Appendix E

Wisconsin Disposal Information

CORRESPONDENCE/MEMORANDUM — State of Wisconsin

DATE: December 15, 1998

TO: Paul Putzier - RETEC
Chris Carleo - RETEC

FROM: Ed Lynch - DNR RR/3 EJL

SUBJECT: Fox River Disposal Issues

Purpose. The purpose of this memo is to outline State upland and in water disposal requirements for use in the preparation of the FS. State laws that need to be considered in evaluating in-river disposal options include Wisconsin's solid waste statutes found in ch.. 289,Wis. Stats., and statutes concerning in-water placement of materials found in ch. 30, Wis. Stats. Ch. 289, Wis Stats., is also applicable to upland disposal options.

Please note that this memo is intended as an overview of the issues and that, as proposals are considered, there will need to be case by case determinations regarding the State's various authorities. This concern is that, if you look at the summary re: public trust issues and the potential types of remedies available (bulkhead lines, lakebed grants, etc.) someone can, and probably will, argue in the future that DNR indicated these methods for placing fill were determined to be acceptable in the various reaches of river. All we are saying is that these are potential mechanisms to deal with these stretches, and we will have to review the specific designs and impacts on a case by case basis.

The feasibility study should provide a sufficient analysis of the institutional feasibility of all technically feasible disposal options to select a remedy. Therefore, the feasibility study must be complete in terms of the hurdles to implement an alternative and fully describe them. Discussion such as "the state would have to approve of this but we don't know if they will" is not acceptable. If a decision needs to be made on the institutional feasibility of an alternative that reqnires a case by case decision by us based on the merits of the technical proposal, then the FS should describe that proposal in sufficient detail so we can make that decision before the FS is finalized. Deferral of the tough issues to after the FS and ROD is not expected.

Applicable State Disposal Laws and Regulations. Dredged sediment material is a solid waste in Wisconsin, defined by the statutory definition of solid waste and by case law. Sediment in place in a water body does not come under solid waste regulation until a person picks it up, say, in a dredging operation. In that case, solid waste authority comes into play only due to the act of dredging and managing the sediment. As a general rule, the solid waste facility siting process in ch. 289, Wis. Stats., (feasibility report, plan of operation, needs, negotiation/arbitration, etc.) applies to any new solid waste disposal facility, including in-water facilities for the disposal of solid waste. The siting process administrative requirements may not apply to on-site Superfund actions (see discussion on this below). There are locational criteria in NR 504.04 (setbacks from navigational waters, flood plains) which may not be met for such facilities, so a DNR exemption or CERCLA waiver would be necessary to allow in-water disposal. DNR has authority to issue exemptions from regulation under ch. 289, Wis. Stats., under some circumstances. For confined engineered, disposal sites, the Waste management program has regulatory authority. For in water disposal in what is essentially a non engineered fill, discharge of dredged material would be subject to Watershed Management Requirements.

DNR Solid Waste Program Exemptions. The primary exemption exists in s. NR 500.08(3), Wis. Adm. Code (June, 1996) that covers dredged materials. This exemption reads as follows:
"(3) DREDGED MATERIAL EXEMPTIONS. The following facilities are exempt from the licensing and plan review requirements of chs. NR 500 to 536 but shall be developed in accordance with the following requirements:
(a) Facilities for the disposal of non hazardous dredged material consisting of less than 3000 cubic yards from Lake Michigan, Lake Superior, the Wisconsin River, the Sheboygan River, the Milwaukee River, the Brule and Menomonee rivers, the Fox rivers, or from any inland lakes or ponds treated with arsenicals provided the facility complies with the performance standards in s. NR 504.04(4).
(b) Facilities for the disposal of non-hazardous dredged material from rivers not listed in par. (a) provided the facility complies with the performance standards specified in s. NR 504.04(4).
(c) Facilities for the disposal of non hazardous dredged material from inland lakes or ponds that have not been treated with arsenicals provided the facility complies with the performance standards specified in s. NR 504.04(4)."

Paragraph (a) allows for the disposal of small amounts of dredged sediment materials (less than 3000 cubic yards) from listed bodies of water to be disposed of into upland land disposal sites without plan review or licensing provided solid waste location and performance standards are met. Paragraph (b) applies to non-listed water bodies and rivers and is similar to (a) but does not have a quantity limit. The focus of par. (c) is dredged sediment material from inland lakes or ponds that have not been treated with arsenicals. S. NR 500.08(3)(a), Wis. Adm. Code, does not seem to apply to the Fox River for this project (because more than 3000 cubic yards of material will be dredged). The underlying assumption is that unengineered upland disposal sites would not affect groundwater or other protected resources. If we suspect that is not the case, the Department can require upgrading or relocation of the disposal site even if volumes or sources fall within exemptions categories listed in the code.

Another option is to seek a Low Hazard Exemption as identified in s. NR 500.08(4) and s. 289.43(8), Wis. Stats. (formerly s. 144.44(7)(g), Wis. Stats.). Finally, the dredge sediment material may be suitable for a Beneficial Reuse Exemption under s. NR 500.08(5), Wis. Adm. Code. Note that the criteria for a low hazard exemption do not apply solely to waste itself, but also considers the way the waste is managed within the specifics of the conditions of the low hazard determination. In practice, this type of exemption should be applied to non hazardous, nontoxic wastes situations.

Examples of past exemptions include the granting of a conditional "low hazard exemption" under s. 289.43(8), Wis. Stats., authorizing disposal of dredge materials in the Kidney Island CDF in Green Bay. This had the effect of waiving the statutory siting process for that solid waste disposal facility. Use of that exemption by DNR in that situation was upheld by the courts in Public Intervenor v. DNR, 156 Wis2d 376. DNR has used the low hazard exemption process for the Bayport facility. We required the full landfill siting process for an upland dredge spoil disposal facility in Green Bay (Schuster Pit). For small projects, exemptions have been issued for a variety of disposal options, including disposal in covered mass, land spreading, use in landfills as daily covers and confined disposal facilities. Given the degree of contamination of the dredged material coming from the river, it is not likely that either the beneficial reuse or low hazard exemptions are viable options.

Other Regulations Related to Solid Waste Requirements. Ch. NR 347, Wis. Adm. Code, covers Sediment Sampling and Analysis, Monitoring Protocol and Disposal for Dredging Projects. This code is interpreted by Watershed Management for site specific sampling and analysis needs based on existing knowledge of the site. The code is used by Fish & Habitat Protection, Watershed Management, Waste Management and Air Management programs in evaluation of permit application as well as other submittals. Section NR 347.04 (1)(b) indicates that all dredging projects must be reviewed under s. 144.44, Wis. Stats. (s. 289.31, Wis. Stats., as of January 1, 1997) , and chs. NR 500 to 520 for disposal of dredged material under the Waste Management program. Section NR 347.04 (1)(g) states that sites for the disposal of hazardous waste and PCBs require review under ss. 144.64 (now ss. 291.23 and 291.25, Wis. Stats.) and 144.79 (now s. 299.45.), Wis. Stats., respectively, and chs. NR 600 to 685. (While not stated in Par. (g), ch. NR157 must also be considered when PCBs are being disposed of.) Paragraphs NR 347.04 (1) (b) & (g) apply when the dredged sediment material is removed from the water body for upland disposal and are Waste Management program responsibilities.

There are two additional items to note. The first is that on January 24, 1995, the U.S. EPA issued DNR an approval under the Toxics Substances Control Act (TSCA) allowing the disposal of PCB contaminated sediments resulting from certain sediment remediation projects into solid waste landfills. The second item deals with hazardous waste determination on the PCB contaminated dredge materials. In Wisconsin, unlike some other states, PCB contamination is not a basis for classifying a waste as hazardous. Additionally, there is no basis for stating that any of the dredged material would be listed hazardous waste. In the absence of listing criteria being met, the basis for a hazardous waste determination would be if the sediment failed the toxicity characteristic leaching procedure or TCLP analysis. We ask that you review Fox River data base for TCLP data. Based upon that evaluation you may be able to determine that none of the dredged material is hazardous waste and consequently we can then dismiss RCRA and the State hazardous waste ARARs at this time.

11/2000 being renegotiated

Upland disposal options by River Reach. The following table identifies the possibility of applying exemptions to upland disposal by River Reach.

Table 1

River Reach	*Beneficial Reuse*	*Low hazard*	*Site a Landfill*	*Use Existing Commercial or Private Landfill Capacity*
Little Lake Buttes Des Mortes	Not Likely	Possible for low level material	Possible	Yes
Appleton to Little Rapids[1]	No	No	Possible	No
Little Rapids to DePere	Not Likely	Possible for low level material	Possible	Yes
DePere to Green Bay	Not Likely	Possible for low level material	Possible	Yes

1. At this time we do not anticipate removing any sediment from the Appleton to Little Rapids reach of the river.

Applicable State In Water Disposal Laws. For more than 25 years, Wisconsin has had legislation which bans the open water disposal of dredged material on the bed of all navigable waters. This ban has had a significant effect on the ease with which navigational dredging can occur, in particular in the Great Lakes commercial ports in Wisconsin. This ban can be found in s. 30.12(1)(a) Wis. Stats. Structures and deposits in navigable waters prohibited; exceptions; penalty. (1) GENERAL PROHIBITION. Except as provided under sub. (4), unless a permit has been granted by the department pursuant to statute or the legislature has otherwise authorized structures or deposits in navigable waters, it is unlawful:

(a) To deposit any material or to place any structure upon the bed of any navigable water where no bulkhead line has been established; or

(b) To deposit any material or to place any structure upon the bed of any navigable water beyond a lawfully established bulkhead line.

The following discussion outlines how the law concerning in-water disposal has been applied and interpreted and how some permitted operations have been allowed. Since the law states that open water disposal is prohibited without a permit, the real question becomes when can a permit be issued. The law only authorizes the issuance of permits for the construction of structures on the bed of navigable waters and prohibits the deposition of materials except into structures which are permitted or authorized under statute or other legislative means. A structure has been defined by the Attorney General and the DNR as something which has "form, function and utility" in order to receive a permit. Open water disposal without a structure designed to contain dredged material does not meet this test.

Deposits on the bed of navigable waters in Wisconsin have been authorized under four scenarios. Exceptions to open water disposal prohibition include:

a) Legislative Authorization. Legislative authorization with riparian owners as applicants or co-applicants (examples: s. 30.202 & 30.203). This must be consistent with the public trust doctrine.

b) Lakebed Grants. Lakebed grants have been used in the past to authorize CDFs (s.30.05) - limited to natural lakebed, not the bed of a raised lake (dammed lake) unless the is agreement of riparian property owners and special legislation (Note: this is not always straight forward; A lakebed grant has been used in Lake Buttes Des Mortes, which is in part a dammed lake. Need to consider area of raised river versus actual lake bed area). Special legislation can result in the issuance of a lakebed grant. While the lakebed grant removes the specific area of the grant from the prohibition of deposits, the structure built to contain the materials deposited in the area must comply with all approvals and permits required to protect the water quality of the surrounding water body.

c) Bulkhead Lines. Bulkhead lines (s.30.11) can be used, however these are explicitly limited by statute to "conform as nearly as practicable to the existing shores, except in the case of leases...". Bulkhead lines cannot be used to fill large areas or lake or riverbed. Under s. 30.11, a municipality by ordinance and with DNR approval may establish a bulkhead line along the shore of any navigable water within its boundaries. Once a bulkhead line has been established, filling of the area behind the bulkhead line may occur in conformance with DNR conditions and limitations relating to off-site impacts.

d) Leases. Leases can be granted (s.24.29), but are only applicable to construct or enlarge harbors or improve navigation. This involves the Commission of Public Lands (the State Treasurer, the Secretary State and the Attorney General). This mechanism allows for the issuance of a lease to a municipality for the use of submerged lands, and for deposits on those submerged lands, under s. 24.39(4). A lease can be issued only for the purpose of improvement of navigation or for the improvement or construction of harbor facilities. Prior to granting such a lease, the Department of Natural Resources must find that the issuance of such a lease is in the public interest. As is the case for the establishment of bulkhead lines, the Department may include conditions of use and operation of the site in order to assure the public interest is protected. By statute, the board of commissioners of public lands must include these conditions as part of the lease agreement.

While each of these methods of acquiring the right to deposit materials on the bed of navigable waters has specific statutory authorization, each must still meet the conditions and limitations of the state relating to the protection of water quality and protection of other water related interests in the areas involved.

In Water Options by River Reach and In Green Bay. The following table identifies which in water disposal options are possible by River Reach.

Table 2

River Reach	*Legislative Authorization*	*Lakebed Grants*	*Bulkhead Lines*	*Leases*
Little Lake Buttes Des Mortes	Yes	Yes	No	No
Appleton to Little Rapids[2]	Yes	No	Yes	No
Little Rapids to DePere	Yes	No	Yes	No
DePere to Green Bay	Yes	No	Yes	Yes
Green Bay	Yes	Yes	No	Yes

2. At this time we do not anticipate removing any sediment from the Appleton to Little Rapids reach of the river.

CERCLA On Site Permit Exemption. The "on-site permit exemption" found in section 121(e) of CERCLA (42 U.S.C. ss. 9621(e)) only applies if U.S. EPA is going to be conducting the work or has issued an order or signed a consent decree with PRPs (and, potentially, the state as well) under the authority of CERCLA, which requires the PRPs to conduct the work. The "on-site permit exemption" does not apply if the State of Wisconsin conducts the work or if DNR issues an order or signs a consent decree with PRPs under the authority of state law.

The definition of "on-site" is in sections 300.5 and 300.400(e) of the NCP. Discussion of the topic in the NCP preamble begins on FR 8688, 3/8/90. "On-site" means the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action. The distinction between substantive and administrative requirements is discussed in relation to the definitions of "applicable" and "relevant and "appropriate" requirements in section 300.5. This discussion begins on FR 8756, 3/8/90.

CERCLA does not authorize states to issue orders or require PRPs to conduct cleanup actions under CERCLA. Only EPA can do those things under CERCLA. In order for the "on-site permit exemption" to be applicable, CERCLA authority must be used and only EPA can use it. If DNR issues an order under spill law (ch. 292.11, Wis. Stats.), the federal on-site permit exemption does not apply and all required permits and approvals must be obtained.

For this site, DNR's position is upland disposal units immediately adjacent to the River and in-water disposal units are the only ones that could be considered "on-site" under CERCLA. DNR also believes permanent upland disposal units close enough to the river to be considered "on-site" would not meet locational criteria ARARs, and those ARARs should not be exempted or waived.

Please contact me at 608/266-3084 if you have questions.

CC: Bob Paulson - WT/2
Linda Meyer - LS/5
Chuck Hammer - LS/5
Kevin Kessler - WA/3
Tim Thompson - RETEC
Mike Cain - LS/5
Chuck Leveque - LS/5
Gary Edelstein - RR/3
Len Polczinski - NER

CORRESPONDENCE/MEMORANDUM — State of Wisconsin

3.5.6 5/8/18

w/ 8/6/98 Memo from Ekl Landfills

DATE: January 31, 1997

TO: RR Regional Team Supervisors Mark Giesfeldt - RR/3
BRR Section Chiefs & Team Leaders - RR/3

FROM: Ed Lynch - RR/3 EKL

SUBJECT: Dredged Sediment Materials Management

At the November 5 & 6, 1996 RR team leaders meeting, Pat McCutcheon of SCR requested information on how regions managed dredged sediment material. The discussion that followed indicated that in most cases this material is handled as a solid waste that may be covered by a waste management program exemption. I agreed to review available information on the management of dredge sediment materials and relay my findings back to you. This memo summarizes my findings. It is not meant to address all the technical or programmatic issues related to dredge sediment materials management. Please share this information with your staff. In preparing this memo, I discussed this topic with staff from the Waste Management program and they concur with the content of this memo. For the most part, upland disposal of dredged sediments is a Waste Management program issue. Please remember to maintain open communications with other programs when dealing with dredge materials management issues.

Dredged sediment material is a solid waste in Wisconsin, defined by the statutory definition of solid waste and by case law. Sediment in place in a water body is not a regulated solid waste operation until someone picks it up in a dredging operation. Contaminated or unwanted sediment in a water body may be a problem for someone and may deserve cleanup, but solid waste authority comes into play only due to the act of dredging and managing the sediment. Liability for discharges from contaminated sediment may fall under state spill law and other authorities in other circumstances.

Department rules and State statutes provide for a range of options for the regulation of dredged sediment materials based on the degree of risk that the materials may present to human health and the environment. In a broad sense ch. NR 150, Wis. Adm. Code and various manual codes provide for a cross program review of the potential for harm to human health and the environment of dredging projects including the effects of removal and disposal of the material.

Management options for dredged sediment material range from low restriction beneficial reuse to highly restrictive disposal due to toxic or hazardous properties or other threats to human health and the environment. The evaluation of the risk of disposal may be based upon information on the dredge sediment material, the proposed disposal site and disposal methods, data requested by Waste Management from the applicant, data from the reporting requirements of ch. NR 347, Wis. Adm. Code, existing data on sediment chemistry, and where applicable ch. NR 150, Wis. Adm. Code requirements.

First of all, there are several specific solid waste rules and statutes that apply to the management of dredged materials and provide exemptions to certain solid waste rules. The primary exemption exists in s. NR 500.08(3), Wis. Adm. Code (June, 1996) that covers dredged materials. This exemption reads as follows:

"(3) DREDGED MATERIAL EXEMPTIONS. The following facilities are exempt from the licensing and plan review requirements of chs. NR 500 to 536 but shall be developed in accordance with the following requirements:

(a) Facilities for the disposal of nonhazardous dredged material consisting of less than 3000 cubic yards from Lake Michigan, Lake Superior, the Wisconsin River, the Sheboygan River, the Milwaukee River, the Brule and Menomonee rivers, the Fox rivers, or from any inland lakes or ponds treated with arsenicals provided the facility complies with the performance standards in s. NR 504.04(4).

(b) Facilities for the disposal of non-hazardous dredged material from rivers not listed in par. (a) provided the facility complies with the performance standards specified in s. NR 504.04(4).

(c) Facilities for the disposal of nonhazardous dredged material from inland lakes or ponds that have not been treated with arsenicals provided the facility complies with the performance standards specified in s. NR 504.04(4)."

Chapter NR 504, Wis. Adm. Code covers Landfill Location, Performance, Design and Construction Criteria and s. NR 504.04(4) (attachment A) is the performance standards section. This section allows property to be used for a solid waste land disposal facility provided the facility is properly located and there are no significant adverse impacts or detrimental effects. Waste Management staff are the appropriate personnel to make these determinations regarding the effects or impacts from this type of disposal facility.

With regards to s. NR 500.08(3)(a), this allows for the disposal of small amounts of dredged sediment materials (less than 3000 cubic yards) from listed bodies of water to be disposed of into upland land disposal sites without plan review or licensing provided solid waste location and performance standards are met. Paragraph (b) applies to non-listed water bodies and rivers and is similar to (a) but does not have a quantity limit. The focus of par. (c) is dredged sediment material from inland lakes or ponds that have not been treated with arsenicals. It is up to the Watershed Management program and the Waste Management program to make decisions concerning in-water disposal. (This memo is not meant to address issues related to the need for obtaining any COE approvals or permits.)

In cases where the exemption criteria of s. NR 500.08(3) are not met, other options exist. One option is to follow the siting process and eventually establish a solid waste disposal facility. Another option is to seek a Low Hazard Exemption as identified in s. NR 500.08(4) and s. 289.43(8) Stats. (formerly s. 144.44(7)(g), Stats; see attachment B). Finally, the dredge sediment material may be suitable for a beneficial reuse exemption per s. NR 500.08(5), Wis. Adm. Code. The Waste Management program is responsible for making these decisions and for issuing low hazard exemptions. Note that the criteria for a low hazard exemption do not apply solely to waste itself, but also considers the way the waste is managed within the specifics of the conditions of the low hazard determination.

Solid waste staff have generally provided feedback by way of interprogram memos for small projects, for use by dredging permit writers to include as conditions of dredging permits. Larger harbor projects or dredge sediment projects have historically been subject to formal grants of exemptions. Most of the reviews have involved contaminated sediments or disposal locations that would affect protected resources such as wetlands. Exemptions have been issued for a variety of disposal options, including disposal in covered mass, land spreading, use in landfills as daily covers and confined disposal facilities.

Generally, the Waste Management program is part of the multiprogram review of a proposed dredging project. A dredging project coordinator should usually be appointed to address water regulation and environmental impact responsibilities. Historically, the Waste Management program has not been brought into projects until basic decisions have been made concerning the overall dredging project.

In addition, ch. NR 347, Wis. Adm. Code, (attachment C) covers Sediment Sampling and Analysis, Monitoring Protocol and Disposal for Dredging Projects. This code is interpreted by Watershed Management for site specific sampling and analysis needs based on existing knowledge of the site. The code is used by Fish & Habitat Protection, Watershed Management, Waste Management and Air Management programs in evaluation of permit application as well as other submittals. Section NR 347.04 (1)(b) requires all dredging projects be reviewed under s. 144.44, Stats., and chs. NR 500 to 520 for disposal of dredged material under the

Waste Management program. Section NR 347.04 (1)(g) states that sites for the disposal of hazardous waste and PCBs require review under ss. 144.64 and 144.79, Stats., respectively, and chs. NR 500 to 520 and chs. NR 600 to 685. (While not stated in Par. (g), ch. NR 157 must also be considered when PCBs are of a concern.) Parens. (b) & (g) apply when the dredged sediment material is removed from the waterbody for upland disposal and are Waste Management program responsibilities.

An additional item to note is that on January 24, 1995, the U.S. EPA issued DNR an approval under the Toxics Substances Control Act (TSCA) allowing the disposal of PCB contaminated sediments resulting from certain sediment remediation projects into solid waste landfills. It is important to note that this was a conditional approval and there are a number of issues related to this determination. These issues are discussed in a March 20, 1995 memo from Dave Carper to the district solid waste program supervisors and staff (attachment D). Please review this memo closely. EPA's approval is far from an open invitation to dispose of PCB contaminated sediments into Wisconsin landfills

Application of ch. NR 720. As indicated previously, dredged sediment material *is* a solid waste and there is no direct connection between table values in ch. NR 720, Wis. Adm. Code, and the land disposal of contaminated dredge sediment materials. In addition, NR 720 table values *were not* developed for the purpose of managing contaminated dredge sediment material at an off-site location (NR 720 *was* developed for on-site management of contaminated soils and not developed to be a waste management regulation). However, as the NR 720 table values are risk-based, there may be some validity in using those values as a basis for evaluating the risk associated with management of the dredge sediment material on a case by case basis and for determining the need for subsequent management. Regardless of the sediment contamination level, the Waste Management program is responsible for determining whether a proposed waste management practice is appropriate based upon the level of risk posed by the dredged sediment material.

In summary, management of dredge sediment material at upland locations fall primarily within the confines of the Waste Management program. The above mentioned statutes, rules and guidance should be considered for any dredging project be it remediation related or not. As I indicated before, communications with other programs when dealing with dredge materials management is important and should not be overlooked.

I hope this information is useful. Should you have any questions, you may wish to contact Bob Grefe of the Bureau of Waste Management at 608/266-2178 or Chuck Leveque of the Bureau of Legal Services at 608/266-0228. Questions concerning the TSCA PCB approval from EPA can be directed to Dave Carper at 608/267-6823.

Concurrence:

Paul P. Didier

Paul P. Didier, P.E., Director
Bureau of Waste Management

1/31/97
Date

Attachments: A. Section 504.04(4), Wis. Adm. Code.
B. Section 289.43(8), Stats.
C. Chapter NR 347, Wis. Adm. Code.
D. DNR Memo dated March 20, 1995 concerning TSCA PCB Approval

cc: WA Section Chiefs - WA/3
Bob Grefe - WA/3
RR Program Attorneys - LS/5
Paulette Harder/Sue Bangert - WT/2
Mary Ellen Vollbrecht - FH/4
Regional WA Team Leaders
Dave Carper - WA/3
Chuck Leveque - LS/5
Bill Fitzpatrick - WT/2

a:dredge.ckl.rrl

department by up to 2 years if the owner or operator demonstrates that there is no available alternative disposal capacity and there is no immediate threat to human health and the environment.

Note: Owners or operators proposing to site a new or expand an existing municipal solid waste landfill within a 5 mile radius of any airport runway end used by turbojet or piston type aircraft must notify the owner or operator of the affected airport and the federal aviation administration (FAA).

(f) Within 1,200 feet of any public or private water supply well.

(g) Within 200 feet of a fault that has had displacement in Holocene time.

(h) Within seismic impact zones.

(i) Within unstable areas.

(4) PERFORMANCE STANDARDS. No person may establish, construct, operate, maintain or permit the use of property for a landfill if there is a reasonable probability that the landfill will cause:

(a) A significant adverse impact on wetlands as provided in ch. NR 103.

(b) A significant adverse impact on critical habitat areas.

(c) A detrimental effect on any surface water.

(d) A detrimental effect on groundwater quality or will cause or exacerbate an attainment or exceedance of any preventive action limit or enforcement standard at a point of standards application as defined in ch. NR 140. For the purposes of design the point of standards application is defined by s. NR 140.22 (1).

(e) The migration and concentration of explosive gases in any landfill structures excluding the leachate collection system or gas control or recovery system components in excess of 25% of the lower explosive limit for such gases at any time. The migration and concentration of explosive gases in the soils outside of the limits of filling within 200 feet of the landfill property boundary or beyond the landfill property boundary in excess of the lower explosive limit for such gases at any time. The migration and concentration of explosive gases in the air outside of the limits of filling within 200 feet of the landfill boundary or beyond the landfill property boundary in excess of the lower explosive limit for such gases at any time.

(f) The emission of any hazardous air contaminant exceeding the limitations for those substances contained in s. NR 445.03.

History: Cr. January, 1988, No. 385, eff. 2–6–88; am. (1), (2) (a), (b), (3) (intro.), (a), (d), (4) (intro.), (a), (3), r. and recr. (3) (e), cr. (3) (g) to (i).

NR 504.05 General design and construction criteria. (1) Unless otherwise specified in this chapter, the minimum design criteria in ss. NR 504.06 to 504.09 apply to all new landfills and to the expansion of existing landfills for which the plan of operation was approved after July 1, 1996, as well as to proposed design changes for all landfills which are submitted after July 1, 1996. Landfills designed in substantial conformance with these design criteria are presumed to be capable of meeting the performance standards of s. NR 504.04(4)(d) regarding groundwater quality.

(2) If the proposed design differs from the requirements in ss. NR 504.06 to 504.09, the applicant shall provide supporting justification for any differences.

(3) The design capacity of all proposed landfills, except landfills that are exempted in s. 144.44(2)(nr), Stats., shall be determined such that the projected operating life of the landfill is not less than 10 years nor more than 15 years. Expansions of existing landfills are not subject to the 10–year minimum design capacity requirement. Waste approved for use in construction of landfill components is not considered part of the design capacity.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. and recr., Register, June, 1996, No. 486, eff. 7–1–96.

NR 504.06 Minimum design and construction criteria for landfill liners and leachate collection systems. (1) GENERAL. (a) All major phases of landfills initially accepting municipal solid waste after July 1, 1996, shall be designed with a composite liner and a leachate collection system capable of limiting the average leachate head level on the composite liner to one foot or less during operation and after closure of the landfill, except as provided in s. NR 504.10(1) (c). The composite liner shall consist of 2 components; the upper component shall consist of a nominal 60–mil or thicker geomembrane liner with no thickness measurements falling below the minimum industry accepted manufacturing tolerances, and the lower component shall consist of a minimum 4 foot thick layer of compacted clay meeting the specifications of s. NR 504.06(2)(a). The geomembrane component shall be installed in direct and uniform contact with the compacted clay soil component, and the landfill shall meet or exceed the standards in the applicable portions of subs. (2), (3) and (4). All other landfills shall be designed to contain and collect leachate to the maximum practical extent. This shall be accomplished by designing the landfill to meet the standards contained in the applicable portions of subs. (2), (3) and (4), unless the department approves the applicant's alternative design as per s. NR 504.10, which provides an equivalent or better level of performance than the standards contained in this chapter.

(b) If the applicant does not complete construction of the first major phase of the landfill within 2 years from the date of the plan of operation approval, the applicant shall reapply to the department for approval to construct the landfill. This application does not constitute a feasibility report as defined in s. 144.44(2), Stats. The department may require additional conditions of approval and require redesign of the landfill in accordance with state–of–the–art design criteria.

(2) COMPOSITE OR CLAY LINED LANDFILLS. All landfills designed with a composite liner or a clay liner shall meet the following requirements:

(a) All clay used in liner construction shall meet the following specifications:

1. A minimum of 50% by weight which passes the 200 sieve.

2. A saturated hydraulic conductivity of $1x10^{-7}$ cm/sec or less, when compacted to required moisture contents and densities based on the modified Proctor method, standard Proctor method, or a line of optimums method approved by the department.

3. An average liquid limit of 25 or greater with no values less than 20.

4. An average plasticity index of 12 or greater with no values less than 10.

(b) The separation distance between the seasonal high groundwater table and the bottom of the clay component of a composite liner or a clay liner shall be at least 10 feet except for zone–of–saturation landfills.

(c) The separation distance between the top of the bedrock surface and the bottom of the clay component of a composite liner or a clay liner shall be at least 10 feet.

(d) The slope of the liner surface toward the leachate collection lines shall be at least 2%.

(e) The minimum thickness of the clay component of a composite liner at all locations shall be at least 4 feet. The minimum thickness of a clay liner at all locations shall be at least 5 feet.

(f) The clay component of a composite liner or a clay liner shall be constructed in the following manner:

1. All clay layers in the liner shall be constructed in lift heights no greater than 6 inches after compaction using footed compaction equipment having feet at least as long as the loose lift height. As needed, clay shall be disked or otherwise mechanically processed prior to compaction to break up clods and allow for moisture content adjustment. Clod size shall be no greater than 4 inches. All compaction equipment utilized shall have a minimum static weight of 30,000 pounds. Lighter equipment may be used in small areas where it is not possible to use full size equipment. Alternative procedures or equipment may be proposed for approval by the department.

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under this chapter or conditions of operation made applicable to a solid waste disposal facility by the department.

(2) (a) No person engaged in the construction, operation or maintenance of a solid waste disposal facility or hazardous waste disposal facility may dismiss, discipline, demote, transfer, reprimand, harass, reduce the pay of, discriminate against or otherwise retaliate against any employe, or threaten to take any of those actions, because the employe reported to any supervisor, appointing authority, law enforcement official, member of the governing body of the local governmental unit in which the solid waste disposal facility or hazardous waste disposal facility is located or the department any information gained by the employe which the employe reasonably believes demonstrates a violation of this chapter or rules promulgated under this chapter.

(b) Paragraph (a) does not restrict the right of an employer to take appropriate disciplinary action against an employe who knowingly makes an untrue statement or discloses information the disclosure of which is expressly prohibited by state or federal law.

(c) 1. Any employe who believes that his or her rights under par. (a) have been violated may, within 30 days after the violation occurs or the employe obtains knowledge of the violation, whichever is later, file a written complaint with the department specifying the nature of the retaliatory action or threat of retaliatory action and requesting relief. The department shall investigate the complaint and shall determine whether there is probable cause to believe that a violation of par. (a) has occurred. If the department finds that probable cause exists, it shall attempt to resolve the complaint by conference, conciliation or persuasion. If the complaint is not resolved, the department shall proceed with notice and a contested case hearing on the complaint as provided in ch. 227. The hearing shall be held within 60 days after receipt of the complaint by the department, unless the parties to the proceeding agree otherwise.

2. The department shall issue its decision and order on the complaint within 30 days after the hearing. If the department finds that a violation of par. (a) has occurred, it may order the employer to take action to remedy the effects of the violation, including reinstating the employe, providing back pay to the employe or taking disciplinary action against employes responsible for the violation.

(d) This subsection does not limit other protections or remedies available to an employe, including those granted by ordinance, statute, rule, contract or collective bargaining agreement.

History: 1995 a. 227 ss. 531, 532, 991.

289.43 Waivers; exemptions. (1) DEFINITION. In this section, "recycling" means the process by which solid waste is returned to productive use as material or energy, but does not include the collection of solid waste.

(2) WAIVER; EMERGENCY CONDITION. The department may waive compliance with any requirement of ss. 289.21 to 289.32, 289.47, 289.53 or 289.95 or shorten the time periods under ss. 289.21 to 289.32, 289.47, 289.53 or 289.95 provided to the extent necessary to prevent an emergency condition threatening public health, safety or welfare.

(3) WAIVER; RESEARCH PROJECTS. The intent of this subsection is to encourage research projects designed to demonstrate the feasibility of recycling certain solid wastes while providing adequate and reasonable safeguards for the environment. The department may waive compliance with the requirements of this chapter for a project developed for research purposes to evaluate the potential for the recycling of high–volume industrial waste if the following conditions are met:

(a) The project is designed to demonstrate the feasibility of recycling solid waste or the feasibility of improved solid waste disposal methods.

(b) The department determines that the project is unlikely to violate any law relating to surface water or groundwater quality including this chapter or ch. 160 or 283.

(c) The department reviews and approves the project prior to its initiation.

(d) The owner or operator of the project agrees to provide all data, reports and research publications relating to the project to the department.

(e) The owner or operator of the project agrees to take necessary action to maintain compliance with surface water and groundwater laws, including this chapter and chs. 160 and 283 and to take necessary action to regain compliance with these laws if a violation occurs because of the functioning or malfunctioning of the project.

(4) EXEMPTION FROM LICENSING OR REGULATION; DEVELOPMENT OF IMPROVED METHODS. For the purpose of encouraging the development of improved methods of solid waste disposal, the department may specify by rule types of solid waste facilities that are not required to be licensed under ss. 289.21 to 289.32 or types of solid waste that need not be disposed of at a licensed solid waste disposal facility.

(5) EXEMPTION FROM REGULATION; SINGLE–FAMILY WASTE DISPOSAL. The department may not regulate under chs. 281, 285 or 289 to 299 any solid waste from a single family or household disposed of on the property where it is generated.

(6) EXEMPTION FROM LICENSING; AGRICULTURAL LANDSPREADING OF SLUDGE. The department may not require a license under ss. 289.21 to 289.32 for agricultural land on which nonhazardous sludges from a treatment work, as defined under s. 283.01 (18), are land spread for purpose of a soil conditioner or nutrient.

(6m) EXEMPTION FROM LICENSING, AGRICULTURAL USE OF WOOD ASH. No license is required under ss. 289.21 to 289.32 for the agricultural use of wood ash.

(7) EXEMPTION FROM LICENSING; RECYCLING OF HIGH–VOLUME INDUSTRIAL WASTE. (a) Any person who generates, treats, stores or disposes of high–volume industrial waste may request the department to exempt an individual solid waste facility or specified types of solid waste facilities from this chapter for the purpose of allowing the recycling of any high–volume industrial waste.

(b) A person who requests an exemption under par. (a) shall provide any information requested by the department relating to the characteristics of the high–volume industrial waste, the characteristics of the site of the recycling and the proposed methods of recycling.

(c) The department shall approve the requester's exemption proposal if the department finds that the proposal, as approved, will comply with this chapter and chs. 30, 31, 160 and 280 to 299 and ss. 1.11, 23.40, 59.692, 59.693, 60.627, 61.351, 61.354, 62.231, 62.234 and 87.30. If the proposal does not comply with one or more of the requirements specified in this paragraph, the department shall provide a written statement describing how the proposal fails to comply with those requirements. The department shall respond to an application for an exemption under this subsection within 90 days.

NOTE: Par. (c) is shown as affected by two acts of the 1995 legislature and as merged by the revisor under s. 13.93 (2) (c).

(d) The department may require periodic testing and may impose other conditions on any exemption granted under this subsection. The department may require a person granted an exemption under this subsection to identify the location of any site where high–volume industrial waste is recycled.

(e) 1. Each applicant for an exemption under this subsection shall submit a nonrefundable fee of $500 with the application to cover the department's cost for the initial screening of the application. The department may waive this fee if the cost of the initial screening to the department will be minimal.

2. The department shall, by rule, establish fees for approved applications which, together with the $500 application fees, shall, as closely as possible, equal the actual cost of reviewing applications.

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3. All fees collected under this paragraph shall be credited to the appropriation under s. 20.370 (2) (dg).

(8) *Exemption from regulation; low-hazard waste.* (a) The department shall conduct a continuing review of the potential hazard to public health or the environment of various types of solid wastes and solid waste facilities. The department shall consider information submitted by any person concerning the potential hazard to public health or the environment of any type of solid waste.

(b) If the department, after a review under par. (a), finds that regulation under this chapter is not warranted in light of the potential hazard to public health or the environment, the department shall either:

1. Promulgate a rule specifying types of solid waste that need not be disposed of at a licensed solid waste disposal facility.

2. On a case-by-case basis, exempt from regulation under this chapter specified types of solid waste facilities.

3. Authorize an individual generator to dispose of a specified type of solid waste at a site other than a licensed solid waste disposal facility.

(c) The department may require periodic testing of solid wastes and impose other conditions on exemptions granted under par. (b).

(9) EXEMPTION FROM REGULATION; ANIMAL CARCASSES. The department may not regulate under chs. 281, 285 or 289 to 299 any animal carcass buried or disposed of, in accordance with ss. 95.35 and 95.50, on the property owned or operated by the owner of the carcass, if the owner is a farmer, as defined under s. 102.04 (3).

History: 1995 a. 227 ss. 574, 577 to 580; s. 13.93 (2) (c).

Exemption from regulation under sub. (7) (g) does not prevent municipal regulation but instead places the municipality in the position it would be in regarding regulation if the statutory scheme under ss. 144.43 to 144.47 did not exist. DeRosso Landfill Co. v. City of Oak Creek, 191 W (2d) 46, 528 NW (2d) 468 (Ct. App. 1995).

289.44 Exemption for certain alcohol fuel production systems. (1) DEFINITIONS. As used in this section:

(a) "Distillate waste product" means solid, semisolid or liquid by-products or wastes from the distillation or functionally equivalent process of an alcohol fuel production system.

(b) "Environmentally sound storage facility" means a facility, including a holding lagoon, which is used to store distillate waste products so that no waste products from the facility enter or leach into the waters of the state.

(c) "Private alcohol fuel production system" means an alcohol fuel production system from which no alcohol is sold and from which all the alcohol is used as a fuel by the owner.

(2) EXEMPTION. No permit, license or plan approval is required under this chapter for the owner of a private alcohol fuel production system to establish, construct or operate a system for the treatment, storage or disposal of distillate waste products if the distillate waste product is stored in an environmentally sound storage facility and disposed of using an environmentally safe land spreading technique and the storage, treatment or disposal is confined to the property of the owner.

History: 1979 c. 221; 1995 a. 227 s. 537.

289.445 Exemption for certain fruit and vegetable washing facilities. (1) DEFINITIONS. As used in this section:

(b) "Washing station" has the meaning given in s. 283.62 (1) (b).

(c) "Wash water" has the meaning given in s. 283.62 (1) (c).

(d) "Wash water storage facility" has the meaning given in s. 283.62 (1) (d).

(2) EXEMPTION. No permit, license or, except as provided in par. (d), plan approval is required under this chapter for the owner of a washing station to establish, construct or operate a solid waste facility for the treatment, storage or disposal of wash water or to compost or land spread plant parts separated from wash water if all of the following requirements are met:

(a) The washing station is not adjacent to or operated as part of a food processing plant, as defined in s. 97.29 (1) (h).

(b) All wash water is either stored in a sealed wash water storage facility or is dispersed on land owned or leased by the owner of the washing station in a manner which avoids ponding, runoff or nuisance conditions and in accordance with acceptable agricultural practices or acceptable practices for the land spreading of waste.

(c) All plant parts that are separated from wash water are either composted or stored in a plant parts storage facility and disposed of using an environmentally safe land spreading technique. The treatment, storage, disposal or composting under this paragraph must be confined to property owned or leased by the owner of the washing station.

(d) For a washing station that anticipates operating at least 100 days per year or that operated at least 100 days during the immediately preceding year, do all of the following:

1. Register annually with the department as a washing station.

2. Submit annually an operating plan that implements best management practices and that is approved by the department.

3. Operate only in accordance with the approved operating plan.

History: 1995 a. 99; 1995 a. 227 s. 538; Stats. 1995 s. 289.445.

289.45 Solid waste storage. No person may store or cause the storage of solid waste in a manner which causes environmental pollution.

History: 1981 c. 374.; 1995 a. 227 s. 539; Stats. 1995 s. 289.45.

289.46 Transference of responsibility. (1) Any person acquiring rights of ownership, possession or operation in a licensed solid or hazardous waste facility at any time after the facility begins to accept waste is subject to all requirements of the license approved for the facility including any requirements relating to long-term care of the facility and is subject to any negotiated agreement or arbitration award related to the facility under s. 289.33. Upon acquisition of the rights, the department shall issue a new operating license if the previous licensee is no longer connected with the operation of the facility, if the new licensee meets all requirements specified in the previous license, the approved plan of operation, if any, and the rules promulgated under s. 291.05 or 291.07, if applicable.

(2) Any person having or acquiring rights of ownership in land where a solid or hazardous waste disposal facility was previously operated may not undertake any activities on the land which interfere with the closed facility causing a significant threat to public health, safety or welfare.

History: 1977 c. 377; 1981 c. 374; 1983 a. 410 ss. 62, 2202 (38); Stats. 1983 s. 144.444; 1989 a. 31; 1995 a. 227 s. 625; Stats. 1995 s. 289.46.

See note to 144.60, citing Kelly, 67 MLR 691 (1984).

289.47 Closure notice. At least 120 days prior to the closing of a solid waste disposal facility or at least 180 days prior to the closing of a hazardous waste facility, the owner or operator shall notify the department in writing of the intent to close the facility.

History: 1995 a. 227 s. 573.

SUBCHAPTER V

FACILITIES; REGULATION OF SPECIFIC FACILITY OR WASTE TYPES

289.51 Solid waste open burning standards. (1) As used in this section:

(a) "Air curtain destructor" means a solid waste disposal operation that combines a fixed wall open pit and a mechanical air supply which uses an excess of oxygen and turbulence to accomplish the smokeless combustion of clean wood wastes.

Chapter NR 347

SEDIMENT SAMPLING AND ANALYSIS, MONITORING PROTOCOL AND DISPOSAL CRITERIA FOR DREDGING PROJECTS

Note: Chapter NR 347 as it existed on February 28, 1989 was repealed and new chapter NR 347 was created effective March 1, 1989.

NR 347.01 Purpose and policy. **(1)** The purpose of this chapter is to protect the public rights and interest in the waters of the state by specifying definitions, sediment sampling and analysis requirements, disposal criteria and monitoring requirements for dredging projects regulated under one or more of the following statutes: s. 30.20, Stats., which requires a contract or permit for the removal of material from the beds of waterways; s. 144.04, Stats., which establishes a wastewater treatment facility plan approval program; ss. 144.43 to 144.47, Stats., which establish the solid waste management program; ss. 144.60 to 144.74, Stats., which establish the hazardous waste program; and ch. 147, Stats., which establishes the Wisconsin pollutant discharge elimination system (WPDES) program.

(2) It is department policy to encourage reuse of dredged material and to minimize environmental harm resulting from a dredging project.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89.

NR 347.02 Applicability. The provisions of this chapter apply to the removal and disposal of material from the beds of waterways except where exempted by statute.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89.

NR 347.03 Definitions. **(1)** "Analyte" means the chemical substance or physical property being tested for in a sample.

(2) "Bathymetry" means the measurement of depth of water in lakes or rivers to determine lake or river bed topography.

(3) "Beach nourishment disposal" means the disposal of dredged material on the beaches or in the water landward from the ordinary high-water mark of Lakes Michigan and Superior for the purpose of adding, replenishing or preventing erosion of beach material.

(4) "Bioassay" means a method for determining the acute or chronic toxicity of a material by studying its effects on test organisms under controlled conditions.

(5) "Bulk sediment analysis" means a test to measure the total concentration of a specific constituent in a sample being analyzed.

(6) "Carriage water" means the water portion of a slurry of water and dredged material.

(7) "Carriage water return flow" means the carriage water which is returned to a receiving water after separation of the dredged material from the carriage water in a disposal, rehandling or treatment facility.

(8) "Connecting waterways" means a portion of a navigable lake or stream which is directly joined to Lake Michigan or Lake Superior and which contains a navigation channel providing access for commercial or recreational watercraft to Lake Michigan or Lake Superior.

(9) "Contamination" means a solid, liquid or gaseous material, microorganism, noise, heat, odor, or radiation, alone or in any combination, that may harm the quality of the environment in any way.

(10) "Contract" means a binding written agreement between the department and a dredging applicant authorizing the removal of material from the bed of a natural navigable lake or outlying water.

(11) "Department" means the department of natural resources

(12) "Disposal facility" means a site or facility for the disposal of dredged material.

(13) "Dredged material" means any material removed from the bed of any waterway by dredging.

(14) "Dredging" means any part of the process of the removal of material from the beds of waterways; transport of the material to a disposal, rehandling or treatment facility; treatment of the material; discharge of carriage or interstitial water; and disposal of the material.

(15) "Grain size analysis" means a method to determine dredged material and disposal site sediment particle size distribution.

(16) "Hazardous waste", as defined in s. 144.61(5), Stats., means any solid waste identified as a hazardous waste under ch. NR 605.

(17) "Interstitial water" means water contained in the interstices or voids of soil or rock in the dredged material.

(18) "Limit of detection" means the lowest concentration level that can be determined to be statistically different from a blank sample for that analytical test method and sample matrix.

(19) "Limit of quantitation" (LOQ) means the concentration of an analyte at which one can state with a stated degree of confidence for that analytical test method and sample matrix that an analyte is present at a specific concentration in the sample tested.

(20) "Parent material" means the native unconsolidated material which overlies the bedrock.

(21) "PCBs" means those materials defined in s. 144.79(1)(a), Stats.

(22) "Particle size distribution" means a cumulative frequency distribution or frequency distribution of percentages of particles of specified diameters in a sample.

(23) "Rehandling facility" means a temporary storage site or facility used during the transportation of dredged material to a treatment or disposal facility.

(24) "Treatment facility" in this chapter means a natural or artificial confinement facility used for the separation of dredged material solids from the interstitial or carriage water.

(25) "Upland disposal" means the disposal of dredged materials landward from the ordinary high-water mark of a waterway or waterbody.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; correction in (16) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1995, No. 478.

NR 347.04 Permits, approvals and reviews required. **(1)** The following are the permit, approval and review requirements for dredging projects:

(a) Except where otherwise provided by law, all private and municipal dredging projects require a permit or contract under s. 30.20, Stats., and ch. NR 346. Dredging in portions of the Missis-

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sippi, St. Croix and Black rivers by the U.S. army corps of engineers is governed by s. 30.202, Stats.

(b) All dredging projects require review under s. 144.44, Stats., and chs. NR 500 to 520 for disposal of dredged material under the solid waste management program.

(c) All dredging projects shall be reviewed under ss. 1.11 and 23.11(5), Stats., and ch. NR 150 for compliance with the Wisconsin environmental policy act.

(d) All federally funded, permitted or sponsored dredging projects require water quality certification under ss. 144.025 and 147.01, Stats., and ch. NR 299.

(e) A Wisconsin pollutant discharge elimination system (WPDES) permit under ch. 147, Stats., is required for dredging projects with carriage water return flows to surface water or groundwater.

(f) Plan approval under s. 144.04, Stats., is required for dredging projects which include a dredged material treatment facility.

(g) Sites and facilities for the disposal of hazardous waste and PCBs require review under ss. 144.64 and 144.79, Stats., and chs. NR 500 to 520 and chs. NR 600 to 685.

(2) The project application process shall be coordinated by the department. Except as otherwise provided by law, decisions on all applicable department approvals, permits, contracts and licenses relating to a dredging project shall be made concurrently and with the decision on:

(a) Water quality certification under ch. NR 299 for all federally funded, permitted or sponsored projects, or

(b) Permit or contract under s. 30.20, Stats., and ch. NR 346 for all other projects.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; corrections in (1) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1995, No. 478.

NR 347.05 Preliminary application and analytical requirements. **(1)** Prior to submission of a formal application, anyone seeking to remove material from the beds of waterways shall provide the department with preliminary information including:

(a) Name of waterbody and location of project;

(b) Volume of material to be dredged;

(c) Brief description of dredging method and equipment;

(d) Brief description of proposed disposal method and location and, if a disposal facility is to be used, size of the disposal facility;

(e) Any previous sediment sampling (including field observations) and analysis data from the area to be dredged or from the proposed disposal site;

(f) Copy of a map showing the area to be dredged, the depth of cut, the specific location of the proposed sediment sampling sites and the bathymetry of the area to be dredged; and

(g) Anticipated starting and completion dates of the proposed project.

(2) An initial evaluation shall be conducted by the department within 30 business days after receipt of the information under sub. (1) to determine if there is reason to believe that the material proposed to be dredged is contaminated. This initial evaluation shall be used by the department in specifying sediment sampling and analysis requirements to the applicant under s. NR 347.06 and shall be accomplished with existing data. Factors which shall be considered by the department in its evaluation of the dredging site and, if appropriate the disposal site, include, but are not limited to, the following:

(a) Potential that contaminants may be present. Potential routes that may have introduced contaminants into the dredging site shall be identified by examining appropriate maps, aerial photographs, or other graphic materials that show surface watercourses and groundwater flow patterns, surface relief, proximity to surface and groundwater movement, private and public roads, location of buildings, agricultural land, municipal and industrial sewage and stormwater outfalls, etc., or by making supplemental field inspections.

(b) Previous tests of the material at the dredging site or from other projects in the vicinity when there are similar sources and types of contaminants, water circulation and stratification, accumulation of sediments, general sediment characteristics, and potential for impact on the aquatic environment, as long as nothing is known to have occurred which would render the comparisons inappropriate.

(c) The probability of past introduction of contaminants from land runoff.

(d) Spills of toxic or hazardous substances.

(e) Introduction of contaminants from point sources.

(f) Source and previous use of materials used or proposed to be used as fill.

(g) Natural deposits of minerals and other natural substances.

(h) Any other relevant information available to the department.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89.

NR 347.06 Sampling and analysis. Upon completion of the initial evaluation, the department shall establish sampling and analysis requirements.

(1) EXCEPTION. Except as provided in subs. (3)(a) and (6), the applicant shall collect and analyze data on sediments to be dredged in the manner outlined in this section.

(2) CORRECT METHODS. Unless otherwise specified, sampling, sample handling and sample analysis to demonstrate compliance with this section shall be in accordance with methods from applicable sources enumerated in ch. NR 149.

(3) NUMBER OF SAMPLES. (a) Sediment sampling may be waived by the department if it determines from its review of available information under s. NR 347.05(2) that sediment contamination is unlikely.

(b) If available information is either insufficient to determine the possibility for sediment contamination, or shows a possibility for sediment contamination, the department shall require the applicant to collect sufficient samples to describe the chemical, physical and biological properties of the sediment. The exact number and location of sediment samples required and analyses to be conducted shall be specified by the department, in consultation with the applicant, based on the initial evaluation and on other factors including, but not limited to, the potential for possibility of contamination, volume and aerial extent of material to be dredged, depth of cut and proposed method of disposal.

(c) For a project involving the disposal of dredged material at an upland disposal site, the department may require samples to be taken from the proposed disposal site and analyzed for parameters found to be elevated in the dredged material sediment samples. The number and location of disposal site samples required shall be specified by the department based on the size and other characteristics of the site.

(d) For a project to be conducted in the Great Lakes with beach nourishment disposal, at least one sample every 250 linear feet of beach with a minimum of 2 samples shall be taken from the proposed beach nourishment disposal site and analyzed for particle size and color. Core or grab samplers may be used.

(4) METHOD OF TAKING SAMPLES. (a) All samples shall be taken with a core sampler except as provided in sub. (3)(d). The department may approve other sampling methods if it finds them to be appropriate.

(b) All sampling equipment shall be properly cleaned prior to and following each sample collection.

(c) Samples collected for PCB, pesticide and other organic analyses shall be collected and processed using metallic (stainless steel preferred) liners, tubs, spoons and spatulas. Samples collected for other chemical analysis, including heavy metals, shall be collected and processed using non–metallic liners, tubs, spoons and spatulas.

(d) Core samples from the dredging site shall be taken to the proposed dredging depth plus 2 feet.

(e) Core samples shall be visually inspected for the existence of strata formation, and a written description including position, length, odor, texture and color of the strata shall be provided to the department.

(5) SAMPLE HANDLING AFTER COLLECTION AND PRIOR TO ANALYSIS. Sample handling and storage prior to analysis shall be in accordance with the maximum holding times and container types given in table F of ch. NR 219. Samples shall be preserved at the time of collection by cooling to 4°C.

(6) ANALYSES TO BE PERFORMED ON SEDIMENT SAMPLES. Analyses shall be done in accordance with methods from applicable sources enumerated in ch. NR 149. Analyses submitted to the department under this chapter shall be done by a laboratory certified or registered under ch. NR 149.

(a) Samples shall be analyzed from each distinct layer observed in the material to be dredged. If no strata formation exists, core samples shall be divided into 2–foot segments, and each segment shall be analyzed for the required chemicals and characteristics. For cores extending into parent material, analysis of only the top 2–foot segment of parent material is required. The department may approve other subsampling methods if it finds them to be appropriate.

(b) All samples shall be analyzed for those parameters listed in table 1 unless waived by the department as provided in par. (d). Elutriate testing may be required for all chemicals listed in Table 1 unless waived by the department as provided in par. (d).

(c) If previous sampling data or other adequate available information indicates the possibility of contamination by chemicals not listed in table 1, the department may require analysis for those chemicals.

(d) If previous sampling data or other adequate available information demonstrates that the possibility of contamination is negligible, analysis for any chemical may be waived, in writing, by the department.

(e) The department may require additional samples and analyses as specified by law or for other appropriate reasons.

TABLE 1
ANALYSES TO BE PERFORMED ON SEDIMENT SAMPLES

	GREAT LAKES	INLAND WATERS
PCB (Total)	X	X
Total 2,3,7,8 TCDD	X	X
Total 2,3,7,8 TCDF	X	X
	GREAT LAKES	INLAND WATERS
Aldrin	X	X
Dieldrin	X	X
Chlordane	X	X
Endrin	X	X
Heptachlor	X	X
Lindane	X	X
Toxaphene	X	X
DDT	X	X
DDE	X	X
Arsenic	X	X
Barium	X	X
Cadmium	X	X
Chromium	X	
Copper	X	X
Cyanide	X	
Iron	X	
Lead	X	X
Manganese	X	
Mercury	X	X
Nickel	X	X
Selenium	X	X
Zinc	X	X
Oil and Grease	X	X
NO^2, NO^3, NH^3 –N, TKN	X	X
Total P	X	X
Grain–size	X	X
Percent Solids	X	X
Total Organic Carbon	X	X

Moisture Content	X	X
Settleability (if return water)	X	X

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. (5) and (6) (intro.), Register, November, 1992, No. 443, eff. 12-1-92.

NR 347.07 Review procedures and review criteria. **(1)** When sediment sampling and analyses have been completed, the applicant shall submit a copy of the testing report to the department. This report shall include raw data for all analyses, a map of the project area showing the specific locations of sediment sampling sites and the name and address of the laboratory which performed the tests. All testing and quality control procedures shall be described and analytical methods, detection limits and quantification limits shall be identified.

(2) The department shall review the information submitted under sub. (1) within 30 business days after receipt and determine the applicable statutory and administrative rule provisions and any additional information required from the applicant under this section.

(3) Based on the submitted testing report the department may after consultation with the applicant require additional sediment sampling and analyses when there is evidence of contamination.

(4) For projects in the Great Lakes involving beach nourishment disposal, grain-size analysis results of the proposed dredged material and the beach shall be compared by the department.

(a) The department may allow beach nourishment disposal if:

1. The average percentage of silt plus clay (material passing a #200 sieve or less than .074 mm dia.) in the dredged material does not exceed the average percentage of silt plus clay in the existing beach by more than 15% and the color of the dredged material does not differ significantly from the color of the beach material.

Note: For example, if the silt plus clay content of the existing beach is 10%, suitable dredged material must have a silt plus clay content of less than 25%.

2. The criteria of any general permit regulating wastewater discharges under the Wisconsin pollutant discharge elimination system is not exceeded.

(5) For all projects where upland disposal is required or planned, the results of sediment sampling and analysis shall be compared by the department to the solid waste disposal standards and criteria specified in chs. NR 500 to 520.

(6) If the bulk sediment analysis criteria in sub. (4) is exceeded, the applicant shall have the option of demonstrating to the department through use of bioassay, or other methods approved by the department, that the dredging and sediment disposal operations will have minimum effects on the environment.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; correction in (5) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1995, No. 478.

NR 347.08 Monitoring, reporting and enforcement. **(1)** SURVEILLANCE. (a) The permittee shall contact the department 5 business days prior to the commencement of dredging to provide an opportunity for the department to review all required environmental safeguards to ensure they are in place and operable.

(b) The department may inspect the dredging project at any time during operation to determine whether requirements of permits and approvals are being met or to conduct effluent sampling.

(2) MONITORING. (a) For those projects authorized in part by a WPDES permit, monitoring, analyses and reporting shall be performed as specified in the WPDES permit.

(b) For all other projects, monitoring, analyses and reporting shall be performed as specified in ss. NR 347.06 (2) and 347.07 (1).

(c) Project characteristics to be monitored may include, but are not limited to, carriage water return flow, total suspended solids, dissolved oxygen concentrations, effluent and receiving water temperatures, receiving stream flow rates, effluent ammonia–nitrogen concentrations, and pH.

(3) SUSPENSION OF WORK. If the department determines that project performance is not in compliance with permit or contract conditions, the permittee shall suspend work upon written notification from the department. This shall be a condition of any permit or contract issued by the department. The permittee shall be accorded an opportunity for hearing in accordance with s. 227.51 (3), Stats. The issuance of a suspension order under this subsection shall not limit other enforcement actions or penalties. The department and permittee shall analyze operational deficiencies and the department shall prescribe changes necessary to bring project operation into conformance with permit or contract conditions.

(4) PENALTIES. (a) Each violation of the conditions of a permit or contract issued under s. 30.20, Stats., or this chapter, may result in a forfeiture of not less than $100 nor more than $10,000 for the first offense and shall forfeit not less than $500 nor more than $10,000 upon conviction of the same offense a second or subsequent time. The permit or contract may be rescinded and appropriate restoration orders may be issued as authorized by ss. 23.79, 30.03, 30.12, 30.15, 30.20, 30.292, 30.294 and 30.298, Stats.

(b) The enforcement provisions of s. 147.21, Stats., shall apply to any violations of WPDES permits associated with dredging projects.

(c) The enforcement provisions of ss. 144.47 and 144.99, Stats., and chs. NR 500 to 520 shall apply to violations of solid waste management approvals for this chapter.

(d) The enforcement provisions of ss. 144.73 and 144.74, Stats., shall apply to violations of any hazardous waste approvals for disposal activities associated with dredging projects authorized by this chapter.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; correction in (4) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1995, No. 478.

CORRESPONDENCE/MEMORANDUM

State of Wiscons
Department of Natural Resour

DATE: March 20, 1995

TO: District Solid Waste Program Supervisors/Staff

FROM: Dave Carper - SW/3 DC

SUBJECT: Solid Waste issues related to disposal of PCB contaminated sediments in Wisconsin landfills

The Environmental Protection Agency, on January 24, 1995, issued an approval to the department allowing disposal of PCB contaminated sediments resulting from remediation projects conducted at sites in Wisconsin. There are a number of issues related to disposal of these sediments in Wisconsin's landfills. In an effort to inform those landfills interested in accepting these sediments of the types of requirements they might expect from the department, we have developed a list of the minimum general requirements. A number of these requirements are specifically related to the EPA approval. The remainder are requirements related to Wisconsin's statutes and administrative codes. Please be advised that this is a general list, and that each individual landfill will have specific conditions related to their facility.

