Snitz Creek 3 Stream and Floodplain Restoration Project
Cornwall Borough, Lebanon County, Pennsylvania

Section 319 Nonpoint Source Management Grants
Supporting Documentation

August 2019

CLEAR CREEKS CONSULTING

1317 Knopp Road, Jarrettsville, Maryland 21084

(410) 692-2164

Snitz Creek 3 Stream and Floodplain Restoration Project
Cornwall Borough, Lebanon County, Pennsylvania

Section 319 Nonpoint Source Management Grants
Supporting Documentation

Prepared for

Lebanon Valley Conservancy
and
Quittapahilla Watershed Association

Prepared by

Clear Creeks Consulting

August 2019

Table of Contents

Detailed Project Description

Snitz Creek #3 Stream Restoration Project
Detailed Project Description

I. Statement of Environmental Need

The Quittapahilla Creek Watershed is situated in the Ridge and Valley physiographic region in Lebanon County, Pennsylvania. Quittapahilla Creek is a tributary to Swatara Creek and is part of the Susquehanna River Basin. Its headwaters begin just southeast of Lebanon, Pennsylvania and it enters the Swatara Creek near North Annville, Pennsylvania.

The major land use in the watershed is agricultural. There are significant areas of urbanization along the Route 422 corridor in the City of Lebanon, West Lebanon, Cleona, and Annville. In addition, new development in the watershed is replacing farms with suburban communities. Past and current land use and land management practices in the rural areas, suburban communities, and urban centers have resulted in degraded water quality, stream bank and bed erosion, sedimentation, flooding, and the loss of riparian and in-stream habitat throughout the Quittapahilla Creek Watershed.

The Pennsylvania Department of Environmental Protection (PADEP) conducted studies in the 1980's and 1990's that indicate impairment of aquatic resources in the Quittapahilla Creek Watershed. In fact, the mainstem as well as all of the major tributaries to the Quittapahilla Creek are listed as impaired in the 303(d) listings. The 2000 305(b) Report prepared by DEP indicates that there are 88.9 miles of stream in the Quittapahilla Creek Watershed. Only 1.82 miles of stream (2%) were found to support designated aquatic life uses. The identified land use activities contributing to impairment include agriculture, crop related agriculture, urban/storm sewers, and bank modification. Sources of impairment include nutrients, siltation, suspended solids, organic enrichment/low dissolved oxygen concentrations, flow alteration, and other habitat alterations.

The Total Maximum Daily Loads (TMDLs) Report (PADEP, 2000) cites excessive sediment and nutrient levels as a major water quality problem in the Quittapahilla Creek Watershed. The report indicates that these pollutants are causing increased algae growth, large accumulations of fine sediments on the streambed, and degradation of in-stream habitat. Although the report attributes the excessive sediment and nutrient levels principally to agricultural activities, these pollutants are also associated with other upland sources (e.g., urban runoff) as well as in-stream sources (e.g., stream bed and bank erosion).

Since 1998, the Quittapahilla Watershed Association (QWA) has been working with a number of private organizations and public agencies to improve the water quality and aquatic habitat of Quittapahilla Creek. However, until 2001 there had been no comprehensive assessment, nor coordinated effort to identify and prioritize water quality, habitat and stream channel stability problems throughout the watershed. As a consequence, targeting of stream reaches for improvements had been on a project-by-project basis.

The QWA believed that their best chance for resolving the existing problems and avoiding future problems was to step back from the project-based approach and develop a comprehensive plan of action based on an assessment of the entire watershed. They believed that this approach would serve to focus funding and restoration and management efforts where they are most needed. They also believed that it is the approach that has the greatest chance for long-term success.

Accordingly, in 2000 the QWA contracted Clear Creeks Consulting to conduct an assessment of Quittapahilla Creek Watershed and develop a restoration and management plan focused on addressing the problems identified by the assessment. In cooperation with the QWA, Clear Creeks formed an interdisciplinary team that included; Skelly & Loy, Inc.; U.S. Fish & Wildlife Service, Chesapeake Bay Field Office; Penn State Institutes of the Environment, Pennsylvania State University; Department of Biology, Lebanon Valley College; and U.S. Geological Survey, New Cumberland Field Office. Supported by Growing Greener Grants received from PADEP in 2001 and 2003, the Assessment Phase of Quittapahilla Watershed Project was completed between 2001 and 2005 and the Planning Phase between 2005 and 2006.

The major components of the Assessment Phase included analysis of natural and man-made watershed characteristics and their influence on the hydrologic and sediment regime of the watershed; geomorphologic stream assessment; subwatershed reconnaissance and analysis; ecological assessment of habitat and biological communities; water quality modeling; water quality monitoring; and problem identification and prioritization. The Planning Phase of the project focused on identifying and prioritizing Best Management Practices (BMPs) to address the problems identified in the subwatersheds and along the main stem of Quittapahilla Creek. This included a comprehensive evaluation and prioritization of general, as well as site specific BMPs for controlling agricultural and urban runoff; and a comprehensive evaluation of general, as well as site specific restoration measures to correct stream stability and habitat problems. In addition, county, city and township land use, land development, environmental, and resource protection policies and programs were evaluated. Recommendations were developed for policies and programs focused on stream, wetland and floodplain protection and management.

At the time the Restoration and Management Plan was prepared, deadlines for meeting MS4 requirements were still years away for the City of Lebanon and the other Townships in the watershed. Undeterred, the QWA resolved to move forward with implementation of the stream restoration projects identified in their Restoration and Management Plan. Utilizing Growing Greener Grants the QWA proceeded with design, permitting and construction of restoration projects along the mainstem Quittapahilla Creek. The major obstacle slowing their restoration efforts has been a lack of funding. The QWA determined that they would seek other funding sources. In order to qualify for 319 funding they decided to prepare the USEPA required Watershed Implementation Plan (WIP).

