



PART D: OVERALL ASSESSMENT RECOMMENDATIONS

Introduction

Based on the overall observations, results, and conclusions of all components of this Valley Creek watershed assessment, the following recommendations are provided for consideration by agencies, organizations, municipalities and other stakeholders to address the concerns identified in the watershed.

It is important to recognize that the recommendations and priorities presented here are intended to be flexible and may change over time. Revisions and improvements to the recommendations offered in this plan should be incorporated wherever possible. With that in mind, strong efforts to coordinate watershed planning and implementation must be stressed.

Stormwater Runoff Reduction

Complete and implement the proposed Act 167 Stormwater Management Plan and study to quantify runoff problems and establish criteria and standards for improving stormwater management and reducing runoff impacts to stream channel erosion and water quality and identify priorities for watershed restoration, and consider:

- runoff volume and quality controls for stormwater management using best management practices (BMPs),
- management of salt and road deicing operations,
- BMPs that lower water temperature before allows runoff to reach the stream,
- regional stormwater management alternatives, and
- recommendations for retrofitting existing stormwater facilities.

Hydrologic Conditions and Instrumentation

- Continue discussions with Trammel Crow to evaluate potential for long-term continued pumping of water from the lake at Cedar Hollow Quarry into the North Cedar Hollow tributary.
- Install continuous precipitation gage at Valley Creek stream gage station to develop long-term precipitation records and to assist local emergency coordinators in monitoring and responding to flood events.
- Maintain Valley Creek continuous stream gage as a basis of continued monitoring and evaluation of stream conditions and flood response.
- Consider installation and maintenance of a continuous temperature probe at the USGS Valley Creek stream gage to provide data during the spring, summer and fall on a continuous basis. This would provide an opportunity to monitor change in temperature over the long-term. Data would then be collected, processed and organized via a database by USGS and would be available to the public via the USGS website.

Surface Water Quality Monitoring

- CCHD semi-annual monitoring should be continued with the possible addition of calcium. If possible, CCHD monitoring should occur in months other than those sampled by USGS.
- Consideration should be given to monitoring of bacteria, nitrate, nitrite and phosphate (and/or orthophosphate) concentrations in the headwaters of Little Valley Creek, Valley Creek and in the vicinity of areas of extensive onlot sewage disposal systems. Very minimal bacteria data are available for the watershed and this has been found to be a widespread problem in other multi-use watersheds.
- Within the next two years, re-sample stream sediments for chlordane and PCBs previously detected by USGS sampling.
- Explore opportunities to obtain high flow water quality data reflecting stormwater nonpoint source runoff conditions.
- Support development and implementation of TMDLs to address water quality impairments identified by PADEP.
- In any future surface water quality monitoring conducted in the watershed, include hardness, specific conductance, chloride, sodium, calcium, TDS, TSS, and temperature to determine if long-term increasing trends continue.
- In any future surface water quality monitoring conducted in the watershed, include pH and temperature to determine if long-term trends in declining quality continue.

Biological Monitoring

- Continue annual USGS/Chester County Streams Condition monitoring (benthic macroinvertebrates and water chemistry) in the watershed.
- Conduct another USGS synoptic sampling survey within the next 5 years.
- Develop and implement a periodic fish monitoring program to track trends in populations and deformities of indicator species. Fish sampling program should a) inventory fish diversity and populations on a regular basis, and b) analyze fish tissue for PCBs and other toxic chemical that may be causing the lesions and other physical fish impacts. This could be done on a multi-year basis, but should be considered to keep informed about the condition of the instream fisheries.

Significant Contaminated Sites

- Pursue remedy for exposed waste and debris from Knickerbocker Landfill in stream channel.
- Investigate reasons for abnormal water chemistry levels at CCHD site 431 and USGS site 72 (both near Knickerbocker Landfill).
- Support efforts to finalize and implement plans for remediation of the three Superfund sites within the watershed.
- Chemical contaminants known to exist in ground water due to migration of contamination from the three Superfund sites should be monitored to track the migration or mitigation of their respective plumes. Because these are associated with sites being investigation and/or remediated under Federal oversight, this monitoring should be incorporated within the remediation planning/implementation activities. Reports of findings of this monitoring should be periodically provided to the affected municipalities, CCHD and CCWRA.

