Final Laurel Run Watershed TMDL
Clearfield County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

April 2, 2007

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ATTACHMENTS

[1]TMDL
Laurel Run Watershed
Clearfield County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 08D Moshannon Creek								
Year	**Miles**	**Segment ID Assessment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	5.4	7159	25853	Laurel Run	CWF	RE	AMD	Metals
1998	5.45	7159	25853	Laurel Run	CWF	SWMP	AMD	Metals
2002	6.9	20010802-1435-TAS	25853	Laurel Run	CWF	SWMP	AMD	pH Metals
2004	2.0	20020717-1000-TAS	25853	Laurel Run	CWF	SWMP	AMD	pH Metals
2004	0.7	20020717-1000-TAS	25624	UNT Laurel Run	CWF	SWMP	AMD	Metals
2004	1.6	20010802-1436-TAS	25855	UNT Laurel Run	CWF	SWMP	AMD	Metals
2002	7.6	20010802-1310-TAS	25857	Little Laurel Run	CWF	SWMP	AMD	pH Metals
2004	5.6	20010802-1310-TAS	25857	Little Laurel Run	CWF	SWMP	AMD	pH Metals
2004	1.9	20010802-1310-TAS	25859	UNT Little Laurel Run	CWF	SWMP	AMD	pH Metals
2002	1.8	20010531-1300-TAS		Albert Run	CWF	SWMP	AMD	pH Metals

Resource Extraction = RE
Cold Water Fishery = CWF
Resource Extraction = RE
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

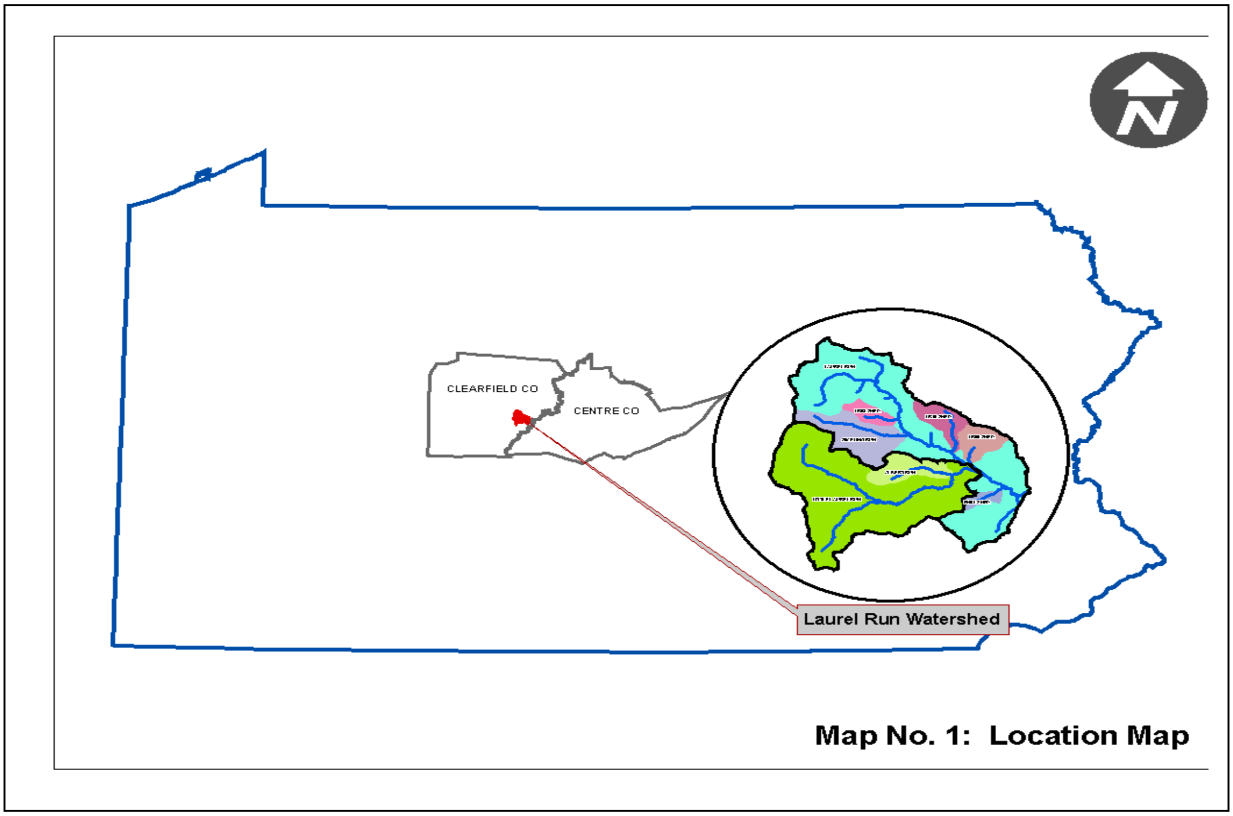
Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for six segments in the Laurel Run Watershed (Attachment A). It was done to address the impairments noted on the 1996, 1998, 2002, and 2004 Pennsylvania 303(d) lists, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). Depressed pH and in some areas, high levels of metals caused these impairments. Impairments resulted due to acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

[1] Pennsylvania's 1996, 1998, 2002 and 2004 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Directions to the Laurel Run Watershed

The Laurel Watershed is located in Central Pennsylvania, occupying the east central portion of Clearfield County in Boggs, Decatur, and Morris Townships, and parts of Chester Hill and Wallaceton Boroughs. Map 1 shows the Laurel Run watershed and the main subwatersheds addressed as part of this TMDL.



Map No. 1: Location Map

The watershed area is displayed on the United States Geological Survey's Philipsburg and Wallaceton 7.5-Minute Quadrangles. The headwaters region of Laurel Run is within Boggs Township, south and southwest of Wallaceton Borough, and is about five to six miles northwest of the mouth. The Borough of Philipsburg is located just east of the mouth of this watershed on the eastern side of Moshannon Creek. The main stem of Laurel Run follows SR 0322 west of Philipsburg, PA, beginning due south of Wallaceton where two headwater tributaries combine. The mouth of Laurel Run enters Moshannon Creek just south of the intersection of Philipsburg Borough's Ninth Street and SR 0053. The total drainage area of the Laurel Run watershed encompasses approximately 22 square miles. A major tributary to Laurel Run is known as Little Laurel Run, and enters Laurel Run approximately 1.3 miles northwest of the mouth, adjacent to the northeast shoulder of SR0322. Little Laurel Run is the largest tributary to Laurel Run, and its drainage area is nearly equal to that of Laurel Run at the confluence of these two streams.

Land types and land uses within the watershed include forest and timberland, cropland, pastureland, wetlands, residential, business, active surface mine sites (herein defined as those actively removing overburden or not yet completely backfilled, regraded, and revegetated)*, inactive mine sites (completely reclaimed), and abandoned mine sites (unreclaimed with either open pits, spoil piles, poor surface grading, little or no topsoil, and/or inadequate vegetation; no company liable for the site).

Hydrology and Geology

Laurel Run and its tributaries are part of the much larger Moshannon Creek Watershed. The stream drains from the northwest to the southeast. Both Laurel Run and its main tributary, Little Laurel Run, begin at an elevation above 1850 feet near the headwaters and drain to an elevation of about 1450 feet at Laurel Run's confluence with Moshannon Creek. This is a difference in elevation of slightly more than 400 feet.

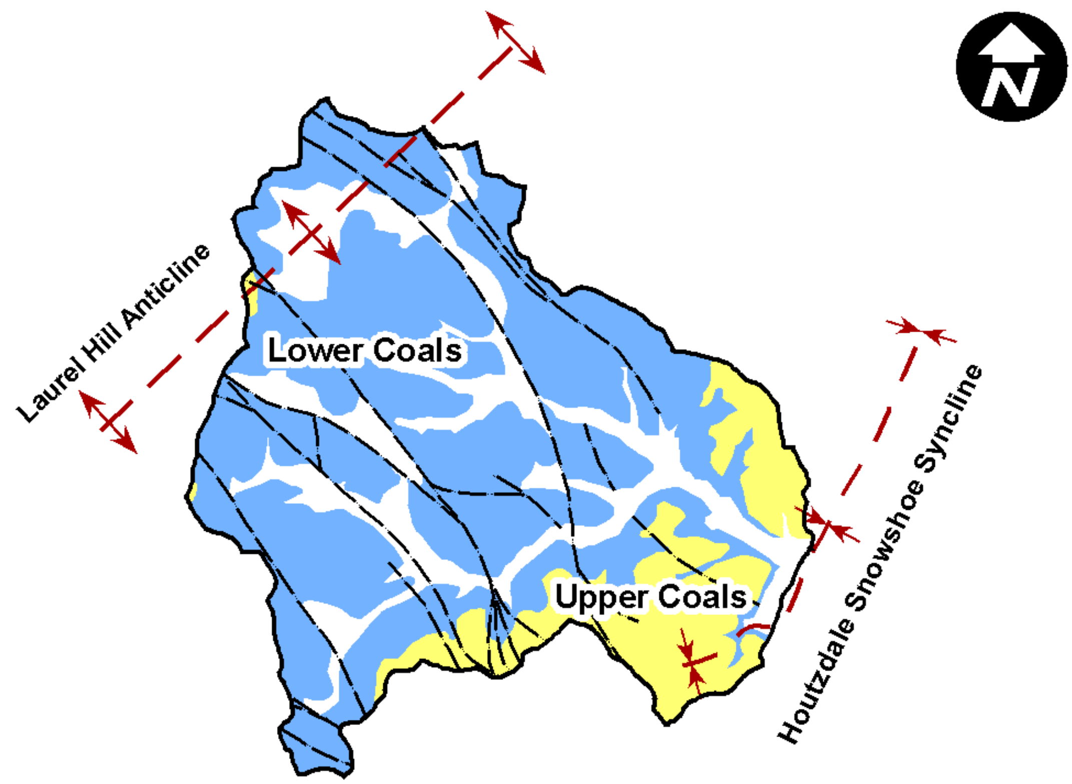
The Laurel Run Watershed lies within the Appalachian Plateau Physiographic Province about 10 miles northwest of the Allegheny Front (separating the Appalachian Plateau from the Ridge and Valley provinces). The watershed area is comprised for the most part of Pennsylvania-age rocks within the Conemaugh, Allegheny, and Pottsville Groups. Most formations are coal-bearing rocks and include, in descending order, the Mahoning and Upper Freeport strata of the lower Conemaugh Group, the Upper Freeport coal seam and the Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, and Clarion strata (including coals) of the Allegheny Group, and the Mercer coals/clays and associated strata of the upper Pottsville Group. Near the base of some of the incised stream valleys, the unconformity (ancient erosional boundary) separating Pennsylvanian and Mississippian age rocks may be exposed.

Map No. 2, Generalized Geology Map, displays selected structural features and surface rocks within the Laurel Run watershed. This map was generalized from the more detailed geology maps of the Pennsylvania Geological Survey's Atlas A85ab and Atlas A95a. On Map No. 2, the strata containing the Mercer, Clarion, Lower Kittanning, and Middle Kittanning coals are grouped together and labeled as the "Lower Coals". The strata containing the Upper Kittanning, Lower Freeport, Upper Freeport, and Mahoning coals are grouped together and labeled as the "Upper Coals". The coal-bearing rocks are partitioned into these two broad stratigraphic "regimes" because there appears to be a correlation between the coal seams mined and the quality of the surface and groundwater drainage. As will become evident later in this report, mining of coal seams that are lower in the stratigraphic section was responsible for producing a quality of mine drainage that is more acidic and higher in metals. Mining of coal seams that are higher in the stratigraphic section usually resulted in alkaline or less acidic drainage, and where the upper coal seams have been mined in conjunction with the lower coal seams, partial neutralization of the acid mine drainage has resulted in generally alkaline waters but with elevated metals.

As shown, the lower coal seams are exposed at the surface over most of the Laurel Run Watershed except for the hills of the southern and eastern boundary area. In the southern and eastern portions of the Laurel Run watershed, the upper coals predominate, while the lower coals

* The Department's definition of "active" mine sites are those in which bonds are still applied to the site, regardless of the state of reclamation. Some permits are still considered active by the Department even if the site is reclaimed, but mine drainage discharges are present for which the coal company is held liable.

are at significant depth. For most of the watershed, the uppermost rocks that are present on the hilltops are the Lower Kittanning coal and associated overburden, with a few isolated hills where the Middle Kittanning and/or Upper Kittanning rocks are exposed. It is thought that past mining of the Lower Kittanning coal and associated overburden is responsible for creating most of the acid mine drainage pollution within the watershed.



Map No. 2: Generalized Geologic Map

Structurally, the axial trace of the SW—NE trending Laurel Hill anticline intersects the very northwestern portion of the Laurel Run watershed, and the axial trace of the Houtzdale-Snowshoe syncline intersects the very eastern boundary of the watershed near the mouth of Laurel Run. Therefore, the strata are dipping generally toward the southeast for most of the watershed. The maximum structural relief of the Laurel Hill anticline from the approximate location of its axial trace* in the northwestern watershed to the axial trace of the Houtzdale-Snowshoe syncline at the mouth of Laurel Run is nearly 950 feet. This is about twice the drop in elevation than the gradient of Laurel Run from its headwaters region to the mouth (400+ feet). With a distance of about 29,000 feet between the axial traces of these major folds,

* Where the axial plane intersects the Lower Kittanning horizon. This axial line is generalized and approximately located. The true axial trace would be dissected because of the numerous tear faults that have cut, translated, and rotated large "blocks" of strata.

the strata fall more than 170 feet per mile, for an average dip of approximately 1.9 degrees (3.3 percent) to the southeast.

Although the general trend of the rocks within the Laurel Run Watershed dip about 2 degrees to the southeast, the strike and dip of the strata within the Laurel Run Watershed is anything but uniform along the southeast limb of the Laurel Hill anticline. Numerous sub-vertical, SE—NW trending tear faults cut through the strata. Between adjacent fault blocks, the rocks were rotated and tilted independently. As such, the local attitude of the coal seam bedding surfaces can vary significantly among the various fault blocks. In some instances, the rocks within the southeast limb of the Laurel Hill anticline are actually dipping to the northwest, opposite the regional structural trend. Differential rotation and buckling among fault blocks is thought by Edmunds (PaGS Atlas 85ab, 1973) to be the result of continued tectonic compressional stress and folding after the faults were developed.

The presence of tear faults and subsequent folding that have buckled the strata and resulted in significant horizontal and vertical displacements greatly complicate the geology and hydrogeology of the watershed. Fault planes can serve as barriers to lateral groundwater flow within localized perched aquifers. On the other hand, faults can serve as vertical and horizontal conduits to groundwater flow, especially where fractures and breccia are concentrated along the faulted zone. Therefore, some coal mines that appear to be contained within one surface drainage subwatershed may contribute mine drainage to an adjacent subwatershed along fault or fracture zone lineaments. On the other hand, where the dip of the strata might suggest that subsurface mine waters should impact an adjacent subwatershed, the presence and orientation of a tear fault could prevent and/or redirect groundwaters away from that subwatershed.

Segments addressed in this TMDL

Laurel Run is affected by pollution from AMD. This pollution has caused high levels of metals and depressed pH in the watershed. There are ten mining operations in this watershed which require waste load allocations. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Table 3 for TMDL calculations and see Attachment C for TMDL explanations.

Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be “fishable” and “swimmable.”

Additionally, the federal Clean Water Act and the U.S. Environmental Protection Agency’s (EPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to EPA every two years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and non-point sources; and

- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and EPA had not developed many TMDLs. Beginning in 1986, organizations in many states filed lawsuits against the EPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While EPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of non-point source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a

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[2] Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

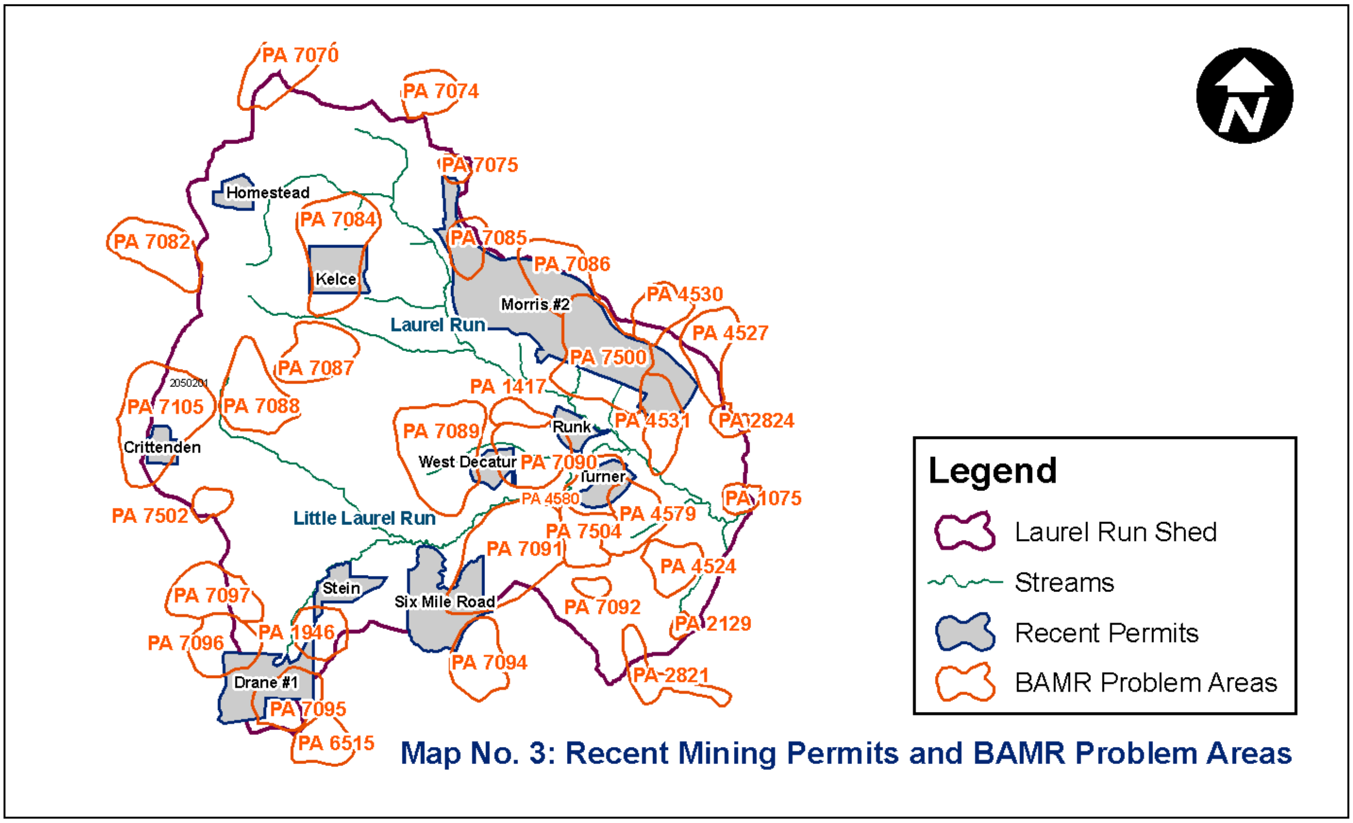
1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL to EPA.
7. EPA approval of the TMDL.

Watershed History

<u>Brief Mining History and General Discussion of Mining Impacts on Water Quality</u>

The coal and clay mining within the watershed was initially conducted by underground methods in the first half of the 19th century, with more intense underground mining taking place in the latter part of the 19th century and early 20th century. Large-scale surface mining began in the 1940s and today is the only method of mining in this watershed. Surface coal mining peaked in the latter half of the 20th century. The Department's Bureau of Abandoned Mine Reclamation (BAMR) has mapped and documented numerous "problem areas" within the Laurel Run

Watershed. These are shown on the map identified as Map No. 3, Recent Mining Permits and BAMR Problem Areas.



Map No. 3: Recent Mining Permits and BAMR Problem Areas

There are six surface coal mines of interest in which surface mining activities are currently taking place, or where active mining had just recently been completed. They are the Sky Haven Coal Inc., ***Homestead*** Operation (SMP #17040108) on the Mercer and Brookville coal seams; the Amfire Mining, LLC, ***Crittenden*** Operation (SMP #17030111) on the Lower Kittanning coal seam; the Junior Coal Contracting, Inc., ***West Decatur*** Operation (SMP #17980110) on the Mercer coal seam; the Junior Coal Contracting, Inc., ***Runk*** Operation (SMP #17980117) on the Lower Kittanning coal seam; the Larry D. Baumgardner Coal Co., Inc., ***Turner*** Operation (SMP #17990111) on the Middle and Upper Kittanning coal seams; and the River Hill Coal Company, ***Six Mile Road*** Mine (SMP #17990102) on the Clarion through Upper Freeport coal seams. There is also a pending surface coal mining permit that should have a significant impact within the watershed. It is the River Hill Coal Company, ***Stein*** Operation (SMP #17030102) on the Clarion and Lower Kittanning coal seams. Furthermore, three older surface mine permits are identified on the map because they have resulted in acid mine drainage discharges for which the permittee was held responsible for chemical treatment. They are the Penn Coal Land, Inc. (formerly Stott Coal Company), ***Kelce*** Operation (SMP #17753180) on the Lower Kittanning coal seam, the Penn Coal Land, Inc. (formerly Stott Coal Company), ***Drane #1*** Operation (SMP #4473SM10) on the Clarion through Upper Kittanning coal seams, and the Thompson Bros. Coal Company (transferred to Al Hamilton Coal Contracting, Inc.), ***Morris #2*** Operation (SMP #17810104) on the Clarion through Lower Freeport coal seams. The treatment responsibility for the main discharge on the Morris #2 permit was transferred to the Commonwealth of Pennsylvania as part of a comprehensive settlement between the Commonwealth and Al Hamilton Contracting Coal, Inc.

Because the coals of the Conemaugh Group and Upper Allegheny Group are absent for most of the Laurel Run Watershed, most of the surface and underground coal mining in the past was conducted on the coals and clays that are lower in the stratigraphic section ("lower coals" as defined in this report--Middle Kittanning, Lower Kittanning, Clarion, and Mercer). These lower coals are notorious for harboring excess sulfide minerals (primarily pyrite) and lack natural calcium carbonate minerals that would prevent or neutralize acid mine drainage. Unless the lower coals were mined in conjunction with the upper coals, to the extent that a significant volume of natural calcium carbonates were encountered[*], acid mine drainage would predominate. Therefore, most mining within the Laurel Run Watershed resulted in acidic and mineralized waters discharging to the groundwaters and receiving streams.

In the "transitional area" between those portions of the watershed where just lower coals are present and where the upper coals cap the ridges, some surface coal mining of the lower coal seams did encounter significant volumes of calcium carbonate minerals. In those mining areas, acid mine drainage was either moderated or neutralized. This may be the case for some mines along the south side of Little Laurel Run. A recent example is the Larry D. Baumgardner, Turner Operation, where mining of the Middle Kittanning coal takes place under relatively deep cover, to the extent that alkaline rocks of the Johnstown limestone horizon are encountered. Fragments of natural limestone can be found throughout the spoil. Even though the Middle Kittanning overburden is usually elevated in pyritic minerals, incorporation of these alkaline rocks into the spoil has resulted in a postmining aqueous environment that is generally alkaline.

