Depth to saturated zone (1.00)	10.2	0.1%
				Slow water movement (1.00)		
			Brinkerton (5%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
			Philo (1%)	Flooding (1.00)		
				Depth to saturated zone (1.00)		
				Depth to bedrock (1.00)		
				Slow water movement (0.46)		

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
ErC	Ernest silt loam, 8 to 15 percent slopes	Very limited	Ernest (80%)	Depth to saturated zone (1.00)	12.4	0.2%
				Slow water movement (1.00)		
				Slope (0.63)		
			Brinkerton (4%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Slope (0.63)		
Ho	Holly silt loam	Very limited	Holly (80%)	Flooding (1.00)	138.4	1.8%
				Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Seepage, bottom layer (1.00)		
				Slow water movement (0.72)		
Ln	Lindside silt loam	Very limited	Lindside (80%)	Flooding (1.00)	72.8	0.9%
				Depth to saturated zone (1.00)		
				Seepage, bottom layer (1.00)		
				Slow water movement (0.72)		

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
Me	Melvin silt loam	Very limited	Melvin (90%)	Flooding (1.00)	0.2	0.0%
				Ponding (1.00)		
				Depth to saturated zone (1.00)		
				Slow water movement (0.46)		
			Lindside (7%)	Flooding (1.00)		
				Depth to saturated zone (1.00)		
				Seepage, bottom layer (1.00)		
				Slow water movement (0.72)		
MrC	Murrill gravelly loam, 8 to 15 percent slopes	Somewhat limited	Murrill (90%)	Slow water movement (0.72)	17.7	0.2%
				Slope (0.63)		
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	Very limited	Murrill (85%)	Too steep (1.00)	171.4	2.2%
				Slow water movement (0.72)		
Pg	Philo gravelly loam	Very limited	Philo (75%)	Flooding (1.00)	42.6	0.6%
				Depth to saturated zone (1.00)		
				Seepage, bottom layer (1.00)		
				Slow water movement (0.50)		
Ph	Philo silt loam	Very limited	Philo (75%)	Flooding (1.00)	10.7	0.1%
				Depth to saturated zone (1.00)		
				Seepage, bottom layer (1.00)		
				Slow water movement (0.46)		
Qm	Quarry, limestone	Not rated	Quarry, limestone (97%)		1.2	0.0%
			Caneyville (1%)			
			Murrill (1%)			
			Opequon (1%)			

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
Qo	Quarry, sandstone	Not rated	Quarry, sandstone (95%)		162.1	2.1%
			Schaffenaker (2%)			
			Vanderlip (2%)			
			Dekalb (1%)			
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	Very limited	Schaffenaker (80%)	Seepage, bottom layer (1.00)	23.6	0.3%
				Depth to bedrock (1.00)		
				Filtering capacity (1.00)		
				Slope (0.04)		
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly	Not rated	Rock outcrop (40%)		161.1	2.1%
			Lithic Quartzipsamments (8%)			
			Vanderlip (5%)			
			Dekalb (2%)			
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	Very limited	Schaffenaker (45%)	Too steep (1.00)	34.9	0.5%
				Seepage, bottom layer (1.00)		
				Depth to bedrock (1.00)		
				Filtering capacity (1.00)		
			Vanderlip (40%)	Filtering capacity (1.00)		
				Too steep (1.00)		
				Seepage, bottom layer (1.00)		
				Large stones (0.07)		
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	Very limited	Vanderlip (40%)	Filtering capacity (1.00)	295.4	3.9%
				Too steep (1.00)		
				Seepage, bottom layer (1.00)		
				Large stones (0.07)		
			Schaffenaker (40%)	Too steep (1.00)		
				Seepage, bottom layer (1.00)		
				Depth to bedrock (1.00)		
				Filtering capacity (1.00)		

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	Very limited	Sideling (80%)	Slow water movement (1.00)	39.7	0.5%
				Depth to saturated zone (1.00)		
				Too steep (1.00)		
			Hazleton (10%)	Too steep (1.00)		
				Seepage, bottom layer (1.00)		
				Depth to bedrock (1.00)		
				Large stones (0.18)		
			Andover (1%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
Ua	Udorthents, smoothed	Not rated	Udorthents (95%)		391.1	5.1%
			Weikert (1%)			
			Urban land (1%)			
			Ernest (1%)			
			Clearbrook (1%)			
			Berks (1%)			
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes	Not rated	Urban land (45%)		288.5	3.8%
			Berks (2%)			
			Philo (2%)			
			Weikert (2%)			
			Vanderlip (1%)			
			Clearbrook (1%)			
			Buchanan (1%)			
			Ernest (1%)			
W	Water	Not rated	Water (100%)		13.1	0.2%

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
WaB	Weikert channery silt loam, 3 to 8 percent slopes	Very limited	Weikert (85%)	Depth to bedrock (1.00)	21.1	0.3%
				Seepage, bottom layer (1.00)		
			Rough (9%)	Depth to bedrock (1.00)		
				Seepage, bottom layer (1.00)		
			Clearbrook (5%)	Slow water movement (1.00)		
				Depth to saturated zone (1.00)		
				Depth to bedrock (1.00)		
WaC	Weikert channery silt loam, 8 to 15 percent slopes	Very limited	Weikert (85%)	Depth to bedrock (1.00)	340.0	4.4%
				Seepage, bottom layer (1.00)		
				Slope (0.63)		
			Rough (9%)	Depth to bedrock (1.00)		
				Seepage, bottom layer (1.00)		
				Slope (0.50)		
			Clearbrook (5%)	Depth to saturated zone (1.00)		
				Depth to bedrock (1.00)		
				Slope (0.50)		
				Large stones (0.02)		
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	Very limited	Weikert (45%)	Depth to bedrock (1.00)	802.6	10.5%
				Seepage, bottom layer (1.00)		
				Slope (0.63)		
			Berks (40%)	Seepage, bottom layer (1.00)		
				Depth to bedrock (1.00)		
				Slope (0.63)		

Septic Tank Absorption Fields— Summary by Map Unit — Morgan County, West Virginia (WV065)						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	Very limited	Weikert (50%)	Depth to bedrock (1.00)	1,709.5	22.3%
				Too steep (1.00)		
				Seepage, bottom layer (1.00)		
			Berks (35%)	Too steep (1.00)		
				Seepage, bottom layer (1.00)		
				Depth to bedrock (1.00)		
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	Very limited	Weikert (50%)	Depth to bedrock (1.00)	2,294.1	29.9%
				Too steep (1.00)		
				Seepage, bottom layer (1.00)		
			Berks (35%)	Too steep (1.00)		
				Depth to bedrock (1.00)		
				Seepage, bottom layer (1.00)		
Totals for Area of Interest					**7,667.9**	**100.0%**

Septic Tank Absorption Fields— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Very limited	6,633.1	86.5%
Somewhat limited	17.7	0.2%
Null or Not Rated	1,017.1	13.3%
Totals for Area of Interest	**7,667.9**	**100.0%**

Rating Options—Septic Tank Absorption Fields

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

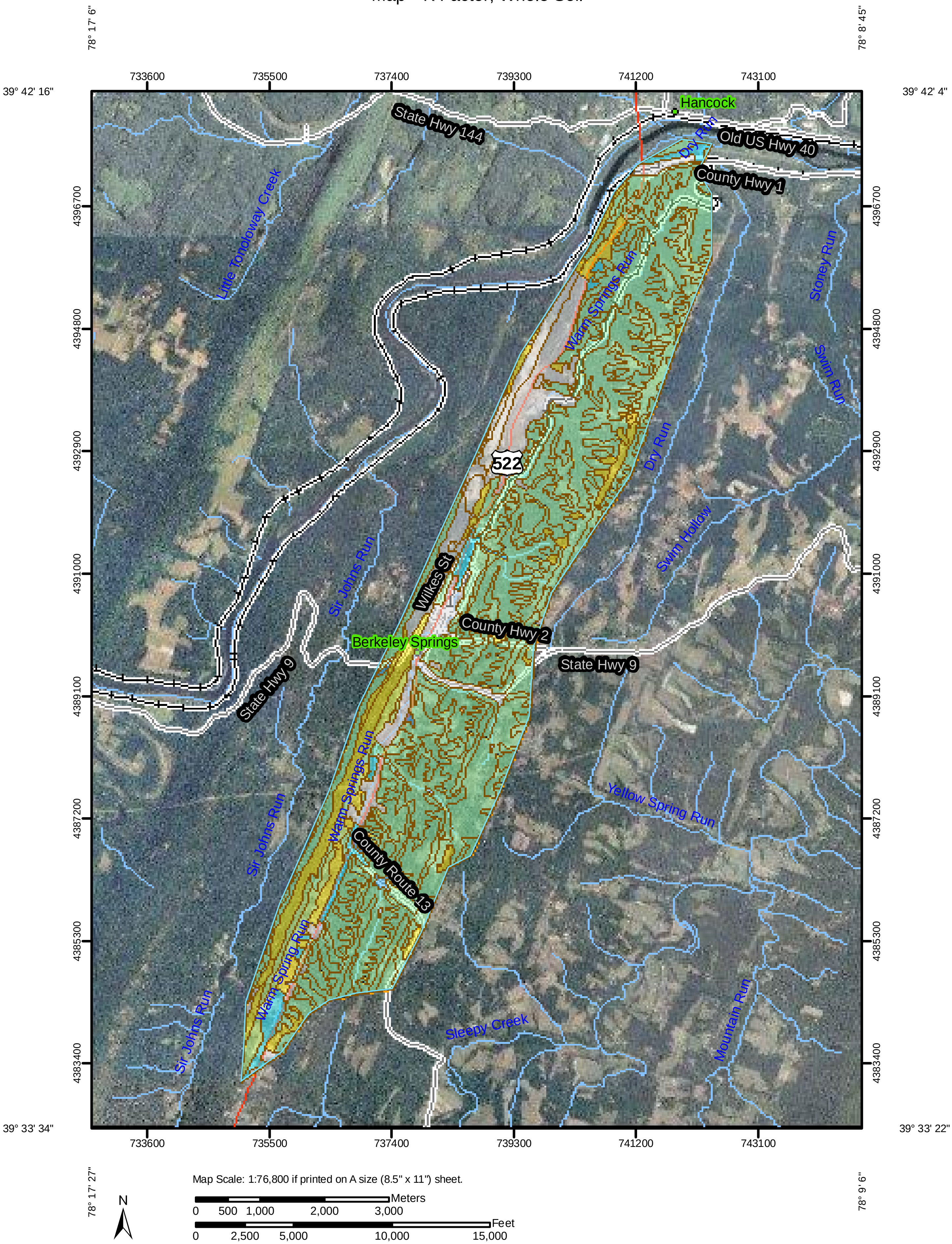
Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Map—K Factor, Whole Soil



Map Scale: 1:76,800 if printed on A size (8.5" x 11") sheet.

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:76,800 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	.17	224.4	2.9%
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	.17	72.2	0.9%
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	.28	19.8	0.3%
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	.24	7.0	0.1%
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	.24	34.2	0.4%
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	.24	100.6	1.3%
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	.24	43.3	0.6%
ClD	Caneyville silt loam, 15 to 25 percent slopes	.43	3.8	0.0%
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	.28	2.7	0.0%
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	.37	88.8	1.2%
Cz	Combs fine sandy loam	.28	16.8	0.2%
ErB	Ernest silt loam, 3 to 8 percent slopes	.43	10.2	0.1%
ErC	Ernest silt loam, 8 to 15 percent slopes	.43	12.4	0.2%
Ho	Holly silt loam	.28	138.4	1.8%
Ln	Lindside silt loam	.37	72.8	0.9%
Me	Melvin silt loam	.43	0.2	0.0%
MrC	Murrill gravelly loam, 8 to 15 percent slopes	.28	17.7	0.2%
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	.28	171.4	2.2%
Pg	Philo gravelly loam	.37	42.6	0.6%
Ph	Philo silt loam	.37	10.7	0.1%
Qm	Quarry, limestone		1.2	0.0%
Qo	Quarry, sandstone		162.1	2.1%
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	.17	23.6	0.3%
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly		161.1	2.1%
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	.17	34.9	0.5%
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	.17	295.4	3.9%

K Factor, Whole Soil— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	.20	39.7	0.5%
Ua	Udorthents, smoothed		391.1	5.1%
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes		288.5	3.8%
W	Water		13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	.28	21.1	0.3%
WaC	Weikert channery silt loam, 8 to 15 percent slopes	.28	340.0	4.4%
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	.28	802.6	10.5%
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	.28	1,709.5	22.3%
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	.28	2,294.1	29.9%
Totals for Area of Interest			**7,667.9**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options: All Layers