Funded by a 2016 Growing Greener Grant, the first steps in developing the USEPA Approved WIP were initiated in March 2017 and involved bringing the QWA members and representatives of local municipalities up to speed on what was involved in the original Quittapahilla Creek Watershed Assessment, what had been accomplished since the completion of Quittapahilla Watershed Restoration and Management Plan, and what remained to be done to prepare a Watershed Implementation Plan. In addition, the QWA formed working committees for each WIP task:

Utilizing the original list of restoration projects from the Restoration and Management Plan, a preliminary projects list was prepared for the Prioritization Committee to review. The four major tributary subwatersheds and each project within a subwatershed were evaluated relative to its contribution to pollutant loadings based on water quality modeling, observations recorded during the field reconnaissance survey and subsequent assessments. Projects that fell outside of the QWA's ability to control the outcome, such as those involving removal of concrete flumes, bank stabilization in quarries and on golf courses were dropped from the list.

The Prioritization Committee prioritized the four tributary subwatersheds in descending order, with Snitz Creek being the highest priority, Killinger Creek second, Beck Creek third and Bachman Run fourth. It was agreed that projects would be completed by priority subwatershed starting at the top of the watershed and working in a downstream direction. Projects representing severe conditions and contributing high sediment loadings would warrant moving out of order.

The final WIP document includes pollutant loading reduction estimates by subwatershed and pollutant loading reduction estimates by projects within subwatersheds. Cost estimates for design and permitting, cost estimates for construction, and total project costs were developed for all of the prioritized projects. Specific funding sources were identified for each prioritized project. An implementation schedule was prepared that shows completion of all prioritized projects by 2030. This includes 69 projects in the subwatersheds and 19 projects along the mainstem Quittapahilla Creek.

The WIP also includes a detailed monitoring plan to evaluate the success of the projects in meeting the water quality and habitat objectives of the WIP. QWA and DFTU will assume responsibility for maintenance of individual restoration projects.

The WIP also outlines how the QWA will continue their current public outreach and education efforts to enlist support for and promote public participation in the restoration of the Quittapahilla Watershed.

In preparing this grant proposal request for Section 319 Nonpoint Source Management grant funds for Fiscal Year 2020, the QWA evaluated the list of priority projects identified in our WIP document relative to their goals for 2020. Snitz Creek watershed ranks first among the four subwatersheds covered by our WIP. Snitz Creek, Project #2 was submitted for Water Quality Improvement Projects along the Sunoco Mariner East 2 Pipeline Corridor Grant Program in 2018. That grant application was approved in March, 2019. Design plan development and permitting are currently underway. Snitz Creek, Project #3 is the third on the priority projects list for Snitz Creek watershed.

Justification for Funding

Section 319 Nonpoint Source Management grant funds are provided to implement nonpoint source management plans and activities identified in Pennsylvania's WIP watersheds. These grants fund activities focused on nonpoint source pollution identified by the Pennsylvania Nonpoint Source Management Plan. The Plan includes three objectives that directly relate to our objectives and activities in the Quittapahilla Watershed: reducing nitrogen, phosphorus and sediment pollutant loads by implementing stream and floodplain restoration projects and planting riparian buffers.

As noted, the Total Maximum Daily Loads (TMDLs) Report (PADEP, 2000) cites excessive sediment and nutrient levels as a major water quality problem in the Quittapahilla Creek Watershed. The report indicates that these pollutants are causing increased algae growth, large accumulations of fine sediments on the streambed, and degradation of in-stream habitat. The excessive sediment and nutrient levels are attributed to agricultural activities, urban runoff and stream bed and bank erosion. The 2018 Integrated Water Quality Report lists this reach of Snitz Creek as impaired with the source of impairment being crop related agriculture and the cause of impairment being siltation.

The Quittapahilla Creek Watershed Implementation Plan identified projects focused on stream bed and bank erosion and impacts associated with agricultural operations. The WIP includes nitrogen, phosphorus and sediment loading reduction estimates by subwatershed and loading reduction estimates

by projects within subwatersheds. An implementation schedule was prepared that shows completion of all prioritized projects by 2030. This includes 69 projects in the subwatersheds and 19 projects along the mainstem Quittapahilla Creek.

Snitz Creek watershed ranks first among the four subwatersheds covered by our WIP. Snitz Creek 3 is the third on the priority projects list for Snitz Creek watershed. It represents an important next step in our continuing effort to implement those projects identified in our WIP for the Snitz Creek subwatershed. It will significantly reduce nutrient and sediment loadings to the Snitz Creek and Quittapahilla Watershed and will ultimately help us meet the TMDL goals for both watersheds.

Given that priority is given to 319 grant applications that address nonpoint source pollution originating from agriculture, stormwater runoff, and stream channel degradation where the proposed project is identified in an existing Section 319 Watershed Implementation Plan, this project meets all of that criteria. Snitz Creek, Project #3 is third on the priority projects list for Snitz Creek watershed. It represents an important next step in our continuing effort to implement those projects identified in our WIP for the Snitz Creek subwatershed. It will significantly reduce nutrient and sediment loadings to the Snitz Creek and Quittapahilla Watershed and will ultimately help us meet the TMDL goals for both watersheds.

Existing Conditions

The reaches along this part of Snitz Creek were historically straightened. The results of a rapid geomorphic assessment conducted during the summer of 2018 indicated that the stream reaches through this project area are laterally and vertically unstable due to meander redevelopment and maintenance of riparian vegetation. Stability problems include high width to depth ratio, significant bank erosion, debris jams, heavy sedimentation and aggradation (lateral and mid-channel bars). Bank erosion is a source of sediment to downstream reaches along Snitz Creek, Quittapahilla Creek, as well as Swatara Creek. A large number of undercut and leaning trees are falling into the creek creating debris jams which further accelerates the bank erosion and aggradation. The increased sedimentation has significantly degraded in-stream habitat resulting in riffles that are highly embedded with fine sediments. The following photographs documenting the existing conditions were taken along the project area in April 2019.

The Unnamed tributary that enters this reach immediately downstream of Culvert Road drains a 646 acre watershed. Approximately 388 acres or 60% of this watershed is cultivated land (see ground and aerial photographs on the following pages). According to the landowner, this tributary is a significant source of sediment to Snitz Creek carrying runoff directly from the cultivated fields.

The following photographs documenting the existing conditions were taken along the project area in May 2019.