Stream Channel Geomorphology

The implementation of the Valley Creek Trustee Council's restoration plan should be supported and encouraged to restore environmental and recreational values of the watershed. Specific recommendations for stream improvements and restoration priorities are presented below.

As described in Part C: Fluvial Geomorphology (FGM) Assessment – Valley Creek Watershed, the current state of instability of sites within the Valley Creek watershed indicates that watershed-wide instream-flow management and stream restoration measures are needed.

Reaches and sites identified for priority restoration or watershed management reflect the streams' response to changes in the stream channel and the contributing land areas. Without intervention or restoration efforts, this process could potentially continue over numerous decades, resulting in continued erosion of private property, flooding, increased threats to roads and other infrastructure, and the mobilization, transport and redistribution of significant quantities of sediment.

Many of the sites identified for restoration would benefit from the completion of the Act 167 Stormwater Management Study. This is due to the complexity of the hydrology/hydraulics and the need to address and/or stabilize the rate and volume of stormwater runoff and other root causes of impacts in the watershed. The Act 167 Study will establish criteria and standards for managing runoff from new development, and will also model the impacts of existing stormwater management facilities, including detention basins. However, as the Act 167 Study is still under development and may not be completed until 2006-07, depending on funding levels from PADEP, efforts for watershed-based restoration should consider the following recommendations.

Protection and Preservation of Riparian Corridors

The continued protection and preservation of undeveloped riparian stream corridors throughout the watershed should be a high priority. Existing, relatively intact ecosystems are the keystone for conserving biodiversity, and provide the biota and other natural materials needed for the recovery of impaired systems. Thus, restoration does not replace the need to protect aquatic resources in the first place. Rather, restoration is a complementary activity that, when combined with protection and preservation, can help achieve overall improvements to the Valley Creek watershed. Even with sites for which restoration is planned, the first objective should be to prevent further degradation. (EPA, 2000) Riparian protection will also contribute to protecting stream temperatures, which were observed to be increasing.

Address Sites Unrelated to Stormwater Management.

A number of Group 1 Priority Sites (which are discussed in detail below) have been assessed as having the principle causes of instability unrelated to stormwater management. The causes have often been identified as the loss of deep-rooted vegetation, impacts from adjoining land uses, or channel modifications. The following were identified as reaches that would benefit from restoration or stabilization efforts even prior to the completion of the Act 167 Stormwater Management Study:

- Reach 006 (Valley Creek immediately downstream from Church Road),
- Reach 012 (Valley Creek adjacent to the Knickerbocker Landfill),
- Reach 021 (Valley Creek immediately downstream of N. Valley Road),
- Reach 1503 (Crabby Creek upstream of Route 252).

Address Sites with Significant Resources at Risk.

The following sites (which are discussed in detail below) are experiencing accelerated erosion which may have as the principle cause impacts from stormwater management. However, the threats to resources, whether cultural, historical or infrastructure, reflect the need for action at these sites:

- Reach 012 (Valley Creek adjacent to the Knickerbocker Landfill),
- Reach 027 (Valley Creek adjacent to Route 23 in Valley Forge National Historical Park),
- Reach 030 (Valley Creek next to Washington's Headquarters), and
- Reach 1503 (Crabby Creek upstream of Route 252).

Periodic Monitoring of Stream Channel Conditions.

In order to measure any continuing changes to the stream channel, long-term monitoring pins have been located at each Measured Reach site (a total of 34 sites). These sites have been surveyed, with cross-sections included in Appendix B.

- Availability of manpower will likely determine the number of sites to be monitored. In general, highest priority should be given to all Category 1 EMR reaches. Second highest priority sites should include Category 2 MR sites. Each of these category reaches has had at least one permanent cross-section located within the reach limits.
- Additional consideration should also be given to any of the eroding site locations identified with a "triangle" symbol on [Figure C-4](#).
- Consider developing a volunteer monitoring program to monitor streambank erosion at permanent pins installed in the FGM study, as well as temperature at several locations in tributaries and mainstem.

Monitoring of Completed Restoration Projects.