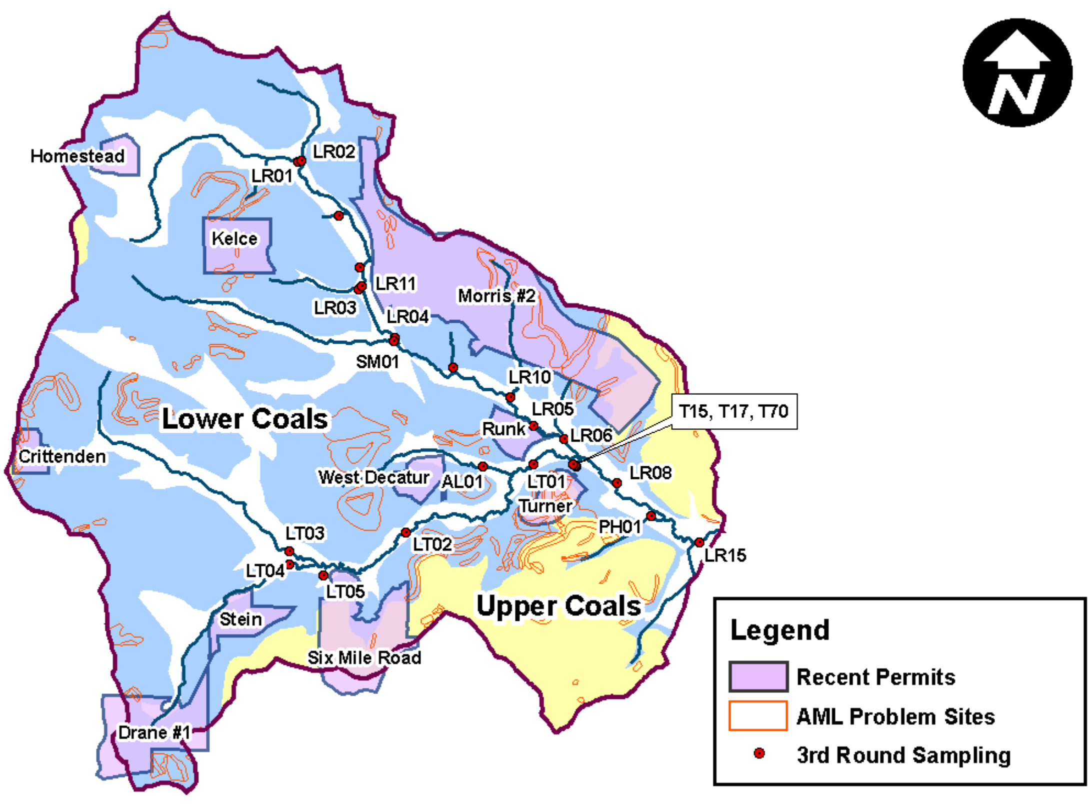
Another exception to the generalization that mining of the lower coals results in severe acid mine drainage is where mining takes place at fairly low cover, or the mining is very limited in areal extent. For instance, within the headwaters region of the main stem of Laurel Run, there are some shallow Mercer and Clarion coal and/or clay surface mines where the water quality associated with mining is not highly acidic and is not severely degrading the receiving streams. Although the overburden disturbed during mining probably does not contain natural calcite, the concentration of pyrite may not necessarily be excessive. Furthermore, where mining is conducted under relatively low depth of cover, a significant percentage of the pyritic minerals may have been weathered (oxidized) naturally.

Overall within the Laurel Run Watershed, very few streams have elevated alkalinity (either natural or mining-related) to the extent that they would present any effective buffering capacity. Of the streams and discharge drainage sampled as part of this TMDL project, only Simeling Run (SM01), where it appears that surface and underground mining was quite limited and its alkalinity likely natural, and "Pleasant Hill Run" (PH01), where the surface mining took place largely on the upper coal seams where natural calcium carbonate minerals were probably

[*] Natural calcium carbonates can be found beneath the Upper Kittanning coal seam at the Johnstown "limestone" horizon, and within the Upper and Lower Freeport overburden. Precipitation of calcite may also be present along bedding planes and joints of the lower strata.

abundant, are net alkaline (negative hot acidity results). All other major sampling points revealed positive hot acidity concentrations and have relatively low alkalinities.

For most of the Laurel Run Watershed, past and present mining did not encounter strata that contained significant amounts of calcium carbonate minerals. Where calcareous rocks were encountered, the areal extent and total tonnage were probably low in comparison to those rocks containing elevated concentrations of pyrite. In the case of Simeling Run, it appears that surface and underground mining was quite limited within that subwatershed, so its alkalinity is probably natural. In the case of "Pleasant Hill Run", the surface mining in that minor subwatershed took place for the most part on the upper coal seams where natural calcium carbonate minerals were probably abundant. That is likely the reason that the surface and groundwater drainage represented at PH01 is so highly alkaline (refer to Map No. 3a below).



Map No. 3a: Coal Regimes, Mines, and Main Sampling Stations

The quality of the two headwater tributaries to Laurel Run (LR01 and LR02) are slightly net acidic, but they still harbor some marginal buffering capacity. Of these two headwater stream segments, the northern branch to Laurel Run (sampled at LR02) has the highest alkalinity and lowest net acidity concentrations. However, very little coal or clay mining took place within that subwatershed. As for the western branch to Laurel Run (sampled at LR01) some coal mining did take place, but the mines were of limited areal extent. Either slightly acidic runoff from the few coal mines within the LR01 subwatershed consumed some of the natural alkalinity, and/or there is a greater source of natural alkalinity in the drainage basin of LR02. The upper segment of Little Laurel Run, sampled at LT03, is also just slightly net acidic with some marginal buffering capacity (alkalinity). Like the subwatershed of LR01, the drainage basin to LT03 also experienced limited surface and underground mining.

It is most likely that extensive surface (and underground) mining of the Clarion and Lower Kittanning coal seams (and clays) is the source of the worst pollution within the Laurel Run Watershed. Where tributaries are highly degraded, the coal mining upgradient was usually limited to the Lower Kittanning and Clarion coal seams (in places, the Middle Kittanning was also encountered). The Lower Kittanning, especially, is notorious for producing acid mine drainage. Examples of tributary or discharge pollution directly associated with lower coal seam mining are the sampling locations at AL01, LR03, LR06, LR08, LR10, LT04, T15, T17, and T70. Some acid mine drainage was not sampled, and there is probably a considerable amount of degraded groundwater runoff (base flow to streams and wetlands), but the pollutional loading of those points and subsurface drainage should be accounted for by the main stream samples with accurate flow measurements.

Where a portion of the less acid-producing and more “alkaline” upper coal seams were surface mined in combination with, or upgradient of, the Lower Kittanning and/or Clarion coal seams, the overall quality of mine drainage may contain some alkalinity. But unless there was enough natural carbonates present within the upper coal seam strata to preclude the production of acid within the lower coal seam pits, a considerable amount of acid mine drainage would still be generated. Some of the acid waters that are produced may be neutralized by the contribution of alkaline waters from above, but the net result would likely be mine drainage with moderately high acidity, some alkalinity, and relatively high concentrations of metals. These net alkaline or moderately acidic waters with elevated metals concentrations would still have a negative impact on the groundwater and biota of the receiving streams. For example, the middle segment of Little Laurel Run (sampled at LT02) includes some significant acreage of upper coal seam mining to the south of that stream which should have imparted alkaline waters to that portion of the subwatershed. However, there are also many acres of lower coal seam mines in that area that would have produced significant acid mine drainage. The net result is neutralized mine drainage or acid mine drainage with elevated alkalinity.

Specific Discussion of Water Quality Impacts to Laurel Run and Little Laurel Run

In the following more detailed discussion, the sampling results are presented first for Laurel Run and then for Little Laurel Run, in order from the headwaters region to the mouth. The polluted segments are linked to general mining problem areas and the coal seams mined. Many of these problem areas are mapped under BAMR’s Abandoned Mine Land (AML) Inventory GIS layers (general problem areas and specific problem site “polygons”). Where pollutional discharges or degraded tributary drainage are associated with a more recent surface mine that is legally responsible for treatment, the specific coal company, mine site, and the entity responsible for treatment are identified.

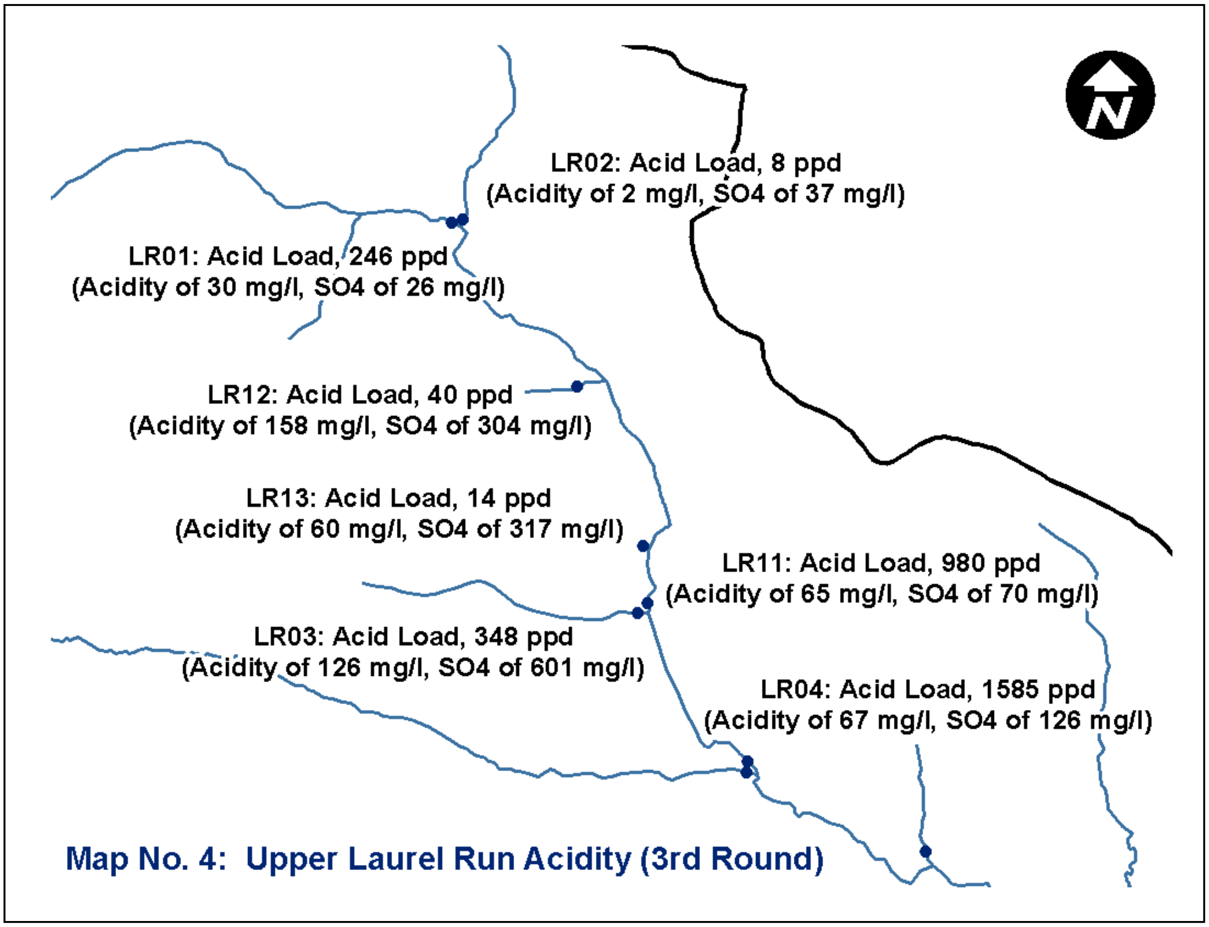
The following water quality and pollutional loading observations, interpretations, and conclusions are based primarily on the third round TMDL sampling of June 2004. This sampling period included most of the sampled points, the laboratory had missed no analyses during this period, and the flows were somewhat "intermediate" (i.e. representative of "normal conditions" that were not too high due to abundant precipitation or snowmelt and not too low due to unusually dry conditions). Also, the downstream sampling station on Laurel Run was changed to a better location for measuring flows (LR15, from LR07), so the flow measurement at that sampling point should be more reliable. It should also be noted that just one sample was collected for each sampling station (except at LR07 during the first two sampling rounds, where three samples were collected). This might be a problem on some of the larger streams if the water quality is not uniform across the channel. All water samples collected represent total metals analyses; that is, the sample used for analyzing metals concentrations was not filtered to eliminate any suspended, non-soluble metal compounds. However, the surface and groundwaters were collected carefully to ensure that a "clean" sample was obtained. Still, at certain sample locations, the stream water was slightly turbid, which may indicate the presence of fine-grained particles of suspended clay or metal compounds.

Laurel Run

As mentioned earlier, the two headwater tributaries to Laurel Run, sampled at stations LR01 and LR02, are of relatively good quality with limited mine drainage impacts [Map No. 4, Upper Laurel Run Acidity (3rd Round)]. Both streams contain native brook trout. LR01, which represents the "western headwaters tributary" to Laurel Run, is still of good quality despite what appears to be significant areas of the Lower Kittanning, Clarion, and Mercer surface coal mining from BAMR Problem Area PA 7084. Subsurface drainage within most of these mine sites should migrate down dip to the hollow of sample point LR16, which was sampled and analyzed during the fourth round of sampling. Sample station LR16 is not shown on Map No. 4, but it represents the small tributary from the south that enters the western headwaters tributary to Laurel Run upstream of sample station LR01. The quality of drainage from LR16 revealed acidic waters of elevated aluminum and manganese, but of very low flow compared to the stream flow at LR01.

As for the "northern headwaters tributary" to Laurel Run, sampled at LR02, very little mining was conducted within that subwatershed; and where mining did take place east of that stream (BAMR Problem Area PA 7075), the dip of the coal seams is generally toward the east and southeast, away from the stream. The quality of LR02 is similar to that of LR01, but there is a higher concentration of (natural?) alkalinity.

Between the point of confluence of the two headwater tributaries to Laurel Run and the first mid-stream sampling station on Laurel Run (LR11), surface and subsurface mine drainage apparently impacts Laurel Run, although fish still may be present in the upper part of this segment. The surface drainage that was sampled along this segment includes LR12 and LR13, both of which enter the western side of Laurel Run. It is clear from the pollutional loading data that additional mine drainage enters the stream that cannot be attributed to just LR12 and LR13. LR12 represents surface drainage from an area that had been surface mined, primarily on the Lower Kittanning and Clarion coal seams. These mines lie within BAMR Problem Area PA 7084 and just east of that problem area. LR12 is characterized by elevated acidity, aluminum, iron, and manganese. LR13 is an abandoned discharge located near the western bank of Laurel Run about one-half mile south-southeast of LR12, just after Laurel Run crosses under SR0322 from east to west. The mining east of PA 7084 lies just uphill from this discharge. LR13 is also characterized by elevated acidity, aluminum, iron, and manganese. During higher flow periods, it may contain some measurable alkalinity.



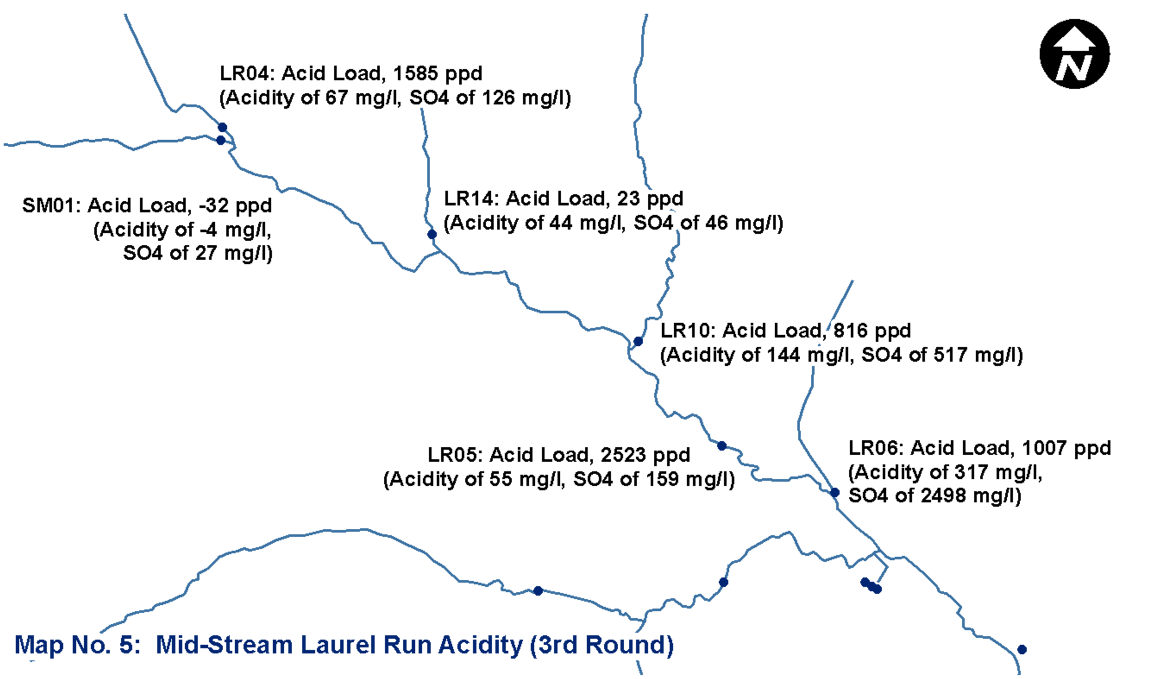
Map No. 4: Upper Laurel Run Acidity (3rd Round)

Sampling station LR11 was established during the second round of sampling on Laurel Run at the downstream side of the DuPree Road Bridge, just before the major mine drainage of LR03 enters. If one compares and sums the pollutional loadings from LR01, LR02, LR12, plus LR13 with the loadings at LR11, it is evident that additional mine drainage pollution is contributing to the stream, much more than can be accounted for by just LR12 and LR13. Some of this mine drainage that was not accounted for could be contributing via groundwater (subsurface flow, or base flow) from the western side of Laurel Run, and also from groundwater and surface drainage from the eastern side of Laurel Run. East of Laurel Run along this segment, there are additional surface and underground mines (some that are included within BAMR Problem Area PA 7085). In a recent examination of the eastern side of Laurel Run above LR11, no evidence of any major surface discharge or tributary from that side of the stream was found. Therefore, it is probable that the main degradation to Laurel Run as revealed at LR11 is subsurface. It should be noted that although the measured flow values of Laurel Run at LR11 reveal a significant increase in pollutional loading at that point in the stream, it is suspected that the flow measurements at LR11 may be underestimated. Therefore, the acid loading could even be higher than was calculated and displayed on Map No. 4.

Below LR11, Laurel Run is significantly impacted by a major surface mine discharge, draining within the main draw due east of Pea Vine Road. Surface mining on the Lower Kittanning coal seam by Stott Coal Company (Kelce Mine) resulted in several discharges of acid mine drainage here. That drainage converges in a shallow draw that enters the western bank of Laurel Run not far below LR11. This discharge was sampled at station LR03, about 150 feet above its confluence with Laurel Run. LR03 is characterized by relatively high flows, elevated acidity, negligible alkalinity, high aluminum, and high manganese. The substrate is stained yellow and orange, but the iron concentration at LR03 is low, so oxidation has effectively removed much of the dissolved iron by the time the drainage reaches Laurel Run. Laurel Run below this discharge exhibits the light-gray staining characteristic of aluminum deposition. Note that the pH of Laurel Run at LR11 is about 6.0, so aluminum is not very soluble under those conditions. It should be noted also that some of the discharges contributing to LR03 being treated by Stott Coal Company, and then by Penn Coal Land, Inc., the company that is currently liable for treatment. However, according to DEP Mining Specialist Eric Rosengrant, chemical treatment was not taking place during the time of this TMDL sampling.

Aside from the uncertainties between LR03 and sampling station LR04, there is little doubt that LR03 is the first major discharge that pollutes Laurel Run. The quality of Laurel Run at LR04 reveals about twice the concentration of aluminum, manganese, and sulfate than at LR11. The aluminum concentration is of special concern, because it is consistently just above 1.0 mg/l at LR04, whereas at LR11, the mean aluminum concentration of the three samples (sampling rounds two, three, and four), is 0.46 mg/l, with a high of just 0.54 mg/l. According to Steve Kepler of the PA Fish and Boat Commission, the general threshold for aluminum toxicity to fish is 0.60 mg/l for waters of pH 6.0 and below, and 0.70 mg/l for waters of pH greater than 6.0. At LR11, the field pH was estimated at 6.0 or just above, so the aluminum toxicity threshold would be about 0.70 mg/l. At LR04, with the influx of LR03, the field pH was estimated at just above 6.0 but also just below 6.0 (the suppressed pH at LR04 would likely be caused by the additional acidity from LR03 as well as the hydrolysis of dissolved aluminum from LR03). Regarding the impacts to fish, the quality at LR11 would be marginal, but still not above the aluminum toxicity threshold. But at LR04, the aluminum concentrations are well above the aluminum toxicity threshold to fish (regardless of whether one sets the toxicity threshold at 0.70 mg/l or 0.60 mg/l).

Beyond LR04, the water quality of Laurel Run generally becomes much worse. Refer now to Map No. 5: Mid-Stream Laurel Run Acidity (3rd Round). However, before other major acidic discharges enter the stream, there is an influx of good quality water from Simeling Run directly below sampling station LR04. At station SM01, at the mouth of Simeling Run, the water quality exhibits a pH at and above 7.0, low acidity, moderate alkalinity (the last two sampling events revealed negative hot acidity values, or net alkaline conditions), low aluminum, manganese, iron, and sulfate. There was some mining in the past within the Simeling Run subwatershed (e.g. BAMR problem area PA 7087 and other surface and underground mines), and mining was largely on the Mercer and Clarion coal and clay seams, but the extent of mining was quite limited. The relatively large Lower Kittanning surface mine (Stott Coal Company, Kelce Mine), that is largely responsible for polluting the tributary of LR03, does intersect the northern portion of the Simeling Run subwatershed. Nevertheless, probably because of the strong structural dip to the east, little or no mine drainage from that mine contributes to Simeling Run.



