Water Quality Analysis of Heavy Metals for the Lower Gunpowder Falls in Baltimore County, Maryland

FINAL

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List of Abbreviations

As	Arsenic
Be	Beryllium
Cd	Cadmium
COMAR	Code of Maryland Regulations
Cr	Chromium
Cu	Copper
CWA	Clean Water Act
DOC	Dissolved Organic Carbon
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
HAC	Hardness Adjusted Criteria
Hg	Mercury
IBI	Index of Biotic Integrity
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
mg/l	Milligrams per Liter
mg/kg	Milligrams per Kilogram
Ni	Nickel
NPDES	National Pollution Discharge Elimination System
Pb	Lead
ppb	Parts per billion
Sb	Antimony
SCS	Soil Conservation Service
Se	Selenium
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
Zn	Zinc

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 Lower Gunpowder Falls (basin code 02-13-08-02), located in Baltimore County, MD, was identified on the State's list of WQLSs as impaired by heavy metals (1996 listing), nutrients (1996 listing) and evidence of biological impacts (2002 listing). All impairments are listed for the non-tidal streams. This report provides an analysis of recent monitoring data, including hardness data, which shows that the aquatic life criteria for heavy metals and the designated uses supported by those criteria are being met in the Lower Gunpowder Falls. The analysis supports the conclusion that a TMDL of heavy metals is not necessary to achieve water quality standards, because the standards are currently being met. Barring the receipt of any contradictory data, this report will be used to support the removal of the Lower Gunpowder Falls from Maryland's list of WQLSs for heavy metals when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future. The nutrient and biological impairments will be addressed separately at a future date.

Although the waters of the Lower Gunpowder Falls do not display signs of toxic impairments due to heavy metals exceeding water quality criteria, the State reserves the right to require additional pollution controls in the Lower Gunpowder Falls watershed if evidence suggests that heavy metals 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 Lower Gunpowder Falls (basin code 02-13-08-02) was first identified on the 1996 303(d) list submitted to EPA by the Maryland Department of the Environment (MDE) as impaired by heavy metals and nutrients, with biological impairment added to the list in 2002. All impairments are listed for the non-tidal streams. The initial listing for heavy metals was questionable because: 1) no specific pollutants were defined; 2) the original listing was based on total recoverable metals (current standard is based on dissolved metals); 3) inappropriate sampling techniques were applied (lack of filtration); 4) supporting data needed to interpret criteria was not available (hardness); and 5) 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 heavy metals for Lower Gunpowder Falls was performed using recent water column data. Results show no impairment for heavy metals. The nutrient and biological impairments will be addressed separately at a future date.

The term "heavy metals" and "metals" are interchangeable and generally interpreted to include those metallic elements from periodic table groups IIA through VIA. At trace levels, many of these elements are necessary to support life. However, at elevated levels they become toxic, may build up in biological systems, and become a significant detriment to aquatic life. For the purposes of this WQA, metals are those priority pollutant metals that are commonly permitted in National Pollution Discharge Elimination System (NPDES) industrial or NPDES stormwater discharges. The following metals were sampled in the Lower Gunpowder Falls: arsenic (As); cadmium (Cd); chromium (Cr); copper (Cu); mercury (Hg); nickel (Ni); lead (Pb); selenium (Se) and zinc (Zn).

Basin geological conditions, land use, and past/present industrial practices did not indicate the potential for the presence of other priority pollutants, such as antimony (Sb) and beryllium (Be) - metals commonly found at Superfund sites.

If a specific water quality impairment exists that identifies specific metal(s) as impairing substances, sampling and analysis may be limited to those metal(s) of concern.

The remainder of this report lays out the general setting of the waterbody within the Lower Gunpowder 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 Lower Gunpowder Falls is achieving water quality criteria for metals.

2.0 GENERAL SETTING

The Lower Gunpowder Falls watershed is located in the Upper Western Shore region of the Chesapeake Bay watershed within Maryland (see Figure 1). The watershed covers a portion of Baltimore County. The watershed area covers 29,240 acres.

The Lower Gunpowder 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 Lower Gunpowder 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 625 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 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.