Several sites within the watershed have plans under development, or approved, to begin stream restoration work. It is recommended that these sites be monitored by field survey (or at a minimum with a tape measure and survey rod) for stability and for success/failure of meeting the goals of the individual project. It is recommended that they be monitored:

- At least yearly for the first three years,
- immediately following a 1-year storm event (2.6 inches/24 hours or greater).

Conduct Watershed-wide Visual Habitat Assessment Every Two to Five Years.

Two different protocols have been used to visually assess the habitat and stream corridor conditions within Valley Creek watershed over the past seven years. This assessment utilized the USDS/NRCS Stream Visual Assessment Protocol. USGS, PADEP and the Valley Creek Trustee Council utilized the EPA Rapid Bioassessment Protocol in preceding years. The protocols allow for the characterization of the existence and severity of impairment and provide a screening tool to help identify sources and causes of impairment.

- As the protocols allow for the rapid assessment of numerous reaches within a day, it is recommended that the effort organized by the Valley Creek Trustee Council in 2002 be repeated every two to five years at the same 26 reaches which were analyzed in 2002 following the same protocol (EPA Rapid Bioassessment.)
- OR a coordinated effort by PADEP, Valley Creek Trustee Council, CCWRA and USGS to conduct a re-assessment that will satisfy all agencies needs.

Utilize Educational Outreach to Build Public Support.

As in all environmental management activities, the importance of community perspectives and values should not be overlooked. Coordination with the people and organizations that may be affected by the project can help build the support needed to get the project moving and ensure long-term protection of

the restored area. (EPA, 2000) Additionally, public outreach should include efforts to educate the public relative to proper stream bank vegetation management and the detrimental impacts which can result from loss of stability provided by deeply rooted woody vegetation.

Prioritize stormwater management in the areas that drain to reaches that contribute high sediment loads or highly erosive storm flows to the watershed.

- Tributaries currently contributing high sediment loads have been identified as:
 - Reach 700 (Unnamed tributary to Valley Creek, west of Mill Road),
 - Reach 1300 (Unnamed tributary to Little Valley Creek, near Paoli),
 - Reach 1900 (Unnamed tributary to Valley Creek, 1 mile east of Mill Road),
 - Reach 2100 (Wilson Run), and
 - the headwater reaches of the main stem of Valley Creek.
- It is recommended that these areas be investigated for failing or ineffective stormwater basins that can be retrofitted to manage stormwater runoff better.
- It is also recommended that small-scale solutions such as disconnecting impervious cover be prioritized in these areas.

Project Selection

During the selection and implementation of stream channel and watershed restoration projects, the following should be considered:

- Representatives of the Valley Creek Restoration Partnership, and others who are interested in conducting stream restoration, should visit each of the Priority 1 and 2 site locations identified in this report in order to obtain a first-hand understanding of conditions at these locations.
- An initial effort should also entail an identification of the landowners involved in the project scope and a determination of their willingness to participate in a stream restoration project.
- For those Priority projects, which may be significantly affected by the implementation of future stormwater management controls, consideration should be given to completing the Phase II Act 167 stormwater modeling effort in order to consider the feasibility and cost-effectiveness of this alternative for reducing peak flows and restoring stream stability in comparison to other intervention and stream restoration techniques.
- The determination of the final ranking between the Group 1, 2, and 3 Priority sites identified herein should be refined based on familiarity with land owners, volunteers and other labor resources, and funding availability.
- An evaluation should be performed to define available funding sources, including private partnerships and land owners, Growing Greener, federal and other sources.
- Sponsors of watershed restoration efforts, and their design team, should meet with other knowledgeable individuals for their insight into potential causes that are impacting the reach or watershed area in consideration for restoration.
- Coordination should occur with the PADEP Watershed Manager to incorporate their feedback in determining the final ranking of projects and which projects to attempt to undertake first.
- A more detailed refinement of the project scope and cost estimate for the selected priority projects should be completed prior to final decision making and applying for design and implementation funding. Landowner consent should also be obtained prior to applying for funding.

Stream Restoration Design

- In undertaking stream restoration designs, variations in hydraulic geometry data from different geologic formations within the watershed indicate that consideration should be given to the underlying geology to ensure that proper dimensioning of the stream channel.

