Lancaster County Conservation District
Water Quality Volunteer Coalition (WQVC)
Study Design of Lancaster County

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Introduction

Lancaster County Conservation District & WQVC

Lancaster County Conservation District (LCCD) is an organization that is concerned with the natural resources of Lancaster County. LCCD's main focus is the protection and conservation of those natural resources. The District's programs are multifaceted and deal with a variety of topics and issues. Programs that the District is involved with are: Chesapeake Bay Program, Nutrient Management, Erosion and Sedimentation Control, Educational Outreach, Ombudsman, and Watershed Protection. All of the above programs are run in conjunction with County, State, and Federal entities, and funding is provided through several avenues.

In July of 2001, Lancaster Healthy Communities (LHC) convened a collaborative with, the Environmental Alliance for Senior Involvement (EASI), Office of the Aging, and Retired Senior Volunteer Program (RSVP) to form the Water Quality Volunteer Coalition (WQVC) of Lancaster County. The primary goal of this corps was water quality monitoring, however; volunteers have expanded the scope of WQVC by getting involved in various other projects throughout the county that focus on water quality issues. Some examples of projects our volunteers have taken on are; stream restoration, stream bank planting, environmental education, intergenerational mentoring, stream clean-ups, fish stocking, flora and fauna identification, trail marking, seeding, weeding and much more. In October of 2003 the Lancaster County Conservation District took over the EASI program from LHC.

The volunteer's efforts will help to strengthen watershed awareness in Lancaster County through education, programs, policy, and through broad involvement of citizens in their watersheds.

This document was compiled by a committee whose members included; the county watershed specialist and WQVC volunteers. It will serve as a strategic plan for the county's water quality monitoring efforts. Due to the nature of this work, this document will be continually evolving. Updated versions will be available as necessary.

Our County and Its Watersheds

Watersheds of Lancaster County, located in south central Pennsylvania, feed directly into the Susquehanna River and contribute more nutrient pollutants from agriculture than any other county in the Chesapeake Bay. Approximately 80% of the county's land is designated for agricultural purposes, and much of that land is actively utilized for both crops and livestock. This agriculture takes place on gently sloping hills with karst, soluble limestone subsoils.

Nutrient and sediment loading are the primary concerns in Lancaster County originating from non-point pollution (NPS) sources including agriculture and urban sources. This includes farm applications of pesticides, fertilizer, and manure; urban/suburban pesticide lawn applications, sediment from non-vegetated soil (urban and ag land use), various compounds from roads (road salts, engine oil, animal waste, and others), and many other sources.

Some of the major issues on farms include a lack of riparian buffer, unrestricted livestock access to the stream, and overuse and misuse of pesticides, fertilizers, and manure. Excess nutrients from fertilizer and manure are a significant source of nutrients including nitrogen and phosphorous. Manure also carries bacteria which leaches into groundwater, affects livestock health, and alters the stream ecosystem.

Streams on farms are typically next to pasture because the area is too wet to farm. For this reason, livestock historically are pastured by the stream and farmers only keep pasture grass growing for the animals. Cows and other farm animals then tear up and compact the unprotected stream banks, leading to streambank erosion.

Finally, tillage practices and crop harvest can leave soil exposed for long periods, a significant source of sediment to waterways. Dams are also a common historical feature on farms from past mill production which has caused significant legacy sediment build up behind streams. Combined with a lack of riparian buffer protecting the banks and providing needed habitat, Lancaster's streams face multiple issues that are leading to their degradation

Urban and suburban areas also contribute a significant portion of pollution to Lancaster streams. The county population has increased dramatically in the past few decades along with development. Increased impervious surface with minimal water retention mechanisms results in: 1. Increase stormwater runoff volume and velocity 2. Thermal impacts 3. Direct inputs of road salts, engine oils, and other compounds from roadways, home and industry. Increased development is also associated with more lawn which has limited water holding capacity, leading to similar issues with stormwater runoff.

Both of these NPS pollutions have led to the stream degradation of Lancaster County. In some cases, water flow, chemistry, temperature, and habitat have been altered so greatly that most plants, insects, and fish cannot live there. However, the positive story is significant work has been done over decades to combat these issues from the private and public sectors. WQVC monitors work to long-term quantify how are these practices working and if we are seeing our water quality improve. These individuals are motivated and want to support the work of their community by obtaining quality, usable data on the impact of these projects and the state of our waters.

Members will also monitor in locations to determine the impact of development, industry, sewage treatment plants, woodlands and wetlands.

Our main goals are to:

- Measure the quality of water throughout selected watersheds of Lancaster County.
- Use data to show measurable environmental results in water quality due to restoration efforts.
- Determine where current restoration practices need to be modified and/or expanded.
- Raise state water quality designations where possible.
- Educate the public about the threats facing our waterways.
- Support current restoration efforts and the groups involved.

Background on Waters of Interest

The information in the chart below (Table 1A) was taken from a map designed by the Lancaster County GIS Department using aerial photographs from 1993. The original map was 36" X 48" and was minimized by Lancaster Blueprint Company to 18" X 24" for the purpose of this report.

