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Subject: EPA review & proposal for the Area A Wetland data
Attachments: AreaAPRGmemo.doc; PRGdevelAreaA041509.xls

(See attached file: AreaAPRGmemo.doc)(See attached file: PRGdevelAreaA041509.xls)

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Area A Wetland Toxicity Test Results and Draft PRGs
Naval Submarine Base, New London, CT
April 15, 2009

Background Information

EPA reviewed the toxicity test using two-species (*i.e., Chironomus dilutus* and *Hyalella azteca*) and chemistry data for the Area A Wetland and developed preliminary remediation goals (PRGs). The Navy evaluated the data using regression analysis to determine the chemicals (or chemical groups) associated with observed toxicity. EPA indicated that this approach was statistically unlikely to be successful because of the presence of multiple contaminants and relatively few toxicity test samples. EPA proposes an alternative method that can be refined to produce reasonable PRGs by efficient use of available data.

Overall toxicity was not high for the survival endpoint for either species, with the exception of station SD-70, which was acutely toxic to both species. There were growth effects observed, primarily in the toxicity test using *C. dilutus*. Consistent with our approach at other sites, EPA supports the use of the combined reference station data set for interpreting these results. Based on the combined data set, eight Area A Wetland sediment samples exhibited growth effects that were significantly reduced relative to the combined reference data (*i.e.,* SD-62, SD-66, SD-69, SD-70, SD-74, SD-75, SD-76, and SD-79). These results, combined with extensive chemical contamination with multiple contaminants, indicate that the Area A wetland is a degraded environment that would not likely support a healthy benthic community. While there may be additional food chain risks that have not been evaluated, this technical memorandum focuses only on the toxicity results.

EPA considers the growth endpoint to be significant in toxicity testing, particularly in C. *dilutus* testing where it is easier to reliably discern significant growth effects. *Hyalella azteca*, because of their low mass overall, are more difficult to weigh accurately at the end of the test. Although there were an unusually high number of adult *C. dilutus* emerging during the test, from what is known to date the test results remain valid.

PRG Development Methods

EPA compiled the data in the attached Excel file, and indicated their toxicity status and associated concentrations of chemicals and chemical groups. The evaluation is performed based on total PAHs, Total PCBs, DDE, DDT, and several metals, all of which were detected above Threshold Effects Values (TECs) and some of which were detected above Probably Effects Concentrations (PECs). EPA reviewed each toxic sample and chemical group to determine a No Observed Effect Concentration (NOEC) and a Lowest Observed Effect Concentration (LOEC). The NOEC is defined as the highest concentration at which toxicity was not observed. The LOEC is defined as the lowest concentration at which toxicity was observed. Based on these observations, a preliminary range of potentially toxic concentrations was developed. EPA based the PRGs on the NOEC to be protective of benthic organism growth.

In some instances the toxicity profile for a contaminant was uneven or contradictory. This can occur because of differences in bioavailability between samples, or synergistic or antagonistic effects amongst contaminants. As an example, in one sample arsenic appeared to be associated with toxicity in one sample at 38 mg/kg, while in another sample 53 mg/kg was non-toxic. When faced with contradictory evidence, EPA defaulted to the LOEC. If another contaminant within that sample provided a more likely explanation of toxicity, EPA disregarded the chemical as a risk-driver.

Finally, EPA identified some samples where a milder degree of toxicity was observed, and no single risk-driving chemical or chemical group was evident. Often eight, nine, or ten TECs were exceeded, suggesting an overall degradation of sediment quality owing to multiple contaminants. For stations where eight or more TECs are exceeded, EPA proposes an additional qualitative PRG to consider that station potentially toxic.

EPA developed this memorandum for discussion purposes and anticipates some refinement in order to finalize PRGs. However, EPA believes that it is a reasonable conceptual approach for selecting risk-driving sediments at the Area A Wetland.

Results and Discussion

PAHs: Toxicity was observed at concentrations as low as 4,556 ug/kg, however there were other samples in this range that were non-toxic, which precludes selecting this value as a PRG based on the NOEC. Toxicity was not observed at 5,735 ug/kg and no values above 5,735 ug/kg were non-toxic, therefore this value was selected as the PRG for total PAHs. Station SD-75 is questionable because it appears from the raw data that PAH may not have been analyzed, but a high concentration, 50,953 ug/kg, was detected at depth.

DDE: Toxicity was observed in samples with concentrations as low as 42 ug/kg. It is uncertain whether to evaluate DDE separately or evaluate it as part of total DDTR. EPA proposes a PRG of 21 ug/kg for DDE as the highest concentration with no observed toxicity.

