Water Quality Analysis of Zinc Contamination for the Jones Falls Baltimore City and Baltimore County, Maryland

FINAL

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List of Abbreviations

CEES	Center for Estuarine and Environmental Science
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
COMAR	Code of Maryland Regulation
Cu	Copper
CWA	Clean Water Act
DHMH	Department of Health and Mental Hygiene
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
m	Meters
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
mg/l	Milligrams Per Liter
mi^2	Square miles
NCHF	North Central Hardwood Forest
NGP	Northern Glaciated Plain
NLF	Northern Lakes and Forest
Pb	Lead
T	Temperature
USGS	United States Geologic Survey
WQLS	Water Quality Limited Segment
μg/l	Micrograms Per Liter
Zn	Zinc

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the 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. 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) was identified on the State's 1996 list of WQLSs as impaired by nutrients, suspended sediments, zinc, copper, lead and chlordane. This report provides an analysis of recent monitoring data, which shows that the aquatic life criteria and designated uses associated with zinc are being met in the Jones Falls. This analysis supports the conclusion that a TMDL of zinc is not necessary to achieve water quality standards in this case. Barring the receipt of any contradictory data, this report will be used to support the removal of Jones Falls from Maryland's list of WQLSs for zinc when MDE proposes the revision of Maryland's 303(d) list for public review in the future. The nutrient listing will be addressed separately at a future date. The chlordane impairment was addressed by a TMDL analysis in relation to a fish tissue impairment in Lake Roland. The nutrient, suspended sediment, copper, and lead listings will be addressed separately at a future date.

Although the waters of the Jones Falls do not display signs of toxic impairments due to zinc, the State reserves the right to require additional pollution controls in the Jones Falls watershed if evidence suggests that zinc from the basin is 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 indicates that the impairment no longer exists (i.e., water quality standards are being met); 2) more recent and updated water quality modeling demonstrates that the segment is now attaining standards; 3) refinements to water quality standards, or the interpretation of those standards, result in standards being met; or 4) correction are made to errors made in the initial listing.

The Jones Falls was first identified on the 1996 303(d) list submitted to EPA by the Maryland Department of the Environment (MDE) as impaired by nutrients, suspended sediments, zinc, copper, lead and chlordane (based on data in Fisher, 1984). The initial listing for zinc was questionable due to the fact that 1) the original listing was based on total recoverable metals (current standard is for dissolved metals); 2) outdated sampling techniques (lack of filtration) were applied; 3) water quality criteria dependent data such as hardness was not obtained 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 of zinc performed more recently using current sampling and analytical techniques shows no zinc impairment for Jones Falls.

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. The most recent data establishes that the Jones Falls is achieving water quality standards for zinc. The chlordane impairment was addressed by a TMDL analysis in relation to a fish tissue impairment in Lake Roland. The nutrient, suspended sediment, copper, and lead listings will be addressed separately at a future date.

2.0 GENERAL SETTING

The Jones Falls watershed is located in the Upper Western Shore region of the Chesapeake Bay watershed within Maryland (see Figure 1). The watershed covers portions of Baltimore City and Baltimore county. The watershed area covers 37,700 acres.

