Water Quality Analysis of Copper and Lead for the Jones Falls in Baltimore County and Baltimore City, Maryland

FINAL

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List of Abbreviations

COMAR	Code of Maryland Regulations
Cu	Copper
CWA	Clean Water Act
DOC	Dissolved Organic Carbon
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
HAC	Hardness-adjusted Criteria
IBI	Index of Biotic Integrity
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
mg/l	Milligrams per Liter
NPDES	National Pollution Discharge Elimination System
Pb	Lead
ppb	Parts per billion
SCS	Soil Conservation Service
SSURGO	Soil Survey Geographic
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WER	Water Effects Ratio
WQA	Water Quality Analysis
WQLS	Water Quality Limited Segment
µg/l	Micrograms per Liter

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) implementing regulations direct each state to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

The Jones Falls (basin code 02-13-09-04), located in Baltimore County and Baltimore City, MD, was identified on the State's list of WQLSs as impaired by chlordane (1996 listing), copper (Cu) (1996 listing), lead (Pb) (1996 listing), zinc (Zn) (1996 listing), nutrients (1996 listing) suspended sediments (1996 listing), fecal coliform (2002 listing), polychlorinated biphenyls (PCBs) in fish tissue (2002 listing) and evidence of biological impacts (2002 listing). The PCB listing is designated for the Lake Roland impoundment while the remaining listings apply to the non-tidal streams. This report provides an analysis of recent heavy metals monitoring data, including hardness data. A data solicitation for metals was conducted by MDE and all readily available data from the past five years was considered. The study finds that the applicable aquatic life criteria for Cu and Pb and the designated uses supported by those criteria are being met in the Jones Falls except for the lower most 12-digit basin (basin code 02-13-09-04-10-32). Exceedances of the applicable criteria for Cu were found only in this basin. Based on impairment listing methodologies applied by the Maryland Department of the Environment (MDE), this 12-digit basin is impaired for Cu. The analysis supports the conclusion that a TMDL of Cu and Pb is not required for the entire 8-digit basin. Additional monitoring in the 12-digit basin is necessary to identify the source of impairment. An evaluation of this data will determine if a TMDL or implementation of a technological control is required to correct the impairment. Barring the receipt of any contradictory data, this report will be used to support the removal of the 8-digit basin from Maryland's list of WQLSs for Cu and Pb and to only list the 12-digit basin for Cu when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future. A TMDL of chlordane for Lake Roland was completed in 2001. A water quality analysis (WQA) of Zn was completed in 2003. The nutrient, suspended sediments, fecal coliform, PCBs and biological impairments will be addressed at a future date.

Although the remaining 12-digit basins in the Jones Falls do not display signs of toxic impairments due to Cu and Pb exceeding water quality criteria, the State reserves the right to require additional pollution controls in the Jones Falls watershed if evidence suggests that Cu and Pb from the basin are contributing to downstream water quality problems.

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and U.S. Environmental Protection Agency (EPA)'s implementing regulations direct each State to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

A segment identified as a WQLS may not require the development and implementation of a TMDL if current information contradicts the previous finding of an impairment. The most common factual scenarios obviating the need for a TMDL are as follows: 1) more recent data indicating that the impairment no longer exists (i.e., water quality criteria are being met); 2) more recent and updated water quality modeling demonstrates that the segment is now attaining criteria; 3) refinements to water quality criteria, or the interpretation of those standards, which result in standards being met; or 4) correction to errors made in the initial listing.

The Jones Falls (basin code 02-13-09-04) was first identified on the 1996 303(d) list submitted to EPA by the Maryland Department of the Environment (MDE) as impaired by copper (Cu), lead (Pb), zinc (Zn), chlordane, suspended sediments and nutrients, with fecal coliform, polychlorinated biphenyls (PCBs) in fish tissue and biological impairment added to the list in 2002. The PCB listing is designated for the Lake Roland impoundment while the remaining listings apply to the non-tidal streams. The initial listing for Cu and Pb is questionable because: 1) the listing was based on total recoverable metals (current standard is based on dissolved metals); 2) inappropriate sampling techniques were applied (lack of filtration); 3) supporting hardness data needed to interpret criteria was not available; and 4) a default hardness of 100 mg/L was used to convert and relate the total recoverable metals to the dissolved criteria, which superceded the total recoverable metals criteria.

A water quality analysis (WQA) of Cu and Pb for Jones Falls was performed using recent water column data. A data solicitation for metals was conducted by MDE and all readily available data from the past five years was considered. Two exceedances of the applicable aquatic life criteria for Cu were found in the lower most 12-digit basin (basin code 02-13-09-04-10-32) of the watershed. The 12-digit basins are displayed in Figure 1. No additional exceedances were found outside of this basin. Based on impairment listing methodologies adopted by the Maryland Department of the Environment (MDE), only the 12-digit basin is impaired for Cu. The analysis supports the conclusion that a TMDL of Cu and Pb is not required for the entire 8-digit basin. Additional monitoring in the 12-digit basin is necessary to identify the source of impairment. An evaluation of this data will determine if a TMDL or implementation of a technological control is required to correct the impairment. This report will be used to support the removal of the 8-digit basin from Maryland's list of WQLSs for Cu and Pb and to list only the 12-digit basin for Cu when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future. A TMDL for chlordane was completed in 2001. A

water quality analysis (WQA) for Zn was completed in 2003. The nutrient, suspended sediments, fecal coliform, PCB and biological impairments will be addressed at a future date. The remainder of this report lays out the general setting of the waterbody within the Jones Falls watershed, presents a discussion of the water quality characterization process, and provides conclusions with regard to the characterization. .

