Phase II Watershed Assessment and Restoration Plan for the Upper Two Lick Creek Watershed

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Introduction

The Upper Two Lick subwatershed is located in northern Indiana County, within the Blacklick Creek and Conemaugh drainages of western Pennsylvania. The Upper Two Lick drainage presently has significant stretches of moderately to severely acid mine drainage-contaminated surface water, mainly a product of past and present coal extraction activities. The Blacklick Creek Watershed Association (BCWA), a non-profit environmental group made up of local citizens, was established in 1993 with goals of working in this region to improve water quality and educate citizens regarding land and water resources. This document is an attempt by the BCWA and its partners to assess the extent and pattern of water contamination present in the Upper Two Lick basin, and to develop a rational and cost effective restoration plan for the area that will yield improvements in the surface water quality, aquatic habitats, and quality of life for the its citizens.

Context/Watershed Description

Background

Upper Two Lick Creek, located in Clymer Borough and Cherryhill, East Mahoning, Grant, Green, and Rayne Townships in Indiana County, Pennsylvania, is one of nine management subwatersheds defined by the Pennsylvania Department of Environmental Protection (PADEP) and employed by the Blacklick Creek Watershed Association in its stewardship activities (see Appendix B – Project Maps and Figures, Figure 1). PADEP and BCWA also recognize 12 smaller subbasins within Upper Two Lick: Brown's Run, Buck Run, Dixon Run, North Branch Upper Two Lick Creek, Penn Run, Pompey Run, Repine Run, Rock Run, Sides Run, South Branch Upper Two Lick Creek, Whitaker Run, and the main stem of Upper Two Lick Creek (Appendix B - Figure 2). The Upper Two Lick subwatershed is part of HUC area 0510007, Conemaugh River, designated a Category I Watershed in the 1999/2000 Pennsylvania Unified Watershed Assessment. In 2000, several stream segments in the Upper Two Lick drainage were listed on PADEP's section 303-d list as being impaired as a result of acid mine drainage with pH and metals noted as principal contaminants. In PADEP's 2004 Integrated Monitoring and Assessment Report, many of the stream segments in the Upper Two Lick were included on List 3 (Unassessed) indicating that not enough data was available to determine whether steam segments met designated uses. Some stream segments in the Penn

Run and Two Lick (main stem) subwatersheds of the Upper Two Lick were designated as Category 5 (Pollutants) by PADEP in the 2004 report, indicating that they were impaired for one or more designated uses.

Geology and Landuse

Coal and natural gas deposits are found throughout large parts of the Upper Two Lick drainage. Coal deposits occur on average intervals of 50 feet within the 300 foot thick Allegheny Group. A combination of folded rock strata and erosional downcutting by Two Lick Creek have resulted in exposure of some coal seams in narrow stream valleys. Large amounts of underground coal mining have been undertaken in the watershed in the past, extracting coal mostly from the Lower Kittanning and Lower Freeport coal beds. Voids formed by past deep mining in many cases have filled with large volumes of groundwater which contaminates much of the subwatershed in the form of acid mine drainage. Natural gas drilling is prevalent within the subwatershed, and in some cases disturbances of subsurface materials related to drilling causes increases in acid mine drainage contamination levels, as well as sedimentation.

The Upper Two Lick Creek watershed is largely rural in character. The only urban settlement of any size in the drainage is Clymer Borough, which had a population of 1,547 in 2000. Abandoned surface (strip) mines, and coal waste piles dot the landscape, as well as previously-farmed land that has reverted to forest. Small-scale dairy farming is common, as well as a significant amount of tree farming. The state transportation routes through the subbasin are Routes 286 and 403 (Appendix B – Figure 1).

Water Quality Issues

By far the most pressing water quality issue in the Upper Two Lick Creek watershed is *acid mine drainage (AMD)*. There are at least 19 significant identifiable sources of AMD contamination in the Upper Two Lick, and many lesser sources (seeps and waste piles) that are dispersed in nature. Impacts of AMD that have been documented in the Upper Two Lick drainage include acid water (low pH), elevated metals (in particular iron and aluminum), and severely impacted aquatic ecosystems. Much of the groundwater in the subwatershed is contaminated by AMD as a result of past underground coal mining, causing water

supply problems for rural residents utilizing on-lot wells (see Appendix A – AMD Source Sampling Site Photographs and Descriptions, and Appendix B - Figure 3).

A second, much less urgent, problem in the watershed at this time is *untreated rural sewage*. Malfunctioning or non-existent on-lot sewage systems can be found throughout the Upper Two Lick basin, contributing raw sewage to the main stem and its tributaries. This problem is fairly typical in rural areas such as the subject watershed, and is far overshadowed by the AMD issues in the short term context of this plan.

Water Quality (AMD Contamination) Assessment Methodology

The methodology used to assess water quality in the Upper Two Lick Creek watershed involved identifying sources of contamination, characterizing the severity of those sources as well as the quality of upstream and downstream surface waters, and analyzing contamination patterns to develop a restoration strategy for the watershed. The specific tasks carried out were: 1) identification of problem areas 2) detailed (12 month) monitoring of contamination sources 3) prioritization of water quality problems and development of restoration plan.

Identification of Problem Areas from Existing Data

At the outset of the project, it was necessary to determine the location and nature of problem areas within the Upper Two Lick Creek drainage. This was accomplished mainly by working with conservation partners and local citizens. The Armstrong County Conservation District (ACCD) provided water quality data from their Phase I assessment of streams in Armstrong, Butler, Clarion, and Indiana Counties (funded through the Growing Greener program). The Phase I assessment provided a "snapshot" of water quality conditions and involved sampling tributaries contributing to main stem streams to determine whether specific subwatersheds were contaminated. The Phase I project funded by ACCD provided valuable coarse data to target activities for this project, as specific subwatersheds were identified as having AMD-related problems. The BCWA was also assisted by Lou Kopczyk of the Indiana County Conservation District, who personally drove areas of the watershed with project personnel to locate AMD sites. This data

was combined with historical data, such as that from the Operation Scarlift report, to develop a comprehensive survey of contamination sources impacting the Upper Two Lick Creek watershed.

Detailed Water Monitoring at Identified Contamination Sources

Based on the information collection and reconnaissance work described above, nineteen significant AMD contamination source sites were identified and located in the Upper Two Lick watershed (see Appendix A – AMD Source Sampling Site Photographs and Descriptions, and Appendix B - Figure 3). In addition, nineteen "control" sites for water quality monitoring were chosen upstream and downstream of the contamination sources, in order to gauge the impact of particular sources on water quality. There were 38 water sampling locations (including AMD origins and control sites) in the study area. The locations of these features were digitally recorded using GPS techniques, and incorporated into the geographic information system (GIS). The following procedure was used to monitor the sites and collect the data.

Water Monitoring Procedure and Chemical Analysis of Samples

Chemical testing of water is an often used method of determining water quality. With respect to Acid Mine Drainage contamination in particular, there are five chemical parameters that are normally used to gauge water quality: 1) acidity (pH) 2) aluminum 3) iron 4) manganese 5) sulfates. Water chemistry results are generally reported in two ways: 1) in terms of the concentration of a substance in water, which is often recorded in milligrams per liter (mg/L); and 2) in terms of the loading of a substance, or the total amount contributed to a water body or watershed over a particular time period, which in many cases is recorded in pounds per day (lbs./day)[1]. For the purposes of analyzing AMD contamination patterns and remediation, both methods of reporting are useful as they provide a total description of water quality and contamination contribution for sampling locations. In terms of evaluating remediation that may be required, and prioritizing locations for AMD remediation, loading data becomes of primary importance in that total amount of contamination can be gauged. Data on chemical parameters was gathered for AMD

[1] The calculation of the loading contribution of any particular substance from a sampling location would be a product of the concentration of that substance in water, and the amount of the flow of water from that location.

contamination origins and discharge locations in the study area (see Appendices C – Summary Statistics of AMD-related Chemical Parameters by Source Location; D - Summary Statistics of AMD-related Chemical Loadings by Source Location; E – AMD Loading Data by Source Location, and F – Chemical Concentrations by Source Location).

Acidity

pH is an important factor in determining the health of aquatic ecosystems. A key impact of AMD in many cases is to lower water pH, creating acid conditions. Most aquatic organisms have a defined range of pH tolerance within which they can survive. If pH falls below an organism's tolerance range, a disturbance in the balance of sodium and chloride ions in the blood will occur, causing death as a result of respiratory or osmoregulatory failure (Earle and Callaghan 1999; Kimmel 1983). For this study, a pH reading of below 6 was considered indicative of significant acid contamination based on water quality guidelines adapted from Chapter 93 Water Quality Standards of the Pennsylvania Code (PA DEP 1997) (Table 1).

Acid contamination was found to be prevalent throughout the study area. Fourteen of the nineteen AMD source sampling locations that field water samples were gathered for had average pH values less than 6 (outside of Pennsylvania drinking water standards) Appendices C – Summary Statistics of AMD-related Chemical Parameters by Source Location; D - Summary Statistics of AMD-related Chemical Loadings by Source Location; E – AMD Loading Data by Source Location, and F – Chemical Concentrations by Source Location). In fact, 13 of the14 sampling locations had average pH values for the 12 month sampling period of 4 or below. In terms of the loading of acidity (or the amount of acid being contributed to the watershed at particular locations), some very identifiable geographic patterns were evident. Sampling locations 1 (Waste pile below Clymer, 6133.64 lbs.), 4 (Buck Run, 2391.72 lbs.), and 7 (no name, 748.88 lbs.) were found to contribute very large amounts of acidity to the study watershed. Locations 6, 9, 12, and 14 (no names) were found to have contributed over 300 pounds of acid daily (Appendix B, Figure 4). These results indicate that some very acid water conditions exist in the study area, and based on information in the literature these conditions very likely are impacting aquatic ecosystems.

Table 1: Pennsylvania Guidelines for AMD-related Substances in Water

Chemical Criteria	Acceptable Values
pH	6.0-9.0
Total Iron	Maximum 1.5 mg/l
Total Aluminum	If pH is > 6.0, Al levels > 0.7 mg/l are unacceptable If pH is < 6.0, AL levels >0.6 mg/l are unacceptable
Total Manganese	Maximum 1.0 mg/L
Sulfates	Maximum 250 mg/L

Aluminum

Under pristine conditions, aluminum rarely occurs in water naturally at concentrations of greater than a few tenths of a milligram per liter. In combination with low pH, aluminum can have severe adverse effects on stream aquatic life. Aluminum ions compound the effect of low pH by interacting with hydrogen ions, decreasing sodium uptake and increasing sodium loss in blood and tissues. Research results reported by Earle and Callahan (1999) indicate that a combination of a pH of less than 5.5 and dissolved aluminum concentrations greater than 0.5 mg/L will generally eliminate all fish and most macroinvertebrates. Precipitated aluminum is also problematic, as it coats stream substrate ruining macroinvertebrate habitat, accumulates on fish gills interfering with breathing, and under some conditions can be directly toxic to macroinvertebrates and fish (Brown and Sadler 1989).

Eighteen of the nineteen contamination source sampling locations for which data was collected (location 16 was the exception) in the study area exceeded state water quality limits for aluminum content. It is clear that aluminum contamination is a serious problem throughout the study area. Particularly high concentrations of aluminum (over 50 times higher than the state parameters at a pH of above 6) were found at 4 AMD origin and tributary sampling locations in the Upper Two Lick Creek basin (locations 1, 2, 4 and 5). The largest aluminum loading contributors in the study area (over 200 pounds per day) were the waste pile area below Clymer (location #1, 738.56 lbs./day) and the Buck Run source (location #4, 270.74 lbs./day). The combination of high aluminum concentrations and high flow at these locations makes them

the largest total contributors of aluminum in the study watershed. Very significant aluminum contributions (over 30 pounds per day) were also documented at sites 7, 9, 14, and 16 (Appendix B – Figure 5, Appendices C ,D, E, and F).

Iron

Iron is commonly present in acid mine drainage, and can have detrimental effects on steam ecosystems and aquatic organisms. Although dissolved iron is not generally considered as toxic as aluminum in solution, severe impacts have been documented in water with pH lower than 3.5 (Letterman and Mitsch 1978; Wiederholm 1984). Iron precipitate from acid mine drainage may result in complete coverage or armoring of a stream bottom (regionally called "yellow boy"), adversely affecting both macroinvertebrates and fish. The severity of impacts from iron armoring in general are linked to the acidity of water – the lower the pH, the more severe the impact of iron (Earle and Callahan 1999; Hoehn and Sizemore 1977).

Iron was also present in average concentrations over the sampling period exceeding state parameters at a vast majority (17 out of 19) of the AMD contamination source sampling locations distributed throughout the study area. Only two sampling locations (16 and 17) did not yield values indicating significant iron contamination. One location that contributed a very large amount of iron (942 lbs./day) was noted – the waste pile area below Clymer (Sample ID 1). Other locations contributing over 100 pounds of iron per day were sampling locations 4, 7, and 16 (Appendix B - Figure 6, Appendices C ,D, E, and F).

Manganese

Manganese is another heavy metal contaminant that is often associated with acid mine drainage. Manganese is persistent and can be carried be carried downstream long distances from a source of acid mine drainage, because it is usually difficult to remove from contaminated water as the pH must be raised to above 10 before the metal will precipitate out. The specific impacts of manganese itself on aquatic life are not clear, as it tends to be associated with other metals that have a more pronounced impact (see above) or which may mask the effects of manganese. Research that has been done indicates that manganese tolerance of various fish species varies widely, and that the toxicity of dissolved manganese is lowest in water with low levels of hardness (Earle and Callahan 1999).

Nine of the nineteen AMD source sampling locations had 12-month averages that exceeded the state contamination level of 1.0 mg/L for manganese concentration in water (locations 1, 2, 4, 5, 6, 7, 11, 12, 13). Particularly high concentration levels of manganese (more than 5 times the state level) were recorded at three locations – 1, 4, and 5 (Appendix C) . In terms of manganese contribution to the study watershed, the largest single manganese loading location by far was number 16 at over 75 pounds per day, found at the upper end of the main stem Two Lick Creek subwatershed. The other large contributor of manganese in the study area was sampling location number 1, with an average loading of over 36 pounds per day (Appendix B - Figure 7).

Sulfates

Sulfate contamination patterns again indicate the presence of AMD-associated sulfate contamination throughout the watershed, as 13 of the 19 sampling locations exceeded the state water quality standard of 250 mg/L. Sites with an average of over 1000 mg/L were documented at locations 1 and 5, with locations 2, 4, and 8 having average concentrations of over 500 mg/L of sulfates (Appendix C). In terms of sulfate loading, the two highest contributors are number 1 (8260.46 lbs./day) and number 16 (6210.52 lbs./day), with locations 4, 6, 7, 12, 14, and 18 contributing over 1000 lbs./day each (Appendix B – Figure 8, Appendix D).

Assessment and Prioritization of Water Quality Problems

Once water quality data had been collected for a twelve month period, and entered into a GIS, it was possible to assess contamination sources and analyze patterns of water contamination within the Upper Two Lick Watershed.

Overall Water Chemistry Analysis

In order to evaluate the overall level and geographic pattern of chemical contamination in the study area, two indices were developed based on the loading contribution amount of acidity, aluminum, iron, manganese, and sulfate at each of the AMD contamination source locations. To develop the first index, for each AMD contaminant type a rank of 1 to 16 was assigned to the sampling sites for which loadings could be calculated, with 16 being assigned to the location with the highest amount of loading

contribution of each substance and 1 assigned to the location with the lowest amount contributed. The rank for the loading of each of the five contaminants was then added up to obtain one total index score of chemical contamination for each of the 19 sampling locations. The results of the chemical contamination index calculations and ranking are shown in Table 2 – Chemical Contamination Indices for AMD Source Sampling Locations.

The top 3 ranked sites using the chemistry index method described above with index scores of over 70 are: Site Number 1 (the waste pile below Clymer), ranked as the worst single chemical contamination location, followed by Site Number 16, located at the upper end of the main stem Upper Two Lick Creek drainage ranked 2, and the Buck Run source location (Site Number 4) ranked 3. Each of these locations contributes large amounts of all of the AMD-related chemical substances to the study watershed. Other locations that were ranked highly based on the above approach include Site Number 7 below Number 16 on the Upper Two Lick main stem ranked 4, Site Numbers 9 and 12 which ranked 5 and 6 respectively, found in the North Branch Two Lick Creek subbasin.

The geographic distribution of the sampling locations discussed above is shown in Appendix B - Figures 9 and Figure 10. Site Number 1 is the most "downstream" sampling site in the study area to the southwest of Clymer borough, along the main stem of Upper Two Lick Creek. Although this AMD source is the largest absolute contributor of AMD contaminants in the study area, its downstream location may mean that it will make sense to address significant problems upstream. Site Number 4 is located along Buck Run, slightly less than a mile upstream from its confluence with the main stem of Upper Two Lick. Addressing this source would obviously have a direct positive impact on the areas of Buck Run downstream, with probably negligible impacts on the main stem of Upper Two Lick Creek. Site Number 16 is located in the upper portion of the main stem Upper Two Lick subbasin, almost 7 (linear stream) miles upstream of Site Number 1.

Table 2 - Water Chemistry Index Scores and Ranks by Sampling Location

LOCATION	ACIDITY RANK	IRON	MANGANESE	ALUMINUM	SULFATES	INDEX TOTAL	OVERALL RANK
1	16	16	15	16	16	79	1
16	14	14	16	14	15	73	2
4	15	15	13	15	14	72	3
7	13	13	11	13	13	63	4
9	12	8	10	11	12	53	5
12	10	10	12	8	11	51	6
6	9	6	14	10	9	48	7
14	11	2	8	12	10	43	8
13	6	12	9	3	6	36	9
5	8	11	3	9	3	34	10
11	7	4	6	7	5	29	11
18	2	5	7	5	7	26	12
17	3	7	5	2	8	25	13
2	5	9	2	6	2	24	14
3	4	3	4	4	4	19	15
10	1	1	1	1	1	5	16

Upper Two Lick Watershed: AMD Problem Assessment

In PADEP BAMR's AMD comprehensive plan document, many different types of problems relating to abandoned mine lands are discussed. For the Upper Two Lick watershed plan, the most prevalent aspect of AMD impact is *water pollution*. BAMR describes water pollution problems as those relating to streams that do not meet state water quality standards, with impact on streams the key impact to be considered (PADEP 1998, C-1). BAMR's suggested characterization of AMD-related water quality problems is based on 2 parameters: 1) distance of stream impacted by water pollution from any discharge or source; and 2) the percentage of stream pollution load contributed from any discharge or source. Combinations of these two parameters are used to characterize AMD water pollution problems from better to worse as *Moderate*, *Serious*, *Very Serious*, and *Critical* (PADEP 1998, C-3).

