Comparison between Sparrows Point Shipyard's Contaminated Sediment and NOAA Sediment Screening Values

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January 23, 2007

BWI-Sparrows Point, LLC (BWI-Sparrows Point) is dredging 600,000 cubic yards of toxic sediment from Sparrows Point Shipyard in the Baltimore Harbor/Patapsco River Basin. BWI-Sparrows Point plans to dredge an additional 2.6 million cubic yards of toxic sediment from Sparrows Point Shipyard to provide overseas tankers access to a proposed liquid natural gas (LNG) terminal which would also be located at Sparrows Point. Some of the most contaminated sediments in the Chesapeake Bay are located in the Baltimore Harbor/Patapsco River Basin.[1] Results from an October 2006 Maryland Port Authority and Maryland Department of Transportation commissioned bulk sediment analysis show high levels of toxic metals, chlorinated pesticides, polycholorinated biphenyls (PCBs) congeners and polycyclic aromatic hydrocarbons (PAHs) in Sparrows Point Shipyard.

- The October data showed that one or more samples of at least 14 different contaminants were *above* levels that the National Oceanographic and Atmospheric Administration (NOAA) expects to result in *actual harm* to marine life. In some cases, the samples showed contamination many times higher than the levels known to cause actual harm to one or more biota. For example, one sample measured concentrations of selenium at 6200 parts per billion (ppb), which is more than 6 times higher than the 1000 ppb level known to be harmful to the normal development and survival of amphipods (category of crustaceans).
- The October data showed that one or more samples of at least 18 different contaminants were well above levels expected to cause *probable harm* to marine life or human health. For example, one sample measured arsenic at 56900 ppb which is 1.6 times higher than the level expected to cause probable harm.
- These results are all the more remarkable given that the samples were diluted by aggregating results, and including sediment at deeper levels than contaminants can be found.

BWI-Sparrows Point will aim to complete phase one of the dredging project it began on December 8, 2006 by January 31, 2007, the expiration date of its dredging permit. Given the high levels of sediment contamination and rushed dredging process, resuspention of sediment contaminants released during the dredging project may pose a substantial threat to Chesapeake Bay aquatic life and the health of Baltimore County residents.

[1] McGee, Beth., Fisher, Daniel J., Yonkos, Lance T., Ziegler, Gregory P., Turley, Steve., "Assessment of Sediment Contamination, Acute Toxicity, and Pollution Viability of the Estuarine Amphipod Leptocheirus Plumulosus in Baltimore Harbor, Maryland, USA," Environmental Toxicology and Chemistry Journal, Vol. 18 Issue 10 (1999).

I. Brief Background on Sparrows Point Shipyard, Patapsco River and Community Concerns

Citizens living near the Sparrows Point Shipyard are concerned about adverse health and environmental impacts the BWI-Sparrows Point dredging project and the proposed AES Sparrows Point LNG, LLC (AES) terminal will have upon their community. Both projects would share the same geographic footprint, Baltimore Harbor/Patapsco River Basin near Sparrows Point, Baltimore County. This area abuts the low income minority communities of Turner Station and Dundalk and lies about three miles upstream from the Chesapeake Bay. The communities are concerned that the projects will increase their exposure to carcinogens and threaten air and water quality. In December 2007 the Greater Dundalk Alliance and several independent citizens filed for a temporary restraining order and preliminary and permanent injunctive relief to enjoin BWI-Sparrows Point from continuing its dredging project.

Sparrows Point, Patapsco River's history of pollution is long and until recently, unregulated. BWI-Sparrows Point, LLC assumed ownership of the Sparrows Point Shipyard in 2003. From 2000-2003 the site was owned first by Baltimore Marine Industry then by International Steel Group (IGS), who still holds some property rights. Bethlehem Steel Corporation (Bethlehem) operated the site from 1893 until 2000. Behlehem's toxic water discharges went unregulated until approximately 1980. From 1990 through 1994 alone, Bethlehem dumped more carcinogens (79,900 lbs), persistent toxic metals (851,000 lbs) and toxic chemicals that cause reproductive damage or birth defects (3,000 lbs) into Maryland's waters than any other facility.[2]

BWI-Sparrows Point's current project seeks to dredge sediment from a channel and berthing area of the Baltimore Harbor/Patapsco River Basin to deepen the canal in order to provide access to AES's overseas tankers. The phase one permit allows the BWI-Sparrows Point to remove 600,000 cubic yards of sediment and deposit the dredged material at the already overburdened Hart Miller Island disposal site (HMI). Phase one of the BWI-Sparrows Point dredging project commenced on December 8, 2006. The Maryland Port Administration requires the facility deposit all of the phase one dredge material to HMI by January 31, 2007. BWI Sparrows point will remove an additional 2.6 million cubic yards of sediment during phase two of the dredging project. The facility has yet to identify a disposal site for the phase two dredge material.