- Stream restoration efforts should follow the guidelines produced by the Keystone Stream Team and the document entitled, “Guidelines for Natural Stream Channel Design for Pennsylvania Waterways”, March 2003.
- Identification of the factors that influence the stream erosion and stream channel evolution, that have occurred at any particular site, should be a critical component of any future restoration design effort as intervention efforts are initiated.

Municipal Implementation of Watershed Restoration

- Initiate discussions with various municipalities within the watershed relative to the feasibility of adopting management strategies and ordinances that would protect sensitive A, B, C, and E stream type areas.
- Consider pursuing a follow up study to better delineate the extent and location of these sensitive A, B, C and E stream type areas.

Priority Group 1: Project Descriptions, Contributing Causes, And Conceptual Restoration Approaches

In many cases, the exact cause of the accelerated erosion could not be absolutely determined, and was not field researched as part of this assessment. However, a general evaluation to determine the probable root causes of the accelerated erosion based on the understanding of the watershed as a whole and the reaches in particular was performed. The factors that were included as part of this evaluation include:

- slopes in the upstream watershed,
- impervious cover/land use in the upstream watershed,
- research on the ineffective controls at most of the stormwater detention basins in the watershed,
- areas of the watershed with no or limited stormwater management facilities (due to construction prior to stormwater regulations),
- historic, or recent, changes within the reach which is unstable, i.e.
 - physical changes to the stream channel due to road widening or construction,
 - removal of deep-rooted woody vegetation from the riparian zone,
 - construction of culverts for railroads and roadways,
 - altering stream alignment to match these new culverts,
 - movement of the stream channel to accommodate expansion of the Knickerbocker Landfill back in the 1960's,
 - movement of the stream channel for other land uses, including agricultural uses,
 - armoring/riprap of one or both stream banks (either upstream or downstream) of eroded reaches to protect roads or bridges,
 - old dams (or grist mills) which were in use during the 1700's & 1800's, but that may have been removed back decades ago which are still causing instability of the reach,
 - livestock grazing,
 - or some other restriction to the channel or flood plain alteration, etc.

Not every problem in the watershed can be traced to one, or a small group, of influences. It is also understood that stormwater management (or lack thereof) are not the only problems that are causing stream instability or accelerated erosion. However, accelerated erosion (i.e. unnatural erosion) in certain stream reaches can be traced to "man's" influence, although it is not an exact science, and the influence may have happened last century and been removed decades ago (i.e. old mills and dams).

Identification of the factors that influence the stream erosion and stream channel evolution, which has occurred at any particular site, should be a critical component of any future restoration design effort as intervention efforts are initiated. A summary of reach descriptions, likely contributing causes and

conceptual restoration approaches are presented below for the Group 1 Priority Sites. The ability to identify the factors influencing the instabilities within a particular reach may also provide direction in establishing the final ranking and prioritization of restoration efforts.

The following discussion is intended to present a generalized description of the Group 1 Priority reaches existing conditions along with a recommended approach to consider for restoration efforts. The project approaches presented are intended to address the primary cause of instability at the referenced project site. Cost information presented herein is intended to represent a general order of magnitude so as to provide insight in determining final prioritization of projects and determining which projects could potentially be pursued based on funding availability. It is strongly recommended that a refinement of both the project restoration plan and anticipated funding requirements be completed prior to final decision making to ensure that the extent of proposed restoration efforts addresses all necessary work and contributing causes.

Reach 005 (Valley Creek between Route 202 and Church Road)

This project area is located between Route 202 and Church Road in East Whiteland Township. Most of the stream corridor is wooded except for the downstream portion of the reach where it borders the Chester Valley Golf Course on the right bank. Significant portions of this reach where established wooded riparian areas exist are currently in fairly stable condition. The principle type of instability present throughout this reach consists of high, actively eroding stream banks and meanders. The apparent cause for this instability appears to relate to a legacy of hydrologic changes that have occurred throughout the watershed.

