

WHITE PAPER NO. 5B – EVALUATION OF API CAPPING COSTS REPORT

Response to a Document by The Johnson Company

**ECOSYSTEM-BASED REHABILITATION PLAN –
AN INTEGRATED PLAN FOR HABITAT ENHANCEMENT AND
EXPEDITED EXPOSURE REDUCTION IN THE
LOWER FOX RIVER AND GREEN BAY**

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ABSTRACT

This White Paper is the second in a series prepared in response to the Appleton Paper, Inc. Panel's (API Panel's) alternate proposed remedial activity plan entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (referred to herein as the "Panel Report") (The Johnson Company, 2002). As stated in *White Paper No. 5A – Responses to the API Panel Report*, the API Panel proposed remedial activities in the Panel Report which they contend would result in achievement of the risk reduction goals defined in the Remedial Action Objectives (RAOs) and would be more cost effective than the remedial activities in the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001). The Wisconsin Department of Natural Resources (WDNR) and United States Environmental Protection Agency (EPA) disputed this conclusion, and this White Paper addresses various aspects of the Panel Report. Specifically, this paper evaluates the capping costs presented in the Panel Report.

The following findings are developed in this White Paper:

- The Panel Report does not accurately compare remedial costs. The Panel Report compares its alternatives developed at a less protective Remedial Action Level (RAL) (5 ppm) with the Proposed Plan RAL (1 ppm). The practical result of this decision is that the Panel Report develops costs for an area that is only one-half of that managed by the Proposed Plan.
- When compared at the same RAL (5 ppm), contaminated sediment removal alternatives in the *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002) are less expensive, or equivalent, in cost to the API Panel plan for all three Operable Units (OUs).
- The Proposed Plan removal alternative for OU 1 (dredge with off-site disposal), at an RAL of 1 ppm is equivalent in cost to the API Panel capping alternative.
- The Proposed Plan removal alternative for OUs 3 and 4 achieves permanent removal of polychlorinated biphenyls (PCBs) from the River at a lower (more protective) RAL, but are within 23 to 25 percent of the costs proposed by the Panel Report.
- The Panel Report costs, when projected onto the 1 ppm RAL footprint, are greater than removal costs in OUs 1 and 3, and equivalent to removal costs in OU 4.
- The capping design offered by the Panel Report did not consider addition of a foundation layer, nor incorporate any safety factors. Based on engineering

judgment and experience at other sites, the API Panel cap thickness requires an additional 8 to 12 inches.

- When the technical adjustments to the cap design are applied, along with an accounting for the larger remedial footprint, the cost of the API Panel cap is either greater than, or equivalent to the cost of removal in all OUs.

PURPOSE

This White Paper re-evaluates the costs developed and presented within the Proposed Plan prepared by the WDNR and EPA, with those proposed by the API Panel and presented as part of the Panel Report dated January 17, 2002 (The Johnson Company, 2002). In order to understand the similarities and differences between the two plans, it is necessary to establish a comparable level of costs. This White Paper provides that basis of comparison.

The Panel Report compares costs for its proposed alternative with those presented in the Proposed Plan. However, a direct comparison of cost is not applicable; Panel Report assumes a residual risk level that is up to four times greater than that proposed by WDNR (see *White Paper No. 5A – Responses to the API Panel Report*). The API Panel proposed to manage risks to an effective RAL of 5 mg/kg (5 ppm) total PCBs in sediments, whereas the Proposed Plan used an RAL of 1 ppm. The practical result of this decision is that the Panel Report develops costs for an area that is only one-half of that managed by the Proposed Plan.

In addition, the Panel Report did not take into consideration the necessary risk, technical design considerations, and regulatory requirements that have been required at other capping sites throughout North America. These risk, technical, and regulatory-related omissions in the API Panel-proposed cap design are documented in *White Paper No. 5A – Responses to the API Panel Report* (WDNR, 2002a), *White Paper No. 6A – Comments on the API Panel Report* (Palermo, 2002), *White Paper No. 6B – In-situ Capping as a Remedy Component for the Lower Fox River* (Palermo et al., 2002), and *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits* (WDNR, 2002b). Thus, the costs reported by the API Panel do not reflect these considerations, as well.