Culvert under Culvert Street at upstream end of Snitz Creek 3 Project Area

Bank washout with flow around tree and small debris jam, Lateral bars upstream and down

Bank erosion, undercut tree, and lateral bar along Upper Reach

Undercut and leaning tree, debris and old tires along Upper Reach

Undercut and leaning tree along Upper Reach

Undercut trees along Upper Reach

Bank erosion and undercut trees along Upper Reach

Undercut trees along Middle Reach

Bank erosion along Middle Reach

Bank erosion along Middle Reach

Fallen tree and debris jam along Lower Reach

Bank erosion along Lower Reach

Bank erosion and undercut trees along Lower Reach

Bank erosion and middle channel bar along Lower Reach

Fallen tree and mid-channel bar along Lower Reach

Bank erosion and undercut tree along Lower Reach

Culvert under Cornwall Road at downstream end of Project Area

Cultivated field draining to Unnamed Tributary

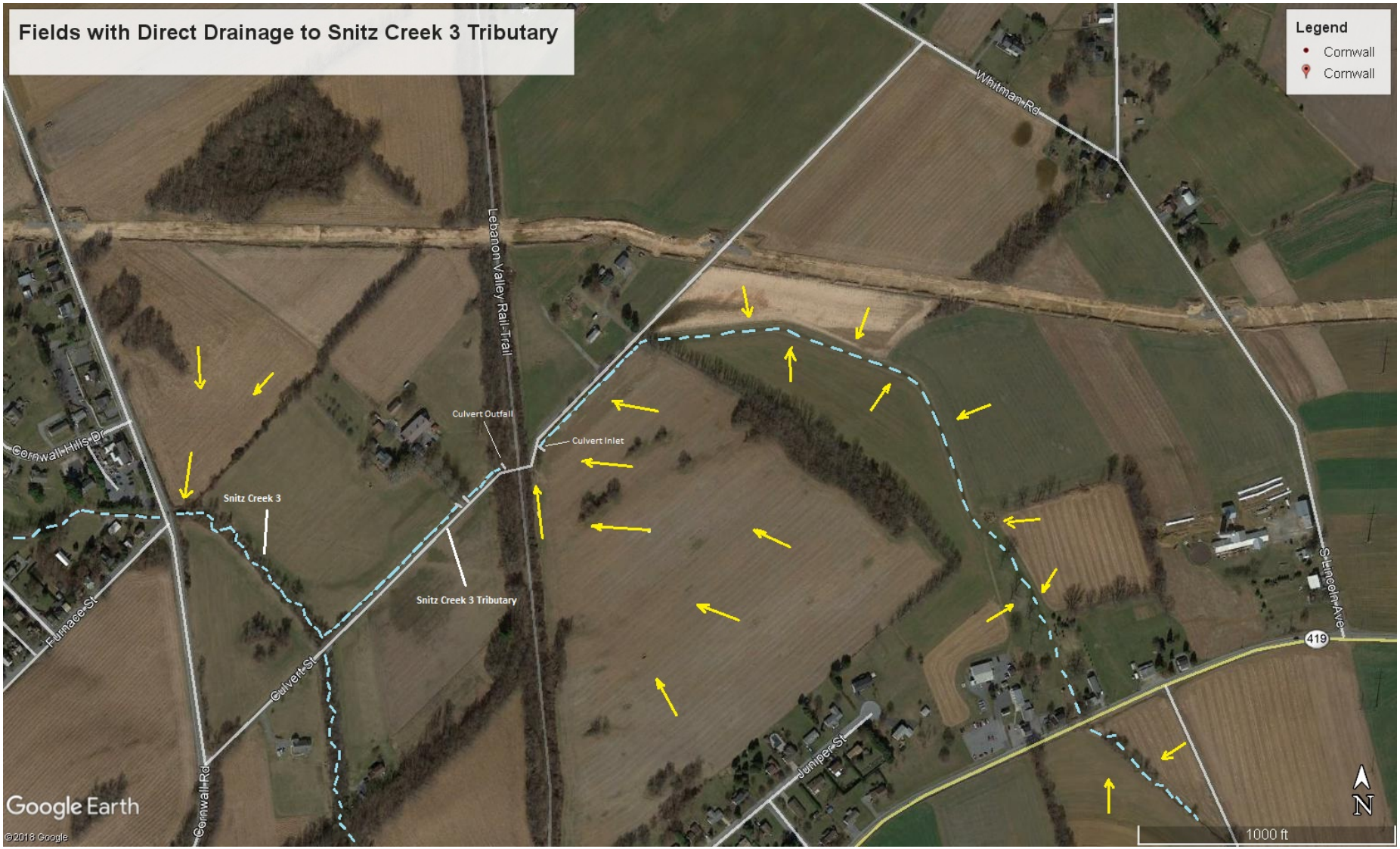
Head-cut at edge of field where runoff enters Unnamed Tributary

Inlet of culvert pipe under Culvert Road that carries runoff from fields

Outlet of culvert pipe under Culvert Road that carries runoff from fields

Unnamed Tributary downstream of culvert pipe

Unnamed Tributary immediately upstream of Snitz Creek


Fields with Direct Drainage to Snitz Creek 3 Tributary
Legend
Cornwall
Cornwall
Whitman Rd
Lebanon Valley Rail Trail
Culvert Outfall
Culvert Inlet
Cornwall Hills Dr
Snitz Creek 3
Snitz Creek 3 Tributary
Furnace St
Culvert St
Cornwall Rd
Juniper St
Linden Ave
419
Google Earth
©2018 Google
N
1000 ft

Restoration Approach and Expected Environmental Benefits

This project proposes to restore approximately 1,000 linear feet of Snitz Creek from the culvert outfall downstream of Culvert Street to the bridge at Cornwall Road.

The restoration design objectives are to create a stable meandering C4/E4 stream channel along the project reaches. Floodplain restoration will include the creation of 1.2 – 1.5 acres emergent and scrub-shrub wetland along the adjacent right and left floodplain to capture and provide water quality treatment for agricultural runoff draining more than 388 acres of cultivated fields along an Unnamed Tributary Snitz Creek. A concept of the proposed restoration is included below.

