# FINAL
# HARTSHORN RUN WATERSHED TMDL
## Clearfield County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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## Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Hartshorn Run Watershed (Attachment A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list (shown in Table 1) and three additional segments from subsequent lists. High levels of metals and sulfates, and in some areas depressed pH, caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

**Table 1. 303(d) Sub-List**
**State Water Plan (SWP) Subbasin: 08-B Chest Creek**

| Year | Miles | Segment ID | DEP Stream Code | Stream Name | Designated Use | Data Source | Source | EPA 305(b) Cause Code |
|---|---|---|---|---|---|---|---|---|
| 1996 | 1 | 7191 | 26652 | Hartshorn Run | CWF | 305(b) Report | RE | Metals, pH, & Other Inorganics |
| 1998 | 3.06 | 7191 | 26652 | Hartshorn Run | CWF | SWMP | AMD | Metals, pH, & Other Inorganics |
| 2002 | 1.3 | 7191 | 26652 | Hartshorn Run | CWF | SWMP | AMD | Metals, pH, & Other Inorganics |
| 2004 | 1.3 | 7191 | 26652 | Hartshorn Run | CWF | SWMP | AMD | Metals, pH, & Other Inorganics |
| 1996 | Not on list. | | | | | | | |
| 1998 | Part of segment 7191 listing. | | | | | | | |
| 2002 | 1.8 | 981029-1035-JLR | 26652 | Hartshorn Run | CWF | SWMP | AMD | Metals & pH |
| 2004 | 1.8 | 981029-1035-JLR | 26652 | Hartshorn Run | CWF | SWMP | AMD | Metals & pH |
| 1996 | Not on list. | | | | | | | |
| 1998 | Not on list. | | | | | | | |
| 2002 | Not on list. | | | | | | | |
| 2004 | 1.2 | 20030929-1957-JCO | 26652 | Hartshorn Run | CWF | SSWAP | AMD | Metals |

[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). Approval of the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report is pending. The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

| Table 1. 303(d) Sub-List | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **State Water Plan (SWP) Subbasin: 08-B Chest Creek** | | | | | | | | |
| **Year** | **Miles** | **Segment ID** | **DEP Stream Code** | **Stream Name** | **Designated Use** | **Data Source** | **Source** | **EPA 305(b) Cause Code** |
| 1996 | Not on list. | | | | | | | |
| 1998 | Not on list. | | | | | | | |
| 2002 | Not on list. | | | | | | | |
| 2004 | 1.3 | 20030929-1955-JCO | 26653 | Hartshorn Run | CWF | SSWAP | AMD | Metals |

Resource Extraction=RE
Cold Water Fishes = CWF
Surface Water Monitoring Program = SWMP
Statewide Surface Waters Assessment Protocol = SSWAP
Abandoned Mine Drainage = AMD

See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists.*

The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

**Directions to the Hartshorn Run Watershed**

The Hartshorn Run Watershed is located in Central Pennsylvania, occupying a central portion of Clearfield County within Pike Township. The watershed area is found on United States Geological Survey maps covering Curwensville, Elliot Park, and Glen Richey 7.5-Minute Quadrangles.

Hartshorn Run flows beneath State Route 879 between Clearfield and Curwensville where Old Erie Pike meets State Route 879. Township Route 511 parallels Hartshorn Run north towards the headwaters. Township Route 511 is easily accessed from State Route 879 just east of its intersection with Old Erie Pike. State Route 879 is easily accessed from Clearfield or Curwensville.

Land use within the watershed is divided between forestlands in the headwaters and lower section of the stream valley, abandoned mine lands and reclaimed mine lands on the hilltops surrounding the watershed, and 10-15 family homes in the mid section of the watershed. There are a few homes in the upper section of the watershed, but for the most part all homes are concentrated near the mid section of the watershed.

**Hydrology and Geology**

The area within the watershed consists of 4.61 square miles. The area is characterized by rolling flat-topped uplands separated by broadly V-shaped stream valleys. The streams in the watershed flow from north to south. Hartshorn Run flows from an elevation of 1980 feet above sea level in the headwaters to an elevation of 1240 feet above sea level at its confluence with the West Branch of the Susquehanna River.

The Hartshorn Run Watershed lies within the Appalachian Plateau Physiographic Province. The area is underlain by a thick sequence of sedimentary rocks consisting mainly of alternating layers of sandstone, shale, siltstone, and limestone along with intermittent coal beds. The watershed area is comprised of Pennsylvanian and Mississippian aged rocks, which are divided into the Pottsville and Allegheny Formations of the Pennsylvanian System and Burgoon Sandstone Formation of the Mississippian System. The Clearfield syncline trends in a northeast-southwest direction and is located near the mouth of Hartshorn Run.

Older Mississippian rocks of the Pocono and Burgoon Sandstone Members are exposed in the valleys of the watershed and the younger Pennsylvanian rocks of the Pottsville and Allegheny Formations are on the side slopes and hilltops surrounding the watershed. Strata within the watershed are oriented in a northeast-southwest trend and dip to the southeast. Minable coal seams in the watershed include the lower Kittanning, middle Kittanning, upper Kittanning and lower Freeport coals.

**Segments addressed in this TMDL**

There are no active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the PA 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 Attachment C for TMDL calculations.

**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 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 nonpoint 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, other 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 nonpoint source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1997 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 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 assessed stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. 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 habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. If the stream is determined to be impaired, the source and

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

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; and
7. EPA approval of the TMDL.

**Watershed History**

Portions of the watershed have been previously mined by pre-law operations. Many of these mine sites were limited in extent and consisted of simple crop cut operations that seldom established a 60-foot highwall height. Following coal removal, the exposed highwalls were covered by backfilling. Generally, the highwalls were never reclaimed and spoil banks were left in an unregraded manner and seldom was vegetative cover reestablished.

Past mining operations have been conducted on the Upper, Middle, and Lower Kittanning coal seams in the watershed. Mining activities on the Kittanning coals has had a significant effect on the quality of surface water. The extensive mining on of the Lower Kittanning coal seam in the watershed and surrounding area has historically resulted in the degradation of waters of the Commonwealth.