The restoration approach recommended for this reach consists of spot treatments of these actively eroding zones. Spot treatments should consist of a combination of bank grading (to reduce slope) and the installation of methods to divert flow energy and reduce the stress on these areas. These methods could consist of in-stream structures such as rock vanes or cross-rock vanes as shown in [Figure D-1](#) or a flood plain bench as shown in [Figure D-2](#). Riparian seeding and vegetation re-establishment will likely require the use of shade-tolerant species due to the existing wooded corridor. Access routes to the work areas should be selected so as to minimize the amount of disturbance to existing vegetation. In sensitive areas, consideration should be given to forgoing physical intervention techniques where construction impacts would potentially cause greater impacts. It is estimated that approximately 30 percent of the total stream length on this reach or approximately 500 feet will require some level of remedial treatment. A preliminary order of cost for engineering and construction of this project is approximately \$150,000 which reflects the anticipated difficulties in gaining access to the work areas.

At the point in time when this site is selected for intervention, consideration should be given to extending the scope of the restoration work to include appropriate portions of the Reach 004 since this reach is currently a Group 2 Priority project and is located upstream of the subject project location. Stabilizing this upstream source would help to ensure long-term success of the Reach 005 efforts. However, due to the fact that significant portions of this reach have remained in fairly stable condition, it is reasonable that restoration efforts be initiated as soon as funding is available to accomplish these efforts, even before the Act 167 Stormwater Management Plan is completed.

Figure D-1

Figure D-2

Reach 006 (Valley Creek immediately downstream of Church Road)

Site 006 is located on the main stem of Valley Creek just downstream of Church Road in East Whiteland Township, Chester County. A description of the existing conditions at this Category 1 site is included in the Measured Reach Results section of this report. Adjacent land area at the site is currently used as a horse pasture. The vegetation in the riparian corridor is primarily open grassland with limited pockets of trees and shrubs interspersed at different locations along the stream corridor. The principle causes for the instability observed in this reach appears to relate to both the legacy of hydrologic changes that have occurred throughout the watershed (e.g., land cover and land use changes, etc.) in addition to the loss of deep-rooted vegetation from the riparian zone.

A restoration approach would entail the reconstruction of a stable stream meander geometry, longitudinal profile and channel cross-sectional area. [Figure D-3](#) portrays this general concept. Stream restoration efforts undertaken should follow the guidelines produced by the Keystone Stream Team and the document entitled, “Guidelines for Natural Stream Channel Design for Pennsylvania Waterways”, March 2003. Reconstruction of the channel cross-sectional dimensions should include correcting the current entrenched conditions of the channel by regrading banks, incorporating grade control structures in-stream and re-establishing an active flood plain area. Revegetation of the riparian community should also be undertaken to restore channel bank stability. This project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. Stream bank fencing would be a necessary part of this restoration effort to protect the riparian vegetation from over-grazing. It is estimated that a minimum of 1,500 feet of channel will be involved in the project scope. A preliminary order of cost for engineering and construction of this project is \$100 per foot or approximately \$150,000.

Prior to undertaking restoration efforts on this reach, consideration should be given to the level of impact which may result from the upstream Reaches 004 and 005 and whether their restoration should be performed concurrently so as to avoid negative impacts from sediment supply generated from these areas.

Reach 012 (Valley Creek adjacent to the Knickerbocker Landfill)

The primary cause of impact at this site relates to the apparent water quality degradation occurring as a result of the presence of the Knickerbocker Landfill located on the adjoining land area. The principle causes for the instability observed in this reach appears to relate to both the legacy of hydrologic changes that have occurred throughout the watershed in addition to the flood plain encroachment and stream confinement that has occurred as a result of the landfill operation. Evidence of direct contact of the stream with refuse was observed in the form of plastics and other debris being transported downstream.

Minimum remedial actions at this site should included stabilizing any areas of the site where the stream is eroding and contacting waste material. In order to achieve this, it may be necessary to either remove waste material from the site or relocate the stream to an area that is isolated from these materials. To determine the appropriate course of action, appropriate municipal and regulatory authorities should be contacted to review permit status and requirements. In the event the determination is made to relocate or otherwise alter the stream’s dimension, pattern or longitudinal profile, this project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. The full scope of clean-up efforts or other potential factors need to be evaluated in order to assign an order of cost associated with this effort.

Though both the construction cost and permitting complexity associated with this project are anticipated to be high, this project was still selected as a Group 1 Priority reach due to the overriding influence of the potential public health and safety related issues. It is recommended that restoration efforts be initiated as soon as funding is available to accomplish these efforts, even before the Act 167 Stormwater

Figure D-3

Management Plan is completed, especially in light of the ongoing degradation in water quality that is occurring as a result of the increasing exposure of landfill materials.

