

Little Conestoga Watershed Action Plan

Lancaster County, PA
July 29, 2015



Prepared for:
Little Conestoga Watershed Alliance
PO Box 6355
Lancaster, PA 17607

Prepared by:
LandStudies, Inc.
315 North Street
Lititz, PA 17543
717-627-4440
www.landstudies.com



Table of Contents

1	Introduction	1
1.1	Purpose	1
1.2	Regulatory Implications.....	1
2	Inventory and Prioritization of Restoration Projects	1
2.1	Project Inventory and Focus Areas	1
2.2	Project Prioritization	5
3	Masterplans and Benefit Quantification	7
3.1	East Petersburg Park Green Masterplan.....	7
3.2	Manheim Township Linear Park Green Masterplan	8
3.3	Centerville Middle School Green Masterplan	8
3.4	Mennonite Homes / Private Landowner Green Masterplan	9
3.5	Conestoga Country Club.....	9
4	Recommended Updates to the 2003 Little Conestoga Creek Watershed Assessment.	11
5	References	12

Table of Appendices

Appendix A: BMP Reference Plan and Little Conestoga Project Inventory

Appendix B: Lancaster Farmland Trust Strategy for Agricultural Areas and Alternative Salt Management Practices

Appendix C: Green Masterplans for Five (5) Projects

1 Introduction

1.1 Purpose

This report provides a comprehensive Watershed Action Plan for the Little Conestoga Watershed. The Watershed Action Plan (WAP) was developed by building upon existing data and studies as well as through valuable stakeholder input gained during two visioning sessions. Stakeholders represented at the visioning sessions included the Little Conestoga Watershed Alliance (LCWA) members, the Lancaster County Conservation District (LCCD), and municipal representatives. The plan focuses on documenting and prioritizing opportunities for watershed improvement projects as well as provides restoration masterplans for five of these priority sites. The action plan will provide guidance to the LCWA on where to focus implementation efforts to improve water quality, minimize adverse effects from stormwater, and improve riparian habitat.

Important deliverables included in this report and summarized in the sections below include:

- Inventory of planned, proposed, and implemented projects as well as project prioritization spreadsheet.
- Map of planned, proposed and implemented projects including watershed focus areas.
- Masterplans for five high-priority restoration sites.
- An inventory of recommended updates to the 2003 Little Conestoga Creek Watershed Assessment and Restoration Plan.

1.2 Regulatory Implications

Secondary outcomes of this action plan include providing information and projects applicable to addressing Lancaster County's Phase 2 Watershed Implementation Plan (WIP) as well as Municipal Separate Storm Sewer System (MS4) permit requirements of the municipalities in the watershed. Municipalities are in the process of developing a Geographic Information System (GIS) based Best Management Practice (BMP) inventory and tracking system. Project information collected during the action plan development may be used to populate the BMP tracker which will also include nutrient and sediment reductions resulting from the implemented projects. Nutrient and sediment reductions are also important to document County compliance with the Phase 2 WIP. An inventory of the implemented and planned projects will help with this documentation.

2 Inventory and Prioritization of Restoration Projects

2.1 Project Inventory and Focus Areas

The 2003 Little Conestoga Creek Watershed Assessment and Restoration Plan was used as a base for project identification as well as one source of information used in the prioritization phase. Additional planned or potential projects as well as completed projects were

inventoried during the visioning sessions. All projects were assigned an identification number, listed on the BMP Prioritization Spreadsheet and located on the Little Conestoga BMP Reference Plans. Both the plans and spreadsheet are provided as Appendix A. As projects were mapped, it became apparent that certain areas represented typical characteristics that could be replicated in similar types of locations in other areas of the county. Projects were grouped into themed focus areas based on watershed characteristics and project types. The resulting focus areas are shown on the BMP Reference Plans and are summarized below. Focus areas are not listed in prioritized order.

Focus Area A - East Petersburg Borough Open Space Network

Theme – Boroughs represent unique challenges related to water quality because of development density, aging or lack of stormwater systems (typically developed prior to stormwater management regulations) and minimal available open space. The existing open space network in East Petersburg represents an opportunity to showcase the efficient use of available green space.

A green infrastructure strategy is proposed for East Petersburg Borough and represents an efficient use of the greenspace park system which includes wellhead protection areas, MS4 permit requirements, and stormwater management as well as recreation.

A masterplan has been prepared to show how the greenspace in East Petersburg Borough could be utilized to meet regulatory requirements and improve water quality and bio-diversity while continuing to serve as the primary recreation space for the community. More information about the site is included in Section 3 and the masterplan for the borough's park is included in Appendix C.

Focus Area B - East Hempfield Un-named Tributary (UNT) Watershed Improvements

Theme – The majority of the land within this focus area is agricultural. An agriculture based strategy targeting this subwatershed that addresses conservation plans and BMP implementation is recommended. Lancaster Farmland Trust (LFT) has established a Phase 1 and Phase 2 strategies for working with agricultural landowners and the township to implement BMPs on farms. Phase 1 involves identifying the properties, which has been done through the project inventory in this action plan. Phase 2 involves a set course of actions to engage landowners, leverage funding, and implement and monitor practices. LFT is currently employing this strategy in multiple townships in Lancaster County. An outline of their Phase 2 strategy is included in Appendix B. By working with the land owners in a smaller sub-watershed to implement BMP's, there is the potential of measurable results and significant improvements to an impaired stream. A goal could be to improve water quality so that the sub-watershed could be removed from the 303d list.

Focus Area C - Swarr Run Watershed Improvements

Theme – This is a suburban watershed improvement strategy that addresses common water quality issues in residential and light industrial land use areas. In the case of the Swarr Run Watershed, sites were selected with willing landowners where multiple benefits could be

realized through restoration. The headwaters of Swarr Run is also the wellhead protection area for the region's drinking water supply. The Swarr Run Green Masterplans and Cost-Benefit Analysis report, dated June 2013, identifies numerous projects that could be considered as part of this sub-watershed improvement strategy. These include Four Seasons Golf Course, Hempfield Sports Complex, and Hempfield School District. Masterplans for BMP projects at the Hempfield Sports Complex (Project #15), Swarr Run Floodplain Restoration (Former Charter Homes Development Site) (Project #26), Amos Herr Park (Project #33 and #34) and Nissley Road (Project #113) have been developed and are included in the Swarr Run report.

Focus Area D - Park City Regional Stormwater Management Improvements

Theme – Regional stormwater management improvements consider how potential stream and floodplain restoration sites on the nearby Little Conestoga Creek could address stormwater runoff associated with Park City and meet Lancaster City's MS4 permit requirements as well as any potential for using treated stormwater to improve the supply to Long's Park's pond. These improvements could help to improve regional stormwater management and flooding issues while also helping to improve water quality of the Little Conestoga Creek. A masterplan for a site located on the Mennonite Homes property and adjacent private property has been prepared as part of the Watershed Action Plan. (Project #86). See Section 3 and Appendix C for more detail. This focus area also considers the findings and Floodplain Restoration Masterplan from the existing report "Little Conestoga Sustainable Stormwater Solutions and Cost Benefit Analysis" for Site #85 as well as the masterplan for the implementation of raingardens, bioswales, meadows and pervious pavement at Park City.

Focus Area E - Millers Run Watershed Improvements

Theme – This focus area consists of a small watershed-based water quality improvement strategy that would build upon existing completed and designed projects in this sub-watershed, addressing streambank stability and run-off from adjacent suburban developments. By implementing the remaining restoration opportunities in this small watershed, there is the potential goal of de-listing the subwatershed from the 303d list. One of the remaining restoration sites is a residential community, Village Grande, which is actively engaging its residents and homeowners association and implementing conservation landscaping as part of a program called Greening the Lower Susquehanna, which is administered by Penn State University through a grant from the National Fish and Wildlife Foundation (NFWF). The program educates residents about the benefits of conservation landscaping and provides green infrastructure design assistance for the community's open space. The restoration of Millers Run, which runs through the Village Grande property, is part of the recommendations proposed by the program.

Focus Area F - Maple Grove Corridor Improvements – North and South

Theme – This is a linear corridor improvement strategy which would link open space from Franklin and Marshall College and the Lancaster County Solid Waste Management Authority (LCSWMA) properties to the Conestoga Country Club. The corridor includes public open

space areas including existing restoration efforts at Maple Grove and would provide recreation and educational opportunities in established residential communities just outside of the city limits. In addition, this focus area is located downstream of Park City, which was constructed prior to the establishment of local stormwater management requirements. Restoration throughout this corridor that addresses stormwater runoff and mitigates flooding could improve two frequently flooded western gateways to the City of Lancaster (Columbia Avenue and Marietta Avenue).

Focus Area G - Penn Township Headwaters FPR

Theme – This is a strategic location for headwaters restoration incorporating floodplain restoration and aquifer recharge. Improvements made to this subwatershed could help remove the stream from the 303d list. Several large landowners in the area have already shown interest in conservation projects with regional and community benefits. A concept has been completed by one of the large landowners to restore a floodplain corridor if grant funding were available. The project would create wetlands, restore a connection between the stream, floodplain and groundwater, and establish a riparian corridor of native plants. (Project #58)

Focus Area H - Granite Run Watershed Improvements

Theme – This is a strategic location to improve the ecological value of corporate open space that is underutilized and currently has high maintenance needs. Township representatives noted that the landowners and support this project. A concept and cost-benefit analysis for floodplain restoration has been completed and is described in the report “Little Conestoga Sustainable Stormwater Solutions and Cost Benefit Analysis.” The project would be located in existing open space with recreational access, visibility, and educational benefits

Focus Area I - Spring Haven / PPL Park Corridor Improvements

Theme – This stream corridor has the potential for floodplain restoration or other headwater improvements to protect groundwater recharge and improve the stream corridor. Landowner access and flooding issues could be considered as part of improvements.

Focus Area J - Bachman Run Watershed Improvements

Theme – This focus area includes suburban watershed improvements with a focus on restoration and green infrastructure. Consider findings from the report “Little Conestoga Sustainable Stormwater Solutions and Cost Benefit Analysis” for stormwater basin retrofits in residential areas along Bachman Run. A concept plan for the Manheim Township Linear Park has been prepared as part of this action plan. More information about the Linear Park site is included in Section 3 and the masterplan is included in Appendix C.

Focus Area K - Brubaker Run Watershed Improvements

Theme – This focus area includes a mix of suburban and industrial land uses as well as proposed development. There is potential to expand on the stormwater BMPs as part of National Pollutant Discharge Elimination System (NPDES) permitting for the proposed

development site (Project #5) and incorporate them into other sites up and downstream of the development..

Focus Area L - School Lane Hills Suburban BMPs

Theme – The urban residential BMP strategy is to address stormwater, improve water quality, and riparian corridor management practices in a suburban setting. This strategy will require engaging local homeowners and educating them about the benefits of BMPs and their role in improving water quality in the watershed.

Focus Area M - Conestoga Country Club Improvements

Theme – Continuing BMP implementation efforts on this property is recommended. The implementation will focus on stream restoration and flood mitigation potential along with numerous green infrastructure and BMP improvements. A masterplan has been prepared as part of this Action Plan. More information about the site is included in section 3 and the masterplan is included in Appendix C.

Focus Area N - Armstrong Headwaters Restoration

Theme – A headwaters restoration with potential for fishery improvements and wild trout introduction is recommended. This large site is unique because the headwaters are owned by one single landowner.

Focus Area O - West Branch Watershed Improvements

Theme – An agriculture based strategy targeting this subwatershed that addresses conservation plans and BMP implementation is recommended. Lancaster Farmland Trust (LFT) has established a Phase 1 and Phase 2 Strategy for working with agricultural landowners and the township to implement BMPs on farms. Phase 1 involves identifying the properties, which has been done through the project inventory in this action plan. Phase 2 involves a set course of actions to engage landowners, leverage funding, implement and monitor practices. LFT is currently employing this strategy in West Lampeter Township. An outline of their Phase 2 Strategy is included in Appendix B.

Focus Area P - Indian Run Watershed Improvements

Theme – An Agriculture Based Strategy focusing on agricultural BMPs and conservation plans is recommended. This smaller watershed is a good candidate for potential de-listing with a concentrated BMP implementation effort. This watershed is also a good candidate for LFT's Phase 2 agricultural strategy.

2.2 Project Prioritization

Both projects and focus areas were prioritized. The visioning sessions as well as a survey were used to prioritize watershed issues and project functions. A survey of stakeholders indicated that project priorities should be based on the following project functions, with #1 being the highest priority:

1. Nutrient and sediment load reductions
2. Stream stability

3. Flood mitigation and infrastructure projection
4. Stormwater volume and/or peak rate reduction
5. Habitat restoration
6. Recreation

In order to prioritize the list of projects, point values were assigned to the list of prioritized functions and projects were cumulatively scored based on the number of functions addressed. For example, a stream stabilization and buffer project might receive six (6) points for nutrient and sediment reductions, five (5) points for stream stability and two (2) points for habitat restoration for a total score of 13 points. Project scoring is provided in the “Scoring of Project Functions” column on the BMP prioritization spreadsheet in Appendix A. Projects were sorted from largest to smallest point values based on the results.