K Factor, Whole Soil

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

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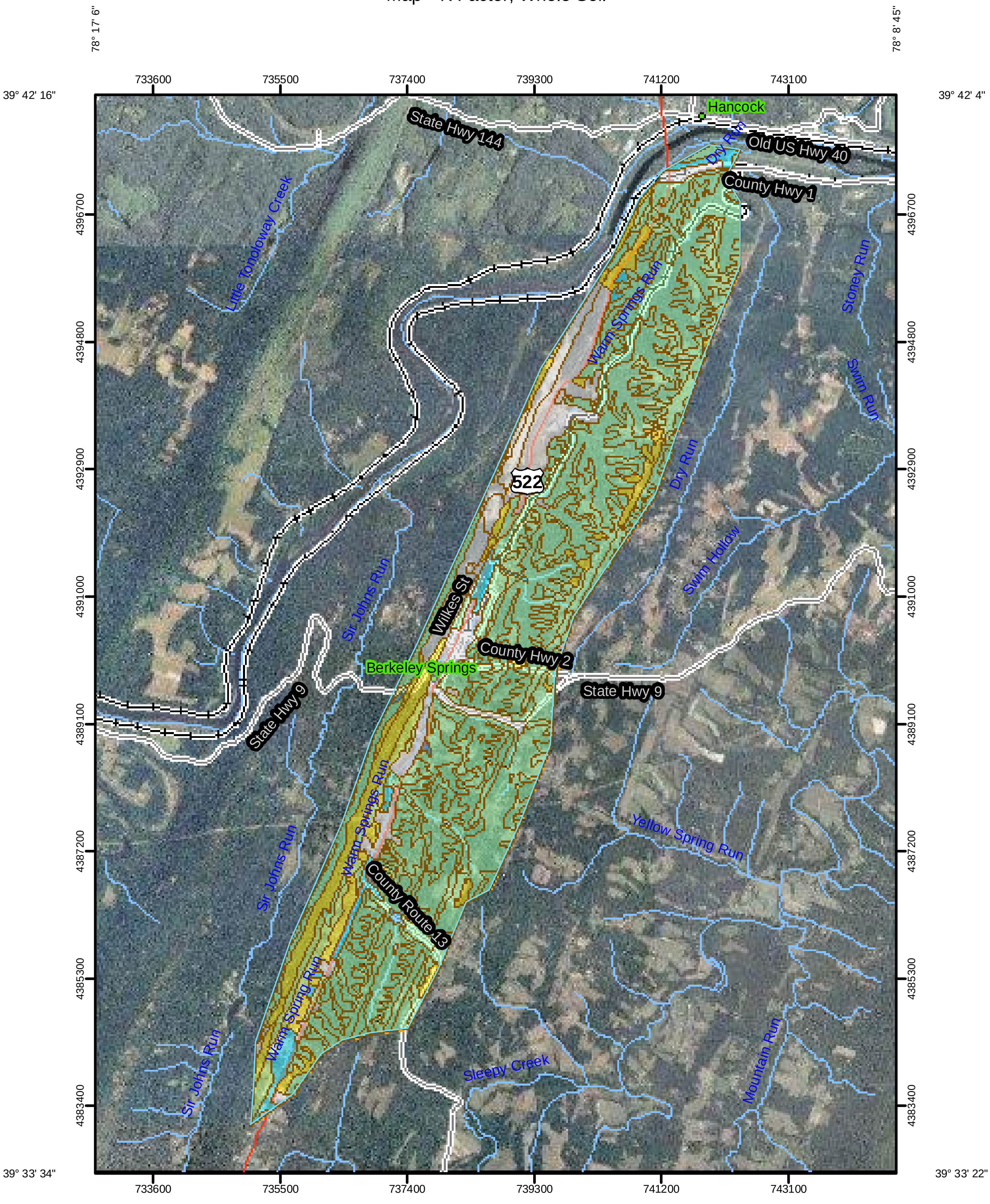
Map—K Factor, Whole Soil



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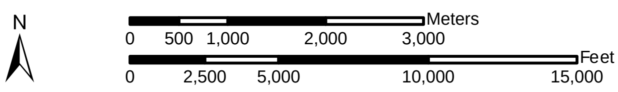

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

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K Factor, Whole Soil— Summary by Map Unit — Morgan County, West Virginia (WV065)				
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W	Water		13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	.28	21.1	0.3%
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WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	.28	2,294.1	29.9%
Totals for Area of Interest			**7,667.9**	**100.0%**

Rating Options—K Factor, Whole Soil

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options: All Layers

Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

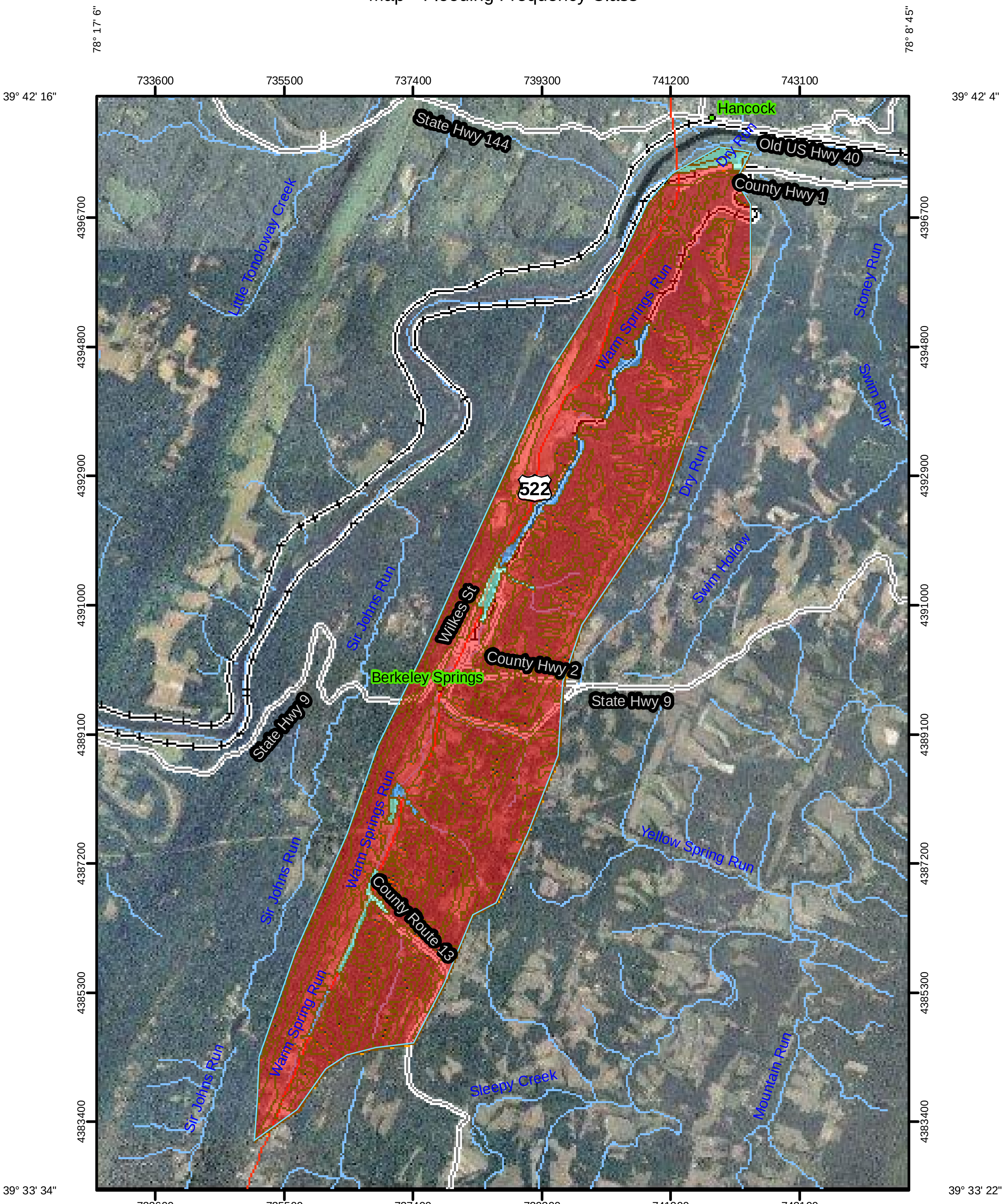
"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

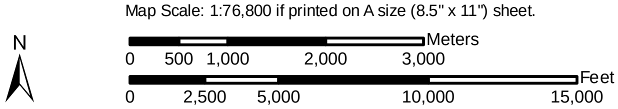
"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Custom Soil Resource Report
Map—Flooding Frequency Class



Map Scale: 1:76,800 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

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Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Morgan County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Flooding Frequency Class

Flooding Frequency Class— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BeC	Berks-Clearbrook channery silt loams, 8 to 15 percent slopes	None	224.4	2.9%
BkB	Berks-Weikert channery silt loams, 3 to 8 percent slopes	None	72.2	0.9%
BqF	Blackthorn very gravelly sandy loam, 35 to 55 percent slopes, rubbly	None	19.8	0.3%
BuB	Buchanan gravelly loam, 3 to 8 percent slopes	None	7.0	0.1%
BuC	Buchanan gravelly loam, 8 to 15 percent slopes	None	34.2	0.4%
BxC	Buchanan loam, 3 to 15 percent slopes, extremely stony	None	100.6	1.3%
BxE	Buchanan loam, 15 to 35 percent slopes, extremely stony	None	43.3	0.6%
ClD	Caneyville silt loam, 15 to 25 percent slopes	None	3.8	0.0%
CrC	Clarksburg gravelly silt loam, 8 to 15 percent slopes	None	2.7	0.0%
CvB	Clearbrook-Cavode silt loams, 0 to 8 percent slopes	None	88.8	1.2%
Cz	Combs fine sandy loam	Occasional	16.8	0.2%
ErB	Ernest silt loam, 3 to 8 percent slopes	None	10.2	0.1%
ErC	Ernest silt loam, 8 to 15 percent slopes	None	12.4	0.2%
Ho	Holly silt loam	Frequent	138.4	1.8%
Ln	Lindside silt loam	Occasional	72.8	0.9%
Me	Melvin silt loam	Frequent	0.2	0.0%
MrC	Murrill gravelly loam, 8 to 15 percent slopes	None	17.7	0.2%
MsE	Murrill loam, 15 to 35 percent slopes, extremely stony	None	171.4	2.2%
Pg	Philo gravelly loam	Occasional	42.6	0.6%
Ph	Philo silt loam	Occasional	10.7	0.1%
Qm	Quarry, limestone	None	1.2	0.0%
Qo	Quarry, sandstone	None	162.1	2.1%
ShC	Schaffenaker loamy sand, 3 to 15 percent slopes, very bouldery	None	23.6	0.3%
SkF	Schaffenaker-Rock outcrop complex, 35 to 65 percent slopes, rubbly	None	161.1	2.1%
SnE	Schaffenaker-Vanderlip loamy sands, 15 to 35 percent slopes, very bouldery	None	34.9	0.5%

Flooding Frequency Class— Summary by Map Unit — Morgan County, West Virginia (WV065)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
SnF	Schaffenaker-Vanderlip loamy sands, 35 to 65 percent slopes, very bouldery	None	295.4	3.9%
SxE	Sideling gravelly loam, 15 to 35 percent slopes, extremely stony	None	39.7	0.5%
Ua	Udorthents, smoothed	None	391.1	5.1%
Uu	Urban land-Udorthents complex, 0 to 25 percent slopes	None	288.5	3.8%
W	Water	None	13.1	0.2%
WaB	Weikert channery silt loam, 3 to 8 percent slopes	None	21.1	0.3%
WaC	Weikert channery silt loam, 8 to 15 percent slopes	None	340.0	4.4%
WbC	Weikert-Berks channery silt loams, 8 to 15 percent slopes	None	802.6	10.5%
WbD	Weikert-Berks channery silt loams, 15 to 25 percent slopes	None	1,709.5	22.3%
WkF	Weikert-Berks very channery silt loams, 25 to 70 percent slope	None	2,294.1	29.9%
Totals for Area of Interest			**7,667.9**	**100.0%**

Rating Options—Flooding Frequency Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

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Appendix B: Example Quality Assurance Project Plan (QAPP)

CHESAPEAKE BAY WATER-QUALITY MONITORING PROGRAM

POTOMAC RIVER NONTIDAL NUTRIENT AND SEDIMENT SAMPLING

QUALITY ASSURANCE PROJECT PLAN

JUNE 1, 2005 to MAY 31, 2006

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION, DIVISION OF WATER AND WASTE MANAGEMENT

IN COOPERATION WITH THE
U.S. GEOLOGICAL SURVEY

Created April 2005

QUALITY ASSURANCE PROJECT PLAN

for the

West Virginia Potomac River Nontidal Monitoring Program
NUTRIENT AND SEDIMENT SAMPLING

Prepared by

Douglas B. Chambers
U.S. Geological Survey, Water Resources Discipline
West Virginia Water Science Center
11 Dunbar Street
Charleston, West Virginia 25301

for

West Virginia Department of Environmental Protection
Division of Water and Waste Management
601 57th Street
Charleston, WV 25304

for the period of

June 1, 2005 to May 31, 2006

Approvals:

____ ______________

Douglas B. Chambers, Project Chief, USGS Date

____ ______________

John Wirts, Project Coordinator, WVDEP Date

____ ______________

Matthew Monroe, Environmental Coordinator, WVDAg Date

____ ______________

Richard Batiuk, Quality Assurance Officer, EPA Chesapeake Bay Program Office Date

CONTENTS

Tables

A. Project Management

A.1 Introduction

This Quality-Assurance Project Plan (QAPP) describes quality-assurance goals and measures for the Potomac River Nontidal monitoring program designed to support Chesapeake Bay restoration programs.

The project, the *Potomac River Nontidal Monitoring Program*, includes the monitoring of nutrient and suspended-sediment concentrations and streamflow in selected West Virginia tributaries of the Potomac River. This project is supported through West Virginia Department of Environmental Protection (WVDEP) and U.S. Geological Survey (USGS) cooperative funds. The objectives of this project are to:

- characterize nutrient and sediment concentrations in terms of flow and load for four (4) major West Virginia tributaries to the Potomac River;
- provide nutrient and sediment data for calibration of the Chesapeake Bay Watershed model (WSM) and loading inputs to the Chesapeake Bay Water-Quality (WQ) model; and
- integrate the information collected in this program with other elements of the monitoring program to gain a better understanding of the processes affecting the water quality of the Chesapeake Bay.