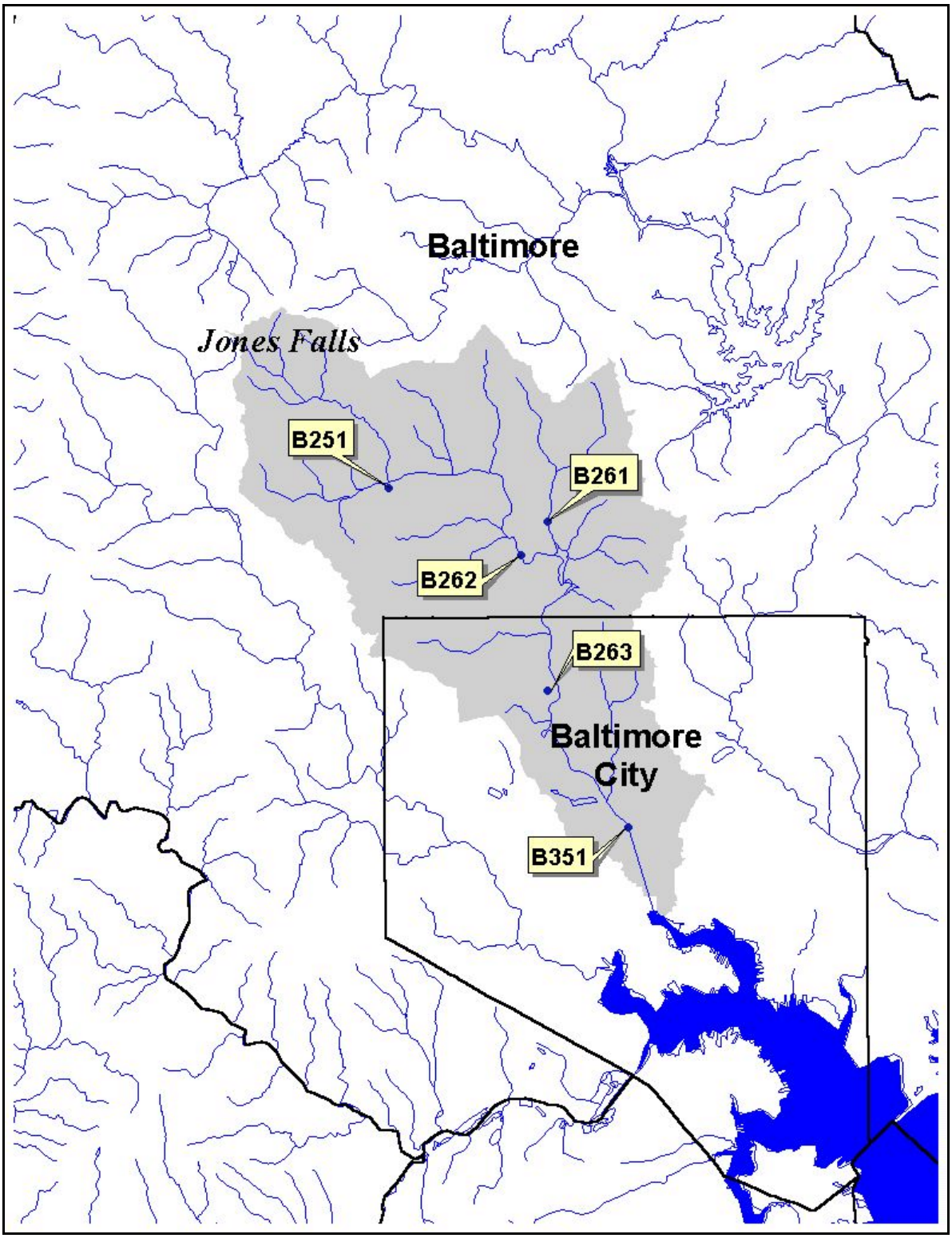

Figure 1: Watershed Map of the Jones Falls, Maryland

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, 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 and into the soft, flat Coastal Plain sediments (Coastal, 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):

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

The soil distribution within the watershed is approximately 65.4% of the B soil group, 18.1% of the D soil group, 14.8% of the C soil group, and 1.2% of the A soil group.

The Jones Falls flows through agricultural, low to medium density residential and forest land within the Baltimore County portion of the watershed and mostly medium to high density residential and commercial land uses within Baltimore City (see Figure 2). No major point sources drain to the stream, nor are there other apparent anthropogenic sources of pollutants. The Jones Falls flows into the Northwest Branch of the Baltimore Harbor. The land use distribution in the watershed is approximately 57.5 % residential, 17.5% forestland, 9.0 % agricultural, 7.8 % commercial/industrial with the remaining 8.2 % designated as barren, open urban lands and open water.

