Comment Response Document
Regarding the Water Quality Analysis of Chromium in Northwest Branch and Bear Creek Portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment, Baltimore City and Baltimore County, Maryland

The Maryland Department of the Environment (MDE) has conducted a public review of the proposed Water Quality Analysis (WQA) of Chromium in the Northwest Branch and Bear Creek Portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment. The public comment period was open from April 16, 2013 through May 15, 2013. MDE received three sets of written comments.

Below is a list of commentors, their affiliation, the date comments were submitted, and the number referenced to the comments submitted. In the pages that follow, comments are summarized and listed with MDE's response.

Author	Affiliation	Date	Comment Number
Mr. Steve Stewart, Mr. Kevin Brittingham and Ms. Erin Wisnieski	**Baltimore County Dept. of Environmental Protection & Sustainability**	**5/9/2013**	**1 – 6**
Ms. Mary Sorensen	**ENVIRON, consultants for Maryland Port Admin. & Honeywell International, Inc.**	**5/14/2013**	**7 - 11**
Ms. Tina Meyers	**Baltimore Harbor WATERKEEPER/Blue Water Baltimore**	**5/15/2013**	**12 - 16**

Comments and Responses

1. The commentor states that there are two mentions of the Trash TMDL [in the Baltimore Harbor Chromium WQA] (Exec. Summary and Intro). The commentor asks if MDE still plans to submit [the Trash TMDL] to EPA in 2013?

Response: The language in the Executive Summary and Introduction regarding the status of the trash listing has now been revised to state that the Trash TMDL will be addressed at a future date. The TMDL submittal to EPA has been delayed in order to complete a full re-evaluation of the TMDL and its methodology. EPA has been notified of and is in agreement with this decision. This re-evaluation is anticipated to produce a more robust TMDL document.

MDE is fully committed to addressing all of the impairment listings in the Patapsco River Mesohaline Tidal Chesapeake Bay Segment (PATMH), including the trash impairment. MDE is cognizant of the comments it has received expressing concerns regarding the serious and detrimental nature of trash to recreation and

aquatic life in the PATMH. It is for these reasons that the development of a trash TMDL will remain a high priority for MDE.

In addition to the TMDL development, the trash impairment is also being addressed through the municipal separate storm sewer system (MS4) permits for Baltimore City and Baltimore County. Both of these permits are in the process of being renewed and will contain specific language regarding requirements to reduce the trash impairment, including: inventory of and improvements to current trash reduction practices, development and evaluation of an educational/outreach program, and annual reporting of trash reduction strategies.

The Department will keep the commentor informed of any progress regarding this project, via mail, email or our website. Once the re-evaluation is complete, if the TMDL has been significantly changed, a full public comment period will be conducted.

2. The commentor states that on page 19 [of the WQA], there was a mention of 3210 mg/kg Cr as highest spiking level in the text, but in Table 5.1.1(a) there is a 4180 mg/kg Cr spike as well.

Response: The first paragraph on page 19 states that the highest spiking level of 3,210 mg/kg is specifically for station BSM 68. The column labeled Spike C in Table 5.1.1(a) displays the highest spiking level for each sediment sample. The maximum spiking level for all sediment samples (4,180 mg/kg) applies to station BSM 45.

3. The commentor states that at the end of the 2nd Paragraph on page 31 [of the WQA] the mention of fresh sediment burying "historically contaminated sediments" brings to mind a few questions: How are the sediment samples taken and/or how deep into the sediment?

Response: Sediment samples are collected from the top 2 cm of bottom sediments using a sediment ponar grab sampler. These samples are representative of the active layer in which benthic organisms live and feed.

4. The commentor asks if sediments at different depths have different Cr levels.

Response: Concentrations of chromium within the sediments of the Baltimore Harbor will most likely be higher with increasing depth due to greater historical releases of chromium from past industrial activities (*e.g.* chromium extraction and steel manufacturing processes). The highest levels of chromium deposition would most likely have occurred in the past when these industries were operating at peak levels. This WQA establishes that chromium is not a source of toxicity within the inhabitable zone of the sediment, the active layer from which sediment samples

were collected. Therefore, quantification of chromium at varying depths within the sediment core is not necessary for assessing sediment quality.