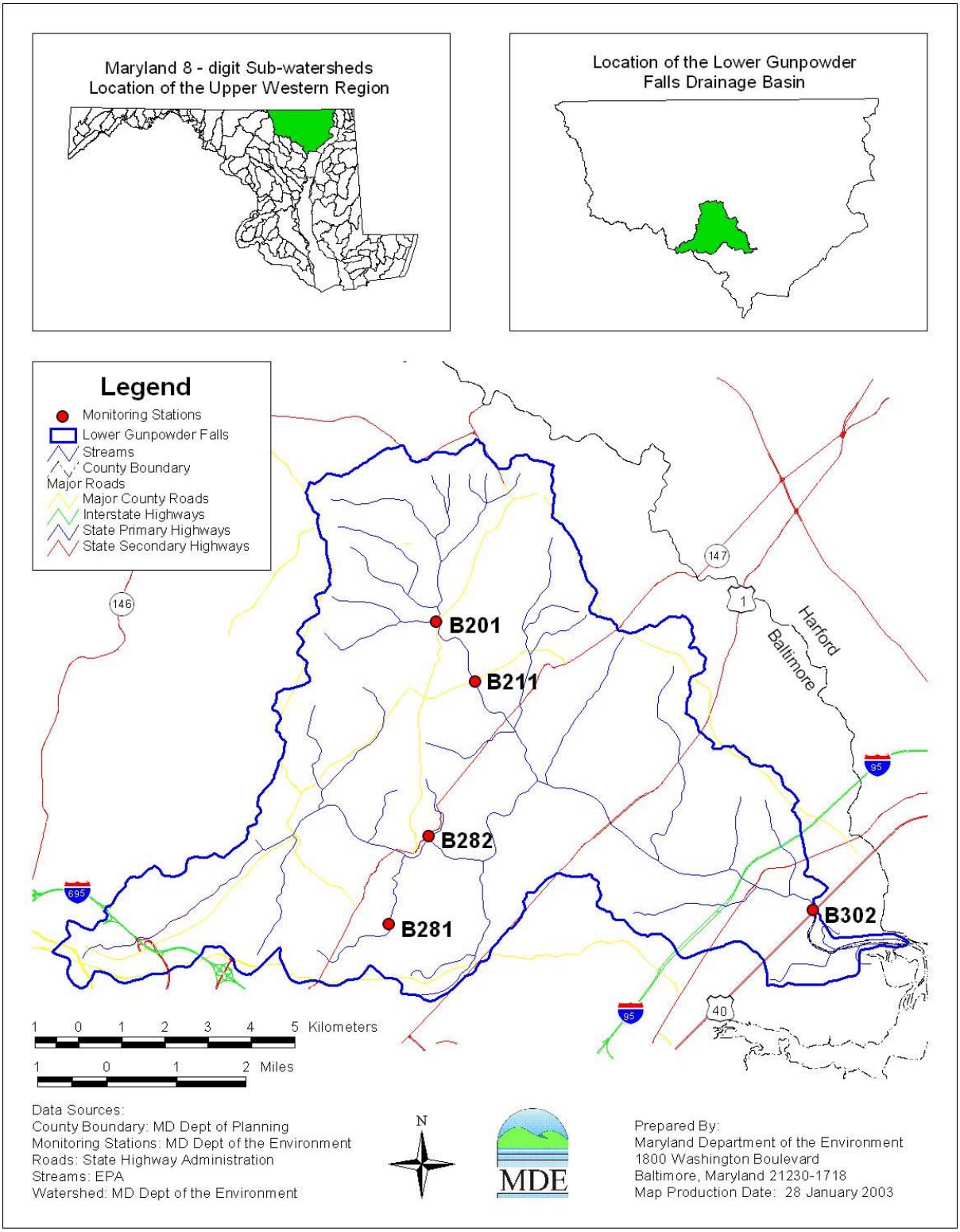

Figure 1: Watershed Map of the Lower Gunpowder Falls

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.

The soil distribution within the watershed is approximately 3.3% soil group A, 51.1% soil group B, 35.3% soil group C and 10.3% soil group D. Soil data was obtained from Soil Survey Geographic (SSURGO) coverages created by the National Resources Conservation Service.