This White Paper, then, provides for a common base comparison of costs.

PROCEDURE

The basis for these cost comparisons come from the FS (RETEC, 2002), technical discussions in the API Panel's *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay*, and the *Cost Analysis, Ecosystem-Based Rehabilitation Plan* dated January 17, 2002 (The Johnson Company, 2002). The basis for WDNR's understanding

of the Panel Report's costs are listed in Addendum 1 to this White Paper. In addition, the following assumptions are applicable:

- *White Paper No. 7 – Lower Fox River Dredged Sediment Process Wastewater Quality and Quantity: Ability to Achieve Compliance with Water Quality Standards and Associated WPDES Permit Limits* (WDNR, 2002b), documents that there are no effective water quality limits that would limit water treatment in a removal alternative. Therefore, the costs of treating water proposed in the FS, which are equivalent to those used in the two demonstration projects, are effective and viable.
- The Panel Report develops a technical basis and cost for a capping action that fits within the remedial footprint developed on an effective RAL of 5 ppm. The Proposed Plan uses an RAL of 1 ppm to achieve risk reduction. This White Paper compares costs at both action levels.
- The costs presented in the API Panel's analysis did not necessarily match up with the cap designs presented in the body of the technical Panel Report. The costs used in this White Paper reflect those developed in the Cost Analysis.
- The Panel Report describes a design basis for arriving at an effective cap thickness that included both an isolation layer and an armor layer where appropriate. While the procedure described appears to follow United States Army Corps of Engineers (USACE) guidance, the Panel Report did not offer any of the models for review, and thus there was no way to verify the accuracy of the design basis. For the purpose of this analysis, their design basis is assumed to be valid. Critique of the API Panel's design basis is left to *White Paper No. 6A – Comments on the API Panel Report* (Palermo, 2002).
- The API Panel did not report any contingency or potential range of costs associated with their estimates. Therefore, the costs presented here also do not consider contingency or range.

RESULTS

Risk-Related Cost Comparison

As noted in *White Paper No. 5A – Responses to the API Panel Report* (WDNR, 2002a), the Panel Report used an alternate Surface-Weighted Average Concentration (SWAC) based not upon risk considerations, but on so-called engineering considerations. The Panel Report in effect applied an RAL of 5 ppm, whereas the Proposed Plan uses 1 ppm. Table 1 compares the API Panel-reported costs for OUs 1, 3, and 4, with the costs reported in the FS. In this White Paper, only the capping alternatives (Alternative F), and the dredge and disposal options (Alternatives C1–C3) from the FS are shown for the three reaches at both the 1 and 5 ppm RAL.

TABLE 1 COMPARISON OF THE PANEL REPORT COST ESTIMATE FOR THE 5 PPM RAL WITH THE FS COST ESTIMATE AT BOTH 1 AND 5 PPM RAL

River Reach	Alternative	Proposed Plan SWAC ¹	API Panel SWAC ²	API Panel Estimated Costs ³	Feasibility Study Costs ⁴	
					1,000 ppb ⁵	5,000 ppb ⁶
Little Lake Butte des Morts (OU 1)	Cap to Maximum Extent Possible (F)	185	709	\$66,502,368	\$90,500,000	\$66,200,000
	Hydraulic Dredge, Passive Dewatering, and Off-site Disposal (C1)	185			\$116,700,000	\$48,500,000
	Hydraulic Dredge, Mechanical Dewatering, and Off-site Disposal (C2)	185			\$66,200,000	\$28,300,000
Little Rapids to De Pere (OU 3)	Cap to Maximum Extent Possible (F)	264	563	\$32,876,896	\$62,900,000	\$34,700,000
	Hydraulic Dredge, Passive Dewatering, and Off-site Disposal (C1)	264			\$95,100,000	\$38,100,000
	Hydraulic Dredge, Pipeline Transfer, Combined Passive Dewatering/Landfill (C2A)	264			\$43,900,000	\$32,400,000
	Hydraulic Dredge, Pipeline Transfer, Separate Passive Dewatering/Landfill (C2B)	264			\$99,900,000	\$65,300,000
	Hydraulic Dredge, Mechanical Dewatering, and Off-site Disposal (C3)	264			\$69,100,000	\$28,400,000
De Pere to Green Bay (OU 4)	Cap to Maximum Extent Possible (F)	156	706	\$133,633,847	\$357,100,000	\$234,400,000
	Hydraulic Dredge, Passive Dewatering, and Off-site Disposal (C1)	156			\$660,600,000	\$511,100,000
	Hydraulic Dredge, Pipeline Transfer, Combined Passive Dewatering/Landfill (C2A)	156			\$173,500,000	\$138,700,000
	Hydraulic Dredge, Pipeline Transfer, Separate Passive Dewatering/Landfill (C2B)	156			\$491,800,000	\$388,000,000
	Hydraulic Dredge, Mechanical Dewatering, and Off-site Disposal (C3)	156			\$513,500,000	\$397,200,000

