IMPLEMENTATION PLAN FOR JOHNSON CREEK

TIOGA COUNTY, PENNSYLVANIA

Prepared for:

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TABLE OF CONTENTS

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TABLE OF CONTENTS (CONTINUED)

LIST OF APPENDICES

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EXECUTIVE SUMMARY

This implementation plan has been developed for the restoration of Johnson Creek, located in Tioga County, Pennsylvania. Extensive mining activities have occurred in the watershed, and the stream is impacted by abandoned mine drainage (AMD). Consequently, Johnson Creek contributes pollutant loadings, mainly acidity and metals, to its receiving waters, the Tioga River.

The Johnson Creek Watershed has been included in two recent studies of the Tioga River Watershed. The stream was studied in detail in the *Watershed Assessment and Remediation Strategy for Abandoned Mine Drainage in Upper Tioga River Watershed* developed by the Susquehanna River Basin Commission (SRBC) in 2003. The *Tioga River Watershed Total Maximum Daily Load* (TMDL), developed for the Pennsylvania Department of Environmental Protection (DEP) in 2003, included specific pollutant loading reductions for Johnson Creek. These two documents serve as the basis for this plan.

The primary pollutant source in the watershed is AMD that originates from abandoned deep mines. Erosion concerns are present in some areas, but sediment pollution is minor and secondary to water quality impairment due to AMD, and the primary sediment source is currently being addressed through stream stabilization activities. Three AMD pollutant sources, the Arnot No. 5 discharge, the Flower Mine discharge, and the discharges from the South Mountain Complex, must be addressed in the watershed before the watershed can be restored. A passive treatment system for a fourth source, the Arnot No. 2 Mine, #1 Discharge, is under construction.

This implementation plan prioritizes the four major pollutant sources in the watershed, and discusses required reductions in pollutant loadings to meet the TMDLs established for the stream. Best management practices (BMPs) required to meet prescribed load reductions and the impacts of the BMPs on the downstream receiving waters are addressed. The technical assistance needed to implement the necessary BMPs and an implementation schedule for addressing the remaining pollutant sources are also provided. Plans for water quality

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monitoring, evaluation of the success of restoration measures, and remedial actions in the event of problems with restoration measures have been developed.

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1.0 BACKGROUND

The Johnson Creek Watershed is located in northcentral Pennsylvania in Tioga County. A watershed location map is provided as Figure 1 of Appendix A. The watershed is located in Bloss, Hamilton, and Liberty Townships and in the Town of Blossburg. The majority of the watershed is located west of the Town of Blossburg and east of the Village of Arnot, although the watershed does extend slightly west of Arnot.

The Johnson Creek Watershed is impaired by abandoned mine drainage (AMD). However, most of the AMD sources in the watershed have moderate water quality and do not significantly impair water quality in the main stem of the stream, other than causing periodic net acidity and low concentration aluminum spikes. Water quality throughout the watershed ranges from good to poor. Some portions of the watershed have water quality sufficient to support fish and other aquatic life, and a brook trout population has been reported in portions of the stream.

Johnson Creek is listed on Pennsylvania's 2002 Section 303(d) List of Impaired Waters and the 2004 and 2006 Integrated Lists of All Waters. The stream was not listed on the Section 303(d) List in 1996 or 1998. The stream is listed because of impairments due to AMD, including acidity and metals such as iron, manganese, and aluminum.

This implementation plan has been developed for the restoration of Johnson Creek. Extensive mining activities have occurred in the watershed, and the stream is impacted by abandoned mine drainage (AMD). Consequently, Johnson Creek contributes pollutant loadings, mainly acidity and metals, to its receiving waters, the Tioga River.

This Implementation Plan prioritizes activities relating to the four major pollutant sources in the watershed, and discusses required reductions in pollutant loadings to meet the TMDLs established for the stream. Best management practices (BMPs) required to meet prescribed load reductions and the impacts of the BMPs on the downstream receiving waters are addressed. The technical assistance needed to implement the necessary BMPs and an implementation schedule

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for addressing the remaining pollutant sources are also provided. Plans for water quality monitoring, evaluation of the success of restoration measures, and remedial actions in the event of problems with restoration measures have been developed.

The following sections of this narrative provide a brief overview of the watershed characteristics, mining activities, and other studies of the Johnson Creek Watershed. The Susquehanna River Basin Commission's (SRBC's) *Watershed Assessment and Restoration Strategy* provides more detail about the characteristics of the watershed.

1.1 Watershed Characteristics

The Johnson Creek Watershed encompasses a drainage area of 17 square miles. A watershed boundary map is provided as Figure 2 in Appendix A. The centroid of the watershed is located at 41º39'33" north latitude and 77º6'00" west longitude.

1.1.1 Topography and Land Use

According to the USGS 7.5 minute topographic quadrangle maps of Cherry Flats, Pennsylvania, and Blossburg, Pennsylvania, elevations across the watershed range from 2,080 feet to 1,340 feet above mean sea level. Site topography is provided on Figure 2 in Appendix A. Moderate to steep slopes exist along the hillsides, with more mild slopes along the valley floor.

The majority of the watershed is contained within State Forest Lands that are part of the Tioga State Forest. Other minor land uses in the watershed include mining (formerly mined areas), and rural residential communities. The Village of Arnot and the Town of Blossburg form the population centers in the watershed.

1.1.2 Geology

The Johnson Creek Watershed is located in the glaciated upland plateau section of the Appalachian Physiographic Province. The geologic strata consist mostly of coal-bearing strata

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belonging to the Pennsylvania-aged Allegheny Group. The Blossburg Syncline is present near the Village of Arnot. The valley floor near the Village of Arnot consists of unconsolidated glacial moraine, which contains sediment ranging from clay to cobbles and boulders.

The Johnson Creek watershed is located near the eastern extent of the bituminous coal fields. Six coal seams are present in the watershed: the A (Bear Creek); B (Bloss); C (Cushing); C' (Morgan); D (Seymore); and E (Rock Vein). Most of the mining occurred on the Bloss or B seam. Coal is generally found on hilltops and other higher areas of the watershed as opposed to the valley.

1.1.3 Surface Water Resources and Wetlands

Johnson Creek flows in an easterly direction from just west of the Village of Arnot to Route 15 for a distance of approximately 2.5 miles. After crossing under Route 15, the stream turns and flows northeast to its confluence with the Tioga River in Blossburg. The total length of the main stem is 4.2 miles.

The main stem of Johnson Creek receives drainage from the following tributaries which enter the stream from the north: Boon Run, Mills Creek, unnamed tributary No. 7 (UNT7.0), and several other unnamed tributaries. The tributaries of Sawmill Creek, Flower Run, Long Run (which flows into Flower Run), and the South Mountain Tributary (unnamed tributary No. 5/UNT5.0) drain into Johnson Creek from the south.

A large wetland complex is located along the western boundary of the watershed along Route 2016 west of Arnot. The source of hydrology to this wetland is the Arnot No. 2 Mine. Several other ponds and wetlands are present in the watershed, including a constructed wetland located near Route 15.

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1.2 Mining History

Mining activities in the watershed began in the 1790s, after coal was discovered near Blossburg. The deep mines near Arnot, including the Arnot No. 1, the Arnot No. 2, and other mines east of Arnot, have been estimated to have opened around 1865. In 1881, a standard gage railroad was constructed from Arnot to Morris to convey coal and other materials. The refuse from these underground mines is spread out around the Village of Arnot in many areas.

In the 1960s through the 1980s, mining in the region experienced a resurgence as mining companies began remining areas that had previously been deep mined and daylighting the deep mines. Most of the surface mining in the watershed occurred to the south of Johnson Creek.

There is no active mining in the watershed at this time. Limited coal resources are present as most have been deep mined and the deep mines were later daylighted by surface mining. The surface mining left only isolated pockets of coal. The limited coal reserves make it unlikely that significant mining will occur in the watershed, so reclamation and restoration efforts will not likely be affected by future mining activities. A permit application has been submitted for a small aggregate mine within the watershed, but that operation should have little to no impact on Johnson Creek.

1.3 Prior Studies

The *Watershed Assessment and Remediation Strategy for Abandoned Mine Drainage in the Upper Tioga River Watershed* was prepared by the Watershed Assessment and Protection Division of the SRBC in October of 2003. This report indicated that portions of the Upper Tioga River Watershed, located in northcentral Pennsylvania, are severely impacted by abandoned mine drainage (AMD). Some portions of the watershed were described as displaying a depressed pH due to non-AMD acidity sources such as acid rain and tannins from natural headwaters. This Implementation Plan for Johnson Creek serves as an addendum to the W*atershed Assessment and Remediation Strategy for Abandoned Mine Drainage in the Upper Tioga River Watershed* prepared by the SRBC.

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The SRBC report identified pollutant sources in the Upper Tioga River Watershed, which includes Johnson Creek. Water quality data, proposed conceptual treatment designs and other remediation and reclamation practices, cost estimates, and a ranking of pollutant sources are provided in that report.

Some of the mine drainage discharges to the Johnson Creek Watershed were addressed in the *Babb Creek Watershed Restoration Plan* prepared by Corey Cram of the Pennsylvania Department of Environmental Resources (DER) in 1996. This report primarily addresses the Babb Creek Watershed, but the #1 discharge of the No. 2 Mine, which underlies both the Babb Creek and Johnson Creek Watersheds near Arnot is included in the report. The DER Bureau of Mining and Reclamation instituted a Comprehensive Mine Reclamation Strategy (CMRS) to address pollution within the Babb Creek Watershed. The PA DER plan encouraged the judicious use of limited resources that are available to obtain measurable stream recovery rather than the expenditure of efforts in a less-focused manner.

The Johnson Creek Watershed was included in the Total Maximum Daily Load (TMDL) study developed for the Tioga River. The *Tioga River Watershed Total Maximum Daily Load*, developed for the Pennsylvania Department of Environmental Protection (DEP) in 2003, included specific pollutant loading reductions for Johnson Creek. The TMDLs for Johnson Creek are discussed in detail in this Implementation Plan. The Tioga River Watershed TMDL document and the SRBC report serve as the basis for this Implementation Plan.

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2.0 IDENTIFICATION OF POLLUTION SOURCES

Pollutant sources in the Johnson Creek Watershed were identified and described in the SRBC's *Watershed Assessment and Restoration Strategy*. Staff from Alder Run Engineering visited each of the identified pollutant sources in the fall of 2005, with the exception of the South Mountain Discharges which were fenced and posted at that time, to verify current conditions and have periodically visited the watershed to track current conditions. The total maximum daily loads (TMDLs) and other watershed problems, applicable water quality standards, and prioritization of pollutant sources are described in the following paragraphs.

2.1 Total Maximum Daily Loads and Other Watershed Problems

The Johnson Creek Watershed is impaired by abandoned mine drainage (AMD), a legacy from the past mining activities that have occurred in the watershed. AMD is the primary source of impairment in the watershed, and other sources of impairment such as sediment and nutrients are not significant in the watershed.

TMDLs for the Johnson Creek Watershed were developed as part of the *Tioga River TMDL* prepared for the DEP and dated 2003. TMDL criteria for the watershed are provided in Section 3 of this narrative. The SRBC's *Watershed Assessment and Restoration Strategy* divided Johnson Creek into reaches based on water quality data at sample points common to both the SRBC Assessment and the DEP's TMDL. Excerpts from both of those documents are provided in Appendices B and C, and a CD containing the full documents is provided in Appendix B.

Water quality in the watershed ranges from only slightly impaired to moderately impaired in the main stem. Fish populations are present in some stream segments. Some tributaries have poor quality water due to AMD impacts. A discussion of the water quality and level of impairment by stream reach is provided in the following paragraphs. The discussion references mapping developed by the SRBC and water quality data provided by the SRBC and the DEP, included in Appendices B and C. Figures 3A and 3B of Appendix A show the location of specific mine discharges. Figures 4A and 4B of Appendix A and Figure 1 of Appendix B show the sample

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points that are referenced in the following paragraphs. Figure 2 of Appendix B (found near the end of Appendix B), an excerpt of the SRBC's *Restoration Strategy*, provides a color-coded representation of the water quality of Johnson Creek.

The SRBC determined their stream quality classifications based on water quality data. The classifications ranged from good quality to very poor quality, as shown on Figure 2 of Appendix B. Water quality in the Johnson Creek main stem was classified has having either good quality with pH > 6.0, acidity less than alkalinity, and low metals, or fair quality, again with pH > 6.0, acidity less than alkalinity, and low metals during average conditions. Poor water quality, present in some tributaries, is described has having pH > 4.5 and net acidity < 50 mg/L.

Sample point JOHN3.0 is the furthest upstream sample point on Johnson Creek. The point is located in the headwaters of the stream. State Route 2016 serves as the drainage boundary between Johnson Creek and the Babb Creek Watershed to the west, and the headwaters of Johnson Creek is formed by a wetland area near 2016. This segment of stream has good water quality from the headwaters downstream to JOHN3.0.

Two mine drainage discharges flow into Johnson Creek in this section. Flow from the Arnot No. 2 Mine, #1 Discharge travels from a deep mine opening through a large wetland area. Flow from the Arnot #1 Mine enters Johnson Creek from the south. Both the Arnot No. 2 and No. 1 Mines underlie both the Johnson Creek and Babb Creek Watersheds, and both mines have discharges into both watersheds. The Arnot No. 1 Mine Discharge has good quality and is utilized by the Arnot Sportsmen Association as a source of water for a trout nursery. The discharge is also used a public water supply for the village of Arnot. The Arnot No. 2 Mine, #1 Discharge is impaired by metals, and is a priority for restoration of this watershed. Tributaries entering this segment of Johnson Creek include several unnamed tributaries and Sawmill Creek.

Sample point JOHN3.0 conveys an average flow of 3.2 cubic feet per second (cfs), with measured flows ranging from 0.25 cfs to 6.36 cfs. The pH in this segment ranges from 6.0 to 6.5. Other average chemical parameters for this reach include acidity of 13.37 milligrams per

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liter (mg/l), alkalinity of 16.33 mg/l, total iron of 0.74 mg/l, total manganese of 0.47 mg/l, total aluminum of 0.51 mg/l, and total sulfate of 66.38 mg/l. These data, and all data provided in this section of this narrative were used for the development of the TMDL for the Tioga River.

Sample point JOHN2.0 is located west of Route 15 approximately 1/3 mile from the highway. The point is located in the mid-section of the stream upstream of the affects of the South Mountain Mine Site and Flower Run Deep Mine. This segment of stream between JOHN3.0 and JOHN2.0 has fair water quality according to the SRBC.

This segment of Johnson Creek receives flow from the Arnot No. 5 Mine Discharge, which travels in unnamed tributary 7.0 from the deep mine opening through a large wetland area. Several seepage areas emanate from coal refuse material located near the Arnot No. 5 Mine Discharge. Several unnamed tributaries enter Johnson Creek between JOHN3.0 and JOHN2.0.

Sample point JOHN2.0 conveys an average flow of 10.4 cfs, with measured flows ranging from 3.06 cfs to 21.36 cfs. The pH in this segment ranges from 6.1 to 6.4, with an average pH of 6.25. Other average chemical parameters for this reach include acidity of 20.4 mg/l, alkalinity of 13.83 mg/l, total iron of 0.36 mg/l, total manganese of 0.38 mg/l, total aluminum of 0.50 mg/l, and total sulfate of 62.03 mg/l.

Sample point JOHN1.0 is located at the mouth of Johnson Creek near the confluence with the Tioga River. This segment of stream between sample points JOHN2.0 and JOHN1.0 has fair water quality according to the SRBC.

This segment of Johnson Creek receives flow from the South Mountain Complex via unnamed tributary 5.0 and from the Flower Run Deep Mine. Both the South Mountain Discharges and the Flower Run Deep Mine Discharge have degraded water quality. Several unnamed tributaries enter Johnson Creek between JOHN2.0 and JOHN1.0.

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Sample point JOHN1.0 conveys an average flow of 20.21 cfs, with measured flows ranging from 5.40 cfs to 44.94 cfs. The pH in this segment ranges from 6.2 to 6.5, with an average pH of 6.32. Other average chemical parameters for this reach include acidity of 19.17 mg/l, alkalinity of 16.63 mg/l, total iron of 0.31 mg/l, total manganese of 0.45 mg/l, total aluminum of 0.53 mg/l, and total sulfate of 49.00 mg/l.

TMDLs were established for two tributaries to Johnson Creek, unnamed tributary No. 7 and the South Mountain Tributary (also referenced as unnamed tributary No. 5). Unnamed tributary No. 7 (UNT7.0) is located at the eastern edge of the Village of Arnot, and the UNT7.0 receives drainage from the Arnot No. 5 discharge. Unnamed tributary No. 5 (UNT5.0) receives discharges from the South Mountain Site located east of Route 15.

Flows at UNT7.0 range from 1.63 cfs to 8.33 cfs with an average flow of 4.11 cfs. Pollutant concentrations average 0.60 mg/L of iron, 0.52 mg/l of manganese, 0.52 mg/l of aluminum, and 88.28 mg/l of sulfate. Acidity averages 24.57 mg/l, while alkalinity averages 16.30 mg/l. Sample data at point UNT7.0 show pH ranging from 5.7 to 6.4. This unnamed tributary was not classified in the SRBC study, but would be classified as having fair quality based on SRBC's water quality criteria.