DDT: Samples as low as 511 ug/kg exhibited toxicity, however one sample at 671 ug/kg was non-toxic. EPA proposes to set the DDT PRG at 671 ug/kg as the highest non-toxic concentration.

Total Aroclors: There were two samples at 480 ug/kg; one was toxic to *H. azteca* and one was not toxic to either species. Since acute toxicity was observed for *C. tentans* at 590 ug/kg, EPA therefore proposes 480 ug/kg as the PRG. While there is some uncertainty because of rejected results, it seems to affect mainly non-toxic samples.

Arsenic: No PRG is proposed for arsenic because the lowest toxic sample at 38.3 mg/kg was contradicted by a non-toxic sample at 53.5 ug/kg, suggesting that this might not be a risk-driving chemical. EPA has had extensive experience with contradictory results for arsenic, which is often confounded by a wide variability in its bioavailability.

Other Metals: With the exception of copper, most of the metals do not appear to be risk-driving as individual contaminants, however there are some indications that when eight to ten TECs are exceeded the sample shows indications of toxicity.

PRG Application

EPA proposes that the aforementioned PRGs be applied to all stations for which chemical analyses have been performed. EPA has done this informally basis and discovered that the areas identified as problematic are those areas where toxicity was expected based on the sediment chemistry. The southwest corner of the wetland and the drainage from the weapons area exhibited most of the predicted or observed toxic samples. Sediments that exceed PRGs should be remediated and restored. As mentioned previously, aggressive *Phragmites australis* control measures should be undertaken to protect the improved wetlands and adjacent operable units.

TABLE 1

SUMMARY OF TOXICITY TEST DATA - STATIS
SITE 2B - AREA A WETLA
NSB-NLON, GROTON, CONNE

	Hyalella azteca						Zn						
	Survival			Growth			.6	459					
	Statistically Different Comp to:			Statistically Different Comp to:									
Sample Number	Ref SD80	Ref SD81	Combined Reference	Ref SD80	Ref SD81	Combined Reference	.7	121	TEC ex	PEC ex	Avg PEC-Q dde	Avg PEC-Q ddx	Avg PEC-Q metals
Laboratory Control Sample													
Lab Control	-	-	-	-	-	-							
Reference Samples													
SD-SD80-0001	-	NO	-	-	NO	-	.2	44.5	6	0	0.29	0.28	0.33
SD-SD81-0001	NO	-	-	NO	-	-	.8	44.3	7	0	0.34	0.33	0.4
Composite Reference	NO	NO	-	NO	NO	-							
Site Samples													
SD-SD60-0001	YES	NO	NO	NO	NO	NO	.2	68.4	5	1	0.5	0.5	0.55
	NO	NO	NO	NO	NO	NO	.6	118	3	1	0.33	0.29	0.14
	YES	NO	YES	NO	YES	NO	.6		10	2	0.66	0.62	0.73
SD-SD68-0001	NO	NO	NO	NO	NO	NO	.7		5	1	0.46	0.43	0.51
	NO	NO	NO	NO	NO	NO	.4	247	8	2	0.84	0.47	0.36
	YES	YES	YES	NO	NO	NO	.1		10	4	0.97	0.88	0.9
SD-SD72-0001	NO	NO	NO	NO	NO	NO	.2	264	9	1	0.45	0.5	0.41
SD-SD73-0001	NO	NO	NO	NO	NO	NO	.4		3	1	0.33	0.29	0.36
	NO	NO	NO	NO	NO	NO	.7	139	7	3	2.77	1.01	0.27
	NO	NO	NO	NO	NO	NO	.3	242	8	3	2.5/7.7	1.1/3.5	0.4
	NO	NO	NO	NO	NO	NO	.4	323	7	1	0.42	0.35	0.28
	YES	NO	YES	NO	NO	NO	.3	206	4	1	0.69	0.69	0.39
	YES	NO	NO	NO	NO	NO							

here high concentrations stand-out as likely causing observed toxicty.

the above results should be set at 8 to 10 exceedances.