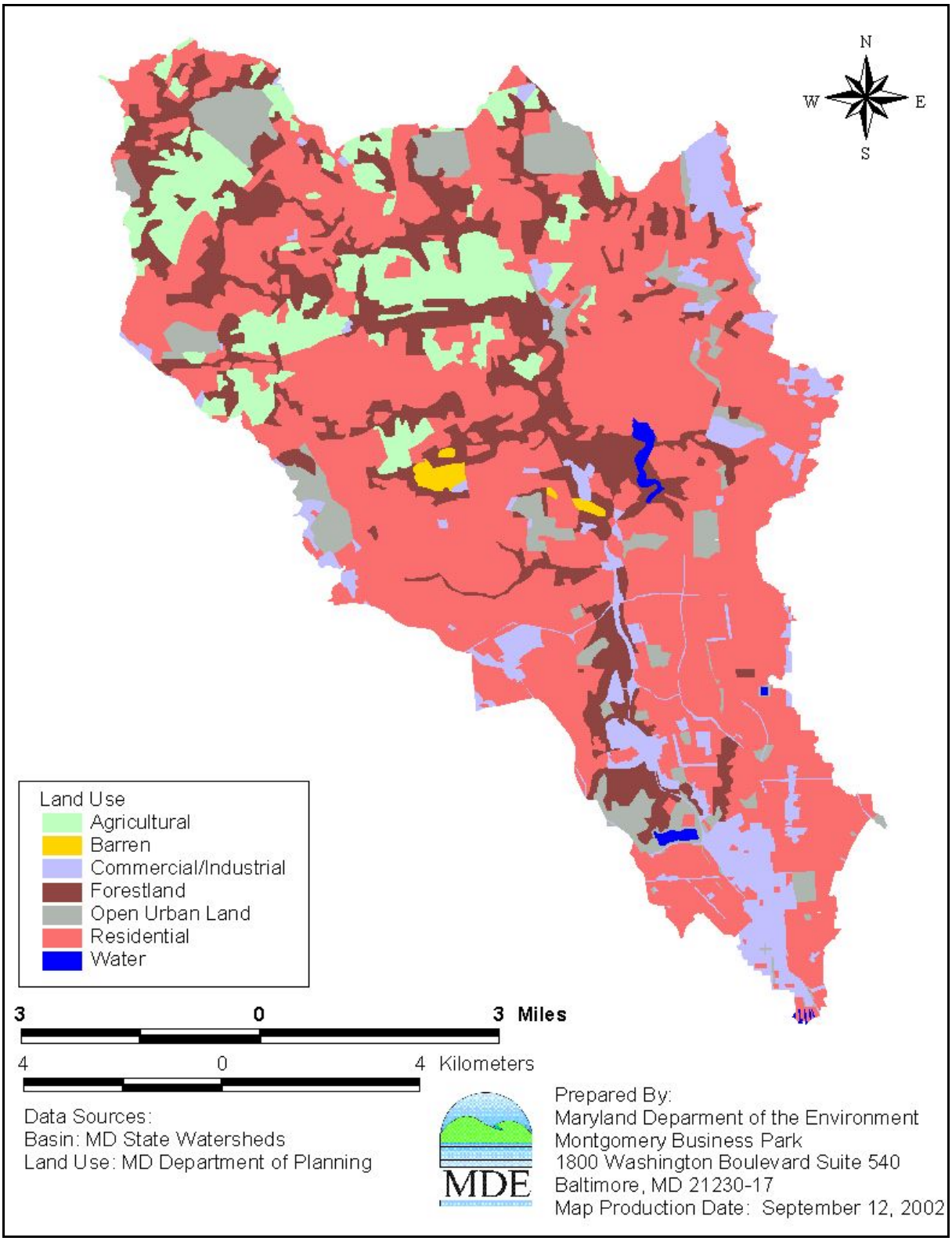

Figure 2: Landuse Map of Jones Falls, Maryland

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 activities such as aquatic life use and support, 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 are dependent on the specific designated use(s) of a waterbody. Maryland's water quality standards presently impose numeric criteria for metals and other toxic substances based on the need to protect aquatic life, wildlife and human health.