In order to be able to characterize AMD contamination locations using the above classification scheme, data about stream distance impacted had to be derived. As described above, the locations of all of the significant AMD discharges in the study watershed were determined. Those locations, in combination with spatial data about drainage in the watershed allowed for the calculation of stream distance between each contamination location.

To perform stream distance calculation, the steam system in the watershed was used to determine linear distance between locations where AMD contamination was entering the network. The primary piece

of data needed was the distance of stream downstream of any AMD discharge/source (each length of downstream distance ended at the location where the next source of contamination entered the stream). The stream distance data allows a comparison of AMD contamination locations in terms of the amount of stream impacted. The Network Analyst extension of the ArcView 3.3 GIS software package was used to calculate stream distance between each AMD discharge location. The GIS could calculate the distance between any contamination discharge/origin and the next downstream contamination location by using a data model called dynamic segmentation. Dynamic segmentation allows for the "re-segmentation' of a network based on user specification, or based on the location of "events." For this analysis, the locations of AMD contamination discharges and origins were events, and the GIS measured the distance of the stream segments between them (Appendix B – Figure 11). Once this distance was calculated, it was stored as a piece of data associated with each AMD contamination discharge (Table 3 – Downstream Distances from AMD Contamination Sources).

Table 3 – Downstream Distances from Contamination Sources

ID	DOWNSTREAM DISTANCE (meters)	DOWNSTREAM DISTANCE (miles)	DOWNSTREAM PT.
2	3232.57	2.01	1
3,4	2789.4	1.73	2
5	426.16	0.26	6
6	986.11	0.61	3,4
7	1208.285	0.75	5
8	2328.86	1.45	7
9	1624.97	1.01	16
10	395.69	0.25	9
11	152.76	0.09	10
12	1296.21	0.81	18
13	896.16	0.56	12
14	1152.49	0.72	13
15,19	370.78	0.23	14
16	2496.33	1.55	8
17	1137.42	0.71	15,19
18	504.38	0.31	11
1	3005.35	1.87	boundary

The percentage of pollution load being contributed to a stream by any discharge was calculated as a product of the loading of acidity, aluminum, iron, manganese, and sulfates recorded at any discharge location divided by the loading of those contaminants in the stream at a location directly upstream. The combination of stream distance data and AMD contaminant loading percentage derived by the GIS allowed a characterization of the water pollution problem caused by contamination at AMD discharge site. The criteria used by Pennsylvania Bureau of Abandoned Mine Reclamation (BAMR) to classify AMD discharge sites based on the level of water pollution problems they create are shown in Table 4 - BAMR AMD Water Pollution Problem Classifications.

Table 4 – BAMR AMD Water Pollution Problem Classifications

Moderate	**Discharge pollutes < 1.0 miles of stream and contributes < 25% of the pollution load to the stream.**
Serious	**Discharge pollutes > 1.0 miles of stream and contributes > 25% of the pollution load to the stream.**
Very Serious	**Discharge pollutes > 1.5 miles of stream and contributes > 50% of the pollution load to the stream.**
Critical	**Discharge pollutes > 3.0 miles of stream and contributes > 75% of the pollution load to the stream.**

With the data on stream distance and percent of contamination loading available, it was possible to query for the AMD discharges that met BAMR problem criteria. In terms of the AMD water pollution classification, 12 discharges were classified as *moderate* water pollution sources, 3 as *serious* sources, and 3 as *very serious/critical*. The very serious/critical class is an amalgam of the *very serious* and *critical* BAMR classifications, as these discharges met the distance criteria for the very serious category and the percent loading criteria for the critical category (Table 5 – BAMR Problem Classification by Sampling Location).

The geographic distribution AMD discharge locations by problem classification is shown in Appendix B - Figure 12. There are three areas in the study watershed where *very serious/critical* AMD discharges are found: 1) Site Number 1 (the waste pile below Clymer); 2) Site Number 4; and 3) Site Number 16. Sites 1 and 16 are both located in the main stem drainage, at the downstream and upstream

portions, respectively. Site Number is found along Buck Run, a tributary that enters the Upper Two Lick just north of Clymer. Sites that were classified as *Serious* included numbers 3, 12, 13, and 14. Sites 12-14 are each located in the North Branch Two Lick Creek subbasin, with sites 12 and 13 very near the North Branch itself, and site 14 approximately a quarter of a mile upstream on an unnamed tributary. Site Number 3 is located in Buck Run subbasin, less than 300 meters east of Site 4 on the opposite side of the stream.

Table 5 – BAMR Problem Classification by Sampling Location

ID	NAME	DOWNSTREAM DIST. (miles)	CONTAMINANT(S)	PROBLEM	SUBBASIN
1	Waste below Clymer	1.37	Acidity, Iron	very ser./critical	Main Stem
4		1.73	All	very ser./critical	Buck Run
16		1.55	All	very ser./critical	Main Stem
3		1.73	Acidity	serious	Buck Run
12		0.82	Acidity, Manganese	serious	North Branch
13		0.56	Iron	serious	North Branch
14		0.72	Acidity, Alum., Sulf.	serious	North Branch
2		2.01	No Major Contribution	moderate	Dixon Run
5		0.26	No Major Contribution	moderate	Main Stem
6		0.61	No Major Contribution	moderate	Main Stem
7		0.75	Acidity	moderate	Main Stem
8		1.45	Could Not Determine	moderate	Main Stem
9		1.01	Could Not Determine	moderate	North Branch
10		0.25	No Major Contribution	moderate	North Branch
11		0.09	Acidity	moderate	North Branch
15		0.23	Could Not Determine	moderate	North Branch
17		0.71	Could Not Determine	moderate	North Branch
18		0.31	Could Not Determine	moderate	North Branch
19		0.23	Could Not Determine	moderate	North Branch

Development of Watershed Restoration Plan and Remediation Strategy for the Upper Two Lick Creek Watershed

Based on the results and analysis discussed above, AMD problem sources were prioritized for remediation. The approach in developing a remediation plan for the watershed was to address the most significant water quality problems within subbasins as units. The results of the reconnaissance and sampling phases of this project indicate that the subbasins of the Upper Two Lick Creek drainage that

contain the vast majority of AMD contamination sources are: 1) North Branch Upper Two Lick Creek 2) Buck Run 3) Dixon Run, and 4) Main Stem Upper Two Lick Creek.

North Branch Upper Two Lick Creek

The North Branch subbasin contains 10 identified AMD contamination sources, 3 of which (Locations 12, 13, and 14) have been determined to be Serious AMD-related problems based on PADEP BAMR criteria. This is significant, as the North Branch is a headwaters subbasin for Upper Two Lick Creek, meaning that any remediation accomplished should theoretically improve conditions downstream.

Buck Run

Two AMD contamination sources are located within the Buck Run drainage. These two sources are significant, with Site Number 4 classified as Very Serious/Critical and Site Number 3 classified as Serious based on BAMR parameters. Certainly addressing these two sources would have definite positive impacts on the approximately 1 mile of stream downstream of where they enter Buck Run. However, when viewed in the entire watershed context, Buck Run flows into Upper Two Lick Creek at a fairly downstream location, and it might make sense to address this area later than impacted areas at more upstream locations.

Dixon Run

The Dixon Run subbasin contains one (comparatively) minor AMD source, and is located at a fairly downstream location in the Upper Two Lick Creek watershed. Dixon Run, although impacted by AMD downstream of Site Number 2, likely will not be a priority during the early phases of remediation planning in the watershed.

Main Stem Upper Two Lick Creek

There are six AMD contamination sources located within the Main Stem subbasin. Of these, two sites (1 and 16) are classified as Very Serious/Critical problems and are ranked as the first and second most significant AMD contribution sources in the study area, respectively, based on the contribution of AMD-related chemicals. It is very likely that Site 16 would be addressed, if feasible, before Site 1 as Site 16 is approximately seven miles upstream.

Based on the data collected and analysis conducted for this project, the following remediation prioritization is recommended.

Phase I

It is recommended that the first areas to be targeted for remediation in the Upper Two Lick Watershed are Sites 14, 13, and 12 (in that order) located in the North Branch subbasin. These areas are at upstream locations in the watershed and they contribute significant amounts of AMD-related contaminants. Remediating these sources should have positive cumulative impacts on approximately 2.5 miles of the North Branch Upper Two Lick Creek downstream. If length of stream upstream of Site 14 is included (the areas upstream do not seem to be heavily impacted by AMD), a continuous corridor of better quality water along approximately 3.4 miles of stream will be created by remediating Sites 14, 13, and 12. Each of these sourses are small tributaries that originate in abandoned deep and/or strip mines. Site 14 will likely require an alkaline producing system, however, land is not available in the immediate vicinity to construct such a system. A potential solution would be to pipe contaminated water downslope to a larger site, however, this possibility will have to be investigated with landowners. Site 13 presently flows into an small existing wetland that is overwhelmed by the contaminated inflow. Although there does not appear to be enough space to treat the AMD at this site, it may be possible to more effectively remediate this water by piping the outflow from the existing wetlands downslope to a series of constructed wetlands. Again, the feasibility of this treatment option is dependent on landowner cooperation. As site 12 is a very narrow flow, and little proximate land exists for a passive alkalinity producing system, this source may be amenable to in-stream alkaline-based treatment.

Once these sites 14, 13 and 12 are addressed, Site Number 9 will be the next target of remediation. Site 9 is a small tributary that originates in old abandoned country banks and strip workings where significant amounts of acid, aluminum, and sulfates flow into the North Branch. Although only classified as a Moderate AMD-related problem based on BAMR criteria, site 9 is the next significant source of AMD downstream of sites 14, 13 and 12, and should be addressed as part of a comprehensive remediation strategy. There is possibly some room for the construction of an alkaline producing system on the right side of road near site 9 to address the contamination problem. .If Sites 14, 13, and 12 are remediated, followed by Site 9, approximately 4.25 stream miles of the North Branch should be positively impacted.

Phase II

Once the significant sources on the North Branch are addressed, Site 16 found at an upstream location on the Main Stem Upper Two Lick Creek should be targeted. Site 16 is a major AMD contamination source, contributing thousands of pounds per day of acid and sulfates into Upper Two Lick Creek. It is hard to gauge the positive impact that remediating this site might have, as the large flow of water in Two Lick Creek dilutes its chemical impact downstream. However, this source is too large of an AMD contributor to ignore and it would be remiss not to address this site as we work to improve water quality in the watershed in an upstream-to-downstream manner. If Site 16 is remediated, approximately 1.55 miles of the Upper Two Lick Creek downstream should be positively impacted.

Phase II will also include the treatment of sites 7, 5, and 6 (in that order) on the main stem of Upper Two Lick Creek. Each of these sites have been classified as moderate problems based on the assessment methodology and BAMR criteria, however, they are significant contributors of AMD-related contaminants. Site 7 is a discharge from the abandoned Egypt deep mine, that has been treated in the past by the Richards project alkaline producing system. The Richards systems has experienced periodic malfunctions, allowing large volumes of highly acidic water to flow directly into the main stem of Two Lick Creek. Site 5 originates in an abandoned clay mine high on the slopes above Route 403, and its outflow contains large loads of acidity, iron, and aluminum. This site will require an alkaline producing treatment system, and it appears that sufficient area to build such systems is available in the vicinity of the contamination origin. Site 6, a spring impacted by the disturbed area of an abandoned strip mine, is not as significant as sites 7 and 5. This site will require minimal treatment, and perhaps none once the remediation of sites 7 and 5 are assessed.

Phase III

Phase III of a watershed-wide approach to remediation would address the remaining significant sources of AMD at farther downstream locations. Based on this assessment, Sites 4 and 1 (in that order) would be the targets of tertiary mitigation efforts. Site 4 is a tributary to Buck Run that discharges from an area that has seen both previous deep and strip mining. This source has both high AMD chemical concentrations and high flows, making it a very significant contributor of AMD contamination. Loadings of contaminants are too high to be treated on the site as is, however, since remediation will not be until years

into the future based on this plan, there is time to work with local landowners to explore options. Site number 1 at Sample Run in the Buck Run ranked as the largest and most serious AMD contamination source in the Upper Two Lick Creek drainage. It's mitigation will be delayed until phase 3 only because of its downstream location relative to other problem areas. The sources of AMD contributing to Sample Run are diffuse, and will require further study to characterize in necessary detail to design treatment systems. An alkalinity producing treatment system with very high loading capabilities will be required. Adjacent land is available in the area for the construction of treatment systems.

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Appendix A – AMD Source Sampling Site

Photographs and Descriptions

1. **Sample Run** - Since the sources of AMD on this stream are diffuse and scattered, further detailed study will be necessary to fulfill treatment design needs. The contaminants in this stream indicate the usage of alkalinity producing treatment systems with high loading capabilities. Sufficient area for system location is available nearby.

2. **Un-named trib/Dixon Run** - This un-named tributary to Dixon Run discharges from an old abandoned deep mine and in wet weather flows significantly. Previously opened and captured by DEP/BAMR, this discharge could be treated by a small alkalinity producing system located across the railroad in the Dixon Run flood plain area.

3. **Un-named trib/Buck Run** - This un-named tributary to Buck Run discharges from an abandoned deep mine complex and carries sufficient acidity and metals to require Alkalinity producing system for treatment. Available area will depend upon land-owner cooperation.

4. **Un-named trib/Buck Run** - This un-named tributary to Buck Run discharges from a combined abandoned deep and surface mine area. Treatable flows may be of volume/loading too high for available treatment.

5. **Un-named trib to Two Lick/Clay mine -** This trib to Two Lick originates in an abandoned clay mine high on the slopes above Route 403. It is very acid and carries a significant load of iron and aluminum requiring an alkalinity producing treatment system. Sufficient area and previously built but abandoned sedimentation ponds are located in the vicinity on the stream side of Two Lick Creek.

6. **Un-named trib to Two Lick/natural spring -** This trib to Two Lick originates in a spring off the disturbed area of an abandoned surface mine area. Water quality appears satisfactory and flow is low except in high precipitation events.

7. **Discharge from abandoned deep mine (Egypt Mine)** presently being treated by Richards Project of 3 alkalinity producing systems. Un-treated this discharge is the second major AMD contaminant of main stem Two Lick Creek.

8. **Diamondville Borehole Discharge -** This discharge is the largest and most significant source of AMD loading (iron, aluminum, acidity) to the main stem Two Lick Creek. Various treatment systems have been considered however sufficient area for passive alkalinity systems is not available in the near vicinity. Possibilities exist downstream for location at a second discharge area (portal) from the same mine. Sufficient area for alkalinity systems is available at that site.

9. **Un-named trib to North Branch Two Lick** - This small tributary originates in old abandoned country bank and strip workings. The load of acidity and metals is not high but at times may contribute sufficiently to have a moderate effect upon the quality of the North Branch.

10. **Un-named Trib to North Branch Two Lick** - This small tributary originates in old abandoned surface mined areas and although low in flow contributes very small amounts of AMD from acidity and metals. It flows through a culvert under Route ?? into an area possibly available and large enough for treatment.

11. **Un-named Trib to North Branch Two Lick** - This small tributary originates in old mine workings (deep and surface) and flows through a culvert under Route ?? enroute to North Branch Two Lick Creek. There may be sufficient area downstream from Route ?? for passive alkalinity treatment systems.

12. **Small tributary originating from abandoned deep mine** - Water quality best treated by a passive alkalinity producing system. However, sufficient space in the immediate area may not be available – may be amenable to “in-stream” treatment.

13. This small tributary arises upslope from the highway and flows into a small AMD impacted wetland. The AMD loading may require more space for treatment than is available. Piping to downslope may be necessary.

14. Small tributary carrying AMD from abandoned deep and surface mining. Requires alkalinity producing system for treatment but sufficient area not available in immediate vicinity. May be piped down slope to suitable area.

15. Site 15 was/is a sewage system overflow from a pressured main line along Dixon Run. No action needed. However, immediately upstream are two deep mine discharges presently being monitored by DEP mining.

16. North Branch Two Lick Creek at confluence with South Branch in village of Wandin.

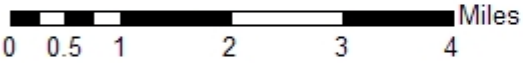
17. **Un-named tributary to North Branch in Starford** - Originates in abandoned deep, surface mines and refuse piles. Diffuse sources.

18. **Un-named tributary to North Branch upstream from Site 11 -** No treatment necessary as dilution appears to remediate.

19. **Un-named trib to North Branch entering Two Lick at Commodore** - Requires alkalinity producing system for treatment. Availability of area needed unknown.