The WVDEP and the USGS conduct this project cooperatively. Sampling events, goals, and objectives for this project are overseen by the USGS Project Chief, Douglas B. Chambers.

A.2 Distribution List

This QAPP will be distributed to the following project participants:

Douglas B. Chambers, USGS West Virginia Water Science Center, Project Chief/Water-Quality Specialist, (304) 347-5130 ext 231

Ronald D. Evaldi, USGS West Virginia Water Science Center, Supervisory Hydrologist, (304) 347-5130 ext. 239

John Wirts, WVDEP, Watershed Assessment Section, Project Coordinator, (304) 926-0495

Matthew Monroe, WVDAg, Environmental Coordinator, (304) 260-8627

A.3 Project/Task Organization

Douglas B. Chambers, USGS, is the Project Chief for the Potomac River Nontidal Monitoring Program and is responsible for the technical design, operation, and execution of the program as outlined in the annual scope of work to WVDEP. He is also responsible for the evaluating and describing of collected data, quality assurance and quality control for the program, and producing USGS reports. Doug is also the Water-Quality Specialist for the USGS West Virginia Water Science Center.

John Wirts, WVDEP, DWWM, Watershed Assessment Section, serves as the Project Coordinator for the Potomac River Nontidal Monitoring Program. He is tasked with assuring that all project commitments, the project timetable, and deliverables are completed.

A.4 Problem Definition/Background

The decline in water quality of the Chesapeake Bay within the last decade has, in large part, been attributed to excessive nutrients entering the estuary from its surrounding tributaries. In an effort to improve the water quality of the Bay, Federal, State, and local governments have initiated point and non-point source nutrient-reduction programs within the tributary basins discharging to the Bay. Monitoring at key sites can help to quantify improvements in water quality and verify the effectiveness of nutrient-control measures implemented in the watersheds.

In addition, the quality of the river discharge, and the timing and magnitude of the pollutant concentrations and loads delivered to the estuary are important data needed to enhance knowledge of or need to strengthen other components of the Chesapeake Bay water-quality monitoring program. The integration of all of these components will lead to a better understanding of the factors influencing water quality that can then be translated into better water-quality management for the Bay and its tributaries.

With these general goals in mind, the West Virginia Department of Environmental Protection'(WVDEP), in cooperation with the USGS, initiated the Potomac River Nontidal Monitoring Program as part of the Chesapeake Bay Water-Quality Monitoring Program.

The Chesapeake Bay Nontidal Water Quality Monitoring Work Group and the State of West Virginia selected four Potomac River tributaries – Patterson Creek, the South Branch of the Potomac River, The Cacapon River, and Opequon Creek –for monitoring. Combined, these streams contribute over 30 percent of the flow to the Potomac River above Point of Rocks, Maryland and they contribute nutrients and sediments from a wide range of land-use, geologic, and hydrologic conditions. A monitoring site will be established near the most downstream stream flow gaging station in each stream to monitor nutrient and sediment concentrations and streamflow to help calculate transport of these nutrient and sediment loads to the Potomac River and, ultimately, to the Bay.

A.5 Project/Task Description

Water-quality samples that are representative of the entire river cross section are collected and later analyzed to determine concentrations of selected nutrient species and suspended sediment in the river. These samples are collected during different seasons across different flow regimes. When combined with the continuous, 15-minute flow record from the USGS gage at each station, it is possible to estimate nutrient and sediment loads on a monthly and annual basis with a known level of confidence. Additionally, water-quality field measurements are made for dissolved oxygen, pH, alkalinity, specific conductance, water temperature and air temperature.

The USGS's National Field Manual for the Collection of Water-Quality Data (Wilde and others, 1998, http://water.usgs.gov/public/owq/FieldManual/index.html) describes the sampling process in detail. Data-collection quality will be monitored by the assessment of field blanks and replicates and by annually conducting and documenting the results of random field audits.

Sampling will be performed during each season. Field data will be entered and quality-assured monthly. Streamflow, nutrient, and suspended-sediment concentration data sets from each monitoring station will be forwarded to John Wirts at WVDEP by September 30 of each year. Quarterly reports describing field activities, quality-control results, and data-management issues will be submitted with the data to John Wirts. Additionally, data interpretation of nutrient trends and trend explanation will be performed by project hydrologists and incorporated into various USGS and/or WVDEP reports.

A.6 Data-Quality Objectives and Criteria for Measurement Data

This study provides West Virginia resource managers with information that can help to quantify changes in water quality, quantify nutrient loads critical for evaluating progress towards reducing controllable nutrients to the Chesapeake Bay, and verify the effectiveness of nutrient-control measures taken in the watersheds. These data can be also be used to calibrate or validate models used to calculate watershed capload allocations. A calibrated model was developed that can simulate constituent relationships, seasonal variation, and changes in trends. As a result, water-quality samples need to be collected monthly throughout the year under different streamflow conditions to determine loads within a known confidence interval. Once completed, this information is then given to researchers and Bay resource managers.

For laboratory precision and accuracy, approximately 10% of samples are analyzed in duplicate. Detailed quality assurance procedures are described for NWQL in Pritt and Raese (1995), and for the USGS Kentucky Sediment Laboratory in Sholar and Shreve (1998).

A.7 Special Training Certification

Field sampling teams will be led by UISGS personnel trained in water-quality sampling operations, record management, quality-assurance procedures, vehicle operations and maintenance, and troubleshooting. Laboratory personnel must be trained in analytical methods, quality-control procedures, record management, maintenance and troubleshooting.

A.8 Documentation and Records

Water-quality field measurements of temperature, dissolved oxygen, pH, alkalinity, and specific conductance are recorded at each site. Additionally, water-quality samples are collected and submitted for analysis to the USGS National Water-Quality Laboratory in Denver, Colorado. Samples are evaluated for total nitrogen (ammonium plus organic nitrogen), dissolved nitrite, dissolved nitrate plus nitrite, dissolved ammonia, total phosphorus, dissolved orthophosphate, and total suspended solids. Suspended sediments, including a sand/fines split for storm samples, are analyzed at the USGS Sediment Laboratory in Louisville, Kentucky.

All data will be recorded using standardized data sheets for the specific projects (Attachment A). These data will be keyed into the USGS data management systems by technicians who collect the data. These data will be provided to WVDEP in hard copy in the form of tables and data summaries. Electronic data will be submitted with the final deliverables in ASCII text files and spreadsheets via CD-ROM or by email.

B. Measurement/Data Acquisition

B.1 Experimental Design

This document provides a detailed description of the monitoring and analysis components of a study conducted by the WVDEP, in cooperation with the USGS, to quantify nutrient and suspended-sediment contributions of 4 West Virginia tributaries to the Potomac River.

The number of events to be sampled and the number of samples per event is based on the requirements of the Chesapeake Bay Nontidal Water-Quality Monitoring Network. Water-quality samples need to be collected monthly during base flow and under various stormflow conditions. “Continuous” flow measurements also need to be collected.

Station Description
Monitoring stations were selected from a list of Chesapeake Bay Program priority monitoring sites. The location of the monitoring sites and drainage area information are presented in table 1.

Table 1. Location of Potomac River Non-Tidal Monitoring sites.

Station Name	USGS Station Identification	Latitude	Longitude	Drainage (sq. mi.)
Patterson Creek near Headsville, WV	01604500	39° 26' 35"	78° 49' 20"	211
South Branch Potomac River near Springfield, WV	01608500	39° 26' 49"	78° 39' 16"	1,486
Cacapon River near Great Cacapon, WV	01611500	39° 34' 56"	78° 18' 36"	675
Opequon Creek near Martinsburg, WV	01616500	39° 25' 25"	77° 56' 20"	273

B.2 Sampling Method

USGS personnel, with assistance from WVDEP and WVDAg personnel, collect all water-quality samples at each of the four Potomac River Non-tidal Monitoring stations in accordance with the USGS National Field Manual for the Collection of Water Quality Data (Wilde and others, 1998).

Base-flow samples are collected at monthly and stormflow samples are collected seasonally, with an average coverage of two storms per season. An experienced USGS Hydrologic Technician, assisted by an individual from either WVDEP or WVDAg, will collect routine monthly, baseflow samples. The monitoring program emphasizes the collection of water-quality samples during periods of high flow (storm-event sampling), because most of the river-borne nutrient and suspended-sediment load is associated with storm events. Teams of two USGS Hydrologic Technicians will collect samples during high-flow events predicted through weather forecasts and by remote monitoring of river stage from the USGS offices. Discrete samples are collected during storm events, and can be collected during the rise, peak, or fall of the hydrograph. Sediment samples collected during storm events will also be analyzed for sand/fine percentage. No more than one sample per day will be collected at each site, although storm samples may be collected on succesive days during the same event. Water-discharge data are also collected for each of the streams throughout the period.

Water-quality samples are collected using the appropriate isokinetic sampler. These samplers hold either a 1- or 3 liter polyethylene bottle. The samplers are either mounted on a wading rod for use in wadeable conditions or lowered to the water using bridge crane for sampling higher flows. The general approach is to collect depth-integrated water samples using the Equal-Width Increment (EWI) sampling method, with minor variations to conform to site conditions. If velocities at a site fall below 1.5 ft/s, below which a true isokinetic sample cannot be collected, a weighted-bottle sample will be collected.

Patterson Creek
USGS personnel collect water samples from Patterson Creek at the Headsville streamflow gaging station. Base-flow and stormflow samples are collected using the equal-width increment (EWI) method. This method involves the collection of water-quality samples at the centroids of equal width increments along the river cross section. Under wadeable conditions, a gage height < 4.5, corresponding to a discharge of 465 cfs, samples will be collected using a USGS DH-81 sampler. At stages higher than 4.5, samples will be collected using a D-95 sampler suspended from the WV Route 46 bridge near Champwood, WV, downstream from the gaging station.

South Branch Potomac River
USGS personnel collect samples from the South Branch Potomac River near Springfield using the EWI method. Under wadeable conditions, a gage height $\leq$ 3.00 corresponding to a discharge of 1,365 cfs, samples will be collected using a USGS DH-81 sampler. At stages higher than 3.0', samples will be collected using a D-95 sampler suspended from the W. Va. Secondary Route 3 bridge downstream from the gaging station.

Cacapon River
USGS personnel collect Cacapon River water samples at the USGS gaging station near Great Cacapon. Under wadeable conditions, a gage height <2.5' corresponding to a discharge of 535 cfs, samples will be collected by wading, using a USGS DH-81 sampler. At stages above 2.5' samples will be collected using a D-95 sampler suspended from the W. Va. Secondary Route 7 low-water bridge up to a stage of 4' and discharge of 1,480 cfs, when the low-water bridge becomes too dangerous to sample from. At stages exceding 4' samples will be collected from the WV route 9 bridge using a D-95 sampler suspended from a bridge crane.

Opequon Creek
USGS personnel collect Opequon Creek water samples at the stream flow gaging station near Martinsburg. Under wadeable conditions, a gage height $\leq$ 3.5' corresponding to a discharge of 375 cfs, samples will be collected at a cross section about 40 feet upstream from the bridge using a USGS DH-81 sampler. At stages higher than 3.5', samples will be collected using a D-95 sampler suspended from the bridge on County Road 19.

Constituents Monitored
The monitoring program focuses on quantifying the water quality and loads of major nutrient species and suspended sediment from Patterson Creek, Cacapon River, South Branch of the Potomac River, and Opequon Creek. Chemical parameters monitored for the program include:

TN total nitrogen
NO_2 dissolved nitrite
NH_4 dissolved ammonia as N
NO_{23} dissolved nitrate plus nitrite as N
TP total phosphorus
o-PO_4 dissolved orthophosphorus as P
TSS total suspended solids
SSC total suspended sediment
S/F sand-fine split (storm samples only)

Analytical methods for these constituents are shown in table 2.

B.3 Sample Handling and Custody

Sample Treatment and Preservation
Water-quality samples collected by the USGS (Wilde and others, 1998) are split using a polypropylene churn splitter. The composite sample is introduced into a pre-cleaned plastic churn splitter and sub-samples for whole-water analysis are drawn while churning at a rate of 1.0 ft/second. The remaining samples are filtered on site for dissolved analysis using a 0.45-micrometer (average pore size, polycarbonate) capsule filter (Wilde and others, 1998). After acid is added to the appropriate samples for preservation, the nutrient samples are placed immediately on ice and chilled to a temperature of 4 degrees Celsius. Samples are shipped to the USGS NWQL in Denver, CO according to USGS technical

memorandum 02.04 (W.D. Lanier, 2002). This document can be found at (http://nwql.usgs.gov/Public/tech_memos/nwql.02-04.html). Suspended-sediment samples, collected concurrently with the water-quality samples from the churn splitter or collected separately, are shipped to the USGS Sediment Laboratory in Louisville, Kentucky, for analysis. Chain-of-custody procedures follow recommended USGS National Water-Quality Laboratory procedures.

Table 2. Potomac River Nontidal Monitoring sampling parameters.