Unnamed tributary 5.0 drains South Mountain, which was extensively mined. Flows at UNT5.0 range from no flow to 1.32 cfs with an average flow of 0.78 cfs. Pollutant concentrations average 0.74 mg/L of iron, 9.05 mg/l of manganese, 10.22 mg/l of aluminum, and 193.22 mg/l of sulfate. Acidity averages 107.76 mg/l, while alkalinity ranges for 0 mg/l to 4.6 mg/l and averages 0.92 mg/l. Sample data at point UNT5.0 show pH ranging from 3.5 to 4.1. This tributary was classified as having poor water quality.

2.2 Applicable Water Quality Standards

Johnson Creek is listed as having a protected use of Cold Water Fishes in Title 25, Chapter 93 of the Pennsylvania Code. The stream is included in Drainage List H for the Tioga River Basin. In addition to the TMDLs for iron, manganese, aluminum, and acidity that were established by the

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DEP for the watershed, specific and state-wide water quality criteria for the stream are provided in Title 25, Chapter 93 of the Pennsylvania Code.

Tables 3 and 4 of 25 PA Code §93.7 provide specific water quality criteria for critical uses including CWF, as Johnson Creek is classified. Specific criteria for CWF include dissolved oxygen and temperature. Water quality criteria for CWF uses are provided in Table 2.1.

TABLE 2.1 WATER QUALITY CRITERIA FOR CWF

PARAMETER	CRITERIA
Alkalinity	Minimum 20 mg/l as $CaCO_3$ except where natural conditions are less
Dissolved Oxygen	6.0 mg/l minimum daily average for flowing waters; 5.0 mg/l minimum
Osmotic Pressure	50 milliosmoles per kilogram
Temperature	Ranges from 38 to 66 degrees, maximum, depending on the month
Total Dissolved Solids	500 mg/l monthly average value; 750 mg/l maximum
Total Residual Chlorine	0.011 mg/l for 4-day average; 0.019 mg/l for hourly average

Values have also been established for iron and pH but they duplicate the values for these parameters established by the TMDLs for the stream and were included with the TMDLs.

The TMDLs for the Tioga River Watershed were developed to meet water quality endpoints or goals as provided in Table 2.2.

TABLE 2.2 WATER QUALITY ENDPOINTS FOR THE TIOGA RIVER WATERSHED

PARAMETER	ENDPOINT
Aluminum, Total Recoverable	0.75
Manganese, Total Recoverable	1.00
Iron, 30-day Average Recoverable	1.50

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PARAMETER	ENDPOINT
Iron, Dissolved	0.3
pH	6.0-9.0

These endpoints were selected as they should allow the waters to achieve their designated uses. The required reductions were designed to be protective of the water quality criterion for each specific parameter 99 percent of the time. Additional information about specific TMDL limits and reductions for points in the Johnson Creek Watershed is provided in Section 3 of this narrative.

2.3 Identification and Prioritization of Pollution Sources

The SRBC's *Watershed Assessment and Restoration Strategy* identified pollutant sources in the Johnson Creek Watershed and provided for a prioritization of pollutant sources. During the development of this Implementation Plan, Alder Run Engineering personnel visited the watershed and the identified pollutant sources to verify the current conditions and any restoration work that has occurred in the watershed since the time of the SRBC's report. A discussion of existing pollution sources and their priority with respect to restoration of the Johnson Creek Watershed is provided in the following paragraphs. Location maps showing the pollution sources are provided as Figures 3A and 3B in Appendix A. Photographs of the pollution sources are provided in Appendix E. Water quality data for the mine drainage discharges were obtained from the SRBC's *Conceptual Treatment and Restoration Plan*.

The SRBC's *Conceptual Treatment and Restoration Plan* recommended addressing four areas listed later in this section in an upstream to downstream direction, in accordance with the overall progressive restoration plan for the Tioga River Watershed. Using SRBC's recommended prioritization, restoration activities would begin at the Arnot No. 2 Mine, #1 Discharge, followed by the Arnot No. 5 Discharge, the Flower Run Discharge, and finally completed by the restoration of the South Mountain Discharges. SRBC's prioritization was based on an upstream-to-downstream progression rather than on loadings, anticipated costs, results, etc.

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The prioritization developed for this Implementation Plan follows the SRBC's priorities for the most part. A treatment system for the Arnot No. 2 Mine, #1 Discharge is under construction, and that discharge remains as priority 1. However, the South Mountain Discharges have been moved to priority two due to local considerations as two environmental organizations are now active in the watershed, and one of the organizations wishes to focus on the large South Mountain Project(s). Subsequently, the Arnot No. 5 and Flower Run Discharges shifted to priorities 3 and 4, respectively. Table 2.3 provides a comparison of prioritization of restoration projects in the Johnson Creek Watershed.

TABLE 2.3 PRIORITIZATION OF RESTORATION PROJECTS IN THE JOHNSON CREEK WATERSHED

POLLUTANT SOURCE	SRBC PRIORITY RANKING WITHIN JOHNSON CREEK	IMPLEMENTATION PLAN PRIORITY RANKING
Arnot No. 2 Mine, #1 Discharge	1	1
Arnot No. 5 Discharge	2	3
Flower Run Discharge	3	4
South Mountain Discharges	4	2

2.3.1 Arnot No. 2 Mine, #1 Discharge

The first priority in the Johnson Creek Restoration is the #1 Discharge from the Arnot No. 2 Mine located northwest of the Village of Arnot. This discharge is labeled as point DJC904 in the SRBC report. The continuous discharge originates from a deep mine opening and displays the following average water quality as shown on Table 2.4.

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TABLE 2.4 AVERAGE WATER QUALITY FOR THE ARNOT NO. 2 MINE#1 DISCHARGE (DJC904)

PARAMETER	AVERAGE VALUE	SRBC POLLUTANT RANKING
Flow	97 gallons per minute (gpm)	
pH	4.65	
Acidity	70	16
Alkalinity	2	
Aluminum	3.19	17
Iron	0.24	18
Manganese	3.14	17
Sulfate	220	

All values in mg/l unless otherwise noted. pH values provided in SU.

According to SRBC's calculations, the DJC904 discharge contributes 0.27 percent of the acidity to the acid loading at sample point TIOG2 (Tioga River below Johnson Creek and Bear Creek) and 0.62 percent of the sulfate loading to that same sample point.

The SRBC ranked each discharge in the Tioga River Watershed in terms of iron load, manganese load, aluminum load, and acidity load. These rankings were used to develop a total overall ranking of the discharges. The rankings for DJC904 are shown on Table 2.4. The overall ranking for this discharge was 17th in the Tioga River Watershed. Although DJC904 ranked 17th in the Tioga River Watershed, construction efforts are underway, and completion of the ongoing project remains as the first priority of this implementation plan.

2.3.2 South Mountain Discharges

The South Mountain Discharges are the second priority for the restoration of Johnson Creek. The South Mountain site was extensively mined, and both reclaimed and unreclaimed areas are present on the site. Areas of acid-producing overburden material or spoil material with no vegetation are present, as well as an open strip pit with an unreclaimed highwall. Several diffuse AMD seeps emanate from the edges of the strip mine area Two separate treatment areas have been identified for this site at sample points DJC902 and DJC903. The two sample points are

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points where several discharge were collected and sampled together. The drainage from the two sample points combines to form the South Mountain Tributary to Johnson Creek (UNT5.0). This site drains to the Tioga River as well as Johnson Creek, but the discharges to the Tioga River are not addressed in this implementation plan. Tables 2.5 and 2.6 provide the average water quality data and SRBC pollutant ranking for the two sample points at South Mountain.

TABLE 2.5 AVERAGE WATER QUALITY FOR THE SOUTH MOUNTAIN DISCHARGE (DJC902)

PARAMETER	AVERAGE VALUE	SRBC POLLUTANT RANKING
Flow	80 gpm	
pH	2.88	
Acidity	332	9
Alkalinity	0	
Aluminum	24.00	8
Iron	24.03	8
Manganese	28.96	7
Sulfate	583	

All values in mg/l unless otherwise noted. pH values provided in SU.

TABLE 2.6 AVERAGE WATER QUALITY FOR THE SOUTH MOUNTAIN DISCHARGE (DJC903)

PARAMETER	AVERAGE VALUE	SRBC POLLUTANT RANKING
Flow	46 gpm	
pH	3.02	
Acidity	274	12
Alkalinity	0	
Aluminum	24.36	12
Iron	4.42	15
Manganese	26.80	12
Sulfate	517	

All values in mg/l unless otherwise noted. pH values provided in SU.

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Phone (814) 339-6998
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According to SRBC's calculations, the DJC902 discharge point contributes 1.05 percent of the acidity to the acid loading at sample point TIOG2 (Tioga River below Johnson Creek and Bear Creek) and 1.37 percent of the sulfate loading to that same sample point. The DJC903 sample point contributes 0.49 percent of the acidity loading and 0.69 percent of the sulfate load to TIOG2.

Sample point UNT5.0, which receives flow from DJC902 and DJC903 is ranked by the SRBC is the 3rd worst discharge in the Tioga River Watershed in terms of exceeding DEP's criterion for manganese. It is also ranked 5th in terms of exceeding the criterion for aluminum in the Tioga River Watershed.

The SRBC's pollutant rankings for DJC902 and DJC903 are shown on Tables 2.5 and 2.6. The overall ranking for these discharges are 9th and 13th, respectively. This discharge ranks lower in the Tioga River Watershed than the Arnot No. 5 discharge, but again efforts to remediate these discharges are underway and are assisted by the DEP, so this discharge is considered the second priority of this implementation plan.

2.3.3 Arnot No. 5 Mine Discharge

The Arnot No. 5 Mine Discharge is located east of the Village of Arnot. This discharge is the third priority in the restoration of Johnson Creek. This discharge is labeled as point DJC900 in the SRBC report. This discharge is the second largest discharge in the Tioga River Watershed, and the discharge contributes almost all of the flow in UNT7.0. The continuous discharge originates from a deep mine opening and displays the following average water quality as shown on Table 2.7.

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Phone (814) 339-6998
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TABLE 2.7 AVERAGE WATER QUALITY FOR THE ARNOT NO. 5 DISCHARGE (DJC900)

PARAMETER	AVERAGE VALUE	SRBC POLLUTANT RANKING
Flow	2322 gpm	
pH	5.73	
Acidity	42	5
Alkalinity	13	
Aluminum	0.65	9
Iron	0.85	7
Manganese	0.68	8
Sulfate	96	

All values in mg/l unless otherwise noted. pH values provided in SU.

According to SRBC's calculations, the DJC900 discharge contributes 3.88 percent of the acidity to the acid loading at sample point TIOG2 (Tioga River below Johnson Creek and Bear Creek) and 6.5 percent of the sulfate loading to that same sample point. The SRBC's pollutant rankings for DJC900 are shown on Table 2.7. The overall ranking for this discharge is 7th in the Tioga River Watershed, and as such the discharge was assigned priority 3 of this Implementation Plan. This discharge will be addressed as soon as the other two ongoing projects in the Johnson Creek Watershed are completed.

2.3.4 Flower Run Deep Mine

The Flower Run Deep Mine Discharge is the fourth and final priority for the restoration of Johnson Creek. The discharge located to the immediate west of Route 15. This discharge was labeled as sample point DJC106 in the SRBC study. The discharge is continuous in nature. Average water quality data for the discharge are provided in Table 2.8.

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TABLE 2.8 AVERAGE WATER QUALITY FOR THE FLOWER MINE DISCHARGE (DJC106)

PARAMETER	AVERAGE VALUE	SRBC POLLUTANT RANKING
Flow	51 gpm	
pH	2.85	
Acidity	185	15
Alkalinity	0	
Aluminum	10.13	16
Iron	8.38	13
Manganese	3.04	19
Sulfate	228	

All values in mg/l unless otherwise noted. pH values provided in SU.

According to SRBC's calculations, the DJC106 discharge contributes 0.37 percent of the acidity to the acid loading at sample point TIOG2 (Tioga River below Johnson Creek and Bear Creek) and 0.34 percent of the sulfate loading to that same sample point. The SRBC's pollutant rankings for DJC106 are shown on Table 2.8. The overall ranking for this discharge is 16th in the Tioga River Watershed. This discharge has the lowest ranking of the four proposed treatment project in terms of the Tioga River Watershed, and consequently is the fourth and last priority of this implementation plan.

2.3.5 Other Sources

Other pollution sources in the watershed include two refuse piles and an area in need of stream restoration activities. A mine refuse pile is located east of the Village of Arnot as shown as Refuse Area S5 on Figure 3-A. The SRBC identified mine drainage discharges originating from this pile, and determined that these discharges have little impact to the water quality of Johnson Creek. Since the refuse area has little impact on water quality, the removal or stabilization of the refuse area was not determined to be absolutely necessary for the restoration of Johnson Creek, and thus this area was not assigned a priority value.

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A second refuse pile is shown as Refuse Area S4 on Figure 3A in Appendix A. Due to its proximity to the Arnot No. 5 Discharge and the need for removal of refuse to create room for AMD treatment, as discussed later in this narrative, this refuse pile area is grouped together with the Arnot No. 5 project.

Stream restoration activities are needed at the Stream Channel Restoration area shown on Figure 3A. This site is the location of a former coal washing facility, and erosion has occurred around the remnants of the former washing facility. The stream channel has left its historical location and is eroding an area of coal refuse materials. A photograph of the ongoing stream bank erosion is provided in Appendix E. This problem does not have major quantifiable impacts to the water quality in Johnson Creek, but this area is a source of sediment and coal fines to the stream. Since there are no major water quality impacts from this area, this area was not considered a priority for the purposes of this implementation plan.

During the summer of 2006, additional erosion occurred in this area due to a flooding event. The DEP has issued an emergency permit for repair of this area, and is assisting the Arnot Sportsmen Association with restoration of the original channel to create a stable channel that is not eroding mine refuse. The area will be permanently stabilized. As a result, this pollutant source is considered to have been addressed and is not included in the future restoration plans for the watershed.

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3.0 POLLUTANT REDUCTIONS REQUIRED TO MEET TMDLS

Total Maximum Daily Loads (TMDLs) for Johnson Creek were included in the *Tioga River Watershed TMDL* prepared for the PA DEP in 2003. Excerpts from the TMDL relating to the Johnson Creek Watershed are provided in Appendix C, and the full TMDL is contained on the CD provided in Appendix B. This section is based on the limits established by and published in the *Tioga River Watershed TMDL.*

The TMDLs for Johnson Creek were developed for depressed pH and high levels of metals due to acid mine drainage from abandoned coal mines. The TMDL addresses pH and the three primary metals associated with AMD (iron, manganese, and aluminum). No other categories of impairment were listed for the Johnson Creek Watershed. The required pollutant reductions specified in the TMDL and the impacts to downstream waters from the required reductions are discussed in the following paragraphs.

3.1 Required Reductions

The TMDLs for Johnson Creek were developed for specific reaches of the stream and are provided in reference to several points in the watershed, including the following: Johnson Creek above point JOHN3; Johnson Creek above point JOHN2; Johnson Creek above point JOHN1, and unnamed tributaries 5.0 and 7.0 (UNT5.0 and UNT7.0). Figures showing the locations of each of the sample points are provided as Figures 4A and 4B in Appendix A.

The TMDLs were developed to meet water quality criterion values of 0.75 mg/l of total recoverable aluminum, 1.00 mg/l of total recoverable manganese, 1.50 mg/l of 30-day average recoverable iron, 0.3 mg/l of dissolved iron, and a pH between 6.0 and 9.0 The pollutant reductions needed to meet the water quality criteria are described in detail below for each stream segment. The required reductions were designed to be protective of the water quality criterion for each specific parameter 99 percent of the time.

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Johnson Creek Above Point JOHN3

TMDLs have been developed for iron and manganese for this segment above sample point JOHN3, which is located between the Elm Street and Walnut Street Bridges in the Village of Arnot. The segment is net alkaline, with pH ranging from 6.0 to 6.5, so pH was not included in the TMDL for the segment.

TABLE 3.1 REQUIRED POLLUTANT REDUCTIONS FOR JOHNSON CREEK ABOVE SAMPLE POINT JOHN 3

SAMPLE POINT JOHN3	MEASURED SAMPLE VALUES		ALLOWABLE VALUES		REDUCTION IDENTIFIED
	Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
Iron	0.74	12.7	0.30	5.2	59
Manganese	0.47	8.1	0.39	6.7	18
Aluminum	0.51	8.8	0.51	8.8	0
Acidity	13.37	229.7	13.37	229.7	0
Alkalinity	16.33	280.6			

All values shown in this table are long-term average daily values.

Iron concentrations in this segment must be reduced from a long-term average daily value of 0.74 mg/l to 0.30 mg/l, while iron loading must be reduced from 12.7 pounds per day (lb/day) to 5.2 lb/day. Manganese concentrations must be reduced from 0.47 mg/l to 0.39 ml/l for the long-term average daily concentration, with a corresponding reduction in loading from 8.1 lb/day to 6.7 lb/day. The reductions identified are 59 percent for iron and 18 percent for manganese.

Unnamed Tributary to Johnson Creek Above UNT7.0

TMDLs have been developed for aluminum and acidity for this segment of an unnamed tributary to Johnson Creek located east of the Village of Arnot. Sample point UNT7.0 is located at the mouth of the unnamed tributary, which carries the flow from the Arnot No. 5 Mine Discharge. While the pH in this segment ranges between 5.7 to 6.4, the segment is net acidic due to mining impacts so pH values were included in the TMDL for the segment.

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TABLE 3.2 REQUIRED POLLUTANT REDUCTIONS FOR THE UNNAMED TRIBUTARY TO JOHNSON CREEK ABOVE SAMPLE POINT UNT7.0

SAMPLE POINT UNT7.0	MEASURED SAMPLE VALUES		ALLOWABLE VALUES		REDUCTION IDENTIFIED
	Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
Iron	0.60	13.3	0.60	13.3	0
Manganese	0.52	11.5	0.52	11.5	0
Aluminum	0.54	12.0	0.51	11.3	7
Acidity	24.57	545.1	3.93	87.2	84
Alkalinity	16.30	361.6			

All values shown in this table are long-term daily values.