5. The commentor asks what the consequences of dredging, storm activity, etc. may be.

Response: The dissertation "Geochemical Influences on Chromium Speciation and Fate in Estuarine Sediments; Importance of Redox Interactions with Manganese Sulfide Minerals" referenced in section 5.1.3 on page 23 of the WQA investigated chromium speciation and fate in Baltimore Harbor sediments under oxygenation to replicate conditions of sediment resuspension that may occur due to dredging, bioturbation, and flood events. This study was completed by Amar Wadhawan of the Johns Hopkins University Center for Contaminant Transport, Fate and Remediation (JHU CTFR), under the direction of Dr. Edward Bouwer, professor and department chair of Geography and Environmental Engineering. In this study, field sediments collected from various locations throughout the Baltimore Harbor, including the Bear Creek and Northwest Branch tidal segments addressed in this WQA, were suspended and re-oxygenated for extended periods of time, upwards of thirty days, resulting in no oxidation of Cr (III) to Cr (VI). Therefore, under conditions of resuspension due to dredging or storm activity, there will be no consequences as chromium in sediments of the Baltimore Harbor will remain as Cr (III), resulting in no toxicological impact to the benthic community. Please refer to section 5.1.3 for additional information.

6. The commentor asks if synergistic effects were included. If not, it should be included in future investigations.

Response: Synergistic effects are not directly investigated within this WQA, however, they are implicitly accounted for in establishing that chromium is not a source of toxicity within the sediments of the Northwest Branch and Bear Creek. In order to assess synergistic effects directly it would require conducting laboratory sediment bioassays for an endless array of substances at varying concentrations to determine a conservative threshold at which a specific contaminant is toxic to aquatic life. EPA's nationally recommended water quality criteria are developed for individual contaminants and do not incorporate synergistic effects except for the adjustment of heavy metals criteria based on the mitigating effects of hardness.

While synergy is not directly investigated, this WQA does establish that chromium is not a source of toxicity in sediments in the presence of elevated levels of other toxic contaminants, indicating that synergistic effects do not induce chromium toxicity. Chromium is predominantly found in its trivalent state [Cr (III)], the relatively non-toxic species under the environmental conditions in this watershed. Reductants present within the system facilitate the conversion of Cr (VI) to Cr (III). Cr (III) will remain stable and relatively inert within these sediments where it will be biologically unavailable to benthic organisms. As Cr (III) is a non-toxic substance and does not adversely impact the health of aquatic organisms, there is no potential for toxic contaminants present within the system to enhance toxicity

through synergistic effects. Synergy can only enhance the toxicological impact of a substance and not induce toxicity. Based on these findings, future investigations would not require an assessment of synergy related to the toxicity of chromium.

7. The commentor states that while the UMD study [referenced in the WQA] was inconclusive on the compounds causing toxicity, the UMD provided a substantial amount of information showing that chromium was not the cause of toxicity. In order to emphasize this point, the commentor states that Section 5.0 would be improved with the addition of the following information at the conclusion of Section 5.1.1 (page 22):

"While the TIE was inconclusive in regard to implicating a particular metal or group of metals for the toxicity observed in Bear Creek / Northwest Branch, UMD provided a substantial amount of information showing that chromium was not the cause of toxicity via partition to porewater or via bulk sediment exposure."

Response: MDE appreciates the recommendations Environ has provided for further justification within this WQA establishing that chromium is not an impairing substance in the Northwest Branch and Bear Creek. After review of the recommendations, MDE has incorporated changes to the document in section 4.2.

8. The commentor states that while the WQA does a good job summarizing the Johns Hopkins University studies overall, there is one element of the Wadhawan (2012) dissertation that merits further amplification because of its importance to the story of potential Cr (VI) oxidation. In Section 5.1.3, the commentor recommends that the two paragraphs beginning on Page 25 (Paragraph 2) and continuing on to Page 27 (Paragraph 1) in the MDE 2013 WQA be replaced with the following three paragraphs (note that Page 26 contains figures only which would be retained as they are called out here or earlier):