Reach 021 (Valley Creek immediately downstream of N. Valley Road)

Site 021 is located just downstream of North Valley Road in Tredyffrin Township, Chester County on the land area occupied by the Great Valley Grist Mill. The vegetation in the riparian corridor is open grassland that is mowed up to the stream banks. Causes of instability at this site relate to the increase in stormwater runoff from upstream developed areas as well as the loss of deep-rooted woody vegetation along the stream corridor which historically provided significant levels of stream bank stability. Total reach length is estimated to be approximately 3,000 feet.

A restoration approach for the upper 1500 feet of this reach would entail the reconstruction of a stable stream meander geometry, longitudinal profile and channel cross-sectional area for portions of this reach where meander bends have migrated to extremely tight radii. [Figure D-3](#) portrays this general concept. It is estimated that up to approximately 50% of this upper reach would require this level of treatment. Reconstruction of the channel cross-sectional dimensions should include correcting the current entrenched conditions of the channel by regrading banks, incorporating grade control structures in-stream and re-establishing an active flood plain area. The remaining portions of this upper segment of this reach as well as the lower remaining 1,500 feet with more stable plan form could likely be restored through bank grading and installation of in-stream structures as shown on [Figure D-1](#).

Revegetation of the riparian community should also be undertaken to restore channel bank stability. In the highly landscaped setting of the upper portion of this reach, incorporation of streamside ornamentals and flowering species would likely add to the aesthetic appeal of the completed project and serve to reduce the streamside mowing pressure. This project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. A preliminary order of cost for engineering and construction of this project is estimated at approximately \$350,000 for the overall 3,000-foot project limits.

Reach 027 (Valley Creek adjacent to Route 252 upstream of the dam)

This project reach is located on the main stem of Valley Creek along Route 252 upstream of Gulph Road (Route 29) in the Valley Forge National Historic Park. The general nature of instability throughout this reach consists of severe bank erosion, channel migration and in-stream sediment deposition. One constraint on the stream channel in this reach includes the floodplain encroachment from Route 252.

The restoration design for this reach would benefit from the completion of the Act 167 Stormwater Management Study due to the complexity of the hydraulics in this portion of Valley Creek. The ongoing stream bank erosion and the associated risk Route 252 in this area would justify an accelerated completion of this modeling effort. General recommendations for consideration in this design effort include the incorporation of geomorphic principles to the extent possible so as to provide the best long-term, maintenance-free solution. Specifically, consideration of proper dimensioning of the bankfull and floodplain channels (e.g., area, width, depth, etc.) would help to ensure long-term sediment transport.

The restoration strategy at this site would entail bank regrading to correct all currently vertical, highly erosive bank conditions and the re-establishment of deeply rooted vegetation along the stream corridor. [Figure D-4](#) portrays this general concept. Coordination with the National Park Service and the Pennsylvania Department of Transportation should be part of this design effort. This project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. Order of cost associated with engineering and construction of the project, depending on the

Figure D-4

aggressiveness of the treatment, is estimated to range between \$150,000 and \$250,000. Site access complications for this project are reflected in this cost estimate.

Reach 030 (Valley Creek next to Washington’s Headquarters)

This project reach is located on the main stem of Valley Creek from the approximate vicinity of Gulph Road (Route 29) to the confluence with the Schuylkill River in the Valley Forge National Historic Park. The general nature of instability throughout this reach consists of severe bank erosion, channel migration and in-stream sediment deposition. Constraints on the stream channel in this reach include backwater influences from the Schuylkill River, an abandoned railroad culvert crossing, floodplain encroachment from existing roads and the historic resources present in the alluvial deposit that make up the current stream banks.

The restoration design for this reach would benefit from the completion of the Act 167 Stormwater Management Study due to the complexity of the hydraulics in this portion of Valley Creek. The ongoing stream bank erosion and the associated risk to the historic resources in this area would justify an accelerated completion of this modeling effort. A proposed streambank stabilization design study has been commissioned by the National Park Service to address the stream instabilities while incorporating consideration of these constraints. General recommendations for consideration in this design effort include the incorporation of geomorphic principles to the extent possible so as to provide the best long-term, maintenance-free solution. Specifically, consideration of proper dimensioning of the bankfull and floodplain channels (e.g., area, width, depth, etc.) would help to ensure long-term sediment transport. Additionally, consideration should also be given to the influence of the backwater condition and the delta-type setting of this reach’s position in the watershed.