II. Bulk Sediment Analysis of Sparrows Point

In October 2006, the Maryland Port Authority and Maryland Department of Transportation commissioned EA Engineering, Science and Technology Inc. (EA Engineering), to take sediment samples from Sparrow Point Shipyard and Severn Trent Laboratories to perform a bulk sediment analysis of those samples. The results of both the October 2006 study, as well as a bulk sediment analysis commissioned in 1985 by Bethlehem Steel, found a substantial number of priority pollutants at Sparrows Point.

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[2] Savitz, Jacqueline D., Campbell, Christopher., Wiles, Richard., and Hartman, Carolyn., "Dishonorable Discharge: Toxic Pollution of Maryland Waters," Environmental Working Group and The State PIRGS (September 1996).

The results of these studies differ dramatically from the results of the June 2004 sediment analysis performed on behalf of BWI-Sparrows Point by GZA GeoEnvironmental, Inc. The Maryland Port Administration required BWI-Sparrows Point conduct a sediment analysis of the contaminated Baltimore Harbor dredge material the facility would deposit at HMI. The 2004 study concluded that "No priority pollutant organics were detected in the three composite samples collected."[3] The October 2006 sediment results show substantial concentrations of at least thirty-four priority pollutant organics and six metals at Sparrows Point Shipyard. The inconsistency between the 1985, 2006 and 2004 raise questions as to accuracy of GZA's 2004 bulk sediment analyses.

Baltimore Harbor is an active shipping channel subject to the US Army Corp of Engineers' Channels Dredged Material Management Plan. As such, some could argue that because maintenance dredging is already occurring in the same ecosystem, additional dredging would not have much of an environmental impact. The 2006 bulk sediment analysis shows levels of sediment contamination that are more alarming than those shown in the 2004 studies. Regardless of the reason for the discrepancy, maintenance dredging occurring in the Baltimore Harbor should not limit an inquiry and diligent examination of potential contamination that may arise from dredging an additional 3.2 million cubic yards of sediment in an already unhealthy ecosystem.

III. Method of Evaluating Toxins at Sparrows Point Shipyard

The tables below compare the sample concentrations taken in October 2006 to the NOAA Screening Quick Reference Tables (SQuiRTs). SQuiRTs provide screening concentrations for estuarine and marine sediment, however, SQuiRTs are "intended for internal use [by the Coastal Protection and Restoration Division of NOAA] only." SQuiRTs are not endorsed by NOAA and do not "constitute criteria or clean up levels." That said, SQuiRTs provide a gauge for understanding when toxic concentrations should trigger concern for aquatic and human life. SQuiRTs screening values also help identify which toxins need additional site specific testing.

There are three SQuiRTs values provided in the tables below: Effects Range-Low, Probable Effects Level and Apparent Effects Threshold:

- Effects Range-Low or **ERL** is calculated at the low end of a range of levels at which toxicity may begin to be observed in sensitive species (calculated as the lower 10^{th} percentile concentration of the available sediment toxicity data).[4]
- Probable Effects Level or **PEL** is the level above which adverse effects are frequently expected (geometric mean of the 50% of impacted, toxic samples and the 85% of the non-impacted samples).[5]
- Apparent Effects Threshold or **AETs** represent the concentration above which adverse biological impacts would always be expected by the biological indicators listed below due to exposure to that contaminant alone. While the AET values

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[3] Bulk Sediment Analysis for the BWI Sparrows Point LLC, Patapsco River, June 2004 Sampling, performed by GZA GeoEnvironmental, Inc., on behalf of BWI Sparrows Point LLC in June, 2004.
[4] National Oceanographic and Atmospheric Administration, Screening Quick Reference Tables (SQuiRTs), available at http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html (updated February 2004).
[5] Id at 12.