Additionally, a number of landfill owner/operators have inquired about pre-qualification for approval to accept PCB contaminated sediments at their facilities. The Department is prepared to review proposals which address the requirements of this memorandum and discuss general wastehandling criteria for the sediments specific to the individual facilities. Upon review of this information, the Department will issue a preliminary opinion to the landfill owner/operators as to whether they substantially meet the requirements for disposal of PCB contaminated sediments. This would not be in the form of a plan of operation modification approval and should not be considered by the landfill owner/operators as an approval to accept sediments for disposal. The intent would be to enable landfills to commit, for bidding purposes, to a specific remediation. A landfill associated with the selected contractor for sediment remediation/excavation would then have to request a modification to their plan of operation to accept PCB contaminated sediment. The landfill owner/operator would be required to adhere to the public notification requirements of this memorandum, which would require a minimum 30-day public notice period, an informational public meeting, a public comment period, and response to any comments received. It is hoped that the Department's notice of "pre-qualification" would streamline the approval process for a facility requesting approval to accept these contaminated sediments.

Issues related to the TSCA approval:

1. The EPA approval allows the department to approve individual landfills to accept for disposal PCB containing sediments at 50 ppm or greater only if they originate from a specified department project.

2. The landfill is required by the conditions of the TSCA approval and s. 40 CFR Section 761.205(a)(1) to notify U.S. EPA of the landfill's PCB

Attachment D

waste handling activities by filing U.S. EPA Form 7710-53, which identifies the EPA identification number; name, owner, contact and location of the facility; and the type of PCB waste activity engaged in at the facility. The landfill operator is also required by 40 CFR Section 761.207 to sign and maintain copies of the PCB manifest accompanying each load of PCB waste received, and to notify the originator of the PCB waste at the end of each business day of confirmation that the loads were received.

3. PCB contaminated sediments must not be commingled with any potentially incompatible waste. Potentially incompatible wastes include organic solvents and waste products containing organic solvents which can increase the mobility of PCBs.

4. Initial testing of the landfill's leachate for PCBs must be performed. This is required to establish site leachate characteristics prior to accepting contaminated dredge material. The specific analytical method is defined as method 8080 found in "Test Methods for Evaluating Solid Waste", SW-846, U.S. EPA, 3rd edition, November, 1986.

5. The landfill will be required to perform quarterly PCB testing of the leachate for the first four quarters after accepting PCB contaminated dredged material and would use the analytical method previously cited. Notification of detectable levels of PCBs in the leachate is required within 60 days of sampling.

6. Annual PCB testing of the leachate will be required after the first year of quarterly sampling is completed, and will continue through the active life and long-term care period of the facility. The analytical method previously cited must be used. Should significant change in the levels of PCBs detected in the leachate occur, this monitoring schedule may be modified.

7. PCB testing for groundwater. Should significant change in the levels of PCBs detected in the leachate occur, groundwater monitoring may be required. A decision would be made based on indicator parameters in groundwater, levels of PCBs detected, and other site conditions. If determined to be required, PCB monitoring would be added to analytical parameters for the Subtitle D wells at MSW landfills, or as otherwise appropriate for the specific landfill to adequately characterize groundwater conditions.

8. Prior to acceptance of sediments by landfills, the landfill must notify the receiving POTW that the landfill intends to accept PCB contaminated sediments.

9. Groundwater sampled at the landfill monitoring wells must meet s. NR 140.10 groundwater preventative action limit for PCBs (0.003 micrograms per liter). The specific analytical method is defined as method 8080 found in "Test Methods for Evaluating Solid Waste", SW-843, U. S. EPA, 3rd edition, November, 1986. This method currently has a minimum detection limit of approximately 0.01 micrograms per liter.

10. Monitoring well water suspected or known to contain PCBs in excess of s. NR 140.10 groundwater enforcement standards for PCBs (0.03 micrograms per liter) must not be allowed to be discharged directly to the ground or to receiving waters and must be contained, managed and treated as leachate.

11. PCB contaminated sediments must be dewatered or solidified to pass the paint filter test prior to disposal at the landfill.

12. The landfill is required to comply with the record keeping requirements of the TSCA PCB regulations s. 40 CFR Part 761.180(b), which require an annual document log identifying the disposal facility, manifest numbers, dates, quantities, and date of confirmation of PCB waste accepted at the landfill in the calendar year covered. Additionally, the landfill must submit an annual report, which briefly summarizes the records and annual document log, to the Regional Administrator of EPA Region 5 by July 15 of each year. This information must also be submitted to the department as part of the annual report requirements for the landfill.

Additional issues:

13. The landfill owner/operator must submit a request for a modification to the plan of operation for the landfill. The request must include a detailed discussion of dredged material disposal procedures, including but not limited to: material handling; placement location; testing; monitoring; and impacts on financial assurance for long-term care. Additionally, a review fee of $1,500.00 is required to be submitted to the department's Solid Waste Management program.

14. The dredged materials need to be segregated to the degree practical in the landfill. The following type of controls may be required:

    a. Dredged material should be placed as a "monolith", rather than mixed directly with other waste. A thicker mass of sediments over a smaller lateral area is preferred to the extent allowable by stability considerations. Dredged material should be placed in the landfill cell adjacent to the sideslope liner and as close as practical to the final cover to minimize the measures necessary to reduce commingling with other wastes and the amount of waste materials placed above the dredged material.

    b. The "monolith" should be underlain by a geofabric of sufficient mesh size to prevent migration of silt-sized particles from the dredged material. The side slopes of the "monolith" should be no greater than 3 horizontal to 1 vertical and the top slopes should be a minimum of 5%. The final surface should be flat-rolled and covered with 12 inches of granular material with a hydraulic conductivity greater than or equal to 1 X 10' cm/sec at the anticipated field density to facilitate water movement around the dredged material rather than through it. A geonet/geotextile combination with equivalent hydraulic properties may also be considered for this drainage layer.

c. The "monolith" of dredged material must have adequate stability to support it's own weight and the weight of any other materials placed over it without slumping and be able to maintain stable slopes. A minimum unconfined compressive strength of one ton per square foot for finer grained (silt/clay/organic) or a minimum 60% solids for granular material will be used to determine the stability of the dredged material as placed in the landfill. If addition of stabilizing material such as lime, cement or pozzolanic ash is needed to achieve the required specifications, bench scale testing must be performed on the dredged material to determine proper moisture content ranges and compactability prior to disposal.

d. Dredged material should be compacted in maximum 6-inch lifts at the landfill. Thicker lifts would be considered if it can be demonstrated that minimum densities are achievable. Dry density and as-placed moisture content will be determined on the dredged material placed. At least 3 sets of tests should be performed for each acre for every one-foot thickness of dredged material placed.

e. The location of the dredged material must be identified by survey, and records maintained. The disturbance of the sediments must be minimized once they are placed in the landfill (as in drilling of gas extraction wells, or during remedial actions).

f. Dredged material must be disposed of in a manner which prevents wind-blown dust exposure. The department may require daily cover to be placed over the dredged material if necessary to prevent fugitive dust problems.

15. Measures must be taken to contain PCB contaminated dredged material to the specified disposal area. These would include a vehicle wash for cleaning equipment as necessary. Wash water will need to be collected and treated as leachate.

16. Health and safety considerations for the disposal project must be addressed with a site-specific health and safety plan meeting Occupational Safety and Health Administration guidance as outlined in 29 C.F.R. § 1910.120.

Long Term Care Costs

17. The established long-term care financial responsibility account would need to be modified to reflect the additional cost associated with PCB leachate monitoring. Financial responsibility in anticipation of leachate treatment or groundwater monitoring will not be required initially. If problems occur in the future which require additional monitoring or remedial action, financial responsibility for monitoring/remediation will have to be established at that time.

Specific conditions will be required for any landfill requesting a plan modification to accept these sediments. The preferred disposal location in a landfill would be such that a minimum amount of municipal solid waste be placed above the "monolith" of dredged material. Priority will be given landfills which can selectively place this dredged material or, ideally, dedicate a monofill for dredged material disposal with a discreet leachate collection system.

APPROVED:

Lakshmi Sridharan

Lakshmi Sridharan, Ph.D, P.E., Chief
Solid Waste Management Section
Bureau of Solid & Hazardous Waste Management

cc: Paul Didier - SW/3
Kevin Kessler - SW/3
Mark Giesfeldt - SW/3
Barb Zellmer - SW/3
Chuck Leveque - SW/3

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CORRESPONDENCE/MEMORANDUM

State of Wisconsin

5/8/18

DATE: August 6, 1998

TO: Paul Putzier - RETEC
Alessandro Battaglia - RETEC

FROM: Ed Lynch - DNR EXL

SUBJECT: Landfill Location and Disposal Capacity Information

Attached to this table is a statewide list of municipal and non-municipal solid waste disposal facilities. Municipal sites include those operated by counties and non-municipal sites include company owned landfills. For instance, Brown County -East is the first site listed under municipal and Appleton Papers is the first site listed under non-municipal. Also attached is a separate list of landfills with the facilities' contacts identified. You may need to contact these people to identify the specific location of the landfills. I have also have included an attachment identifying the DNR waste management staff assigned to the counties. These staff may also be contacted for location information.

These landfills are operated in accordance with the requirements of the chapter NR 500 series of the Wis. Adm. Code. The municipal sites and many of the non-municipal sites may be capable of receiving plan modifications for disposal of PCB contaminated sediments should it be necessary. I am forwarding this information to you so you are aware of the available landfill capacity and haul distance in the Northeast Region (NER) as well as other locations that may be near the Fox River for the Feasibility Study. Please note that landfills under construction or proposed are not on the list. In NER, that includes two facilities. One is in Calumet County which will be operated by Superior Environmental Services. The other will be county operated facility in Brown County.

Please note that the Bayport sediment management facility is not included on the attached list. Bayport is not a licensed solid waste landfill because it had an exemption from the normal NR 500 series design and location requirements. This is a key point because DNR could not allow Bayport to accept PCB sediment under the state's TSCA approval from EPA. In your evaluation of alternatives, consideration of available landfill capacity at facilities operated by the PRPs for the management of dredged sediment sludge is an appropriate option, should dredging be necessary. Please be aware that these PRP industrial sites may not meet the requirements to obtain an approval under the DNR's TSCA approval.

You may wish to discuss these existing and proposed facilities with Len Polczinski who is the NER Waste Management Team Supervisor. Len's phone number is 920/492-5870. Len may also help with facilitating communications and discussions with county and local governments as well as serve as a sounding board for ideas dealing with dredged sediment management. You may also want to consider the requirements of the Wisconsin Solid Waste Landfill Siting law when you evaluate the feasibility of alternative using Bayport or the PRP industrial landfills.

For your information I have also attached to this memo a DNR guidance memo discussing applicability or department regulations to dredge sediment material management. Please distribute this information to the appropriate members of your Feasibility Study team. You may give me a call if you have any questions at 608/266-3084. ?

Attachments:

CC: Len Polczinski - NER
Bob Paulson - WT/2
Tim Thompson - RETEC
Paul Huebner - WA/3
Kevin Kessler - WA/3
George Boronow - NER
Steve Westenbroek - Baird
Jim Hahnenberg - EPA SR/6J

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WISCONSIN SOLID WASTE LANDFILL [illegible]AGE/CAPACITY REPORT
WISCONSIN DEPARTMENT OF NATURAL RESOURCES-BUREAU OF WASTE MANAGEMENT

REVISED [illegible], 1998

FACILITY NAME	LIC NO	RE	TYPE	INITIAL CAPACITY	CAPACITY AS OF 1/1/97 CU YDS	1997 TONNAGE* Cat. 1 TONNAGE	Cat. 2-6,20 TONNAGE	CAPACITY AS OF 1/1/98 CU YDS	STATUS	Out-of-State Waste (In Tons) Received In 1997 IL	IN	IA	MI	MN	Other
Municipal Waste Sites															
BROWN COUNTY EAST LANDFILL	2569	NE	LF3	4,500,000	1,311,871	161,336	47,893	934,875		0	0	0	0	0	0
BROWN COUNTY WEST LANDFILL	2568	NE	LF3	3,500,000	0	0	0	0	Closed	0	0	0	0	0	0
DOOR COUNTY SANITARY LANDFILL	2937	NE	LF3	741,000	69,500	17,277	0	31,184		0	0	0	0	0	0
KEWAUNEE COUNTY SW BALEFILL & COMPOST SITE	2975	NE	LF3	517,000	267,679	11,638	0	259,367		0	0	0	0	0	0
MAR-OCO LANDFILL	3095	NE	LF3	1,480,000	1,114,336	16,791	0	1,080,754		0	0	0	0	0	0
OUTAGAMIE COUNTY SW DIV LANDFILL	2484	NE	LF3	4,740,000	1,255,491	167,189	43,305	1,653,029	exp 710,000	0	0	0	0	0	0
SHAWANO CTY PHASE 2 LANDFILL	3069	NE	LF3	405,000	11,752	13,865	8,342	88,088		0	0	0	0	0	0
W M W I - RIDGEVIEW RECYCLING & DISPOSAL	3041	NE	LF3	9,689,000	1,830,600	241,974	200,313	1,490,800		0	0	0	0	0	0
W M W I - VALLEY TRAIL	3066	NE	LF3	2,813,000	4,829,736	239,846	265,269	4,252,805		0	0	0	0	1,200	0
WASHINGTON ISLAND LANDFILL/COMPOST SITE	2837	NE	LF1	9,320	876	25	10	818		0	0	0	0	0	0
WINNEBAGO COUNTY SUNNYVIEW LF/COMPOST SITI	3175	NE	LF3	8,000,000	5,362,798	194,655	25,098	5,015,557		0	0	0	0	0	0
ANTIGO CITY LANDFILL	3294	NO	LF2	203,000	25,559	2,268	0	21,779		0	0	0	0	0	0
ASHLAND CITY OF LANDFILL	3087	NO	LF2	159,415	27,000	2,585	0	18,337		0	0	0	0	0	0
BFI WASTE SYSTEMS OF NORTH AMERICA INC	3144	NO	LF3	978,000	9,000	12,964	8,155	0		0	0	0	6,955	9,233	0
BFI WASTE SYSTEMS OF NORTH AMERICA INC	3474	NO	LF3	4,347,900	329,012	93,341	29,993	219,415		0	0	0	0	69,298	0
HIGHWAY G SANITARY LANDFILL	3100	NO	LF2	250,000	183,330	8,025	0	169,995		0	0	0	0	0	0
LINCOLN COUNTY SANITARY LANDFILL	3141	NO	LF3	825,000	638,549	14,246	0	606,966		0	0	0	0	0	0
ONEIDA COUNTY	2805	NO	LF3	1,100,000	130,918	19,749	6,477	165,000		0	0	0	0	0	0
SANITARY NORTHWOODS REFUSE DISPOSAL INC	3212	NO	LF3	500,000	363,479	7,471	0	328,320		0	0	0	0	0	0
SUPERIOR CITY OF MOCASSIN MIKE LANDFILL	2627	NO	LF3	1,500,000	298,318	70,726	3,031	217,488		0	0	0	0	42,866	0
W M W I - TIMBERLINE TRAIL RDF	3455	NO	LF3	2,933,000	2,513,335	224,580	50,871	2,155,505		0	0	0	0	122,959	0
DANE COUNTY LF #2 RODEFELD	3018	SC	LF3	3,800,000	2,913,936	83,448	35,499	2,745,273		0	0	0	0	0	0
DEER TRACK PARK INC	3230	SC	LF3	2,862,000	1,873,396	229,762	15,692	1,368,862		0	0	0	0	0	0
GREEN COUNTY LANDFILL	2990	SC	LF3	495,000	127,086	15,260	0	117,167		0	0	0	0	0	0
RICHLAND CENTER CITY LANDFILL	3065	SC	LF2	250,000	177,336	0	0	177,336	Site Inactive	0	0	0	0	0	0
ROCK COUNTY/JANESVILLE CITY OF LANDFILL	3023	SC	LF3	4,200,000	1,821,900	124,704	8,731	1,279,449		19,461	0	0	0	0	0
SAUK COUNTY SANITARY LANDFILL	2978	SC	LF3	1,284,000	627,417	24,286	0	586,940		0	0	0	0	0	0
SUPERIOR GLACIER RIDGE LANDFILL	3068	SC	LF3	3,885,800	1,461,667	254,032	61,800	1,051,994		0	0	0	0	0	0
SUPERIOR VALLEY MEADOWS LANDFILL	2686	SC	LF3	1,594,700	325,724	89,780	45,910	159,000		2,744	412	2,884	0	0	0
KESTREL HAWK PARK	572	SE	LF3	5,000,000	7,652,670	115,905	33,995	7,347,615		36,509	0	0	0	0	0
SUPERIOR EMERALD PARK INC	3290	SE	LF3	3,550,360	2,591,771	473,417	219,968	1,776,867		2,559	0	2,245	0	0	0
W M W I - MALLARD RIDGE NORTHERN EXPANSION	3244	SE	LF3	5,197,000	3,891,504	264,141	50,083	3,423,708		100,560	0	4,450	0	0	0
W M W I - METRO RECYCLING & DISPOSAL FACILTY	1099	SE	LF3	19,000,000	1,986,335	377,593	85,670	1,432,000		0	0	0	0	0	0
W M W I - ORCHARD RIDGE RECYCLING & DISP FAC	3360	SE		9,352,900	7,582,181	283,127	138,524	6,928,360		135		2,844	0	0	0
W M W I - PHEASANT RUN RECYCLING & DISPOSAL	3062	SE	LF3	6,936,900	3,488,400	771,774	65,847	2,280,600		722,188	0	0	0	0	0
ABBOTSFORD CTY LANDFILL	2932	WC	LF1	50,000	8,545	420	0	7,495		0	0	0	0	0	0
ADAMS COUNTY LANDFILL & RECYCLING CENTER	3150	WC	LF3	700,000	464,486	6,272	0	451,942		0	0	0	0	0	0
JACKSON COUNTY SANITARY LANDFILL INC	2004	WC	LF3	700,000	94,929	15,119	2,585	68,153		0	0	0	0	0	0
JUNEAU COUNTY LANDFILL #2	3070	WC	LF2	420,000	237,320	6,383	0	225,265		0	0	0	0	0	0
LA CROSSE COUNTY	3253	WC	LF3	1,840,000	1,359,983	34,689	10,377	1,300,270		0	0	0	0	4,392	0
MARATHON COUNTY LANDFILL AREA B	3338	WC	LF3	2,508,000	1,847,300	93,535	40,028	1,651,300		0	0	0	0	0	0
MONROE COUNTY RIDGEVILLE SITE & DEMO LF	2858	WC	LF3	823,000	229,000	19,644	4,234	193,000		0	0	0	0	0	0
PORTAGE COUNTY LANDFILL	2966	WC	LF3	1,280,000	356,160	30,360	0	295,440		0	0	0	0	0	0
SUPERIOR CRANBERRY CREEK	2967	WC	LF3	1,200,000	1,400,000	127,344	0	1,250,000		0	0	0	153	0	0
SUPERIOR SEVEN MILE CREEK LANDFILL INC-SEC#2	3097	WC	LF3	3,000,000	2,217,800	124,627	6,010	2,039,000		0	0	0	0	10,369	0
VERNON COUNTY SOLID WASTE/RECYCLING FACILIT	3268	WC	LF2	314,942	232,623	8,042	0	216,539		0	0	0	0	0	0
TOTALS (MUNICIPAL)				129,435,237	65,542,608	5,094,214	1,513,712	57,083,657		884,157	412	12,423	7,108	260,317	0

FACILITY NAME	LIC NO	RE	TYPE	INITIAL CAPACITY	CAPACITY AS OF 1/1/97 CU YDS	1997 TONNAGE* Cat. 1 TONNAGE	1997 TONNAGE* Cat. 2-6,20 TONNAGE	CAPACITY AS OF 1/1/98 CU YDS	STATUS	IL	Out-of-State Waste (In Tons) Received in 1997 IN	IA	MI	MN	Other
Non-Municipal Waste Sites															
APPLETON PAPERS INC-LOCKS MILL LF	3036	NE	LF2	425,000	42,900	0	22,863	65,800		0	0	0	0	0	0
BADGER PAPER MILLS INC	1344	NE	LF2	375,000		0	0		Closed	0	0	0	0	0	0
FORT JAMES CORP GREEN BAY WEST LANDFILL	2332	NE	LF4	9,360,000	4,302,810	0	351,716	3,972,964		0	0	0	0	0	0
GENERAL CHEMICAL CORP ALUM LF	1907	NE	LF2	300,000	128,361	0	1,150	127,334		0	0	0	0	0	0
JAMES RIVER OPERATING CO-NORTHLAND LANDFILL	2893	NE	LF4	700,200	729,000	0	14,038	265,000		0	0	0	0	0	0
SADOFF & RUDOY INDUSTRIES	1554	NE	LF3	700,000	500,000	0	34,425	500,000	cap >500,000	0	0	0	0	0	0
SHAWANO PAPER MILLS LANDFILL	2719	NE	LF2	108,000	7,554	0	2,376	4,941		0	0	0	0	0	0
THILMANY PHASE 5 RED HILLS LANDFILL	3251	NE	LF3	2,749,471	2,454,460	0	91,963	2,325,954		0	0	0	0	0	0
WAUPACA FOUNDRY INC LANDFILL #3	3412	NE		1,339,000	1,030,218		200,817	881,464		0	0	0	0	0	0
WISCONSIN TISSUE MILLS INC LF	3131	NE	LF4	1,710,300	139,081	0	121,362	0		0	0	0	0	0	0
WISCONSIN TISSUE MILLS NORTH SITE	3275	NE	LF4	3,062,000	378,400	0	57,176	312,869		0	0	0	0	0	0
FORT JAMES OPERATING CO	2826	NO	LF2	410,000	29,963	0	23,986	10,838		0	0	0	0	0	0
FRASER PAPERS INC LANDFILL	3051	NO	LF2	490,000	164,455	0	30,678	133,845		0	0	0	0	0	0
NSP WOODFIELD ASH LF	3233	NO	LF2	255,000	220,870	0	15,911	202,203		0	0	0	0	0	0
RHINELANDER PAPER CO LANDFILL	2965	NO	LF2	394,000	53,000	0	0	53,000		0	0	0	0	0	0
TENNECO PACKAGING INC-TOMAHAWK LANDFILL	3114	NO	LF4	3,014,000	2,548,000	0	25,011	2,467,700		0	0	0	0	0	0
DAIRYLAND POWER COOP	3122	SC	LF2	83,400	59,764	0	0	59,764		0	0	0	0	0	0
GREDE-REEDSBURG FOUNDRY LANDFILL	2974	SC	LF2	375,000	104,414	0	19,594	89,342		0	0	0	0	0	0
TERRA ENGINEERING & CONSTRUCTION	1912	SC	LF2	75,000	54,668	0	16	54,642		0	0	0	0	0	0
US ARMY BADGER ARMY AMMUNITION PLT LANDFILL	3118	SC	LF2	130,000	83,424	0	335	82,508		0	0	0	0	0	0
W M W I - MADISON PRAIRIE	3318	SC	LF3	4,284,000	2,715,562	0	113,006	2,556,606		0	0	0	0	0	0
WIS POWER & LIGHT CO COLUMBIA GEN STN	2325	SC	LF4	500,000	2,360	0	0	2,360		3,932	0	0	0	6	0
WIS POWER & LIGHT CO COLUMBIA GEN STN	3025	SC	LF4	6,529,200	5,106,341	0	59,233	5,056,980		0	0	0	0	0	0
WIS POWER & LIGHT CO NELSON DEWEY GEN STATI	2525	SC	LF4	607,000	48,000	0	12,825	22,853		0	0	0	0	0	0
WIS POWER & LIGHT CO ROCK RIVER GEN STN	728	SC	LF2	350,000	91,018	0	3,128	20,000	98 cap - survey	0	0	0	0	0	0
FALK CORP	1882	SE	LF4	569,000	243,676	0	47,535	208,465		0	0	0	0	0	0
FUTURE PARKLAND DEVELOPMENT INC	3120	SE	LF4	448,000	200,822	0	42,486	163,224		0	0	0	0	0	0
KOHLER CO LANDFILL	1508	SE	LF4	4,240,000	500,000	0	65,010	512,000	cap >500,000	0	0	0	0	0	0
MANN BROS LANDFILL	1996	SE	LF2	110,000	110,000	0	5,000	100,000		0	0	0	0	0	0
WEPCO CALEDONIA LANDFILL	3232	SE	LF4	4,050,000	3,180,175	0	186,412	2,993,763		0	0	0	0	0	0
WEPCO HWY 32 LANDFILL	2801	SE	LF4	2,000,000	926,566	0	61,599	864,967		0	0	0	0	0	0
WEPCO PLEASANT PRAIRIE LNDFL	2786	SE	LF4	1,470,000	4,067,000	0	8,302	4,058,698		0	0	0	0	0	0
WEPCO SYSTEMS CONTROL CENTER ASH LANDFILL	2887	SE	LF4	560,000	1,444,646	0	7,009	1,437,637		0	0	0	0	0	0
WIS POWER & LIGHT CO-EDGEWATER POWER PLANT	2853	SE	LF4	1,150,000	747,000	0	38,978	714,518		0	0	0	0	0	0
COLTEC INDUSTRIES-FARNAM MEILLOR SEALING SY	640	WC	LF2			0	0	0	Closed	0	0	0	0	0	0
CONSOLIDATED PAPERS-WATER QUALITY CENTER L	2488	WC	LF4	2,954,600	679,384	0	26,836	647,040		0	0	0	0	0	0
CONSOLIDATED PAPERS INC-KRAFT DIV	1838	WC	LF4	2,000,000	276,500	0	98,909	181,478		0	0	0	0	0	0
CONSOLIDATED PAPERS WATER RENEWAL CENTER	1686	WC	LF4	1,551,000	659,534	0	53,433	591,001		0	0	0	0	0	0
DAIRYLAND POWER COOPERATIVE	2927	WC	LF4	1,655,700	664,516	0	77,772	724,723		0	0	0	0	0	0
MOSINEE PAPER CORP LANDFILL	2806	WC	LF2	500,000	106,450	0	6,316	100,000		0	0	0	0	0	0
NEENAH PAPER - WHITING MILL LANDFILL	2576	WC	LF2	169,000	107,453	0	0	0	Closing	0	0	0	0	0	0
NEKOOSA PAPERS INC ASH BARK SITE	1365	WC	LF4	1,260,000	973,099	0	30,106	935,524		0	0	0	0	0	0
NEKOOSA PAPERS INC WW TREATMENT SITE	2613	WC	LF4	2,736,369	820,642	0	52,303	745,852		0	0	0	0	0	0
PLAINWELL TISSUE	2695	WC	LF4	1,200,000	125,452	0	33,107	45,000		0	0	0	0	0	0
WAUSAU-MOSINEE PAPER CO LANDFILL #3	3115	WC	LF2	368,900	0	0	14,216	0		0	0	0	0	0	0
WIS PUBLIC SERV CORP-WESTON ASH DISP SITE #3	3067	WC	LF4	873,000	863,768	0	0	863,768		0	0	0	0	0	0

FACILITY NAME	LIC NO	RE	TYPE	INITIAL CAPACITY	CAPACITY AS OF 1/1/97 CU YDS	1997 TONNAGE* Cat. 1 TONNAGE	Cat. 2-6,20 TONNAGE	CAPACITY AS OF 1/1/98 CU YDS	STATUS	Out-of-State Waste (In Tons) Received in 1997 IL	IN	IA	MI	MN	Other
WIS PUBLIC SERVICE CORP WESTON #3 LANDFILL	2879	WC	LF2	350,000	46,448	0	847	45,742		0	0	0	0	0	0
TOTAL (NON-MUNICIPAL)				68,541,140	37,737,754	0	2,057,785	35,182,367		3,932	0	0	0	6	0
TOTAL(combined)				197,976,377	103,280,362	5,094,214	3,571,497	92,266,024		888,089	412	12,423	7,108	260,323	0

LF1=<50,000 CYDS; LF2=50,000-500,000 CYDS;LF3=>500,000 CYDS;LF4>500,000 CYDS(MONOFILL)
CAT. 1=MUNICIPAL SOLID WASTE
CAT. 2-6=ASHES & SLUDGES FROM UTILITY POWER PLANTS; PULP OR PAPERMILL WASTE/SLUDGES;FOUNDRY MFG
WASTES WASTEWATER TREATMENT PLANT WASTE SLUDGES; AND ALL OTHER SOLID WASTE NOT DESIGNATED AS HAZARDOUS OR MINING WASTE
CAT. 20=ASH FROM INCINERATION FOR ENERGY RECOVERY
EXCLUDED ARE WASTES EXEMPT FROM ENVIRONMENTAL
OUT OF STATE WASTE=ALL WASTE CATEGORIES, INCLUDING WASTE EXEMPT FROM FEES
(APPROX 28,976 TONS OF OUT OF STATE WASTE WAS WASTE EXEMPT FROM FEES)

***Tonnages which have been reported as exempt from environmental fees are not included in these two columns. However, both exempt and non-exempt tonnages are reported in the columns representing waste received from other states. 28,976 tons of waste received from other states were reported as being exempt from environmental fees.**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

1/27/95

REPLY TO THE ATTENTION OF

R-19J

George E. Meyer
Secretary
Wisconsin Department of Natural Resources
Box 7921
Madison, Wisconsin 53707

RECEIVED

Dear Mr. Meyer:

Pursuant to the Federal Polychlorinated Biphenyl (PCB) regulations published on February 17, 1978, 40 Code of Federal Regulations (C.F.R.) § 761.60 (a) (5), under the authority of the Toxic Substances Control Act (TSCA) of 1976 (Public Law 94-469), 15 U.S.C. §§ 2605 and 2617, the United States Environmental Protection Agency, Region 5 (U.S. EPA) is issuing the enclosed document entitled "In The Matter of The State of Wisconsin, Department of Natural Resources, Approval To Dispose of Polychlorinated Biphenyls (PCBs)." This approval allows the Wisconsin Department of Natural Resources (WDNR) to select disposal facilities that comply with Wisconsin Administrative Code Chapters NR 500-520 for the disposal of sediments contaminated with PCBs at concentrations of 50 ppm or greater from sediment remediation projects conducted under the authority and supervision of the WDNR. In granting this approval, the U.S. EPA retains all of its authority to issue PCB disposal approvals in the State of Wisconsin under 40 C.F.R. §§ 761.60, 761.70, and 761.75.

This approval is based upon the WDNR's May 6, 1994 application to dispose of dredged sediments by an alternative disposal method, under 40 C.F.R. § 761.60 (a) (5), and upon the U.S. EPA's evaluation of the State of Wisconsin's solid waste landfill regulations (Wisconsin Administrative Code Chapters NR 500-520). In addition, the approval is based upon the Agency's conclusion that the disposal of PCB contaminated sediments in a State of Wisconsin solid waste landfill will provide adequate protection to human health and the environment. In evaluating this application, the U.S. EPA has given great weight to the WDNR's record of commitment to environmental protection and demonstrated ability to administer its programs.

This approval shall be effective upon the date of my signature, and it may be terminated at any time by either the WDNR or the U.S. EPA by written notice to the other party. The WDNR and the U.S. EPA will meet at the end of each year to discuss the progress made under this program and to discuss the objectives for the next year.

While the U.S. EPA anticipates no significant problems with the State's administration of this approval, it is the responsibility of the WDNR and of the disposal facilities selected under this approval to ensure that all applicable provisions of TSCA, the Federal PCB regulations, and the terms of this approval are followed. Violation of any of the applicable provisions may be cause for an enforcement action under Section 15 of TSCA, 15 U.S.C. § 2614.

In closing, I applaud the WDNR's plans for remediation of PCB contaminated sediments from State waters. The WDNR is clearly at the forefront of such efforts. We at Region 5 also place a high priority on remediation of contaminated sediments from our rivers and lakes. It is my hope that by issuing this disposal approval the U.S. EPA will help to realize WDNR's ambitious sediment program.

Please contact Phyllis Reed of my staff, at (312) 886-6086, if you have any questions pertaining to this matter.

Sincerely yours,

David A. Ullrich

for Valdas V. Adamkus
Regional Administrator

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

IN THE MATTER OF:	)	APPROVAL TO DISPOSE OF POLYCHLORINATED BIPHENYLS (PCBs)
THE STATE OF WISCONSIN DEPARTMENT OF NATURAL RESOURCES	)))	

AUTHORITY

This approval is issued pursuant to Sections 6(e)(1) and 18(a)(2)(B) of the Toxic Substances Control Act of 1976 (TSCA), Public Law No. 94-469, 15 U.S.C. §§ 2605 and 2617, and the Federal PCB Regulations, 40 C.F.R. § 761.60(a)(5).

EFFECTIVE DATE

This approval shall be effective upon the signature of the Regional Administrator.

BACKGROUND

Section 6(e)(1)(A) of TSCA requires the United States Environmental Protection Agency (U.S. EPA) to promulgate rules for the disposal of polychlorinated biphenyls (PCBs). The rules implementing section 6(e)(1)(A) were published in the Federal Register of May 31, 1979 (44 FR 31514) and recodified in the Federal Register of May 6, 1982 (47 FR 19527). Those rules require, among other things, that various types of PCBs and PCB Articles be disposed of in U.S. EPA-approved landfills (40 C.F.R. § 761.75), incinerators (40 C.F.R. § 761.70), high efficiency boilers (40 C.F.R. § 761.60), or by alternative methods (40 C.F.R. § 761.60(e)) that demonstrate a level of performance equivalent to U.S. EPA-approved incinerators. Those rules also allow for the approval to dispose of dredged materials by an alternate method (40 C.F.R. § 761.60(a)(5)) that provides adequate protection to health and the environment, provided that disposal in a U.S. EPA-approved incinerator (40 C.F.R. § 761.70) or chemical waste landfill (40 C.F.R. § 761.75) is not reasonable and appropriate based on technical, environmental, and economic considerations. The May 31, 1979 Federal Register designated Regional Administrators as the approval authority for PCB disposal facilities.

Section 18(a)(2)(B) of TSCA prohibits any State or political subdivision of a State from establishing or continuing in effect any requirement applicable to any chemical substance or mixture or article containing such substance or mixture regulated under

Sections 5 or 6 of TSCA, except that a State may regulate the disposal of such chemicals, mixtures, and articles as described at Section 6(a)(6) of TSCA. U.S. EPA has determined that under TSCA, State requirements regarding disposal of PCBs are completely exempt from Federal preemption insofar as they prescribe what may be done within the State boundaries, but that a State may not require PCBs generated within its boundaries to be disposed of by a method less restrictive than prescribed by TSCA (43 FR 7153, February 17,1978).

FINDINGS

1. On May 6, 1994, the Wisconsin Department of Natural Resources (WDNR) submitted a written application to the Regional Administrator of Region 5 to dispose of sediments containing PCBs at concentrations of 50 ug/g (ppm) or greater from remediation projects authorized and supervised by the WDNR in landfills within Wisconsin which comply with Wisconsin Administrative Code (Wis. Adm. Code) chapters (chs.) NR 500-520 and have been authorized under § NR 157.07, Wis. Adm. Code, to accept PCB contaminated sediments.

2. In 1989, the Wisconsin State Legislature recognized the serious problem contaminated sediments present to the State by providing funding to establish WDNR's sediment remediation program. The goal of the program is to restore the surface waters of the state where the resource uses have been impaired or damaged by the presence of contaminated sediments.

3. Sediments contaminated with PCBs represent a serious risk to human health through consumption of contaminated fish; represent risks to aquatic ecosystems, which include endangered species; and present limitations to economic well-being by impairing commercial fisheries, recreational uses, and commerce through increased dredging costs.

4. The WDNR sediment remediation program has set goals to fully restore aquatic environments with cleanup standards for PCBs in the parts per billion range where environmentally and technically feasible.

5. The PCB contaminated sediment problem in Wisconsin is large in scope. There are approximately seven million cubic yards of sediments contaminated with PCBs which need to be remediated to restore full beneficial uses of impaired overlying waters.

6. Presently, there is no U.S. EPA-approved PCB disposal facility within the State of Wisconsin.

7. The disposal of PCB containing sediments from WDNR remediation projects in existing out of state PCB disposal facilities is not reasonable and appropriate because the WDNR's cleanup goals and the technical constraints of sediment remediation will likely generate a significantly larger volume of TSCA regulated sediments during remediation than existed in situ; because of the risk presented by delaying remediation efforts in dynamic, often high energy, and ecologically sensitive aquatic environments and the additional risk of spills presented by long distance shipping of such large quantities of contaminated sediments; and because increased disposal costs could limit planned State sediment remediation efforts and would prevent much needed sediment remediation and risk reduction in the State of Wisconsin.

8. Based on technical, environmental, and economic considerations, disposal of PCB contaminated sediments within the scope of the WDNR application in a TSCA incinerator or TSCA chemical waste landfill is not reasonable and appropriate.

9. PCBs are regulated in the State of Wisconsin by ch. NR 157, Wis. Adm. Code. Section NR 157.07, Wis. Adm. Code, authorizes the WDNR to approve the disposal of PCB contaminated sediments into chs. NR 500-520, Wis. Adm. Code, landfills as an alternate disposal option.

10. The disposal of sediments contaminated with PCBs at concentrations of 50 ppm or greater in a landfill which fully complies with chs. NR 500-520, Wis. Adm. Code, and with the additional conditions of this approval, as set out herein, provides adequate protection to human health and the environment as required under 40 C.F.R. § 761.60(a)(5).

11. Under the supervision of the WDNR, the disposal of sediments contaminated with PCBs at concentrations of 50 ppm or greater in a landfill which fully complies with chs. NR 500-520, Wis. Adm. Code, and with the additional conditions of this approval set out herein, provides the same level of protection required for these sediments by U.S. EPA, Region 5, and therefore is not less restrictive than TSCA.

CONDITIONS OF APPROVAL

40 C.F.R. § 761.60(a)(5) provides that the Regional Administrator may set limitations in an alternate disposal approval. This approval is conditioned upon the WDNR sediment remediation program's compliance with the following conditions:

1. This approval applies only to sediments contaminated at PCB concentrations of 50 ppm or greater which have originated in Wisconsin waterways. Dilution of sediments to reduce the PCB concentration to below 50 ppm is not allowed. Disposal of sediments contaminated at concentrations of 500 ppm or greater is subject to concurrence by both U.S. EPA, Region 5, and the WDNR on a case by case basis.

2. This approval applies only to sediment remediation projects conducted under the authority and supervision of WDNR.

3. WDNR shall provide a written notice of project activity to U.S. EPA, Region 5 within 30-days following the selection of each sediment disposal landfill under this approval.

4. WDNR shall provide public notification at least 30-days prior to the selection of each sediment disposal landfill under this approval. If this notification generates sufficient public interest, WDNR shall hold a public meeting to discuss the selection of the landfill. WDNR shall consider all oral and written comments received prior to issuing a landfill plan modification to accept PCB contaminated sediments.

5. WDNR shall give full consideration to issues of environmental justice in selecting or siting the sediment disposal landfills under this approval.

6. WDNR shall issue a plan modification to the selected landfill requiring the landfill to comply with approval conditions numbered 11, 12, 14, 16, 18, 19, 21, 24, and 25, as set forth herein.

7. In issuing a plan modification to a chs. NR 500-520, Wis. Adm. Code, landfill for disposal of PCB contaminated sediments, WDNR shall specify to the selected landfill(s) the nature of the remediation and disposal project. This plan modification shall also include a statement that the facility may be used for the disposal of PCB containing sediments at 50 ppm or greater only if they originated from a specified WDNR project.

8. Prior to issuing a plan modification for a landfill to accept PCB contaminated sediment, WDNR shall review all past exemptions from chs. NR 500-520, Wis. Adm. Code, granted to said landfill and determine whether any exemption is relevant to TSCA and the conditions of this approval. If the exemption is relevant to TSCA or the conditions of this approval, WDNR shall receive U.S. EPA concurrence with the exemption before issuing the plan modification.

9. If WDNR issues additional exemptions from chs. NR 500-520, Wis. Adm. Code, relevant to this approval, after a landfill

has received a plan modification, WDNR shall obtain U.S. EPA concurrence before placing additional PCB contaminated sediments in the landfill.

10. WDNR shall provide written notice to each selected landfill that the landfill is required under 40 C.F.R. § 761.205(a)(1) to notify U.S. EPA of the landfill's PCB waste handling activities by filing U.S. EPA Form 7710-53.

11. Prior to placing any PCB contaminated sediment in a landfill, the selected landfill shall file U.S. EPA Form 7710-53, as required by 40 C.F.R. § 761.205(a)(1).

12. PCB contaminated sediments placed in a chs. NR 500-520, Wis. Adm. Code, landfill may not be commingled with any potentially incompatible waste. Potentially incompatible wastes are those wastes that have the capacity to mobilize PCBs.

13. WDNR shall conduct an annual evaluation of PCB (≥50 ppm) sediment disposal projects. WDNR shall submit an evaluation report to the Regional Administrator, U.S. EPA, Region 5, by July 1 of each year covering the previous calendar year's activities under the approval. The report shall include the total volume of PCB contaminated sediment disposed under this approval during the year. The conditions of this permit shall serve as a basis for this evaluation. Upon receipt of the WDNR annual evaluation report, U.S. EPA, Region 5 shall comment either by concurring with the evaluation or by indicating where U.S. EPA disagrees with the results.

14. In the event that this permit is terminated by either the U.S. EPA or WDNR, PCB contaminated sediments previously disposed in a landfill designated pursuant to this approval shall be considered by U.S. EPA to have been properly disposed of and in full compliance with 40 C.F.R. § 761.60 requirements, provided that the sediment was disposed of according to State regulatory requirements and the conditions of this approval and that the landfill continues to operate under the terms and conditions of this approval.

15. In the event that this approval is terminated, WDNR shall ensure that the landfill continues to comply with the monitoring and corrective action requirements of this approval.

16. Owners or operators of landfills accepting PCB contaminated sediments under this approval shall be required by WDNR to test for PCBs in the leachate on a quarterly basis for the first year following disposal. If no PCBs are detected in leachate, the WDNR may allow testing on an annual basis. The landfill owner or operator shall be required by WDNR to

perform PCB sampling at site groundwater monitoring wells in the event of any significant change to PCB levels in the leachate. Leachate or groundwater known or suspected of having concentrations of 50 ppm or greater shall be managed as PCB waste in accordance with § NR 157.07, Wis. Adm. Code, and 40 C.F.R. § 761.60.

17. Prior to WDNR issuing a plan modification for a landfill to accept PCB contaminated sediment, the owner or operator of the landfill shall analyze their leachate for PCBs and shall provide WDNR with a copy of the analytical results.

18. Prior to the discharge of leachate to a publicly owned treatment works (POTW), and regardless of the actual PCB concentration in the leachate, a landfill selected under this approval shall notify the POTW that the landfill accepts PCB contaminated sediments.

19. Groundwater at any landfill accepting PCB contaminated sediments under this approval shall meet § NR 140.10, Wis. Adm. Code, groundwater preventive action and enforcement standards for PCBs, as defined in the point of standards application at § NR 140.22, Wis. Adm. Code.

20. The WDNR shall respond to exceedances of groundwater standards in accordance with §§ NR 140.24, NR 140.26, and ch. NR 708, Wis. Adm. Code.

21. Monitoring well water suspected or known to contain PCBs in excess of § NR 140.10, Wis. Adm. Code, groundwater standards for PCBs of 0.03 parts per billion shall not be discharged directly to the ground or to receiving waters and shall be contained, managed, and treated as leachate.

22. The Department shall provide written notice to Region 5 within 10 days of any state-ordered remedial action related to PCB waste at a landfill authorized to accept PCB contaminated sediments under this approval. Remedial response to spills or exceedances of groundwater standards shall be performed under §§ NR 140.24. and NR 140.26 and chs. NR 158 and NR 708, Wis. Adm. Code, authority and 40 C.F.R. § 761.125.

23. Landfills selected under this approval may not be located in the 100 year floodplain.

24. PCB contaminated sediments shall be dewatered or solidified prior to arrival at a landfill selected under this approval.

25. PCB contaminated sediments disposed under this approval may not be used as daily cover.

26. WDNR shall notify each landfill selected under this approval that the landfill shall provide U.S. EPA with an annual document log, complying with 40 C.F.R. § 761.180(b), for each year that the landfill accepts PCB contaminated sediments.

27. This approval will expire five (5) years from the date of the Regional Administrator's signature on the approval. This approval may be renewed upon the concurrence of both parties to the approval at five year intervals. Discussions on approval renewal will begin 180 days before the approval's next expiration date.

APPROVAL

Providing the above mentioned conditions are met, and in accordance with 40 C.F.R. § 761.60(a)(5), and consistent with the WDNR's May 6, 1994 sediment disposal application and its attachments, the WDNR is granted an approval to select disposal facilities having approved plans of operation under § 144.44(3) Wis. Stats. that comply with chs. NR 500-520, Wis. Adm. Code, and are authorized under § NR 157.07, Wis. Adm. Code, for the disposal of sediments contaminated with PCBs at concentrations of 50 ppm or greater. This approval applies only to the disposal of PCB containing sediment originating in Wisconsin and remediated under the authority and supervision of WDNR. WDNR may not approve facilities within the State of Wisconsin to accept sediments containing PCBs at 50 ppm or greater from projects not conducted under the authority and supervision of WDNR. In addition to the terms and conditions of this approval, selected facilities shall comply with all applicable State and Federal environmental statutes and regulations. This approval may be terminated at any time by either the WDNR or U.S. EPA by written notice to the other party.

for Valdas V. Adamkus
Regional Administrator
U.S. Environmental Protection Agency
Region 5

1/24/95
Date

BOB PAULSON WT/2

CORRESPONDENCE/MEMORANDUM

DATE: June 26, 1998

TO: Bernie Robertson - WT/2

FROM: Duane Schuettpelz - WT/2

SUBJECT: Effluent limitations for the Fox River Demonstration Projects

The attached report contains an analysis and recommendations we will use in the development of final recommendations for effluent limitations for the Deposit N and Deposit 56/57 demonstration project sites on the Fox River. Please use this information to develop the WQBEL recommendations for PCB and other substances for these sites. Prepare the memoranda containing this information for my approval and signature.

My conclusions stated in this report indicate that the removal of contaminants from Deposits N and 56/57 will rid the river of hundreds of pounds of PCB. Through well-designed handling and treatment techniques, only a small amount of PCB(less than one pound) will return to the river with the carriage return water and these operations will occur over only a relatively short period of time. These removal actions will not, themselves, cause the water quality criteria for PCB in the Fox River to come into compliance with the water quality standards. They will, however, move the River in a direction toward water quality standards attainment.

Our recommended effluent limitations for PCB at both sites shall not be less than 1.2 ug/L and are to be established on the basis of treatment technology which does <u>not</u> involve additional carbon adsorption treatment processes. Such limitations are appropriate within the overall context of these specific demonstration projects discussed in this report and are not to be used as a precedent for future effluent limitations or requirements for sediment remediation projects. Permits should be proposed for issuance to allow these projects to be implemented in this manner. The result will be the best overall environmental solution to the problem of contaminants in the Fox River.

cc: Fox River Guidance Team
Bob Masnado - WT/2
Mike Witt - WT/2

DEVELOPMENT OF EFFLUENT LIMITATIONS FOR THE FOX RIVER FIELD-SCALE DEMONSTRATION OF RESTORATION PROJECTS

by
Duane H. Schuettpelz
June 26, 1998

1.0 INTRODUCTION

The Department of Natural Resources, in cooperation with several parties in the Fox River Valley(Fox River Group), have agreed to conduct "field-scale demonstration of restoration projects" at two locations along the Fox River. In order to assure completion of these demonstration projects, certain permit or other regulatory and non-regulatory decisions must be made. The purpose of this document is to provide an overall rationale and perspective for use in the decision processes associated with the WPDES permits(and others as it may apply) which must be issued by the Department. This document will not address the handling and disposal of the residual sediments which are removed from the river.

The restoration of the Fox River to the full range of uses which are safe for humans and the ecological integrity of the River and the downstream areas of Green Bay, Lake Michigan and the other Great Lakes requires a reduction in the amount of contaminated sediments which exist in the river. Through on-going erosion and transport, the bioaccumulating contaminants in the sediments continue to move slowly through the system, eventually making their way to the downstream areas. In both the Fox River and downstream, the contaminants are, through various physicochemical and biological processes, available for uptake through the food chain into fish and, eventually, humans and wildlife. Once bioaccumulating substances reach Green Bay and Lake Michigan, they have escaped any realistic means to effect their eventual removal or isolation from the ecosystem.

In removing or otherwise dealing with these sediments, certain activities may result in the release of toxic substances into the water through resuspension, the return of carriage water from dewatering operations, etc. This discussion is specific with respect to the WQBELs for the carriage return water discharges, but may be considered for other decisions as well. Although WPDES permits are required for the discharge of carriage return water from contaminated sediment sites, the application of specific provisions of existing rules to such discharges may not be logical in the context under which the rules were developed. It is with this dilemma as the backdrop that this document is provided.

The conclusions reached in this report are based solely on the situation which is present with respect to these specific projects, including:

- these projects are demonstration projects
- these projects are of limited scope and duration

- these projects are designed to help answer questions for future work
- these projects will provide directions for future decision processes, including need for changes in statutes, rules and guidance

Therefore, these projects must not be considered precedent setting and the decisions reached will not be considered as establishing the process or decision result for any future project which may or may not have similarities to these projects.

2.0 WATER QUALITY STANDARDS

Water quality standards are contained in NR 102 through NR 106, Wis. Adm. Code. Criteria which serve as the basis for actions of the Department in regulatory or other decisions are contained in NR 102 and NR 105. For purposes of this discussion, only the application of the criterion for PCB will be evaluated and this substance may be used as a surrogate for other substances(toxic or otherwise) in reviewing the decisions which must be made.[1]

The applicable PCB criteria for the Fox River are as follows:

Wildlife	0.12 ng/L[2]
Human health	0.003 ng/L(criterion applies to all waters of the Great Lakes system)

3.0 SETTING

There are two specific areas which have been designated for the "demonstration of restoration projects". They are called Deposit N and Deposit 56/57(the Agreement describes this latter deposit only as a site below DePere Dam).

3.1 Deposit N

Deposit N is located a short distance upstream of the lock and dam at the Village of Kimberly and near the south shore of the river. It is a small deposit of soft sediment which contains high concentrations of PCBs. Based on sampling of the Deposit, sediment PCB concentrations range from zero to 180 mg/kg[3], with an average of about 45 mg/kg. The estimated mass of PCB in the designated deposition area is 414 pounds(188 kg).

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[1]Investigation of the contaminants in the sediments at the Deposit 56/57 site have indicated the presence of the substance dioxin in one layer of a single core sample and in the simulated effluent. See Attachment A for additional information.

[2]A water concentration expressed as ng/L is equivalent to parts per trillion

[3]A sediment concentration expressed as mg/kg is equivalent to part per million.

Fox River water PCB concentrations at or near this location range from 10 to 200 ng/L depending on the time of year and analytical method. The average measured concentration is approximately 33 ng/L. Fish collected from the River near this location within the past 5 years contain PCB in concentrations ranging from 0.5 mg/kg[4] to more than 4.0 mg/kg depending on the species, its size and type of sample(fillet or whole fish). Under the existing condition, water quality criteria for PCB in the Fox River are, therefore, being exceeded. Current point-source discharges of PCB are generally less than the analytical detection levels, and the primary source of PCB in the water column is release from the sediments or attached to sediment particles moving with the water.

At this site, the average annual mass of PCB moving with the water in the river from upstream locations is estimated to be 300 pounds per year, including the amount of PCB transported during high flow events. On an annual basis, the Green Bay Mass Balance Study predicted that the loss of PCB from Deposit N is approximately 46 pounds per year, both through release to the water and sediment movement downstream.

3.2 Deposit 56/57

This deposit is located in the lower part of the Fox River below the DePere Dam, the last downstream dam on the River. The River at this point is influenced by the seiche and backwater effects of Green Bay. It is off-shore of the property occupied by the Fort James Corporation paper mill. This deposit is a significantly larger deposit of soft sediments containing, on average, a higher concentration of PCB(85 mg/kg) than Deposit N. This deposit is specifically characterized in the agreement as a large-scale sediment restoration project.

Sediment PCB concentrations at Deposit 56/57 range from zero to 700 mg/kg with an average concentration of 85 mg/kg. The currently estimated mass of PCB in this deposit is 4600 pounds(2090 kg). Water concentrations of PCB measured at or near this location range from 10 to 200 ng/L, with an average of approximately 50 ng/L. Fish collected from the River near this location within the past 5 years contained from 0.2 to over 5 mg/kg of PCB depending on species, size and type of sample(fillet or whole fish). At this location, however, fish are migratory, and not always reflective of residents of this part of the River. Under the existing condition, water quality criteria in the Fox River are not being attained. Current point-source discharges of PCB are less than analytical detection levels, and the primary source of PCB in the water column is release from the sediments.

The estimated average annual mass of PCB from upstream sources moving through the river at this location is 600 pounds per year[5] including that which is transported during

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[4]A tissue concentration expressed as mg/kg is equivalent to parts per million.

[5]River flow at the two project sites is similar as is the measured water column concentration. The difference in the mass loading of PCB at the two sites is caused by differences in the amount of

high flow events. Only about 4 pounds of PCB are predicted to move directly from this site on an annual basis due to the low velocities of the river at this location.

4.0 PROPOSALS FOR DEMONSTRATION OF RESTORATION

Considerable discussion has occurred regarding the best, most practicable, most environmentally sound, least expensive, etc. method for the restoration of the Fox River from the impacts caused by contaminated sediments. Sediment removal has been identified as the methodology which will be used to demonstrate how best to deal with the sediments. Consultants, working under the guidance of the Department and in collaboration with the Fox River Group, have evaluated several means to remove and treat the sediments and have concluded that dredging and on-land dewatering followed by disposal to landfill is the most efficient means to address these sediments. For purposes of these demonstration projects, the proposed restoration scenarios are as follows:

4.1 Deposit N

Sediment would be dredged from the River and piped to an on-shore dewatering facility located on the north shore of the river. Carriage water would be separated from the solids utilizing an active dewatering process, and be sent to a treatment facility from where it would discharge back to the River near the same location(but near the north bank of the River).

Existing design will remove approximately 10,000 cubic yards of sediment from Deposit N. Based on the amount of PCB in this sediment deposit, about 414 pounds(188 kg) of PCB will be removed from the River at this location. The design consultants estimate that no or little PCB will remain within the boundaries of the deposit site after the project. Silt curtains employing the current state of practicable technology would isolate the active dredging area from the surrounding waters of the Fox River. Using modern environmental dredging techniques, approximately 0.1 kg of PCB is predicted to be lost during dredging.

4.2 Deposit 56/57

At this site, environmentally sound dredging techniques will be used similar to the work at the upstream site. Under the current proposed design, the dredged materials would be piped to a passive dewatering facility on property(known as the former Shell Oil Company site) northeast of the railroad tracks which cross the river immediately adjacent to the Fort James paper mill in Green Bay. River velocities at this location may be either upstream or downstream depending on the seiche action.

The proposed passive dewatering facility for this site is a large lagoon which simply relies on quiescent settling of solid particles into the bed of the lagoon with water bled

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material transported during high flow events.

off the surface and passed through treatment prior to discharge back to the river a short distance downstream from the dredging site. Preliminary design conditions would allow for the removal of approximately 40,000 cubic yards of sediment from this deposit. Based on the amount of PCB in this sediment deposit, about 2,700 pounds(1,227 kg) of PCB will be removed from the River at this location while an estimated mass of PCBs remaining within the boundaries of the deposit site will be 1,900 pounds(864 kg). Silt curtains employing current state of practicable technology would isolate the active dredging area from the surrounding waters of the Fox River.

5.0 WPDES PERMIT EFFLUENT REQUIREMENTS

The overall purpose of addressing sediments in the Fox River is to remove these substances from continuing long term exposure and movement to Lake Michigan and the other downstream Great Lakes. Without removal from the River, the substances will continue to move with the sediments and into the water column down the river. From the long-term and large-scale perspective, therefore, removal and isolation of these contaminants in places which are not accessible by humans and other organisms in the food chain means the substance is generally not available to cause toxicological effects. Each molecule of contaminant removed from the river now is a molecule which will not be available for exposure through the food chain at a point in the future.

In developing effluent limitations for these discharges of PCB and certain other substances, several different provisions of NR 106 may apply. For bioaccumulative chemicals of concern(BCCs) like PCBs, the limitations for new discharges must be equal to the criterion for that substance. The basis for this provision is contained in the U.S. Environmental Protection Agency's Supplemental Information Document for the Water Quality Guidance for the Great Lakes System and is stated as follows:

> *The final Guidance is consistent with the Steering Committee's policy that every reasonable effort be made to reduce all loadings of BCCs to the Great Lakes System... A general principle of the Great Lakes Water Quality Agreement supports the elimination of point source impact zones(i.e., mixing zones) for toxic substances as consistent with the overall policy of the virtual elimination of persistent toxic substances.*

In summary, the rationale for this BCC provision is to assure that no <u>new</u> BCCs are added to the Great Lakes System.

In the case of these demonstration projects, any substances in the discharge of carriage return water are already present in the system. There is no <u>new</u> introduction of the substance to the system, but, rather, there is a significant net removal from the system.

Based on the above information, it is appropriate to apply the provisions of NR 106.06(6), Wis. Adm. Code. This section of the rule applies when the concentration of a substance in the background of the receiving water at the point of discharge is greater than the established water quality criterion for the substance. In the case of PCB, the concentration of the substance in the water column exceeds the water quality criterion.

If the source of the water being discharged is made up of more than 10% receiving water, the rule requires that the effluent limit be set equal to background . This is the case for these demonstration projects.

Alternatively, the rule allows an effluent limitation or other requirement to be established *"...in the event the discharger's relative contribution to the mass of the...substance...is negligible..."*. Furthermore, this is allowed when there is a demonstration that treatment provided is the *"...best demonstrated treatment technology reasonably achievable"*, a level of treatment applied on a case-by-case basis within the discretion of the Department.

The carriage return water from the dewatering facilities at both sites require that the Department issue a WPDES permit for these discharges. There are no specific technology-based effluent limitations which apply to such facilities. However, the provisions of NR 220 require the case-by-case establishment of treatment technology-based limitations. In addition, the Department must establish water quality based effluent limitations which are determined through the application of the provisions of NR 106, Wis. Adm. Code. This code is designed to assure that discharges do not result in the exceedance of the water quality criteria applicable at the point of discharge as implemented through the provisions contained in NR 106. For these projects, the following conditions will apply:

- PCB concentrations in the background(upstream) water of the River at these locations exceeds current water quality criteria
- PCB and other substances will be present in the material which is sent to the dewatering facilities
- Treatment of the dredged material should employ the best demonstrated treatment technology reasonably achievable given the nature, duration and overall objective of the each of the demonstration projects
- Treatment for the carriage return water should employ the best demonstrated treatment technology reasonably achievable given the nature, duration and overall objective of each of the demonstration projects

5.1 Deposit N

5.1.1 Wastewater treatment

The permit application design parameters for the carriage return water at this site include a discharge rate of approximately 360,000 gallons per day. Based on the relatively small amount of sediment removed, an active dewatering process has been proposed. Similarly, because this project also produces a relatively small volume of discharge, the treatment processes identified in The permit application has been prepared with the assumption that the treatment requirements for this discharge may include carbon adsorption, in addition to coagulation, settling and filtration. Carbon adsorption removes PCB to concentrations less than detectable levels. Without this latter treatment process, effluent PCB is projected to be between 0.9 ug/L and 1.2 ug/L[6].

5.1.2 Removal/discharge

As noted above, the mass of the substance PCB being removed from the Fox River at Deposit N is 414 pounds(188 kg). In the permit application for this discharge, the concentration of PCB in the simulated effluent from the system employing advanced treatment as described above was not detected at approximately 0.5 ug/L. The discharge volume will be not more than 360,000 gallons per day for 40 days.

