

**WHITE PAPER NO. 11 – COMPARISON OF SQTs, RALs, RAOs, AND SWACs
FOR THE LOWER FOX RIVER**

RESPONSE TO PUBLIC COMMENTS RECEIVED

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ABSTRACT

Commenters expressed confusion over sediment quality thresholds (SQTs), remedial action levels (RALs), remedial action objectives (RAOs), and surface-weighted average concentrations (SWACs). Further, commenters expressed concern that the action levels were not risk based. The purpose of this White Paper is to respond to the comments received, to clarify these terms, and show the relationship between them.

This White Paper summarizes the nomenclature that was used throughout the *Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* and *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (RI/FS) (RETEC, 2002a, 2002b) process to describe sediment concentrations of contaminants of concern (COCs). The discussion includes descriptions of SQTs, RALs, RAOs, and SWACs. The relationship between these concentrations of total polychlorinated biphenyls (PCBs) is presented on Figure 1 and in Table 1. WDNR and EPA in the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001) selected an RAL of 1 ppm for Operable Units (OUs) 1, 3, and 4, and monitored natural recovery (MNR) for OUs 2 and 5. As indicated on Figure 1, assuming an agency-selected RAL of 1 part per million (ppm), the resultant SWACs for each River reach are well below the RAL. Future projections described in the FS indicate that SQTs for recreational anglers will be met in 10 years, SQTs for high-intake fish consumers will be met in 30 years, and SQTs for wildlife will be met in 30 years.

INTRODUCTION

The overall objective of the RI/FS was to evaluate corrective actions that may be applied to contaminated sediment within the Lower Fox River and Green Bay. The remedial actions were evaluated based on knowledge of the current potential risk to human health and wildlife posed by COCs, and the likelihood of risk reduction resulting from remedial action. This approach is consistent with that recommended by the National Research Council's report to Congress (NRC, 2001).

PCBs were identified as the principal contaminant causing or potentially causing risk to human health and the environment. In order to translate risks to human health and the environment into a cleanup goal, it became necessary to associate risks with sediment concentrations of PCBs. Three separate but related risk and remedial action numbers were generated in the *Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and Green Bay, Wisconsin, Remedial Investigation and Feasibility Study* (BLRA) (RETEC, 2002c) and the FS. These are as follows:

- **Sediment Quality Thresholds** were developed that linked single-point concentrations of PCBs to specific risks to human health and the environment.

- **Surface-Weighted Average Concentrations** related the single point risk estimate in the SQT to the entire area of the OU (e.g., Little Lake Butte des Morts [OU 1], De Pere dam to Green Bay [OU 4]).
- **Remedial Action Level** is the engineering design level around which the removal or containment alternative is structured. The RAL is selected so that when the cleanup is achieved, the SWAC is also achieved.

The relationship between these three are shown on Figure 1 and are discussed in more detail below.

SEDIMENT QUALITY THRESHOLDS

To facilitate the selection of a remedy that would result in decreased risks, it was necessary to establish a link between levels of PCBs toxic to human and ecological receptors and the principal source of those PCBs, the Lower Fox River and Green Bay sediment. SQTs are estimated threshold concentrations of PCBs in sediment that below which risks should not occur.

SQTs should be considered as point estimates (i.e., they are calculated for a specific sediment location, pathway, and receptor). SQT thresholds are site-specific, and are developed in Section 7 of the BLRA for each pathway and receptor identified as important by the resource agencies for the Lower Fox River and Green Bay (e.g., sport fishing consumption, bald eagles). These risk-based sediment thresholds were determined based on cancer and noncancer risks to humans, and no and low observed adverse effect concentrations for each ecological receptor. Other inputs included receptor-specific (e.g., fish, bird, and mammal) dietary preferences, fish lipid concentrations, and total organic carbon sediment concentrations. These inputs were also specific to each OU of the River.

The SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment thresholds and were considered to be “working values” from which RALs were selected.

