DISPOSAL SITE MONITORING CHEMICAL EVALUATION GUIDELINES REASSESSMENT AND PROPOSED CHANGES TO NONDISPERSIVE SITE MANAGEMENT PLANS.

DMMP CLARIFICATION PAPER

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INTRODUCTION

This paper documents proposed changes to the site management plan for evaluating temporal chemical changes at nondispersive disposal sites, and the geographic scope of these changes are limited to Puget Sound .

The DMMP (formerly PSDDA) monitoring plan (MPTA, 1988; MPR, 1989) assesses the physical, chemical, and biological effects of dredged material deposited on each disposal site and its surrounding area. Under the monitoring framework, specific questions and hypotheses were formulated to answer three questions:

1. Does the dredged material stay onsite?

2. Has dredged material disposal caused the biological effects conditions for site management to be exceeded at the site?

3. Are unacceptable adverse effects due to dredged material disposal occurring to biological resources offsite?

This clarification paper addresses the first question. In managing these sites, the DMMP agencies must verify that dredged material disposed within each of the five nondispersive sites does not migrate offsite (e.g., site question 1) and lead to increases in surrounding ambient sediment chemistry over time. Tracking changes in chemicals of concern (COC) in the disposal site environment over time is a significant challenge and the DMMP agencies have applied adaptive management to keep the monitoring plan relevant with updated methods and technological improvements.

PROBLEM IDENTIFICATION

Perimeter site evaluations. The initial monitoring plan (MPTA, 1988; MPR, 1989) established baseline pre-disposal ambient sediment quality conditions at perimeter stations surrounding each site, within each site boundary, and at benchmark stations located outside any potential influence of dredged material disposal (PTI, 1988; PTI, 1989). These baseline sediment quality values formed the basis for all future post-disposal comparisons. Subsequently, guideline values were developed (PTI 1990) that multiplied baseline concentrations by statistically-derived trigger values of 1.25X for metals, and 1.47X for organic chemicals. Post-disposal monitoring of chemical concentrations at perimeter stations were found to frequently exceed trigger guideline values for one or more chemicals of concern. This required an analysis of benchmark stations to determine if "area-wide" changes could explain the apparent exceedances. The DMMP agencies re-examined the trigger-value approach and found that the methodology was prone to yield a high number of false positive trigger exceedances, could not accurately reflect potential migration of chemicals offsite and was statistically invalid (SAIC 1993).

Faced with the apparent inability of the original monitoring program design to identify changes in chemicals of concern (COC) over time, the DMMP agencies implemented risk limits at perimeter stations patterned after the Washington State Sediment Quality Standards (SQS). The SQS define the lower limit where biological effects may be expected. In addition, the DMMP agencies established an objective to develop a method of detecting trends over time in chemical concentrations without the frequent "false alarms" that plagued the original monitoring program.

Additional issues related to comparisons of post-disposal baseline data were raised by the 1995 Commencement Bay monitoring event.

??Seven years had elapsed since baseline and the 1995 monitoring event, and it is likely that temporal changes occurred in the sediment chemistry and benthic infauna over the entire area.

??There were significant differences in the analytical methods used in 1988 and 1995. For example, grain size comparisons were problematic because hydrogen peroxide was used in the 1988 baseline to analyze grain size, whereas all grain size analyses currently prohibit its use. The sediment and tissue acid/base/neutral organics analysis in 1988 incorporated EPA Method 1625, whereas Method 8270 is currently recommended/used due to prohibitive expense of the former method. Detection limits for organic compounds were significantly lower in 1988 compared to those currently required by the DMMP program.

??*Molpadia intermedia* tissue collections and processing methods were not standardized in 1988. In 1991, DMMP agencies established the requirement to standardize sizes of organisms collected in order to decrease variability in data (SAIC 1991). The 1988 analysis included all internal organs except the gastro-intestinal tract, whereas *Molpadia* tissue data collected since 1991 does not include any internal organs.

??Benthic infaunal identifications for transect stations in 1989 were limited to major taxa: there were no species or biomass data with which to conduct more in-depth analysis of subsequent monitoring years. Since 1995, the DMMP requires identification of benthic infaunal data to the lowest practical taxonomic level.

Technical Discussion. The DMMP agencies applied a new time trend statistical procedure to the 1996 Commencement Bay monitoring data to determine if changes observed in perimeter site chemistry were significant over time. The model developed and applied was called the "Chemical Tracking System" (CTS), and is described in detail in SAIC (1996a). Briefly, the CTS evaluates the changes in site chemistry for each chemical, or for a guild of chemicals (e.g., metals, LPAHs), as a slope expressing the trend in concentrations over time. Underlying the approach is the assumption that if there is mass movement of dredged material, multiple chemicals will be involved and there will be a common trend among the chemical concentrations. The mean slope of concentration versus time for several chemicals gives a more accurate estimate of change than use of the slopes of individual chemicals.

The CTS model was incorporated into an Excel spreadsheet, and run for Commencement Bay perimeter stations using the baseline (1988), 1995, and 1996 monitoring data (SAIC, 1996b). It demonstrated that there were no exceedances of the state SQS at any of the perimeter stations (figure 1). Results for the time trend analyses indicated that there have been no significant changes in chemical concentrations since 1988 (Table 1). A brief discussion of the analysis outcome from CTS is included below.

All chemicals of concern. Table 1 presents the maximum likelihood estimations for each perimeter station; first as a global estimate for all COC and then by individual groups. The analyses were based on the Puget Sound specific conventionals, metals, LPAHs and HPAHs, bis(2-ethylhexyl)phthalate and phenol. The remaining COC were reported as unmeasured or undetected in the 1988, 1995, and 1996 surveys.