The restoration approach for the Upper and Middle Reaches will involve:

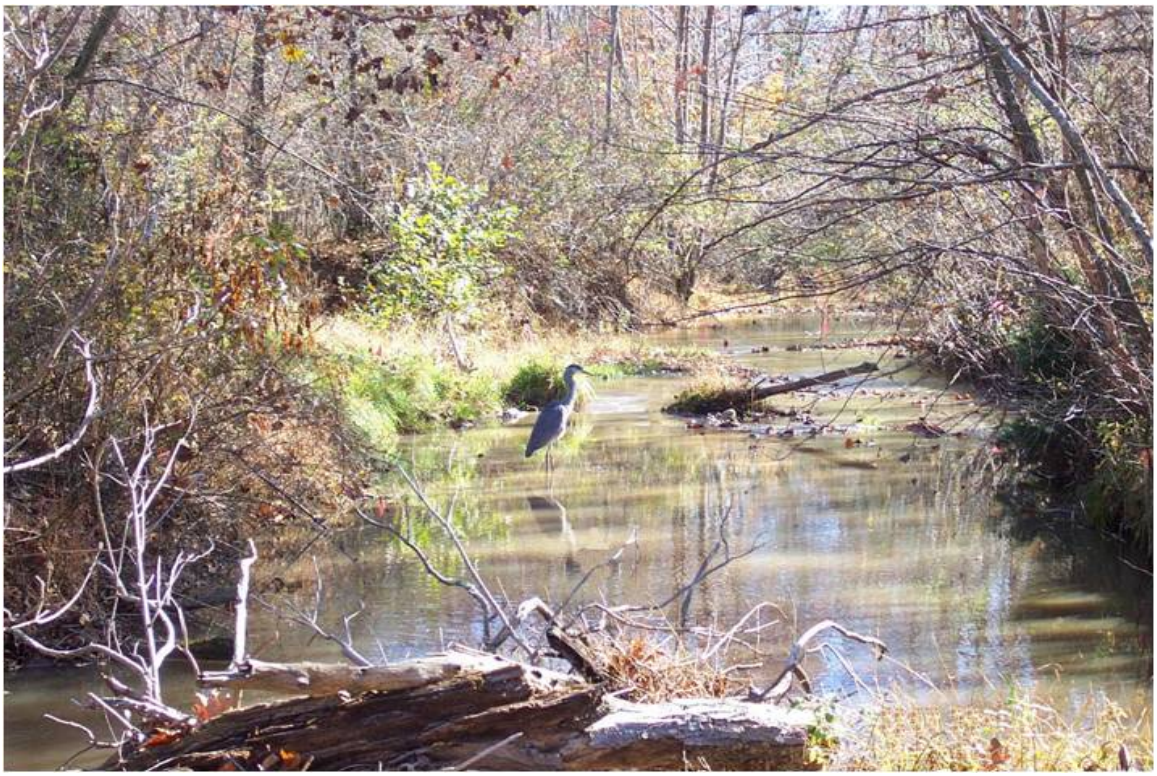
- Removing existing debris jams and junk from the channel;
- Constructing a meandering C4/E4 channel for approximately 820 linear feet.
- The new channel will have a narrower cross-section with improved sediment transport capacity.
- Streambanks will be reconstructed and stabilized by Installing toe wood along the outside of meander bends to create the lower portion of the new streambank. Soil fabric lifts will be installed along the top of the toe wood to create the new upper streambank.
- The channel profile will be modified to create streambed features that increase the pool to riffle ratio and improve overall pool and riffle habitat.
- Grade control will be provided by installing constructed riffles composed of small boulders, cobble and gravel.
- The floodplain will be excavated and graded to create 1.2 – 1.5 acres of emergent and scrub-shrub wetlands.
- The lower 150 linear feet of the Unnamed Tributary currently channelized along Culvert Road will be relocated to meander approximately 1,000 linear feet across the restored floodplain through the created wetlands trapping sediments and nutrients carried during stormflow.
- The newly constructed streambanks, floodplain and wetlands will be stabilized by seeding with native grasses and planted with native trees and shrubs.

The restoration approach for the Lower Reach will involve:

- Removing existing debris jams from the channel;
- Constructing a moderately sinuous B4c for approximately 180 linear feet.
- The new channel will be shifted away from the high terrace along the left side of the floodplain.
- Streambanks will be reconstructed and stabilized by installing large boulder outcrops along the outside of meander bends to create the lower portion of the new streambank. Soil fabric lifts will be installed along the top of the rock outcrops to create the new upper streambank.
- The channel profile will be modified to create streambed features that increase the pool to riffle ratio and improve overall pool and riffle habitat.
- Grade control will be provided by installing constructed riffles composed of small boulders, cobble and gravel.
- The newly constructed streambanks will be stabilized by seeding with native grasses and planted with native trees and shrubs.