Map No. 5: Mid-Stream Laurel Run Acidity (3rd Round)

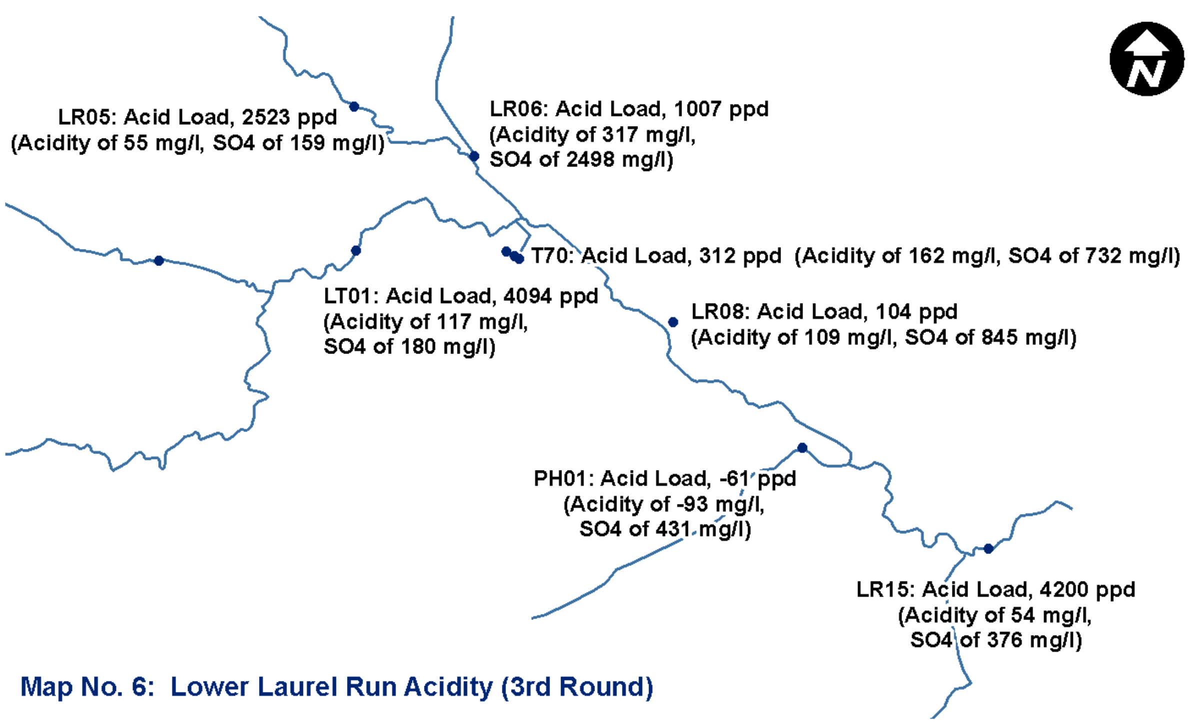
The next mid-stream sampling location on Laurel Run is at LR05, and it reflects not only the positive impact of Simeling Run, but the affects of significant acid mine drainage from LR10 and any polluted groundwaters that contribute to the stream from within a large wetland area before LR10 enters. There does not seem to have been much surface mining south of Laurel Run along this stretch of stream, but there could be some old underground mines impacting the groundwater and indirectly contributing mine drainage. Close inspection of the true-color aerial photography of 2001 (source: Centre County GIS Department) reveals some orange discharge areas (indicative of ferric iron precipitation) south of the stream and near the eastern extent of the large wetlands complex.

On the north side of Laurel Run, between the confluence with SM01 and the sampling station of LR05, the main pollution is clearly from the polluted tributary of LR10. The pollutional loading from this stream accounts for nearly all of the increased loadings between LR04 and LR05. LR10, which enters Laurel Run from the north side, is the second major surface discharge of pollution to Laurel Run after LR03. The quality of LR10 is characteristically very low in pH, high in acidity, no alkalinity, and high in aluminum, iron, manganese, and sulfate concentrations. Mining within the subwatershed of LR10 is from BAMR problem areas PA 7500 and PA 7086 and other, smaller surface mine areas and underground mines. Most of the past surface mining was conducted on the Lower and Middle Kittanning coal seams. Past underground mining may have been conducted on the Clarion coal seam as well. Again, it is the Lower Kittanning coal seam and associated overburden that is likely the major pollutional source, although a more detailed sampling program will be necessary to determine the specific problem areas and discharges degrading this small tributary. The effect on Laurel Run at LR05 is a general increase in iron and manganese concentration, although the average aluminum concentration is still about the same as it was at LR04. The stream water also appears to be more turbid at LR05, possibly due to insoluble iron compounds being carried in suspension. Furthermore, the stream bottom was covered with a thick layer of fine-grained sediment at LR05. This is where the stream depth increases and the velocity is much reduced, compared to the channel just below where LR10 enters. Directly to the west of LR05, Junior Coal Contracting, Inc. is mining the Lower Kittanning coal on their “Runk Operation” (SMP #17980117). However, the dip of the coal strata is such that waters flowing within that mine on the pit floor should be directed toward Little Laurel Run to the southeast. Some leakage of mine waters below the pit floor may be directed toward Laurel Run and LR05. It should also be noted that Junior Coal is applying significant amounts of lime to their Runk mine site in order to offset the potential for producing acid mine drainage. It is not known yet whether these alkaline addition practices have been effective.

Beyond LR05, Laurel Run itself was not sampled until near its confluence with Moshannon Creek. However, several major discharges and the degraded tributary of Little Laurel Run served to quantify the major contributors of pollutional loading. Below LR05 and before Little Laurel Run enters, the third major pollutional discharge to Laurel Run again comes from the north. Mine drainage from surface mines east of the tributary hollow of LR10 all drain into a large wetlands complex that has developed between the main active railroad grade that parallels SR0322 and an inactive grade that splits off to the north and northeast along the eastern side of this tributary hollow. The surface discharge from these degraded wetlands was monitored at sampling station LR06 right at the point where the two railroad grades converge. This discharge contributes a considerable amount of pollution to Laurel Run. A typical analysis has a field pH of 4.0 or less, acid concentration near 300 mg/l, no alkalinity, aluminum and manganese concentrations both above 30 mg/l, iron above 5.0 mg/l, and sulfate that can exceed 2,000 mg/l. With flows ranging from 200 to over 800 gpm, this is a formidable discharge, even without considering any base flow contribution to Laurel Run of degraded groundwaters. Based upon the third round sampling, and compared to the total loading of LR05 plus LR06, the discharge of LR06 represents about 29 percent of the total acid loading, 71 percent of the total aluminum loading, 29 percent of the total iron loading, 47 percent of the total manganese loading, and 52 percent of the total sulfate loading.

The past coal mining that contributes drainage to this degraded tributary hollow of LR06 includes those within BAMR problem areas PA 4530, PA 4583, PA 7500, and other old surface and underground mines. The main coal seam that was surface-mined in this subwatershed was the Lower Kittanning, with some minor stripping of the Middle Kittanning and higher coal seams. The more recent Al Hamilton Contracting, Inc. (formerly Thompson Brothers Coal Company) Morris #2 surface mining permit on the Lower and Middle Kittanning coal seams resulted in a major discharge of acidic and mineralized waters (identified in their mining permit as MP #11). Al Hamilton Contracting, Inc. was responsible for treating this particular discharge until the DEP accepted responsibility under a comprehensive agreement between the two parties. Discharge MP#11 was being treated chemically by Al Hamilton Contracting, Inc. until early 2003. According to DEP Mining Specialist Eric Rosengrant, the Department did not take over and resume “consistent” chemical treatment until February 2006. Therefore, during the period of the TMDL sampling, no treatment at MP#11 was effectively taking place. Regardless of whether or not MP#11 was or is being treated, it is doubtful that there would be a significant impact to LR06. MP#11 may not represent a large percentage of the pollutional loading within this subwatershed. However, future studies would be needed to establish the contribution of MP#11 to the pollution at LR06.

Below the confluence of LR06 with Laurel Run, the next (fourth) major contributor of poor quality waters to Laurel Run is from the degraded tributary of Little Laurel Run and the Lower Kittanning underground mine discharges of T15, T17, and T70. The specific degradation to Little Laurel Run will be discussed following this description of Laurel Run, but the quality and pollutional loading determined near its mouth at LT01 will be mentioned here as well. Refer to Map No. 6: Lower Laurel Run Acidity (3^{rd} Round). Little Laurel Run as sampled at LT01 near the bridge along the Old Erie Pike reveals that it too is a major contributor of mine drainage to Laurel Run. In fact, based upon the third round sampling event, LT01 contributed loadings of 1.6 times the acid, 0.96 times the aluminum, 0.48 times the iron, 0.85 times the manganese, and 0.87 times the sulfate as did Laurel Run at LR05. And as mentioned above, the underground mine discharges of T15, T17, and T70 contribute even more pollution to Little Laurel Run after sampling station LT01 and just before the confluence of Little Laurel Run with Laurel Run.



Map No. 6: Lower Laurel Run Acidity (3rd Round)

The mine discharges of T15 through T70 drain to Little Laurel Run adjacent to the southwest side of SR 0322 just before Little Laurel Run crosses under the SR0322 bridge from west to east and meets with Laurel Run on the northeast side of the bridge. These mine discharges contribute to a fairly large iron bog area that is clearly visible from SR0322. The individual discharges are permitted as part of the Subchapter F program for the Larry D. Baumgardner Coal Co., Inc. “Turner Operation” (SMP #17990111). The Turner Operation is being conducted on the Middle Kittanning, Upper Kittanning, and some Lower Freeport coal seams overlying or hydrologically connected to the Lower Kittanning mine complex associated with T15, T17, and T70. The coal operator is applying waste lime to offset the potential for producing acid mine drainage where natural calcium carbonate rocks are absent. Where natural calcium carbonates are encountered (mostly from the Johnstown limestone horizon beneath the Upper Kittanning coal), those alkaline rocks help to preclude or neutralize acid production from pyrite oxidation. Thus far, the Turner surface mine has not adversely impacted the Lower Kittanning mine drainage at T15, T17, and T70. It is too soon to determine whether or not there will be some long-term positive impact to these mine discharges.

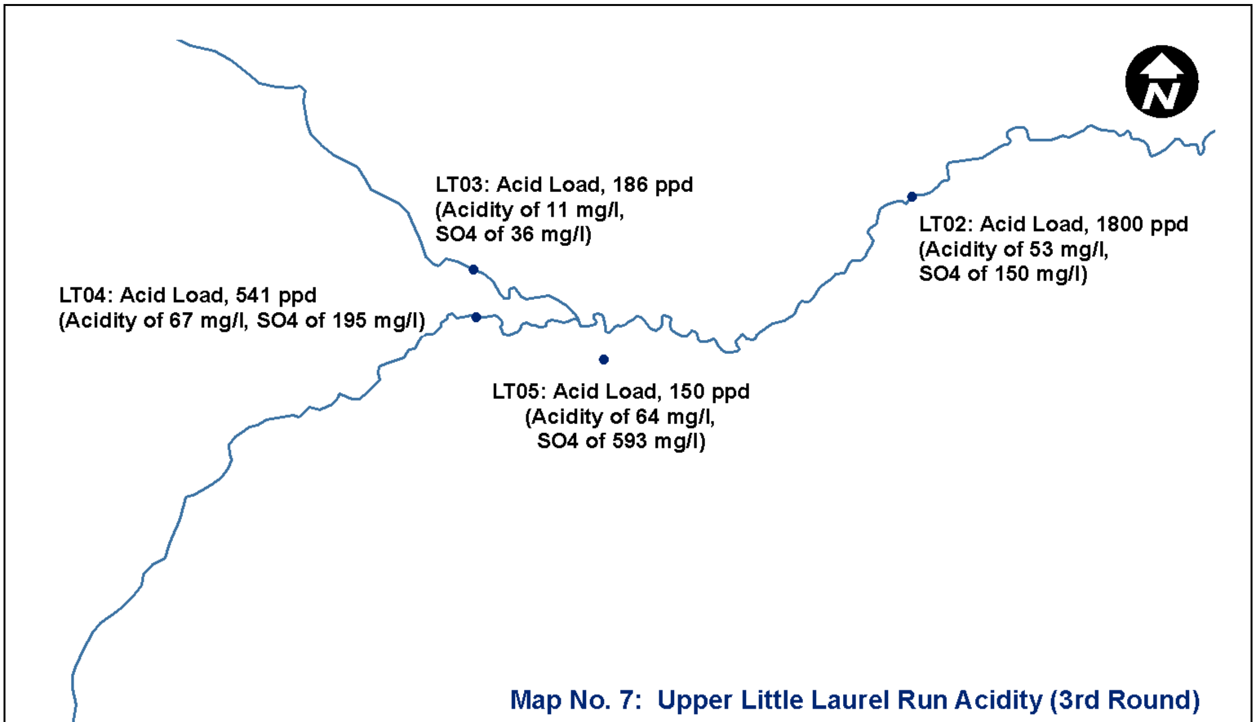
Below its confluence with Little Laurel Run, Laurel Run continues flowing southeast between the railroad grade and SR0322 through and adjacent to vast wetland systems. It is suspected that a significant volume of groundwater recharges Laurel Run between its confluence with Little Laurel Run and the mouth at Moshannon Creek. Within this stretch, acid mine drainage contributes mainly from the northeast from numerous surface and underground coalmines. In places, degraded waters within the wetlands north of Laurel Run are focused into distinct discharge channels. One such discharge was sampled at LR08. LR08 is highly acidic with elevated aluminum, iron, manganese, and sulfate. However, this particular discharge is not as contaminated as LR06, and the flow is usually much lower (with the high-flow period during the second round of sampling being a notable exception). Between LR08 and the mouth of Laurel Run, additional pollution may be contributing to Laurel Run, but no other discharges from the north were sampled. The only other discharge sampled beyond LR08 was PH1, which represents the combined drainage from the "Pleasant Hill" tributary and wetlands on the south side of Laurel Run. PH1 is alkaline with relatively low metals but elevated sulfate. The good quality and elevated sulfate of PH1 reflects the upper coal seam mining (Upper Kittanning, Lower Freeport, and Upper Freeport) within the Pleasant Hill tributary subwatershed. Between LR08 and PH1, surface discharges and groundwater runoff from the north (and south?) would more likely be net acidic, reflecting the prevalence of lower coal seam mining that is upgradient of that segment. Between PH1 and the mouth of Laurel Run, surface discharges and groundwater runoff from both the north and south would more likely be net alkaline, reflecting the prevalence of upper coal seam mining upgradient of that segment.

Little Laurel Run

As mentioned, Little Laurel Run also has been degraded by acid mine drainage, and is a major contributor of pollution to Laurel Run. If one ranks the acid loading of the major sources of pollution to Laurel Run, Little Laurel Run sampled at LT01 (representing all of the individual discharges and polluted groundwater runoff to Little Laurel Run to that point) is the greatest contributor of pollution to Laurel Run. This ranking of acid loading to Laurel Run for each round of sampling (in descending order) is usually as follows: Little Laurel Run sampled at LT01, the degraded unnamed tributaries to Laurel Run at LR06, LR10, and LR03, underground mine drainage at T70 (which actually flows to Little Laurel Run just before the confluence with Laurel Run), and the degraded wetland discharge at LR08. The only positive spin is that Little Laurel Run does not meet Laurel Run until after the two very worst degraded tributaries, LR06 and LR10, effectively devastate Laurel Run.

Little Laurel Run is of fairly good quality within the upstream "northwestern branch", despite the presence of some abandoned surface and underground coalmines within that subwatershed

[Map No. 7: Upper Little Laurel Run Acidity (3rd Round)]. The downstream sampling station on this "good" segment of Little Laurel Run is identified as LT03. This sampling point is located just before the degraded "southwestern branch" of Little Laurel Run enters the stream (sampled near the mouth at LT04). The quality at LT03 is characterized by net acidic waters of marginal buffering capacity, but with relatively low concentrations of metals and sulfate. Brook trout are present and naturally reproducing within this segment. Most of the past and present mines are limited to the headwaters region of this subwatershed, and they are primarily on the lower coal seams. BAMR problem areas PA 7087, PA7088, PA 7105, and PA7502 are contained within this subwatershed or intersect this subwatershed boundary. The most recent surface coal mining was conducted under the inactive Swistock Coal Corporation's "Smeal Mine" (SMP #17870110) on the Middle Kittanning seam and the recently activated Amfire Mining Company, LLC's "Crittenden Mine" (SMP #17030111) on the Lower Kittanning coal seam. The Crittenden permit requires alkaline addition in the form of waste lime to offset the potential for producing acid mine drainage. The mining planned is very limited in scope and under very low cover.



Map No. 7: Upper Little Laurel Run Acidity (3rd Round)

The degraded southwestern tributary to Little Laurel Run was sampled downstream at LT04. This stream has been polluted by acid mine drainage primarily from within the headwaters region of that subwatershed. The surface and underground coal mining were conducted primarily on the lower coal seams, with some minor stripping of the Upper Kittanning coal. BAMR problem areas PA 7095, PA 7096, PA 7097, and PA 1946 lie within or intersect this subwatershed. Stott Coal Company was responsible for treatment of acid mine drainage associated with their "Drane #1 Mine" (SMP #4473SM10), but the responsibility of treatment was transferred to Penn Coal Land, Inc. According to DEP Surface Mining Conservation Inspector John DeHaas, chemical treatment is continuing to this day, and chemical treatment was taking place during the period of the TMDL sampling. Despite the ongoing chemical treatment near the headwaters of this tributary, the stream is still degraded at LT04 due to other inputs of mine drainage from abandoned sources. Typically, the water at LT04 is of low pH (4.0-4.5), elevated acidity, virtually no alkalinity, elevated aluminum (between 1 and 2 mg/l), elevated manganese, and elevated sulfate. The iron is also elevated slightly, and the substrate is stained orange, but most of the iron has oxidized and precipitated before reaching LT04.

Just beyond the confluence of Little Laurel Run and the tributary of LT04, a smaller degraded tributary enters Little Laurel Run from the south. It flows from a hollow downgradient of the pending River Hill Coal Company's "Stein Operation" (SMP #17030102), and it was sampled at LT05. LT05 has a low pH, elevated acidity, minor concentrations of alkalinity, high aluminum, high manganese, and high sulfate. The mining upgradient of LT05 took place on both the lower and upper coal seams, but surface mining on the lower coal seams, the Clarion, Lower Kittanning, and Middle Kittanning, predominated. Water quality contribution from mining of the upper coal seams probably consumed some of the acidity associated with the lower coal seam mines, and is most likely responsible for some of the alkalinity present. Still the water quality at LT05 is highly toxic to aquatic life. If and when mining on the Stein Operation begins, remining of the Lower Kittanning spoils and abandoned cuts, coupled with massive alkaline addition (over 2,500 tons per mining acre), may improve the water quality at LT05.

Beyond the degraded tributary of LT05, down to the mid-stream sampling station on Little Laurel Run at LT02, no other discharges or degraded tributaries were sampled. However, it is clear that additional mine drainage contributes to Little Laurel Run along this segment of the stream. Large tracts of mining took place south of Little Laurel Run on both the lower coal seams and upper coal seams, including the very recent permit of River Hill Coal Company's "Six Mile Road Operation" (SMP #17990102). Mining on the Six Mile Road permit was recently initiated in 2006, but mining has begun only on some Upper Freeport underground coal mine stumps. Eventually, significant remining of abandoned Clarion and Lower Kittanning strip cuts is planned, including alkaline addition of more than 2,000 tons per mining acre. BAMR problem areas PA 7089 (north side) and PA 7091 (south side) also intersect the Little Laurel Run Watershed upstream of LT02. Past mining on the north side of Little Laurel Run took place on the lower coal seams only, primarily the Clarion and Lower Kittanning coal seams.

The quality of Little Laurel Run at LT02 is typified by a depressed pH (about 5.5), elevated acidity, minor concentrations of alkalinity, and elevated aluminum, manganese, and sulfate. Compared to the quality of LT03, the mean acidity concentration increases by about 300 percent, the mean aluminum concentration increases by more than 300 percent, the mean iron concentration nearly increases by 300 percent, and the mean manganese concentration increases by as much as 800 percent. In comparing the flows and pollutional loadings at LT02 with the combined loadings at LT03, LT04, and LT05 (using the third round of sampling as an example), it is clear that additional mine drainage pollution contributes to the stream which is not accounted for by the three upstream sampling stations. Also, the combined measured flow (during the third round of sampling) of LT03, LT04, and LT05 is about 2,250 gpm, whereas the flow measured at LT02 was 2,800 gpm. This increase in flow is not unexpected given the wetland discharges and groundwater runoff that should contribute to the stream below the confluence of LT05. As for pollutional loading during the third round sampling event, the acid loading nearly doubled at LT02 to about 1,800 ppd (compared to the combined acid loading from

LT03, LT04, and LT05). Regarding the metals loadings during the third sampling round, both the iron and manganese loadings increased at LT02, but the aluminum loading did not increase. During the second and fourth round sampling events, the aluminum loading did increase a little at LT02, but it was also essentially the same during the first round. Apparently, the additional mine drainage (both surface and groundwater runoff) that is impacting LT02 beyond the degraded tributary of LT05 is not very high in aluminum concentration, or there is significant precipitation of aluminum within Little Laurel Run between LT05 and LT02.

Downstream of LT02 on Little Laurel Run, additional mine drainage should continue to recharge the stream by groundwater runoff (base flow), groundwater discharges, and small tributaries. However, no discharges or tributaries were sampled until the larger tributary identified as Albert Run. In this stretch of Little Laurel Run below LT02 and before its confluence with Albert Run, surface and underground mines exist on both sides of Little Laurel Run, including old mines contained within BAMR problem areas PA 4580, PA 7089, PA 7090, PA 7091, and PA 7504. The most recent mining that took place along this stretch was conducted by Junior Coal Contracting, Inc. on their “West Decatur Mine” (SMP #17980110) on the Mercer and Clarion coal seams. Alkaline materials were incorporated into the spoil of this surface mine, which is now essentially completed.

The next major source of pollution to Little Laurel Run that was quantified under the TMDL sampling was the degraded tributary of Albert Run, collected at AL01 before this stream enters a wetlands complex [Map No. 8: Lower Little Laurel Run Acidity (3rd Round)]. The quality and loadings calculated at AL01 should represent most of the polluted drainage to Albert Run. The coal seams mined within the Albert Run subwatershed were Lower Kittanning, Clarion, and Mercer, including those old surface mines within BAMR problem areas PA 1417, PA 7089, and PA 7090. The quality of Albert Run at AL01 is characterized by a low pH, high acidity, zero alkalinity, high aluminum, elevated iron, high manganese, and elevated sulfate. Regarding the pollutional loading from AL01, this tributary contributes a considerable amount of acid and metals to Little Laurel Run, and ultimately, to Laurel Run.

AMD Methodology

A two-step approach is used for the TMDL analysis of impaired stream segments. The first step uses a statistical method for determining the allowable instream concentration at the point of interest necessary to meet water quality standards. This is done at each point of interest (sample point) in the watershed. The second step is a mass balance of the loads as they pass through the watershed. Loads at these points will be computed based on average annual flow.

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to non-point sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are point-source impacts alone, or in combination with non-point sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = maximum {0, (1-Cc/Cd)} where (1)

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

Cd = RiskLognorm(Mean, Standard Deviation) where (1a)

[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

Once the allowable concentration and load for each pollutant is determined, mass-balance accounting is performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below.

Load tracking through the watershed utilizes the change in measured loads from sample location to sample location, as well as the allowable load that was determined at each point using the @Risk program.

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

Tracking loads through the watershed gives the best picture of how the pollutants are affecting the watershed based on the information that is available. The analysis is done to insure that water quality standards will be met at all points in the stream. The TMDL must be designed to meet standards at all points in the stream, and in completing the analysis, reductions that must be made to upstream points are considered to be accomplished when evaluating points that are lower in the watershed. Another key point is that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

In low pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Statistical procedures are applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for streams affected by low pH may not represent a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Information for the TMDL analysis performed using the methodology described above is contained in the "TMDLs by Segment" section of this report.