NR 106 requires that whenever a substance in the receiving water is greater than the applicable criterion, the effluent limitation is equal to the background (0.33 ng/L) or an alternative is established according to the provisions contained in NR 106.06(6)(d). However, as reported in the permit application and as is the case for most wastewater discharges, the limit of detection is approximately 0.5 ug/L. NR 106 indicates that any effluent sample reported as less than the limit of detection is in compliance with the permit, and is assumed equal to zero. Therefore, even though a limit equal to 0.33 ng/L may be established in the permit, compliance is determined on the basis of the limit of detection.

For purposes of illustration, if it is assumed the discharge concentration is equal to the limit of detection(0.5 ug/L) and at the noted flow, then the mass of PCB returning to the river would be 0.0015 lbs/day(.0007 kg/day). In this instance the discharge will occur over a 40 day period and the total mass of PCB discharged to the river will not be greater than an estimated 0.06 pounds(.028 kg) over the life of the project.

If the additional carbon adsorption treatment process is removed from the wastewater treatment train, the concentration of PCB in the simulated effluent from the system ranged from 0.9 to 1.2 ug/L. Given the flow conditions noted above, this produces an effluent mass discharge of approximately between 0.108 and .144 pounds(0.049-0.065 kg) for the period of discharge.

Therefore, in removing 414 pounds of PCB from the Fox River system and its potential for long term exposure, the permit may allow, with additional carbon adsorption treatment, the reintroduction of less than one-tenth of a pound back to the River. Without the additional treatment, between one-tenth and two-tenths of a pound may be returned to the river.

5.1.3 Summary

The table below summarizes the several components associated with the removal and discharge of PCB at this site. The short-term discharge of PCB from this project will result in the <u>return</u> of a negligible amount of PCB to the Fox River in relation to the

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[6]A water concentration expressed as ug/L is equivalent to parts per billion.

amount being removed. It is also an insignificant amount when compared to the amount of PCB currently in the water column at the site.

PCB removed from River	414 pounds
PCB in River water moving across site during 40 day period	25 pounds
PCB discharged with additional treatment(effluent assumed = LOD)	0.06 pounds
PCB discharged without additional treatment	0.108 - 0.144 pounds

5.2 Deposit 56/57

5.2.1 Wastewater treatment

As described above, this site is proposing to remove a significantly larger volume of contaminated sediment from the River than the site further upstream. Accordingly, under the current proposed design, the amount of carriage return water is much larger both in terms of rate and overall total project volume. The design flow for the carriage return water at this site is projected to be approximately 2.1 mgd(million gallons per day) during the active dredging phase of the project lasting approximately 30 days. This will be followed by a flow rate of 0.14 mgd during the 120-day phase when the sediment in the dewatering facility is undergoing further drying. All flow will be diverted through a wastewater treatment system prior to discharge back to the Fox River.

Two wastewater treatment processes have been evaluated during the design of this project. The first process employs flocculation, coagulation and filtration. Wastewater treatment using this process train produces an effluent containing approximately 0.9 to 1.2 ug/L of PCB. The second involves additional treatment, in the form of carbon adsorption, to the above basic treatment. The addition of carbon adsorption removes PCB to concentrations less than detectable levels(<0.5 ug/L). Simulated effluent from the latter process was used to provide information for the WPDES permit application on the assumption this treatment technology may be required as part of the treatment process.

5.2.2 Removal/discharge

As noted above, the mass of the substance PCB proposed to be removed from the Fox River at Deposit 56/57 is 2,700 pounds(1,227 kg). NR 106 requires that whenever a substance in the receiving water is greater than the applicable criterion, the effluent limitation is equal to the background (0.33 ng/L) or an alternative may be established according to the provisions contained in NR 106.06(6)(d). However, as reported in the permit application, and as is the case for most wastewater discharges, the limit of detection is approximately 0.5 ug/L. NR 106 indicates that any effluent sample reported as less than the limit of detection is in compliance with the permit, and is assumed equal to zero. Therefore, even though a limit equal to 0.33 ng/L may be established in the permit, compliance is determined on the basis of the limit of detection.

In the permit application for this discharge, the concentration of PCB in simulated effluent from the system employing coagulation, flocculation and filtration plus carbon adsorption treatment system was provided. As with the Deposit N discharge, the concentration of PCB in the simulated effluent was not detected at 0.5 ug/L. However, for purposes of illustration, if it is assumed the discharge concentration is at the limit of detection(0.5 ug/l) and at the noted flow, then the mass of PCB returning to the river would be approximately 0.33 pounds(0.15 kg) for the period of discharge. This results from 0.26 pounds for the 30 day period of active dredging and 0.07 pounds for the estimated 120 day period of further sediment dewatering.

If the additional treatment process(as described) is removed from the wastewater treatment train, the concentration of PCB in the simulated effluent from the system ranged from 0.9 to 1.2 ug/L. Given the flow conditions noted above, this produces an effluent mass discharge of approximately between 0.61 and .80 pounds(0.28 - 0.37 kg) for the period of discharge.

Therefore, this project will result in the removal of 2,700 kg of PCB from the Fox River system and its potential for long term exposure. If a permit is issued to meet effluent concentrations equal to background, the permit could allow the reintroduction of less than one-third of a pound back to the River. If the additional treatment is not employed, then the discharge would be between six-tenths and eight-tenths of a pound.

5.2.3 Summary

The table below summarizes the several components associated with the removal and discharge of PCB at the project 56/57 site. The short-term discharge of PCB from this project will result in the return of a negligible amount of PCB to the Fox River in relation to the amount being removed. It is also an insignificant amount when compared to the amount of PCB currently in the water column at the site.

PCB removed from River	2,700 pounds
PCB in River water moving across site during 30 day period	50 pounds
PCB discharged with additional treatment (effluent assumed = LOD)	0.33 pounds
PCB discharged without additional treatment	0.61 - 0.80 pounds

6.0 COST FOR TREATMENT

Treatment costs increase with the provision of additional technologies to the coagulation-flocculation-filtration treatment trains. Based on the information in the design reports from the Department's consultants, costs for the additional treatment and for treatment without the carbon adsorption technology is provided in the following sections.

6.1 Deposit N

The additional treatment costs associated with providing carbon adsorption treatment for the carriage return water at this site is not available at this writing. However, assuming it is proportionately(based on a comparison of wastewater flow) the same as that for the Deposit 56/57 site(see discussion in Sec. 6.2), the cost are estimated to be approximately $45,000 to $50,000. Using the same comparison as shown in Sec. 6.2, an additional significant quantity of sediment may be removed at another river location with this funding.

6.2 Deposit 56/57

The additional treatment costs associated with providing carbon adsorption treatment for the carriage return water for this site is estimated at $250,000 based on providing this level of treatment for the entire period of discharge. Therefore, at an additional cost of $250,000, the effluent from the wastewater treatment system will be between 0.3 and 0.5 pounds less than without the additional treatment process. The estimated overall cost associated with the project is $180 per cubic yard of sediment removed. If the $250,000 is diverted from wastewater treatment to additional removal of sediment, an additional 1,400 cubic yards of sediment could be removed from this deposit. At the average concentration of PCB in this deposit, this 1,400 cubic yards of sediment would contain 82 pounds of PCB removed from the River.

7.0 DISCUSSION

The primary objective of the Memorandum of Agreement between the Department and the FRG as related to these projects is "to begin certain plans, studies or activities in the Lower Fox River/Green Bay area that will improve natural resources and will serve as the basis for evaluating certain sediment management techniques". More specifically, as stated above, these projects were envisioned to test field-scale demonstration projects for sediment restoration. The underlying purpose of the agreement is to undertake activities to restore the river from the damages which have been claimed due to the deposition of contaminants in the sediments.

The development and issuance of permits for these demonstration projects should, therefore, be in conformance with these principles contained in the agreement. The information in this report describes, to the extent possible, the environmental consequences associated the discharge of treated carriage return water to the Fox River from these specific projects. It compares those consequences with the overall benefits which will accrue from the removal of contaminants from the River. It is apparent, from the information presented, that these projects, when implemented, will result in the removal of significant quantities of PCB from further exposure in the Fox

River/Great Lakes environment. The planned activities will, however, result in the need to discharge back to the River carriage return water containing some of the contaminants which are removed in the dredging process. These projects are short-term in duration and are returning to the River only a small fraction of the material which is removed.

In establishing an alternative effluent limitation under NR 106.06(6)(d), the Department must determine that the "...relative contribution to the mass of the... substance is negligible..." (emphasis added). From the data presented in this document, there is no new contribution of PCB to the River beyond that which already exists in the River environment. The discharges back to the river are in the range of about 0.03% or less of the PCB removed at either site. Therefore, it is reasonable to conclude that these discharges are negligible according to the provisions of the rule.

Existing water quality in the Fox River already exceeds the water quality standards for parameters such as PCB. The addition of PCB in the effluent from the demonstration sites via carriage return water discharges will minimally add to the existing exceedances regardless of which of the treatment technologies described above is applied. The risk associated with these discharges in the over-all context of the existing and on-going risk is insignificant. On the other hand, the opportunity to eliminate the long term release of these contaminants to the water and the continuing level of exposure through uptake of contaminants in the food chain, is great.

In applying existing rules, the Department has discretion in the application of effluent limitations and treatment technologies for the wastewaters generated by these projects. The rule requires the application of best demonstrated treatment technology reasonable achievable whenever the Department determines that an alternative to the background concentration effluent limitation is established. As noted, there is little experience in Wisconsin to determine what technology meets this requirement, especially considering the unique nature of these projects. While the application of additional treatment could be required for these projects, the decision to establish a treatment technology as stated in this report is based on the overall goal of the projects to "...improve natural resources and...serve as a basis for evaluating certain sediment management techniques"(exerpt from the Agreement, part II).

This analysis has considered the individual impacts on the Fox River from the effluents from the demonstration project sites and any conclusions should not be extended to future sediment remediation projects along the River. Any proposals for sediment removal, treatment and disposal at other sites and projects(including whole river strategies) should undergo independent evaluation. However, it may be appropriate, following the implementation of these projects, to consider the development of rules and guidance which would provide more specific direction in decision-making regarding sediment contamination projects.

8.0 CONCLUSION

The removal of substantial quantities of PCBs(and other contaminants) from the Fox River through dredging and treatment of the residual carriage return water is being implemented to evaluate if a means exists to remove contaminants from the river and to effectively dispose of them in a manner which eliminates them from future exposure. The information presented here substantiates that the removal of contaminants from Deposits N and 56/57 in a manner consistent with the project designs will rid the river of hundreds of pounds of PCB. Through well-designed handling and treatment techniques, only a small amount of PCB(less than one pound) will return to the river with the carriage return water from each site. These operations will occur over only a relatively short period of time. The removal actions will not, themselves, cause the water quality criteria for PCB in the Fox River to come into compliance with the water quality standards. They will, however, move the River in a direction toward water quality standards attainment.

This report establishes that the discharges of carriage water from these specific "demonstration of restoration" projects are negligible In accordance with the provisions of NR 106.06(6)(d). Effluent limitations to meet background water quality are not needed to meet the requirements of the rule. Furthermore, effluent limitations established on the basis of treatment technology which does <u>not</u> involve carbon adsorption treatment processes(maximum effluent concentrations = 1.2 /L) are appropriate within the overall context of the demonstration projects discussed in this report. Permits should be proposed for issuance to allow these projects to be implemented in this manner. The result will be the best overall environmental solution to the problem of contaminants in the Fox River, and will provide data and information to all the parties seeking to identify methods to address contaminated sediment issues in the River.

ATTACHMENT A

IMPLICATIONS OF DIOXIN FOR THE DEPOSIT 56/57 DEMONSTRATION OF RESTORATION PROJECT

Investigation of the contaminants in the sediments at the Deposit 56/57 site have indicated the presence of the substance dioxin in one layer of a single core sample. This substance has the lowest water quality criteria values in current Department rules. Very limited data is available to suggest that the substance is present in the sediments of the river at low concentrations. The extent of dioxin within the sediments of this demonstration project area is unknown.

In the development of the design information for the site, the consultant had provided data which indicates that dioxin was present in the effluent from the bench-scale tests following the application of carbon adsorption treatment. Only one sample analysis is available. Although the reported result for this simulated effluent was qualified by the laboratory due to detection of dioxin in the method blank, the laboratory has confirmed that dioxin was present in the sample. The Department's position is that any such confirmed sample result is sufficient to establish it as "representative" for the purpose of establishing effluent limitations under the provisions of NR 106.

Based on tissue samples from fish in the Fox River, one may logically conclude that water concentrations for dioxin are not equal to zero. In reality, it may also be appropriate to assume that dioxin concentrations in the water column are greater than the most stringent water quality criterion of 0.003 pg/L(parts per quadrillion). As with PCB, therefore, effluent limits for dioxin may be established based upon negligible contributions from the demonstration project discharges. However, the base of data to support precise calculations is not available.

Dioxin is a substance which reacts in the environment similar to PCB. It is hydrophobic and it bioaccumulates in the food chain. It is reasonable dioxin will respond in a manner similar to PCB when treatment technology is employed. Therefore, given the uncertainties in the data with respect to dioxin in sediments, water column and fish, the use of PCB as a surrogate for dioxin in the demonstration projects is appropriate. Monitoring of this substance as part of the project evaluation is necessary, and action appropriate to the situation should be taken if the data reveal these assumptions are not true.

WISCONSIN'S LANDFILL SITING PROCESS

SEPTEMBER 1996

By Paul M. Huebner[1]

Wisconsin's landfill siting process is considered one of the most successful in the country because it strikes a balance between the statewide need for environmentally sound waste disposal capacity and the legitimate concerns of local citizens and municipalities. The siting process requires that landfills meet stringent siting, design, construction, operation, monitoring, performance and financial responsibility requirements to maximize the protection of public health and the environment.

In Wisconsin, all new landfills and expansions to existing landfills must obtain both state and any applicable local approvals prior to construction. Licensing of a landfill and the negotiation/arbitration of local approvals are two separate processes and occur concurrently. The landfill licensing process administered by the Wisconsin Department of Natural Resources (WDNR) is a technical decision-making process focusing on the ability of the proposed landfill design to meet all criteria and standards to protect public health and the environment. The local approval process focuses on the local economic, social and land use impacts of the landfill and is overseen by the Wisconsin Waste Facility Siting Board.

Over the last several years, a number of landfill applications in Wisconsin have been significantly delayed by new state and federal locational requirements regarding wetlands and airports and new state statutory changes made to the siting process since 1988. Other major factors contributing to such delays were lack of planning and poor site selection by some applicants, submittal of incomplete information, inadequate justification for exemptions or unique/alternative designs, and of course public opposition.

In 1995 with the assistance of a public technical advisory committee (TAC), the WDNR completed the task of incorporating the necessary changes into Wisconsin's solid waste management regulations (chs. NR 500 - 520, Wis. Adm. Codes) to conform to the new statutory requirements and the federal (Subtitle D) criteria for municipal solid waste landfills. Another primary goal of the TAC and the WDNR was to streamline the NR 500 series of codes without jeopardizing public health or the environment. Areas of duplication and unnecessary and burdensome requirements found over the past several years to not be providing any additional environmental protection were eliminated. Significant clarification was also added to make the codes more user friendly. Since the landfill siting process is laid out in state statutes it essentially remained unaltered. However, substantial changes made to the front of the technical decision making process and streamlining of the technical submittal requirements should lead to some efficiencies being realized.

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[1]Solid Waste Team Leader, Bureau of Waste Management, Wisconsin Department of Natural Resources, 101 South Webster Street, Madison, Wisconsin, 53707.

Landfill Licensing Process - The WDNR technical decision-making process is summarized in Figure 1. It includes the following mandatory steps:

INITIAL SITE INSPECTION

The purpose of an initial site inspection is to obtain a preliminary evaluation from the WDNR on the potential a proposed property has to comply with the locational criteria and performance standards specified in s. NR 504.04, Wis. Adm. Code. As specified in ch. NR 509, Wis. Adm. Code, an applicant must first submit a written request to the WDNR to arrange for an initial inspection. This request must include the following minimum information:

1. A cover letter identifying the applicant and authorized contact, type of landfill and operation being proposed, property ownership, location by quarter -quarter section and present land use.

2. A letter from the WDNR's Bureau of Endangered Resources addressing the known presence of critical habitat areas and state or local natural areas within one mile of the proposed landfill, in accordance with ch. NR 29, Wis. Adm. Code.

3. A letter from the Wisconsin State Historical Society identifying the presence of any historical, scientific or archaeological areas within the vicinity of the proposed landfill, in accordance with s. 44.40, Stats.

4. A map depicting existing conditions within one mile of the proposed boundaries of the proposed landfill.

5. A preliminary identification of all potential conflicts with the locational criteria and performance standards specified in s. NR 504.04, Wis. Adm. Code, for landfills, except for s. NR 504.04(4)(d) to (f).

Note: An initial site inspection is also required for all noncommercial soil borrow sources designated to be used in the construction, operation, or closure of a specific landfill. A written request for an inspection of a soil borrow source must include the information listed in items 1. through 4. above, and a preliminary identification of all potential effects on wetlands, critical habitat areas or surface waters.

During the inspection, WDNR staff evaluate whether or not the proposed landfill would be within a floodplain or within an area that would have an adverse impact on critical habitat, historical/archeological features, and wetlands. The WDNR staff also check to see if the anticipated landfill footprint would be within required setback distances to navigable waters, state and federal highways, public parks, airports, and water supply wells. After the inspection the applicant is notified in writing which locational criteria and performance standards the proposed property complies with and does not comply with and if further evaluations or additional studies are necessary. The initial site inspection letter from the WDNR can be used by an applicant to decide if the proposed property merits further investigation. If no follow up evaluations or studies are necessary to determine navigability of nearby surface waters, the presence of critical habitat, or to define wetland boundaries etc., the completion of this step by the WDNR generally should not take more than a couple of weeks.

LANDFILL LICENSING PROCESS

INITIAL SITE INSPECTION

↓

INITIAL SITE REPORT
Completeness Determination

↓

INITIAL SITE REPORT OPINION

Voluntary Pre-feasibility Report →

↓

FEASIBILITY REPORT
Completeness Determination &
Preliminary Determination on
Need for EIS

↓

Public Notice Is Issued

↓

Finalization of EA or EIS

↓

HEARING
Informational,
Contested or None

↓

FEASIBILITY DETERMINATION

↓

PLAN OF OPERATION
Completeness Determination

↓

PLAN OF OPERATION APPROVAL

↓

Construction

↓

AS-BUILT DOCUMENTATION

↓

Establishment of Proof of Financial
Responsibility & Site Inspection

↓

LICENSE ISSUANCE

↓

Site Operation

Figure 1. Landfill Licensing Process

INITIAL SITE REPORT

The next step in the landfill licensing process is for the applicant to submit an Initial Site Report (ISR). The ISR was originally developed as a voluntary screening tool to allow an applicant to receive an opinion from the WDNR on whether a proposed property had potential for development as a landfill before committing to the time and cost of a preparing a feasibility report. In 1990, the state's comprehensive recycling law became effective and it mandated that all applicant's proposing to site a new landfill or to expand an existing landfill shall submit an ISR to the WDNR. Over the years, some of the requirements originally specified for a feasibility report were moved to or added to the minimum ISR submittal requirements reducing the effectiveness of the report as an inexpensive screening tool. The new rule revisions returned this report back to its original purpose by significantly streamlining the minimum requirements for an ISR.

The minimum requirements for an ISR are found in ch. NR 509, Wis. Adm. Code. An ISR must include the information submitted for the initial site inspection and the WDNR's initial site inspection response letter; the proposed project's title; identification of the owner and proposed operator of the landfill and any consultant; a description of the proposed property and the anticipated limits of filling; proposed landfill life and disposal capacity; municipalities and industries to be served; anticipated waste types, characteristics and amount of waste to be handled; anticipated cover frequency; mode of operation; and the anticipated subbase, base and final grades. An ISR must also contain a thorough discussion of the land uses which may have an impact on the suitability of the property for waste disposal or on groundwater quality, and include a summary of the available published information concerning the regional geotechnical characteristics of the proposed location. No site-specific geotechnical investigation is required.

An ISR is evaluated by a WDNR plan review team consisting of a hydrogeologist and an environmental engineer. The hydrogeologist has the lead review responsibility and receives comments on the report from a waste management investigator in the applicable local WDNR field office. After completing a review of the ISR, the WDNR renders an opinion on the proposed property's potential for development as a landfill and notifies the applicant in writing. The ISR opinion letter is also used by the plan review team to identify any known constraints to feasibility. In a favorable ISR response, the WDNR specifies site-specific additional or unique information needed to be included in a feasibility report which is the next mandatory step in the siting process. An unfavorable opinion letter is used to discourage an applicant before an irrevocable financial or political commitment to an unsuitable property is made. The completion of this step by the WDNR generally should not take more than a couple of months.

<u>Pre-feasibility report</u>

In those cases where the regional geotechnical or any available site-specific geotechnical information indicates the proposed property may have poor geology or unusual hydrogeological conditions, the WDNR will suggest that a pre-feasibility report be submitted. Submitting a pre-feasibility report, however, is not a required step in the siting process. The level of site-specific geotechnical information specified for a pre-feasibility report is found in ch. NR 510, Wis. Adm. Code, and it is similar to the information formerly required for ISR's. The advantage of the voluntary pre-feasibility report option is that it allows a landfill applicant to obtain a revised opinion from the WDNR based on site-specific geotechnical information which should reduce the risk of proceeding directly from the reduced scope ISR to doing major feasibility studies on a property which may have little or no potential of being approved.

FEASIBILITY REPORT

Obtaining a favorable feasibility determination from the WDNR virtually assures the applicant the proposed landfill can be developed from a technical standpoint. Chapter NR 512, Wis. Adm. Code, specifies the minimum information that must be included in a feasibility report. Required items already addressed in an ISR or a pre-feasibility report can be cross referenced rather than included in the feasibility report. Along with information requested in the WDNR's ISR opinion letter and any revised pre-feasibility opinion letter, a feasibility report must contain a comprehensive and detailed site-specific geologic and hydrogeologic investigation that includes baseline groundwater quality data; a preliminary engineering design that includes a description of the proposed environmental monitoring for groundwater, leachate, surface water, gas, air quality, and soil moisture (if applicable); an environmental assessment; documentation of the need for the proposed landfill; and an analysis of the alternatives to landfilling such as waste reduction, reuse, recycling, composting, and energy recovery initiatives and services. Initial site inspection response letter(s) and soil test results for any proposed noncommercial soil borrow source(s) designated to be used in the construction, operation, or closure of the first phase of the proposed landfill also must be included in a feasibility report.

For a feasibility report, the hydrogeologist of the WDNR plan review team is once again the lead reviewer and receives comments from a waste management investigator and several other program specialists in the applicable local WDNR field office. The hydrogeologist fills out a feasibility completeness checklist to determine if all of the minimum information required by ch. NR 512, Wis. Adm. Code, has been submitted. If required information is found to be missing, the WDNR notifies the applicant in writing that the report is incomplete and lists the information needed to make the report complete. The incompleteness letter may also include a request for additional or unique information the plan review team believes is necessary before a feasibility determination can be made.

Environmental analysis

When a feasibility report is found to be complete, the hydrogeologist prepares an analysis of the significance of any impacts the proposed project would have on the public's health, welfare and the environment. After completing a draft of the analysis, the hydrogeologist recommends whether or not an Environmental Impact Statement (EIS) should be completed on the proposed project. If the WDNR decides that an EIS must be written, the feasibility determination is delayed until the EIS is completed. The completion of an EIS, and an associated mandatory public hearing on the completeness of the study, can take up to a year or more to complete.

Public hearings

If an EIS is not required or after an EIS is completed, the hydrogeologist prepares a short summary of the proposal and a public notice stating that the WDNR has received a complete feasibility report. The public notice is published in the local newspaper to invite public comment and provide information on how six citizens or an official of the host municipality or any municipality located within 1,200 feet of the proposed landfill can request that an informational public hearing or a contested case hearing be held on the technical feasibility of the proposal.

If no hearing is requested, the plan review team considers the public comments received before writing the feasibility determination. If an informational public hearing is held the feasibility determination is written within 60 days after the hearing. When a contested case hearing is held, it is conducted before a hearing examiner in much the same way as a court trial. The WDNR plan review team and the other parties to the hearing testify under oath and are subject to cross examination. After a contested case hearing, the feasibility determination is made by the Secretary of the WDNR or the WDNR Secretary's designee based only upon a review of the hearing record. A contested case hearing is intended to address technical issues of site feasibility including the need for the landfill and the ability of the proposal to meet design and performance standards and to protect the public's health, welfare and the environment.

Submittal of incomplete/inadequate information, public controversy, locational problems such as potential impacts to wetlands or the potential of creating a bird hazard to aircraft, and poor geology and unusual hydrogeologic conditions significantly impact the review time for some feasibility reports. Depending on the completeness of a feasibility report, any locational problems, and whether or not an EIS must be prepared or a public hearing must be held, the WDNR's completion of the feasibility step in the siting process can take six months to more than three years.

PLAN OF OPERATION REPORT

A plan of operation report includes the final engineering design, design calculations, details on the phases of construction, proposed construction documentation, sequencing of operations, daily operations, monitoring, closure design, long-term care of the proposed landfill after closure and a detailed estimate of the costs for construction, operation, closure and long-term care of the landfill. Chapter NR 514, Wis. Adm. Code, and the conditions in a feasibility determination specify the minimum information a plan of operation must contain. After the applicant receives a feasibility determination there is usually at least one meeting between the applicant and the WDNR to discuss the feasibility conditions of approval, prior to the submittal of the plan of operation report.

The WDNR plan review team is responsible for ensuring that all design, construction, operation, closure and financial responsibility details required by ch. NR 514, Wis. Adm. Code, and all of the conditions of feasibility are addressed in the plan of operation. The environmental engineer is the lead reviewer and makes sure that good engineering practices are being proposed. The hydrogeologist reviews the environmental monitoring proposal, any alternative concentration limits proposed for exemptions to the groundwater standards which were granted in the feasibility determination and preventative action limits proposed for the groundwater quality indicator parameters for each well at the site. The WDNR typically completes its review of a plan of operation in four to six months.

LANDFILL CONSTRUCTION DOCUMENTATION REPORT

Following WDNR approval of a plan of operation for the proposed landfill and after obtaining any required local approvals, the owner can begin construction of the facility. Landfills are constructed one phase or unit at a time. During major construction steps of the landfill, WDNR staff conduct inspections. Documentation (as-built) plans are prepared by the applicant's engineering consultant documenting the construction process such as the compaction of the clay liner and installation of the geomembrane liner (composite liners consisting of a 60-mil HDPE geomembrane and 4 foot thick clay liner are now required for municipal solid waste landfills) and leachate collection pipes.

After construction, the owner must submit a comprehensive report containing a detailed narrative describing the construction of the landfill phase or unit in chronological fashion with particular emphasis given to any deviations from the approved plan of operation. The report must also include detailed documentation of all aspects of construction. This includes surveys of various grades, field and laboratory soil test results, engineering plan sheets documenting the constructed grades, the precise location of all leachate collection storage and removal structures, the specifications of materials, and photo documentation.

Chapter NR 516, Wis. Adm. Code, describes what elements must be included in a landfill construction documentation report. After the as-built documentation has been reviewed and approved by the assigned WDNR engineer and the proofs of financial responsibility have been implemented, a final inspection of the constructed phase or unit is made before a license is issued. The landfill owner can only begin to accept waste after receipt of the license from the WDNR. The review of a landfill construction documentation report is usually concluded by the WDNR in a month.

Local Approval Process - Simultaneous to the WDNR technical decision-making process, the applicant must seek and obtain any applicable local approvals (see Figure 2). These would include any permits or approvals required by pre-existing local ordinances to construct or operate a landfill such as zoning variances, building permits, etc. Although local approvals need only be obtained prior to construction of a landfill, as a practical matter, many applicants do not proceed to develop a feasibility report until the issue of local approvals is resolved. The local approval process has two major components: negotiation and state arbitration if a negotiated agreement cannot be reached.

NEGOTIATION

A person proposing a new landfill or expansion of an existing landfill must apply for all local approvals at least 120 days before submitting a

LOCAL APPROVAL PROCESS

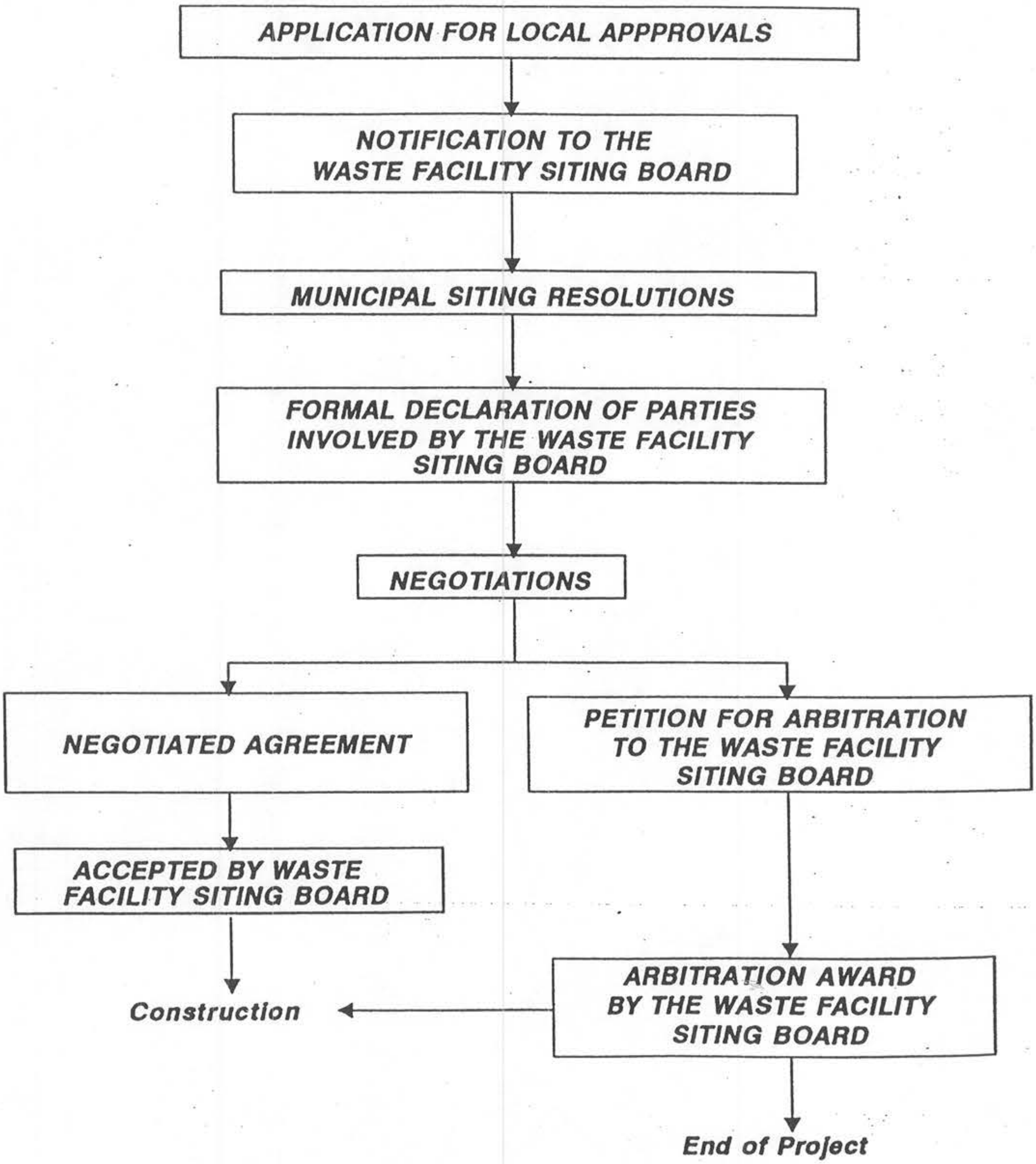

Figure 2. Local Approval Process

feasibility report to the WDNR. At that time, any affected municipality (county, township, village, or city within 1,200 feet of the proposed landfill's limits of filling) may choose to enter into negotiations with the applicant. Any municipality choosing not to negotiate waives its rights to enforce any local approval requirements. In general, the site owner will offer design, financial and operational incentives to the municipality in exchange for a negotiated agreement and to gain waiver or approval of local permits. Virtually any issue is negotiable except the need for the proposed landfill and agreements which would make the owner's responsibilities under the WDNR approved feasibility report less stringent. Commonly negotiated concessions on the part of the owner include: operational issues such as hours of operation, waste materials accepted, nuisance control, lighting, vehicle routes and access, aesthetic screening and fencing; recycling efforts to be implemented; private well monitoring and replacement if necessary; post-closure site use; payments to local governments for local costs of regulation, fire control, road maintenance, payments in lieu of taxes; economic protection of neighboring property owners for loss of property value; and establishment of a local advisory committee.

ARBITRATION

If the parties are unable to reach a negotiated settlement, they may petition the Wisconsin Waste Facility Siting Board (WWFSB) to issue an arbitration award. Each party must submit its final offer for a negotiated settlement to the WWFSB. After a hearing on the final offers, the WWFSB must select, without modification, the final offer of either the applicant or the local committee.

As described above, Wisconsin's landfill siting process is complex, comprehensive and time consuming. It can take three to five years or more to plan, design and construct a new facility.

If you should have questions on the WDNR technical decision-making process please contact Paul Huebner at (608) 267-7573. If you should have questions on the local approval process please contact Patti Cronin, Executive Director of the WWFSB at (608) 267-7854.

References

1. Schuff, R.G. 1986. Solid Waste Landfill Siting in Wisconsin an Effective Process. 12 pp.

2. Huebner, P.M. 1991. Wisconsin's Landfill Siting Process. 8 pp.

3. Sections 144.43 - 144.447, Stats.

4. Chapters NR 500 - 520, Wis. Adm. Code, Revisions Effective July 1, 1996.

PORT AND SOLID WASTE DEPARTMENT

Brown County
2561 SOUTH BROADWAY
GREEN BAY, WI 54304

CHARLES J. LARSCHEID

PHONE (920) 492-4950 FAX (920)492-4957

DIRECTOR OF PORT AND SOLID WASTE DEPARTMENT

April 9, 1999

Lower Fox River Cleanup, RR/3
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
101 South Webster Street
P.O. Box 7921
Green Bay, WI 53707

RE: Draft RI/FS/RA Studies, Lower Fox River, Wisconsin Comments

Dear Sirs:

Brown County would like to bring up an issue that was not addressed in the Risk Assessment of the Draft RI/FS/RA Studies of the Lower Fox River. The study defines the Lower Fox River as the 39 miles stretch beginning at the outlet of Lake Winnebago and terminating at the mouth of the river. It is our contention that the problem of PCB impacted sediments does not end at the mouth of the river.

Brown County has an agreement with the US Army Corps of Engineers (USACE) to provide a disposal site for sediments removed during maintenance of the navigation channel. This channel, which must be dredged annually, starts approximately 8 miles north of the mouth of the river. Because the sediment is impacted with PCB's, the Wisconsin Department of Natural Resources, (WDNR) requires that all of the sediment must be deposited in a confined disposal facility (CDF). Over the last 25 years, the USACE has dredged millions of cubic yards of sediment and deposited it at the Bay Port upland CDF and the Renard Island in-water CDF.

Renard Island consists of a stone rubble dike with a steel sheet-pile cut-off wall. The total area enclosed by the cut-off wall is approximately 60 acres. The last load of sediment was deposited in the CDDF in 1997. Currently, there are discussions going on between the USACE and Brown County regarding the closure and long-term care of the CDF. The WDNR has identified minimum standards that must be met for the closure because PCB impacted sediment was disposed of in the CDF.

The 400 plus acre Bay Port CDF has restrictions on its use because PCB impacted sediments have and continue to be deposited there. Recently, 110 acres of Bay Port were reconstructed to facilitate dewatering sediment for eventual beneficial reuse. Off-site beneficial reuse projects can not take place yet because of the low levels of PCB's in the sediments. Without beneficial reuse projects, Bay Port will fill within 40 years, and the County will be required to locate another CDF for the disposal of sediment from maintenance dredging.

The County is of the opinion that the RI/RA/FS is incomplete because it fails to address the need to remediate the two CDF's. The County will be required to spend a significant amount of money to cap the Renard Island CDF and may have to spend additional money to eventually close the Bay Port CDF. These dollars would not have to be spent if the sediments were not impacted with PCB's.

The Brown County Port and Solid Waste Department encourages the SDNR to consider not only future transport of PCB's to the bay of Green Bay, but also the PCB's already located in the two CDF's. Of the eight alternatives evaluated in the Risk Assessment, our department prefers those alternatives that remove the greatest volume of PCB's. Since the Port of Green Bay is the recipient of the majority of sediment that moves down river, we (Brown County and the USACE) bear the additional cost of handling the PCB impacted sediment. Our costs for dredging will decrease significantly when the sediments are no longer impacted. Therefore, we encourage the quick remediation of the impacted sediments.

Brown County requests that the RI/RA/FS be corrected to reflect the costs associated with the closure of the Renard Island and Bay Port CDF's . The specific requirements for closure of Renard Island have not been finalized yet, but the WDNR has directed the County to follow the closure plan requirements of NR 514.08. Furthermore, the department indicated that as much as 3 feet of topsoil might have to be used to cover the complete CDF. Preliminary estimates place the cost to perform such work at $4-6 million.

Bay Port has cost over $2 million to construct and will cost $2-4 million in 1999 dollars to close, depending upon final requirements. Brown County does not believe that it is responsible for any past or future incremental costs associated with handling sediments impacted with PCB's. In conclusion, each of the eight alternatives identified in the RA must include the cost to close the two CDF's.

The Brown County Port and Solid Waste Department thanks you for the opportunity to comment on the draft report. Please call if you have any questions or comments.

Sincerely,

Charles J. Larscheid

Charles J. Larscheid
Director

CJL:nl
Cc: Fox River RI/FS U.S. EPA
Len Polczinski, WDNR NER
Paul Vornholt, Assistant to County Executive
Dnr499.ltr

Ed
for the FS-
Greg

Mark Reimer
Senior Counsel
Environmental

FORT JAMES

Fort James Corporation
1650 Lake Cook Road, 2S7
Deerfield, IL 60015

telephone 847.317.5326
facsimile 847.317.5456
Mark.Reimer@fortjamesmail.com

PLEASE DELIVER THE FOLLOWING PAGES TO:

Date: **11/22/99**

Name: **Greg Hill**

Fax No.: **608/267-2800**

FROM:

Name: **Mark Reimer**

Fax No.: **847-317-5456**

COMMENT:

Number of pages including this sheet:

If you do not receive all the pages or if they are not clear, please call Karen Weber (847) 317-5441.

Mark Reimer
Senior Counsel Environmental

FORT JAMES

November 22, 1999

Fort James Corporation
1650 Lake Cook Road
P O Box 89
Deerfield, IL 60015-0089

telephone 847 317 5326
facsimile 847 317 5456
email mark.reimer@fortjamesmail.com

Greg Hill
Wisconsin DNR
101 South Webster Street
P.O. Box 7921
Madison, WI., 53707-7921

RE: Preliminary PCB Sediment Cell 12A Budget and Costs

Dear Greg:

Per your request, enclosed please find a preliminary budget and costs incurred as of October 31, 1999 for the design, permitting, construction, operation, closure and post closure of Cell 12A located at Fort James Operating Company's Green Bay-West Landfill. Included in the spreadsheet is an estimate of transportation costs as well. Please note that the enclosed spreadsheet does note include the value of all of the services provided by Fort James on the SMU 56/57 sediment restoration demonstration project as provided in paragraph F of the agreement between Fort James and WDNR effective July 22, 1999 entitled "Agreement Between the State of Wisconsin and Fort James Corporation". For example, the value of services such as management time spent on Cell 12A, use of the Shell Property for a dewatering facility, or any imputed tipping fees, are not included. The value of those and other services will be valued at a later date.

If you have any questions, please feel free to contact me at 847/317-5326.

Sincerely,
Fort James Corporation

Mark S. Reimer

Mark S. Reimer
Senior Counsel

C. Richard Jones -- Fort James

Mark Travers -- demaximis, inc.
103 North Eleventh Street, Suite 210
St. Charles, IL., 60174

John Hanson -- Beveridge & Diamond
1350 I Street NW
Suite 700
Washington DC, 20005-3311

Preliminary PCB Sed. Cell 12A Costs and Budget
As of 10/31/99

	BUDGETS		ACTUAL AND FORECASTED PROJECT COSTS			
	Original Budget	Adjusted Budget	Paid to Date	Total Committed	Est. to Complete	Final Forecast
01 040 Excavation/Berm Constr.	155,000	155,000	144,117	146,938	3,062	150,000
01 140 Roads	34,000	75,000	56,678	56,678	18,322	75,000
01 200 Transportation/Landfill[1]	544,000	544,000	-0-	-0-	544,000	544,000
01 400 Lysimeter	211,334	211,334	208,025	208,025	3,309	211,334
01 401 Primary Liner/Leachate	472,841	499,347	479,347	479,347	20,000	499,347
01-402 Final Cover System[2]	348,000	332,861	348,000	-0-	332,861	332,861
01 403 Miscellaneous	25,000	25,000	2,684	3,496	21,504	25,000
01 650 Power Dist. (Electrical)	15,000	15,000	12,483	13,594	1,406	15,000
01 800 Permitting Fees	10,000	10,000	3,500	3,500	6,500	10,000
01 801 Waste Disposal Permit Fee	20,400	20,400	-0-	-0-	20,400	20,400
01-820 Engineering (Fort James)[3]	96,700	96,700	45,535	45,535	51,165	96,700
01 821 Engineering (STS Consult)	230,000	230,000	109,956	142,200	87,800	230,000
01-900 Contingency	174,000	106,494	-0-	-0-	106,494	106,494
01 940 Port Closure Cost[4]	121,000	48,170	121,000	-0-	48,170	48,170
TOTAL	**2,423,275**	**2,369,306**	**1,531,325**	**1,099,313**	**1,264,993**	**2,364,306**

[1] Transportation costs assumes removal of 80,000 cubic yards of sediment from SMU 56/57

[2] $348,000 estimate was used to establish escrow account for financial assurance purposes.

[3] Does not include time spent on project by other internal Fort James personnel. That cost will be compiled at a later date.

[4] $121,000 estimate was used to establish escrow account for financial assurance purposes.

FORT JAMES WEST LANDFILL
GREEN BAY, WISCONSIN
Construction Cost Estimate
STS Project No.: 24702 Task 5000

The landfill has a planned area of 3.1 acres and an approximate disposal volume of 70,000 cubic yards.

ITEM	QUANTITY	UNITS	COST/UNIT	COST
PRELIMINARY WORK				
Mobilization	1	ea.	$50,000.00	$50,000.00
EXCAVATION and BERM CONSTRUCTION				
Structural Fill (onsite or borrow)	85,000	cy	$2.85	$242,250.00
Anchor Trench (excavation and backfilling)	1,500	lf	$7.60	$11,400.00
LYSIMETER				
60 mil HDPE Textured (sideslopes)	140,000	sf	$0.56	$78,400.00
GCL (base and sideslopes)	141,500	sf	$0.40	$56,600.00
Geocomposite	140,000	sf	$0.48	$67,200.00
18-inch dia. HDPE (SDR 17) riser pipe	140	lf	$15.50	$2,170.00
Pump and Controls	1	ea	$7,750.00	$7,750.00
PRIMARY LINER and LEACHATE SYSTEM				
5-foot-thick Compacted Clay Layer	25,000	cy	$10.00	$250,000.00
60 mil HDPE Textured	120,000	sf	$0.56	$67,200.00
Cushion Geotextile 12 oz. / sq. yd.	120,000	sf	$0.15	$18,000.00
1-18 inch HDPE (SDR 17) Risers Pipe	120	lf	$15.50	$1,860.00
6-inch dia. SDR 17 HDPE - Perforated	750	lf	$2.60	$1,950.00
6-inch dia. SDR 17 HDPE - solid	300	lf	$2.20	$660.00
Leachate Gravel	825	cy	$13.00	$10,725.00
12-inch Sand Drainage Blanket	4,600	cy	$14.00	$64,400.00
Pump and Controls	1	ea	$7,750.00	$7,750.00
LEACHATE CONVEYANCE AND STORAGE				
Leachate Storage Tank (20,000 gallon tank)	365	ea	$40.00	$14,600.00
Leachate Storage Tank Mobilization & Setup	1	ea	$1,430.00	$1,430.00
Tank Containment Area	1	ea	$5,000.00	$5,000.00
LANDFILL OPERATION				
Daily Operation - (2 dozers and operators, 6 days/week, 12 weeks)	72	days	$2,000.00	$144,000.00
Transportation (80,000 river yds = 48,000 stabilized tons)	48,000	tons	$3.00	$144,000.00
FINAL COVER SYSTEM				
12-inch Gas Venting/Drainage Layer	4,700	cy	$5.00	$23,500.00
24-inch Clay Cover	9,400	cy	$10.00	$94,000.00
40 mil VFPE Geomembrane	140,000	sq	$0.47	$65,800.00
36 inch Rooting Zone	15,000	cy	$2.50	$37,500.00
6 inch Topsoil Layer	2,500	cy	$6.50	$16,250.00
Seed, Fertilizer and Mulch	3.6	ac	$1,250.00	$4,500.00
4 inch Perforated Gas Vent Pipe	2,540	lf	$0.45	$1,143.00
Gas Vent Trench Backfill	100	cy	$13.00	$1,300.00
Gas Vent Trench Geotextile (8oz)	9,000	sf	$0.14	$1,260.00
Gas Vent Risers	5	ea	$350.00	$1,750.00
4 inch Perforated Cover Slope Drain Pipe w/sock	1,400	lf	$0.57	$798.00
8 inch Rip Rap	25	cy	$14.00	$350.00
MISCELLANEOUS ITEMS				
Power distribution	1	ea	$15,000.00	$15,000.00
Post Closure Cost (present worth at a 6% interest rate)	1	ea	$48,170.63	$48,170.63
Bidding and Construction Adminstration	1	ea	$100,000.00	$100,000.00
CQA Documentation	1	ea	$139,000.00	$139,000.00
Subtotal				$1,797,667
Contingency 15%				$269,650
TOTAL COST ESTIMATE				$2,067,317

Appendix F

Dechlorination Memorandum

Review of Natural PCB Degradation Processes in Sediments for the Lower Fox River and Green Bay, Wisconsin

Prepared for:

Wisconsin Dept. of Natural Resources

♦ **The RETEC Group, Inc.**

RETEC Project No.: WISCN-14414

December 2002

Review of Natural PCB Degradation Processes in Sediments

Prepared by:

The RETEC Group, Inc.
3040 William Pitt Way
Pittsburgh, Pennsylvania 15238

RETEC Project No.: WISCN-14414-530

Prepared for:

Wisconsin Department of Natural Resources
101 South Webster Street
Madison, Wisconsin 53707

Prepared by:

Alessandro Battaglia

Alessandro Battaglia, Ph.D., P.E.

Project Manager:

Paul F. Putzier

Paul Putzier, P.G.

Reviewed by:

Timothy A. Thompson

Timothy Thompson

December 2002

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1 Introduction

This paper provides a review of literature documenting field and laboratory studies that examine the occurrence and extent of natural biodegradation processes (aerobic degradation and anaerobic dechlorination) of polychlorinated biphenyls (PCBs) at various sites both in the U.S and internationally. The review was prepared as part of the Lower Fox River Remedial Investigation/Feasibility Study.

The objective of this review was to evaluate information relating to the viability of natural biodegradation as a potential remedial action for the sediment-bound PCBs in the Lower Fox River and Green Bay. The information presented in this paper will be evaluated together with additional site-specific information generated for the Lower Fox River and Green Bay in the Feasibility Study. It is recognized that the rate at which *in situ* microbial processes can occur is an important element of any evaluation of such processes when assessing natural bioremediation as a potential remedial action. However, based on the results of the literature review presented here, no degradation (aerobic or anaerobic) rates have been reliably measured under field conditions. The only rates that have been estimated are for laboratory experiments done under controlled conditions. These rates are generally not applicable to field conditions; as such, they are not reported in this paper.

The paper consists of five sections, in addition to this introductory section, articulated as follows.

- Section 2 provides an overview of PCB chemistry and nomenclature;
- Section 3 provides a review of microbial processes relevant to PCBs;
- Section 4 provides a review of field and laboratory studies of natural degradation of PCBs in sediments;
- Section 5 provides the conclusion of the literature review; and
- Section 6 is a list of cited references.

2 PCB Chemistry, Nomenclature, and Toxicology

PCBs are a class of 209 individual chemicals (PCB congeners), in which one to ten chlorine atoms are attached to a biphenyl molecular frame. PCBs were commercially produced as mixtures for a variety of uses, including dielectric fluids in capacitors and transformers, and carbonless copy paper. Monsanto Industrial Chemicals Company (Monsanto) was the world's largest producer and sole manufacturer of commercial PCBs in the U.S. Monsanto marketed PCBs under the trade name Aroclor from 1930 to 1977 (Erickson 1986). Table 2-1 provides a list of the uses of PCBs and the type of Aroclor used.

Most Aroclors contained from 60 to 90 different PCB congeners and were identified by a four-digit number; the first two digits were usually 12, for 12 carbon atoms, and the last two digits indicated the percent substituted chlorine by weight. Thus, Aroclor 1242 contains 12 carbon atoms and 42% substituted chlorine by weight (Hutzinger *et al*., 1974; Bedard and Quensen 1995). Table 2-2 provides the chlorine content of various Aroclors.

Key to the discussion of natural degradation processes is an understanding of the nomenclature associated with the numbering and position of the chlorine atoms within the PCB biphenyl rings. The general chemical formula for PCBs is

$$C_{12}H_{10-n}Cl_n$$

with n indicating the number of chlorine substitutions; n=1 through 10.

PCB congeners with the same number of chlorine substitutions are defined as a class of PCB homologs. For example, the twenty-four PCB congeners with three chlorine substitutions form the trichlorobiphenyl homolog class. PCB congeners in a given homolog class are sometimes referred to as PCB isomers (Erickson, 1986).

The chlorine positions on the biphenyl rings are numbered as shown in Figure 2-1(a). Different congeners are specified by the positions of the chlorine atoms. For example, in Figure 2-1(b), the 2,4'-dichlorobiphenyl is shown. (As discussed later, this is the most abundant congener in Aroclor 1242). PCB congeners have been arranged in ascending numerical order between 0 (biphenyl) and 209 (2,2',3,3',4,4',5,5',6,6'–decachlorobiphenyl) and are commonly identified by this number, which is referred to as the "IUPAC" or "PCB" number. For example, the 2,4' dichlorobiphenyl congener is also referred to as PCB 8. Finally, some authors refer to individual congeners by listing the substituted positions on each ring, separated by a hyphen. Thus, in this notation 2,4' dichlorobiphenyl is referred to as 2-4 chlorobiphenyl or 2-4-CB. This paper reports on studies by a number of authors. To minimize the possibility of transcription errors, the notation used by each author is used when reporting on that author's results.

As shown in Figure 2-1(c), chlorine atoms at positions 2, 6, 2' and 6' are referred to as being oriented *ortho* with respect to the opposite phenyl ring. Positions 3, 5, 3' and 5' are oriented *meta*, while positions 4 and 4' are oriented *para* with respect to the opposite phenyl ring.

Table 2-1 Uses of PCBs (from Huntzinger *et al.*, 1974)

Use of PCB	Grade of Aroclor Used
Electrical capacitors	1016 (1221, 1254)
Electrical transformers	1242, 1254, 1260
Vacuum pumps	1248, 1254
Gas-transmission turbines	1221, 1242
Hydraulic fluids	1232, 1242, 1248, 1254, 1260
Plasticizer in synthetic resins	1248, 1254, 1260, 1262, 1268
Adhesives	1221, 1232, 1242, 1248, 1254
Plasticizer in rubbers	1221, 1232, 1242, 1248, 1254, 1268
Heat transfer systems	1242
Wax extenders	1242, 1254, 1268
Dedusting agents	1254, 1260
Pesticide extenders, inks, lubicants, cutting oils	1254
Carbonless reproducing paper	1242

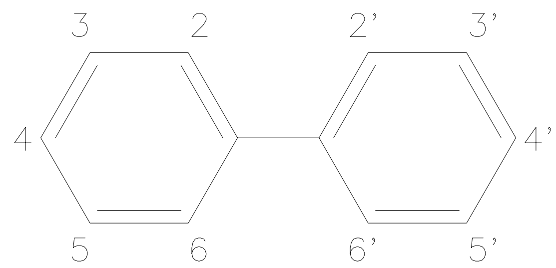
Table 2-2 Chlorine Content of Aroclor Preparations

Aroclor	% Cl	Average number of Cl per molecule	Average molecular weight
1221	20.5 – 21.5	1.15	192
1232	31.5 – 32.5	2.04	221
1242	42	3.10	261
1248	48	3.90	288
1254	54	4.96	327
1260	60	6.30	372
1262	61.5 – 62.5	6.80	389
1268	68	8.70	453

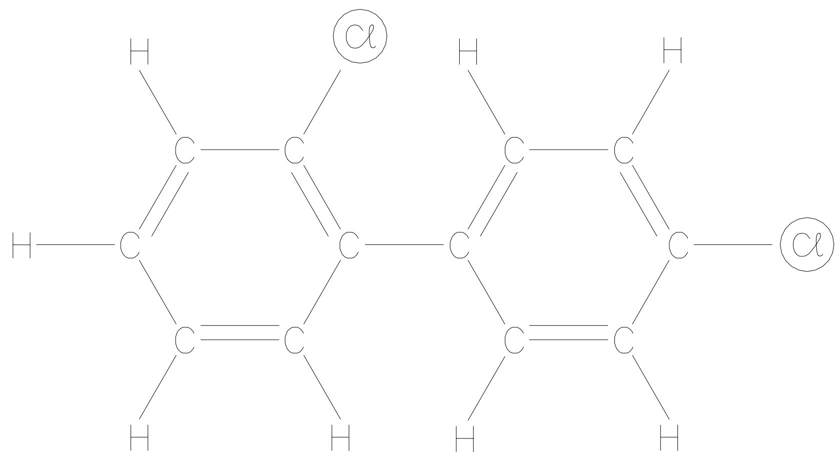
Selected physical and chemical properties of PCB congeners are presented in Tables 2-3 and 2-4. Table 2-5 presents the molecular composition of some Aroclors. This table shows that Aroclor 1242 is mostly comprised of tri-, tetra- and pentachlorobiphenyls, and that no congeners with more than six chlorine substitutions are present in Aroclor 1242.