Appendix B – Project Maps and Figures

Figure 2 - Upper Two Lick Creek Watershed Subbasins



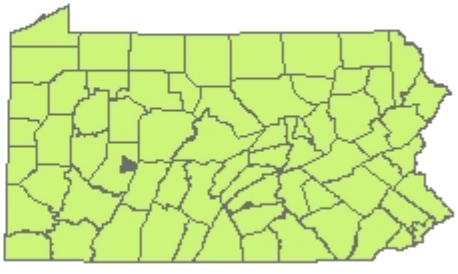


Figure 3 - Locations of AMD Sources in the
Upper Two Lick Creek Watershed

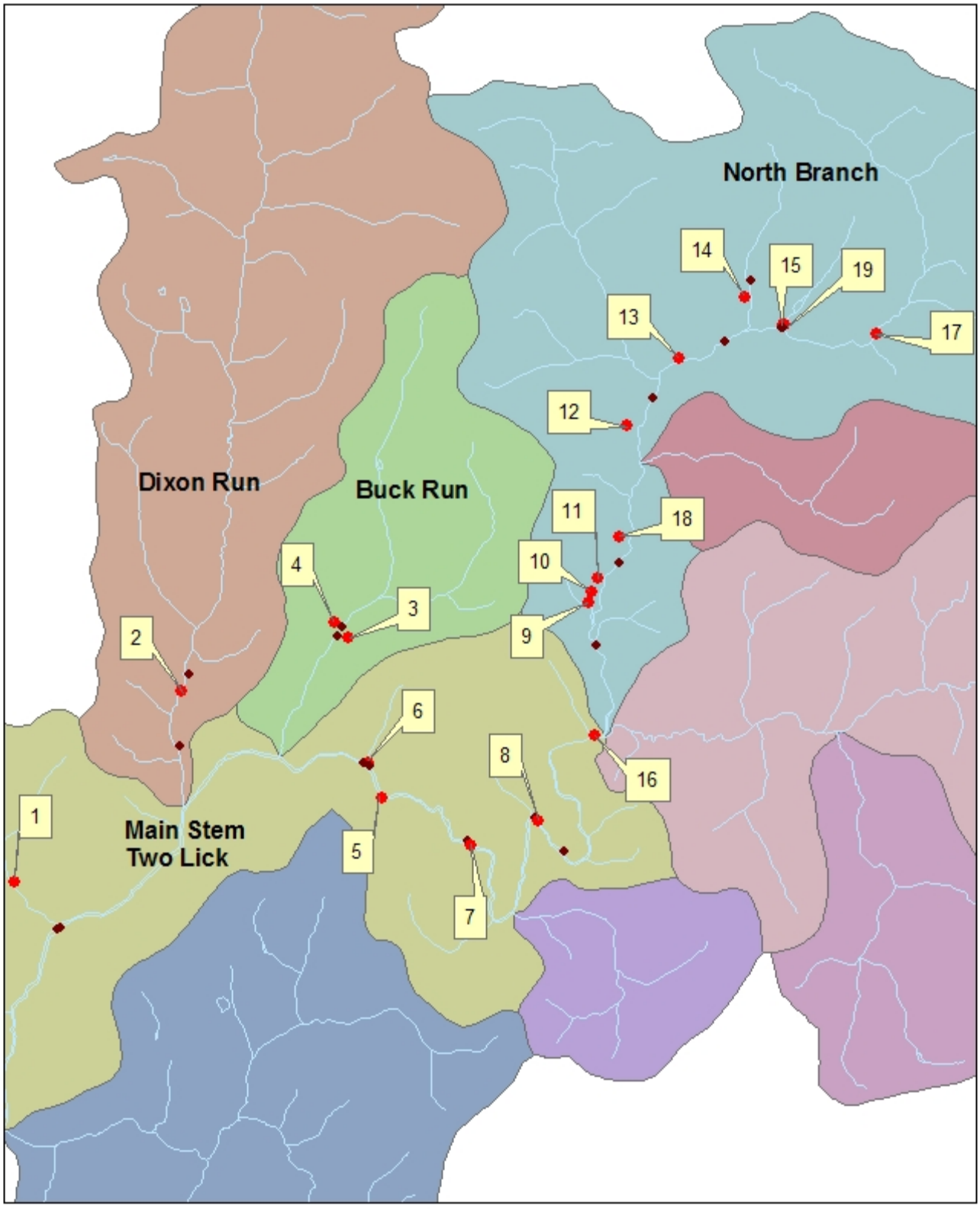


Figure 4 - Average Pounds Per Day of Acidity Contributed
at AMD Source Locations in the Upper Two Lick Creek Watershed

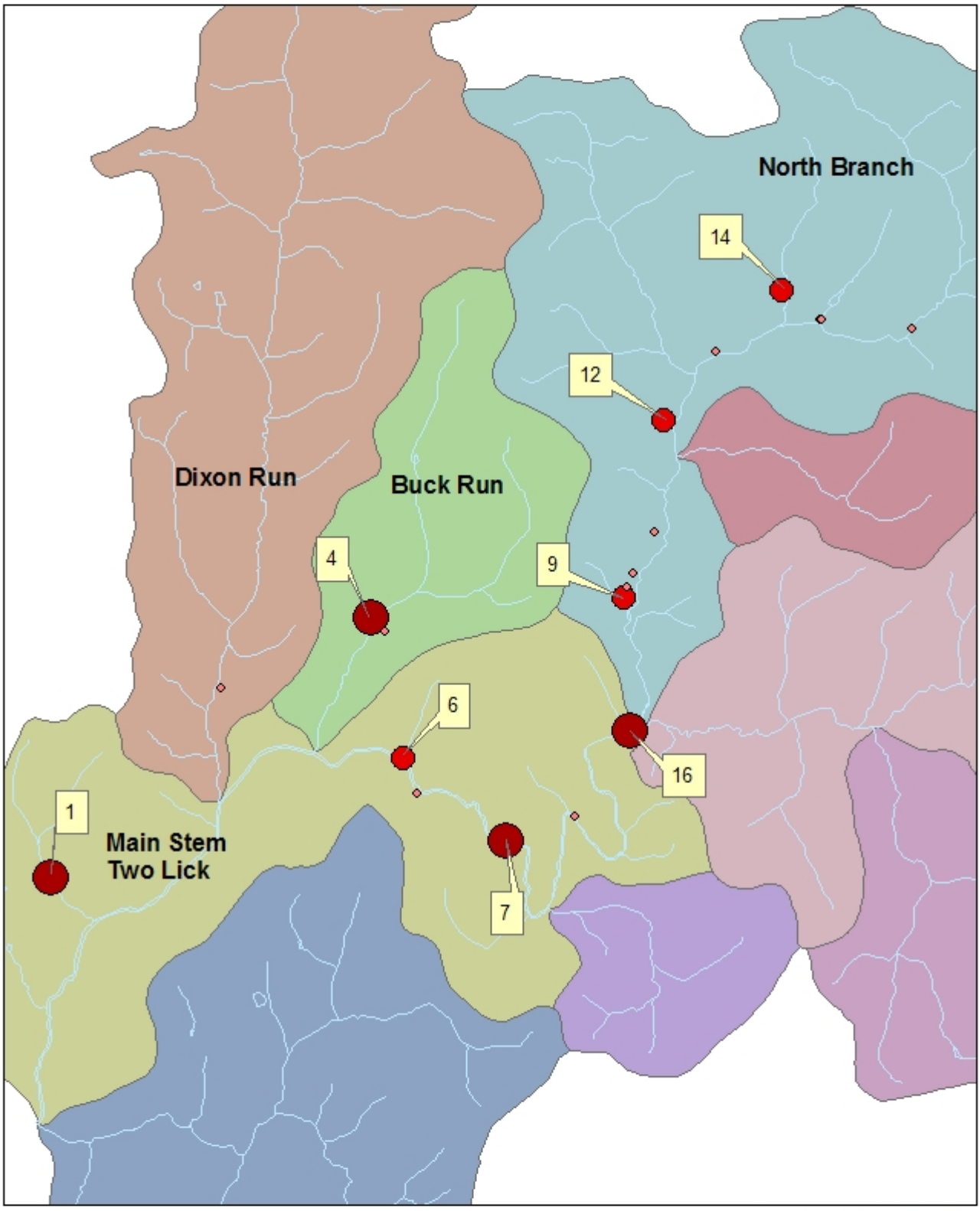


Figure 5 - Average Pounds Per Day of Aluminum Contributed at AMD Source Locations in the Upper Two Lick Creek Watershed

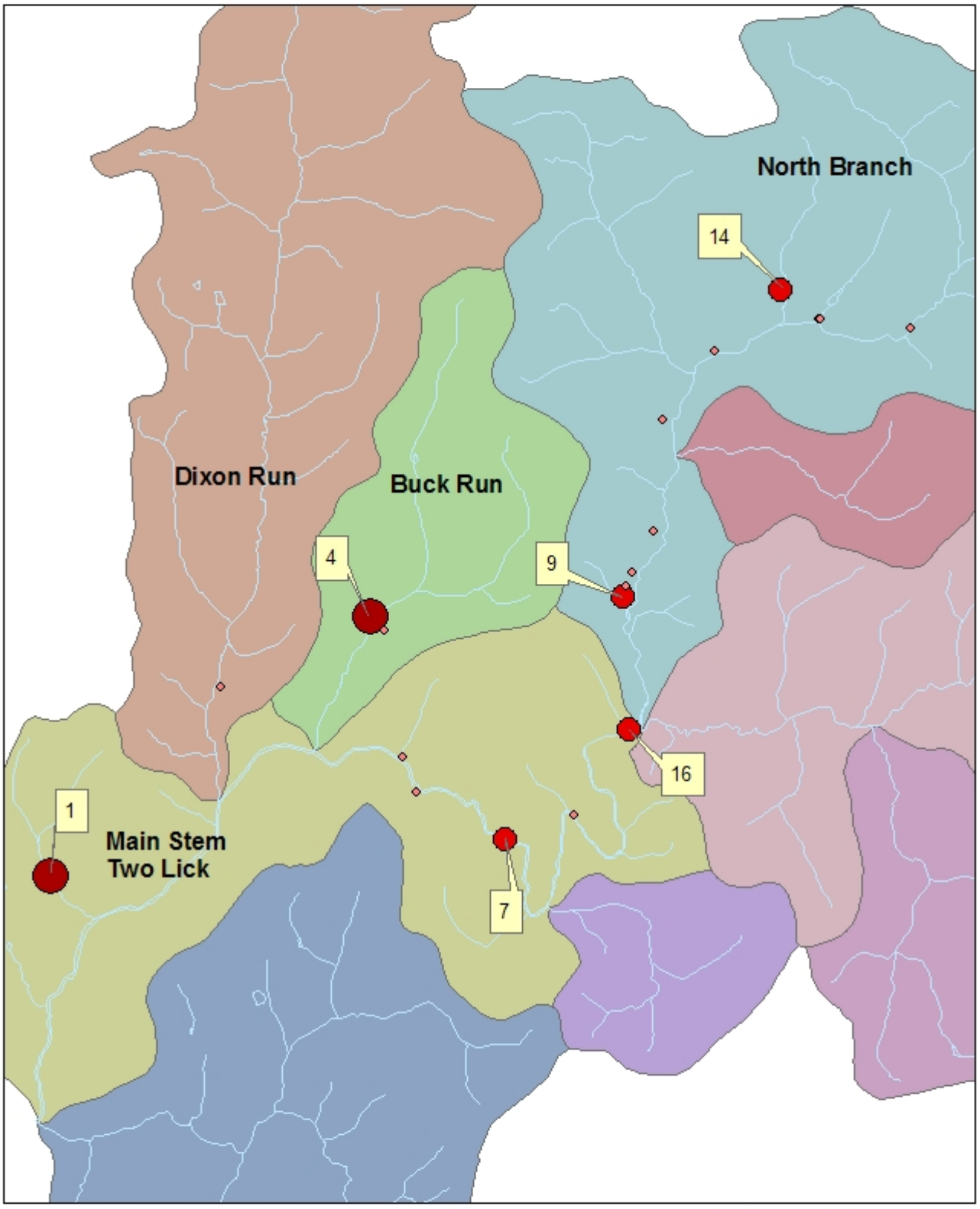


Figure 6 - Average Pounds Per Day of Iron Contributed
at AMD Source Locations in the Upper Two Lick Creek Watershed

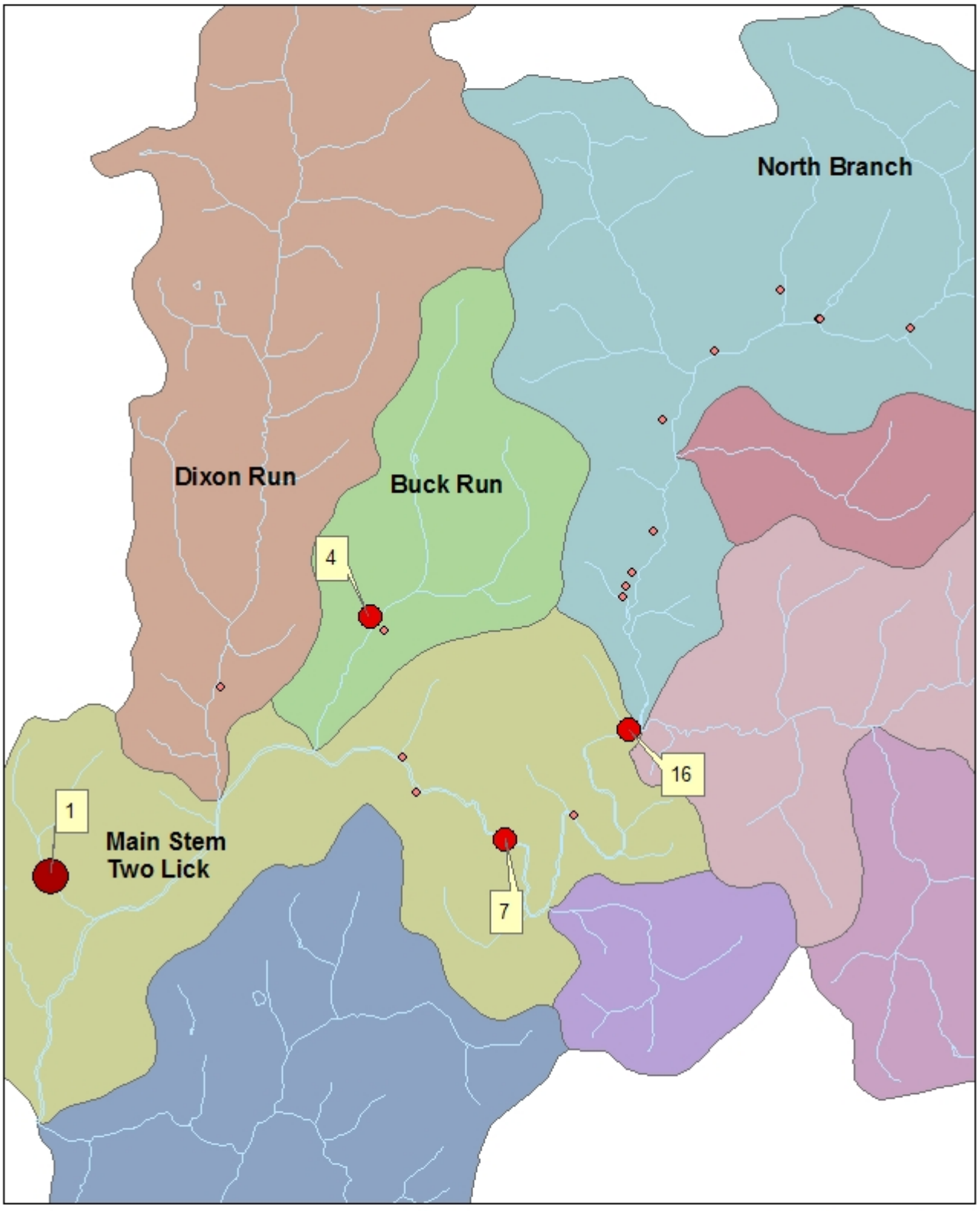


Figure 7 - Average Pounds Per Day of Manganese Contributed at AMD Source Locations in the Upper Two Lick Creek Watershed

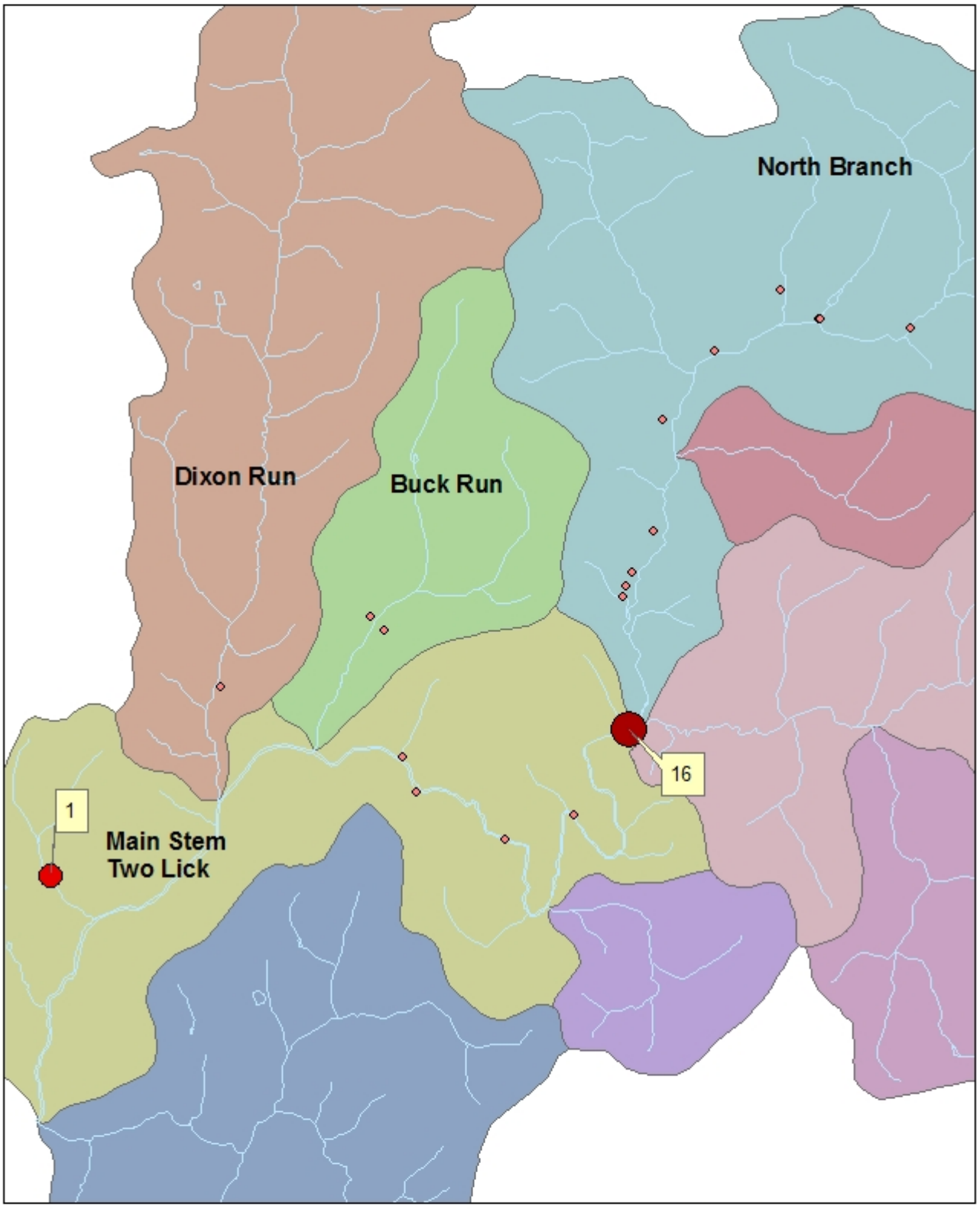


Figure 8 - Average Pounds Per Day of Sulfates Contributed
at AMD Source Locations in the Upper Two Lick Creek Watershed