Additional criteria used to prioritize projects included whether the project addressed wellhead protection, severe erosion issues, a 303d list stream, was a priority stream reach in the 2003 assessment, as well as whether there was a known willing landowner, or if the subwatershed was a size that could be a focus area for de-listing. These criteria are listed on the “Prioritization Spreadsheet” in Appendix A and an “X” was used to designate the criteria applied. The number of “X’s” were tallied and were used as a secondary ranking criteria to further sort the projects from high to low priority. Projects were then assigned an “Overall Project Ranking” number.

Individual Project Ranking

1. East Hempfield Sports Complex (Focus Area C; Project #15)
2. Swarr Run Floodplain Restoration Site (Focus Area C; Project #26)
3. Mennonite Homes (Focus Area D; Project #85)
4. Granite Run (Focus Area H; Project # 83)
5. PPL and Adjacent Landowners (Focus Area I; Project #138)
6. Maple Grove (Focus Area F; Project #96)
7. Stoner Farm (Focus Area C; Project #20)
8. Private Property (Focus Area D; Project #86)
9. Guengerich Farm (Focus Area I; Project #150)
10. Buch Avenue Private Landowners (Focus Area I; Project #139)

As shown on the spreadsheet, projects were reorganized by overall ranking within their focus areas. In order to prioritize focus areas, the average overall ranking was calculated for the top 5 ranking projects within each focus area. The results are shown below.

RANKING	FOCUS AREA
1	C – Swarr Run Watershed Improvements
2	O – West Branch Watershed Improvements
3	G – Penn Township Headwaters FPR
4	M – Conestoga Country Club Improvements
5	N – Armstrong Headwaters Restoration
6	D – Park City Regional SWM Improvements
7	I – Spring Haven / PPL Park Corridor Improvements
8	J – Bachman Run Watershed Improvements

9	B – East Hempfield Unnamed Tributary Watershed Improvements
10	H – Granite Run Watershed Improvements
11	F – Maple Grove Corridor Improvements
12	K – Brubaker Run Watershed Improvements
13	P – Indian Run Watershed Improvements
14	E – Millers Run Watershed Improvements
15	A – East Petersburg Borough Open Space Network
16	L – School Lane Hills Suburban BMPs

3 Masterplans and Benefit Quantification

The following sites were chosen by the LCWA to have masterplans developed. Sites with no previous planning were chosen based on multiple criteria including results of previous studies, willingness of landowners, funding potential, and prioritization criteria. The LCWA also wanted to have masterplans developed for projects within various subwatersheds rather than concentrating them all in one location. Nutrient and sediment reduction benefits were estimated for the proposed BMPs at each site. The methodology used for each calculation is referenced below. The most appropriate methodology was chosen based on site conditions.

Masterplans are included in Appendix C. The Masterplans are for planning purposes only and are not meant for construction or implementation of the proposed BMP's. A professional engineer or licensed Landscape Architect may be needed to provide guidance on design and permitting needs. The local municipality and conservation district should be notified and made aware of the proposed improvements, schedule and method of implementation. The following generally applies for Township approval of stormwater management projects:

- Township approval is typically required for any project that directly affects or will act as a stormwater management facility as outlined in the Township's stormwater management ordinance (e.g. reduction in volume, change in quality, etc.).
- Township approval is typically NOT required for "complimentary" projects that may provide improvements but do not necessarily alter/modify a SWM facility or create a new facility but a courtesy notification is recommended.
- Township staff should be made aware ahead of time how the proposed BMP will be maintained and who is responsible for the maintenance.

3.1 East Petersburg Park Green Masterplan

The strategy shown for East Petersburg Park represents an efficient use of the greenspace park system (Project #117 on BMP Reference Plan). A stormwater basin retrofit and bioswale is recommended for the park. Implementation of these BMPs will improve water quality through filtration and biological processes. This pollutant load reduction could be part of the borough's MS4 compliance strategy. Establishing a warm season grass and wildflower meadow in areas currently maintained as lawn will reduce maintenance, provide wildlife habitat, and improve recreation opportunities for wildlife observation. Strategically placed native trees and shrubs could provide a visual screen of the surrounding commercial land

uses. Additional trailheads and trail extensions could provide supplementary access to the park. The use of interpretive panels throughout the park could provide public education about the improvements and could also be used to meet requirements of the borough's MS4 permit for education and outreach. The borough could also coordinate a volunteer planting day to get the community involved in the proposed park improvements. The masterplan shows how the greenspace in East Petersburg Borough could be utilized to meet regulatory requirements and improve water quality and bio-diversity while continuing to serve as the primary recreation space for the community.

Approximate nutrient and sediment load reductions realized by retrofitting the stormwater basin were calculated using the procedures given in Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects (Schueler and Lane, 2012).. It is estimated that a basin retrofit would remove 961 lbs of nitrogen per year, 53.1 lbs of phosphorus per year and 20.1 tons of sediment per year

3.2 Manheim Township Linear Park Green Masterplan

The Manheim Township Linear Park is located within the Stonehenge community, east of Fruitville Pike and south of Snyder Road (Project #151 on BMP Reference Plan). An unnamed tributary to Bachman Run flows through Linear Park which is flanked on both sides by the Stonehenge residential community. Proposed BMPs within the park include streambank stabilization to reduce bank erosion, riparian buffer creation and wetland creation. Four locations were identified to create wetland pockets. Implementation of these BMPs would improve water quality. This pollutant load reduction could be a component of Manheim Township's MS4 permit compliance strategy. Riparian habitat would also be greatly improved by the establishment of a forested buffer and native plant meadow. Park maintenance would also be reduced. Recreation and environmental education opportunities will be improved within the park and interpretive panels could be installed which could also be used to meet requirements of the borough's MS4 permit for education and outreach. The township could also coordinate a volunteer planting day to get the community involved in the proposed park improvements.

The following approximate nutrient and sediment load reductions were estimated as a result of BMP implementation as shown on the masterplan.

Table 1. Estimated Nutrient and Sediment Reductions for Manheim Township Linear Park

BMP	Total Amount	N Removal (lbs/yr)	P Removal (lbs/yr)	Sediment Removal (Tons/yr)	Calculation Method
Streambank Stabilization	1700 feet	311.4	34.4	16.4	Schueler and Stack, 2014
Forested Riparian Buffer	3.9 acres	69	3.4	0.3	Tetra Tech, 2013

Created Wetland (left bank)	0.69 acres (1 wetland)	302	3.9	1.8	Schueler and Lane, 2012
Created Wetlands (right bank)	0.38 acres (3 wetlands)	96	6.9	3.2	Schueler and Lane, 2012

3.3 Centerville Middle School Green Masterplan

Centerville Middle School is located in the headwaters of the Millers Run subwatershed (Project #133 on BMP Reference Plan). This site was chosen for a masterplan because restoration work in Miller Run has a lot of momentum right now which could show some water quality improvements. Proposed BMPs at Centerville Middle School include retrofitting existing conventional detention basins to filter stormwater and provide habitat through native plantings. There is also potential to implement new stormwater BMPs including a bioretention basin and two (2) rain gardens. These improvements could generate pollution load reductions that can be applied to East Hempfield Township’s CBPRP required by their MS4 permit. The masterplan also designates areas for native meadow establishment and reforestation as well as grass trails. The combination of these BMPs coupled with the school property makes it an ideal place for environmental education and recreational opportunities.

The following approximate nutrient and sediment load reductions were estimated as a result of BMP implementation as shown on the masterplan.

Table 2. Estimated Nutrient and Sediment Reductions for Centerville Middle School BMPs (Schueler and Lane, 2012)

BMP	Total Amount	N Removal (lbs/yr)	P Removal (lbs/yr)	Sediment Removal (Tons/yr)
Bioswale	0.2 acre	99	4	1.6
2 Rain Gardens	0.17 acre	179	7.5	2.2
Basin Retrofit	0.76 acre	484	25	9.5
Bioretention Basin	0.18 acre	49	3.1	1.3

3.4 Mennonite Homes / Private Landowner Green Masterplan

This potential 4,000 foot floodplain restoration project on the Little Conestoga Creek is located in East Hempfield and Manheim Townships south of Harrisburg Pike near Park City (Project #86 on BMP Reference Plan). This site was chosen due to its close proximity to Park City, visibility, and connection to another potential floodplain restoration reach upstream. A floodplain restoration project on these properties has the potential to improve water quality through the stabilization of eroding banks, creation of 4 acres of riparian wetlands, re-connection of the floodplain to the stream and groundwater, and establishment of a functional riparian buffer. The project could also reduce runoff volume, provide regional flood

storage, reduced stream peak discharges, and greatly improve in-stream and terrestrial habitat. Since this project is located on private property significant effort must be made to work with the landowners.

Based on the protocols presented in the Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects (Schueler and Stack, 2014), it is estimated that a stream and floodplain restoration project implemented at this site would remove 5,444 lbs of nitrogen per year, 230 lbs of phosphorus per year and 207 tons of sediment per year.

3.5 Conestoga Country Club

The Conestoga Country Club is located along the main stem of the Conestoga River in Manor Township (Project #154 on BMP Reference Plan). This site was chosen because the Country Club has made a significant effort to implement BMPs and has done an excellent job maintaining them. They are very interested in continuing their water quality and habitat improvement efforts. BMPs proposed at the Country Club includes a rain garden, bioswale, and four (4) bioretention areas that will collect and filter runoff from key areas of the property. Meadow plantings are also proposed to reduce maintenance and increase terrestrial and riparian wildlife habitat. Table 3. Estimated Nutrient and Sediment Reductions for Conestoga Country Club

BMP	Total Amount	N Removal (lbs/yr)	P Removal (lbs/yr)	Sediment Removal (Tons/yr)	Calculation Method
Bioswale	1700 feet	462	25.7	10.4	Schueler and Lane, 2012
Bioretention for Maintenance Facilities (2 basins)	0.22 acres	42	2.9	1.3	Schueler and Lane, 2012
Bioretention Basins (2)	0.63 acres	25	1.6	0.2	Tetra Tech, 2013

3.6 Salt Management Strategy

Another outcome from the work group sessions in addition to specific restoration projects and focus areas, is the need to address snow removal and salt storage in more urban areas, specifically the Boroughs. One of the Borough managers involved in the workshop noted that there are no guidelines for snow removal and salt storage and identified the negative impact of road salt on stream systems. For this reason, we also included a strategy for salt storage and snow removal (see Appendix B) as part of the BMPs for boroughs

4 Recommended Updates to the 2003 Little Conestoga Creek Watershed Assessment

As part of the scope of work for the Watershed Action Plan, LandStudies reviewed the 2003 Little Conestoga Creek Assessment and Restoration Plan to determine out of date items that could be revised to provide current and beneficial information to the group. The following list identifies those items could be updated based on more current available data, or where updated data collection would be helpful to provide a more current snapshot of watershed conditions.

Section 1

- Impaired streams data based on newest 303d list.
- Detailed site investigations (ID of site specific impairment sources, fish and macro studies) are out of date. These could be updated at the same sampling locations to provide a current snapshot of conditions. This could be a good project for Millersville Biology department.
- Section 1 and 9 - Review and update municipal ordinance, land use planning and comprehensive plan information and provide a summary of updates could be included as an addendum. National Pollutant Discharge Elimination System (NPDES) permits are now added to considerations for development. Consider an ordinance audit that identifies water quality improvement related land use recommendations using the Ordinance Audit template prepared as part of the Northern Lancaster County Resource Management Recommendations prepared by LandStudies and the Susquehanna River Basin Commission (SRBC).
- Revise Threatened & Endangered (T&E) species summary to identify changes
- List of known impairments updated to identify new issues.
- Wellhead protection areas have been mapped on the BMP Recommendations Plan.
- Add a summary of any subsequent studies and projects

Section 2

- Update land use data to reflect current conditions using Lancaster County GIS data.
- Update impaired stream inventory and total length of impaired streams. Ideally, update the map of impaired streams as well.

Section 3

- Update descriptions of photos showing sites that have been restored or are planned for restoration.

Section 4

- Macro surveys could be done at the same sampling locations to provide an updated snapshot and document changes.

Section 5

- Fish surveys could be done at the same sampling locations to provide an updated snapshot and document changes

Section 6

- Perform water quality monitoring at the same sampling locations to provide an updated snapshot and document changes. Any additional water quality monitoring could also be evaluated to identify changes since 2002.