Figure 2-1 PCB Structure and Nomenclature

a) Numbering in the Biphenyl Ring System



b) Structure of 2,4'- dichlorobiphenyl



c) Orientation of Chlorine Atoms in Biphenyl Ring System

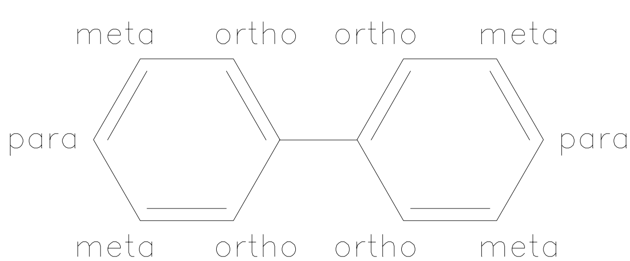


Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s $mmol/m^3$	Subcooled Liquid Concentration C_L $mmol/m^3$	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
0	0	154.21	1.3	3.69	7	45.39	129.7	3.9	53.5
1	2	188.66	2.04	2.5	5.5	29.15	35.66	4.3	70.1
2	3	188.66	1	1	2.5	13.25	13.24	4.6	75.55
3	4	188.66	0.271	0.9	1.2	6.36	21.15	4.5	42.56
4	2,2'	223.11	0.265	0.6	1	4.48	10.14	4.9	59.17
5	2,3	223.11							
6	2,3'	223.11							
7	2,4	223.11	0.254	0.25	1.25	5.6	5.51	5	45.39
8	2,4'	223.11			1	4.48	6.73	5.1	
9	2,5	223.11	0.18	0.18	2	8.96	8.95	5.1	20.1
10	2,6	223.11			1.4	6.28	7.84	5	
11	3,3'	223.11	0.027	0.03	0.354	1.587	1.738	5.3	17.26
12	3,4	223.11			0.008				
13	3,4'	223.11							
14	3,5	223.11	0.105	0.12					
15	4,4'	223.11	0.0048	0.08	0.06	0.269	4.56	5.3	17
16	2,2',3	257.56							
17	2,2',4	257.56							
18	2,2',5	257.56	0.143	0.22	0.4	1.55	2.39	5.6	92.21
19	2,2',6	257.56							
20	2,3,3'	257.56							
21	2,3,4	257.56							
22	2,3,4'	257.56							
23	2,3,5	257.56							
24	2,3,6	257.56							
25	2,3',4	257.56							
26	2,3',5	257.56			0.251	0.975	1.387		

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s $mmol/m^3$	Subcooled Liquid Concentration C_L $mmol/m^3$	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
27	2,3',6	257.56							
28	2,4,4'	257.56			0.16	0.621	1.28	5.8	
29	2,4,5	257.56	0.132	0.044	0.14	0.544	1.81	5.6	24.29
30	2,4,6		0.0384	0.09	0.2	0.777	1.82	5.5	49.51
31	2,4',5	257.56							
32	2,4',6	257.56							
33	2,3,4	257.56	0.0136	0.003	0.08	0.311	0.69	5.8	43.67
34	2',3,5	257.56							
35	3,3',4	257.56							
36	3,3',5	257.56							
37	3,4,4'	257.56			0.015	0.0582	0.24	5.9	
38	3,4,5	257.56							
39	3,4',5	257.56							
40	2,2',3,3'	292.01	0.00225	0.002	0.03	0.103	0.91	5.6	21.94
41	2,2',3,4	292.01							
42	2,2',3,4'	292.01							
43	2,2',3,5	292.01							
44	2,2',3,5'	292.01			0.1	0.342	0.565	6	
45	2,2',3,6	292.01							
46	2,2',3,6'	292.01							
47	2,2',4,4'	292.01	0.0054	0.002	0.09	0.308	1.15	5.9	17.38
48	2,2',4,5	292.01							
49	2,2',4,5'	292.01			0.016	0.0548	0.133	6.1	
50	2,2',4,6	292.01							
51	2,2',4,6'	292.01							
52	2,2',5,5'	292.01	0.0049	0.002	0.03	0.103	0.42	6.1	47.59
53	2,2,5,6'	292.01						5.5	
54	2,2',5,6'	292.01						5.48	

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s $mmol/m^3$	Subcooled Liquid Concentration C_L $mmol/m^3$	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
55	2,3,3',4	292.01							
56	2,3,3',4'	292.01							
57	2,3,3',5	292.01							
58	2,3,3',5'	292.01							
59	2,3,3',6	292.01							
60	2,3,4,4'	292.01						6.31	
61	2,3,4,5	292.01			0.02	0.0685	0.314	5.9	
62	2,3,4,6	292.01							
63	2,3,4',5	292.01							
64	2,3,4',6	292.01							
65	2,3',4,4'	292.01						5.94	
66	2,3',4,4'	292.01			0.04	0.0147	1.3	5.8	
67	2,3',4,5	292.01							
68	2,3',4,5'	292.01							
69	2,3',4,6	292.01							
70	2,3',4',5	292.01							
71	2,3',4',6	292.01							
72	2,3',5,5'	292.01							
73	2,3',5',6	292.01							
74	2,4,4',5	292.01							
75	2,4,4',6	292.01			0.091			6.21	
76	2',3,4,5	292.01							
77	3,3',4,4'	292.01	0.0000588	0.002	0.001	0.0342	1.165	6.5	1.72
78	3,3',4,5	292.01							
79	3,3',4,5'	292.01							
80	3,3',5,5'	292.01			0.0012	0.0041	0.0974		
81	3,4,4',5	292.01							
82	2,2',3,3',4	326.46							
83	2,2',3,3',5	326.46							

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s mmol/m^3	Subcooled Liquid Concentration C_L mmol/m^3	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
84	2,2',3,3',6	326.46							
85	2,2',3,4,4'	326.46							
86	2,2'3,4,5	326.46	0.00927	0.051	0.02	0.0613	0.337	6.2	151.4
87	2,2',3,4,5'	326.46	0.000304	0.0023	0.004	0.0123	0.0927	6.5	24.81
88	2,2',3,4,6	326.46			0.012	0.0368	0.202	6.5	
89	2,2',3,4,6'	326.46							
90	2,2',3,4',5	326.46							
91	2,2',3,4',6	326.46							
92	2,2',3,5,5'	326.46							
93	2,2',3,5,6	326.46							
94	2,2',3,5,6'	326.46							
95	2,2',3,5',6	326.46							
96	2,2',3,6,6'	326.46							
97	2,2',3',4,5	326.46							
98	2,2',3',4,6	326.46							
99	2,2',4,4',5	326.46							
100	2,2',4,4',6	326.46							
101	2,2',4,5,5'	326.46	0.00109	0.0035	0.01	0.0306	0.0986	6.4	35.48
102	2,2',4,5,6'	326.46							
103	2,2',4,5,6'	326.46							
104	2,2',4,6,6'	326.46		0.00434	0.0156	0.0306	0.3103		13.98
105	2,3,3',4,4'	326.46						6	
106	2,3,3',4,5	326.46							
107	2,3,3',4',5	326.46							
108	2,3,3',4,5'	326.46							
109	2,3,3',4,6	326.46							
110	2,3,3',4',6	326.46			0.004			6.3	
111	2,3,3',5,5'	326.46							
112	2,3,3',5,6	326.46							

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s $mmol/m^3$	Subcooled Liquid Concentration C_L $mmol/m^3$	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
113	2,3,3',5',6	326.46							
114	2,3,4,4',5	326.46							
115	2,3,4,4',6	326.46							
116	2,3,4,5,6	326.46			0.008	0.0145	0.233	6.3	
117	2,3,4',5,6	326.46							
118	2,3',4,4',5	326.46							
119	2,3',4,4',6	326.46							
120	2,3',4,5,5'	326.46							
121	2,3',4,5',6	326.46							
122	2,3,3',4,5	326.46							
123	2',3,4,4',5	326.46							
124	2',3,4,5,5'	326.46							
125	2',3,4,5,6'	326.46							
126	3,3',4,4',5	326.46							
127	3,3',4,5,5'	326.46							
128	2,2',3,3',4,4'	360.91	0.0000198	0.00034	0.0006	0.00166	0.0286	7	11.91
129	2,2',3,3',4,5	360.91			0.0006	0.00166	0.0065	7.3	
130	2,2',3,3',4,5'	360.91							
131	2,2',3,3',4,6	360.91							
132	2,2',3,3',4,6'	360.91							
133	2,2',3,3',5,5'	360.91							
134	2,2',3,3',5,6	360.91			0.0004	0.00111	0.0061	7.3	
135	2,2',3,3',5,6'	360.91							
136	2,2',3,3',6,6'	360.91			0.0008	0.00222	0.0161	6.7	
137	2,2',3,4,4',5	360.91							
138	2,2',3,4,4',5'	360.91							
139	2,2',3,4,4',5'	360.91							
140	2,2',3,4,4',6'	360.91							
141	2,2',3,4,5,5'	360.91							

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s $mmol/m^3$	Subcooled Liquid Concentration C_L $mmol/m^3$	Log K_{ow}	Henry's Law Const. H $Pa\ m^3/mol$
142	2,2',3,4,5,6	360.91							
143	2,2',3,4,5,6	360.91							
144	2,2',3,4,5',6	360.91							
145	2,2',3,4,5',6	360.91							
146	2,2',3,4',5,5'	360.91							
147	2,2',3,4,6,6'	360.91							
148	2,2',3,4',5,6'	360.91							
149	2,2',3,4',5',6	360.91							
150	2,2',3,4',6,6'	360.91							
151	2,2',3,5,5',6	360.91							
152	2,2',3,5,6,6'	360.91							
153	2,2',4,4',5,5'	360.91	0.000119	0.0007	0.001	0.00277	0.0163	6.9	42.9
154	2,2',4,4',5,6'	360.91							
155	2,2',4,4',6,6'	360.91	0.00048	0.00363	0.002	0.0055	0.042	7	86.616
156	2,3,3',4,4',5	360.91							
157	2,3,3',4,4',5'	360.91							
158	2,3,3',4,4',6	360.91							
159	2,3,3',4,5,5'	360.91							
160	2,3,3',4,5,6	360.91							
161	2,3,3',4,5',6	360.91							
162	2,3,3',4',5,5'	360.91							
163	2,3,3',4',5,6	360.91							
164	2,3,3',4',5',6	360.91							
165	2,3,3',5,5',6	360.91							
166	2,3,4,4',5,6	360.91							
167	2,3',4,4',5,5	360.91							
168	2,3',4,4',5',6	360.91							
169	3,3',4,4',5,5'	360.91							
170	2,2',3,3',4,4',5	395.36							

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s $mmol/m^3$	Subcooled Liquid Concentration C_L $mmol/m^3$	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
171	2,2',3,3',4,4',6	395.36	0.0000273	0.00025	0.002	0.00506	0.046	6.7	5.4
172	2,2',3,3',4,5,5'	395.36							
173	2,2',3,3',4,5,6	395.36							
174	2,2',3,3',4,5,6'	395.36							
175	2,2',3,3',4,5',6	395.36							
176	2,2',3,3',4,6,6'	395.36							
177	2,2',3,3',4',5,6	395.36							
178	2,2',3,3',5,5',6	395.36							
179	2,2',3,3',5,6,6'	395.36							
180	2,2',3,4,4',5,5'	395.36							
181	2,2',3,4,4',5,5'	395.36							
182	2,2',3,4,4',5,6'	395.36							
183	2,2',3,4,4',5',6	395.36							
184	2,2',3,4,4',6,6'	395.36							
185	2,2',3,4,5,5',6	395.36			0.00045	0.00114	0.0191	7	
186	2,2',3,4,5,6,6'	395.36							
187	2,2',3,4',5,5',6	395.36							
188	2,2',3,4',5,6,6'	395.36							
189	2,3,3',4,4',5,5'	395.36							
190	2,3,3',4,4',5,6	395.36							
191	2,3,3',4,4',5',6	395.36							
192	2,3,3',4,5,5',6	395.36							
193	2,3,3',4',5,5',6	395.36							
194	2,2',3,3',4,4',5,5'	429.81			0.0002	0.00047	0.0098	7.4	
195	2,2',3,3',4,4',5,6	429.81							
196	2,2',3,3',4,4',5',6	429.81							
197	2,2',3,3',4,4',6,6'	429.81							
198	2,2',3,3',4,5,5',6	429.81							
199	2,2',3,3',4,5,5',6'	429.81							

Table 2-3 Summary of Physical-Chemical Properties of PCB Congeners (Continued)

Number	Structure	Molecular Weight	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Water Solubility S g/m^3	Solid Molar Concentration C^s mmol/m^3	Subcooled Liquid Concentration C_L mmol/m^3	Log K_{ow}	Henry's Law Const. H Pa m^3/mol
200	2,2',3,3',4,5,6,6'	429.81							
201	2,2',3,3',4,5',6,6'	429.81							
202	2,2',3,3',5,5',6,6'	429.81	0.0000266	0.0006	0.0003	0.0007	0.0158	7.1	38.08
203	2,2',3,4,4',5,5',6	429.81							
204	2,2',3,4,4',5',6,6'	429.81							
205	2,3,3',4,4',5,5',6	429.81							
206	2,2',3,3',4,4',5,5',6	464.26	0.000000197	0.000012	0.00011	0.000237	0.0146	7.2	82.2
207	2,2',3,3',4,4',5,6,6'	464.26						7.52	
208	2,2',3,3',4,5,5',6,6'	464.26			0.000018	0.000038	0.00141	8.16	
209	2,2',3,3',4,4',5,5',6,6'	498.71	5.02E-08	0.00003	0.000001	0.000002	0.0144	8.26	20.84

Table 2-4 Summary of Physical-Chemical Properties of PCB Isomer Groups and Aroclor Mixtures at 20-25 Degrees Celsius

PCB Isomer Groups	Water Solubility S g/m^3	Solid Molar Concentration C^s mmol/m^3	Subcooled Liquid Concentration C_L mmol/m^3	Solid Vapor Pressure P^s Pa	Subcooled Liquid Vapor Pressure P_L Pa	Henry's Law Const. H Pa m^3/mol	Log K_{ow} range
Biphenyl	7.0	45.39	129.7	1.30	3.69	28.64	3.90
Mono-	1.21 - 5.50	6.36 - 29.15	113.24 - 35.66	0.271 - 2.04	0.9 - 2.5	42.56 - 75.55	4.3 - 4.60
Di-	0.060 - 2.0	0.269 - 8.96	4.56 - 10.14	0.0048 - 0.279	0.008 - 0.60	17.0 - 92.21	4.9 - 5.30
Tri-	0.015 - 0.40	0.0582 - 1.55	0.24 - 2.39	0.0136 - 0.143	0.003 - 0.22	24.29 - 92.21	5.5 - 5.90
Tetra-	0.0043 - 0.010	0.0147 - 0.342	0.133 - 1.30	0.000059 - 0.0054	0.002	1.72 - 47.59	5.6 - 6.50
Penta-	0.004 - 0.020	0.0123 - 0.0613	0.093 - 0.337	0.000304 - 0.0093	0.0023 - 0.051	24.8 - 151.4	6.2 - 6.50
Hexa-	0.0004 - 0.0007	0.0011 - 0.002	0.0061 - 0.0286	0.000020 - 0.0015	0.0007 - 0.012	11.9 - 818	6.7 - 7.30
Hepta-	0.000045 - 0.0002	0.00114 - 0.0051	0.0191 - 0.046	0.0000273	0.00025	5.40	6.7 - 7.0
Octa-	0.0002 - 0.0003	0.00047 - 0.0007	0.0098 - 0.0158	0.0000266	0.0006	38.08	7.10
Nona-	0.00018 - 0.0012	0.000038 - 0.00024	0.00141 - 0.0146				7.2 - 8.16
Deca-	0.000761	0.0000024	0.0144	0.00000005	0.00003	20.84	8.26

Arochlor Mixtures	Water Solubility S g/m^3		Subcooled Liquid Concentration C_L mmol/m^3		Subcooled Liquid Vapor Pressure P_L Pa	Henry's Law Const. H Pa m^3/mol	Log K_{ow} range
Arochlor 1016	0.22 - 0.84		0.856 - 0.216		0.06 - 0.2	70 - 900	4.4 - 5.8
Arochlor 1221	0.59 - 5.0		0.307 - 26.0		0.89 - 2.0	34 - 450	4.1 - 4.7
Arochlor 1232	1.45		6.56 - 2.0		0.54	82 - 270	4.5 - 5.2
Arochlor 1242	0.1 - 0.75		0.383 - 2.87		0.05 - 0.13	45 - 130	4.5 - 5.8
Arochlor 1248	0.1 - 0.5		0.347 - 1.74		0.0085 - 0.11	5 - 300	5.8 - 6.3
Arochlor 1254	0.01 - 0.30		0.306 - 0.92		0.008 - 0.02	20 - 260	6.1 - 6.8
Arochlor 1260	0.003 - 0.08		0.00806 - 0.215		0.0002 - 0.012	20 - 60	6.3 - 7.5

Table 2-5 Molecular Composition of Some Aroclors (from Huntzinger *et al.*, 1974)

Chlorobiphenyl Composition	Presence (%) in Aroclor			
	1242	1248	1254	1260
$C_{12}H_9Cl$	3			
$C_{12}H_8Cl_2$	13	2		
$C_{12}H_7Cl_3$	28	18		
$C_{12}H_6Cl_4$	30	40	11	
$C_{12}H_5Cl_5$	22	36	49	12
$C_{12}H_4Cl_6$	4	4	34	38
$C_{12}H_3Cl_7$			6	41
$C_{12}H_2Cl_8$				8
$C_{12}HCl_9$				1

Table 2-6 (from Schulz *et al*., 1989) and Figure 2-2 present the congener composition (on a weight basis) of Aroclor 1242. From this table, it can be seen that the most abundant congener in this Aroclor is 2,4'–dichlorobiphenyl (PCB 8) at 7.65% by weight. The congeners 2,4,4'–trichlorobiphenyl (PCB 28) and 2,2',5–trichlorobiphenyl (PCB 18) are also abundant at 6.52% and 6.28% by weight, respectively.

A large number of studies have linked PCBs with a variety of health effects, including cancer. A study of four commercial mixtures (Aroclors 1016, 1242, 1254, and 1260) demonstrated that all PCB mixtures can cause cancer, although different mixtures have different potencies (Brunner *et al*., 1996). The EPA used the study by Brunner *et al*. (1996) to develop cancer slope factors for different congeners (EPA, 1996). The cancer slope factors also vary depending on the route of exposure. Table 2-7 presents the cancer slope factors for different PCB aroclors and exposure pathways.

There is evidence that dioxin-like congeners may cause cancer by the same mechanism as 2,3,7,8 tetrachlorodibenzo-p-dioxin (dioxin). EPA (1996) has developed toxicity equivalency factors that allow the toxicity of dioxin-like congeners to be related to the toxicity of dioxin. Table 2-7 presents the cancer slope factors for specific congeners based on their similarity to dioxin. Congeners 77 (34-34), 126 (345-34) and 169 (345-345) are non-ortho chlorinated and most resemble dioxin (Sonzogni *et al*., 1991). These congeners have the highest cancer slope factors. The congeners with the most dioxin-like behavior have chlorine molecules in non-ortho positions. This is significant because PCBs with chlorines in non-*ortho* positions are the most suitable to anaerobic dechlorination, as discussed in detail later in this paper. The Aroclors and congeners presented in Table 2-7 are those evaluated in the human health risk assessment for the Lower Fox River and Green Bay.

Table 2-6 Percent Contribution of Individual Congeners to Aroclor 1242

Number	Structure	Weight Percent
0	0	0
1	2	0
2	3	0
3	4	0
4	2,2'	3.01
5	2,3	0.060
6	2,3'	1.38
7	2,4	0.60
8	2,4'	7.65
9	2,5	0.54
10	2,6	0.20
11	3,3'	0
12	3,4	0
13	3,4'	0
14	3,5	0
15	4,4'	1.51
16	2,2',3	2.01
17	2,2',4	2.88
18	2,2',5	6.28
19	2,2',6	0.53
20	2,3,3'	0.29
21	2,3,4	0
22	2,3,4'	3.41
23	2,3,5	0.00
24	2,3,6	0.22
25	2,3',4	0.79
26	2,3',5	1.33
27	2,3',6	0.28
28	2,4,4'	6.52
29	2,4,5	0.10
30	2,4,6	0
31	2,4',5	4.59
32	2,4',6	0.88
33	2,3,4	4.79
34	2',3,5	0.050
35	3,3',4	0.11
36	3,3',5	0
37	3,4,4'	0.27
38	3,4,5	0
39	3,4',5	0
40	2,2',3,3'	0.89
41	2,2',3,4	1.86
42	2,2',3,4'	0.83
43	2,2',3,5	0
44	2,2',3,5'	3.20
45	2,2',3,6	1.16
46	2,2',3,6'	0.49
47	2,2',4,4'	0.94
48	2,2',4,5	0.82
49	2,2',4,5'	3.60
50	2,2',4,6	0
51	2,2',4,6'	0.23
52	2,2',5,5'	4.04
53	2,2,5,6'	0.64
54	2,2',5,6'	0
55	2,3,3',4	0
56	2,3,3',4'	1.60
57	2,3,3',5	0
58	2,3,3',5'	0
59	2,3,3',6	0.34
60	2,3,4,4'	1.33
61	2,3,4,5	0
62	2,3,4,6	0
63	2,3,4',5	0.23
64	2,3,4',6	1.64
65	2,3',4,4'	0
66	2,3',4,4'	1.66
67	2,3',4,5	0.41
68	2,3',4,5'	0
69	2,3',4,6	0.11
70	2,3',4',5	3.89
71	2,3',4',6	0
72	2,3',5,5'	0
73	2,3',5',6	0
74	2,4,4',5	2.17
75	2,4,4',6	0.11
76	2',3,4,5	0
77	3,3',4,4'	0.45
78	3,3',4,5	0
79	3,3',4,5'	0
80	3,3',5,5'	0
81	3,4,4',5	0
82	2,2',3,3',4	0.44
83	2,2',3,3',5	0.12
84	2,2',3,3',6	0.72
85	2,2',3,4,4'	0.53
86	2,2'3,4,5	0
87	2,2',3,4,5'	0.77
88	2,2',3,4,6	0
89	2,2',3,4,6'	0
90	2,2',3,4',5	0.32
91	2,2',3,4',6	0.17
92	2,2',3,5,5'	0.25
93	2,2',3,5,6	0
94	2,2',3,5,6'	0
95	2,2',3,5',6	2.87
96	2,2',3,6,6'	0
97	2,2',3',4,5	0.65
98	2,2',3',4,6	0
99	2,2',4,4',5	0.86
100	2,2',4,4',6	0
101	2,2',4,5,5'	1.33
102	2,2',4,5,6'	0
103	2,2',4,5,6'	0
104	2,2',4,6,6'	0

Table 2-6 Percent Contribution of Individual Congeners to Aroclor 1242 (Con't)

Number	Structure	Weight Percent
105	2,3,3',4,4'	0.86
106	2,3,3',4,5	0
107	2,3,3',4',5	0.07
108	2,3,3',4,5'	0
109	2,3,3',4,6	0
110	2,3,3',4',6	1.53
111	2,3,3',5,5'	0
112	2,3,3',5,6	0
113	2,3,3',5',6	0
114	2,3,4,4',5	0
115	2,3,4,4',6	0
116	2,3,4,5,6	0
117	2,3,4',5,6	0
118	2,3',4,4',5	1.62
119	2,3',4,4',6	0.05
120	2,3',4,5,5'	0
121	2,3',4,5',6	0
122	2,3,3',4,5	0
123	2',3,4,4',5	0
124	2',3,4,5,5'	0
125	2',3,4,5,6'	0
126	3,3',4,4',5	0
127	3,3',4,5,5'	0
128	2,2',3,3',4,4'	0
129	2,2',3,3',4,5	0
130	2,2',3,3',4,5'	0
131	2,2',3,3',4,6	0
132	2,2',3,3',4,6'	0.30
133	2,2',3,3',5,5'	0
134	2,2',3,3',5,6	0
135	2,2',3,3',5,6'	0.08
136	2,2',3,3',6,6'	0.07
137	2,2',3,4,4',5	0
138	2,2',3,4,4',5'	0.54
139	2,2',3,4,4',5'	0
140	2,2',3,4,4',6'	0
141	2,2',3,4,5,5'	0
142	2,2',3,4,5,6	0
143	2,2',3,4,5,6	0
144	2,2',3,4,5',6	0
145	2,2',3,4,5',6	0
146	2,2',3,4',5,5'	0
147	2,2',3,4,6,6'	0
148	2,2',3,4',5,6'	0
149	2,2',3,4',5',6	0.63
150	2,2',3,4',6,6'	0
151	2,2',3,5,5',6	0
152	2,2',3,5,6,6'	0
153	2,2',4,4',5,5'	0.68
154	2,2',4,4',5,6'	0
155	2,2',4,4',6,6'	0
156	2,3,3',4,4',5	0.09

Number	Structure	Weight Percent
157	2,3,3',4,4',5'	0
158	2,3,3',4,4',6	0
159	2,3,3',4,5,5'	0
160	2,3,3',4,5,6	0
161	2,3,3',4,5',6	0
162	2,3,3',4',5,5'	0
163	2,3,3',4',5,6	0
164	2,3,3',4',5',6	0
165	2,3,3',5,5',6	0
166	2,3,4,4',5,6	0
167	2,3',4,4',5,5	0
168	2,3',4,4',5',6	0
169	3,3',4,4',5,5'	0
170	2,2',3,3',4,4',5	0.11
171	2,2',3,3',4,4',6	0.05
172	2,2',3,3',4,5,5'	0
173	2,2',3,3',4,5,6	0
174	2,2',3,3',4,5,6'	0
175	2,2',3,3',4,5',6	0
176	2,2',3,3',4,6,6'	0
177	2,2',3,3',4',5,6	0
178	2,2',3,3',5,5',6	0
179	2,2',3,3',5,6,6'	0
180	2,2',3,4,4',5,5'	0.06
181	2,2',3,4,4',5,5'	0
182	2,2',3,4,4',5,6'	0
183	2,2',3,4,4',5',6	0
184	2,2',3,4,4',6,6'	0
185	2,2',3,4,5,5',6	0
186	2,2',3,4,5,6,6'	0
187	2,2',3,4',5,5',6	0
188	2,2',3,4',5,6,6'	0
189	2,3,3',4,4',5,5'	0
190	2,3,3',4,4',5,6	0
191	2,3,3',4,4',5',6	0
192	2,3,3',4,5,5',6	0
193	2,3,3',4',5,5',6	0
194	2,2',3,3',4,4',5,5'	0
195	2,2',3,3',4,4',5,6	0
196	2,2',3,3',4,4',5',6	0
197	2,2',3,3',4,4',6,6'	0
198	2,2',3,3',4,5,5',6	0
199	2,2',3,3',4,5,5',6'	0
200	2,2',3,3',4,5,6,6'	0
201	2,2',3,3',4,5',6,6'	0
202	2,2',3,3',5,5',6,6'	0
203	2,2',3,4,4',5,5',6	0
204	2,2',3,4,4',5',6,6'	0
205	2,3,3',4,4',5,5',6	0
206	2,2',3,3',4,4',5,5',6	0
207	2,2',3,3',4,4',5,6,6'	0
208	2,2',3,3',4,5,5',6,6'	0
209	2,2',3,3',4,4',5,5',6,6'	0

Figure 2-2 Percent Contribution of Individual Congeners to Aroclor 1242

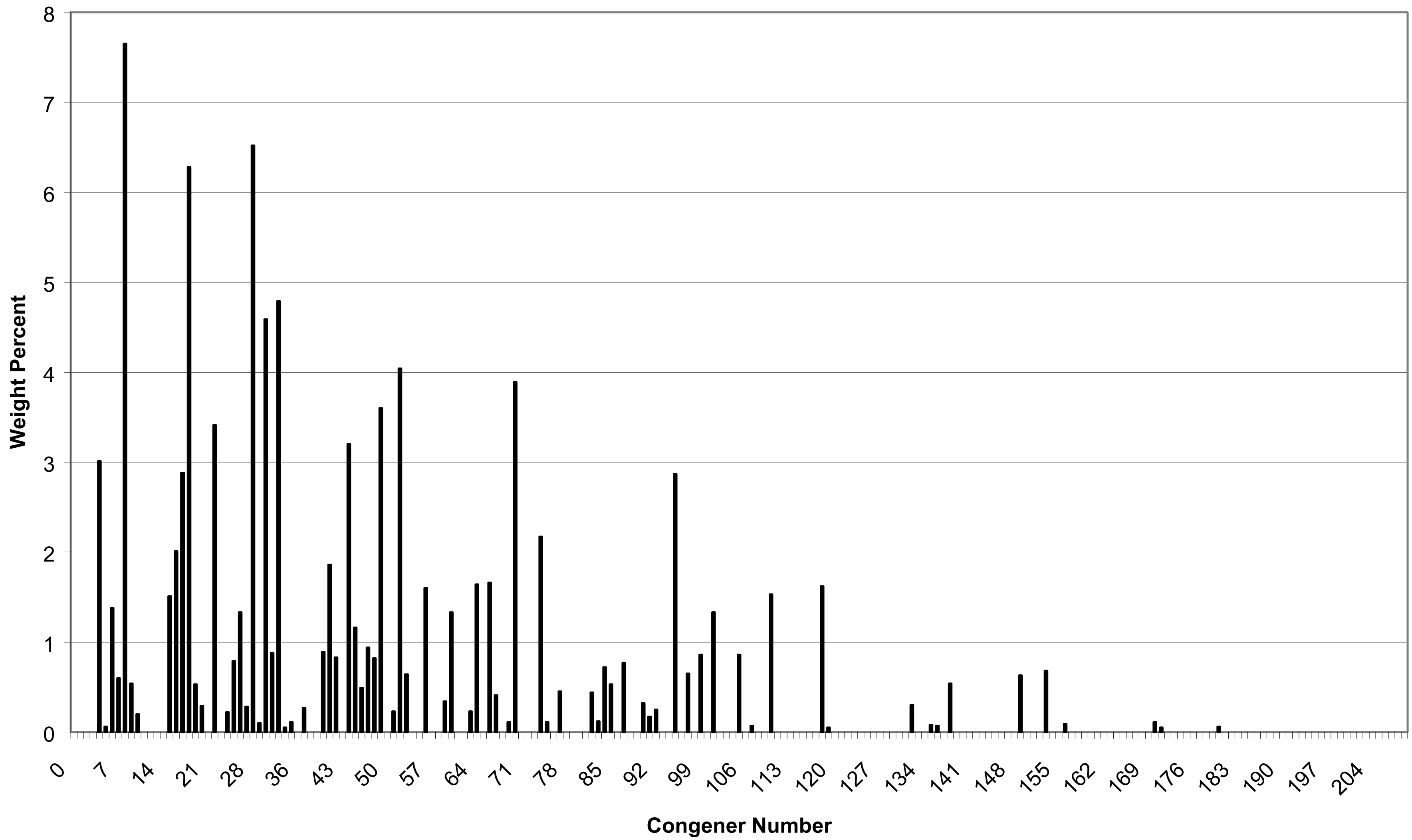


Table 2-7 Cancer Slope Factors for Selected Aroclors and PCB Congeners

Chemical of Potential Concern	Oral Soil/Sed CSFslo $(mg/Kg\text{-}day)^{-1}$	Oral Water CSFwo $(mg/Kg\text{-}day)^{-1}$	Oral Fish/Food CSFfo $(mg/Kg\text{-}day)^{-1}$	Dermal Soil/Sed CSFsld $(mg/Kg\text{-}day)^{-1}$	Dermal Water CSFwd $(mg/Kg\text{-}day)^{-1}$	Inhalation Vapor CSFavi $(mg/Kg\text{-}day)^{-1}$	Inhalation Particulate CSFapi $(mg/Kg\text{-}day)^{-1}$
Aroclor 1016	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Aroclor 1221	2	0.4	2	2	0.4	0.4	2
Aroclor 1232	2	0.4	2	2	0.4	0.4	2
Aroclor 1242	2	0.4	2	2	0.4	0.4	2
Aroclor 1248	2	0.4	2	2	0.4	0.4	2
Aroclor 1254	2	0.4	2	2	0.4	0.4	2
Aroclor 1260	2	0.4	2	2	0.4	0.4	2
3,3',4,4'-TeCB (PCB-77)	75	75	75	75	75	75	75
2,3,3',4,4'-PeCB (PCB-105)	15	15	15	15	15	15	15
2,3,4,4',5-PeCB (PCB-114)	75	75	75	75	75	75	75
2,3',4,4',5-PeCB (PCB-118)	15	15	15	15	15	15	15
2',3,4,4',5-PeCB (PCB-123)	15	15	15	15	15	15	15
3,3',4,4',5-PeCB (PCB-126)	15,000	15,000	15,000	15,000	15,000	15,000	15,000
2,3,3',4,4',5-HxCB (PCB-156)	75	75	75	75	75	75	75
2,3,3',4,4',5'-HxCB (PCB-157)	75	75	75	75	75	75	75
2,3',4,4',5,5'-HxCB (PCB-167)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
3,3',4,4',5,5'-HxCB (PCB-169)	1,500	1,500	1,500	1,500	1,500	1,500	1,500
2,2',3,3',4,4',5-HpCB (PCB-170)	15	15	15	15	15	15	15
2,2',3,4,4',5,5'-HpCB (PCB-180)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2,3,3',4,4',5,5'-HpCB (PCB-189)	15	15	15	15	15	15	15

3 Review of PCB Microbial Degradation Processes

PCBs are stable compounds that do not degrade easily. Under certain conditions, they may be destroyed by chemical, thermal, and biological processes (Erickson, 1986). In the environment, photolysis is the only significant chemical degradation process. However, microbial processes are the main route of environmental degradation in PCBs.

Photochemical degradation in water or sediments is likely not a significant means of PCB losses in the environment due to the following facts (Hutzinger *et al*., 1974):

- PCBs have low solubilities in water; and
- UV and solar radiation do not penetrate deeply into solid media, making photodegradation in the solid state inefficient.

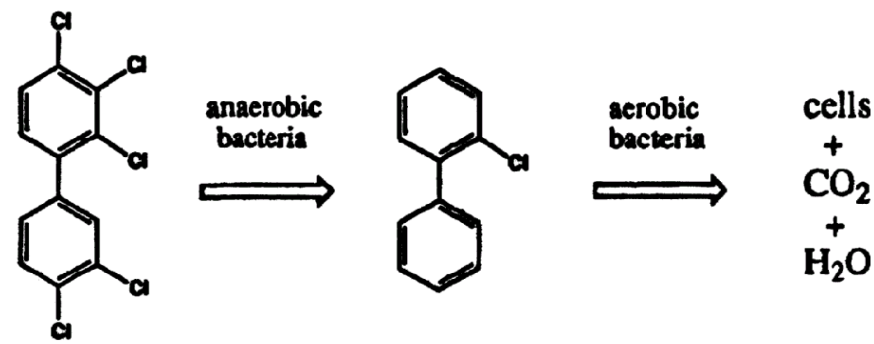
These facts also make experiments on the photodecompositions of PCBs difficult to carry out. Photodegradation in the atmosphere has been studied (see Erickson [1986] and references therein) and half lives for atmospheric photodegradation have been measured as ranging from 0.62 to 1.4 days for monochlorobiphenyls to 67 days pentachlorobiphenyls. (These data, however conradict information presented in Hutzinger, Safe *et al*. [1974] who state that "higher chlorinated biphenyls disappear faster than those with lower chlorine content on irradiation" [page 123].) Volatilization can result in significant removal of PCBs from an environmental department without any net loss of PCBs from the environment. Once volatilized, however, the chances of photodegradation are increased (Erickson, 1986).

PCBs can undergo microbial degradation in natural environments under both aerobic (i.e., in the presence of oxygen) and anaerobic (i.e., in the absence of oxygen) conditions. Under aerobic conditions, PCB congeners can be degraded by microbial processes that result in the breaking of a carbon to carbon bond of the biphenyl molecular frame, the net destruction of PCBs, and the generations of degradation by-products. Under anaerobic conditions, PCB congeners can be degraded by microbial processes that result in the substitution of chlorine atoms with hydrogen atoms within a PCB molecule. This results in the transformation of PCB congeners into other less chlorinated PCB congeners (Abramowicz, 1990). This process it referred to as dechlorination. Aerobic degradation results in a net PCB loss from a given PCB inventory, whereas anaerobic dechlorination does not.

In river sediments, aerobic conditions are typically found in the top few centimeters of the sediment core, while anaerobic conditions are found at greater depths.

Figure 3-1 (reproduced from Abramowicz [1990]) illustrates the effect of aerobic and anaerobic PCB degradation. In the first step, mediated by anaerobic bacteria, the pentachlorobiphenyl (five chlorine atoms) congener is transformed into a monochlorobiphenyl (a single chlorine atom). In the second step, mediated by aerobic bacteria, the monochlorobiphenyl is degraded to microbial cells, carbon dioxide and water.

Figure 3-1 Aerobic and Anaerobic PCB Degradation



3.1 Aerobic PCB Degradation

The microbial degradation of PCBs under aerobic conditions is well documented and studied (see for example: Abramowicz ,1990; Bedard, 1990 and references therein). Naturally occurring organisms that can degrade PCBs aerobically are quite common in nature and consist of many microbiological types. A diverse group of 25 strains of aerobic PCB-degrading bacteria has been isolated and characterized. All organisms isolated have the ability to degrade the less chlorinated PCBs, i.e., mono-, di-, some tri-, and possibly some tetrachlorinated biphenyls. However, as the number of chlorines per PCB increases, the fraction of organisms capable of degrading these congeners decreases. In particular, no aerobic microorganisms have been reported to degrade penta- and higher chlorinated PCB congeners (Abramowicz, 1990).

Furukawa (1986) reports that commercial PCB mixtures that contain predominantly mono- and dichlorobiphenyls readily undergo primary biodegradention by activated sludge microorganisms, and that as the levels of tri-, tetra-, and pentachlorobiphenyls increase, the degradation rates decrease accordingly. Furukawa (1986) reports degradation rates in laboratory experiments ranging from > 50 nmol/ml/h for some monochlorobiphenyls to 0 for some tetrachlorobiphenyls. He indicates that PCBs containing two chlorines in the *ortho* position of a single ring (i.e., 2,6) and in each ring (i.e., 2,2') show a striking resistance to degradation. The congener 2,4,6-trichlorobiphenyl is the exception to this rule.

In reference to the molecular composition of Aroclor 1242, which is the main contaminant originally discharged in the Fox River, the data presented in Table 2-4 indicates that 76% of this Aroclor is comprised of tetra- and lower chorobiphenyls. As such, based on the data discussed above, up to 76% of Aroclor 1242 can be degraded aerobically under the proper conditions. A greater percent might be degraded aerobically after the Aroclor has undergone some degree of dechlorination (see discussion in Section 3-2).

Even though laboratory studies have documented the existence of naturally occurring aerobic bacteria capable of degrading a large spectrum of PCB congeners, there is little direct evidence indicating that the aerobic degradation process is effective at reducing the PCB mass under field conditions. The difficulty of documenting such occurrences may explain the lack of direct observation. Another explanation may reside in the fact that a biphenyl must be present as the sole carbon source for effective PCB degradation under aerobic conditions. This may represent a major obstacle to PCB degradation *in situ*, since PCB congeners themselves apparently cannot support bacterial activity in the absence of a biphenyl substrate. No alternate substrate has been identified that is capable of sustaining or enhancing the activity of PCB-degrading bacteria under aerobic conditions (Bedard, 1990).

Of the papers reviewed, only a few addressed aerobic degradation of PCBs in sediments. Laboratory and controlled field studies (using caissons driven into the sediments to isolate them from the surrounding environment) were performed to assess the extent of aerobic biodegradation of PCBs in the Hudson River (Harkness *et al.*, 1993; Harkness et al., 1994). These studies indicated that indigenous aerobic microorganisms can degrade the less chlorinated PCBs present in Hudson River sediments, and that aerobic PCB biodegradation can be stimulated by adding inorganic nutrients, biphenyl, and oxygen. Less than 60% of the PCBs in the Hudson River sediment samples that were collected in both field and laboratory experiments were biodegraded aerobically. In the laboratory studies, PCB losses were highest for mono- and dichlorobiphenyls (approximately 50% for monochorobiphenyls and 43% - 47% for dichlorobiphenyls). Losses for trichlorobiphenyls ranged between 26% and 30%. Losses for higher chlorinated congeners ranged between 17% and 5%. In the field studies, similar results were obtained with monochlorobiphenyl losses averaging greater than 60%, and dichlorobiphenyl losses averaging greater than 50%. Lesser losses of higher molecular congeners were also observed. Harkness *et al.* (1993) indicate that up to 90% of PCBs can potentially be degraded aerobically based on previous laboratory experiments. They state that a potential short-term biodegradation limit in both the laboratory and the field might be physically determined by the desorption kinetics of the PCBs from the sediments.

The occurrence of aerobic degradation of PCBs in Hudson River sediments is also supported by the presence of intermediate metabolites in the sediments, such as chlorobenzoic acids. A correlation between chlorobenzoic acids and PCB concentrations was demonstrated, supporting the hypothesis that these acids were formed as a by-product of the aerobic degradation of PCBs (Flanagan and May, 1993).

Grasse River sediments were demonstrated to contain microorganisms that can aerobically degrade the lower chlorinated congeners in Aroclor 1242 spiked sediments as the test substrate (Minkley *et al*., 1999a; Minkley, Blough *et al*., 1999b).

A study of PCB patterns in Green Bay sediments (PCB concentrations not exceeding 2 mg/kg) by Pham (1993) suggests that aerobic biodegradation is not a significant transformation mechanism in those sediments. Similarly, McLaughlin (1994) reports that no evidence of significant aerobic biodegradation was found in Lower Fox River sediments. A discussion of the findings of Pham (1993) and McLaughlin (1994) is provided in Sections 4.1 and 4.2.

Research in the application of bioremediation techniques for the treatment *in situ* of soils and sediments contaminated with PCBs is ongoing (see, for example, the review presented in Morris and Pritchard [1994]). Ongoing research focuses on the development of methods to improve the bioavailability of PCBs for degradation (Rogers, 1998). The engineered combination of aerobic and anaerobic biodegradation has been identified as a promising approach to remedy PCBs in soils or sediments. Laboratory comparison of reactor-based versus *in situ* PCB processes has demonstrated significantly higher rates of PCB destruction in soil slurry reactors. However, for many sites the advantages of not excavating continues to favor the *in situ* process configuration as a very viable, albeit slower, alternative (Shannon, Rothmel *et al*., 1994).

In summary, based on the literature reviewed, aerobic bacteria have been shown to be capable of degrading the less chlorinated PCBs under laboratory conditions. In addition, aerobic biodegradation of PCBs in sediments was observed under controlled field conditions and after the addition of amendments and oxygen. Finally, intermediate metabolites of aerobic PCB degradation were detected in one study of field sediments. However, significant intrinsic aerobic degradation has not been widely demonstrated under field conditions, nor have engineered approaches yet been discovered and implemented that would result in the effective aerobic degradation of PCBs in surface waters, soils or sediments. In particular, there is no significant evidence of longer scale natural PCB degradation occurring in sediments.

3.2 Anaerobic PCB Dechlorination

Reductive dechlorination under anaerobic conditions is generally viewed as an important means of biodegradation for numerous compounds including organochlorine pesticides (e.g., DDT, lindane), alkyl solvents (e.g., PCE, TCE, chloroform), and aryl halides (e.g., chlorobenzenes, PCBs, chlorophenols). Reductive dechlorination can alter the toxicity of these compounds and make them more readily degradable. Reductive dechlorination is mainly known to occur under anaerobic conditions, and it involves the substitution of a chlorine atom with a hydrogen atom within a PCB molecule (Mohn and Tiedje, 1992).

Starting in the mid 1980s, alterations in the composition of PCBs present in anaerobic river and lake sediments with respect to the original PCB composition have been widely documented. These alterations involve the removal of highly chlorinated PCB congeners with corresponding increases in the concentration of PCB congeners containing less chlorine substitutions (mono-, di-, and tri-dominated chlorobiphenyls). Three major patterns of alterations were observed for Hudson River sediments that were originally contaminated with Aroclor 1242. All three patterns showed lower levels of tri-, tetra-, and pentachlorobiphenyls and increased levels of mono- and dichlorobiphenyls. It was suggested that transformation processes such as evaporation or aerobic degradation could not account for the changes observed. It was, therefore, proposed that anaerobic microorganisms in the sediments were reductively dechlorinating the PCBs (Brown *et al*., 1985; Brown, Jr. *et al*., 1987).

The anaerobic dechlorination process is complex and diverse and can vary widely in the field, even at a scale of a few feet or less. There are at least five major factors that are of importance in determining whether or not the dechlorination of a particular chlorine on a PCB congener can occur in anaerobic sediments (Bedard and Quensen, 1995):

1) the nature of the active microbial population(s);
2) the type of chlorine substitution to be removed (*ortho*, *meta* or *para*);
3) the surrounding chlorine configuration on the phenyl ring;

4) the chlorine configuration on the opposite phenyl ring; and
5) the incubation conditions (temperature, redox conditions, ionic strength, type of carbon substrate, availability of electron acceptors, presence of oil, presence of other contaminants, etc.).

Anaerobic dechlorination of PCBs occurs via a set of specific, microbially mediated, reactions. A specific set of reactions is referred to as a dechlorination process. Depending on site- and chemical-specific conditions, one or more processes may control the overall PCB dechlorination rate. A number of individual dechlorination processes have been identified in sediments at different sites. The characteristics of these dechlorination processes, and the conditions and locations where they have been observed, are presented in Bedard and Quensen (1995). A discussion of these processes is provided below.

Bedard and Quensen (1995) identified at least six separable processes that dechlorinate Aroclors. These processes are labeled M, Q, H, H', N and P. These processes can occur alone or in combinations. For example, a dechlorination pattern, labeled C, has been identified that is the combination of processes M and Q, which are mediated by different microorganisms. Also, processes M and/or H and H' have been shown to occur concurrently at some sites. The processes can be distinguished by their congener selectivity patterns and by their chlorophenyl group reactivity patterns. Figure 3-2 (reproduced from Bedard and Quensen [1995]) provides, as an example, the dechlorination patterns for Process N.

Table 3-1 (reproduced from Bedard and Quensen [1995]) presents a summary of the chlorophenyl reactivity patterns of the various PCB dechlorination processes.

Table 3-2 (reproduced from Bedard and Quensen [1995]) summarizes the characteristics of the PCB dechlorination processes.

None of the processes described by Bedard and Quensen (1995) have been shown to remove chlorine in the *ortho* substitution. The dechlorination of *ortho*-substituted chlorine has, however, been reported to occur (albeit less prevalently than other types of dechlorination) both in the laboratory and the field (Brown, Jr. *et al*., 1987; Minkley, *et al*. 1999a; Minkley *et al*., 1999b).

Anaerobic dechlorination of Aroclor 1248–spiked sediments in an anaerobic bioreactor has been demonstrated by Pagano, Scrudato *et al*. (1995). The bioreactor was operated in a batch recycle mode and sanitary landfill leachate was used as a carbon, nutrient and/or microbial source. Research in this area is ongoing.

Figure 3-2 Dechlorination Process N

DECHLORINATION PROCESS N

234-4 → 24-4
236-4 → 26-4
245-4 → 24-4

25-34 → 25-4
234-34 → 24-34 → 24-4
245-34 → 24-34 → 24-4
236-34 → 26-34 → 26-4

234-25 → 24-25
245-25 → 24-25
236-25 → 25-26

234-236 → 236-24 → 24-26
236-245 → 236-24 → 24-26

234-234 → 234-24 → 24-24
2345-234 → 234-245 → 245-24 → 24-24
2356-234 → 2356-24 → 236-24 → 24-26

2345-2345 → 2345-245 → 245-245 → 245-24 → 24-24
2345-2346 → 2345-246 → 245-246 → 246-25
2345-2356 → 2356-245 → 2356-24 → 236-24 → 24-26

Specificity:	Flanked meta Cl, doubly flanked meta Cl
Reactive Groups:	34, 234, 236, 245, 2345, 2346, 23456
	Weak activity against 235, 2356
Unreactive meta Cl:	3, 23, 25
Comments:	Very reactive on all tetra- through octa-CB with susceptible CP groups

Aroclor	Reported As	Source	Reference
1260	N	Silver Lake	Quensen et al., 1990, Tab 3, Fig 8
1260	--	Silver Lake	Alder et al., 1993, Fig 6
1260	N	Woods Pond	Bedard et al., 1993, Bedard & Van Dort, in prep.
1254	H	Hudson River	Rhee et al., 1993e, Fig 1B (biphenyl)

Table 3-1 Chlorophenyl Reactivity Patterns of Various PCB Dechlorination Processes

Dechlorination Reaction	Dechlorination Process						
	M	Q	C	H	H'	P	N
3[a] → 0	?		X				
4 → 0		X	X				
23 → 2	X	X	X		X		
24 → 2		X	X				
25 → 2	X		X				
34 → 3		X	X	X	X	X	
34 → 4	X		X				X
234 → 2		X	X				
234[b] → 23		?					
234[b] → 24	X	?		X	X		X
236 → 26	X	?	X		?		X
245 → 2			X				
245 → 24	?						X
245 → 25		X	X	X	X	X	
2345 → 24	NA[c]	NA	NA				X
2345 → 235	NA	NA	NA	X	X	X	

[a]It is not clear whether the ability to remove this chlorine is due to process M or to a separate activity that sometimes occurs with process M.
[b]For process Q it is not clear which chlorine is removed first, but the ultimate product is the 2-chlorophenyl group.
[c]Data not available.

Table 3-2 Characteristics of PCB Dechlorination Processes

Dechlorination Process	Characteristic Dechlorination Products[a]	Susceptible Chlorines	Susceptible Aroclors	Source of Microorganisms
M	2 2-2/26 2-4 24-2 24-4 26-2	Flanked and unflanked *meta*	1242 1248? 1254?	Upper Hudson Silver Lake
Q	2 2-2/26 2-3 25-2 26-2 26-3	Flanked and unflanked *para* *Meta* of 23	1242 1248 1254	Upper Hudson
C	2 2-2/26 26-2 26-3	Flanked and unflanked *meta* and *para*	1242 1248 1254	Upper Hudson
H'	2-3 2-4 24-2 25-2 24-3 25-3 26-3 24-4/25-4 24-24[b] 24-25 25-25 235-24[b] 235-25[b] 236-24[b] 236-25[b]	Flanked *para* *Meta* of 23, 24	1242 1248 1254 1260	Upper Hudson Lower Hudson? New Bedford
H	2-3 24-3 25-3 26-3 24-4/25-4 24-24 24-25 25-25 235-24 235-25 236-24 236-25	Flanked *para* Doubly flanked *meta*	1242 1248 1254 1260	Upper Hudson Lower Hudson New Bedford Silver Lake?
P	23-25 24-25 25-25 235-23 235-25	Flanked *para*	1254? 1260	Woods Pond Silver Lake?
N	24-4 24-24 24-25 24-26 246-24 2356-24	Flanked *meta*	1254 1260	Upper Hudson Silver Lake Woods Pond

[a]Products will vary depending on the congener composition of the PCB mixture being dechlorinated.
[b]Proposed products from Aroclors 1254 and 1260.

4 Review of Studies of Natural Degradation in Aquatic Sediments

This section discusses laboratory and field studies aimed at studying natural degradation processes, including reductive dechlorination and aerobic biodegradation, occurring in sediments at various sites. The discussion is organized by site, and (where available) the results of both laboratory and field studies are briefly discussed. The sites for which data were reviewed are the following:

- Lower Fox River;
- Green Bay;
- Sheboygan River and Harbor
- Hudson River;
- Grasse River;
- Woods Pond;
- St. Lawrence River;
- Silver Lake;
- Acushnet Estuary;
- Other Locations, including:
  - Escambia Bay,
  - Hoosic River,
  - Waukegan Harbor,
  - Lake Ketelmeer;
  - Lake Shinji (Japan), and
  - Otonabee River-Rice Lake (Canada).

4.1 Lower Fox River

Natural degradation processes in the Lower Fox River between Little Lake Buttes des Morts and the De Pere Dam were studied by McLaughlin (1994). He examined PCB congener distributions within 173 sediment cores from deposits proximate to known historical sources of PCBs to the river (deposits A and N), and from deposits 30-40 km (19-25 mi) downstream (deposits EE, GG, and HH).

McLaughlin (1994) estimated PCBs lost to weathering based on the weight fraction enrichment of congeners believed to be resistant to their respective weathering processes (desorption, biodegradation). He reports that depletion of low molecular weight congeners relative to both Aroclor 1242 and to deposits A and N was observed in downstream Fox River sediments (deposits EE, GG, and HH). This depletion is attributed mostly to desorptive losses to the water column taking place during sediment transport downstream, rather than aerobic biodegradation. No evidence of anaerobic dechlorination of PCBs was observed in downstream deposits EE, GG, and HH, where the maximum PCB concentration is approximately 30 mg/kg.

Volatilization is not explicitly accounted for in McLaughlin (1994). However, volatilization results in a mass loss from the water column to the atmosphere. As such, volatilization of PCB mass previously sorbed to sediment can only occur after such mass has desorbed to the water column. Therefore, the explicit quantification of mass loss to volatilization from the unit column does not affect the estimate of mass loss from sediments due to biodegradation and desorption.

The congener distribution data in deposits A and N support the conclusion that anaerobic dechlorination has occurred in these deposits, along with some physical/chemical weathering. The data suggest that dechlorinating activity is limited to sediment PCB concentrations of 30 mg/kg or greater. The overall PCB losses due to microbial degradation in deposits A and N were estimated to be approximately 10% (McLaughlin, 1994) with respect to the original inventory of PCBs deposited in the river.

It was estimated that no biodegradation losses have occurred in sediments in the Lower Fox River above the DePere Dam, and that 10% biodegradation has occurred in sediments from SMUs with a PCB concentration of 30 mg/kg or higher, resulting in an overall PCB mass loss from the river of approximately 1,600 kg. Conversely, an overall 33% desorption for all river sediments was estimated, resulting in an overall PCB mass loss from the river of approximately 15,000 kg (McLaughlin, 1998).

Another evaluation of aerobic and anaerobic degradation of PCBs in Deposit A of Little Lake Buttes des Mortes is provided in Appendix D, Deposit A - PCB Biodegradation Assessment from the *Remedial Investigation/Feasibility Study Little Lake Butte des Morts Sediment Deposit A* (Blasland & Bouck Engineers, 1993). Anaerobic dechlorination (as measured by a 20% decrease of the non-orthochlorine ratio with respect to the ratio of Aroclor 1242) was observed, with the exception of one sample which exhibited significantly higher levels of dechlorination. As a result of dechlorination, levels of PCB congener 2,3',4,4',5 were shown to have decreased in almost all samples. An examination of certain aerobically biodegradable congeners (2,3; 2,4'; 2,4,4'; and 2,5,4') relative to the Aroclor 1242 standard provided no evidence of aerobic degradation. Rather, the levels of these congeners were increased as a result of dechlorination. It was concluded that either no aerobic biodegradation had taken place, or its effect was being masked by the effects of anaerobic PCB dechlorination.

In another study of dechlorination patterns in the Lower Fox River (Hollifield, *et al*. 1995), PCB-contaminated sediments were collected from the southern portion of Little Lake Butte des Mortes and analyzed for their congener distribution. The results of these analyses are consistent with *in situ* dechlorination of PCBs. However, the extent of *in situ* dechlorination was less than that typically reported in the literature. It was estimated that the extent of dechlorination in these sediments ranged from 3.77% to 8.18% of total chlorine, and 10.1% to 16.9% of the *meta* and *para* chlorines relative to Aroclor 1242. The dechlorination appeared to have occurred primarily at the *meta* and *para* positions, with a preference for the *meta* position noted.

Attempts by Hollifield *et al*. (1995) to further dechlorinate Fox River sediments in the laboratory met with limited success. The range of additional dechlorination ranged from –0.65% to 6.86% on a total chlorine basis, and –0.65% to 11.2% on a *meta* and *para* chlorine basis. Furthermore, all samples displaying dechlorination in the laboratory tended to converge on a common chlorine distribution (removal of ~10% of total chlorine and ~20% of *meta* and *para* chlorines, relative to Aroclor 1242). The concentration in sediments also appeared to have an effect. Those sediments with higher PCB concentrations were observed to undergo more successful dechlorination to a greater extent (quantification of this effect is not provided in Hollifield, Park *et al*. [1995]). In addition, the data were consistent with the existence of a threshold below which dechlorination will not proceed.

In summary, a threshold of approximately 30 mg/kg appears to exist in Fox River sediments for PCB dechlorination. Below this threshold, no significant anaerobic dechlorination of PCBs is expected to occur. In addition, no significant aerobic degradation has been documented in sediments throughout the river.

4.2 Green Bay

The PCB congener patterns exhibited by PCBs in Green Bay sediments are different from the congener patterns associated with Lower Fox River sediments. The congener distribution was observed to shift from the lighter, lower chlorinated biphenyls, toward the heavier, higher chlorinated biphenyl. However, the depletion of the lighter chlorinated congeners does not show selective removal of non-*ortho*-chlorinated congeners, as would be expected if aerobic degradation were occurring. Furthermore, the shift toward higher chlorinated congeners suggests that anaerobic dechlorination is not a relevant process in the sediments in Green Bay (Pham, 1993). The latter observation is consistent with the absence of dechlorination in Lower Fox River sediments containing less than 30 mg/kg total PCBs (McLaughlin, 1994).

The concentrations of PCBs in Green Bay sediments (less than 2 mg/kg) appear to be below the levels necessary for microbial degradation to occur (McLaughlin, 1998), and the differences in congener distribution between Fox River and Green Bay sediments are attributed to chemical and physical processes such as diffusion into pore water, solubilization, and re-suspension, rather than biological processes such as aerobic degradation or anaerobic dechlorination (Pham, 1993).

4.3 Sheboygan River and Harbor

The Sheboygan River flows westward and drains into Lake Michigan at the city of Sheboygan, Wisconsin. The river is contaminated with PCBs from the mouth to about 22.6 km (14 miles) upstream (Sonzogni *et al*., 1991). Waste hydraulic fluids containing Aroclor 1248 and Aroclor 1254 were the source of the contamination (David, 1990).

The PCB congener distribution in the Sheboygan River between the Sheboygan Falls dam and the harbor in Sheboygan (22.4 km) was studied by David (1990) and Sonzogni, Maack *et al*. (1991). The conclusions of these studies are summarized below.

- The PCB congener distribution (congeners present as well as the weight percentages of each congener) from highly contaminated sediments (PCB concentration greater than 50 mg/kg) are considerably different from the PCB congener distribution of the Aroclor 1248 and 1254 which were originally discharged at the site.

- The weight percents of the toxic congeners in these sediments were generally lower than those found in Aroclor 1248 and 1254 (the primary PCB mixtures discharged to the river), and in Aroclor 1242 and 1260. The weight percents of the most toxic congeners (77, 118, and 105) were about an order of magnitude lower than the weight percents in Aroclor 1248. The average weight percents in Sheboygan River samples were 0.02%, 0.2% and 0.04% for congeners 77, 118 and 105, respectively. This compares with 0.3%, 3.35% and 0.55% for the same congeners in Aroclor 1248.

- The enrichment of the highly contaminated sediments with lower chlorinated congeners is not easily explained by known physical-chemical partitioning or known abiotic chemical reactions. This suggests that a biotic process might be responsible for the enrichment. It is suggested in David (1990) that this process is anaerobic dechlorination.

- In sediments containing concentrations less than 50 mg/kg, the congener distributions were similar to the original Aroclors, suggesting the existence of a threshold for dechlorination of approximately 50 mg/kg.

4.4 Hudson River

PCBs were first detected in fish from the Hudson River in 1969. The principal source of PCB contamination was related to the release of Aroclors to the river and river sediments.

In 1987, Brown Jr. *et al*. (Brown, Jr., Bedard *et al*., 1987; Brown, Jr., Wagner *et al*., 1987) reviewed chromatograms of hundreds of sediment, water, and soil samples contaminated with PCBs to determine changes in the relative concentrations of isomers with respect to the original PCB composition. They reported that in the upper Hudson River as a whole, approximately 40 to 70 metric tons of PCBs (out of an estimated total of 134 metric tons), have been converted from tri-, tetra- and higher chlorobiphenyls to mono-, di-, and predominantly *ortho*-substituted tri-chlorobiphenyls due to reductive dechlorination. Potential changes in sediment PCB congener distribution due to desorption and volatilization were not addressed in these studies. The extent of dechlorination was more pronounced in highly contaminated sediments (i.e., >50 mg/kg) but more modest in less contaminated sediments. As part of this study, the authors found evidence of dechlorination in sediments from adjacent Silver Lake, Hoosic River, Sheboygan River, and Acushnet Estuary. The dechlorination patterns were, however, different at these locations when compared with the Hudson River. The study also reported that all of the lower chlorinated PCB congeners formed by the observed reductive dechlorination could be biodegraded by one or more of the aerobic PCB-degrading bacteria that were isolated from soils and sediments. The authors proposed the hypothesis that a two-step sequence of dechlorination followed by oxidative biodegradation might eventually achieve total PCB destruction under properly engineered conditions.

In 1997, the U.S. Environmental Protection Agency (EPA) published an analysis of *in situ* dechlorination in the Hudson River from the results of a high-resolution sediment coring program (Tams Consultants, 1997). The main conclusions of this study are as follows.

- No evidence was found of extensive dechlorination within sediments in the Hudson River.

- Anaerobic dechlorination of PCBs in the Hudson River is limited to *meta* and *para* chlorines. Based on the composition of Aroclor 1242 (the main contaminant) no more than 26% ultimate mass loss by dechlorination is possible.

- The data suggest that other PCB destruction processes are not effective at removing PCBs from the sediments.

- Dechlorination appears to proceed, to a limited degree, dependent on the initial PCB concentration and does not continue to occur indefinitely; all sediment mass loss via dechlorination has occurred for current contamination and no further significant amelioration can be expected.

- No sediments were found which had a calculated PCB mass loss of greater than 25%.

- Below a concentration of 30 mg/kg, dechlorination mass loss did not occur predictably and was frequently 0%.

- The data verify the general persistence of PCBs in the environment.

The EPA report concluded that PCBs in the sediments of the upper Hudson River can be expected to be available for sediment-water exchange, re-suspension and biological interaction for at least 35 years and probably longer.

A number of laboratory studies were performed on sediments collected from the Hudson River (or using anaerobic microorganisms obtained from these sediments). These studies were aimed at demonstrating the effectiveness of dechlorination of PCB congeners present in these sediments (Quensen III *et al*., 1988; Quensen III *et al*., 1990; Morris, Mohn *et al*., 1992; Abramowicz *et al*., 1993; Rhee *et al*., 1993a; Rhee *et al*., 1993b; Sokol *et al*., 1995; Williams, 1994). The following bullet items summarize the main findings of these laboratory studies.

- The laboratory studies consistently show that dechlorination at the *meta* and *para* positions under anaerobic conditions is readily achieved in laboratory studies. However, no significant *ortho* dechlorination was observed.

- Inocula prepared from PCB-contaminated sediments from the Hudson River can effect *meta* and *para* dechlorination of sediments spiked with mixtures of Aroclor 1242, 1248, 1254 and 1260.

- Biphenyl enrichment decreased both the rate and extent of dechlorination, and affected the dechlorination products.

- The extent and rate of dechlorination in Hudson River sediments, as well as the lag time before the onset of dechlorination activity, was consistently shown to depend on PCB concentrations. Dechlorination activity was generally determined to be directly related to PCB concentration (i.e., the greater the PCB concentration, the greater the extent of dechlorination). For example, Quensen *et al*. (1988) reported that in the 700 mg/kg PCB concentration samples, the average number of *meta* plus *para* chlorines per biphenyl decreased from an average of 1.98 to 0.31 after 16 weeks, but only decreased to 1.19 in the 140 mg/kg samples. At 14 mg/kg there was no difference between the live samples and the autoclaved controls, indicating that a threshold to dechlorination might exist at or above that concentration level. Two additional studies (Rhee *et al*. 1993a, Rhee *et al*. 1993b) also report the existence of a concentration threshold for dechlorination activity (no concentration values for this threshold were provided). The threshold level might be site- and congener-specific.

4.5 Grasse River

A stretch of the Grasse River near Massena, New York was contaminated with PCBs, primarily from the release of products containing Aroclor 1242. A comprehensive field and laboratory study of naturally occurring PCB biodegradation processes in Grasse River sediments was prepared by the Carnegie Mellon Research Institute Biotechnology Group (Minkley *et al*., 1999a; Minkley *et al*., 1999b). The following summarizes the results of this study.

- *In situ* PCB dechlorination is an ongoing process in Grasse River sediments.

- Dechlorination activity is dependent on PCB concentration. Dechlorination appears to be occurring in sediments having less than 10 mg/kg total PCB concentration, but the statistical evidence of dechlorination at concentrations below 7 to 10 mg/kg is less strong than at higher concentrations (i.e., the statistical confidence level is less than 95%).