Aluminum concentrations in this segment must be reduced from a long-term average daily value of 0.54 mg/l to 0.51 mg/l, while aluminum loading must be reduced from 12.0 lb/day to 11.3 lb/day. Acidity must be reduced from 24.57 mg/l to 3.93 mg/l for the long-term average daily concentration. The corresponding reduction in acidity is a reduction from 545.1 lb/day of acidity to 87.2 lb/day. The reductions identified are 7 percent for aluminum and 84 percent for acidity.

Johnson Creek Between JOHN3.0 and JOHN2.0

This segment of the main stem of Johnson Creek is located east of the Village of Arnot and west of Route 15. Sample point JOHN2.0 is located at the a bridge at a trail crossing approximately 1/3 mile upstream from the Route 15 overpass. Johnson Creek between JOHN3.0 and JOHN2.0 receives drainage from the UNT7.0 unnamed tributary which conveys the Arnot No. 5 Discharge and a series of discharges from a large abandoned refuse pile on former State Forest Lands just outside the Village of Arnot. Point JOHN2.0 represents Johnson Creek upstream of the influence of the UNT5.0 unnamed tributary, which conveys flows from the South Mountain Site.

The load reductions for this segment consist of reduction in acidity. While the pH in this segment ranges between 6.1 and 6.4, pH will be addressed as part of this TMDL because the water quality is net acidic due to mining impacts in this segment.

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The Tioga River Watershed TMDL developed load allocations for sample point JOHN2.0. These allocations are provided in Table 3.3.

TABLE 3.3 LOAD ALLOCATIONS FOR JOHNSON CREEK BETWEEN SAMPLE POINTS JOHN3.0 AND JOHN2.0

SAMPLE POINT JOHN2.0	MEASURED SAMPLE VALUES		ALLOWABLE SAMPLE VALUES	
	Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.36	20.2	0.36	20.2
Manganese	0.38	21.3	0.38	21.3
Aluminum	0.50	28.0	0.50	28.0
Acidity	20.40	1143.3	3.06	171.5
Alkalinity	13.83	775.1		

All values shown in this table are long-term average daily values.

Based on the data included in Table 3.3, reductions in acidity from concentrations of 20.40 mg/l to 3.06 mg/l and reductions in acidity loading from 1143.4 lb/day to 171.5 lb/day are required at JOHN2.0.

Sample points JOHN3.0 and UNT7.0 are located upstream of JOHN2.0, and loading reductions for both of those upstream points were prescribed. The TMDL plan accounted for loading reductions at points JOHN3.0 and UNT7.0. For each pollutant, the total load that was removed upstream at JOHN3.0 and UNT7.0 was subtracted from the existing load at point JOHN2.0, and the calculated value was compared to the allowable load at point JOHN2.0. Reductions at point JOHN2.0 are necessary for any pollutant parameter that exceeds the allowable load at JOHN2.0. The required reductions at point JOHN2.0 are shown in Table 3-4.

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TABLE 3.4 POLLUTANT REDUCTIONS NECESSARY AT POINT JOHN2.0

	Iron (lb/day)	Manganese (lb/day)	Aluminum (lb/day)	Acidity (lb/day)
Existing Loads at JOHN2.0	20.2	21.3	28.0	1143.3
Total Load Reduction at JOHN3.0 and UNT7.0	7.5	1.4	0.7	457.9
Remaining Load	12.7	19.9	27.3	685.4
Allowable Loads at JOHN2.0	20.2	21.3	28.0	171.5
Percent Reduction	0	0	0	75
Load Reduction	0	0	0	513.9

Provided that the specified reductions at JOHN3.0 and UNT7.0 are met, acidity is the only parameter where reductions are needed at point JOHN2.0. The loadings for iron, manganese, and aluminum will be below the allowable loads at JOHN2.0. Acidity loadings at JOHN2.0 will be reduced from 1143.3 lb/day to 685.4 lb/day due to upstream reductions, so reductions in loading from 685.4 lb/day to 171.5 lb/day must be achieved in this segment.

Unnamed Tributary to Johnson Creek Above UNT5.0

Unnamed tributary 5.0 to Johnson Creek drains the South Mountain site. This site is located east of Route 15 and west of Blossburg and the Tioga River. This unnamed tributary conveys flow from several AMD discharges on the former mining site, and sample point UNT5.0 is located at the mouth of the unnamed tributary.

TMDLs have been developed for iron, manganese, aluminum, and acidity for this segment of the South Mountain Tributary to Johnson Creek. The pH in this segment ranges between 3.5 and 4.1, and pH values were included in the TMDL for the segment. The load allocations made at point UNT5.0 are provided in Table 3.5.

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TABLE 3.5 REQUIRED POLLUTANT REDUCTIONS FOR THE UNNAMED TRIBUTARY TO JOHNSON CREEK ABOVE SAMPLE POINT UNT5.0

SAMPLE POINT UNT5.0	MEASURED SAMPLE VALUES		ALLOWABLE VALUES		REDUCTION IDENTIFIED
	Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
Iron	0.74	3.1	0.61	2.6	17
Manganese	9.05	38.0	0.45	1.9	95
Aluminum	10.22	43.0	0.10	0.4	97
Acidity	107.76	453.0	0.32	1.3	99.7
Alkalinity	0.92	3.9			

All values shown in this table are long-term average daily values.

Iron concentrations in this segment must be reduced from a long-term average daily value of 0.74 mg/l to 0.61 mg/l, while iron loading must be reduced from 3.1 lb/day to 2.6 lb/day. Manganese concentrations must be reduced from a 9.05 mg/l to 0.45 mg/l, while manganese loading must be reduced from 38.0 pounds per day lb/day to 1.9 lb/day. Aluminum concentrations must be reduced from 10.22 mg/l to 0.1 mg/l, while loadings must be reduced from 43.0 lb/day to 0.4 lb/day. Acidity must be reduced from 107.76 mg/l to 0.32 mg/l for the long-term average daily concentration. Acidity loadings must display a reduction from 453.0 lb/day of acidity to 1.3 lb/day. The reductions identified are 17 percent for iron, 95 percent for manganese, 97 percent for aluminum and 99.7 percent for acidity.

Johnson Creek Between JOHN2.0 and JOHN1.0

This segment of the main stem of Johnson Creek is located west of the Town of Blossburg and extends a short distance west of Route 15. Sample point JOHN1.0 is located at the mouth of Johnson Creek. This segment receives discharge from the Flower Run Deep Mine and drainage from UNT5.0.

The load reductions for this segment consist of reductions in manganese and acidity. While the pH in this segment ranges from 6.2 to 6.5, pH will be addressed as part of this TMDL because the water quality is net acidic due to mining impacts in this segment.

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The Tioga River Watershed TMDL developed load allocations for sample point JOHN2.0. These allocations are provided in Table 3.6.

TABLE 3.6 LOAD ALLOCATIONS FOR JOHNSON CREEK BETWEEN SAMPLE POINTS JOHN2.0 AND JOHN1.0

SAMPLE POINT JOHN1.0	MEASURED SAMPLE VALUES		ALLOWABLE SAMPLE VALUES	
	Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.31	33.8	0.31	33.8
Manganese	0.45	49.0	0.34	37.0
Aluminum	0.53	57.7	0.53	57.7
Acidity	19.17	2088.0	3.07	334.4
Alkalinity	16.63	1811.3		

All values shown in this table are long-term average daily values.

Based on the data included in Table 3.6, reductions in manganese concentrations from 0.45 mg/l to 0.34 mg/l, and reductions in manganese loadings from 49.0 lb/day to 37.0 lb/day are required. However, as described in the following paragraphs of this narrative, manganese reductions will be achieved upstream, and acidity is the only parameter for which reductions will be necessary in this reach. Acidity concentrations must be reduced from 19.17 mg/l to 3.07 mg/l, and reductions in acidity loading from 2088.0 lb/day to 334.4 lb/day are required at JOHN1.0.

Sample points JOHN3.0, UNT7.0, UNT5.0, and JOHN2.0 are located upstream of JOHN1.0, and loading reductions for those upstream points were prescribed. The TMDL plan accounted for loading reductions at the four upstream sample points. For each pollutant, the total load that was removed upstream at sample points JOHN3.0, UNT7.0, UNT5.0, and JOHN2.0 was subtracted from the existing load at point JOHN1.0, and the calculated value was compared to the allowable load at point JOHN1.0. Reductions at point JOHN1.0 are necessary for any pollutant parameter that exceeds the allowable load at JOHN1.0. The required reductions at point JOHN1.0 are shown in Table 3-7.

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TABLE 3.7 POLLUTANT REDUCTIONS NECESSARY AT POINT JOHN1.0

	Iron (lb/day)	Manganese (lb/day)	Aluminum (lb/day)	Acidity (lb/day)
Existing Loads at JOHN1.0	33.8	49.0	57.7	2088.0
Total Load Reduction at JOHN3.0, UNT7.0, UNT5.0, JOHN2.0	8.0	37.5	43.3	1423.5
Remaining Load	25.8	11.5	14.4	664.5
Allowable Loads at JOHN1.0	33.8	37.0	57.7	334.4
Percent Reduction	0	0	0	50
Load Reduction	0	0	0	330.1

Provided that the specified reductions at JOHN3.0, UNT7.0, UNT5.0, and JOHN2.0 are met, acidity is the only parameter where reductions are needed at point JOHN1.0. The loadings for iron, manganese, and aluminum will be below the allowable loads at JOHN1.0. Acidity loadings at JOHN1.0 will be reduced from 2088.0 lb/day to 664.5 lb/day due to upstream reductions, so reductions in loading from 664.5 lb/day to 334.4 lb/day must be achieved in this segment.

3.2 Impacts to Downstream Waters

Johnson Creek discharges to the Tioga River at the Town of Blossburg. The Tioga River at Blossburg is severely impacted by AMD. The SRBC's *Watershed Assessment and Restoration Strategy* determined that restoration activities in the Johnson Creek Watershed "will not produce any significant improvements in the Tioga River main stem as long as larger upstream AMD sources remain." Although there will not be a significant impact to the Tioga River from restoration of Johnson Creek, the SRBC report recommended the restoration of Johnson Creek because of high benefit-to-cost ratios, the potential for successful restoration, and the potential use of the proposed project as demonstration projects to increase public interest.

The restoration of Johnson Creek through the implementation of BMPs in four areas of the Johnson Creek Watershed will result in a reduction in pollutant loadings in the Tioga River. However, the reduction in loadings from Johnson Creek to the Tioga River alone will not be sufficient to restore the Tioga River below its confluence with Johnson Creek.

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The TMDL plan for the Tioga River contained a summary of all loads affecting sample point TIOG2.0 and reductions necessary at this point, which is the Tioga River downstream of Bear Creek (which is downstream of Johnson Creek). In order for the TMDL for the Tioga River to be met at sample point TIOG2.0, loading reductions of 1320.5 lb/day of manganese, 2177.3 lb/day of aluminum, and 3410.0 lb/day of acidity are required. The TMDL assumes load reductions in the Fallbrook Creek, Morris Run, Coal Run, and Bear Creek Watersheds, as well as reductions in the segment of the Tioga River between TIOG3.0 (upstream of Johnson Creek) and TIOG2.0. Even if all pollutant loadings of manganese, aluminum, and acidity were somehow removed from Johnson Creek, the reduction in loadings in the receiving waters of the Tioga River would not be sufficient to realize a significant impact to the water quality of the river or to achieve the TMDL reductions for the river.

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4.0 MANAGEMENT MEASURES REQUIRED TO ACHIEVE PRESCRIBED LOAD REDUCTIONS

Water quality and flow data were studied during the preparation of this implementation plan and as part of the SRBC's *Watershed Assessment and Restoration Strategy*. SRBC's report identified four areas in the watershed where management measures are needed to achieve the prescribed load reductions and meet the TMDLs for Johnson Creek, and the existing conditions were verified the ensure that that a need for best management practices was still present. Existing best management practices (or BMPs), areas designated for additional controls, and appropriate best management practices and their anticipated performance are described in the following paragraphs.

4.1 Existing Best Management Practices

Existing BMPs relating to impairments from AMD in the Johnson Creek Watershed include passive treatment systems, reclamation activities, and other BMPs. Passive treatment systems have been built for the #2 and #4 Discharges from the No. 2 Mine, located west and south of the Village of Arnot. Reclamation has occurred in various areas throughout the watershed. Other BMPs such as a constructed wetland, diversion wells and both active and passive treatment systems for AMD are located near but outside of the Johnson Creek Watershed.

The existing passive treatment system at the Arnot No. 2 Mine, #4 Discharge is not located in the Johnson Creek Watershed. This system drains to Lick Creek. Although the system is not located in the Johnson Creek Watershed, it is located very close to the watershed, and it treats water discharge from the Arnot No. 2 deep mine pool. The effectiveness and experiences with this existing system can be applied to passive treatment practices in the Johnson Creek Watershed. The existing system was designed to treat for acidity and aluminum, and the system has experienced some problems with high flows in the recent past. The system consists of a sequential alkalinity producing system (or SAPS) plus an anoxic limestone drain (ALD) and was constructed in 1996. All flow was originally designed to pass through the treatment components and no high-flow bypass was provided. This configuration led to problems with the functionality of the treatment cells due to excessive flows. Modifications and repairs to this system were

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recently made to improve the effectiveness of this treatment system. This lesson should be applied to the Johnson Creek Watershed and to passive treatment systems designed to treat water discharging from deep mine pools. The initial design of passive treatment systems must consider the potential for high discharges, and high flow bypass systems should be incorporated into the project design to protect the integrity and functionality of treatment cells during high flows.

Other BMPs in the watershed include a diversion well was constructed to treat the #2 Discharge of the No. 2 Mine. The well, which was designed by the DER, has consistently produced alkaline water. A constructed wetland was constructed at the Flower Mine Discharge by the Pennsylvania Department of Transportation (PennDOT), but the wetland does not have sufficient size to adequately treat the mine discharge. The DEP's RAMP program funded the removal of the former Blossburg Coal Company dam on Sawmill Run which was leaking water into abandoned deep mines. Several projects, including private removal of deep mine refuse and a RAMP-funded project to reclaim the Arnot No. 4 Mine site have occurred in the watershed.

A passive treatment system for AMD is under construction at the Arnot No. 2 Mine, #1 Discharge site. This site is one of the five areas identified to be in need of BMPs by the SRBC's *Watershed Assessment and Remediation Strategy*, and construction of this system has commenced since the SRBC report was completed. Construction is to be completed in October of 2006. This system is addressed in the next section of this narrative as an area designated for additional controls.

4.2 Areas Designated for Additional Controls

The available water quality data were used to identify areas where additional controls are needed. Four areas within the watershed have been designated as having a need for BMPs to control pollutants resulting from AMD. The proposed controls are located at the four remaining large AMD sources. Approximately four miles of stream could benefit from this work. The areas where controls are proposed include the following:

- Arnot No. 2 Mine, #1 Discharge
- South Mountain Discharges

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- Arnot No. 5 Mine
- Flower Run Mine

The location of each of these areas is provided on Figures 3A and 3B in Appendix B. Each area is described in detail in the following paragraphs. Conceptual designs and cost estimates prepared as part of the SRBC's *Watershed Assessment and Restoration Strategy* are included as Appendix D. Photographs of each area are provided in Appendix E. The treatment system for the Arnot No. 2 Mine, #1 Discharge is included in this section of this narrative as it is not yet fully functional and because construction of the system will result in the restoration of a portion of Johnson Creek.

4.2.1 Arnot No. 2 Mine, #1 Discharge

The passive treatment system for the Arnot No. 2 Mine, #1 Discharge has been designed and permitted, and construction is substantially complete. This passive treatment system will consist of two sets of a limestone cell followed by settling basins. The intent of the system is to provide an increase in alkalinity to the deep mine discharge and to allow for the precipitation of aluminum from the mine water. Limestone cells were selected as the treatment component as opposed to treatment containing compost because of low iron concentrations. This system was designed prior to the development of this implementation plan.

The system was designed to increase alkalinity in the discharge and allow for the precipitation and subsequent removal of aluminum. The TMDLs for this reach of stream require the reduction of iron and manganese. The generation of additional alkalinity and increased settling time, combined with treatment in naturally-occurring downstream wetlands, will assist with the removal of iron and manganese.

The treatment system for the Arnot No. 2 Mine, #1 Discharge will be treating water with marginal water quality. The passive treatment system at the Arnot No. 2 Mine, #1 discharge is partially functional, so the long-term performance and effectiveness of a fully-functional system cannot yet be determined.

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4.2.2 South Mountain Discharges

Two areas of treatment are proposed for the South Mountain Discharges. The treatment will consist of a series of collection ditches, vertical flow wetlands, surface flow wetlands, and settling basins. Active treatment could be implemented at this site, but is not proposed due to financial constraints and operating expenses.

4.2.3 Arnot No. 5 Mine

The Arnot No. 5 discharges a large volume of water with mild characteristics. Due to the relatively high pH and low metals concentrations, a compost wetland would be provided for this discharge, which would allow for the reduction of metals already at low concentrations. The removal of mine refuse associated with this project must occur to create space for the construction of the treatment system.

4.2.4 Flower Run Mine

The Flower Run Mine discharges poor quality water but flows are low. Construction at this site is limited by the available space. BMPs proposed for this site include an open limestone channel, which would serve to add alkalinity to the discharge. The existing wetland at the site would remain in place to serve as additional treatment.