2.0 GENERAL SETTING

The Jones Falls watershed is located in the Patapsco River region of the Chesapeake Bay watershed within Maryland (see Figure 1). The watershed covers a portion of Baltimore County and Baltimore City, MD. The watershed area covers 37,290 acres.

The Jones Falls watershed lies within the Piedmont and Coastal Plain provinces of Central Maryland. The piedmont province is characterized by gentle to steep rolling topography, low hills and ridges. The surficial geology is characterized by crystalline rocks of volcanic origin consisting primarily of schist and gneiss. These formations are resistant to short-term erosion and often determine the limits of stream bank and stream bed. These crystalline formations decrease in elevation from northwest to southeast and eventually extend beneath the younger sediments of the Coastal Plain. The fall line represents the transition between the Atlantic Coastal Plain Province and the Piedmont Province. The Atlantic Coastal Plain surficial geology is characterized by thick, unconsolidated marine sediments deposited over the crystalline rock of the piedmont province. The deposits include clays, silts, sands and gravels (Coastal Environmental Services, 1995).

The Jones Falls watershed drains from northwest to southeast, following the dip of the underlying crystalline bedrock in the Piedmont Province. The surface elevations range from approximately 680 feet to sea level at the Chesapeake Bay shorelines. Stream channels of the sub-watersheds are well incised in the Eastern Piedmont, and exhibit relatively straight reaches and sharp bends, reflecting their tendency to following zones of fractured or weathered rock. The stream channels broaden abruptly as they flow down across the fall line into the soft, flat Coastal Plain sediments (Coastal Environmental Services, 1995).

The watershed is comprised primarily of B and C type soils. Soil type is categorized by four hydrologic soil groups developed by the Soil Conservation Service (SCS). The definitions of the groups are as follows (SCS, 1976):

> Group A: Soils with high infiltration rates, typically deep well-drained to excessively drained sands or gravels.
> Group B: Soils with moderate infiltration rates, generally moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
> Group C: Soils with slow infiltration rates, mainly soils with a layer that impedes downward water movement or soils with moderately fine to fine texture.
> Group D: Soils with very slow infiltration rates, mainly clay soils, soils with a permanently high water table, and shallow soils over nearly impervious material.