- The study suggested that biphenyl detected in Grasse River sediments resulted from the dechlorination of PCB congeners and that congeners with *ortho*-substituted chlorines are being degraded. In addition, the study suggested the possibility for anaerobic biodegradation of biphenyl and PCB congeners with low chlorine substitutions.

In summary, the study concluded that the Grasse River sediments are undergoing both aerobic and anaerobic PCB biodegradation under field conditions. The rate and extent of this biodegradation have not yet been determined.

4.6 Woods Pond

Woods Pond (Lenox, Massachusetts) is a shallow impoundment on the Housatonic River located 10.5 miles downstream from Silver Lake. The pond's sediments are contaminated with hydrocarbon oil and PCBs from the release of products containing Aroclor 1260 (95%) and Aroclor 1254 (5%). The results of a core sampling study in Woods Pond indicated the following (Bedard, 1990; Van Dort and Bedard, 1991; Bedard, Bunnell *et al*., 1996; Bedard and May, 1996; Bedard, Van Dort *et al*., 1997; Van Dort, Smullen *et al*., 1997).

- The PCB congener distribution in Woods Pond sediments results from declorination of Aroclor 1260 and Aroclor 1254 (95:5).

- All samples collected from Woods Pond showed some evidence of reductive dechlorination when compared to Aroclor 1260. The sample with the most extensive dechlorination was depleted by only 13.7% of the *meta* and *para* chlorines (3.92% for Aroclor 1260 versus 3.38%, for the most extensively dechlorinated sample). The most extensively dechlorinated samples had lost 11% to 19% (2.27% to 2.08% versus 2.57% for Arclor 1260) of the *meta* chlorines, and 2% to 7% of the *para* chlorines (1.33% to 1.26% versus 1.35% for Aroclor 1260).

- The dechlorination process targeted most of the hexa-, hepta- and octachlorobiphenyls, and converted them into tetra- and pentachlorobiphenyls containing predominantly *ortho* and *para* chlorine substitutions. *Meta* dechlorination was favored over *para* dechlorination.

- The extent and type of dechlorination process varied considerably among samples, depending on the sample location within the pond.

- It is possible to stimulate, or "prime", in the laboratory indigenous microorganisms in Woods Pond to effect rapid dechlorination of PCBs that have persisted in the environment for decades. This was shown to be true even in the presence of high concentrations of oil (5 mg/kg).

- Under laboratory conditions, indigenous anaerobic microorganisms from Woods Pond are capable of removing chlorine from the *ortho* position of at least one PCB congener (2, 3, 5, 6-tetrachlorobiphenyl).

4.7 St. Lawrence River

The St. Lawrence River is located along the northeast border of New York State and has been contaminated with PCBs from industrial sources. The presence of PCBs was related to the release of products containing Aroclor 1248 and to a minor extent Aroclor 1260. The results of field and laboratory studies indicated the following (Sokol *et al*., 1994; Sokol, Bethoney *et al*., 1998a; Sokol *et al*., 1998b).

- Sediment cores taken on the St. Lawrence River showed evidence of *in situ* reductive dechlorination at all sites along the river where cores were collected, except for one location. The extent of dechlorination varied widely from site to site, ranging from 2% to 45% (with respect to Aroclor 1248), based on the average number of chlorines per biphenyl.

- At most sites, dechlorination resulted in the removal of *meta* and *para* chlorines. *Meta* dechlorination was favored over *para* dechlorination at most sites. There was no evidence of *ortho* dechlorination at any of the sites.

- The lack of dechlorination at the one site was not attributed to the lack of competent microorganisms, but appeared to be associated with a high level of contamination (93,000 mg/kg aluminum, 4,794 mg/kg, PAHs) that may have included non-aqueous fluids.

- Location specific sediment characteristics can significantly affect indigenous populations and thus affect the resulting dechlorination pattern and extent.

- Additional dechlorination in the laboratory of partially dechlorinated samples collected in the St. Lawrence River occured rapidly over the first four months of incubation. Over this period of time, total chlorines per biphenyl were reduced by 22% (from 3.2 to 2.5) with respect to the field samples. With further incubation, a second phase of dechlorination ensued after 15 months, with the total number of chlorines per biphenyl decreasing slightly further from 2.5 to 2.4. After this additional dechlorination the transformation reached a plateau with no further change until the end of incubation at 39 months, indicating an endpoint. These laboratory results, when compared to the field data, suggest that *in situ* dechlorination at the site has not yet reached a plateau, although they are not able to reveal the *in situ* dechlorination rate.

- Some earlier field data indicated no correlation between the extent of dechlorination and sediment PCB concentration (Sokol *et al*., 1994). However, more recent laboratory studies (Sokol *et al*., 1998) indicated a clear dechlorination threshold concentration of 35 to 45 ppm total PCBs. In addition, these laboratory studies indicated that above the threshold concentration, the dechlorination rate was a function of total PCB concentration.

4.8 Silver Lake

Silver Lake is a 26-acre urban pond in Pittsfield, Massachusetts. Products containing Aroclor 1254 and Aroclor 1260 were likely used and released at different times from facilities close to the lake (Bedard and Quensen, 1995).

Brown, Jr., Bedard *et al*. (1987) and Brown, Jr., Wagner *et al*. (1987) studied the PCB congener distribution in sediment and concluded that dechlorination had altered the congener distribution pattern, that the PCB deposited in Silver Lake sediments was originally virtually all Aroclor 1260, and that PCBs in Silver Lake had undergone *ortho* as well as *meta* and *para* dechlorination. Bedard and Quensen (1995), however, questioned the finding that *ortho* dechlorination occurred in Silver Lake sediments, and indicated that the observed PCB patterns can be attributed to *meta* and *para* dechlorination of Aroclor 1254.

Quensen III *et al*., (1990) studied the rate and pattern of dechlorination of four commercial Aroclors (1242, 1248, 1254 and 1260) by microbial cultures prepared from PCB-contaminated sediments from Silver Lake and compared then with those obtained from microbial cultures from PCB-contaminated sediments in the Hudson River. In both cases dechlorination of *meta* and *para* chlorines (ranging from 15% to 85%, with the respect to the original Aroclor) was observed. For each inoculum, the rate and extent of dechlorination tended to decrease as the degree of chlorination of the Aroclor increased. The results suggested that there are different groups of PCB-dechlorinating microorganism at the two sites, and that each group has specific characteristics for PCB-dechlorination. The issue of the existence of a potential dechlorination threshold was not examined in the Silver Lake references reviewed.

4.9 Acushnet Estuary

Congener-specific analyses of the PCBs in the Acushnet Estuary (New Bedford, Massachusetts) sediments and waters were undertaken to identify the alteration and transport processes of PCBs in a coastal marine environment. PCBs in the Acushnet Estuary are from the release of products containing Aroclor 1242 and 1254. (Brown, Jr. and Wagner, 1990). The study concluded that anaerobic microbial processes had selectively removed non-*ortho* chlorines from most of the higher chlorinated PCB congeners. The dechlorination process occurring within the Acushnet Estuary was identified as Process H. The dechlorination process appeared to have begun near the upper end of the estuary and not have yet reached the lower portions of the estuary. In addition, the study concluded that PCBs had undergone desorption into the water column and vertical movement within the sediments (rather than remaining stratified), but there was no horizontal translation between sites.

4.10 Other Locations

Limited evidence of *in situ* dechlorination at a number of additional locations is reported in Bedard and Quensen (1995). The following summarizes information from these locations and, where available, the Aroclor type constituting the bulk of the original PCB contamination. Complete quantitative congener-specific analyses of sediment PCBs was not available for any of these locations, but the data that are available suggest that PCB dechlorination has occurred to an observable extent at the following locations:

- Escambia Bay (near the mouth of the Pensacola River, FL);
- Hudson Estuary and River (near Troy, Mechanicville, Albany and Kingston, Catskill and Poughkeepsie, NY).
- Hoosic River (North Adams, MA).
- Waukegan Harbor, IL, contaminated with Aroclor 1248.
- Lake Ketelmeer, a sedimentation area of the Rhine River in the Netherlands.
- Lake Shinji, Japan, contaminated with Kanechlor 500, a commercial PCB mixture similar to Aroclor 1254.
- Otonabee River/Rice Lake, in Petersborough, Canada

5 Conclusions

The purpose of this review was to evaluate information relating to the viability of natural biodegradation as a potential remedial action for the sediment-bound PCBs in the lower Fox River and Green Bay. Based upon the evidence presented in the literature, the following conclusions can be drawn.

- Naturally occurring reductive dechlorination processes in sediments has been documented. There are three principle lines of evidence.

  — The PCB congener distribution in sediment cores has been analyzed and compared with the distribution of the original source of PCB contamination at a number of locations. This type of analysis has shown that, under the right conditions, a reduction of the concentrations of the highly chlorinated congeners and an increase in the concentrations of the medium- to lower-chlorinated congeners (indicating that dechlorination of the highly chlorinated congeners had occurred) can be documented.

  — Laboratory experiments have been performed on sediment samples contaminated with PCBs obtained from a number of different locations. These experiments have shown the ability of anaerobic microbial populations to effect dechlorination of PCBs under laboratory conditions.

  — Anaerobic microorganisms extracted from PCB-contaminated sediments have been shown to degrade sediment samples spiked with standard Aroclors.

- Anaerobic PCB degradation under field conditions was demonstrated to have occurred at almost all the sites studied. However, the reduction in PCB concentrations through anaerobic processes is site-dependent. In the Lower Fox River, only 10% reduction could be accounted for by anaerobic processes for deposits with average PCB concentrations greater than 30 mg/kg. No PCB reductions due to anaerobic processes could be accounted for in deposits with average concentrations less than 30 mg/kg. Conversely, it was estimated that 33% of the PCB mass originally deposited in the Lower Fox River was lost due to desorption (that is, the PCBs were re-suspended in the water column). Physical loss through desorption from sediments seems to exceed any biodegradation in the Lower Fox River environment.

- *Meta* and *para* dechlorination are most prevalent under both field and laboratory conditions. However, only limited evidence supports the occurrence of *ortho*-substituted PCB congeners under both field and laboratory conditions. The concentration of ortho-substituted congeners in the Aroclors deposited at any given site might represent a lower limit to the extent of dechlorination achievable at that site.

- The rate and extent of dechlorination under field and laboratory conditions appear to be influenced by the overall PCB concentration in sediments. The greater the PCB concentration, the greater the rate and extent of dechlorination.

- The most well documented of the PCB contaminated sites demonstrate that a threshold PCB concentration must exist before anaerobic dechlorination can occur. The threshold PCB concentration level is site specific. At different sites, thresholds have been shown to range from about 10 mg/kg up to about 50 mg/kg. The sediments from the Lower Fox River show a threshold of 30 mg/kg. At concentration levels below 30 mg/kg no reductions of PCBs have been documented in the Lower Fox River. Based on the available data, even if these sediments could be aerated, complete removal of PCBs by biological means might not be feasible, because the highly chlorinated congeners will not dechlorinate below the threshold values. It is possible that other active treatment options might promote dechlorination of the sediments, making the PCBs more amenable to aerobic biological destruction.

- The type, rate, and extent of dechlorination processes are influenced by a number of site-specific conditions, and can vary from sample to sample even within the same site. Based on the literature reviewed, it appears that site-specific predictions on dechlorination processes cannot be made without recourse to site-specific dechlorination studies.

- Aerobic degradation of the lower chlorinated PCB congeners (which results in the actual destruction of PCB molecules) has been documented in laboratory studies, but is poorly documented under field conditions. No field rates for aerobic PCB degradation have been measured at any sites. In particular, aerobic degradation has not been documented in the Lower Fox River and Green Bay. Aerobic processes might be effective in reducing PCB concentrations if used under controlled conditions (such as sediment management units).

- Aerobic degradation is not effective at degrading the higher chlorinated PCB congeners.

- Rates of PCB destruction are not available from field studies. These rates are critical to understanding whether natural biological processes can be relied on to eventually cleanup the sediments. One of the conclusions of the EPA study of the Hudson River is that unless action is taken, PCBs in the Hudson River can be expected to be available for sediment water exchange, re-suspension, and biological interaction for at least 35 years and, possibly longer.

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Appendix G

Glass Aggregate Feasibility Study

G Glass Aggregate Feasibility Study

Executive Summary

During the comment period of the 2001 draft of the Lower Fox River RI/FS, WDNR completed a project to evaluate the feasibility of a vitrification technology, based on standard glass furnace technology, to treat contaminated sediment. Following the release of the 1999 Draft RI/FS, Minergy Corporation prepared a proposal for a multi-phased study to determine the treatment and cost effectiveness of this technology to destroy organic contaminants (primarily PCBs) and immobilize inorganic contaminants (primarily heavy metals) in river sediments. Minergy Corporation proposed a four-phased feasibility study for the testing of a glass furnace technology and proposed to cost share the study. With funding assistance from EPA's GLNPO, WDNR accepted Minergy Corporation's proposal to conduct the Glass Furnace Technology Feasibility Study. Also, recognizing the extreme scrutiny PCBs have been under and the need for a thorough independent evaluation of contaminant fate, WDNR requested assistance from the EPA SITE Program. The SITE Program agreed to independently undertake the evaluation of cost and treatment effectiveness for this project.

Initially the four proposed phases of the study were:

- **Phase I:** Mineralogy and sediment characterization;
- **Phase II:** Crucible melt and preliminary design engineering;
- **Phase III:** Pilot-scale sediment melt of dewatered dredge material; and
- **Phase IV:** Full-scale facility construction.

WDNR and Minergy Corporation agreed to conduct Phases I through III. Minergy Corporation approached the feasibility of this technology from the perspective of designing a system that would produce a high quality, reusable glass aggregate product. They recognized that the conditions necessary to produce a quality glass aggregate product would also be ideal for destruction of organic contaminants, such as PCBs. Many trace metals found in sediment are permanently immobilized in the melting and quenching process, producing a final aggregate product that is very inert.

Phase I testing characterized the mineral composition of river sediments to estimate the glass quality, durability, and melting point. Sixteen archived river sediment samples, representing the entire 39 river miles, that were collected during previous investigations were analyzed for mineral composition and loss on

ignition (LOI). The mineral composition of the river sediments was very consistent throughout the river and is very favorable for producing a quality glass product. The low results generated in the LOI tests confirm that a melting technology is more appropriate for river sediments than an incineration technology. With these positive results in hand, the project moved into Phase II.

During Phase II, crucible melts of Lower Fox River sediment were conducted to determine the actual melting conditions and glass characteristics/qualities of the sediment alone and when augmented with other materials (flux mixtures). Fluxes are added to the batch material to optimize the mineral composition, which in turn minimizes the amount of energy necessary to melt the material. The four different "recipes" were tested and all successfully melted the sediment into glass. The addition of limestone, as a fluxing agent, to the sediment provided the best results (Minergy Corporation, 1999). Phase II results included a proposed recipe for melting river sediment into glass aggregate and preliminary engineering designs for the pilot test facility proposed for Phase III. This preliminary engineering recommended not using an existing glass furnace for Phase III testing. Results of Phase II testing indicated that:

- The cost to retrofit an existing facility to the specification needed to melt sediment would be as much as building a pilot melter to these same specifications;

- Most existing facilities are too large to accommodate a limited duration test and would not provide the ability to adequately sample the various waste streams to determine destruction efficiency; and

- Use of oxy-fuel burners would be most energy efficient.

Together, the results of Phase I and II indicated that the glass furnace construction and operating costs could allow the processing and melting of the river sediments to be considered an economically viable option. Therefore, Minergy Corporation and WDNR initiated Phase III, the construction and operation of a pilot-scale glass furnace, specially designed to generate the operational data, treatment effectiveness data, and cost information needed for scale-up to a full-scale facility (Phase IV). The glass furnace technology process consists of two basic steps: a sediment drying step followed by the vitrification (melting) step. Due to the potential to release contaminants during both steps and the limited scale of this phase, treatment of approximately 60 tons of dredged and dewatered sediment, it was necessary to evaluate these two steps independently. Both processes were independently evaluated by the EPA SITE Program. The evaluation of the drying step was completed using a bench-scale

Holoflite® dryer at Hazen Research, Inc.'s Golden, Colorado facility. Results from the dryer will not be discussed here because the waste streams from this process can and will be incorporated directly into the design of the melter thus effectively treating these waste streams. However, the dryer evaluation did provide some insights into the material handling characteristics of the sediment including (Hazen, 2001):

- Fox River sediments can be physically modified to provide flowable feed to a dryer;
- The amount of moisture in the sediments can be reduced to less than 10 percent;
- Heat transfer coefficients and thermal efficiencies;
- Dewatered sediment exhibited stickiness or agglomerating characteristics at less than 65 percent solids; and
- Dewatered sediment at greater than 65 percent solids did not exhibit sticky or agglomerating characteristics.

The pilot-scale glass furnace is simply a refractory-lined rectangular melter (refer to Figure 6-11). The refractory is brick or concrete that has been specially treated to resist chemical and physical abrasion, has a high melting point, and provides a high degree of insulating value to the process. Natural gas is fired in the furnace, raising the internal temperatures to between 2600 and 3000 ˚F. Exhaust treatment is simplified and energy efficiency improved by the melter's use of purified oxygen (oxy-fuel) rather than ambient air as the oxygen source. At these temperatures, the sediment melts and flows out of the furnace as molten glass. Due to low gas volumes produced by the oxy-fuel melter and the large volume of gas space above the molten line, gases remain resident in the melter for a significant period of time (greater than 2 seconds). These conditions are more extreme than the conditions demonstrated to destruct PCBs. Other vitrification technologies have demonstrated greater than 99.9999 percent destruction of PCBs (cite NY/NJ WRDA work in WEDA). In addition, any trace metals in the molten glass will be stabilized when it is quenched and the glass matrix is formed.

The two primary objectives of Phase III testing were (EPA SITE, 2000):

- **P1** To determine the treatment efficiency (TE) of PCBs in dredged and dewatered river sediment when processed in the Minergy Corporation glass furnace technology (GFT); and

- **P2** To determine whether the GFT glass aggregate product meets the criteria for beneficial reuse under relevant federal and state regulations.

In addition, there were three secondary objectives:

- **S1** Determine the unit cost of operating the GFT on dewatered dredged river sediment;

- **S2** Quantify the organic and inorganic contaminant losses resulting from the existing or alternative drying process used for the dredged and dewatered river sediment; and

- **S3** Characterize organic and inorganic constituents in all GFT process input and output streams. Of principal concern is the formation of dioxin and furan during the vitrification step.

Phase III was completed in August 2001. During the pilot, approximately 50 tons of dredged and dewatered river sediment was processed through the melter. This phase clearly showed that the glass furnace technology created a quality glass aggregate material from river sediments. The properties of the glass aggregate were quite positive and were very consistent, producing a hard, dark, granular material (Minergy Corporation, 2001).

The EPA SITE Program has released the validated results of the chemical testing conducted during Phase III. As described in the Quality Assurance Project Plan (QAPP) (EPA SITE, 2001), all input and waste streams were sampled during the pilot. Testing was performed for a wide range of chemicals including congener PCBs (n = 78), dioxins/furans, SVOCs, VOCs, and heavy metals. In addition, the glass aggregate was subjected to both American Society for Testing and Materials (ASTM) water leaching procedures and SPLP procedures.

The sediment charged into the melter during the pilot testing averaged 28.1 milligrams of PCB per kilogram (mg-PCB/kg). Exhaust gas emissions were sampled on the pilot melter before and after the air quality control equipment. The average PCB concentration of the exhaust after the air quality control equipment was 36.6 nanograms per dry standard cubic meter (ng/DSCM) meter). In comparison, the average PCB concentration of the exhaust before the air quality control equipment was only slightly higher at 45.9 ng/DSCM. Thus, on an hourly average post-air quality control stack basis, this equates to PCB destruction of greater than 99.99993 percent during the pilot.

The formation of dioxins and furans during the thermal treatment of PCB-contaminated sediment was identified as a concern during the development of the sampling plan and were sampled. The sediment on average contained 23.5 and 65.6 ng/kg 2,3,7,8-TCDD and 2,3,7,8-TCDF, respectively. No 2,3,7,8-TCDD was detected in either the pre- or post-air quality control equipment samples. 2,3,7,8-TCDF was detected at an average of 0.0018 ng/DSCM post-air quality control equipment. Therefore, on an hourly average basis during the pilot, 8,815.5 ng of 2,3,7,8-TCDD and 2,3,7,8-TCDF were loaded into the melter while less than 0.1 ng of only 2,3,7,8-TCDF was emitted. This not only represents a greater than 99.998 percent reduction in 2,3,7,8-TCDD/TCDF, but more importantly that these compounds are not created to any extent during this treatment process.

Using the results from the pilot melter, the emissions from a 250 glass tons per day full-scale facility were calculated. The facility would meet all current state and federal air emissions regulations and is not expected to trigger the major source thresholds (Minergy Corporation, 2002).

The glass aggregate also demonstrated acceptable characteristics for beneficial reuse. As identified in the project QAPP (EPA SITE, 2001), the glass aggregate did not exceed any of the criteria specified. In fact, the ASTM water leach test and SPLP test did not detect any 2,3,7,8-TCDD/TCDF, not a single PCB congener, any SVOCs, nor any of the eight heavy metals.

In response to EPA SITE's need to also determine the cost of the technology, Minergy Corporation performed a *Unit Cost Study for Commercial-Scale Sediment Melter Facility* (Minergy Corporation, 2002). This report used standard build-up estimating approaches in developing the cost estimates. This approach used the information generated in Phases I, II, and III and on that basis requested relevant cost, performance, and sizing data from equipment suppliers. With this data, the general plant layout (Figure FVRS-GA-101 from Unit Cost Report presented in Appendix G), mass and energy balance, and equipment arrangements were made. From this, estimates were done for construction and operations and, through financial modeling, a unit-cost forecast. The base case estimates were made using a plant size of 250 glass tons per day. Sensitivity analysis was also conducted for various sized melter plants with and without integrated storage. Table 4 from the Unit Cost Report presented in Appendix G summarizes the unit costs developed during this study.

The glass furnace technology incorporates and optimizes several factors to achieve greater cost and treatment effectiveness than other thermal processes, including rotary kilns. These factors include:

1. **Oxy-Fuel.** The use of pure oxygen (rather than atmospheric air) and natural gas has the added benefits of:

   a. Substantially reducing pollutant emissions thereby reducing capital and annual operating expenses associated with air quality control equipment; and

   b. Higher heat transfer and thermal efficiencies which together increase throughput in an existing facility or reduce the size of new facilities (see Baukal, 1998 for a review of oxy-fuel combustion).

2. **The Use of Highly Insulating Refractory.** A glass furnace is able to utilize several layers of refractory brick, thus increasing the insulating value and keeping the oxy-fuel heat inside the furnace. In comparison, other thermal processes like rotary devices for vitrification can have thinner refractory linings and thus may have up to three times the amount of heat loss.

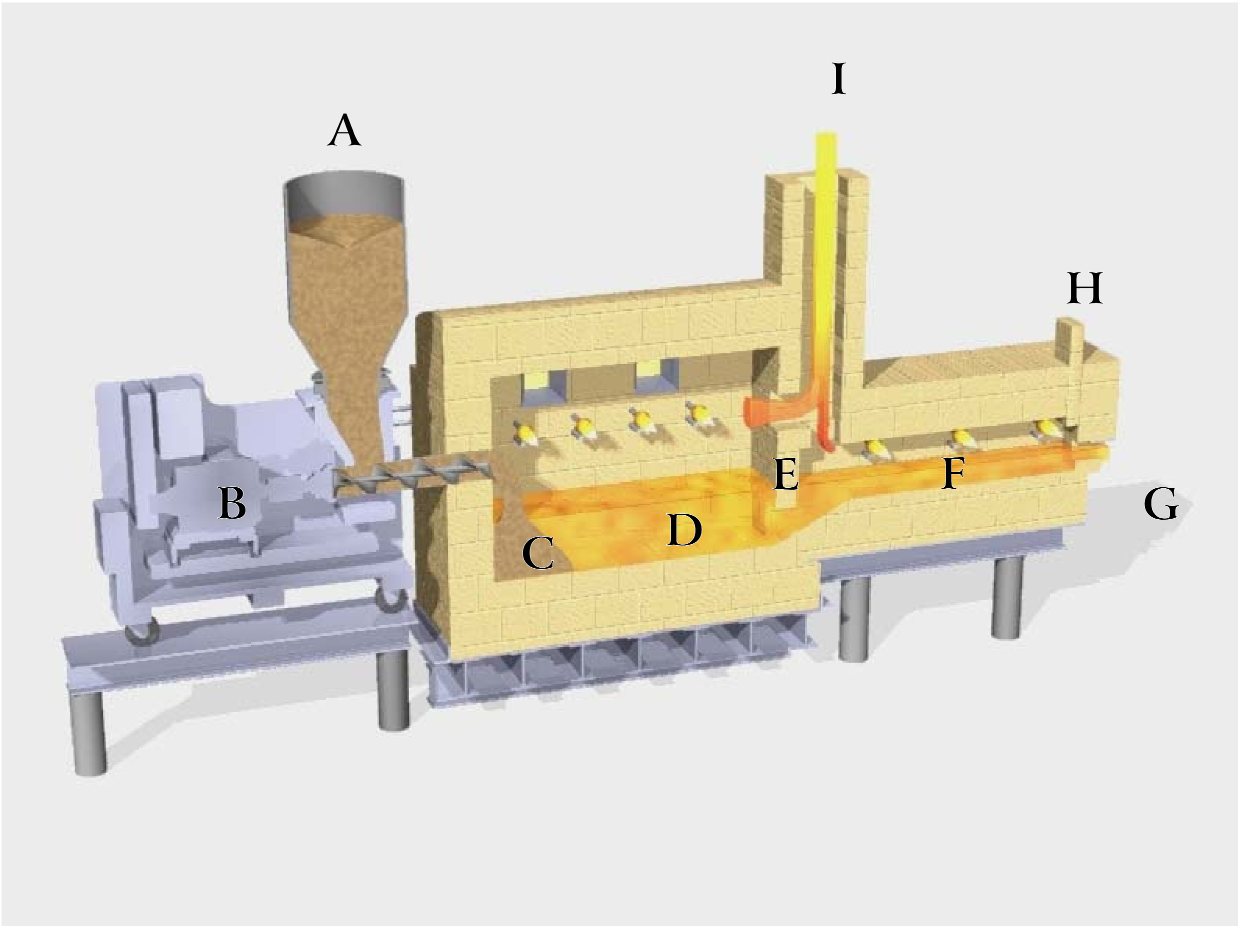
3. **Use of a Dryer to Remove Water from the Sediment.** Many other technologies process wetter material and, therefore, a substantial portion of the energy consumption is used in super-heating water to the same temperature as the sediment.

Thermal recovery from the glass furnace can provide a significant portion (85 percent) of the energy to pre-dry sediment before introduction into the glass furnace.

Table 1 X-Ray Fluorescence Elemental Analysis and Stepped Loss on Ignition Analysis

Date Collected		Nov. 11	Nov. 11								6/3/1998	6/3/1998	6/5/1998	6/5/1998	6/5/1998	6/5/1998
Lab #		**A**	**B**	**5297**	**5300**	**5290**	**5299**	**5298**	**5289**	**5291**	**5295**	**5296**	**5292**	**5293**	**5294**	**5301**
Al_2O_3	10.70	5.03	4.53	9.03	14.10	10.20	14.70	14.20	11.80	10.60	13.80	13.20	11.80	12.80	13.70	11.20
SiO_2	63.70	76.90	80.50	80.50	63.10	58.90	59.20	62.10	58.30	65.80	62.30	58.40	53.30	62.10	61.10	53.50
CaO	7.91	8.10	5.17	1.04	7.29	9.84	9.07	7.15	10.40	8.09	7.22	9.93	15.90	7.88	7.75	11.00
Fe_2O_3	4.58	1.90	1.32	3.19	5.84	3.62	6.00	5.55	4.66	3.73	6.45	5.40	5.29	5.49	5.35	4.61
TiO_2	0.55	0.10	0.07	0.37	0.61	0.54	1.17	0.80	0.71	0.53	0.65	0.89	0.63	0.68	0.68	0.67
Na_2O	0.98	0.88	0.73	0.90	0.52	0.77	0.61	0.71	0.70	0.74	0.56	0.71	0.71	0.74	0.69	0.65
MgO	6.09	4.58	3.87	1.46	6.28	8.16	6.70	6.86	6.53	5.66	6.81	7.92	4.56	7.17	7.96	8.80
P_2O_5	0.22	0.08	0.08	0.10	0.32	0.41	0.72	0.38	0.37	0.30	0.34	0.48	0.30	0.26	0.33	0.40
S	0.48	0.33	0.26	<0.05	0.41	0.66	0.56	0.36	0.52	0.35	0.48	0.69	0.35	0.27	0.27	0.56
Cl	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.03	<0.02	0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	0.03
K_2O	3.48	2.04	2.16	2.87	2.95	2.92	3.23	3.55	3.11	3.17	2.97	3.16	2.99	3.53	3.65	2.99
MnO	0.07	0.02	0.02	0.04	0.07	0.05	0.08	0.06	0.07	0.06	0.07	0.07	0.07	0.06	0.06	0.07
BaO	0.06	0.04	0.04	0.05	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.03
LOI-550				10.9	8.9	12.6	8.0	10.8	6.8	7.4	8.9	2.8	7.9	5.2	9.9	11.6
LOI-750				15.1	13.6	17.2	12.5	16.1	10.7	9.2	13.5	3.1	11.3	8.4	15.1	18.0
Sample Designation	Dep N	Marina	Marina	95001-01	95015-01	95049-01	95055-06	95075-04	95068-01	95100-01	SDC-EE22-1-G-45-55	SDC-EE22-1-G-45-55	SDC-X-4-G-45-55	SDC-W-5-G-45-55	SDC-E-4-G-45-55	SDC-C-1-G-45-55

Figure 1 Glass Furnace Process Description



Sediment (A) is fed into the hopper above the screw feeder (B). The feeder conveys the sediment continuously into the main section of the melter (C). The extremely high temperatures in the melter cause the sediment to become molten, liquid glass (D). The molten glass flows under a skimmer block (E) into the forehearth (F), where the material continues to form a stable glass. At the end of the melter, the glass flows out (G), into a water quenching tank (not shown). A removable block is included at the end of the forehearth (H) to stop the flow of glass if desired. Exhaust gases (I) flow out from the top of the furnace to the air quality control equipment (not shown).

Figure 2 Processing Facility Conceptual Layout

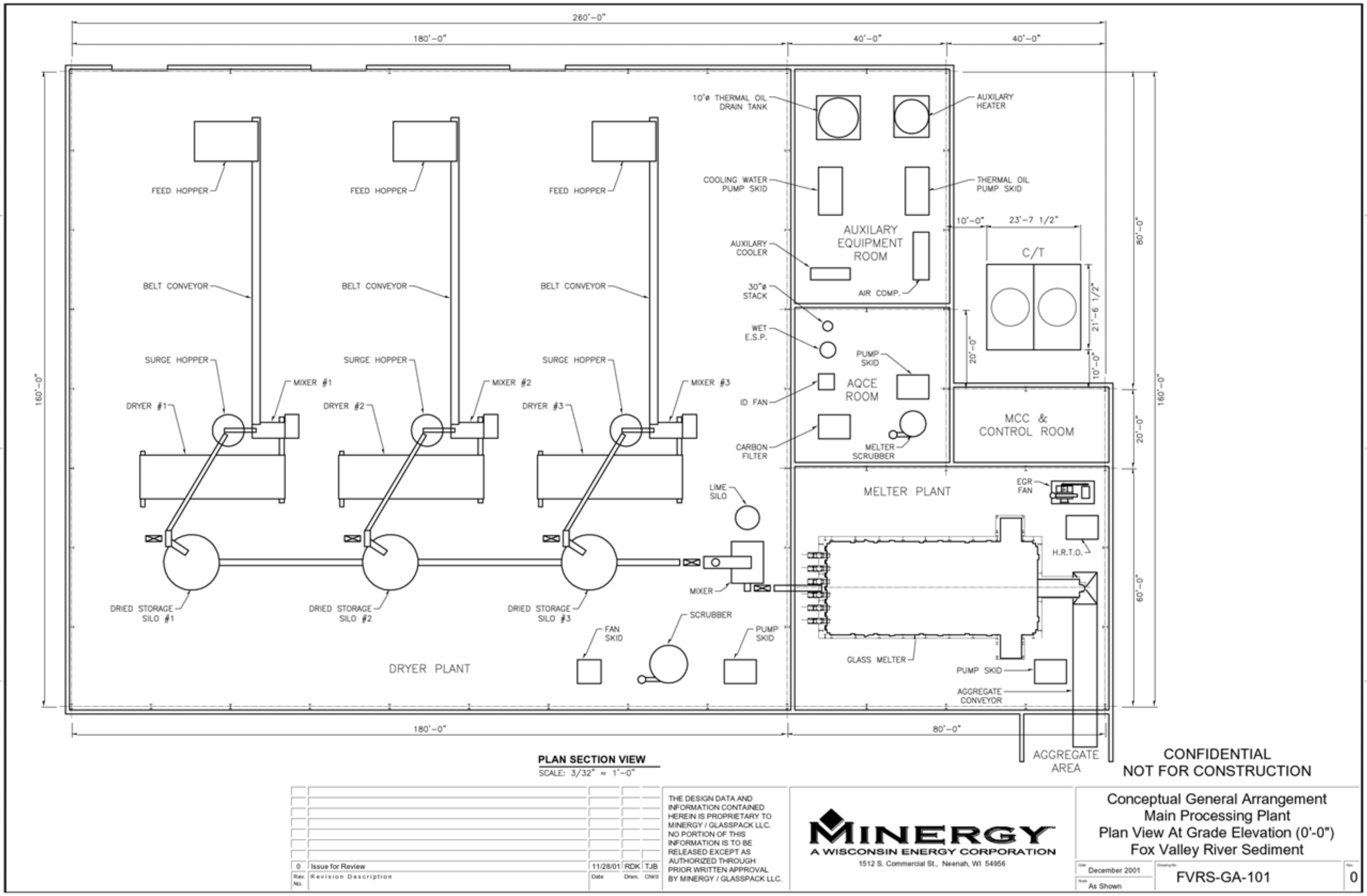


Table 2 Summary of Sensitivity Options: Sediment Melting Plant

	1×100 Integrated No Storage	1×100 Integrated Storage	1×250 Integrated No Storage	1×250 Integrated Storage	1×250 Standalone No Storage	1×250 Standalone Storage	2×250 Standalone No Storage	2×250 Standalone Storage	2×375 Standalone No Storage	2×375 Standalone Storage
Daily Capacity (tons)	240	240	613	613	613	613	1,226	1,226	1,840	1,840
Days/year Operation	240	350	240	350	240	350	240	350	240	350
Project Life (years)	15	15	15	15	15	15	15	15	15	15
Sediment Processed (million tons)	0.86	1.26	2.21	3.22	2.21	3.22	4.41	6.44	6.62	9.66
Capital ($ million)	25.50	26.25	36.99	38.79	34.97	36.77	63.19	66.79	87.39	92.79
Annual O&M ($ million)	2.30	2.76	4.73	6.13	5.44	6.84	9.29	12.17	12.57	16.74
NPV before Glass Sales ($ million)	49.35	54.86	86.04	102.40	91.44	107.81	159.58	193.16	217.88	266.50
Unit Cost (assuming $2 glass) (dollars per ton of wet cake)	**$56.54**	**$42.96**	**$38.41**	**$31.24**	**$40.86**	**$32.92**	**$35.58**	**$29.43**	**$32.32**	**$27.01**
Unit Cost (assuming $25 glass) (dollars per wet ton of cake)	**$49.91**	**$36.33**	**$31.78**	**$24.61**	**$34.23**	**$26.29**	**$28.95**	**$22.80**	**$25.68**	**$20.38**

FINAL REPORT
SEDIMENT MELTER
DEMONSTRATION PROJECT

TABLE OF CONTENTS

INTRODUCTION

The presence of PCBs in the lower Fox River in northeastern Wisconsin has been a concern for many years. Extensive investigations of the river bottom have taken place during the 1980s and 1990s. Two areas of the river have undergone demonstration dredging in the past five years.

While planning the appropriate remedial response to be undertaken, the Wisconsin Department of Natural Resources (DNR) requested input from the public. Minergy proposed a feasibility study to determine the potential to use a glass furnace capable of melting the contaminated river sediment at high temperature, thereby destroying the PCBs and binding any metals in the glass aggregate produced. Such furnaces have been used for decades to make glass. Feedstock consisting primarily of silica sand (which is the main constituent of river sediment) melts in the furnace. The molten product is cooled to form glass aggregate, which is a marketable construction material.

This report is written to summarize the activities undertaken during Phase 3 of the multi-phase glass furnace feasibility study. The first two phases of the feasibility study determined that the minerals contained in dredged sediments could form a stable glass, and that the variability of mineral concentrations along the lower Fox River appeared to be within acceptable ranges. Results from these phases are available in reports sent to the Department under separate cover.

During one of the demonstration dredging projects, the DNR containerized approximately 60 tons of de-watered, contaminated river sediment. The DNR contracted with Minergy for the design, construction, and operation of a pilot melter, to melt the sediment into a glass aggregate.


Sediment Loading into Containers

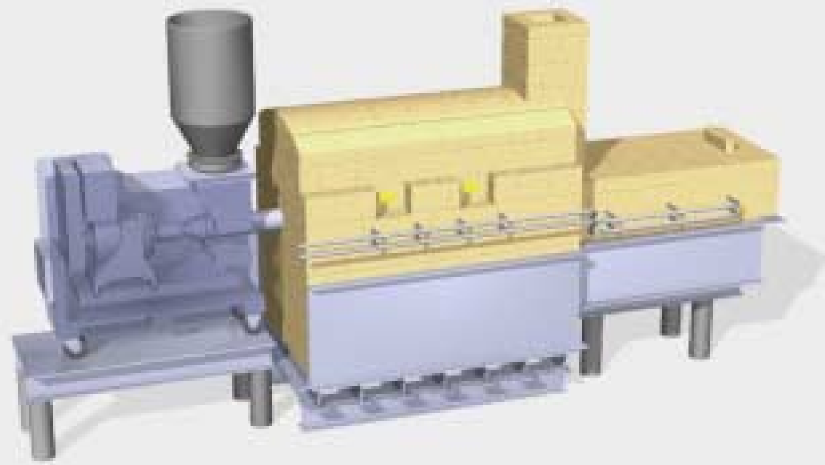
The U.S. EPA Superfund Innovative Technology Evaluation (SITE) program was used to perform an independent evaluation of the fate of PCB and other contaminants for Phase III. The dryer segment of the analysis was performed at the Hazen Research, Inc. facility in Golden, Colorado in January 2001. At that location, Hazen has a demonstration-scale dryer of the appropriate technology for use on sediments.


Sediment Melter

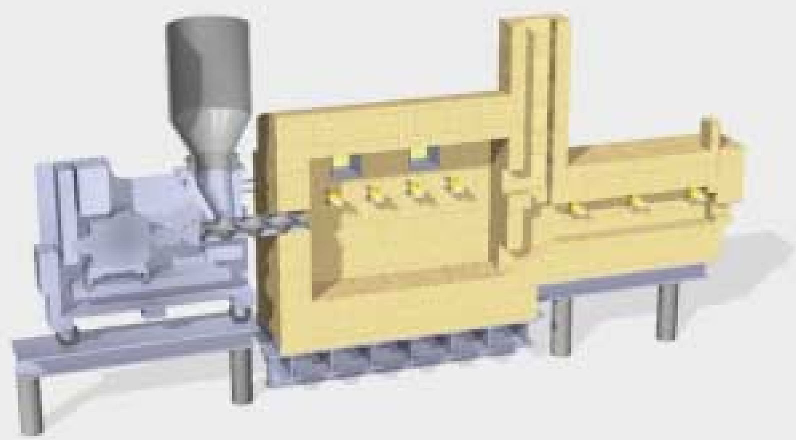
The melter evaluation was performed at Minergy's GlassPack Test Center in Winneconne, Wisconsin. A demonstration-scale melter was constructed, with operation of the melter from May to August, 2001. The pilot program was designed to confirm that the technology can destroy PCB contamination, stabilize trace metals, and convert the mineral content of river sediment into an inert, marketable construction material.

Under SITE program, the fate of PCBs and other compounds within the river sediment were monitored during the processing and melting of the river sediment. The SITE program test results will be submitted under separate cover by the EPA contractors responsible for gathering that data.

GLASS FURNACE TECHNOLOGY DESCRIPTION



External view of sediment melter



Internal view of empty melter with oxy-fuel burners in place (warm-up condition).

Introduction to Glass Furnaces

A Glass Furnace is a refractory-lined, rectangular melter.

Refractory is brick or concrete which has been specially treated to resist chemical and physical abrasion, has a high melting point, and provides a high degree of insulating value to the process.

Current glass furnaces use oxy-fuel burners, combining natural gas and oxygen for a bright flame above the glass. These burners raise the internal temperature of the melter to 2900 degrees Fahrenheit.

At these high temperatures, PCB contaminants are destroyed, and the sediment melts and flows out of the processing system as molten glass.

Melter Process Description

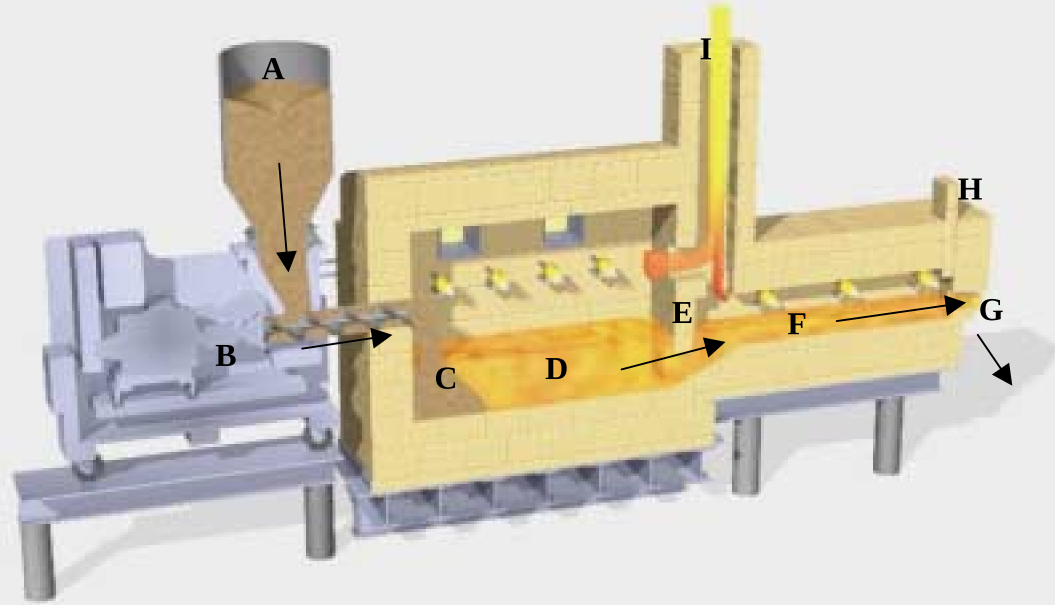


Fig 3. Internal view of melter (sediment feeding and melting)

Sediment (A) is fed to the hopper above the screw feeder (B). The feeder conveys the sediment continuously into the main section of the melter (C). The extremely high temperatures in the melter cause the sediment to become molten, liquid glass (D). The molten glass flows under a skimmer block (E), into the forehearth (F), where the material continues to form a stable glass. At the end of the melter, the glass flows out (G) into a water quenching tank. A removable block is included at the end of the forehearth (H) to stop the flow of glass if desired. Exhaust gases (I) flow out from the furnace up the square flue, to the air quality control equipment.

RIVER SEDIMENT MINERAL STUDY BY WDNR/MINERGY

Phase I of the feasibility study characterized the mineral composition of river sediments to estimate the glass quality, durability and melting points. Phase I conclusions include that river sediment characteristics are consistent throughout the river and are favorable for producing a quality glass product. Further, vitrification technology is more appropriate for river sediments than incineration as demonstrated by the low Loss on Ignition analyses.

River Mineralogy Study

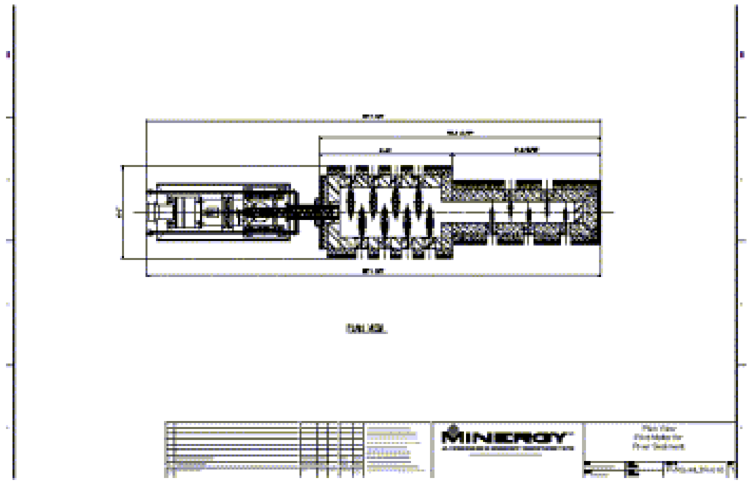
Date Collected	1/5/99	Nov. 11	Nov. 11	9/28/95	9/30/95	10/3/95	10/4/95	10/5/95	10/7/95	10/12/95	6/3/98	6/3/98	6/5/98	6/5/98	6/5/98	6/5/98
Lab #		A	B	5297	5300	5290	5299	5298	5289	5291	5295	5296	5292	5293	5294	5301
Al_2O_3	10.70	5.03	4.55	9.03	14.10	10.20	14.70	14.20	11.80	10.60	13.80	13.20	11.80	12.80	13.70	11.20
SiO_2	63.70	76.90	80.50	80.50	63.10	58.90	59.20	62.10	58.30	65.80	62.30	58.40	55.50	62.10	61.10	55.50
CaO	7.91	8.10	5.17	1.04	7.29	9.84	9.07	7.15	10.40	8.09	7.22	9.93	15.90	7.88	7.75	11.00
Fe_2O_3	4.58	1.90	1.32	3.19	5.84	3.62	6.00	5.55	4.66	3.73	6.45	5.40	5.29	5.49	5.35	4.61
TiO_2	0.55	0.10	0.07	0.37	0.61	0.54	1.17	0.80	0.71	0.53	0.65	0.89	0.63	0.68	0.68	0.67
Na_2O	0.98	0.88	0.75	0.90	0.52	0.77	0.61	0.71	0.70	0.74	0.56	0.71	0.71	0.74	0.69	0.65
MgO	6.09	4.50	3.87	1.46	6.28	8.16	6.70	6.86	6.53	5.66	6.81	7.92	4.56	7.17	7.96	8.80
P_2O_5	0.22	0.08	0.08	0.10	0.32	0.41	0.72	0.38	0.37	0.30	0.34	0.48	0.30	0.26	0.35	0.40
S	0.48	0.33	0.26	<0.05	0.41	0.66	0.56	0.36	0.52	0.35	0.48	0.69	0.35	0.27	0.27	0.56
Cl	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.03	<0.02	0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	0.03
K_2O	3.48	2.04	2.16	2.87	2.95	2.92	3.23	3.55	3.11	3.17	2.97	3.16	2.99	3.53	3.65	2.99
MnO	0.07	0.02	0.02	0.04	0.07	0.05	0.08	0.06	0.07	0.06	0.07	0.07	0.07	0.06	0.06	0.07
BaO	0.06	0.04	0.04	0.05	0.06	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.03

Phase II of the project, crucible melts of actual Lower Fox River sediment, were conducted to determine the actual melting conditions and glass characteristics/qualities of the sediment alone and when augmented with other materials (flux mixtures). Four different test "recipes" were included in the crucible melts and the sediment successfully melted into glass in all four tests. Phase II results include a proposed recipe for melting river sediment into glass aggregate and preliminary engineering designs for the pilot test facility proposed for Phase III. This preliminary engineering recommended

Melt #	Flux utilized	Viscosity	Glass Pouring
1	None	High	Sticky
2	Sodium carbonate	Low	Flowed
3	Dolomitic limestone	Very Low	Flowed
4	3-mix cullet	Medium	Flowed

Crucible Melt Results

not to use an existing glass furnace for Phase III testing. Results of Phase II engineering indicated that the cost to retrofit an existing facility for the purposes of a limited-term test would be as much as building a new pilot melter to those same specifications. Also, most existing facilities were far too large to accommodate a limited duration test.



Melter Preliminary Engineering

U.S. EPA Air Testing

Feasibility Study Phase III

The third phase of the feasibility study was broken into two segments, one to evaluate the sediment dryer and another to evaluate the sediment melter. The U.S. EPA Superfund Innovative Technology Evaluation program was used to perform an independent evaluation of the fate of PCB and other contaminants for both segments. The dryer segment was performed in Golden, Colorado, at the Hazen Research laboratory, where a demonstration-scale dryer of the appropriate technology for use on sediments was already in existence. The melter segment was performed at Minergy's GlassPack Test Center in Winneconne, Wisconsin.

MELTER DESIGN

The pilot melter is designed to simulate a full-scale production melter for the generation of glass aggregate from sediments. In order to adequately produce a model, some assumptions have been made with regard to the full-scale melter in accordance with typical glass operating practices. The pilot melter is scaled down from the full-scale melter and has been designed to operate in a manner which would suggest design features for most major elements of the full scale melter.

Pilot Melter Characteristics

Aspect Ratio	2:1
Area	10 sq ft.
Melting Rate	5.4 ft.^{2}/ton
Dwell Time	6 hrs.
Gas Usage	1.7 MM Btu/hr.
Oxygen Usage	35 ccfh
MM Btu/Ton	20.9 mmbtu/ton
Output	2 tons/day

Exterior Views of Melter

Minergy has intellectual property protection for the application of glass furnace technology on contaminated sediments. Several modifications to the standard melter design have been incorporated to best suit this application. These modifications include:

Molten Glass in Quench Tank

- The use of a water quench system to quickly harden the molten glass and increase the inert characteristics of the final product. Glass melters typically use annealing or other slow-cooling products to enhance glass clarity and other product qualities. These product features are not significant in the manufacture of glass aggregate because its final use is as a construction product where glass clarity is not necessary. Determination of the leaching characteristics of the final product will be done as part of the S.I.T.E. investigation. Molten material is drained from the end of the melter into the water-filled quench tank. An inclined ¼-inch steel plate, cooled by a constant water stream, directs falling liquid aggregate into the hopper of an auger submerged in the quench tank. The auger moves the aggregate out of the quench tank into barrels.

Aggregate Screw Conveyor

- The pilot melter is 10 square feet with a 2:1 aspect ratio. The materials selected are typical for soda-lime glass operations in an oxy-fuel environment. Six inches of extra sidewall has been added to the height to accommodate organics contained in the sediment feedstock.
- The melter will have eight Split-Stream oxy-fuel burners to approximate the burners that would be used in a full-scale melter.

Top View of Melter

Flue Coupled to Outlet Duct

- The melter is oxy-fuel fired to utilize the B.A.C.T. for NO_X emissions and reduced particulate. The glass quality is adequate with 6 hours of dwell time, so it runs a shallow glass level.
- The flue is located in the front of the melter, which is not the traditional location for oxy-fuel furnaces. This is done so that any fine particulate that becomes entrapped into the exhaust gases will have the maximum time in the furnace to allow these particulates to be melted, or minimized.

Sediment Screw Charger

- Sediment is fed in on one end of the melter through a water-cooled screw charger. The charger is a standard screw batch charger that has been used all over the world for charging batch in glass furnaces. The screw charger was chosen due to the ability to tightly seal the charging hopper to the charger and the charger to the furnace. This minimizes dusting of the raw material feedstock. The charger is similar in size to that which would be used in a full-scale unit. It has been retrofitted with a small screw barrel and flights for the pilot melter. This charger can be reused for a full-scale melter by modifying the barrel and flights. A variable-speed drive allows control of the feed rate.

Air Filtration on Sediment Hopper

- Negative pressure is placed on the feed hopper during charging operations to control dust.
- The melter design capacity is 2 tons per day or 170 pounds of river sediment per hour. The sediment bags weighed approximately 50 gross pounds, so the feed rate was expected to be between four and five bags per hour.

- The pilot melter is controlled by control loops to the melter and forehearth. The control loops use thermocouple signals to maintain a constant temperature by automatically adjusting the gas and oxygen for each zone. The control panel contains two single loop controllers, two digital gas flow meters, two digital oxygen flow meters, six digital temperature meters, status lights for the main fuel train, E-stop, alarm horn, and alarm silence push button.


Control Panel


Oxy-Fuel Control System

- Both the gas and oxygen skids have essentially the same safety system. A strainer is utilized prior to a pressure regulator. A high/low pressure switch is tied to the double block automatic shut-off valves. A differential pressure switch is used to determine flow through the system. This is a safeguard against injecting raw natural gas or oxygen into the furnace. If flow is lost on either natural gas or oxygen, the skid shuts down that zone. Each zone is then automatically controlled for gas and oxygen flows via a signal from the mass flow meter to a control loop back to an automatic valve.

Melter Refractory

- Refractory selection has been developed for this pilot melter based on the heat flow analyses for each construction type. These are used to insure that none of the materials is placed in temperatures beyond their capability and to determine the total heat loss of the entire system.

Side of Melter in Operation

- The use of refractory selected by evaluating the abrasive qualities of the molten sediment. Glass products vary according to the chemical makeup of the feedstock. After the June run, an inspection of the inside of the forehearth verified that the refractory material at the glass line was seeing significant wear. The melter was relined with a higher grade refractory in place of the mullite originally installed in the melter for the August run.

- The melter was designed and built under a contract with Frazier-Simplex of Washington, Pennsylvania.

- The melter uses a "shallow" glass line. Glass melters typically have deeper pools of glass inside the melter, taking advantage of the low opacity of the glass being produced. Molten sediments are quite opaque, thus reducing energy transfer by radiation.


Inspection of Glass Line


Warm Up Burner

- Startup of the melter is performed gradually over 36-48 hours. A separate, dedicated warmup burner is used to raise the temperature of the melter to approximately 1,400 degrees F. After this temperature, the main burners are used to reach final temperature target of 2,900 degrees F.

EXTRACTION PROBE DESIGN AND CONSTRUCTION

Extraction Probe

- The purpose of the extraction probe is to cool the hot gas from the melter exhaust at a controlled rate. The rate of cooling would be equivalent to the heat recovery systems installed on a full scale melter system. The extraction probe was designed by Minergy. The section of the probe which is inserted into the melter is contained in a water-cooled jacket, and is hung from a rail that allows it to be inserted into the stack for testing, then removed when testing is not taking place.

Probe Clean-out

- A cleanout port is placed on the back end of the probe, and a brush and rod are used to manually clean out particulate buildup within the probe.

- Piping connects the extraction probe to a contact packed tower condenser. An induced draft fan pulls the exhaust gases through the tower condenser, and then through a carbon barrel, before discharging the air stream out of doors.


Packed Tower Condenser


Carbon Filter

- A heat exchanger loop cools the water in the packed tower condenser. Sampling ports are located before the condenser and after the carbon filter, to allow connection of air testing equipment.

SEDIMENT PREPARATION

The Fox River sediment supplied to Minergy for the pilot melter project contained about 50% moisture by weight. The melter was designed to process sediment containing approximately 10% moisture. Minergy contracted Hazen Research, Inc. (4601 Indiana St., Golden, CO) to determine the material handling characteristics of the sediments and to evaluate moisture removal by indirect drying. It was determined that Fox River sediment, when mixed with drier materials to reduce its moisture content to 37%, would handle easily when undergoing drying activities to bring its moisture content down to 10%.

Hazen dried a batch of Fox River sediment to approximately 10% moisture. The EPA sampled and tested the various medias involved to determine the fate of contaminants during the drying process. Results of that testing will be submitted by the contractors responsible for the testing.

Flux is often a necessary addition to the feed material in glass melters as an oxidizer and for scum control. Minergy contracted Corning Glass Works to mix various concentrations of fluxing compounds with sample sediment from the Fox River, melting the mixed material and observing its melt characteristics.

The pilot project used a flux mix ratio of 5% sodium sulfate by weight.

The pre-processing of the river sediment in the Winneconne facility occurred in a series of steps:

Drying

Minergy purchased a 75-kW electrically-heated drying unit, and dried the river sediment at the Winneconne facility. Twelve barrels of sediment were dried together in a batch. Each batch underwent low-temperature drying, with sediment temperature below 210 degrees F, for 36 hours. A 10-inch diameter wire cage was placed inside each barrel prior to drying to increase heat transfer and evaporation rates. Thirty batches of river sediment were processed, filling 60 supersacks.

Barrel Drying Oven

Dust Enclosure

A 20-foot by 20-foot dust enclosure was built for controlling dust during sediment processing activities. With the exception of the drying activities in the oven, all processing activities took place within the dust enclosure.

The dried river sediment was removed from the oven, and the barrels were dumped into supersacks. Each supersack contained six barrels of river sediment, so each oven batch was transferred into two supersacks. Each supersack weighed approximately 1,100 pounds.

Supersack of Dried Sediment

Each supersack was numbered, to identify when its material was dried, and the lugger from which its material originated.

RIVER SEDIMENT
MINERAL ANALYSIS by
XRF for MAJOR ELEMENTS

Batch Number	Na2O	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	Fe2O3
1	0.43	9.95	9.60	36.3	0.37	1.76	35.9	0.71	2.85
2	0.43	9.71	9.12	34.6	0.38	1.65	34.1	0.66	2.53
3	0.39	10.1	9.42	34.3	0.38	1.56	37.6	0.70	2.76
4	0.43	11.3	9.33	35.3	0.38	1.46	36.3	0.69	2.75
5	0.38	10.1	9.35	35.2	0.36	1.58	35.7	0.69	2.64
6	0.49	10.2	10.1	38.4	0.38	1.82	31.2	0.69	2.71
7	0.50	10.3	10.1	38.4	0.38	1.76	31.1	0.72	2.82
8	0.39	9.30	9.40	34.6	0.35	1.74	36.5	0.68	2.58
9	0.50	8.98	10.1	38.7	0.38	1.83	32.3	0.71	2.71
10	0.45	8.70	9.60	36.5	0.37	1.86	35.1	0.71	2.70
11	0.47	8.56	9.81	37.5	0.37	1.74	34.7	0.71	2.69
12	0.44	8.78	9.62	35.1	0.37	1.59	36.4	0.70	2.66
13	0.51	9.62	9.94	38.0	0.36	1.83	33.2	0.70	2.73
14	0.43	9.64	9.87	36.5	0.37	1.72	35.6	0.70	2.66
15	0.44	11.6	9.77	37.6	0.35	1.88	33.7	0.71	2.69
16	0.44	10.3	9.93	36.6	0.37	1.73	35.0	0.73	2.79
17	0.47	10.2	9.86	37.2	0.36	1.82	35.4	0.72	2.74
18	0.44	8.87	9.59	35.8	0.35	1.82	37.9	0.71	2.63
19	0.49	10.4	9.80	37.7	0.36	1.73	34.8	0.69	2.63
20	0.57	9.77	9.87	38.1	0.33	1.81	32.7	0.69	2.96
21	0.43	8.72	9.48	36.8	0.35	1.77	34.0	0.67	2.54
22	0.45	9.20	9.96	38.0	0.37	1.86	35.7	0.72	4.29
23	0.46	10.8	9.88	38.0	0.37	1.84	33.3	0.70	4.26
24	0.40	8.99	9.75	37.2	0.36	1.81	36.4	0.69	4.52
25	0.40	8.53	9.48	35.8	0.35	1.72	39.4	0.68	4.19
26	0.40	8.83	9.64	36.0	0.39	1.83	38.8	0.71	4.24
27	0.41	9.10	10.2	36.6	0.38	1.73	37.1	0.74	4.41
28	0.37	10.6	9.54	34.3	0.37	1.67	38.9	0.69	4.21
29	0.39	8.86	9.62	36.8	0.38	1.74	37.8	0.69	4.31
30	0.39	9.91	9.87	34.8	0.37	1.62	36.1	0.72	4.74

Mineral Analysis of Dried Sediment

Delumping

The supersacks containing dried river sediment were unloaded through a delumper, reducing particle size of the sediment.