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

The pollution sources in the watershed that are nonpoint source and are expressed as Load Allocations (LAs) in the TMDL equation. The point sources will be expressed as a Waste Load Allocation (WLA). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL. Table 3 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are achieved and also take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit margin of safety (MOS) based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentration in each segment is calculated using Monte Carlo Simulation as described previously. The allowable load is then determined by multiplying the allowable concentration by the flow and a conversion factor at each sample point. The allowable load is the TMDL and each TMDL includes upstream loads.

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There are currently many permitted discharges in the Laurel Run Watershed. The difference between the TMDL and the WLA is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced to the area upstream of the point in order for water quality standards to be met at the point.

In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated upstream load lost within a segment is proportional to the difference in the measured loading between the sampling points**.**

Table 3. Laurel Run Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	NPS Load Reduction (lbs/day)	% Reduction
AL01 – Alberts Run upstream of confluence with Little Laurel Run						
Aluminum (lbs/day)	25.50	3.30	2.25	1.05	22.20	87%
Iron (lbs/day)	10.55	3.88	3.39	0.49	6.67	64%
Manganese(lbs/day)	78.05	3.11	2.25	0.86	74.94	96%
Acidity (lbs/day)	475.68	0.00	-	0.00	475.68	100%
LR01 – Twoey Run/”Southern” headwaters unnamed tributary to Laurel Run						
Aluminum (lbs/day)	6.99	6.99	0.75	6.24	NA	NA
Iron (lbs/day)	4.10	4.10	1.13	2.97	NA	NA
Manganese(lbs/day)	8.68	8.68	0.75	7.93	NA	NA
Acidity (lbs/day)	558.17	89.21	-	89.21	468.96	84%
LR02 – “Northern” headwaters unnamed tributary to Laurel Run						
Aluminum (lbs/day)	3.59	3.59	-	3.59	NA	NA

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	NPS Load Reduction (lbs/day)	% Reduction
Iron (lbs/day)	2.69	2.69	-	2.69	NA	NA
Manganese(lbs/day)	1.80	1.80	-	1.80	NA	NA
Acidity (lbs/day)	61.53	61.53	-	61.53	NA	NA
LR03 – Unnamed tributary east of Pea Vine Road 150 feet from mouth						
Aluminum (lbs/day)	35.45	2.84	-	2.84	32.61	92%
Iron (lbs/day)	0.75	0.75	-	0.75	NA	NA
Manganese(lbs/day)	68.46	3.44	-	3.44	65.02	95%
Acidity (lbs/day)	513.08	15.39	-	15.39	497.69	97%
LR04 – Laurel Run between LR03 and Simeling Run						
Aluminum (lbs/day)	63.50	38.10	2.47	35.63	0	0%*
Iron (lbs/day)	25.40	25.40	3.71	21.69	NA	NA
Manganese(lbs/day)	147.21	35.22	2.47	32.75	46.97	58%*
Acidity (lbs/day)	2265.88	158.76	-	158.76	1140.47	88%*
LR05 – Laurel Run downstream of LR10 unnamed tributary						
Aluminum (lbs/day)	106.56	43.45	-	43.45	0	0%*
Iron (lbs/day)	133.46	72.42	-	72.42	16.49	19%*
Manganese(lbs/day)	361.07	57.94	-	57.94	10.07	15%*
Acidity (lbs/day)	4407.30	528.67	-	528.67	598.34	54%*
LR06 – Unnamed tributary draining railroad wetlands						
Aluminum (lbs/day)	215.09	2.12	0.97	1.15	212.97	99%
Iron (lbs/day)	38.58	4.63	1.45	3.18	33.95	88%
Manganese(lbs/day)	275.21	2.77	0.97	1.80	272.35	99%
Acidity (lbs/day)	1890.78	0.00	-	0.00	1890.78	100%
LR08 – Wetlands discharge from north upstream of mouth of Laurel Run						
Aluminum (lbs/day)	8.75	1.14	-	1.14	7.61	87%
Iron (lbs/day)	23.34	1.17	-	1.17	22.17	95%
Manganese(lbs/day)	39.63	1.58	-	1.58	38.05	96%
Acidity (lbs/day)	310.46	0.00	-	0.00	310.46	100%
LR10 – Unnamed tributary to Laurel Run between LR04 and LR05 from the north						
Aluminum (lbs/day)	86.13	5.12	-	5.12	81.01	95%
Iron (lbs/day)	53.67	9.12	-	9.12	44.55	83%
Manganese(lbs/day)	186.70	5.63	-	5.63	181.07	97%
Acidity (lbs/day)	1173.17	0.00	-	1173.17	1173.17	100%
LRMouth – Laurel Run near confluence with Moshannon Creek						
Aluminum (lbs/day)	292.43	84.48	3.00	81.48	0	0%*

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	NPS Load Reduction (lbs/day)	% Reduction
Iron (lbs/day)	188.46	151.09	4.03	147.06	0	0%*
Manganese(lbs/day)	831.81	90.98	3.00	87.98	0.97	1%*
Acidity (lbs/day)	7327.09	878.93	-	878.93	0	0%*
LT01 – Little Laurel Run near mouth						
Aluminum (lbs/day)	83.53	38.60	0.75	37.85	3.65	9%*
Iron (lbs/day)	68.08	58.96	1.13	57.83	2.45	4%*
Manganese(lbs/day)	258.30	41.41	0.75	40.66	61.01	60%*
Acidity (lbs/day)	4176.27	83.53	-	83.53	1064.26	93%*
LT02 – Little Laurel Run upstream of confluence with Alberts Run						
Aluminum (lbs/day)	50.67	31.59	1.14	30.45	0	0%*
Iron (lbs/day)	23.03	23.03	3.39	19.64	NA	NA
Manganese(lbs/day)	120.43	39.49	2.25	37.24	18.18	32%*
Acidity (lbs/day)	2836.45	283.65	-	283.65	1374.61	83%*
LT03 – “Northern” unnamed tributary to Little Laurel Run near mouth						
Aluminum (lbs/day)	8.61	8.61	0.75	7.86	NA	NA
Iron (lbs/day)	3.56	3.56	1.13	2.43	NA	NA
Manganese(lbs/day)	6.53	6.53	0.75	5.78	NA	NA
Acidity (lbs/day)	430.39	107.75	-	107.75	322.64	75%
LT04 – “Southern” unnamed tributary to Little Laurel Run near mouth						
Aluminum (lbs/day)	17.81	4.81	0.97	3.84	13.00	73%
Iron (lbs/day)	8.91	8.91	1.45	7.46	NA	NA
Manganese(lbs/day)	52.23	5.78	0.97	4.81	46.45	89%
Acidity (lbs/day)	671.53	6.74	-	6.74	664.79	99%
LT05 – Unnamed tributary to Little Laurel Run draining proposed Stein Operation						
Aluminum (lbs/day)	15.18	1.52	0.75	0.77	13.66	90%
Iron (lbs/day)	1.09	1.09	0.94	0.15	NA	NA
Manganese(lbs/day)	18.31	2.00	0.75	1.25	16.31	90%
Acidity (lbs/day)	207.34	16.58	-	16.58	190.76	92%
T15 – Lower Kittanning mine discharge						
Aluminum (lbs/day)	0.86	0.06	-	0.06	0.80	93%
Iron (lbs/day)	0.31	0.09	-	0.09	0.22	71%
Manganese(lbs/day)	0.73	0.09	-	0.09	0.64	88%
Acidity (lbs/day)	10.86	0.00	-	0.00	10.86	100%
T17 – Lower Kittanning mine discharge						
Aluminum (lbs/day)	3.89	0.23	-	0.23	3.66	95%

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	NPS Load Reduction (lbs/day)	% Reduction
Iron (lbs/day)	4.11	0.45	-	0.45	3.66	90%
Manganese(lbs/day)	3.25	0.39	-	0.39	2.86	88%
Acidity (lbs/day)	55.50	0.00	-	0.00	55.50	100%
T70 – Lower Kittanning mine discharge						
Aluminum (lbs/day)	16.67	1.00	-	1.00	15.67	94%
Iron (lbs/day)	26.93	2.15	-	2.15	24.78	92%
Manganese(lbs/day)	13.79	1.51	-	1.51	12.28	90%
Acidity (lbs/day)	267.77	0.00	-	0.00	267.77	100%

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.
NA = not applicable

In the instance that the allowable load is equal to the measured load (e.g. manganese PR02, Table 3), the simulation determined that water quality standards are being met instream and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. This is denoted as "ND" and "NA" in the above table.

Waste Load Allocation –River Hill Coal Company, Stein

The River Hill Coal Company (SMP17030102; NPDES PA0243426) Stein Operation has four discharges requiring treatment. TF1, TF2, TF3, and TF4 are discharges from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table 4. Waste Load Allocations at Stein Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TF1			
Al	2.0	0.045	0.75
Fe	2.5	0.045	0.94
Mn	2.0	0.045	0.75
TF2			
Al	2.0	0.045	0.75
Fe	2.5	0.045	0.94
Mn	2.0	0.045	0.75

TF3			
Al	2.0	0.045	0.75
Fe	1.7	0.045	0.64
Mn	2.0	0.045	0.75
TF4			
Al	2.0	0.045	0.75
Fe	2.5	0.045	0.94
Mn	2.0	0.045	0.75

Waste Load Allocation – Amfire Mining Company, Crittenden

The Amfire Mining Company (SMP17030111; NPDES PA0243558) Crittenden operation has one discharge requiring treatment. TB1 is a discharge from a treatment pond. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table 5. Waste Load Allocations at Crittenden Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TB1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation – Sky Haven Coal Company, Homestead

The Sky Haven Coal Company (SMP170430108; NPDES PA0243825) Homestead Operation has one discharge requiring treatment. TF1 is a discharge from a treatment pond. The following table shows the waste load allocation for this discharge.

Table 6. Waste Load Allocations at Homestead Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TF1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation – Penn Coal Land Company, Inc., Kelce

The Penn Coal Land Company, Inc. (SMP17753180; NPDES PA0609439) Kelce Operation has two discharges requiring treatment. Outfall 002 (K14) and Outfall 006 (K18) are discharges from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table 7. Waste Load Allocations at Kelce Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 002 (K14)			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
Outfall 006 (K18)			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation – Junior Coal Contracting, Inc., West Decatur

The Junior Coal Contracting, Inc.(SMP17980110; NPDES PA0238023) West Decatur operation has one discharge requiring treatment. TF1 is a discharge from a treatment pond. This discharge does not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table 8. Waste Load Allocations at West Decatur Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TF1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation – Junior Coal Contracting, Inc., Runk

The Junior Coal Company, Inc. (SMP17980117; NPDES PA0238104) Runk Operation has three discharges requiring treatment. TP1, TP2, and TP3 are discharges from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table 9. Waste Load Allocations at Runk Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TP1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TP2			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TP3			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation – River Hill Coal Company, Inc., Six Mile Road

The River Hill Coal Company, Inc. (SMP17990102; NPDES PA0238236) Six Mile Road Operation has three discharges requiring treatment. Outfall 001, 008 and 009 are discharges from treatment ponds. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table 10. Waste Load Allocations at Six Mile Road Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 001			
Al	1.0	0.045	0.38
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
Outfall 008			

Al	1.0	0.045	0.38
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
Outfall 009			
Al	1.0	0.045	0.38
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation –Larry D. Baumgardner Coal Co., Inc., Turner

The Larry D. Baumgardner Coal Co., Inc. (SMP17990111; NPDES PA0238341) Turner Operation has four discharges requiring treatment. TT-1, TT-2, TT-3, and TT-4 are discharges from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table 11. Waste Load Allocations at Turner Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TT-1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TT-2			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TT-3			
Al	2.0	0.045	0.75
Fe	1.7	0.045	0.64
Mn	2.0	0.045	0.75
TT-4			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Waste Load Allocation –Penn Coal Lands, Drane #1

Penn Coal Lands (SMP4473SM10; NPDES PA0119440) Drane #1 Operation has one post-mining discharge that enters into an unnamed tributary to Little Laurel Run requiring treatment. Flow for this discharge was calculated using monitoring data for the point (40 GPM). The front treated discharge is a discharge from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table 12. Waste Load Allocations at Drane#1 Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Front Discharge			
Al	2.0	0.058	0.97
Fe	3.0	0.058	1.45
Mn	2.0	0.058	0.97

Waste Load Allocation – Thompson Bros. Coal, Morris #2

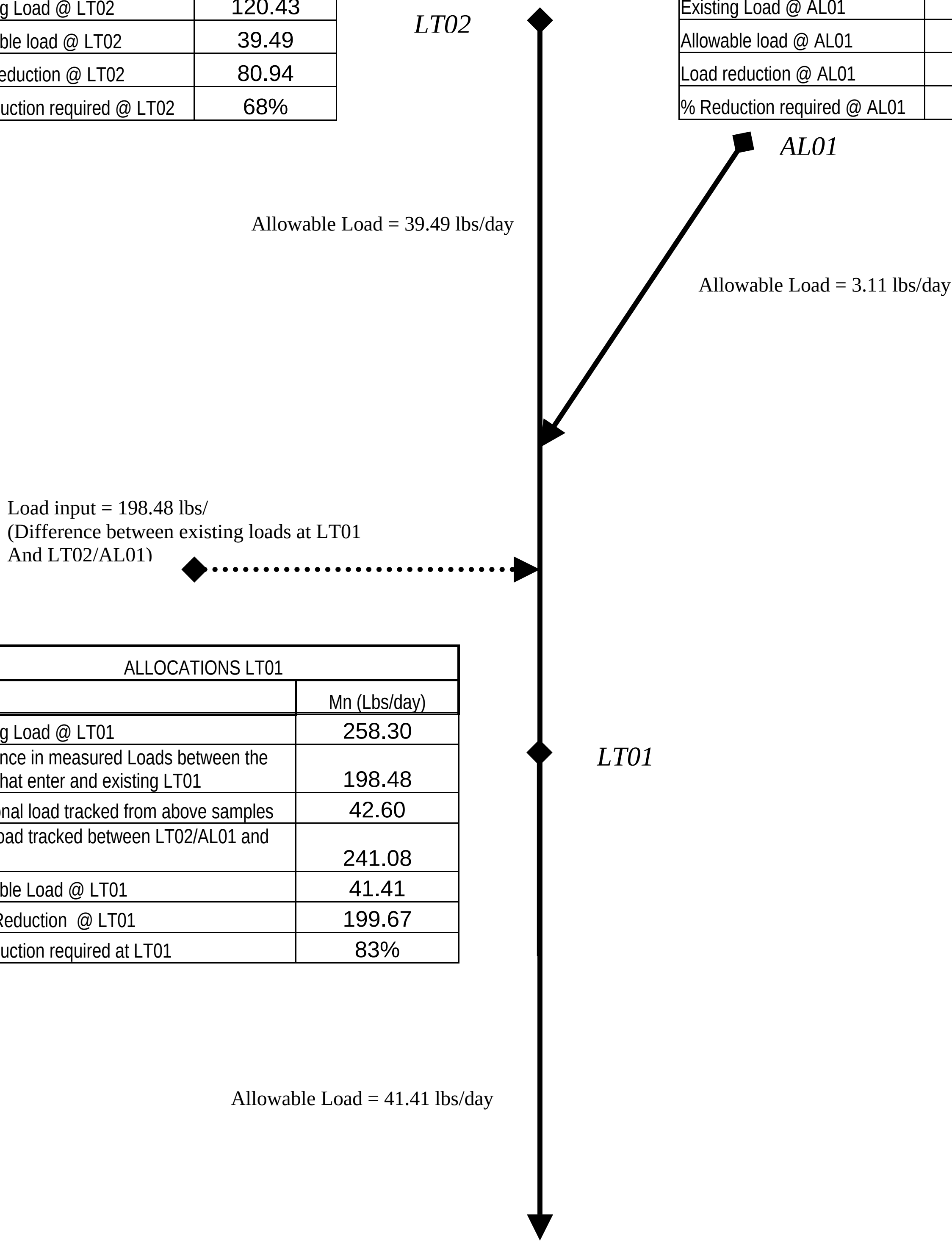
Thompson Bros. Coal (SMP17810104) Morris #2 Operation has one post-mining discharge that drains into an unnamed tributary to Laurel Run with effluent limits. M2FT is the discharge from a treatment system for MP#11, a mine discharge. A consent decree exists for the continual treatment of this discharge. The average flow from monitoring data (40 GPM) was used in the calculation of loads for this operation. This discharge does not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table 13. Waste Load Allocations at Morris#2 Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
M2FT			
Al	2.0	0.058	0.97
Fe	3.0	0.058	1.45
Mn	2.0	0.058	0.97

On the following page is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, manganese allocations for LT01 of Laurel Run are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.

ALLOCATIONS LT02	
LT02	Mn (Lbs/day)
Existing Load @ LT02	120.43
Allowable load @ LT02	39.49
Load reduction @ LT02	80.94
% Reduction required @ LT02	68%

ALLOCATIONS AL01	
AL01	Mn (Lbs/day)
Existing Load @ AL01	78.05
Allowable load @ AL01	3.11
Load reduction @ AL01	74.94
% Reduction required @ AL01	96%



ALLOCATIONS LT01	
LT01	Mn (Lbs/day)
Existing Load @ LT01	258.30
Difference in measured Loads between the loads that enter and existing LT01	198.48
Additional load tracked from above samples	42.60
Total load tracked between LT02/AL01 and LT01	241.08
Allowable Load @ LT01	41.41
Load Reduction @ LT01	199.67
% Reduction required at LT01	83%

The allowable load tracked from LT02 and AL01 was 42.60 lbs/day. The existing load at LT02 and AL01 was subtracted from the existing load at LT01 to show the actual measured increase of manganese load that has entered the stream between these two sample points (198.48 lbs/day).

This increased value was then added to the allowable loads from LT02 and AL01 to calculate the total load that was tracked between LT02 and AL01 and LT01 (allowable loads @ LT02 and AL01 + the difference in existing load between LT02 and AL01 and LT01). This total load tracked was then subtracted from the calculated allowable load at LT01 to determine the amount of load to be reduced at LT01. This total load value was found to be 241.08 lbs/day; it was 199.67 lbs/day greater than the LT01 allowable load of 41.41 lbs/day. Therefore, an 83% manganese reduction at LT01 is necessary.

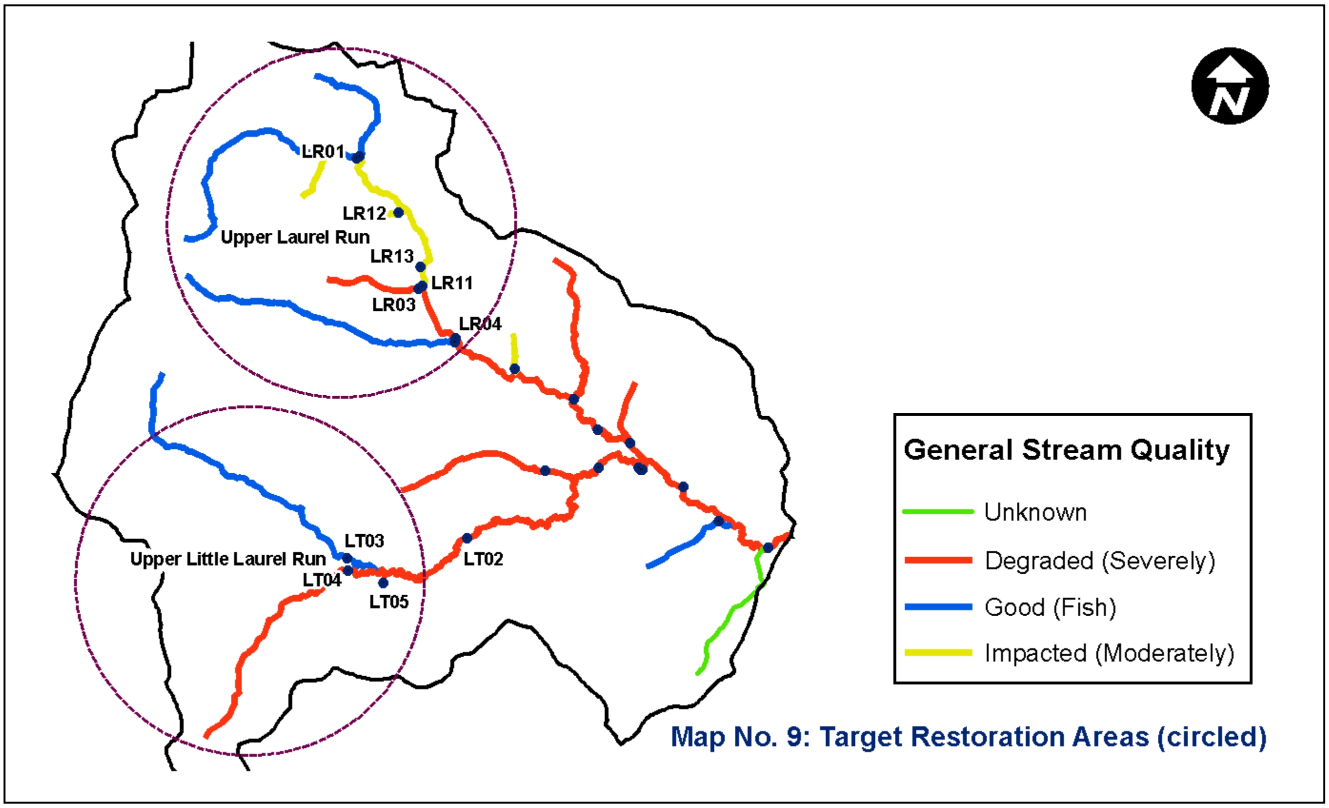
Recommendations

The Laurel Run Watershed has been severely degraded by acid mine drainage over the many years that underground and surface coal mining was taking place. The subwatersheds where acid mine drainage problems developed are usually areas of previous mining on the lower coal seams (Mercer, Clarion, Lower Kittanning, and Middle Kittanning). These coal seams and overlying rocks, are characterized by elevated concentrations of pyrite with little or virtually no natural calcium carbonate rocks and minerals (except where mining of the Middle Kittanning coal reaches the Johnstown limestone horizon). Therefore, the potential was high that mining of these coal seams will generate acid mine drainage with high concentrations of dissolved metals. Abandoned underground mine workings, even on upper coal seams that are generally of better quality with respect to pyritic content, will collect groundwater that pools within an environment that is conducive to generating acidic waters. These underground mines eventually discharge those poor-quality groundwaters to the surface, usually from downdip mine openings or along the downdip cropline. Some of the intercepted groundwater will leak through the floor of the underground mines and recharge deeper aquifers.