The streams in column 1 were chosen by members of the Study Design Committee for various reasons; however, each stream has a minimum of one monitoring location listed in Table 6A. Please note that the percentages of land use listed in column 4 are *estimates and should only be used as a guideline for the designated watershed.*

Table 1A Land Usage for Lancaster's Watersheds according to WikiWatersheds

Water of Interest	Watershed	Body of Water into which Water of Interest Flows	Land Usage in Watershed
Chiques Creek	Chiques	Susquehanna River	51% Cultivated Crops 11% Pasture/Hay 11% Deciduous Forest 8% Developed, Open Space 7% Developed, Low Density 3% Developed, Medium Density 1% Developed, High Density <1% Mixed Forests <1% Shrub/Scrub <1% Woody Wetlands <1% Grassland Herbaceous <1% Evergreen Forest <1% Open Water <1% Barren Land <1% Emergent Herbaceous Wetlands
Cocalico Creek	Cocalico	Conestoga River	28% Deciduous Forest 31% Cultivated Crops 11% Pasture/Hay 10% Developed, Open Space 7% Developed, Low Density 1% Scrub/Shrub 3% Developed, Medium Density 1% Woody Wetlands 1% Developed, High Density 1% Open Water 5% Mixed Forests <1% Grassland Herbaceous <1% Evergreen Forest <1% Barren Land <1% Emergent Herbaceous Wetlands
Conestoga River	Conestoga	Susquehanna River	27% Cultivated Crops 20% Pasture/Hay 19% Deciduous Forest 10% Developed, Open Space 10% Developed, Low Density 6% Developed, Medium Density 1% Scrub/Shrub 2% Developed, High Density <1% Barren Land 1% Woody Wetlands 4% Mixed Forests <1% Grassland Herbaceous <1% Evergreen Forest <1% Open Water <1% Emergent Herbaceous Wetlands

Conoy Creek	Conoy	Susquehanna River	43% Cultivated Crops 11% Pasture/Hay 13% Developed, Open Space 12% Developed, Low Density 5% Deciduous Forest 6% Developed, Medium Density 1% Scrub/Shrub 2% Developed, High Density 6% Mixed Forests <1% Woody Wetlands <1% Grassland Herbaceous <1% Evergreen Forest <1% Open Water <1% Barren Land <1% Emergent Herbaceous Wetlands
Fishing Creek	Fishing	Susquehanna River	38% Cultivated Crops 18% Deciduous Forest 16% Open Water 12% Pasture/Hay 6% Developed, Open Space 1% Scrub/Shrub 6% Mixed Forests <1% Woody Wetlands 1% Developed, Low Density <1% Evergreen Forest <1% Developed, High Density <1% Developed, Medium Density <1% Grassland Herbaceous <1% Emergent Herbaceous Wetlands
Hammer Creek	Hammer	Cocalico Creek	32% Deciduous Forest 37% Cultivated Crops 12% Pasture/Hay 7% Developed, Open Space 4% Developed, Low Density 4% Mixed Forests 1% Developed, Medium Density <1% Scrub/Shrub <1% Open Water <1% Developed, High Density <1% Mixed Forests <1% Woody Wetlands <1% Grassland Herbaceous <1% Evergreen Forest <1% Barren Land <1% Emergent Herbaceous Wetlands
Little Conestoga Creek	Little Conestoga	Conestoga River	33% Cultivated Crops 16% Developed, Open Space 19% Developed, Low Density 8% Pasture/Hay 10% Developed, Medium Density 2% Deciduous Forest 6% Developed, High Density 1% Scrub/Shrub 5% Mixed Forests <1% Evergreen Forest 1% Barren Land

			<1% Woody Wetlands <1% Grassland Herbaceous <1% Open Water <1% Emergent Herbaceous Wetlands
Lititz Run	Lititz	Conestoga River	39% Cultivated Crops 13% Pasture/Hay 14% Developed, Open Space 16% Developed, Low Density 2% Deciduous Forest 8% Developed, Medium Density 2% Developed, High Density <1% Scrub/Shrub <1% Open Water 4% Mixed Forests <1% Woody Wetlands <1% Grassland Herbaceous <1% Evergreen Forest <1% Barren Land
Mill Creek	Mill	Conestoga River	49% Cultivated Crops 12% Pasture/Hay 10% Developed, Open Space 6% Deciduous Forest 10% Developed, Low Density 6% Developed, Medium Density 3% Developed, High Density 1% Scrub/Shrub 3% Mixed Forests <1% Evergreen Forest <1% Barren Land <1% Woody Wetlands <1% Grassland Herbaceous <1% Open Water <1% Emergent Herbaceous Wetlands
Pequea Creek	Pequea	Susquehanna River	44% Cultivated Crops 15% Pasture/Hay 16% Deciduous Forest 9% Developed, Open Space 6% Developed, Low Density 1% Scrub/Shrub 6% Mixed Forests 2% Developed, Medium Density 1% Developed, High Density <1% Evergreen Forest <1% Barren Land <1% Woody Wetlands <1% Grassland Herbaceous <1% Open Water <1% Emergent Herbaceous Wetlands
Conowingo Creek	Conowingo	Susquehanna River	52% Cultivated Crops 15% Pasture/Hay 15% Deciduous Forest 7% Developed, Open Space 1% Scrub/Shrub 2% Developed, Low Density

			<1% Evergreen Forest 5% Mixed Forests 1% Woody Wetlands 1% Developed, Medium Density <1% Developed, High Density <1% Grassland Herbaceous <1% Open Water <1% Barren Land <1% Emergent Herbaceous Wetlands
Climbers Run	Pequea	Pequea Creek	31% Deciduous Forest 28% Cultivated Crops 11% Pasture/Hay 11% Developed, Open Space 12% Mixed Forests 1% Scrub/Shrub 4% Developed, Low Density 1% Developed, Medium Density <1% Woody Wetlands <1% Grassland Herbaceous <1% Evergreen Forest <1% Open Water