Lab Code	Parameter Code	Parameter/ Methodology	Reference	Reporting Level
		Total Nitrogen		
LC 2756	P62855	*Alkaline persulfate digestion* I-4650-03	Patton and Kryskalla (2003)	0.06 mg/L
		Nitrogen, Nitrite as N		
LC 1973	P00613	*Colorimetry, ASF* I-2540-90	Fishman (1993)	0.008 mg/L
		Dissolved Nitrite & Nitrate as NO_{2+3}		
LC 1975	P00631	*Colorimetry, Cd-reduction*	Fishman (1993)	0.05 mg/L
		Dissolved Ammonia (NH_3)		
LC 1976	P00608	*Colorimetry, Auto* i-2522-78	Fishman (1993)	0.02 mg/L
		Total Phosporous		
LC 2333	P00665	*Colorimetry, Auto* USEPA 365.1		0.004 mg/L
		Dissolved Orthophosphate (DIP or o-PO_4)		
LC 1978	P00671	*Colorimetry, Auto* I-2601-81	Fishman (1993)	0.01 mg/L
		Total Suspended Sediment (SSC)		
n/a	P80154	*Hydroscopic glass-fiber filtration* ASTM method D3977-97 Methods A or B	Sholar and Shreve (1998)	0.5 mg/L
		Sand Fine Split (S/F)		
n/a	P70331	Wet-seiving filtration ASTM method D3977-97 Method C	Sholar and Shreve (1998)	
		Total Suspended Solids (TSS)		
LC 169	P00530	*Gravimetric* I-3765-89	Fishman and Friedman (1989)	10 mg/L

B.4 Analytical Methods

Analytical Methods employed Analytical methods for these constituents are documented in table 2 and described in the USGS National Water-Quality Laboratory documents.

Laboratory Analysis

Water-quality samples collected by the USGS for the River Input Monitoring Program are analyzed by the USGS National Water-Quality Laboratory (NWQL) in Denver, CO. Analytical techniques employed by the laboratory are documented in table 2. Sediment samples are analyzed by the USGS Sediment Laboratory in Louisville, Kentucky (Sholar and Shreve, 1998).

B.5 Quality Assurance/Quality Control

Quality assurance and quality control are a significant component of the monitoring program. The quality-assurance effort includes documentation of concentration variability within the cross section, sediment-transport analysis, quality assurance of sample-collection techniques and field personnel, and accounting for variability within and among the analyzing laboratories. Quality-assurance results can be obtained from: USGS West Virginia Water Science Center, at 11 Dunbar Street, Charleston, WV, 25301.

Laboratory quality-control methods are documented in the USGS National Water-Quality Laboratory (NWQL) Quality Control manual (Pritt and Raese, 1995); also available at http://wwwnwql.cr.usgs.gov/Public/pubs/QC_Fact/text.html).

Field quality control is checked during random field audits. The Quality Assurance officer assures that samples were collected, labeled, and preserved according to standard operating procedures. A field checklist will be prepared, and a summary report will be submitted.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

Instrument probes are cleaned and thoroughly inspected between sampling events. If any probe is not functioning correctly, it is determined whether it is necessary to perform maintenance and/or replace (retire) the instrument.

Physical sampling gear is inspected before each use to assure that all parts are intact. Any gear that shows operational deficiency is not used until repairs can be made.

B.7 Instrument Calibration and Frequency

The meters used to determine field parameters are calibrated daily. Specific instructions for calibration are found in the operating manuals provided with the instrument. Fresh standards are available for calibration prior to each sampling period. The field technician is responsible for providing directions for appropriate calibration, including the appropriate potassium chloride concentration to use for salinity calibrations. Dissolved oxygen (DO) is measured with an amperometric meter. The DO meter is calibrated using the saturated air method.

A calibration record is maintained for each unit in a logbook. This log serves as documentation for pre- and post-calibration information for each parameter recorded. The log is useful in determining drift in a probe, which indicates that maintenance is necessary for maintenance. The field technician remains aware of questionable performance of any instruments, and determines when it is necessary to perform maintenance and/or replace an instrument.

B.8 Inspection Acceptance Requirements for Supplies and Consumables

The field technician routinely inspects equipment and supplies. The field technician is responsible for determining when supplies and consumables should be discarded. Special attention should be paid to the condition of any filtration supplies (pads, bottles, etc.) and ultra-clean gear to assure that they are uncontaminated. If contamination is suspected, the supplies should be discarded. Any supplies that have exceeded their expiration date are disposed of.

B.9 Data Acquisition

USGS streamflow data is used in the River Input project but not directly collected as part of the project. Streamflow data is a necessary data input in the load estimation model. Site summaries of historic streamflow conditions are shown in Table 3. Period of record indicates the period for which there are published discharge values for the USGS station. The annual mean for the period of record is the arithmetic mean of the individual daily-mean discharges for the designated period of record. The highest and lowest daily means are the maximum daily-mean discharge and minimum daily-mean discharge, respectively, for the designated period of record.

Daily-mean discharges are computed by applying the daily mean stages (gage heights) to the stage-discharge curves (James and others, 2003). The USGS provides stage and discharge data for gaging stations on the world wide web (WWW). These data may be accessed at http://water.usgs.gov.

Table 3. Potomac River Nontidal Monitoring site drainage area and historic streamflow conditions. [mi^2, square miles; ft^3/s, cubic feet per second]

Period of Record	Drainage (sq. mi.)	Period of Record Annual Mean discharge (ft^3/s)	Highest Daily Mean discharge (ft^3/s)	Lowest Daily Mean discharge (ft^3/s)
Patterson Creek near Headsville, WV (01604500)				
August 1938 to Present Year	211	170.1	11,100	0.48
South Branch Potomac River near Springfield, WV (01608500)				
August 1928 to Present Year	1,486	1,332	145,000	52
Cacapon River near Great Cacapon, WV (01611500)				
December 1922 to September 1995, October 1996 to Present Year	675	581.6	67,900	26
Opequon Creek near Martinsburg, WV (01616500)				
July 1947 to Present Year	273	239.7	15,000 (estimated)	26

B.10 Data Management

All data will be collected using standardized data sheets (see Attachment A) for the specific projects. Data sheets will be coded with a site code (sample area and station number, date, collection time, and collector's initials). These data will be keyed into the USGS's data management systems by technicians who collect the data. All data files will be documented in metadata files. Data files will be maintained on the USGS computer network and backed up by diskette and raw datasheets. The USGS WV Water Science Center in Charleston will house the archived copies. Copies of the original data sets will be provided to WVDEP and maintained by the project coordinator. Electronic files with appropriate metadata will be forwarded to the appropriate analysts. The project data manager will maintain field data sheets, which will be kept at the same location as the electronic files.

Field data are entered into the USGS computers using standard USGS data entry procedures. Summary statistics are calculated to identify anomalies in the data. All data anomalies are verified against the raw data and corrected if necessary. Several times during the year, some provisional data files will be transferred from USGS to WVDEP via CD-ROM or via the Internet. These intermediate data transfers include flow data from each station for the previous calendar year, raw nutrient and suspended-sediment data and quality-control results from the previous calendar year. Metadata files created by the data manager and linked to the data files also will be transferred to WVDEP.

C. Assessment/Oversight

C.1 Assessment and Response Actions

The USGS quality-assurance officer will conduct random field and office audits to ensure that data collection and data manipulation follow guidelines set forth in the to the quality-assurance plan. A minimum of one field audit will be conducted each year. The field audit will consist of examining all aspects of the field collection for accuracy and adherence to sampling procedures. The field audit will be representative of all sites, but will not necessarily require a visit to each site. A summary report documenting the field activities will be provided. Office audits will be conducted to ensure that all logs are completed and up-to-date, and that proper data management and manipulation is being conducted. The principal investigator will be immediately notified of any deficiencies and take immediate corrective actions.

The project coordinator will continually monitor the logs and records associated with the project to assure that project schedules are being met. The project coordinator will immediately take any corrective action necessary if project schedules and procedures are being violated. The quality-assurance officer will perform and report on technical system audits and data-quality audits. Data-quality assessments will be conducted to determine whether the assumptions were met.

A USGS Water Science Center Water-Quality Review is held every three years by the USGS Regional Water-Quality Specialist and Regional Staff. Field methods are observed for consistency with USGS procedures and the District water-quality database (QWDATA) and the national database (STORET) are in agreement.

C.2 Reports to Management

Quarterly progress reports will be submitted from the USGS to WVDEP to describe quarterly project activities (Attachment B). Any deviations from scheduled project activities will be noted and the effect of these deviations on the final project outcome will be described. Corrective measures will also be suggested. The Project Chief (USGS) will be responsible for producing and distributing progress reports.

D. Data Validation and Usability

D.1 Data Review, Validation, and Verification

Data will be verified using a previously developed data quality-control system. After being scrutinized during the data-entry phase, data are analyzed and plotted to examine any outliers or anomalies. These are then examined, verified, and corrected if necessary. Field audits are performed to assure that all data are collected according to standard operating procedures, and that the collection effort is consistent and equal. The USGS Project Chief is responsible for performing quality control, or assuring that quality control is performed by appropriate staff.

All field logs and information are thoroughly reviewed prior to data analysis to assure that all data were collected uniformly. Any data that are not collected according to standard operating procedures are examined to determine whether they are representative. All quality-assurance reports are examined prior to data analysis to verify that data were properly and consistently collected. Any deviations in data collection are taken into account during data analysis. All calibration logs are examined to determine how well the measurement instruments performed. If there appears to be significant drift in instrument performance, the data are adjusted accordingly. All raw data are kept in paper files. Data are entered twice and compared for keying errors. These errors will be corrected. Original (raw) data are retained by the data manager.

D.2 Validation and Verification Methods

The field technician or senior field staff person will verify all data entered in the field. This person will examine all data sheets to ensure that they are accurately and legibly completed. They will then sign and record the date and time on the data sheets when verified. All field validation must occur prior to leaving the site before samples are discarded. Any recording errors are to be marked through and initialed. The true value is to be recorded next to the error, and all errors are to be explained in the remarks column of the data sheet. These data sheets will be placed in a notebook and logged on a daily log sheet. These notebooks will be forwarded to the data manager on request. The data manager will forward the data sheets to the data entry staff. The final verified computerized data set is forwarded to the data analysts.
A substantial effort is incorporated into the monitoring program to document and ensure quality assurance (QA) and quality control (QC). The quality-assurance effort includes documentation of observed concentration variability within the cross section, sediment transport analysis, quality assurance of sample-collection techniques and field personnel, and the variability within and among the analyzing laboratories. Field quality control is verified during random field audits. The QA officer assures that samples are collected, labeled and preserved in accordance with standard operating procedures. Field blanks and trip blanks are submitted to evaluate the potential for contamination of samples during their collection, processing, and transport.

Laboratory validation and verification procedures follow NWQL protocol found on the web at:

http://nwql.usgs.gov/Public/pubs/QC_Fact/text.html.

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Attachment A: Example of Field Data Sheet

Version 6: 11/2004 FIELD ID ___________

U. S. GEOLOGICAL SURVEY SURFACE-WATER QUALITY NOTES

NWIS RECORD NO ___________

STATION NO. ___________ STATION NAME ___________

SAMPLE DATE ________ MEAN SAMPLE TIME (WATCH) ________ TIME DATUM ______ (eg. EST, EDT, UTC) END DATE ________ END TIME ________

SAMPLE MEDIUM ____ SAMPLE TYPE ____ SAMPLE PURPOSE (71999) _____ PURPOSE OF SITE VISIT (50280) _____

PROJECT NO. ________ PROJ NAME________ PROJECT NO. ________ PROJ NAME________

SAMPLING TEAM ___________ TEAM LEAD SIGNATURE ___________ DATE ________

START TIME ________ GAGE HT ______ TIME ________ GHT _____ TIME ________ GHT _____ TIME ________ GHT _____ END TIME ________ GHT _____

Sample Set ID _____

LABORATORY INFORMATION

SAMPLES COLLECTED: NUTRIENTS ___ MAJOR IONS ___ TRACE ELEMENTS: FILTERED ___ UNFILTERED ___ MERCURY: FILTERED ___ UNFILTERED ___ VOC ___

RADON ___ (Radon samp coll time:________) TPC ___ (VOL FILTERED_______mL) PIC ___ (VOL FILTERED_______mL) TPC(QC) ___ (VOL FILTERED_______mL)

DOC ___ ORGANICS: FILTERED ___ UNFILTERED ___ RADIOCHEMICALS: FILTERED ___ UNFILTERED ___ ISOTOPES ___ MICROBIOLOGY ___

CHLOROPHYLL ___ BOD ___ COD ___ ALGAE ___ INVERTEBRATES ___ FISH ___ BED SED. ___ SUSP. SED. ___ CONC. S/F SIZE

WASTEWATER _____ OTHER ________ OTHER ________ OTHER ________ OTHER ________

LABORATORY SCHEDULES: ________ ________ ________ ________ ________ ________

LAB CODES: ________ ADD/DELETE ________ ADD/DELETE ________ ADD/DELETE ________ ADD/DELETE ________ ADD/DELETE ________ ADD/DELETE

COMMENTS: ___________ DATE SHIPPED ________

****Notify the NWQL in advance of shipment of potentially hazardous samples—phone 1-866-ASK-NWQL or email LabLogin@usgs.gov**

FIELD MEASUREMENTS

TEMP, WATER (00010) ________ °C | Q, INST. (00061) ________ cfs MEAS. RATING EST | ANC ( ) ________ mg/L

pH (00400) ________ UNITS | GAGE HT (00065) ________ ft | ALKALINITY ( ) ________ mg/L

COND (00095) ________ µS/cm@25 °C | TEMP, AIR (00020) ________ °C | CARBONATE (00452) ________ mg/L

DIS. OXYGEN (00300) ________mg/L | TURBIDITY ( ) _____ —-_____ METHOD CODE _____ | BICARBONATE (00453) ________ mg/L

UNITS: FNU NTRU FNMU FBU

DO SAT. (00301) ________ % | OTHER: ________ ________ | HYDROXIDE (71834) ________ mg/L

BAROMETRIC PRES. (00025) ________ mm Hg | OTHER: ________ ________ | eH (00090) ________ mvolts

SAMPLING INFORMATION

Sampler Type (84164) _______ Sampler ID ________ Sample Compositor/Splitter: PLASTIC TEFLON CHURN (4L 8L 14L) CONE OTHER _______ ID_______

Sampler Bottle/Bag Material: PLASTIC TEFLON OTHER ________ Nozzle Material: PLASTIC TEFLON OTHER ________ Nozzle Size: 3/16" 1/4" 5/16"

Stream Width: _______ ft mi Left Bank _____ Right Bank _____ Mean Depth: ______ft Ice Cover ______% Ave. Ice Thickness ______ in.