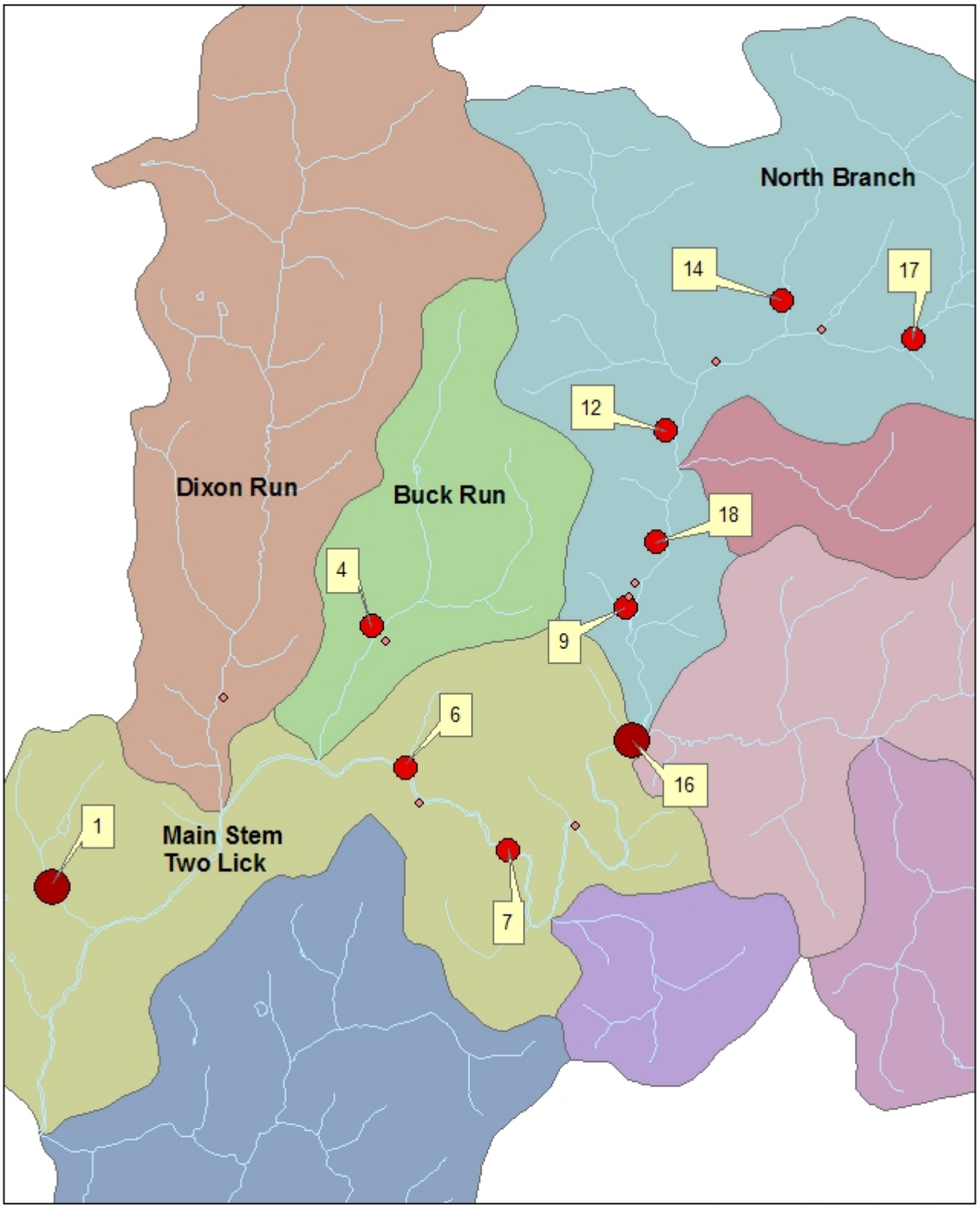
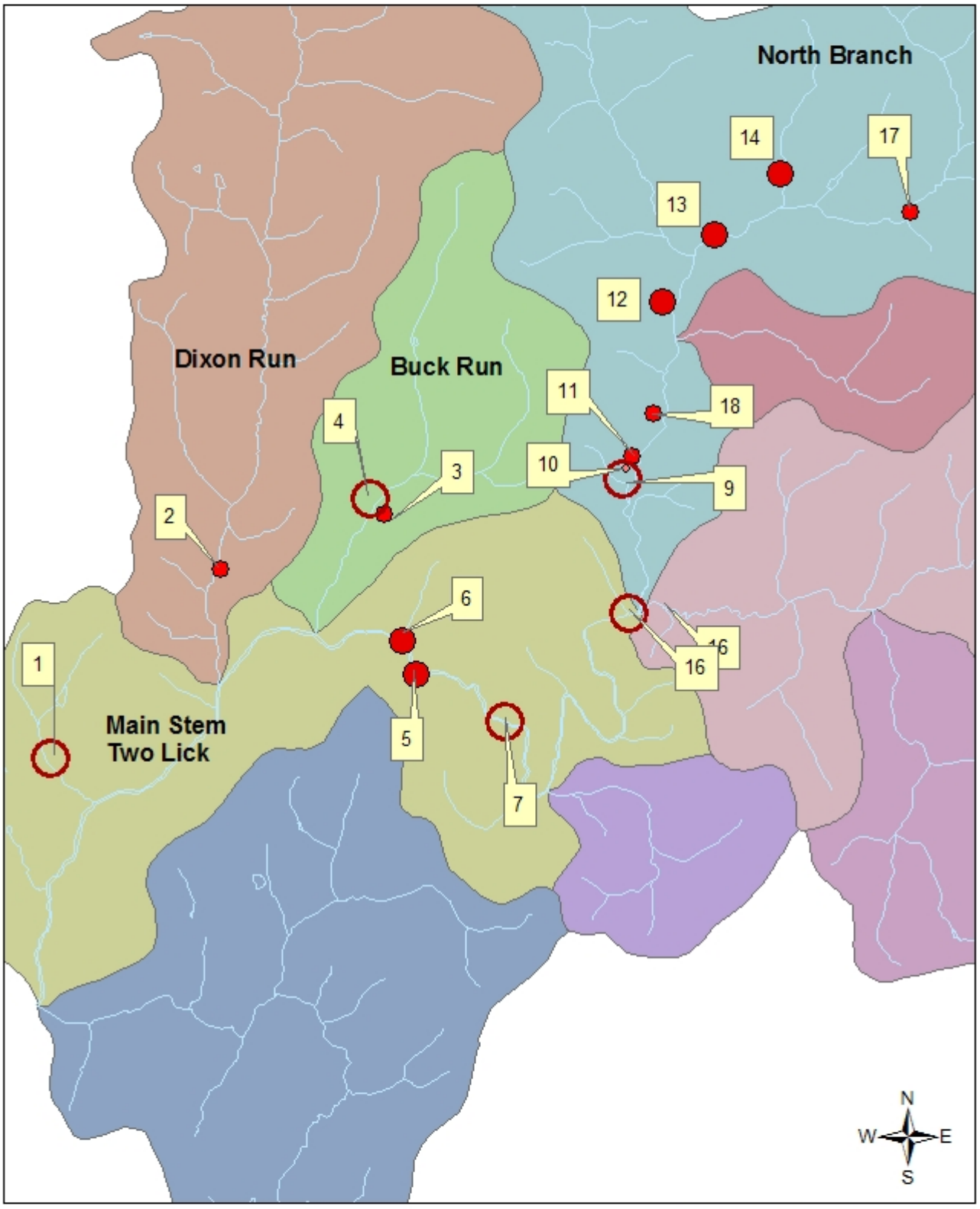


Figure 9 - Water Chemistry Prioritization Ranks of
AMD Source Locations in the Upper Two Lick Creek Watershed



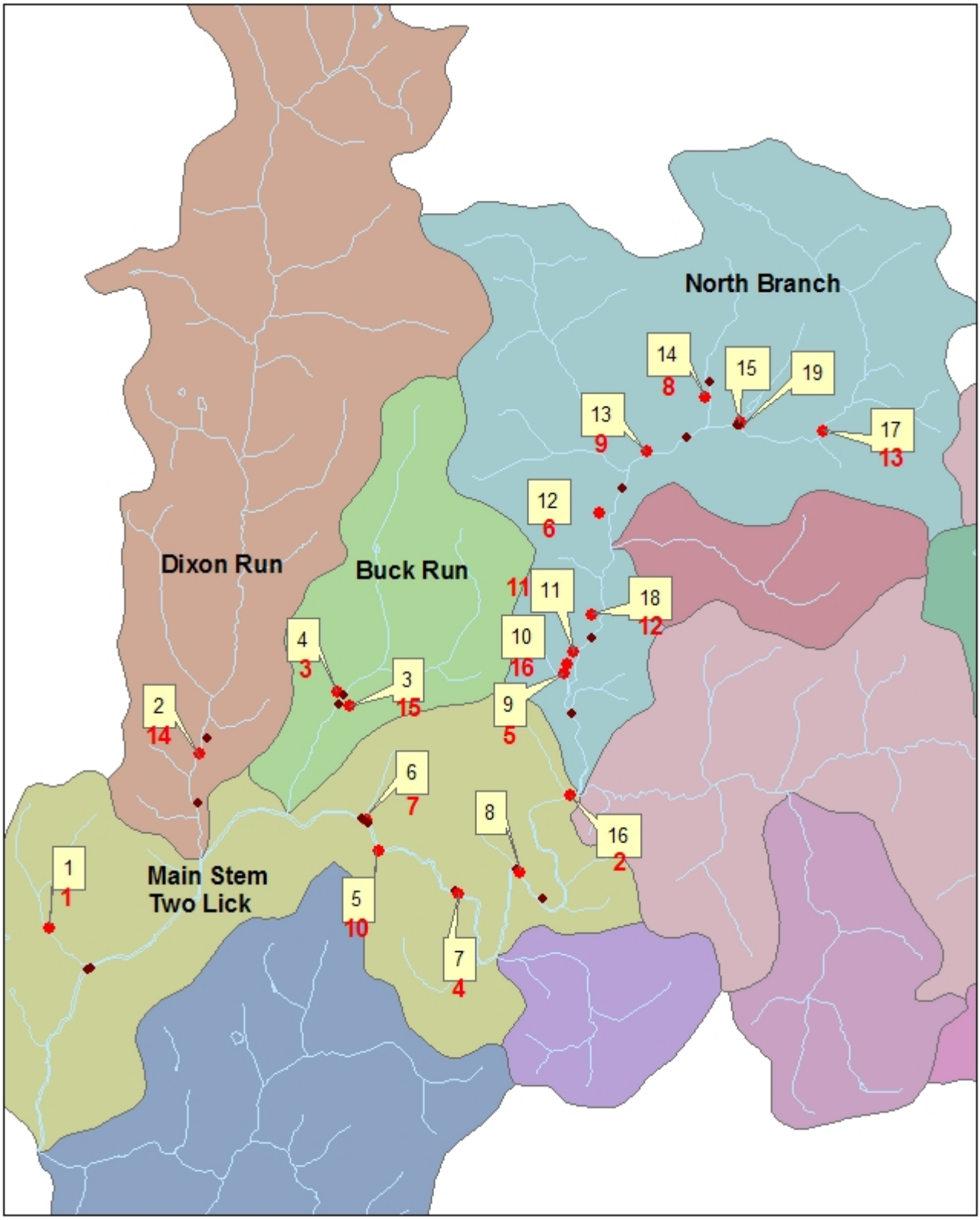
Note: Locations 8, 15 and 19 could not be included in the loading prioritization procedure because these sources did not have flow for much of the sampling period.

0 0.25 0.5 1 1.5 2 Miles

Chemistry Priority Ranking

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 19

Figure 10 - Locations of AMD Sources
and Their AMD Chemistry Ranks



The numbers in call out boxes are the Site Numbers of sampling locations and the red numbers below are the chemistry ranks of each site.

0 0.25 0.5 1 1.5 2 Miles

Sampling Location Types

- AMD Source Location
- Upstream/Downstream Control

Figure 11 - Example of Linear Downstream Distances
Calculated for AMD Sources Using GIS

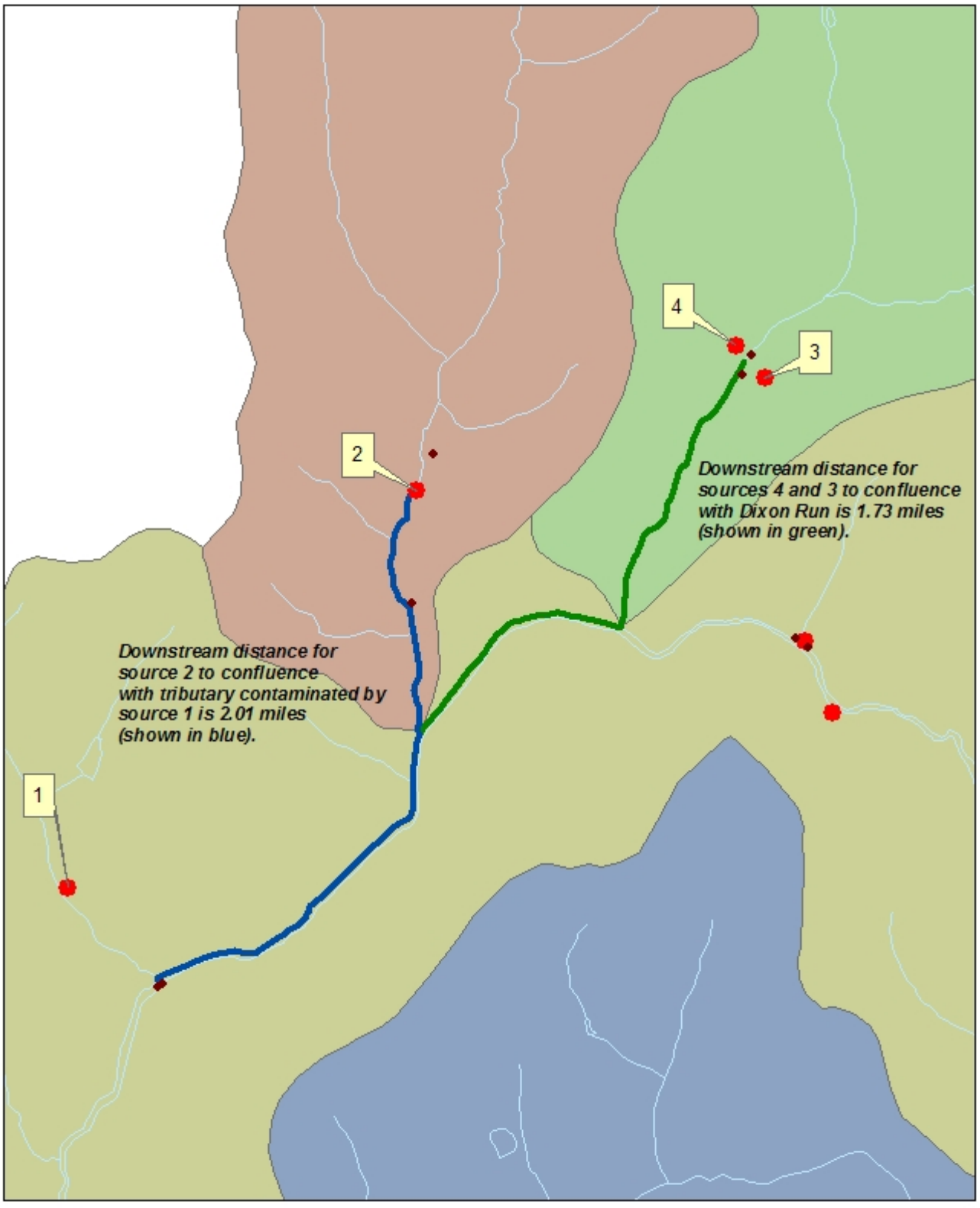
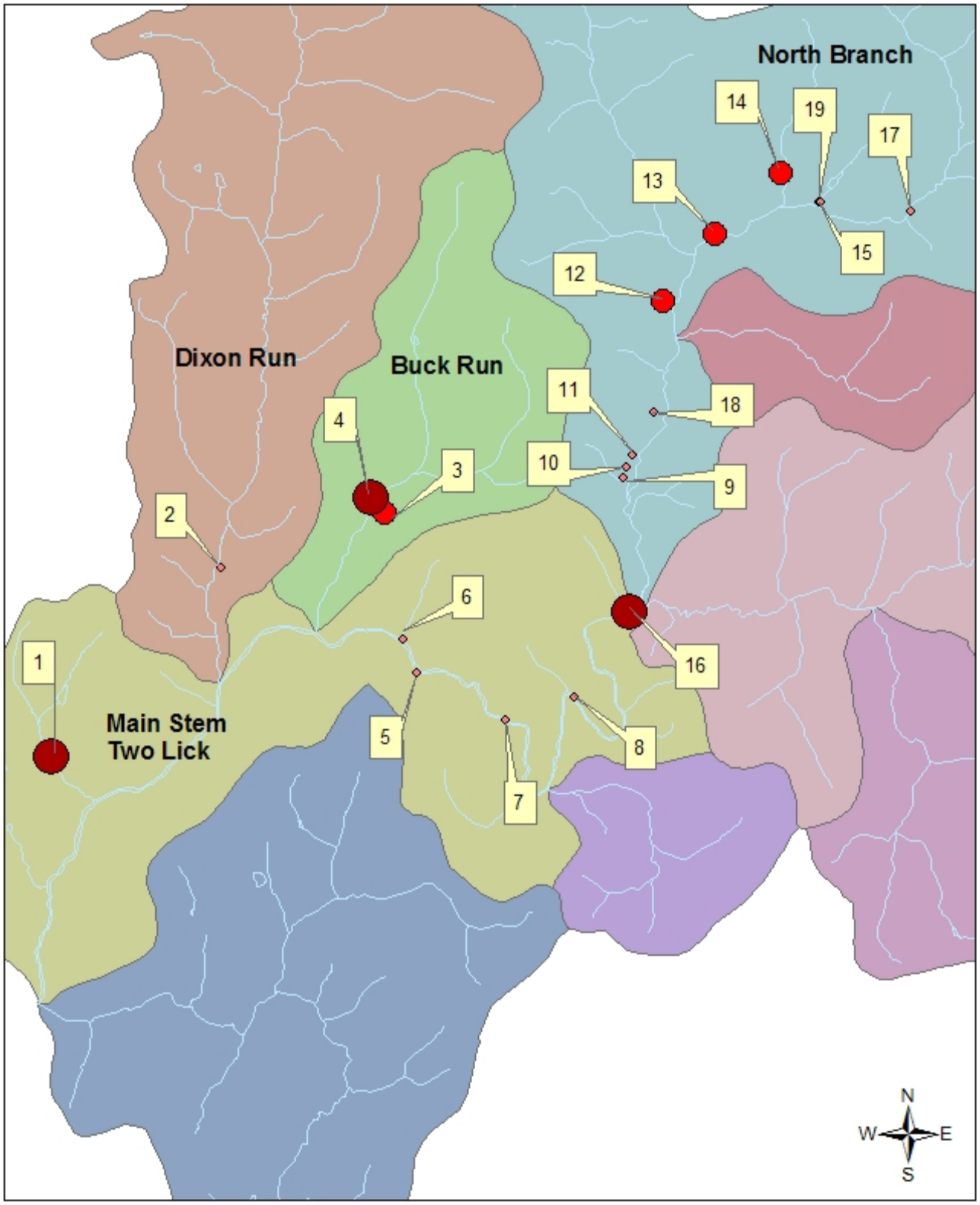


Figure 12 - AMD Problem Classifications of AMD Source Locations in the Upper Two Lick Creek Watershed Based on BAMR Criteria



Note: Locations 8, 15 and 19 were classified as moderate problems based chemical concentration and downstream distance data (even though flow data was not available).