			# exceedances of TEC or PEC	
Location			**TEC**	**PEC**
2WMW2S	082390-2WMW2(0-2)	0-2	3	1
2WTB7	090590-2WTB7(0-2)	0-2	4	0
2WTB7	090590-2WTB7(0-2)-D	0-2	3	1
2WTB2	090690-2WTB2(0-2)	0-2	3	1
2WTB2	090690-2WTB2(0-2)-D	0-2	2	1
2WTB4	090690-2WTB4(0-2)	0-2	4	0
2WTB6	090690-2WTB6(0-2)	0-2	6	0
2WSD1	112690-2WSD1(0-0.5)	0-0.5	8	1
2WSD1	112690-2WSD1(0-0.5)-D	0-0.5	6	0
2WSD2	112690-2WSD2(0-0.5)	0-0.5	6	1
2WSD3	112690-2WSD3(0-0.5)	0-0.5	7	1
2WSD4	112690-2WSD4(0-0.5)	0-0.5	5	0
2WSD5	112690-2WSD5(0-0.5)	0-0.5	4	0
2WSD6	112690-2WSD6(0-0.5)	0-0.5	5	0
2WSD7	112690-2WSD7(0-0.5)	0-0.5	5	0
2WSD8	112690-2WSD8(0-0.5)	0-0.5	7	0
2WSD9	112690-2WSD9(0-0.5)	0-0.5	6	3
2WSD43	2W-SD-SD43-0001	0-0.33	11	4
2WSD44	2W-SD-SD44-0001	0-0.33	9	1
2WSD45	2W-SD-SD45-0001	0-0.33	4	0
2WSD46	2W-SD-SD46-0001	0-0.33	9	1
2WSD47	2W-SD-SD47-0001	0-0.5	9	1
2WSD47	2W-SD-SD47-0001-D	0-0.5	9	2
2WSD48	2W-SD-SD48-0001	0-0.33	10	2
2WSD49	2W-SD-SD49-0001	0-0.33	9	1
2WSD50	2W-SD-SD50-0001	0-0.33	9	1
2WSD51	2W-SD-SD51-0001	0-0.5	6	0
2WSD52	2W-SD-SD52-0001	0-0.5	9	2
2WSD53	2W-SD-SD53-0001	0-0.5	7	0
2WSD53	2W-SD-SD53-0001-D	0-0.5	7	0
2WSD54	2W-SD-SD54-0001	0-0.5	6	0
2WSD55	2W-SD-SD55-0001	0-0.5	5	1
2WSD56	2W-SD-SD56-0001	0-0.33	3	0
2WSD57	2W-SD-SD57-0001	0-0.33	4	1
2WSD58	2W-SD-SD58-0001	0-0.33	0	0
2WSD59	2W-SD-SD59-0001	0-0.33	1	0
2WSD60	2W-SD-SD60-0001	0-0.33	4	1
2WSD60	2W-SD-SD60-0001-D	0-0.33	1	1
2WSD62	2W-SD-SD62-0001	0-0.33	3	1
2WSD63	2W-SD-SD63-0001	0-0.33	0	0
2WSD63	2W-SD-SD63-0001-D	0-0.33	0	0
2WSD64	2W-SD-SD64-0001	0-0.33	2	0
2WSD65	2W-SD-SD65-0001	0-0.33	1	1
2WSD66	2W-SD-SD66-0001	0-0.33	10	2
2WSD67	2W-SD-SD67-0001	0-0.33	2	1
2WSD68	2W-SD-SD68-0001	0-0.33	5	1
2WSD69	2W-SD-SD69-0001	0-0.33	8	2
2WSD70	2W-SD-SD70-0001	0-0.33	10	4
2WSD71	2W-SD-SD71-0001	0-0.33	2	0
2WSD72	2W-SD-SD72-0001	0-0.33	9	1

			# exceedances of TEC or PEC	
Location			**TEC**	**PEC**
2WSD73	2W-SD-SD73-0001	0-0.33	4	1
2WSD74	2W-SD-SD74-0001	0-0.33	7	3
2WSD75	2W-SD-SD75-0001	0-0.33	7	2
2WSD75	2W-SD-SD75-0001-D	0-4	3	3
2WSD76	2W-SD-SD76-0001	0-0.33	7	1
2WSD77	2W-SD-SD77-0001	0-0.33	2	0
2WSD78	2W-SD-SD78-0001	0-0.33	2	0
2WSD79	2W-SD-SD79-0001	0-0.33	4	1
2WSD80	2W-SD-SD80-0001	0-0.33	6	0
2WSD81	2W-SD-SD81-0001	0-0.33	7	0
2WSD81	2W-SD-SD81-0001-D	0-0.33	4	0
2WSD82	2W-SD-SD82-0001	0-0.33	7	0
2WSD83	2W-SD-SD83-0001	0-0.33	8	0
2WSD83	2W-SD-SD83-0001-D	0-0.33	7	0
2WSD84	2W-SD-SD84-0001	0-0.33	8	0
2WMW39DS	2W-SU-39DS-00-99	0-2	4	0
2WMW45DS	2W-SU-45DS-00-99	0-2	4	0
2WCSD10	2WCSD10	0-1	1	0
2WCSD11	2WCSD11	0-1	0	0
2WCSD12	2WCSD12	0-1	1	0
2WCSD13	2WCSD13	0-1	2	0
2WCSD14	2WCSD14	0-1	6	1
2WCSD14	2WCSD14-D	0-1	3	1
2WCSD15	2WCSD15	0-1	2	0
2WCSD4	2WCSD4	0-1	6	1
2WCSD5	2WCSD5	0-1	7	2
2WCSD6	2WCSD6	0-1	5	0
2WCSD7	2WCSD7	0-1	1	0
2WCSD8	2WCSD8	0-1	1	0
2WCSD9	2WCSD9	0-1	0	0
T1A	T1-A	0-1	3	0
T1B	T1-B	0-1	4	0
T10A	T10-A	0-1	5	0
T10B	T10-B	0-1	2	0
T2A	T2-A	0-1	7	2
T2A	T2-A-D	0-1	7	2
T2B	T2-B	0-1	5	0
T3A	T3-A	0-1	4	3
T3B	T3-B	0-1	6	2
T4A	T4-A	0-1	0	0
T4B	T4-B	0-1	1	0
T5A	T5-A	0-1	4	2
T5B	T5-B	0-1	0	0
T6A	T6-A	0-1	9	2
T6A	T6-A-D	0-1	9	1
T6B	T6-B	0-1	7	1
T7A	T7-A	0-1	3	0
T7B	T7-B	0-1	10	3
T8A	T8-A	0-1	7	0
T8B	T8-B	0-1	6	0