Notes:

- ¹ SWAC corresponds to RAL of 1,000 ppb.
- ² API Panel SWAC represents the re-calculated value as detailed in White Paper No. 5A.
- ³ API Panel-reported costs correspond to capping with no dredging.
- ⁴ Costs reported in the FS. Contingency costs are not included.
- ⁵ RAL proposed in the Proposed Plan.
- ⁶ RAL corresponding to API Panel SWAC.

The cost to implement any of the FS alternatives in OUs 1 and 3 (capping or removal), are less than those proposed by the API Panel, when compared at an equivalent level of risk reduction (5 ppm). In essence, at this action level, it is less expensive to permanently remove the PCB-contaminated sediments than it is to isolate them under a cap. At the 1 ppm RAL, the removal and landfill alternative (C2) for OU 1 is roughly equivalent to the Panel Report cost for 5 ppm. For OU 3, the capping or removal alternatives are generally more expensive than those estimated for the API Panel alternative.

For OU 4, the Panel Report alternative is generally less than the FS alternative costs at both the 1 and 5 ppm levels. However, at 5 ppm the hydraulic removal with combined passive dewatering and landfilling (Alternative C2A) is approximately 3 percent more than the API Panel alternative. At 1 ppm, that same removal alternative is within 23 to 25 percent of the API Panel alternative for both OUs 3 and 4.

To compare the API Panel alternative with those developed for the Proposed Plan, it was necessary to adjust the API Panel costs for the 1 ppm RAL footprint. As shown in Table 2, the number of acres within the 1 ppm RAL footprint are 1.7 to 2.7 times greater than the 5 ppm RAL used by the API Panel. As noted above, unit costs were developed on a per-acre basis for capping from the Panel Report. The cost of wetland development and monitoring were not figured into these bulk estimates. The unit costs were then multiplied by the number of acres within the 1 ppm RAL.

TABLE 2 ADJUSTING THE PANEL REPORT CAPPING COSTS TO THE 1 PPM RAL

Reach	Remedial Footprint (acres)	Reported Costs	Minus Monitoring and Wetland Costs	Cost/Acre
Panel Report Costs within the 5 ppm RAL Footprint				
Little Lake Butte des Morts (OU 1)	240	\$66,502,368	\$52,354,045	\$218,142
Little Rapids to De Pere (OU 3)	120	\$32,876,896	\$25,899,529	\$215,829
De Pere to Green Bay (OU 4)	600	\$133,633,847	\$123,136,725	\$205,228
Panel Report Costs Adjusted to the 1 ppm RAL Footprint				
Little Lake Butte des Morts (OU 1)	526	\$114,742,615.29		
Little Rapids to De Pere (OU 3)	328	\$70,792,045.93		
De Pere to Green Bay (OU 4)	1034	\$212,205,622.75		

Table 3 compares the adjusted cost for the API Panel alternative with those developed for the FS at 1 ppm. Of importance to note is that at 1 ppm, the API Panel costs are double what they present in their Panel Report for 5 ppm. When compared to the 1 ppm RAL, the cost for permanent removal of PCB-contaminated sediments from the River is less expensive than the capping alternative proposed by the API Panel in OUs 1 and 3. For OU 4, the cost for removal versus capping is approximately equivalent at the 1 ppm RAL.