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4.3 Appropriate Best Management Practices

Appropriate BMPs have been determined for each of the three areas, the South Mountain Discharges, the Arnot No. 5 Mine, and the Flower Mine, yet to be addressed. The BMPs were selected based on the nature and magnitude of the pollutant sources, flow data, the location of the pollutant source, availability of treatment area, engineering feasibility, permitting feasibility, and cost effectiveness. The BMPs selected for each area were discussed in the proceeding paragraphs.

The selection of appropriate BMPs in the Johnson Creek watershed poses some difficulty as the AMD to be treated often has fairly mild chemical characteristics. Current passive treatment technologies have limitations with respect to discharge of pollutants, and reductions in concentrations of metals below 1 mg/l are often difficult to achieve. At best, both passive and active treatment systems can be expected to discharge waters with aluminum concentrations of 0.25 mg/l and iron and manganese concentrations of 0.5 mg/l. An estimated 20 mg/l of alkalinity can be expected to be generated. The Johnson Creek TMDLs for metals are mostly less than 0.5 mg/l, which is difficult to achieve using current technologies. Additionally, the waters discharging from the deep mines in the watershed often have pH in the range of 5-6, which slows the dissolution of limestone and impairs alkalinity generation, further complicating this issue.

4.4 Performance of Best Management Practices

The anticipated performance of the appropriate BMPs has been estimated based on current reclamation and treatment technology and the expected performance of passive treatment systems treating water of similar quality. The SRBC's *Acid Mine Drainage Conceptual Treatment and Restoration Plan,* a component of their *Watershed Assessment and Restoration Strategy,* contains detailed modeling regarding the expected performance of BMPs and the anticipated water quality improvements resulting form the implementation of each BMP. The reader is referred to this detailed performance analysis created using the Watershed Restoration Analysis Module (WRAM).

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The WRAM analysis examined the expected performance of proposed BMPs on an individual basis as well as on a more-regional stream recovery basis. Johnson Creek was included in Stage 2 of the SRBC's WRAM analysis, and the analysis assumed that all five projects in the Johnson Creek Watershed (Arnot No. 2 Mine, Arnot No. 5 Mine, Flower Run, and the two South Mountain projects) were implemented. The anticipated results provided an estimate of the recovery of the main stems of Johnson Creek and the Tioga River and estimates of the performance of the five proposed individual treatment systems.

The SRBC's WRAM analysis indicated that water quality in the entire main stem of Johnson Creek would be improved to the extent that the water quality in the main stem and the major tributaries could be classified as good quality (pH > 6.0, acidity less than alkalinity, and low metals) after all of the BMPs discussed in this narrative are implemented. As discussed in Section 2 of this narrative, current water quality in the main stem ranges from good to fair depending on the segment. Some tributaries are classified as having poor water quality. SRBC's water quality classification criteria were provided in Section 2.1 of this narrative.

SRBC's estimation of stream classification improvements following the implementation of the proposed BMPs is summarized in Table 4.1

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TABLE 4.1 SUMMARY OF SRBC's PROJECTED WATER QUALITY IMPROVEMENTS IN JOHNSON CREEK FOLLOWING IMPLEMENTATION OF BMPS

STREAM SEGMENT OR TRIBUTARY	EXISTING SRBC CLASSIFICATION	CLASSIFICATION AFTER BMP IMPLEMENTATION	CHANGE IN CLASSIFICATION?
Main Stem Above JOHN3.0	Good	Good	No Change
Main Stem Between JOHN3.0 and JOHN2.0	Fair	Good	Yes--From Fair to Good
Main Stem Between JOHN2.0 and JOHN1.0	Fair	Good	Yes—From Fair to Good
Bell Run Tributary	Good	Good	No Change
South Mountain Tributary	Poor	Good	Yes—From Poor to Good

In terms of quantifiable predicted water quality data, the SRBC provided the data contained in Tables 4.2.A and 4.2.B for existing and anticipated (or treated) water quality conditions in terms of pollutant concentrations in Stage 2 of their WRAM analysis model. Minor improvements in water quality at the Johnson Creek sampling points JOHN3.0, JOHN2.0, and JOHN1.0 are predicted, with major improvements predicted at UNT5.0 (South Mountain tributary). Table 4.2.B compares the predicted water quality data (in terms of concentrations) to the TMDLs for each section of Johnson Creek.

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TABLE 4.2.A SUMMARY OF SRBC's EXISTING AND PROJECTED WATER QUALITY IN JOHNSON CREEK FOLLOWING IMPLEMENTATION OF BMPS

CODE 5817

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
JOHN3.0	pH	6.27	pH	6.27
	Acidity	13	Acidity	8
	Alkalinity	16	Alkalinity	17
	Aluminum	0.51	Aluminum	0.31
	Iron	0.74	Iron	0.74
	Manganese	0.47	Manganese	0.29
JOHN2.0	pH	6.25	pH	6.47
	Acidity	20	Acidity	2
	Alkalinity	14	Alkalinity	18
	Aluminum	0.50	Aluminum	0.24
	Iron	0.36	Iron	0.26
	Manganese	0.38	Manganese	0.27
JOHN1.0	pH	6.32	pH	6.40
	Acidity	19	Acidity	5
	Alkalinity	17	Alkalinity	19
	Aluminum	0.53	Aluminum	0.18
	Iron	0.31	Iron	0.20
	Manganese	0.45	Manganese	0.14
UNT5.0 (South Mountain Tributary)	pH	3.70	pH	6.22
	Acidity	108	Acidity	0
	Alkalinity	1	Alkalinity	10
	Aluminum	10.22	Aluminum	0.11
	Iron	0.74	Iron	0.02
	Manganese	9.05	Manganese	0.16

*pH in S.U. All other values in mg/l.

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TABLE 4.2.B SUMMARY OF TMDL ALLOWABLE VALUES AND ANTICIPATED (TREATED) CONDITIONS IN JOHNSON CREEK

CODE 5817

SAMPLE POINT	TMDL ALLOWABLE LTA CONCENTRATIONS		ANTICIPATED (TREATED) CONCENTRATIONS	
JOHN3.0	Acidity	13.37	Acidity	8
	Aluminum	0.51	Aluminum	0.31
	Iron	0.30	Iron	0.74
	Manganese	0.39	Manganese	0.29
JOHN2.0	Acidity	3.06	Acidity	2
	Aluminum	0.50	Aluminum	0.24
	Iron	0.36	Iron	0.26
	Manganese	0.38	Manganese	0.27
JOHN1.0	Acidity	3.07	Acidity	5
	Aluminum	0.53	Aluminum	0.18
	Iron	0.31	Iron	0.20
	Manganese	0.34	Manganese	0.14
UNT5.0 (South Mountain Tributary)	Acidity	0.32	Acidity	0
	Aluminum	0.10	Aluminum	0.11
	Iron	0.61	Iron	0.02
	Manganese	0.45	Manganese	0.16

*pH in S.U. All other values in mg/l.

**indicates TMDL water quality will not be achieved

The predicted water quality data developed by the SRBC can also be presented in terms of pollutant loadings and load reductions. Alder Run Engineering staff utilized the SRBC's anticipated water quality data and SRBC's average flow data at each sample point to calculate predicted loadings and predicted load reductions. Existing loadings were obtained from the Tioga River TMDL to allow comparison between existing and proposed conditions. Tables 4.3.A through 4.3.C provide existing and anticipated (or treated) water quality conditions in terms of pollutant loadings and compare the predicted loadings to the TMDLs for each section of Johnson Creek. As with pollutant concentrations, reductions in loadings at the Johnson Creek sampling points JOHN3.0, JOHN2.0, and JOHN1.0 are predicted.

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TABLE 4.3.A SUMMARY OF EXISTING POLLUTANT LOADS AND PROJECTED REDUCTIONS FROM IMPLEMENTATION OF BMPS FOR JOHNSON CREEK (CODE 5817) ABOVE SAMPLE POINT JOHN3.0

BEST MANAGEMENT PRACTICE OR STREAM SECTION	POLLUTANT	INITIAL STREAM LOAD (LB/DAY)	ESTIMATED LOAD REDUCTION FROM BMP (LB/DAY)	PREDICTED LOAD BELOW BMPS (LB/DAY)	TMDL ALLOWABLE VALUE FOR SEGMENT (LB/DAY)	LOAD REDUCT -ION AT JOHN3.0 (%)	TARGET REDUCT-ION AT JOHN3.0 (%)
Johnson Creek Above JOHN3.0	Iron	12.7	---	12.7	5.2	0	59
	Manganese	8.1	---	5.0	6.7	38	18
	Aluminum	8.8	---	5.3	8.8	40	0
	Acidity	229.7	---	146.8	229.7	36	0
Passive Treatment System for Arnot No. 2 Mine, #1 Discharge (DJC904)	Iron	---	0.0	---	---	---	---
	Manganese	---	3.1	---	---	---	---
	Aluminum	---	3.5	---	---	---	---
	Acidity	---	82.9	---	---	---	---

Loadings based on average stream flow of 3.2 cfs and water quality chemistry as provided in Table 3.1 for sample point JOHN3.0. Loadings based on an average discharge of 97 gpm (0.22 cfs) and chemistry as provided in Tables 2.4 and 4.4.A for the Arnot No. 2 Mine #1 Discharge (Point DJC904).

**indicates TMDL water quality will not be achieved

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TABLE 4.3.B SUMMARY OF EXISTING POLLUTANT LOADS AND PROJECTED REDUCTIONS FROM IMPLEMENTATION OF BMPS FOR JOHNSON CREEK (CODE 5817) ABOVE SAMPLE POINT JOHN2.0

BEST MANAGEMENT PRACTICE OR STREAM SECTION	POLLUTANT	INITIAL STREAM LOAD (LB/DAY)	ESTIMATED LOAD REDUCTION FROM BMP (LB/DAY)	PREDICTED LOAD BELOW BMPS (LB/DAY)	TMDL ALLOWABLE VALUE FOR SEGMENT (LB/DAY)	LOAD REDUCT-ION AT JOHN2.0 (%)	TARGET REDUCT-ION AT JOHN2.0 (%)
Johnson Creek above JOHN2.0	Iron	20.2	---	7.7	20.2	62	0
	Manganese	21.3	---	12.7	21.3	40	0
	Aluminum	28.0	---	9.7	28.0	65	0
	Acidity	1143.3	---	18.1	171.5	98	85
Upstream Reductions due to BMPS in Other Segments	Iron	---	0.0	---	---	---	---
	Manganese	---	3.1	---	---	---	---
	Aluminum	---	3.5	---	---	---	---
	Acidity	---	82.9	---	---	---	---
Passive Treatment System for Arnot No. 5 Mine (DJC900)	Iron	---	7.7	---	---	---	---
	Manganese	---	3.9	---	---	---	---
	Aluminum	---	8.8	---	---	---	---
	Acidity	---	929.2	---	---	---	---
Passive Treatment System for Flower Run Mine (DJC106)	Iron	---	4.8	---	---	---	---
	Manganese	---	1.6	---	---	---	---
	Aluminum	---	6.0	---	---	---	---
	Acidity	---	113.1	---	---	---	---

Loadings based on average stream flow of 10.4 cfs and water quality chemistry as provided in Table 3.3 for sample point JOHN2.0. Loadings based on an average discharge of 4.11 cfs and chemistry as provided in Tables 2.7 and 4.8.A for the Arnot No. 5 Mine Discharge (Point DJC900). Average flows from DJC900 adjusted from 5.17 cfs as reported to 4.11 cfs as DJC900 contributes almost all of the flow in UNT7.0, and the reported average flow in UNT7.0 at the monitoring point below the discharge was 4.11 cfs. Loadings based on an average discharge of 51 gpm (0.11 cfs) and chemistry as provided in Tables 2.8 and 4.9.A for the Flower Run Mine Discharge (Point DJC106).

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TABLE 4.3.C TABLE 4.3.B SUMMARY OF EXISTING POLLUTANT LOADS AND PROJECTED REDUCTIONS FROM IMPLEMENTATION OF BMPS FOR JOHNSON CREEK (CODE 5817) ABOVE SAMPLE POINT JOHN1.0

BEST MANAGEMENT PRACTICE OR STREAM SECTION	POLLUTANT	INITIAL STREAM LOAD (LB/DAY)	ESTIMATED LOAD REDUCTION FROM BMP (LB/DAY)	PREDICTED LOAD BELOW BMP (LB/DAY)	TMDL FOR SEGMENT (LB/DAY)	LOAD REDUCT -ION IN SEGMENT (%)	TARGET REDUCT-ION IN SEGMENT (%)
Johnson Creek above JOHN1.0	Iron	33.8	---	0.0	2.6	100	17
	Manganese	49.0	---	0.0	1.9	100	95
	Aluminum	57.7	---	3.4	0.4	94	97
	Acidity	2088.0	---	494.3	1.3	76	99.7
Upstream Reductions due to BMPS in Other Segments	Iron	---	12.5	---	---	---	---
	Manganese	---	8.6	---	---	---	---
	Aluminum	---	18.3	---	---	---	---
	Acidity	---	1125.2	---	---	---	---
Passive Treatment System for DJC901/903	Iron	---	2.2	---	---	---	---
	Manganese	---	14.4	---	---	---	---
	Aluminum	---	13.2	---	---	---	---
	Acidity	---	150.4	---	---	---	---
Passive Treatment System for DJC902	Iron	---	22.5	---	---	---	---
	Manganese	---	27.3	---	---	---	---
	Aluminum	---	22.8	---	---	---	---
	Acidity	---	318.1	---	---	---	---

Loadings based on average stream flow of 20.21 cfs and water quality chemistry as provided in Table 3.6 for sample point JOHN1.0. Loadings based on an average discharge of 46 gpm (0.102 cfs) and chemistry as provided in Tables 2.6 and 4.6 for Discharge Point DJC901/903. Loadings based on an average discharge of 80 gpm (0.178 cfs) and chemistry as provided in Tables 2.5 and 4.7 for Discharge Point DJC902.

**indicates TMDL water quality will not be achieved

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In addition to the TMDLs contained in Tables 4.3.A through and 4.3.C, TMDLs were established for unnamed tributaries UNT5.0 and UNT7.0. The reductions due to BMPs on the unnamed tributaries were included in the appropriate main stem stream segment in Tables 4.3.A through 4.3.C.

The SRBC WRAM analysis did not include anticipated water quality data for the UNT7.0 point. The TMDLs at this point specify reductions in aluminum and acidity concentrations, with aluminum reduced from 0.54 mg/l to 0.51 mg/l and acidity reduced from 24.57 mg/l to 3.93 mg/l. Given the proposed treatment of the Arnot No. 5 discharge, as discussed in a subsequent paragraph, these reductions should be achievable.

The data in Tables 4.3.A through 4.3.C indicate that even under the best conditions when the anticipated water quality is achieved following installation of the proposed BMPs, the TMDLs established for Johnson Creek will not be met in some cases. Although all of the TMDLs will not be met at JOHN3.0 and JOHN1.0, the anticipated pollutant concentrations are sufficiently low that the goal of restoring aquatic life to Johnson Creek will be achieved. Following implementation of the identified BMPs, Johnson Creek will be able to be removed from the List of Impaired Waters/Integrated List of All Waters for impairment by acidity and metals due to AMD. If stream recovery is based on biology rather than on chemistry and achievement of TMDLs, then Johnson Creek will have fully recovered following implementation of all five identified BMPs. Pollutant concentrations will no longer prevent healthy populations of aquatic life in Johnson Creek.

The SRBC's analysis included estimations of the effluent characteristics from BMPs proposed for the five treatment projects to be implemented. Performance was examined on an individual basis, in addition to the stream impacts discussed in the preceding paragraphs. The proposed treatment concepts and existing and anticipated water quality data for individual BMPs are discussed in the following paragraphs.

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A passive treatment system is under construction at the #1 Discharge of the No. 2 Mine (DJC904), and construction is substantially complete to the extent that some preliminary effluent water quality data have been obtained. The passive treatment system, when fully completed, will consist of two sets of limestone cells followed by settling basins. The treatment system for the Arnot No. 2 Mine, #1 Discharge will be treating water with marginal water quality and a moderate pH, so rapid limestone dissolution or large increases in pH cannot be expected.

The SRBC proposed a slightly different treatment concept for this discharge which consisted of two vertical flow wetland cells, a surface flow wetland, and a manganese-oxidizing bacteria bed. SRBC's anticipated performance of the treatment system is based on their treatment concept and not on the actual system under construction, which was designed by Skelly and Loy, Inc. The WRAM estimates of system performance indicated by existing and anticipated water quality data and loadings are provided in Tables 4.4.A and 4.4.B.

TABLE 4.4.A SUMMARY OF SRBC's EXISTING AND PROJECTED WATER QUALITY DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC904

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC904	pH	4.65	pH	> 6.00
	Acidity	70	Acidity	0
	Alkalinity	2	Alkalinity	20
	Aluminum	3.19	Aluminum	0.25
	Iron	0.24	Iron	0.24
	Manganese	3.14	Manganese	0.50

*pH in S.U. All other values in mg/l.

TABLE 4.4.B SUMMARY OF SRBC's EXISTING AND PROJECTED LOADING DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC904

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC900	Acidity	82.9	Acidity	0.0
	Aluminum	3.8	Aluminum	0.3
	Iron	0.3	Iron	0.3
	Manganese	3.7	Manganese	0.6

*All values in lb/day.