Reach 700 and 701 (Unnamed tributary to Valley Creek, west of Mill Road)

These two reaches make up the entirety of a small tributary system that enters Valley Creek just west of Mill Road in Tredyffrin Township. Having no flow at the time of the field assessment, this tributary system appeared to function primarily in response to storm events. Severe bank and channel erosion was evident throughout both reaches. Riparian vegetation consisted of mowed turf grass. In the lower portion of Reach 701, a low-head dam existed which appeared to temporarily impound water following a flow event. This structure also appeared to function as a sediment trap for the sediment supply generated from the eroding upstream channel.

The principle causes for the instability observed in this reach appear to relate to the legacy of hydrologic changes and increases in stormwater runoff that have occurred throughout this subwatershed in addition to the loss of deep-rooted vegetation from the riparian zone. The influence of the hydrologic changes, however, appear to be more significant in that stream channel erosion was observed even within wooded portions of the stream corridor. The restoration design for this reach would benefit from the completion of the Act 167 Stormwater Management Study.

The restoration strategy at this site would entail bank regrading to correct all currently vertical, highly erosive bank conditions and the re-establishment of more deeply rooted vegetation along the stream corridor. [Figure D-4](#) portrays this general concept. Coordination with the landowner relative to the benefits of maintaining more deeply rooted vegetative community should be pursued. Up to approximately 1,500 feet of channel is currently anticipated to be involved in this project. This project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. Order of cost associated with engineering and construction of the project is estimated to be \$150,000.

Reach 1102 (Cedar Hollow Road tributary)

This site is located on the Cedar Hollow Road tributary just above its confluence with Valley Creek. This tributary originates from the Paoli Yards train station and is the subject location of an EPA-coordinated PCB cleanup effort. PCB concentrations at this site were detected in the floodplain soils. The current cleanup plan for this site is to excavate and remove the contaminated soils and reconstruct the stream channel with clean soil materials. During June 2004, approximately 2000+ cubic yards of PCB contaminated soils/sediments were removed from the floodplain at the base of the Cedar Hollow Road Tributary. Permanent bank stabilization activities are set to begin in late-June 2004, and will consist of “biologs” and erosion control fabric in addition to seeding and planting to provide additional bank stability. EPA and the U.S. Army Corps of Engineers will oversee the site stabilization methods.

Due to the nature of the PCB contamination identified on this site, additional field surveys should be conducted in years to come to determine whether the bank stabilization methods used at this site are functioning as designed. The measures installed were not based on a detailed FGM design, however, the site may be stabilized and improve local aquatic habitat.

Reach 1503 (Crabby Creek upstream of Route 252)

Site 1503 is located on Crabby Creek just upstream of Route 252 in Tredyffrin Township, Chester County. The land use in the areas outside the stream corridor at this site is a residential neighborhood, however, the stream corridor itself is well vegetated with mature trees and other woody species. Causes of instability at this site are not completely obvious, however, contributing factors are felt to include the presence of a sanitary sewer line crossing the stream channel, downstream channel encroachment and restrictions and debris jamb influences caused by fallen mature trees.

A restoration approach for this project site would include reconstructing the stream profile in the vicinity of the 4-foot headcut and constructing a series of step/pool complexes similar to the concept portrayed on [Figure D-5](#). These complexes would provide a more gradual transition of the stream bottom slope in such a way so as not to preclude fish migration. The elevation change that currently occurs across the headcut would be divided over a series of smaller steps formed from a series of cross rock vanes or similar structures ([Figure D-1](#)). These structures would also serve as grade control points to prevent the redevelopment of any downcutting or headcutting activity, thus protecting the integrity of the upstream sewer line crossing.