The Lower Gunpowder Falls flows through mostly agricultural and forested lands joining the Little Gunpowder Falls within the Gunpowder Falls State Park before reaching the estuarine portion of the Gunpowder River. There are very little commercial/industrial practices within the Lower Gunpowder Falls watershed, which is comprised primarily of agricultural, forest and residential land uses (see Figure 2). No major point sources discharge metals within the watershed. The land use distribution in the watershed is approximately 33.9 % forest/herbaceous, 32.8 % urban, 32.7 % agricultural and 0.6 % water (Maryland Department of Planning, 2000).

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. Water quality standards for toxic substances also address sediment quality to ensure the bottom sediment of a waterbody is capable of supporting aquatic life, thus protecting the designated uses. In addition to evaluation of the sediment and water column, MDE has evaluated several other media in performing this WQA. These media include mercury in fish tissue and biological data.

The Maryland Surface Water Use Designation (Code of Maryland Regulations (COMAR) 26.08.02.08I) for the Lower Gunpowder Falls is Use I – *water contact recreation, fishing, and protection of aquatic life and wildlife.* Long Green Run and Sweathouse Branch, and their respective tributaries are situated within the Lower Gunpowder Falls watershed and are designated as Use III – *natural trout waters*. The applicable numeric aquatic life criteria and human health criteria (fish consumption) for dissolved metals in freshwater are described below in Table 1 (COMAR 26.08.02.03-2G). There are two species of chromium, trivalent Cr (III) and hexavalent Cr (VI). Cr (VI) has the highest toxicity of the Cr species, therefore, the numeric criterion is more stringent. Total chromium concentrations were analyzed in the water column survey and are compared with the Cr (VI) numeric water quality criterion.