Section 7

- Update T&E species list

Section 8

- Update Rapid Bioassessment Protocol to document changes since 2002.

Section 10

- Review contact information and update with information from the Watershed Action Plan project.

Section 11

- Update per new list of completed projects developed as part of the Watershed Action Plan.
- Include BMP Reference Map prepared as part of the Watershed Action Plan.

Section 12

- Provide list of prioritized projects and strategies completed as part of the Watershed Action Plan.
- Include the five (5) green masterplans completed as part of this project, along with other masterplans completed for projects within the watershed.
- Include available cost estimates for each of the projects.

5 References

Alliance for the Chesapeake Bay. Recommended Model Development Principles, Local Site Planning Roundtable. Builders for the Bay. November, 2004.

Center for Watershed Protection. Memorandum – Findings and Recommendations From the Lancaster County Stormwater Retrofit Assessment. 2011.

DeWet, A.P., Marshall, J. Merritts, D., & Weaver, S. Little Conestoga Creek Watershed Assessment, Lancaster PA.

Environmental Protection Agency. Chesapeake Bay TMDL. Web.
<http://www.epa.gov/chesapeakebaytmdl/>

Lancaster County Conservation District. The Homeowners Guide to Stormwater. Web.
http://www.lancasterwatersheds.org/documents/HomeownersGuideFINALweb_000.pdf

Lancaster County Conservation District. Strategic Plan 2010-2015. 25 January 2010.

Lancaster County Planning Commission. Blueprints. October 2012.

LandStudies, Inc. Little Conestoga Sustainable Stormwater Solutions and Cost Benefit Analysis Little Conestoga Creek Watershed. 28 June 2014.

LandStudies, Inc. Swarr Run Green Masterplans and Cost Benefit Analysis. 26 June 2014

National Fish and Wildlife Foundation. Little Conestoga Partnership Healthy Watersheds Incentives Program. 2013 to 2015.

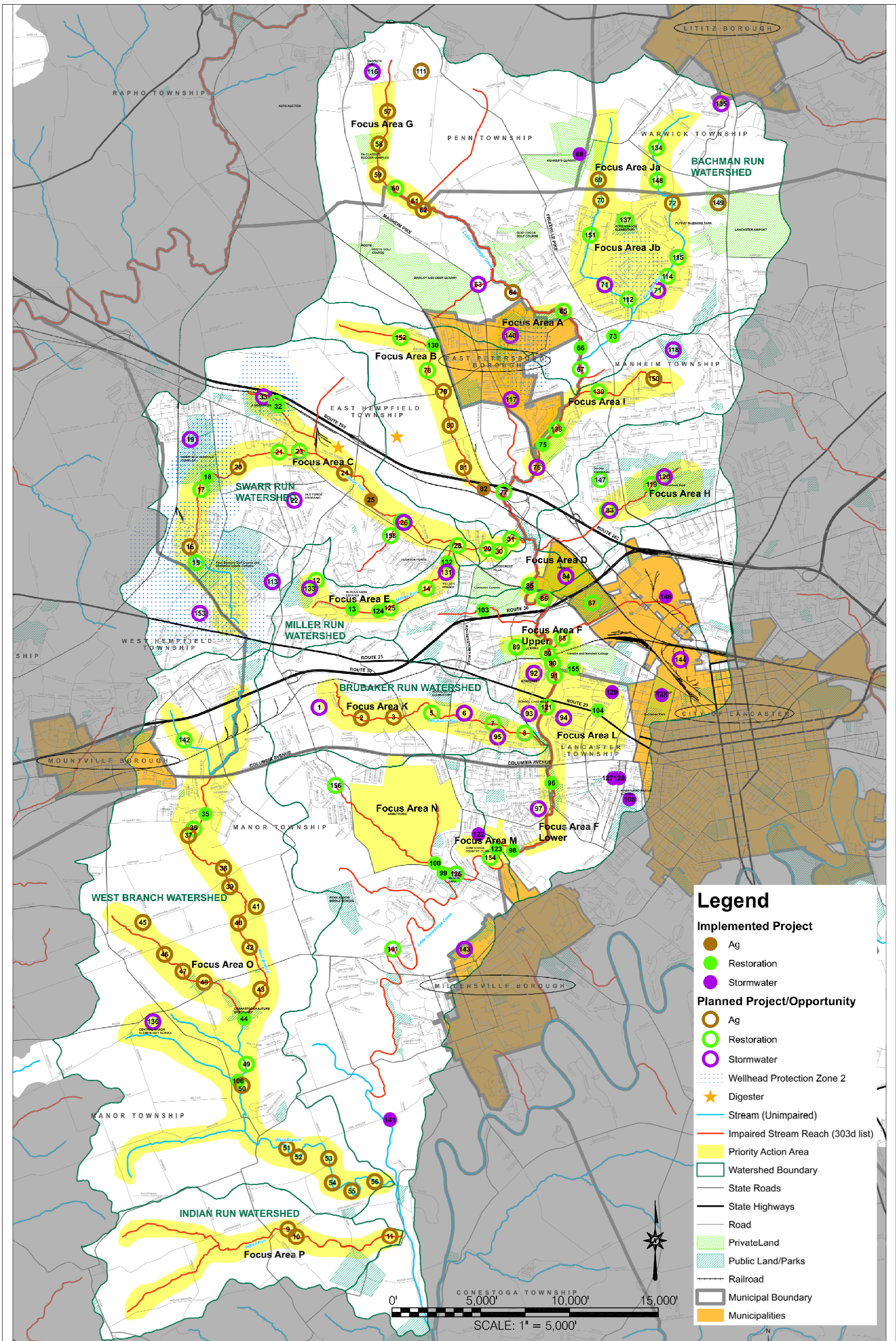
Rettew Associates, Inc. Little Conestoga Creek Watershed Assessment and Restoration Plan. 2003.

Schueler, Tom and Bill Stack. September 8, 2014. Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects. Chesapeake Bay Partnership, Urban Stormwater Workgroup.

Schueler, Tom and Cecilia Lane, October 9, 2012. Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects. Chesapeake Bay Partnership, Urban Stormwater Workgroup.

Tetra Tech. BMP Cost-Benefit Analysis, Scenarios 2 and 3. Lancaster County Clean Water Consortium. April 2013.

Appendix A
BMP Prioritization Spreadsheet and BMP Reference Plans



PROJECT NUMBER	D-486, L-14
DATE	JULY 17, 2015
SCALE	1" = 5000'
PLAN SHEET	
SHEET NUMBER	1

SHEET TITLE:
LITTLE CONESTOGA WATERSHED ACTION PLAN
BMP REFERENCE PLAN
 LANCASTER COUNTY | PENNSYLVANIA

CLIENT:
Little Conestoga Watershed Alliance

PARTNERS:
 Little Conestoga Partnership - Grant Administration
 National Fish and Wildlife Foundation (NFWF) - Funding
 LandStudies, Inc. - NFWF Technical Service Provider



717-627-4440
 fax: 717-627-4660
 landstudies.com
 land@landstudies.com
 315 North Street | Lititz, PA 17543

BMP Prioritization

* Status: **Opportunity** = Identified project not actively being pursued; **Planned** = Select active project with quantifiable BMPs; **Implemented** = In the ground project

** Source: **WA** = Little Conestoga Watershed Assessment (Retnew 2003); **SR**= Swarr Run Green Masterplan and Cost Benefit Analysis (LandStudies 2013); **SSS** = Little Conestoga Sustainable Stormwater Solutions and Cost Benefit Analysis (LandStudies 2013); **LCCD** = Lancaster County Conservation District; **LCP** = Little Conestoga Partnership

Legend: **Purple** = Stormwater; **Green** = Restoration; **Brown** = Agricultural Notes: Cell/text color corresponds to colored dots / categories on BMP Reference Map Solid Colored Rows = implemented projects

Focus Area	Project /Map #	BMP Category	Name	Description/Issues	Watershed	Township	Status *	Priority (WA 2003 Report)	Notes	Source **	Within UA	Concept Plan	Prioritization Criteria								Ranking			
													Wellhead Protection	Severe Erosion	Willing landowner	Potential Delisting	303d List	Priority Stream Reach (2003)	Visibility/Education	Additional Important Criteria	Sum of "X" in Columns Q - X	Scoring of Project Functions	Overall Project Ranking	Focus Area Ranking
K	1	Stormwater	SW Retrofits	Stormwater and water quality retrofits	Brubaker Run	East Hempfield	Opportunity	High		WA	X					X	X	X			3	8	103	
K	2	Agriculture	Hershey Farm	Streambank erosion, lack of riparian buffer	Brubaker Run	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	51	
K	3	Agriculture	Hurley Industries	Streambank erosion, lack of riparian buffer	Brubaker Run	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	52	
K	5	Restoration	Development	Pending development - stream improvements and BMPs planned as part of NPDES permit	Brubaker Run	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	53	
K	6	Stormwater	Stauffers	Littering, channelized stream, thermal pollution, parking lot of contaminants, stormwater quality BMP retrofit possibilities and/or cistern	Brubaker Run	East Hempfield	Opportunity	High	cistern green masterplan and cost/benefit analysis complete (SSS)	WA; SSS	X	X				X	X	X	X		4	4	120	
K	7	Restoration	Church of the Apostles	Buffer, stream improvements	Brubaker Run	East Hempfield	Opportunity	Medium		WA	X					X	X	X			3	13	54	
K	8	Restoration	Glenbrook Development	Habitat improvements, littering, invasive species control at E. Hempfield Twp. Park	Brubaker Run	East Hempfield	Opportunity	Low		WA	X					x	X	X			3	2	121	
P	9	Agriculture	Indian Run Headwaters	Sporadic pasturelands where livestock has free access to stream, streambank erosion, lack of forest buffer	Indian Run	Manor	Opportunity	Medium/High		WA						X	X	X			3	13	69	
P	10	Agriculture	Indian Run	Sporadic stream erosion	Indian Run	Manor	Opportunity	Low		WA						X	X	X			3	13	70	
P	11	Agriculture	Indian Run	Free cattle access to stream	Indian Run	Manor	Opportunity	Medium		WA						X	X	X			3	13	71	
E	12	Restoration	Millers Run Headwaters	Sporadic streambank erosion	Millers Run	East Hempfield	Opportunity	Medium	There is a lot of momentum already established in this watershed	WA	X						X	X		X	2	13	78	
E	13	Restoration	School Lane Estates	Cross vanes implemented (Phase I)	Millers Run	East Hempfield	Implemented	High		WA	X		X				X	X						
E	14	Restoration	Village Grande	Plans complete for stream stabilization from Sylvan Rd to Harrisburg Pike (Phase II)	Millers Run	East Hempfield	Planned	High	There is a lot of momentum already established in this watershed	WA	X			X		X	X	X		X	5	13	35	
C	15	Restoration	E. Hempfield Sports Complex	Severe stream erosion and lack of riparian buffer, potential for FPR	Swarr Run	East Hempfield	Opportunity	High	Green masterplan and cost/benefit analysis complete (SR)	WA; SR	X	X		X		X	X	X	X		5	21	1	
C	16	Agriculture	Booth Farm	Lack of forest buffer, sporadic streambank erosion	Swarr Run	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	44	
C	17	Restoration	Meinzer	Lack of forest buffer, streambank erosion	Swarr Run	East Hempfield	Opportunity	High		WA	X					X	X				2	13	75	
C	18	Restoration	Hempfield School District	Buffer implemented (Lack of forest buffer, evidence of stream relocation, existing wetland impacts, currently farmed but owned by	Swarr Run	East Hempfield	Implemented	High		WA	X					X	X		X					
C	19	Stormwater	Hempfield School District	Retrofit SW basins with water quality BMPs at Hempfield High School and Middle School	Swarr Run	East Hempfield	Opportunity	Medium		WA	X		X			X	X		X		4	8	101	
C	20	Agriculture	Stoner Farm	Free cattle access to stream, streambank erosion, lack of forest buffer, sedimentation from cropland	Swarr Run	East Hempfield	Opportunity	High		WA	X					X	X				2	20	7	
C	21	Restoration	Landis Farm Development	Potential stream project in conjunction with new development	Swarr Run	East Hempfield	Opportunity	Medium	FPR Cost/benefit analysis complete (LandStudies 2013); open space for planned community	WA	X	X			X	X	X		X		4	14	29	
C	22	Stormwater	Old Forge Crossing	Stormwater retrofits	Swarr Run	East Hempfield	Opportunity	Medium		WA	X					X	X				2	8	105	
C	23	Restoration	Denlinger Property	Lack of forest buffer, streambank erosion	Swarr Run	East Hempfield	Opportunity	Medium		WA	X					X	X		X		3	13	45	
C	24	Agriculture	Centaurus LLC	Free sheep access to stream, sporadic streambank erosion, lack of forest buffer; additional restoration possibilities	Swarr Run	East Hempfield	Opportunity	Medium		WA	X					X	X		X		3	13	46	
C	25	Agriculture	Mann Family Partnership	Buffer implemented to address - free cattle access to stream, severe streambank erosion, lack of in stream cover, lack of forest buffer, sedimentation from cropland, occasional manure spills due to overflowing manure storage	Swarr Run	East Hempfield	Implemented	High	LCCD Project	WA							X	X						
C	26	Restoration/Stormwater	Charter Homes Fairmont	FPR with SWM in conjunction with Charter Homes development; 2003 Report - Free cattle access to stream, severe streambank erosion, lack	Swarr Run	East Hempfield	Planned	High	Green masterplan and cost benefit analysis complete for floodplain	WA; SR	X	X		X		X	X	X	X		5	21	2	
C	28	Restoration	Golden Meadows	Sporadic streambank erosion, lack of forest buffer, lack of in-stream cover	Swarr Run	East Hempfield	Opportunity	Medium	Concept plan completed	WA	X	X				X	X				2	13	74	
C	29	Restoration	TC Lancaster West Co.	Sporadic streambank erosion, lack of forest buffer, lack of in-stream cover	Swarr Run	East Hempfield	Opportunity	Medium		WA	X					X	X				2	13	76	
C	30	Restoration	Mennonite Home	Sporadic streambank erosion, lack of forest buffer, lack of in-stream cover, stormwater basin water quality BMP retrofits	Swarr Run	East Hempfield	Opportunity	Medium		WA	X					X	X				2	13	73	
C	31	Restoration	MGA Acquisition LP Property	Sporadic Streambank erosion, lack of forest buffer, lack of in-stream habitat, littering	Swarr Run	East Hempfield	Opportunity	Medium		WA	X					X	X				2	13	77	
C	32	Restoration	A Herr Park	Stream buffer	Swarr Run	East Hempfield	Implemented			SR	X		X			X	X							
C	33	Stormwater	A Herr Park	Proposed SW BMPs at Township building	Swarr Run	East Hempfield	Planned		Green masterplan and cost benefit analysis complete (SR)	SR	X	X	X		X	X	X		X		5	9	96	
	27	Restoration	Getz Property	Sporadic Streambank erosion	Swarr Run	East Hempfield	Opportunity	Medium		WA											0		31	
C	34	Restoration	A Herr Park	Wetland creation and meadow plantings along Swarr Run	Swarr Run	East Hempfield	Planned		Green masterplan and cost benefit analysis complete (SR)	SR	X	X	X		X	X	X		X	X	5	9	95	