Table 1B Current Status of Our Waters of Interest

Streams	Stream Designation	Actual Uses & Values	Non-Point Source (NPS) Pollution	Source of Impairment	Cause of Impairment	Known Problems Conflicts, or Threats	Known Efforts To Address Problems
Chiques Creek	WWF	Recreation & Agriculture	Yes	Agriculture	Nutrients & Siltation	Agriculture, Stormwater, & Wastewater	Chiques Creek Watershed Alliance
Cocalico Creek	WWF	Recreation & Agriculture	Yes	Agriculture, Urban runoff, & Storm sewers	Nutrients, Siltation, & Causes Unknown	Agriculture, Stormwater, & Wastewater	Cocalico Creek Watershed Association
Conestoga River	WWF	Drinking water, Recreation, & Agriculture	Yes	Agriculture, Municipal Point source, Residential runoff, Upstream Channels, Removal of veg., & Other	Nutrients, Organic enrichment, Low D.O., Chlorine, Siltation, & Flow alteration	Agriculture, Stormwater, & Wastewater	Conestoga River Club
Conoy Creek	WWF	Recreation & Agriculture	Yes	Agriculture, Urban runoff, & Storm sewers	Nutrients & Siltation	Agriculture, Stormwater, & Wastewater	Conoy Creek Watershed Association
Fishing Creek	CWF	Recreation & Agriculture	Yes	Agriculture	Nutrients Siltation	Agriculture & Stormwater	Friends of Fishing Creek Watershed Association
Hammer Creek	WWF	Recreation & Agriculture	Yes	Agriculture	Nutrients Siltation	Agriculture, Stormwater, & Wastewater	Hammer Creek Watershed Association
Landis Run	WWF	Recreation & Agriculture	Yes			Agriculture & Stormwater	None
Little Conestoga Creek	WWF & TSF	Recreation & Agriculture	Yes	Agriculture, Urban runoff, Storm sewers, & Industrial point source	Nutrients, Siltation, & Cause Unknown	Agriculture, Stormwater, & Wastewater	Little Conestoga Watershed Alliance

Lititz Run	CWF	Recreation & Agriculture	Yes	Urban runoff/ Storm sewers	Suspend ed solids	Agriculture, Stormwater, & Wastewater	Lititz Run Watershed Alliance
Mill Creek	CWF & WWF	Recreation & Agriculture	Yes	Agriculture	Nutrients & Siltation	Agriculture & Stormwater	Mill Creek Preservation Association
Muddy Creek	WWF	Recreation & Agriculture	Yes	Agriculture	Nutrients & Siltation	Agriculture & Stormwater	None
Pequea Creek-Eshleman/ Londonland Run	CWF	Recreation & Agriculture	Yes	Agriculture, Municipal Point source, & Residential runoff	Nutrients, Organic enrichme nt, & Siltation	Agriculture, Stormwater, & Wastewater	Paradise Sportsman Association & Pequea Creek Watershed Association
Swarr Run	TSF	Recreation & Agriculture	Yes	Agriculture	Nutrients & Siltation	Agriculture & Stormwater	Little Conestoga Watershed Alliance

The most pressing water quality issue(s) facing our waters of interest are:

- Stream bank erosion
- Livestock contamination & general agricultural runoff issues
- Minimal riparian zones/buffers
- Urban runoff
- Development/Sprawl

Monitoring Implementation & Analysis

Purpose & Goals

Table 2A Gaps and Issues in Monitoring

1) Issue	2) Information Needed	3) Existing Monitoring Efforts
Stream-bank erosion	Visual, chemical & macroinvertebrate assessments	Variable
Livestock contamination	Visual, chemical & macroinvertebrate assessments	Variable
Lack of riparian buffers	Visual, chemical & macroinvertebrate assessments	Variable
Urban run-off	Chemical testing done by a certified lab following PADEP protocols	None

Monitoring Questions

- Where are the impaired waters that should be a high priority for restoration? What is causing these impairments?
- Where are the threatened waters that should be a high priority for protection? What is causing these threats?
- What is the impact of various types of land and water use activities on ecological conditions and human uses? (e. g. various types of point and non-point source pollution).
- How effective are various strategies (e.g. wastewater treatment, best management practices) in protecting and restoring ecological integrity?
- How effective are various post-construction stormwater management facilities?

Monitoring Purposes

- Community Education and Awareness
- Baseline Data Collection
- Water Quality Education to Secondary Students
- Community and/or Watershed Level Assessment
- State and Federal Agency Assessment

Table 2B. List of intended uses and users of the information we collect.

User	Uses
Watershed Associations	Determine the needs and effectiveness of restoration efforts
Nature Abounds	Use as baseline data for PADEP
Conservation District	Education Focus of compliance efforts
Local School Students	Education and/or research related studies
Local County Citizens	Education/Awareness Encourage more citizen-based activity
Pennsylvania Department of Environmental Protection	To determine if designations/classification standards are being met and to upgrade stream classifications
Lancaster County Planning Commission	Planning purposes and public information for county residents
Environmental Group (Chesapeake Bay Foundation, Alliance for the Chesapeake Bay, Susquehanna River Basin Commission, etc.)	Determine effects of restoration efforts in Lancaster County streams and how this relates to the rest of the Bay

Monitoring Equipment & Data Quality

At this time, WQVC will be performing a Basic Watershed Inventory and Assessment. This consists of a Watershed Inventory and a Condition and Trend Assessment of Wadeable Waters. We will be measuring air and water temperature, dissolved oxygen, total phosphates, conductivity, pH, salinity, total dissolved solids, total alkalinity, nitrate-nitrogen, turbidity, flow, and benthic macroinvertebrates. Habitat assessments will also be conducted biannually to physically assess the stream over time.