Sampling Points: _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

Sampling Location: WADING CABLEWAY BOAT BRIDGE UPSTREAM DOWNSTREAM SIDE OF BRIDGE _______ ft mi above below gage _______

Sampling Site: POOL RIFFLE OPEN CHANNEL BRAIDED BACKWATER Bottom: BEDROCK ROCK COBBLE GRAVEL SAND SILT CONCRETE OTHER ______

Stream Color: BROWN GREEN BLUE GRAY CLEAR OTHER ________ Stream Mixing: WELL-MIXED STRATIFIED POORLY-MIXED UNKNOWN OTHER____

Weather: ***SKY***- CLEAR PARTLY CLOUDY CLOUDY ***PRECIPITATION***- NONE LIGHT MEDIUM HEAVY SNOW SLEET RAIN MIST ________

WIND- CALM LIGHT BREEZE GUSTY WINDY EST. WIND SPEED______ MPH ***TEMPERATURE***- VERY COLD COOL WARM HOT ________

Sampling Method (82398): EWI [10] EDI [20] SINGLE VERTICAL [30] MULT VERTICAL [40] OTHER ________ Stream Velocity (81904) ______ ft/sec

Transit Rate, minimum (50014) ________ft/sec Transit Rate (50015) ________ ft/sec Transit Rate, maximum (50016) ________ ft/sec

Hydro.Condition: Not determined [A]; Stable, low stage [4]; Falling stage [5]; Stable, high stage [6]; Peak stage [7]; Rising stage [8]; Stable, normal stage [9]

No. Days Since Last Significant Rainfall ________

OBSERVATIONS: ___________

COMPILED BY: ________ **DATE** ______ **CHECKED BY:** ________ **DATE:** ______ **LOGGED INTO NWIS BY:** ________ **DATE** ______

METER CALIBRATIONS/FIELD MEASUREMENTS

STN NO___________________________

Calibrated by:_______________________________ Location:___________________________

Date:_________________ Time:_____________

TEMPERATURE Meter MAKE/MODEL __________________ S/N _______________ Thermister S/N ______________ Thermometer ID ______________

Lab Tested against NIST Thermometer/Thermister? N Y Date: ____________________ ±___________ °C

Measurement Location: SINGLE POINT AT _______ ft DEEP STREAMSIDE _______ FT FROM LEFT RIGHT BANK VERTICAL AVG/MEDIAN OF ________ POINTS

Field Readings # 1 ________ # 2 ________ # 3 ________ # 4 _________ # 5 _________ **MEDIAN:**___________ **°C** Remark ___ ___ Qualifier ___ ___

pH Meter MAKE/MODEL ______________________ S/N _________________ Electrode No. ________________ Type: GEL LIQUID OTHER ____________

Sample: FILTERED UNFILTERED CONE SPLITTER CHURN SPLITTER SINGLE POINT AT _______ FT DEEP VERTICAL AVG. OF _____ POINTS

pH BUFFER	BUFFER TEMP	THEO-RETICAL pH FROM TABLE	pH BEFORE ADJ.	pH AFTER ADJ.	SLOPE	MILLI-VOLTS
pH 7						
pH 7						
pH 7						
pH ___						
pH ___						
pH ___						
CHECK pH ___						

TEMPERATURE CORRECTION FACTORS FOR BUFFERS APPLIED? Y N

BUFFER LOT NUMBERS :

pH 7: ______________________________

pH ____: ______________________________

CHECK pH ____: ______________________________

BUFFER EXPIRATION DATES:

pH 7: ______________________________

pH ____ : ______________________________

CHECK pH ____: ______________________________

Calibration Criteria: ± 0.2 pH units

Field Readings # 1________ # 2_______ # 3_______ # 4_______ # 5 _______ **MEDIAN:** ________ **Units** Remark ___ ___ Qualifier ___ ___

SPECIFIC CONDUCTANCE Meter MAKE/MODEL ______________________ S/N _________________ Sensor Type: DIP FLOW-THRU OTHER____________

Sample: CONE SPLITTER CHURN SPLITTER SINGLE POINT AT _______ ft DEEP VERTICAL AVG. OF _______ POINTS

STD VALUE	STD TEMP	SC BEFORE ADJ.	SC AFTER ADJ.	STD LOT NO	STD EXPIR-ATION DATE	COMMENTS

AUTO TEMP COMPENSATED METER ___

MANUAL TEMP COMPENSATED METER ___

CORRECTION FACTOR APPLIED? Y N

CORRECTION FACTOR= ____________

Calibration Criteria: the greater of 5 µS/cm or 3% of measured value

Field readings # 1________ # 2_______ # 3_______ # 4_______ # 5 _______ **MEDIAN:** ________ **µS/cm**

DISSOLVED OXYGEN Meter MAKE/MODEL _____________________________ S/N ____________________ Probe No. ________________________

Air Calibration Chamber in Water Air-Saturated Water Air Calibration Chamber in Air Winkler Titration Other___________________________

Sample: SINGLE POINT AT _______ ft DEEP VERTICAL AVG. OF _____ POINTS BOD BOTTLE OTHER_____________ Stirrer Used? Y N

WATER TEMP °C	BAROMETRIC PRESSURE mm Hg	DO TABLE READING mg/L	SALINITY CORR. FACTOR	DO BEFORE ADJ.	DO AFTER ADJ.

Calibration Criteria: ± 0.3 mg/L

Zero DO Check __________mg/L Adj. to __________ mg/L Date: _______________

Zero DO Solution Date___________ Thermister Check? Y N Date__________

Membrane Changed? N Y Date: ________________ Time: ________

Barometer Calibrated? N Y Date: __________________ Time: ________

Battery Check: REDLINE _____ RANGE ______________

Field readings # 1________ # 2_______ # 3_______ # 4_______ # 5 _______ **MEDIAN:** ________ **mg/L** Remark ___ ___ Qualifier ___ ___

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STN NO___________________________

TURBIDITY CALIBRATION

Meter: MAKE/MODEL ______________________ S/N ____________________ Type: TURBIDIMETER SUBMERSIBLE SPECTROPHOTOMETER

Sample: COLLECTION TIME: ________ MEASUREMENT TIME: ________

MEASUREMENT: IN-SITU/ON-SITE VEHICLE DISTRICT LAB NWQL OTHER ___________________

SAMPLE DILUTED? Y N VOL. OF DILUTION WATER _________ mL SAMPLE VOLUME ________ mL

TURBIDITY VALUE = A x (B+C) / C

A= TURBIDITY VALUE IN DILUTED SAMPLE
B= VOLUME OF DILUTION WATER, mL
C= SAMPLE VOLUME, mL

Calibration Criteria: ± 0.5 TU or ± 5%	Lot Number or Date Prepared	Expiration Date	Concentration ______ (units)	Temperature °C	Initial instrument reading	Reading after adjustment
Stock Turbidity Standard						
Zero Standard *(DIW)*						
Standard 1						
Standard 2						
Standard 3						

COMMENTS:

Field Readings #1 __________ #2 __________ #3 __________ #4 __________ #5 __________

MEDIAN _________ **Parameter Code** ________ FNU NTRU FNMU FBU **METHOD CODE** ___ **Remark Codes(s)** ___ ___ **Qualifier(s)** ___ ___

CROSS SECTION NOTES BAROMETRIC PRESSURE = ________ MM HG

STATION	ft FROM LEFT BANK (00009) OR ft FROM RIGHT BANK (72103)	TIME	GAGE HT ft (00065)	DISCHARGE (INST) cfs (00061)	DEPTH ft (81903)	TEMP °C (00010)	SC µS/cm (00095)	DO mg/L (00300)	DO SAT % (00301)	pH units (00400)	TURBIDITY ______ (______) ____ (METHOD	NWIS RECORD NO.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

NOTES:

STN NO____________________________

ALKALINITY/ANC CALCULATIONS

BEGINNING H_2O TEMP. _________ °C

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

End H_2O temp. _________ °C

BEGINNING H_2O TEMP. _________ °C

pH	ΔpH	VOL ACID DC OR mL	ΔVOL ACID DC OR mL	ΔpH / ΔVOL ACID

End H_2O temp. _________ °C

FIRST TITRATION RESULTS

DATE ______________ INITIALS _______________

BEGIN TINE___________ END TIME___________

ALKALINITY/ANC ______________ meq/L

ALKALINITY/ANC ______________ mg/L AS $CaCO_3$

BICARBONATE ______mg/L ______meq/L AS HCO_3^-

CARBONATE _______mg/L ______ meq /L AS CO_3^{2-}

ACID: 1.6N 0.16N 0.01639N

OTHER:________________________________

ACID LOT NO. ___________________________

ACID EXPIRATION DATE ___________________

SAMPLE VOLUME: _______________mL

FILTERED UNFILTERED CHURN CONE

METHOD: INFLECTION POINT GRAN

FIXED ENDPOINT

STIRRING METHOD: MAGNETIC MANUAL

SECOND TITRATION RESULTS

DATE ______________ INITIALS _______________

BEGIN TINE___________ END TIME___________

ALKALINITY/ANC ______________ meq/L

ALKALINITY/ANC ______________ mg/L AS $CaCO_3$

BICARBONATE ______mg/L ______meq/L AS HCO_3^-

CARBONATE _______mg/L ______ meq /L AS CO_3^{2-}

ACID: 1.6N 0.16N 0.01639N

OTHER:________________________________

ACID LOT NO. ___________________________

ACID EXPIRATION DATE ___________________

SAMPLE VOLUME: _______________mL

FILTERED UNFILTERED CHURN CONE

METHOD: INFLECTION POINT GRAN

FIXED ENDPOINT

STIRRING METHOD: MAGNETIC MANUAL

CALCULATIONS

ALKALINITY OR ANC (meq/L) = 1000 (B) (C_a) (CF) / V_s

ALKALINITY (mg/L AS $CaCO_3$) = 50044 (B) (C_a) (CF) / V_s

where:

B = volume of acid titrant added from the initial pH to the bicarbonate equivalence point (near pH 4.5), in milliliters. To convert from digital counts to milliliters, divide by 800 (1.00 mL = 800 counts)

C_a = concentration of acid titrant, in milliequivalents per milliliter (same as equivalents per liter, or *N*)

CF = correction factor (obtain from OWQRL for Hach acid cartridges of certain lot numbers — default value is 1.00)

V_s = volume of sample, in milliliters

For samples with pH ≤ 9.2:

BICARBONATE (meq/L) = 1000 (B-2A) (C_a) (CF) / V_s

BICARBONATE (mg/L) = 61017 (B-2A) (C_a) (CF) / V_s

CARBONATE (meq/L) = 2000 (A) (C_a) (CF) / V_s

CARBONATE (mg/L) = 60009 (A) (C_a) (CF) / V_s

where:

A = volume of acid titrant added from the initial pH to the carbonate equivalence point (near pH 8.3), in milliliters. To convert from digital counts to milliliters, divide by 800 (1.00 mL = 800 counts)

NOTE: For samples with pH > 9.2, these equations for bicarbonate and carbonate will fail to give accurate results. Use the Alkalinity Calculator at http://oregon.usgs.gov/alk or PCFF.