The following mine sites straddle the Hartshorn Run and Welch Run Watershed boundary:

The C. A. Ogden Company (MDP4572BSM6) was issued a mine drainage permit and began mining in and around the watershed in May of 1972. Mining included the removal of the Middle Kittanning coal seam. The mining permit consisted of woodlands and pastureland. The area was not previously mined.

The McDonald Land and Mining, Smay permit (MDP45A76SM3) was issued in October of 1976. The initial permit covered approximately 247 acres of which 83 acres was planned for mining with 108.7 acres to be affected by mining activity. Portions of the permit were previously affected by surface mining. McDonald Land and Mining reaffected approximately six acres of the pre-law mining areas. In addition, the permittee affected approximately four acres of the C. A. Ogden Company area. Mining was initiated in November of 1978. The coal seams mined were the Upper Kittanning (4.3 acres), Middle Kittanning (20.7 acres), and the Lower Kittanning (59.6 acres). All mining was completed by June of 1983 and the site was backfilled and topsoiled by November of 1984. In May of 1984, the permit was reissued under Surface Mining Permit 17810141.

The Sky Haven Coal, Inc., Walker permit (SMP17800105) was issued in July of 1980. The permit covered 194 acres of which 137 acres were planned for mining. Mining activity was confined to the Middle Kittanning and Lower Kittanning coal seams. The site had been previously affected by Earl M. Brown who mined the same coal seams. The Earl Brown operation left abandoned highwalls and several spoil piles. Sky Haven reclaimed the pre-law site and eliminated the abandoned highwall. Mining was initiated in February of 1981. In May of 1985 the permit was reissued under Surface Mining Permit 17800105. As a special condition, Sky Haven was requested to apply alkaline material at the rate of 50 tons/acre to the pit floor and backfilled areas. Mining and backfilling was completed in the fall of 1986. Sky Haven affected 139.7 acres of the 194-acre mine drainage permit site.

More recent mining in the Hartshorn Run watershed includes the following mine sites:

The Thunder Coal Company, Smay permit (SMP17960117) was issued on May 7, 1997. The permitted area was 133.1 acres. The Upper Kittanning (32.4 acres) coal seam was mined affecting 55.2 acres. Mining was completed and the site backfilled in January of 2000. This permit is in Stage II bond release. This site is located in the northeastern portion of the watershed.

One deep mine discharge enters the unnamed tributary to Hartshorn Run between sample points HART04 and HART05. This discharge impairs the unnamed tributary below the discharge and continues on into Hartshorn Run below the confluence. The discharge flows from and old deep mine entry on the hillside above the unnamed tributary.

**AMD Methodology**

A two-step approach is used for the TMDL analysis of AMD 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 or a discharge that has a responsible party, 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)

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)

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

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.

For 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. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/**l**) $CaCO_3$. 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 from AMD may not 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 a 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.

Because most of the pollution sources in the watershed are nonpoint sources, the larges part of the TMDL is expressed as Load Allocations (LAs). 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 Recoverable |
| Manganese (Mn) | 1.00 | Total Recoverable |
| Sulfates (SO4) | 250 | 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.

## Other Inorganics

The cause of inorganic impairment as listed on the 1996 Section 303(d) list is sulfates. A TMDL to address sulfates is not necessary due to Title 25 Chapter 96.3(d), which states that criterion of 250 mg/L be met at any potable water supply intake. The average sulfate concentration at the mouth of Hartshorn Run is 64.1 mg/L, which is below the criterion. In addition a large number of the sulfate concentrations at upstream points are undetected. The nearest potable water withdrawal to Hartshorn Run occurs approximately 20 miles downstream of the mouth at the Shawville Power Plant (#6170333) located on the West Branch Susquehanna River. Sulfate data is located in Appendix E.

## TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The waste load 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.

## 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 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 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.

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 no permitted discharges in the watershed and therefore all waste load allocations are equal to zero. The difference between the TMDL and the WLA at each point 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 within a segment 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. TMDL Component Summary for the Hartshorn Run Watershed**

| Station | Parameter | Existing Load (lbs/day) | TMDL Allowable Load (lbs/day) | WLA (lbs/day) | LA (lbs/day) | Load Reduction (lbs/day) | Percent Reduction % |
|---|---|---|---|---|---|---|---|
| **HART07** | *Hartshorn Run, upstream of Unnamed Tributary 26654* | | | | | | |
| | Fe | ND | NA | NA | NA | 0.0 | 0 |
| | Mn | ND | NA | NA | NA | 0.0 | 0 |
| | Al | ND | NA | NA | NA | 0.0 | 0 |
| | Acidity | 89.4 | 45.6 | 0.0 | 45.6 | 43.8 | 49 |
| **HART08** | *Mouth of Unnamed Tributary 26654* | | | | | | |
| | Fe | ND | NA | NA | NA | 0.0 | 0 |
| | Mn | 0.1 | 0.1 | NA | NA | 0.0 | 0 |
| | Al | ND | NA | NA | NA | 0.0 | 0 |
| | Acidity | 6.1 | 2.3 | 0.0 | 2.3 | 3.8 | 63 |
| **HART03** | *Hartshorn Run, upstream of Unnamed Tributary 26653* | | | | | | |
| | Fe | ND | NA | NA | NA | 0.0 | 0 |
| | Mn | ND | NA | NA | NA | 0.0 | 0 |
| | Al | ND | NA | NA | NA | 0.0 | 0 |
| | Acidity | 77.5 | 36.4 | 0.0 | 36.4 | 2.4 | 6 |
| **HART05** | *Unnamed Tributary 26653 below reservoir* | | | | | | |
| | Fe | ND | NA | NA | NA | 0.0 | 0 |
| | Mn | ND | NA | NA | NA | 0.0 | 0 |
| | Al | ND | NA | NA | NA | 0.0 | 0 |
| | Acidity | 9.6 | 7.7 | 0.0 | 7.7 | 1.9 | 20 |
| **HART04** | *Mouth of Unnamed Tributary 26653* | | | | | | |
| | Fe | 6.9 | 6.9 | NA | NA | 0.0 | 0 |
| | Mn | 12.6 | 1.6 | 0.0 | 1.6 | 11.0 | 87 |
| | Al | 48.0 | 1.4 | 0.0 | 1.4 | 46.6 | 97 |
| | Acidity | 882.9 | 8.8 | 0.0 | 8.8 | 872.2 | 99 |
| **HART01** | *Mouth of Hartshorn Run* | | | | | | |
| | Fe | ND | NA | NA | NA | 0.0 | 0 |
| | Mn | 7.3 | 7.3 | NA | NA | 0.0 | 0 |
| | Al | ND | NA | NA | NA | 0.0 | 0 |
| | Acidity | 785.1 | 86.4 | 0.0 | 86.4 | 0.0 | 0 |