BMP Prioritization

Focus Area	Project /Map #	BMP Category	Name	Description/Issues	Watershed	Township	Status *	Priority (WA 2003 Report)	Notes	Source **	Within UA	Concept Plan	Wellhead Protection	Severe Erosion	Willing landowner	Potential Delisting	303d List	Priority Stream Reach (2003)	Visibility/ Education	Additional Important Criteria	Sum of "X" in Columns Q - X	Scoring of Project Functions	Overall Project Ranking	Focus Area Ranking	
O	35	Restoration	Fieldcrest Associates	3.2 acre buffer of trees and shrubs planted in October 2014	West Branch	Manor	Implemented	High	Implemented by LCP	WA	X					X	X	X							
O	36	Restoration	Shearer Farm now Odonaghue	Streambank erosion, lack of forest buffer	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	68	
O	37	Agriculture	Hershey Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	55	
O	38	Agriculture	Charles Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	56	
O	39	Agriculture	Sensenig Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	57	
O	40	Agriculture	Rohrer Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	58	
O	41	Agriculture	Charles Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	59	
O	42	Agriculture	Harnish Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	60	
O	43	Agriculture	Rohrer Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	61	
O	44	Restoration	Chanastocka Nature Sanctuary	Lack of forest buffer, lack of in-stream habitat, localized sedimentation problem due to dam at the George B Mann farm, remove dam	West Branch	Manor	Implemented	Medium	GG Ap 2003	WA						X	X	X							
O	45	Agriculture	Headwaters UNT	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	62	
O	46	Agriculture	Krieder Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	63	
O	47	Agriculture	Funk Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA						X	X	X				3	13	64	
O	48	Agriculture	Rohrer Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	Medium		WA						X	X	X				3	13	65	
O	49	Restoration	Bender Mill Rd	Severe streambank erosion, lack of buffer	West Branch	Manor	Opportunity	High		WA	X			X		X		X				3	13	66	
O	50	Agriculture	Barley Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High		WA	X					X						1	13	84	
O	51	Agriculture	Witmer Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, cattle have free access to the stream	West Branch	Manor	Opportunity	High	a lot of dams in this area; potential for FPR	WA						X						1	20	11	
O	52	Agriculture	Frey Farm	streambank erosion, lack of forest buffer, sedimentation from cropland	West Branch	Manor	Opportunity	High	a lot of dams in this area; potential for FPR	WA						X						1	20	12	
O	53	Agriculture	Letort Farm	Agricultural related impacts	West Branch	Manor	Opportunity	Medium	a lot of dams in this area; potential for FPR	WA						X						1	20	13	
O	54	Agriculture	Walmer Farm	Agricultural related impacts	West Branch	Manor	Opportunity	Medium	a lot of dams in this area; potential for FPR	WA						X						1	20	14	
O	55	Agriculture	Breslin Farm	Agricultural related impacts	West Branch	Manor	Opportunity	Medium	a lot of dams in this area; potential for FPR	WA						X						1	20	15	
O	56	Agriculture	Hunt Farm	Agricultural related impacts	West Branch	Manor	Opportunity	Medium	a lot of dams in this area; potential for FPR	WA						X						1	20	16	
G	57	Agriculture	Nolt Farm	Streambank erosion, lack of buffer, sedimentation from cropland, stream has been channelized	Main Stem	Penn	Opportunity	High		WA	X					X	X					2	16	20	
G	58	Agriculture	Kreider Farm	Streambank erosion, lack of buffer, sedimentation from cropland, stream has been channelized	Main Stem	Penn	Opportunity	High		WA	X	X			X	X	X		X			4	16	18	
G	59	Agriculture	Nolt Farm	Streambank erosion, lack of buffer, sedimentation from cropland, stream has been channelized	Main Stem	Penn	Opportunity	High		WA	X					X	X					2	16	21	
G	60	Restoration	Oakwood Properties	Lack of forested buffer	Main Stem	Penn	Opportunity	Medium		WA	X					X	X					2	16	22	
G	61	Agriculture	Scott Farm	Streambank erosion, lack of forest buffer, free cattle access to stream	Main Stem	Penn	Opportunity	High		WA	X					X	X					2	16	23	
G	62	Agriculture	Lyons Farm	Streambank erosion, lack of forest buffer, free cattle access to stream	Main Stem	East Hempfield	Opportunity	High		WA	X					X	X					2	16	24	
	63	Stormwater	McMinns and Binkley and Ober Quarry	McMinns parking lot and staging area yielding contaminants to quarry discharge, high rates of runoff from McMinns parking lot, no SW	Main Stem	East Hempfield	Opportunity	Medium		WA	X						X					1	8	114	
	64	Agriculture	Ober Farm	Streambank erosion, lack of forest buffer, free cattle access to stream	Main Stem	East Hempfield	Opportunity	High		WA	X						X	X				2	13	80	
A	65	Agriculture	Rod and Gun Club	Rod and gun club bought farm and are interested in implementing stream restoration on the property	Main Stem	East Hempfield	Opportunity	High		WA	X			X		X	X					3	14	30	
	66	Restoration	Wetherburn	Following pasture, sporadic streambank erosion, possibility to improve forest buffer and in-stream habitat	Main Stem	Manheim	Implemented	Medium	Buffer planted in conjunction with #73	WA							X	X							
	67	Restoration	Rohrer Farm	Following pasture, sporadic streambank erosion, possibility to improve forest buffer and in-stream habitat	Main Stem	Manheim/ East	Opportunity	Medium		WA							X					1	13	85	
	68	Stormwater	Rohrer's Quarry	Currently in midst of upgrading sediment basin which should greatly improve pumping influence to Bachman Run - Depending on storm events and groundwater levels, the quarry pumps large quantities of water from the quarry pit into the stream thus dramatically controlling flow volumes within the upper reaches of Bachman Run - sometimes the stream has water in it and sometimes it doesn't during the summer months	Bachman Run	Penn/ Warwick	Implemented	High		WA															
Ja	69	Agriculture	King Farm	Streambank erosion, littering, introduction of manure due to poor barnyard management, lack of forest buffer, free cattle access to stream, sinkholes in substrate of stream	Bachman Run	Warwick	Opportunity	High	If just a buffer, no permit required		X					X	X	X		X		3	13	47	

BMP Prioritization

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Ja	70	Agriculture	Buckwalter Farm	Streambank erosion, sedimentation from cropland, sinkholes in stream substrate	Bachman Run	Manheim	Opportunity	High	If just a buffer, no permit required		X					X	X	X		X	3	13	48	
Jb	71	Stormwater	SW Retrofits	Water quality stormwater retrofits within the following residential developments: Milton Estates, Wetherburn North, Flyway Business Park, Buckfield, Mill Pond, Stonehenge, Kingspointe	Bachman Run	Manheim	Opportunity	High	Green masterplan/ cost benefit analysis complete for basin retrofits, according to MT basin retrofit could be an issue with homeowners (SSS)	WA; SSS	X	X	X			X	X	X			4	8	102	
Ja	72	Agriculture	Buckwater Farm	Implement buffer in conjunction with project numbers 148 and 134 to provide a continuous stretch of buffer at the headwaters of Bachman Run. Issues identified on property include streambank erosion, lack of forest buffer, free cattle access to stream	Bachman Run	Warwick/ Maheim	Opportunity	High	If just a buffer, no permit required	WA	X					X	X	X		X	3	13	49	
Jb	73	Restoration	Wetherburn Stabilization/ Buffer Planting	Streambank erosion, lack of forest buffer, lawn clippings dumped into stream, floodway encroachments	Bachman Run	Manheim	Implemented	Medium	Buffer implemented in conjunction with #66	WA	X							X						
I	75	Restoration	PPL Dam Removal	Implemented: Dam removal, fish habitat and buffer	Main Stem	Manheim	Implemented	High		WA	X					X	X							
I	76	Stormwater	Stormwater retrofits	retrofit stormwater quality BMPs	Main Stem	Manheim	Opportunity	Medium		WA	X					X	X				2	8	106	
	77	Restoration	Flory Mill	Lack of forest buffer and in-stream cover	Main Stem	Manheim/ Hemfield	Opportunity	Medium		WA	X						X				1	13	86	
B	78	Restoration	Lapp Nursery	Streambank erosion, sedimentaiton from nursery and greenhouse operation, lack of forest buffer	UNT	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	39	
B	79	Agriculture	Rohrer Farm	Streambank erosion, sedimentation from cropland	UNT	East Hempfield	Opportunity	Medium		WA	X					X	X	X			3	13	40	
B	80	Agriculture	Charles Farm	Streambank erosion, lack of forest buffer, free cattle access to stream	UNT	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	41	
B	81	Agriculture	Kreider Farm	Streambank erosion, lack of forest buffer, sedimentation from cropland, processing of corn product waste generating a liquid waste that is routinely irrigated on cropland where it evidently washes into stream via storm events - BOD problems suspected, - a yeasty fermenting smell is very discernable in the substrate sediments ate Route 283 - Need to involve PADEP	UNT	East Hempfield	Opportunity	High		WA	X					X	X	X			3	13	42	
B	82	Agriculture	Kolb Farm	Buffer planted	UNT	East Hempfield	Implemented			WA	X					X	X				2			
H	83	Restoration/ Stormwater	Granite Run	Lack of forest buffer, potential stormwater water quality retrofits, potential floodplain restoration site; Horst brothers have shown interest in doing something; trail is being developed through this area	UNT	Manheim Township	Opportunity	High	Green Masterplan/Cost Benefit Analysis for floodplain restoration and buffer scenarios (SSS)	WA; SSS	X	X			X	X	X		X		4	21	4	
D	84	Stormwater	Park City SW Retrofits	Thermal pollution, stormwater management and water quality retrofits; City representative said they are looking into sending some of the SW to a created wetland at Long's Park and then feeding the pond with it	Main Stem	Lancaster City	Opportunity	High	Green Masterplan/Cost Benefit Analysis (SSS)	WA; SSS	X						X		X	1	16	27		
D	85	Restoration	Mennonite Home	Potential FPR, Severe streambank erosion, lack of forest buffer, very poor in-stream habitat/cover, potential opportunity for Park City	Main Stem	Manheim	Opportunity	High	Potential to address Park City Stormwater; Green Masterplan/Cost Benefit Analysis for floodplain restoration (SSS)	WA;SSS	X	X		X			X	X	X	X	4	21	3	
D	86	Restoration	Ashley Property	Severe streambank erosion, lack of forest buffer, lack of instream cover	Main Stem	East Hempfield	Opportunity	High		WA	X			X				X		X	2	20	8	
D	87	Restoration	Longs Park	water quality issues with pond and waterfowl, nutrient loading; City representative mentioned treating Park City stormwater in a created wetland at longs park and then sending water to pond	Main Stem	Lancaster City	Opportunity	Medium		WA	X				X				X	X	2	9	99	
F	88	Restoration	The Crossings (Deisley Family Partnership)	Sporadic Streambank Erosion, various locations where forest buffer could be improved, instream cover/habitat especially for smallmouth bass could be greatly improved	Main Stem	Manheim/ Hemfield	Opportunity	Medium		WA	X						X				1	13	81	
F	89	Restoration	LCSWMA	Potential floodplain restoratiion site; Sporadic Streambank Erosion, various locations where forest buffer could be improved, instream cover/habitat especially for smallmouth bass could be greatly improved	Main Stem	East Hempfield	Opportunity	Medium		WA	X						X				1	13	82	
F	90	Restoration	F&M	Sporadic Streambank Erosion, various locations where forest buffer could be improved, instream cover/habitat especially for smallmouth bass could be greatly improved	Main Stem	Manheim	Opportunity	Medium		WA	X						X		X		2	14	33	
F	91	Restoration	Windsor Court	Streambank erosion, lack of forest buffer, very poor instream habitat	Main Stem	East Hempfield	Opportunity	High		WA	X						X				1	13	83	
L	92	Stormwater	Barrcrest	Retrofit stormwater quality BMPs	Main Stem	East Hempfield	Opportunity	High		WA	X						X		X		2	8	107	
L	93	Stormwater	School Lane Hills	Retrofit stormwater quality BMPs	Main Stem	Lancaster Township	Opportunity	High		WA	X						X		X		2	8	108	
L	94	Stormwater	Woodlawn	Retrofit stormwater quality BMPs	Main Stem	East Hempfield	Opportunity	High		WA	X						X		X		2	8	109	
L	95	Stormwater	Glenbrook	Retrofit stormwater quality BMPs	Main Stem	East Hempfield	Opportunity	High		WA	X						X				1	8	111	
F	96	Restoration	Maple Grove	FPR opportunity; some in-stream structures and buffer implemented which could be maintained but there is opportunity to do more	Main Stem	Manor/ Lancaster Twp	Opportunity			WA	X						X				1	21	6	