TABLE 3 COMPARISON OF THE PANEL REPORT COST ESTIMATE FOR THE 5 PPM RAL, ADJUSTED TO THE 1 PPM RAL, AND ADJUSTED FOR TECHNICAL CORRECTIONS TO THE DESIGN, AS COMPARED WITH THE FS COST ESTIMATE AT THE 1 PPM RAL

River Reach	Feasibility Study Alternatives	API Panel- Estimated Costs for the 5 ppm RAL	API Panel- Estimated Costs for the 1 ppm RAL	Feasibility Study Costs (1,000 ppb)	Technical Corrections to the API Panel-Estimated Cost for the 5 ppm RAL
Little Lake Butte des Morts (OU 1)	Cap to Maximum Extent Possible (F)	\$66,502,368	\$114,742,615	\$90,500,000	\$90,297,613
	Hydraulic Dredge, Passive Dewatering, and Off-site Disposal (C1)			\$116,700,000	
	Hydraulic Dredge, Mechanical Dewatering, and Off-site Disposal (C2)			\$66,200,000	
Little Rapids to De Pere (OU 3)	Cap to Maximum Extent Possible (F)	\$32,876,896	\$70,792,046	\$62,900,000	\$41,761,957
	Hydraulic Dredge, Passive Dewatering, and Off-site Disposal (C1)			\$95,100,000	
	Hydraulic Dredge, Pipeline Transfer, Combined Passive Dewatering/Landfill (C2A)			\$43,900,000	
	Hydraulic Dredge, Pipeline Transfer, Separate Passive Dewatering/Landfill (C2B)			\$99,900,000	
	Hydraulic Dredge, Mechanical Dewatering, and Off-site Disposal (C3)			\$69,100,000	
De Pere to Green Bay (OU 4)	Cap to Maximum Extent Possible (F)	\$133,633,847	\$212,205,623	\$357,100,000	\$193,508,434
	Hydraulic Dredge, Passive Dewatering, and Off-site Disposal (C1)			\$660,600,000	
	Hydraulic Dredge, Pipeline Transfer, Combined Passive Dewatering/Landfill (C2A)			\$173,500,000	
	Hydraulic Dredge, Pipeline Transfer, Separate Passive Dewatering/Landfill (C2B)			\$491,800,000	
	Hydraulic Dredge, Mechanical Dewatering, and Off-site Disposal (C3)			\$513,500,000	

Technical Correction to the API Panel Cap Design

In addition to comparing the costs on an equivalent risk basis, it is important to ensure that costs incorporate the state-of-the-science engineering and regulatory considerations for the design. As discussed in *White Paper No. 6A – Comments on the API Panel Report* (Palermo, 2002), the Panel Report states that it utilizes the models developed by the USACE for designing a cap, but does not provide any means for checking parameters or results for those models (i.e., there is no way to verify the API Panel's calculations). While acknowledging this fact, based upon experience at other capping sites (see *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* [Palermo et al., 2002]) and professional experience, the API Panel's proposed cap design is too thin for adequate chemical isolation. Furthermore, the design does not incorporate losses to the underlying sediments during cap placement (foundation layer), nor does it incorporate any kind of safety factor into the overall design. As noted in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* (Palermo et al., 2002), experience at other capping sites has shown that up to 4 inches of additional sand is needed to account for the foundation layer, and that a safety factor of 1.5 times the isolation design is recommended for the Lower Fox River.

Table 4 shows the effective cap thickness after application of these technical corrections. Table 4 assumes, without verification, that the isolation layer of sand and the armor requirements estimated by the Panel Report are valid. Table 4 applies a 4-inch foundation layer and a 1.5 safety factor to the total sand application to achieve total cap thickness of 24, 21, and 24 inches for OUs 1, 3, and 4, respectively.