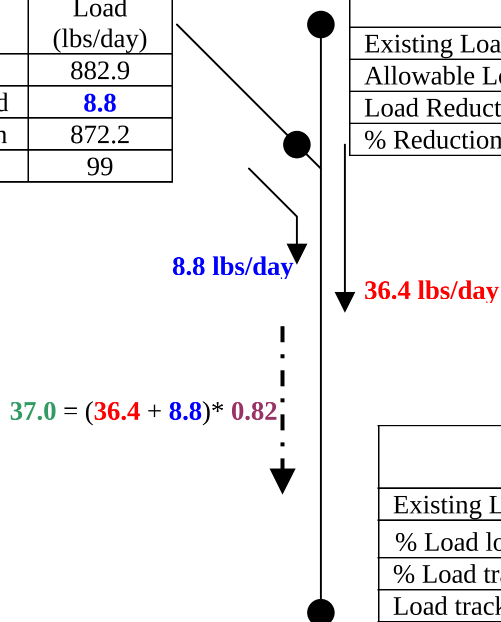
ND, not detected
NA meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the existing load (e.g. manganese point HART08, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and 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. In addition, when all measured values are below the method detection limit, denoted by ND (e.g. iron point HART07, Table 3), no TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, acidity allocations for HART01 of Hartshorn 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. Attachment A contains a map of the sampling point locations for reference.

| HART04 | Load (lbs/day) |
|---|---|
| Existing Load | 882.9 |
| Allowable Load | **8.8** |
| Load Reduction | 872.2 |
| % Reduction | 99 |

| HART03 | Load (lbs/day) |
|---|---|
| Existing Load | 77.5 |
| Allowable Load | **36.4** |
| Load Reduction | 2.4 |
| % Reduction | 6 |




| HART01 | Load (lbs/day) |
|---|---|
| Existing Load | 785.1 |
| % Load lost | 18 |
| % Load tracked through segment | **82** |
| Load tracked from HART03 & HART04 | **37.0** |
| Allowable Load | 86.4 |
| Load Reduction | 0.0 |
| % Reduction | 0 |

## Recommendations

There is currently no watershed group focused on the Hartshorn Run Watershed. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

Two primary programs provide maintenance and improvement of water quality in the watershed. DEP's efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by DEP's Bureau of Abandoned Mine Reclamation, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania; the United States Office of Surface Mining; the National Mine Land Reclamation Center; the National Environmental Training Laboratory; and many other agencies and individuals. Funding from EPA's CWA Section 319(a) Grant program and Pennsylvania's Growing Greener program has been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

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; 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).

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 1960s, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. 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.