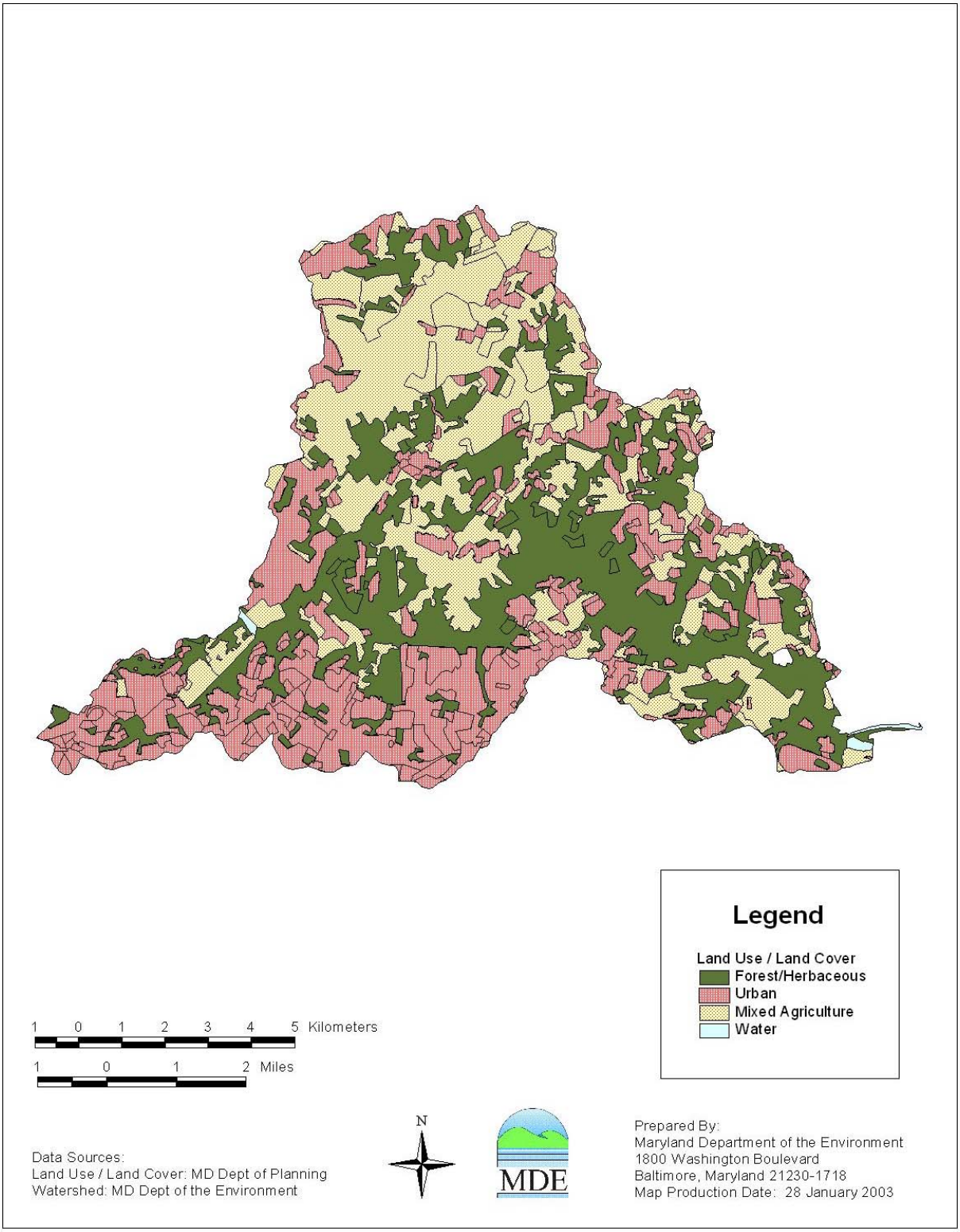

Figure 2: Land Use Map of Lower Gunpowder Falls Watershed

Table 1: Numeric Water Quality Criteria (Metals)

Metal	Fresh Water Aquatic Life Acute Criteria (µg/l)	Fresh Water Aquatic Life Chronic Criteria (µg/l)	Human Health Criteria Fish Consumption (µg/l)
As	340	150	41
Cd	4.3	2.2	-
Cr (VI)	16	11	-
Cu	13	9	1,300
Hg	1.4	0.77	0.051
Ni	470	52	4,600
Pb	65	2.5	-
Se	20	5	11000
Zn	120	120	69,000

As noted above, MDE in performing this WQA also considered information regarding mercury (Hg) in fish tissue. Although mercury samples in fish tissue were not available specifically for the Lower Gunpowder Falls, information was available in a study conducted by MDE in nearby streams (MDE, 2000). The study includes data on mercury in fish tissue from 1985 to 1997 in non-tidal lentic (standing water) systems within the State including, the Gunpowder River Basin, which is considered to be representative of the conditions expected in the Lower Gunpowder Falls. Twenty-six fish tissue samples of varying species were collected in the Gunpowder River Basin and analyzed for mercury concentrations showing an average of 39.5 µg/kg (wet weight). This compares to the EPA fish tissue residue criterion of 300 µg/kg (EPA, 2001), indicating that a low potential exists for excessive mercury bioaccumulation in fish species residing in this basin.

This water quality assessment also considered the potential impact of metals on indices of biological integrity (IBI). Maryland Biological Stream Survey (MBSS) data was collected at three stations within the Lower Gunpowder Falls (Cowen Run, Long Greek Creek, and an unnamed tributary of Long Green Creek) in 1996 and 2002. The sampling found that fish IBI range from 2.3 to 2.78 in 1996 and 3.2 to 4.3 in 2002 and benthic IBI range from 2.56 to 3.0 in 1996 and 1.89 to 3.7 in 2002. The acceptable threshold for fish and benthic IBI is 3.0. The physical habitat indices for 1996 MBSS sampling are low ranging from 39.75 to 58.46 out of 100. The channel alteration and bank stability values for 1996 MBSS sampling are also low ranging from 4 to 9 and 3 to 10 (out of 20), respectively. An additional Gunpowder River Basin stream assessment study conducted by DNR shows that 79 % of the stream miles in the basin have degraded bank conditions in term of unstable or moderately unstable stream banks (Boward, 1997). 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 Lower Gunpowder Falls watershed. Field sampling teams observed no appreciable sediment in the streambed, as a result they were unable to collect samples. The Lower Gunpowder Falls is classified as a high gradient stream, therefore, sediment entering the channel from soil erosion due to stream bank instability tends to be flushed out leaving no appreciable deposition of fine grained material. It's generally accepted that course grained material has no significant potential to accumulate toxic substances. There are also no known sources of contaminated soil in the watershed thus any eroded sediment will be clean, containing only trace amounts of metals. Furthermore, the metals concentrations within the water column are extremely low, more than an order of magnitude less than their respective numeric water quality criteria. Based on the weight of this evidence, it is unlikely that metals have an impact on biological integrity in the water column or sediment.