Example of Toe Wood installed along outside of meander bend

Example of Constructed Riffle



Examples of Created Wetlands

Example of Large Boulder Outcrops

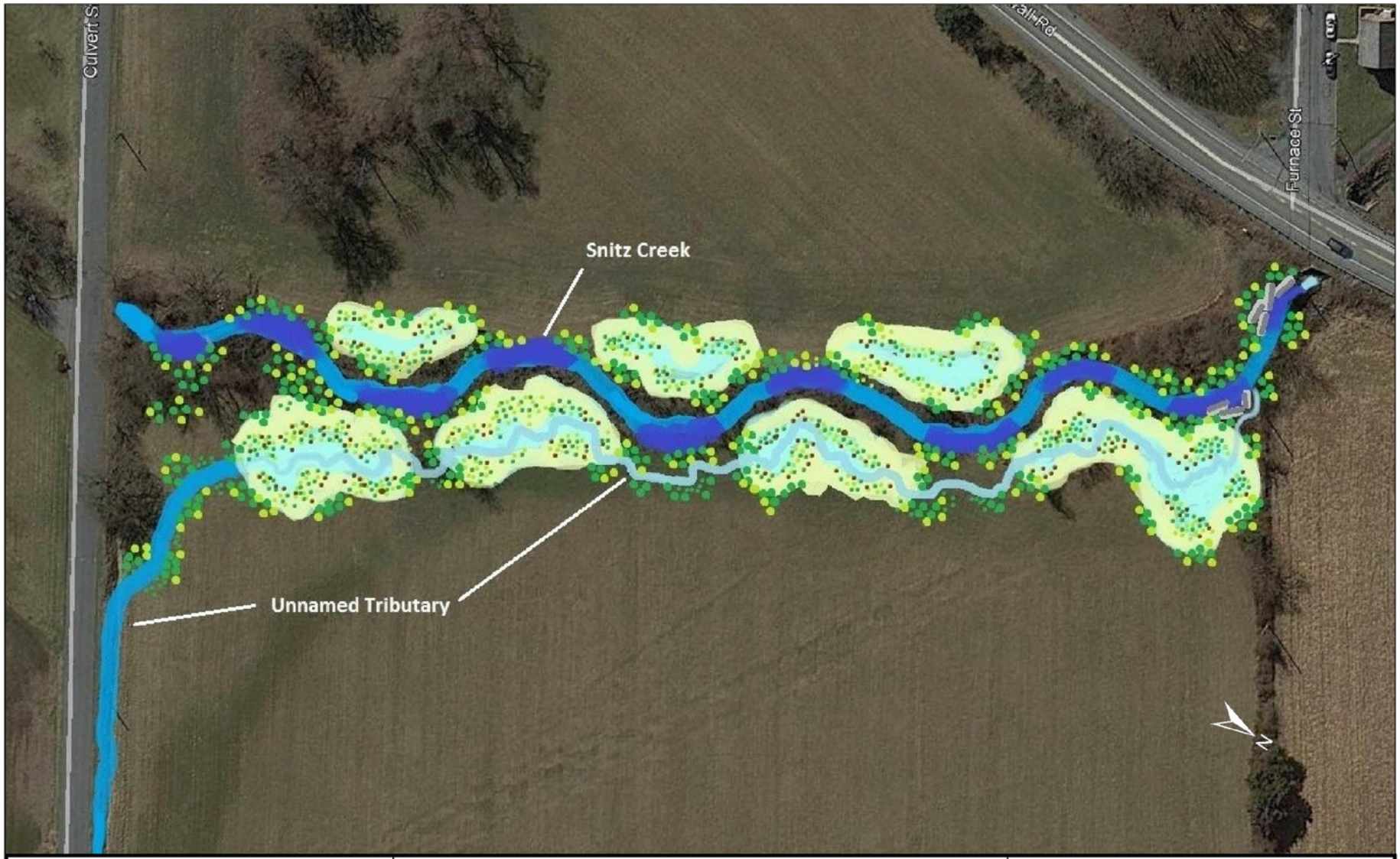
The Snitz Creek #3 restoration project will restore 1,000 linear feet of in-stream and riparian habitat. It will reduce nitrogen, phosphorus and sediment loadings to Snitz Creek from streambank erosion by 75.0 lbs./yr., 68.0 lbs./yr. and 44,880.0 lbs./yr., respectively. In addition, the created 1.2 – 1.5 acres of emergent and scrub-shrub wetlands will provide water quality treatment for runoff from more than 388 acres of cultivated fields.

Partnerships and Synergy with Other Projects in the Watershed

Over the years, the QWA has formed a close working relationship with Doc Fritchey Trout Unlimited (DFTU) and the Lebanon Valley Conservancy. The QWA and its partners have provided many hours of in-kind services. For this project, the DFTU will provide administrative and contract management services. QWA will coordinate with the landowner to obtain the necessary Letters of Commitment and Letters of Agreement. They will also provide volunteers for installation of plant materials and post-construction monitoring and maintenance.

Initial contact made by representatives of QWA and DFTU indicate that the landowner is interested in participating. The Stoner Family has agreed to allow 1.2 – 1.5 acres of their hay fields along the floodplain to be converted into wetlands and riparian buffer to support the project.

The Lebanon County Stormwater Consortium was formed by the City of Lebanon, Annville Township, Cleona Borough Authority, North Cornwall Township, North Lebanon Township and South Lebanon Township. The Joint Pollutant Reduction Plan they developed to meet MS4 requirements includes proposed retrofits to existing urban BMPS, proposed new urban BMPs, as well as fourteen stream restoration projects along the mainstem Quittapahilla Creek. In addition, USDA-NRCS and the Lebanon County Conservation District, have committed to work with the QWA and DFTU to implement stream restoration projects that were identified on farms in the Quittapahilla Watershed Restoration and Management Plan. They propose to utilize EQUIP funds supplemented by matching funds from other sources to design, permit and implement thirty two restoration projects over the next 5 – 10 years.



CONCEPT PLAN	SNITZ CREEK 3	DATE: AUGUST 2019
MAP NOT TO SCALE	SNITZ CREEK, QUITTAPAHILLA CREEK WATERSHED, LEBANON COUNTY, PA	PREPARED BY: EPR Ecosystem Planning & Restoration Clear Creeks Consulting

Contractor Provisions

After evaluating other consultants, the Quittapahilla Watershed Association and Doc Fritchey Trout Unlimited selected the consulting team of Clear Creeks Consulting and Environmental Planning and Restoration (EPR) to prepare the restoration design plans and to obtain local, state and federal permits for this project.

Staffs from these firms were key members of the multidisciplinary team that conducted the original detailed assessment of the Quittapahilla Creek watershed. Clear Creeks prepared the Restoration and Management Plan (2006). Clear Creeks and EPR have teamed to provide design and permitting services for the QWA, DFTU and LVC to complete two restoration projects along Snitz Creek and Beck Creek utilizing the grant funds obtained from the Water Quality Improvement Projects along the Sunoco Mariner East 2 Pipeline Corridor Grant Program in 2018. Most recently Clear Creeks completed the Quittapahilla Creek Watershed Implementation Plan (2018) for QWA and LVC.