Although underground mining is certainly a major source of acidity and metals loading, surface mines in the Laurel Run Watershed are also a significant contributor of acid mine drainage pollution. It is suspected that the Lower Kittanning coal and overburden are the strata with the highest potential for producing pollution. It should be noted that surface mining of some of the lowest coal seams, such as the Mercer coal and clay seams (and in places the Clarion coal and clays where mined under relatively low cover), resulted in drainage that was only moderately acidic with minor concentrations of metals. Moreover, poor mining and reclamation practices, such as burying refuse and spoiling of pyritic rock within the groundwater fluctuation zone, mining through streams or wetlands, not backfilling open cuts, leaving large spoil piles exposed to weathering, burying topsoil and subsoil, and inadequately revegetating disturbed lands, has exacerbated the potential to produce acid mine drainage. Furthermore, surface mining companies prior to the mid-1990s did not normally incorporate large quantities of lime to adequately counteract the potential for producing acid mine drainage. Although surface mining continues to this day, very few coal mines are actively being worked, and where mining has been permitted on the lower coal seams, mining practices are closely monitored, significant alkaline addition is often required, and the post-mining reclamation standards are high.

Based upon this TMDL study, there are limited stretches of degraded streams within the Laurel Run watershed that could realistically be targeted today for restoration by a watershed group or other interested environmental organization. They are, in ascending order of presumed level of difficulty to restore, 1) the western branch of the two headwaters tributaries to Laurel Run above

LR01, 2) the northwestern branch of Little Laurel Run above LT03, 3) the upper segment of Laurel Run above LR11, 4) the tributary of LT05, 5) the tributary to Little Laurel Run of LT04, and 6) the segment of Little Laurel Run below LT03 if the quality of LT04 and LT05 are restored [Map No. 9, Targeted Restoration Areas].



Map No. 9: Target Restoration Areas (circled)

The first two segments of stream that have the highest cost/benefit ratio with today's technology are the western headwaters tributary of Laurel Run above LR01 and the northwestern branch of Little Laurel Run above LT03. Although both of these streams are considered good quality, and both support a reproducing population of native trout, they could each benefit from some relatively minor treatment or abatement to improve the water quality, especially the buffering capacity of the streams. A thorough assessment of these subwatersheds would be advisable to identify the specific pollutional sources and determine whether restoration is economically feasible. It is possible that these streams would need nothing more than some limestone diversion wells to increase the alkalinity and enhance the buffering capability.

The next stretch of stream that should be targeted is the main stem of Laurel Run below the confluence of the two headwaters tributaries down to LR11. Although this segment of stream would be much more difficult to restore than those of LR01 and LT03, it would provide a much-needed improvement to a stream that is currently of marginal quality, is more visible and accessible, and probably of more importance to the general public overall. Upstream of LR11, some fishing of stocked and native trout still takes place, and every year there is a fishing derby on this segment of stream. As discussed previously, Laurel Run at LR11 is impacted by mine drainage, but the current level of pollution is not necessarily toxic to aquatic life. Point-source discharges such as at LR13 and affected tributaries such as at LR12 could be intercepted and treated (or diverted downstream). As discussed earlier in this report, there are very likely other sources of pollution, some on the east side of Laurel Run. Base flow contribution of degraded groundwaters likely enter the stream from both the east and west sides, so some remediation of the source areas may be needed to effectively reduce the pollutional loading.

If any environmental organization plans to tackle this segment of Laurel Run above LR11, they should first conduct a more focused assessment of the water quality and pollutional loading. This assessment would be similar to the larger-scale TMDL study, but smaller in scope and much more in-depth. One should describe the geology, hydrogeology, and hydrology in sufficient detail, coupled with a detailed history of surface and underground mining. All polluted drainage entering Laurel Run on both sides of the stream should be documented and sampled with accurate flows. A careful and comprehensive sampling program should provide the necessary data to produce meaningful mass balance calculations. LR11 could represent the downstream sampling point, and one or two mid-stream sampling stations could be added. When the pollutional sources are identified, this subwatershed assessment could present specific methods of confronting the various pollutional problems, such as chemical treatment, passive treatment, surface water or groundwater diversion, and abatement at the source. If the pollution to LR11 could be treated and/or abated, one could then examine the feasibility of taking on the pollution to LR03 and any other pollution within that degraded tributary hollow. If the pollution contributing to LR03 was eliminated, then Laurel Run down to LR10 could effectively be restored. Other segments could be addressed in the downstream reaches as funds and technologies become available.

Various methods to eliminate or treat pollutant sources and to provide a reasonable assurance that the proposed TMDLs can be met exist in Pennsylvania. These methods include PADEP's primary efforts to improve water quality through reclamation of abandoned mine lands (for abandoned mining) and through the National Pollution Discharge Elimination System (NPDES) permit program (for active mining). Funding sources available that are currently being used for projects designed to achieve TMDL reductions include the Environmental Protection Agency (EPA) 319 grant program and Pennsylvania's Growing Greener Program (which has awarded almost $37 M since 1999 for watershed restoration and protection in mine-drainage impacted watersheds and abandoned mine reclamation). In 2006 alone, federal funding through the Office of Surface Mining (OSM) contributed $949 K for reclamation and mine drainage treatment through the Appalachian Clean Streams Initiative and another $298 K through Watershed Cooperative Agreements. According to the Department of the Interior, Office of Surface Mining (www.osmre.gov/annualreports/05SMCRA2AbandMineLandReclam.pdf), during 2005, Pennsylvania reclaimed 54 acres of gob piles, 73 acres of pits, 2,500 acres of spoil areas, 7,658 feet of highwall, and treated 94,465 gallons of mine drainage under their environmental (Priority 3) program only (priorities 1&2 are for reclaiming features threatening public health and safety with much larger number of features reclaimed).

OSM reports that nationally, of the $8.5 billion of high priority (defined as priority 1&2 features or those that threaten public health and safety) coal related AML problems in the AML inventory, $6.6 billion (78%)have yet to be reclaimed; $3.6 billion of this total is attributable to Pennsylvania watershed costs. Almost 83 percent of the $2.3 billion of coal related environmental problems (priority 3) in the AML inventory are not reclaimed. The Bureau of Abandoned Mine Reclamation, the Department's primary bureau in dealing with abandoned mine reclamation (AMR) issues, has established a comprehensive plan for abandoned mine reclamation throughout the Commonwealth to prioritize and guide reclamation efforts for throughout the state to make the best use of valuable funds (www.dep.state.pa.us/dep/deputate/minres/bamr/complan1.htm). In developing and implementing a comprehensive plan for abandoned mine reclamation, the resources (both human and financial) of the participants must be coordinated to insure cost-effective results. The following set of principles is intended to guide this decision making process:

- Partnerships between the DEP, watershed associations, local governments, environmental groups, other state agencies, federal agencies and other groups organized to reclaim abandoned mine lands are essential to achieving reclamation and abating acid mine drainage in an efficient and effective manner.

- Partnerships between AML interests and active mine operators are important and essential in reclaiming abandoned mine lands.

- Preferential consideration for the development of AML reclamation or AMD abatement projects will be given to watersheds or areas for which there is an approved rehabilitation plan. (guidance is given in Appendix B to the Comprehensive Plan).

- Preferential consideration for the use of designated reclamation moneys will be given to projects that have obtained other sources or means to partially fund the project or to projects that need the funds to match other sources of funds.

- Preferential consideration for the use of available moneys from federal and other sources will be given to projects where there are institutional arrangements for any necessary long-term operation and maintenance costs.

- Preferential consideration for the use of available moneys from federal and other sources will be given to projects that have the greatest worth.

- Preferential consideration for the development of AML projects will be given to AML problems that impact people over those that impact property.

- No plan is an absolute; occasional deviations are to be expected.

A detailed decision framework is included in the plan that outlines the basis for judging projects for funding, giving high priority to those projects whose cost/benefit ratios are most favorable and those in which stakeholder and landowner involvement is high and secure.

In addition to the abandoned mine reclamation program, regulatory programs also are assisting in the reclamation and restoration of Pennsylvania's land and water. PADEP has been effective in implementing the NPDES program for mining operations throughout the Commonwealth. During 2006, District Mining Offices issued 31 new remining permits with the potential for reclaiming 1,058 acres of abandoned mine lands; an additional 328 acres were reclaimed during 2006 from existing remining permits. This reclamation was done at no cost to the Commonwealth or the federal government. Long-term treatment agreements were initialized for 109 facilities/operators who need to assure treatment of post-mining discharges or discharges they degraded which will provide for long-term treatment of 211 discharges. Of the 109 agreements, 34 have been finalized with 17 conventional bonding agreements totaling $75 M and 17 with treatment trusts totaling $73 M. According to OSM, "PADEP is conducting a program where active mining sites are, with very few exceptions, in compliance with the approved regulatory program". In addition, the Commonwealth dedicates 359 full-time equivalents (staff) to its regulatory and AML programs.

The DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; and administers a loan program for bonding anthracite underground mines and for mine subsidence and administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

The Commonwealth is exploring all options to address its abandoned mine problem. During 2000-2006, many new approaches to mine reclamation and mine drainage remediation have been explored and projects funded to address problems in innovative ways. These include:

- Project XL - The Pennsylvania Department of Environmental Protection ("PADEP"), has proposed this XL Project to explore a new approach to encourage the remining and reclamation of abandoned coal mine sites. The approach would be based on compliance with in-stream pollutant concentration limits and implementation of best management practices ("BMPs"), instead of National Pollutant Discharge Elimination System ("NPDES") numeric effluent limitations measured at individual discharge points. This XL project would provide for a test of this approach in up to eight watersheds with significant acid mine drainage ("AMD") pollution. The project will collect data to compare in-stream pollutant concentrations versus the loading from individual discharge points and provide for the evaluation of the performance of BMPs and this alternate strategy in PADEP's efforts to address AMD.
- Awards of grants for 1) proposals with economic development or industrial application as their primary goal and which rely on recycled mine water and/or a site that has been made suitable for the location of a facility through the elimination of existing Priority 1 or 2 hazards, and 2) new and innovative mine drainage treatment technologies that will provide waters of higher purity that may be needed by a particular industry at costs below conventional treatment costs as in common use today or reduce the costs of water treatment below those of conventional lime treatment plants. Eight contracts totaling $4.075 M were awarded in 2006 under this program.
- Projects using water from mine pools in an innovative fashion, such as the Shannopin Deep Mine Pool (in southwestern Pennsylvania), the Barnes & Tucker Deep Mine Pool (the Susquehanna River Basin Commission into the Upper West Branch Susquehanna River), and the Wadesville Deep Mine Pool (Excelon Generation in Schuylkill County).

Citizen and stakeholder involvement is critical to watershed reclamation in Pennsylvania and is strongly encouraged through the TMDL program and process. There currently isn't a watershed organization interested in the Laurel Run Watershed. It is recommended that agencies work with local interests to form a watershed group that will be dedicated to the remediation and preservation of these watersheds through public education, monitoring and assessment, and improvement projects. Information on formation of a watershed group is available through websites for the PADEP (www.dep.state.pa.us), the AMR Clearinghouse (www.amrclearinghouse.com), the EPA (www.epa.gov), the Susquehanna River Basin Commission (www.srbc.net) and others. In addition, each DEP Regional Office (6) and each District Mining Office (5) have watershed managers to assist stakeholder groups interested in restoration in their watershed. Most Pennsylvania county conservation districts have a watershed specialist who can also provide assistance to stakeholders (www.pacd.org). Potential funding

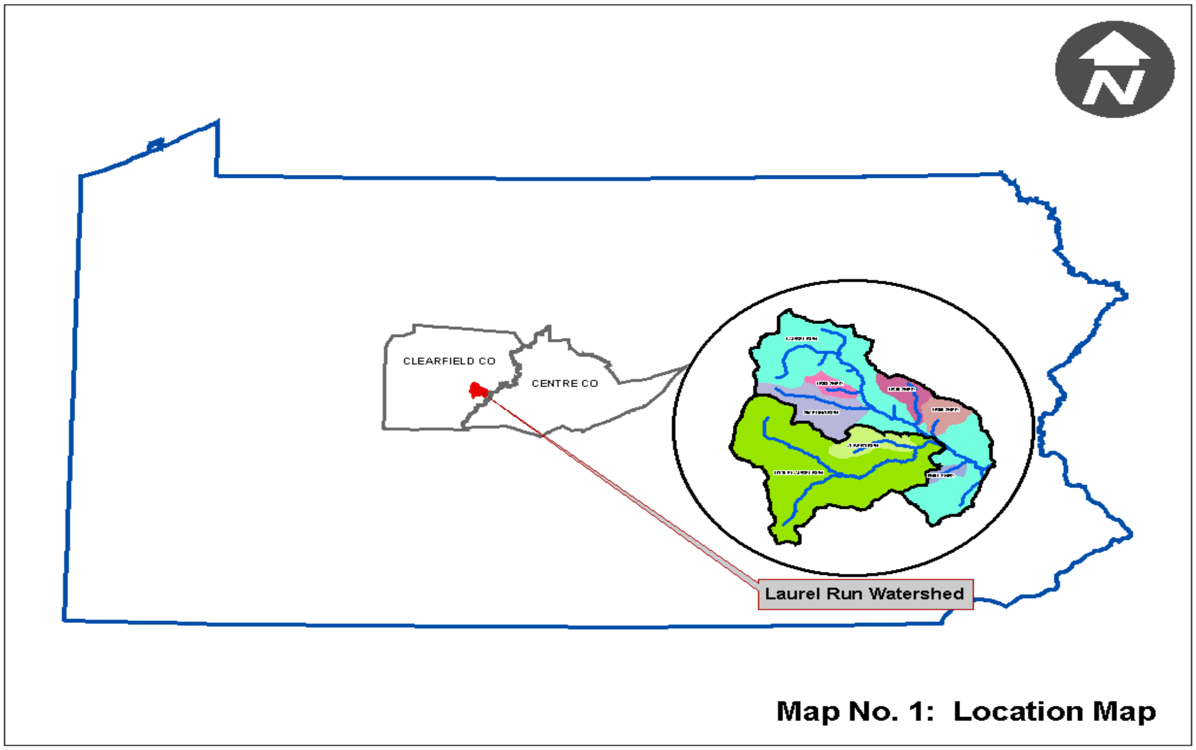
sources for AMR projects can be found at
www.dep.state.pa.us/dep/subject/pubs/water/wc/FS2205.pdf.

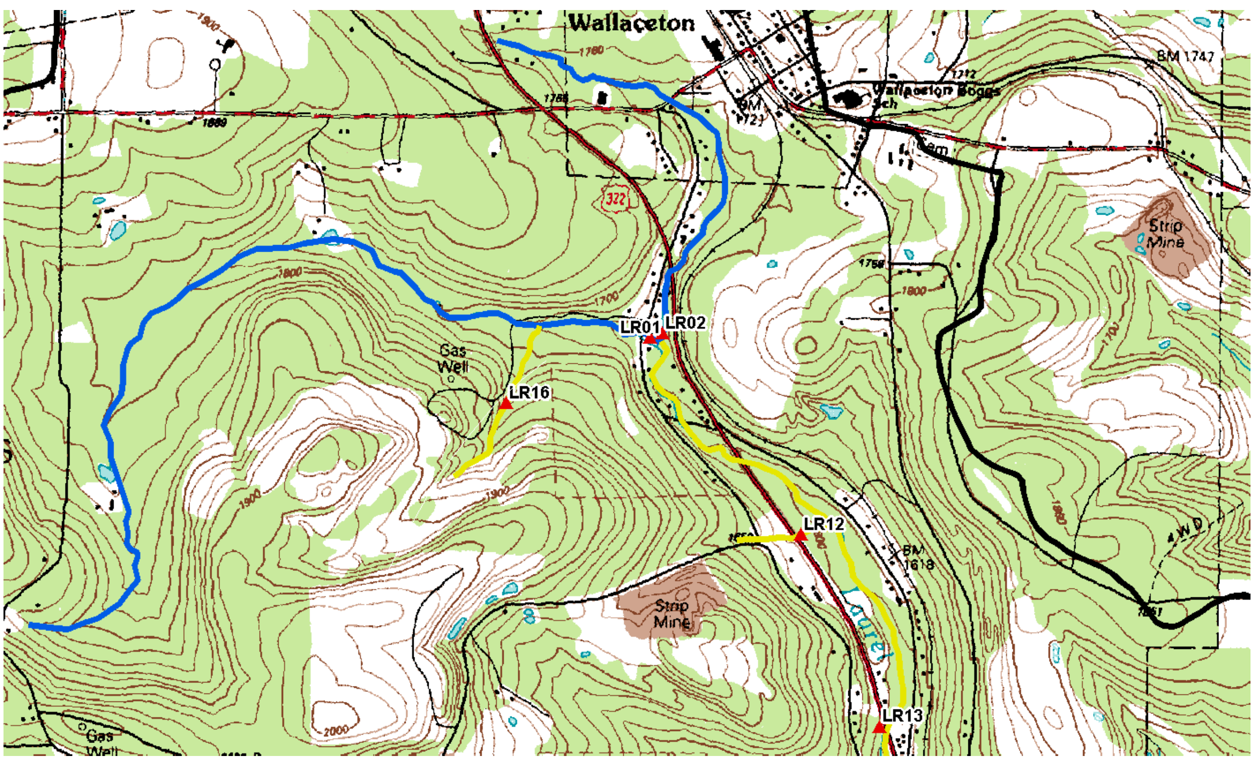
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and *The Progress*, to foster public comment on the allowable loads calculated. A public meeting was held on February 8, 2007 at the Department's Moshannon District Mining Office in Philipsburg, Pennsylvania to discuss the proposed TMDL.