Sampling

Samples were retrieved from one foot below the surface of the material in each supersack to analyze for moisture and mineral content. Select material was also analyzed for loss on ignition. The results of the mineral analysis are included at left.

Metal Separation

The delumped sediment was passed through a grate containing 13 bar magnets, placed in four rows offset to each other. Significant amounts of magnetic material were separated.

Mixing/Bagging

The dried river sediment was mixed with a sodium sulfate flux. The ratio of sediment to flux varied from supersack to supersack due to variations in moisture content among the various runs. The appropriate amount of flux was added to each drum of dried river sediment, and the barrels were rolled on the floor to mix the contents. The mixture was then poured into approximately 50-pound bags, which were marked with their weight and the supersack number from which they originated. The bags were loaded on a pallet. Each pallet contained all the bags of sediment/flux mix produced from a single supersack, so that during melting operations, material processing could take place based on moisture content and lugger of origination..

Batch Bags of Dried Sediment

All sediment processing activities were carried out within the dust enclosure. Workers wore Tyvek suits with full-face air filtration. A negative air machine was connected to the dust enclosure to remove particulates from the air.

JUNE 2001 TRIAL

Media Relations Activities

The June 2001 trial took place from June 16 – 23, 2001, on a 24 hours per day schedule. Featured during this test run was a series of four public and media relations events Monday and Tuesday, June 18-19.

Shakedown of the melter system was delayed for several days due to a severe storm which occurred June 11, the originally planned startup date. The storm resulted in an extended power outage to the facility (approximately 4 days). Public relations had been planned for Monday June 18 and Tuesday June 19, featuring a number of high-profile visitors who had arranged their schedules to visit the demonstration. To maintain the schedule, shakedown of various systems was eliminated. Instead, the unit was put into continuous production at the earliest possible time.

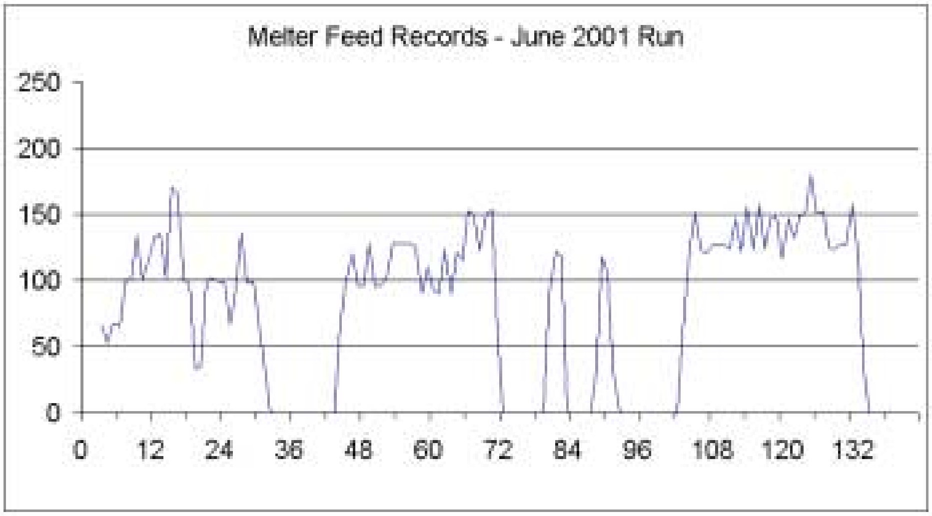
Public Relations Tours

The melter was brought up to temperature slowly from Saturday, June 16 to Monday, June 18. The first river sediment was fed into the melter at 3:00 a.m. on June 18.

The run was interrupted on a number of occasions, due to clogging of the batch charger, clogging of the tap, and a power outage. The operation of the extraction probe was shut down on a number of occasions due to plugging of the filters in the air testing equipment. Many of the equipment problems can be attributed to having performed what otherwise would have been shakedown during the operational timeframe.

The run was concluded when representatives from Frazier-Simplex suspected degradation of the forehearth section of the melter. The total run time was insufficient to provide adequate sampling required in the EPA's plan

Approximately 10,700 net pounds of river sediment had been processed at the time. The oxy-fuel train was shut down, and the melter was allowed to cool down over a period of a week.



<u>Inspections And Modifications</u>

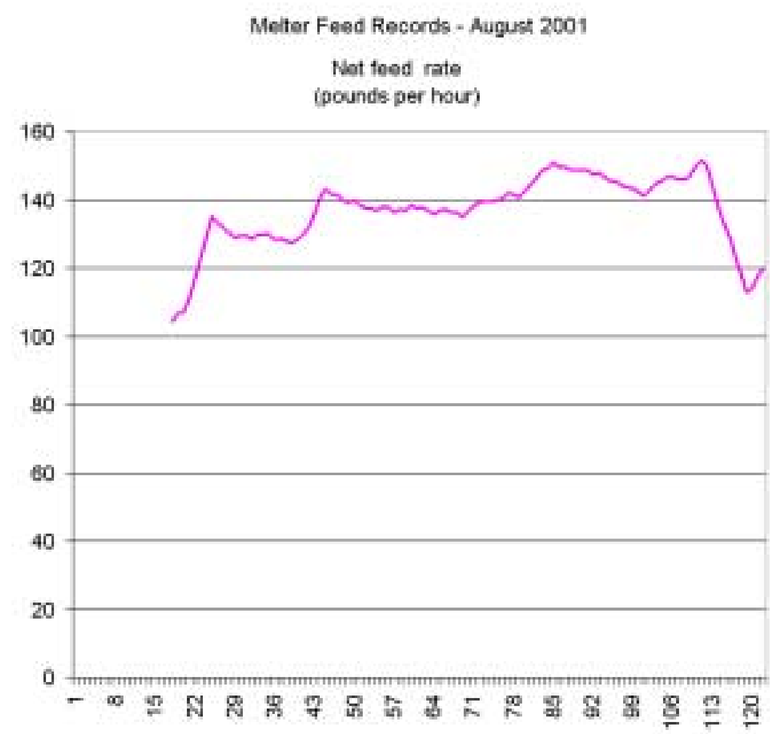
An inspection of the inside of the forehearth verified that the originally specified refractory material at the glass line was subject to accelerated wear. The melter was relined with a higher grade refractory in place of the mullite originally installed in the melter.

AUGUST 2001 TRIAL

The August 2001 trial took place from August 11 – 18, 2001. Melting operations took place 24 hours per day. This trial went smoothly, attributable to the fact that significant systems had been shaken down and tested during the June run. In the interim timeframe, optimizations were made that allowed for a successful run in August.

After the melter was rebuilt in July, the August run took place smoothly and uneventfully. Steady state conditions were achieved fairly quickly, and with the exception of two periods of downtime involving the extraction probe/air emissions assembly, steady state was maintained until completion of the testing.

The melter was brought up to temperature slowly from Saturday, August 11 to Monday, August 13. The first river sediment was fed into the melter at 6:00 a.m. on August 13. Air testing started at midnight on Tuesday, August 14, and was carried out routinely until 7:00 a.m., Saturday, August 18.

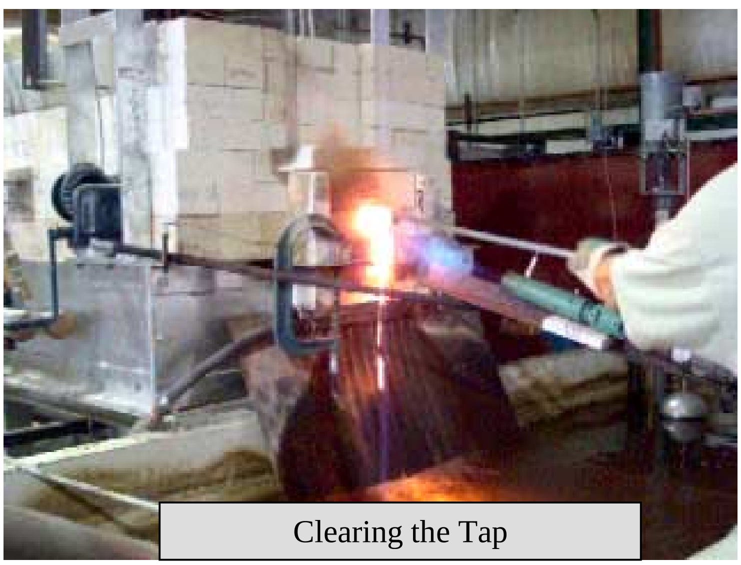


Approximately 16,500 net pounds of river sediment were processed during the August trial.

OBSERVATIONS

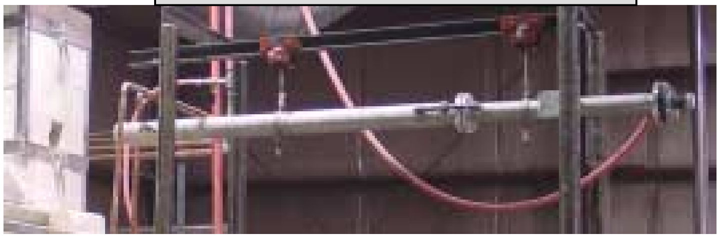
The pilot project determined that river sediment melts easily at high temperature into a hard, angular aggregate. The melter worked well with this type of feedstock, and the end product appeared consistent and marketable. When river sediment was being fed into the melter, temperatures within the melter were maintained between 2600 and 2900 degrees F.

Molten Glass Tapping



Clearing the Tap

The pilot melter was designed for a relatively low flow rate of glass through the melter tap. As expected, the tap refractory did not reach temperatures sufficient to provide for unattended tapping of glass. To keep the tap open, a secondary external gas fired burner was used, and operators used metal bars to loosen prematurely cooled aggregate.


Extraction Probe

The extraction probe needed routine maintenance. When hot exhaust gases were drawn into the water-cooled extraction probe, condensation took place, which tended to capture particulates moving through in the exhaust gas. When flow through the probe decreased significantly due to particulate build-up, the cleanout port was opened and the probe was cleaned.


Sediment Feed

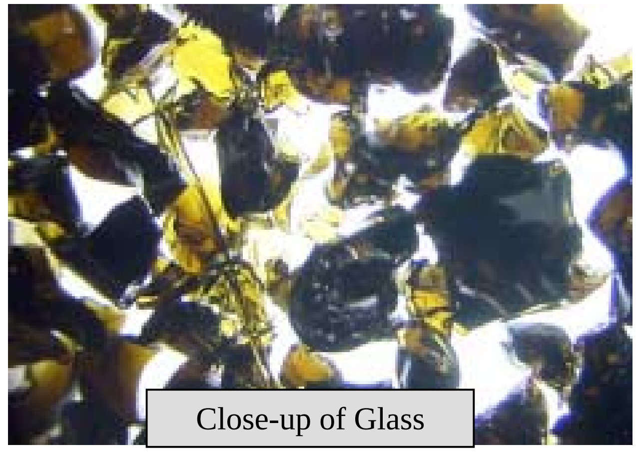
The moisture content of the river sediment affected feed rates. Moisture contents ranged from 5% to 20%. River sediment with higher moistures tended to bridge in the charger, and to cake around the auger. A technician permanently observed the feeding process, to make sure the charger was always feeding material to the melter.

The downstream end of the extraction probe assembly, involving the condenser, carbon barrel, and associated piping and pumps, suffered plugging due to accumulation of particulate and sulfates, primarily attributable to the use of sodium sulfate as a flux. The condenser cooling water was blown down periodically to alleviate the potential for low pH.


Air Quality Control

SUMMARY

The Phase III demonstration clearly showed that dried sediment will successfully create a quality glass aggregate material using a glass furnace. The properties of the glass aggregate product were quite positive. The aggregate was very consistent, producing a hard, dark, granular material.



Close-up of Glass

Leach tests performed on the aggregate by the WDNR showed no detect for PCBs or any trace metals. This confirms the original goal of the project: the glass aggregate product is a quality material, PCB-free, with excellent leaching characteristics.

DNR Parameter Description	Result value
ARSENIC TCLP	ND
BARIUM TCLP	0
CADMIUM TCLP	ND
CHROMIUM TCLP ICP	ND
LEAD TCLP	ND
MERCURY TCLP	ND
PCB SUM OF CONGENEI	ND
SELENIUM TCLP	ND
SILVER TCLP	<0
ZINC TCLP	ND

Shortly after the completion of the demonstration, the DNR participated in the construction and dedication of a picnic shelter along the Fox River. At the DNR's request, glass aggregate from the demonstration run was used in the foundation of the picnic shelter. A plaque was installed to inform the public about the success of the demonstration project.

Product marketing specialists are analyzing the glass qualities to determine the marketability of the material. Based on Minergy's experience in marketing similar glass products, and given the high quality of this material, we are confident that all of the glass aggregate produced in a commercial-sized facility would be successfully marketed. The indicated list shows the preliminary assessment of the suitability for using glass aggregate from river sediment in various markets.

Minergy Corporation
Glass Aggregate Marketing
Chemical and Physical Property Guidelines

Roofing Shingle Granules	Target	Glass Aggregate	Accept?	Method
Loose Bulk Density	> 80 lbs/cf	90 lbs/cu ft	Yes	Weight/volume
Fe2O3 (for opacity)	> 5%	7%	Yes	ASTM 4326
Hardness	>5.5	6.2	Yes	Moh's mineral scale
Crystalline Silica content	<1%	no detect	Yes	X-Ray Diffraction
Leachability	TCLP test	passes	Yes	TCLP method 1311
Particle size	>80% between #12-#30	passes (crushed)	Yes	ASTM C136

Industrial Abrasives	Target	Glass Aggregate	Accept?	Method
Loose Bulk Density	> 80 lbs/cf	90 lbs/cu ft	Yes	Weight/volume
CaO	< 50%	17%	Yes	ASTM 4326
Al2O3	< 40%	10%	Yes	ASTM 4326
Fe2O3	< 20%	7%	Yes	ASTM 4326
Hardness	>5.5	6.2	Yes	Moh's mineral scale
Crystalline Silica content	<1%	no detect	Yes	X-Ray Diffraction
Leachability	TCLP test	passes	Yes	TCLP method 1311
Particle Size	>80% between #16-#50	passes (crushed)	Yes	ASTM C136
Embedment	<20%	7%-15%	Yes	KTA Tater Test

Ceramic Floor Tile	Target	Glass Aggregate	Accept?	Method
Loose Bulk Density	> 80 lbs/cf	90 lbs/cu ft	Yes	Weight/volume
Crystalline Silica content	<1%	no detect	Yes	X-Ray Diffraction
CaO	< 50%	17%	Yes	ASTM 4326
Glass Melting Point	> 2000 °F	2200 °F	Yes	ASTM 965
Particle Size	>80% between #16-#50	passes (crushed)	Yes	ASTM C136
Tile Strength	> 15 Mpa	22 Mpa	Yes	MOR/3-E (*)

Cement Pozzolan	Target	Glass Aggregate	Accept?	Method
Particle Size	480 m2/kg	passes (crushed)	Yes	ASTM C618
Iron-Alumo-Silicate	> 50%	52% - 60%	Yes	ASTM 114
L.O.I.	<6%	no detect	Yes	ASTM 114 ch.16
Cement Strength (3 day)	2535 psi	2850 psi	Yes	ASTM C311
Cement Strength (7 day)	3470 psi	3680 psi	Yes	ASTM C311
Cement Strength (28 day)	3953 psi	5300 psi	Yes	ASTM C311

Construction Fill
Acceptable gradation and compaction.

UNIT COST STUDY
FOR COMMERCIAL-SCALE
SEDIMENT MELTER FACILITY

FOR

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

SUPPLEMENT TO

GLASS AGGREGATE FEASIBILITY STUDY

JANUARY 19, 2002

**UNIT COST STUDY
FOR COMMERCIAL-SCALE
SEDIMENT MELTER FACILITY**

TABLE OF CONTENTS

INTRODUCTION

Minergy Corporation respectfully submits this report to the Wisconsin Department of Natural Resources (the "Department") containing the results of the Unit Cost Study For Commercial-Scale Sediment Melter Facility. This work was necessary to fulfill the requirements of the U.S. EPA's Quality Assurance Project Plan ("QAPP") as part of their reporting of the pilot sediment melter. The activities leading to this report are in conjunction with the Glass Aggregate Feasibility Study under the agreement between Minergy and the Department dated September 21, 2000, (State of Wisconsin purchase order number NMJ00001936), as amended under State of Wisconsin purchase order number NMB0000488.

Minergy used a standard build-up estimating approach in performing the Cost Study. This approach used the information derived from Phases 1, 2, and 3 of the Glass Aggregate Feasibility Study, and on that basis, Minergy requested relevant cost, performance, and sizing data from equipment suppliers. With this data, the general plant flowsheet, mass & energy balance, and equipment arrangements were made. From this, estimates were done for construction and operations, and through financial modeling, a unit-cost forecast.

The base case estimates are made using a plant size of 250 glass tons per day. This size is consistent with that used elsewhere in the Glass Aggregate Feasibility Study. A sensitivity analysis is included for various sized melter projects.

This report is the result of a Cost Study and not an offer to construct a facility. The engineering performed within the scope of this study does not represent final detail. Further detail engineering and design would improve the accuracy of the Cost Study results. Notwithstanding the Department's or any other party's desire to proceed with detail engineering or the development of a commercial scale facility, Minergy nonetheless reserves the right to make final determination on Minergy's participation.

PROCESS DESCRIPTION

This section describes the process and equipment used in the base project with a capacity of 250 glass tons per day. The facility is designed to melt 600 tons per day of partially dewatered river sediment that has been dredged from the Fox River.

The sediment enters the plant, is mixed with previously dried sediment to make it easier to handle, and is then dried to approximately 10% moisture. (See Drawing FVRS-PF-101 – Process Flow Diagram, Sediment Drying and Preparation, and Drawing FVRS-GA-101 – Conceptual General Arrangement, Main Processing Plant.) After the sediment is mixed with a fluxing material, it is fed into a large melter, capable of maintaining temperatures in the 2900 ^{o}F range. The sediment melts into a molten material, which drains from the melter, is quenched in a water bath, and turns into a glass aggregate. The melter is designed to produce 250 tons per day of aggregate, which will be sold for building products.

The entire process is optimized to conserve energy, reduce heat losses, and minimize labor requirements.

Sediment Preparation (pre-drying)

Sediment is dredged and hydraulically transported to the dewatering site, and mechanically dewatered by others at the site. The material is moved by front-end loader into the short-term storage/mixing area in the dryer plant. Three wet sediment mixers are installed in the dryer plant. (See Drawing FVRS-PF-101 – Process Flow Diagram, Sediment Drying and Preparation.) Each mixer has a rating of 11.3 tons per hour. Sediment, which has already been dried (total moisture content is approximately 10%), is added to the inlet of the mixer. The purpose for the mixing is to improve material handling and behavior in the dryers, by eliminating the self-agglomeration or“sticky phase” of the material. The moisture content of the sediment after mixing is approximately 39%.

Sediment Drying

After the sediment has been prepared by mixing, it is transported by enclosed conveyors to the sediment dryer (See Drawing PC1100309 – Holo-Flite Dryer.) The heat source for the dryers will be high temperature thermal oil. The sediment moisture content is reduced in the dryers from 39% to 10%. Water vapor from the drying of the sediment is exhausted to a vapor collection system, as described in *Dryer exhaust gas treatment system*, below.

Dry Sediment Storage and Dry Sediment Feed Mixer

Each drying line will have a 110-ton live bottom storage hopper, for a total of 330 tons of dry sediment storage. The dry sediment storage hopper discharges sediment to a small 9-ton surge hopper at the wet sediment mixers or to a dry sediment mixer. A 200-ton lime silo provides a supply of ground limestone to the feed mixer to work as a fluxing agent for control of the melting temperature. The dry sediment mixer will have a capacity of 9.2 tons. A conveyor will transport the material discharged form the dry sediment mixer to the melter inlet surge hopper.

Melter Feeding and Operation

A total of six chargers supply the melter with dry and fluxed river sediment. (See Drawing Q8596-006 – Melter Plan View.) The melter heats the sediment to 2500 ^{o}F to 2900 ^{o}F. The molten material exits the main melter section and enters the forehearth. The forehearth then drains the hot glass into a water-filled quench tank. The glass furnace is heated with oxy-fuel fired burners. The burners are supplied by the fuel rails. Oxygen is provided by an on-site oxygen generation plant. Hot exhaust gas generated by the melter is exhausted into a hot gas heat recovery system and air quality control system (AQCS) prior to the exhaust stack.

Melter Quench Tank

The quench tank is water-filled, and receives the hot glass flow from the melter. The direct contact of the hot gas with the water will cause the material to solidify and fracture into the glass aggregate product. A set of screws will withdraw, dewater and transport the material to an adjacent storage pile. The quench tank will be in a closed cooling water loop. The quench tank temperature will be maintained by constant circulation of water through a set of heat exchangers.

Melter Off-Gas Treatment

The exhaust gas from the melter exits at 2700 to 2850 ^{o}F into the exhaust flue. (See Drawing FVRS-PF-102 – Process Flow Diagram, Melter Exhaust Heat Recovery and AQCE.) The exhaust flue also receives cool exhaust gas from an exhaust gas recirculation fan, which blends the cooler and hotter gases together within the flue. The cooled flue gas enters a heat recovery/thermal oil (HRTO) unit. The HRTO heats thermal oil, which is used to supply energy to the sediment drying process. The flue gas exiting the HRTO is split into two parts. The first part is used as flue gas recirculation, and is routed back through a flue gas recirculation fan (FGR) into the blending section of the melter exhaust gas flue. The second part of the flue gas flow enters a high-energy venturi and packed tower section. The venturi section removes particulate from the exhaust, and the packed tower section removes SO_2. The water in the packed tower is in a closed recirculation loop. The packed tower operates in the condensing mode, requiring some blowdown water from the loop. Sodium hydroxide is added to the process to control pH and provide for optimum SO_2 removal.

After the exhaust gas exits the packed tower, the flue gas enters a wet electrostatic precipitator (wet ESP). This device provides additional control and is especially effective for fine particulate. The exhaust flow from the wet ESP proceeds to a carbon filter bed. The carbon filter bed provides for absorption of mercury, and can also absorb PCBs and other chlorinated organic compounds. After the exhaust gas exits the carbon absorber, the gas is exhausted through a 95-foot tall and 30-inch diameter stack.

Thermal Oil Energy Supply and Distribution System

The main purpose of the thermal oil system is to provide thermal energy to the sediment dryers for the drying process. (See Drawing FVRS-PF-104 – Process Flow Diagram, Thermal Oil Supply System.) The system consists of the following components:

(1) A thermal oil auxiliary heater, which uses natural gas to heat thermal oil. The amount of natural gas fired in the unit is a function of the dryer plant energy demand.

(2) The HRTO unit, which recovers energy from the melter hot exhaust gas.

(3) An auxiliary heat sink (AHS), which dissipates heat in the event that one or all of the sediment dryers are not operational, while the HRTO continues to recover heat from an operational melter. The AHS unit is a standard shell and tube heat exchanger. Heat will be dissipated to the circulation water system.

(4) Circulation pumps and control valves, which provide the necessary energy to force the circulation of the thermal oil at the required process conditions.

(5) A thermal oil expansion tank.

(6) A thermal oil drain tank. Both items (5) and (6) are standard features for thermal oil systems, and are necessary for proper operation and maintenance of the system.

Dryer Exhaust Gas Treatment System

The process of sediment drying forces water that is contained in the wet sediment feed to vaporize, while the sediment is in contact with the heated components of the sediment dryer. To assist in efficient removal of the water vapor, a controlled volume of sweep air is admitted into the dryer housing. (See Drawing FVRS-PF-103 – Process Flow Diagram, Dryer Off Gas Treatment.) At the opposite end of the dryer housing, the combined water vapor and sweep air are exhausted from the dryer unit. The exhaust gas passes through a mechanical collector. The mechanical collector removes a significant fraction of the sediment dust that is entrained in the water vapor/sweep air mixture that is exhausted from the dryer. The dust is collected and the material is recombined with the dry sediment in any one of the dry sediment storage silos.

To provide for a "zero emissions" design, the water vapor/sweep air mixture is introduced into a venturi scrubber and packed tower arrangement. This device is similar in function to the venturi collector and packed tower used on the melter exhaust gas treatment system. The venturi collector removes an additional fraction of entrained sediment dust from the dryer exhaust stream. The water vapor is then condensed and removed by the packed tower section of the unit. A steady stream of water is circulated from a closed cooling water loop to the top of the packed tower. The condensing process increases the water volume in the cooling loop, requiring some blowdown of water to a wastewater treatment facility.

The exhaust gas that exits the packed tower section is circulated by an exhaust fan. The entire dryer and exhaust system operates under a negative pressure condition to prevent fugitive dust emissions from the dryer casings. Since some inward air leakage is expected, a small vent stream will be split off from the exhaust fan. The exhaust stream will be directed to one of the burners on the melter. This will provide destruction of any organics in the dryer exhaust. The balance of the exhaust fan discharge is directed back to the sediment dryers as the sweep air source.

Circulating Cooling Water System

A number of systems will require a steady stream of cooling water to remove heat. All of the systems use non-contact heat exchangers to prevent contamination of the cooling water system. The cooling system is a closed system. Heat is dissipated through a mechanical draft cooling tower. Make-up water is required to recover some evaporative losses from the system. Blowdown water will need to be drained from the cooling tower to limit total dissolved solids (TDS) concentrations in the water.

Circulating water is pumped to the users by motor-driven centrifugal pumps. The major users of circulation water are:

(1) Indirect heat exchanger for exhaust gas packed tower cooling system.
(2) Indirect heat exchanger for dryer exhaust gas packed tower cooling system.
(3) Aggregate quench tank indirect cooling heat exchanger.
(4) Cooling water for the thermal oil auxiliary heat dissipation unit.
(5) Charger cooling water.
(6) Cooling water required for the oxygen generation system.

ASU Oxygen Supply

Oxygen will be generated on-site. The approximate oxygen volume needed will require the generation of 171 tons of oxygen per day. The oxygen will be generated with a technology called gaseous oxygen generation, or GOX. This technology generates oxygen at a purity of 99.5%. The oxygen is generated in the gas phase (non-cryogenic). The plant will be completely designed and constructed from the foundations up by a third party. No detailed process description is included in this scope document. The sediment drying and melting facility will need to interconnect utilities and infrastructure to the oxygen plant to minimize infrastructure development costs. The main requirement will be the supply of 4160V power from the dryer and melting facility electric substation to the ASU.

Dust Control System

All of the sediment conveyors, storage hoppers and silos will have a closed design. To prevent fugitive emissions from the conveyor systems, they will be ventilated continuously. The exhaust will be directed to a high efficiency fabric filter. All collected dust will be directed back to one of the dry sediment storage silos.

Plant Wastewater Summary

There are three sources of process wastewater for the operation. The condensate from the dryer exhaust results in a waste stream of 48 GPM. This waste stream has a wastewater loading of 1000 to 3000 ppm of total suspended solids (TSS). The suspended solids will consist of fines that are carried out of the dryers. There is a potential that PCBs are attached to the sediment particles, requiring this flow stream to be treated by the same wastewater treatment facility processing the dredged sediment.

The packed tower on the exhaust of the melter generates 15 GPM of constant blowdown. This flow stream will have high concentrations of both TSS and chemical oxygen demand (COD), and will need to be sent for additional wastewater treatment. The discharge volume and concentration levels will not require any pretreatment prior to discharge to the publicly owned treatment works (POTW).

The cooling tower generates a maximum blowdown flow of 37 GPM. This flow can be permitted as a non-contact cooling water source. If the proper permits are obtained, it is possible to either discharge the water into the stormwater sewer system or into the final effluent of the wastewater treatment facility for the dredge water.

SUMMARY OF ASSUMPTIONS

Several assumptions were made in preparing the Cost Study estimates contained in this report. These assumptions were made based on our understanding of the scope of the project at the time of the award of the Department's Purchase Order. Others were made based on equipment design features provided by suppliers and the data which was then available. Final engineering and design would address variances from the assumptions.

1. The following assumptions were made relative to incoming sediment:
    a. Previously de-watered to 50% solids
    b. Previous removal of all debris, including metal and other material greater than ¼-inch in size
    c. Received in a non-frozen state, even during winter operations
    d. Gross calorific value (GCV) of approximately 1300 Btu per pound
    e. Loss on ignition of approximately 29%
    f. Fluxing requirement of 15% lime
    g. Self-agglomeration does not occur at 39% moisture or lower
2. The following assumptions were made relative to facility permitting:
    a. No hazardous waste incinerator regulations apply
    b. Oxyfuel is best available control technology (BACT) for NO_x control
    c. Wet scrubber at 95% control is BACT for SO2
3. The following assumptions were made relative to the facility design:
    a. Facility is staffed for 24 hours per day, year-round
    b. Site soils are capable of loading to 2500 pounds per square foot
    c. No provisions have been incorporated for soil testing or boring
    d. No compactor is assumed necessary for feeding to the melter
    e. The dryers require 10 Btu per square foot per degree F
    f. Facility design will be for an industrial area
4. The following assumptions were made relative to the cost of supplies:
    a. The gas price was assumed to be $3.25 per million Btu
    b. The electricity price was assumed to be 4½ cents per kilowatt hour

c. The lime flux cost was assumed to be $25.00 per ton
d. The oxygen cost is assumed to be 6 cents per hundred cubic feet from a 3rd party

5. No provisions were included for the following items:
   a. Salvage/removal at the end of the plant's economic life
   b. Dredging, dewatering, and delivery of cake solids
   c. Hedges or other financial instruments on commodity prices
   d. Site development costs other than those explicitly listed
   e. Financing costs during and after plant construction and working capital requirements

COST SUMMARIES

Capital Costs

The cost to build the melter facility is estimated to be approximately $36,800,000. (See Table 1 – Projected Capital Costs.) The primary equipment costs include the melter ($7,500,000, installation included), the material handling system ($3,000,000), and the dryers ($2,600,000). The main building is estimated at $2,600,000 and the sediment storage building is $1,800,000. Mechanical and electrical contracting is expected to be $10,000,000.

Operating Costs

The cost to operate the melter facility is estimated to be approximately $6,800,000 annually. (See Table 2 – Projected Operating Costs.) The primary cost drivers for the facility would be labor, supplies, and fuel.

Unit Cost Analysis

Over the 15-year projected life of the facility, approximately 3.15 million tons of contaminated river sediment would be processed. The present worth of the project, assuming construction and operating costs listed above, a State of Wisconsin interest rate of 5% (used as the discount rate), and glass sales of $2 to $25 per ton, is between $84,600,000 and $106,000,000. This results in a present worth unit cost between $26.29 and $32.92 per ton. (See Table 3 – Estimated Present Worth Cost for 250 Glass Ton per Day Sediment Melting Plant.)

SENSITIVITY ANALYSIS

Overview

A series of sensitivity analyses have been performed on the base project. These analyses estimate the capital, O&M, and unit cost of melter projects of varying sizes. These costs were derived using a combination of build-up estimates, generally accepted scale factors, and operational experience. The base case project was used as a reference.

Each major capital line item was analyzed to determine the new expected values, factoring in the impacts of the larger or smaller sized plants. For example, the slope of the cost curve of a melter is rather flat because a large portion of the cost of a melter is fixed. Sediment dryer plants, in comparison, scale fairly well due to the use of multiple dryer lines for each facility (increasing or decreasing the capacity of the plant is done by using more or fewer dryer lines).

The O&M line items were also analyzed individually to determine the new expected values. These items fall into two categories: fixed and variable O&M. Variable O&M items include natural gas, oxygen, electricity, and lime flux, the consumption of which varies in proportion to the amount of processing. Fixed O&M included staffing, G&A, and maintenance, although these items were individually estimated for each plant size.

Project Sizes

The project sizes were varied as indicated:

A. 1 x 250: This is the base case project described in this report. This facility has one sediment melter rated at 250 glass tons per day and three dryers rated at 200 wet ton per day (each), along with the associated balance of plant.
B. 2 x 250: This facility has two sediment melters each rated at 250 glass tons per day and six dryers rated at 200 wet ton per day (each), along with the associated balance of plant.
C. 2 x 375: This facility has two sediment melters each rated at 375 glass tons per day and ten dryers rated at 180 wet ton per day (each), along with the associated balance of plant.

D. 1 x 100: This facility has one sediment melter each rated at 100 glass tons per day and one dryer rated at 250 wet ton per day, along with the associated balance of plant.

Sediment Storage

The sensitivity analysis included provisions for each project to operate at 240 or 350 days per year. Limiting operations to 240 days per year would coincide with the 8-month dredging season, and avoid the capital expenditure of a building to store sediment and minimize potential permitting problems with storing such material and reduce. To operate 350 days per year, a storage would be used into which one-third of the de-watered sediments would be placed during the dredging season. During the non-dredging season, the accumulated inventory would be used as feedstock to the melter plant. For each 250 glass ton per day increment of capacity, sufficient storage could be accomplished using a 60,000 square foot building. The estimated cost of such a building would be $1.8 million per 250 glass ton/day unit.

Stand-alone Facility Design

The melter projects can be designed to be stand-alone facilities or integrated into the operation of an adjacent industrial facility with which it can share resources. Integration tends to be more applicable to the smaller projects (1x100 and 1x250). It was assumed that the 1x100 project would not be feasible without integration with an existing industrial facility. The 1x250 project was studied both as a stand-alone and as integrated. The 2x250 and 2x375 plants have sufficient volume to allow full independent staffing, and therefore were studied as stand-alone.

A provision was also included to account for special foundation requirements associated with integrated projects. This is because many area industrial plants are located along shorelines with poor soil load bearing capacities.

CONCLUSION

At the beginning of the Glass Aggregate Feasibility Study, Minergy had performed some preliminary analyses that indicated a unit cost in the range of $40 - $60 per ton. The results from the Cost Study confirm those initial results.

Table 1
Projected Capital Costs for 250 Glass Ton per Day Sediment Melting Plant

Item	Cost
Melter (delivered and installed)	$ 7,511,976
Dryer (total for 3, equipment only)	$ 2,588,505
Material handling system	$ 3,019,923
Dryer off gas system equipment	$ 394,515
Thermal oil system equipment	$ 995,579
AQCE system equipment	$ 468,931
BOP equipment	$ 845,081
Utilities equipment	$ 488,383
Mechanical contractor	$ 7,886,711
Electrical contractor	$ 2,113,548
Start-up costs	$ 763,277
Main building	$ 2,634,966
Engineering	$ 5,274,684
Sediment Storage Building	$ 1,800,000
TOTAL:	$ 36,768,000

Table 2
Projected Operating Costs for 250 Glass Ton per Day Sediment Melting Plant

Item	**Annual Cost**
Gas	$1,315,860
Electricity	$1,086,750
Labor	$2,125,000
Supplies	$1,612,310
Lime Flux	$447,125
G&A	$257,000
TOTAL:	$6,844,045

Table 3
Estimated Present Worth Cost for 250 Glass Ton per Day Sediment Melting Plant

Assumptions:		
Project life =	15	years
Interest rate =	5.0%	
Days per Year =	350	
Sediment processing rate =	613	tons daily
Total sediment processed =	3,218,250	tons over project life
Construction costs =	$36,768,000	
Operating costs =	$6,844,000	annually
Income from glass sales =	$2 - $25	per ton of glass sold
Glass production rate =	255	tons daily

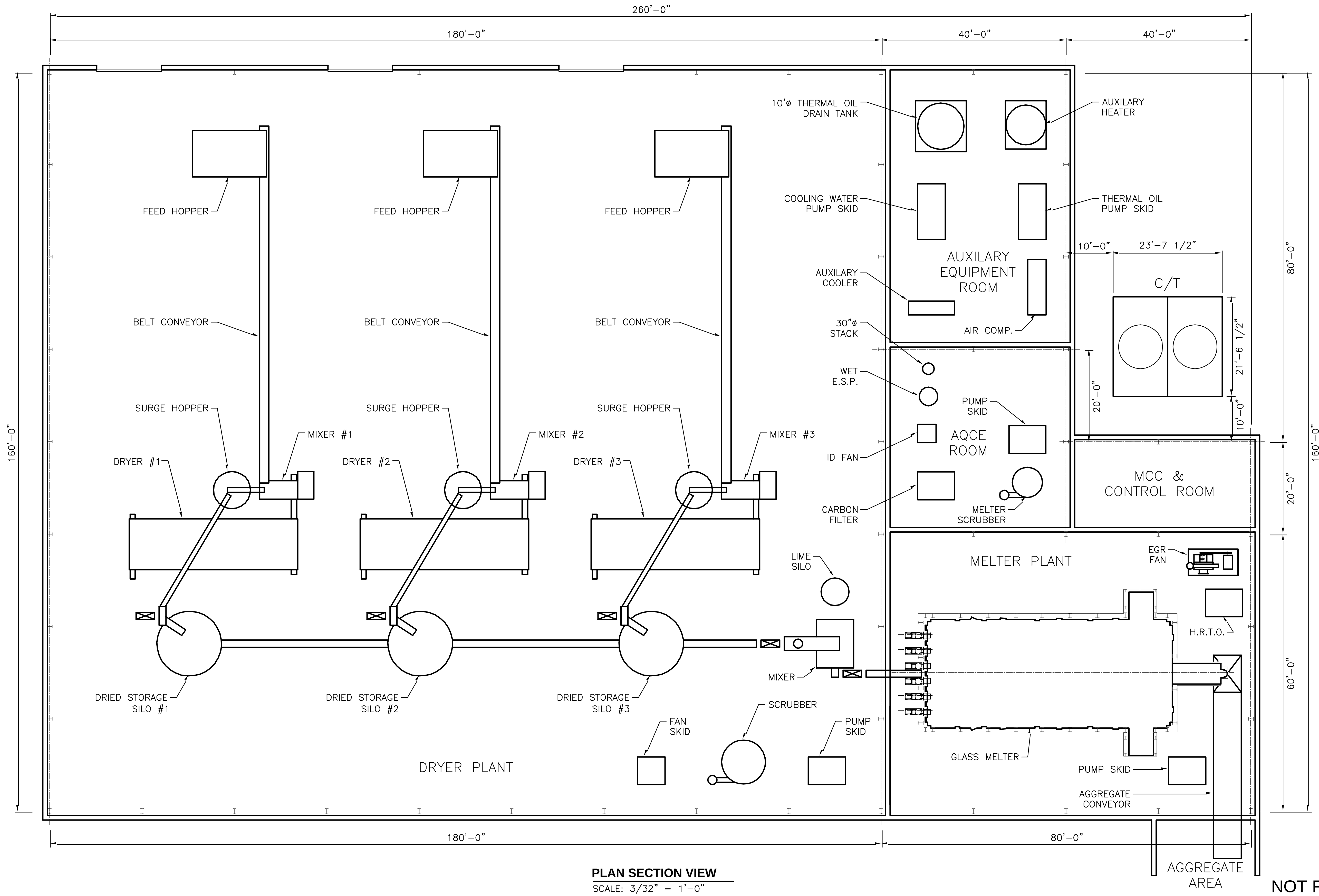
Estimated Costs:	**Initial Costs**	**Net Annual Costs**
Construction costs	$36,768,000	
Operating costs with no glass sales		$6,844,000
Operating costs minus glass income at $2/ton		$6,665,208
Operating costs minus glass income at $25/ton		$4,609,104

Total Present Worth Cost of Project:	
No glass sales	$107,806,380
With glass sales at $2/ton	$105,950,583
With glass sales at $25/ton	$84,608,925

Unit Costs (Per Ton of Sediment Processed):	
No glass sales	$33.50
With glass sales at $2/ton	$32.92
With glass sales at $25/ton	$26.29

Table 4
Summary of Sensitivity Options
Sediment Melting Plant

	1x100 Integrated No Storage	1x100 Integrated Storage	1x250 Integrated No Storage	1x250 Integrated Storage	1x250 Standalone No Storage	1x250 Standalone Storage	2x250 Standalone No Storage	2x250 Standalone Storage	2x375 Standalone No Storage	2x375 Standalone Storage
Daily capacity (tons)	240	240	613	613	613	613	1,226	1,226	1,840	1,840
Days/yr Operation	240	350	240	350	240	350	240	350	240	350
Project Life (years)	15	15	15	15	15	15	15	15	15	15
Sediment Processed (million tons)	0.86	1.26	2.21	3.22	2.21	3.22	4.41	6.44	6.62	9.66
Capital ($million)	25.50	26.25	36.99	38.79	34.97	36.77	63.19	66.79	87.39	92.79
Annual O&M ($million)	2.30	2.76	4.73	6.13	5.44	6.84	9.29	12.17	12.57	16.74
NPV before Glass Sales ($million)	49.35	54.86	86.04	102.40	91.44	107.81	159.58	193.16	217.88	266.50
Unit Cost (assuming $2 Glass) (dollars per ton of wet cake)	**$ 56.54**	**$ 42.96**	**$ 38.41**	**$ 31.24**	**$ 40.86**	**$ 32.92**	**$ 35.58**	**$ 29.43**	**$ 32.32**	**$ 27.01**
Unit Cost (assuming $25 Glass) (dollars per wet ton of cake)	**$ 49.91**	**$ 36.33**	**$ 31.78**	**$ 24.61**	**$ 34.23**	**$ 26.29**	**$ 28.95**	**$ 22.80**	**$ 25.68**	**$ 20.38**



PLAN SECTION VIEW

SCALE: 3/32" = 1'-0"

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NOT FOR CONSTRUCTION

Rev. No.	Revision Description	Date	Drwn.	Chk'd
0	Issue for Review	11/28/01	RDK	TJB

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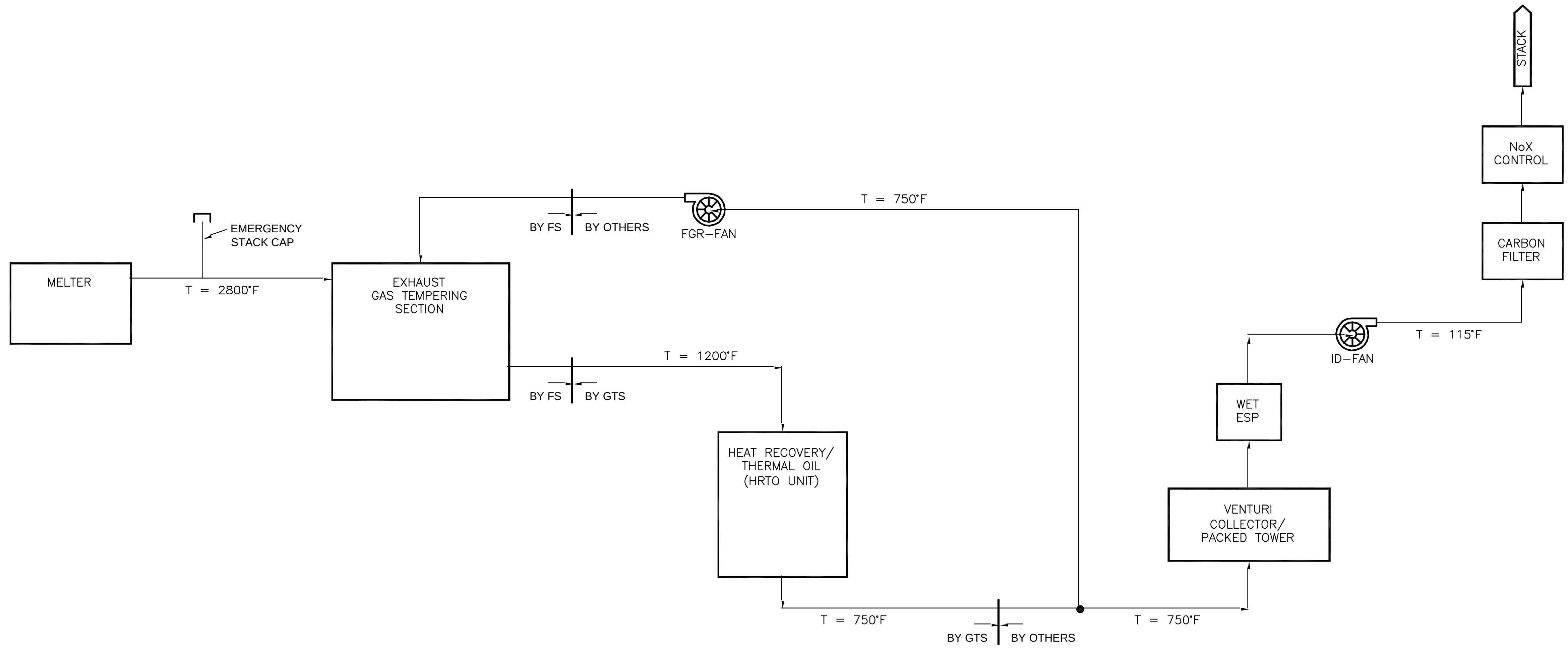
MINERGY™
A WISCONSIN ENERGY CORPORATION
1512 S. Commercial St., Neenah, WI 54956

Conceptual General Arrangement
Main Processing Plant
Plan View At Grade Elevation (0'-0")
Fox Valley River Sediment

Date: December 2001
Scale: As Shown
Drawing No.: FVRS-GA-101
Rev.: 0



Rev. No.	Revision Description	Date	Drwn.	Chk'd

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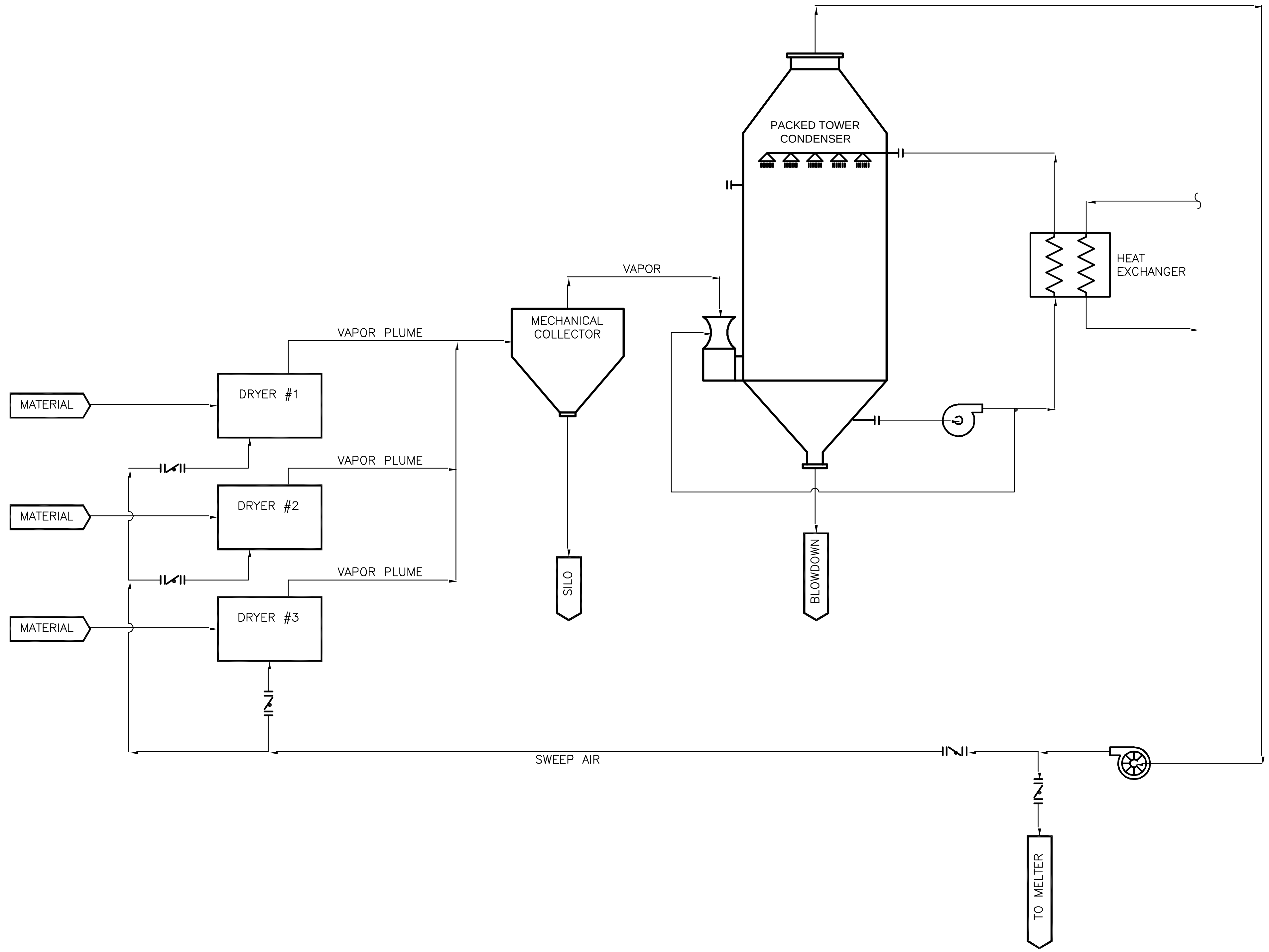
Process Flow Diagram
Melter Exhaust Heat Recovery & AQCE
250 Glass Ton Plant
Fox Valley River Sediment

Date: December 2001
Scale: None
Drawing No.: FVRS-PF-102
Rev.: 0



Rev. No.	Revision Description	Date	Drwn.	Chk'd

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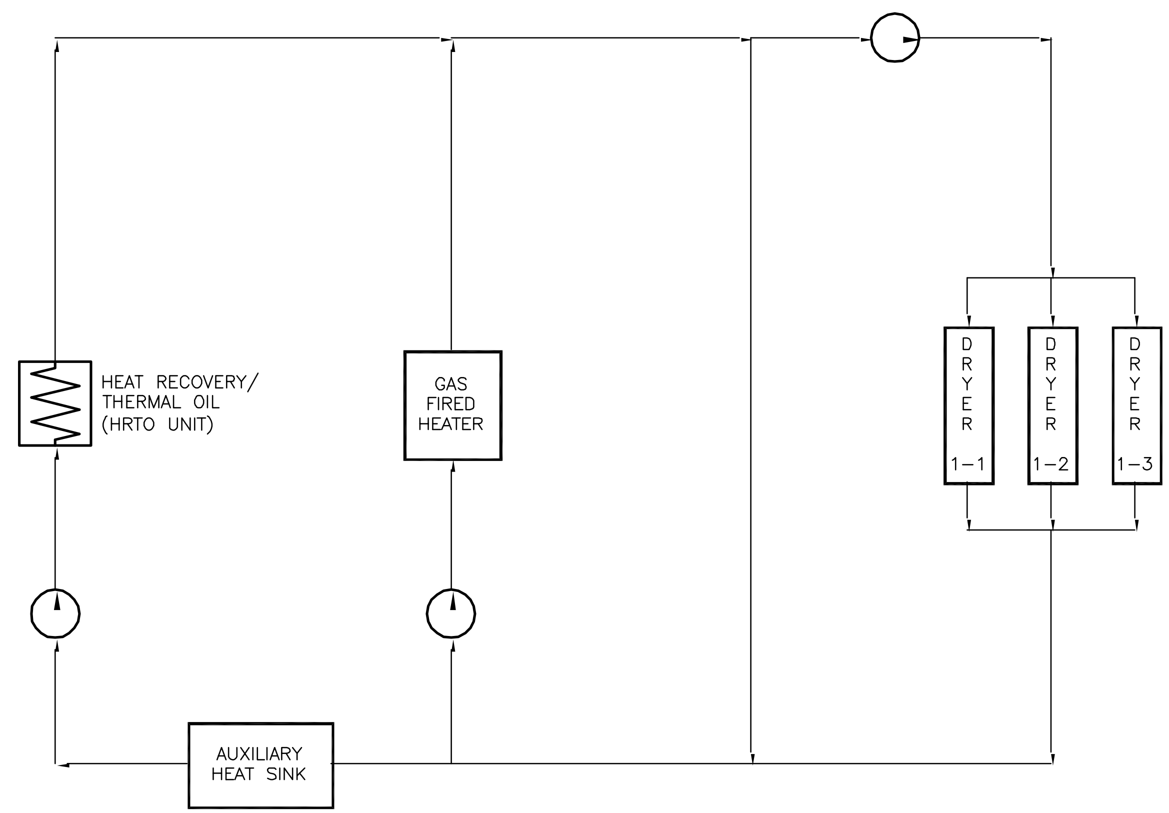
Process Flow Diagram
Dryer Off Gas Treatment
250 Glass Ton Plant
Fox Valley River Sediment

Date: December 2001
Scale: None
Drawing No. FVRS-PF-103
Rev. 0



Rev. No.	Revision Description	Date	Drwn.	Chk'd

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Process Flow Diagram
Thermal Oil Supply System
250 GlassTon Plant
Fox Valley River Sediment

Date: December 2001
Scale: None
Drawing No.: FVRS-PF-104
Rev.: 0

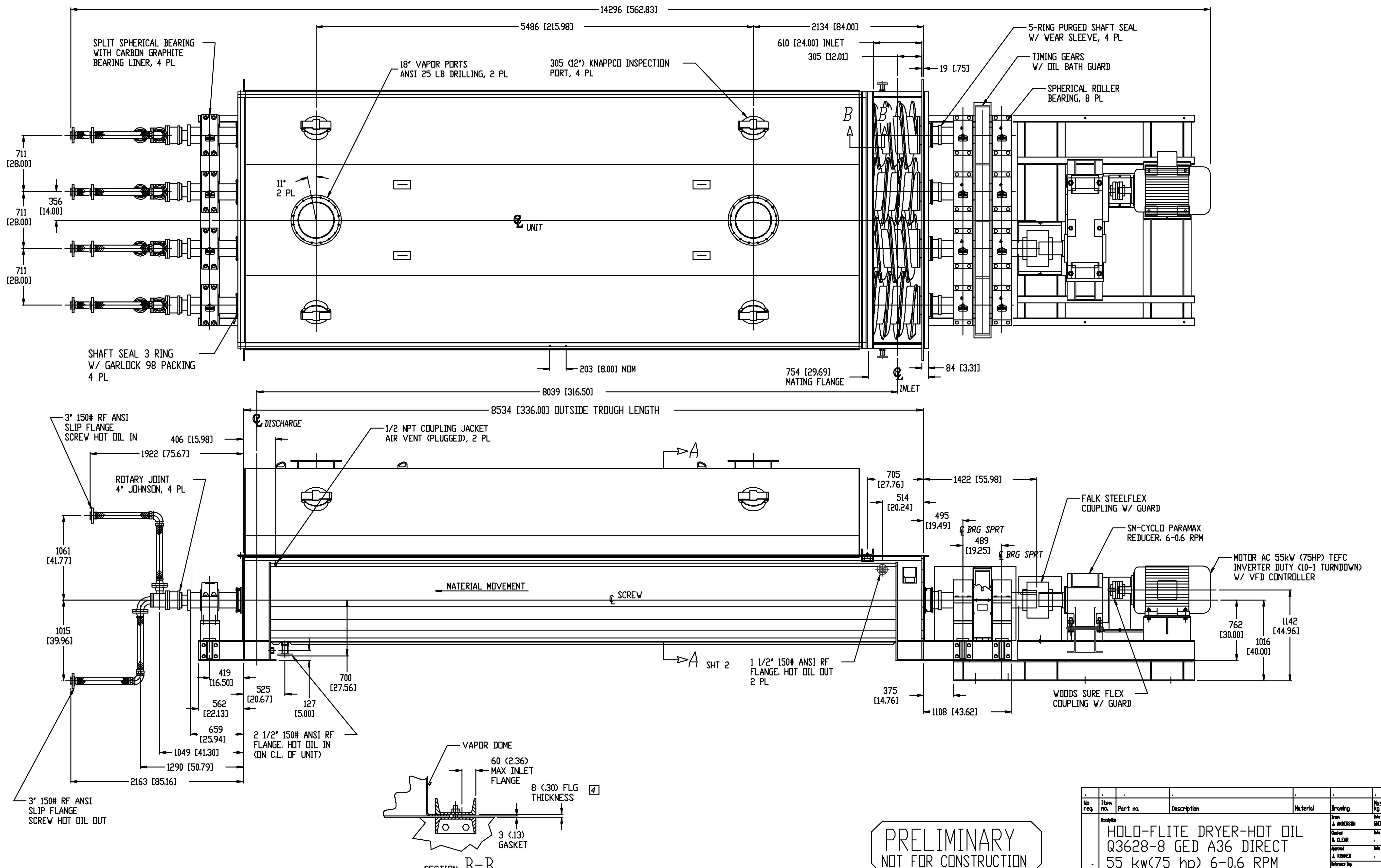
A		INITIAL DRAWING RELEASE

ALL DIMENSIONS ARE MILLIMETERS.

GENERAL ARRANGEMENT DRAWING TOLERANCES, ISO 2768-1, CLASS DESIGNATION COARSE (C)
VALUES SMALLER THAN THOSE LISTED BELOW TO BE NOTED NEAR DIMENSION ON FIELD OF DRAWING.

ALL DIMENSIONS ARE MILLIMETERS.