0 0.25 0.5 1 1.5 2 Miles

AMD Problem Classification

- Very Serious/Critical
- Serious
- Moderate

Appendix C – Summary Statistics of AMD-related Chemical Parameters by Source Location

Chemical Concentration Summary Statistics by Source Location

MONTRPOINT 1

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 1 (12 detail records)									
Avg	3.01083333	2120	0	947.041667	128.393333	5.8625	1199.60833	117.45	2098.83333
Min	2.59	748	0	173.2	35.02	0.82	239.3	17.34	400
Max	4.22	3704	0	2382.3	289.44	17.19	3144.2	312.87	5394

MONTRPOINT 10

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 10 (10 detail records)									
Avg	3.45142857	739.71428571	0	84.0428571	0.27285714	0.76857143	325.371429	7.45142857	602.571429
Min	3.37	654	0	72.8	0.2	0.62	274.7	6.46	446
Max	3.55	779	0	95.2	0.55	0.87	359.9	9.1	742

MONTRPOINT 11

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 11 (12 detail records)									
Avg	3.6575	709.75	0	74.9583333	0.77666667	1.24333333	330.308333	7.5475	604.5
Min	3.28	596	0	61.2	0.15	0.76	253.3	5.59	392
Max	4.02	864	0	102.3	2.86	1.91	425.8	12.46	824

MONTRPOINT 12

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 12 (12 detail records)									
Avg	3.33583333	1067.75	0	79.025	2.13416667	3.45083333	482.475	4.17	848.5
Min	3.18	950	0	51.9	1.52	2.61	426.7	2.33	668
Max	3.53	1182	0	107.6	2.73	4.3	546.4	7.26	1042

MONTRPOINT 13

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 13 (12 detail records)									
Avg	6.57833333	396.83333333	31.625	14.675	9.24916667	0.96	144.483333	0.34083333	290.5
Min	6.11	339	19	2.1	7.43	0.7	123	-0.1	232
Max	7.16	443	49.2	29.6	11.98	1.47	181.2	2.06	338

MONTRPOINT 14

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 14 (12 detail records)									
Avg	3.83	724.16666667	0	76.825	0.02583333	0.6075	355.308333	9.11583333	636.5
Min	3.74	612	0	53.1	-0.04	0.46	302.7	5.61	442
Max	4.01	831	0	94.8	0.16	0.76	428.1	11.8	808

MONTRPOINT 15

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 15 (12 detail records)									
Avg	6.79833333	485.83333333	49.4333333	9.35833333	0.1775	0.17666667	175.841667	0.5325	365.166667
Min	6.49	437	36.7	1.6	0.05	0.14	148.2	-0.1	294
Max	7.5	536	62.7	13.3	0.33	0.23	198.1	2.49	440

MONTRPOINT 16

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 16 (12 detail records)									
Avg	7.68166667	452.91666667	122.4	2.30833333	0.3625	0.18916667	93.9916667	0.315	294
Min	6.87	219	25.5	-1	0.19	0.11	49.6	-0.1	154
Max	8.33	773	274	6.3	0.59	0.46	141.1	0.99	534

MONTRPOINT 17

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 17 (12 detail records)									
Avg	7.00583333	197.66666667	38.5333333	3.025	0.20833333	0.03166667	42.225	0.34416667	135.333333
Min	6.69	150	21.6	1.2	0.04	-0.02	23.2	-0.1	88
Max	7.52	320	97.8	5.3	0.61	0.17	85.4	1.92	248

MONTRPOINT 18

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 18 (9 detail records)

Avg	4.31555556	789.66666667	-0.3333333	33.1555556	0.54222222	0.91333333	391.922222	3.05555556	658
Min	3.91	670	-1	15.5	-0.04	0.58	329.3	1.7	492
Max	4.65	874	0	67.1	4.14	1.2	443.5	5.49	796

MONTRPOINT 19

LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 19 (9 detail records)

Avg	7.1	465.77777778	92.9111111	8.34444444	0.47777778	0.09222222	132.566667	0.23444444	319.777778
Min	6.8	433	81.8	1.6	0.29	0.05	111.3	-0.1	268
Max	7.66	493	104.6	11.3	0.85	0.17	144.9	2.04	356

MONTRPOINT 2

LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 2 (12 detail records)

Avg	3.37666667	1593.0833333	0.475	393.291667	26.7508333	3.5675	874.691667	47.5833333	1666.66667
Min	2.87	772	0	8.4	6.27	1.94	360.1	4.34	746
Max	6.02	2346	5.7	758.5	51.56	6.27	1481.2	96.44	3348

MONTRPOINT 3

LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 3 (12 detail records)

Avg	3.39454545	726.45454545	0	74.2272727	0.45	0.63727273	302.8	5.65545455	550.727273
Min	3.24	643	0	63.1	0.28	0.5	254.2	4.19	416
Max	3.56	846	0	91.7	0.73	0.81	375.5	8.16	738

MONTRPOINT 4

LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 4 (12 detail records)

Avg	2.76	1866.2727273	0	762.772727	73.04	4.11363636	973.6	82.2363636	1908.72727
Min	2.58	985	0	243.1	9.64	1.79	359.6	24.19	736
Max	3.07	2688	0	1553.4	202.16	6.96	1989.5	164.47	3638

MONTRPOINT 5

LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS

Summary for 'MONTRPOINT' = 5 (12 detail records)

Avg	2.555	2502.1666667	0	789.541667	84.9408333	2.46083333	1062.50833	53.8533333	2143.5
Min	2.29	1667	0	428.9	32.11	1.46	637.6	32.23	1046
Max	2.76	3644	0	1202.7	126.16	3.45	1689.3	78.07	3192

MONTRPOINT 6

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 6 (12 detail records)									
Avg	4.00181818	633	0	51.8636364	0.89090909	3.53	300.118182	4.06636364	545.818182
Min	3.68	489	0	34.1	0.35	2.04	221.5	2.69	346
Max	4.19	884	0	72.1	1.98	6.08	434.7	5.44	820

MONTRPOINT 7

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 7 (12 detail records)									
Avg	3.56083333	900.83333333	-0.0833333	115.408333	15.2275	1.5925	370.175	9.86333333	664.166667
Min	3.08	774	-1	72	8.74	1.35	339.6	5.11	548
Max	4.57	1139	0	168.3	24.29	1.92	419	14.2	846

MONTRPOINT 8

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 8 (12 detail records)									
Avg	2.86166667	1696.9166667	0	444.516667	57.2883333	1.76083333	752.8	35.1241667	1453.5
Min	2.72	1590	0	390.1	32.57	1.5	666	28.95	1262
Max	3.03	1795	0	524.3	90.03	2.02	852.1	40.11	1682

MONTRPOINT 9

	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
Summary for 'MONTRPOINT' = 9 (12 detail records)									
Avg	3.89166667	434.83333333	0	42.325	0.685	0.7	182.958333	2.97583333	326.333333
Min	3.65	389	0	34.3	0.27	0.46	137.8	2.29	242
Max	4.18	502	0	51.6	2.97	1.22	231.2	3.83	414

Appendix D – Summary Statistics of AMD-related Chemical Loadings by Source Location

AMD Chemical Loading Summary Statistics by Location

MP 1

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 1 (9 detail records)									
Sum		0	55389.01918	8477.974359	328.299148318	6647.0140699	74344.11469	6405.619675	127689.7856
Avg	1132.693265	0	6154.335464	941.9971510	36.4776831464	738.55711888	8260.457188	711.7355195	14187.75396
Min	9.140625	0	122.4777895	11.61616703	0.96883776117	16.722886707	174.2370132	8.128570785	371.7173451
Max	3174.165306	0	17209.09731	2528.721638	90.980763819	2037.3396829	19495.06052	1589.238674	35276.50371

MP 10

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 10 (9 detail records)									
Sum		0	58.33193084	0.174491066	0.57322478386	5.0112103746	217.904732	0.576829971	363.9797118
Avg	6.666666667	0	6.481325648	0.019387896	0.06369164265	0.5568011527	24.21163689	0.072103746	40.44219020
Min	0	0	0	0	0	0	0	-0.28841499	0
Max	30	0	28.69729107	0.093734870	0.31365129683	2.3505821326	99.03449568	0.576829971	160.7913545

MP 11

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 11 (9 detail records)									
Sum		0	1365.304983	11.72819108	23.8174200237	135.14834253	6172.874265	90.74999463	10541.83647
Avg	172.6168973	0	151.7005536	1.303132342	2.64638000264	15.016482503	685.8749184	22.68749866	1171.315163
Min	64.5	0	55.80829971	0.198366132	1.00505506776	6.2861848703	267.2597464	-2.64488176	518.3968244
Max	309.68694	0	276.8868984	3.294780692	6.50664207493	24.503737176	1251.836403	74.43196195	2262.731643

MP 12

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 12 (9 detail records)									
Sum		0	3183.820372	85.69191811	119.213031247	178.62466725	18471.09973	51.24020546	32074.84824
Avg	337.5705199	0	353.7578192	9.521324234	13.2458923607	19.847185250	2052.344414	10.24804109	3563.872027
Min	168.063633	0	131.6824576	3.211274657	7.93730150999	4.7058301573	887.0388863	-6.180667	1712.679817
Max	612	0	650.8805187	18.53354697	23.0198420749	37.297465418	3815.557210	20.54956772	7663.474582

MP 13

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 13 (9 detail records)									
Sum		2139.609956	1053.448226	589.7428829	60.6575065739	25.931213741	9172.26811	1987.694652	17987.46525
Avg	569.4458963	237.7344395	117.0498028	65.52698699	6.73972295266	6.4828034351	1019.140901	220.8549613	1998.607250
Min	236.331585	75.54574084	5.964137435	25.27658246	2.86846609955	1.8294523055	383.9768482	73.84170157	959.9421204
Max	1039.5	529.4650202	259.8330605	133.7890422	12.7418135447	13.994661203	1828.825003	738.9641651	3637.381643

MP 14

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 14 (9 detail records)									
Sum		0	3685.128553	1.734264108	29.7293810141	432.46805929	17756.67807	212.349957	29574.56005
Avg	481.504842	0	409.4587281	0.433566027	3.30326455712	48.052006587	1972.96423	35.3916595	3286.062228
Min	135	0	146.4967867	0.129786744	1.10318731988	19.062427954	626.7077378	-14.3726073	1281.644092
Max	859.58181	0	686.9346796	0.862356440	5.37940451438	91.743298809	3380.958205	103.2984481	5829.318346

MP 15

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 15 (9 detail records)									
Sum		0	0	0	0	0	0	0	0
Avg	0	0	0	0	0	0	0	0	0
Min	0	0	0	0	0	0	0	0	0
Max	0	0	0	0	0	0	0	0	0

MP 16

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 16 (9 detail records)									
Sum		339129.2079	18580.95884	1549.254683	784.942496872	1194.7342546	342079.1850	39421.7394	979816.4233
Avg	44391.98548	37681.0231	2654.422692	172.1394093	87.2158329858	199.12237576	38008.79834	6570.289899	108868.4915
Min	3662.642045	12060.11974	212.9313761	13.64466101	5.28180426382	41.3741334	6210.521514	1548.193411	23504.02897
Max	102135.0023	77661.23512	6910.533633	405.8567372	161.045880692	745.89886837	82158.56653	24132.02221	214133.648

MP 17

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday

Summary for 'MP' = 17 (9 detail records)									
Sum		8375.823279	941.7110422	35.95936829	9.83797197392	29.480106681	13027.48574	1953.630650	38045.97086
Avg	2838.53625	930.647031	104.6345602	3.995485365	1.63966199565	7.3700266703	1447.498415	325.6051083	4227.330096
Min	18.75	22.03670749	1.171685879	0.089228386	0.02230709654	0.0669212896	5.227521614	-84.4094065	28.84149856
Max	8496	3062.967147	377.7659481	16.33582478	8.16791239193	24.760092586	4165.63532	1031.670524	13477.05545

MP 18

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 18 (9 detail records)									
Sum		5.255705995	1096.706409	13.26133969	29.2680863255	97.412977453	11323.02118	132.6644556	18355.76049
Avg	267.0172202	0.583967333	121.8562677	1.657667461	3.25200959172	10.823664161	1258.113464	26.53289111	2039.528944
Min	91.5	0	26.73970849	0.078863473	0.79169913545	2.9327422218	464.2435764	-6.70088092	875.2673775
Max	538.736064	3.237074044	434.4153368	10.41673811	7.76897770679	35.543073009	2798.126804	77.68977707	4234.092850

MP 2

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 2 (9 detail records)									
Sum		0	981.2570006	63.25373256	7.70832311239	114.32496035	2027.391510	16.78575216	3892.477487
Avg	24	0	109.0285556	7.028192507	0.85648034582	12.702773372	225.2657233	2.797625360	432.4974986
Min	10.8	0	45.75703746	2.631786744	0.37061325648	5.0890824207	98.98402305	0.778720461	157.7629971
Max	42	0	151.3097118	9.476595389	1.21999538905	18.457838040	301.0619827	6.056714697	639.4160231

MP 3

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 3 (9 detail records)									
Sum		0	1047.700056	6.478752432	8.84320253514	78.189270846	4213.414040	14.24115471	7343.820883
Avg	125.8965753	0	116.4111173	0.719861381	0.98257805946	8.6876967606	468.1571156	2.848230942	815.9800981
Min	0	0	0	0	0	0	0	-3.91986811	0
Max	250.47495	0	276.0197858	2.167221873	2.37792399938	20.799309919	1070.968809	12.85024907	2058.860779

MP 4

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday

Summary for 'MP' = 4 (9 detail records)									
Sum		0	21130.85586	1665.240028	118.492889904	2376.7242675	27135.45439	131.6093034	52632.6216
Avg	304.5025368	0	2347.872873	185.0266697	13.165876656	264.08047416	3015.050488	21.93488389	5848.069066
Min	0	0	0	0	0	0	0	-7.77914485	0
Max	471.048672	0	5585.57673	434.6105430	27.2145978195	738.03136143	7152.062149	76.81539707	12114.88548

MP 5

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 5 (9 detail records)									
Sum		0	2574.405212	306.7668455	8.36422205187	182.00310137	3430.637777	33.26866859	6724.085343
Avg	32.02	0	286.0450236	34.08520506	0.92935800576	20.222566818	381.1819753	5.544778098	747.1205937
Min	19.98	0	185.551781	22.66076542	0.63162881844	13.943422478	275.8400922	-0.86524496	452.5231124
Max	40.2	0	422.5632847	45.48304323	1.45894720461	32.236936081	593.0475458	28.1204611	1131.408726

MP 6

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 6 (9 detail records)									
Sum		0	2636.141934	33.58131202	163.920944899	221.36199268	14855.64409	382.494713	25937.6796
Avg	512.7005	0	292.9046593	3.731256891	18.2134383221	24.595776964	1650.627121	47.81183912	2881.9644
Min	0	0	0	0	0	0	0	-19.4112046	0
Max	1152	0	610.5168415	10.52137867	46.6540080692	50.581195233	3782.158755	219.301396	6506.642075

MP 7

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 7 (9 detail records)									
Sum		13.12513509	6292.154568	1044.929351	107.049707185	544.49092857	23566.27613	5434.164545	38870.51079
Avg	600.0468453	1.458348343	699.1282853	116.1032613	11.8944119094	60.498992063	2618.475126	679.2705682	4318.945643
Min	24	0	27.48594813	4.277194236	0.44704322767	2.3866340058	100.714513	2.163112392	189.7770605
Max	2184.375	13.12513509	1890.019452	402.1541390	40.9504214697	134.13888058	8914.591751	4455.079382	14385.14805

MP 8

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday

Summary for 'MP' = 8 (9 detail records)									
Sum		0	0	0	0	0	0	0	0
Avg	0	0	0	0	0	0	0	0	0
Min	0	0	0	0	0	0	0	0	0
Max	0	0	0	0	0	0	0	0	0

MP 9

	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
Summary for 'MP' = 9 (9 detail records)									
Sum		0	4998.752629	48.66449592	80.963989382	315.21342909	19694.10624	213.0139777	34424.75975
Avg	979.1680381	0	555.4169588	5.407166213	8.99599882022	35.023714343	2188.234027	53.25349442	3824.973305
Min	25.3125	0	11.68080692	0.876060519	0.27072703530	0.9368980548	70.32819164	-11.0916822	125.9336996
Max	3116.01312	0	1840.504387	16.47625612	35.5737347979	110.84026842	7361.890801	155.9493986	13630.35733
Grand Total		349663.0219	125015.6968	13934.43602	1881.68154620	12578.132852	587487.5557	56481.84393	1424276.585

Appendix E – AMD Loading Data by Source Location

AMD Loading Data by Source Location

MP 1

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	39.1015625	0	1119.43052	103.9172478	8.0774926040	147.01600413	1434.448032	49.80885492	2534.612862
9/30/2002	9.140625	0	122.4777895	11.61616703	0.9688377612	16.722886707	174.2370132	8.128570785	371.7173451
10/30/2002	2133	0	9209.894447	1025.571603	75.360672622	1247.0397017	15674.50725	1589.238674	24146.1747
11/26/2002	1165.55866	0	6319.894182	954.1471446	39.359270058	745.02475958	8264.046027	1260.617190	14791.24170
12/23/2002	3174.165306	0	6606.691202	1335.833290	31.278792067	661.43201762	9128.067002	76.28973675	15257.94735
1/30/2003	1190.380716	0	17209.09731	2528.721638	90.980763819	2037.3396829	19495.06052	1029.970911	35276.50371
3/4/2003	1099.021482	0	2932.011950	482.0650279	20.075036777	385.7840949	4275.190398	871.6792285	7105.506438
3/30/2003	1004.798808	0	5451.844322	879.2985682	29.945900152	649.27058515	8008.113299	772.7974233	11761.01079
4/30/2003	379.072224	0	6417.677458	1156.803672	32.252382457	757.38433718	7890.445149	747.0890852	16445.07072
Summary for 'MP' = 1 (9 detail records)									
Sum		0	55389.01918	8477.974359	328.29914832	6647.0140699	74344.11469	6405.619675	127689.7856
Avg	1132.693265	0	6154.335464	941.9971510	36.477683146	738.55711888	8260.457188	711.7355195	14187.75396
Min	9.140625	0	122.4777895	11.61616703	0.9688377612	16.722886707	174.2370132	8.128570785	371.7173451
Max	3174.165306	0	17209.09731	2528.721638	90.980763819	2037.3396829	19495.06052	1589.238674	35276.50371