HACH CARTRIDGE CORRECTION FACTOR ___________

[SEE OWQ WAQI NOTES FOR INFO]

pH meter calibration	Meter make/model:		S/N	
Electrode No.		Type: gel liquid other	Slope	Milli-volts
pH buffer	**Buffer temp**	**Theoretical pH from table**	**pH before adj.**	**pH After adj.**
pH 7				
pH __				
Check pH ___				

Comments/Calculations:

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STN NO_______________

QUALITY-CONTROL INFORMATION

LOT NUMBERS

PRESERVATIVE LOT NUMBERS

PLACE LABELS FROM VIALS ON SAMPLE BOTTLES

7.5N HNO_3 ________ (METALS&CATIONS) 6N HCl ________ (Hg) 4.5N H_2SO_4 ________ (NUTRIENTS&DOC) Conc. H_2SO_4 ________ (COD, PHENOL, O&G) NaOH ________ (CYANIDE)

OTHER ________ 1:1 HCl ________ (voc) Number of drops of HCL added to lower pH to ≤ 2 ______ (**NOTE:** Maximum number of drops = 6)

BLANK WATER LOT NUMBERS

Inorganic (99200) ________ 2nd Inorganic (99201) ________

Pesticide (99202) ________ 2nd Pesticide (99203) ________

VOC/Pesticide (99204) ________ 2nd VOC/Pesticide (99205) ________

Spike vials (99104) ________

Surrogate vials ________

FILTER LOT NUMBERS

capsule________ pore size ________ type ________

disc________ pore size ________ type ________

plate ________ pore size ________ type ________

organic carbon ________ pore size ________ type ________

other ________ pore size ________ type ________

QC SAMPLES

WERE QC SAMPLE COLLECTED? YES NO

Starting date for set of samples (99109) (YMMDD) ________

Ending date for set of samples (99110) (YMMDD) ________

Sample Type	NWIS Record No.	Sample Type	NWIS Record No.	Sample Type	NWIS Record No.
Equip Blank ____	________	Sequential ____	________	Trip Blank ____	________
Field Blank ____	________	Spike ____	________	Other ____	________
Split ____	________	Concurrent ____	________	Other ____	________

NWQL Schedules/lab codes (QC Samples) ______ ______ ______ ______ ______ ______

______ ______ ______ ______ ______ ______ ______ ______ ______

COMMENTS________________

(Circle appropriate selections)

99100 Blank-solution type
- 10 Inorganic grade (distilled/deionized)
- 40 Pesticide grade (OK for organic carbon)
- 50 Volatile-organic grade (OK for inorganic, organic, and organic carbon)
- 80 Universal blank water
- 200 Other

99101 Source of blank water
- 10 NWQL
- 40 NIST
- 55 Wisconsin District Mercury Lab
- 200 Other

99105 Replicate-sample type
- 10 Concurrent
- 20 Sequential
- 30 Split
- 40 Split-Concurrent
- 50 Split-Sequential
- 200 Other

99102 Blank-sample type
- 1 Source Solution
- 30 Trip
- 40 Sampler
- 50 Splitter
- 60 Filter
- 70 Preservation
- 80 Equipment (done in non-field environment)
- 90 Ambient
- 100 Field
- 200 Other

99111 QC sample associated with this environmental sample
- 1 No associated QA data
- 10 Blank
- 30 Replicate Sample
- 40 Spike sample
- 100 More than one type of QA sample
- 200 Other

99106 Spike-sample type
- 10 Field

99107 Spike-solution source
- 10 NWQL

99108 Spike-solution volume, mL ________

99112 Purpose, Topical QC data
- 1 Routine QC (non-topical)
- 10 Topical for high bias (contamination)
- 20 Topical for low bias (recovery)
- 100 Topical for variability (field equip)
- 110 Topical for variability (field collection)
- 120 Topical for variability (field personnel)
- 130 Topical for variability (field processing)
- 140 Topical for variability (shipping&handling)
- 200 Topical for variability (lab)
- 900 Other topical QC purpose

REFERENCE LIST FOR CODES USED ON THIS FORM

A COMPLETE SET OF FIXED-VALUE CODES CAN BE FOUND ON-LINE AT: http://wwwnwis.er.usgs.gov/currentdocs/index.html

Sample Medium Codes
9 Surface water
R Quality-control sample (associated environmental sample –9 (SW))
Q Artificial

Value Qualifiers
e see field comment
f sampleield preparation problem
k counts outside the acceptable range

Null-value Qualifiers
e required equipment not functional or available
f sample discarded; improper filter used
o insufficient amount of water

71999 SAMPLE PURPOSE

10	Routine
15	NAWQA
20	NASQAN
30	Benchmark
40	SW Network
60	Lowflow Network
70	Highflow Network
110	Seepage Study
180	Cross-Section Variation

84164 SAMPLER TYPE

100	Van Dorn Sampler
110	Sewage Sampler
125	Kemmerer Bottle
3044	US DH-81
3045	US DH-81 With Teflon Cap And Nozzle
3047	Sampler, Frame-Type, Plastic Bottle W/Reynolds Oven Bag
3048	Sampler, Frame-Type, Teflon Bottle
3049	Sampler, Frame-Type, Plastic Bottle
3050	Sampler, Frame-Type, Plastic Bottle W/Teflon Collapsible Bag
3051	US DH-95 Teflon Bottle
3052	US DH-95 Plastic Bottle
3053	US D-95 Teflon Bottle
3054	US D-95 Plastic Bottle
3055	US D-96 Bag Sampler
3057	US D-99 Bag Sampler
3058	US DH-2 Bag Sampler
3060	Weighted-Bottle Sampler
3061	US WBH-96 Weighted-Bottle Sampler
3070	Grab Sample
3071	Open-Mouth Bottle
3080	VOC Hand Sampler
4010	Thief Sampler
4115	Sampler, point, automatic
8000	None
8010	Other

Sample Type Code

9	Regular
7	Replicate
2	Blank
1	Spike
4	Blind
5	Duplicate
6	Reference material
8	Spike solution
A	Not determined
B	Other QA
H	Composite

ALKALINITY/ANC PARAMETER CODES
39086 Alkalinity, water, filtered, incremental titration, mg/L
00418 Alkalinity, water, filtered, fixed endpoint, mg/L
29802 Alkalinity, water, filtered, Gran titration, mg/L

00419 ANC, water, unfiltered, incremental titration
00410 ANC, water, unfiltered, fixed endpoint, mg/L
29813 ANC, water, unfiltered, Gran titration, mg/L
29804 Bicarbonate, water, filtered, fixed endpoint, mg/L
63786 Bicarbonate, water, filtered, Gran, mg/L
00453 Bicarbonate, water, filtered, incremental, mg/L
00440 Bicarbonate, water, unfiltered, fixed endpoint, mg/L
00450 Bicarbonate, water, unfiltered, incremental, mg/L
29807 Carbonate, water, filtered, fixed endpoint, mg/L
63788 Carbonate, water, filtered, Gran, mg/L
00452 Carbonate, water, filtered, incremental, mg/L
00445 Carbonate, water, unfiltered, fixed endpoint, mg/L
00447 Carbonate, water, unfiltered, incremental, mg/L
29810 Hydroxide, water, filtered, fixed endpoint, mg/L
71834 Hydroxide, water, filtered, incremental, mg/L
71830 Hydroxide, water, unfiltered, fixed endpoint, mg/L
71832Hydroxide, water, unfiltered, incremental, mg/L

Time Datum Codes

Time Zone	Std Time Code	UTC Offset (hours)	Daylight Time Code	UTC Offset (hours)
Hawaii-Aleutian	HST	-10	HDT	-9
Alaska	AKST	-9	AKDT	-8
Pacific	PST	-8	PDT	-7
Mountain	MST	-7	MDT	-6
Central	CST	-6	CDT	-5
Eastern	EST	-5	EDT	-4
Atlantic	AST	-4	ADT	-3

82398 SAMPLING METHOD

10	Equal Width Increment (EWI)
20	Equal Discharge Increment (EDi)
25	Timed Sampling Interval
30	Single Vertical
40	Multiple Verticals
50	Point Sample
55	Composite, multi-point samples
70	Grab Sample (Dip)
80	Discharge Integrated, Equal Transit Rate (ETR)
90	Discharge Integrated, Centroid
120	Velocity Integrated
8010	Other
8030	Grab Sample At Water-Supply Tap

50280 PURPOSE OF SITE VISIT

1001	Fixed frequency, surface-water
1002	Storm hydrograph, surface-water
1003	Extreme high flow, surface-water
1004	Extreme low flow, surface-water
1005	Diurnal, surface-water
1006	Synoptic, surface-water
1098	NAWQA surface-water quality control
1099	Other, surface-water
3001	Occurrence Survey, bed sediment or tissue
3002	Spatial Distribution Survey, bed sediment or tissue
3003	Synoptic Study, bed sediment or tissue
3098	Bed-sediment or tissue quality control
3099	Other, bed sediment or tissue

Attachment B: Example of Quarterly Report to West Virginia Department of Environmental Protection

SAMPLE

Potomac River Nontidal Monitoring Program : *Quarterly Progress Report*

Monitoring Sites:

- (01578310) Patterson Creek near Headsville, WV
- (01646580) South Branch of the Potomac River near Springfield, WV
- (01594440) Cacapon River at Great Cacapon, WV
- (01491000) Opequon Creek near Martinsburg, WV

Report Period: January 1, 2003 – March 31, 2003

Funding: West Virginia Department of Environmental Protection (WVDEP) and U.S. Geological Survey (USGS)

Start Date: June 2005

Completion Date: continuous

Project Personnel: USGS Chief: Doug Chambers; USGS Lead Technician: Jeremy White and additional assistance from various other USGS and WVDEP personnel.

Project Objectives:

Determine the ambient concentration of nutrient and suspended sediment water-quality samples collected over a range in flow conditions in four major West Virginia tributaries to the Potomac River: Patterson Creek, the South Branch of the Potomac River, The Cacapon River, and Opequon Creek.

This Quarter's Sampling Events:

	Sample Type		
	Routine	Storm	QA/QC
Patterson Creek Nr Headsville	3	5	2
So. Br. Potomac @ Springfield	3	3	1
Cacapon River @ Great Cacapon	3	4	1
Opequon Cr. Nr Martinsburg	3	3	1

SAMPLE

Appendix C: Accounting for Trees in Stormwater Modeling and Calculations

Accounting for Trees in Stormwater Models and Calculators

Trees and forests have a natural ability to reduce stormwater runoff. As more and more communities encourage or even require the use of natural vegetative systems as part of their stormwater management programs, municipal planners and engineers require technical tools that allow them to quantify the stormwater benefits of this "green infrastructure" in a way that works seamlessly with existing models and methods.

This fact sheet summarizes methods and tools to account for the ability of green infrastructure to reduce runoff and remove pollutants. It is organized into two categories:

1. Methods for incorporating green infrastructure into runoff models
2. Models and calculators for estimating the functions, benefits, and economics of green infrastructure

1. Methods for Incorporating Green Infrastructure into Runoff Models

Historically, stormwater management has focused on peak runoff rate control, which requires a site designer to generate a post-development runoff hydrograph and a pre-development runoff hydrograph and manage the difference between the two.

More recently, site designers have been introduced to water quality control criteria that are intended to manage the "capture and treat" (e.g. water quality) volume.

Most recently, communities have developed stormwater ***runoff reduction*** criteria that specify a runoff volume that must be "captured and reduced" (e.g., reused, evaporated, utilized by plants, infiltrated or otherwise retained on site). Green infrastructure practices, such as conservation of forests, rain gardens and green rooftops, can be used to meet the runoff reduction criteria. A particular challenge is providing credit for these runoff reduction volumes within rainfall/runoff models.

In principle, when runoff reduction practices are used to capture and retain or infiltrate runoff, downstream stormwater management practices should not be required to detain, retain or otherwise treat the volume that is removed. In other words, ***runoff reduction should be accounted for in stormwater runoff computations***.

While it is not easy to predict the absolute hydrograph modification provided by reducing stormwater runoff volumes, it is clear that reducing runoff volumes will have an impact on the runoff hydrograph of a development site. The challenge facing stormwater managers and site designers is developing a hydrograph generating technique that provides adequate credit for stormwater runoff volumes that are reduced on site.

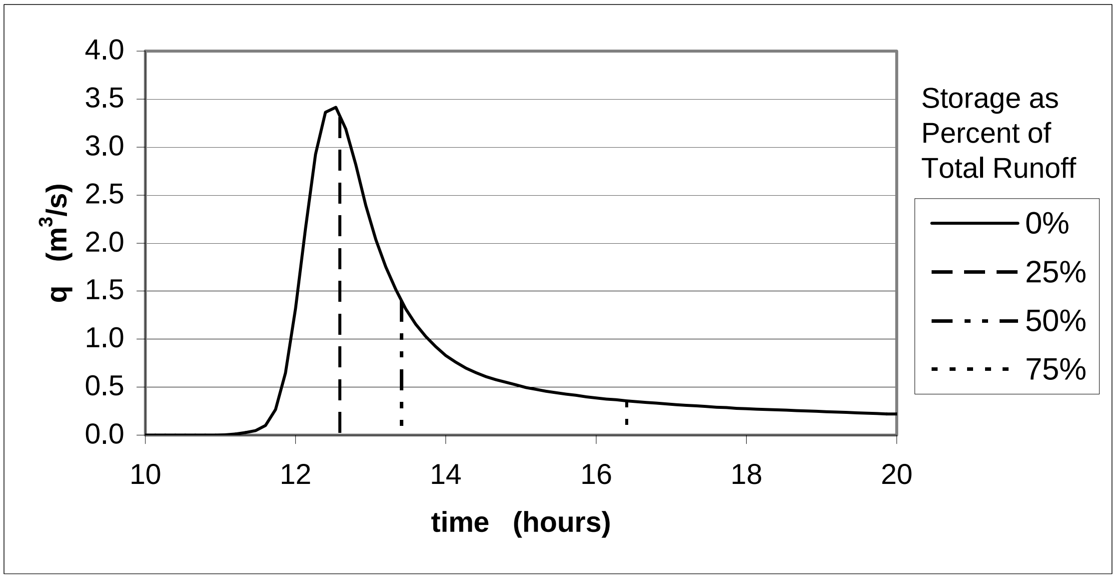
There are a variety of approaches that can be used to adjust the runoff hydrograph to account for the effect of runoff reduction practices in a site drainage area. In most cases, the "credit" received is likely dependent on the storm event and development intensity. In order to be useful to stormwater managers and site designers, the method developed and used must meet a number of objectives:

1. Field performance – solves real problems (e.g., water quality, channel protection, long term maintenance/performance)
2. Greater efficiency – does not lead to the overbuilding of stormwater best management practices (BMPs) (e.g., size or number of practices)
3. Incentivizes runoff reduction and environmental site design – leads to meaningful results if the designer applies ample effort to use runoff reduction practices
4. Simple – easy to understand & use, fits into spreadsheets and common models (e.g., TR-55)
5. Allows for a range of practices – broadens the suite of BMPs to use at a site – basins are not "automatic"
6. Accountability for the local public works staff – provides some assurance that today's plan approvals will not equal tomorrow's drainage complaints
7. Defensible – makes sense with the site hydrology; engineers believe it is realistic and plausible
8. Accurate – reflects actual site hydrology
9. Adaptable to different pollutants -- Addresses pollutants of concern for different applications
10. Relevant at the subwatershed scale – Can be tied to stormwater benchmarks for the subwatershed, such as flow, volume, and pollutant load reduction

The following section describes five approaches, all of which use the USDA Natural Resources Conservation Service (NRCS) (formerly known as the Soil Conservation Service) unit hydrograph method (USDA SCS, 1986) as a baseline. For some methods, a post-development hydrograph without runoff reduction practices is generated for the site, and is then adjusted. Other methods initially adjust the runoff depth that results from a site with runoff reduction practices, and then generates a post-development site hydrograph. Each approach is discussed below.