Table 5 presents the incremental increase in cost for adding additional layers of sand to the cap for chemical isolation. These costs were determined using the same assumptions and numbers that are listed in the Panel Report's Cost Analysis, and are only for the 5 ppm RAL footprint. As can be seen on Figure 1, the costs are relatively linear and add 3 to 4 percent per inch of additional isolation layer. The required effective cap thickness for each of the OUs is highlighted in Table 5 and increase the Panel Report costs by 27 to 45 percent. When compared then to the cost at the 1 ppm RAL (Table 3), the removal alternatives in the WDNR and EPA's Proposed Plan are still favorable to capping in OUs 1 and 3, and comparable to capping in OU 4. If these costs are then adjusted by a factor of 2 to account for the larger area within the 1 ppm RAL (see Table 2), the removal alternatives in all OUs are more cost effective than those proposed in the Panel Report.

TABLE 4 CORRECTION OF THE API PANEL CAP DESIGN TO ACCOUNT FOR FOUNDATION LAYER AND SAFETY FACTOR

River Reach	Effective Isolation Cap Thickness			Safety Factor of 1.5	API Panel Armor Layer	Total Cap Thickness
	Foundation Layer	API Panel-Estimated Isolation Layer	Subtotal			
Little Lake Butte des Morts (OU 1)	4	11.5	15.5	23.25	0.5	23.75
Little Rapids to De Pere (OU 3)	4	6	10	15	6	21
De Pere to Green Bay (OU 4)	4	12	16	24	0	24

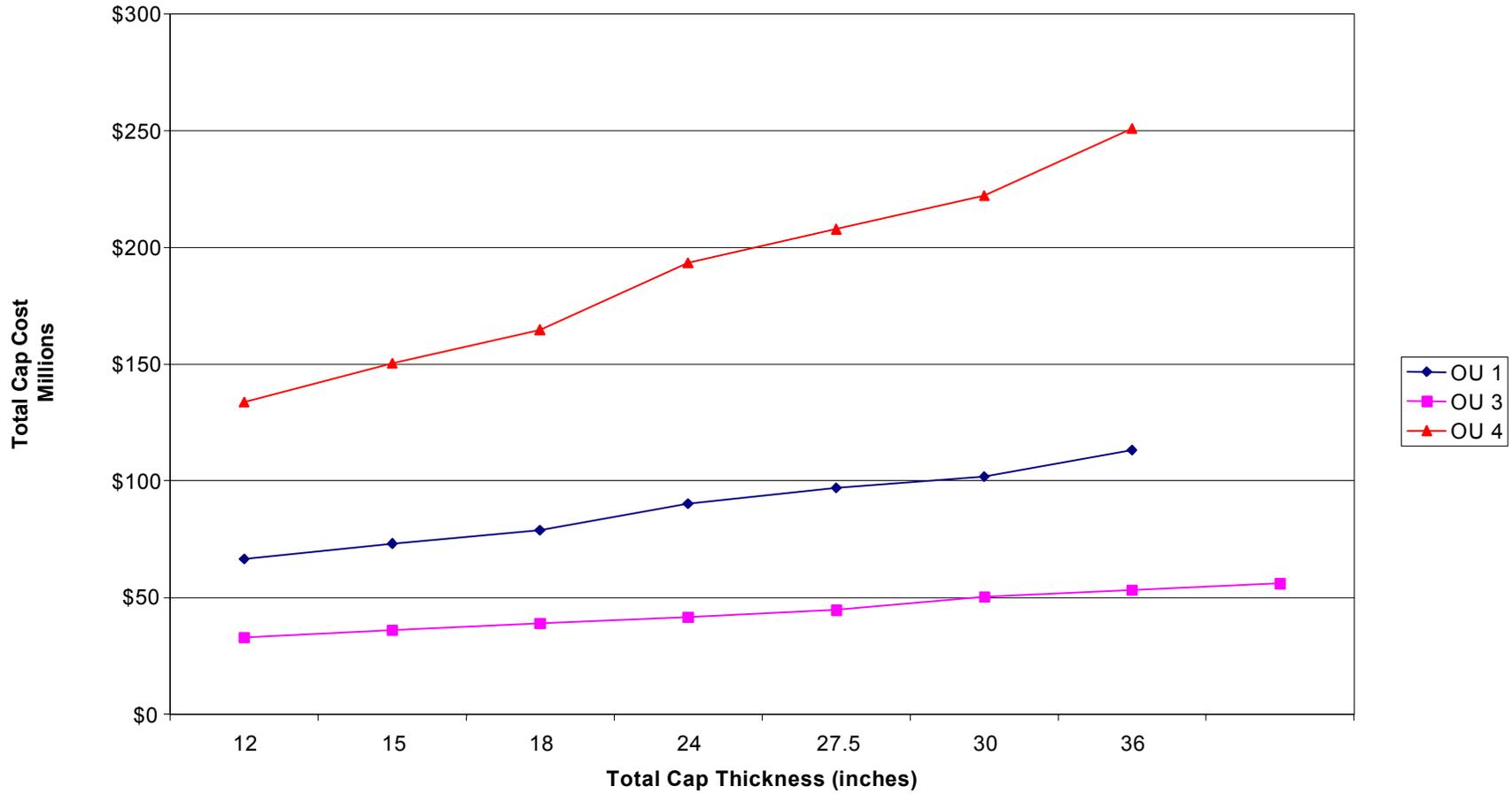
Notes:

- ¹ Foundation layer is 4 inches of placed material that mixes with the underlying sediments.
- ² API Panel-estimated isolation layer is the thickness of sand cap (fine + medium + coarse fractions) as reported in Cost Analysis addendum to the Panel Report.
- ³ A safety factor of 1.5 times the total sand thickness is applied as recommended in Palermo and Thompson (*White Paper No. 6A – Comments on the API Panel Report* [Palermo, 2002]).
- ⁴ API Panel armor layer is as reported in the Cost Analysis addendum to the Panel Report.

TABLE 5 INCREMENTAL INCREASE IN THE PANEL REPORT COSTS ASSOCIATED WITH INCREASING THE THICKNESS OF THE CHEMICAL ISOLATION LAYER

Reach	API Panel Design Basis			Alternative Design Basis		Incremental Cost Increase			Percent Increase
	Fine Sand	Coarse Sand	Gravel	Incremental Medium Sand Addition	Total Cap Thickness	API Panel Cost	Incremental Increase	Final Cost	
Little Lake Butte des Morts (OU 1)	2.2	9.3	0.5	0	12	\$66,502,368	\$0	\$66,502,368	0%
	2.2	9.3	0.5	3	15	\$66,502,368	\$6,574,424	\$73,076,792	10%
	2.2	9.3	0.5	6	18	\$66,502,368	\$12,314,697	\$78,817,065	19%
	2.2	9.3	0.5	12	24	\$66,502,368	\$23,795,245	\$90,297,613	36%
	2.2	9.3	0.5	15.5	27.5	\$66,502,368	\$30,492,231	\$96,994,599	46%
	2.2	9.3	0.5	18	30	\$66,502,368	\$35,275,792	\$101,778,160	53%
	2.2	9.3	0.5	24	36	\$66,502,368	\$46,756,339	\$113,258,707	70%
Little Rapids to De Pere (OU 3)	3	3	6	0	12	\$32,876,896	\$0	\$32,876,896	0%
	3	3	6	3	15	\$32,876,896	\$3,144,787	\$36,021,683	10%
	3	3	6	6	18	\$32,876,896	\$6,014,924	\$38,891,820	18%
	3	3	6	9	21	\$32,876,896	\$8,885,061	\$41,761,957	27%
	3	3	6	12	24	\$32,876,896	\$11,755,197	\$44,632,093	36%
	3	3	6	18	30	\$32,876,896	\$17,495,471	\$50,372,367	53%
	3	3	6	21	33	\$32,876,896	\$20,365,608	\$53,242,504	62%
	3	3	6	24	36	\$32,876,896	\$23,235,745	\$56,112,641	71%
De Pere to Green Bay (OU 4)	6	6	0	0	12	\$133,633,847	\$0	\$133,633,847	0%
	6	6	0	3	15	\$133,633,847	\$16,822,534	\$150,456,381	13%
	6	6	0	6	18	\$133,633,847	\$31,173,218	\$164,807,065	23%
	6	6	0	12	24	\$133,633,847	\$59,874,587	\$193,508,434	45%
	6	6	0	15	27	\$133,633,847	\$74,225,271	\$207,859,118	56%
	6	6	0	18	30	\$133,633,847	\$88,575,955	\$222,209,802	66%
	6	6	0	24	36	\$133,633,847	\$117,277,323	\$250,911,170	88%