"Wadhawan (2012) performed multiple experiments to evaluate the potential for chromium to oxidize from Cr(III) to Cr(VI). One experiment evaluated the potential for Cr(III) oxidation under anaerobic conditions, which is the predominant state of in-situ sediments. Cr(III) was added to Baltimore Harbor sediments that were maintained in an anaerobic condition. Addition of Cr(III) to anaerobic sediments resulted in no formation of Cr(VI) in any of the samples from multiple batch experiments (Wadhawan, Page 79, Paragraph 1 and page 87 Paragraph 1). A second experiment evaluated the potential for Cr(III) to oxidize to Cr(VI) under aerobic conditions, in which the sediment suspension was actively oxygenated using two approaches: (1) without the addition of Cr(III) and (2) with the addition of a laboratory grade, freshly prepared Cr(III) aqueous solution. With regard to approach (1), Wadhawan states that "Oxidation of background Cr(III) in sediments was insignificant as experimental controls of unspiked sediment suspensions did not show Cr(VI) formation upon aeration (data not shown)"(Wadhawan 2012, Page 87). The data that is not shown is that approach 1 involved the aeration of each of the Harbor sediment samples for up to 30 days, or 720 hours, as noted by Wadwahan (2012, Page 118). The experimental aeration period is very conservative in terms of reflecting the natural conditions of

Baltimore Harbor where stable sediments could be aerated from potential dredging, flood events, and bioturbation. Cr(VI) was not detected and the lack of Cr(VI) from these Harbor sediment - 3 - samples indicate that Cr(VI) formation due to sediment suspension will not occur under normal conditions in Baltimore Harbor.
The oxidation of Cr(III) to Cr(VI) was further evaluated by Wadhawan (2012) using approach (2) through the spiking of a freshly prepared Cr(III) solution in aerated conditions. Cr(III) oxidation to Cr(VI) occurred and results ranged between 0.2 and 3 % in all sediment suspensions except for station DMT-109 in which 70 % of the freshly prepared Cr(III) was oxidized. Wadhawan states that aerating the sediments consumes their reductant capacity, which favors Cr(VI) formation. The reduction of sediment reductant capacity upon aeration is due to the rapid loss of AVS and the reduced forms of other key reductants (i.e. iron and manganese). The concentrations of Cr(VI) formed over the duration of these experiments are presented in Figure 5.1.3(e) (Wadhawan 2012). Concentrations of AVS and iron were notably lower at sampling location DMT-109 in comparison to other locations and the sample does not appear characteristic of naturally occurring conditions in the Harbor. Consequently, aerating this sample after amending it with freshly prepared Cr(III) produced the greater percentage of Cr(III) oxidation observed at this location. Despite the lower reducing capacity at this location, Cr(VI) was not formed when sediments were aerated for 30 days (without the addition of Cr(III)). In summary, Wadhawan showed that where no Cr(III) was added to sediments, aeration of the sediments did not yield Cr(VI) (approach 1). Cr(VI) was only formed under conditions of added freshly prepared Cr(IIII) and active aeration of the sediments (approach 2)."

Following these proposed additions, the text should continue with the next paragraph that begins with "For an evaluation of Cr(VI) reoccurrence…" as it is currently written.

Response: After review of the recommendations, MDE has incorporated changes to the document in Section 5.1.3**.**

9. The commentor states that in Section 5.1.3, the following paragraph could be added before paragraph 2 on page 28:

"The Cr(III) that was produced upon reduction of the added Cr(VI) is freshly prepared Cr(III) which is far more reactive than the aged, weathered and unreactive Cr(III) that is actually present in Baltimore Harbor sediments. The loss of reactivity of aged Cr(III) is dramatic even after 5 days (Wadhawan 2012). The Cr(III) in Harbor sediments is far older and therefore even less reactive. Consequently, despite the finding that minimal oxidation of the fresh Cr(III) occurred in the Wadwahan (2012) study, this result is not representative of natural conditions. Cr(III) present in Baltimore Harbor sediments will remain inert as oxidation reactivity is minimized due to the inactive nature of the aged Cr(III) and the prolonged anoxia that supports a sulfide rich environment."