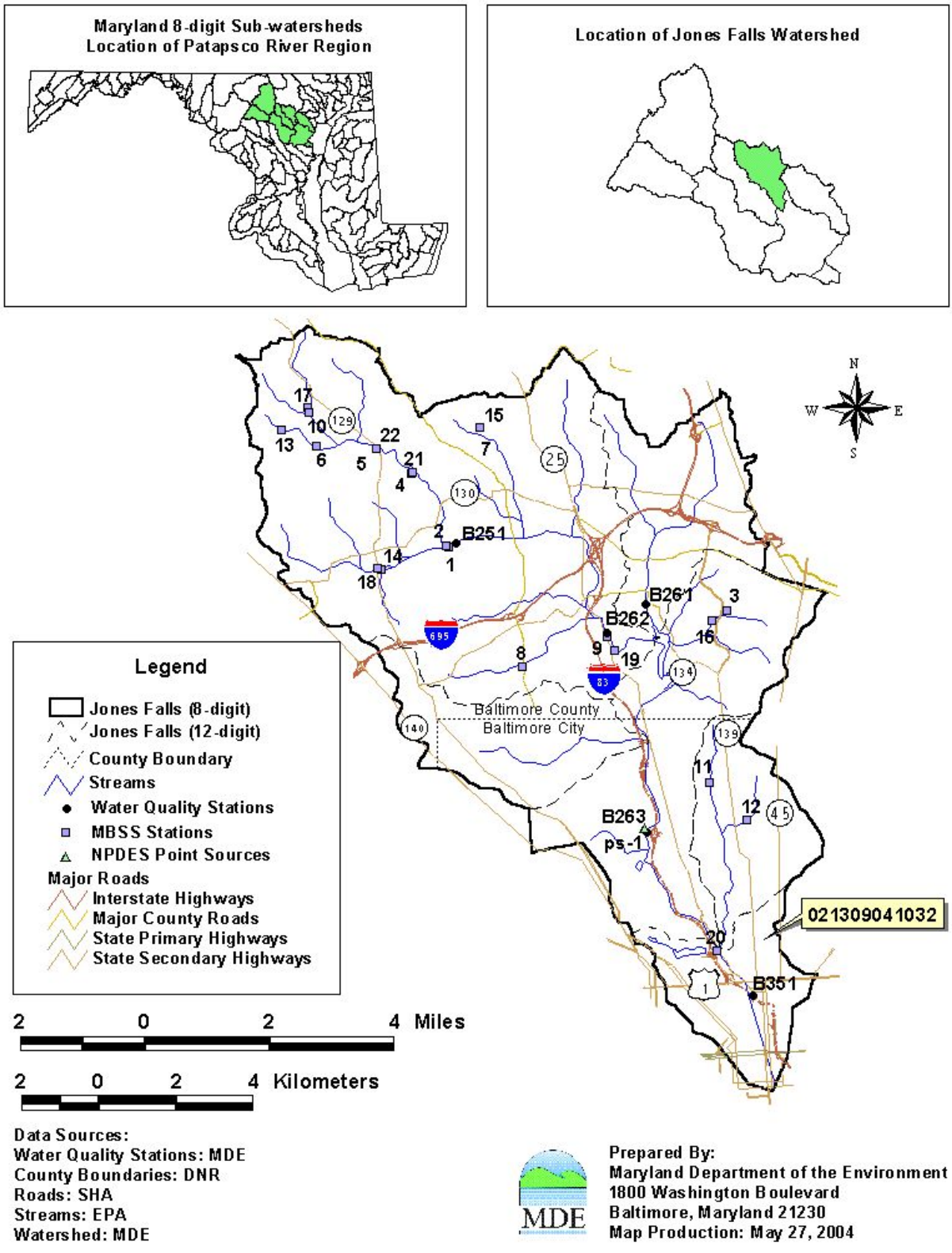


Figure 1: Watershed Map of the Jones Falls

The soil distribution within the watershed is approximately 1.2% soil group A, 65.4% soil group B, 14.8% soil group C and 18.1% soil group D. Soil data was obtained from Soil Survey Geographic (SSURGO) coverages created by the National Resources Conservation Service.

The primary land use in the Jones Falls watershed is developed urban land. Agricultural areas are located in the Baltimore County portion of the watershed (see Figure 2). Lake Roland is located just north of the Baltimore City boundary along the main stem of the Jones Falls. No major point sources discharge Cu or Pb within the watershed. One minor facility is regulated for Cu and is listed in Table 1. The location of this facility is displayed in Figure 1. The land use distribution in the watershed is approximately 16.1% forest/herbaceous, 75.6% urban, 7.9% agricultural and 0.4% water (Maryland Department of Planning, 2002).

Table 1: Jones Falls Point Source Facilities

Station	NPDES	Facility	Latitude	Longitude	Metals
ps-1	MD0002101	Fleischmann's Vinegar Company, Inc.	39.347	-76.650	Cu

3.0 WATER QUALITY CHARACTERIZATION

A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include support of aquatic life, primary or secondary contact recreation, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. The criteria developed to protect the designated use may differ and are dependent on the specific designated use(s) of a waterbody. Maryland's water quality standards presently include numeric criteria for metals and other toxic substances based on the need to protect aquatic life, wildlife and human health. The water quality standard is only applicable to the water column, therefore, MDE has also evaluated sediment quality and biological conditions of the watershed.

The Maryland Surface Water Use Designation (Code of Maryland Regulations (COMAR) 26.08.02.08J) for the Jones Falls is Use III (natural trout waters) for the mainstem and all tributaries above Lake Roland and Use IV (recreational trout waters) for the mainstem from North Avenue to Lake Roland. In addition, COMAR requires these waterbodies to support a Use I designation (water contact recreation, fishing and protection of aquatic life and wildlife). The applicable numeric aquatic life criteria and human health criteria (fish consumption) for dissolved concentrations of Cu and Pb in freshwater are described in Table 2 (COMAR 26.08.02.03-2G).