			# exceedances of TEC or PEC	
Location			**TEC**	**PEC**
T9A	T9-A	0-1	7	2
T9B	T9-B	0-1	6	0
SUBSURFACE (out of 8 total)				
2WMW3S	082190-2WMW3(10-12)	10-12	1	0
2WMW3S	082190-2WMW3(16-18)	16-18	2	11
2WTB8	083090-2WTB8(1-3)	1-3	4	0
2WTB8	083090-2WTB8(10-12)	10-12	1	1
2WTB8	083090-2WTB8(6-8)	6-8	3	1
2WTB3	083190-2WTB3(10-12)	10-12	4	1
2WTB3	083190-2WTB3(15-17)	15-17	2	1
2WTB3	083190-2WTB3(20-22)	20-22	3	1
2WTB3	083190-2WTB3(4-6)	4-6	5	1
2WTB3	083190-2WTB3(4-6)-D	4-6	6	1
2WMW5S	090490-2WMW5(10-12)	10-12	4	1
2WMW5S	090490-2WMW5(13)	13-13.2	1	0
2WMW5S	090490-2WMW5(4-6)	4-6	1	1
2WTB1	090590-2WTB1(10-12)	10-12	0	0
2WTB1	090590-2WTB1(15-17)	15-17	0	0
2WTB1	090590-2WTB1(20-22)	20-22	0	0
2WTB1	090590-2WTB1(8-10)	8-10	0	0
2WTB7	090590-2WTB7(10-12)	10-12	1	1
2WTB7	090590-2WTB7(4-6)	4-6	2	1
2WTB2	090690-2WTB2(10-12)	10-12	2	1
2WTB2	090690-2WTB2(15-17)	15-17	1	1
2WTB2	090690-2WTB2(20-22)	20-22	1	1
2WTB2	090690-2WTB2(4-6)	4-6	2	1
2WTB6	090690-2WTB6(15-17)	15-17	2	1
2WTB6	090690-2WTB6(20-22)	20-22	1	1
2WTB6	090690-2WTB6(4-6)	4-6	0	0
2WMW6S	100390-2WMW6(2-4)	2-4	3	1
2WSD44	2W-SD-SD44-0002	1-2	na	
2WSD45	2W-SD-SD45-0002	2.5-3.3	8	0
2WSD46	2W-SD-SD46-0204	2-3	4	0
2WSD48	2W-SD-SD48-0204	2-3	5	1
2WSD50	2W-SD-SD50-0204	2-4	5	0
2WSD53	2W-SD-SD53-0204	2-4	6	0
2WSD55	2W-SD-SD55-0002	2.25-2.5	na	
2WSD56	2W-SD-SD56-0002	2-2.25	na	
2WSD57	2W-SD-SD57-0002	1.25-1.6	na	
2WMW40DS	2W-SU-40DS-06-99	6-8	1	0
2WMW41DS	2W-SU-41DS-04-99	4-6	0	0
2WMW42DS	2W-SU-42DS-7.5-99	7.5-9.5	0	0
2WMW43DS	2W-SU-43DSA-04-99	4-6	4	0
2WMW44DS	2W-SU-44DS-04-99	4-6	0	0
2WMW46DS	2W-SU-46DS-04-99	4-6	3	0