Response: After review of the recommendations, MDE has incorporated changes to the document in Section 5.1.3**.**

10. The commentor states that in Section 5.1.3; Paragraph 2, this paragraph should be restated to say:

"Oxidation of Cr(III) to Cr(VI) will not occur from oxygenation during sediment resuspension due to dredging, flood events, and bioturbation under normal conditions in Baltimore Harbor because Wadhawan demonstrated that native Harbor sediments did not oxidize when aerated for up to 30 days (Wadwahan 2012, Page 118). Cr(VI) will not form due to the reduced reactivity of the aged Cr(III) in the sediments and its long-term persistence is governed by the reducing capacity of Baltimore Harbor sediments. Considering all these factors, it is understandable that no significant Cr (VI) was detected in the 'in-situ' Baltimore Harbor sediments and that this will remain so in the future as these conditions persist (Wadhawan 2012)."

Response: After review of the recommendations, MDE has incorporated changes to the document in Section 5.1.3**.**

11. The commentor recommends the addition of a new section (Section 5.4).

[PROPOSED NEW SECTION] ***"5.4 Supplemental Information on the Geochemical Stability and Toxicity of Chromium in Estuarine Sediments***

The following information is intended to supplement the peer reviewed papers currently summarized in Section 5.1.2 (i.e., Watlington et al. (2007)). The sediments within the Northwest Branch and Bear Creek support a reducing environment indicating that Cr(III), the non-toxic species at levels typically found within the environment, is the predominant form of chromium present within the sediment (MDE 2004). These results are consistent with chromium studies where chromium was determined to be geochemically stable and non-toxic in estuarine, marine and freshwater environments. The following studies and chromium concentrations illustrate that chromium concentrations greater than established SQG's are not toxic:

- *United States Environmental Protection Agency (USEPA 2005) showed that despite concentrations of chromium exceeding 1,700 to 3,000 mg/kg, amphipod mortality in those sediments (5-25%) was no greater than in sediments from reference sites (5-20%).*

- *Becker et al. (2006) evaluated the toxicity and bioavailability of total chromium in sediments of the Hackensack River offshore from the Kearny wetland. The study results showed that measurable concentrations of AVS were associated with low concentrations of Cr(VI) and that chromium toxicity was low in sediments with measurable concentrations of AVS. The maximum no-effect concentration estimated in this study was 1,310 mg/kg; considerably greater than existing ERM SQG of 370 mg/kg.*

- *Besser et al. (2004) evaluated the toxicity of chromium species to the amphipod, H. azteca in fresh water and freshwater sediments. Non-toxic sediments in the Cr(VI) spiking study contained chromium concentrations up to 5,000 mg/kg, presumably as Cr(III), suggesting that Cr(III) has low toxicity in freshwater sediments.*

- *Martello et al. (2007) evaluated chromium geochemistry and bioaccumulation in sediments from a chromium contaminated site. Total chromium and Cr(VI) were measured in sediment and sediment porewater to assess the relationship between sediment geochemistry and chromium speciation. In whole sediments, total chromium and Cr(VI) concentrations ranged from 5 to 9,190 mg/kg dry weight and <0.47 to 31 mg/kg dry weight, respectively. Cr(VI) was not detected in sediment porewater at any of the sampling locations. Concentrations of AVS and other geochemical measurements indicated anoxic, reducing conditions in the majority of sediment samples.*

- *Sorensen et al. (2007) conducted a Sediment Quality Triad (SQT) study consisting of chemical characterization in sediment, sediment toxicity and bioaccumulation testing, and benthic community assessments at a chromium site in the Lower Hackensack River, NJ. Although elevated total chromium concentrations in sediment were the rationale for conducting the investigation, Cr(VI) was not detected in porewater and total chromium levels in sediment porewater were well below the chronic saltwater ambient water quality criteria for Cr(VI) (50 µg/L). Therefore, total chromium was unlikely to contribute to toxicity to benthic organisms* in these laboratory experiments."

Response: While this information provides additional supporting evidence that chromium is not a source of toxicity, these studies were conducted in regions outside of the Northwest Branch and Bear Creek for which this WQA was developed. Geochemical properties of sediments from these studies may not be representative of conditions found within the Northwest Branch and Bear Creek and potentially differ in their influence on chromium chemistry. The primary function of this WQA is to demonstrate that chromium present within the sediments of these tidal segments is not a source for toxicity. Therefore MDE has elected not to include this information in the document.