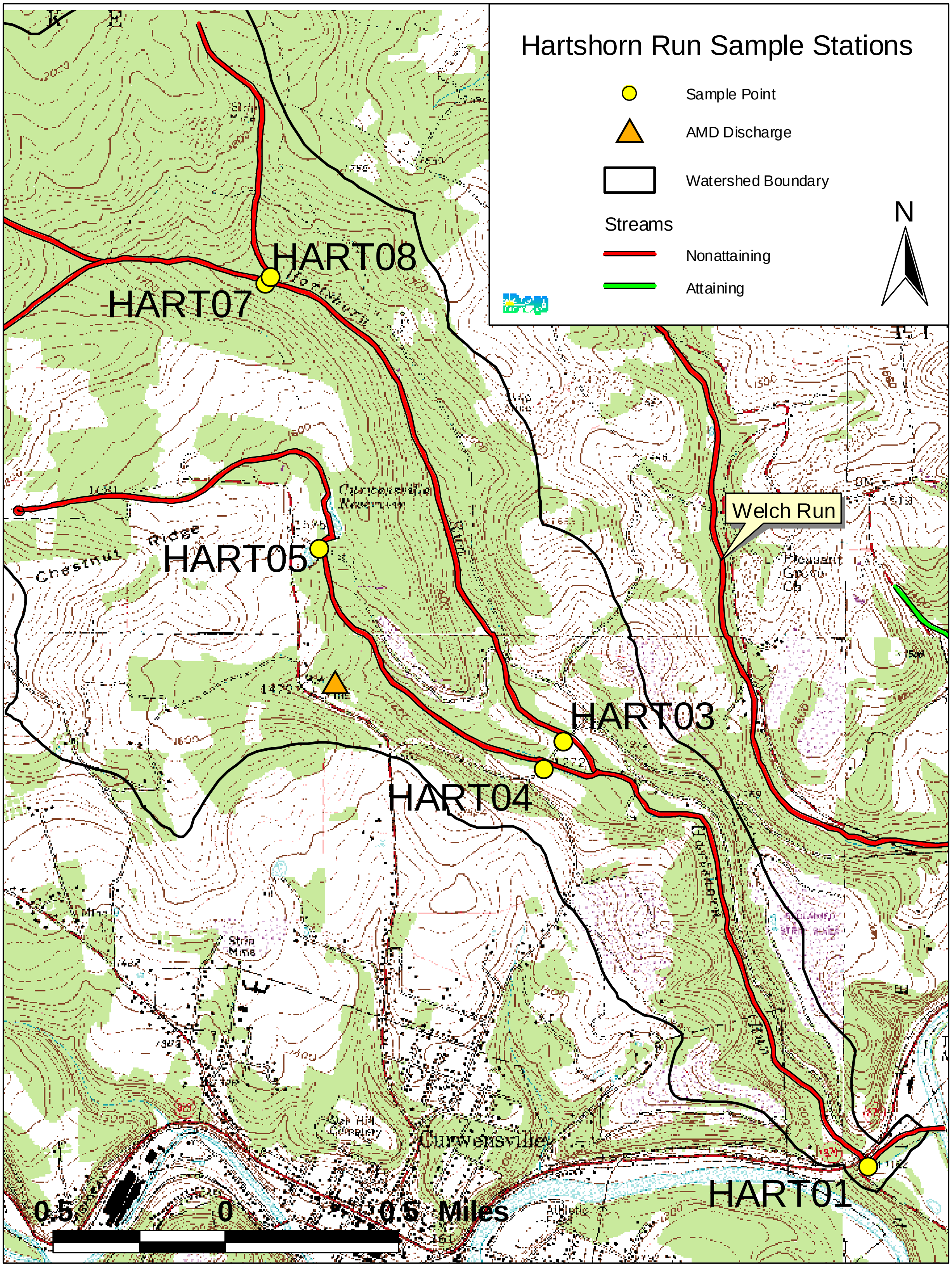
**Public Participation**

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on August 14, 2004 and *The Progress* on August 16 and August 23, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from August 14, 2004 to October 13, 2004. A public meeting was held on September 1, 2004 at the Clearfield County Multiservice Center to discuss the proposed TMDL.

# Attachment A

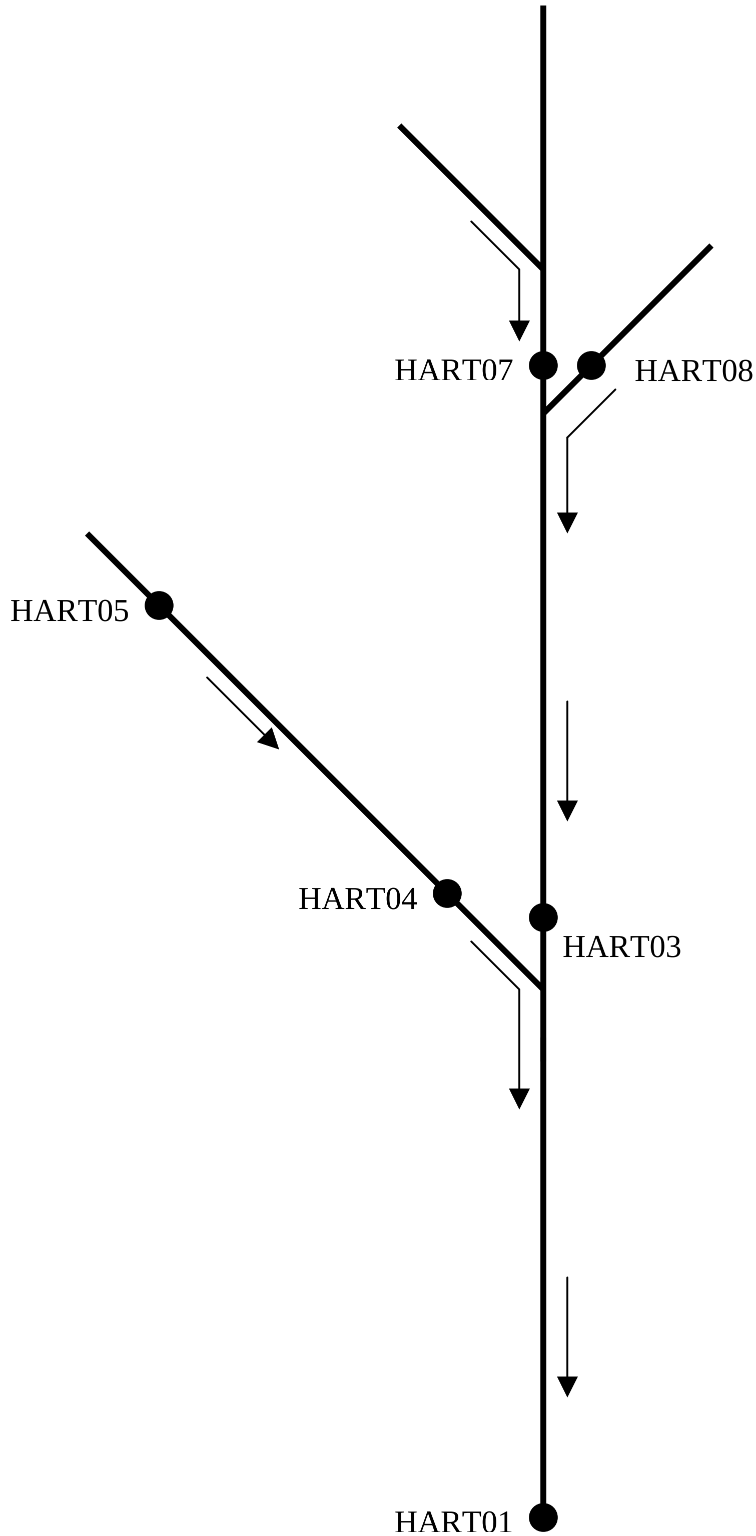
**Hartshorn Run Watershed Maps**

HART08
HART07
Hartshorn Run
HART05
Welch Run
HART03
HART04
HART01
Curwensville
Susquehanna Bridge
The Narrows
Hyde
Clearfield County
Hartshorn Run
0.5
0
0.5 Miles
Legend
Sample Point
AMD Discharge
Watershed Boundary
Streams
Nonattaining
Attaining
N


Hartshorn Run Sample Stations
Sample Point
AMD Discharge
Watershed Boundary
Streams
Nonattaining
Attaining
N
HART08
HART07
HART05
HART03
HART04
HART01
Welch Run
0.5
0
0.5 Miles


20030929-1957-JCO
20030929-1955-JCO
7191
981029-1035-JLR
Hartshorn Run
Listed Segments
0.5 0 0.5 1 Miles
Legend
N
Nonattaining Streams
Watershed Boundary

**Hartshorn Run Sampling Station Diagram**
Arrows indicate direction of flow.
(Not to scale)



# Attachment B

## Method for Addressing Section 303(d) Listings for pH

# 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 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 EPA'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 Section 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. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. 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. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. 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.