Figure 1 Increase in Costs with Incremental Increase in Cap Thickness



CONCLUSIONS

Based upon this analysis, the following conclusions can be drawn:

- The Panel Report does not accurately portray comparable remedial costs. The Panel Report compares its alternative, a less protective RAL (5 ppm) with the Proposed Plan RAL (1 ppm).
- When compared at the same RAL (5 ppm), contaminated sediment removal alternatives in the FS are less expensive, or equivalent, in cost to the API Panel plan for all three OUs.
- The Proposed Plan removal alternative for OU 1 (dredge with off-site disposal), at an RAL of 1 ppm is equivalent in cost to the API Panel capping alternative.
- The Proposed Plan removal alternative for OUs 3 and 4 achieve permanent removal of PCBs from the River at a lower (more protective) RAL, but are within 23 to 25 percent of the costs proposed by the Panel Report.
- The Panel Report costs, when projected onto the 1 ppm RAL footprint, are greater than removal costs in OUs 1 and 3, and equivalent to removal costs in OU 4.
- The capping design offered by the Panel Report did not consider addition of a foundation layer, nor incorporate any safety factors. Based on engineering judgment and experience at other sites, the API Panel cap thickness requires an additional 8 to 12 inches.
- When the technical adjustments to the cap design are applied, along with an accounting for the larger remedial footprint, the cost of the API Panel cap is either greater than, or equivalent to the cost of removal in all OUs.

REFERENCES

- Palermo, M. R., 2002. *White Paper No. 6A – Comments on the API Panel Report*. Wisconsin Department of Natural Resources, Madison, Wisconsin. December.
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ADDENDUM 1

BASIS FOR COST EVALUATION

The following steps summarize the cost analysis performed to include additional coarse sand in the subaqueous cap proposed by the API Panel for Lower Fox River OUs 1, 3, and 4. WDNR referred to the document *Cost Analysis, Ecosystem-Based Rehabilitation Plan* dated January 17, 2002 to obtain the unit costs for calculations (Panel Report).

Little Lake Butte des Morts (OU 1)

- 1) Proposed Capping Area = 240 acres
- 2) Breakdown of API Panel-Proposed 12-inch Cap:
 - a) Fine Sand (quartz) = 1.7 inches
 - b) Medium Sand (quartz) = 0.5 inch
 - c) Coarse Sand (quartz) = 9.3 inches
 - d) Fine Gravel (limestone) = 0.5 inch
- 3) Area in Square Feet (ft²) = 240 acres × 43,560 ft²/acre = 10,454,400
- 4) Additional Volume of Coarse Sand (quartz/limestone) Required (12 inches of coarse sand) = 10,454,400 ft² × 1 ft × 1 cubic yards (cy)/27 cubic feet (ft³) × 1.4 tons/cy = 542,080 tons
- 5) From Panel Report, Capping Placement Rate = 1,150 tons/day
- 6) Additional Number of Days Required for Capping = 542,080 tons/1,150 tons/day = 471 days
- 7) Therefore, Additional Costs Include:
 - a) Cap Placement = 471 days × \$25,454/day = \$11,988,834
 - b) Sand Procurement – Material/Delivery/Tax = 542,080 tons × \$17.14/ton = \$9,292,251
 - c) Cap Placement QA/Bathymetry = 471 days × \$ 3,546/day = \$1,670,166
 - d) Mobilization/Demobilization = 2 seasons = 2 × \$210,473 = \$420,946
 - e) Silt Curtain = 2 seasons = 2 × \$64,177 = \$128,354
 - f) Winterization of Four Cap Barges = 2 seasons = 2 × \$142,425 = \$248,850
- 8) Total Additional Costs Due to Additional 12-inch Coarse Sand Cap Layer = \$23,749,401
- 9) Total Cost (not inflated) Proposed in the Panel Report for 12-inch Subaqueous Cap = \$66,502,368
- 10) Final Cost after Adding Additional Costs for 12-inch Coarse Sand Cap = \$90,251,769
- 11) Total Cost Increase Due to Addition of 12-inch Coarse Sand Cap = 36%