Given their outstanding work on the assessment, management plans and restoration projects, and the fact that they have been working closely with the QWA since 2000, the members feel they are the most qualified and best prepared consultants to help implement our stream restoration projects. The following scope of work outlines the services and deliverables they will provide under the grant funds we are requesting.

Detailed Scope of Work

<u>Phase 1 - Design and Permitting</u>

- Existing Conditions Survey and Base Map Preparation

  - Set up a GPS ground control network.
  - Field run topography will be utilized to develop design base maps along the Snitz Creek stream corridor (approximately 1,000 linear feet).
  - In addition, a field-run survey will be conducted to provide detailed channel topography. This will:
    - Extend 100 feet from top of bank along the right and left floodplain,
    - A longitudinal profile will be surveyed along the project reach. The profile survey will follow the thalweg and include channel bed, water surface, and top of bank profiles at key points (e.g., top and bottom of riffles, bottom of run, Dmax of pools, and top of glide, etc.);
    - A baseline will be established along the right floodplain for the entire length of the project reach.
    - Cross-sections will be established off the base-line, extending 100 feet from top of bank along the right and left floodplain and include key points along the channel (Apex of bends, mid-riffle, max depth of pools). Significant in channel features (e.g. bedrock outcrops) will be identified.
    - Identification and survey of any public or private utilities, such as culverts, bridges, sanitary sewer manholes, storm drain outfalls, pipelines, phone and power poles, etc.
    - Survey upstream, downstream and through the stream sections at the culvert at Culvert Street and the bridge at Cornwall Road sufficient detail to allow hydraulic analysis of these structures.
    - Vertical and horizontal controls will be set.

- Develop the following base maps of the project area from the field run survey for use in developing restoration designs.
  - The plan view will be prepared at 1 in. = 20 ft. Cross-sections will be prepared at 1 in. = 5 ft. vertical and 1 in. = 5 ft. horizontal. Longitudinal Profile will be prepared at 1 in. = 5 ft. vertical and 1 in. = 20 ft. horizontal.
  - The plan view will include topography at one-foot contour intervals in the channel and across the floodplain/terraces and adjacent hill slopes to either side of the channel;
  - It will show existing structures, such as roads, culvert and bridge;
  - Major stream features (e.g., point bars, depositional areas, rock outcrops, etc.) will be shown.

➢ Hydrologic and Hydraulics Analysis

- Utilizing standard hydrologic modeling methods (TR-20) develop the peak discharge rate for the 1-, 2-, 10-, 50- and 100-year 24-hour storms under existing conditions for the project reach. The model will be calibrated to regional regressions and/or the FEMA 100-year published flow data so as to serve as the basis for analyzing in the following flood plain modeling effort.
- Utilizing the 1-, 2-, 10-, 50 and 100-year flows developed from the hydrologic analysis and regional regressions, conduct existing and proposed hydraulic analyses for the project reach. Traditional methods including HEC-RAS will be used to approximate and model existing and proposed water surfaces and hydraulic parameters associated with these flow events.
- The HEC-RAS model will also import the HEC-2 data from the detailed FEMA modeling used for the Flood Insurance Rate Mapping of the project area. This cost estimate assumes that we will be able to develop a model that reflects less than 0.01 foot flood water surface elevation change to remain consistent with PADEP regulations.
- If, however this cannot be achieved, it will become necessary to proceed through the process to obtain a Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) process with FEMA. This effort is estimated to require an additional $0.00 of effort to complete this procedure.

➢ Field Studies and Design Criteria

- Conduct Level II and Level III Geomorphic Assessment
- Collect and analyze bulk sediment to verify sediment transport capacity
- Determine design bankfull channel dimensions.

➢ Preliminary Design Plans

- Utilizing the field-run topography and base maps, hand drawn preliminary design plans will be prepared. The plans will include: plan view sheets, representative cross-section sheets, structure typical details, and preliminary landscape plans for the Snitz Creek corridor.

➢ Final Design Plans and Construction Documents

- Prepare final restoration design plans utilizing the field-run topography and base maps. The plans package will include: grading plans, cross-section sheets, profile sheets, and grading typical details, and final landscape plans for the Snitz Creek corridor.
- Prepare a Design Report that summarizes the results of the field studies, existing/proposed conditions hydrologic and hydraulic analysis, sediment transport analysis, and supporting engineering computations for the restoration/stabilization of Snitz Creek project reach.

- Prepare Erosion and Sediment Control Plans including sequence of construction; stockpile and staging areas, clean water diversion, sediment and erosion control measures,
- Prepare quantity estimates for materials, and final engineer's cost estimates for materials and construction.
- A Professional Engineer licensed in the state of Pennsylvania will review, sign and seal the final design plans.

➢ Local State and Federal Permit Applications

- Conduct environmental assessments required for permitting including wetland delineation, archeological, historical, RET, etc.
- Conduct a pre-application field meeting with the local, state and federal permitting agencies to present the concept design plans, discuss overall project goals and objectives and site specific constraints.
- Prepare Erosion and Sediment Control Submittal Package.
- Prepare Joint Permit Application packages for submission to the Quittapahilla Watershed Association. The authorized representative for the QWA will sign and forward the permit application package to the permitting agencies.
- Prepare written responses (with accompanying plan revisions) to agency comments and or questions.

➢ Bid Assistance

- After the design plans are completed but prior to permits being issued Clear Creeks will prepare Bid Documents and conduct a Site Showing for perspective contractors. DFTU and QWA will solicit bid proposals from a list of qualified construction contractors.
- The Construction Contractor selected for the Project will assist Clear Creeks, DFTU and QWA in preparing grant applications for funding of the Construction Phase of the Project.

➢ OM&R Plan

- Clear Creeks will prepare a Preliminary OM&R Plan for the Project Area that defines allowed and prohibited activities along the project area. Identify monitoring, maintenance and repair activities to be performed, outline a schedule for those activities and the parties responsible for conducting those activities.