1. Truncated Hydrograph (Volume Diversion)

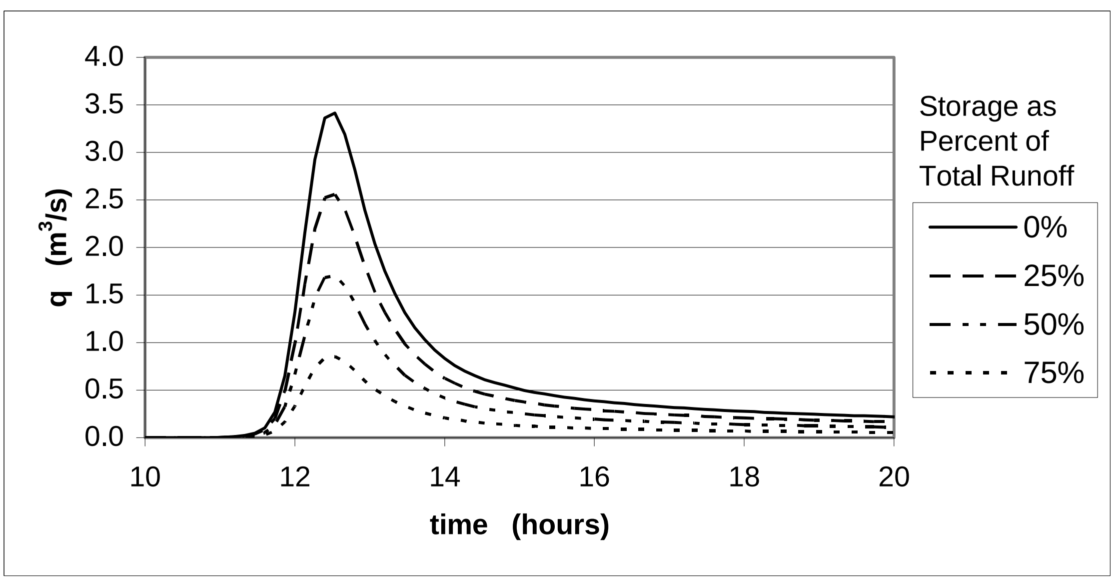
The truncated hydrograph approach applies runoff reduction in-line at the outlet of a drainage area. The philosophy behind this approach is that runoff reduction practices will accept and retain a portion of the initial runoff during a given rain event, which will modify the ultimate volume of runoff from the site, as well as the shape of the ultimate runoff hydrograph. For this particular option, a post-development runoff hydrograph for the original site prior to implementing runoff reduction practices is generated. The volume of runoff reduced by runoff reduction practices is then subtracted from the rising limb, or front portion, of the hydrograph. If the amount of runoff reduced is less than the volume up to the hydrograph peak, then no reduction in the peak flow or time to peak is reflected. As a result, this approach often results in conservative design estimates of the resulting peak flow, and ultimately gives less credit for runoff reduction practices.



Graphic source: Paul Koch

2. Hydrograph Scalar Multiplication

Similar to the previous approach, the hydrograph scalar approach begins by generating a post-development hydrograph for the original site prior to implementing runoff reduction practices. In this particular approach, the hydrograph is then multiplied by a scalar, which adjusts the magnitude of the original site hydrograph. The scalar is simply the ratio of runoff generated from the site with runoff reduction practices to the runoff generated from the original site (with no runoff reduction practices). The effect of runoff reduction practices is applied over the entire hydrograph rather than at the beginning. As a result, the degree to which the peak flow rate would be reduced is decreased, resulting in a conservative peak flow rate estimate, and giving less credit for runoff reduction practices. Also, no delay in the time to peak is reflected using this approach.



Graphic source: Paul Koch

3. Precipitation Adjustment- Subtract Retention from Rainfall

This approach adjusts the NRCS runoff depth formula (USDA SCS, 1986) prior to generating a hydrograph, eliminating the need to develop an original post-development site hydrograph. For this approach, the amount of runoff reduced is subtracted from the rainfall depth (Equation 1), and hydrograph calculations are subsequently performed.

$$Q = \frac{\left((P-R)-I_a\right)^2}{\left((P-R)-I_a\right)+S} \qquad (1)$$

where

P=rainfall depth (in),

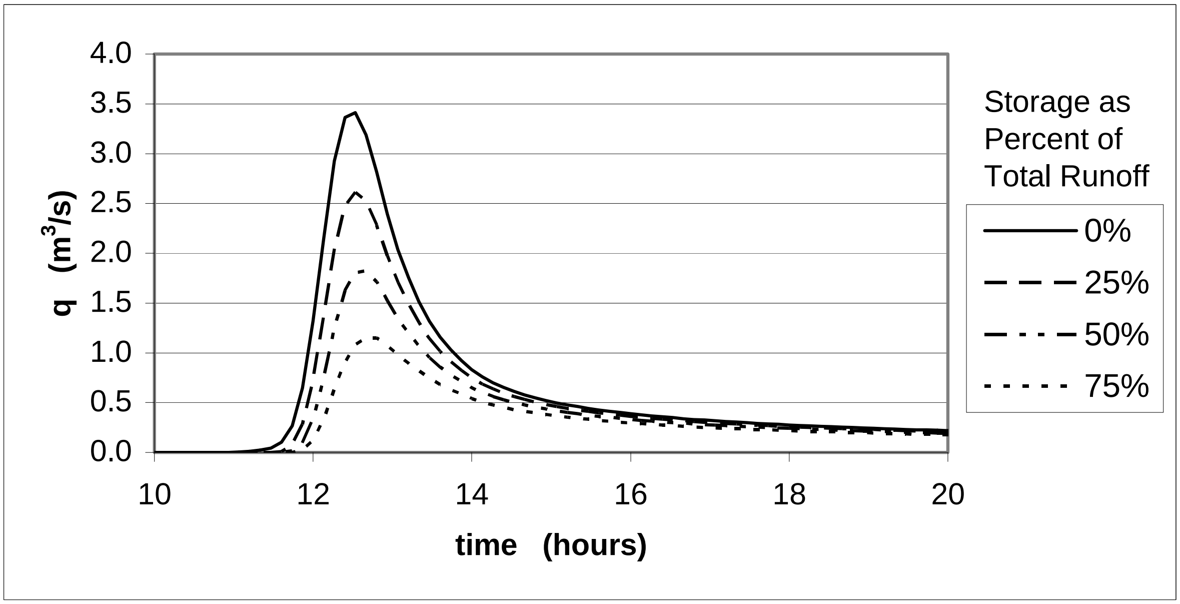
R = Reduced Runoff (in),

Q= Runoff (in),

I_a *= initial abstraction,*

S = potential maximum retention after runoff begins

The problem with this approach is that the volume of runoff reduced is never fully accounted for, as the change in runoff volume generated will always be less than the amount of runoff reduced. Further, adjusting the rainfall is not truly representative of what actually occurs over the site, and no delay in the time to peak is reflected using this approach.



Graphic source: Paul Koch

4. Adjusted CN

The Adjusted CN approach adjusts the NRCS runoff depth formula (USDA SCS, 1986) by changing the curve number (CN) for the portion of the site draining to runoff reduction practices. Site runoff is calculated using Equations 2-4. The CN can be adjusted to an improved site condition; for example, to a meadow in good condition.

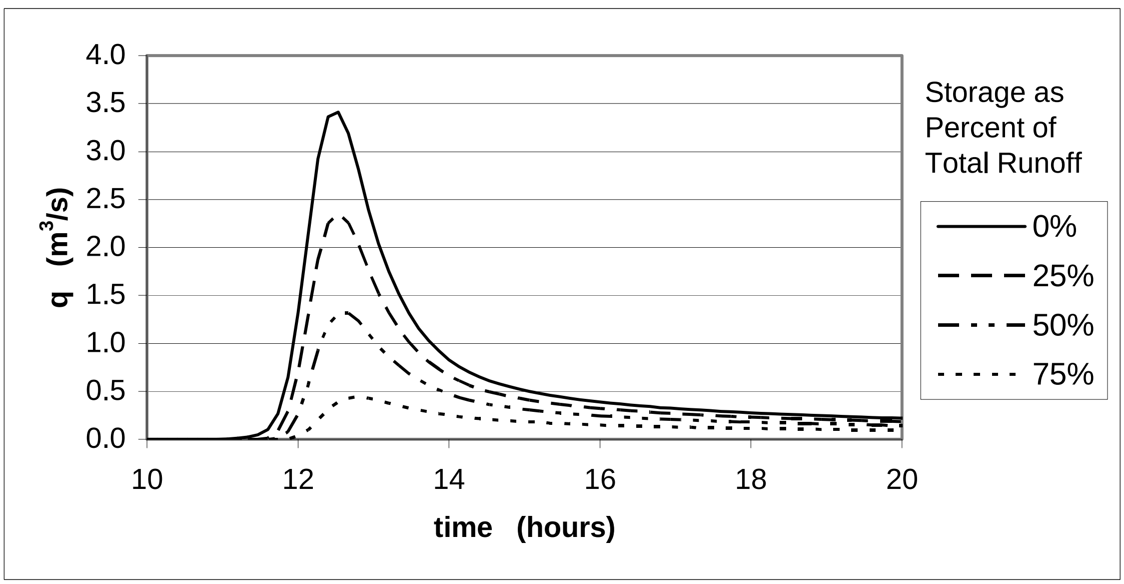
$$S = \frac{1000}{CN} - 10 \quad (2)$$

$$I_a = 0.2S \quad (3)$$

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \quad (4)$$

where
P=rainfall depth (in),
Q= Runoff (in),
I_a *= initial abstraction,*
S = potential maximum retention after runoff begins
CN = curve number

This approach reduces the runoff generated from the site and the runoff peak flow rate; however, no delay in the time to peak is reflected. Further, the effect of runoff reduction is distributed over the entire course of the storm, as opposed to occurring at the beginning. As a result, the degree to which the peak flow rate would be reduced is decreased, resulting in a conservative peak flow rate estimate, and less credit for runoff reduction practices. This method is a plausible way to reduce volumes and peak rates, and fits into the models that are understood by design consultants and plan reviewers.



Graphic source: Paul Koch

<u>*5. Runoff Adjustment - Subtract Retention from Runoff*</u>
The philosophy behind this approach is that runoff reduction practices will accept and retain a portion of the initial runoff during a given rain event, which will modify the volume of runoff from the site, as well as the shape of the resulting runoff hydrograph. The runoff adjustment

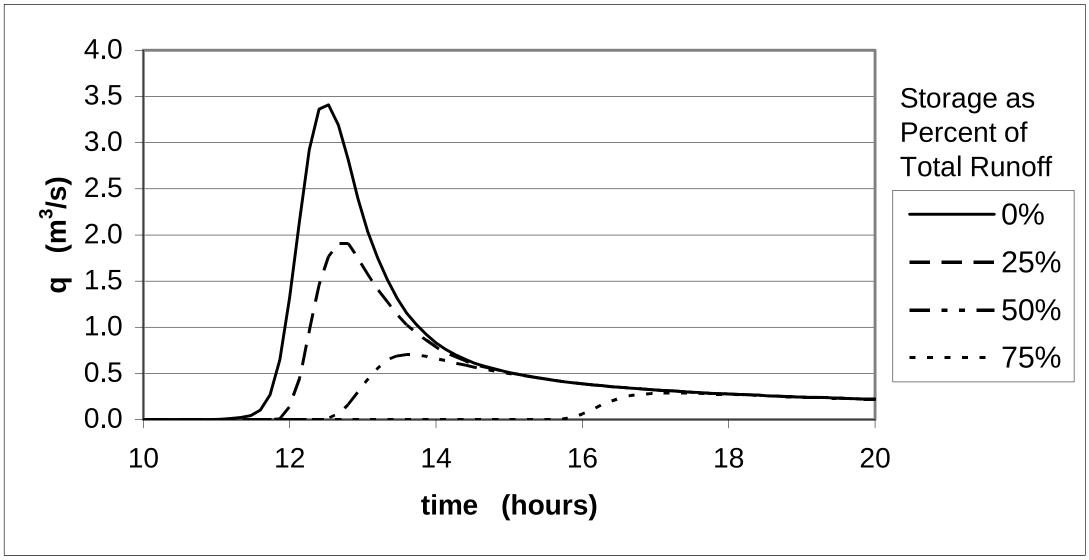
approach was developed by Koch (2005), and adjusts the NRCS runoff depth formula (USDA SCS, 1986) prior to generating a hydrograph. The amount of runoff reduced is subtracted from the calculated site runoff (Equation 5).