There are several documented cases of streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the Section 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches added to the acidity of the polluted portion in question. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion (added to the acidity of the polluted portion) of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to reduce the acid load so the net alkalinity is greater than zero 99% of time.

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.*

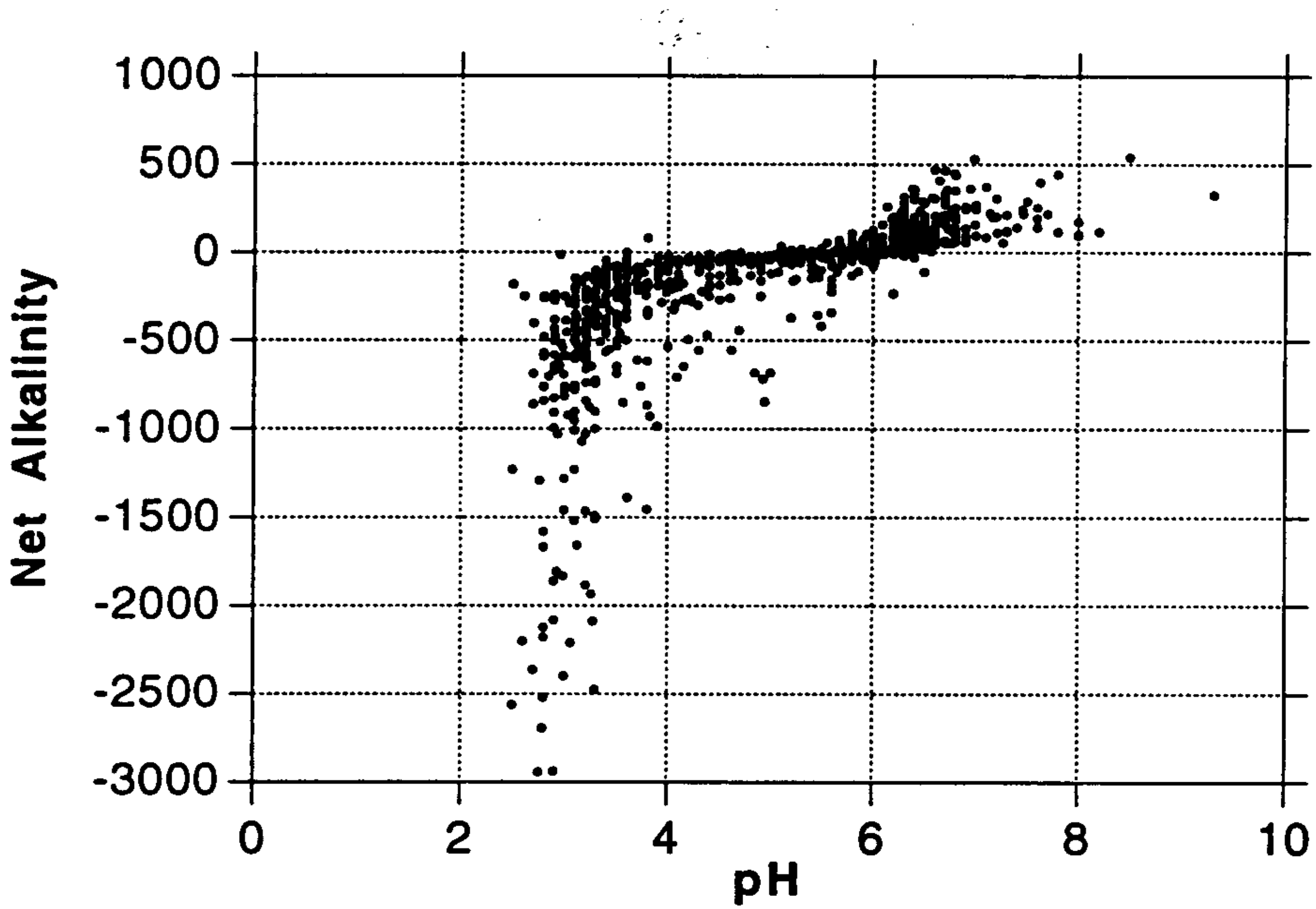



**Figure 1**. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

# Attachment C
## TMDLs By Segment

## Hartshorn Run

The TMDL for the Hartshorn Run consists of load allocations of two tributaries and three sampling sites along the stream. There are no waste load allocations in the watershed because there are no active NPDES mining permits in the watershed.

Hartshorn Run is listed as impaired on the PA Section 303(d) list by both high metals and sulfates and low pH from AMD as being the cause of the degradation to the stream. A TMDL is not necessary for sulfates as explained in the *Other Inorganics* section of the report. For pH, the objective is to reduce acid loading to the stream that will in turn raise the pH to the acceptable range. 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 aluminum, iron, manganese, 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 lognormally 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.

TMDLs for metals are not necessary except at point HART04. Metals at all other points are either below detection limits or meet water quality standards. HART04 is affected by an abandoned discharge upstream of the point.

***TMDL Calculations - Sample Point HART07, Hartshorn Run upstream of Unnamed Tributary 26654***

The TMDL for sample point HART07 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point HART07. The average flow of 1.19 MGD, measured at point HART07, is used for these computations.

This segment is contained on the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report for metals impairments from AMD. There is currently no listing for pH for this segment. Sample data at point HART07 shows pH ranging between 5.7 and 6.4; pH is addressed as part of this TMDL because of the mining impacts.