Table 4A Data Quality Objectives for Sampling

Sample Type	Completeness	Representativeness
All Except macroinvertebrates	80% at 12 samples/year	All samples will be taken in the midstream section of the monitoring site.
Macroinvertebrates	100% at 2 samples/year	All samples will be taken in the midstream section of the monitoring site.
Visual Habitat Assessment	100% at 2 samples/year	All samples will be taken from the bank looking approximately 100 yards upstream & downstream.

Table 4B Data Quality Objectives for Analysis

Parameter	Detection Limit/Measurement Range	Units	Practical Quantitation Limit	Precision	Accuracy
Temperature	Armored Thermometer/0-100	° Celsius or Fahrenheit	0	± 20%	± 0.5 ° C
Dissolved Oxygen	Dissolved Oxygen Meter	mg/l	0.2	± 20% RPD*	75-125% recovery**
pH	PcoketPro	pH units	1.0	± 20% RPD*	90-110% recovery**
Conductivity	PocketPro	uS/cm	10	± 20% RPD*	± 10 uS/cm
Total Phosphate	Colorimeter	mg/l	0.1	± 20% RPD*	75-125% recovery**
Nitrate	Colorimeter	mg/l	0	± 20% RPD*	75-125% recovery**
Turbidity	Colorimeter	Mg/l	0	± 20% RPD*	75-125% recovery**
Alkalinity	End Point Titration/5-400	mg/l	5	± 20% RPD*	75-125% recovery**
Total Dissolved Solids	PcoketPro	mg/l	10	± 20% RPD*	90-100% recovery**
Salinity	PocketPro	mg/l	0.1	± 20% RPD*	90-100% recovery**

*RPD (Relative Percent Difference) = $\frac{|X_s - X_d|}{\left(\frac{X_s + X_d}{2}\right)} \times 100$

Where: X_s = result for the sample & X_d = result for the duplicate sample

**Percent (%) Recovery = Measured Value/Calibration Standard Value x 100

Sampling Methods

Table 5A: Sample Collection Methods

Indicator	What will be sampled	Sampling containers or devices/ preservation	Quantity of sample to be collected	# of samples collected per site	Methods Reference
Temperature	Mid/Mid Stream	Direct	N/A	N/A	Thermometer
pH	Mid/Mid Stream	Direct	N/A	N/A	PocketPro
Dissolved Oxygen	Mid/Mid Stream	Direct	N/A	N/A	Dissolved Oxygen Meter
Conductivity	Mid/Mid Stream	Direct	N/A	N/A	PocketPro
Nitrates	Mid/Mid Stream	Direct	10 ml	2	Colorimeter
Total Phosphate	Mid/Mid Stream	Direct	10 ml	2	Colorimeter
Turbidity	Mid/Mid Stream	Direct	10 ml	2	Colorimeter
Alkalinity	Mid/Mid Stream	Plastic/ Glass Bottle	5 ml	2	H_2S0_4 eyedropper Bromcisciol
Total Dissolved Solids	Mid/Mid Stream	Direct	N/A	N/A	PocketPro
Benthic Macoinvertabates	Stream Bottom	Kick net	1 sq. meter	2-3	Kick nets
Salinity	Mid/Mid Stream	Direct	N/A	N/A	PocketPro

Table 5B: Sample Analysis Methods

Indicator	How Sample Transported to Lab	Maximum Holding Time	Method Reference	Brief Description of Method	Reporting Units
Temperature	N/A Field	Analysis done on site	Direct Pocket pen	Direct	Degrees C
PH	N/A Field	Analysis done on site	Direct PocketPro	Direct	-
DO	N/A Field	Analysis done on site	DO Meter	Direct	mg/l (ppm)
Conductivity	N/A Field	Analysis done on site	Direct PocketPro	Direct	uS/cm
Nitrates	Dark & Cool 4°C	48 hours refrigerated	Colorimeter	Direct	mg/l (ppm)
Total Phosphate	Dark & Cool 4°C	48 hours refrigerated	Colorimeter	Direct	mg/l (ppm)
Turbidity	N/A Field	Analysis done on site	Colorimeter	Direct	mg/l (ppm)
Alkalinity	Dark & Cool 4°	24 hours refrigerated	Sulfuric acid titration	Sulfuric acid Titration	mg/l (ppm)
Total Dissolved Solids	N/A Field	Analysis done on site	Direct PocketPro	Direct	mg/l (ppm)
Macroinvertebrates	N/A Field	1 hour	visual	Visual I.D.	Actual count
Salinity	N/A Field	Analysis done on site	Direct PocketPro	Direct	mg/l (ppm)

* The places of analysis for each indicator listed in this table are recommended locations. However, any test that is not a direct sample may be analyzed back at the lab or in the field.

Sampling Locations

As of 2023, there are 82 active sampling locations and 32 inactive sampling locations in the Water Quality Volunteer Coalition. Table 6A displays active and inactive sites with information on the Site ID, waterbody name, location description, group monitoring (if applicable), lat/long, and sampling status. Sampling status was determined if sites have been sampled in the last 3 years and will be updated as needed. Table 6B indicates location of analysis for sampling tests.