were principally derived from sediment samples collected in Puget Sound, they serve as useful prediction models with which to screen bulk sediment data and identify areas requiring further investigation in diverse sediment locations, including the Chesapeake Bay.[6] The AET columns in the tables below contain letters representing the following biological indicators: I-Infaunal community impacts; A-Amphipod; B-Bivalve; M-Microtox; O-Oyster larvae; E-Echinoderm larvae; L-Larval max; or, N-Neanthes bioassays.[7]

All calculations are represented in the tables below as ***parts per billion***. Those compounds highlighted in grey indicate that either the probable effects threshold or apparent effects threshold was met or exceeded by one or more of the samples analyzed. Sample concentrations **bolded** indicate that the concentration met or exceeded either the probable effects threshold or apparent effects threshold. Footnoted compounds were identified using chemfinder.com to assure the SQuiRTs compounds analyzed shared the same CAS number as the analyte examined by Severn Trent Labs.

IV. Flawed Bulk Sediment Analysis

While we believe the October 2006 study provides more accurate information than the July 2004 analysis, the study is flawed for a number of reasons. Unrepresentative samples of perspective dredging area, diluted analytical parameters, a high threshold instrument calibration and a comparatively inexpensive study cast doubt on whether additional toxins and higher quantities of those toxins detected were not actually present in Sparrows Point, Patapsco River sediment.

First, the samples analyzed did not represent the entire perspective dredging area. Neither the berthing areas nor the heavily contaminated side walls were sampled. Instead, the Shipyard channel itself was sampled, from which 400,000 cubic yards of contaminated sediment was removed in 1988. A toxicologist from the USEPA, Bureau of Solid Waste stated that 1985 study revealed a 30% overall concentration of Non-Aqueous Phase Liquid (NAPL) at the five foot level. The toxicologist concluded that the highest levels of toxic contamination would be present between the five and twenty feet core levels.[8] All 2006 samples were taken from a forty foot core. Because all the samples were taken around the forty foot level, it is likely that the 2006 study did not capture the most concentrated levels of core contamination.

Second, the parameters of analysis deviate from the ASTM standard test method which recommends analyzing the core by the foot.[9] Instead, EA Engineering took a composite sample which dilutes the sediment analyzed and weakens the specificity of the sediment

[6] Buchman, Michael, author of “NOAA/ARD Screening Quick Reference Tables”, telephone conversation, January 19, 2007.
[7] Id.
[8] The USEPA Bureau of Solid Waste toxicologist based these calculations on factors including the 1985 core samples, the previous 110 years of accumulated toxic sediment and the roughly three feet of new sediment that accumulated since the 1985 core samples were taken.
[9] ASTM International, formerly known as the American Society for Testing and Materials, is an organization of scientists and engineers that develop technical standards including standard test methods for sediment sampling.

analysis. Severn Trent Laboratories analyzed the composite sediment sample, expressed as “SPSY-01,” “SPSY-02,” “SPSY-03,” “SPSY-04” in the tables below. Each “SPSY” represents three grab samples averaged together from twelve core samples.

Third, the analytical reporting limit was calibrated at too high a level. This may indicate that toxins which are dangerous in quantities at levels lower than that of the instrument’s calibration would not be detected. The majority of semi-volatile and volatile compounds sampled were not detected because the reporting limit did not correspond with the levels at which those concentrations pose a threat. For example, the Apparent Effects Threshold for the semi-volatile compound dimethyl phtyalate is six parts per billion for bivalve (clams, scallops, oysters, etc…) however, the reporting limit for dimethyl phtyalate is 778 parts per billion. Therefore, while significant levels of dimethyl phtyalate may threaten bivalves (any value ≥6 parts per billion) the report would not manifest evidence to that effect. In other words, because the detection levels were set so high, alarming levels of toxins may have flown under the radar.

Finally, a bulk sediment analysis study usually costs approximately half a million dollars However, the state of Maryland only spent $50,000 on this sediment analysis. The scientific community refers to studies done quickly and on the cheap as a “snapshot” as opposed to a comprehensive study. We believe the lack of investment in the bulk sediment analysis fails to meet the threshold necessary to achieve a comprehensive study.