MP 10

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	0	0	0	0	0	0	0	0	0
9/30/2002	0	0	0	0	0	0	0	0	0
10/30/2002	0	0	0	0	0	0	0	0	0
11/26/2002	0	0	0	0	0	0	0	0	0
12/23/2002	30	0	28.69729107	0.093734870	0.3136512968	2.3505821326	99.03449568		160.7913545

1/30/2003	0	0	0	0	0	0	0	0	0
3/4/2003	12	0	12.82004611	0.031725648	0.1153659942	1.1536599424	51.90027666	-0.28841499	87.10132565
3/30/2003	12	0	10.49830548	0.030283573	0.0894086455	0.9907054755	42.59889337	0.288414986	68.93118156
4/30/2003	6	0	6.316288184	0.018746974	0.0547988473	0.5162628242	24.37106628	0.576829971	47.15585014
Summary for 'MP' = 10 (9 detail records)									
Sum		0	58.33193084	0.174491066	0.5732247839	5.0112103746	217.904732	0.576829971	363.9797118
Avg	6.666666667	0	6.481325648	0.019387896	0.0636916427	0.5568011527	24.21163689	0.072103746	40.44219020
Min	0	0	0	0	0	0	0	-0.28841499	0
Max	30	0	28.69729107	0.093734870	0.3136512968	2.3505821326	99.03449568	0.576829971	160.7913545

MP 11

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	111	0	136.4599452	3.294780692	2.1342708934	16.620634582	567.9828415	21.34270893	1099.149510
9/30/2002	64.5	0	55.80829971	2.216829683	1.4804701729	6.2861848703	267.2597464		598.3889914
10/30/2002	288	0	211.8119654	2.630344669	6.5066420749	24.503737176	1251.836403		1924.304784
11/26/2002	180.088072	0	200.8350483	0.952235143	3.1596893370	18.070826003	833.8550011		1302.830809
12/23/2002	228.444825	0	186.4050521	0.411793193	2.964910991	15.346159666	695.3814389		1191.454972
1/30/2003	162.771968	0	129.883587	0.371654842	2.0538820227	13.88815463	663.5016972		1021.072777
3/4/2003	99.0154305	0	86.14856078	0.23797945	1.2374931383	8.0794023164	365.417445	-2.3797945	623.5061581
3/30/2003	110.0448405	0	81.06562586	0.198366132	1.0050550678	8.0139917245	361.2908480	-2.64488176	518.3968244
4/30/2003	309.68694	0	276.8868984	1.414207277	3.2750063257	24.339251557	1166.348844	74.43196195	2262.731643
Summary for 'MP' = 11 (9 detail records)									
Sum		0	1365.304983	11.72819108	23.817420024	135.14834253	6172.874265	90.74999463	10541.83647
Avg	172.6168973	0	151.7005536	1.303132342	2.6463800026	15.016482503	685.8749184	22.68749866	1171.315163
Min	64.5	0	55.80829971	0.198366132	1.0050550678	6.2861848703	267.2597464	-2.64488176	518.3968244
Max	309.68694	0	276.8868984	3.294780692	6.5066420749	24.503737176	1251.836403	74.43196195	2262.731643

MP 12

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday

9/9/2002	427.5	0	521.9590202	13.61408862	15.360801873	37.297465418	2758.779467	20.54956772	4818.873631
9/30/2002	612	0	650.8805187	18.53354697	23.019842075	36.03745245	3815.557210	14.70916427	7663.474582
10/30/2002	536.25	0	587.7176369	17.59286347	19.526145173	36.603466859	3521.150403		6083.393084
11/26/2002	271.975386	0	351.6806337	8.301754736	8.5305432525	17.845504275	1698.264473		2660.483604
12/23/2002	273.759624	0	311.8776931	7.698246856	11.514471793	13.290990299	1439.966944		2454.227417
1/30/2003	241.589466	0	197.7113884	6.938769726	11.003321030	11.351711142	1497.787156		2247.116221
3/4/2003	257.157248	0	245.0634465	4.697306919	11.001587257	11.434233946	1571.434584	-6.180667	2429.002130
3/30/2003	249.839322	0	185.2475773	5.104066149	11.319017283	10.058012705	1281.120603	6.004783705	2005.597757
4/30/2003	168.063633	0	131.6824576	3.211274657	7.93730151	4.7058301573	887.0388863	16.15735676	1712.679817
Summary for 'MP' = 12 (9 detail records)									
Sum		0	3183.820372	85.69191811	119.21303125	178.62466725	18471.09973	51.24020546	32074.84824
Avg	337.5705199	0	353.7578192	9.521324234	13.245892361	19.847185250	2052.344414	10.24804109	3563.872027
Min	168.063633	0	131.6824576	3.211274657	7.93730151	4.7058301573	887.0388863	-6.180667	1712.679817
Max	612	0	650.8805187	18.53354697	23.019842075	37.297465418	3815.557210	20.54956772	7663.474582

MP 13

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	565.3125	155.5717192	201.0883357	81.38642777	6.4538486131	13.994661203	956.5282997	108.6963977	1779.903512
9/30/2002	1039.5	374.7592219	259.8330605	133.7890422	12.741813545		1828.825003	199.8715850	3347.849049
10/30/2002	895.5	529.4650202	184.021379	89.64316297	7.5330389049	1.8294523055	1597.004248	344.3674928	3637.381643
11/26/2002	569.367984	256.5847795	67.7383818	73.55430347	8.0738677293	5.8159216694	841.5980769	738.9641651	2011.624672
12/23/2002	410.697	136.2188447	67.12232929	45.99853743	4.2938548885		698.3683526	78.96744622	1322.704724
1/30/2003	556.762944	252.2424947	82.29662294	60.61848812	9.8354500589		1212.369762	133.8156471	2114.287224
3/4/2003	410.697	172.7412886	115.9834366	36.67050784	4.1951455807		769.9326007	118.4511693	1362.188447
3/30/2003	440.844054	186.4808462	69.40054218	42.8058306	4.6620211543	4.2911785625	883.6649188	190.7190472	1451.583859
4/30/2003	236.331585	75.54574084	5.964137435	25.27658246	2.8684660996		383.9768482	73.84170157	959.9421204

Summary for 'MP' = 13 (9 detail records)										
Sum		2139.609956	1053.448226	589.7428829	60.657506574	25.931213741	9172.26811	1987.694652	17987.46525
Avg	569.4458963	237.7344395	117.0498028	65.52698699	6.7397229527	6.4828034351	1019.140901	220.8549613	1998.607250
Min	236.331585	75.54574084	5.964137435	25.27658246	2.8684660996	1.8294523055	383.9768482	73.84170157	959.9421204
Max	1039.5	529.4650202	259.8330605	133.7890422	12.741813545	13.994661203	1828.825003	738.9641651	3637.381643

MP 14

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	135	0	146.4967867	0.129786744	1.1031873199	19.062427954	626.7077378		1281.644092
9/30/2002	193.5	0	180.4468357		1.7672628242	23.416232421	945.9506801	4.650691643	1878.879424
10/30/2002	263.25	0	264.7892918	0.25308415	2.3726639049	33.596920893	1354.316557		2461.243357
11/26/2002	435.219264	0	495.8188431		3.6611096012	52.876882954	1958.693637	10.46031315	3263.617702
12/23/2002	597.996972	0	557.6571647		3.6650148713	43.980178456	2187.510837		3837.486159
1/30/2003	437.11002	0	278.9278398		2.4163240356	29.468647478	1590.046273	10.50575668	2321.772226
3/4/2003	597.996972	0	511.6648213	0.862356440	4.0961930915	52.172564639	2599.286037	-14.3726073	3866.231374
3/30/2003	859.58181	0	686.9346796		5.2682208511	86.150905682	3380.958205	103.2984481	4834.367369
4/30/2003	813.88854	0	562.3922901	0.489036774	5.3794045144	91.743298809	3113.208104	97.80735481	5829.318346

Summary for 'MP' = 14 (9 detail records)									
Sum		0	3685.128553	1.734264108	29.729381014	432.46805929	17756.67807	212.349957	29574.56005
Avg	481.504842	0	409.4587281	0.433566027	3.3032645571	48.052006587	1972.96423	35.3916595	3286.062228
Min	135	0	146.4967867	0.129786744	1.1031873199	19.062427954	626.7077378	-14.3726073	1281.644092
Max	859.58181	0	686.9346796	0.862356440	5.3794045144	91.743298809	3380.958205	103.2984481	5829.318346

MP 15

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	0	0	0	0	0	0	0		0
9/30/2002	0	0	0	0	0	0	0	0	0
10/30/2002	0	0	0	0	0		0	0	0
11/26/2002	0	0	0	0	0	0	0	0	0

12/23/2002	0	0	0	0	0	0	0	0	0
1/30/2003	0	0	0	0	0		0	0	0
3/4/2003	0	0	0	0	0		0	0	0
3/30/2003	0	0	0	0	0	0	0	0	0
4/30/2003	0	0	0	0	0	0	0	0	0
Summary for 'MP' = 15 (9 detail records)									
Sum		0	0	0	0	0	0	0	0
Avg	0	0	0	0	0	0	0	0	0
Min	0	0	0	0	0	0	0	0	0
Max	0	0	0	0	0	0	0	0	0

MP 16

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	3662.642045	12060.11974		13.64466101	5.2818042638	41.3741334	6210.521514		23504.02897
9/30/2002	11812.5	28490.21812	212.9313761	39.74719020	31.229935159		16651.23361		60472.51081
10/30/2002	29133	30248.61759	1645.468781	185.5528625	161.04588069	80.522940346	31999.11629	2100.598444	86124.5362
11/26/2002	19964.868	19433.81402	887.7174305	76.77556155	43.186253374	47.984725971	17658.37916		54222.74035
12/23/2002	102135.0023	31298.34428	4786.805596	233.2033495	135.01246552		60878.34809	4909.544201	189017.4517
1/30/2003	19964.868	34572.99506	287.9083558	141.5549416	52.783198568	50.38396227	25024.03459	1919.389039	72456.93622
3/4/2003	100105.5908	71097.18311	3849.593671	372.9293869	156.38974289	228.56962422	74224.97797	4811.992089	214133.648
3/30/2003	91277.65105	77661.23512	6910.533633	405.8567372	153.56741408	745.89886837	82158.56653	24132.02221	195249.9979
4/30/2003	21471.74715	34266.68083		79.98999291	46.445802337		27274.00726	1548.193411	84634.57315
Summary for 'MP' = 16 (9 detail records)									
Sum		339129.2079	18580.95884	1549.254683	784.94249687	1194.7342546	342079.1850	39421.7394	979816.4233
Avg	44391.98548	37681.0231	2654.422692	172.1394093	87.215832986	199.12237576	38008.79834	6570.289899	108868.4915
Min	3662.642045	12060.11974	212.9313761	13.64466101	5.2818042638	41.3741334	6210.521514	1548.193411	23504.02897
Max	102135.0023	77661.23512	6910.533633	405.8567372	161.04588069	745.89886837	82158.56653	24132.02221	214133.648

MP 17

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	18.75	22.03670749	1.171685879	0.137447767	0.0383051153	0.4326224784	5.227521614	7.21037464	28.84149856
9/30/2002	37.125	28.06232745	1.293811599	0.089228386	0.0223070965	0.0669212896	14.54422695		69.59814121
10/30/2002	8496	3062.967147	377.7659481	16.33582478	8.1679123919		4165.63532	612.5934294	13477.05545
11/26/2002	1070.179704	299.6534012	47.58444569	0.64303305	0.3858198299		529.8592330		1620.443286
12/23/2002	3564.309006	1113.666808	227.0166955	1.713333551			1571.983533		4797.333943
1/30/2003	1070.179704	398.6804909	32.15165249	0.77163966	0.3858198299		706.0502887	51.44264398	1491.836676
3/4/2003	3511.99809	911.6215907	54.86611425	3.376376262		4.2204703272	1857.006944	-84.4094065	5486.611425
3/30/2003	4292.44211	1139.995929	149.5922260	6.190023147		24.760092586	2032.390933	1031.670524	4539.350307
4/30/2003	3485.842632	1399.138876	50.26846262	6.702461683	0.8378077104		2144.787739	335.1230842	6534.900141
Summary for 'MP' = 17 (9 detail records)									
Sum		8375.823279	941.7110422	35.95936829	9.8379719739	29.480106681	13027.48574	1953.630650	38045.97086
Avg	2838.53625	930.647031	104.6345602	3.995485365	1.6396619957	7.3700266703	1447.498415	325.6051083	4227.330096
Min	18.75	22.03670749	1.171685879	0.089228386	0.0223070965	0.0669212896	5.227521614	-84.4094065	28.84149856
Max	8496	3062.967147	377.7659481	16.33582478	8.1679123919	24.760092586	4165.63532	1031.670524	13477.05545

MP 18

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	91.5	0	33.86712968		0.7916991354	4.1674162824	464.2435764		875.2673775
9/30/2002	131.25	0	43.69036383	0.078863473	1.0094524496	3.4699927954	699.5190022		1223.961095
10/30/2002	209.375	0	80.76746218	10.41673811	1.4593497839	7.2715877161	1049.977008	20.12896254	1871.993516
11/26/2002	538.736064	0	434.4153368	0.647414809	7.7042362259	35.543073009	2798.126804		4234.092850
12/23/2002	278.80164	0	156.4655694	0.636583687	3.0824052210	12.731673739	1216.209886		2171.085417
1/30/2003	538.736064	3.237074044	168.9752651	0.582673328	7.7689777068	16.185370222	2443.990904	77.68977707	3793.850780
3/4/2003	278.80164	0	98.83799350	0.536070473	3.8195021217	10.486878632	1255.410039	-6.70088092	1923.152823
3/30/2003	192.399552	1.156060709	52.94758046	0.138727285	1.8728183481	4.6242428348	761.3815828	27.74545701	1137.563737

4/30/2003	143.555022	0.862571242	26.73970849	0.224268523	1.7596453331	2.9327422218	634.1623769	13.80113987	1124.792899
Summary for 'MP' = 18 (9 detail records)										
Sum		5.255705995	1096.706409	13.26133969	29.268086325	97.412977453	11323.02118	132.6644556	18355.76049
Avg	267.0172202	0.583967333	121.8562677	1.657667461	3.2520095917	10.823664161	1258.113464	26.53289111	2039.528944
Min	91.5	0	26.73970849	0.078863473	0.7916991354	2.9327422218	464.2435764	-6.70088092	875.2673775
Max	538.736064	3.237074044	434.4153368	10.41673811	7.7689777068	35.543073009	2798.126804	77.68977707	4234.092850

MP 2

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	18	0	151.3097118	9.476595389	1.2199953890	18.457838040	301.0619827	2.595734870	639.4160231
9/30/2002	13.2	0	116.8614259	8.178872161	0.9945990778	14.162329452	227.5839389		531.0873545
10/30/2002	10.8	0	97.71643919	6.542549741	0.7255078963	11.61850928	192.2401245	0.778720461	333.0327839
11/26/2002	12	0	109.3813833	6.989737176	0.7441106628	13.907370605	210.1103170		334.2729683
12/23/2002	36	0	135.800196	6.90898098	0.9171596542	14.981716427	280.7287262	1.730489914	500.1115850
1/30/2003	12	0	45.75703746	2.631786744	0.3706132565	5.0890824207	98.98402305		157.7629971
3/4/2003	36	0	96.25850144	5.840403458	0.8392876081	11.719742939	223.1899366	2.595734870	349.5589625
3/30/2003	36	0	105.776196	7.549262248	0.8522662824	10.992937176	236.9905937	6.056714697	427.4310086
4/30/2003	42	0	122.3961095	9.135544669	1.0447832853	13.395434006	256.5018674	3.028357349	619.8038040
Summary for 'MP' = 2 (9 detail records)									
Sum		0	981.2570006	63.25373256	7.7083231124	114.32496035	2027.391510	16.78575216	3892.477487
Avg	24	0	109.0285556	7.028192507	0.8564803458	12.702773372	225.2657233	2.797625360	432.4974986
Min	10.8	0	45.75703746	2.631786744	0.3706132565	5.0890824207	98.98402305	0.778720461	157.7629971
Max	42	0	151.3097118	9.476595389	1.2199953890	18.457838040	301.0619827	6.056714697	639.4160231

MP 3

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	250.47495	0	276.0197858	2.167221873	2.3779239994	20.799309919	1070.968809		2058.860779
9/30/2002	61.875	0	61.49322947	0.542806016	0.5948559078	4.6696188761	265.6031628		548.7545749
10/30/2002	99	0	104.5756686	0.642444380	0.9636665706	9.708048415	446.7367867	2.379423631	754.2772911

	11/26/2002	136.784856	0	119.6674336	0.46025936	0.9205187197	8.2353549743	465.1907101		710.1144409
	12/23/2002	121.658808	0	98.83182912	0.423982699	0.7310046533	6.1258189943	371.6427657		640.3600763
	1/30/2003	0	0	0	0	0	0	0	0	0
	3/4/2003	178.218882	0	144.5653020	0.749597862	1.2636078253	11.522390000	609.9584892	12.85024907	933.7847658
	3/30/2003	163.092834	0	143.467173	0.803572963	1.0975630719	10.034862372	551.5254436	-3.91986811	815.3325677
	4/30/2003	121.963848	0	99.07963412	0.688867279	0.8940617872	7.0938672951	431.787873	2.931350122	882.3363867
Summary for 'MP' = 3 (9 detail records)										
Sum			0	1047.700056	6.478752432	8.8432025351	78.189270846	4213.414040	14.24115471	7343.820883
Avg		125.8965753	0	116.4111173	0.719861381	0.9825780595	8.6876967606	468.1571156	2.848230942	815.9800981
Min		0	0	0	0	0	0	0	-3.91986811	0
Max		250.47495	0	276.0197858	2.167221873	2.3779239994	20.799309919	1070.968809	12.85024907	2058.860779