The water column data presented in Section 3.1, Table 6 through Table 10, shows that concentrations of metals in the water column do not exceed the criteria. The water column in the Lower Gunpowder Falls is therefore not impaired by metals, thus the designated uses are supported and the water quality standard is being met for these substances.

Water column surveys conducted at five monitoring stations in the Lower Gunpowder Falls from May 2001 to April 2002 were used to support the water WQA. For every sample, dissolved concentrations of the nine metals were determined. Table 3 shows the list of stations with their geographical coordinates and descriptive location in the Lower Gunpowder Falls. Refer back to Figure 1 for station locations.

Table 2: Water Quality Analysis Stations for Lower Gunpowder Falls

Station I.D.	GPS coordinates	Station Description
B201	39.470 76.491	Long Green Pike - Industrial Area
B211	39.457 76.480	Long Green Creek at Glen Arm, Md.
B281	39.407 76.504	Jennifer Branch - Old Residential Development
B282	39.425 76.493	Gunpowder Falls @ Harford Rd.
B302	39.409 76.390	Gunpowder Falls @ Pulaski Hwy (Route 40)

Water column sampling was performed six times at each station from May 2001 to April 2002 to capture seasonal variation. The sampling dates 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).

For the water quality evaluation, a comparison is made between the water column concentrations of the metals and fresh water aquatic life chronic criteria, the more stringent of the numeric water quality criteria for metals except for As and Hg in which the human health criteria for fish consumption are more stringent and will be applied. 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 metals. The State used hardness adjustment to calculate fresh water aquatic life chronic criteria for those metals (Cd, Cu, Pb, Ni and Zn) for which toxicity is a function of total hardness. The fresh water aquatic life chronic criteria are not adjusted for Cr (VI), Se and Hg because hardness either does not affect the bioavailability of these metals to aquatic life or there is significant uncertainty in the correlation between hardness and criteria. According to EPA's National Recommended Water Quality Criteria (EPA, 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, 2002). MDE adopts this recommendation. The HAC equation for Cr 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 metals are presented in Table 4.

Table 3: HAC Parameters (Fresh Water Aquatic Life Chronic Criteria)

Chemical	Slope (m)	y Intercept (b)	Conversion Factor (CF)
Cd	0.7852	-2.715	1.102 - ln(hardness)*0.0418
Cu	0.8545	-1.702	0.960
Pb	1.2730	-4.705	1.462 - ln(hardness)*0.146
Ni	0.8460	0.0584	0.997
Zn	0.8473	0.884	0.986

The State will perform a scientific review of all data submitted where a water quality criterion exceedance was the result of a hardness adjustment below 50 mg/L. This review is necessary because of the scientific uncertainty existing for hardness-toxicity relationships below 50 mg/l due to:

A. Paucity of toxicity test data below 50 mg/l that was used to develop the relationship between hardness and toxicity.
B. Presence/absence of sensitive species in the waterbody of concern.
C. 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.

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 which hardness data is unavailable must not fall during a storm event substantially greater than the 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 Lower Gunpowder 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 metals was conducted by the MDE and all readily available data from the past five years was considered in the WQA. The water column data is presented in Table 6 through Table 10 for each station and is evaluated using the fresh water aquatic life chronic HAC, the more stringent of the numeric water quality criteria for metals (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 6 for the sampling date of 6/11/01 the hardness is 36.15 mg/L, the hardness adjusted criterion for Cu is 3.75 µg/l and the Cu sample concentration is 0.43 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 metals analysis are displayed in Table 5.