The Maryland Surface Water Use Designation (COMAR 26.08.02.07) for the Patapsco River (Basin code 02-13-09) and its tributaries (including Jones Falls) is Use I – *water contact recreation, fishing, and protection of aquatic life and wildlife.* The applicable numeric criteria for zinc (dissolved phase) in freshwater is described below in Table 1 (COMAR 26.08.02.03-3G). The water quality data present in this section will show the designated use of Jones Falls is not impaired by zinc contamination.

Table 1: Freshwater Aquatic Life Criteria For Inorganic Substances (Metals)

Metal	Aquatic Life Acute (CMC) (ug/L)	Aquatic Life Chronic (CCC) (ug/L)
Zn	120	120

Water quality surveys conducted at five stations in the Jones Falls watershed from May 2001 until April 2002 were used to conduct the analysis. Zinc was sampled for dissolved concentrations. Table 2 shows the list of stations with their geographical coordinates and descriptive location in the Jones Falls.

Table 2: Water Quality Analysis Stations for Jones Falls, Maryland.

#	Station I.D.	GPS coordinates	Station Description
1	B251	39°24.77' 76°42.34'	Villa Julie College
2	B261	39°23.91' 76°38.95'	Roland Run (York Rd Corridor)
3	B262	39°23.51' 76°39.65'	Jones Falls @ Sorrento MD
4	B263	39°20.74' 76°38.95'	Cold Spring Lane (near light rail)
5	B351	39°18.46' 76°37.06'	Jones Falls @ Maryland Ave.

3.1 Metals Data

Sampling was performed six times at each station from May 2001 to April 2002 to capture seasonal variation. Three sampling periods were taken during wet weather and the other three, during dry weather. The dates of the sampling periods were as follows: 5/21/01 (Spring wet weather), 6/11/01 (Spring dry weather), 7/25/01 (Summer dry weather), 7/30/01 (Summer wet weather), 4/3/02 (Spring wet weather) and 4/25/02 (Spring dry weather).

Hardness concentrations were obtained for each station to adjust the EPA standard water quality criteria, established at a hardness of 100 mg/L. The hardness adjusted criteria equation for heavy metals is as follows (EPA, 1996):

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

HAC = Hardness Adjusted Criteria
m = slope
b = y intercept
CF = Conversion Factor

The hardness adjusted criteria parameters for zinc are presented in Table 3.

Table 3: Hardness Adjusted Criteria Parameters

Chemical	Slope (m)	y Intercept (b)	Conversion Factor (CF)
Zn	0.8473	0.884	0.986

According to the Revised Aquatic Life Metals Criteria in EPA's National Toxics Rule (EPA, 1995), the allowable hardness values must fall within the range of 25 - 400 mg/L. The EPA though, now recommends that no lower limit be assigned based on technical information provided by the EPA's Office of Research and Development.

The water quality data (Baker, 2001) is presented in Table 3A–3F for each sampling period. Each Table displays the EPA standard water quality criteria along with the sample concentration and hardness adjusted criteria concentration for Zn at each station. Sample concentrations are listed in columns headed by the station I.D. Hardness adjusted criteria are listed in columns headed by HAC followed by the station I.D. The first row of the table reports the hardness concentrations for each station. Criteria and dissolved metals concentrations are expressed as µg/L and hardness is expressed as mg/L. As an example in Table 3A, for station B251 the hardness is 31.65 mg/L, the hardness adjusted criteria is 44.6 µg/L and the Zn concentration is 0.68 µg/L.