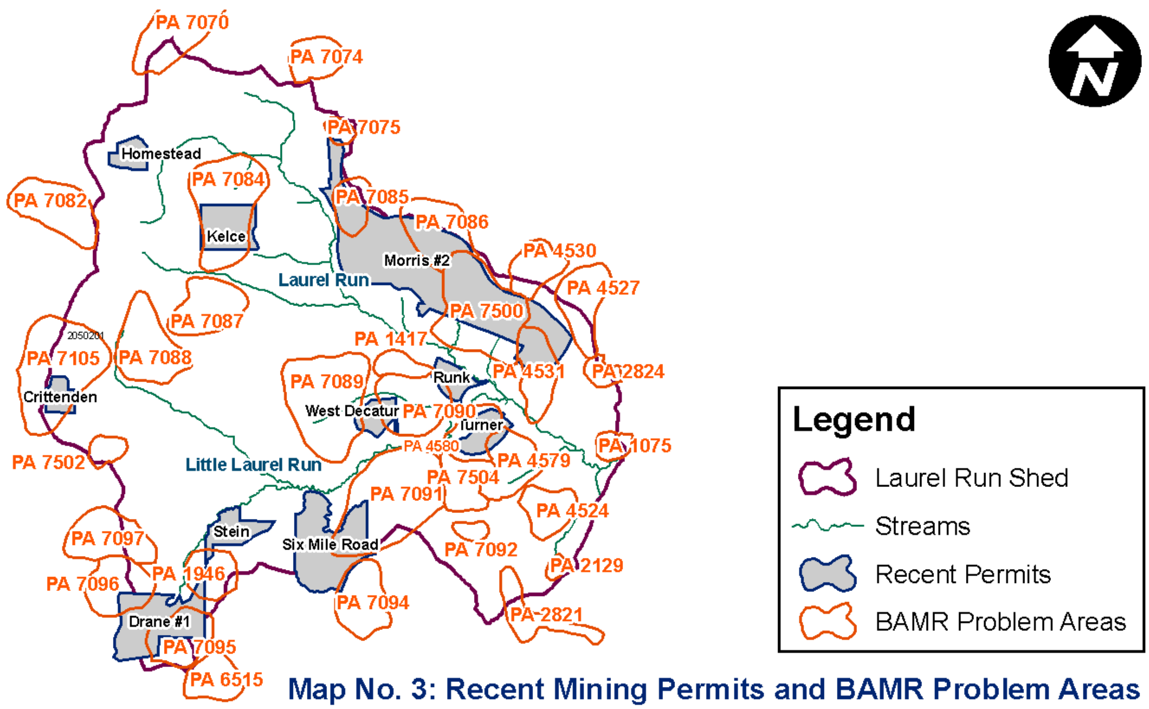
Attachment A

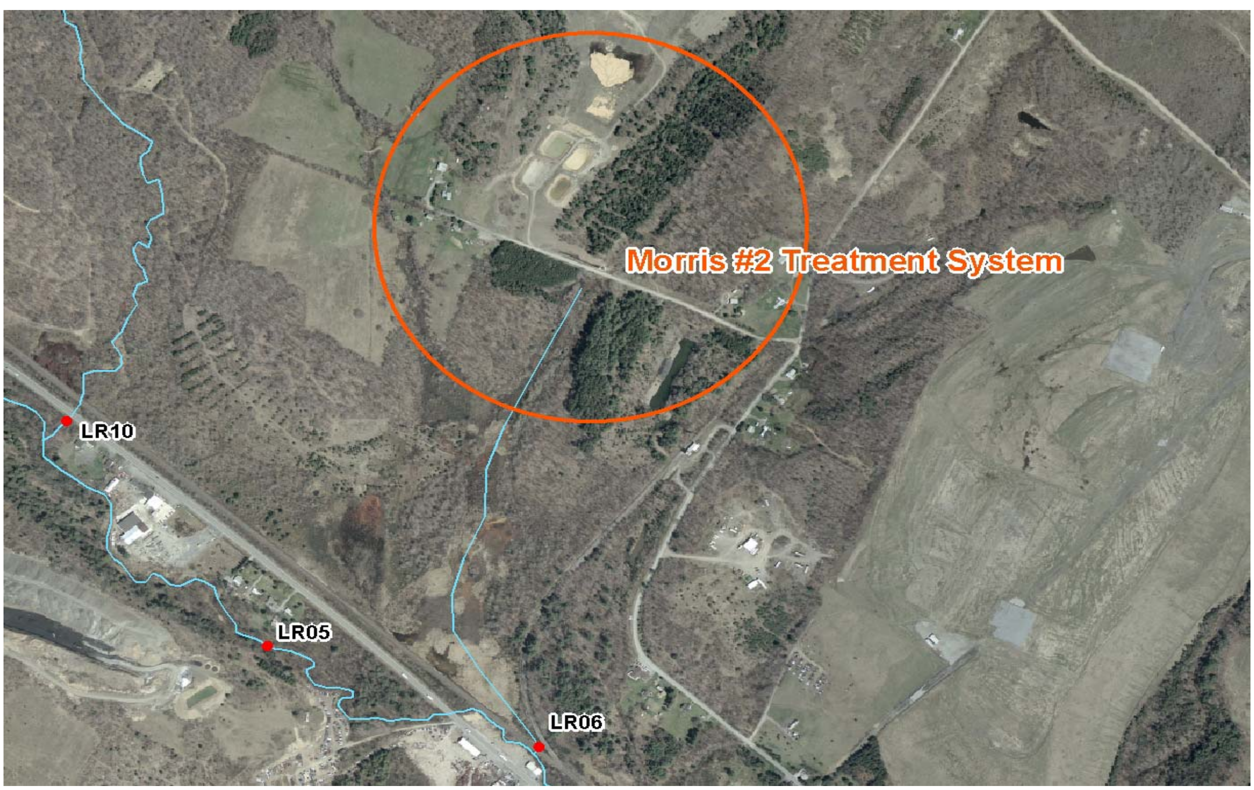
Laurel Run Watershed Maps



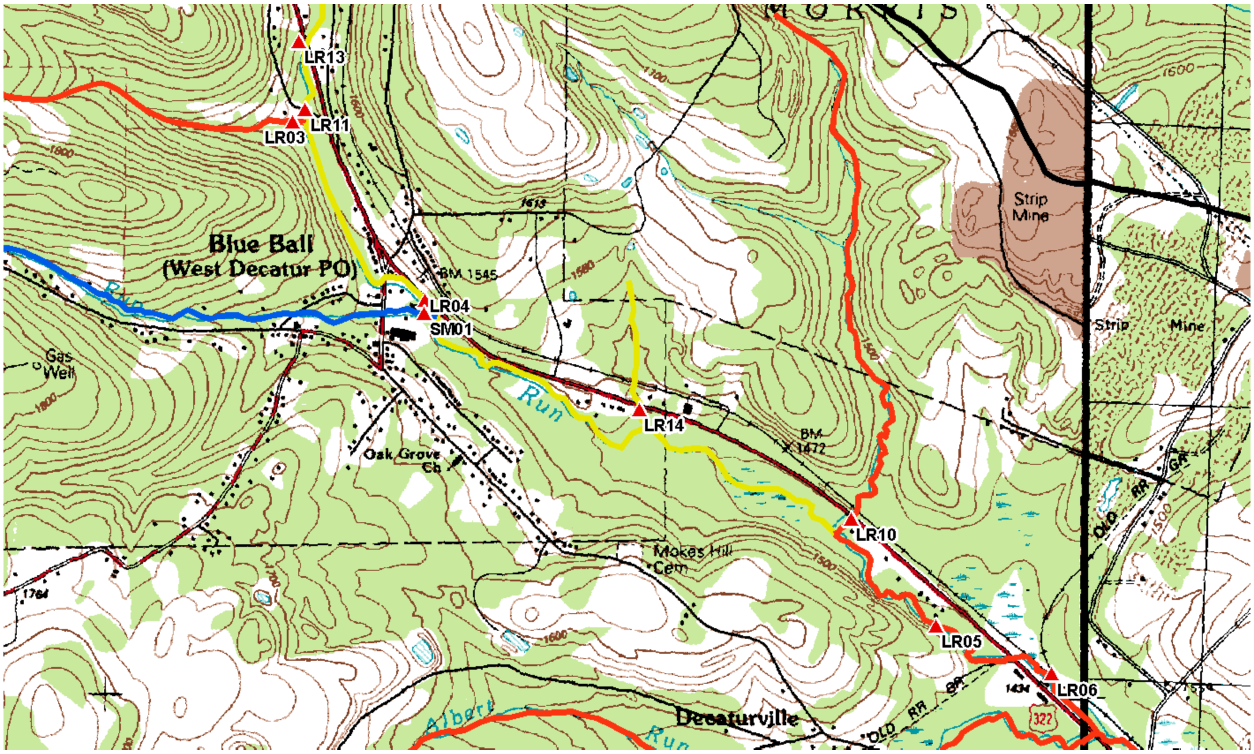


Map 2. Upper Laurel Run sample points

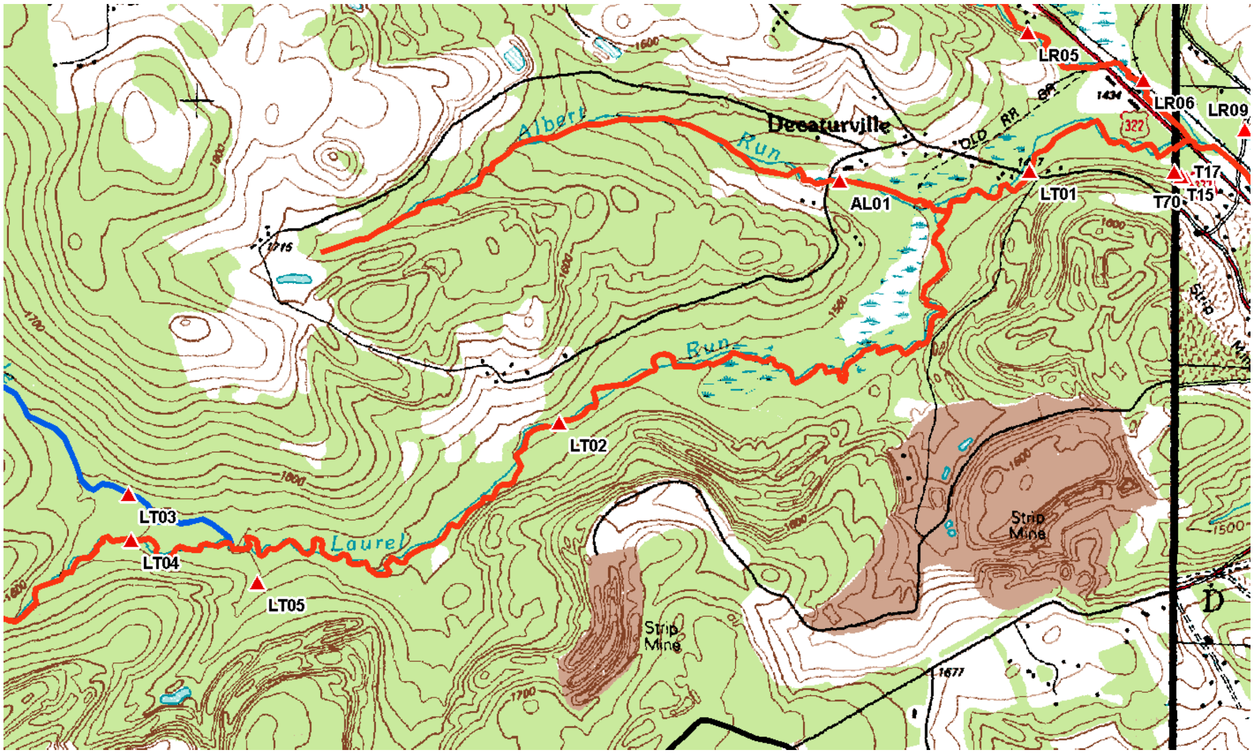




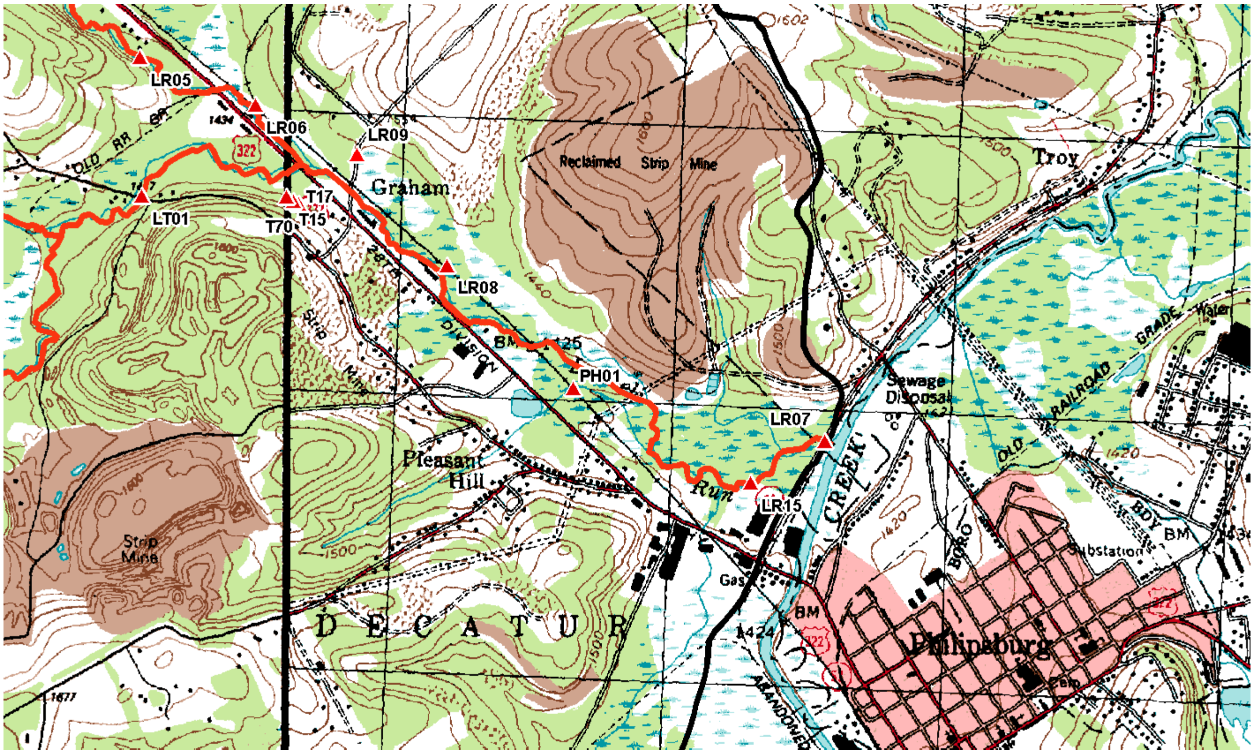
Map 4. Aerial photo of Morris #2 treatment system; effluent drains to LR06.



Map 5. Middle Laurel Run sample points



Map 6. Little Laurel Run sample points



Map 7. Lower Laurel Run sample points*

LR07 and LR15 were combined to produce LRMouth.

Attachment B

Method for Addressing Section 303(d) Listings for pH and *Surface Mining Control and Reclamation Act*

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Pa. Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the USEPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Reference: *Rose, Arthur W. and Charles A. Cravotta, III 1998. Geochemistry of Coal Mine Drainage. Chapter 1 in Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania. Pa. Dept. of Environmental Protection, Harrisburg, Pa.*

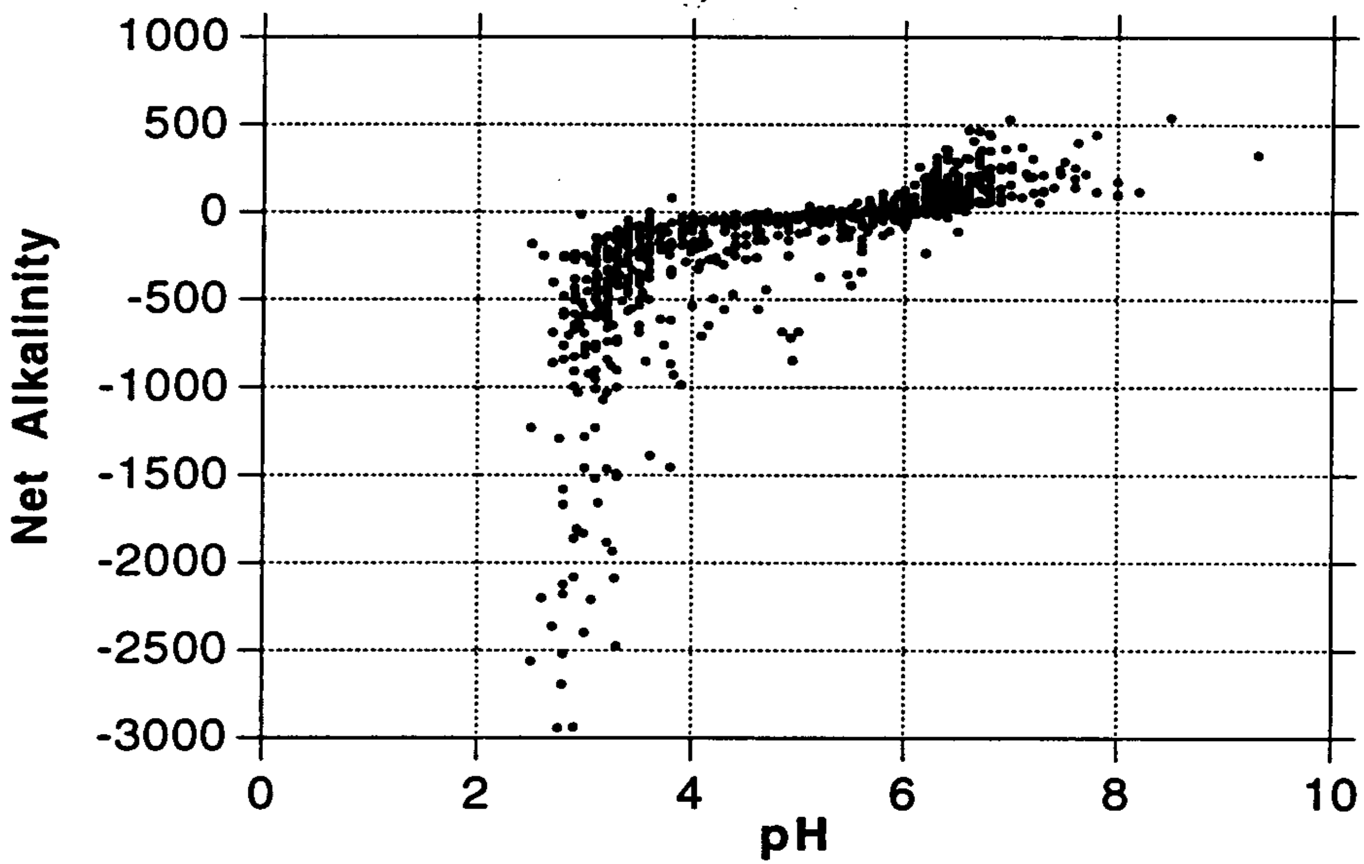


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
Method to Quantify Treatment Pond Loads

Method to Quantify Treatment Pond Pollutant Load

Calculating Waste Load Allocations for Active Mining in the TMDL Stream Segment.

The end product of the TMDL report is to develop Waste Load Allocations (WLA) and Load Allocations (LA) that represent the amount of pollution the stream can assimilate while still achieving in-stream limits. The LA is the load from abandoned mine lands where there is no NPDES permit or responsible party. The WLA is the pollution load from active mining that is permitted through NPDES.

In preparing the TMDL, calculations are done to determine the allowable load. The actual load measured in the stream is equal to the allowable load plus the reduced load.

$$\text{Total Measured Load} = \text{Allowed Load} + \text{Reduced Load}$$

If there is active mining or anticipated mining in the near future in the watershed, the allowed load must include both a WLA and a LA component.

$$\text{Allowed Load (lbs/day)} = \text{WLA (lbs/day)} + \text{LA (lbs/day)}$$

The following is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits.

Surface coalmines remove soil and overburden materials to expose the underground coal seams for removal. After removal of the coal the overburden is replaced as mine spoil and the soil is replaced for revegetation. In a typical surface mining operation the overburden materials is removed and placed in the previous cut where the coal has been removed. In this fashion, an active mining operation has a pit that progresses through the mining site during the life of the mine. The pit may have water reporting to it, as it is a low spot in the local area. Pit water can be the result of limited shallow groundwater seepage, direct precipitation into the pit, and surface runoff from partially regarded areas that have been backfilled but not yet revegetated. Pit water is pumped to nearby treatment ponds where it is treated to the required treatment pond effluent limits. The standard effluent limits are as follows, although stricter effluent limits may be applied to a mining permit's effluent limits to insure that the discharge of treated water does not cause in-stream limits to be exceeded.

Standard Treatment Pond Effluent Limits:
Alkalinity > Acidity
$6.0 \le pH \le 9.0$
$Fe < 3.0$ mg/l
$Mn < 2.0$ mg/l
$Al < 2.0$ mg/l

Discharge from treatment ponds on a mine site is intermittent and often varies as a result of precipitation events. Measured flow rates are almost never available. If accurate flow data are available, they can be used to quantify the WLA. The following is an approach that can be used to determine a waste load allocation for an active mining operation when treatment pond flow rates are not available. The methodology involves quantifying the hydrology of the portion of a surface mine site that contributes flow to the pit and then calculating waste load allocation using NPDES treatment pond effluent limits.

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the unregraded area following the pit's progression through the site. Groundwater seepage reporting to the pit is considered negligible compared to the flow rates resulting from precipitation.

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 41.4 inches of precipitation per year (Mid-Atlantic River Forecast Center, National Weather Service, State College, PA, 1961-1990, http://www.dep.state.pa.us/dep/subject/hotopics/drought/PrecipNorm.htm). A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming that 5 percent of the precipitation evaporates and the remaining 95 percent flows to the low spot in the active pit to be pumped to the treatment ponds, results in the following equation and average flow rates for the pit area.

41.4 in. precip./yr x 0.95 x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. =

= 21.0 gal/min average discharge from direct precipitation into the open mining pit area.

Pit water can also result from runoff from the unregraded and revegetated area following the pit. In the case of roughly backfilled and highly porous spoil, there is very little surface runoff. It is estimated that 80 percent of precipitation on the roughly regarded mine spoil infiltrates, 5 percent evaporates, and 15 percent may run off to the pit for pumping and potential treatment (Jay Hawkins, Office of Surface Mining, Department of the Interior, Personal Communications 2003). Regrading and revegetation of the mine spoil is conducted as the mining progresses. DEP encourages concurrent backfilling and revegetation through its compliance efforts and it is in the interest of the mining operator to minimize the company's reclamation bond liability by keeping the site reclaimed and revegetated. Experience has shown that reclamation and revegetation is accomplished two to three pit widths behind the active mining pit area. DEP uses three pit widths as an area representing potential flow to the pit when reviewing the NPDES permit application and calculating effluent limits based on best available treatment technology and insuring that in-stream limits are met. The same approach is used in the following equation, which represents the average flow reporting to the pit from the unregraded and unrevegetated spoil area.

41.4 in. precip./yr x 3 pit areas x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. x 15 in. runoff/100 in. precipitation =

= 9.9 gal./min. average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 21.0 gal./min + 9.9 gal./min. = 30.9 gal./min.

The resulting average waste load from a permitted treatment pond area is as follows.

Allowable Iron Waste Load Allocation:
30.9 gal./min. x 3 mg/l x 0.01202 = 1.1 lbs./day

Allowable Manganese Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

Allowable Aluminum Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

(Note: 0.01202 is a conversion factor to convert from a flow rate in gal/min. and a concentration in mg/l to a load in units of lbs./day.)

There is little or no documentation available to quantify the actual amount of water that is typically pumped from active pits to treatment ponds. Experience and observations suggest that the above approach is very conservative and overestimates the quantity of water, creating a large margin of safety in the methodology. County specific precipitation rates can be used in place of the long-term state average rate, although the margin of safety is greater than differences from individual counties. It is common for many mining sites to have very “dry” pits that rarely accumulate water that would require pumping and treatment.

Also, it is the goal of DEP’s permit review process to not issue mining permits that would cause negative impacts to the environment. As a step to insure that a mine site does not produce acid mine drainage, it is common to require the addition of alkaline materials (waste lime, baghouse lime, limestone, etc.) to the backfill spoil materials to neutralize any acid-forming materials that may be present. This practice of ‘alkaline addition’ or the incorporation of naturally occurring alkaline spoil materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. A comprehensive study in 1999 evaluated mining permits issued since 1987 and found that only 2.2 percent resulted in a post-mining pollution discharge (Evaluation of Mining Permits Resulting in Acid Mine Drainage 1987-1996: A Post Mortem Study, March 1999). As a result of efforts to insure that acid mine drainage is prevented, most mining operations have alkaline pit water that often meets effluent limits and requires little or no treatment.

While most mining operations are permitted and allowed to have a standard, 1500’ x 300’ pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater than the standard size or multiple pits are present, the calculations to define the potential pollution load can be adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered. A large margin of safety is included in the WLA calculations.

The allowable load for the stream segment is determined by modeling of flow and water quality data. The allowable load has a potential Waste Load Allocation (WLA) component if there is active mining or anticipated future mining and a Load Allocation (LA). So, the sum of the Load Allocation and the Waste Load Allocation is equal to the allowed load. The WLA is determined by the above calculations and the LA is determined by the difference between the allowed load and the WLA.

Allowed Load = Waste Load Allocation + Load Allocation
Or
Load Allocation = Allowed Load – Waste Load Allocation

This is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits. This allows for including active mining activities and their associated Waste Load in the TMDL calculations to more accurately represent the watershed pollution sources and the reductions necessary to achieve in-stream limits. When a mining operation is concluded its WLA is available for a different operation. Where there are indications that future mining in a watershed are greater than the current level of mining activity, an additional WLA amount may be included in the allowed load to allow for future mining.

Attachment D

TMDLs By Segment

Laurel Run

The TMDL for Laurel Run consists of load allocations to nine sampling sites along Laurel Run (LR01-06, LR08, LR10, LRMouth), six sampling sites on Little Laurel Run (LT01-05, AL01), three pre-Act discharges (T15, T17, T70), and waste load allocations to ten permits with effluent limits. Sample data sets were collected during the previous three years. All sample points are shown on the maps included in Attachment A as well as on the loading schematic presented on the following page.

Laurel Run is listed on the 1996 PA Section 303(d) list for pH from AMD as being the cause of the degradation to this stream. This TMDL will focus on pH and reduced acid loading as well as metals analysis to the Laurel Run watershed. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

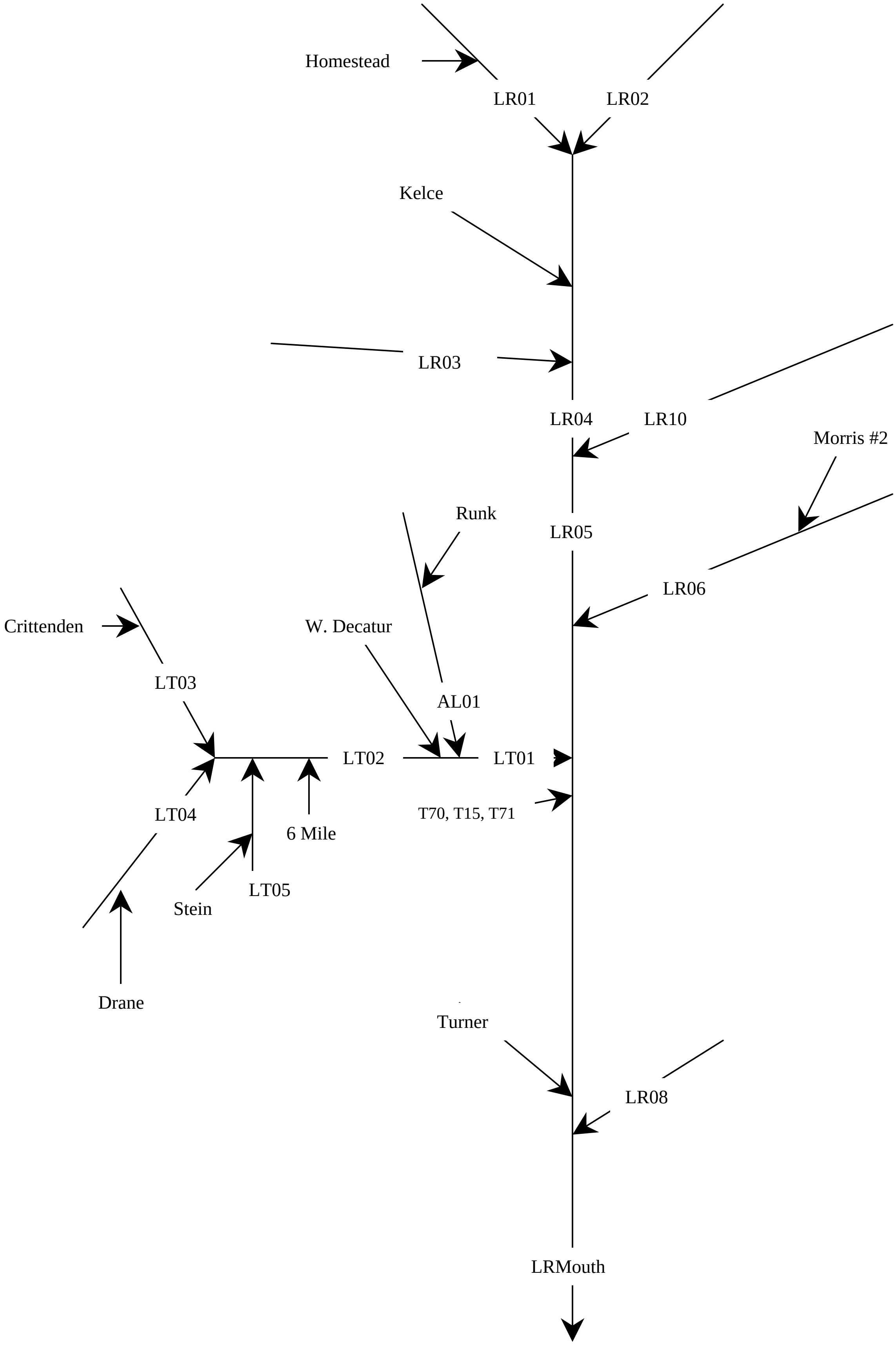
An allowable long-term average in-stream concentration was determined at each sample point for metals and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was log normally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards.