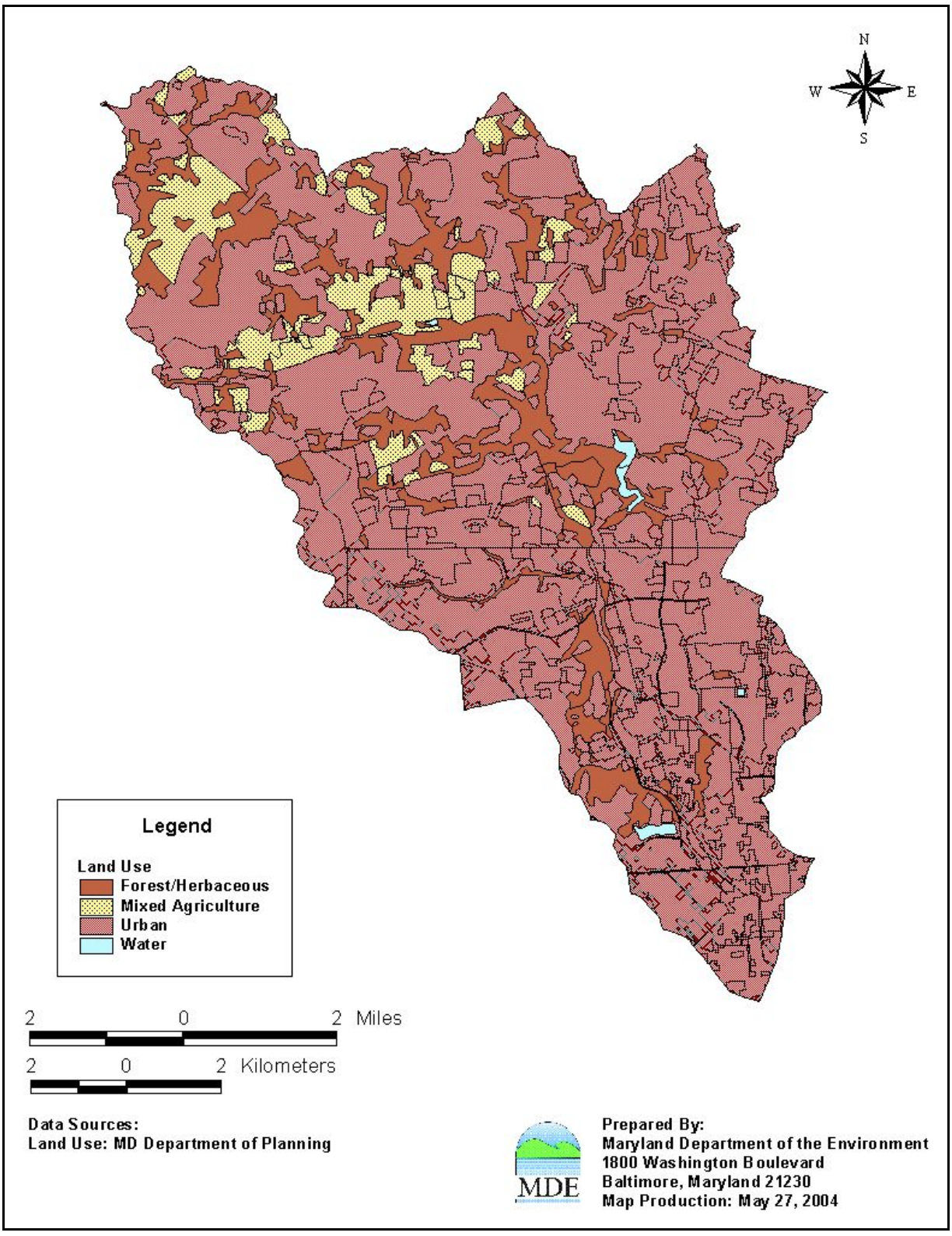


Figure 2: Land Use Map of Jones Falls Watershed

Table 2: Numeric Water Quality Criteria (Cu and Pb)

Metal	Fresh Water Aquatic Life Acute Criteria (µg/l) *	Fresh Water Aquatic Life Chronic Criteria (µg/l) *	Human Health Criteria Fish Consumption (µg/l)
Cu	13	9	1,300
Pb	65	2.5	-

* Assumes hardness of 100 mg/L

This water quality assessment considers the potential impact of Cu and Pb on indices of biological integrity (IBI). Maryland Biological Stream Survey (MBSS) data was collected at ten stations in 1995-1996 and seventeen stations in 2000-2002 throughout the watershed. Refer to Figure 1 for station locations. The MBSS data is presented in Table 3 (Maryland Department of Natural Resources, 2004).

Table 3: Jones Falls MBSS Data

Station	Sample Year	Fish IBI	Benthic IBI	Physical Habitat Index	Channel Alteration	Bank Stability
1	1996	2.56	3	99.92	6	10
2	1995	2.56	2.78	72.23	12	10
3	1996	1	2.11	6.87	6	18
4	1996	3	3.67	93.05	15	12
5	1995	2.56	3.44	58.96	12	10
6	1995	-	3	2.29	3	5
7	1995	-	3.67	52.91	7	7
8	1996	1	1.22	56.96	11	11
9	1995	3.22	3.22	63.33	7	8
10	2002	2.78	3.89	-	-	-
11	2002	1	1.44	-	-	-
12	2002	1	1.44	-	-	-
13	2002	-	4.11	-	-	-
14	2002	1.89	3.22	-	-	-
15	2000	-	4.11	-	-	-
15	2001	-	4.11	-	-	-
15	2002	-	3.89	-	-	-
16	2002	1.44	2.11	-	-	-
17	2002	2.56	3.89	-	-	-
18	2002	2.56	3.67	-	-	-
19	2002	3	3.44	-	-	-
20	2002	3.44	1.67	-	-	-
21	2000	3.22	4.33	-	-	-
21	2001	3.44	3.00	-	-	-
21	2002	3.44	3.44	-	-	-
22	2000	2.78	4.33	-	-	-

The average value for fish IBI was 2.1 in 1995-1996 and 2.5 in 2002 and the average value for benthic IBI was 2.7 in 1996 and 3.3 in 2002. The acceptable threshold for fish and benthic IBI is 3.0 or above. These data confirm the 2002 listing for biological impacts. The average physical habitat index for the 1995-1996 MBSS sampling was 56 out of 100. A rating of 72 or above is considered good. The channel alteration and bank stability average values for the 1995-1996 MBSS sampling were 8.6 and 10.1 (out of 20), respectively. Bank instability and channel alteration is significant for values less than 10. An additional Patapsco River Basin stream assessment study conducted by Maryland Department on Natural Resources (DNR) establishes that over 65 % of the stream miles in the basin have degraded bank conditions in term of unstable or moderately unstable stream banks (Boward, 1998). This information suggests that degraded physical habitat is a major contributing factor to the depressed fish and benthic IBI.

Sediment quality could not be assessed in this WQA due to the lack of depositional areas in the Jones Falls watershed. Field sampling teams observed no appreciable sediment in the streambed, as a result they were unable to collect samples. The Jones Falls is classified as a high gradient stream, therefore any sediment entering the channel tends to be flushed out leaving no appreciable deposition of fine grained material. Coarse grained material generally does not accumulate toxic substances. There are also no known sources of contaminated soil in the watershed thus any eroded sediments are expected to be clean, containing only trace amounts of Cu and Pb. Furthermore, the Cu and Pb concentrations within the water column are extremely low. Based on the weight of this evidence, it is unlikely that Cu and Pb have an impact on biological integrity in the water column or sediment.

Water column surveys conducted at five monitoring stations in the Jones Falls from May 2001 to April 2002 were used to support this WQA. For every grab sample, dissolved concentrations of Cu and Pb were analyzed. Table 4 shows the list of stations with their geographical coordinates and descriptive location in the Jones Falls. Refer to Figure 1 for station locations.

Table 4: Water Quality Analysis Stations for Jones Falls

Station I.D.	GPS coordinates	Station Description
B251	39.413 76.706	Villa Julie College
B261	39.399 76.650	Roland Run
B262	39.392 76.661	Jones Falls at Sorrento MD
B263	39.346 76.650	Cold Spring (near light rail)
B351	39.308 76.618	Jones Falls at Maryland Ave.