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The current treatment system under construction will consist of limestone cells and settling basins and will not include vertical flow wetlands, surface flow wetlands, or a manganese removal bed. The treatment system components will produce effluent that shows increased pH, decreased acidity, and increased alkalinity, along with decreased aluminum concentrations. Iron concentrations, due to the low influent concentrations, are unlikely to be reduced any further. Unlike with the treatment system results predicted by SRBC, manganese concentrations are unlikely to be reduced significantly, and reductions below 1 mg/l are not anticipated.

The portion of the treatment system completed to date has been brought on line, and some sampling data have been obtained. Influent data are not available as the raw mine water is no longer accessible. Effluent data collected at the treatment system outfall during November of 2006 displayed the following characteristics as provided in Table 4.5

TABLE 4.5 SUMMARY OF EFFLUENT WATER QUALITY DATA AT DJC904 FOR NOVEMBER 2006

SAMPLE POINT	POST-TREATMENT CONDITIONS	
DJC904 OUTFALL	pH	7.5
	Acidity	-106
	Alkalinity	126
	Aluminum	0.23
	Iron	<0.5
	Manganese	0.94

*pH in S.U. All other values in mg/l.

The effluent water data obtained during the November sampling indicate that the performance of the treatment system is meeting the SRBC's anticipated system performance for the parameters of pH, acidity, alkalinity, and aluminum. Manganese concentrations, while reduced from the typical inflow concentrations, are not meeting the SRBC's anticipated concentrations, as was expected due to the lack of a manganese removal bed in the treatment system configuration. Insufficient data are available for a comparison of iron concentrations, but reductions in iron are not anticipated in the treatment system.

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Two areas of treatment are proposed for the South Mountain Discharges. The treatment for DJC 901/903 will consist of two vertical flow wetlands followed by settling basins, a third vertical flow wetland, a surface flow wetland, and a manganese removal bed. Treatment at DJC902 will consist of three vertical flow wetlands followed by settling basins, a surface flow wetland, and a manganese removal bed. Tables 4.6.A, 4.6.B, 4.7.A, and 4.7.B contain the SRBC's existing and anticipated water quality data and loadings following the construction of the proposed treatment systems at the South Mountain Site.

TABLE 4.6.A SUMMARY OF SRBC's EXISTING AND PROJECTED WATER QUALITY DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC901/903

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC901/903	pH	3.02	pH	> 6.00
	Acidity	274	Acidity	0
	Alkalinity	0	Alkalinity	20
	Aluminum	24.36	Aluminum	0.25
	Iron	4.42	Iron	0.50
	Manganese	26.80	Manganese	0.50

*pH in S.U. All other values in mg/l.

TABLE 4.6.B SUMMARY OF SRBC's EXISTING AND PROJECTED LOADING DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC901/903

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC901/903	Acidity	150.4	Acidity	0.0
	Aluminum	13.4	Aluminum	0.1
	Iron	2.4	Iron	0.3
	Manganese	14.7	Manganese	0.3

*All values in lb/day.

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TABLE 4.7.A SUMMARY OF SRBC's EXISTING AND PROJECTED WATER QUALITY DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC902

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC902	pH	2.88	pH	> 6.00
	Acidity	332	Acidity	0
	Alkalinity	0	Alkalinity	20
	Aluminum	24.00	Aluminum	0.25
	Iron	24.03	Iron	0.50
	Manganese	28.96	Manganese	0.50

*pH in S.U. All other values in mg/l.

TABLE 4.7.B SUMMARY OF SRBC's EXISTING AND PROJECTED LOADING DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC902

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC902	Acidity	318.1	Acidity	0
	Aluminum	23.0	Aluminum	0.2
	Iron	23.0	Iron	0.5
	Manganese	27.7	Manganese	0.5

*All values in lb/day.

The anticipated conditions for the effluent from the South Mountain treatment projects show drastic reductions in metals and acidity. While large, multi-component treatment systems are proposed to treat these discharges, the anticipated reductions in pollutant concentration are large and may not always be achieved. Even if the anticipated conditions are not achieved, Johnson Creek will benefit from any improvements in water quality in the South Mountain tributary.

The Arnot No. 5 (DJC900) discharges a large volume of water with mild characteristics. A compost wetland is proposed to treat this discharge, which would allow for the reduction of metals already at low concentrations. Tables 4.8.A and 4.8.B contain SRBC's existing and anticipated water quality data and calculated loadings for the proposed treatment system.

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TABLE 4.8.A SUMMARY OF SRBC's EXISTING AND PROJECTED WATER QUALITY DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC900

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC900	pH	5.73	pH	> 6.00
	Acidity	42	Acidity	0
	Alkalinity	13	Alkalinity	20
	Aluminum	0.65	Aluminum	0.25
	Iron	0.85	Iron	0.50
	Manganese	0.68	Manganese	0.50

*pH in S.U. All other values in mg/l.

TABLE 4.8.B SUMMARY OF SRBC's EXISTING AND PROJECTED LOADING DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC900

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC900	Acidity	929.2	Acidity	0.0
	Aluminum	14.4	Aluminum	5.5
	Iron	18.8	Iron	11.1
	Manganese	15.0	Manganese	11.1

*All values in lb/day.

Provided a sufficiently large wetland is constructed to accommodate the high flows of this discharge, the water quality improvements indicated in Tables 4.8.A and 4.8.B can be achieved. However, as stated previously, reductions in metals concentrations below 1 mg/L can be difficult to achieve using passive technologies.

The Flower Run Mine (DJC106) discharges poor quality water but flows are low. Construction at this site is limited by the available space, so the BMP proposed for this site is an open limestone channel, which would serve to add alkalinity to the discharge. The existing wetland at the site would remain in place to serve as additional treatment. Tables 4.9.A and 4.9.B contain SRBC's existing and anticipated water quality data for the proposed treatment system.

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TABLE 4.9.A SUMMARY OF SRBC's EXISTING AND PROJECTED WATER QUALITY DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC106

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC106	pH	2.85	pH	>6.0
	Acidity	185	Acidity	0
	Alkalinity	0	Alkalinity	20
	Aluminum	10.13	Aluminum	0.25
	Iron	8.38	Iron	0.50
	Manganese	3.04	Manganese	0.50

*pH in S.U. All other values in mg/l.

TABLE 4.9.B SUMMARY OF SRBC's EXISTING AND PROJECTED LOADING DATA FOLLOWING IMPLEMENTATION OF TREATMENT AT DJC106

SAMPLE POINT	EXISTING CONDITIONS		ANTICIPATED (TREATED) CONDITIONS	
DJC106	Acidity	113.0	Acidity	0.0
	Aluminum	6.2	Aluminum	0.2
	Iron	5.1	Iron	0.3
	Manganese	1.9	Manganese	0.3

*All values in lb/day.

Based on the available space and lack of area to provide settling volumes and the variability of flows, the SRBC's predicted results for this discharge may be optimistic in terms of acidity, aluminum, iron, and manganese reductions. However, this discharge constitutes only a small portion of the total flow in Johnson Creek near Route 15, and the stream should have sufficient quality to support aquatic life if the anticipated conditions are not achieved. Johnson Creek will receive benefits from any reduction in the pollutants contributed by this discharge.

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5.0 TECHNICAL AND FINANCIAL ASSISTANCE NEEDED TO IMPLEMENT BMPS

Two organizations, the Arnot Sportsmen Association, Inc. (ASA) and the Tioga County Concerned Citizens Committee (TCCCC), are working to restore Johnson Creek and the Tioga River Watershed. These roles and efforts of these organizations are discussed later in this narrative. Both organizations are comprised of volunteers, and both have limited technical and financial resources. The Babb Creek Watershed Association, Inc. (BCWA) has been assisting the ASA with project administration and oversight for restoration projects in the Johnson Creek Watershed, but the BCWA is also a volunteer organization that is unable to provide significant amounts of funding for the restoration of Johnson Creek. Therefore, both the ASA and the TCCCC will need technical and financial assistance to implement the BMPs needed to restore the Johnson Creek Watershed. The technical and financial assistance needed for design, installation, and maintenance and potential funding sources and shortfalls are described in the following paragraphs.

5.1 Design, Installation, and Maintenance Costs

This implementation plan has identified four areas where BMPs are currently being installed or will need to be installed to remediate the water quality problems in the Johnson Creek Watershed in order for the TMDLs for the stream to be met. A listing of the four areas and the activities for which future funding will be required is provided in the following table. Five projects are listed for the four areas as the South Mountain site contains two discharge points to Johnson Creek.

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TABLE 5.1 PROJECTS AND PROJECT TASKS REQUIRING FUTURE FUNDING

PROJECT	DESIGN AND PERMITTING FUNDS NEEDED	CONSTRUCTION FUNDS NEEDED	OPERATION AND MAINTENANCE FUNDS NEEDED
Passive Treatment System for Arnot No. 2 Mine, #1 Discharge (DJC 904)	NO Task Completed. Funds Provided by the 319 Program	NO Task Ongoing. Funds Provided by the 319 Program	YES
South Mountain Mine Complex (DJC 901/903)	YES	YES	YES
South Mountain Mine Complex (DJC 902)	YES	YES	YES
Passive Treatment System for Arnot No. 5 Mine (DJC 900)	YES	YES	YES
Passive Treatment System for the Flower Mine Discharge (DJC 106)	YES	YES	YES

Note: Each discharge is referenced to the SRBC's *Watershed Assessment and Remediation Strategy* by the use of SRBC's sample point identifiers (DJC 106, DJC 901, etc.)

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5.1.1 Overall Watershed Restoration Costs

Construction and operation and maintenance costs for the future treatment and reclamation sites in the Johnson Creek Watershed were addressed in the *SRBC's Treatment and Restoration Plan for the Upper Tioga River Watershed.* The SRBC plan included construction cost estimates, operation and maintenance cost estimates, and 15-year present values of proposed treatment systems that were developed using TARCO Technologies Watershed Restoration Analysis Model (WRAM), version 1.2. The report, prepared in 2003, concluded that the construction cost to restore the four impaired miles of Johnson Creek would be approximately $2.6 million, with annual operating costs of $10,000 and a 15-year present value of $2.7 million. These treatment costs equate to approximately $46,000 per stream mile per year. The following paragraphs provide updated information relating to the SRBC's findings and costs estimates in terms of projects already implemented, treatment alternatives selected, and updated funding needs.

5.1.2 Arnot No. 2 Mine, #1 Discharge

Future funding will be needed for the operation and maintenance of the passive treatment system for the Arnot No. 2 Mine, #1 Discharge (DJC 904). This discharge is incorrectly identified as the Arnot No. 1 Mine Discharge in the SRBC's *Watershed Assessment and Remediation Strategy*, but is more correctly called the #1 Discharge of the Arnot No. 2 Mine.

The passive treatment system for the Arnot No. 2 Mine, #1 discharge is currently under construction, and funding has been awarded from the 319 Program for this construction project. Design and permitting funds were also provided by the 319 program, and the project was designed by Skelly and Loy, Inc. At this time, the estimated construction costs will be approximately $325,000.

Future funding needs will include operation and maintenance costs. Long-term operation costs will be minimal due to the nature of the passive treatment system which requires only periodic flushing by the opening and closing of a flush valve. Operation will be performed by volunteers from the ASA.

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Long-term maintenance costs will include the eventual cleanout of the two settling basins to maintain the necessary settling volume. The second component of long-term maintenance will be the replenishment of the limestone in the limestone cells, plus potential replacement of the outlet piping concurrent with the replenishment of limestone should the piping and/or limestone become clogged with aluminum. The project designer determined a maintenance frequency of 15 years for cleanout of basins and 10 years for replenishment of limestone. The limestone was designed to last 25 years with one limestone replenishment activity. In light of the need for limestone replenishment during or around 2016, anticipated limestone costs and basin clean-out costs were included for long-term maintenance costs. Fifteen percent of the limestone was estimated to require replenishment in 10 years, an amount equal to approximately 1000 tons, at an estimated future cost of $30.00 per ton for a future cost of $30,000. Maintenance of the treatment basins, to include cleanout of the basins and disposal of aluminum precipitates, was estimated at $10,000 for 15-year total maintenance costs. The combined maintenance of limestone replenishment at $30,000 plus $10,000 for settling basin cleanout totals $40,000, which results in annualized maintenance costs of $2700.00

5.1.3 South Mountain Discharges

The South Mountain Mine Complex is in need of restoration activities in the form of both reclamation activities and passive treatment. For the purposes of this implementation plan, the costs of treatment of the South Mountain discharges (DJC 901/903 and DJC 902) to meet the water quality objective of restoration of Johnson Creek are included in this cost estimate. Land reclamation and revegetation, while beneficial to the watershed, are not absolutely necessary to achieve the water quality objectives and thus are not included in the cost estimates. Only that portion of the complex that drains to Johnson Creek is addressed in this narrative, as part of the complex drains directly to the Tioga River.

The PA DEP’s Bureau of Abandoned Mine Reclamation (BAMR) is assisting the TCCCC with restoration efforts for this area, and may provide some or all of the design and construction funding needed for the project. It is assumed, at minimum, that the TCCCC will become responsible for obtaining at least a portion of the construction funding for the project(s) and for the operation and maintenance of any treatment systems constructed for this site. It is also

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assumed that operation and maintenance funding will be needed in the future, whether through DEP or TCCCC. According to representatives of the DEP, the exact nature of the BAMR's efforts have not been determined at this time.

The SRBC report provided construction cost estimates for both active and passive treatment systems for the three discharges on the west flank of the South Mountain site that discharge to Johnson Creek. The report suggested the use of passive treatment for the site in keeping with the overall passive treatment activities in the watershed. The costs for construction were divided into construction costs for two systems, labeled as DJC 901/903 and DJC 902. The costs to treat DJC 901/903 are estimated to be $710,000 for construction, with annualized operation and maintenance costs of $2,200 and a 15-year present value (in 2003) of $730,000. The costs to treat DJC 902 are estimated to be $1,000,000 for construction, with annualized operation and maintenance costs of $6,300 and a 15-year present value (in 2003) of $1,100,000. In the event that BAMR is unable to provide design resources, the estimated design costs for each project are $50,000 each, which is typical for the design of complex passive treatment systems.

5.1.4 Arnot No. 5 Deep Mine Discharge

The Arnot No. 5 Deep Mine Discharge and the Flower Run Deep Mine Discharge have been identified as the two remaining pollutant sources to be addressed using BMPs for which design and construction funding have yet to be obtained. The *SRBC Treatment and Restoration Plan* included conceptual designs for the treatment of the discharge and also included cost estimates for the installation and maintenance of the proposed treatment system.

A passive treatment system is proposed for the Arnot No. 5 Discharge (DJC 900). Costs for site design and permitting, including site surveying, for a typical passive treatment system are estimated to be $55,000 for the Arnot No. 5 Discharge. The estimated design and permitting cost is at the high end of the range of typical passive treatment designs, but is at the high end of the range because the Arnot No. 5 project will involve the reclamation of the adjacent area containing coal mine refuse to remove the refuse and allow sufficient room for the construction of a passive treatment system. Substantial reclamation to allow room for the proposed treatment system plus the added complexity of the existing deep mine opening on the site must be

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accounted for in the project design. The Arnot No. 5 project will also likely require a full Joint Permit from the PA DEP and the U.S. Army Corps of Engineers for wetland and stream impacts associated with the project. An application to the Growing Greener Program for design and permitting funding was made in 2006 for the Arnot No. 5 Mine Discharge, and funding was not awarded.

The presence of the coal mine refuse on the site was a topic of discussion with the DEP during the grant application process, and the issue of disposal of the refuse is under investigation. This area is shown as mine refuse area S4 on the SRBC report documents. Two local contractors are investigating the potential of either a Mining Permit or a Government-Financed Construction Contract (GFCC) for the removal of this refuse. The marketability of this refuse is being determined at this time. The SRBC estimated costs of an additional $25,000 to remove this refuse from the former Arnot No. 4 and No. 5 mines, but due to the current prices of fuel, these costs would be closer to $35,000.

The SRBC report provided construction cost estimates for both active and passive treatment systems for the Arnot No. 5 Mine discharge. Due to funding constraints and the increased costs for operation and maintenance of an active treatment system, the ASA prefers to utilize a passive treatment system for this discharge at this time. The costs for construction of a compost wetland system to treat this high-volume discharge are estimated to be $450,000, with annualized operation and maintenance costs of $1,3000 and a 15-year present value (in 2003) of $470,000.

5.1.5 Flower Mine Discharge

The Flower Run Deep Mine Discharge (DJC 106) would be the last remaining pollutant source to be addressed according to the schedule of this Implementation Plan. Funding has yet to be requested or obtained for this project. As with the other restoration projects, the SRBC's *Treatment and Restoration Plan* included conceptual designs for the treatment of the discharge and also included cost estimates for the installation and maintenance of the proposed treatment system.

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A passive treatment system is proposed for the Flower Mine Discharge. Costs for site design and permitting, including site surveying, for a typical passive treatment system are estimated to be $20,000 for the Flower Mine Discharge. This estimated design and permitting cost is at the lower end of the range of typical passive treatment designs due to the lack of space at the site, which limits the size and number of components of a passive treatment system that can be built. The Flower Mine project will involve the construction of an open limestone channel and potentially settling or wetland areas, but the project is severely constrained by available space.

The SRBC report provided construction cost estimates for both active and passive treatment systems for the Flower Mine discharge. Due to funding constraints and the increased costs for operation and maintenance of an active treatment system, the ASA prefers to utilize a passive treatment system for this discharge at this time. The costs for construction of an open limestone channel above the existing wetlands on the site to treat this discharge are estimated to be $61,000, with no annualized operation and maintenance costs associated with the channel and a 15-year present value (in 2003) of $61,000.