Table 1: Metal Concentration found in Sediment at Sparrows Point Shipyard (October, 2006) Compared to SQuiRTs for Estuarine and Marine Sediment

Compound	***Effects Range-Low (ERL)***	***Probable Effects Level (PEL)***	***Apparent Effects Threshold (AET)***	***SPSY -01***	***SPSY -02***	***SPSY -03***	***SPSY -04***
Antimony			9300 E	960 BN	970 NU	960 NU	730 BN
Arsenic	8200	41600	35000 B	**56900**	4700	5100	12500
Cadmium	1200	4210	3000 N	1500	480 U	480 U	1600
Chromium	81000	160400	62000 N	**328000 NE**	31500 NE	31900 NE	**128000 NE**
Copper	34000	1082000	390000 MO	201000	13000	16100	129000
Lead	46700	112180	400,000 B	**180000 E**	17800 E	14900 E	**203000 E**
Mercury	150	696	410 M	300	39	40	320
Nickel	20900	42800	110000 EL	**43000 E**	10600 E	21100 E	**43700 E**
Selenium			1000 A	**6200**	400 B	480 U	**1200**
Silver	1000	1770	3100 B	1500	180 B	200 B	750
Zinc	150000	271000	410000 I	**670000 E**	58100 E	70300 E	**380000 E**

B = compound was detected, but below the reporting limit (value is estimated)[10]
E = reported value is estimated because of presence of interference[11]
N = spiked sample recovery is not within control limits[12]
U = compound was analyzed, but not detected[13]

Table 2: Chlorinated Pesticide Concentration found in Sediment at Sparrows Point Shipyard (October, 2006) Compared to SQuiRTs for Estuarine and Marine Sediment

Compound	***Effects Range-Low (ERL)***	***Probable Effects Level (PEL)***	***Apparent Effects Threshold (AET)***	***SPSY - 01***	***SPSY - 02***	***SPSY - 03***	***SPSY - 04***
4,4'-DDD [14]	2	7.81	<16 I	**9**	1.7 U	1.6 U	17 U
4,4'-DDE [15]	2.2	374.17	<9 I	8.7	1.7 U	1.6 U	17 U
4,4'- DDT [16]	1	4.77	<22 E	**7.9 PG**	1.4 J	1.6 U	**8.1 J PG**

J = compound was detected, but below the reporting limit (value is estimated)[17]
PG = the percent difference between the original and confirmation analysis is greater than 40%[18]
U = compound was analyzed, but not detected [19]

Table 3: Polycholorinated biphenyls (PCBs) Congener Concentrations in Sediment Sparrows Point Shipyard (October, 2006) Compared to SQuiRTs for Estuarine and Marine Sediment

Compound	***Effects Range-Low (ERL)***	***Probable Effects Level (PEL)***	***Apparent Effects Threshold (AET)***	***SPSY - 01***	***SPSY - 02***	***SPSY - 03***	***SPSY - 04***
*Total PCBs (ND=0)	22.7	188.79	130 M	**196**	2.98	1.16	129
*Total PCBs (ND=1/2 DL)	22.7	188.79	130 M	**202**	22.6	25.2	**132**

* The columns report slightly different results because the analyst used two different USEPA/USACE 1998 formulas to summarize the total PCBs analyzed. There are a total

[10] Bulk Sediment Analysis for BWI Sparrows Point Shipyard, October 2006 Sampling, performed by Seven Trent Laboratories, prepared for Maryland Port Authority and Maryland Department of Transportation.
[11] Id.
[12] Id.
[13] See supra note 7.
[14] Cas. No. 72-54-8 declares 4,4-DDD a synonym for p,p - DDD.
[15] Cas. No. 72-55-9 declares 4,4'-DDE a synonym for p,p -DDE.
[16] Cas. No. 50-29-3 declares 4,4'-DDT a synonym for p,p - DDT.
[17] See supra note 7.
[18] Id.
[19] Id.

of 109 PCB Congeners of which 27 PCB Congeners were analyzed in the table above. The formulas are used in efforts to unbias the results.

Table 4: Polycyclic Aromatic Hydrocarbons (PAHs) Concentrations in Sediment Sparrows Point Shipyard (October, 2006) Compared to SQuiRTs for Estuarine and Marine Sediment