Water column sampling was performed six times at each station from May 2001 to April 2002 to capture seasonal variations. The sampling dates were as follows: May 21, 2001 (spring wet weather); June 11, 2001 (spring dry weather); July 25, 2001 (summer dry weather); July 30, 2001 (summer wet weather); April 3, 2002 (spring dry weather) and April 25, 2002 (spring wet weather).

For the water quality evaluation, a comparison is made between the Cu and Pb water column concentrations and the hardness-adjusted fresh water aquatic life chronic criteria, the most stringent of the numeric water quality criteria. Simultaneous hardness concentrations were obtained for each station to adjust the fresh water aquatic life chronic criteria that are established at a hardness of 100 mg/l for Cu and Pb.

The State uses hardness adjustment to calculate fresh water aquatic life chronic criteria for those metals (Cu and Pb in this analysis) for which toxicity is a function of total hardness. According to EPA's National Recommended Water Quality Criteria (EPA, Nov 2002), "allowable hardness values must fall within the range of 25 - 400 mg/L." MDE uses an upper limit of 400 mg/l in calculating the hardness-adjusted criteria (HAC) when the measured hardness exceeds this value. Based on technical information, EPA's Office of Research and Development does not recommend a lower limit on hardness for adjusting criteria (EPA, July 2002). A lower limit may result in criteria that is less protective of the water quality standard. In analyses where available hardness data indicates a value below 25 mg/L, the Department may perform additional analyses to insure data quality objectives for the assessments were met. When data is of questionable quality, the Department will take additional samples to establish the veracity of the initial assessment.

Under circumstances where a water quality criterion exceedance is the result of a hardness adjustment below 25 mg/l, the state will perform a scientific review of the following conditions to determine if the exceedance is valid:

A. Presence/absence of sensitive species in the waterbody of concern.
B. Existence of other environmental conditions (e.g. high Dissolved Organic Carbon (DOC)), which might mitigate the toxicity of metals due to competitive binding/complexation of metals.

This review is necessary because of the scientific uncertainty existing for hardness-toxicity relationships below 25 mg/l due to limited toxicity test data used to develop the relationship.

The HAC equation for Cu and Pb is as follows (EPA, 2002):

$$HAC = e^{(m[\ln(\text{Hardness(mg/l)})]+b)} * CF$$

Where,

HAC = Hardness-adjusted Criterion (µg/l)
m = slope
b = y intercept
CF = Conversion Factor (conversion from totals to dissolved numeric criteria)

The HAC parameters for Cu and Pb are presented in Table 5 (EPA, 2002).

In instances where hardness data is not available, the State will calculate an average of existing hardness concentrations for each station. In applying average hardness, the sampling date for

Table 5: HAC Parameters (Fresh Water Aquatic Life Chronic Criteria)

Chemical	Slope (m)	y Intercept (b)	Conversion Factor (CF)
Cu	0.8545	-1.702	0.960
Pb	1.2730	-4.705	1.462 - ln(hardness)*0.146

which hardness data is unavailable must not fall during a rainfall event substantially greater than the remaining sampling dates used to calculate the average. A major rainfall event has the potential to reduce hardness. An analysis of rainfall data from the National Weather Service (NWS) precipitation gauge (0180465) at Baltimore/Washington International Airport (BWI) shows no significant variation in storm events for the sampling dates, thus the average will apply. This is the closest gauge to Jones Falls and is likely to be representative of the rainfall events that occur within the watershed.

3.1 WATER COLUMN EVALUATION

A data solicitation for Cu and Pb was conducted by MDE and all readily available data from the past five years was considered in the WQA. The water column data is presented in Table 7 through Table 11 for each station and is evaluated using the fresh water aquatic life chronic HAC, the most stringent of the numeric water quality criteria for Cu and Pb (Baker, 2002). Each table displays hardness (mg/l), sample concentrations (µg/l) and fresh water chronic HAC (µg/l) by sampling date. For example, in Table 7 for the sampling date of June 11, 2001 the hardness is 34.95 mg/l, the hardness-adjusted criterion for Cu is 3.65 µg/l and the Cu sample concentration is 0.5 µg/l. The hardness concentrations reported in bold are for sampling dates in which hardness was not measured and an average value was applied. The detection limits for Cu and Pb analysis are displayed in Table 6. The water quality data for all stations is also displayed in Figure 3 and Figure 4 for Cu and Pb, respectively.

Table 6: Cu and Pb Analysis Detection Limits

Analyte	Detection Limit (µg/l)
Cu	0.01
Pb	0.003

The range of concentrations for Cu and Pb sampled in the water quality survey are as follows:

Cu = 0.35 to 13.3 µg/l
Pb = ND to 4.83 µg/l

Table 7: Station B251 (Villa Julie College) Water Column Data

Sampling Date	5/21/01		6/11/01		7/25/01		7/30/01		4/3/02		4/25/02	
Hardness (mg/l)	31.65		34.95		45.75		42.15		44.85		40.35	
Analyte	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)
Cu	1.02	3.35	0.50	3.65	0.42	4.59	0.35	4.28	0.40	4.51	0.53	4.12
Pb	0.06	0.71	0.07	0.79	0.10	1.06	0.02	0.97	0.04	1.04	0.04	0.93