Table 4: Metals Analysis Detection Limits

Analyte	Detection Limit (µg/l)
As	0.09
Cd	0.001
Cr	0.03
Cu	0.01
Hg	0.00004
Ni	0.01
Pb	0.003
Se	0.09
Zn	0.25

The range of concentrations for metals sampled in the water quality survey are as follows:

As = ND to 0.6 µg/l
Cd = ND to 0.019 µg/l
Cr = ND to 1.04 µg/l

Cu = 0.31 to 2.98 µg/l
Hg = 0.0004 to 0.0024 µg/l
Ni = ND to 1.45 µg/l

Table 5: Station B201 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)	45.54		36.15		49.8		48.45		46.05		47.25	
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)
As	0.21	41	ND	41	0.27	41	0.14	41	0.15	41	0.05	41
Cd	ND	1.25	0.003	1.05	0.002	1.34	ND	1.31	0.004	1.26	ND	1.29
Cr	0.39	11	0.54	11	0.27	11	0.27	11	0.38	11	ND	11
Cu	0.64	4.57	0.43	3.75	0.41	4.94	0.41	4.82	0.31	4.62	0.40	4.72
Hg	0.0008	0.051	0.0005	0.051	0.0005	0.051	0.0004	0.051	0.0005	0.051	0.0007	0.051
Ni	0.28	26.73	0.47	21.99	ND	28.83	0.04	28.17	ND	26.99	ND	27.58
Pb	0.06	1.06	0.10	0.82	0.07	1.17	0.02	1.13	0.02	1.07	0.08	1.10
Se	0.33	5	0.33	5	0.53	5	0.37	5	0.39	5	0.57	5
Zn	0.53	60.67	0.49	49.89	0.42	65.44	0.59	63.94	0.26	61.24	0.58	62.59

* Fresh Water Aquatic Life Chronic HAC
A) Cr (VI) criterion is applied
B) Hardness adjustment is unnecessary for Cr (VI), Hg and Se
C) Human Health Criterion (fish consumption) is applied for As and Hg

ND - Not detected

Table 6: Station B211 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)	42.21		36.3		39		46.5		43.95		45.3	
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)
As	0.25	41	ND	41	0.31	41	0.15	41	0.2	41	0.08	41
Cd	ND	1.18	0.003	1.06	0.003	1.11	0.004	1.27	0.004	1.22	ND	1.25
Cr	0.36	11	0.45	11	0.15	11	0.22	11	0.32	11	0.14	11
Cu	0.93	4.29	0.39	3.77	0.43	4.01	0.42	4.66	0.45	4.44	1.28	4.55
Hg	0.0009	0.051	0.0004	0.051	0.0009	0.051	0.0005	0.051	0.0008	0.051	0.0010	0.051
Ni	0.30	15.07	0.44	22.07	0.02	23.45	0.05	27.21	ND	25.94	0.11	26.61
Pb	0.09	0.97	0.04	0.82	0.07	0.89	ND	1.08	0.02	1.02	0.08	1.05
Se	0.45	5	0.34	5	0.49	5	0.45	5	0.39	5	0.45	5
Zn	1.81	56.89	0.46	50.06	0.60	53.20	0.82	61.75	0.49	58.87	2.27	60.40

Table 7: Station B281 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)	49.29		46.95		39.75		55.35		60.45		43.95	
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)
As	0.45	41	ND	41	0.29	41	0.4	41	0.33	41	0.38	41
Cd	ND	1.33	0.014	1.28	0.013	1.13	0.015	1.44	0.011	1.54	0.019	1.22
Cr	1.04	11	0.52	11	0.42	11	0.32	11	0.40	11	0.52	11
Cu	2.98	4.89	1.20	4.69	1.14	4.07	1.43	5.40	1.44	5.83	2.81	4.44
Hg	0.0024	0.051	0.0011	0.051	0.0007	0.051	0.0009	0.051	0.0010	0.051	0.0022	0.051
Ni	1.45	28.58	0.97	27.43	0.57	23.83	0.67	31.53	0.28	33.97	0.89	25.94
Pb	0.27	1.16	0.03	1.10	0.04	0.91	ND	1.31	0.03	1.45	0.19	1.02
Se	0.40	5	0.31	5	ND	5	0.34	5	0.40	5	0.43	5
Zn	5.34	64.87	1.98	62.25	1.08	54.06	3.67	71.57	1.21	77.12	4.60	58.87