MP 4

	Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
	9/9/2002	0	0	0	0	0	0	0	0	0
	9/30/2002	264.84375	0	2025.154829	203.247505	14.926883781	174.88960847	2433.177537		6008.945965
	10/30/2002	156.25	0	1089.630313	74.01900216	9.482393732	116.79304755	1595.295389		3199.603746
	11/26/2002	463.66695	0	2563.686722	199.1440197	21.452279679	256.20151160	3477.498116	11.14404139	5962.062145
	12/23/2002	471.048672	0	1376.123219	54.56942754	10.132704906	136.93303446	2035.598148	11.321458	4166.296542
	1/30/2003	456.576615	0	5585.57673	434.6105430	27.21459782	738.03136143	7152.062149	76.81539707	12114.88548
	3/4/2003	333.748692	0	2389.206858	220.9525026	11.550974903	268.76070426	2965.151301	40.10755175	5454.627038
	3/30/2003	323.66466	0	2767.430782	207.2364189	11.435342936	312.60493597	3310.415093	-7.77914485	6798.972603
	4/30/2003	270.723492	0	3334.046404	271.4606089	12.297712147	372.51006371	4166.256660		8927.228077
Summary for 'MP' = 4 (9 detail records)										
Sum			0	21130.85586	1665.240028	118.49288990	2376.7242675	27135.45439	131.6093034	52632.6216
Avg		304.5025368	0	2347.872873	185.0266697	13.165876656	264.08047416	3015.050488	21.93488389	5848.069066
Min		0	0	0	0	0	0	0	-7.77914485	0
Max		471.048672	0	5585.57673	434.6105430	27.21459782	738.03136143	7152.062149	76.81539707	12114.88548

MP 5

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	19.98	0	288.7748554	25.38875298	0.8211607262	14.451948571	405.6101798		746.7280288
9/30/2002	24	0	321.8711239	30.64986052	0.9950317003	22.516557925	409.2320231		920.6206340
10/30/2002	40.2	0	422.5632847	45.11142052	1.4589472046	32.236936081	593.0475458	0.966190202	1131.408726
11/26/2002	30	0	352.4431124	43.09640922	1.1103976945	25.261547550	456.5609222	0.721037464	726.0847262
12/23/2002	36	0	256.8479654	33.12590317	0.9863792507	18.200427666	295.4811527		654.1251873
1/30/2003	30	0	265.0173199	45.48304323	0.8508242075	20.358492795	305.3954179	28.1204611	642.4443804
3/4/2003	36	0	241.9657522	35.75624784	0.7743942363	18.304257061	325.4618905	2.595734870	648.0684726
3/30/2003	36	0	185.551781	22.66076542	0.6316288184	13.943422478	275.8400922	-0.86524496	452.5231124
4/30/2003	36	0	239.3700173	25.49444265	0.7354582133	16.729511239	364.0085533	1.730489914	802.0820749
Summary for 'MP' = 5 (9 detail records)									
Sum		0	2574.405212	306.7668455	8.3642220519	182.00310137	3430.637777	33.26866859	6724.085343
Avg	32.02	0	286.0450236	34.08520506	0.9293580058	20.222566818	381.1819753	5.544778098	747.1205937
Min	19.98	0	185.551781	22.66076542	0.6316288184	13.943422478	275.8400922	-0.86524496	452.5231124
Max	40.2	0	422.5632847	45.48304323	1.4589472046	32.236936081	593.0475458	28.1204611	1131.408726

MP 6

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	23.4375	0	20.30734420	0.557677414	1.6955646614	1.1125382745	122.4355412	0.563310519	230.9573127
9/30/2002	86.625	0	58.60817831	1.415757061	6.3292668588	5.1529393012	440.6543851		809.8963184
10/30/2002	1152	0	610.5168415	10.52137867	46.654008069	43.746785014	3782.158755	55.37567723	6506.642075
11/26/2002	282.24072	0	216.7340316	2.950838928	14.991618463	18.451222724	1278.696869	6.783537766	2021.494254
12/23/2002	921.01416	0	566.6864761	3.873833333	29.441133330	50.581195233	2659.663285	22.13619047	4980.642857
1/30/2003	0	0	0	0	0	0	0	0	0
3/4/2003	580.98312	0	330.2411861	5.725111471	17.803700307	29.184104817	1839.715698	97.74580561	3113.902093
3/30/2003	807.63645	0	400.8413748	3.785184895	22.516997325	41.151753732	2247.817492	-19.4112046	3358.138394

	4/30/2003	760.3675500	0	432.2065012	4.751530246	24.488655884	31.98145358	2484.502065	219.301396	4916.006293
Summary for 'MP' = 6 (9 detail records)										
Sum			0	2636.141934	33.58131202	163.9209449	221.36199268	14855.64409	382.494713	25937.6796
Avg		512.7005	0	292.9046593	3.731256891	18.213438322	24.595776964	1650.627121	47.81183912	2881.9644
Min		0	0	0	0	0	0	0	-19.4112046	0
Max		1152	0	610.5168415	10.52137867	46.654008069	50.581195233	3782.158755	219.301396	6506.642075

MP 7

	Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
	9/9/2002	24	0	27.48594813	4.277194236	0.4470432277	2.702448415	100.714513	2.307319885	189.7770605
	9/30/2002	30	0	30.17541787	5.836798271	0.6200922190	2.3866340058	123.2974063	2.163112392	239.3844380
	10/30/2002	2184.375	13.12513509	1890.019452	402.1541390	40.95042147	134.13888058	8914.591751		14385.14805
	11/26/2002	413.065488	0	528.1619603	73.41649806	7.843006554	41.796275433	1776.09351	79.42285118	2809.583360
	12/23/2002	476.931024	0	616.7006773	63.73337855	9.8580405664	42.985642005	2050.701695	114.6283787	3828.587848
	1/30/2003	388.695744	0	624.0549376	40.82515085	6.3993657519	52.035718595	1776.40788	28.02641935	2755.931236
	3/4/2003	585.65958	0	760.108497	99.16600669	12.246192451	67.565199731	2800.436768	197.0651659	3997.607651
	3/30/2003	550.270512	0	794.1925850	137.3470441	11.440076371	73.335518469	2770.746820	555.4719163	3927.979979
	4/30/2003	747.42426	0	1021.255092	218.1731415	17.245468574	127.54461133	3253.285790	4455.079382	6736.511162
Summary for 'MP' = 7 (9 detail records)										
Sum			13.12513509	6292.154568	1044.929351	107.04970718	544.49092857	23566.27613	5434.164545	38870.51079
Avg		600.0468453	1.458348343	699.1282853	116.1032613	11.894411909	60.498992063	2618.475126	679.2705682	4318.945643
Min		24	0	27.48594813	4.277194236	0.4470432277	2.3866340058	100.714513	2.163112392	189.7770605
Max		2184.375	13.12513509	1890.019452	402.1541390	40.95042147	134.13888058	8914.591751	4455.079382	14385.14805

MP 8

	Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
	9/9/2002	0	0	0	0	0	0	0		0
	9/30/2002	0	0	0	0	0	0	0		0
	10/30/2002	0	0	0	0	0	0	0		0

11/26/2002	0	0	0	0	0	0	0	0	0
12/23/2002	0	0	0	0	0	0	0	0	0
1/30/2003	0	0	0	0	0	0	0	0	0
3/4/2003	0	0	0	0	0	0	0	0	0
3/30/2003	0	0	0	0	0	0	0	0	0
4/30/2003	0	0	0	0	0	0	0	0	0
Summary for 'MP' = 8 (9 detail records)									
Sum		0	0	0	0	0	0	0	0
Avg	0	0	0	0	0	0	0	0	0
Min	0	0	0	0	0	0	0	0	0
Max	0	0	0	0	0	0	0	0	0

MP 9

Date	galmin	Alklbsday	Acidlbsday	Ironlbsday	Manglbsday	Alumlbsday	Sulflbsday	TSSlbsday	TDSlbsday
9/9/2002	270	0	135.9516138	0.876060519	2.0116945245	12.427080692	687.8697406		1194.038040
9/30/2002	25.3125	0	11.68080692	0.90343741	0.2707270353	0.9368980548	70.32819164		125.9336996
10/30/2002	301.5	0	126.4501427	2.391320749	4.4203201729	9.492818732	747.1065735		1246.385360
11/26/2002	3116.01312	0	1722.517685	16.47625612	35.573734798	110.84026842	7361.890801	74.89207326	13630.35733
12/23/2002	890.71065	0	509.5070269	4.923807403	10.810968428	33.717376781	1475.001435		2890.060867
1/30/2003	2968.113984	0	1840.504387	16.05091035	20.331153108	104.50926071	6787.751643		10914.61904
3/4/2003	280.255008	0	136.4001932	1.414520522	1.9533854823	7.8135419291	623.0626107	-6.73581201	969.9569291
3/30/2003	461.488456	0	251.2266018	2.329253262	2.7729205497	19.521360670	940.0200664	-11.0916822	1342.093546
4/30/2003	499.118625	0	264.5141723	3.298929586	2.8190852828	15.95482309	1001.075178	155.9493986	2111.314935
Summary for 'MP' = 9 (9 detail records)									
Sum		0	4998.752629	48.66449592	80.963989382	315.21342909	19694.10624	213.0139777	34424.75975
Avg	979.1680381	0	555.4169588	5.407166213	8.9959988202	35.023714343	2188.234027	53.25349442	3824.973305
Min	25.3125	0	11.68080692	0.876060519	0.2707270353	0.9368980548	70.32819164	-11.0916822	125.9336996
Max	3116.01312	0	1840.504387	16.47625612	35.573734798	110.84026842	7361.890801	155.9493986	13630.35733
Grand Total		349663.0219	125015.6968	13934.43602	1881.6815462	12578.132852	587487.5557	56481.84393	1424276.585

Appendix F – Chemical Concentrations by Source Location

Chemical Concentrations by Source Location

MONTRPOINT 1

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.03	1095	0	285.2	43.37	1.36	379.2	31.01	754
6/28/2002	2.62	2508	0	1128.7	197.83	4.68	710.4	114.05	572
7/26/2002	2.64	3586	0	2184.3	289.44	14.29	3144.2	288.39	5096
9/9/2002	2.84	3704	0	2382.3	221.15	17.19	3052.7	312.87	5394
9/30/2002	2.91	2496	0	1115	105.75	8.82	1586.2	152.24	3384
10/30/2002	3.18	1210	0	359.3	40.01	2.94	611.5	48.65	942
11/26/2002	3.05	1797	0	451.2	68.12	2.81	590	53.19	1056
12/23/2002	4.22	748	0	173.2	35.02	0.82	239.3	17.34	400
1/30/2003	2.78	2742	0	1203	176.77	6.36	1362.8	142.42	2466
3/4/2003	3.5	1030	0	222	36.5	1.52	323.7	29.21	538
3/30/2003	2.77	1594	0	451.5	72.82	2.48	663.2	53.77	974
4/30/2003	2.59	2930	0	1408.8	253.94	7.08	1732.1	166.26	3610

Summary for 'MONTRPOINT' = 1 (12 detail records)

Avg	3.01083333	2120	0	947.041667	128.393333	5.8625	1199.60833	117.45	2098.83333
Min	2.59	748	0	173.2	35.02	0.82	239.3	17.34	400
Max	4.22	3704	0	2382.3	289.44	17.19	3144.2	312.87	5394

MONTRPOINT 10

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.46	761	0	75.7	0.2	0.7	334.9	6.46	700
6/28/2002	3.45	777	0	95.2	0.21	0.85	320	8.05	742
7/26/2002									

9/9/2002									
10/30/2002									
12/23/2002	3.5	654	0	79.6	0.26	0.87	274.7	6.52	446
1/30/2003	3.55	773	0	88.5	0.55	0.78	354.7	9.1	594
3/4/2003	3.38	779	0	88.9	0.22	0.8	359.9	8	604
3/30/2003	3.37	676	0	72.8	0.21	0.62	295.4	6.87	478
4/30/2003	3.45	758	0	87.6	0.26	0.76	338	7.16	654

Summary for 'MONTRPOINT' = 10 (10 detail records)

Avg	3.45142857	739.71428571	0	84.0428571	0.27285714	0.76857143	325.371429	7.45142857	602.571429
Min	3.37	654	0	72.8	0.2	0.62	274.7	6.46	446
Max	3.55	779	0	95.2	0.55	0.87	359.9	9.1	742

MONTRPOINT 11

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.6	678	0	65.7	0.23	0.9	281.8	6.3	634
6/28/2002	3.7	662	0	74.7	0.45	1.07	300.4	6.99	638
7/26/2002	3.54	801	0	88.4	1.04	1.29	377.7	9.2	748
9/9/2002	3.62	864	0	102.3	2.47	1.6	425.8	12.46	824
9/30/2002	3.83	779	0	72	2.86	1.91	344.8	8.11	772
10/30/2002	4.02	676	0	61.2	0.76	1.88	361.7	7.08	556
11/26/2002	3.79	773	0	92.8	0.44	1.46	385.3	8.35	602
12/23/2002	3.75	596	0	67.9	0.15	1.08	253.3	5.59	434
1/30/2003	3.68	710	0	66.4	0.19	1.05	339.2	7.1	522
3/4/2003	3.55	687	0	72.4	0.2	1.04	307.1	6.79	524
3/30/2003	3.53	607	0	61.3	0.15	0.76	273.2	6.06	392
4/30/2003	3.28	684	0	74.4	0.38	0.88	313.4	6.54	608

Summary for 'MONTRPOINT' = 11 (12 detail records)										
Avg		3.6575	709.75	0	74.9583333	0.77666667	1.24333333	330.308333	7.5475	604.5
Min	3.28	596	0	61.2	0.15	0.76	253.3	5.59	392	
Max	4.02	864	0	102.3	2.86	1.91	425.8	12.46	824	

MONTRPOINT 12

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.53	1003	0	51.9	1.8	4.3	455.6	2.51	888
6/28/2002	3.44	987	0	64.7	2.06	3.48	446.2	3	910
7/26/2002	3.3	1056	0	73.7	1.77	3.32	438.1	3.9	824
9/9/2002	3.18	1155	0	101.6	2.65	2.99	537	7.26	938
9/30/2002	3.23	1182	0	88.5	2.52	3.13	518.8	4.9	1042
10/30/2002	3.23	1173	0	91.2	2.73	3.03	546.4	5.68	944
11/26/2002	3.31	1176	0	107.6	2.54	2.61	519.6	5.46	814
12/23/2002	3.31	1041	0	94.8	2.34	3.5	437.7	4.04	746
1/30/2003	3.37	1061	0	68.1	2.39	3.79	515.9	3.91	774
3/4/2003	3.28	1037	0	79.3	1.52	3.56	508.5	3.7	786
3/30/2003	3.39	950	0	61.7	1.7	3.77	426.7	3.35	668
4/30/2003	3.46	992	0	65.2	1.59	3.93	439.2	2.33	848

Summary for 'MONTRPOINT' = 12 (12 detail records)										
Avg		3.33583333	1067.75	0	79.025	2.13416667	3.45083333	482.475	4.17	848.5
Min	3.18	950	0	51.9	1.52	2.61	426.7	2.33	668	
Max	3.53	1182	0	107.6	2.73	4.3	546.4	7.26	1042	

MONTRPOINT 13

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	6.28	391	28.1	12.9	8.22	0.83	142.8	-0.1	316
6/28/2002	7.07	367	30.7	7.3	8.12	0.8	124.1	0.55	304
7/26/2002	6.58	339	19	13.9	10.09	0.96	127.6	0.25	232

9/9/2002	6.11	344	22.9	29.6	11.98	0.95	140.8	2.06	262
9/30/2002	6.39	373	30	20.8	10.71	1.02	146.4	-0.1	268
10/30/2002	6.62	424	49.2	17.1	8.33	0.7	148.4	0.17	338
11/26/2002	6.71	442	37.5	9.9	10.75	1.18	123	0.85	294
12/23/2002	6.43	371	27.6	13.6	9.32	0.87	141.5	-0.1	268
1/30/2003	6.37	442	37.7	12.3	9.06	1.47	181.2	-0.1	316
3/4/2003	6.55	435	35	23.5	7.43	0.85	156	-0.1	276
3/30/2003	6.67	443	35.2	13.1	8.08	0.88	166.8	0.81	274
4/30/2003	7.16	391	26.6	2.1	8.9	1.01	135.2	-0.1	338

Summary for 'MONTRPOINT' = 13 (12 detail records)

Avg	6.57833333	396.83333333	31.625	14.675	9.24916667	0.96	144.483333	0.34083333	290.5
Min	6.11	339	19	2.1	7.43	0.7	123	-0.1	232
Max	7.16	443	49.2	29.6	11.98	1.47	181.2	2.06	338

MONTRPOINT 14

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	4.01	748	0	88.4	0.06	0.71	388	11.8	798
6/28/2002	3.91	676	0	82.8	-0.04	0.51	319.1	9.15	668
7/26/2002	3.79	725	0	78.4	0.16	0.58	346.5	9.18	594
9/9/2002	3.79	803	0	90.3	0.08	0.68	386.3	11.75	790
9/30/2002	3.77	816	0	77.6	-0.04	0.76	406.8	10.07	808
10/30/2002	3.76	831	0	83.7	0.08	0.75	428.1	10.62	778
11/26/2002	3.74	808	0	94.8	-0.04	0.7	374.5	10.11	624
12/23/2002	3.77	682	0	77.6	-0.04	0.51	304.4	6.12	534
1/30/2003	4	612	0	53.1	-0.04	0.46	302.7	5.61	442
3/4/2003	3.78	698	0	71.2	0.12	0.57	361.7	7.26	538

3/30/2003	3.86	642	0	66.5	-0.04	0.51	327.3	8.34	468
4/30/2003	3.78	649	0	57.5	0.05	0.55	318.3	9.38	596

Summary for 'MONTRPOINT' = 14 (12 detail records)

Avg	3.83	724.16666667	0	76.825	0.02583333	0.6075	355.308333	9.11583333	636.5
Min	3.74	612	0	53.1	-0.04	0.46	302.7	5.61	442
Max	4.01	831	0	94.8	0.16	0.76	428.1	11.8	808