* Fresh Water Aquatic Life Chronic HAC
ND - Not detected

Table 8: Station B261 (Roland Run) Water Column Data

Sampling Date	5/21/01		6/11/01		7/25/01		7/30/01		4/3/02		4/25/02	
Hardness (mg/l)	54.9		74.55		83.1		80.25		94.95		91.05	
Analyte	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)
Cu	4.40	5.36	0.79	6.97	0.87	7.65	1.77	7.42	0.97	8.57	2.20	8.27
Pb	0.44	1.30	0.06	1.83	0.09	2.06	0.09	1.98	0.05	2.38	0.11	2.27

Table 9: Station B262 (Sorrento) Water Column Data

Sampling Date	5/21/01		6/11/01		7/25/01		7/30/01		4/3/02		4/25/02	
Hardness (mg/l)	46.65		50.25		62.25		61.35		63.75		58.2	
Analyte	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)
Cu	1.38	4.67	0.52	4.97	0.56	5.97	0.49	5.90	0.52	6.10	0.89	5.64
Pb	0.11	1.09	0.04	1.18	0.11	1.50	ND	1.47	0.03	1.54	0.05	1.39

Table 10: Station B263 (Cold Spring Lane) Water Column Data

Sampling Date	5/21/01		6/11/01		7/25/01		7/30/01		4/3/02		4/25/02	
Hardness (mg/l)	62.37		52.05		61.95		61.8		73.35		62.7	
Analyte	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)
Cu	2.58	5.98	1.95	5.13	2.84	5.95	1.41	5.94	2.68	6.87	3.61	6.01
Pb	0.38	1.50	0.17	1.23	0.21	1.49	0.02	1.48	0.20	1.79	0.43	1.51

Table 11: Station B351 (Maryland Ave.) Water Column Data

Sampling Date	5/21/01		6/11/01		7/25/01		7/30/01		4/3/02		4/25/02	
Hardness (mg/l)	25.65		72.45		79.95		68.4		76.35		40.35	
Analyte	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)	Sample (µg/l)	Criteria* (µg/l)
Cu	**8.71**	2.80	2.29	6.80	2.40	7.40	2.79	6.47	2.28	7.11	**13.30**	4.12
Pb	**1.33**	0.56	0.26	1.77	0.45	1.97	0.72	1.66	0.10	1.87	**4.83**	0.93

* Fresh Water Aquatic Life Chronic HAC
ND - Not detected

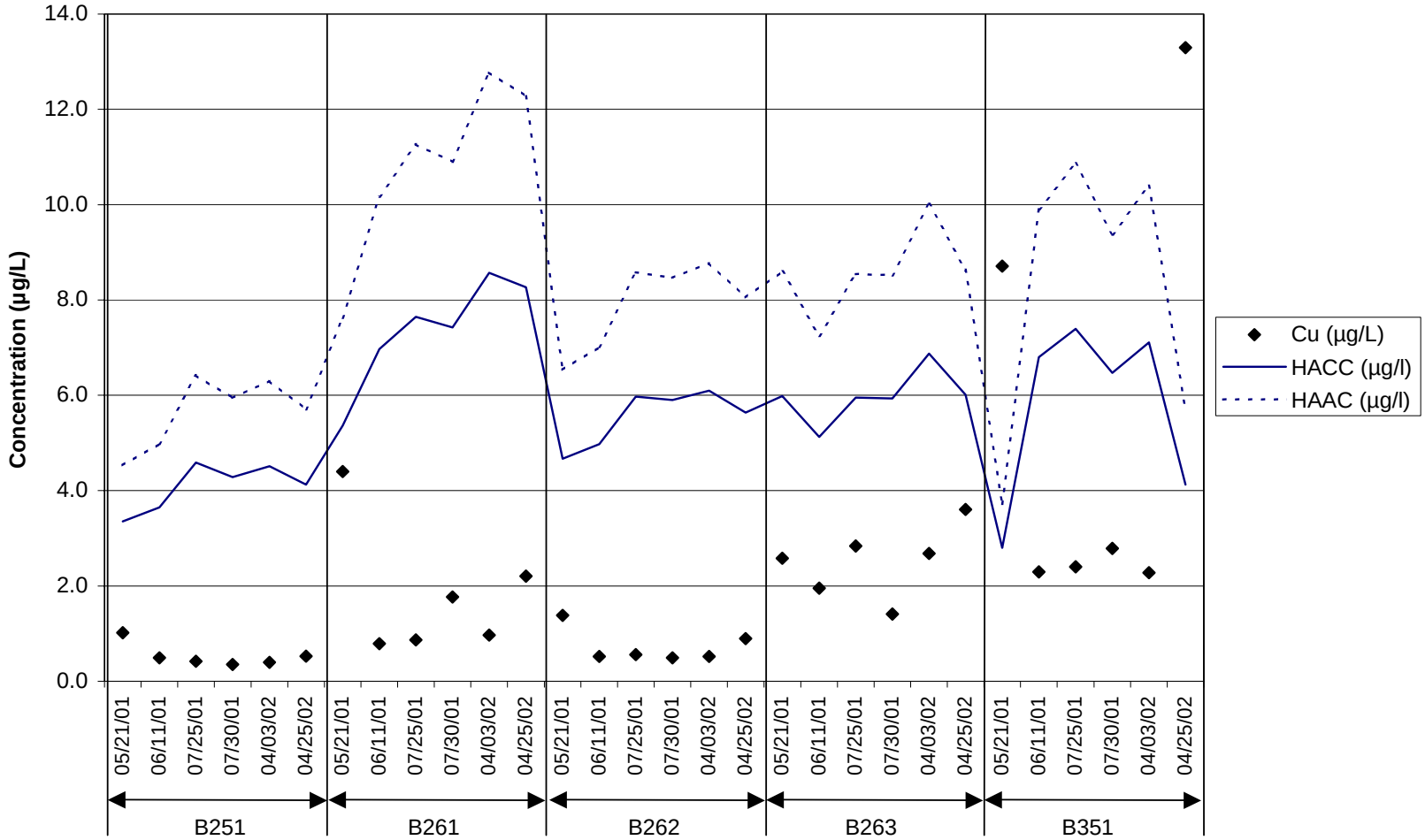
Hardness ranged from 25.65 mg/l to 94.95 mg/l. A total of thirty samples were collected. Cu and Pb samples collected at station B351 on May 21, 2001 and April 25, 2002 exceed the hardness-adjusted chronic criteria. The remaining four stations in the watershed have no exceedances. Station B351 is located in the lower most 12-digit basin (basin code 02-13-09-04-10-32) of the Jones Falls watershed. The land use within this basin is primarily urban. Due to the extensive imperviousness of this basin, a storm event will flush all contaminants from the surface and deposit them into the Jones Falls, resulting in a temporarily significant increase in metals concentrations. The samples that exceeded the criteria were collected during spring storm events. Though this water quality evaluation is conducted by comparing sample concentrations versus hardness-adjusted chronic criteria (HACC), grab samples collected during storm events are only representative of an acute condition, a one-hour exposure. The chronic condition is based on an aquatic organism being exposed to a concentration over a 96-hour period. There is significant variation in the concentration profile during a storm event as contaminants are being flushed from the surface, therefore grab samples are not representative of the pollutant concentration over a 96-hour period. In order to properly quantify a chronic concentration for a storm event it would be necessary to calculate an average of multiple samples over the 96-hour period. The Cu and Pb samples at Station B351 cannot be evaluated against the HACC thus a comparison is made using the hardness-adjusted acute criterion (HAAC) and displayed in Table 12.