Iron, manganese, and aluminum concentrations at sample point HART07 are below the method detection limits; therefore, no TMDLs are necessary for metals at the point.

| Table C1. TMDL Calculations at Point HART07 | | | | |
|---|---|---|---|---|
| Flow = 1.19 MGD | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | LTA Conc. (mg/l) | Load (lbs/day) |
| Fe | ND | ND | NA | NA |
| Mn | ND | ND | NA | NA |
| Al | ND | ND | NA | NA |
| Acidity | 9.00 | 89.4 | 4.59 | 45.6 |
| Alkalinity | 7.75 | 76.9 | | |

| Table C2. Calculation of Load Reduction Necessary at Point HART07 | | | | |
|---|---|---|---|---|
| | Fe (lbs/day) | Mn (lbs/day) | Al (lbs/day) | Acidity (lbs/day) |
| Existing Load | ND | ND | ND | 89.4 |
| Allowable Load | NA | NA | NA | 45.6 |
| Load Reduction | 0.0 | 0.0 | 0.0 | 43.8 |
| % Reduction Segment | 0 | 0 | 0 | 49 |

***TMDL Calculations - Sample Point HART08, Mouth of Unnamed Tributary 26654***

The TMDL for sample point HART08 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point HART08. The average flow of 0.16 MGD, measured at point HART08, is used for these computations.

This segment is contained on the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report for metals impairments from AMD. There is currently no listing for pH for this segment. Sample data at point HART08 shows pH ranging between 5.5 and 6.6; pH is addressed as part of this TMDL because of the mining impacts. Iron and aluminum concentrations at sample point HART08 are below the method detection limits, denoted by ND and the measured manganese load is equal to the allowable load. Because WQS are met, no TMDLs are necessary for metals at the point; however, the measured manganese load is considered at the next downstream point (HART03).

| Table C3. TMDL Calculations at Point HART08 | | | | |
|---|---|---|---|---|
| Flow = 0.16 MGD | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | LTA Conc. (mg/l) | Load (lbs/day) |
| Fe | ND | ND | NA | NA |
| Mn | 0.06 | 0.1 | 0.06 | 0.1 |
| Al | ND | ND | NA | NA |
| Acidity | 4.50 | 6.1 | 1.67 | 2.3 |
| Alkalinity | 9.20 | 12.5 | | |

| Table C4. Calculation of Load Reduction Necessary at Point HART08 | | | | |
|---|---|---|---|---|
| | Fe (lbs/day) | Mn (lbs/day) | Al (lbs/day) | Acidity (lbs/day) |
| Existing Load | ND | 0.1 | ND | 6.1 |
| Allowable Load | NA | 0.1 | NA | 2.3 |
| Load Reduction | 0.0 | 0.0 | 0.0 | 3.8 |
| % Reduction Segment | 0 | 0 | 0 | 63 |

***TMDL Calculations - Sampling Point HART03, Hartshorn Run upstream of Unnamed Tributary 26653***

The TMDL for sampling point HART03 consists of a load allocation of the area between sample points HART07, HART08, and HART03. The load allocation for this stream segment was computed using water-quality sample data collected at point HART03. The average flow of 1.74 MGD, measured at the point, is used for these computations.

There is currently an entry for this segment on the PA Section 303(d) list for impairments due to metals and pH. This segment appeared on the list in 1996. Sample data at point HART03 shows pH ranging between 6.1 and 6.6; however, pH is addressed as part of this TMDL because of the mining impacts.

Iron, manganese, and aluminum concentrations at sample point HART03 are below the method detection limits, denoted by ND. Because WQS are met, TMDLs for metals are not necessary at HART03.

| Table C5. TMDL Calculations at Point HART03 | | | | |
|---|---|---|---|---|
| Flow = 1.74 MGD | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | LTA Conc. (mg/l) | Load (lbs/day) |
| Fe | ND | ND | NA | NA |
| Mn | ND | ND | NA | NA |
| Al | ND | ND | NA | NA |
| Acidity | 5.35 | 77.5 | 2.51 | 36.4 |
| Alkalinity | 8.90 | 128.9 | | |

The calculated load reductions for all the loads that enter point HART03 must be accounted for in the calculated reductions at sample point HART03 shown is Table C6. Because all metals concentrations are below the method detection limits, it is not necessary to consider the upstream metals loads entering the segment. A comparison of measured acidity loads between points HART07, HART08, and HART03 shows that there is a loss of load. To determine the total segment load, the percent decrease in existing loads between HART07, HART08, and HART03 is applied to the upstream loads entering the segment. For acidity the allowable load at HART03 is less than the upstream loads entering the segment, which results in a load reduction for the segment. It is assumed that this is a result of variability and once allocations at upstream points are met, the TMDL at HART03 will also be met.

**Table C6. Allocations at Point HART03**

| | Fe (lbs/day) | Mn (lbs/day) | Al (lbs/day) | Acidity (lbs/day) |
|---|---|---|---|---|
| Existing Load | ND | ND | ND | 77.5 |
| Difference in Existing Load between HART07, HART08, & HART03 | - | - | - | -18.0 |
| Load tracked from HART08 and HART07 | - | - | - | 47.8 |
| Percent load lost due to instream mechanism | - | - | - | 19 |
| Percent of loads tracked through segment | - | - | - | 81 |
| Total Load tracked between points HART07, HART08 & HART03 | - | - | - | 38.8 |
| Allowable Load at HART03 | NA | NA | NA | 36.4 |
| Load Reduction at HART03 | 0.0 | 0.0 | 0.0 | 2.4 |
| % Reduction required at HART03 | 0 | 0 | 0 | 6 |

***TMDL Calculations - Sample Point HART05, Unnamed Tributary 26653 below reservoir***

The TMDL for sample point HART05 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point HART05. The average flow of 0.46 MGD, measured at point HART05, is used for these computations.