5.1.6 Other Areas

This implementation plan identified three additional areas that would benefit from reclamation activities in the Johnson Creek Watershed. These areas include the following: reclamation of the South Mountain Site to address issues not related to water quality such as highwall reclamation; removal of the refuse pile at SRBC point S5 (DJC 906); and channel restoration activities near the Arnot No. 5 Mine Site (main stem Johnson Creek immediately upstream of the Arnot No. 5 unnamed tributary). No major water quality impacts result from these areas, and the reclamation of these areas will not have a significant positive impact on water quality in Johnson Creek. The restoration of the additional areas is not essential to achieve the water quality objectives of this plan.

5.2 Cost Summary

A summary of the costs provided in Section 5.1 is provided in the following table. Detailed cost information developed by SRBC is provided in Appendix D.

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TABLE 5.2 COST SUMMARY FOR JOHNSON CREEK IMPLEMENTATION PLAN

PROJECT	DESIGN AND PERMITTING	CONSTRUCTION COST	OPERATION AND MAINTENANCE COST (ANNUALIZED)	TOTAL COST FOR 15 YEARS
Passive Treatment System for Arnot No. 2 Mine, #1 Discharge	Not Needed	Not Needed	<$100/Year Operation $2700/Year Maintenance	$42,000
South Mountain Mine Complex (DJC 901/903)	Up to $50,000, depending on BAMR assistance	$710,000	$2200	$762,500
South Mountain Mine Complex (DJC 902)	Up to $50,000 depending on BAMR assistance	$1,000,000	$6300	$1,056,300
Passive Treatment System for Arnot No. 5 Mine	$55,000	$450,000 - $485,000*	$1300/Year Operation and Maintenance	$524,500-$559,500
Passive Treatment System for the Flower Mine Discharge	$20,000	$61,000	<$100/Year	$82,500

*An additional $35,000 would be required for refuse removal at the Arnot No. 5 site if it is not removed by a private venture.

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Funding in the amount of $649,000 for remaining design and construction efforts as well as ongoing operation and maintenance requirements will address all discharges west of State Route 15 and restore water quality in Johnson Creek down to the west flank of the South Mountain Discharges. If the coal refuse at the Arnot No. 5 site is not removed by a private, for-profit organization to create room for the construction of the proposed treatment system, the amount of funding required increases to $684,000. An additional $1,818,800 will be needed to address the South Mountain discharges, although some funding may be provided by DEP BAMR and some improvements in water quality may be realized through planned surface reclamation activities.

5.3 Sources of Funding for Plan Implementation

Several potential sources of funding have been identified for the remaining restoration efforts in the Johnson Creek Watershed. These funding sources include Pennsylvania's Growing Greener Program (both the Growing Greener I and II Programs) and the Federal Section 319 Program. The ASA has been successful in obtaining Section 319 and Growing Greener funding for projects in the area in the past. Other potential sources of funding include Federal Funding available through the Office of Surface Mines and/or assistance from the DEP BAMR.

Other smaller potential sources of funding in the form of matching funds and volunteer funds have also been identified. These include funding provided by project consultants, who typically provide some services at no charge as a form of matching funds, volunteer labor for the collection of water samples, and matching funds provided by the BCWA for project oversight and management. Potential other sources include volunteer labor for planting and other small projects.

Operation and maintenance costs will require long-term and ongoing funding. The ASA will explore all avenues for long-term operation and maintenance, including the potential for re-use or sale of precipitates, such as iron and aluminum, recovered from their treatment facilities. If current research into the recovery and reuse of metals precipitates from treatment systems results in a market for these materials, these precipitates will be sold, donated to research, etc. in a manner which either generates funds that could be used for operation and maintenance costs or that minimizes the costs of disposal of materials for the ASA and/or the TCCCC.

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5.4 Funding Shortfalls

At the present time, it is believed that the current funding sources are sufficient to provide for the design and construction of reclamation/remediation projects for the restoration of the watershed to occur west of State Route 15. However, funding for the more-costly projects east of State Route 15 at the South Mountain site may be more difficult to obtain due to limited funding sources and competition for funding among projects.

A known funding shortfall for treatment system operation, maintenance, and replacement currently exists for all projects to be implemented. Prior to the 2006 Growing Greener Grant Application Round, funding was not available for the operation and ongoing maintenance of treatment systems. Although some grant funding is now available for operation and maintenance, these funds are limited. While the ASA and the TCCCC can provide varying amounts of volunteer labor for operation and maintenance activities, both groups will be in need of funds for future maintenance activities, such as replacement of limestone in passive treatment systems.

5.5 Technical Assistance Required

The ASA and the TCCCC are organizations comprised of volunteers, and both have limited technical and financial resources. Both organizations will be in need of technical assistance for these projects to be implemented in the Johnson Creek Watershed. The needed technical assistance will include, but will not be limited to, engineering and design services such as site design, development of erosion and sediment control plans, and development of operation and maintenance plans, and permitting assistance such as obtaining stream encroachment permits. Both organizations have established consultants who have been assisting them with watershed restoration activities for a number of years.

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6.0 PUBLIC INFORMATION AND PARTICIPATION

The SRBC's *Watershed Assessment and Remediation Strategy* for the Tioga River Watershed identified stakeholders for restoration of the Upper Tioga River and its tributaries. This section updates the information collected by the SRBC and provides more detailed information specific to the Johnson Creek watershed regarding stakeholders, sources of information and influence in the watershed, a watershed advisory group, and information strategy.

6.1 Stakeholder Identification

Page 44 of the *Watershed Assessment and Remediation Strategy* for the Tioga River Watershed identified the following stakeholders for restoration activities in the watershed: SRBC; PA DEP; Tioga County Conservation District (TCCD); Mansfield University: The Pennsylvania State University; TCCCC; Hillside Rod and Gun Club; Tioga River Watershed Reclamation Projects, Inc.; Tioga County Planning Commission; U.S. Office of Surface Mining; U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; U.S. Department of Agriculture; private consultants; other government interests; and local tourism and development interests. At this time, tourism organizations include the Tioga County Visitor's Bureau, the Tioga County Development Authority, and the Blossburg Visions in Business and Entertainment. The stakeholders were identified as potential partners for implementation of projects and further studies in the Upper Tioga River Watershed which includes Johnson Creek. The SRBC concluded that strong, sustainable partnerships between local stakeholders and other entities is crucial in assuring that the restoration of the Tioga River Watershed.

The stakeholder list should be expanded to include the following parties specific to the Johnson Creek Watershed: the Arnot Sportsmen Association, Inc. (ASA); the Babb Creek Watershed Association, Inc. (BCWA); the Pennsylvania Department of Conservation and Natural Resources—Bureau of Forestry (Tioga State Forest); PA DEP Bureau of Abandoned Mine Reclamation (BAMR); the Pennsylvania Department of Transportation (PennDOT); Bloss Township; the Borough of Blossburg; the Arnot Historical Society; residents and property owners of Arnot, Blossburg, and nearby communities; and local contractors including Signor

Brothers Contracting and Berguson Trucking. Each of these parties has a vested interest in restoration activities in the watershed.

The ASA operates a fish nursery on the headwaters of Johnson Creek. This group has been working to restore the length of Johnson Creek, and is responsible for the construction of the passive treatment system for the Arnot No. 2 Mine, #1 Discharge. The group wishes to continue restoration efforts until the entire length of Johnson Creek is restored.

The BCWA has provided ongoing support for the ASA's restoration activities in the Johnson Creek Watershed, although Johnson Creek is not located within the Babb Creek Watershed. The BCWA provides fiscal administration for the ASA's grants, as the ASA does not have 501(c)(3) status, provides matching funds in the form of project administration costs, and shares their project and technical experience with similar AMD treatment projects in the region.

The TCCCC is also working to implement restoration activities in the Johnson Creek Watershed. The TCCCC is cooperating with the PA DEP BAMR to conduct reclamation activities at the South Mountain Site, as discussed later in this narrative.

A large portion of the Johnson Creek Watershed is located within the boundaries of the Tioga State Forest. Because the stream is located within State Forest Lands, opportunities for public access and recreation are abundant. Water quality improvements in the stream will provide improvements to aquatic life, wildlife, and wetland and riparian habitats on the State Forest Lands, and well as improved recreational opportunities.

The list of stakeholders includes Bloss Township, the Borough of Blossburg, the Arnot Historical Society, and residents and property owners of Arnot, Blossburg, and nearby communities. Johnson Creek flows through the communities of Arnot and Blossburg, and past the community park in Blossburg. Improved water quality in the stream would result in improved quality of living in these areas, increased property values, and increased recreational opportunities.

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Signor Brothers Contracting and Berguson Trucking have or will have active resource extraction and/or reclamation activities in the watershed. The activities of both parties will serve to improve conditions in the watershed through removal or stabilization of coal mine refuse and vegetation of unvegetated or poorly-vegetated areas. These parties may be able to provide land, equipment, or other resources needed for the construction, operation, and maintenance of BMPs. Both parties would serve to benefit directly from water quality improvements and reclamation activities as both own frontage along Johnson Creek.

The PennDOT and the current owners of the South Mountain site should be considered as the final local stakeholders. Treatment for the Flower Mine discharge would be located within PennDOT highway right-of-way, and the cooperation of this agency will be essential to the completion of restoration activities in the watershed. Similarly, the cooperation of the current property owner of the South Mountain site is essential for the successful restoration of that area.

6.2 Sources of Information and Influence in the Watershed

Sources of information and influence in the watershed include newspapers, websites, and local gathering places. The Wellsboro Gazette and the Mansfield Gazette are the local newspapers and the primary sources of printed information in the watershed. Both are owned by the Tioga Publishing Company that is based in Wellsboro. The Wellsboro Gazette is available online at www.tiogapublishing.com, and this paper includes community and outdoor sections in addition to regular news that would be appropriate for publication of watershed-related activities.

A website is available for the community of Blossburg, which could also potentially serve to publicize information relating to watershed issues. This website can be located at www.blossburg.org. The site includes a community calendar that publicizes community events. Information on the annual Blossburg Coal Festival is located on this site, and this event could potentially be used to raise public awareness of the Johnson Creek restoration.

A second website that could potentially be used to publicize watershed restoration activities is that of the Hillside Rod and Gun Club located at www.hillsiderodandgun.org. This organization

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has been identified as a project stakeholder and has been working cooperatively with the TCCCC towards restoration of the Tioga River Watershed.

The Village of Arnot is a very small community with limited public and commercial locations. Events and news relating to Johnson Creek could be posted in the Arnot Post Office and the Arnot Sportsmen Association's building in Arnot. Additional public places for the distribution of information in Blossburg include the Blossburg Memorial Library and the Blossburg Post Office.

6.3 Watershed Advisory Group

Several watershed stakeholders have been designated from the list of identified stakeholders to form a Watershed Advisory Group. The Watershed Advisory Group members will be involved with sponsoring projects, reviewing and planning projects, setting watershed priorities, gaining landowner cooperation, and secure funding for implementation of projects.

The Watershed Advisory Group is to consist of the following members: ASA with the support of the BCWA; the TCCCC and any other watershed, civic, or sportsman's organizations supporting their efforts, such as the Hillside Rod and Gun Club; the TCCD Watershed Specialist; and the PA DEP Bureau of Mining and Reclamation (BMR) Mining Inspector for the county. This group includes the two organizations currently conducting restoration activities in the watershed, the ASA and the TCCCC, to ensure project coordination between the two groups. The TCCD Watershed Specialist has been included to ensure coordination of projects from a county-wide restoration point-of-view as well as a project permitting standpoint. Finally, the DEP BMR County Mining Inspector has been included to keep the DEP apprised of current activities in the watershed. Additionally, the local DEP Mining Inspector typically acts as the grant advisor or DEP liaison for state-funded projects.

The Watershed Advisory Group will meet at least once per year, preferably in January of each year. The meeting in January will allow for coordination of project funding applications, which are typically made in early spring of each year. This meeting can be held at the ASA building in Arnot, which is centrally-located between Wellsboro and Blossburg, and the ASA will provide

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the meeting space. The agenda of the annual meeting will address the planning of future projects, the review of ongoing and completed projects, and address the water quality monitoring, evaluation, and remediation actions described in Section 8 and 9 of this narrative. The meeting of the Watershed Advisory Group is to be coordinated by the ASA.

6.4 Information Strategy

Local citizens will be informed about current watershed issues in the Johnson Creek Watershed, and their involvement will solicited during implementation of restoration projects in the watershed. Two primary mechanisms will be utilized to disseminate information: public presentations to be held during meetings of the ASA and press releases to local websites and newspapers identified previously in this narrative.

The ASA meets on a monthly basis, and these meetings are typically attended by more than 100 local residents. Therefore, these meetings are an excellent setting for distribution of watershed information, and the meetings have traditionally been the means for distribution of information about prior projects. The meetings allow for dialog with local citizens and provide an opportunity for citizens to provide input on the project and restoration plan. The local newspapers and websites will also provide a means of distributing information to the general public.

Public distribution of planning and project information shall occur at three key points for the remaining projects in the watershed: 1) Prior to the application for funding for design and for construction; 2) Prior to commencement of construction; and 3) Following completion of construction. A project status report will be provided at an ASA meeting for each of the three key points. A press release will also be distributed to the newspapers and websites listed previously prior to the commencement of construction activities.

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7.0 IMPLEMENTATION SCHEDULE AND EVALUATION

This implementation plan has identified four areas where BMPs are currently being installed or will need to be installed to remediate the water quality problems in the Johnson Creek Watershed in order for the TMDLs for the stream to be met. In three of the four areas, efforts to obtain funding for reclamation and remediation, design and permitting activities, or construction activities are underway. Efforts have yet to begin in the forth and final area, the Flower Mine, in need of remediation in order for the TMDLs for Johnson Creek to be met. An implementation schedule, including implementation milestones, funding, construction, and maintenance activities, responsible parties, local considerations, and progress monitoring and reporting is detailed in the following paragraphs. Because the watershed is fairly small in size, the watershed was not divided into subwatersheds.

7.1 Implementation Milestones

The implementation milestones for the restoration of Johnson Creek include funding, construction, and maintenance activities, as shown in Section 7.5 of this narrative. The milestones provide specific target dates to obtain funding, construct or implement projects, to maintain projects, and to monitor and report on the progress of projects.

The Watershed Advisory Group for Johnson Creek will meet at least once per year, preferably in January of each year. The meeting will allow for coordination of project funding applications, and will provide an opportunity for the responsible parties to address the planning of future projects, to review and report on the progress of ongoing and completed projects, and to address any difficulties in achieving the project implementation milestones. If milestones are not achieved due to a lack of funding, weather, or any other unforeseen factors that may prevent construction of all of the scheduled projects in any given year, the project implementation milestones and schedule will be adjusted accordingly, and uncompleted projects will be rescheduled for the following year.

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7.2 Funding, Construction, and Maintenance Activities

Funding for restoration activities in the Johnson Creek Watershed has historically been obtained from grant sources, with small amounts of matching funds provided from contractors, watershed organizations, and consultants. A schedule for applying for funding for remaining projects in the watershed is included in Section 7.5. This schedule is subject to change based on availability and award of funding.

The status of construction of existing projects has been included in Section 7.5, and estimated construction dates have been included for anticipated future projects. Construction is dependent on project funding, and the construction schedule may need to be revised in the future. As construction of each project is completed, the evaluation process will begin and the implementation schedule for future projects will be reviewed to determine if changes should be made prior to construction to incorporate considerations such as improvements in BMP technology, successes or failures of BMPs in the watershed, and maintenance concerns specific to the watershed.

Maintenance activities have also been included in the implementation schedule. Operation and maintenance activities have been determined for those BMPs designed and/or constructed. Maintenance activities have been estimated for those treatment systems or BMPs not yet designed. The actual performance of various BMPs may vary in following implementation, and the operation and maintenance schedule will be revised accordingly in the future.

7.3 Parties Responsible for Implementation Milestones

Two parties are or will be responsible for the funding, implementation, construction, operation and maintenance, and progress monitoring and reporting for the restoration projects in this watershed. These parties include the ASA and the TCCCC. The ASA is and will be responsible for the reclamation activities and treatment systems that it installs. Similarly, the TCCCC is and will be responsible for those reclamation activities and BMPs that it constructs and installs. Both groups have historically assumed operation and maintenance responsibility for all the projects that they have implemented. Specific project responsibilities are summarized in the Schedule in Section 7.5.

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7.4 Local Considerations

The Johnson Creek Watershed benefits from having two conservation groups, the ASA and the TCCCC, conducting watershed restoration activities. Unfortunately, the priorities of each group are sometimes in conflict with respect to scheduling of projects and the limited availability of project funding, so areas of focus were developed between the groups to eliminate any conflicts in priorities. The ASA is working locally, primarily around the Village of Arnot, to restore Johnson Creek, while the TCCCC is working more regionally to restore the Upper Tioga River Watershed. As a result, the local priorities for restoration of Johnson Creek are often not the same as the more regional priorities and needs for restoration of the much larger Upper Tioga River Watershed. For example, addressing the Arnot No. 5 Discharge, which is identified as the next priority for the ASA, is listed as the 14th priority in the Upper Tioga River Watershed. Because of limited funding available for watershed restoration and the differences in priorities, conflicts in project scheduling have arisen between the two organizations in past years.