BMP Prioritization

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L	97	Stormwater	Stormwater retrofits	Retrofit stormwater quality BMPS within the following residential developments: Stone Mill Manor Mobile Home Park, Pheasant Ridge, Canterbury Place, West Ridge	Main Stem	Manor/Lancaster Twp	Opportunity	Medium		WA	X						X				1	8	112		
M	98	Restoration	Conestoga CC	LASA Streambank stability and instream habitat project; cross vanes implemented	Main Stem	Manor/Lancaster Twp	Implemented	High		WA	X														
	99	Restoration	Manor Twp Park	Stream restoration implemented to address erosion/stability/ poor habitat	Main Stem	Manor	Implemented	Medium		WA	X														
	100	Restoration	LASA	Completed stabilization and fish habitat and buffer planting	Main Stem	Manor	Implemented		LASA Pump Station	WA	X														
	101	Restoration	Frantz Mill Dam	Remove Frantz Mill Dam	Main Stem	Manor	Opportunity	High		WA	X										0	20	17		
	102	Restoration	Shertzer Farm	Remove Log Jam	Main Stem	Manor	Implemented	High		WA											0	7	119		
	103	Restoration	Lancaster General Hospital	Buffer	UNT	East Hempfield	Implemented																		
L	104	Restoration/Stormwater	Ware Property	Floodplain restoration and rain gardens for stormwater management	UNT	Lancaster Twp	Implemented										X		X						
	105	Stormwater	Wheatland Middle School	Raingarden		Lancaster Twp	Implemented				X														
O	106	Restoration	Russ Guthrie	Stream project	West Branch	Manor	Implemented				X					X									
	107	Restoration	Bachman Run	Bachman Run Stream and Buffer project	Bachman Run	Manheim	Implemented											X							
	108	Restoration	Jacob's Creek	Buffer project	Unknown	Unknown	Implemented																		
O	109	Restoration	W. Branch	Stream and buffer project	West Branch	Unknown	Implemented									X									
	110	Restoration	Manor Twp Project	Buffer project	Unknown	Unknown	Implemented																		
	111	Agriculture	Neuenschwander Farm	Preserved farm; landowners are good to work with, could be opportunity for buffer and fencing, not much of a stream	Main Stem	Penn	Opportunity				X						X				1	13	87		
Jb	112	Restoration	East Pete Parcel	East Pete Spring erosion issues	Bachman Run	Manheim	Opportunity		parcel owned by East Pete Borough		X		X	X	X	X	X	X			6	11	92		
C	113	Stormwater	Nissley Rd. Regional SWM	Bioretention basin could be implemented in conjunction with potential land development activity	Swarr Run	East Hempfield	Planned		Green masterplan and cost benefit analysis complete (SR)	SR	X	X			X	X		X			3	15	28		
Jb	114	Restoration	FPR	Floodplain Restoration of stream channel between detention basins	Bachman Run	Manheim	Opportunity		suggested by Manheim Twp. At Oct. 16 meeting		X					X	X	X			3	16	19		
Jb	115	Restoration	Flyway	Stream restoration and pond improvements	Bachman Run	Manheim	Opportunity		suggested by Manheim Twp. At Oct. 16 meeting		X					X	X	X			3	13	50		
	116	Stormwater	Sweetbriar Park	developer did not implement stormwater retrofit, HOA may be interested in improvements, consider healthy watershed cost share?	Main Stem	Penn	Opportunity		Penn Twp suggested at Oct. 16 meeting		X						X				1	8	115		
A	117	Stormwater	East Pete Fitness Park	Currently renovating park, includes SW basin; Consider healthy watershed cost share for planting related improvements	Main Stem	East Petersburg	Opportunity				X		X		X		X		X		4	9	97		
	118	Stormwater	Weaver Rd Park	Basin Retrofits	UNT	Manheim	Opportunity				X						X				1	8	116		
H	119	Restoration	Overlook Park	Stream restoration	UNT	Manheim	Opportunity				X			X	X	X	X		X		4	13	36		
H	120	Stormwater	Overlook Park	Basin retrofits	UNT	Manheim	Opportunity				X			X	X	X	X		X		4	9	98		
F	121	Restoration	School Lane Hills	Buffer - LCWA has been having conversations with landowners on River and Oakwood to implement a buffer	Main Stem	Lancaster Twp./ East Hempfield	Opportunity		Already have established contact with landowners		X						X		X	X	2	13	79		
M	122	Stormwater	Conestoga CC	Raingarden and native meadow (native meadow not yet implemented)	Main Stem	Manor	Implemented		Implemented by LCP		X														
M	123	Restoration	Conestoga CC	Cross vanes	Main Stem	Manor	Implemented		Implemented through Growing Greener Grant		X														
E	124	Restoration	School Lane Estates	Stream stabilization (Phase III) implemented	Millers Run	East Hempfield	Implemented	High		WA	X														
E	125	Restoration	School Lane Estates	Additional work could be implemented throughout this reach to address streambank erosion forested buffer, floodway encroachments by landowners, stream channel disconnected from floodplain; interested landowner had stream frontage for 600' upstream of sylvan rd.	Millers Run	East Hempfield	Opportunity	High	There is a lot of momentum already established in this watershed	WA	X			X	X	X	X	X		X		6	13	34	
	126	Restoration	Manor Twp Park	Reach would benefit from riparian buffer, streambank stabilization and habitat enhancement	Main Stem	Manor	Opportunity			LCCD	X										0	13	90		
	127	Stormwater	Gretchen Thomas Property	Porous paving and raingarden implementation	Main Stem	Lancaster Twp	Implemented		Implemented by LCP		X														
	128	Stormwater	Morgan Elmore Property	Implemented three 300 gal. rain barrels, permeable walk, raingarden	Main Stem	Lancaster Twp	Implemented		Implemented by LCP		X														
L	129	Stormwater	Private residence	Converted driveway to permeable paving	Main Stem	Lancaster Twp	Implemented		Implemented by LCP		X						X		X						
B	130	Restoration	Larry Lamberth property	Implemented a wet meadow	UNT	East Hempfield	Implemented		Implemented by LCP		X														
E	131	Stormwater	Village Grande	green infrastructure proposed such as raingarden, porous paving, and planting	Millers Run	East Hempfield	Planned		There is a lot of momentum already established in this watershed	LCP	X	X			X	X	X	X	X	X	5	11	93		
E	132	Stormwater	Village Grande	buffer implemented and monitored	Millers Run	East Hempfield	Implemented			LCP	X														
E	133	Stormwater	Centerville Middle School	proposed basin retrofits with environmental education component	Millers Run	East Hempfield	Opportunity		There is a lot of momentum already established in this watershed	LCCD	X				X	X	X	X	X	X	6	6	120		
Ja	134	Restoration	Traditions Development	Planned restoration and riparian buffer	Bachman Run	Warwick	Planned			Warwick Twp	X				X	X	X			X	4	13	37		
	135	Stormwater	Highlands Extension	Potential for basin retrofits	Bachman Run	Warwick	Opportunity		Warwick Twp	Warwick Twp	X							X			1	8	117		

BMP Prioritization

Focus Area	Project /Map #	BMP Category	Name	Description/Issues	Watershed	Township	Status *	Priority (WA 2003 Report)	Notes	Source **	Within UA	Concept Plan	Wellhead Protection	Severe Erosion	Willing landowner	Potential Delisting	303d List	Priority Stream Reach (2003)	Visibility/Education	Additional Important Criteria	Sum of "X" in Columns Q - X	Scoring of Project Functions	Overall Project Ranking	Focus Area Ranking
O	136	Stormwater	Central Manor Elementary	Potential for basin retrofits	West Branch	Manor	Opportunity			LCCD						X		X			2	8	110	
Jb	137	Restoration	Reidenbaugh Elementary	Meadow/Reforestation for environmental education	Bachman Run	Manheim	Opportunity			LCCD								X			1	9	100	
I	138	Restoration	PPL and adjacent landowners	Potential stream and floodplain restoration	Main Stem	Manheim	Opportunity		PPL ROW through this area	LCCD	X					X	X		X		3	21	5	
I	139	Restoration	Private landowners	Potential floodplain restoration upstream of Buch Rd on small unnamed tributary	UNT	Manheim	Opportunity				X					X	X				2	20	10	
A	140	Stormwater	East Pete Park Network	Potential for stormwater improvements, raingardens, demonstration area in the network of parks within East Petersburg Borough	Main Stem	East Petersburg	Opportunity				X		X		X		X		X		4	12	90	
	141	Stormwater	May Property	Rain garden and meadow implementation	Main Stem	Manor	Implemented		Implemented by landowner															
O	142	Restoration	Clipper Magazine	Excessive streambank erosion and siltation through reach	West Branch	East Hempfield	Opportunity		Interested landowner	LSI	X		X	X		X					3	13	67	
	143	Stormwater	Freedom Memorial Park	Masterplan complete including raingardens, swale planting; this is a headwaters area	Main Stem	Millersville Borough	Planned		Masterplan Complete		X	X	X								1	8	113	
	144	Stormwater	Gateway Project	Old Railroad yard is being developed by F&M and Lancaster General. Potential to implement BMPs in conjunction with development	Main Stem	Lancaster City	Opportunity				X				0						3	11	94	
	145	Stormwater	F&M College	F&M has implemented numerous GI projects since 2011 including 13,295 sf of green roof, rain gardens, porous pavement	Main Stem	Lancaster City	Implemented				X													
	146	Stormwater	Red Rose Transit	1350 foot green roof implemented	Main Stem	Lancaster City	Implemented				X													
	147	Restoration	Bucher Elementary	Opportunity to alleviate issues with springs on school property, potentially create wetlands	UNT	Manheim	Opportunity				X						X				1	13	88	
Ja	148	Restoration	Future Development	Stream will be buffered as part of planned development	Bachman Run	Warwick	Planned		Buffer will also be implemented upstream at Traditions development (# 134) and potential to implement downstream at #72		X				X	X	X		X		4	13	38	
	149	Agriculture	Airport Property	Airport owns cropland with swales through it. Opportunity for to implement agricultural BMPs	Bachman Run	Manheim	Opportunity				X							X			1	13	89	
I	150	Agriculture	Guengerich Farm	Potential for streambank stabilization and buffer or full floodplain restoration	UNT	Manheim	Opportunity				X					X	X				2	20	9	
Jb	151	Restoration	Stonehenge Linear Park	Potential stream restoration opportunities	Bachman Run	Manheim	Opportunity				X					X	X	X			3	14	32	
B	152	Restoration	UNT Upstream of Stevens Rd	Evaluate stream condition and BMP opportunities upstream of Stevens road through the development and into the agricultural area	UNT	East Hempfield	Opportunity		This small tributary could be a focus area (projects #78-81)		X					X	X	X			3	13	43	
C	153	Stormwater	Kayo Rd Basin	Applied for grant money to improve basin, swale already done	Swarr Run	West Hempfield	Planned		Quick implementation potential		X		X		X				X		2	8	104	
M	154		Conestoga CC	Additional opportunity to implement raingardens, native meadows and stream stabilization	Main Stem	Manor	Opportunity				X				X		X				2	16	25	
F	155		Spalding Conservancy	Recently created wetlands and trails at Spalding Conservancy - owned by F&M	Main Stem	Manheim Township	Implemented																	
	156		Woods Edge	Created wetlands - nutrients and invasive species problem	West Branch	Manor	Opportunity				X										0	8	118	
N	157		Armstrong	Headwaters restoration and fishery improvement	UNT	Manor	Opportunity		1 large contiguous land owner		X					X	X				2	16	26	
C	158		UNT - Private Landowner	Restoration upstream of Harrisburg Pike (bank grading and stabilization) - potential for multi-landowner project	Swarr Run	East Hempfield	Opportunity				X				X	X	X				3	13	72	