PERMISSIBLE DEVIATIONS FOR LINEAR DIMENSIONS, BASED ON LENGTH L (mm).										PERMISSIBLE DEVIATIONS FOR EXTERNAL RADII AND CHAMFER HEIGHTS, (mm).			PERMISSIBLE DEVIATIONS OF ANGULAR DIMENSIONS, USE SHORTER SIDE OF THE ANGLE L (mm).				
0.5 ≤L ≤3	3 ≤ L ≤ 6	6 < L ≤ 30	30 < L ≤120	120 < L ≤ 400	400 < L ≤1000	1000 < L ≤2000	2000 < L ≤4000	4000 < L ≤8000	8000 < L ≤12000	0.5 ≤L ≤3	3 < L ≤ 6	6 < L	L ≤ 10	10 < L ≤50	50 < L ≤120	120 < L ≤400	400 < L
± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2	± 3	± 4	± 5	± 6	± 0.4	± 1	± 2	± 1° 30′	± 1°	± 0° 30′	± 0° 15′	± 0° 10′

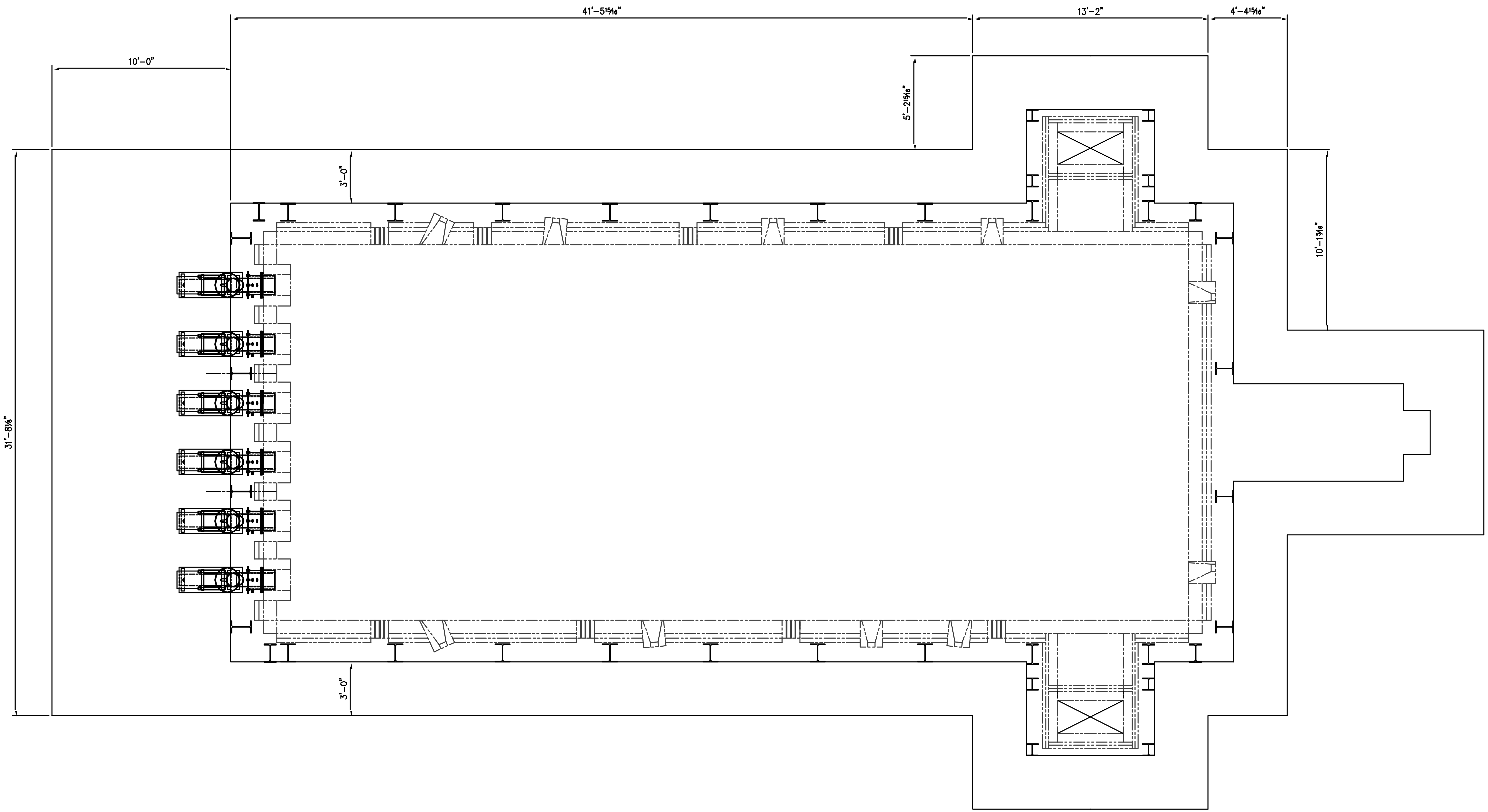


No req.	Item no.	Part no.	Description	Material	Drawing	Mass kg each

Description
HOLO-FLITE DRYER-HOT OIL
Q3628-8 GED A36 DIRECT
55 kw(75 hp) 6-0.6 RPM

Drawn: J. ANDERSON	Date: 6NOV01
Checked: D. CLEAR	Date
Approved: J. KRAMER	Date
Reference Dwg	

Projection
File name: PC1100309-1
Scale: 1:22
Revision: A
Size: A1
Drawing number: PC1100309
Sheet: 1
Cont. 2

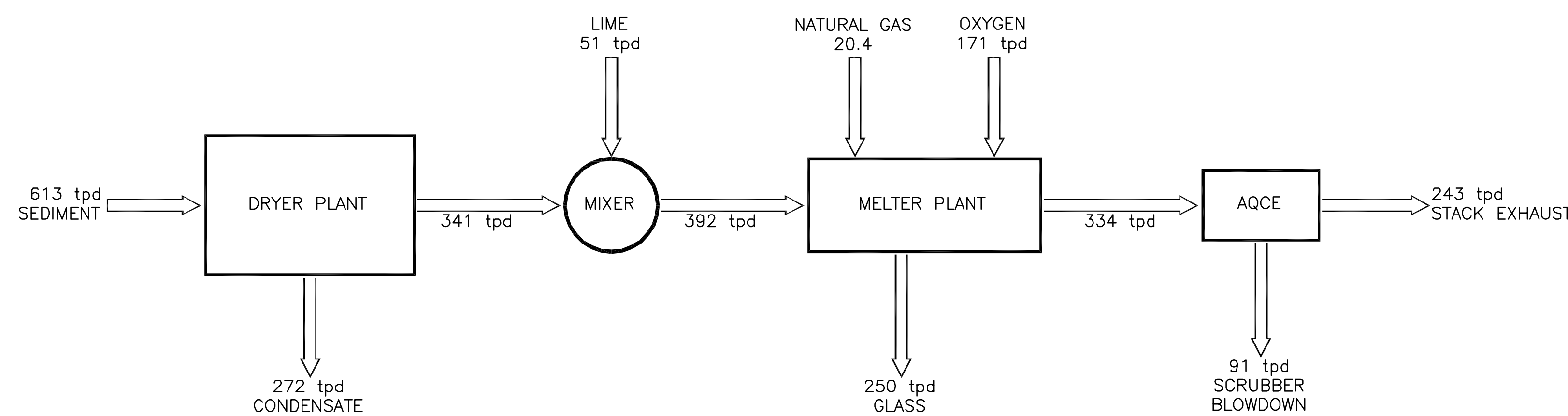


ENGINEERS & CONSULTANTS TO THE GLASS & STEEL INDUSTRIES SINCE 1918.

250 TPD
GENERAL ARRANGEMENT
STEEL PLAN VIEW
FOR : MINERGY
WISCONSIN

DRAWN MPH	DATE 6/21/01	FILE	CAD FILE WIQ8596/Q8596-006
ENGINEER	SCALE 3/8"=1'-0"	DRAWING NO.	
CHCK'D	CONTRACT 8596	Q8596-006	

file: M:\CAD - FURNACE\WIQ\WIQ8596 - MINERGY - 275 TPD\Q8596-006A.DWG Last edited: JUL 31, 01 @ 09:59 a.m. by: mhodpem



Rev. No.	Revision Description	Date	Drwn.	Chk'd

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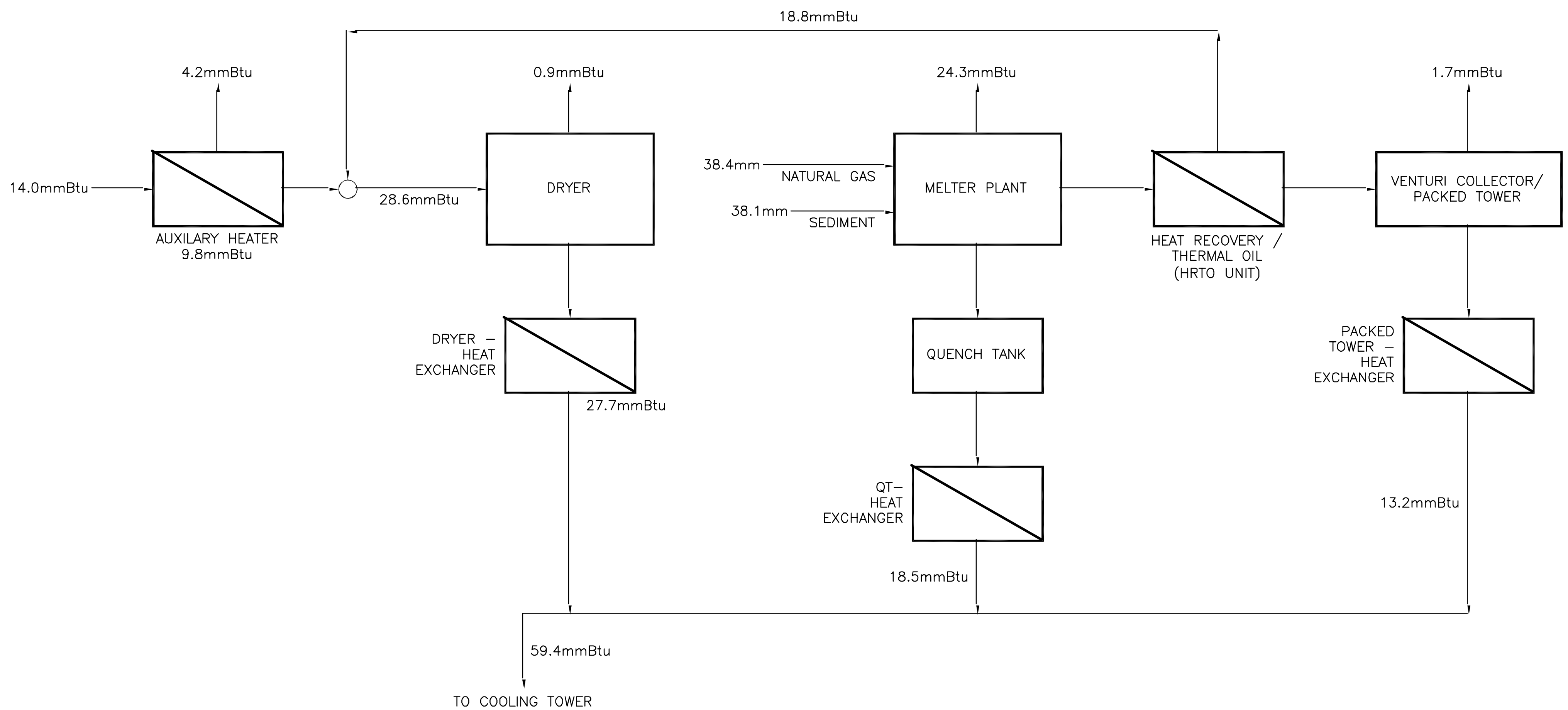
1512 S. Commercial St., Neenah, WI 54956

Mass Balance

250 Glass Ton Plant
Fox Valley River Sediment

Date: December 2001
Scale: None
Drawing No.: FVRS-MB-101
Rev.: 0



Rev. No.	Revision Description	Date	Drwn.	Chk'd

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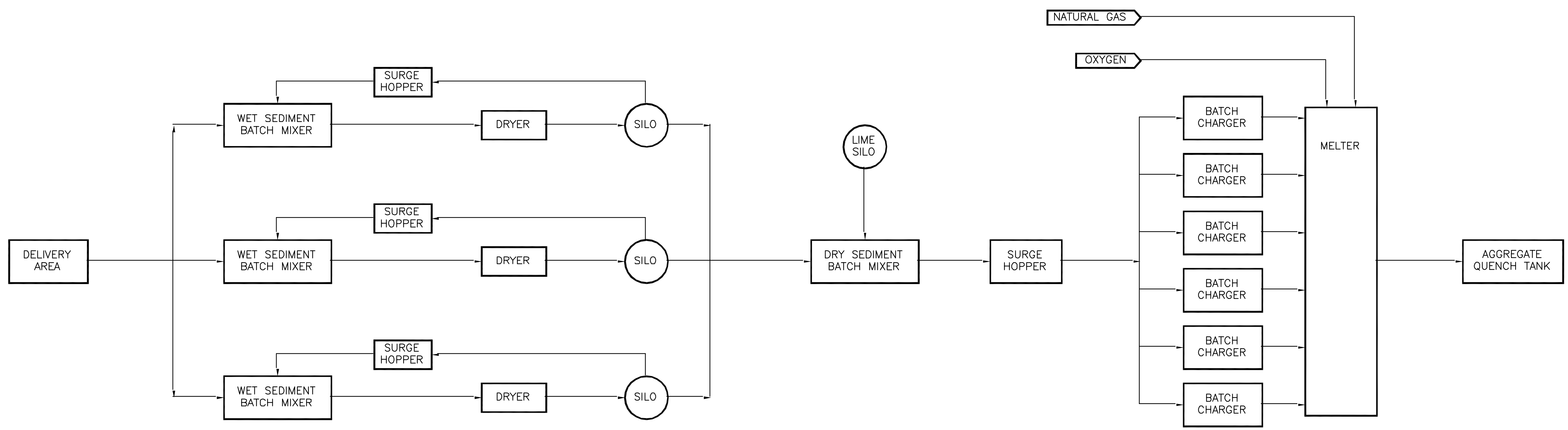
1512 S. Commercial St., Neenah, WI 54956

Energy Balance

250 Glass Ton Plant
Fox Valley River Sediment

Date: December 2001
Scale: None
Drawing No.: FVRS-EB-101
Rev.: 0



LEGEND:

mc = MOISTURE CONTROL
tpd = TONS PER DAY
ts = TOTAL SOLIDS CONTENT

Rev. No.	Revision Description	Date	Drwn.	Chk'd

MINERGY™
A WISCONSIN ENERGY CORPORATION
1512 S. Commercial St., Neenah, WI 54956

Process Flow Diagram
Sediment Drying and Preparation
250 Glass Ton Plant
Fox Valley River Sediment

Date: December 2001
Drawing No.: FVRS-PF-101
Rev.: 0
Scale: None

January 21, 2002

Mr. Robert Paulson
Wisconsin Department of Natural Resources
101 South Webster
P.O. Box 7921
Madison, WI 53707

Dear Sirs:

<u>Subject: Permitting Feasibility – Sediment Melter Plant</u>

Minergy Corp. has performed an analysis regarding the permitting feasibility of a commercial-scale sediment melter.

A full scale 250 glass ton per day melting facility emissions were based on values measured from the demonstration testing. Using good engineering practice, the results were extrapolated to commercial scale, and compared the results against the Wisconsin Administrative Code air regulations (NR400 series).

The expected emissions from a full scale operations would be very low, including a stack-basis destruction of PCBs of greater than 99.9999%. The facility would meet all current air state and federal emissions regulations. The expected annual emissions would not trigger the major source threshold. A discussion of the results of the analysis are listed below.

<u>Background</u>
During the week of August 14, 2001 a project team consisting of the Department, the U.S. EPA, Minergy Corp., Tetra Tech EMI, and EER Environmental conducted demonstration scale testing on a 2 glass ton per day demonstration melter. The project objectives and detailed testing procedures were included by the Quality Assurance and Project Plant (QAPP) which was developed and approved by the USEPA prior to the commencement of the testing.

The primary objective of the testing is "To determine the treatment efficiency (TE) of PCBs in dredged-and-dewatered sediment when processes in the Minergy GFT". To achieve the objectives the testing included sampling the feed material (contaminated sediment) to the melter, the finished product, and melter stack emissions for PCBs and other Contaminants of Concern (COC's). Demonstration scale air quality control equipment (AQCE) was also furnished and operated during the testing. The AQCE includes a wet scrubber and a carbon filter.

The data validation was completed by January 5, 2002 and the USEPA has released the data. This letter will review the data, and will make emissions projections to a full scale projection melter. The full scale facility is presently assumed to be a 250 glass ton per day operation. The emissions will be compared to the standards in the Wisconsin administrative code (NR400 series regulations) to determine the feasibility of permitting a full scale facility.

PCB emissions

Exhaust gas emissions were sampled on the demonstration unit before and after the air quality control equipment. PCB concentrations were measured using high resolution gas chromatography / high resolution mass spectrometry. The instrument has the capability of detecting PCBs to extremely low levels. The detection limit for most PCB congeners was 1.00 nanogram (10^{-9} gram). The controlled emissions were measured at an average of 36.6 ng/DSCM.

The full scale unit will have a exhaust gas flow of 4,940 DSCM per hour. The annual PCB emissions in the stack would equate to 1.58 grams per year or 0.0035 pounds per year. This is only 3.5 % of the Wisconsin Administrative Code section NR-445 table 3 values for PCB emissions. In summary, no additional study for the economic and technical feasibility for additional controls will be necessary at this emission level. A full scale facility producing 250 glass tons per day would process 341 tons per day of sediment (dry basis). With an average feed concentration of 28,000 ng/g of total PCBs into the melter the annual input of pure PCBs would be 6,983 pounds. On a stack emission basis this results in a PCB destruction of 99.999949%.

The annual PCB emissions projected above may be over-estimated for at least two reasons. First, during the demonstration, the water cooled extraction probe required frequent manual cleaning, causing a significant risk of contamination. Second, the full scale facility will have a significant increase in exhaust gas residence time over the demonstration scale. The demonstration scale glass melter had an average residence time for the exhaust gases of 2.1 seconds. The full scale is expected to have a residence time of approximately 16 seconds. The additional residence time will tend to increase the destruction of PCBs.

Mercury emissions

Mercury emissions were measured both before and after air quality control equipment. It is clear from the data that mercury removal is occurring in the AQCE equipment. The final melter exhaust emissions were measured at 1.924 ug/DSCM. This equates to 0.1834 lbs/year pounds per year of stack emissions for a full scale unit. The NR446 standard for mercury emissions is expressed as an ambient air concentration of 1.0 ug/m^3, and a mass limit of 3200 grams per day. The expected ambient air concentration for a full scale plant is 0.00011 ug/m^3, and a daily mass emissions of 0.228 g/day. The above ambient air concentrations are based on a 95’ tall stack with a 3’ inside diameter.

Other HAP emissions

The stack was also sampled for Silver, Arsenic, Barium, Cadmium, Chromium, Lead and Selenium. Testing was performed both before and after the AQCE. The above metals were not detected in the exhaust gas stream after the air quality control equipment for all 3 samples taken. It is not expected that the above metals will be an issue in the air permitting process.

Sampling and laboratory analysis for a total of 63 Semi-volatile organic compounds (SVOC) was conduced as part of the demonstration test. USEPA method 10 was used. The only semi volatile compound detected was Benzoic acid. The annual emissions for a full scale unit is projected at 2.37

pound per year. This compound is NOT listed as a hazardous air pollutant under the Wisconsin administrative code.

Sampling and laboratory analysis for a total of 51 specific Volatile organic compounds (VOC's) was conduced as part of the demonstration test. USEPA method 31 was used. None of the 51 specific VOC's were detected on any of the runs.

Sampling and laboratory analysis was also conducted for Polychlorinated Dibenzo Dioxins and Furans (PCDD/Fs). 2,3,7,8-TCDD is listed in the Wisconsin administrative codes hazardous pollutants listing in NR-445. No 2,3,7,8-TCDD was detected in the final exhaust after the air quality control equipment. Some PCDD/F's were detected in the exhaust gases prior to the air quality control equipment, however PCDD/F's were clearly present in the sediment feed material. The dioxin destruction factor on a toxic equivalency (TEQ) basis was 99.9894%. This type of a destruction factor provides a strong indication that post combustion reformation of PCDD/F was not occurring in the process.

NOx Emissions

High temperature thermal processes are usually associated with the formation of NOx (a combination of NO and NO_2.) During the demonstration testing a continuous emissions monitor (CEM) for NOx was connected to the melter exhaust. NOx emissions averaged 2450 ppmdv during the duration of the testing. The designers of the demonstration melter have seen a strong correlation between NOx emissions and melter scale up, with NOx emissions decreasing as melter capacity increases. At this time, the supplier estimates full-scale emissions of 1200 ppmdv. The resulting annual emissions will be 109.4 tons per year. This quantity is below the major source threshold of 250 tons per year established in chapter NR405 of the State regulations. If it is later determined that the emissions are not acceptable, additional end of pipe controls can be added to reduce NOx emissions by up to 90%.

SO_2 emissions

Traces of sulfur can be found in the dredged sediment. The sulfur is converted to SO_2 in the high temperature oxidizing environment inside the melter. During the demonstration testing a continuous emissions monitor (CEM) for SO_2 was connected to the melter exhaust. The efficiencies of SO_2 control equipment are well established and are accepted by the USEPA and WDNR. The expected full scale facility SO_2 emissions are 44.41 tons per year assuming a typical wet scrubber with 93% removal efficiency. This quantity is below the major source threshold.

CO emissions

The production of CO is associated with the incomplete thermal oxidization of organic materials. During the demonstration testing a continuous emissions monitors (CEM) for CO was connected to the melter exhaust. The CO emissions during the demonstration test were 3.3 ppm. The expected full scale facility CO emissions are 0.18 tons per year. This quantity is below the major source threshold.

VOC emissions

Much like CO the production of VOC's (Volatile Organic Compounds) is associated with the incomplete thermal oxidization of organic materials. During the demonstration testing a continuous emissions monitor (CEM) for VOC's was connected to the melter exhaust. This emissions monitor detects all VOC's; however, it is unable to identify specific compounds like USEPA method 10 and 31 discussed in the HAP Emissions section above. The VOC emissions during the demonstration test was 2.3 ppm. The expected full scale facility VOC emissions are 0.07 tons per year. This quantity is below the major source threshold.

Particulate Matter

Equipment vendors guarantee 0.01 grain per DSCF of exhaust gas for particulate control equipment. The resulting full scale emissions result in 1.09 tons per year. This quantity is below the major source threshold.

Summary of Emissions

The following is a summary of emissions from a 250 glass ton per day river sediment melter exhaust.

Air pollutant	Annual potential to emit	Unit of measure
Particulate	1.09	Tons per year
Sulfur dioxide	44.41	Tons per year
Organic compounds	0.07	Ton per year
Carbon monoxide	0.18	Ton per year
Nitrogen oxides	109.4	Tons per year
Mercury	0.183	pound per year
PCBs	0.0035	pound per year

Conclusion

A commercial-scale sediment melter facility appears to be fully permittable under Federal and Wisconsin regulations.

Please contact me at (920) 727-1411 if you have any questions.

Sincerely,

Terrence W. Carroll
Regional Manager

Appendix H

Detailed Cost Estimate Worksheets

Table 7-4 Cost Summary for Remedial Alternatives - Little Lake Butte des Morts

125 ppb

Alternative	Dredge Volume (cy)	TSCA Dredge Vol. (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	1,689,173	16,165	$37,700,000	---	---	$3,200,000	$1,900,000	---	---	$184,200,000	$4,500,000	$231,500,000	$46,300,000	$277,800,000
C2	1,689,173	16,165	$37,700,000	---	---	$36,200,000	$2,100,000	---	---	$45,700,000	$4,500,000	$126,200,000	$25,240,000	$151,440,000
D	1,689,173	16,165	$36,700,000	$1,700,000	---	---	$2,100,000	---	$69,300,000	$1,700,000	$4,500,000	$116,000,000	$23,200,000	$139,200,000
E	1,689,173	16,165	$37,700,000	---	---	$3,200,000	$1,900,000	$69,900,000	---	---	$4,500,000	$117,200,000	$23,440,000	$140,640,000
F	1,253,873	16,165	$32,300,000	$1,700,000	$33,600,000	---	$1,800,000	---	$69,300,000	$2,000,000	$4,500,000	$145,200,000	$29,040,000	$174,240,000

250 ppb

Alternative	Dredge Volume (cy)	TSCA Dredge Vol. (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	1,322,818	16,165	$32,000,000	---	---	$3,200,000	$1,600,000	---	---	$144,300,000	$4,500,000	$185,600,000	$37,120,000	$222,720,000
C2	1,322,818	16,165	$32,000,000	---	---	$28,400,000	$1,800,000	---	---	$35,800,000	$4,500,000	$102,500,000	$20,500,000	$123,000,000
D	1,322,818	16,165	$31,000,000	$1,700,000	---	---	$1,800,000	---	$69,300,000	$2,000,000	$4,500,000	$110,300,000	$22,060,000	$132,360,000
E	1,322,818	16,165	$32,000,000	---	---	$3,200,000	$1,600,000	$54,700,000	---	---	$4,500,000	$96,000,000	$19,200,000	$115,200,000
F	999,117	16,165	$27,900,000	$1,700,000	$31,600,000	---	$1,600,000	---	$69,300,000	$2,000,000	$4,500,000	$138,600,000	$27,720,000	$166,320,000

500 ppb

Alternative	Dredge Volume (cy)	TSCA Dredge Vol. (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	1,023,621	16,165	$27,000,000	---	---	$3,200,000	$1,400,000	---	---	$111,700,000	$4,500,000	$147,800,000	$29,560,000	$177,360,000
C2	1,023,621	16,165	$27,000,000	---	---	$22,000,000	$1,600,000	---	---	$27,700,000	$4,500,000	$82,800,000	$16,560,000	$99,360,000
D	1,023,621	16,165	$26,000,000	$1,700,000	---	---	$1,600,000	---	$69,300,000	$2,000,000	$4,500,000	$105,100,000	$21,020,000	$126,120,000
E	1,023,621	16,165	$27,000,000	---	---	$3,200,000	$1,400,000	$42,400,000	---	---	$4,500,000	$78,500,000	$15,700,000	$94,200,000
F	771,564	16,165	$23,700,000	$1,700,000	$28,700,000	---	$1,400,000	---	$37,300,000	$2,000,000	$4,500,000	$99,300,000	$19,860,000	$119,160,000

1000 ppb

Alternative	Dredge Volume (cy)	TSCA Dredge Vol. (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	784,192	16,165	$22,100,000	---	---	$3,200,000	$1,300,000	---	---	$85,600,000	$4,500,000	$116,700,000	$23,340,000	$140,040,000
C2	784,192	16,165	$22,100,000	---	---	$16,900,000	$1,400,000	---	---	$21,300,000	$4,500,000	$66,200,000	$13,240,000	$79,440,000
D	784,192	16,165	$21,100,000	$1,700,000	---	---	$1,400,000	---	$37,300,000	$2,000,000	$4,500,000	$68,000,000	$13,600,000	$81,600,000
E	784,192	16,165	$22,100,000	---	---	$3,200,000	$1,300,000	$32,500,000	---	---	$4,500,000	$63,600,000	$12,720,000	$76,320,000
F	635,547	16,165	$20,100,000	$1,700,000	$23,600,000	---	$1,300,000	---	$37,300,000	$2,000,000	$4,500,000	$90,500,000	$18,100,000	$108,600,000

5000 ppb

Alternative	Dredge Volume (cy)	TSCA Dredge Vol. (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	281,689	16,165	$8,900,000	---	---	$3,200,000	$1,000,000	---	---	$30,900,000	$4,500,000	$48,500,000	$9,700,000	$58,200,000
C2	281,689	16,165	$8,900,000	---	---	$6,100,000	$1,100,000	---	---	$7,700,000	$4,500,000	$28,300,000	$5,660,000	$33,960,000
D	281,689	16,165	$7,900,000	$1,700,000	---	---	$1,100,000	---	$37,300,000	$2,000,000	$4,500,000	$54,500,000	$10,900,000	$65,400,000
E	281,689	16,165	$8,900,000	---	---	$3,200,000	$1,000,000	$11,700,000	---	---	$4,500,000	$29,300,000	$5,860,000	$35,160,000
F	222,635	16,165	$8,000,000	$1,700,000	$11,700,000	---	$1,000,000	---	$37,300,000	$2,000,000	$4,500,000	$66,200,000	$13,240,000	$79,440,000

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE LAKE BUTTE DES MORTS
Action Level - 125 ppb

Material Handling Assumptions:						
Volume > 125 ppb	1,689,173	cy	761 ac	1,289,445	m3	Acres corresponds to dredge
Volume > 250 ppb	1,322,818	cy		1,009,785	m3	footprint area
Volume > 500 ppb	1,023,582	cy		781,360	m3	
Volume > 1,000 ppb	784,192	cy		598,620	m3	
Volume > 5,000 ppb	281,689	cy		215,030	m3	
Volume > 50,000 ppb	16,165	cy		12,340	m3	
Solids Specific Gravity	2.51					
Fresh Water Density	62.4	lb/ft3				
In Situ Density	24.2%	w/w	11.3% v/v	0.99	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3% v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density (passive pond)	20%	w/w	9.1% v/v	0.96	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	28.5% v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.8%	w/w	60.0% v/v	1.35	tons per cy	
Arrowhead/Menasha CDF Capacity	1,406,932	cy	in situ	1,337,963	m3	
HTTD Treatment Capacity	1,099,327	cy	in situ	1,650,000	tons	
Cap Volume	435,300	cy		332,290	m3	
Vitrification Treatment Capacity	4,496,073	cy	in situ	2145500.00	tons	
Cost Estimating Parameters & Methodology:						
Interest Rate	6.0%					Not Used
Sales Tax	5.5%					
Engineering, Procurement and Construction Mgmt	12.0%					
Contractor Overhead and Profit - Dredging Only	15.0%					
<u>Dredging</u>						
Debris Sweep	$16,000	per acre				Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day				
Sediment Removal QA	$1,200	per day				
Hydraulic - 10-inch Cutterhead						
Site Preparation	$100,000	per dredge launch site				pj
Mobilization - Equipment	$135,000	per dredge				Ogden Beeman
Mobilization - Silt Curtain	$35,000					Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift				Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift				Ogden Beeman (Oct 11, 2000)
Site Restoration	$600,000	per dredge launch site				pj
Mechanical - 3 cy bucket						
Dock Construction	$400,000	LS				pj
Mobilization - Equipment	$455,000	per dredge				Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS				Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea				Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$9,000	per shift				Ogden Beeman
Dredge Rate	630	cy in situ per 10 hour shift				Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area				pj
Free Water per cy Dredged (10%)	20	gal				Ogden Beeman
Offload Crane Mobilization	$50,000	LS				pj
Site Restoration	$75,000	LS				pj
High Temperature Thermal Desorption						
Setup Staging Area	$50,000					pj
Mobilization/Site Prep	$150,000					Maxymillian
Sediment Treatment QA	$2	per ton				
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1				
Sand Purchase and Deliver	$6	per ton				Ole
Blending	$25	per ton				Ole
HTTD (includes off-gas treatment)	$75	per ton				Maxymillian
Stack Testing	$50,000	LS				Maxymillian
Place Treated Material	$3	per ton				
Vitrification						
Vitrification (unit cost incl Cap and Op Costs)	$27.0	per ton (250 glass ton per day melter unit)				Unit Cost Study- Minergy
Capping						
Mobilization/Site Prep	$200,000					Ogden Beeman
Area	9,322,396	sf	866,100		m2	
Sand Cap Depth	1.7	feet				
Sand Placement	$6	per cy				Ogden Beeman
Sand Purchase	$6	per ton				Ole
Sand Density	1.4	tons per cy				
Armored Cap Depth	1.0	feet				
Cobbles	$30	per cy				Means
Cap Placement QA	$100,000	LS				Ogden Beeman
Long-term O&M	2%	of capital				pj
Long-term Monitoring	$400,000	per year				Anne LTM

Nearshore CDF	Arrowhead		Menasha			
Land Lease or Purchase	$1.8	per sf	$1.8			Ole
Length	8,000	lf	9,200			Baird
Capping Volume	190,000	cy	170,000			Baird
Seeding Area	280,000	sy	250,000			Baird
Sheetpile Wall Length	8,000	lf	9,200			Baird
Sheetpile Depth	30	ft	30			based on bathymetry
Sheetpile Cost	$19	per sf	$19			pj
Shot Rock Berm	$650	per lf	$550			Baird
Rip Rap	$215	per lf	$250			Baird
Place Treated Material	$2	per cy	$2			pj
Clean Soil Cap	$10	per cy	$10			Baird
Seeding	$1	per sy	$1			Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	644,791	sf	14.80			2 days slurry + 13 wk solids * 2 cell
Perimeter	3,212	lf	802.9890256			assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				pj
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Water Treatment						
Flow Rate (passive dewatering)	395	gpm				assume operate 24/7
Unit, Purchase (passive dewatering)	$691,096	LS				pj
Flow Rate (mechanical dewatering)	484	gpm				
Unit, Purchase (mechanical dewatering)	$781,094	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Disposal						
Off-Site Disposal						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Institutional Controls						
Public Education Program	$100,000					pj
O&M Plans	$20,000					pj
Deed Restrictions	$5,000					pj
Annual Costs						
Public Education Program	$30,000					pj
Maintaining O&M Plans	$800					pj
Reporting	$20,000					pj
Long-term Monitoring	$600,000					Anne LTM
Long-term Monitoring (no action)	$300,000					Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Off-site Disposal (Passive Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	761	acre		$12,176,000
Dredging - 12 hour shifts	1609	Day	12.37692308	$9,171,300
Dredge Monitoring (Water Quality)	1609	Day		$4,827,000
Sediment Removal QA	1609	Day		$1,930,800
Site Restoration	2	Each		$1,200,000
Direct Capital:				$29,675,100
Engineering, Procurement & Construction Management:				3,561,012
Contractor Overhead/Profit:				4,451,265
Total Capital:				**$37,700,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	1,280,733,951	gal	$512,294
Water Treatment QA	2,253	day	$450,600
Direct Capital:			$1,653,989
Engineering, Procurement & Construction Management:			198,479
Total Capital:			**$1,900,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	2,015,159	ton		$50,378,975
Lime Purchase	201,516	ton		$12,090,960
Soil Loading	2,015,159	ton		$5,642,445
Soil Hauling	2,015,159	ton		$9,446,058
Tipping Fees (non-TSCA)	1,995,874	ton		$85,822,578
Tipping Fees (TSCA)	19,285	ton		$1,060,680
Direct Capital:				$164,441,696
Engineering, Procurement & Construction Management:				19,733,004
Total Capital:				**$184,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$231,500,000**

ALTERNATIVE C2: Dredge Sediment With Off-site Disposal (Mechanical Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	761	acre		$12,176,000
Dredging - 12 hour shifts	1609	Day	12.37692308	$9,171,300
Dredge Monitoring (Water Quality)	1609	Day		$4,827,000
Sediment Removal QA	1609	Day		$1,930,800
Site Restoration	2	Each		$1,200,000
Direct Capital:				$29,675,100
Engineering, Procurement & Construction Management:				3,561,012
Contractor Overhead/Profit:				4,451,265
Total Capital:				**$37,700,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	403,032	bdt	$32,242,544
Direct Capital:			$32,342,544
Engineering, Procurement & Construction Management:			3,881,105
Total Capital:			**$36,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	1,570,606,822	gal	$628,243
Water Treatment QA	2,253	day	$450,600
Direct Capital:			$1,859,937
Engineering, Procurement & Construction Management:			223,192
Total Capital:			**$2,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	806,064	ton	$2,256,978
Soil Hauling	806,064	ton	$3,778,423
Tipping Fees (non-TSCA)	798,350	ton	$34,329,031
Tipping Fees (TSCA)	7,714	ton	$424,272
Direct Capital:			$40,788,704
Engineering, Procurement & Construction Management:			4,894,645
Total Capital:			**$45,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$126,200,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	15,939	ton	$398,475
Lime Purchase	1,594	ton	$95,640
Soil Loading	15,939	ton	$44,629
Soil Hauling	15,939	ton	$74,714
Tipping Fees (TSCA)	15,939	ton	$876,645
Direct Capital:			$1,490,103
Engineering, Procurement & Construction Management:			178,812
Total Capital:			**$1,700,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	761	acre	$12,176,000
Dredging - 12 hour shifts	1594	Day	$9,085,800
Dredge Monitoring (Water Quality)	1594	Day	$4,782,000
Sediment Removal QA	1594	Day	$1,912,800
Site Restoration	1	LS	$600,000
Direct Capital:			$28,926,600
Engineering, Procurement & Construction Management:			3,471,192
Contractor Overhead/Profit:			4,338,990
Total Capital:			**$36,700,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,520,000	sf	$4,536,000
Shot Rock/Rip Rap	8,000	lf	$6,920,000
Sheetpile Placement	240,000	sf	$4,560,000
Clean Soil Cap	190,000	cy	$1,900,000
Seeding	280,000	sy	$280,000
Mitigation	58	acre	$578,512
Direct Capital:			$18,774,512
Engineering, Procurement & Construction Management:			2,252,941
Total Capital:			**$21,027,454**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs			$16,258,262
Total Project Capital and O&M Cost			**$37,300,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	27,778	sf	$50,000
Shot Rock/Rip Rap	9,200	lf	$7,360,000
Sheetpile Placement	276,000	sf	$5,244,000
Clean Soil Cap	170,000	cy	$1,700,000
Seeding	250,000	sy	$250,000
Mitigation	52	acre	$516,529
Direct Capital:			$15,120,529
Engineering, Procurement & Construction Management:			1,814,463
Total Capital:			**$16,934,992**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs			$15,026,734
Total Project Capital and O&M Cost			**$32,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	1,555,902,577	gal	$622,361
Water Treatment QA	2,253	day	$450,600
Direct Capital:			$1,854,055
Engineering, Procurement & Construction Management:			222,487
Total Capital:			**$2,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$116,000,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	761	acre	$12,176,000
Dredging - 12 hour shifts	1609	Day	$9,171,300
Dredge Monitoring (Water Quality)	1609	Day	$4,827,000
Sediment Removal QA	1609	Day	$1,930,800
Site Restoration	2	Each	$1,200,000
Direct Capital:			$29,675,100
Engineering, Procurement & Construction Management:			3,561,012
Contractor Overhead/Profit:			4,451,265
Total Capital:			**$37,700,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	1,280,733,951	gal	$512,294
Water Treatment QA	2,253	day	$450,600
Direct Capital:			$1,653,989
Engineering, Procurement & Construction Management:			198,479
Total Capital:			**$1,900,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	2,015,159	ton	$54,409,293
Soil Loading	2,015,159	ton	$5,642,445
Soil Hauling	2,015,159	ton	$2,361,514
Direct Capital:			$62,413,252
Engineering, Procurement & Construction Management:			$7,489,590
Total Capital:			**$69,900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$117,200,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge to CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Lime Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	805,639	tons		$4,833,835
Sand Placement	575,457	cy		$3,452,739
Cobble Purchase and Placement	345,274	cy		$10,358,218
Cap Placement QA	1	LS		$100,000
Direct Capital:				$18,944,792
Engineering, Procurement & Construction Management:				2,273,375
Total Capital:				**$21,218,167**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$424,363	$6,385,097
Total Present Worth, Longer Term O&M Costs				$12,403,616
Total Project Capital and O&M Cost				**$33,600,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	761	acre	$12,176,000
Dredging - 12 hour shifts	1179	Day	$6,720,300
Dredge Monitoring (Water Quality)	1179	Day	$3,537,000
Sediment Removal QA	1179	Day	$1,414,800
Site Restoration	2	Each	$1,200,000
Direct Capital:			$25,418,100
Engineering, Procurement & Construction Management:			3,050,172
Contractor Overhead/Profit:			3,812,715
Total Capital:			**$32,300,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	1,151,157,170	gal	$460,463
Water Treatment QA	1,672	Day	$334,400
Direct Capital:			$1,575,957
Engineering, Procurement & Construction Management:			189,115
Total Capital:			**$1,800,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,520,000	sf	$4,536,000
Shot Rock/Rip Rap	8,000	lf	$6,920,000
Sheetpile Placement	240,000	sf	$4,560,000
Clean Soil Cap	190,000	cy	$1,900,000
Seeding	280,000	sy	$280,000
Mitigation	58	acre	$578,512
Direct Capital:			$18,774,512
Engineering, Procurement & Construction Management:			2,252,941
Total Capital:			**$21,027,454**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs			$16,258,262
Total Project Capital and O&M Cost			**$37,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$113,200,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE LAKE BUTTE DES MORTS
Action Level - 250 ppb

Material Handling Assumptions:

Volume > 250 ppb	1,322,818	cy	697	ac	1,009,785	m3	Acres corresponds to dredge
Volume > 125 ppb	1,689,173	cy			1,289,445	m3	footprint area
Volume > 500 ppb	1,023,621	cy			781,390	m3	
Volume > 1,000 ppb	784,192	cy			598,620	m3	
Volume > 5,000 ppb	281,689	cy			215,030	m3	
Volume > 50,000 ppb	16,165	cy			12,340	m3	
Solids Specific Gravity	2.51						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.3%	v/v	0.99	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density (passive pond)	20%	w/w	9.1%	v/v	0.96	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	28.5%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.8%	w/w	60.0%	v/v	1.35	tons per cy	
Arrowhead/Menasha CDF Capacity	1,406,932	cy	in situ		1,337,963	m3	
HTTD Treatment Capacity	1,099,327	cy	in situ		1,650,000	tons	
Cap Volume	323,701	cy			247,100	m3	
Vitrification Treatment Capacity	4,496,073	cy	in situ		2145500.00	tons	

Cost Estimating Parameters & Methodology:

Interest Rate	6.0%				Not Used
Sales Tax	5.5%				
Engineering, Procurement and Construction Mgmt	12.0%				
Contractor Overhead and Profit - Dredging Only	15.0%				
Dredging					
Debris Sweep	$16,000	per acre			Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day			
Sediment Removal QA	$1,200	per day			
Hydraulic - 10-inch Cutterhead					
Site Preparation	$100,000	per dredge launch site			pj
Mobilization - Equipment	$135,000	per dredge			Ogden Beeman
Mobilization - Silt Curtain	$35,000				Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift			Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift			Ogden Beeman
Site Restoration	$600,000	per dredge launch site			pj
Mechanical - 3 cy bucket					
Dock Construction	$400,000	LS			pj
Mobilization - Equipment	$455,000	per dredge			Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS			Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea			Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$9,000	per shift			Ogden Beeman
Dredge Rate	630	cy in situ per 10 hour shift			Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area			pj
Free Water per cy Dredged (10%)	20	gal			Ogden Beeman
Offload Crane Mobilization	$50,000	LS			pj
Site Restoration	$75,000	LS			pj
High Temperature Thermal Desorption					
Setup Staging Area	$50,000				pj
Mobilization/Site Prep	$150,000				Maxymillian
Sediment Treatment QA	$2	per ton			
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1			
Sand Purchase and Deliver	$6	per ton			Ole
Blending	$25	per ton			Ole
HTTD (includes off-gas treatment)	$75	per ton			Maxymillian
Stack Testing	$50,000	LS			Maxymillian
Place Treated Material	$3	per ton			
Vitrification					
Vitrification (unit cost incl Cap and Op Costs)	$27.0	per ton (250 glass ton per day melter unit)			Unit Cost Study- Minergy
Capping					
Mobilization/Site Prep	$200,000				Ogden Beeman
Area	8,630,293	sf	801,800	m2	
Sand Cap Depth	1.7	feet			
Sand Placement	$6	per cy			Ogden Beeman
Sand Purchase	$6	per ton			Ole
Sand Density	1.4	tons per cy			
Armored Cap Depth	1.0	feet			
Cobbles	$30	per cy			Means
Cap Placement QA	$100,000	LS			Ogden Beeman
Long-term O&M	2%	of capital			pj
Long-term Monitoring	$400,000	per year			Anne LTM

Nearshore CDF	Arrowhead		Menasha				
Land Lease or Purchase	$1.8	per sf	$1.8				Ole
Length	8,000	lf	9,200				Baird
Capping Volume	190,000	cy	170,000				Baird
Seeding Area	280,000	sy	250,000				Baird
Sheetpile Wall Length	8,000	lf	9,200				Baird
Sheetpile Depth	30	ft	30				based on bathymetry
Sheetpile Cost	$19	per sf	$19				pj
Shot Rock Berm	$650	per lf	$550				Baird
Rip Rap	$215	per lf	$250				Baird
Place Treated Material	$2	per cy	$2				pj
Clean Soil Cap	$10	per cy	$10				Baird
Seeding	$1	per sy	$1				Baird
Mitigation	$10,000	per acre					Tim
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					Anne LTM
Long-term O&M	2%	of capital					pj
Solidification							
Percent Lime	10%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area	644,791	sf					2 days slurry + 13 wk solids * 2 cell
Perimeter	3,212	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Alphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate (passive dewatering)	395	gpm					assume operate 24/7
Unit, Purchase (passive dewatering)	$691,096	LS					pj
Flow Rate (mechanical dewatering)	484	gpm					
Unit, Purchase (mechanical dewatering)	$781,094	LS					
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample/day
Disposal							
Off-Site Disposal							
Load Soil for Hauling	$2.80	per ton					pj
Round-trip Hauling	2	hours					pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours					pj
Tipping Fee (non-TSCA)	$43	per ton					St. Paul
Tipping Fee (TSCA)	$55	per ton					St. Paul
Truck Rate	$75	per hour					pj
Truck Load	32	tons					pj
Institutional Controls							
Public Education Program	$100,000						pj
O&M Plans	$20,000						pj
Deed Restrictions	$5,000						pj
Annual Costs							
Public Education Program	$30,000						pj
Maintaining O&M Plans	$800						pj
Reporting	$20,000						pj
Long-term Monitoring	$600,000						Anne LTM
Long-term Monitoring (no action)	$300,000						Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	**Quantity**	**Units**		**Cost**
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	**Years**	**Annual Cost**	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Off-site Disposal (Passive Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	697	acre		$11,152,000
Dredging - 12 hour shifts	1260	Day	9.692307692	$7,182,000
Dredge Monitoring (Water Quality)	1260	Day		$3,780,000
Sediment Removal QA	1260	Day		$1,512,000
Site Restoration	2	Each		$1,200,000
Direct Capital:				$25,196,000
Engineering, Procurement & Construction Management:				3,023,520
Contractor Overhead/Profit:				3,779,400
Total Capital:				**$32,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	1,002,963,239	gal	$401,185
Water Treatment QA	1,764	day	$352,800
Direct Capital:			$1,445,081
Engineering, Procurement & Construction Management:			173,410
Total Capital:			**$1,600,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	1,578,104	ton		$39,452,600
Lime Purchase	157,811	ton		$9,468,660
Soil Loading	1,578,104	ton		$4,418,691
Soil Hauling	1,578,104	ton		$7,397,363
Tipping Fees (non-TSCA)	1,558,819	ton		$67,029,213
Tipping Fees (TSCA)	19,285	ton		$1,060,680
Direct Capital:				$128,827,207
Engineering, Procurement & Construction Management:				15,459,265
Total Capital:				**$144,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$185,600,000**

ALTERNATIVE C2: Dredge Sediment With Off-site Disposal (Mechanical Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	697	acre		$11,152,000
Dredging - 12 hour shifts	1260	Day	9.692307692	$7,182,000
Dredge Monitoring (Water Quality)	1260	Day		$3,780,000
Sediment Removal QA	1260	Day		$1,512,000
Site Restoration	2	Each		$1,200,000
Direct Capital:				$25,196,000
Engineering, Procurement & Construction Management:				3,023,520
Contractor Overhead/Profit:				3,779,400
Total Capital:				**$32,000,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	315,621	bdt	$25,249,652
Direct Capital:			$25,349,652
Engineering, Procurement & Construction Management:			3,041,958
Total Capital:			**$28,400,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	1,229,967,319	gal	$491,987
Water Treatment QA	1,764	day	$352,800
Direct Capital:			$1,625,881
Engineering, Procurement & Construction Management:			195,106
Total Capital:			**$1,800,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	631,241	ton	$1,767,476
Soil Hauling	631,241	ton	$2,958,944
Tipping Fees (non-TSCA)	623,527	ton	$26,811,672
Tipping Fees (TSCA)	7,714	ton	$424,272
Direct Capital:			$31,962,363
Engineering, Procurement & Construction Management:			3,835,484
Total Capital:			**$35,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$102,500,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Lime Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	697	acre		$11,152,000
Dredging - 12 hour shifts	1245	Day		$7,096,500
Dredge Monitoring (Water Quality)	1245	Day		$3,735,000
Sediment Removal QA	1245	Day		$1,494,000
Site Restoration	1	LS		$600,000
Direct Capital:				$24,447,500
Engineering, Procurement & Construction Management:				2,933,700
Contractor Overhead/Profit:				3,667,125
Total Capital:				**$31,000,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,520,000	sf		$4,536,000
Shot Rock/Rip Rap	8,000	lf		$6,920,000
Sheetpile Placement	240,000	sf		$4,560,000
Clean Soil Cap	190,000	cy		$1,900,000
Seeding	280,000	sy		$280,000
Mitigation	58	acre		$578,512
Direct Capital:				$18,774,512
Engineering, Procurement & Construction Management:				2,252,941
Total Capital:				**$21,027,454**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs				$16,258,262
Total Project Capital and O&M Cost				**$37,300,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	27,778	sf		$50,000
Shot Rock/Rip Rap	9,200	lf		$7,360,000
Sheetpile Placement	276,000	sf		$5,244,000
Clean Soil Cap	170,000	cy		$1,700,000
Seeding	250,000	sy		$250,000
Mitigation	52	acre		$516,529
Direct Capital:				$15,120,529
Engineering, Procurement & Construction Management:				1,814,463
Total Capital:				**$16,934,992**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs				$15,026,734
Total Project Capital and O&M Cost				**$32,000,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	484	gpm		$781,094
Water Treatment (Includes Operator)	1,215,263,074	gal		$486,105
Water Treatment QA	1,764	day		$352,800
Direct Capital:				$1,619,999
Engineering, Procurement & Construction Management:				194,400
Total Capital:				**$1,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$110,300,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	697	acre	$11,152,000
Dredging - 12 hour shifts	1260	Day	$7,182,000
Dredge Monitoring (Water Quality)	1260	Day	$3,780,000
Sediment Removal QA	1260	Day	$1,512,000
Site Restoration	2	Each	$1,200,000
Direct Capital:			$25,196,000
Engineering, Procurement & Construction Management:			3,023,520
Contractor Overhead/Profit:			3,779,400
Total Capital:			**$32,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	1,002,963,239	gal	$401,185
Water Treatment QA	1,764	day	$352,800
Direct Capital:			$1,445,081
Engineering, Procurement & Construction Management:			173,410
Total Capital:			**$1,600,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	1,578,103	ton	$42,608,787
Soil Loading	1,578,103	ton	$4,418,689
Soil Hauling	1,578,103	ton	$1,849,340
Direct Capital:			$48,876,816
Engineering, Procurement & Construction Management:			$5,865,218
Total Capital:			**$54,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$96,000,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge to CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Cement Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	745,828	tons		$4,474,967
Sand Placement	532,734	cy		$3,196,405
Cobble Purchase and Placement	319,640	cy		$9,589,215
Cap Placement QA	1	LS		$100,000
Direct Capital:				$17,560,587
Engineering, Procurement & Construction Management:				2,107,270
Total Capital:				**$19,667,857**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$393,357	$5,918,568
Total Present Worth, Longer Term O&M Costs				$11,937,087
Total Project Capital and O&M Cost				**$31,600,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	697	acre	$11,152,000
Dredging - 12 hour shifts	937	Day	$5,340,900
Dredge Monitoring (Water Quality)	937	Day	$2,811,000
Sediment Removal QA	937	Day	$1,124,400
Site Restoration	2	Each	$1,200,000
Direct Capital:			$21,998,300
Engineering, Procurement & Construction Management:			2,639,796
Contractor Overhead/Profit:			3,299,745
Total Capital:			**$27,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	914,283,237	gal	$365,713
Water Treatment QA	1,333	Day	$266,600
Direct Capital:			$1,413,407
Engineering, Procurement & Construction Management:			169,609
Total Capital:			**$1,600,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,520,000	sf	$4,536,000
Shot Rock/Rip Rap	8,000	lf	$6,920,000
Sheetpile Placement	240,000	sf	$4,560,000
Clean Soil Cap	190,000	cy	$1,900,000
Seeding	280,000	sy	$280,000
Mitigation	58	acre	$578,512
Direct Capital:			$18,774,512
Engineering, Procurement & Construction Management:			2,252,941
Total Capital:			**$21,027,454**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs			$16,258,262
Total Project Capital and O&M Cost			**$37,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$106,600,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE LAKE BUTTE DES MORTS
Action Level - 500 ppb

Material Handling Assumptions:							
Volume > 500 ppb	1,023,621	cy	625	ac	781,390	m3	Acres corresponds to dredge
Volume > 125 ppb	1,689,173	cy			1,289,445	m3	footprint area
Volume > 250 ppb	1,322,818	cy			1,009,785	m3	
Volume > 1,000 ppb	784,192	cy			598,620	m3	
Volume > 5,000 ppb	281,689	cy			215,030	m3	
Volume > 50,000 ppb	16,165	cy			12,340	m3	
Solids Specific Gravity	2.51						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.3%	v/v	0.99	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density (passive pond)	20%	w/w	9.1%	v/v	0.96	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	28.5%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.8%	w/w	60.0%	v/v	1.35	tons per cy	
Arrowhead/Menasha CDF Capacity	1,406,932	cy	in situ		1,337,963	m3	
HTTD Treatment Capacity	1,099,327	cy	in situ		1,650,000	tons	
Cap Volume	252,057	cy			192,410	m3	
Vitrification Treatment Capacity	4,496,073	cy	in situ		2145500.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						Not Used
Sales Tax	5.5%						
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
<u>Dredging</u>							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Mechanical - 3 cy bucket							
Dock Construction	$400,000	LS					pj
Mobilization - Equipment	$455,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$9,000	per shift					Ogden Beeman
Dredge Rate	630	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					pj
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Offload Crane Mobilization	$50,000	LS					pj
Site Restoration	$75,000	LS					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Vitrification (unit cost incl Cap and Op Costs)	$27.0	per ton (250 glass ton per day melter unit)					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	7,636,809	sf	709,500		m2		
Sand Cap Depth	1.7	feet					
Sand Placement	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF	Arrowhead		Menasha			
Land Lease or Purchase	$1.8	per sf	$1.8			Ole
Length	8,000	lf	9,200			Baird
Capping Volume	190,000	cy	170,000			Baird
Seeding Area	280,000	sy	250,000			Baird
Sheetpile Wall Length	8,000	lf	9,200			Baird
Sheetpile Depth	30	ft	30			based on bathymetry
Sheetpile Cost	$19	per sf	$19			pj
Shot Rock Berm	$650	per lf	$550			Baird
Rip Rap	$215	per lf	$250			Baird
Place Treated Material	$2	per cy	$2			pj
Clean Soil Cap	$10	per cy	$10			Baird
Seeding	$1	per sy	$1			Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing

Dewatering - Upland Pond (2 cells)			
Land Lease or Purchase	$1.80	per sf	Ole
Area	644,791	sf	2 days slurry + 13 wk solids * 2 cell
Perimeter	3,212	lf	assume square
Depth of Material in Dewatering Cell	8	feet	based on size at Arrowhead Park
Cell Retention Time	24	hours	Not Used
Cell Depth	10	feet	
Mobilization	$20,000	LS	pj
Clear and Grub	$2,000	per acre	pj
Berm Volume	10.4	cy per lf	2:1 slope, 8-foot top
Berm Construction	$6	per cy	pj
Rough Grading	$0.25	per sf	pj
Alphalt Liner	$1.50	per sf	pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS	pj
Regrade Berm Soils	$6	per cy	pj
Seed/Sod	$1	per sy	Baird
Dewatering - Mechanical			
Mobilization	$100,000		pj
Holding Pond-Centrifuge	$80	per bone dry ton	Global Dewatering
Water Treatment			
Flow Rate (passive dewatering)	395	gpm	assume operate 24/7
Unit, Purchase (passive dewatering)	$691,096	LS	pj
Flow Rate (mechanical dewatering)	484	gpm	
Unit, Purchase (mechanical dewatering)	$781,094	LS	
Water Treatment (Including Operator)	$0.40	per 1,000 gallons	pj
Water Treatment QA	$200	per day	pj, 1 sample/day
Disposal			
Off-Site Disposal			
Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj
Institutional Controls			
Public Education Program	$100,000		pj
O&M Plans	$20,000		pj
Deed Restrictions	$5,000		pj
Annual Costs			
Public Education Program	$30,000		pj
Maintaining O&M Plans	$800		pj
Reporting	$20,000		pj
Long-term Monitoring	$600,000		Anne LTM
Long-term Monitoring (no action)	$300,000		Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Off-site Disposal (Passive Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	625	acre		$10,000,000
Dredging - 12 hour shifts	975	Day	7.5	$5,557,500
Dredge Monitoring (Water Quality)	975	Day		$2,925,000
Sediment Removal QA	975	Day		$1,170,000
Site Restoration	2	Each		$1,200,000
Direct Capital:				$21,222,500
Engineering, Procurement & Construction Management:				2,546,700
Contractor Overhead/Profit:				3,183,375
Total Capital:				**$27,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	776,111,197	gal	$310,444
Water Treatment QA	1,365	day	$273,000
Direct Capital:			$1,274,540
Engineering, Procurement & Construction Management:			152,945
Total Capital:			**$1,400,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	1,221,165	ton		$30,529,125
Lime Purchase	122,117	ton		$7,327,020
Soil Loading	1,221,165	ton		$3,419,262
Soil Hauling	1,221,165	ton		$5,724,211
Tipping Fees (non-TSCA)	1,201,880	ton		$51,680,836
Tipping Fees (TSCA)	19,285	ton		$1,060,680
Direct Capital:				$99,741,134
Engineering, Procurement & Construction Management:				11,968,936
Total Capital:				**$111,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$147,800,000**

ALTERNATIVE C2: Dredge Sediment With Off-site Disposal (Mechanical Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	625	acre		$10,000,000
Dredging - 12 hour shifts	975	Day	7.5	$5,557,500
Dredge Monitoring (Water Quality)	975	Day		$2,925,000
Sediment Removal QA	975	Day		$1,170,000
Site Restoration	2	Each		$1,200,000
Direct Capital:				$21,222,500
Engineering, Procurement & Construction Management:				2,546,700
Contractor Overhead/Profit:				3,183,375
Total Capital:				**$27,000,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	244,233	bdt	$19,538,640
Direct Capital:			$19,638,640
Engineering, Procurement & Construction Management:			2,356,637
Total Capital:			**$22,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	951,771,083	gal	$380,708
Water Treatment QA	1,365	day	$273,000
Direct Capital:			$1,434,802
Engineering, Procurement & Construction Management:			172,176
Total Capital:			**$1,600,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	488,466	ton	$1,367,705
Soil Hauling	488,466	ton	$2,289,684
Tipping Fees (non-TSCA)	480,752	ton	$20,672,334
Tipping Fees (TSCA)	7,714	ton	$424,272
Direct Capital:			$24,753,995
Engineering, Procurement & Construction Management:			2,970,479
Total Capital:			**$27,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$82,800,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Lime Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	625	acre	$10,000,000
Dredging - 12 hour shifts	960	Day	$5,472,000
Dredge Monitoring (Water Quality)	960	Day	$2,880,000
Sediment Removal QA	960	Day	$1,152,000
Site Restoration	1	LS	$600,000
Direct Capital:			$20,474,000
Engineering, Procurement & Construction Management:			2,456,880
Contractor Overhead/Profit:			3,071,100
Total Capital:			**$26,000,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,520,000	sf		$4,536,000
Shot Rock/Rip Rap	8,000	lf		$6,920,000
Sheetpile Placement	240,000	sf		$4,560,000
Clean Soil Cap	190,000	cy		$1,900,000
Seeding	280,000	sy		$280,000
Mitigation	58	acre		$578,512
Direct Capital:				$18,774,512
Engineering, Procurement & Construction Management:				2,252,941
Total Capital:				**$21,027,454**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs				$16,258,262
Total Project Capital and O&M Cost				**$37,300,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	27,778	sf		$50,000
Shot Rock/Rip Rap	9,200	lf		$7,360,000
Sheetpile Placement	276,000	sf		$5,244,000
Clean Soil Cap	170,000	cy		$1,700,000
Seeding	250,000	sy		$250,000
Mitigation	52	acre		$516,529
Direct Capital:				$15,120,529
Engineering, Procurement & Construction Management:				1,814,463
Total Capital:				**$16,934,992**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs				$15,026,734
Total Project Capital and O&M Cost				**$32,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	937,066,839	gal	$374,827
Water Treatment QA	1,365	day	$273,000
Direct Capital:			$1,428,921
Engineering, Procurement & Construction Management:			171,470
Total Capital:			**$1,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$105,100,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	625	acre	$10,000,000
Dredging - 12 hour shifts	975	Day	$5,557,500
Dredge Monitoring (Water Quality)	975	Day	$2,925,000
Sediment Removal QA	975	Day	$1,170,000
Site Restoration	2	Each	$1,200,000
Direct Capital:			$21,222,500
Engineering, Procurement & Construction Management:			2,546,700
Contractor Overhead/Profit:			3,183,375
Total Capital:			**$27,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	776,111,197	gal	$310,444
Water Treatment QA	1,365	day	$273,000
Direct Capital:			$1,274,540
Engineering, Procurement & Construction Management:			152,945
Total Capital:			**$1,400,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	1,221,165	ton	$32,971,455
Soil Loading	1,221,165	ton	$3,419,262
Soil Hauling	1,221,165	ton	$1,431,053
Direct Capital:			$37,821,769
Engineering, Procurement & Construction Management:			$4,538,612
Total Capital:			**$42,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$78,500,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge to CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Cement Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	659,971	tons		$3,959,827
Sand Placement	471,408	cy		$2,828,448
Cobble Purchase and Placement	282,845	cy		$8,485,343
Cap Placement QA	1	LS		$100,000
Direct Capital:				$15,573,617
Engineering, Procurement & Construction Management:				1,868,834
Total Capital:				**$17,442,452**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$348,849	$5,248,886
Total Present Worth, Longer Term O&M Costs				$11,267,405
Total Project Capital and O&M Cost				**$28,700,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	625	acre	$10,000,000
Dredging - 12 hour shifts	720	Day	$4,104,000
Dredge Monitoring (Water Quality)	720	Day	$2,160,000
Sediment Removal QA	720	Day	$864,000
Site Restoration	2	Each	$1,200,000
Direct Capital:			$18,698,000
Engineering, Procurement & Construction Management:			2,243,760
Contractor Overhead/Profit:			2,804,700
Total Capital:			**$23,700,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	702,702,086	gal	$281,081
Water Treatment QA	1,029	Day	$205,800
Direct Capital:			$1,267,975
Engineering, Procurement & Construction Management:			152,157
Total Capital:			**$1,400,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,520,000	sf	$4,536,000
Shot Rock/Rip Rap	8,000	lf	$6,920,000
Sheetpile Placement	240,000	sf	$4,560,000
Clean Soil Cap	190,000	cy	$1,900,000
Seeding	280,000	sy	$280,000
Mitigation	58	acre	$578,512
Direct Capital:			$18,774,512
Engineering, Procurement & Construction Management:			2,252,941
Total Capital:			**$21,027,454**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs			$16,258,262
Total Project Capital and O&M Cost			**$37,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$99,300,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE LAKE BUTTE DES MORTS
Action Level - 1,000 ppb