Table 12: Station B351 Water Column Exceedances

Sampling Date	5/21/01			4/25/02		
Hardness (mg/l)	25.65			40.35		
Analyte	Sample (µg/l)	HACC (µg/l)	HAAC (µg/l)	Sample (µg/l)	HACC (µg/l)	HAAC (µg/l)
Cu	**8.71**	2.80	3.7	**13.30**	4.12	5.7
Pb	**1.33**	0.56	14.3	**4.83**	0.93	23.7

HACC – Hardness-adjusted chronic criterion
HAAC – Hardness-adjusted acute criterion

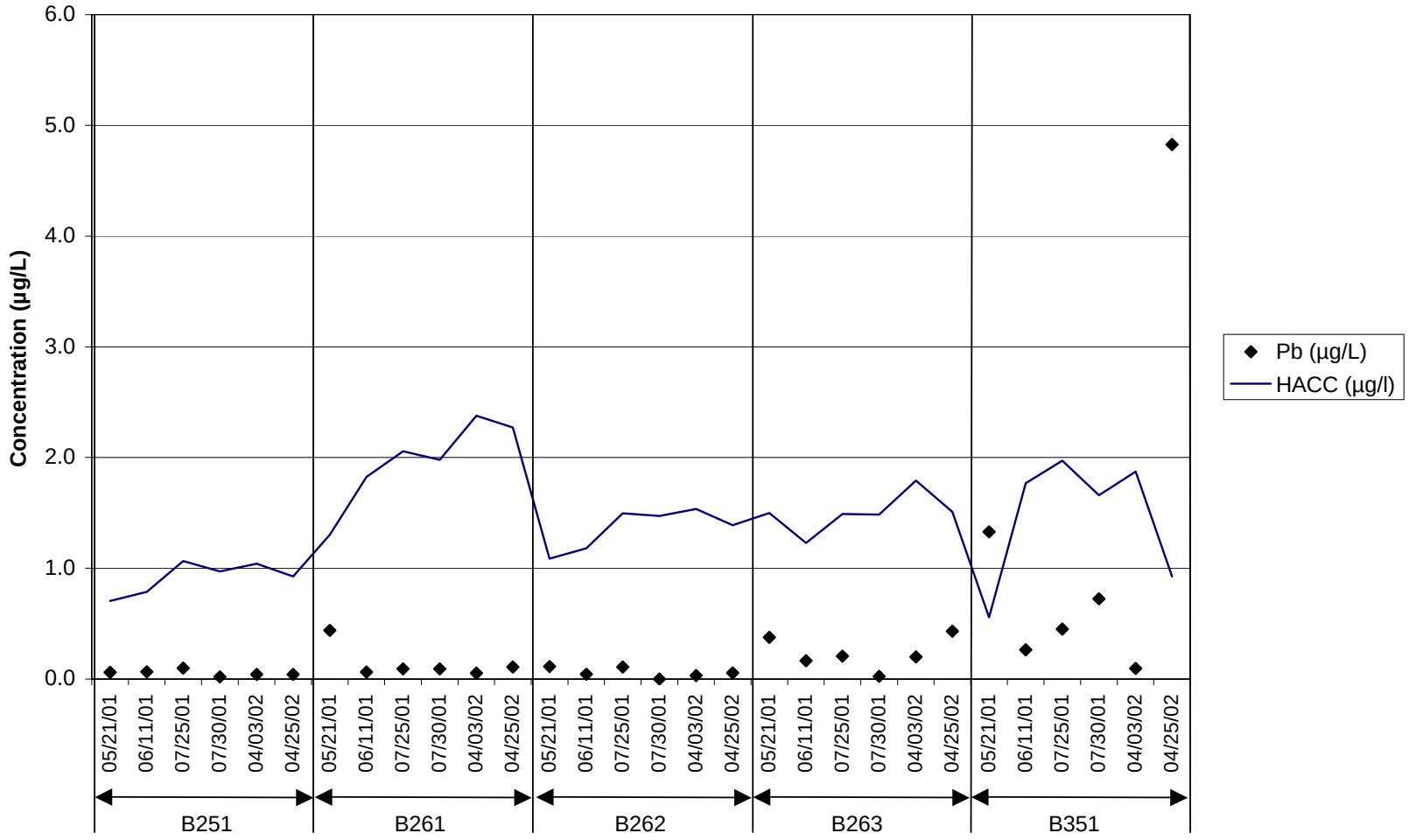
Figure 3: Jones Falls Water Column Data (Cu)