12. The commentor states that the WQA fails to adequately consider the potential for significant ongoing chromium discharges from contaminated stormwater and groundwater at the Harbor Point / Chrome Works redevelopment site.

The commentor states that the continuing redevelopment of the Harbor Point / Chrome Works site could result in additional chromium discharges into Baltimore Harbor from contaminated groundwater and stormwater. During the 1980s, large quantifies of chromium were migrating from this site as a result of the Baltimore Chrome Works operations. The commentor references a consent decree entered into in 1989 by the EPA and MDE with Allied (Honeywell's predecessor) requiring it to investigate,

remedy, and control chromium discharges from the site. Allied installed a perimeter slurry wall, a multi-layer cap over the site, and a head maintenance system which collects contaminated groundwater. Under the consent decree, Honeywell must conduct continuing environmental monitoring to ensure that containment is maintained.

The commentor states that the WQA does not discuss or analyze any of the monitoring data for the Chrome Works site and that without analyzing the current groundwater and surface water conditions at the Chrome Works, the WQA cannot adequately consider the potential effects that this site may continue to have on the Baltimore Harbor. MDE should revise the draft WQA to consider recent groundwater and surface water monitoring data from this site.

The commentor states that the developers of the Harbor Point project intend to pierce the protective cap during the redevelopment which conflicts with earlier statements that the cap would not be disturbed during the redevelopment. This raises concerns regarding additional air and water pollution resulting from exposing contaminated soils that are currently encapsulated and that MDE should not re-categorize the Northwest Branch impairment until the construction on this project has been completed and subsequent environmental monitoring data have been collected and analyzed. In summary, the commentor states that the current WQA fails to consider existing and potential pollution discharges from the Harbor Point / Chrome Works site, and it is therefore inadequate.

Response: This WQA establishes that chromium present in the water column and sediment of the Northwest Branch and Bear Creek portions of the Patapsco River Mesohaline Chesapeake Bay segment is not an impairing substance and toxicity present within the sediments is not due to chromium contamination. This WQA fully acknowledges that ongoing sources of chromium enter the waters of Northwest Branch and Bear Creek, though under existing conditions the chromium from these discharges (groundwater and storm water) does not impair water quality as chromium present in the ambient water column and sediment is found predominantly in its non-toxic trivalent state [Cr (III)]. As demonstrated within this WQA, under existing conditions, chromium has no impact on the health of the aquatic community inhabiting the water column and sediment and is supportive of the “protection of aquatic life” designated use. This WQA establishes that chromium is not an impairing substance and may be removed from Category 5 of Maryland’s Integrated Report.

Honeywell entered into a consent decree on September 29, 1989 with EPA and MDE which required the company to fully investigate the environmental impact of releases from the site, and implement remedial measures approved by State and Federal agencies. Remedial activities were completed in 1999. Under the consent decree Honeywell is required to conduct surface water and ground water sampling quarterly to ensure that chromium contamination is fully contained by these remedial practices and does not impact water quality adjacent to the site. Quarterly monitoring requires collection of water column samples one foot below the surface

water and one foot above the sediment at eighteen stations surrounding the perimeter of the Harbor Point remediation site and all samples are analyzed for total dissolved chromium. Water quality data from quarterly reports over the last four quarters, beginning in the 1st quarter of 2012, found that total dissolved chromium concentrations for all samples were well below the freshwater aquatic life chronic criterion for Cr (VI) of 11 ppb.[1] Therefore, surface water discharges of chromium from Harbor Point do not impair the water column. Please note that this information has been included in the comment response to address the commentor's concern over the potential impacts of ongoing sources of chromium from Harbor point but will not be presented within the body of the WQA.

While groundwater samples are also collected quarterly and analyzed for total dissolved chromium as required under the consent decree, this data is not useful for assessment purposes as groundwater monitoring wells are not representative of ambient water quality in the Northwest Branch to which aquatic life is exposed. Therefore water quality data from groundwater is not included in this assessment. Furthermore, the surface water quality data demonstrates that no chromium impairment exists, indicating that groundwater sources do not impact ambient water quality. A head maintenance system is in operation designed to extract contaminated groundwater from sixteen (16) wells located within the hydraulic barrier, lowering groundwater levels within the barrier to elevations less than that of the Patapsco River, and thereby reducing releases of chromium to the river from any imperfections in the wall. Contaminated groundwater collected by this system is temporarily stored on-site in two 10,000 gallon tanks and then transported from the site to a hazardous waste treatment facility.[2]