MONTRPOINT 15

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	6.54	437	43	12.3	0.21	0.18	148.2	0.21	342
6/28/2002	6.83	446	48.8	5.2	0.19	0.16	163.7	0.88	380
7/26/2002	7.22	495	57.2	11.1	0.21	0.18	193.8	0.86	360
9/9/2002	6.6	536	56.7	12.8	0.33	0.23	184.2	2.49	440
9/30/2002	6.75	529	62.7	10	0.25	0.23	198.1	0.62	400
10/30/2002	6.62	534	61.9	12.5	0.19	0.19	187.4	-0.1	412
11/26/2002	6.56	508	47.7	10.4	0.05	0.18	178.9	0.47	350
12/23/2002	6.49	456	36.7	13.3	0.21	0.15	152.8	0.29	328
1/30/2003	6.68	489	45.9	6.4	0.11	0.18	186.1	-0.1	322
3/4/2003	6.95	483	43.8	9.6	0.05	0.15	165.2	-0.1	370
3/30/2003	6.84	455	42.5	7.1	0.15	0.14	185.5	0.58	294
4/30/2003	7.5	462	46.3	1.6	0.18	0.15	166.2	0.29	384

Summary for 'MONTRPOINT' = 15 (12 detail records)

Avg	6.79833333	485.83333333	49.4333333	9.35833333	0.1775	0.17666667	175.841667	0.5325	365.166667
Min	6.49	437	36.7	1.6	0.05	0.14	148.2	-0.1	294
Max	7.5	536	62.7	13.3	0.33	0.23	198.1	2.49	440

MONTRPOINT 16

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	7.32	321	61.4	3.5	0.39	0.17	80.7	-0.1	246

6/28/2002	7.64	443	119.1	1.7	0.29	0.19	98.5	0.74	286
7/26/2002	8.33	660	213.9	0	0.46	0.15	129.1	0.99	424
9/9/2002	8.29	773	274	-1	0.31	0.12	141.1	0.94	534
9/30/2002	8.16	626	200.7	1.5	0.28	0.22	117.3	-0.1	426
10/30/2002	7.21	385	86.4	4.7	0.53	0.46	91.4	0.23	246
11/26/2002	7.49	360	81	3.7	0.32	0.18	73.6	0.2	226
12/23/2002	6.87	219	25.5	3.9	0.19	0.11	49.6	-0.1	154
1/30/2003	7.83	511	144.1	1.2	0.59	0.22	104.3	0.21	302
3/4/2003	7.55	311	59.1	3.2	0.31	0.13	61.7	0.19	178
3/30/2003	7.48	338	70.8	6.3	0.37	0.14	74.9	0.68	178
4/30/2003	8.01	488	132.8	-1	0.31	0.18	105.7	-0.1	328

Summary for 'MONTRPOINT' = 16 (12 detail records)

Avg	7.68166667	452.91666667	122.4	2.30833333	0.3625	0.18916667	93.9916667	0.315	294
Min	6.87	219	25.5	-1	0.19	0.11	49.6	-0.1	154
Max	8.33	773	274	6.3	0.59	0.46	141.1	0.99	534

MONTRPOINT 17

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	6.91	150	24.9	2.8	0.28	0.03	28.6	-0.1	112
6/28/2002	6.77	158	35.2	2.5	0.36	-0.02	28.7	1.15	120
7/26/2002	7.37	320	54.2	2.3	0.38	0.05	85.4	0.93	248
9/9/2002	7.33	218	97.8	5.2	0.61	0.17	23.2	1.92	128
9/30/2002	7.52	208	62.9	2.9	0.2	0.05	32.6	0.15	156
10/30/2002	6.69	184	30	3.7	0.16	0.08	40.8	-0.1	132
11/26/2002	6.76	192	23.3	3.7	0.05	0.03	41.2	-0.1	126
12/23/2002	6.93	169	26	5.3	0.04	-0.02	36.7	-0.1	112

1/30/2003	6.84	214	31	2.5	0.06	0.03	54.9	-0.1	116
3/4/2003	7.05	193	21.6	1.3	0.08	-0.02	44	0.1	130
3/30/2003	6.71	160	22.1	2.9	0.12	-0.02	39.4	0.48	88
4/30/2003	7.19	206	33.4	1.2	0.16	0.02	51.2	-0.1	156

Summary for 'MONTRPOINT' = 17 (12 detail records)

Avg	7.00583333	197.66666667	38.5333333	3.025	0.20833333	0.03166667	42.225	0.34416667	135.333333
Min	6.69	150	21.6	1.2	0.04	-0.02	23.2	-0.1	88
Max	7.52	320	97.8	5.3	0.61	0.17	85.4	1.92	248

MONTRPOINT 18

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
9/9/2002	4.35	874	0	30.8	-0.04	0.72	422.2	3.79	796
9/30/2002	4.38	873	0	27.7	0.05	0.64	443.5	2.2	776
10/30/2002	4.33	863	0	32.1	4.14	0.58	417.3	2.89	744
11/26/2002	4.07	852	0	67.1	0.1	1.19	432.2	5.49	654
12/23/2002	3.91	739	0	46.7	0.19	0.92	363	3.8	648
1/30/2003	4.65	797	-1	26.1	0.09	1.2	377.5	2.5	586
3/4/2003	3.93	751	0	29.5	0.16	1.14	374.7	3.13	574
3/30/2003	4.61	670	-1	22.9	0.06	0.81	329.3	2	492
4/30/2003	4.61	688	-1	15.5	0.13	1.02	367.6	1.7	652

Summary for 'MONTRPOINT' = 18 (9 detail records)

Avg	4.31555556	789.66666667	-0.3333333	33.1555556	0.54222222	0.91333333	391.922222	3.05555556	658
Min	3.91	670	-1	15.5	-0.04	0.58	329.3	1.7	492
Max	4.65	874	0	67.1	4.14	1.2	443.5	5.49	796

MONTRPOINT 19

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
9/9/2002	6.9	484	104.6	10.7	0.85	0.14	138.4	2.04	344
9/30/2002	7.19	493	103.6	9.2	0.72	0.17	144.9	-0.1	356

10/30/2002	7.15	492	104.1	10.3	0.52	0.13	135.5	-0.1	336
11/26/2002	7.03	482	92.4	11.3	0.43	0.08	140.4	0.26	336
12/23/2002	6.8	452	95.6	8.5	0.36	0.06	111.3	-0.1	336
1/30/2003	6.92	465	86.9	5.3	0.37	0.08	134.3	-0.1	280
3/4/2003	7.05	457	83.5	10.7	0.39	0.06	126.3	-0.1	314
3/30/2003	7.2	434	83.7	7.5	0.29	0.05	135.9	0.41	268
4/30/2003	7.66	433	81.8	1.6	0.37	0.06	126.1	-0.1	308

Summary for 'MONTRPOINT' = 19 (9 detail records)

Avg	7.1	465.77777778	92.9111111	8.34444444	0.47777778	0.09222222	132.566667	0.23444444	319.777778
Min	6.8	433	81.8	1.6	0.29	0.05	111.3	-0.1	268
Max	7.66	493	104.6	11.3	0.85	0.17	144.9	2.04	356

MONTRPOINT 2

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.09	1262	0	228.3	19.1	2.01	526.4	22.29	1132
6/28/2002	6.02	772	5.7	8.4	6.27	2.11	360.1	4.34	746
7/26/2002	4.33	1443	0	194.5	18.12	5.36	937.9	34.84	1660
9/9/2002	2.87	2220	0	699.5	43.81	5.64	1391.8	85.33	2956
9/30/2002	2.98	2346	0	736.7	51.56	6.27	1434.7	89.28	3348
10/30/2002	2.96	2290	0	752.9	50.41	5.59	1481.2	89.52	2566
11/26/2002	3.06	2320	0	758.5	48.47	5.16	1457	96.44	2318
12/23/2002	3.18	1311	0	313.9	15.97	2.12	648.9	34.63	1156
1/30/2003	3.06	1422	0	317.3	18.25	2.57	686.4	35.29	1094
3/4/2003	3.1	1146	0	222.5	13.5	1.94	515.9	27.09	808
3/30/2003	2.94	1257	0	244.5	17.45	1.97	547.8	25.41	988
4/30/2003	2.93	1328	0	242.5	18.1	2.07	508.2	26.54	1228

Summary for 'MONTRPOINT' = 2 (12 detail records)										
Avg	3.37666667	1593.0833333	0.475	393.291667	26.7508333	3.5675	874.691667	47.5833333	1666.66667	
Min	2.87	772	0	8.4	6.27	1.94	360.1	4.34	746	
Max	6.02	2346	5.7	758.5	51.56	6.27	1481.2	96.44	3348	

MONTRPOINT 3

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.48	656	0	63.1	0.38	0.56	259.4	4.78	524
6/28/2002	3.47	658	0	64.5	0.32	0.52	257.6	4.51	526
7/26/2002	3.29	766	0	77.9	0.46	0.71	327.3	7.03	628
9/9/2002	3.4	830	0	91.7	0.72	0.79	355.8	6.91	684
9/30/2002	3.4	837	0	82.7	0.73	0.8	357.2	6.28	738
10/30/2002	3.35	846	0	87.9	0.54	0.81	375.5	8.16	634
11/26/2002	3.56	700	0	72.8	0.28	0.56	283	5.01	432
12/23/2002	3.41	643	0	67.6	0.29	0.5	254.2	4.19	438
1/30/2003									
3/4/2003	3.24	694	0	67.5	0.35	0.59	284.8	5.38	436
3/30/2003	3.36	665	0	73.2	0.41	0.56	281.4	5.12	416
4/30/2003	3.38	696	0	67.6	0.47	0.61	294.6	4.84	602

Summary for 'MONTRPOINT' = 3 (12 detail records)										
Avg	3.39454545	726.45454545	0	74.2272727	0.45	0.63727273	302.8	5.65545455	550.727273	
Min	3.24	643	0	63.1	0.28	0.5	254.2	4.19	416	
Max	3.56	846	0	91.7	0.73	0.81	375.5	8.16	738	

MONTRPOINT 4

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	2.74	1613	0	571.3	44.02	3.15	743.7	59.37	1740
6/28/2002	2.63	2312	0	996	137.58	5.2	1204.1	97.05	2160
7/26/2002	2.58	2688	0	1553.4	202.16	6.96	1989.5	164.47	3638

9/9/2002										
9/30/2002	2.71	1813	0	636.3	63.86	4.69	764.5	54.95	1888
10/30/2002	2.73	1788	0	580.3	39.42	5.05	849.6	62.2	1704
11/26/2002	2.95	1434	0	460.1	35.74	3.85	624.1	45.98	1070
12/23/2002	3.07	985	0	243.1	9.64	1.79	359.6	24.19	736
1/30/2003	2.87	2170	0	1018	79.21	4.96	1303.5	134.51	2208
3/4/2003	2.71	1592	0	595.7	55.09	2.88	739.3	67.01	1360
3/30/2003	2.67	1862	0	711.5	53.28	2.94	851.1	80.37	1748
4/30/2003	2.7	2272	0	1024.8	83.44	3.78	1280.6	114.5	2744

Summary for 'MONTRPOINT' = 4 (12 detail records)									
Avg	2.76	1866.2727273	0	762.772727	73.04	4.11363636	973.6	82.2363636	1908.72727
Min	2.58	985	0	243.1	9.64	1.79	359.6	24.19	736
Max	3.07	2688	0	1553.4	202.16	6.96	1989.5	164.47	3638

MONTRPOINT 5

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	2.57	1727	0	519.1	32.11	1.84	777.8	34.59	1596
6/28/2002	2.48	2866	0	815.8	64.34	2.3	1106.3	52.73	2618
7/26/2002	2.29	3450	0	1098.3	101.22	2.83	1502.4	72.11	3158
9/9/2002	2.37	3644	0	1202.7	105.74	3.42	1689.3	60.19	3110
9/30/2002	2.39	3354	0	1116	106.27	3.45	1418.9	78.07	3192
10/30/2002	2.5	2586	0	874.7	93.38	3.02	1227.6	66.73	2342
11/26/2002	2.62	2728	0	977.6	119.54	3.08	1266.4	70.07	2014
12/23/2002	2.76	1851	0	593.7	76.57	2.28	683	42.07	1512
1/30/2003	2.75	2196	0	735.1	126.16	2.36	847.1	56.47	1782
3/4/2003	2.61	1813	0	559.3	82.65	1.79	752.3	42.31	1498

3/30/2003	2.69	1667	0	428.9	52.38	1.46	637.6	32.23	1046
4/30/2003	2.63	2144	0	553.3	58.93	1.7	841.4	38.67	1854

Summary for 'MONTRPOINT' = 5 (12 detail records)

Avg	2.555	2502.1666667	0	789.541667	84.9408333	2.46083333	1062.50833	53.8533333	2143.5
Min	2.29	1667	0	428.9	32.11	1.46	637.6	32.23	1046
Max	2.76	3644	0	1202.7	126.16	3.45	1689.3	78.07	3192

MONTRPOINT 6

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	4.07	489	0	34.1	0.52	2.04	221.5	3.1	424
6/28/2002	3.85	557	0	48	0.93	2.7	234.3	2.69	498
7/26/2002	3.68	703	0	64.9	1.3	3.99	330	4.95	638
9/9/2002	3.74	884	0	72.1	1.98	6.02	434.7	3.95	820
9/30/2002	3.88	813	0	56.3	1.36	6.08	423.3	4.95	778
10/30/2002	4.18	594	0	44.1	0.76	3.37	273.2	3.16	470
11/26/2002	4.18	734	0	63.9	0.87	4.42	377	5.44	596
12/23/2002	4.19	551	0	51.2	0.35	2.66	240.3	4.57	450
1/30/2003									
3/4/2003	4.15	556	0	47.3	0.82	2.55	263.5	4.18	446
3/30/2003	4.08	517	0	41.3	0.39	2.32	231.6	4.24	346
4/30/2003	4.02	565	0	47.3	0.52	2.68	271.9	3.5	538

Summary for 'MONTRPOINT' = 6 (12 detail records)

Avg	4.00181818	633	0	51.8636364	0.89090909	3.53	300.118182	4.06636364	545.818182
Min	3.68	489	0	34.1	0.35	2.04	221.5	2.69	346
Max	4.19	884	0	72.1	1.98	6.08	434.7	5.44	820

MONTRPOINT 7

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.08	1139	0	168.3	9.96	1.35	364.3	12.88	846

6/28/2002	3.13	1039	0	154.2	17.42	1.36	405.3	11.68	806
7/26/2002	3.26	877	0	122	15.21	1.51	366.7	10.75	712
9/9/2002	3.82	805	0	95.3	14.83	1.55	349.2	9.37	658
9/30/2002	4.25	792	0	83.7	16.19	1.72	342	6.62	664
10/30/2002	4.57	774	-1	72	15.32	1.56	339.6	5.11	548
11/26/2002	3.55	844	0	106.4	14.79	1.58	357.8	8.42	566
12/23/2002	3.61	949	0	107.6	11.12	1.72	357.8	7.5	668
1/30/2003	3.4	891	0	133.6	8.74	1.37	380.3	11.14	590
3/4/2003	3.27	896	0	108	14.09	1.74	397.9	9.6	568
3/30/2003	3.47	924	0	120.1	20.77	1.73	419	11.09	594
4/30/2003	3.32	880	0	113.7	24.29	1.92	362.2	14.2	750

Summary for 'MONTRPOINT' = 7 (12 detail records)

Avg	3.56083333	900.83333333	-0.0833333	115.408333	15.2275	1.5925	370.175	9.86333333	664.166667
Min	3.08	774	-1	72	8.74	1.35	339.6	5.11	548
Max	4.57	1139	0	168.3	24.29	1.92	419	14.2	846

MONTRPOINT 8

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	2.72	1790	0	524.3	71.59	1.79	793.3	36.13	1682
6/28/2002	2.77	1650	0	418.8	43.78	1.59	666	28.95	1550
7/26/2002	2.77	1590	0	401.5	50.81	1.62	760.6	32.63	1412
9/9/2002	2.99	1635	0	430.7	57.17	1.67	790.3	33.77	1562
9/30/2002	2.96	1712	0	434.5	32.57	1.84	705.5	37	1542
10/30/2002	2.94	1786	0	469.9	75.61	1.8	852.1	38.31	1518
11/26/2002	2.86	1788	0	462.9	75.74	1.82	844.2	37.43	1340
12/23/2002	3.03	1795	0	488.9	90.03	2.02	732.6	36.27	1502

1/30/2003	2.88	1744	0	490.4	61.5	1.89	783.7	40.11	1324
3/4/2003	2.81	1618	0	395.9	48.9	1.86	708.4	33.27	1318
3/30/2003	2.77	1654	0	426.3	43.16	1.73	707.8	36.05	1262
4/30/2003	2.84	1601	0	390.1	36.6	1.5	689.1	31.57	1430

Summary for 'MONTRPOINT' = 8 (12 detail records)

Avg	2.86166667	1696.9166667	0	444.516667	57.2883333	1.76083333	752.8	35.1241667	1453.5
Min	2.72	1590	0	390.1	32.57	1.5	666	28.95	1262
Max	3.03	1795	0	524.3	90.03	2.02	852.1	40.11	1682

MONTRPOINT 9

DATE	LAB_PH	CONDUCT	ALKAL	ACID	IRON	MANG	SULF	ALUM	TDS
5/30/2002	3.92	390	0	34.3	0.35	0.46	160.9	2.29	316
6/28/2002	3.93	389	0	45.3	0.47	0.51	156.3	2.81	306
7/26/2002	3.85	423	0	38	0.76	0.62	182.8	3.54	346
9/9/2002	3.91	461	0	41.9	0.27	0.62	212	3.83	368
9/30/2002	3.85	491	0	38.4	2.97	0.89	231.2	3.08	414
10/30/2002	4.12	458	0	34.9	0.66	1.22	206.2	2.62	344
11/26/2002	4.18	502	0	46	0.44	0.95	196.6	2.96	364
12/23/2002	3.83	398	0	47.6	0.46	1.01	137.8	3.15	270
1/30/2003	3.87	450	0	51.6	0.45	0.57	190.3	2.93	306
3/4/2003	3.81	424	0	40.5	0.42	0.58	185	2.32	288
3/30/2003	3.65	408	0	45.3	0.42	0.5	169.5	3.52	242
4/30/2003	3.78	424	0	44.1	0.55	0.47	166.9	2.66	352

Summary for 'MONTRPOINT' = 9 (12 detail records)

Avg	3.89166667	434.83333333	0	42.325	0.685	0.7	182.958333	2.97583333	326.333333
Min	3.65	389	0	34.3	0.27	0.46	137.8	2.29	242
Max	4.18	502	0	51.6	2.97	1.22	231.2	3.83	414