The limited scope of the step/pool complex project would likely involve 100 to 200 feet of stream channel. Due to the current potential risk to the upstream sewer line, it may be advantageous to undertake only this limited scope stabilization project as a stopgap measure. The order of cost associated with engineering and construction of this project is estimated to be approximately \$50,000. It is reasonable that restoration efforts be initiated as soon as funding is available to accomplish these efforts, even before the Act 167 Stormwater Management Plan is completed, especially in light of the imminent risk to the sanitary sewer system within the project limits.

In the event it is determined that the rate of advancement of the headcut is currently relatively slow and that no eminent threat to the sewer line exists, this restoration project could be coupled with restoration work extended further upstream. Based on physical observation of upstream condition, bank grading or bank toe protection and stabilization efforts would likely extend upstream an additional 500 feet. In the event this additional effort is undertaken at the same time, the order of cost associated with engineering and construction of this additional stream length is estimated to be approximately an additional \$50,000.

Figure D-5

Reach 1900 (Unnamed tributary to Valley Creek, 1 mile east of Mill Road)

This reach makes up the majority of a small tributary system that enters Valley Creek approximately 1 mile east of Mill Road in Tredyffrin Township. This tributary system runs somewhat parallel and to the east of the previously discussed Reach 700, 701 tributary system. The confluence area of this tributary system, however, appears to have been recently (i.e., within the past year) altered to the extent that the stream channel, as it enters the flood plain area adjacent to Valley Creek, has been graded and seeded, thus eliminating any defined channel. Having no flow at the time of the field assessment, this tributary system appeared to function primarily in response to storm events. Riparian vegetation consisted of wooded area with a residential development along the eastern border. An extremely high sediment supply is present in this system that potentially is influenced by runoff from either the Pennsylvania Turnpike, which crosses the tributary system approximately mid-length, or from the adjoining development. The portion of this tributary upstream of this Pennsylvania Turnpike crossing did not exhibit the same characteristics of instability and sediment supply.

The restoration strategy at this site would entail stabilizing the source of sediment in this system. This may entail a combination of implementing stormwater management controls and stabilizing in-channel sediment sources. For this reason, the restoration design for this reach would benefit from the completion of the Act 167 Stormwater Management Study. Bank regrading to correct identified vertical, highly erosive bank conditions and the reestablishment of deeply rooted vegetation along the stream corridor may also be required. [Figure D-3](#) portrays this general concept. Up to approximately 1500 feet of channel can be anticipated to be involved in this project. This project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. Order of cost associated with engineering and construction of the in-stream portion of the project is estimated to be \$75,000. The cost of stormwater management efforts would be in addition to these costs.

Reach 2103 (Lower Reach of Wilson Run)

This reach is the lower reach of Wilson Run located just north of the Valley Forge Junior High School in Tredyffrin Township. This tributary joins Valley Creek just inside the Valley Forge National Historical Park. Frequently having no or little flow in the system, this tributary appears to function largely in response to storm events. Severe bank and channel erosion was evident throughout the entire tributary system extending into the headwaters of the system. Riparian corridor is generally wooded, however, buffer widths are narrow in the upstream areas where land development has occurred. The principle causes for the instability observed in this reach appear to relate to the legacy of hydrologic changes and increases in stormwater runoff that have occurred throughout this subwatershed.

The restoration strategy at this site would entail a combination of implementing stormwater management controls and bank regrading to correct currently vertical, highly erosive bank conditions. For this reason, the restoration design for this reach would benefit from the completion of the Act 167 Stormwater Management Study. Reestablishment of deeply rooted vegetation along the stream corridor would also be part of the strategy. [Figure D-4](#) portrays the general bank regrading concept. Up to approximately 2,000 feet of channel is currently anticipated to be involved in this project. This project should incorporate natural channel design principles to provide channel stability and enhance the aesthetics of the stream. Order of cost associated with engineering and construction of the project is estimated to be \$200,000.

Prior to undertaking restoration efforts on this reach, consideration should be given to the level of impact which may result from the upstream Reaches 2100 through 2102 and whether their restoration should be performed prior to or concurrently with this reach so as to avoid negative impacts from sediment supply generated from these areas. Additionally, since stormwater runoff contributes significantly to the

channel instabilities, consideration should be given to completing the Phase II Act 167 stormwater modeling effort in order to consider the feasibility and cost-effectiveness of the alternative of reducing peak flows to a sufficient level so as to restore stream stability.