In regards to concerns over potential releases of chromium in the future due to the construction of Exelon's new headquarters at Harbor Point, the construction plans are currently being reviewed by the Land Management Administration at MDE and EPA. It is anticipated that these plans will incorporate measures for addressing potential releases from the site to ensure chromium discharges do not impact water quality. Quarterly monitoring of surface water will also continue during and after construction activities are completed as required under the consent decree. The necessary steps will be implemented to ensure chromium contamination is contained during construction. As it is only speculation as to whether chromium releases in the future will impact water quality, a delay in release of the WQA would not be warranted. A WQA is solely based on existing conditions and cannot predict potential changes in water quality due to future activities. If in the future it is determined that chromium is an impairing substance, the Northwest Branch will be relisted and addressed.

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[1] CH2MHILL. 2012. Baltimore Inner Harbor Environmental Media Monitoring Plan. Chantilly, VA. Quarterly Report No. 90-94

[2] MDE. 2013a. Fact Sheet: Allied/Honeywell Site at Inner Harbor. Baltimore, MD: Maryland Department of the Environment. Also available at: http://www.mde.state.md.us/assets/document/waste/Allied_Honeywell_fact_sheet_long_version.pdf

13. The commentor states that the WQA fails to adequately consider the potential for significant ongoing chromium discharges from contaminated stormwater and groundwater at Dundalk Marine Terminal (DMT) into Bear Creek and Baltimore Harbor. Although Chromium mitigation at the DMT is occurring through a storm drain relining project, the commentor asserts that discharges will continue to occur until the mitigation is complete and that comprehensive monitoring will be required to ensure that the corrective measures will prevent future discharges of chromium laden stormwater. Until that monitoring is complete, MDE will lack sufficient data to conclude that DMT is not contributing to toxic chromium discharges into the receiving waters. In summary, the commentor states that MDE should not de-list the impairments until this monitoring data has been collected, analyzed, and incorporated into an adequate water quality analysis.

Response: Surface water and groundwater discharges from the Dundalk Marine Terminal do not transport into the waters of the Northwest Branch or Bear Creek for which this WQA was developed to address the chromium listings. Therefore it is not necessary to address sources of chromium for this facility in the WQA. Furthermore, please refer to the response to comment 12 in the first paragraph for information explaining that chromium discharges from ongoing sources do not impair the waters of Northwest Branch and Bear Creek.

In addition, this WQA did reference the Ecological Risk Assessment for Dundalk Marine Terminal as supporting evidence for establishing that chromium is not an impairing substance. Chromium discharges from this site do not cause levels in ambient water quality to exceed applicable criteria supportive of the "protection of aquatic life" designated use. The Ecological Risk assessment did not identify chromium as a contaminant of concern for further investigation. Please refer to Section 5.3 for more detailed information.

MDE also requires ongoing monitoring of the water discharges from the various stormwater discharge points at Dundalk Marine Terminal. The Maryland Port Administration submits NPDES discharge reports to the Water Management Administration. A water treatment plant will continue operating at Dundalk Marine Terminal. This plant removes chromium from stormwater and groundwater entering into the 14th and 15th Street storm drains that run through the Dundalk Marine Terminal where chromium ore processing residue (COPR) materials were deposited. The plant will remain operational until the storm drain repair and relining project is completed. The project completion is anticipated by the end of 2015. Once the remedial measures are completed, a three-year, enhanced groundwater monitoring plan will be implemented to determine whether the overall containment is effective or the remedial measures must be amended. Nonetheless, it is reasonably anticipated that some level of stormwater and groundwater releases are expected to continue until remedial measures are completed.

14. The commentor states that the WQA fails to adequately consider the potential for discharges from additional sources. In addition to the DMT and the Harbor Point/Chrome Works sites, many other sites throughout the Baltimore Harbor watershed contain potentially contaminated sediments. In summary, the commentor states that until MDE investigates the other sites that potentially contain chromium contamination and studies the extent of chromium laden discharges from those sites, it will be unable to adequately determine the extent to which existing discharges are affecting Bear Creek and the Northwest Branch.