Waste Load Allocation – Sky Haven Coal Company, Homestead

The Sky Haven Coal Company (SMP170430108; NPDES PA0243825) Homestead Operation has one discharge with effluent limits. Flows for this discharge were derived using the default pit size method. The loads from this discharge will be evaluated in the calculated allowable loads at LR01. TF1 is a discharge from a treatment pond. The following table shows the waste load allocation for this discharge.

Table C1. Waste Load Allocations at Homestead Operation

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TF1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75


Homestead
LR01
LR02
Kelce
LR03
LR04
LR10
Morris #2
Runk
LR05
LR06
Crittenden
W. Decatur
LT03
AL01
LT02
LT01
LT04
T70, T15, T71
6 Mile
LT05
Stein
Drane
Turner
LR08
LRMouth

TMDL calculations- LR01 Unnamed tributary to Laurel Run (Twoey Run) in headwaters

The TMDL for sample point LR01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this uppermost segment (headwaters) of Laurel Run was computed using water-quality sample data collected at point LR01. The average flow, measured at sampling point LR01 (2.891 MGD), is used for these computations. This is the most upstream point of this segment and the allowable load allocations calculated at LR01 will directly affect the downstream point LR03.

Sample data at point LR1 shows that this headwaters section of Laurel Run has a pH ranging between 5.6 and 6.0. There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL for acidity has been calculated. All measured sample data for iron, manganese and aluminum were below detection limits. Because water quality standards are met, TMDLs for these parameters are not necessary.

Table C2 shows the measured and allowable concentrations and loads at LR01. Table C3 shows the percent reduction for acidity needed at LR01.

Table C2		Measured		Allowable	
Flow (gpm)=	2007.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.29	6.99	0.29	6.99
	Iron	0.17	4.10	0.17	4.10
	Manganese	0.36	8.68	0.36	8.68
	Acidity	23.15	558.17	3.70	89.21
	Alkalinity	8.30	200.12		

Table C3. Allocations LR01	
LR01	Acidity (Lbs/day)
Existing Load @ LR01	558.17
Allowable Load @ LR01	89.21
Load Reduction @ LR01	468.96
% Reduction required @ LR01	84%

TMDL calculations- LR02 Unnamed tributary to Laurel Run in headwaters

The TMDL for sample point LR02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this uppermost segment (headwaters) of Laurel Run was computed using water-quality sample data collected at point LR02. The average flow, measured at sampling point LR02 (1.537 MGD), is used for these computations. This is the most upstream point of this segment and the allowable load allocations calculated at LR02 will directly affect the downstream point LR04.

Sample data at point LR02 shows that this headwaters section of Laurel Run has a pH ranging between 6.9 and 7.6. There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. However, since all sample data in within the standard range (6.0-9.0), a TMDL for the parameter is not necessary and is not calculated. All measured sample data for iron, manganese and aluminum were below detection limits. Because water quality standards are met, a TMDL for these parameters are not necessary. Table C4 shows the measured and allowable concentrations and loads at LR02.

Table C4		Measured		Allowable	
Flow (gpm)=	1067.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.28	3.59	0.28	3.59
	Iron	0.21	2.69	0.21	2.69
	Manganese	0.14	1.80	0.14	1.80
	Acidity	4.80	61.53	4.80	61.53
	Alkalinity	29.95	383.92		

Waste Load Allocation – Penn Coal Land Company, Inc., Kelce

The Penn Coal Land Company, Inc. (SMP17753180; NPDES PA0609439) Kelce Operation has two discharges with effluent limits and one post-mining discharge requiring treatment. The loads from these discharges will be evaluated in the calculated allowable loads at LR04. Outfall 002 (K14) and Outfall 006 (K18) are discharges from mine drainage treatment facilities; flow for these discharges was derived using the default pit size method. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. Mining is currently not occurring on this permit; however, post-mining discharges are being treated (lower pond effluent); the average flow (40 GPM) from measured values was used to calculate loadings for this discharge. The following table shows the waste load allocations for this operation.

Table C5. Waste Load Allocations at Kelce Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 002 (K14)			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
Outfall 006 (K18)			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

Lower Pond Effluent			
Al	2.0	0.058	0.97
Fe	3.0	0.058	1.45
Mn	2.0	0.058	0.97

<u>TMDL calculations- LR03 Unnamed tributary to Laurel Run upstream of Blue Ball at mouth</u>

The TMDL for sampling point LR03 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LR03. The average flow, measured at the sampling point LR03 (0.597 MGD), is used for these computations.

Sample data at point LR03 shows pH ranging between 4.1 and 4.4; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LR03 for aluminum, manganese, iron and acidity was computed using water-quality sample data collected at the point. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LR03.

Table C6 shows the measured and allowable concentrations and loads at LR03. Table C7 shows the percent reductions for aluminum, manganese and acidity needed at LR03.

Table C6		Measured		Allowable	
Flow (gpm)=	414.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	Mg/L	lbs/day
	Aluminum	7.12	35.45	0.57	2.84
	Iron	0.15	0.75	0.15	0.75
	Manganese	13.75	68.46	0.69	3.44
	Acidity	103.05	513.08	3.09	15.39
	Alkalinity	5.85	29.13		

Table C7. Allocations LR03			
LR03	Aluminum (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LR03	35.45	68.46	513.08
Allowable Load @ LR03	2.84	3.44	15.39
Load Reduction @ LR03	32.61	65.02	497.69
% Reduction required @ LR03	92%	95%	97%

TMDL calculations- LR04 Laurel Run upstream of Simeling Run

The TMDL for sampling point LR04 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LR04. The average flow, measured at the sampling point LR04 (6.922 MGD), is used for these computations.

Sample data at point LR04 shows pH ranging between 5.3and 6.4; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Water quality standards for iron were being met at this point; therefore, no TMDL was necessary. The measured and allowable loading for point LR04 for aluminum, manganese and acidity from nonpoint sources was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LR01/LR02/LR03 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LR01/LR02/LR03 to LR04 determine a total load tracked for the segment of stream between LR04 and LR01/LR02/LR03. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LR04.

Table C8 shows the measured and allowable concentrations and loads at LR04. Table C9 shows the percent reductions for aluminum, manganese and acidity needed at LR04.

Table C8		Measured		Allowable	
Flow (gpm)=	4806.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.10	63.50	0.66	38.10
	Iron	0.44	25.40	0.44	25.40
	Manganese	2.55	147.21	0.61	35.22
	Acidity	39.25	2265.88	2.75	158.76
	Alkalinity	9.95	574.41		

Table C9. Allocations LR04			
LR04	Al (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LR04	63.50	147.21	2265.88
Difference in measured Loads between the loads that enter and existing LR04	17.47	68.27	1133.10
Percent loss due calculated at LR04	0	0	0
Additional load tracked from above samples	13.42	13.92	166.13
Percentage of upstream loads that reach LR04	100	100	100
Total load tracked between upstream points and LR04	30.89	82.19	1299.23
Allowable Load @ LR04	38.10	35.22	158.76
Load Reduction @ LR04	0	46.97	1140.47
% Reduction required at LR04	0	58	88

There is a 17.47 lbs/day increase of aluminum at LR04 compared to the sum of measured loads from upstream segments. The total aluminum load measured was 7.21 lbs/day less than the calculated allowable aluminum load of 38.10 lbs/day, resulting in a 0% aluminum reduction at this point. The total manganese load tracked at LR04 was 46.97 lbs/day greater than the calculated allowable manganese load of 35.22 lbs/day. Therefore a 58% reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 1299.23 lbs/day, which was 1140.47 lbs/day greater than the calculated allowable acidic load. An 88% acidic reduction is necessary to meet water quality standards for acid at LR04.

<u>TMDL calculations- LR10 Unnamed tributary to Laurel Run</u>

The TMDL for sampling point LR10 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LR10. The average flow, measured at the sampling point LR10 (1.228 MGD), is used for these computations.

Sample data at point LR10 shows pH ranging between 3.4 and 3.5; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LR10 for aluminum, manganese, iron and acidity was computed using water-quality sample data collected at the point. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LR10.

Table C10 shows the measured and allowable concentrations and loads at LR10. Table C11 shows the percent reductions for aluminum, manganese and acidity needed at LR10.

Table C10		Measured		Allowable	
Flow (gpm)=	852.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	8.41	86.13	0.50	5.12
	Iron	5.24	53.67	0.89	9.12
	Manganese	18.23	186.70	0.55	5.63
	Acidity	114.55	1173.17	0.00	0.00
	Alkalinity	0.00	0.00		

Table C11. Allocations LR10				
LR10	Iron (Lbs/day)	Aluminum (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LR10	53.67	86.13	186.70	1173.17
Allowable Load @ LR10	9.12	5.12	5.63	0.00
Load Reduction @ LR10	44.55	81.01	181.07	1173.17
% Reduction required @ LR10	83%	95%	97%	100%

TMDL calculations- LR05 Laurel Run downstream of LR10 unnamed tributary

The TMDL for sampling point LR05 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LR05. The average flow, measured at the sampling point LR05 (12.405 MGD), is used for these computations.

Sample data at point LR05 shows pH ranging between 4.9 and 6.2; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LR05 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LR4/LR10 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LR4/LR10 to LR05 determine a total load tracked for the segment of stream between LR05 and LR4/LR10. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LR05.

Table C12 shows the measured and allowable concentrations and loads at LR05. Table C13 shows the percent reductions for iron, aluminum, manganese and acidity needed at LR05.

Table C12		Measured		Allowable	
Flow (gpm)=	8614.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.03	106.56	0.42	43.45
	Iron	1.29	133.46	0.70	72.42
	Manganese	3.49	361.07	0.56	57.94
	Acidity	42.60	4407.30	5.11	528.67
	Alkalinity	9.75	1008.71		

Table C13. Allocations LR05				
LR05	Fe (Lbs/day)	Al (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LR05	133.46	106.56	361.07	4407.30
Difference in measured Loads between the loads that enter and existing LR05	54.39	-43.07	27.16	968.25
Percent loss due calculated at LR05	0	29	0	0
Additional load tracked from above samples	34.52	43.22	40.85	158.76
Percentage of upstream loads that reach LR05	100	71	100	100
Total load tracked between upstream points and LR05	88.91	30.69	68.01	1127.01
Allowable Load @ LR05	72.42	43.45	57.94	528.67
Load Reduction @ LR05	16.49	0	10.07	598.34
% Reduction required at LR05	19	0	15	54

The total iron load tracked at LR05 was 16.49 lbs/day greater than the calculated allowable iron load of 72.42 lbs/day. Therefore a 19% reduction is required to achieve the calculated allowable iron loading. There is a 43.07 lbs/day decrease of aluminum at LR05 compared to the sum of measured loads from upstream segments. This decrease of aluminum loading in this segment of stream between LR04/LR10 and LR05 can be a result of dilution or other natural stream processes. The total aluminum load measured was 12.76 lbs/day less than the calculated allowable aluminum load of 43.45 lbs/day, resulting in a 0% aluminum reduction at this point. The total manganese load tracked at LR05 was 10.07 lbs/day greater than the calculated allowable manganese load of 57.94 lbs/day. Therefore a 15% reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 1127.01 lbs/day, which was 598.34 lbs/day greater than the calculated allowable acidic load. A 54% acidic reduction is necessary to meet water quality standards at LR05.

Waste Load Allocation – Thompson Bros. Coal, Morris #2

Thompson Bros. Coal (SMP17810104) Morris #2 Operation has one post-mining discharge that drains into an unnamed tributary to Laurel Run with effluent limits. The loads from these discharges will be evaluated in the calculated allowable loads at LR06. M2FT is the discharge from a treatment system for MP#11, a mine discharge. A consent decree exists for the continual treatment of this discharge. The average flow from monitoring data (40 GPM) was used in the calculation of loads for this operation. This discharge does not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table C14. Waste Load Allocations at Morris#2 Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
M2FT			
Al	2.0	0.058	0.97
Fe	3.0	0.058	1.45
Mn	2.0	0.058	0.97

TMDL calculations- LR06 Unnamed tributary (mine discharge) to Laurel Run near mouth

The TMDL for sampling point LR06 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LR06. The average flow, measured at the sampling point LR06 (0.771 MGD), is used for these computations.

Sample data at point LR06 shows pH ranging between 3.1and 3.5; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C15 shows the measured and allowable concentrations and loads at LR06. Table C16 shows the percent reductions for aluminum, manganese, iron and acidity needed at LR06.

Table C15		Measured		Allowable	
Flow (gpm)=	535.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	33.45	215.09	0.33	2.12
	Iron	6.00	38.58	0.72	4.63
	Manganese	42.80	275.21	0.43	2.77
	Acidity	294.05	1890.78	0.00	0.00
	Alkalinity	0.00	0.00		

Table C16. Allocations LR06				
LR06	Iron (Lbs/day)	Aluminum (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LR06	38.58	215.09	275.12	1890.78
Allowable Load @ LR06	4.63	2.12	2.77	0.00
Load Reduction @ LR06	33.95	212.97	272.35	1890.78
% Reduction required @ LR06	88%	99%	99%	100%

Waste Load Allocation – Amfire Mining Company, Crittenden

The Amfire Mining Company (SMP17030111; NPDES PA0243558) Crittenden operation has one discharge with effluent limits. The loads from this discharge will be evaluated in the calculated allowable loads at LT03. Flow for this discharge was derived using the default pit size method. TB1 is a discharge from a treatment pond. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table C17. Waste Load Allocations at Crittenden Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TB1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

TMDL calculations- LT03 Unnamed tributary to Little Laurel Run in headwaters

The TMDL for sampling point LT03 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LT03. The average flow, measured at the sampling point LT03 (3.559 MGD), is used for these computations.

Sample data at point LT03 shows pH ranging between 5.5 and 5.9; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C18 shows the measured and allowable concentrations and loads at LT03. Table C19 shows the percent reductions for aluminum, manganese, iron and acidity needed at LT03.

Table C18		Measured		Allowable	
Flow (gpm)=	2471.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.29	8.61	0.29	8.61
	Iron	0.12	3.56	0.12	3.56
	Manganese	0.22	6.53	0.22	6.53
	Acidity	14.50	430.39	3.63	107.75
	Alkalinity	8.40	249.33		

Table C19. Allocations LT03	
LT03	Acidity (Lbs/day)
Existing Load @ LT03	430.39
Allowable Load @ LT03	107.75
Load Reduction @ LT03	322.64
% Reduction required @ LT03	75%

Waste Load Allocation –Penn Coal Lands, Drane #1

Penn Coal Lands (SMP4473SM10; NPDES PA0119440) Drane #1 Operation has one post-mining discharge that enters into an unnamed tributary to Little Laurel Run requiring treatment. The loads from this discharge will be evaluated in the calculated allowable loads at LT04. Flow for this discharge was calculated using monitoring data for the point (40 GPM). The front treated discharge is a discharge from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table C20. Waste Load Allocations at Drane#1 Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Front Discharge			
Al	2.0	0.058	0.97
Fe	3.0	0.058	1.45
Mn	2.0	0.058	0.97

TMDL calculations- LT04 Unnamed tributary to Little Laurel Run in headwaters

The TMDL for sampling point LT04 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LT04. The average flow, measured at the sampling point LT04 (1.443 MGD), is used for these computations.

Sample data at point LT04 shows pH ranging between 3.8 and 4.3; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH. Water quality standards for iron are being met at this point; therefore, a TMDL for iron is not necessary.

Table C21 shows the measured and allowable concentrations and loads at LT04. Table C22 shows the percent reductions for aluminum, manganese, and acidity needed at LT04.

Table C21		Measured		Allowable	
Flow (gpm)=	1001.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.48	17.81	0.40	4.81
	Iron	0.74	8.91	0.74	8.91
	Manganese	4.34	52.23	0.48	5.78
	Acidity	55.80	671.53	0.56	6.74
	Alkalinity	1.15	13.84		

Table C22. Allocations LT04			
LT04	Aluminum (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LT04	17.81	52.23	671.53
Allowable Load @ LT04	4.81	5.78	6.74
Load Reduction @ LT04	13.00	46.45	664.79
% Reduction required @ LT04	73%	89%	99%

Waste Load Allocation –River Hill Coal Company, Stein

The River Hill Coal Company (SMP17030102; NPDES PA0243426) Stein Operation will have four discharges with effluent limits when activated. The loads from this discharge will be evaluated in the calculated allowable loads at LT05. Flow for this discharge was derived using the default pit size method. TF1, TF2, TF3, and TF4 are discharges from treatment ponds. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table C23. Waste Load Allocations at Stein Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TF1			
Al	2.0	0.045	0.75
Fe	2.5	0.045	0.94
Mn	2.0	0.045	0.75
TF2			
Al	2.0	0.045	0.75
Fe	2.5	0.045	0.94
Mn	2.0	0.045	0.75

TF3			
Al	2.0	0.045	0.75
Fe	1.7	0.045	0.64
Mn	2.0	0.045	0.75
TF4			
Al	2.0	0.045	0.75
Fe	2.5	0.045	0.94
Mn	2.0	0.045	0.75

<u>TMDL calculations- LT05 Unnamed tributary to Little Laurel Run in headwaters</u>

The TMDL for sampling point LT05 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LT05. The average flow, measured at the sampling point LT05 (0.364 MGD), is used for these computations.

Sample data at point LT05 shows pH ranging between 3.9 and 4.8; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C24 shows the measured and allowable concentrations and loads at LT05. Table C25 shows the percent reductions for aluminum, manganese, iron and acidity needed at LT05.

Table C24		Measured		Allowable	
Flow (gpm)=	252.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	5.00	15.18	0.50	1.52
	Iron	0.36	1.09	0.36	1.09
	Manganese	6.03	18.31	0.66	2.00
	Acidity	68.30	207.34	5.46	16.58
	Alkalinity	6.35	19.28		

Table C25. Allocations LT05			
LT05	Aluminum (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LT05	15.18	18.31	207.34
Allowable Load @ LT05	1.52	2.00	16.58
Load Reduction @ LT05	13.66	16.31	190.76
% Reduction required @ LT05	90%	90%	92%

The River Hill Company Stein Operation has four permitted outfalls in its current permit (which has not been activated). The allowable loads for iron, manganese, and aluminum at the downstream point LT05 are such that special operating conditions will need to be implemented on the permit to assure downstream load allocations will be met. Once in operation, only one mine drainage treatment facility will be permitted to discharge at a time to LT05 as mining progresses. These special operating conditions will ensure that downstream water quality standards based on allowable loads will be met.

Waste Load Allocation – River Hill Coal Company, Inc., Six Mile Road

The River Hill Coal Company, Inc. (SMP17990102; NPDES PA0238236) Six Mile Road Operation has three discharges with effluent limits. The loads from these discharges will be evaluated in the calculated allowable loads at LT02. Outfall 001, 008 and 009 are discharges from treatment ponds. Flows for these discharges were derived using the default pit size method. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table C26. Waste Load Allocations at Six Mile Road Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Outfall 001			
Al	1.0	0.045	0.38
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
Outfall 008			
Al	1.0	0.045	0.38
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
Outfall 009			
Al	1.0	0.045	0.38
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

TMDL calculations- LT02 Little Laurel Run downstream of confluence of LT03, LT04, LT05

The TMDL for sampling point LT02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LT02. The average flow, measured at the sampling point LT02 (7.891 MGD), is used for these computations.

Sample data at point LT02 shows pH ranging between 4.9 and 5.1; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LT02 for aluminum, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LT03/LT04/LT05 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LT03/LT04/LT05 to LT02 determine a total load tracked for the segment of stream between LT02 and LT03/LT04/LT05. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LT02. Water quality standards for iron are being met at LT02; therefore, a TMDL for iron will not be required.

Table C27 shows the measured and allowable concentrations and loads at LT02. Table C28 shows the percent reductions for aluminum, manganese and acidity needed at LT02.

Table C27		Measured		Allowable	
Flow (gpm)=	5480.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.77	50.67	0.48	31.59
	Iron	0.35	23.03	0.35	23.03
	Manganese	1.83	120.43	0.60	39.49
	Acidity	43.10	2836.45	4.31	283.65
	Alkalinity	8.30	546.23		

Table C28. Allocations LT02			
LT02	Al (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LT02	50.67	120.43	2836.45
Difference in measured Loads between the loads that enter and existing LT02	9.07	43.36	1527.19
Percent loss due calculated at LT02	0	0	0
Additional load tracked from above samples	14.94	14.31	131.07
Percentage of upstream loads that reach LT02	100	100	100
Total load tracked between upstream points and LT02	24.01	57.67	1658.26
Allowable Load @ LT02	31.59	39.49	283.65
Load Reduction @ LT02	0	18.18	1374.61
% Reduction required at LT02	0	32	83

There is a 9.07 lbs/day increase of aluminum at LT02 compared to the sum of measured loads from upstream segments. The total aluminum load measured was 7.58 lbs/day less than the calculated allowable aluminum load of 31.59 lbs/day, resulting in a 0% aluminum reduction at this point. The total manganese load tracked at LT02 was 18.18 lbs/day greater than the calculated allowable manganese load of 39.49 lbs/day. Therefore a 32% reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 1658.26 lbs/day, which was 1374.61 lbs/day greater than the calculated allowable acidic load. An 83% acidic reduction is necessary to meet water quality standards at LT02.

Waste Load Allocation – Junior Coal Contracting, Inc., Runk

The Junior Coal Company, Inc. (SMP17980117; NPDES PA0238104) Runk Operation has three discharges with effluent limits. The loads from these discharges will be evaluated in the calculated allowable loads at AL01. TP1, TP2, and TP3 are discharges from treatment ponds. Flows for these discharges were derived using the default pit size method. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. The following table shows the waste load allocation for this discharge.

Table C29. Waste Load Allocations at Runk Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TP1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TP2			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TP3			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

TMDL calculations – AL01 Albert Run near mouth in Decaturville

The TMDL for sampling point AL01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point AL01. The average flow, measured at the sampling point AL01 (0.776 MGD), is used for these computations.