➢ Project Management, Coordination, Meetings and Site Visits

- Assist QWA and DFTU in obtaining funding.
- Manage project scheduling, prepare and submit invoices for payment, prepare status reports for DFTU and prepare final project report.
- Conduct Intra-Team office/field meetings to discuss hydrologic and hydraulic analysis, the findings of the field studies and subsequent recommendations, drafting of preliminary and final design drawings, and other project related issues.
- Attend up to three (3) office/field meetings with DFTU, QWA and property owner to discuss project scheduling, the findings of the field studies and subsequent recommendations, discuss landscaping issues, present preliminary and final design drawings, and other project related issues.

Deliverables

- Final Design Plans
- Construction Specification Documents
- Permit Application Package
- Bid Assistance
- OM&R Plan

Project Schedule

Task	**Start and Completion Dates**
Phase 1 – Design and Permitting	
Existing Conditions Topographic Survey and Base Maps	NTP – Day 45
Hydrologic and Hydraulic Analysis	NTP – Day 45
Field Studies and Design Criteria	NTP – Day 45
Preliminary Design	Day 45 – Day 90
Final Design and Construction Documents	Day 90 – Day 120
Local, State and Federal Permitting	Day 120 – Day 270

Commonwealth Investment Criteria

Consulting firms, construction contractors, nurseries, and landscape companies depend primarily on private development and publicly funded projects for business opportunities. Publicly funded projects are critical for sustaining these businesses. An evaluation of the economic impact this project will have on the consulting firms, construction contractor, nursery and landscape company directly involved, as well as the quarries; heavy equipment leasing, parts and maintenance; fuel suppliers; and erosion control products materials and equipment suppliers indicates that a minimum of 20 permanent fulltime jobs would be retained. An additional 51 temporary fulltime jobs would result from this project.

Design and Permitting Scope of Work and Budget for
Snitz Creek Project 3 Restoration Project
(07/30/2019)

Phase 1 – Survey and Preliminary Design

Task 1.0 – Existing Conditions Survey and Base Map Preparation

1. Set up a GPS ground control network.
2. Field-run survey will be conducted to provide detailed channel topography and floodplain topography along 1,000 feet of Snitz Creek from upstream of the culvert section at Lebanon Valley Rail Trail and downstream through the culvert section at Culvert Road. This will include:
   a) The floodplain survey will extend 50 feet from the top of bank on the left side of stream and 100 feet from the top of bank on the right side of the stream.
   b) The longitudinal profile will be surveyed along the project reach. The profile survey will follow the thalweg and include channel bed, water surface, and top of bank profiles at key points (e.g., top and bottom of riffles, bottom of run, Dmax of pools, and top of glide, etc.);
   c) A baseline will be established along the right floodplain/terrace for the entire length of the project reach.
   d) Cross-sections shall be established off the baseline, extending 25 feet on either side of the channel, and surveyed at 100 foot intervals and at key points along the channel (Apex of bends, mid-riffle, max depth of pools). Minimum points along a cross-section shall include start and end of cross-section, top of bank, toe of bank/edge of water, thalweg, centerline, and several points either side of center line).
   e) Significant in channel features (e.g. point bars) will be identified.
   f) Identification and survey of any public or private utilities, such as sanitary sewer manholes, storm drain outfalls, phone and power poles, etc.
   g) Survey upstream, downstream and through the stream sections at the culverts at the Rail Trail and Culvert Road with sufficient detail to allow hydraulic analysis of these structures.
   h) Vertical and horizontal controls will be set.
3. Develop the following base maps of the project area from field run survey for use in developing restoration designs.
   a) The plan view will be prepared at 1 in. = 20 ft. Cross-sections will be prepared at 1 in. = 5 ft. vertical and 1 in. = 5 ft. horizontal. Longitudinal Profile will be prepared at 1 in. = 5 ft. vertical and 1 in. = 20 ft. horizontal.
   b) The plan view will include topography at one-foot contour intervals in the channel and across the floodplain/terraces and adjacent hill slopes to either side of the channel. It will show existing structures, such as buildings, retaining walls, fences, roads, drainage pipes, culverts and bridges; Major stream features (e.g., point bars, depositional areas, rock outcrops, etc.) will be shown. $21,679.00

Task 2.0 - Hydrologic and Hydraulic Analysis

1. Utilizing standard hydrologic modeling methods (TR-20) develop the peak discharge rate for the 1-, 2-, 10-, 50- and 100-year 24-hour storms under existing conditions for the project reach. The model will be calibrated to regional regressions and/or the FEMA 100-year published flow data so as to serve as the basis for analyzing in the following flood plain modeling effort.
2. The hydrology modelling costs are based on using the hydrology that will be developed for Snitz 2. If Snitz 2 is not completed, than an additional $4,500.00 will be required to complete this model.
3. Utilizing the 1-, 2-, 10-, 50 and 100-year flows developed from the hydrologic analysis and regional regressions, conduct existing and proposed hydraulic analyses for the project reach. Traditional methods including HEC-RAS will be used to approximate and model existing and proposed water surfaces and hydraulic parameters associated with these flow events.
4. The HEC-RAS model will also import the HEC-2 data from the detailed FEMA modeling used for the Flood Insurance Rate Mapping of the project area. This cost estimate assumes that we will be able to develop a model that reflects less than 0.01 foot flood water surface elevation change to remain consistent with PADEP regulations.
5. If, however this cannot be achieved, it will become necessary to proceed through the process to obtain a Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) process with FEMA. This effort is estimated to require an additional $50,000.00 of effort to complete this procedure. $25,025.00

Task 3.0 – Field Studies and Design Criteria

1. Conduct Level II and Level III Geomorphic Assessment
2. Collect and analyze bulk sediment to verify sediment transport capacity
3. Determine design bankfull channel dimensions. $4,400.00

Task 4.0 – Preliminary Design

1. Utilizing the field-run topography and base maps, prepare Preliminary Design Plans that include: plan view sheets, representative cross-section sheets, structure typical details, and preliminary landscape plans for the Snitz Creek corridor. $19,635.00