Appendix B
Lancaster Farmland Trust Strategies for Agricultural Areas
and
Alternative Road Salt Management Practices



**LFT Phase II Strategy
Little Conestoga Action Plan**

**Focus Area: East Hempfield UNT Watershed; West Branch and Indian Run Watershed,
Manor Township**

- 1) Identify priority parcels for BMP implementation and restoration (completed in Phase I)
- 2) Host public outreach meeting to introduce concept of action plan to agricultural property owners in Manor Township.
 - a. Develop mailing to all agricultural properties in West Branch and Indian Run subwatersheds
 - b. Host meeting at township building or community-wide space (fire hall, community hall, church)
 - c. Garner support and trust of community through discussion and questions regarding the project
- 3) Follow up with specific landowners who have been identified as “high priority” through mail, phone, site visits
 - a. Depending on relationship, may want to include township staff on visits
 - b. Discuss with landowners current compliance status (conservation plan and/or Ag E&S plan and nutrient/manure management plan)
 - c. Conduct site visit on property
 - d. Identify and discuss barriers/challenges to partnering
 - e. Identify funding sources for BMP implementation
 - i. Township dollars
 - ii. NRCS (National Resource Conservation Service)
 - iii. NFWF (National Fish and Wildlife Foundation)
 - iv. CFA (Commonwealth Financing Authority)
 - v. Growing Greener (DEP)
 - f. Discuss funding sources with landowner to determine comfort level (private vs. public funding)
- 4) Once partner landowners are identified and committed, develop grant applications for BMP implementation work. Scope of work may include:
 - a. Commitment letters/contracts from landowners
 - b. Conservation/manure management plan writing
 - c. Identification of BMP practices to be implemented over the entire watershed
 - d. Estimates on reduction targets in nitrogen, phosphorus, and sediment
 - e. Timelines for completion
- 5) BMP Implementation
 - a. Contract out with consultants (Team Ag, LandStudies) to develop plans for property
 - b. Lancaster Farmland Trust serves as project manager, and possibly, grant administrator, to ensure all work is developed and implemented on schedule

6) Long term BMP Maintenance and Monitoring

- a. In conjunction with township, discuss regulatory requirements for long term maintenance and monitoring of sites
- b. Develop contracts with municipalities or watershed association for long term monitoring of BMPs to ensure its long-term functionality for DEP reporting purposes

Little Conestoga Watershed Action Plan

Alternative Salt Management Practices

Summary:

Road salt application harms the environment when it comes into contact with soil and water sources. In shallow soils along roadways, salt will continuously collect and build until a salt bank is formed. It remains in the soils through rain and snow events entering streams and waterways as a direct result of melting and run-off. Salt that enters water sources can change the chemical composition and water quality, harming the aquatic organisms that live within the stream. Streams can eventually return to their original state if they have a high turnover rate that allows the toxins to be flushed out of the system. Streams and lakes that have a low velocity and little mixing elements could potentially remain contaminated, permanently altering the aquatic habitat. States and municipalities are looking for alternatives to salt and/or reducing the amount of salt used through application techniques. PennDOT currently uses NaCl brines as pre-treatment and de-icing and rock salt mixed with anti-skid (crushed limestone) as deicer on highways and other main roadways. Ground-speed activated spreaders along with infrared temperature sensors allow trucks to appropriately apply amounts of salt and salt-brine. (Schoch 2014).

Salt Application Alternatives:

Beet Heet - Many states are starting to use “Beet Heet”, which is a mixture of sugar beet juice and molasses. Beet Heet is 78% less corrosive than 23.3% NaCl brine and it uses sugar beet by-product without adding phosphates or acid inhibitors (Rhodan, Maya). This mixture allows salt to stick to the roads and increases salts ability to melt ice at extreme temperatures (below 15 degrees). A south-central Ohio county replaced NaCl brine with Beat Heet and found that it was not only more effective on the roads it was also cost effective if they self-blended the brine. Salt applications decreased by 33% and the roadways displayed a similar result as when larger applications of NaCl brine were used (Preston, Denver). Originally it was only sold through contracts with municipalities but now it can be purchased by home owners.

Eco-Traction - Another possibility is a product called Eco-Traction. It is made from hydrothermal volcanic material, and while it is mainly sold to individuals, the company is beginning to make contracts with municipalities. Eco-traction has a dark color and melts ice and snow through thermal concentration. It has been proven to be effective in -50° C. This same thermal effect also helps provide traction on ice. Eco-Traction does not cause any negative environmental impacts and can even improve the condition of the environment directly adjacent to the road. Claimed benefits include: releasing of nutrients and minerals slowly, absorbs and removes heavy metals, absorbs residual white sodium staining caused by salt. Eco-traction is more efficient than salt therefore saving the amount of material deposited on the roadways (example: a cup of EcoTraction will safely cover a parking space); however the cost is almost double when compared to salt (EcoTraction 2014).

Pre-Treatment - Other areas are using management practices such as pre-treatment of roads that prevent ice from binding to the roads instead of applying salt after ice has already

occurred. This allows less salt to be used. Salt brines are commonly used as a pre-treatment. It has proven to decrease the amount of road salt used after precipitation has formed on the roads and it prevents an ice layer from forming on the roads. This is beneficial because snow plows are often unable to break the ice from the roadway (AccuWeather 2014).

“Green snow fences” - These fences are being used on the sides of roads to prevent drift, therefore limiting the amount of salt used to keep the roads clear. It is important to consider the salt-tolerance level of the plants used. Salt levels in soils are highest directly next to the roadway, but elevated levels can be found as far as 50-100 feet from the roadway depending on the speed of the traffic (CSN).

Cheese Brine Additive - Wisconsin has found that mixing salt with cheese brine is effective at reducing the amount of salt that bounces off the road when applied, allowing less to be used. Areas in Wisconsin have an abundance of dairy farms that allow this process to take place. Farmers can turn their byproduct into a beneficial income instead of disposing the waste (Copeland, Larry). The application of a cheese brine has allowed 30-40% less salt to be used over the winters and has also proved useful at melting ice and snow in extreme temperatures. The brine only smells when being applied, otherwise residual effects have not been noticed (Chappell 2014).

Stockpiling Treated Snow:

Heavy accumulations of snow may require removal of the snow to stock pile locations. In these cases it is always recommended that snow is stockpiled in pre-designated locations where heavy metals, salt, sand and cinders can be contained and removed after the snow has melted. The dumping site should be in an upland location away from areas sensitive to this type of run-off such as stream corridors, wellhead protection areas and wetlands. The designated stock pile areas should be lined with a silt sock (or equivalent filter), followed by a minimum buffer of 50 ft. between the stock pile area and sensitive areas. Ideally the locations should be paved or have a non-porous surface so remaining debris can be removed and disposed of safely. Removal of the remaining salt and sand after the winter season should occur no later than early May. In emergency situations, where the original approved dumping areas are completely full, it is recommended that flat open-field sites are used to reduce run-off. Disposal should never occur in wetlands, vegetated shallows, vernal pools, public water supply reservoirs and their tributaries, stormwater facilities, areas where BMPs are in place, or other environmentally sensitive areas.

Salt Storage:

Storage of salt must be on an impermeable pad to prevent salt from leaching into the soil and contacting groundwater supplies. It is also important to provide cover (permanent or temporary) to avoid contact with precipitation. Storage sites should allow for drainage that will take precipitation away from the salt pile and precautions must be made to prevent runoff from connecting with any type of water source. Ideally all storm water would be uncontaminated by salt and therefore collection and disposal would not be necessary (Salt 2013). If stormwater is contaminated, brine can be collected and disposed of properly if a

curb is used for capture. Some municipalities in Michigan are exploring options for re-using the brine to control road dust or for pre-treatment to control ice (Granholm 2007).

Key Elements:

- Salt Application Alternatives
- Stockpiling Treated Snow
- Storage of salt

Recommendations

Municipalities should consider the following snow removal and salt alternative strategy to protect local waterways and water quality:

Alternatives Assessment - Assessing alternatives to current snow removal/disposal practices

- Assessing alternatives to current salt applications
- Processes to keep salt on, and snow off of roadways

Stockpile and Storage Plan

- Determine capability of current dumping sites to hold salt and other chemicals when snow melts
- Identify streams and waterways that are the most effected by salt run-off
- NaCl levels in wells and streams should be assessed to determine where BMPs will be applied
- Identify safe storage facilities, locations and their management techniques
- Precipitation management
- Storage system location

Stockpile Site Protection Plan

- Develop a site plan for selected stockpile sites to treat and manage contaminated snow to be stored
- Considerations:
 - Removal of salt, sand, cinder, etc. residue from pad area after snow melt
 - Provide salt tolerant planting to help filter run-off in area surrounding the stockpile area.

Benefits:

- Provides improved salt management
- Reduces maintenance
- Improves water quality
- Reduces amount of salt needed to remove ice
- Provides economic and regulatory benefits for the municipality

Southeastern Pennsylvania Salt Tolerant Plants

The following are recommended salt *tolerant* plants; however excessive amounts of salt will eventually kill the plants due to their inability to uptake water. Care should be taken to keep from pushing snow and stock-piling in areas planted where diversity is important. Examples are bio-retention areas, rain gardens, etc. This list is for reference only. Consult with a horticulturalist or landscape professional on species best suited for the proposed use.