Table 6A: Sampling Site List

Site Number/ID	Location	Group Monitoring	Watershed	Latitude Longitude	Sampling Status
CCMP #101	**Chiques Creek –** Manheim Memorial Park on E. High St.	Chiques Creek Watershed Association	**Chiques**	40.167896, -76.3836358	Active
CCLL #102	**Chiques Creek –** Leiderkranz Auction House	Chiques Creek Watershed Association	**Chiques**	40.109296, -76.445993	Active
CC4 #107	**Chiques Creek -** Near USGS monitoring sonde on Rt 23 in Marietta	Chiques Creek Watershed Association	**Chiques**	40.063057, -76.515586	Active
LCCCOP #103	**Little Chiques Cr** Cove Outlook Park	Chiques Creek Watershed Association	**Little Chiques**	40.117818, -76.502451	Active
LC-Rt230 #104	**Little Chiques Cr** Rt. 230	Chiques Creek Watershed Association	**Little Chiques**	40.1101255, -76.4910665	Active
DRSEAREC #119	**Dellinger Run** At PSU SEAREC	Chiques Creek Watershed Association	**Chiques**	40.121361, -76.4265	Sampling quarterly
CoC2 #3	**Cocalico Creek** Church St – before bridge in Ephrata		**Cocalico**	40.1878, -76.17	Active
CoC3-1 #114	**Cocalico Creek #1** Filter plant (#1 in sampling sequence)		**Cocalico**	40.232061, -76.140399	Active
LCoCC #115	**Little Cocalico Cr** 2nd Street (#2 in sampling sequence)		**Cocalico**	40.232114, -76.131685	Active
CoC3-3	**Cocalico Creek #3**		**Cocalico**	40.226822,	Active

#116	Hertzog's Garage (#3 in sampling sequence)			-76.13156	
HC5 **#106**	**Hammer Creek** @ Speedwell Forge		**Cocalico**	40.219901, -76.333041	Active
Mud2 **#26**	**Muddy Creek** Brubaker Park		**Cocalico**	40.1792, -76.0817	Active
Mud3 **#27**	**Muddy Creek** Above Black Run		**Cocalico**	40.1964, -76.0569	Active
LaR3 **#13**	**Landis Run** Butter Rd under Bridge (07638)		**Conestoga**	40.075, -76.2694	Active
Kurtz1 **#99**	**Kurtz Run 1** North fork of Kurtz Run	Landis Homes	**Conestoga**	40.111858, -76.2621	Active
Kurtz2 **#100**	**Kurtz Run 2** Confluence of North Fork	Landis Homes	**Conestoga**	40.111229, -76.262563	Active
C4 **#105**	**Conestoga River** Windolph Landing Park		**Conestoga**	40.000654, -76.323241	Active
C5 **#108**	**Conestoga River** @ Eden Mill		**Conestoga**	40.070234, -76.261574	Active
C6 **#110**	**Conestoga River** @ Rocky Springs		**Conestoga**	40.02471, -76.275684	Active
BR1 **#1**	**Bachman Run** @ Fruitville Pike		**Little Conestoga**	40.1114, -76.3325	Active
LC5 **#96**	**Little Conestoga Cr** West Roseville Rd behind Park City		**Little Conestoga**	40.063185, -76.342804	Active
GR1 **#97**	**Granite Run** Granite Run Rd and Fruitville Pike		**Little Conestoga**	40.0775308, -76.328059	Active
LC6 **#98**	**Little Conestoga Cr** Conestoga Country Club		**Little Conestoga**	40.026313, -76.354381	Active

Brubaker Run #109	**Brubaker Run** Radar Park		**Little Conestoga**	40.044773, -76.354849	Active
SR4 #117	**Swarr Run** Woodcrest Village	Woodcrest Village	**Little Conestoga**	40.071288, -76.352603	Active
SR5 #118	**Swarr Run** Amos Herr Park		**Little Conestoga**	40.09544, -76.39762	Active
CW1 #47	**Little Conowingo Cr** Goat Hill Rd		**Conowingo**	39.76356, -76.1679	Active
CW2 #48	**Conowingo Cr** @ Wakefield		**Conowingo**	39.77364, -76.1702223	Active
CW3 #49	**Conowingo Cr** @ Scotland Rd		**Conowingo**	39.8588, -76.20147	Active
CW4 #50	**Conowingo Cr** @ Weaver Farm - Cardinal Dr.		**Conowingo**	39.8304, -76.1892	Active
CW5 #91	**Conowingo Cr** @ New Texas		**Conowingo**	39.7453844, -76.1722349	Active
CW6 #92	**Conowingo Cr** @ Suplee Farm		**Conowingo**	39.7893337, -76.1683638	Active
CW7 #113	**Conowingo Cr** @ McFarland Run		**Conowingo**	39.841762, -76.18561	Active
Mill1 #21	**Mill Cr** Overly's Grove Rd	Garden Spot Village	**Mill**	40.0856, -76.0442	Active
Mill1A #32	**Mill Cr** SW of Kinzer Rd	Garden Spot Village	**Mill**	40.0894, -76.0692	Active
Mill2 #22	**Mill Cr** Meadow Creek Rd	Garden Spot Village	**Mill**	40.0817, -76.0861	Active
Mill3 #23	**Mill Cr** Maple Grove Rd	Garden Spot Village	**Mill**	40.0764, -76.0944	Active
Mill4 #33	**Mill Cr** Below Rt. 772 bridge	Garden Spot Village	**Mill**	40.0625, -76.1567	Active