5.0 – Final Design and Construction Documents

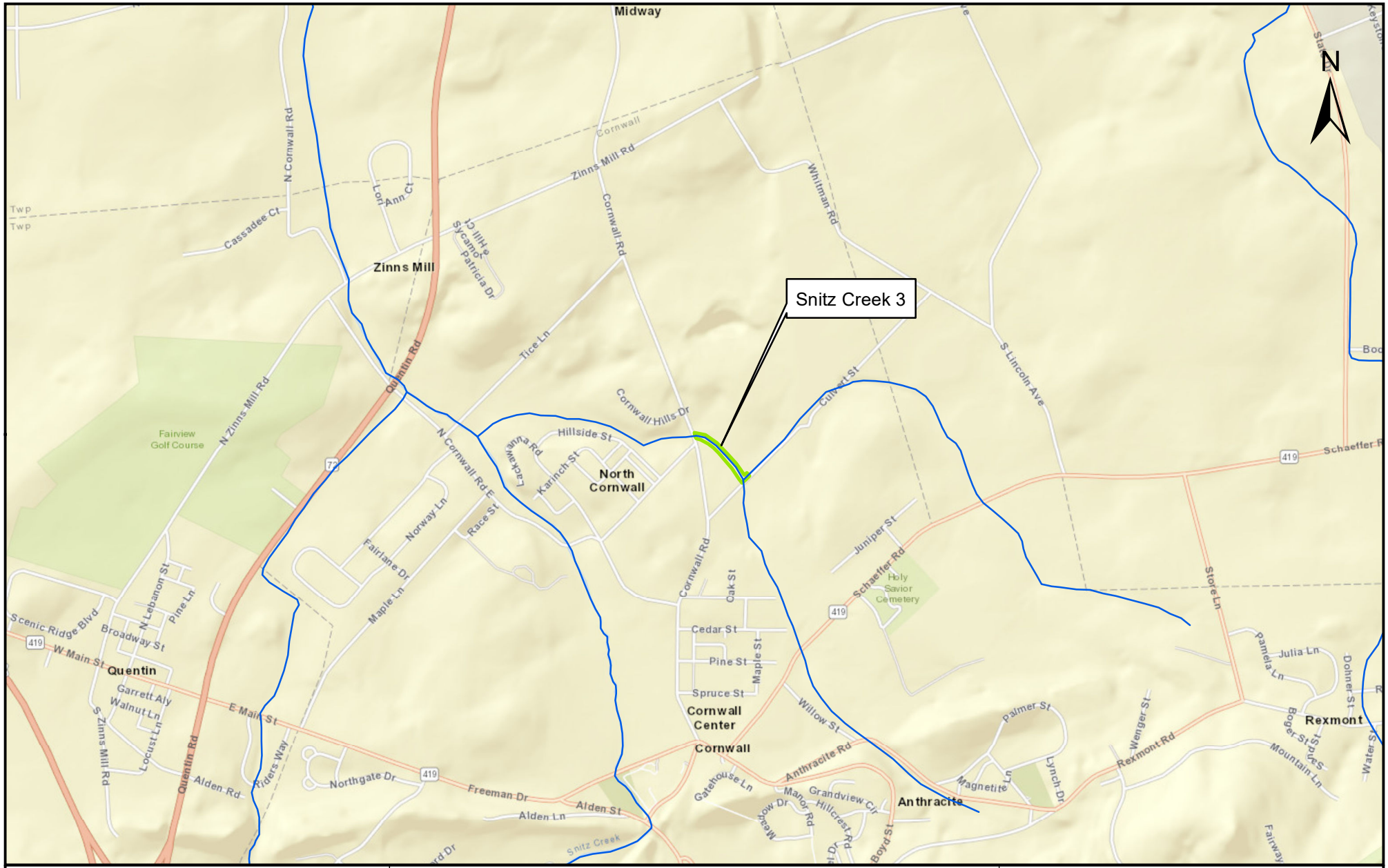
1. Prepare Final Design Plans that include: grading plans, cross-section sheets, profile sheets, and grading typical details, and final landscape plans for the Snitz Creek corridor.
2. Prepare a Final Design Report that summarizes the results of the field studies, existing/proposed conditions hydrologic and hydraulic analysis, sediment transport analysis, and supporting engineering computations for the restoration/stabilization of Snitz Creek project reach.
3. Prepare Erosion and Sediment Control Plans including sequence of construction; stockpile and staging areas, clean water diversion, sediment and erosion control measures.
4. Prepare Construction Specifications and a Bid Package that includes: project description, general and special provisions; an itemized bid tab for all work items - earthwork cut and fill quantity estimates, quantity estimates for construction materials, and final engineer's cost estimates for materials and construction.
5. A Professional Engineer licensed in the state of Pennsylvania will review, sign and seal the final design plans. $60,500.00

6.0 – Local State and Federal Permit Applications

1. Conduct environmental assessments required for permitting including wetland delineation, archeological, historical, RET, etc.
2. Conduct a pre-application field meeting with the local, state and federal permitting agencies to present the concept design plans, discuss overall project goals and objectives and site specific constraints.
3. Prepare Erosion and Sediment Control Submittal Package.
4. Prepare Joint Permit Application packages for submission to the Lebanon Valley Conservancy and Quittapahilla Watershed Association. (Clear Creeks) The authorized representative for the LVC/QWA will sign and forward the permit application package to the permitting agencies.
5. Prepare written responses (with accompanying plan revisions) to agency comments and or questions.
6. This Scope of Work and Budget does not include any detailed archeological, historical studies that may be required by the agencies. $28,325.00

Phase 1 – Design and Permitting Professional Fees

Clear Creeks	
EPR	$47,575.00
Foothills	$97,460.00
Total	$14,529.00
	$159,563.00



LOCATION MAP	SNITZ CREEK 3	DATE: AUGUST 2019
0 750 1,500 3,000 Feet	SNITZ CREEK, QUITTAPAHILLA CREEK WATERSHED, LEBANON COUNTY, PA	PREPARED BY: Ecosystem Planning & Restoration Clear Creeks Consulting

SITE MAP	SNITZ CREEK 3	DATE: AUGUST 2019
0 55 110 220 Feet	SNITZ CREEK, QUITTAPAHILLA CREEK WATERSHED, LEBANON COUNTY, PA	PREPARED BY: Ecosystem Planning & Restoration Clear Creeks Consulting