In order to continue progress towards restoration of both watersheds, a verbal understanding regarding areas of focus was developed between the ASA and the TCCCC. The ASA will be responsible for projects west of State Route 15, while the TCCCC will be responsible for activities east of State Route 15. This agreement allows the ASA to address their primary goal of restoration of Johnson Creek, while allowing the TCCCC to address the South Mountain Discharges, located east of State Route 15, which are a larger priority to the TCCCC than some of the discharges located closer to the Village of Arnot. These areas of focus will allow for complete restoration of the Johnson Creek Watershed, allows the ASA to meet their restoration goals in and around Arnot, and allows the TCCCC to focus on other larger projects throughout the Upper Tioga River Watershed while the Tioga River receives the benefits from improved water quality in Johnson Creek.

Other unique local considerations include winter weather. The winter weather in this watershed can be more severe than many other areas of Pennsylvania, and as a result, construction during the winter months is often not practical or possible. In addition, frozen conditions often make sampling or monitoring difficult due to the presence of ice and thick snow. The schedule

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provided in Section 7.5 accounts for potential weather concerns by allowing longer times for construction activities to offset weather delays.

7.5 Schedule

The proposed schedule for completion of ongoing remediation activities and for future reclamation or remediation efforts is provided in Table 7.1. Milestone and parties responsible for the activities listed on the schedule are also shown.

TABLE 7.1 PROJECT IMPLEMENTATION SCHEDULE

IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Construction of Passive Treatment System for the Arnot No. 2 Deep Mine, #1 Discharge	Construction ongoing and to be completed by October 2006	ASA
Monitoring of Passive Treatment System for the Arnot No. 2 Deep Mine, #1 Discharge	Monthly monitoring associated with construction – October 2006 to August 2007	ASA
Operation and Maintenance of Passive Treatment System for the Arnot No. 2 Mine, #1 Discharge	Flushing of Limestone Cells — yearly Cleanout of Settling Basins — every 15 years Mixing and/or Replacement of Limestone — every 10 years Other — As needed	ASA

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IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Reclamation of the South Mountain Site	Design and Permitting — though fall of 2006 – spring 2007 Construction — fall 2007 though 2008 (as determined by ongoing planning and design) Operation and Maintenance to be determined by BMPs and reclamation plan during design	TCCCC assisted by PA DEP, Bureau of Abandoned Mine Reclamation ASA-to assist as needed or desired by TCCCC
Reclamation of the Arnot No. 5 Deep Mine Site and Construction of Passive Treatment System	Design Funds Requested in March of 2007 Monitoring of discharge for one year beginning in January of 2008 to obtain data for design Construction Funds Requested in Spring of 2008 Final Project Design and Permitting beginning in fall of 2008 Construction to begin Spring of spring 2010 (to allow for private removal of coal refuse from site if possible) Construction completed fall 2010 Operation and Maintenance — Replenishment of wetland limestone and compost substrate — Frequency dependent on design	ASA

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IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Flower Run Deep Mine	Fall of 2007—Parties potentially responsible for the discharge identified and property owner permission obtained Design Funds Requested in March of 2008 Monitoring of Discharge for one year beginning in spring of 2009 to obtain data for design Construction Funds Requested Spring of 2009 Final Design and Permitting to begin fall of 2009 Construction to begin fall of 2010 Construction completed spring 2011 (Project may be delayed until funding for the Arnot No. 5 project is obtained) Operation and Maintenance—Replenishment of Limestone and cleanout of settling basins. Frequency dependent on design.	ASA
Implementation Monitoring—All Projects	Monthly monitoring for the first year following construction; Quarterly monitoring for years 2 and 3 following construction; Semi-annual monitoring thereafter	Responsible Party for the Project as listed above (either ASA or TCCCC) depending on project

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IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Implementation Progress Reporting — All Projects	Annually, at Watershed Advisory Group Meeting	Responsible Party for the Project as listed above (either ASA or TCCCC) depending on project

The Project Implementation Schedule provided above differs slightly from the schedule presented in the SRBC's *Watershed Assessment and Remediation Strategy* in that the restoration efforts relating to the South Mountain Discharges are currently ongoing prior to addressing the Arnot No. 5 Mine and the Flower Mine Discharges. SRBC recommended moving from headwaters to mouth (west to east) along the watershed addressing the discharges in the following geographical order: Arnot No 2. Mine, #1 Discharge; Arnot No. 5 Mine; Flower Mine; and South Mountain Discharges. Since two organizations, ASA and TCCCC are working in the watershed, the TCCCC is undertaking activities at the South Mountain Site, while the ASA is focusing their efforts west of Route 15. Therefore, two of the three remaining problem areas, Arnot No. 5 and South Mountain, are being addressed concurrently. The benefit to the current scheduling is that restoration efforts at these two areas will be completed sooner than scheduled and than would occur if only one organization were addressing all areas.

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7.0 IMPLEMENTATION SCHEDULE AND EVALUATION

This implementation plan has identified four areas where BMPs are currently being installed or will need to be installed to remediate the water quality problems in the Johnson Creek Watershed in order for the TMDLs for the stream to be met. In three of the four areas, efforts to obtain funding for reclamation and remediation, design and permitting activities, or construction activities are underway. Efforts have yet to begin in the forth and final area, the Flower Mine, in need of remediation in order for the TMDLs for Johnson Creek to be met. An implementation schedule, including implementation milestones, funding, construction, and maintenance activities, responsible parties, local considerations, and progress monitoring and reporting is detailed in the following paragraphs. Because the watershed is fairly small in size, the watershed was not divided into subwatersheds.

7.1 Implementation Milestones

The implementation milestones for the restoration of Johnson Creek include funding, construction, and maintenance activities, as shown in Section 7.5 of this narrative. The milestones provide specific target dates to obtain funding, construct or implement projects, to maintain projects, and to monitor and report on the progress of projects.

The Watershed Advisory Group for Johnson Creek will meet at least once per year, preferably in January of each year. The meeting will allow for coordination of project funding applications, and will provide an opportunity for the responsible parties to address the planning of future projects, to review and report on the progress of ongoing and completed projects, and to address any difficulties in achieving the project implementation milestones. If milestones are not achieved due to a lack of funding, weather, or any other unforeseen factors that may prevent construction of all of the scheduled projects in any given year, the project implementation milestones and schedule will be adjusted accordingly, and uncompleted projects will be rescheduled for the following year.

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7.2 Funding, Construction, and Maintenance Activities

Funding for restoration activities in the Johnson Creek Watershed has historically been obtained from grant sources, with small amounts of matching funds provided from contractors, watershed organizations, and consultants. A schedule for applying for funding for remaining projects in the watershed is included in Section 7.5. This schedule is subject to change based on availability and award of funding.

The status of construction of existing projects has been included in Section 7.5, and estimated construction dates have been included for anticipated future projects. Construction is dependent on project funding, and the construction schedule may need to be revised in the future. As construction of each project is completed, the evaluation process will begin and the implementation schedule for future projects will be reviewed to determine if changes should be made prior to construction to incorporate considerations such as improvements in BMP technology, successes or failures of BMPs in the watershed, and maintenance concerns specific to the watershed.

Maintenance activities have also been included in the implementation schedule. Operation and maintenance activities have been determined for those BMPs designed and/or constructed. Maintenance activities have been estimated for those treatment systems or BMPs not yet designed. The actual performance of various BMPs may vary in following implementation, and the operation and maintenance schedule will be revised accordingly in the future.

7.3 Parties Responsible for Implementation Milestones

Two parties are or will be responsible for the funding, implementation, construction, operation and maintenance, and progress monitoring and reporting for the restoration projects in this watershed. These parties include the ASA and the TCCCC. The ASA is and will be responsible for the reclamation activities and treatment systems that it installs. Similarly, the TCCCC is and will be responsible for those reclamation activities and BMPs that it constructs and installs. Both groups have historically assumed operation and maintenance responsibility for all the projects that they have implemented. Specific project responsibilities are summarized in the Schedule in Section 7.5.

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7.4 Local Considerations

The Johnson Creek Watershed benefits from having two conservation groups, the ASA and the TCCCC, conducting watershed restoration activities. Unfortunately, the priorities of each group are sometimes in conflict with respect to scheduling of projects and the limited availability of project funding, so areas of focus were developed between the groups to eliminate any conflicts in priorities. The ASA is working locally, primarily around the Village of Arnot, to restore Johnson Creek, while the TCCCC is working more regionally to restore the Upper Tioga River Watershed. As a result, the local priorities for restoration of Johnson Creek are often not the same as the more regional priorities and needs for restoration of the much larger Upper Tioga River Watershed. For example, addressing the Arnot No. 5 Discharge, which is identified as the next priority for the ASA, is listed as the 14^{th} priority in the Upper Tioga River Watershed. Because of limited funding available for watershed restoration and the differences in priorities, conflicts in project scheduling have arisen between the two organizations in past years.

In order to continue progress towards restoration of both watersheds, a verbal understanding regarding areas of focus was developed between the ASA and the TCCCC. The ASA will be responsible for projects west of State Route 15, while the TCCCC will be responsible for activities east of State Route 15. This agreement allows the ASA to address their primary goal of restoration of Johnson Creek, while allowing the TCCCC to address the South Mountain Discharges, located east of State Route 15, which are a larger priority to the TCCCC than some of the discharges located closer to the Village of Arnot. These areas of focus will allow for complete restoration of the Johnson Creek Watershed, allows the ASA to meet their restoration goals in and around Arnot, and allows the TCCCC to focus on other larger projects throughout the Upper Tioga River Watershed while the Tioga River receives the benefits from improved water quality in Johnson Creek.

Other unique local considerations include winter weather. The winter weather in this watershed can be more severe than many other areas of Pennsylvania, and as a result, construction during the winter months is often not practical or possible. In addition, frozen conditions often make sampling or monitoring difficult due to the presence of ice and thick snow. The schedule

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provided in Section 7.5 accounts for potential weather concerns by allowing longer times for construction activities to offset weather delays.

7.5 Schedule

The proposed schedule for completion of ongoing remediation activities and for future reclamation or remediation efforts is provided in Table 7.1. Milestone and parties responsible for the activities listed on the schedule are also shown.

TABLE 7.1 PROJECT IMPLEMENTATION SCHEDULE

IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Construction of Passive Treatment System for the Arnot No. 2 Deep Mine, #1 Discharge	Construction ongoing and to be completed by October 2006	ASA
Monitoring of Passive Treatment System for the Arnot No. 2 Deep Mine, #1 Discharge	Monthly monitoring associated with construction – October 2006 to August 2007	ASA
Operation and Maintenance of Passive Treatment System for the Arnot No. 2 Mine, #1 Discharge	Flushing of Limestone Cells — yearly Cleanout of Settling Basins — every 15 years Mixing and/or Replacement of Limestone — every 10 years Other — As needed	ASA

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IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Reclamation of the South Mountain Site	Design and Permitting — though fall of 2006 – spring 2007 Construction — fall 2007 though 2008 (as determined by ongoing planning and design) Operation and Maintenance to be determined by BMPs and reclamation plan during design	TCCCC assisted by PA DEP, Bureau of Abandoned Mine Reclamation ASA-to assist as needed or desired by TCCCC
Reclamation of the Arnot No. 5 Deep Mine Site and Construction of Passive Treatment System	Design Funds Requested in March of 2007 Monitoring of discharge for one year beginning in January of 2008 to obtain data for design Construction Funds Requested in Spring of 2008 Final Project Design and Permitting beginning in fall of 2008 Construction to begin Spring of spring 2010 (to allow for private removal of coal refuse from site if possible) Construction completed fall 2010 Operation and Maintenance — Replenishment of wetland limestone and compost substrate — Frequency dependent on design	ASA

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IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Flower Run Deep Mine	Fall of 2007—Parties potentially responsible for the discharge identified and property owner permission obtained Design Funds Requested in March of 2008 Monitoring of Discharge for one year beginning in spring of 2009 to obtain data for design Construction Funds Requested Spring of 2009 Final Design and Permitting to begin fall of 2009 Construction to begin fall of 2010 Construction completed spring 2011 (Project may be delayed until funding for the Arnot No. 5 project is obtained) Operation and Maintenance—Replenishment of Limestone and cleanout of settling basins. Frequency dependent on design.	ASA
Implementation Monitoring—All Projects	Monthly monitoring for the first year following construction; Quarterly monitoring for years 2 and 3 following construction; Semi-annual monitoring thereafter	Responsible Party for the Project as listed above (either ASA or TCCCC) depending on project

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IMPLEMENTATION ACTIVITY OR MILESTONE	SCHEDULE	RESPONSIBLE PARTY
Implementation Progress Reporting — All Projects	Annually, at Watershed Advisory Group Meeting	Responsible Party for the Project as listed above (either ASA or TCCCC) depending on project

The Project Implementation Schedule provided above differs slightly from the schedule presented in the SRBC's *Watershed Assessment and Remediation Strategy* in that the restoration efforts relating to the South Mountain Discharges are currently ongoing prior to addressing the Arnot No. 5 Mine and the Flower Mine Discharges. SRBC recommended moving from headwaters to mouth (west to east) along the watershed addressing the discharges in the following geographical order: Arnot No 2. Mine, #1 Discharge; Arnot No. 5 Mine; Flower Mine; and South Mountain Discharges. Since two organizations, ASA and TCCCC are working in the watershed, the TCCCC is undertaking activities at the South Mountain Site, while the ASA is focusing their efforts west of Route 15. Therefore, two of the three remaining problem areas, Arnot No. 5 and South Mountain, are being addressed concurrently. The benefit to the current scheduling is that restoration efforts at these two areas will be completed sooner than scheduled and than would occur if only one organization were addressing all areas.

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8.0 WATER QUALITY MONITORING AND EVALUATION

The goal of this implementation plan is the restoration of water quality in Johnson Creek to a quality sufficient to achieve the designated use of the stream as a Cold Water Fishery (CWF) and to allow for the stream to be removed from Pennsylvania's 303d List /2006 Integrated List of All Waters. The stream and its receiving water, the Tioga River, are presently listed as impaired waters for pH and metals due to non-point source pollution from AMD and other factors.

In order to determine if the watershed restoration goal for Johnson Creek is met, a water quality evaluation and monitoring plan has been developed. The plan, as discussed in the following sections of this narrative, includes loading and water quality milestones and local considerations, and schedules and identifies responsible parties.

8.1 Loading and Water Quality Milestones

Loading and water quality milestones are presented in Section 8.4 of this narrative. These milestones were developed to fit within the framework provided by the sampling points used in the SRBC's *Watershed Assessment and Remediation Strategy* and the framework of the TMDL developed for the Tioga River, which also included sampling of Johnson Creek and the development of limits for the stream. The headwaters section of the stream was divided into smaller segments to allow water quality improvements of a more-local nature resulting from specific projects to be realized and demonstrated by water sample collection at select locations. Because the Johnson Creek Watershed is of a relatively small size and there are relatively few pollutant sources, the watershed was not divided into subwatersheds based on tributaries.

The water quality milestones were developed for reductions in pollutant load and improvements in water quality that will lead to the achievement of the DEP's standards for water quality and recommended use. The milestones were tailored to the specific impairments in the Johnson Creek Watershed, specifically AMD. The parameters for sampling were based on impairment by AMD, and the resultant parameters of interest--acidity, alkalinity, and metals. Sampling locations and sample collection frequency have been provided.

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8.2 Local Considerations

As stated previously, the Johnson Creek Watershed benefits from having two conservation groups, the ASA and the TCCCC, conducting watershed restoration activities. In order to continue progress towards restoration of both watersheds, a verbal understanding regarding areas of focus was developed between the ASA and the TCCCC. The ASA will be responsible for projects west of State Route 15, while the TCCCC will be responsible for activities east of State Route 15. These areas of focus will allow for complete restoration of the Johnson Creek Watershed, allow the ASA to meet their restoration goals in and around Arnot, and allow the TCCCC to focus on other larger projects throughout the Upper Tioga River Watershed while the Tioga River receives the benefits from improved water quality in Johnson Creek.

Other unique local considerations include winter weather. The winter weather in this watershed can be more severe than many other areas of Pennsylvania, and as a result, collection of water samples during the winter months is often not practical or possible. The presence of ice precludes access to collect samples, and thick snow may prevent the sample collector from reaching the sample site. The schedule provided in Section 8.4 allows for potential weather concerns by allowing some flexibility in the sample collection schedule.

A final consideration for water quality monitoring and evaluation, while not specific to the local area, is the availability of funding for water quality monitoring activities. Both the ASA and the TCCCC rely heavily on volunteer labor and sources of grant funding to achieve project goals. Typically, manpower to collect a small number of water samples on a quarterly to yearly frequency does not pose any difficulties to volunteer organizations such as these groups. However, the cost for ongoing monitoring does present an issue for ongoing water quality monitoring. As mentioned earlier, both organizations are dependent on grant funding for projects, and many of the grant programs do not provide funding for the laboratory analysis of water samples. Long-term monitoring will require the ongoing laboratory analysis of water samples, resulting in significant costs for the responsible parties. The two organizations must seek a funding source to meet the costs of laboratory analysis for ongoing monitoring.

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8.3 Responsible Parties

The Watershed Advisory Group for Johnson Creek will meet at least once per year, preferably in January of each year. The meeting will provide an opportunity for the responsible parties to review the water quality monitoring to determine if pollutant loading and water quality milestones are being achieved.

The two parties who are or will be responsible for the funding, implementation, construction, operation and maintenance, and progress monitoring and reporting for the restoration projects in this watershed will also be responsible for water quality monitoring and evaluation. These parties are the ASA and the TCCCC. Both the ASA and the TCCCC are and will be responsible for the reclamation activities and treatment systems that they install. State Route 15 provides a physical divider for the efforts of these groups, and forms a natural point for the division of water quality monitoring efforts. The ASA will monitor west of State Route 15, while the TCCCC will monitor east of the highway. Specific project responsibilities are summarized in the schedule in Section 8.4 of this narrative.