Mill5 **#34**	**Mill Cr** West of Monterey Rd	Garden Spot Village	**Mill**	40.0536, -76.1725	Active
Mill6 **#24**	**Mill Cr** East of Gibbons Rd	Garden Spot Village	**Mill**	40.0558, -76.1803	Active
Mill7 **#35**	**Mill Cr** East of Strasburg Pk	Garden Spot Village	**Mill**	40.0264, -76.2414	Active
Mill9 **#93**	**Mill Cr** County Park	Garden Spot Village	**Mill**	40.009417, -76.286595	Active
Bells Run **#70**	**Bells Run** Rynear Rd - downstream	Octoraro Watershed Association	**Octoraro**	39.887816, -76.045817	Active
Bells Run **#71**	**Bells Run** Bartville Rd - upstream	Octoraro Watershed Association	**Octoraro**	39.89775, -76.05285	Active
Annan Run **#72**	**Annan Run** Creek Rd	Octoraro Watershed Association	**Octoraro**	39.897857, -75.995203	Active
Coopers Run **#73**	**Coopers Run** Mount Eden Rd	Octoraro Watershed Association	**Octoraro**	39.831417, -76.025528	Active
MH Cr **#74**	**Meetinghouse Cr** Between Heyberger Rd and Lamparter Rd	Octoraro Watershed Association	**Octoraro**	39.91252, -76.06882	Active
NM Run **#75**	**Nickel Mines Run** Between Heyberger Rd and Lamparter Rd	Octoraro Watershed Association	**Octoraro**	39.9127, -76.06865	Active
Bells Run **#76**	**Bells Run** Street Rd	Octoraro Watershed Association	**Octoraro**	39.84649, -76.02204	Active
East Branch **#77**	**East Branch Octoraro** Street Rd (Bellbank)	Octoraro Watershed Association	**Octoraro**	39.8467, -76.02043	Active
West Branch **#78**	**West Branch Octoraro** White Rock	Octoraro Watershed Association	**Octoraro**	39.82485, -76.08998	Active

Muddy Run #79	**Muddy Run** Homeville Rd	Octoraro Watershed Association	**Octoraro**	39.831437, -76.004965	Active
Rattlesnake Run #80	**Rattlesnake Run** Glenville Rd	Octoraro Watershed Association	**Octoraro**	39.86197, -75.97205	Active
Basin Run #81	**Basin Run** McCauley Rd	Octoraro Watershed Association	**Octoraro**	39.6618 -76.1474	Active
Stone Run #82	**Stone Run** Horseshoe Rd	Octoraro Watershed Association	**Octoraro**	39.7029833, -76.1094667	Active
Octoraro #83	**Octoraro Mainstem** Moore Rd – railway	Octoraro Watershed Association	**Octoraro**	39.659947, -76.152979	Active
Octoraro #84	**Octoraro Mainstem** Horseshoe Rd	Octoraro Watershed Association	**Octoraro**	39.7066667, -76.1155556	Active
Knights Run #85	**Knights Run** Ross-Fording Rd	Octoraro Watershed Association	**Octoraro**	39.884646, -75.978733	Active
Good2 #86	**Goods Run #2** Indian Hill Rd	Octoraro Watershed Association	**Octoraro**	39.946972, -76.290444	Active
NM Run #95	**Nickel Mines Run** Mine Rd	Octoraro Watershed Association	**Octoraro**	39.9517407, -76.0767732	Active
Climb1 #40	**Climbers Run -** SRREC LCC Nature Preserve		**Pequea**	39.920757, -76.29744	Active
Stein1 #41	**Steinman Run -** Stump R., LCC Nature Preserve		**Pequea**	39.905046, -76.286754	Active
PEQ3 #59	**Pequea –** Sickman's Mill		**Pequea**	39.934767, -76.323032	Active
Stein3 #61	**UNT Steinman Run-** South of Clearview Rd**.**		**Pequea**	39.893916, -76.286239	Active
Climb3 #63	**Climbers Run #3** Below pipeline		**Pequea**	39.91547, -76.312588	Active

Trout1 #65	**Trout Run**		**Pequea**	39.91528, -76.286944	Active
Silv1 #66	**Silvermine Run #1** Downstream		**Pequea**	39.9447, -76.313433	Active
Silv2 #67	**Silvermine Run #2** Upstream		**Pequea**	39.94755, -76.314952	Active
PEQ2 #68	**UNT Pequea Cr** Silvermine Road		**Pequea**	39.94411, -76.319114	Active
Peq4 #90	**UNT Pequea Cr** Penn Grant Rd		**Pequea**	39.978784, -76.2272	Active
Fish1 #42	**Fishing Cr** Scalpy Hollow Rd (North)	LCC	**Susquehanna**	39.831478, -76.245341	Active
Kelly1 #43	**Kellys Run** LCC Nature Preserve	LCC	**Susquehanna**	39.836524, -76.339021	Active
Tuc1 #45	**Tucquan Cr** LCC Nature Preserve	LCC	**Susquehanna**	39.86339, -76.341193	Active
Fish2 #51	**UNT Fishing Cr** Osceola Dr		**Susquehanna**	39.828759, -76.242286	Active
Fish5 #54	**Fishing Cr** Hollow Rd (South)	LCC	**Susquehanna**	39.795743, -76.254952	Active
Fish6 #55	**Fishing Cr** Drumore Park		**Susquehanna**	39.814735, -76.237063	Active
Fish7 #56	**Fishing Cr** Metzler Sisters		**Susquehanna**	39.851725, -76.243605	Active
Fish8 #57	**UNT Fishing Cr** Furniss and Scalpy Hollow Rd		**Susquehanna**	39.81847, -76.244814	Active
TucTrib1 #62	**Clark Run** Small tributary		**Susquehanna**	39.864814, -76.340042	Active
Fish9 #69	**UNT Fishing Cr** Moser Site		**Susquehanna**	39.83547, -76.24224	Active