Figure 1 Target PCB Concentrations in Sediment Lower Fox River and Green Bay

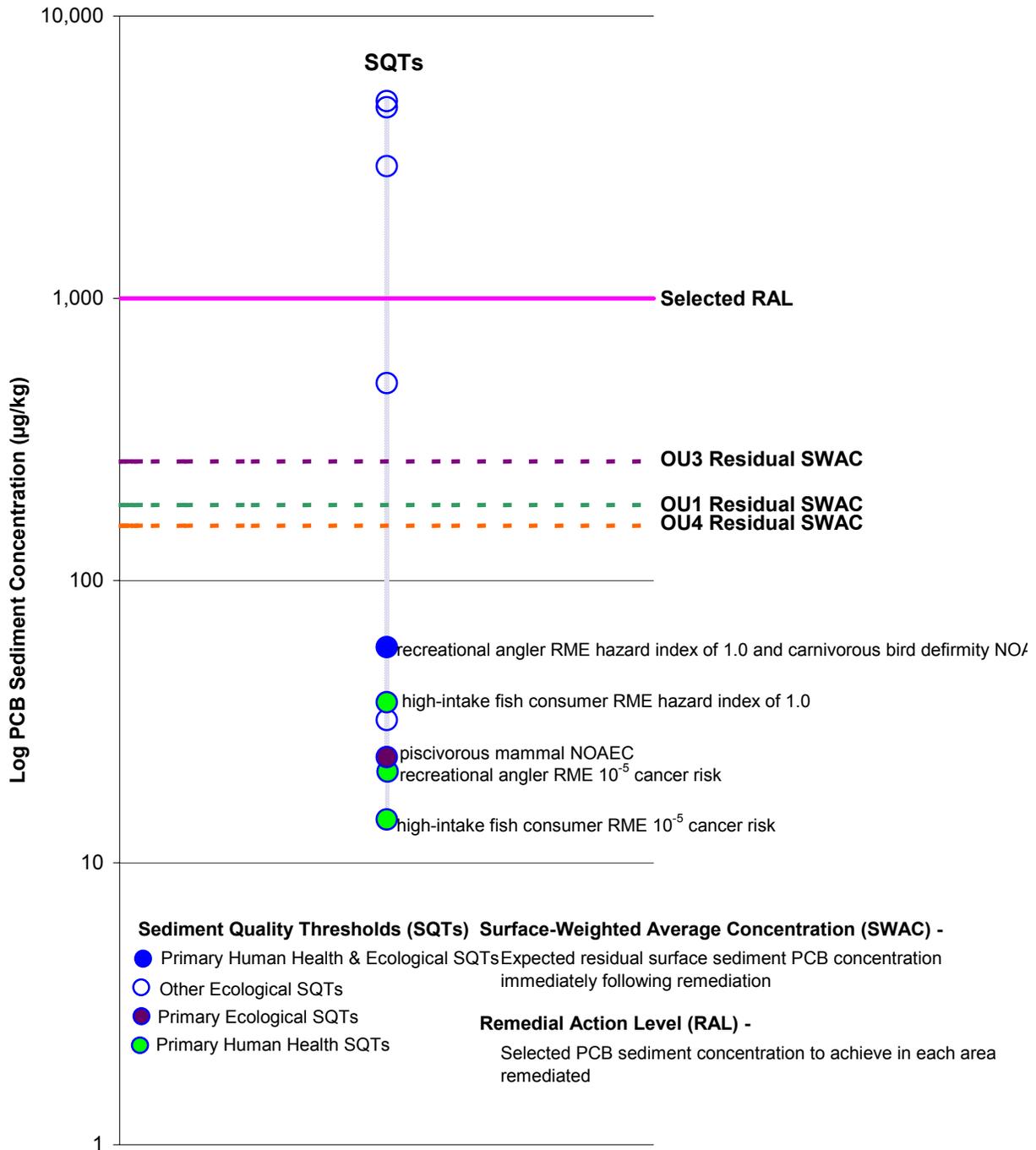


TABLE 1 RELATIONSHIP OF TOTAL PCB SQTs TO RALs, SWACs, AND RISK

Sediment Total PCB Concentration (µg/kg)	Sediment Quality Threshold (SQT) (µg/kg)	Whole Fish Threshold Concentration (µg/kg)	Fish	Risk Level	Receptor	Sediment Remedial Action Level (RAL) (µg/kg)	River Reach and Residual SWACs			
							OU 1	OU 2	OU 3	OU 4
14	14	71	walleye	RME 10 ⁻⁵ cancer risk level	high-intake fish consumer	—	—	—	—	—
21	21	106	walleye	RME 10 ⁻⁵ cancer risk level	recreational angler	—	—	—	—	—
24	24	50	carp	piscivorous mammal NOAEC	mink	—	—	—	—	—
32	32	—	— ¹	TEL	sediment invertebrate	—	—	—	—	—
37	37	181	walleye	RME hazard index of 1.0	high-intake fish consumer	—	—	—	—	—
58	58	288	walleye	RME hazard index of 1.0	recreational angler	—	—	—	—	—
		121	carp	carnivorous bird deformity NOAEC	bald eagle	—	—	—	—	—
125	—	—	—	—	—	125	51	50	54	54
250	—	—	—	—	—	250	66	55	80	67
500	500	408	gizzard shad	piscivorous bird deformity NOAEC	Forster's tern	500	103	61	147	93
1,000	—	—	—	—	—	1,000	185	68	264	156
2,940	2,940	2,399	gizzard shad	piscivorous bird hatching success NOAEC	Forster's tern	—	—	—	—	—
4,753	4,753	3,879	gizzard shad	piscivorous bird hatching success LOAEC	Forster's tern	—	—	—	—	—
5,000	5,003	4,083	gizzard shad	piscivorous bird deformity LOAEC	Forster's tern	5,000	727	95	732	887
10,000	—	—	—	—	—	10,000	1,067	126	1,038	1,946
No Action	—	—	—	—	—	No Action	4,165	607	2,306	3,110

Notes:

1 The media here is not a fish, but rather sediment.

Selected RAL (µg/kg). Note that for OU 2, MNR was the selected action

"—" - Information not available.

SURFACE-WEIGHTED AVERAGE CONCENTRATION

The SWAC is the concentration of PCBs in sediments calculated as an average over the entire surface area of an OU. Since it is used to evaluate risks, the SWAC is calculated using the surface sediment concentrations in the OU, defined as the top 10 cm of sediment. SWACs were calculated for baseline risk and for post-remedial actions based on a series of evaluated RALs (e.g., 0.125, 0.25, 0.5, 1 ppm, etc.) in Section 5 of the FS.