In order to generate a site hydrograph for an entire storm event, the storm is divided into discreet time periods. For each time period, an excess runoff rate is determined based upon watershed characteristics and the amount of rainfall during that time period. This excess runoff rate is then translated into a hydrograph. The site hydrograph for the entire storm event is created by summing each of these hydrographs over the duration of the storm. Instead of making a subtraction from the site hydrograph, the runoff adjustment approach subtracts each individual time period hydrograph, until the volume of runoff reduction has been reached.

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} - R \qquad (5)$$

where
P=rainfall depth (in),
R = Reduced Runoff (in),
Q= Runoff (in),
I_a *= initial abstraction,*
S = potential maximum retention after runoff begins

The runoff adjustment approach not only subtracts the runoff reduction volume at the beginning of the hydrograph, but also tends to reduce the peak flow and extend the time to peak of the site hydrograph, all of which are expected effects of utilizing runoff reduction practices. This approach appears to model the actual hydrology of runoff reduction practices most closely, but it is difficult and time-consuming because subtraction of time period hydrographs requires that the time period hydrographs be individually calculated throughout a storm event cannot be used to generate the resulting hydrograph. Existing hydrology programs, such as TR-55 and TR-20, do not have the capability to subtract individual hydrographs from the site hydrograph and account for runoff reduction practices in this manner.



Graphic source: Paul Koch

2. Models and Calculators for Estimating the Functions, Benefits, and Economics of Green Infrastructure

This section describes sixteen models and calculators that are available to account for the functions, benefits, and economics of green infrastructure. It includes a range of hydrologic and hydraulic (H&H) models, water quality models, build-out models, and cost-benefit calculators and tools. Web links are provided for additional information.

"Green Build-Out" Model
Casey Trees and LimnoTech developed a model (based on the STRATUM model) to predict the stormwater benefits of trees and green roofs for different coverage scenarios in Washington, DC. The model was applied to an "intensive greening" scenario and a "moderate greening" scenario, both of which demonstrated that trees and green roofs can be used to achieve substantial reductions in stormwater runoff and sewage discharges to local rivers. Specific outputs from the model include city-wide runoff volume reduction, reduction in CSO frequency and discharge, and the cost savings associated with these environmental benefits.
http://www.caseytrees.org/programs/planning-design/gbo.html

Green Roof Life Cycle Cost-Benefit Calculator
Green Roofs for Healthy Cities developed this calculator to help evaluate various roofing related investment scenarios. The Tool focuses on long timeframes, real monetary costs and savings, and financial returns attributed to employing conventional and green (vegetative) roofs. It also provides some guidance to the users about how to factor in financial information from benefits that may be overlooked in the analysis. To access the calculator, a free user account must be created.
http://www.greenroofs.org/index.php?option=com_content&task=view&id=626&Itemid=116

"Green Values" Stormwater Calculator

A calculator developed by the Center for Neighborhood Technology that can be used to estimate the financial and hydrologic impacts that various green infrastructure technologies can have on a development site. Specific outputs of the calculator include reduction in peak discharge, average annual groundwater recharge increase, reduction in total detention required and costs associated with green infrastructure versus conventional practices. http://greenvalues.cnt.org/calculator

Hydrological Simulation Program – FORTRAN (HSPF)

EPA's FORTRAN (HSPF) is a comprehensive package for simulation of watershed hydrology and water quality for both conventional and toxic organic pollutants. This model can simulate the hydrologic, and associated water quality, processes on pervious and impervious land surfaces and in streams and well-mixed impoundments. It is the only comprehensive model of watershed hydrology and water quality that allows the integrated simulation of land and soil contaminant runoff processes with in-stream hydraulic and sediment-chemical interactions. The result of this simulation is a time history of the runoff flow rate, sediment load, and nutrient and pesticide concentrations, along with a time history of water quantity and quality at any point in a watershed. HSPF simulates three sediment types (sand, silt and clay) in addition to a single organic chemical and transformation products of that chemical. Analysis of stormwater treatment using HSPF can be cumbersome. http://www.epa.gov/ceampubl/swater/hspf/

Long-Term Hydrologic Impact Assessment Model (L-THIA)

The Local Government Environmental Assistance Network's Long-Term Hydrologic Impact Assessment (L-THIA) model was developed as an accessible online tool to assess the water quality impacts of land use change. Based on community-specific climate data, L-THIA estimates changes in recharge, runoff, and nonpoint source pollution resulting from past or proposed development. Inputs include land use/cover, soils, and runoff event mean concentrations. The model allows the user to modify inputs of impervious cover, forest and open space to reflect the use of green infrastructure practices. As a quick and easy-to-use approach, L-THIA's results can be used to generate community awareness of potential long-term problems and to support planning aimed at minimizing disturbance of critical areas.
http://www.ecn.purdue.edu/runoff/lthianew/

Low Impact Development Rapid Assessment (LIDRA) of Cost-Effectiveness for CSO Control

This paper presents a simple model for assessing the cost-effectiveness of investments in green infrastructure (GI) techniques, including green roofs, porous pavement and stormwater wetlands, for reducing combined sewer overflows (CSOs) in urban watersheds. The LIDRA model can be used as a policy-planning tool to compare GI introduced alone or in conjunction with traditional stormwater management techniques, to conventional approaches focusing wholly on centralized infrastructure. The potential reduction in CSOs resulting from various levels of GI adoption is simulated using a modified Rational Method. A life-cycle cost analysis is used to compare GI with other alternatives. The model assesses GI effectiveness in terms of estimated change in annual CSO hours (an hour during which a CSO event occurs) resulting from GI installation.
http://www.nyc.gov/html/planyc2030/downloads/pdf/water_quality_bmp_study.pdf

Pollutant Load and Reduction Model

Comprehensive Environmental Inc. has developed a Pollutant Load and Reduction Model that can be helpful to a variety of users including watershed groups, municipal land use decision-makers, and engineers. The simple spreadsheet model allows the user to determine how different types of green infrastructure (GI) techniques, including stormwater wetlands, ponds, infiltration facilities, rain gardens and swales, can reduce the pollutant loads in a given watershed. Model inputs include land use, annual rainfall, road sanding information and BMP information. Impervious cover inputs are based on land use type but can be changed manually to account for GI practices that reduce impervious cover or conserve natural areas, if desired. Outputs include annual loads of TSS, TP and TN and the amount reduced by using GI techniques.
http://www.nsrwa.org/programs/low_impact_development.asp

Program for Predicting Polluting Particle Passage through Pits, Puddles, and Ponds (P8)

P8 is a model for predicting the generation and transport of stormwater pollutants in urban watersheds. Continuous water balance and mass balance calculations are performed on a user-defined system consisting of watersheds (divided into pervious and impervious areas), devices (buffer strips, swales, ponds, infiltration basins, pipes, flow splitters and aquifers), particle classes, and water quality components. Simulations are driven by continuous hourly rainfall and daily air temperature time series data. The model simulates pollutant transport and removal in a variety of devices, some of which are green infrastructure practices. Water quality components include total suspended solids, total phosphorus, total Kjeldahl nitrogen, copper, lead, zinc, and hydrocarbons. Outputs for each device include such factors as removal efficiency, flow, loads and concentrations, water and mass balance, and sediment accumulation rates.
http://www.epa.gov/ORD/NRMRL/pubs/600r05149/600r05149p8ucm.pdf

RECARGA

The University of Wisconsin developed RECARGA as a design tool for evaluating the performance of bioretention facilities, raingardens, and infiltrations basins. Individual BMPs, with up to 3 distinct soil layers and optional underdrains, can be modeled under user-specified precipitation and evaporation conditions. The results of this model can be used to properly size BMPs to meet specific performance objectives, such as reducing runoff volume or increasing groundwater recharge, and for analyzing the potential impacts of varying the design parameters.
http://dnr.wi.gov/runoff/stormwater/technote.htm

Site Evaluation Tool (SET)

SET was developed by the Upper Neuse River Basin Association and Tetra Tech Inc. to help assess the environmental impacts and costs of a site's stormwater management design. The SET is designed primarily for local government site review planners, professional developers, and stormwater engineers, but it is useful for anyone with an interest in reducing stormwater runoff impacts. The model predicts total annual stormwater volume and total annual TSS, TP and TN, as well as costs associated with each scenario. Although the model was developed for the Upper Neuse River Basin, it is applicable to the entire Piedmont region. The model includes a wide range of green infrastructure practices, such as green roofs, permeable pavement, ponds, wetlands, rain barrels/cisterns, bioretention, and forest buffers.
http://www.unrba.org/set/index.shtml

Stormwater Management Model (SWMM)
EPA's SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. SWMM was first developed in 1971, and has since undergone several major upgrades since then. It continues to be widely used throughout the world for planning, analysis and design related to stormwater runoff, combined sewers, sanitary sewers, and other drainage systems in urban areas, with many applications in non-urban areas as well. http://www.epa.gov/ednnrmrl/models/swmm/index.htm

Source Loading and Management Model (SLAMM)
SLAMM was originally developed by USGS to better understand the relationships between sources of urban runoff pollutants and runoff quality. It has been continually expanded since the late 1970s and now includes a wide variety of green infrastructure practices and other pollution controls (infiltration practices, wet detention ponds, porous pavement, street cleaning, catchbasin cleaning, and grass swales). SLAMM is strongly based on actual field observations, with minimal reliance on theoretical processes that have not been adequately documented or confirmed in the field. SLAMM incorporates unique process descriptions to more accurately predict the sources of runoff pollutants and flows for the storms of most interest in stormwater quality analyses. SLAMM calculates mass balances for both particulate and dissolved pollutants and runoff flow volumes for different development characteristics and rainfalls. Its primary capabilities include predicting flow and pollutant discharges that reflect a broad variety of development conditions and the use of many combinations of common urban runoff control practices. http://wi.water.usgs.gov/slamm/

Street Tree Management Tool for Urban forest Managers (STRATUM)
STRATUM is a street tree management and analysis tool developed by the Center for Urban Forest Research for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO_2 reduction, stormwater control, and property value increase. STRATUM quantifies the stormwater volume reduction benefits of trees based on canopy interception. It is an easy-to-use, computer-based program that allows any community to conduct and analyze a street tree inventory. Baseline data can be used to effectively manage the resource, develop policy and set priorities. Using a sample or an existing inventory of street trees, this software allows managers to evaluate current benefits, costs, and management needs. http://www.itreetools.org/street_trees/introduction_step1.shtm

Urban Forest Effects Model (UFORE)
The Urban Forest Effects Model (UFORE) is a computer model that calculates the structure, environmental effects and values of urban forests. The UFORE model was developed by researchers at the USDA Forest Service, Northeastern Research Station in Syracuse, NY. The current version was designed only to incorporate data on urban forest structure and carbon storage, and sequestration. This programs aids in urban forest assessments and sampling, including assessments for exotic pest infestations and urban forest effects on carbon dioxide, the dominant greenhouse gas." One component of the model still under development, UFORE-Hydro, is designed to evaluate at the watershed scale, how changes in impervious surface and tree canopy (and some additional variables) affect 1) the total volume of runoff, 2) the peak

storm event volume and duration of peak, 3) stream baseflow, 4) the total annual pollutant loading and 5) the mean event pollution load. These factors are determined based on the canopy interception, infiltration and evapotranspiration provided by individual trees and forest patches. http://www.ufore.org

Water Balance Model (WBM)

The Water Balance Model (WBM) powered by QUALHYMO is a public domain, on-line decision support and scenario modeling tool for promoting rainwater management and stream health protection through implementation of "green" development practices. The appeal and the strength of the tool is that it is evolving to meet the "needs and wants" of participating agencies. The British Columbia Inter-Governmental Partnership developed the WBM in 2003.
Initially, the WBM was a planning tool that had a site focus. It enabled users to evaluate the effectiveness of source controls --- such as absorbent landscaping, infiltration facilities, green roofs, and rainwater harvesting --- in achieving performance targets for rainwater volume capture and runoff rate control under various combinations of land use, soil and climate conditions.
The WBM has since been integrated with QUALHYMO, a rainfall-runoff simulation tool, to provide drainage engineers with a suite of analytical capabilities, from site to watershed. The over-arching goal in integrating these tools is to help local governments achieve desired urban stream health and environmental protection outcomes at a watershed scale.
http://www.waterbalance.ca/

Watershed Treatment Model (WTM)

Developed by the Center for Watershed Protection, the Watershed Treatment Model (WTM) is a simple spreadsheet model that tracks pollutant sources and the effectiveness of various watershed treatment options in urban and urbanizing watersheds. A wide range of treatment options, including green infrastructure practices, are contained in the WTM (e.g., impervious cover disconnection, riparian buffers, ponds, wetlands, swales and filters). The WTM can be used to develop TMDLs for nutrients or sediment; direct bacteria detective work in urbanized watersheds; determine the effectiveness of watershed education programs; and target the future program in a Phase II community. Specific outputs of the WTM include total loads of sediment, nutrients and bacteria from a given watershed. The WTM is currently being revised to provide estimates of runoff reduction associated with various watershed treatment options.
www.cwp.org

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U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS). (1986). *Technical Release 55: Urban Hydrology for Small Watersheds*. *Second Edition.* USDA SCS, Washington, DC.

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