Salt Tolerant Plants (trees/shrub)

- Arctostaphylos uva-ursi
- Baccharis halimifolia
- Calamagrostis 'Karl Foerster'
- Celtis occidentalis
- Cephalanthus occidentalis
- Chasmanthium latifolium
- Clethra alnifolia
- Festuca 'Elijah Blue'
- Heuchera micrantha
- Ilex glabra
- Ilex opaca
- Iva frutescens
- Juniperus virginiana
- Linderia benzoin
- Liriope spicata
- Liriope muscari
- Magnolia virginiana
- Morella cerifera
- Morella pensylvanica
- Nyssa sylvatica
- Parthenocissus quinquefolia
- Pennisetum alopec
- Photinia melanocarpa
- Photinia pyrifolia
- Pinus rigida
- Prunus maritima
- Rhus copallinum
- Rhus typhina
- Sambucus Canadensis
- Schizachyrium scoparium
- Sedum 'Autumn Joy'
- Viburnum dentatum

Salt Tolerant Wetland Plants (herbaceous)

- Acorus americanus
- Distichlis spicata
- Hibiscus moscheutos
- Juncus gerardii
- Juncus roemerianus
- Panicum amarum
- Panicum virgatum
- Schoenoplectus robustus
- Schoenoplectus tabernaemontanii
- Solidago sempervirens
- Spartina patens
- Spartina pectinata
- Typha angustifolia
- Schoenoplectus pungens
- Peltandra virginica
- Pontederia cordata
- Spartina alterniflora
- Spartina cynosuroides

References

- Preston, Denver. Introducing Beet Heet. PlowSite.com. 01 Nov. 2011. Web. 09 March 2015. <<http://www.plowsite.com/showthread.php?t=127445>>
- AccuWeather. Rock Salt Versus Salt Brines: What's Best for Road Safety? AccuWeather.com. 20 Nov. 2014. Web. 09 March 2015. <<http://www.accuweather.com/en/weather-news/rock-salt-vs-salt-brines-whats/22352942>>
- CSN. Winter, Road Salt and the Chesapeake Bay. Chesapeake Stormwater Network. 2014. Web. 09 March 2015. <<http://chesapeakestormwater.net/2009/01/winter-road-salt-and-the-chesapeake-bay/>>
- Stroud. Fresh Water Sources Less "Fresh" from Greater Salt Use, Scientist Say. Stroud Water Research Center. April 2014. Web 09 March 2015. <<http://www.stroudcenter.org/newsletters/2014/issue2/road-salt-in-streams.shtm>>
- Schoch, Barry. 2014-2015 PennDOT Winter Services Guide. Web. 09 March 2015. <<http://www.dot.state.pa.us/PAWinter/PUB628Flip/index.html>>
- EcoTraction. Product Info. Web. 09 March 2015. <<http://www.ecotraction.com/productinfo.html>>
- Copeland, Larry. Communities seek a substitute for road salt. USA Today. 23 Feb. 2013. Web. 09 March 2015. <<http://www.usatoday.com/story/news/nation/2013/02/23/road-salt-substitute/1939793/>>
- Rhodan, Maya. Sanburn, Josh. How Beet Juice is Helping Keep Roads Safe this Winter. Time. 10 Feb. 2014. Web. 09 March 2015. <<http://time.com/5761/salt-shortage-triggers-beet-juice-cheese-brine-alternatives/>>
- Chappell, Bill. Cheese to the Rescue: Surprising Spray Melts Road Ice. NPR. 21 Jan. 2014. Web. 10 March 2015. <<http://www.npr.org/blogs/thetwo-way/2014/01/21/264562529/cheese-to-the-rescue-surprising-spray-melts-road-ice>>
- Post, Rachael. The alternatives to salt for battling ice: cheese, beets and ash. The Guardian. 03 March 2014. Web. 09 March 2015. <<http://www.theguardian.com/sustainable-business/alternatives-salt-battling-ice-cheese-beets-ash>>
- Salt Institute. Salt Storage Handbook Practical Recommendations for Storing and Handling Deicing Salt. Salt Storage Handbook. 2013. Web. 10 March 2015. <<http://www.saltinstitute.org/wp-content/uploads/2013/08/Salt-Storage-Handbook-2013.pdf>>
- Granholm, Jennifer. Chester, Steven. Salt and Brine Storage Guidance. Michigan Department of Environmental Quality. August 2007. Web. 10 March 2015. <http://www.michigan.gov/documents/deq/deq-ess-p2tas-bulksaltbrineguidance_267024_7.pdf>

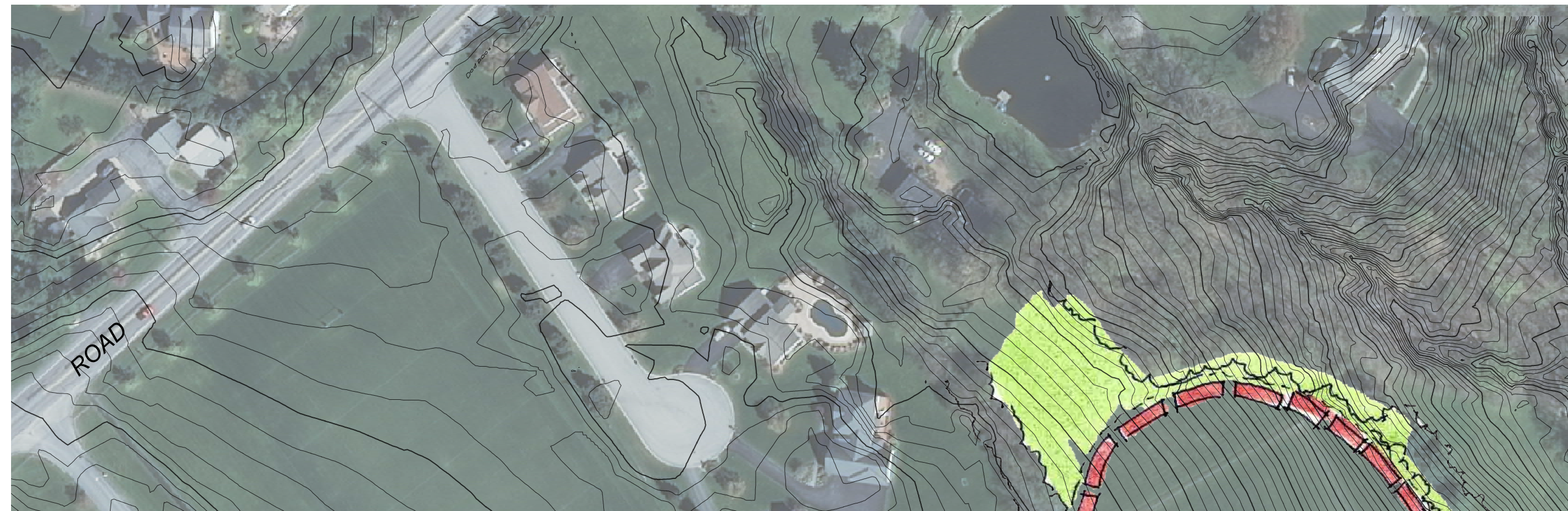
Appendix C
Restoration Masterplans



Existing basin at Centerville Elementary School



Proposed Example - Basin retrofit
Millersville, PA



Existing meadow at Centerville Elementary School



Proposed Example - Wildflower Meadow
Creswell, PA



Legend

- Existing Contour (Major)
- Existing Contour (Minor)

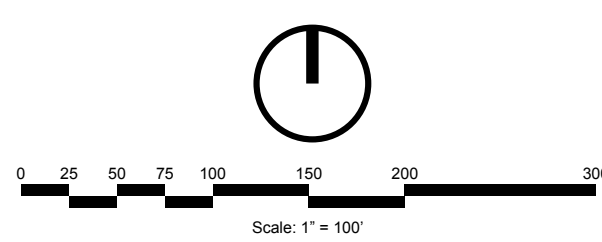
Notes
1. Topographic information is from 2008 LIDAR data collected by Pennsylvania Department of Conservation and Natural Resources (PA DCNR).
2. Parcel information is from 2012 GIS information supplied by Lancaster County Planning Commission, GIS Department.
3. Floodway, 100, and 500 yr floodplains from FEMA GIS information, dated 2005.
4. Aerial imagery is 2008 PAMAP orthoimagery, collected by PA DCNR, 1:2,400 scale, 1-ft pixel resolution, color.

Potential Best Management Practices (BMPs)

1. Detention Basin Retrofit
2. Bioretention Basin
3. Bio-swale Retrofit
4. Rain Garden Retrofit
5. Wildflower Meadow
6. Reforestation

Potential Benefits

1. Improved water quality through the filtration and biological processes in the retrofitted stormwater best management practices. This pollutant load reduction could be a component of the Township MS4 compliance strategy.
2. Improved ecological value through the implementation of aquatic and terrestrial habitat restoration.
3. Recreational opportunities for trails and wildlife/native plant observation.
4. Reduced long-term maintenance (mowing).
5. Environmental education opportunities through the use of interpretive panels within the project area.



**CENTERVILLE MIDDLE SCHOOL
GREEN MASTERPLAN**

LITTLE CONESTOGA - WATERSHED ACTION PLAN
MAY 20, 2015
315 North Street, Lititz, PA | (717) 627-4440



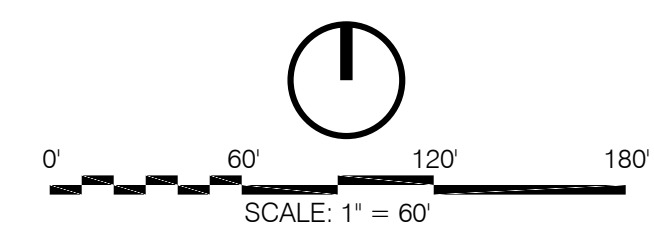


Existing stream channel and vertical banks



Proposed Example - Stream and Floodplain Restoration
Lititz, PA

DRAFT
NOT FOR BIDDING
NOT FOR CONSTRUCTION



Legend

	Existing Contour (1 ft)
	Existing Floodway
	Existing 100-yr Floodplain
	Existing Stream Channel
	Existing Parcel Boundary

Potential Best Management Practices (BMPs)
Stream and Floodplain Restoration
Floodplain restoration is listed as a BMP in the PA Stormwater Best Management Practices Manual (BMP 6.7.4)

- Potential Benefits**
1. Improved water quality through the stabilization of eroding banks, creation of riparian wetlands, re-connection of the floodplain to the stream and groundwater, and establishment of a functional riparian buffer. This pollutant load reduction could be a component of the Township MS4 Compliance Strategy.
 2. Reduced runoff volume via increased infiltration rates and increased frequency of floodplain access by storm flows.
 3. Regional flood storage and reduced stream peak discharges, reducing flood damage downstream.
 4. Improved ecological habitat through the implementation of aquatic and terrestrial habitat restoration.

Notes
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PRIVATE LANDOWNER / MENNONITE HOME
FLOODPLAIN RESTORATION MASTERPLAN

LITTLE CONESTOGA - WATERSHED ACTION PLAN

MAY 20, 2015

315 North Street, Lititz, PA | (717) 627-4440





Existing open space at Conestoga Country Club



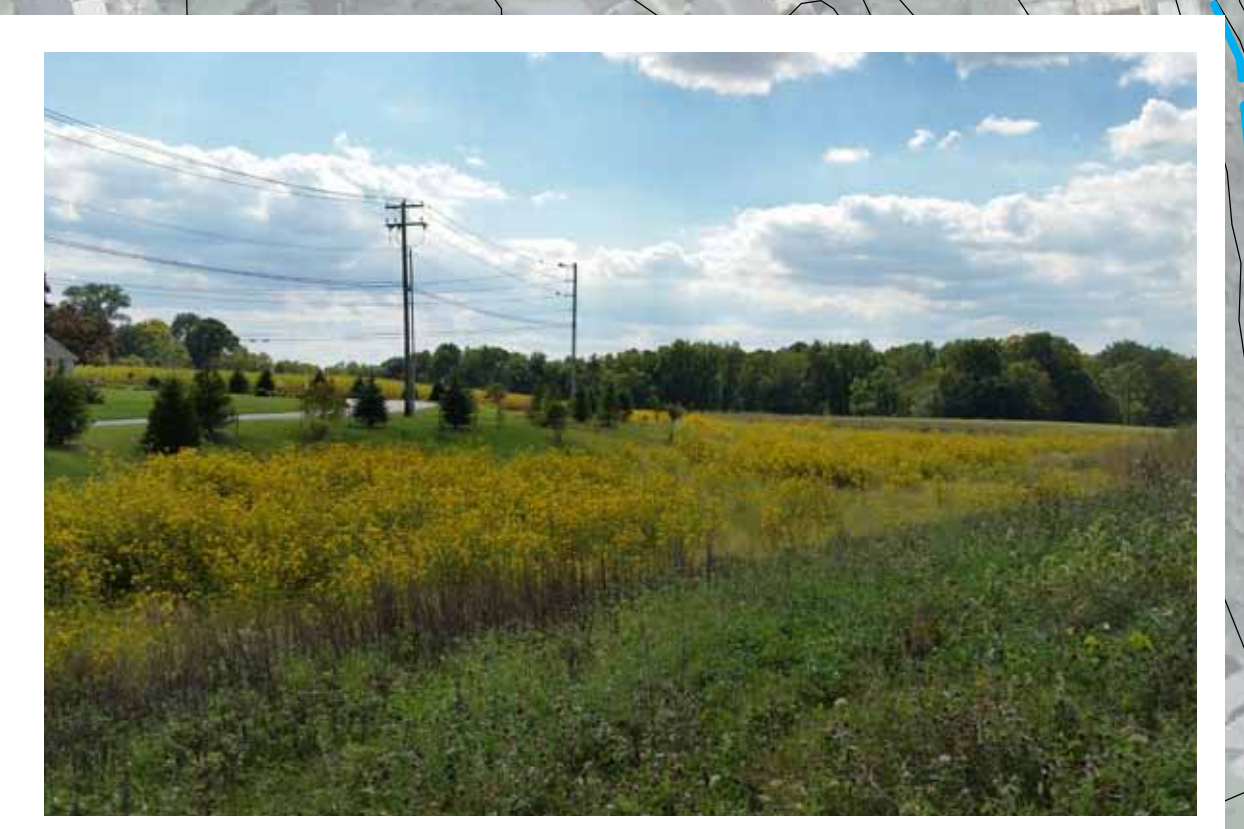
Proposed Example - Meadow (Tall, <5')
Creswell, PA



Eroded swale along entrance drive of Conestoga Country Club



Proposed Example - Bio-swale
Lititz, PA



EXISTING OPEN SPACE AT CONESTOGA COUNTRY CLUB

PROPOSED EXAMPLE: BIORETENTION
MILLERSVILLE, PA

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NOT FOR CONSTRUCTION

LEGEND

- EXISTING CONTOUR (1 FT)
- - - FLOODWAY
- - - 100-YR FLOODPLAIN
- - - PARCEL BOUNDARY
- - - EXISTING STREAM
- - - EXISTING CROSS ROCK VANE
- PROPOSED STORMWATER BMP
- PROPOSED MEADOW (TALL, <5')
- PROPOSED MEADOW (SHORT, <2')

POTENTIAL BEST MANAGEMENT PRACTICES (BMPs)

1. RIPARIAN BUFFERS
2. BIORETENTION
3. NATIVE MEADOWS

POTENTIAL BENEFITS

1. IMPROVED WATER QUALITY THROUGH THE FILTRATION AND BIOLOGICAL PROCESSES IN THE PROPOSED BIORETENTION AREAS. THIS POLLUTANT LOAD REDUCTION COULD BE A COMPONENT OF THE TOWNSHIP MS4 PERMIT COMPLIANCE STRATEGY.
2. IMPROVED ECOLOGICAL VALUE THROUGH THE IMPLEMENTATION OF TERRESTRIAL HABITAT RESTORATION.
3. REDUCED LONG-TERM MAINTENANCE (MOWING).