* Fresh Water Aquatic Life Chronic HAC
    A) Cr (VI) criterion is applied
    B) Hardness adjustment is unnecessary for Cr (VI), Hg and Se
    C) Human Health Criterion (fish consumption) is applied for As and Hg

ND - Not detected

Table 8: Station B282 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)	43.59		33.9		45.15		44.4		48.9		45.6	
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)
As	0.23	41	ND	41	0.23	41	0.3	41	0.19	41	ND	41
Cd	ND	1.21	0.005	1.00	0.006	1.24	0.007	1.23	0.006	1.32	ND	1.25
Cr	0.18	11	0.26	11	0.18	11	0.11	11	0.08	11	ND	11
Cu	1.58	4.41	1.11	3.55	1.14	4.54	1.33	4.47	1.01	4.86	1.53	4.58
Hg	0.0015	0.051	0.0009	0.051	0.0008	0.051	0.0010	0.051	0.0013	0.051	0.0010	0.051
Ni	0.32	25.76	0.39	20.83	0.23	26.54	0.28	26.17	ND	28.39	0.10	26.76
Pb	0.06	1.01	0.07	0.76	0.08	1.05	0.12	1.03	0.01	1.15	0.01	1.06
Se	0.2	5	0.28	5	ND	5	0.33	5	0.3	5	0.41	5
Zn	1.12	58.46	0.98	47.24	0.85	60.23	1.55	59.38	0.83	64.44	1.03	60.73

Table 9: Station B302 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)	44.4		38.1		41.7		48.3		42.9		51	
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)
As	0.34	41	0.10	41	0.6	41	0.56	41	0.22	41	0.32	41
Cd	ND	1.23	0.009	1.10	0.005	1.17	0.005	1.31	0.007	1.20	ND	1.36
Cr	0.2	11	0.36	11	0.23	11	0.08	11	0.24	11	0.05	11
Cu	1.18	4.48	1.46	3.93	1.04	4.24	0.71	4.81	1.05	4.35	1.17	5.04
Hg	0.0005	0.051	0.0008	0.051	0.0007	0.051	0.0005	0.051	0.0006	0.051	0.0010	0.051
Ni	0.29	26.17	0.61	22.99	0.4	24.81	0.27	28.10	0.06	25.42	0.17	29.42
Pb	0.12	1.03	0.10	0.87	0.11	0.96	0.15	1.13	0.05	0.99	0.13	1.20
Se	0.31	5	0.18	5	ND	5	0.26	5	0.23	5	0.29	5
Zn	0.83	59.38	0.79	52.16	0.64	56.30	1.61	63.77	0.58	57.67	1.05	66.78

* Fresh Water Aquatic Life Chronic HAC

A) Cr (VI) criterion is applied
B) Hardness adjustment is unnecessary for Cr (VI), Hg and Se
C) Human Health Criterion (fish consumption) is applied for As and Hg

ND - Not detected

Pb = ND to 0.27 µg/l
Se = ND to 0.57 µg/l
Zn = 0.26 to 5.34 µg/l

Hardness ranged from 36.2 mg/l to 60.5 mg/l. The concentration ranges of all nine metals are well below their associated fresh water aquatic life chronic HAC. The criteria were not exceeded by any of the nine metals sampled.

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

4.0 CONCLUSION

The WQA shows that water quality standards for metals are being achieved. Water column samples collected at five monitoring stations in the Lower Gunpowder Falls, from May 2001 to April 2002, demonstrate that numeric water quality criteria are being met. Barring the receipt of any contradictory data, this information provides sufficient justification to revise Maryland's 303(d) list to remove metals as impairing substances in the Lower Gunpowder Falls.

5.0 REFERENCES

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