8.4 Schedule

The proposed schedule for water quality monitoring activities and the achievement of water quality milestones is provided in the following table. The parties responsible for the activities listed on the schedule are also shown. Maps showing the locations of water sampling points are provided as Figures 4A and 4B in Appendix A.

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The Water Quality Monitoring Schedule and Milestones utilizes the term "restoration" of stream reaches with respect to water quality milestones. This term should be defined as restoration of water quality sufficient to achieve the designed use of Johnson Creek as a CWF, including all applicable water quality criteria as described in 25 PA Code §93 for the designated use as well as sufficient water quality to allow for the stream to be removed from Pennsylvania's 303d List/2006 Integrated List of All Waters. In addition, the specific pollutant limits established by the TMDL for the stream should be met. By doing so, the sport fishery of the stream will be restored.

The schedule also utilizes the phrase "improvement in water quality" with respect to the South Mountain Discharges. Since projects near the headwaters are occurring concurrently with projects at the South Mountain Site, the restoration of the watershed is not progressing in an upstream-to-downstream direction. After the improvements at South Mountain are completed, the water quality in the main stem will not be completely restored until projects at the Arnot No. 5 Mine and the Flower Mine are implemented. Therefore, while loadings in the reach below the South Mountain Discharges will be reduced, as measured at Johnson 1.0, pollutant loadings from the No. 5 and Flower Mines will prevent the reach from being totally restored until those two discharges are addressed.

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TABLE 8.1 WATER QUALITY MONITORING SCHEDULE AND MILESTONES

MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
ACTIVITY 1 Monitoring of Discharge of Passive Treatment System for Arnot No. 2 Mine, #1 Discharge plus Johnson Creek Above No. 5 Discharge (See Note 2)	Construction to be completed by September 2006. Monitoring commences immediately following construction completion. Monthly monitoring September 2006-August 2007. Quarterly monitoring September 2007-August 2009. Semi-annual monitoring September 2009-2015.	Treatment System Outfall at final settling basin **(SRBC Point DJC 901 Outflow)** Johnson Creek Above confluence with unnamed tributary conveying the No. 5 Deep Mine Discharge **(Point JOHN3 of TMDL study)**	pH, acidity, alkalinity, iron, aluminum, and manganese	ASA
MILESTONE *Restoration of Johnson Creek from headwaters down to confluence with unnamed tributary 7.0* ***(Unt 7.0)****(See note 3)*	*To be achieved by March 2007*	*Same as Activity 1*	*Same as Activity 1*	*Same as Activity 1*

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
ACTIVITY 2 Reclamation of the South Mountain Site	Estimated completion of construction by end of 2008. Monitoring commences immediately following construction completion. Monthly monitoring January 2009-December 2009. Quarterly monitoring January 2010-December 2011. Semi-annual monitoring September 2011-2015.	Johnson Creek upstream of South Mountain Site **(New sample point A)** Any treatment system or tributary outfalls as determined by ongoing site design **(DJC 901, 902, and/or 903 outfalls)** Unnamed tributary conveying South Mountain discharges to Johnson Creek at mouth **(Point UNT5 of TMDL Study)** Johnson Creek below South Mountain discharges at mouth **(Point JOHN 1 of TMDL study)**	pH, acidity, alkalinity, iron, aluminum, and manganese	TCCCC assisted by BAMR

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
MILESTONE *Improvement in water quality between South Mountain Discharges and mouth of Johnson Creek* ***(John 1.0)****. Reduction in majority of pollutant loadings to Upper Tioga River*	*To be achieved by June 2009*	*Same as Activity 2*	*Same as Activity 2*	*Same as Activity 2*
ACTIVITY 3 Monitoring of Discharge of Passive Treatment System for Arnot No. 5 Mine plus Johnson Creek Above Flower Mine Discharge	Estimated completion of construction by September 2010. Monitoring commences immediately following construction completion. Monthly monitoring September 2010-August 2011. Quarterly monitoring September 2011-August 2013. Semi-annual monitoring September 2013-2015.	Unnamed tributary conveying Arnot No. 5 mine discharge at mouth **(Point UNT7 of TMDL study)** Johnson Creek above Flower Mine discharge **(Point JOHN 2 of TMDL study)**	pH, acidity, alkalinity, iron, aluminum, and manganese	ASA

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
MILESTONE *Restoration of Johnson Creek from headwaters to upstream of Flower Mine Discharge measured at* ***John 2.0*** *(2 miles) plus 2000 feet of unnamed tributary 7.0*	*To be achieved by February 2011*	*Same as Activity 3*	*Same as Activity 3*	*Same as Activity 3*
ACTIVITY 4 Monitoring of Discharge of Passive Treatment System for Flower Mine discharge plus Johnson Creek above South Mountain Discharges	Estimated completion of construction by spring 2011. Monitoring commences immediately following construction completion. Monthly monitoring June 2011-May 2012. Quarterly monitoring June 2012-May 2014. Semi-annual monitoring June 2014-2015.	Treatment System Outfall at final constructed wetland **(SRBC Point DJC 106 Outfall)** Johnson Creek below Flower Mine treatment system **(New sample point A)**	pH, acidity, alkalinity, iron, aluminum, and manganese	ASA

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
MILESTONE *Restoration of entire length of Johnson Creek from headwaters to discharge into Tioga River at* ***John 1.0***	*To be achieved by fall 2011*	*Same as Activity 4 plus sampling for Activity 2*	*Same as Activity 4*	*Same as Activity 4*
Water Quality Progress Reporting—All Projects	Annually, at Watershed Advisory Group Meeting Special meeting to be called if problems or declines in water quality are noted	All points listed above	All points listed above	Responsible Party for the Project as listed above (either ASA or TCCCC) depending on project

Notes:

1. All samples to be analyzed for the parameters of acidity, alkalinity, iron, aluminum, and manganese.

2. If projects are completed sooner than anticipated, monitoring shall begin immediately following completion of construction.

3. A time of 6 months following completion of construction of passive treatment systems or other BMPs has been allowed before a water quality milestone was considered to be achieved. This 6-month timeperiod was allowed to account for variability in treatment system efficiency during startup and any necessary adjustments to treatment systems due to unforeseen conditions.

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4. The sampling timeframe has been left fairly flexible to allow for adjustments for winter weather conditions, flooding conditions, etc. However, the sample should be collected during high flow winter conditions, when treatment efficiency is likely to decline, and during low flow summer conditions, when discharges may be less diluted and other environmental factors such as temperature and oxygen levels are likely to have negative impacts to aquatic life.

5. See also Sample Location Map provided in Appendix A. Sample location points reference the same sample point designations as the SRBC's *Watershed Assessment and Remediation Strategy* and the *Tioga River TMDL* to the fullest extent possible. One new sample point, sample point A, was added to measure the effects of treatment of the Flower Mine Discharge upstream of the South Mountain Discharges.

6. Manganese, and aluminum to be measured as total recoverable quantity. Iron to be measured as total recoverable, dissolved, as per PA Code, Title 25, Chapter 93.

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TABLE 8.1 WATER QUALITY MONITORING SCHEDULE AND MILESTONES

MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
ACTIVITY 1 Monitoring of Discharge of Passive Treatment System for Arnot No. 2 Mine, #1 Discharge plus Johnson Creek Above No. 5 Discharge (See Note 2)	Construction to be completed by September 2006. Monitoring commences immediately following construction completion. Monthly monitoring September 2006-August 2007. Quarterly monitoring September 2007-August 2009. Semi-annual monitoring September 2009-2015.	Treatment System Outfall at final settling basin **(SRBC Point DJC 901 Outflow)** Johnson Creek Above confluence with unnamed tributary conveying the No. 5 Deep Mine Discharge **(Point JOHN3 of TMDL study)**	pH, acidity, alkalinity, iron, aluminum, and manganese	ASA
MILESTONE *Restoration of Johnson Creek from headwaters down to confluence with unnamed tributary 7.0* ***(Unt 7.0)****(See note 3)*	*To be achieved by March 2007*	*Same as Activity 1*	*Same as Activity 1*	*Same as Activity 1*

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
ACTIVITY 2 Reclamation of the South Mountain Site	Estimated completion of construction by end of 2008. Monitoring commences immediately following construction completion. Monthly monitoring January 2009-December 2009. Quarterly monitoring January 2010-December 2011. Semi-annual monitoring September 2011-2015.	Johnson Creek upstream of South Mountain Site **(New sample point A)** Any treatment system or tributary outfalls as determined by ongoing site design **(DJC 901, 902, and/or 903 outfalls)** Unnamed tributary conveying South Mountain discharges to Johnson Creek at mouth **(Point UNT5 of TMDL Study)** Johnson Creek below South Mountain discharges at mouth **(Point JOHN 1 of TMDL study)**	pH, acidity, alkalinity, iron, aluminum, and manganese	TCCCC assisted by BAMR

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
MILESTONE *Improvement in water quality between South Mountain Discharges and mouth of Johnson Creek* ***(John 1.0)****. Reduction in majority of pollutant loadings to Upper Tioga River*	*To be achieved by June 2009*	*Same as Activity 2*	*Same as Activity 2*	*Same as Activity 2*
ACTIVITY 3 Monitoring of Discharge of Passive Treatment System for Arnot No. 5 Mine plus Johnson Creek Above Flower Mine Discharge	Estimated completion of construction by September 2010. Monitoring commences immediately following construction completion. Monthly monitoring September 2010-August 2011. Quarterly monitoring September 2011-August 2013. Semi-annual monitoring September 2013-2015.	Unnamed tributary conveying Arnot No. 5 mine discharge at mouth **(Point UNT7 of TMDL study)** Johnson Creek above Flower Mine discharge **(Point JOHN 2 of TMDL study)**	pH, acidity, alkalinity, iron, aluminum, and manganese	ASA

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
MILESTONE *Restoration of Johnson Creek from headwaters to upstream of Flower Mine Discharge measured at* ***John 2.0*** *(2 miles) plus 2000 feet of unnamed tributary 7.0*	*To be achieved by February 2011*	*Same as Activity 3*	*Same as Activity 3*	*Same as Activity 3*
ACTIVITY 4 Monitoring of Discharge of Passive Treatment System for Flower Mine discharge plus Johnson Creek above South Mountain Discharges	Estimated completion of construction by spring 2011. Monitoring commences immediately following construction completion. Monthly monitoring June 2011-May 2012. Quarterly monitoring June 2012-May 2014. Semi-annual monitoring June 2014-2015.	Treatment System Outfall at final constructed wetland **(SRBC Point DJC 106 Outfall)** Johnson Creek below Flower Mine treatment system **(New sample point A)**	pH, acidity, alkalinity, iron, aluminum, and manganese	ASA

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MONITORING ACTIVITY OR MILESTONE	SCHEDULE	SAMPLING LOCATION(S)	SAMPLE PARAMETERS	RESPONSIBLE PARTY
MILESTONE *Restoration of entire length of Johnson Creek from headwaters to discharge into Tioga River at* ***John 1.0***	*To be achieved by fall 2011*	*Same as Activity 4 plus sampling for Activity 2*	*Same as Activity 4*	*Same as Activity 4*
Water Quality Progress Reporting—All Projects	Annually, at Watershed Advisory Group Meeting Special meeting to be called if problems or declines in water quality are noted	All points listed above	All points listed above	Responsible Party for the Project as listed above (either ASA or TCCCC) depending on project

Notes:

1. All samples to be analyzed for the parameters of acidity, alkalinity, iron, aluminum, and manganese.

2. If projects are completed sooner than anticipated, monitoring shall begin immediately following completion of construction.

3. A time of 6 months following completion of construction of passive treatment systems or other BMPs has been allowed before a water quality milestone was considered to be achieved. This 6-month timeperiod was allowed to account for variability in treatment system efficiency during startup and any necessary adjustments to treatment systems due to unforeseen conditions.

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4. The sampling timeframe has been left fairly flexible to allow for adjustments for winter weather conditions, flooding conditions, etc. However, the sample should be collected during high flow winter conditions, when treatment efficiency is likely to decline, and during low flow summer conditions, when discharges may be less diluted and other environmental factors such as temperature and oxygen levels are likely to have negative impacts to aquatic life.

5. See also Sample Location Map provided in Appendix A. Sample location points reference the same sample point designations as the SRBC's *Watershed Assessment and Remediation Strategy* and the *Tioga River TMDL* to the fullest extent possible. One new sample point, sample point A, was added to measure the effects of treatment of the Flower Mine Discharge upstream of the South Mountain Discharges.

6. Manganese, and aluminum to be measured as total recoverable quantity. Iron to be measured as total recoverable, dissolved, as per PA Code, Title 25, Chapter 93.

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9.0 REMEDIAL ACTIONS

The need for remedial or corrective actions for BMPs and restoration activities will be based on achieving certain criteria that were established for the purpose of evaluating the results of restoration projects in the Johnson Creek watershed. The criteria for evaluating results and re-evaluation procedures are discussed in the following paragraphs.

9.1 Criteria for Evaluating Results

The results of project implementation and water quality monitoring will be judged against prescribed milestones for water quality improvement. Water quality milestones were addressed in Section 8.4 of this narrative.

The water quality criteria to be met include the following criteria established by the TMDLs for Johnson Creek as provided in Tables 9.1 through 9.5:

TABLE 9.1 WATER QUALITY CRITERIA AT SAMPLE POINT JOHN3

SAMPLE POINT JOHN3	**ALLOWABLE**	
	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.30	5.2
Manganese	0.39	6.7
Aluminum	0.51	8.8
Acidity	13.37	229.7
Alkalinity		

All values shown in these tables are long-term average daily values.

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TABLE 9.2 WATER QUALITY CRITERIA AT SAMPLE POINT UNT 7.0

SAMPLE POINT UNT7	ALLOWABLE	
	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.60	13.3
Manganese	0.52	11.5
Aluminum	0.51	11.3
Acidity	3.93	87.2
Alkalinity		

TABLE 9.3 WATER QUALITY CRITERIA AT SAMPLE POINT JOHN2

SAMPLE POINT JOHN2	ALLOWABLE	
	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.36	20.2
Manganese	0.38	21.3
Aluminum	0.50	28.0
Acidity	3.06	117.5
Alkalinity		

TABLE 9.4 WATER QUALITY CRITERIA AT SAMPLE POINT UNT5.0

SAMPLE POINT UNT5	ALLOWABLE	
	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.61	2.6
Manganese	0.45	1.9
Aluminum	0.10	0.4
Acidity	0.32	1.3
Alkalinity		

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TABLE 9.5 WATER QUALITY CRITERIA AT SAMPLE POINT JOHN1

SAMPLE POINT UNT5	**ALLOWABLE**	
	LTA Conc. (mg/l)	Load (lb/day)
Iron	0.31	33.8
Manganese	0.34	37.0
Aluminum	0.53	57.7
Acidity	3.07	334.4
Alkalinity		

Title 25, §93.7 of the Pennsylvania Code provides water quality criteria for designated uses such as CWF. The criteria listed above for the TMDL should be used for iron, manganese, aluminum, and acidity. Alkalinity must be 20 mg/l minimum as per §93.7.

It should be noted that in some cases the TMDLs for Johnson Creek involve relatively small reductions in pollutant concentrations. Some initial metals concentrations are well below the level of 1 mg/l. Reductions in metals concentrations below 1 mg/l are difficult to predict and achieve using today's current passive treatment technologies, and special care must be exercised to provide appropriate treatment methods to achieve the necessary reductions in pollutant concentration.

9.2 Re-evaluation Procedures

The goal of this implementation plan is the restoration of water quality in Johnson Creek to a quality sufficient to achieve the designated use of the stream as a Cold Water Fishery (CWF) to allow for the stream to be removed from Pennsylvania's 303d List /2006 Integrated List of All Waters and to meet the TMDLs that were established for the stream. Post-construction water quality monitoring will be used to indicate if the implemented projects are meeting the water quality criteria established for the restoration of Johnson Creek.

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In the event that the water quality data collected during the post-construction sampling indicate that project implementation has not produced the desired improvements in water quality, if the water quality criteria are not being met, or if progress is less than expected, the implementation process must be re-evaluated. Implementation efforts, project milestones, the selected restoration measures, and the TMDLs for the stream may be re-evaluated, either collectively or on an individual basis.

The Watershed Advisory Group will be responsible for the re-evaluation process. As indicated on the Water Quality Monitoring Schedule, the Watershed Advisory Group will meet on a yearly basis, but a special meeting will be called if water quality results indicate that the water quality criteria are not being met and a problem is occurring. The group will discuss the nature and severity of the situation and develop a plan and schedule for correction of the situation. As needed, additional special meetings will be called until the situation is addressed. On an as-needed basis, the group may take actions such as re-scheduling proposed activities and shifting priorities to the necessary corrective action to ensure that remediation of the watershed is proceeding in an effective and technically appropriate fashion based on current watershed conditions.

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APPENDIX A

MAPS AND FIGURES

APPENDIX B

EXCERPTS FROM THE SUSQUEHANNA RIVER BASIN COMMISSION *PUBLICATION 230-- WATERSHED ASSESSMENT AND REMEDIATION STRATEGY FOR ABANDONED MINE DRAINAGE IN THE UPPER TIOGA RIVER WATERSHED*

APPENDIX C

EXCERPTS FROM THE TIOGA RIVER WATERSHED TMDL

APPENDIX D

CONCEPTUAL DESIGNS WITH COST ESTIMATES

APPENDIX E

PHOTOGRAPHS OF REMAINING AREAS TO BE ADDRESSED