Thus, specific cleanup goals, or RALs, can be evaluated relative to post-remedial risks.

REMEDIAL ACTION LEVELS

RALs are potential PCB remediation cleanup criteria for sediment that were evaluated in the FS and define the size of the dredge prism requiring removal. The RALs selected for evaluation (e.g., 0.125, 0.25, 0.5, and 1 ppm PCBs) were based on several considerations:

- Action levels should bracket the human health and ecological SQT values;
- The lowest action level should be a concentration where the residual SWAC is protective of approximately 90 percent of human and ecological receptors;
- The highest action level should be a concentration where the residual SWAC is protective of approximately 10 percent of human/ecological receptors;
- Action levels should be implementable based on the precedent set on other site sediment remediation projects; and
- Action levels should bracket a commonly implemented action level of 1 ppm PCBs.

INTEGRATION OF THE RAL, SQT, AND SWAC

The relationship of the selected RAL, SQT, and SWAC is shown on Figure 1. The proposed RAL for the Lower Fox River has been set at 1 ppm total PCBs and is shown on the figure as a solid bar. The individual SQTs for human health and ecological receptors are shown on the figure to be above, and below, the selected RAL. The important consideration from a risk management consideration is the individual reach SWAC. In each case, the resultant SWAC is less than the RAL: for Little Lake Butte des Morts (OU 1), the resultant SWAC is 185 ppb; for De Pere to Green Bay (OU 4), it is 156 ppb. WDNR and EPA made a risk management decision and selected the proposed remedy based in part upon a consideration of allowing some natural attenuation to occur post-remediation that would ultimately achieve the final desired SQT.

REFERENCES

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