This segment is contained on the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report for metals impairments from AMD. Sample data at point HART05 shows pH ranging between 6.4 and 7.1; however, pH is addressed as part of this TMDL because of the mining impacts. Metals concentrations at sample point HART05 are near or below the method detection limits. Because WQS are met, no TMDLs are necessary for metals at the point. Measured iron and manganese loads are considered at the next downstream point, HART04

| Table C7. TMDL Calculations at Point HART05 | | | | |
|---|---|---|---|---|
| Flow = 0.46 MGD | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | LTA Conc. (mg/l) | Load (lbs/day) |
| Fe | 0.55 | 2.1 | 0.55 | 2.1 |
| Mn | 0.12 | 0.5 | 0.12 | 0.5 |
| Al | ND | ND | NA | NA |
| Acidity | 2.50 | 9.6 | 2.00 | 7.7 |
| Alkalinity | 17.10 | 65.6 | | |

| Table C8. Calculation of Load Reduction Necessary at Point HART05 | | | | |
|---|---|---|---|---|
| | Fe (lbs/day) | Mn (lbs/day) | Al (lbs/day) | Acidity (lbs/day) |
| Existing Load | 2.1 | 0.5 | ND | 9.6 |
| Allowable Load | 2.1 | 0.5 | NA | 7.7 |
| Load Reduction | 0.0 | 0.0 | 0.0 | 1.9 |
| % Reduction Segment | 0 | 0 | 0 | 20 |

***TMDL Calculations - Sampling Point HART04, Mouth of Unnamed Tributary 26653***

The TMDL for sampling point HART04 consists of a load allocation of the area between sample points HART05 and HART04. The load allocation for this stream segment was computed using water-quality sample data collected at point HART04. The average flow of 1.37 MGD, measured at the point, is used for these computations.

This segment is contained on the 2004 Pennsylvania Integrated Water Quality Monitoring and Assessment Report for metals impairments from AMD. Sample data at point HART04 shows pH ranging between 3.9 and 4.6; pH is addressed as part of this TMDL because of the mining impacts.

The measured iron load at HART04 is equal to the allowable load. A TMDL for iron at HART04 is not necessary because the WQS is met.

| Table C9. TMDL Calculations at Point HART04 | | | | |
|---|---|---|---|---|
| Flow = 1.37 MGD | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | LTA Conc. (mg/l) | Load (lbs/day) |
| Fe | 0.61 | 6.9 | 0.61 | 6.9 |
| Mn | 1.10 | 12.6 | 0.14 | 1.6 |
| Al | 4.20 | 48.0 | 0.13 | 1.4 |
| Acidity | 77.10 | 882.9 | 0.77 | 8.8 |
| Alkalinity | 3.65 | 41.8 | | |

The calculated load reductions for all the loads that enter point HART04 must be accounted for in the calculated reductions at sample point HART04 shown is Table C10. A comparison of measured loads between points HART04 and HART05 shows that there is additional loading entering the segment for all parameters. The total segment load is the sum of the upstream allocated loads and any additional loading within the segment.

| Table C10. Allocations at Point HART04 | | | | |
|---|---|---|---|---|
| | Fe (lbs/day) | Mn (lbs/day) | Al (lbs/day) | Acidity (lbs/day) |
| Existing Load | 6.9 | 12.6 | 48.0 | 882.9 |
| Difference in Existing Load between HART04 & HART05 | 4.8 | 12.1 | 48.0 | 873.3 |
| Load tracked from HART05 | 2.1 | 0.5 | ND | 7.7 |
| Total Load tracked between points HART04 & HART05 | 6.9 | 12.6 | 48.0 | 881.0 |
| Allowable Load at HART04 | 6.9 | 1.6 | 1.4 | 8.8 |
| Load Reduction at HART04 | 0.0 | 11.0 | 46.6 | 872.2 |
| % Reduction required at HART04 | 0 | 87 | 97 | 99 |

### *TMDL Calculations - Sampling Point HART01, Mouth of Hartshorn Run*

The TMDL for sampling point HART01 consists of a load allocation of the area between sample points HART01, HART03, and HART04. The load allocation for this stream segment was computed using water-quality sample data collected at point HART01. The average flow of 3.15 MGD, measured at the point, is used for these computations.

There is currently an entry for this segment on the PA Section 303(d) list for impairments due to metals and pH. Sample data at point HART01 shows pH ranging between 5.5 and 5.8; pH is addressed as part of this TMDL because of the mining impacts. Iron and aluminum concentrations are below the method detection limits, denoted by ND, and the measured manganese load is equal to the allowable load. Because WQS are met, no TMDLs are necessary for metals at the point.

| Table C11. TMDL Calculations at Point HART01 | | | | |
|---|---|---|---|---|
| Flow = 3.15 MGD | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | LTA Conc. (mg/l) | Load (lbs/day) |
| Fe | ND | ND | NA | NA |
| Mn | 0.28 | 7.3 | 0.28 | 7.3 |
| Al | ND | ND | NA | NA |
| Acidity | 29.90 | 785.1 | 3.29 | 86.4 |
| Alkalinity | 7.85 | 206.1 | | |

The calculated load reductions for all the loads that enter point HART01 must be accounted for in the calculated reductions at sample point HART01 shown is Table C12. Because all iron and aluminum concentrations at HART01 are below the method detection limits, it is not necessary to consider the upstream metals loads entering the segment. A comparison of measured manganese and acidity loads between points HART03, HART04, and HART01 shows that there is a loss of manganese and acidity load. To determine the total segment load, the percent decrease in existing loads between HART03, HART04, and HART01 is applied to the upstream loads entering the segment. No additional reductions are necessary at HART01.

| Table C12. Allocations at Point HART01 | | | | |
|---|---|---|---|---|
| | Fe (lbs/day) | Mn (lbs/day) | Al (lbs/day) | Acidity (lbs/day) |
| Existing Load | ND | 7.3 | ND | 785.1 |
| Difference in Existing Load between HART01, HART03 & HART04 | - | -5.3 | - | -175.2 |
| Load tracked from HART03 & HART04 | - | 1.6 | - | 45.2 |
| Percent loss due to instream process | - | 42 | - | 18 |
| Percent of loads tracked through segment | - | 58 | - | 82 |
| Total Load tracked between points HART01, HART03 & HART04 | - | 0.9 | - | 37.0 |
| Allowable Load at HART01 | NA | 7.3 | NA | 86.4 |
| Load Reduction at HART01 | 0.0 | 0.0 | 0.0 | 0.0 |
| % Reduction required at HART01 | 0 | 0 | 0 | 0 |

### *Margin of Safety*

For this study the margin of safety is applied implicitly. A MOS is implicit because the allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. Other margins of safety used for this TMDL analysis include the following:

- 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.
- An additional MOS is provided because the calculations were done with a daily Fe 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 D

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

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

In the 1996 Section 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 Section 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 Section 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 E
## Water Quality Data Used In TMDL Calculations

| | Date | pH Lab | Alkalinity mg/l | Acidity mg/l | Iron mg/l | Manganese mg/l | Aluminum mg/l | Flow gpm | Sulfate mg/l |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| **HART01** | 9/9/2002 | 5.6 | 8.4 | 15.40 | <0.3 | 0.29 | <0.5 | 60 | 142.6 |
| | 11/4/2002 | 5.8 | 8.6 | 43.60 | <0.3 | 0.32 | <0.5 | 2305 | 35.8 |
| Latitude: | 3/12/2003 | 5.6 | 6.6 | 35.00 | <0.3 | 0.22 | <0.5 | 4995 | 31.7 |
| 40-58-40 | 4/28/2003 | 5.5 | 7.8 | 25.60 | <0.3 | 0.30 | <0.5 | 1386 | 46.3 |
| Longitude: | Average | 5.63 | 7.85 | 29.90 | ND | 0.28 | ND | 2186.50 | 64.10 |
| 78-29-54 | St Dev | 0.13 | 0.90 | 12.14 | NA | 0.04 | NA | 2086.83 | 52.69 |
| | | | | | | | | | |
| **HART03** | 9/9/2002 | 6.2 | 10.6 | 7.8 | <0.3 | <0.050 | <0.5 | 35 | <20.0 |
| | 11/4/2002 | 6.6 | 9.6 | 0.00 | <0.3 | <0.050 | <0.5 | 1113 | <20.0 |
| Latitude: | 3/12/2003 | 6.2 | 7.4 | 8.20 | <0.3 | <0.050 | <0.5 | 2844 | <20.0 |
| 40-59-44 | 4/28/2003 | 6.1 | 8.0 | 5.40 | <0.3 | <0.050 | <0.5 | 832 | <20.0 |
| Longitude: | Average | 6.28 | 8.90 | 5.35 | ND | ND | ND | 1206.00 | ND |
| 78-30-55 | St Dev | 0.22 | 1.47 | 3.77 | NA | NA | NA | 1183.61 | NA |
| | | | | | | | | | |
| **HART04** | 9/9/2002 | 3.90 | 0.00 | 137.20 | <0.3 | 3.59 | 12.00 | 2.00 | 103.20 |
| | 11/4/2002 | 4.5 | 6.0 | 71.00 | 0.65 | 0.30 | 1.68 | 798 | <20.0 |
| Latitude: | 3/12/2003 | 4.6 | 5.6 | 56.20 | 0.59 | 0.19 | 0.99 | 2742 | 31.0 |
| 40-59-40 | 4/28/2003 | 4.1 | 3.0 | 44.00 | 0.59 | 0.34 | 2.11 | 272 | 43.4 |
| Longitude: | Average | 4.28 | 3.65 | 77.10 | 0.61 | 1.10 | 4.20 | 953.50 | 59.20 |
| 78-30-59 | St Dev | 0.33 | 2.77 | 41.56 | 0.04 | 1.66 | 5.22 | 1237.30 | 38.61 |
| | | | | | | | | | |
| **HART05** | 9/5/2002 | 7.1 | 30.0 | 0.00 | 0.55 | 0.12 | <0.5 | 0.5 | <20 |
| | 11/3/2002 | 7.1 | 15.0 | 0.00 | <0.3 | <0.05 | <0.5 | 374 | <20.0 |
| Latitude: | 3/12/2003 | 6.4 | 10.4 | 10.00 | <0.3 | <0.05 | <0.5 | 715 | <20.0 |
| 41-00-13 | 4/29/2003 | 6.6 | 13.0 | 0.00 | <0.3 | <0.05 | <0.5 | 188 | <20.0 |
| Longitude: | Average | 6.80 | 17.10 | 2.50 | 0.55 | 0.12 | ND | 319.38 | ND |
| 78-31-44 | St Dev | 0.36 | 8.80 | 5.00 | NA | NA | NA | 304.65 | NA |
| | | | | | | | | | |
| **HART07** | 9/5/2002 | 6.1 | 8.4 | 11.60 | <0.3 | <0.05 | <0.5 | 24 | <20.0 |
| | 11/4/2002 | 6.4 | 9.4 | 9.80 | <0.3 | <0.05 | <0.5 | 956 | <20.0 |
| Latitude: | 3/12/2003 | 5.7 | 5.8 | 8.00 | <0.3 | <0.05 | <0.5 | 1472 | <20.0 |
| 41-00-53 | 4/29/2003 | 5.7 | 7.4 | 6.60 | <0.3 | <0.05 | <0.5 | 855 | <20.0 |
| Longitude: | Average | 5.98 | 7.75 | 9.00 | ND | ND | ND | 826.75 | ND |
| 78-31-55 | St Dev | 0.34 | 1.54 | 2.17 | NA | NA | NA | 599.52 | NA |
| | | | | | | | | | |
| **HART08** | 9/5/2002 | 6.5 | 12.8 | 0.00 | <0.3 | <0.05 | <0.5 | 2 | <20.0 |
| | 11/4/2002 | 6.6 | 10.4 | 0.00 | <0.3 | <0.05 | <0.5 | 40 | <20.0 |
| Latitude: | 3/12/2003 | 5.5 | 6.0 | 9.20 | <0.3 | 0.06 | <0.5 | 229 | <20 |
| 41-00-54 | 4/29/2003 | 5.6 | 7.6 | 8.80 | <0.3 | 0.06 | <0.5 | 183 | <20.0 |
| Longitude: | Average | 6.05 | 9.20 | 4.50 | ND | 0.06 | ND | 113.50 | ND |
| 78-31-54 | St Dev | 0.58 | 3.01 | 5.20 | NA | 0.01 | NA | 109.55 | NA |

# Attachment F

## Comment and Response

No comments were received on the Hartshorn Run Watershed Draft TMDL.