The global maximum likelihood results indicate that a significant ($p=0.05$) decrease occurred at one perimeter station (CBP01), but that there have been no significant changes in COC at the remaining perimeter stations since 1988. For CBP01, there was a highly significant ($p<0.001$) mean decrease of 7.5% per year, largely caused by the decreases in LPAH and HPAH at all the perimeter stations. While metals showed significant increases, the overall trend at CBP01 was downward. Results of these analyses are discussed below based upon the major chemical groups.

Metals. As a group, the time trend analysis for three of the perimeter stations (CBP03, CBP07, and CBP11) did not demonstrate a significant change in metal concentrations over time. However, at one perimeter station (CBP01), examination of the slopes and p-values for arsenic, copper, mercury, silver and zinc showed significant positive increases since 1988. At all perimeter stations, there were significant ($p<0.01$) increases in lead concentration.

PAHs. Time trend analysis suggest that there is a decreasing trend in perimeter PAH concentrations at CBP01, but LPAH changes at the other three perimeter stations were not significantly different from zero. For the LPAHs at CBP01 there were significant decreases in concentrations for five of the seven measured LPAHs since 1988; as much as 26% for acenapthene and anthracene. Even when comparing 1995 and 1996 CBP01 data, there are decreases in measured concentrations for all LPAHs. HPAHs also show the same trend; a significant decrease at CBP01, but no significant changes at the other three perimeter stations.

Table 1. Sample Maximum Likelihood output for Commencement Bay perimeter stations. Results are presented as both global results, and by major chemical groups.

	SLOPE AND SIGNIFICANCE (Log 10)									*PI CHA*
	Mean	Max	Min	Median	S.E.	95% LCL	95% UCL	P-Value		Mean
CBP01										
Global	-0.03385	0.118328	-0.14716	-0.02316	0.009201	-0.05262	-0.01509	0.000883		-7.50
Conventionals	0.025691	0.118328	-0.02828	0.012117	0.006814	0.008174	0.043208	0.013021		6.09
Metals	0.025906	0.073157	-0.02778	0.025253	0.004098	0.015878	0.035935	0.000732		6.15
LPAH	-0.10661	-0.01467	-0.13367	-0.12374	0.01085	-0.14114	-0.07208	0.002241		-21.77
HPAH	-0.09456	-0.07206	-0.12038	-0.09206	0.028922	-0.16533	-0.02379	0.017046		-19.57
CBP03										
Global	-0.01737	0.176008	-0.19279	-0.00729	0.011183	-0.04021	0.005472	0.130923		-3.92
Conventionals	-0.02185	0.018285	-0.19279	-0.00081	0.01757	-0.06484	0.02114	0.259996		-4.91
Metals	-0.0069	0.035259	-0.04395	-0.00338	0.007619	-0.02555	0.01174	0.399828		-1.58
LPAH	-0.00334	0.039977	-0.03363	-0.00957	0.015016	-0.06795	0.061273	0.844746		-0.77
HPAH	-0.05841	-0.03173	-0.07955	-0.05727	0.032574	-0.14215	0.025319	0.132901		-12.58
CBP07										
Global	-0.01556	0.081621	-0.19841	-0.00982	0.008961	-0.03391	0.002799	0.093548		-3.52
Conventionals	-0.03028	0.027473	-0.19841	-0.00669	0.021853	-0.08376	0.023187	0.215107		-6.74
Metals	-0.01564	0.027473	-0.19841	-0.00669	0.007584	-0.03419	0.002922	0.084868		-3.54
LPAH	0.037012	0.081621	0.000433	0.032996	0.008937	-0.07655	0.150571	0.15084		8.90
HPAH	-0.02557	0.007129	-0.05359	-0.02711	0.019929	-0.0768	0.025659	0.255722		-5.72

CBP11										
Global	-0.01984	0.256909	-0.17144	-0.01089	0.012255	-0.04494	0.005263	0.116663		-4.47
Conventionals	0.018745	0.256909	-0.17144	0.004048	0.013733	-0.01373	0.051219	0.214534		4.41
Metals	-0.0085	0.045254	-0.04101	-0.00831	0.012312	-0.03862	0.021627	0.515815		-1.94
LPAH	-0.01914	0.050683	-0.05771	-0.03477	0.011147	-0.16077	0.12249	0.335725		-4.31
HPAH	-0.08118	0.006492	-0.12868	-0.10115	0.038376	-0.17983	0.017467	0.088015		-17.05

As a measure of decreases in PAHs at the perimeter stations, Table 2 compares mean total LPAH and HPAH concentrations in 1995 and 1996. In all cases, the 1996 perimeter PAH concentrations are less than those reported in 1995.

Table 2. Comparison of 1995 and 1996 total LPAH and HPAH concentrations at the perimeter stations. All values reported as g/kg DW.

	CBP01		CBP03		CBP07		CBP11	
Year	LPAH	HPAH	LPAH	HPAH	LPAH	HPAH	LPAH	HPAH
1996	91	208	81	123	79	174	23	36
1995	297	2105	180	583	98	440	108	515

PROPOSED ACTIONS/MODIFICATIONS

The DMMP proposes to adopt and implement the following changes to the Puget Sound specific site management plans.

??Use 1995 monitoring data as new baseline for Commencement Bay. On a site by site basis, the DMMP will re-examine the need to update baseline data at each Puget sound nondispersive site for future post-disposal monitoring comparisons, similar to Commencement Bay. In this case the original baseline monitoring data (1988 and 1989) would be retained and used to evaluate temporal trends in chemistry at each site.

??Adopt and implement the Chemical Tracking System methodology for analyzing chemical trends over time at all nondispersive disposal sites to provide an objective tool for analyzing chemical changes as part of post-disposal site monitoring.

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