Fish10 **#87**	**UNT Fishing Cr** Site at River Road		**Susquehanna**	39.823361, -76.234518	Active
Fish11 **#88**	**UNT Fishing Cr** Site upstream of Drumore Park		**Susquehanna**	39.819652, -76.235481	Active
Fish12 **#89**	**UNT Fishing Cr** UNT flows into Drumore Park		**Susquehanna**	39.819404, -76.235255	Active
CC3 **#39**	**Chiques Cr** Adele Ave (next to Manheim HS)		**Chiques**	40.1717, -76.3894	Inactive
HC4 **#11**	**Hammer Cr** Buch Mill Rd		**Cocalico**	40.1747, -76.2553	Inactive
Mud1 **#25**	**Muddy Cr** Red Run Campground		**Cocalico**	40.1744, -76.0817	Inactive
LaR2 **#12**	**Landis Run** Landis Woods		**Conestoga**	40.0897, -76.2906	Inactive
HACC1 **#31**	**UNT Conestoga** Trib HACC Campus		**Conestoga**	40.0422, -76.2681	Inactive
HANDMS1 **#58**	**UNT Conestoga** Trib Hand MS		**Conestoga**	40.033071, -76.297069	Inactive
LR3 **#14**	**Lititz Run** Millport Conservancy		**Little Conestoga**	40.1336, -76.2581	Inactive
BR2 **#2**	**Bachman Run** Koser Rd		**Little Conestoga**	40.1164, -76.3306	Inactive
LC2A **#15**	**Little Conestoga** Manor Twp Park		**Little Conestoga**	40.0214, -76.365	Inactive
LC5 **#16**	**Little Conestoga** Buch Ave & Miller Rd		**Little Conestoga**	40.0953, -76.3364	Inactive

LC2 **#17**	**Little Conestoga** Owl Bridge Rd		**Little Conestoga**	39.9833, -76.3789	Inactive
LC3 **#18**	**Little Conestoga** Maple Grove Community Center		**Little Conestoga**	40.0369, -76.3433	Inactive
SR1 **#29**	**Swarr Run** Bridge over Rt 722		**Little Conestoga**	40.0831, -76.3814	Inactive
SR2 **#30**	**Swarr Run** Bridge over Colebrook Rd		**Little Conestoga**	40.0753, -76.37	Inactive
Con2 **#4**	**Conoy Cr** Shrine Rd & Rt 241		**Conoy**	40.1347, -76.6167	Inactive
Con3 **#3**	**Conoy Cr** Masonic Conference Center		**Conoy**	40.1319, -76.6219	Inactive
Con4 **#8**	**Conoy Cr** Arosite Rd		**Conoy**	40.1272, -76.6278	Inactive
Mill8 **#36**	**Mill Cr** East of Strasburg Pike and Mill Cr		**Mill**	40.0261, -76.2419	Inactive
MillTrib1 **#37**	**Mill Cr** Flory Park		**Mill**	40.0269, -76.2422	Inactive
MC3 **#38**	**Conestoga River** County Park		**Mill**	40.0214, -76.2344	Inactive
Mill10 **#94**	**Mill Cr** Welsh Mtn Preserve		**Mill**	40.0905714, -76.0228345	Inactive
PSA2 **#9**	**Eshelman Run** Quarry Rd		**Pequea**	39.9936, -76.1078	Inactive
PSA3 **#10**	**Eshelman Run** Rt 30		**Pequea**	40.0056, -76.1106	Inactive
Climb2	**Climbers Run**		**Pequea**	39.918973,	Inactive

#44	966 Pennsy Rd			-76.28175	
PEQ1 **#46**	**Pequea Cr** PPL Campground		**Pequea**	39.895188, -76.35781	Inactive
Stein2 **#60**	**Steinman Run** Clearview Rd		**Pequea**	39.896465, -76.284922	Inactive
Good1 **#64**	**Goods Run**		**Pequea**	39.94195, -76.306546	Inactive
Peq2 **#28**	**Pequea Cr** Paradise Mem Park		**Pequea**	40.0119, -76.1083	Inactive
Fish3 **#52**	**UNT Fishing Cr** Hollow Rd		**Susquehanna**	39.809412, -76.233583	Inactive
Fish4 **#53**	**Fishing Cr** Furniss Rd		**Susquehanna**	39.807606, -76.236189	Inactive
Fish13 **#111**	**Fishing Cr** Valley Lea Riding Club		**Susquehanna**	39.817438, -76.239506	Inactive
Fish14 **#112**	**Fishing Cr** Northern end of Drumore Park		**Susquehanna**	39.816346, -76.238443	Inactive

Table 6B: Location of analysis*

Place of Analysis	**Indicators Analyzed**
Field	pH – Conductivity – Total Dissolved Solids - D.O. – Temperature – Turbidity - Salinity
Indoor test kit use	Total Phosphates – Nitrates – Alkalinity
Field	Macroinvertebrates & Visual Habitat Assessment

* The places of analysis for each indicator listed in this table are recommended locations. However, any test that is not a direct sample may be analyzed back at the lab or in the field.