Compound	***Effects Range-Low (ERL)***	***Probable Effects Level (PEL)***	***Apparent Effects Threshold (AET)***	***SPSY -01***	***SPSY -02***	***SPSY -03***	***SPSY -04***
Acenaphthene	16	88.9	130 E	42 J	640 U	630 U	**340 J**
Acenaphthylene	44	127.87	71 E	**110 J**	640 U	630 U	**220 J**
Anthracene	85.	245	280 E	200 J	640 U	630 U	**600 J**
Benzo(A)Anthracene	261	692.53	960 E	580 J	40 J	39 J	**1100**
Benzo(A)Pyrene	430	763.22	1100 E	620 J	640 U	46 J	**950**
Benzo(B)Fluoranthene			1800 EI	680 J	64 J	51 J	960
Benzo(GHI)Perylene			670 M	470 J	49 J	38 J	570 J
Benzo(K)Fluoranthene			1800 EI	260 J	23 J	21 J	370 J
Chrysene	384	845.98	950 E	620 J	35 J	35 J	**1100**
Dibenz(A,H)Anthracene	63.4	134.61	230 OM	110 J	640 U	630 U	**150 J**
Fluoranthene	600	1493.54	1300 E	940 J	65 J	64 J	**2600**
Fluorene	19	144.35	120 E	85 J	640 U	630 U	**400 J**
Indeno(1,2,3-CD)Pyrene			600 M	500 J	53 J	42 J	**730**
Naphthalene	160	390.64	230 E	**560 J**	85 J	50 J	**790**
Phenanthrene	240	543.53	660 E	390 J	27 J	24 J	**1600**
Pyrene	665	1397.6	2400 E	830 J	64 J	56 J	**1500**

J = compound was detected, but below the reporting limit (value is estimated)[20]
U = compound was analyzed, but not detected [21]

IV. Findings

Toxic levels of at least six metals, two chlorinated pesticides, twelve PAHs and PCBs exceeded NOAAs screening values for the probable effects level and/or the apparent effects threshold. Meaning that at least twenty-one of the toxins shown in the tables above exceed the level at which adverse effects are frequently expected and/or represent the concentration above which adverse biological impacts would always be expected by that biological indicator due to exposure to that contaminant alone.

- **Toxins Exceeding Apparent Effects Threshold**: arsenic, chromium, selenium, zinc, PCBs, acentaphethene, acenaphthylene, anthracene, benzo(A)anthracene, chrysene, fluoranthene, indeno(1,2,3-CD)pyrene, naphthalene, and phenanthrene
    - One sample measured concentrations of **chromium** at 328000 ppb, which is more than 5 times higher than the 62000 ppb level known to be harmful to a *polychaete* worm (neanthes bioassays is a biological indicator used in SQuiRTs to determine the health of the polychaete worm by evaluating its survival and growth after exposure - in this case to chromium)

[20] See supra note 7.
[21] Id.

- A combined sampling of **PCB congeners** measured the concentration of total PCBs between 196 and 202 ppb, which is nearly twice as high as the 130 ppb level known to harm bacteria (microtox is a biological indicator used in SQuiRTs to determine the of health of bacteria by evaluating the amount of light the bacteria emits after exposure to a containment, unhealthy bacteria emit diminished amounts of light).
- One sample of acenaphthlene, fluorene and naphthalene each measured approximately three times higher that the respective levels known to be harmful to echinoderm larvae (larvae of marine animals including sea cucumbers and starfish). Biological indicators for measuring the health of echinoderm larvae include normal development and survival after exposure.

- **Toxins Exceeding Probable Effects Level**: arsenic, chromium, lead, nickel, zinc, 4,4'-DDD, 4,4'-DDT, PCBs, acentaphethene, acenaphthylene, anthracene, benzo(A)anthracene, chrysene, dibenz(A,H)anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene

- **Metal Concentrations Exceeding AET or PEL**: arsenic, chromium, lead, nickel, selenium, and zinc

- **Chlorinated Pesticides Concentrations Exceeding AET or PEL**: 4,4'-DDD and 4,4'-DDT

- **Total PCB Congeners Exceeded AET and PEL**

- **PAH Concentrations Exceeding AET or PEL**: acentaphthene, acenaphthylene, anthracene, benzo(A)anthracene, chrysene, dibenz(A,H)anthracene, fluoranthene, indeno(1,2,3-CD)pyrene, naphthalene, phenanthrene, and pyrene

V. Conclusion

The findings of the October 2006 bulk sediment analysis justify the need for additional site specific testing. At the very least, additional sampling would be useful to ascertain the spatial (including vertical) distribution of contaminants and identify the location of contamination "hotspots" that might be disturbed by the dredging. In addition, the findings raise warning flags that aquatic and human life may be threatened by remobilized sediment contamination unearthed through the dredging process.