Table 3A: 5/21/01 Spring Wet Weather

Analyte	Criteria *	HAC ** B251	B251	HAC ** B261	B261	HAC ** B262	B262	HAC ** B263	B263	HAC ** B351	B351
Hardness		31.65		54.9		46.65		HND		25.65	
Zn	120	44.6	0.68	71.1	9.95	61.90	1.49	-	2.49	37.7	10.8

* EPA Fresh Water Chronic Criteria are expressed in µg/L (ppb)
** Criteria adjusted for ambient hardness
HAC = Hardness Adjusted Criteria
HND - Hardness not determined
ND - Not detected

Table 3B: 6/11/01 Spring Dry Weather

Analyte	Criteria *	HAC ** B251	B251	HAC ** B261	B261	HAC ** B262	B262	HAC ** B263	B263	HAC ** B351	B351
Hardness		34.95		74.55		50.25		52.05		72.45	
Zn	120	48.5	0.35	92.1	1.69	65.9	0.42	67.9	1.02	89.9	3.14

Table 3C: 7/25/01 Summer Dry Weather

Analyte	Criteria *	HAC ** B251	B251	HAC ** B261	B261	HAC ** B262	B262	HAC ** B263	B263	HAC ** B351	B351
Hardness		45.75		83.1		62.25		61.95		79.95	
Zn	120	60.9	0.61	101	1.33	79.1	0.89	78.7	1.29	97.7	3.83

Table 3D: 07/30/01 Summer Wet Weather

Analyte	Criteria *	HAC ** B251	B251	HAC ** B261	B261	HAC ** B262	B262	HAC ** B263	B263	HAC ** B351	B351
Hardness		42.15		80.25		61.35		61.8		68.4	
Zn	120	56.8	0.67	98	3.17	78.1	0.65	78.6	1.26	85.6	5.84

Table 3E: 04/3/02 Spring Dry Weather

Analyte	Criteria *	HAC ** B251	B251	HAC ** B261	B261	HAC ** B262	B262	HAC ** B263	B263	HAC ** B351	B351
Hardness		44.85		94.95		63.75		73.35		76.35	
Zn	120	59.9	0.41	113.1	1.37	51.3	0.47	57.5	1.54	59.4	2.56

Table 3F: 04/25/02 Spring Wet Weather

Analyte	Criteria *	HAC ** B251	B251	HAC ** B261	B261	HAC ** B262	B262	HAC ** B263	B263	HAC ** B351	B351
Hardness		40.35		91.05		58.2		62.7		40.35	
Zn	120	54.8	0.47	109.1	4.49	47.6	0.83	50.6	4.37	54.8	52.99

Table 4 : Summary of Hardness Data for Jones Falls

Station	05/21/2001	06/11/2001	07/25/2001	07/30/2001	04/03/2002	04/25/2002
B251	31.65	34.95	45.75	42.15	44.85	40.35
B261	54.9	74.55	83.1	80.25	94.95	91.05
B262	46.65	50.25	62.25	61.35	63.75	58.2
B263	HND	52.05	61.95	61.8	73.35	62.7
B351	25.65	72.45	79.95	68.4	76.35	40.35

The range of concentrations for zinc sampled in the water quality survey is 0.35 to 52.99 (µg/L). Hardness ranged from 26 to 95 (mg/L). The concentrations of zinc are below the fresh water chronic hardness-adjusted criteria. The criteria was not exceeded for any of the samples.

4.0 CONCLUSION

Based on the synoptic survey conducted from May 2001 to April 2002, the water quality data indicate that the 8-digit Jones Falls basin does not have toxics-related water quality problems associated with zinc contamination. Barring any contradictory future data, this information provides sufficient justification to revise Maryland's 303(d) list to remove zinc as an impairing substance in relation to the 8 digit Jones Falls Basin.

5.0 REFERENCES

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