Little Rapids to De Pere (OU 3)

- 1) Proposed Capping Area = 120 acres
- 2) Breakdown of API Panel-Proposed 12-inch Cap:
 - a) Fine Sand (quartz) = 0.6 inch
 - b) Medium Sand (limestone) = 0.6 inch
 - c) Medium Sand (quartz) = 2.4 inches
 - d) Coarse Sand (limestone) = 2.4 inches
 - e) Fine Gravel (limestone) = 1.2 inches
 - f) Coarse Gravel (quartz) = 4.8 inches
- 3) Area in Square Feet = 120 acres \times 43,560 ft²/acre = 5,227,200
- 4) Additional Volume of Coarse Sand (quartz/limestone) Required (12 inches of coarse sand) = 5,227,200 ft² \times 1 ft \times 1 cy/27 ft³ \times 1.4 tons/cy = 271,040 tons
- 5) From Panel Report, Capping Placement Rate = 1,150 tons/day
- 6) Additional Number of Days Required for Capping = 271,040 tons/1,150 tons/day = 236 days
- 7) Therefore, Additional Costs Include:
 - a) Cap Placement = 236 days \times \$25,454/day = \$6,007,144
 - b) Sand Procurement – Material/Delivery/Tax = 271,040 tons \times \$17.14/ton = \$4,645,626
 - c) Cap Placement QA/Bathymetry = 236 days \times \$3,546/day = \$836,856
 - d) Mobilization/Demobilization = 1 season = 1 \times \$210,473 = \$210,473
 - e) Silt Curtain = 1 season = 1 \times \$64,177 = \$64,177
- 8) Total Additional Costs Due to Additional 12-inch Coarse Sand Cap Layer = \$11,764,276
- 9) Total Cost (not inflated) Proposed in the Panel Report for 12-inch Subaqueous Cap = \$32,876,896.
- 10) Final Cost after Adding Additional Costs for 12-inch Coarse Sand Cap = \$44,641,172
- 11) Total Cost Increase Due to Addition of 12-inch Coarse Sand Cap = 36%

De Pere to Green Bay (OU 4)

- 1) Proposed Capping Area = 600 acres
- 2) Breakdown of API Panel-Proposed 12-inch Cap – There are several combinations proposed for OU 4, as listed below:
 - a) 6-inch Coarse Sand and 6-inch Fine Sand

- b) 6-inch Fine Gravel, 3-inch Medium Sand, and 3-inch Fine Sand
 - c) 6-inch Medium Sand and 6-inch Fine Sand
- 3) Area in Square Feet = 600 acres \times 43,560 ft²/acre = 26,136,000
 - 4) Additional Volume of Coarse Sand (quartz/limestone) Required (12 inches of coarse sand) = 26,136,000 ft² \times 1 ft \times 1 cy/27 ft³ \times 1.4 tons/cy = 1,355,200 tons
 - 5) From Panel Report, Capping Placement Rate = 1,150 tons/day
 - 6) Additional Number of Days Required for Capping = 1,355,200 tons/1,150 tons/day = 1,178 days
 - 7) Therefore, Additional Costs Include:
 - a) Cap Placement = 1,178 days \times \$25,454/day = \$29,984,812
 - b) Sand Procurement – Material/Delivery/Tax = 1,355,200 tons \times \$17.14/ton = \$23,228,128
 - c) Cap Placement QA/Bathymetry = 1,178 days \times \$ 3,546/day = \$4,177,188
 - d) Mobilization/Demobilization = 9 seasons = 9 \times \$210,473 = \$1,894,257
 - e) Silt Curtain = 9 seasons = 9 \times \$64,177 = \$577,593
 - 8) Total Additional Costs Due to Additional 12-inch Coarse Sand Cap Layer = \$59,861,978
 - 9) Total Cost (not inflated) Proposed in the Panel Report for 12-inch Subaqueous Cap = \$133,633,847
 - 10) Final Cost after Adding Additional Costs for 12-inch Coarse Sand Cap = \$193,495,825
 - 11) Total Cost Increase Due to Addition of 12-inch Coarse Sand Cap = 45%