Sampling Frequency

Table 7A Sampling Schedule, Frequency, Times and Weather

Indicator(s)	Sampling and Analysis Dates	Time of Day Sampled	Special Weather Conditions
Chemical Tests	Once per month	Morning (before noon)	All except dangerous conditions
Macroinvertebrate Assessment	Twice a year – Spring and Autumn	Morning (before noon)	All except dangerous conditions
Physical Habitat Evaluation	Once per year	Morning (before noon)	All except dangerous conditions

Quality Assurance & Quality Control

Table 8A Quality Control Measures

Indicator(s)	Internal Quality Control Measures	Percent Quality Control Samples	External Quality Control Measures
Temperature	Field duplicate	100	Volunteers are trained by certified trainers
pH	Field duplicate Calibration	10 100	Volunteers are trained by certified trainers
DO	Field Duplicate Std check	10 1 per year	Volunteers are trained by certified trainers
Total Phosphates	Field duplicate Field blank Std check	10 2 per year 1 per year	Volunteers are trained by certified trainers
Turbidity	Field duplicate	10 100	Volunteers are trained by certified trainers
Nitrates	Field duplicate Field blank Std check	10 2 per year 1 per year	Volunteers are trained by certified trainers
Conductivity	Field duplicate Field blank Std check	10 2 per year 1 per year	Volunteers are trained by certified trainers
Alkalinity	Field duplicate	10	Volunteers are trained by certified trainers
Total Dissolved Solids	Field duplicate Calibration	10 100	Volunteers are trained by certified trainers

Macroinvertebrates	Two identifiers/counters	-	Volunteers are trained by certified trainers
Salinity	Field duplicate Calibration	10 100	Volunteers are trained by certified trainers

8B Quality Control Response Actions:

- Repeat sampling /analysis
- Procedures overviewed by a technical trainer
- Results checked with colorimeter and digital titrator.

8C Training

Training sessions will be completed on chemical analysis, visual habitat assessment, macroinvertebrate sampling and identification by ALLARM, LCCD Staff, and/or other certified training partners. Retrains or refreshers are welcomed and should be communicated if needed by any volunteers.

All new volunteers will be trained by our site trainers and/or LCCD staff. These people will have extensive knowledge and experience with all of the tests and be certified to train by ALLRAM or District staff.

All volunteers will have the opportunity to attend conferences and workshops throughout the year to brush up on old skills, learn new ones and network with DEP, Nature Abounds, other PASEC sites, ALLARM, and other volunteers monitoring groups if interest is expressed.

8D Training/Reference Manuals

- Volunteer Water Quality Volunteer Field Manual
- The Lancaster Watersheds website provides many training materials (lancasterwatersheds.org)
- Aquatic Entomology by W.P. McCafferty
- HACH Technical and Colorimeter Manuals
- DEP/Nature Abounds Supplements

Data Analysis

9A Recording Data

At this time, all data will be recorded on the data sheets located on the Lancaster Watersheds Volunteer webpage or in the brown drawer at the Farm & Home Center. As the group continues to grow and sampling becomes more diverse, these sheets will need to be modified. Be sure to complete all fields on the data sheet, especially **site name, date, and time.**

9B Data Management

Data sheets will be reviewed by the team performing the tests and then dropped into the data collection box at the lab. The data sheets will then be collected by specified data technicians and reviewed for completeness, as well as, comparing site data from previous sampling. Finally, the information will be entered into the web-based WQVC database. If information is missing from the forms, or the data seems unusual when compared to previous collections, the technician will contact a member from the team to discuss the problem(s). If the team members and the technician cannot solve the problem, they should contact the project coordinator.

Periodically graphs, charts, & spreadsheets will be created by volunteers to show measurable results and to track accuracy within the program. These manipulatives will be utilized in program displays, learning tools, and other education functions as well. The WQVC database that is publicly accessible includes interactive graphs that can be filtered by site for ease of visualization.

Project Tasks and Personnel

Table 10A

Major Project Tasks	Position/Title	Paid Position	Address, Phone #, email
Lab Maintenance (includes Main lab and satellite labs)	All Volunteers	N	All Volunteers
Kit Maintenance	Noelle Cudney/Amanda Goldsmith	Y	1383 Arcadia Rd., Lancaster 717-299-5361 ext. 2557 NoelleLaFaver@lancasterconservation.org
Data Entry	Noelle LaFaver	Y	1383 Arcadia Rd., Lancaster 717-299-5361 ext. 2557 NoelleLaFaver@lancasterconservation.org
Waste Disposal	Volunteers	N	Volunteers
Chemical Trainer(s)	Lancaster Conservancy, LCCD Staff	N/Y	
Macro Trainer(s)	Amanda Goldsmith	Y	1383 Arcadia Rd., Lancaster 717-299-5361 ext. 2562 AmandaGoldsmith@lancasterconservation.org
Recruiter(s)	WQVC volunteers & LCCD	N	

Table 10B Technical Committee

Member Name	Area of Expertise	Address, Phone, E-mail
Amanda Goldsmith	WQVC Co-Lead & Macroinvertebrate Trainer	1383 Arcadia Rd., Lancaster 717-299-5361 ext. 2523 AmandaGoldsmith@lancasterconservation.org
Mike King	Chemical Testing Trainer	
Noelle Cudney	WQVC Co-Lead & Data Technician	1383 Arcadia Rd., Lancaster 717-299-5361 ext. 2557 NoelleLaFaver@lancasterconservation.org

APPENDIX A