Sample data at point AL01 shows pH ranging between 3.6 and 3.8; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C30 shows the measured and allowable concentrations and loads at AL01. Table C31 shows the percent reductions for aluminum, manganese, iron and acidity needed at Al01.

Table C30		Measured		Allowable	
Flow (gpm)=	539.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	3.94	25.50	0.51	3.30
	Iron	1.63	10.55	0.60	3.88
	Manganese	12.06	78.05	0.48	3.11
	Acidity	73.50	475.68	0.00	0.00
	Alkalinity	0.00	0.00		

Table C31. Allocations AL01				
AL01	Iron (Lbs/day)	Aluminum (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ AL01	10.55	25.50	78.05	475.68
Allowable Load @ AL01	3.88	3.30	3.11	0.00
Load Reduction @ AL01	6.67	22.20	74.94	475.68
% Reduction required @ AL01	64%	87%	96%	100%

Waste Load Allocation – Junior Coal Contracting, Inc., West Decatur

The Junior Coal Contracting, Inc. (SMP17980110; NPDES PA0238023) West Decatur operation has one discharge with effluent limits. The loads from this discharge will be evaluated in the calculated allowable loads at LT01. TF1 is a discharge from a treatment pond. Flows for these discharges were derived using the default pit size method. This discharge does not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table C32. Waste Load Allocations at West Decatur Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TF1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

TMDL calculations- LT01 Little Laurel Run near confluence with Laurel Run

The TMDL for sampling point LT01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LT01. The average flow, measured at the sampling point LT01 (8.416 MGD), is used for these computations.

Sample data at point LT01 shows pH ranging between 4.1 and 4.6; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LT01 for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LT02/AL01 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LT02/AL01 to LT01 determine a total load tracked for the segment of stream between LT01 and LT02/AL01. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LT01.

Table C33 shows the measured and allowable concentrations and loads at LT01. Table C34 shows the percent reductions for iron, aluminum, manganese and acidity needed at LT01.

Table C33		Measured		Allowable	
Flow (gpm)=	5844.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.19	83.53	0.55	38.60
	Iron	0.97	68.08	0.84	58.96
	Manganese	3.68	258.30	0.59	41.41
	Acidity	59.50	4176.27	1.19	83.53
	Alkalinity	5.60	393.06		

Table C34. Allocations LT01				
LT01	Fe (Lbs/day)	Al (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LT01	68.08	83.53	258.30	4176.27
Difference in measured Loads between the loads that enter and existing LT01	34.50	7.36	59.82	864.14
Percent loss due calculated at LT01	0	0	0	0
Additional load tracked from above samples	26.91	34.89	42.60	283.65
Percentage of upstream loads that reach LT01	100	100	100	100
Total load tracked between upstream points and LT01	61.41	42.25	102.42	1147.79
Allowable Load @ LT01	58.96	38.60	41.41	83.53
Load Reduction @ LT01	2.45	3.65	61.01	1064.26
% Reduction required at LT01	4%	9%	60%	93%

There is a 34.50 lbs/day increase of iron at LT01 compared to the sum of measured loads from upstream segments. The total iron load measured was 2.45 lbs/day more than the calculated allowable iron load of 58.96 lbs/day, resulting in a 4% iron reduction at this point. There is a 7.36 lbs/day increase of aluminum at LT01 compared to the sum of measured loads from upstream segments. The total aluminum load measured was 3.65 lbs/day more than the calculated allowable aluminum load of 38.60 lbs/day, resulting in a 9% aluminum reduction at this point. The total manganese load tracked at LT01 was 61.01 lbs/day greater than the calculated allowable manganese load of 41.41 lbs/day. Therefore a 60% reduction is required to achieve the calculated allowable manganese loading. The total acidic load tracked from upstream was 1147.79 lbs/day, which was 1064.26 lbs/day greater than the calculated allowable acidic load. A 93% acidic reduction is necessary to meet water quality standards at LT01.

TMDL calculations – T70 Abandoned Mine Discharge

The TMDL for sampling point T70 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point T70. The average flow, measured at the sampling point T70 (0.245 MGD), is used for these computations.

Sample data at point T70 shows pH ranging between 3.4 and 3.6; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C35 shows the measured and allowable concentrations and loads at T70. Table C36 shows the percent reductions for aluminum, manganese, iron and acidity needed at T70.

Table C35		Measured		Allowable	
Flow (gpm)=	170.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	8.16	16.67	0.49	1.00
	Iron	13.18	26.93	1.05	2.15
	Manganese	6.75	13.79	0.74	1.51
	Acidity	131.05	267.77	0.00	0.00
	Alkalinity	0.00			

Table C36. Allocations T70				
T70	Aluminum (Lbs/day)	Iron (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ T70	16.67	26.93	13.79	267.77
Allowable Load @ T70	1.00	2.15	1.51	0.00
Load Reduction @ T70	15.67	24.78	12.28	267.77
% Reduction required @ T70	94%	92%	90%	100%

<u>TMDL calculations – T15 Abandoned Mine Discharge</u>

The TMDL for sampling point T15 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point T15. The average flow, measured at the sampling point T15 (0.014 MGD), is used for these computations.

Sample data at point T15 shows pH ranging between 3.4 and 3.5; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C37 shows the measured and allowable concentrations and loads at T15. Table C38 shows the percent reductions for aluminum, manganese, iron and acidity needed at T15.

Table C37		Measured		Allowable	
Flow (gpm)=	9.98	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	7.32	0.86	0.51	0.06
	Iron	2.64	0.31	0.74	0.09
	Manganese	6.26	0.73	0.75	0.09
	Acidity	93.00	10.86	0.00	0.00
	Alkalinity	0.00	0.00		

Table C38. Allocations T15				
T15	Aluminum (Lbs/day)	Iron (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ T15	0.86	0.31	0.73	10.86
Allowable Load @ T15	0.06	0.09	0.09	0.00
Load Reduction @ T15	0.80	0.22	0.64	10.86
% Reduction required @ T15	93%	71%	88%	100%

TMDL calculations – T17 Abandoned Mine Discharge

The TMDL for sampling point T17 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point T17. The average flow, measured at the sampling point T17 (0.055 MGD), is used for these computations.

Sample data at point T17 shows pH ranging between 3.3 and 3.4; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C39 shows the measured and allowable concentrations and loads at T17. Table C40 shows the percent reductions for aluminum, manganese, iron and acidity needed at T17.

Table C39		Measured		Allowable	
Flow (gpm)=	37.88	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	8.48	3.89	0.51	0.23
	Iron	8.95	4.11	0.98	0.45
	Manganese	7.08	3.25	0.85	0.39
	Acidity	121.00	55.50	0.00	0.00
	Alkalinity	0.00	0.00		

Table C40. Allocations T17				
T17	Aluminum (Lbs/day)	Iron (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ T17	3.89	4.11	3.25	55.50
Allowable Load @ T17	0.23	0.45	0.39	0.00
Load Reduction @ T17	3.66	3.66	2.86	55.50
% Reduction required @ T17	95%	90%	88%	100%

Waste Load Allocation –Larry D. Baumgardner Coal Co., Inc., Turner

The Larry D. Baumgardner Coal Co., Inc. (SMP17990111; NPDES PA0238341) Turner Operation has four discharges with effluent limits. The loads from these discharges will be evaluated in the calculated allowable loads at LRMouth. TT-1, TT-2, TT-3, and TT-4 are discharges from treatment ponds. Flow for was derived using the default pit size method. These discharges do not have effluent limits for aluminum currently; a concentration of 2.0 mg/L was assigned to the discharge for aluminum in the effluent. In addition, this permit has discharge points that are covered as Subchapter F discharges using baseline pollutant loadings. According to Subchapter F, as long as these discharges are not degraded (pollution loads increased over the baseline loads as stipulated in the permit), the operator is responsible for no further treatment. Therefore, no allocations are necessary to these points. The following table shows the waste load allocation for this discharge.

Table C41. Waste Load Allocations at Turner Operation			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
TT-1			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TT-2			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75
TT-3			
Al	2.0	0.045	0.75
Fe	1.7	0.045	0.64
Mn	2.0	0.045	0.75
TT-4			
Al	2.0	0.045	0.75
Fe	3.0	0.045	1.13
Mn	2.0	0.045	0.75

TMDL calculations- LR08 Unnamed (unmapped) tributary to Laurel Run downstream of town of Graham

The TMDL for sampling point LR08 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LR08. The average flow, measured at the sampling point LR08 (0.402 MGD), is used for these computations.

Sample data at point LR08 shows pH ranging between 3.1 and 3.6; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

Table C42 shows the measured and allowable concentrations and loads at LR08. Table C43 shows the percent reductions for iron, aluminum, manganese and acidity needed at LR08.

Table C42		Measured		Allowable	
Flow (gpm)=	279.15	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	2.61	8.75	0.34	1.14
	Iron	6.96	23.34	0.35	1.17
	Manganese	11.82	39.63	0.47	1.58
	Acidity	92.60	310.46	0.00	0.00
	Alkalinity	0.00	0.00		

Table C43. Allocations LR08				
LR08	Aluminum (Lbs/day)	Iron (Lbs/day)	Manganese (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LR08	8.75	23.34	39.63	310.46
Allowable Load @ LR08	1.14	1.17	1.58	0.00
Load Reduction @ LR08	7.61	22.17	38.05	310.46
% Reduction required @ LR08	87%	95%	96%	100%

The Larry D. Baumgardner Coal Company, Inc. Turner Operation has four permitted outfalls in its current permit. The allowable loads for iron, manganese, and aluminum at the downstream point LR08 are such that special operating conditions will need to be implemented on the permit to assure downstream load allocations will be met. For manganese, allowable loads at LR08 allow that 2 mine drainage treatment facilities can simultaneously discharge. For iron and aluminum, allowable loads at LR08 allow that only one mine drainage treatment facility can discharge at a time. These special operating conditions will ensure that downstream water quality standards based on allowable loads will be met.

<u>TMDL calculations- LRMouth Laurel Run near mouth</u>

The TMDL for sampling point LRMouth consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point LRMouth. The average flow, measured at the sampling point LRMouth (19.480 MGD), is used for these computations.

Sample data at point LRMouth shows pH ranging between 4.9 and 5.3; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point LRMouth for aluminum, iron, manganese and acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from points LR05/LR06/LT01/T70/T15/T17/LR08 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points LR05/LR06/LT01/T70/T15/T17/LR08 to LRMouth determine a total load tracked for the segment of stream between LRMouth and LR05/LR06/LT01/T70/T15/T17/LR08. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at LRMouth.

Table C44 shows the measured and allowable concentrations and loads at LRMouth. Table C45 shows the percent reductions for aluminum, manganese and acidity needed at LRMouth.

Table C44		Measured		Allowable	
Flow (gpm)=	13527.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.80	292.43	0.52	84.48
	Iron	1.16	188.46	0.93	151.09
	Manganese	5.12	831.81	0.56	90.98
	Acidity	45.10	7327.09	5.41	878.93
	Alkalinity	8.78	1426.43		

Table C45. Allocations LRMouth				
LRMouth	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ LRMouth	292.43	188.46	831.81	7327.09
Difference in measured Loads between the loads that enter and existing LRMouth	-142.92	-106.84	-120.17	-3791.85
Percent loss due calculated at LRMouth	33%	36%	13%	34%
Additional load tracked from above samples	86.60	140.36	105.69	612.20
Percentage of upstream loads that reach LRMouth	67%	64%	87%	66%
Total load tracked between upstream points and LRMouth	58.02	89.83	91.95	404.05
Allowable Load @ LRMouth	84.48	151.09	90.98	878.93
Load Reduction @ LRMouth	0	0	0.97	0
% Reduction required at LRMouth	0%	0%	1%	0%

The total manganese load tracked at LRMouth was 3.58 lbs/day greater than the calculated allowable manganese load of 90.98 lbs/day. Therefore a 4% reduction is required to achieve the calculated allowable manganese loading. No reductions are necessary for aluminum, iron, and acidity because the total load tracked was less than the allowable load at LRMouth.

Margin of Safety

PADEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water Quality standard states that water quality criteria must be met at least 99% of the time. All of the @Risk analyses results surpass the minimum 99% level of protection. Another margin of safety used for this TMDL analysis results from:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.

- A MOS is also the fact that the calculations were performed with a daily Iron average instead of the 30-day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in these TMDLs because the data used represents all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

Attachment E

Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, and 2002 lists. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Attachment F
Water Quality Data Used In TMDL Calculations

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
AL01	24-Sep-2003	691.00	3.7	58.00	0.00	3.80	2.11	11.20
AL01	24-Mar-2004	960.00	3.8	79.40	0.00	3.27	0.58	8.23
AL01	8-Jun-2004	337.00	3.6	77.20	0.00	4.55	2.15	15.40
AL01	11-May-2005	168.00	3.7	79.40	0.00	4.14	1.67	13.40
AVERAGE		539.00	3.70	73.50	0.00	3.94	1.63	12.06
ST DEV		355.34	0.08	10.39	0.00	0.54	0.73	3.07

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR01	23-Sep-2003	2759.00	5.9	30.00	7.00	0.50	0.38	0.48
LR01	22-Mar-2004	4070.00	5.6	18.40	7.80	0.24	0.08	0.35
LR01	7-Jun-2004	691.00	6.0	29.60	10.00	0.21	0.15	0.41
LR01	9-May-2005	510.00	6.0	14.60	8.40	0.20	0.07	0.22
AVERAGE		2007.50	5.88	23.15	8.30	0.29	0.17	0.36
ST DEV		1712.15	0.19	7.84	1.27	0.14	0.14	0.11

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR02	23-Sep-2003	1354	7.0	0	32	0.5	0.33	0.201
LR02	22-Mar-2004	2305	6.9	10.4	21.4	0.2	0.22	0.158
LR02	7-Jun-2004	356	7.6	1.8	36.4	0.2	0.153	0.095
LR02	9-May-2005	254	7.1	7	30	0.2	0.129	0.091
AVERAGE		1067.25	7.15	4.80	29.95	0.28	0.21	0.14
ST DEV		962.90	0.31	4.77	6.30	0.15	0.09	0.05

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR03	23-Sep-2003	507	4.1	84	2.4	6.5	0.3	14
LR03	22-Mar-2004	808	4.4	102.4	7	6.93	0.087	11.9
LR03	7-Jun-2004	230	4.2	125.8	8.2	7.98	0.135	15.3
LR03	9-May-2005	112	4.2	100	5.8	7.056	0.094	13.8
AVERAGE		414.25	4.23	103.05	5.85	7.12	0.15	13.75
ST DEV		310.35	0.13	17.23	2.50	0.62	0.10	1.40

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR04	23-Sep-2003	5533	6.4	38.8	11.4	1.11	0.469	2.6
LR04	22-Mar-2004	10409	5.7	5.6	8.4	1.05	0.246	1.76
LR04	7-Jun-2004	1956	6.1	67.4	11.8	1.18	0.521	2.87
LR04	9-May-2005	1329	5.3	45.2	8.2	1.053	0.51	2.958
AVERAGE		4806.75	5.88	39.25	9.95	1.10	0.44	2.55
ST DEV		4168.70	0.48	25.56	1.91	0.06	0.13	0.55

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR05	23-Sep-2003	10494	6.2	26.8	12.2	0.699	0.991	2.75
LR05	23-Mar-2004	17849	5.0	45.6	7.8	1.36	0.817	2.66
LR05	7-Jun-2004	3803	5.3	55.2	11	1.06	1.52	4
LR05	10-May-2005	2311	4.9	42.8	8	1.02	1.84	4.55
AVERAGE		8614.25	5.35	42.60	9.75	1.03	1.29	3.49
ST DEV		7110.86	0.59	11.80	2.19	0.27	0.47	0.93

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR06	23-Sep-2003	830	3.1	287.2	0	31.5	5.81	37.6
LR06	23-Mar-2004	821	3.5	231.6	0	27.4	4.07	33.6
LR06	9-Jun-2004	264	3.1	317.2	0	37.6	8.81	50.8
LR06	10-May-2005	226	3.2	340.2	0	37.3	5.32	49.2
AVERAGE		535.25	3.23	294.05	0.00	33.45	6.00	42.80
ST DEV		335.53	0.19	46.95	0.00	4.91	2.01	8.50

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR08	26-Sep-2003	72	3.3	74.2	0	1.84	3.25	9.46
LR08	25-Mar-2004	932	3.6	73.2	0	3.41	2.1	7.3
LR08	9-Jun-2004	80	3.1	109.2	0	1.79	12.8	14.5
LR08	11-May-2005	33	3.3	113.8	0	3.413	9.707	16
AVERAGE		279.15	3.33	92.60	0.00	2.61	6.96	11.82
ST DEV		435.71	0.21	21.91	0.00	0.92	5.13	4.11

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LR10	2-Oct-2003	707	3.4	109.4	0	10.3	6.02	18.3
LR10	23-Mar-2004	1907	3.5	93.6	0	7.21	3.81	13.9
LR10	7-Jun-2004	471	3.4	144.2	0	8.34	4.85	19.9
LR10	10-May-2005	325	3.4	111	0	7.8	6.26	20.8
AVERAGE		852.50	3.43	114.55	0.00	8.41	5.24	18.23
ST DEV		720.40	0.05	21.27	0.00	1.34	1.13	3.06

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LT01	24-Sep-2003	6500	4.4	42.8	5.2	0.958	1.34	3.54
LT01	24-Mar-2004	11920	4.6	40.4	6.4	1.21	0.88	2.49
LT01	8-Jun-2004	2906	4.1	117.2	6.4	1.32	0.954	4.44
LT01	10-May-2005	2051	4.2	37.6	4.4	1.26	0.721	4.25
AVERAGE		5844.25	4.33	59.50	5.60	1.19	0.97	3.68
ST DEV		4485.79	0.22	38.53	0.98	0.16	0.26	0.88

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LT02	24-Sep-2003	5327	5.1	27	7	0.604	0.447	1.88

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LT02	25-Mar-2004	12043	5.1	44.8	7.8	0.683	0.263	1.22
LT02	8-Jun-2004	2805	4.9	53.4	10.4	0.896	0.42	2.07
LT02	11-May-2005	1745	5.0	47.2	8	0.894	0.252	2.142
AVERAGE		5480.00	5.03	43.10	8.30	0.77	0.35	1.83
ST DEV		4626.09	0.10	11.33	1.47	0.15	0.10	0.42

ID		Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LT03	24-Sep-2003	2559	5.9	13.4	7.4	0.5	0.3	0.282
LT03	24-Mar-2004	5204	5.5	23.2	7.4	0.255	0.067	0.27
LT03	8-Jun-2004	1383	5.8	11.2	10.8	0.2	0.068	0.179
LT03	11-May-2005	740	5.8	10.2	8	0.2	0.046	0.142
AVERAGE		2471.50	5.75	14.50	8.40	0.29	0.12	0.22
ST DEV		1971.22	0.17	5.95	1.62	0.14	0.12	0.07

ID	Dates	Flow, GPM	Lab_pH		Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LT04	24-Sep-2003	1020	3.8	53	0	1.29	0.886	4.07
LT04	24-Mar-2004	2007	4.3	36	4.6	1.04	0.839	2.42
LT04	8-Jun-2004	672	3.9	67	0	1.62	0.753	4.85
LT04	11-May-2005	308	3.9	67.2	0	1.982	0.472	6.029
AVERAGE		1001.75	3.98	55.80	1.15	1.48	0.74	4.34
ST DEV		730.50	0.22	14.78	2.30	0.41	0.19	1.51

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
LT05	3-Oct-2003	248	4.4	68	6.4	5.2	0.389	6.14
LT05	24-Mar-2004	489	4.8	69.8	9.2	4.32	0.314	4.66
LT05	8-Jun-2004	194	3.9	64.2	3	6.11	0.541	7.07
LT05	11-May-2005	79	4.4	71.2	6.8	4.387	0.2	6.256
AVERAGE		252.50	4.38	68.30	6.35	5.00	0.36	6.03
ST DEV		172.70	0.37	3.03	2.55	0.84	0.14	1.00

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
T15	24-Sep-2003	17	3.4	96	0	8.32	2.24	6.5
T15	26-Mar-2004	18	3.5	75.6	0	6.33	1.63	5.36
T15	8-Jun-2004	2	3.4	100.4	0	6.55	3.34	6.3
T15	11-May-2005	3	3.5	100	0	8.07	3.364	6.868
AVERAGE		9.98	3.45	93.00	0.00	7.32	2.64	6.26
ST DEV		8.70	0.06	11.77	0.00	1.02	0.86	0.64

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L		Al, mg/L	Fe, mg/L	Mn, mg/L
T17	24-Sep-2003	67	3.3	127.4	0	9.99	9.58	7.56
T17	26-Mar-2004	67	3.4	104	0	7.88	11	6.76

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
T17	8-Jun-2004	15	3.3	132.8	0	8.67	8.07	7.34
T17	11-May-2005	3	3.3	119.8	0	7.379	7.148	6.678
AVERAGE		37.88	3.33	121.00	0.00	8.48	8.95	7.08
ST DEV		34.02	0.05	12.53	0.00	1.14	1.70	0.43

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L	Fe, mg/L	Mn, mg/L
T70	24-Sep-2003	171	3.4	130.4	0	10	11.1	7.61
T70	26-Mar-2004	180	3.4	110	0	7.9	12.6	6.75
T70	8-Jun-2004	160	3.4	162.2	0	7.32	13.3	6.06
T70	11-May-2005	170	3.6	121.6	0	7.426	15.7	6.592
AVERAGE		170.25	3.45	131.05	0.00	8.16	13.18	6.75
ST DEV		8.18	0.10	22.38	0.00	1.25	1.92	0.64

ID	Dates	Flow, GPM	Lab_pH	Acid, mg/L	Alkalinity, mg/L	Al, mg/L		Mn, mg/L
LRMouth	10-Jun-2004	6519	5.0	53.6	9.4	1.844	1.188	5.853
LRMouth	10-May-2005	5800	4.9	34.8	9	2.16	1.33	6.09
LRMouth	25-Sep-2003	15787	5.3	51.5	8.4	1.7533	1.33	5.2733
LRMouth	26-Mar-2004	26004	5.0	40.5	8.3	1.4567	0.8037	3.2667
AVERAGE		13527.50	5.05	45.10	8.78	1.80	1.16	5.12
ST DEV		9479.83	0.17	8.95	0.52	0.29	0.25	1.28

Attachment G
Comment and Response

EPA Region III Comments

1. Comment - Page 53, Table C11: Acidity column needs to be added and table headings need to be corrected.

   Response – The corrections have been made.

2. Comment - Page 59, sample point LT05. The total WLAs from Table C23 are larger than the allowable load in Table C24. However, will only one outfall discharge at a time? If so, add to text on page 58.

   Response – Text has been added below table C24 that outlines special conditions for discharging from the River Hill Stein Operation to assure that allowable loads at LT05 will not be exceeded.

3. Comment - Page 68, sample point LR08. Same comments for Tables C41 and C42 as above.

   Response - Text has been added below table C42 that outlines special conditions for discharging from the Larry D. Baumgardner Turner Operation to assure that allowable loads at LR08 will not be exceeded.