NOTES

1. TOPOGRAPHIC INFORMATION IS FROM 2008 LIDAR DATA COLLECTED BY PENNSYLVANIA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES (PA DCNR).
2. PARCEL INFORMATION IS FROM 2012 GIS INFORMATION SUPPLIED BY LANCASTER COUNTY PLANNING COMMISSION, GIS DEPARTMENT.
3. FLOODWAY, 100, AND 500 YR FLOODPLAINS FROM FEMA GIS INFORMATION, DATED 2005.
4. AERIAL IMAGERY IS 2008 PAMAP ORTHOIMAGERY, COLLECTED BY PA DCNR. 1:2,400 SCALE. 1-FT PIXEL RESOLUTION. COLOR.



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Legend

Existing Contour (1-FT)

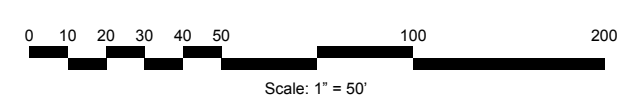
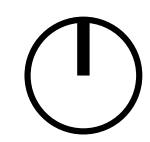
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 3. Floodway, 100, and 500 yr floodplains from FEMA GIS information, dated 2005.
 4. Aerial imagery is 2008 PAMAP orthoimagery, collected by PA DCNR, 1:2,400 scale, 1-ft pixel resolution, color.

Potential Best Management Practices (BMPs)

1. Basin Retrofit
2. Warm Season Grass and Wildflower Meadow

Potential Benefits

1. Improved water quality through the filtration and biological processes in the retrofitted detention basin. This pollutant load reduction could be a component of the Township MS4 compliance strategy.
2. Improved ecological value through the implementation of aquatic and terrestrial habitat restoration.
3. Recreational opportunities for trails and wildlife/native plant observation.
4. Reduced long-term maintenance (mowing).
5. Environmental education opportunities through the use of interpretive panels within the project area.



**EAST PETERSBURG PARK
GREEN MASTERPLAN**

LITTLE CONESTOGA - WATERSHED ACTION PLAN

MAY 20, 2015

315 North Street, Lititz, PA | (717) 627-4440

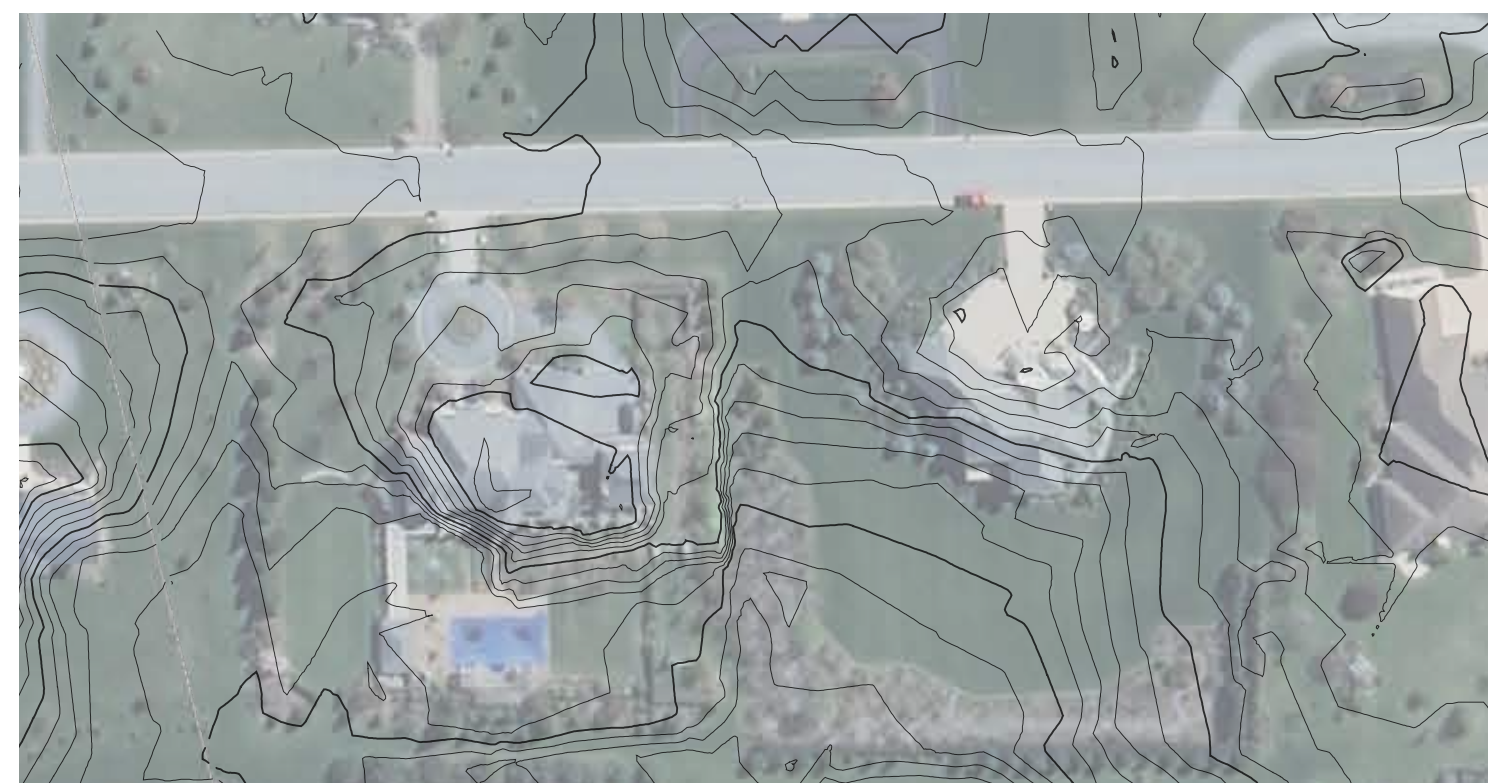




Existing vertical banks along Unnamed Tributary to Bachman Run



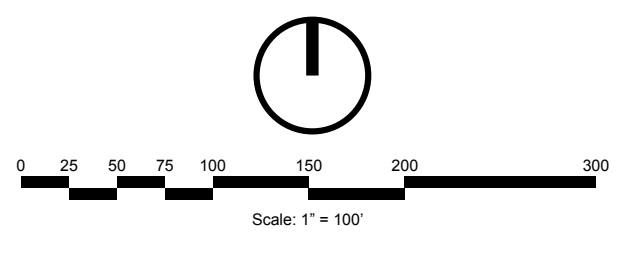
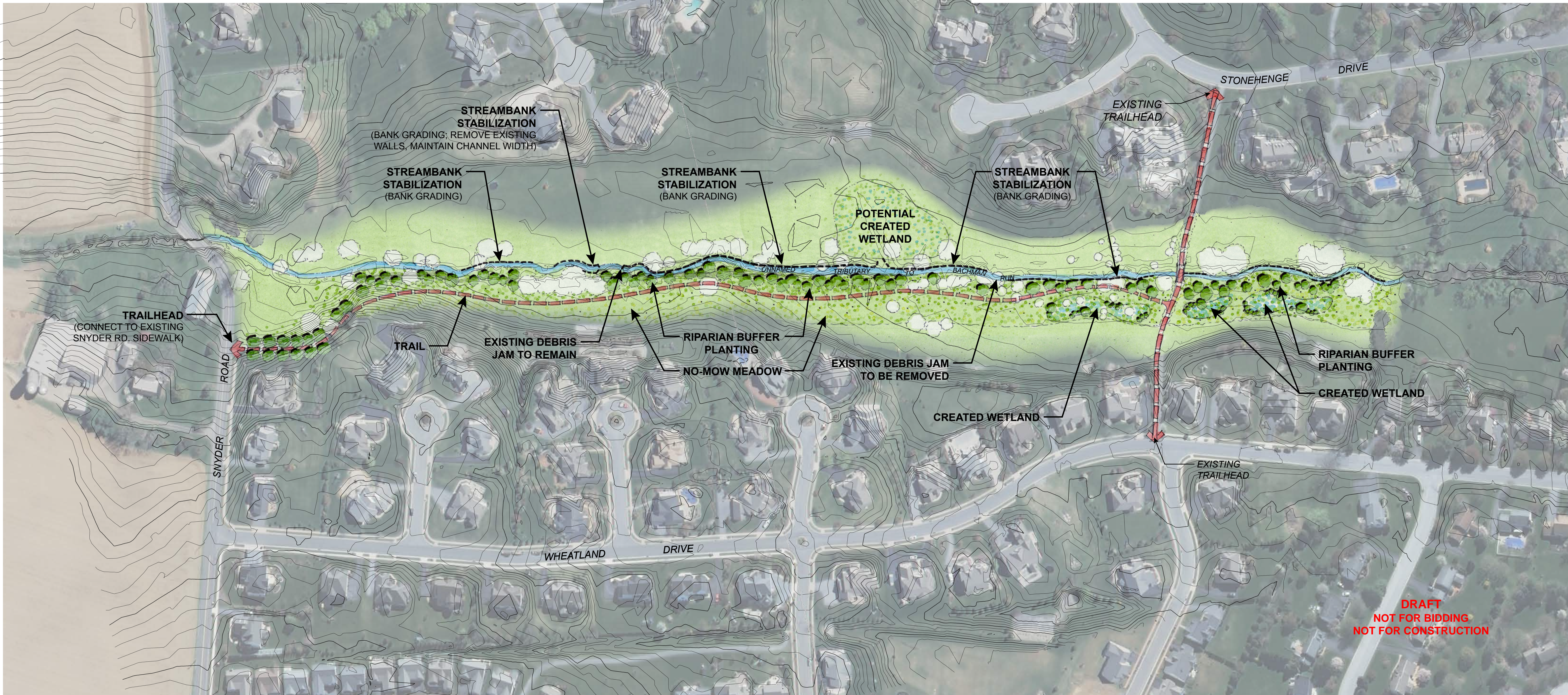
Proposed Example - Streambank Stabilization (Bank Grading)
Millersville, PA



Flooding from snowmelt within Linear Park



Proposed Example - Wetland Creation
Ephrata, PA



Legend

- Existing Contour (Major)
- Existing Contour (Minor)

Notes

- Topographic information is from 2008 LIDAR data collected by Pennsylvania Department of Conservation and Natural Resources (PA DCNR).
- Parcel information is from 2012 GIS information supplied by Lancaster County Planning Commission, GIS Department.
- Floodway, 100, and 500 yr Floodplains from FEMA GIS information, dated 2005.
- Aerial imagery is 2008 PAMAP orthoimagery, collected by PA DCNR, 1:2,400 scale, 1-ft pixel resolution, color.

Potential Best Management Practices (BMPs)

- Riparian Buffers
- Streambank Stabilization
- Wetland Creation

Potential Benefits

- Improved water quality through the establishment of a functional riparian buffer. This pollutant load reduction could be a component of the Township MS4 permit compliance strategy.
- Improved ecological value through the implementation of aquatic and terrestrial habitat restoration.
- Recreational opportunities for trails and wildlife/native plant observation.
- Reduced long-term maintenance (mowing).
- Environmental education opportunities through the use of interpretive panels within the project area.