HACC - Hardness Adjusted Chronic Criterion

HAAC - Hardness Adjusted Acute Criterion

Figure 4: Jones Falls Water Column Data (Pb)



HACC - Hardness Adjusted Chronic Criterion

Hardness Adjusted Acute Criterion is not displayed due to values ranging well above chronic levels (18 to 61 ug/L)

Cu concentrations are significantly higher than the HAAC and Pb concentrations are well below the HAAC. Even though the Pb concentration exceeds the HACC, the sample is not representative of the chronic condition and cannot be justifiably evaluated against the chronic criterion, therefore there is no Pb impairment.

Based on 305(b) guidance, as a first analytical step MDE applies a "rule-of-thumb" that a waterbody is impaired by a chemical contaminant in the water column when greater than 10% of the samples, with a minimum of ten samples collected over a three-year period, exceed the applicable criteria (EPA, 1997). If there are less than 10 samples for a given area, MDE may interpret the data and determine if an impairment exists by considering a number of factors including the magnitude of the criteria exceedance and number of criteria exceeded. Even though only six samples were collected at station B351, the two exceedances of Cu are well above the acute hardness-adjusted criteria. In addition, current EPA guidelines suggest that a waterbody is not fully use-supporting when more than one exceedance of the acute or chronic water quality criterion occurs over a three-year period (EPA, 2002). Based on this weight of evidence, the 12-digit basin is impaired for Cu while the remaining basins are supportive of water quality standards. This analysis finds that a TMDL of Cu and Pb is not required for the entire 8-digit watershed.

Sediment quality is not assessed in this WQA due to the lack of depositional areas in the Jones Falls watershed. Field sampling teams observed no appreciable sediment in the streambed, as a result were unable to collect samples.

The Baltimore City Department of Public Works also collects dry-weather metals samples in non-tidal streams of the Jones Falls watershed. An evaluation of this data was conducted by Baltimore City and no exceedances of the water quality criteria were found, giving additional support to the WQA (Baltimore City, 2004).

4.0 CONCLUSION

The WQA shows that water quality standards for Cu and Pb are being achieved in the Jones Falls watershed except for the lower most 12-digit basin (basin code 02-13-09-04-10-32) in which a Cu impairment exists. Water column samples collected at five monitoring stations in the Jones Falls, from May 2001 to April 2002, established that two Cu samples exceeded the applicable aquatic life criteria in the 12-digit basin. Based on impairment listing methodologies applied by MDE, the 12-digit basin is impaired for Cu. The analysis supports the conclusion that a TMDL of Cu and Pb is not required for the entire 8-digit basin. Additional monitoring in the 12-digit basin is necessary to identify the source of impairment. An evaluation of this data will determine if a TMDL or implementation of a technological control is required to correct the impairment. Barring the receipt of any contradictory data, this information provides sufficient justification to revise Maryland's 303(d) list to remove Cu and Pb as impairing substances for the 8-digit basin of the Jones Falls and to list the 12-digit basin for Cu.

5.0 REFERENCES

Baker, J.E., Ko, F., Burrell, T., Falco, K., Burley, E. *Upper Western Shore Chemical Contaminant Survey 2001 - 2002, Final Data Report: Streamwater Trace Metals and Nutrients*. University of MD, Chesapeake Biological Laboratory, August 20, 2002.

Baltimore City, Department of Public Works, Water Quality Management Section. Jones Falls Non-tidal Streams Water Quality Data. 2004.

Boward, D.M., Dail, H.M., Kazyak, P.F., S.A. Stranko. *Patapsco River Basin: Environmental Assessment of Stream Conditions*. Department of Natural Resources, December 1998.

Coastal Environmental Service, Inc. *Patapsco/Back River Watershed Study*, prepared for the MDE and TARSA, September 30, 1995.

COMAR 26.08.02.02-2G. *Numerical Criteria for Toxic Substances in Surface Waters*.

COMAR 26.08.02.08J. *Stream Segment Designations***.**

Maryland Department of Natural Resources, Maryland Biological Stream Survey. *Searchable Online MBSS Database*, May 25, 2004. <http://mddnr.chesapeakebay.net/mbss/search.cfm>

Maryland Department of Planning, 2002 Land Use, Land Cover Map Series. 2002.

Soil Conservation Service (SCS). *Soil Survey of Baltimore County, MD*, 1976.

U.S. Environmental Protection Agency. *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports).* EPA-841-B97-002. 1997.

U.S. Environmental Protection Agency. *National Recommended Water Quality Criteria: 2002*. EPA-822-R-02-047. November 2002.

U.S. Environmental Protection Agency. *Consolidated Assessment and Listing Methodology: Toward a Compendium of Best Practices*. 1st edition. July 2002.