Response: Please refer to the response to comment 12 in the first paragraph for information explaining that chromium discharges from ongoing sources do not impair the waters of Northwest Branch and Bear Creek.

In addition MDE's Land Restoration Program's (LRP) COPR Initiative funded through a cooperative agreement with the EPA has conducted preliminary assessments/investigations of sites which have historically applied COPR as landfill material for disposal. The LRP has identified several locations where such materials may have been used as fill material. To date, LRP's investigations have determined that these sites do not require additional investigation.

15. The commentor states that the WQA fails to adequately consider the potential for conversion of trivalent chromium to hexavalent chromium through frequent dredging and storm events, and that even if the resulting hexavalent chromium reverts to trivalent chromium within a few days or even a few hours after sediments are disturbed, aquatic organisms can still be exposed to toxic hexavalent chromium until the reversion process is complete. Every occurrence of dredging in the Harbor and every storm event in the Baltimore area provides an opportunity for conversion of trivalent chromium to hexavalent chromium and that the WQA does not consider the frequency of these events, and the extent to which frequent sediment disturbances can cause toxic chromium conditions in the Northwest Branch and Bear Creek. In summary, the commentor states that MDE should not de-list these chromium impairments until the potential for toxic chromium pollution due to sediment disturbance in the Baltimore Harbor is fully understood.

Response: The language referred to in this comment has been revised within Section 5.1.3 in paragraph 3 of page 29 to state "Oxidation of Cr (III) to Cr (VI) will not occur from oxygenation during sediment resuspension due to dredging, flood events, and bioturbation under existing conditions in the Baltimore Harbor." While minimal oxidation of Cr (III) occurred under laboratory conditions in which Cr (VI) additions were oxidized upon aeration following complete reduction to Cr (III), only the freshly produced Cr (III) from the addition underwent this conversion. The dissertation by Amar Wadhawan of the JHU CTFR under the direction of Dr. Edward Bouwer referenced in section 5.1.3 of the WQA demonstrated that oxidation of background Cr (III) in Baltimore Harbor sediments when oxygenated for up to 720 hours is found to be insignificant as Cr (VI) formation did not occur. The oxygenation period is highly conservative in

reflecting natural conditions of sediment resuspension that may occur due to dredging, bioturbation, and storm events. Therefore chromium present in Baltimore Harbor sediments does not have the potential to form Cr (VI) during sediment resuspension under existing conditions. Please refer to section 5.1.3 for additional information. See also response to comment #5.

16. The commentor states that re-categorizing these impairments at this time places a burden on citizen groups to collect additional water quality data. Citizen groups that have limited resources would need to perform extensive testing near DMT, Harbor Point, and other locations to monitor the chromium levels. Such water quality testing is expensive; testing in a legally defensible, comprehensive and statistically meaningful manner could easily cost thousands of dollars.

In summary, the commentator states that given the timing of the projects at DMT and Harbor Point and the continuing investigation of other sites, it would be far more efficient and protective of water quality to maintain the current TMDL categorization for these impairments at this time. With active sources of chromium pollution and the possible disturbance of soils at the Chrome Works site, this is not an appropriate time to remove these impairments from the list of waters for which a TMDL must be developed.

Response: Please refer to the response to comment 12 in the first paragraph for information explaining that chromium discharges from ongoing sources do not impair the waters of Northwest Branch and Bear Creek. As this WQA establishes that chromium is not an impairing substance and may be removed from Category 5 of Maryland's Integrated Report, there is no need for citizen groups to collect additional water quality data to characterize levels of chromium in the Northwest Branch and Bear Creek. In addition, the responses to comments 13, 14, and 15 also explain that monitoring of chromium discharges in storm water and ground water will continue at Harbor Point and DMT and Land Restoration Program's COPR Initiative determined that sites where the COPR material was land applied do not require additional investigation. This further suggests that citizen groups would not be required to conduct monitoring of chromium. MDE will continue to assess water quality of the Baltimore Harbor from ongoing monitoring activities to ensure chromium contamination from ongoing sources do not impact water quality. If in the future chromium levels exceed applicable criterion in ambient water resulting in an impairment, the Northwest Branch or Bear Creek would be relisted.