Material Handling Assumptions:							
Volume > 1000 ppb	784,192	cy	526 ac	598,620	m3		Acres corresponds to dredge
Volume > 125 ppb	1,689,173	cy		1,289,445	m3		footprint area
Volume > 250 ppb	1,322,818	cy		1,009,785	m3		
Volume > 500 ppb	1,023,621	cy		781,390	m3		
Volume > 5,000 ppb	281,689	cy		215,030	m3		
Volume > 50,000 ppb	16,165	cy		12,340	m3		
Solids Specific Gravity	2.51						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.3% v/v	0.99	tons per cy		
Slurry Density (20% in situ)	5.5%	w/w	2.3% v/v	0.87	tons per cy		Ogden Beeman
Dewatered Density (passive pond)	20%	w/w	9.1% v/v	0.96	tons per cy		Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	28.5% v/v	1.20	tons per cy		Foth & VanDyke
Treated Density	93.8%	w/w	60.0% v/v	1.35	tons per cy		
Arrowhead/Menasha CDF Capacity	1,406,932	cy	in situ	1,337,963	m3		
HTTD Treatment Capacity	1,099,327	cy	in situ	1,650,000	tons		
Cap Volume	148,646	cy		113,470	m3		
Vitrification Treatment Capacity	4,496,073	cy	in situ	2145500.00	tons		
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						Not Used
Sales Tax	5.5%						
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Mechanical - 3 cy bucket							
Dock Construction	$400,000	LS					pj
Mobilization - Equipment	$455,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$9,000	per shift					Ogden Beeman
Dredge Rate	630	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					pj
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Offload Crane Mobilization	$50,000	LS					pj
Site Restoration	$75,000	LS					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Vitrification (unit cost incl Cap and Op Costs)	$27.0	per ton (250 glass ton per day melter unit)					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	5,884,487	sf	546,700			m2	
Sand Cap Depth	1.7	feet					
Sand Placement	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF	Arrowhead		Menasha				
Land Lease or Purchase	$1.8	per sf	$1.8				Ole
Length	8,000	lf	9,200				Baird
Capping Volume	190,000	cy	170,000				Baird
Seeding Area	280,000	sy	250,000				Baird
Sheetpile Wall Length	8,000	lf	9,200				Baird
Sheetpile Depth	30	ft	30				based on bathymetry
Sheetpile Cost	$19	per sf	$19				pj
Shot Rock Berm	$650	per lf	$550				Baird
Rip Rap	$215	per lf	$250				Baird
Place Treated Material	$2	per cy	$2				pj
Clean Soil Cap	$10	per cy	$10				Baird
Seeding	$1	per sy	$1				Baird
Mitigation	$10,000	per acre					Tim
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					Anne LTM
Long-term O&M	2%	of capital					pj
Solidification							
Percent Lime	10%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area	644,791	sf					2 days slurry + 13 wk solids * 2 cell
Perimeter	3,212	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Alphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate (passive dewatering)	395	gpm					assume operate 24/7
Unit, Purchase (passive dewatering)	$691,096	LS					pj
Flow Rate (mechanical dewatering)	484	gpm					
Unit, Purchase (mechanical dewatering)	$781,094	LS					
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample/day
Disposal							
Off-Site Disposal							
Load Soil for Hauling	$2.80	per ton					pj
Round-trip Hauling	2	hours					pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours					pj
Tipping Fee (non-TSCA)	$43	per ton					St. Paul
Tipping Fee (TSCA)	$55	per ton					St. Paul
Truck Rate	$75	per hour					pj
Truck Load	32	tons					pj
Institutional Controls							
Public Education Program	$100,000						pj
O&M Plans	$20,000						pj
Deed Restrictions	$5,000						pj
Annual Costs							
Public Education Program	$30,000						pj
Maintaining O&M Plans	$800						pj
Reporting	$20,000						pj
Long-term Monitoring	$600,000						Anne LTM
Long-term Monitoring (no action)	$300,000						Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	**Quantity**	**Units**		**Cost**
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Off-site Disposal (Passive Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	526	acre		$8,416,000
Dredging - 12 hour shifts	747	Day	5.746153846	$4,257,900
Dredge Monitoring (Water Quality)	747	Day		$2,241,000
Sediment Removal QA	747	Day		$896,400
Site Restoration	2	Each		$1,200,000
Direct Capital:				$17,381,300
Engineering, Procurement & Construction Management:				2,085,756
Contractor Overhead/Profit:				2,607,195
Total Capital:				**$22,100,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	594,575,928	gal	$237,830
Water Treatment QA	1,046	day	$209,200
Direct Capital:			$1,138,126
Engineering, Procurement & Construction Management:			136,575
Total Capital:			**$1,300,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	935,530	ton		$23,388,250
Lime Purchase	93,553	ton		$5,613,180
Soil Loading	935,530	ton		$2,619,484
Soil Hauling	935,530	ton		$4,385,297
Tipping Fees (non-TSCA)	916,245	ton		$39,398,531
Tipping Fees (TSCA)	19,285	ton		$1,060,680
Direct Capital:				$76,465,422
Engineering, Procurement & Construction Management:				9,175,851
Total Capital:				**$85,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$116,700,000**

ALTERNATIVE C2: Dredge Sediment With Off-site Disposal (Mechanical Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	526	acre		$8,416,000
Dredging - 12 hour shifts	747	Day	5.746153846	$4,257,900
Dredge Monitoring (Water Quality)	747	Day		$2,241,000
Sediment Removal QA	747	Day		$896,400
Site Restoration	2	Each		$1,200,000
Direct Capital:				$17,381,300
Engineering, Procurement & Construction Management:				2,085,756
Contractor Overhead/Profit:				2,607,195
Total Capital:				**$22,100,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	187,106	bdt	$14,968,480
Direct Capital:			$15,068,480
Engineering, Procurement & Construction Management:			1,808,218
Total Capital:			**$16,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	729,148,320	gal	$291,659
Water Treatment QA	1,046	day	$209,200
Direct Capital:			$1,281,953
Engineering, Procurement & Construction Management:			153,834
Total Capital:			**$1,400,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	374,212	ton	$1,047,794
Soil Hauling	374,212	ton	$1,754,119
Tipping Fees (non-TSCA)	366,498	ton	$15,759,412
Tipping Fees (TSCA)	7,714	ton	$424,272
Direct Capital:			$18,985,597
Engineering, Procurement & Construction Management:			2,278,272
Total Capital:			**$21,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$66,200,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Lime Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	526	acre	$8,416,000
Dredging - 12 hour shifts	732	Day	$4,172,400
Dredge Monitoring (Water Quality)	732	Day	$2,196,000
Sediment Removal QA	732	Day	$878,400
Site Restoration	1	LS	$600,000
Direct Capital:			$16,632,800
Engineering, Procurement & Construction Management:			1,995,936
Contractor Overhead/Profit:			2,494,920
Total Capital:			**$21,100,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,520,000	sf	$4,536,000
Shot Rock/Rip Rap	8,000	lf	$6,920,000
Sheetpile Placement	240,000	sf	$4,560,000
Clean Soil Cap	190,000	cy	$1,900,000
Seeding	280,000	sy	$280,000
Mitigation	58	acre	$578,512
Direct Capital:			$18,774,512
Engineering, Procurement & Construction Management:			2,252,941
Total Capital:			**$21,027,454**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs			$16,258,262
Total Project Capital and O&M Cost			**$37,300,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	714,444,075	gal	$285,778
Water Treatment QA	1,046	day	$209,200
Direct Capital:			$1,276,072
Engineering, Procurement & Construction Management:			153,129
Total Capital:			**$1,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$68,000,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	526	acre	$8,416,000
Dredging - 12 hour shifts	747	Day	$4,257,900
Dredge Monitoring (Water Quality)	747	Day	$2,241,000
Sediment Removal QA	747	Day	$896,400
Site Restoration	2	Each	$1,200,000
Direct Capital:			$17,381,300
Engineering, Procurement & Construction Management:			2,085,756
Contractor Overhead/Profit:			2,607,195
Total Capital:			**$22,100,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	594,575,928	gal	$237,830
Water Treatment QA	1,046	day	$209,200
Direct Capital:			$1,138,126
Engineering, Procurement & Construction Management:			136,575
Total Capital:			**$1,300,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	935,530	ton	$25,259,310
Soil Loading	935,530	ton	$2,619,484
Soil Hauling	935,530	ton	$1,096,324
Direct Capital:			$28,975,118
Engineering, Procurement & Construction Management:			$3,477,014
Total Capital:			**$32,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$63,600,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge to CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Cement Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

CAPPING

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$200,000
Sand Purchase	508,536	tons	$3,051,215
Sand Placement	363,240	cy	$2,179,440
Cobble Purchase and Placement	217,944	cy	$6,538,319
Cap Placement QA	1	LS	$100,000
Direct Capital:			$12,068,973
Engineering, Procurement & Construction Management:			1,448,277
Total Capital:			**$13,517,250**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Monitoring/O&M			
Long-term Monitoring	40	$400,000	$6,018,519
Long-term O&M	40	$270,345	$4,067,691
Total Present Worth, Longer Term O&M Costs			$10,086,210
Total Project Capital and O&M Cost			**$23,600,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	526	acre	$8,416,000
Dredging - 12 hour shifts	590	Day	$3,363,000
Dredge Monitoring (Water Quality)	590	Day	$1,770,000
Sediment Removal QA	590	Day	$708,000
Site Restoration	2	Each	$1,200,000
Direct Capital:			$15,827,000
Engineering, Procurement & Construction Management:			1,899,240
Contractor Overhead/Profit:			2,374,050
Total Capital:			**$20,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	484	gpm		$781,094
Water Treatment (Includes Operator)	576,232,088	gal		$230,493
Water Treatment QA	848	Day		$169,600
Direct Capital:				$1,181,187
Engineering, Procurement & Construction Management:				141,742
Total Capital:				**$1,300,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,520,000	sf		$4,536,000
Shot Rock/Rip Rap	8,000	lf		$6,920,000
Sheetpile Placement	240,000	sf		$4,560,000
Clean Soil Cap	190,000	cy		$1,900,000
Seeding	280,000	sy		$280,000
Mitigation	58	acre		$578,512
Direct Capital:				$18,774,512
Engineering, Procurement & Construction Management:				2,252,941
Total Capital:				**$21,027,454**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs				$16,258,262
Total Project Capital and O&M Cost				**$37,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$90,500,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE LAKE BUTTE DES MORTS
Action Level - 5,000 ppb

Material Handling Assumptions:							
Volume > 5000 ppb	281,689	cy	174	ac	215,030	m3	Acres corresponds to dredge
Volume > 125 ppb	1,689,173	cy			1,289,445	m3	footprint area
Volume > 250 ppb	1,322,818	cy			1,009,785	m3	
Volume > 500 ppb	1,128,565	cy			781,390	m3	
Volume > 1,000 ppb	784,192	cy			598,620	m3	
Volume > 50,000 ppb	16,165	cy			12,340	m3	
Solids Specific Gravity	2.51						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.3%	v/v	0.99	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density (passive pond)	20%	w/w	9.1%	v/v	0.96	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	28.5%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.8%	w/w	60.0%	v/v	1.35	tons per cy	
Arrowhead/Menasha CDF Capacity	1,406,932	cy	in situ		1,337,963	m3	
HTTD Treatment Capacity	1,099,327	cy	in situ		1,650,000	tons	
Cap Volume	59,055	cy			45,080	m3	
Vitrification Treatment Capacity	4,496,073	cy	in situ		2145500.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						Not Used
Sales Tax	5.5%						
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Mechanical - 3 cy bucket							
Dock Construction	$400,000	LS					pj
Mobilization - Equipment	$455,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$9,000	per shift					Ogden Beeman
Dredge Rate	630	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					pj
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Offload Crane Mobilization	$50,000	LS					pj
Site Restoration	$75,000	LS					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Vitrification (unit cost incl Cap and Op Costs)	$27.0	per ton (250 glass ton per day melter unit)					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	1,791,071	sf	166,400			m2	
Sand Cap Depth	1.7	feet					
Sand Placement	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

	Arrowhead		Menasha			
Nearshore CDF						
Land Lease or Purchase	$1.8	per sf	$1.8			Ole
Length	8,000	lf	9,200			Baird
Capping Volume	190,000	cy	170,000			Baird
Seeding Area	280,000	sy	250,000			Baird
Sheetpile Wall Length	8,000	lf	9,200			Baird
Sheetpile Depth	30	ft	30			based on bathymetry
Sheetpile Cost	$19	per sf	$19			pj
Shot Rock Berm	$650	per lf	$550			Baird
Rip Rap	$215	per lf	$250			Baird
Place Treated Material	$2	per cy	$2			pj
Clean Soil Cap	$10	per cy	$10			Baird
Seeding	$1	per sy	$1			Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	644,791	sf				2 days slurry + 13 wk solids * 2 cell
Perimeter	3,212	lf				assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				pj
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Water Treatment						
Flow Rate (passive dewatering)	395	gpm				assume operate 24/7
Unit, Purchase (passive dewatering)	$691,096	LS				pj
Flow Rate (mechanical dewatering)	484	gpm				
Unit, Purchase (mechanical dewatering)	$781,094	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Disposal						
Off-Site Disposal						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Institutional Controls						
Public Education Program	$100,000					pj
O&M Plans	$20,000					pj
Deed Restrictions	$5,000					pj
Annual Costs						
Public Education Program	$30,000					pj
Maintaining O&M Plans	$800					pj
Reporting	$20,000					pj
Long-term Monitoring	$600,000					Anne LTM
Long-term Monitoring (no action)	$300,000					Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	**Quantity**	**Units**	**Cost**
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	**Years**	**Annual Cost**	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Off-site Disposal (Passive Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	174	acre		$2,784,000
Dredging - 12 hour shifts	269	Day	2.069230769	$1,533,300
Dredge Monitoring (Water Quality)	269	Day		$807,000
Sediment Removal QA	269	Day		$322,800
Site Restoration	2	Each		$1,200,000
Direct Capital:				$7,017,100
Engineering, Procurement & Construction Management:				842,052
Contractor Overhead/Profit:				1,052,565
Total Capital:				**$8,900,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	213,577,331	gal	$85,431
Water Treatment QA	376	day	$75,200
Direct Capital:			$851,727
Engineering, Procurement & Construction Management:			102,207
Total Capital:			**$1,000,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	336,052	ton		$8,401,300
Lime Purchase	33,606	ton		$2,016,360
Soil Loading	336,052	ton		$940,946
Soil Hauling	336,052	ton		$1,575,244
Tipping Fees (non-TSCA)	316,767	ton		$13,620,975
Tipping Fees (TSCA)	19,285	ton		$1,060,682
Direct Capital:				$27,615,507
Engineering, Procurement & Construction Management:				3,313,861
Total Capital:				**$30,900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$48,500,000**

ALTERNATIVE C2: Dredge Sediment With Off-site Disposal (Mechanical Dewatering)

SEDIMENT REMOVAL (CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$200,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	174	acre		$2,784,000
Dredging - 12 hour shifts	269	Day	2.069230769	$1,533,300
Dredge Monitoring (Water Quality)	269	Day		$807,000
Sediment Removal QA	269	Day		$322,800
Site Restoration	2	Each		$1,200,000
Direct Capital:				$7,017,100
Engineering, Procurement & Construction Management:				842,052
Contractor Overhead/Profit:				1,052,565
Total Capital:				**$8,900,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	67,210	bdt	$5,376,820
Direct Capital:			$5,476,820
Engineering, Procurement & Construction Management:			657,218
Total Capital:			**$6,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	261,917,015	gal	$104,767
Water Treatment QA	376	day	$75,200
Direct Capital:			$961,061
Engineering, Procurement & Construction Management:			115,327
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	134,421	ton	$376,377
Soil Hauling	134,421	ton	$630,096
Tipping Fees (non-TSCA)	126,706	ton	$5,448,378
Tipping Fees (TSCA)	7,714	ton	$424,272
Direct Capital:			$6,879,124
Engineering, Procurement & Construction Management:			825,495
Total Capital:			**$7,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$28,300,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Lime Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	174	acre	$2,784,000
Dredging - 12 hour shifts	253	Day	$1,442,100
Dredge Monitoring (Water Quality)	253	Day	$759,000
Sediment Removal QA	253	Day	$303,600
Site Restoration	1	LS	$600,000
Direct Capital:			$6,258,700
Engineering, Procurement & Construction Management:			751,044
Contractor Overhead/Profit:			938,805
Total Capital:			**$7,900,000**

CDF CONSTRUCTION - ARROWHEAD

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,520,000	sf	$4,536,000
Shot Rock/Rip Rap	8,000	lf	$6,920,000
Sheetpile Placement	240,000	sf	$4,560,000
Clean Soil Cap	190,000	cy	$1,900,000
Seeding	280,000	sy	$280,000
Mitigation	58	acre	$578,512
Direct Capital:			$18,774,512
Engineering, Procurement & Construction Management:			2,252,941
Total Capital:			**$21,027,454**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	420,549	$6,327,706
Total Present Worth, Longer Term O&M Costs			$16,258,262
Total Project Capital and O&M Cost			**$37,300,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	484	gpm	$781,094
Water Treatment (Includes Operator)	247,212,770	gal	$98,885
Water Treatment QA	376	day	$75,200
Direct Capital:			$955,179
Engineering, Procurement & Construction Management:			114,621
Total Capital:			**$1,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$54,500,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	174	acre	$2,784,000
Dredging - 12 hour shifts	269	Day	$1,533,300
Dredge Monitoring (Water Quality)	269	Day	$807,000
Sediment Removal QA	269	Day	$322,800
Site Restoration	2	Each	$1,200,000
Direct Capital:			$7,017,100
Engineering, Procurement & Construction Management:			842,052
Contractor Overhead/Profit:			1,052,565
Total Capital:			**$8,900,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	644,791	sf	$1,160,624
Mobilization	1	LS	$20,000
Clear and Grub	644,791	sf	$29,605
Berm Construction	33,309	cy	$199,855
Rough Grading	644,791	sf	$161,198
Liner Placement	644,791	sf	$967,187
Demob/Disposal	1	LS	$10,000
Regrade	33,309	cy	$199,855
Seed/Sod	71,643	sy	$71,643
Direct Capital:			$2,819,968
Engineering, Procurement & Construction Management:			338,396
Total Capital:			**$3,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,096
Water Treatment (Includes Operator)	213,577,331	gal	$85,431
Water Treatment QA	376	day	$75,200
Direct Capital:			$851,727
Engineering, Procurement & Construction Management:			102,207
Total Capital:			**$1,000,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	336,051	ton	$9,073,384
Soil Loading	336,051	ton	$940,944
Soil Hauling	336,051	ton	$393,810
Direct Capital:			$10,408,138
Engineering, Procurement & Construction Management:			$1,248,977
Total Capital:			**$11,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$29,300,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge to CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$490,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	26	Day	$234,000
Dredge Monitoring (Water Quality)	26	Day	$78,000
Sediment Removal QA	26	Day	$31,200
Offload Crane Mobilization	1	LS	$50,000
Direct Capital:			$1,358,200
Engineering, Procurement & Construction Management:			162,984
Contractor Overhead/Profit:			203,730
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	19,286	ton	$482,150
Cement Purchase	1,929	ton	$115,740
Soil Loading	19,286	ton	$54,001
Soil Hauling	19,286	ton	$90,403
Tipping Fees (TSCA)	19,286	ton	$1,060,730
Direct Capital:			$1,803,024
Engineering, Procurement & Construction Management:			216,363
Total Capital:			**$2,000,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	154,784	tons		$928,704
Sand Placement	110,560	cy		$663,360
Cobble Purchase and Placement	66,336	cy		$1,990,079
Cap Placement QA	1	LS		$100,000
Direct Capital:				$3,882,142
Engineering, Procurement & Construction Management:				465,857
Total Capital:				**$4,347,999**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$86,960	$1,308,426
Total Present Worth, Longer Term O&M Costs				$7,326,945
Total Project Capital and O&M Cost				**$11,700,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	2	Each	$200,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	174	acre	$2,784,000
Dredging - 12 hour shifts	197	Day	$1,122,900
Dredge Monitoring (Water Quality)	197	Day	$591,000
Sediment Removal QA	197	Day	$236,400
Site Restoration	2	Each	$1,200,000
Direct Capital:			$6,304,300
Engineering, Procurement & Construction Management:			756,516
Contractor Overhead/Profit:			945,645
Total Capital:			**$8,000,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	484	gpm		$781,094
Water Treatment (Includes Operator)	192,303,134	gal		$76,921
Water Treatment QA	297	Day		$59,400
Direct Capital:				$917,415
Engineering, Procurement & Construction Management:				110,090
Total Capital:				**$1,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$66,200,000**

Table 7-6 Cost Summary for Remedial Alternatives - Appleton to Little Rapids

125 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	182,450	$10,100,000	---	---	$3,000,000	$900,000	---	---	$19,800,000	$4,500,000	$38,300,000	$7,660,000	$45,960,000
E	182,450	$10,100,000	---	---	$3,000,000	$900,000	$7,700,000	---	---	$4,500,000	$26,200,000	$5,240,000	$31,440,000

250 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	80,611	$8,000,000	---	---	$3,000,000	$800,000	---	---	$8,700,000	$4,500,000	$25,000,000	$5,000,000	$30,000,000
E	80,611	$8,000,000	---	---	$3,000,000	$800,000	$3,400,000	---	---	$4,500,000	$19,700,000	$3,940,000	$23,640,000

500 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	56,998	$7,200,000	---	---	$3,000,000	$800,000	---	---	$6,200,000	$4,500,000	$21,700,000	$4,340,000	$26,040,000
E	56,998	$7,200,000	---	---	$3,000,000	$800,000	$2,400,000	---	---	$4,500,000	$17,900,000	$3,580,000	$21,480,000

1000 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	46,178	$6,800,000	---	---	$3,000,000	$800,000	---	---	$5,000,000	$4,500,000	$20,100,000	$4,020,000	$24,120,000
E	46,178	$6,800,000	---	---	$3,000,000	$800,000	$2,000,000	---	---	$4,500,000	$17,100,000	$3,420,000	$20,520,000

5000 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	20,148	$6,000,000	---	---	$3,000,000	$800,000	---	---	$2,200,000	$4,500,000	$16,500,000	$3,300,000	$19,800,000
E	20,148	$6,000,000	---	---	$3,000,000	$800,000	$900,000	---	---	$4,500,000	$15,200,000	$3,040,000	$18,240,000

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
APPLETON TO LITTLE RAPIDS
Action Level - 125 ppb

Material Handling Assumptions:							
Volume > 125 ppb	182,450	cy	119	ac	139,275	m3	Acres corresponds to dredge
Volume > 250 ppb	80,611	cy			61,535	m3	footprint area
Volume > 500 ppb	56,998	cy			43,510	m3	
Volume > 1,000 ppb	46,178	cy			35,250	m3	
Volume > 5000 ppb	20,148	cy			15,380	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.4						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.7%	v/v	0.98	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density	20%	w/w	9.4%	v/v	0.95	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	29.4%	v/v	1.19	tons per cy	Foth & VanDyke
Treated Density	93.5%	w/w	60.0%	v/v	1.30	tons per cy	
HTTD Treatment Capacity	1,264,377	cy	in situ		1,650,000	tons	
Vitrification Treatment Capacity	1,328,888	cy	in situ		2145500.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Solidification							
Percent Lime	10.0%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Vitrification							
Vitrification	$27.0	per ton (250 glass ton per dya melter unit)					Unit Cost Study- Minergy
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area	608,771	sf	13.97546543				2 days slurry + 13 wk solids * 2 cell
Perimeter	3,121	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Asphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate	395	gpm					assume operate 24/7
Unit, Purchase	$691,235	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					
Water Treatment QA	$200	per day					
Flow Rate (mechanical dewatering)	484	gpm					pj
Unit, Purchase (mechanical dewatering)	$780,778	LS					pj, 1 sample/day

Disposal

Off-Site Disposal

Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj

Institutional Controls

Public Education Program	$100,000	pj
O&M Plans	$20,000	pj
Deed Restrictions	$5,000	pj
Annual Costs		
Public Education Program	$30,000	pj
Maintaining O&M Plans	$800	pj
Reporting	$20,000	pj
Long-term Monitoring	$600,000	Anne LTM
Long-term Monitoring (no action)	$300,000	Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C: Dredge Sediment With Off-site Disposal

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	119	ac		$1,904,000
Dredging - 12 hour shifts	174	Day	1.338461538	$991,800
Dredge Monitoring (Water Quality)	174	Day		$522,000
Sediment Removal QA	174	Day		$208,800
Site Restoration	5	Each		$3,000,000
Direct Capital:				$7,976,600
Engineering, Procurement & Construction Management:				957,192
Contractor Overhead/Profit:				1,196,490
Total Capital:				**$10,100,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641
Direct Capital:			$2,675,115
Engineering, Procurement & Construction Management:			321,014
Total Capital:			**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	138,380,705	gal	$55,352
Water Treatment QA	244	day	$48,800
Direct Capital:			$795,388
Engineering, Procurement & Construction Management:			95,447
Total Capital:			**$900,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	216,541	ton	$5,413,525
Lime Purchase	21,655	ton	$1,299,300
Soil Loading	216,541	ton	$606,315
Soil Hauling	216,541	ton	$1,015,036
Tipping Fees (non-TSCA)	216,541	ton	$9,311,263
Direct Capital:			$17,645,439
Engineering, Procurement & Construction Management:			2,117,453
Total Capital:			**$19,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$38,300,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	119	ac		$1,904,000
Dredging - 12 hour shifts	174	Day	1.338461538	$991,800
Dredge Monitoring (Water Quality)	174	Day		$522,000
Sediment Removal QA	174	Day		$208,800
Site Restoration	5	Each		$3,000,000
Direct Capital:				$7,976,600
Engineering, Procurement & Construction Management:				957,192
Contractor Overhead/Profit:				1,196,490
Total Capital:				**$10,100,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641
Direct Capital:			$2,675,115
Engineering, Procurement & Construction Management:			321,014
Total Capital:			**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	138,380,705	gal	$55,352
Water Treatment QA	244	day	$48,800
Direct Capital:			$795,388
Engineering, Procurement & Construction Management:			95,447
Total Capital:			**$900,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	216,541	ton	$5,846,596
Soil Loading	216,541	ton	$606,314
Soil Hauling	216,541	ton	$253,758
Direct Capital:			$6,706,668
Engineering, Procurement & Construction Management:			$1,006,000
Total Capital:			**$7,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$26,200,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
APPLETON TO LITTLE RAPIDS
Action Level - 250 ppb

Material Handling Assumptions:								
Volume > 250 ppb	80,611	cy	73	ac	61,535	m3		Acres corresponds to dredge
Volume > 125 ppb	182,450	cy			139,275	m3		footprint area
Volume > 500 ppb	56,998	cy			43,510	m3		
Volume > 1,000 ppb	46,178	cy			35,250	m3		
Volume > 5000 ppb	20,148	cy			15,380	m3		
Volume > 50,000 ppb	0	cy			0	m3		
Solids Specific Gravity	2.4							
Fresh Water Density	62.4	lb/ft3						
In Situ Density	24.2%	w/w	11.7%	v/v	0.98	tons per cy		
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy		Ogden Beeman
Dewatered Density	20%	w/w	9.4%	v/v	0.95	tons per cy		Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	29.4%	v/v	1.19	tons per cy		Foth & VanDyke
Treated Density	93.5%	w/w	60.0%	v/v	1.30	tons per cy		
HTTD Treatment Capacity	1,264,377	cy	in situ		1,650,000	tons		
Vitrification Treatment Capacity	1,328,888	cy	in situ		2145500.00	tons		

Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Solidification							
Percent Lime	10.0%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Vitrification							
Vitrification	$27.0	per ton (250 glass ton per day melter unit)					Unit Cost Study- Minergy
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area	608,771	sf	13.97546543				2 days slurry + 13 wk solids * 2 cell
Perimeter	3,121	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Asphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate	395	gpm					assume operate 24/7
Unit, Purchase	$691,235	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					
Water Treatment QA	$200	per day					
Flow Rate (mechanical dewatering)	484	gpm					pj
Unit, Purchase (mechanical dewatering)	$780,778	LS					pj, 1 sample/day

Disposal
Off-Site Disposal

Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj

Institutional Controls

Public Education Program	$100,000	pj
O&M Plans	$20,000	pj
Deed Restrictions	$5,000	pj
Annual Costs		
Public Education Program	$30,000	pj
Maintaining O&M Plans	$800	pj
Reporting	$20,000	pj
Long-term Monitoring	$600,000	Anne LTM
Long-term Monitoring (no action)	$300,000	Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C: Dredge Sediment With Off-site Disposal

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	73	ac		$1,168,000
Dredging - 12 hour shifts	77	Day	0.592307692	$438,900
Dredge Monitoring (Water Quality)	77	Day		$231,000
Sediment Removal QA	77	Day		$92,400
Site Restoration	5	Each		$3,000,000
Direct Capital:				$6,280,300
Engineering, Procurement & Construction Management:				753,636
Contractor Overhead/Profit:				942,045
Total Capital:				**$8,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641

Direct Capital:	$2,675,115
Engineering, Procurement & Construction Management:	321,014
Total Capital:	**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	61,139,879	gal	$24,456
Water Treatment QA	108	day	$21,600

Direct Capital:	$737,291
Engineering, Procurement & Construction Management:	88,475
Total Capital:	**$800,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	95,673	ton	$2,391,825
Lime Purchase	9,568	ton	$574,080
Soil Loading	95,673	ton	$267,884
Soil Hauling	95,673	ton	$448,467
Tipping Fees (non-TSCA)	95,673	ton	$4,113,939

Direct Capital:	$7,796,196
Engineering, Procurement & Construction Management:	935,543
Total Capital:	**$8,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**
TOTAL COST	**$25,000,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	73	ac		$1,168,000
Dredging - 12 hour shifts	77	Day	0.592307692	$438,900
Dredge Monitoring (Water Quality)	77	Day		$231,000
Sediment Removal QA	77	Day		$92,400
Site Restoration	5	Each		$3,000,000
Direct Capital:				$6,280,300
Engineering, Procurement & Construction Management:				753,636
Contractor Overhead/Profit:				942,045
Total Capital:				**$8,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641
Direct Capital:			$2,675,115
Engineering, Procurement & Construction Management:			321,014
Total Capital:			**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	61,139,879	gal	$24,456
Water Treatment QA	108	day	$21,600
Direct Capital:			$737,291
Engineering, Procurement & Construction Management:			88,475
Total Capital:			**$800,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	95,673	ton	$2,583,165
Soil Loading	95,673	ton	$267,884
Soil Hauling	95,673	ton	$112,117
Direct Capital:			$2,963,165
Engineering, Procurement & Construction Management:			$444,475
Total Capital:			**$3,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$19,700,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
APPLETON TO LITTLE RAPIDS
Action Level - 500 ppb

Material Handling Assumptions:							
Volume > 500 ppb	56,998	cy	48	ac	43,510	m3	Acres corresponds to dredge
Volume > 125 ppb	182,450	cy			139,275	m3	footprint area
Volume > 250 ppb	80,611	cy			61,535	m3	
Volume > 1,000 ppb	46,178	cy			35,250	m3	
Volume > 5000 ppb	20,148	cy			15,380	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.4						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.7%	v/v	0.98	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density	20%	w/w	9.4%	v/v	0.95	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	29.4%	v/v	1.19	tons per cy	Foth & VanDyke
Treated Density	93.5%	w/w	60.0%	v/v	1.30	tons per cy	
HTTD Treatment Capacity	1,264,377	cy	in situ		1,650,000	tons	
Vitrification Treatment Capacity	1,328,888	cy	in situ		2145500.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Solidification							
Percent Lime	10.0%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Vitrification							
Vitrification	$27.0	per ton (250 glass ton per day melter unit)					Unit Cost Study- Minergy
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area	608,771	sf	13.97546543				2 days slurry + 13 wk solids * 2 cell
Perimeter	3,121	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Asphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate	395	gpm					assume operate 24/7
Unit, Purchase	$691,235	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					
Water Treatment QA	$200	per day					
Flow Rate (mechanical dewatering)	484	gpm					pj
Unit, Purchase (mechanical dewatering)	$780,778	LS					pj, 1 sample/day

Disposal			
Off-Site Disposal			
Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj
Institutional Controls			
Public Education Program	$100,000		pj
O&M Plans	$20,000		pj
Deed Restrictions	$5,000		pj
Annual Costs			
Public Education Program	$30,000		pj
Maintaining O&M Plans	$800		pj
Reporting	$20,000		pj
Long-term Monitoring	$600,000		Anne LTM
Long-term Monitoring (no action)	$300,000		Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C: Dredge Sediment With Off-site Disposal

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	48	ac		$768,000
Dredging - 12 hour shifts	55	Day	0.423076923	$313,500
Dredge Monitoring (Water Quality)	55	Day		$165,000
Sediment Removal QA	55	Day		$66,000
Site Restoration	5	Each		$3,000,000
Direct Capital:				$5,662,500
Engineering, Procurement & Construction Management:				679,500
Contractor Overhead/Profit:				849,375
Total Capital:				**$7,200,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641

Direct Capital:	$2,675,115
Engineering, Procurement & Construction Management:	321,014
Total Capital:	**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	43,230,619	gal	$17,292
Water Treatment QA	76	day	$15,200

Direct Capital:	$723,728
Engineering, Procurement & Construction Management:	86,847
Total Capital:	**$800,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	67,649	ton	$1,691,225
Lime Purchase	6,765	ton	$405,900
Soil Loading	67,649	ton	$189,417
Soil Hauling	67,649	ton	$317,105
Tipping Fees (non-TSCA)	67,649	ton	$2,908,907

Direct Capital:	$5,512,554
Engineering, Procurement & Construction Management:	661,506
Total Capital:	**$6,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**
TOTAL COST	**$21,700,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	48	ac		$768,000
Dredging - 12 hour shifts	55	Day	0.423076923	$313,500
Dredge Monitoring (Water Quality)	55	Day		$165,000
Sediment Removal QA	55	Day		$66,000
Site Restoration	5	Each		$3,000,000
Direct Capital:				$5,662,500
Engineering, Procurement & Construction Management:				679,500
Contractor Overhead/Profit:				849,375
Total Capital:				**$7,200,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641
Direct Capital:			$2,675,115
Engineering, Procurement & Construction Management:			321,014
Total Capital:			**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	43,230,619	gal	$17,292
Water Treatment QA	76	day	$15,200
Direct Capital:			$723,728
Engineering, Procurement & Construction Management:			86,847
Total Capital:			**$800,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	67,648	ton	$1,826,497
Soil Loading	67,648	ton	$189,415
Soil Hauling	67,648	ton	$79,275
Direct Capital:			$2,095,187
Engineering, Procurement & Construction Management:			$314,278
Total Capital:			**$2,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$17,900,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
APPLETON TO LITTLE RAPIDS
Action Level - 1,000 ppb

Material Handling Assumptions:							
Volume > 1000 ppb	46,178	cy	34	ac	35,250	m3	Acres corresponds to dredge
Volume > 125 ppb	182,450	cy			139,275	m3	footprint area
Volume > 250 ppb	80,611	cy			61,535	m3	
Volume > 500 ppb	56,998	cy			43,510	m3	
Volume > 5000 ppb	20,148	cy			15,380	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.4						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.7%	v/v	0.98	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density	20%	w/w	9.4%	v/v	0.95	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	29.4%	v/v	1.19	tons per cy	Foth & VanDyke
Treated Density	93.5%	w/w	60.0%	v/v	1.30	tons per cy	
HTTD Treatment Capacity	1,264,377	cy	in situ		1,650,000	tons	
Vitrification Treatment Capacity	1,328,888	cy	in situ		2145500.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Solidification							
Percent Lime	10.0%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Vitrification							
Vitrification	$27.0	per ton (250 glass ton per day melter unit)					Unit Cost Study- Minergy
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area	608,771	sf	13.97546543				2 days slurry + 13 wk solids * 2 cell
Perimeter	3,121	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Asphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate	395	gpm					assume operate 24/7
Unit, Purchase	$691,235	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					
Water Treatment QA	$200	per day					
Flow Rate (mechanical dewatering)	484	gpm					pj
Unit, Purchase (mechanical dewatering)	$780,778	LS					pj, 1 sample/day

Disposal			
Off-Site Disposal			
Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj
Institutional Controls			
Public Education Program	$100,000		pj
O&M Plans	$20,000		pj
Deed Restrictions	$5,000		pj
Annual Costs			
Public Education Program	$30,000		pj
Maintaining O&M Plans	$800		pj
Reporting	$20,000		pj
Long-term Monitoring	$600,000		Anne LTM
Long-term Monitoring (no action)	$300,000		Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C: Dredge Sediment With Off-site Disposal

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	34	ac		$544,000
Dredging - 12 hour shifts	44	Day	0.338461538	$250,800
Dredge Monitoring (Water Quality)	44	Day		$132,000
Sediment Removal QA	44	Day		$52,800
Site Restoration	5	Each		$3,000,000
Direct Capital:				$5,329,600
Engineering, Procurement & Construction Management:				639,552
Contractor Overhead/Profit:				799,440
Total Capital:				**$6,800,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641

Direct Capital:	$2,675,115
Engineering, Procurement & Construction Management:	321,014
Total Capital:	**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	35,023,657	gal	$14,009
Water Treatment QA	62	day	$12,400

Direct Capital:	$717,645
Engineering, Procurement & Construction Management:	86,117
Total Capital:	**$800,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	54,806	ton	$1,370,150
Lime Purchase	5,481	ton	$328,860
Soil Loading	54,806	ton	$153,457
Soil Hauling	54,806	ton	$256,903
Tipping Fees (non-TSCA)	54,806	ton	$2,356,658

Direct Capital:	$4,466,028
Engineering, Procurement & Construction Management:	535,923
Total Capital:	**$5,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**
TOTAL COST	**$20,100,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	34	ac		$544,000
Dredging - 12 hour shifts	44	Day	0.338461538	$250,800
Dredge Monitoring (Water Quality)	44	Day		$132,000
Sediment Removal QA	44	Day		$52,800
Site Restoration	5	Each		$3,000,000
Direct Capital:				$5,329,600
Engineering, Procurement & Construction Management:				639,552
Contractor Overhead/Profit:				799,440
Total Capital:				**$6,800,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641
Direct Capital:			$2,675,115
Engineering, Procurement & Construction Management:			321,014
Total Capital:			**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	35,023,657	gal	$14,009
Water Treatment QA	62	day	$12,400
Direct Capital:			$717,645
Engineering, Procurement & Construction Management:			86,117
Total Capital:			**$800,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	54,806	ton	$1,479,752
Soil Loading	54,806	ton	$153,456
Soil Hauling	54,806	ton	$64,225
Direct Capital:			$1,697,433
Engineering, Procurement & Construction Management:			$254,615
Total Capital:			**$2,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$17,100,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
APPLETON TO LITTLE RAPIDS
Action Level - 5,000 ppb

Material Handling Assumptions:							
Volume > 5000 ppb	20,148	cy	13 ac		15,380	m3	Acres corresponds to dredge
Volume > 125 ppb	182,450	cy			139,275	m3	footprint area
Volume > 250 ppb	80,611	cy			61,535	m3	
Volume > 500 ppb	56,998	cy			43,510	m3	
Volume > 1000 ppb	46,178	cy			35,250	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.4						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	24.2%	w/w	11.7%	v/v	0.98	tons per cy	
Slurry Density (20% in situ)	5.5%	w/w	2.3%	v/v	0.87	tons per cy	Ogden Beeman
Dewatered Density	20%	w/w	9.4%	v/v	0.95	tons per cy	Montgomery Watson
Dewatered Density (mechanical and CDF)	50%	w/w	29.4%	v/v	1.19	tons per cy	Foth & VanDyke
Treated Density	93.5%	w/w	60.0%	v/v	1.30	tons per cy	
HTTD Treatment Capacity	1,264,377	cy	in situ		1,650,000	tons	
Vitrification Treatment Capacity	1,328,888	cy	in situ		2145500.00	tons	

Cost Estimating Parameters & Methodology:						
Interest Rate	6.0%					
Sales Tax	5.5%					Not Used
Engineering, Procurement and Construction Mgmt	12.0%					
Contractor Overhead and Profit - Dredging Only	15.0%					
Dredging						
Debris Sweep	$16,000	per acre				Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day				
Sediment Removal QA	$1,200	per day				
Hydraulic - 10-inch Cutterhead						
Site Preparation	$100,000	per dredge launch site				pj
Mobilization - Equipment	$135,000	per dredge				Ogden Beeman
Mobilization - Silt Curtain	$35,000					Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift				Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift				Ogden Beeman
Site Restoration	$600,000	per dredge launch site				pj
High Temperature Thermal Desorption						
Setup Staging Area	$50,000					pj
Mobilization/Site Prep	$150,000					Maxymillian
Sediment Treatment QA	$2	per ton				
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1				
Sand Purchase and Deliver	$6	per ton				Ole
Blending	$25	per ton				Ole
HTTD (includes off-gas treatment)	$75	per ton				Maxymillian
Stack Testing	$50,000	LS				Maxymillian
Place Treated Material	$3	per ton				
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Vitrification						
Vitrification	$27.0	per ton (250 glass ton per day melter unit)				Unit Cost Study- Minergy
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	608,771	sf	13.97546543			2 days slurry + 13 wk solids * 2 cell
Perimeter	3,121	lf				assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				pj
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Asphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Water Treatment						
Flow Rate	395	gpm				assume operate 24/7
Unit, Purchase	$691,235	LS				pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				
Water Treatment QA	$200	per day				
Flow Rate (mechanical dewatering)	484	gpm				pj
Unit, Purchase (mechanical dewatering)	$780,778	LS				pj, 1 sample/day

Disposal
Off-Site Disposal

Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj
Institutional Controls			
Public Education Program	$100,000		pj
O&M Plans	$20,000		pj
Deed Restrictions	$5,000		pj
Annual Costs			
Public Education Program	$30,000		pj
Maintaining O&M Plans	$800		pj
Reporting	$20,000		pj
Long-term Monitoring	$600,000		Anne LTM
Long-term Monitoring (no action)	$300,000		Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C: Dredge Sediment With Off-site Disposal

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	13	ac		$208,000
Dredging - 12 hour shifts	20	Day	0.153846154	$114,000
Dredge Monitoring (Water Quality)	20	Day		$60,000
Sediment Removal QA	20	Day		$24,000
Site Restoration	5	Each		$3,000,000
Direct Capital:				$4,756,000
Engineering, Procurement & Construction Management:				570,720
Contractor Overhead/Profit:				713,400
Total Capital:				**$6,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641

Direct Capital:	$2,675,115
Engineering, Procurement & Construction Management:	321,014
Total Capital:	**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	15,281,244	gal	$6,112
Water Treatment QA	27	day	$5,400

Direct Capital:	$702,748
Engineering, Procurement & Construction Management:	84,330
Total Capital:	**$800,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	23,913	ton	$597,825
Lime Purchase	2,392	ton	$143,520
Soil Loading	23,913	ton	$66,956
Soil Hauling	23,913	ton	$112,092
Tipping Fees (non-TSCA)	23,913	ton	$1,028,259

Direct Capital:	$1,948,653
Engineering, Procurement & Construction Management:	233,838
Total Capital:	**$2,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**
TOTAL COST	**$16,500,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	5	Each		$500,000
Mobilization - Equipment and Silt Curtain	5	LS		$850,000
Debris Sweep	13	ac		$208,000
Dredging - 12 hour shifts	20	Day	0.153846154	$114,000
Dredge Monitoring (Water Quality)	20	Day		$60,000
Sediment Removal QA	20	Day		$24,000
Site Restoration	5	Each		$3,000,000
Direct Capital:				$4,756,000
Engineering, Procurement & Construction Management:				570,720
Contractor Overhead/Profit:				713,400
Total Capital:				**$6,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	608,771	sf	$1,095,788
Mobilization	1	LS	$20,000
Clear and Grub	608,771	sf	$27,951
Berm Construction	32,365	cy	$194,193
Rough Grading	608,771	sf	$152,193
Liner Placement	608,771	sf	$913,157
Demob/Disposal	1	LS	$10,000
Regrade	32,365	cy	$194,193
Seed/Sod	67,641	sy	$67,641
Direct Capital:			$2,675,115
Engineering, Procurement & Construction Management:			321,014
Total Capital:			**$3,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	395	gpm	$691,235
Water Treatment (Includes Operator)	15,281,244	gal	$6,112
Water Treatment QA	27	day	$5,400
Direct Capital:			$702,748
Engineering, Procurement & Construction Management:			84,330
Total Capital:			**$800,000**

SEDIMENT TREATMENT (VITRIFICATION 1x250 tons Integrated Storage Unit)

Capital Items	Quantity	Units	Cost
Sediment Treatment	23,912	ton	$645,634
Soil Loading	23,912	ton	$66,955
Soil Hauling	23,912	ton	$28,022
Direct Capital:			$740,611
Engineering, Procurement & Construction Management:			$111,092
Total Capital:			**$900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$15,200,000**

Table 7-8 Cost Summary for Remedial Alternatives - Little Rapids to De Pere

125 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	1,483,156	$33,900,000	---	---	$3,100,000	$1,700,000	---	---	$181,000,000	$4,500,000	$224,200,000	$44,840,000	$269,040,000
C2A	1,483,156	$43,300,000	---	---	---	$5,100,000	---	---	$19,400,000	$4,500,000	$72,300,000	$14,460,000	$86,760,000
C2B	1,483,156	$43,300,000	---	---	$22,100,000	$5,000,000	---	---	$104,900,000	$4,500,000	$179,800,000	$35,960,000	$215,760,000
C3	1,483,156	$33,900,000	---	---	$53,400,000	$2,600,000	---	---	$67,300,000	$4,500,000	$161,700,000	$32,340,000	$194,040,000
D	1,483,156	$33,900,000	---	---	---	$1,900,000	---	$32,000,000	---	$4,500,000	$72,300,000	$14,460,000	$86,760,000
E	1,483,156	$43,300,000	---	---	$22,100,000	$10,700,000	$62,100,000	---	---	$4,500,000	$142,700,000	$28,540,000	$171,240,000
F	585,020	$23,100,000	---	$40,500,000	$3,100,000	$1,100,000	---	---	$71,400,000	$4,500,000	$143,700,000	$28,740,000	$172,440,000

250 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	1,171,585	$28,600,000	---	---	$3,100,000	$1,500,000	---	---	$143,000,000	$4,500,000	$180,700,000	$36,140,000	$216,840,000
C2A	1,171,585	$37,600,000	---	---	---	$4,900,000	---	---	$16,200,000	$4,500,000	$63,200,000	$12,640,000	$75,840,000
C2B	1,171,585	$37,600,000	---	---	$22,100,000	$4,900,000	---	---	$83,700,000	$4,500,000	$152,800,000	$30,560,000	$183,360,000
C3	1,171,585	$28,600,000	---	---	$42,200,000	$2,400,000	---	---	$53,100,000	$4,500,000	$130,800,000	$26,160,000	$156,960,000
D	1,171,585	$28,600,000	---	---	---	$1,700,000	---	$32,000,000	---	$4,500,000	$66,800,000	$13,360,000	$80,160,000
E	1,171,585	$37,600,000	---	---	$22,100,000	$10,500,000	$49,100,000	---	---	$4,500,000	$123,800,000	$24,760,000	$148,560,000
F	411,065	$19,500,000	---	$36,000,000	$3,100,000	$1,000,000	---	---	$50,200,000	$4,500,000	$114,300,000	$22,860,000	$137,160,000

500 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	776,791	$20,500,000	---	---	$3,100,000	$1,300,000	---	---	$94,800,000	$4,500,000	$124,200,000	$24,840,000	$149,040,000
C2A	776,791	$30,100,000	---	---	---	$4,700,000	---	---	$12,100,000	$4,500,000	$51,400,000	$10,280,000	$61,680,000
C2B	776,791	$30,100,000	---	---	$22,100,000	$4,700,000	---	---	$56,900,000	$4,500,000	$118,300,000	$23,660,000	$141,960,000
C3	776,791	$20,500,000	---	---	$28,000,000	$2,100,000	---	---	$35,200,000	$4,500,000	$90,300,000	$18,060,000	$108,360,000
D	776,791	$20,500,000	---	---	---	$1,400,000	---	$32,000,000	---	$4,500,000	$58,400,000	$11,680,000	$70,080,000
E	776,791	$30,100,000	---	---	$22,100,000	$10,300,000	$32,500,000	---	---	$4,500,000	$99,500,000	$19,900,000	$119,400,000
F	283,812	$14,600,000	---	$30,100,000	$3,100,000	$900,000	---	---	$34,600,000	$4,500,000	$87,800,000	$17,560,000	$105,360,000

1000 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	586,788	$14,800,000	---	---	$3,100,000	$1,100,000	---	---	$71,600,000	$4,500,000	$95,100,000	$19,020,000	$114,120,000
C2A	586,788	$24,700,000	---	---	---	$4,600,000	---	---	$10,100,000	$4,500,000	$43,900,000	$8,780,000	$52,680,000
C2B	586,788	$24,700,000	---	---	$22,100,000	$4,600,000	---	---	$44,000,000	$4,500,000	$99,900,000	$19,980,000	$119,880,000
C3	586,788	$14,800,000	---	---	$21,200,000	$2,000,000	---	---	$26,600,000	$4,500,000	$69,100,000	$13,820,000	$82,920,000
D	586,788	$14,800,000	---	---	---	$1,200,000	---	$32,000,000	---	$4,500,000	$52,500,000	$10,500,000	$63,000,000
E	586,788	$24,700,000	---	---	$22,100,000	$10,300,000	$24,600,000	---	---	$4,500,000	$86,200,000	$17,240,000	$103,440,000
F	170,418	$9,800,000	---	$23,800,000	$3,100,000	$900,000	---	---	$20,800,000	$4,500,000	$62,900,000	$12,580,000	$75,480,000

5000 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C1	186,348	$6,900,000	---	---	$3,100,000	$900,000	---	---	$22,700,000	$4,500,000	$38,100,000	$7,620,000	$45,720,000
C2A	186,348	$17,400,000	---	---	---	$4,500,000	---	---	$6,000,000	$4,500,000	$32,400,000	$6,480,000	$38,880,000
C2B	186,348	$17,400,000	---	---	$22,100,000	$4,500,000	---	---	$16,800,000	$4,500,000	$65,300,000	$13,060,000	$78,360,000
C3	186,348	$6,900,000	---	---	$6,800,000	$1,700,000	---	---	$8,500,000	$4,500,000	$28,400,000	$5,680,000	$34,080,000
D	186,348	$6,900,000	---	---	---	$1,000,000	---	$32,000,000	---	$4,500,000	$44,400,000	$8,880,000	$53,280,000
E	186,348	$17,400,000	---	---	$22,100,000	$10,100,000	$7,800,000	---	---	$4,500,000	$61,900,000	$12,380,000	$74,280,000
F	50,160	$5,200,000	---	$15,000,000	$3,100,000	$800,000	---	---	$6,100,000	$4,500,000	$34,700,000	$6,940,000	$41,640,000

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE
Action Level - 125 ppb

Material Handling Assumptions:							
Volume > 125 ppb	1,483,156	cy	739	ac	1,132,180	m3	Acres corresponds to dredge footprint area
Volume > 250 ppb	1,171,585	cy			894,340	m3	
Volume > 500 ppb	776,791	cy			592,970	m3	
Volume > 1,000 ppb	586,788	cy			447,930	m3	
Volume > 5000 ppb	186,348	cy			142,250	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.47						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	37.1%	w/w	19.3%	v/v	1.08	tons per cy	
Slurry Density (20% in situ)	9.0%	w/w	3.9%	v/v	0.89	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	14.8%	v/v	1.03	tons per cy	Montgomery Watson
Dewatered Density (CDF or landfill)	50%	w/w	28.8%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.7%	w/w	60.0%	v/v	1.33	tons per cy	
HTTD Treatment Capacity	2,198,917	cy			1,650,000	tons	
Cap Volume	898,136	cy			685,600	m3	
Vitrification Treatment Capacity	8,028,121	cy	in situ		6440000.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Hydraulic - 2 12-inch Cutterheads							
Site Preparation	$803,400	LS					Ogden Beeman
Mobilization - Equipment	$1,135,000	LS					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift					Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift					Ogden Beeman
Winter Over Equipment	$285,000	per year					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					
Length of Piping	95,000	ft	18	mi			Distance to Town of Holland (map provded by Fred Swed) 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft					Ogden Beeman
Number of Road Crossings	4	each					pj, review map
Cost per Road Crossing	$50,000	per crossing					pj, review map
Number of Booster Pumps	4	each					Ogden Beeman
Booster Pump Cost	$2,500	per day					Ogden Beeman
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Capital Costs	$36,000,000	LS					Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year					Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	11,689,322	sf	1,086,000			m2	
Sand Cap Depth	1.7	feet					
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF	Arrowhead		Menasha				
Land Lease or Purchase	$1.8	per sf	$1.8				Ole
Length	8,000	lf	9,200				Baird
Capping Volume	190,000	cy	170,000				Baird
Seeding Area	280,000	sy	250,000				Baird
Sheetpile Wall Length	8,000	lf	9,200				Baird
Sheetpile Depth	30	ft	30				based on bathymetry
Sheetpile Cost	$19	per sf	$19				pj
Shot Rock Berm	$650	per lf	$550				Baird
Rip Rap	$215	per lf	$250				Baird
Place Treated Material	$2	per cy	$2				pj
Clean Soil Cap	$10	per cy	$10				Baird
Seeding	$1	per sy	$1				Baird
Mitigation	$10,000	per acre					Tim
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					Anne LTM
Long-term O&M	2%	of capital					pj
Solidification							
Percent Lime	10.0%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton		pj, pug mill mixing
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area (1050 cy dredge rate)	636,049	sf	14.60168334				2 days slurry + 13 wk solids * 2 cell
Perimeter (1050 cy dredge rate)	3,190	lf					assume square
Area (2885 cy dredge rate)	5,010,182	sf	115.0179519				2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter (2885 cy dredge rate)	8,953	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Asphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate (1 10-inch Dredge; settling pond)	389	gpm					assume operate 24/7
Unit, Purchase (1 10-inch Dredge; settling pond)	$684,675	LS					pj
Flow Rate (1 10-inch Dredge; CDF)	456	gpm					assume operate 24/7
Unit, Purchase (1 10-inch Dredge; CDF)	$752,984	LS					pj
Flow Rate (2 12-inch Dredges)	3,505	gpm					assume operate 24/7
Unit, Purchase (2 12-inch Dredges)	$2,561,265	LS					pj
Flow Rate (2-12-in Dredges; settling pond)	2,991	gpm					assume operate 24/7
Flow Rate (mechanical dewatering)	1,252	gpm					
Unit, Purchase (mechanical dewatering)	$1,380,892	LS					
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet					Distance from town of Holland to river per map provided by Fred Swed
Disposal							
Off-Site Disposal (Existing NR 500 Commercial)							
Load Soil for Hauling	$2.80	per ton					pj
Round-trip Hauling	2	hours					pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours					pj
Tipping Fee (non-TSCA)	$43	per ton					St. Paul
Tipping Fee (TSCA)	$55	per ton					St. Paul
Truck Rate	$75	per hour					pj
Truck Load	32	tons					pj
Conveyer Facility Construction	1,000,000	LS					pj
Dedicated NR 500 Monofill							
Landfill Construction	$5,611,941						
Landfill Area	140	acres					
Local Siting Fee	$5	per cy					
Closure Cap	$100,000	per acre					
Operating Cost	$500,000	per year					
Post-closure Monitoring	$30,000	per year					
Institutional Controls							
Public Education Program	$100,000						pj
O&M Plans	$20,000						pj
Deed Restrictions	$5,000						pj
Annual Costs							
Public Education Program	$30,000						pj
Maintaining O&M Plans	$800						pj
Reporting	$20,000						pj
Long-term Monitoring	$600,000						Anne LTM
Long-term Monitoring (no action)	$300,000						Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	739	ac		$11,824,000
Dredging - 12 hour shifts	1413	Day	10.86923077	$8,054,100
Dredge Monitoring (Water Quality)	1413	Day		$4,239,000
Sediment Removal QA	1413	Day		$1,695,600
Site Restoration	1	Each		$600,000
Direct Capital:				$26,682,700
Engineering, Procurement & Construction Management:				3,201,924
Contractor Overhead/Profit:				4,002,405
Total Capital:				**$33,900,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	389	gpm		$684,675
Water Treatment (Includes Operator)	1,107,174,048	gal		$442,870
Water Treatment QA	1,978	day		$395,600
Direct Capital:				$1,523,145
Engineering, Procurement & Construction Management:				182,777
Total Capital:				**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	1,982,931	ton		$49,573,275
Lime Purchase	198,294	ton		$11,897,640
Soil Loading	1,982,931	ton		$5,552,207
Soil Hauling	1,982,931	ton		$9,294,989
Tipping Fees (non-TSCA)	1,982,931	ton		$85,266,033
Direct Capital:				$161,584,144
Engineering, Procurement & Construction Management:				19,390,097
Total Capital:				**$181,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs		Years	Annual Cost	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

TOTAL COST	**$224,200,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	739	ac		$11,824,000
Dredging - 2 12-hour shifts	258	Day	1.417582418	$7,327,200
Dredge Monitoring (Water Quality)	258	Day		$1,548,000
Sediment Removal QA	258	Day		$619,200
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$2,580,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$34,125,200
Engineering, Procurement & Construction Management:				4,095,024
Contractor Overhead/Profit:				5,118,780
Total Capital:				**$43,300,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,505	gpm		$2,561,265
Water Treatment (Includes Operator)	1,297,331,997	gal		$518,933
Water Treatment QA	258	day		$103,200
Piping	20,000	ft		$1,340,000
Direct Capital:				$4,523,398
Engineering, Procurement & Construction Management:				542,808
Total Capital:				**$5,100,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$5,611,941
Local Siting Fee	992,071	cy		$4,960,355
Closure	31	acres		$3,074,600
Direct Capital:				$13,646,896
Engineering, Procurement & Construction Management:				1,637,628
Total Capital:				**$15,300,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs			$4,131,432
Total Project Capital and O&M Cost			**$19,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$72,300,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	739	ac		$11,824,000
Dredging - 2 12-hour shifts	258	Day	1.417582418	$7,327,200
Dredge Monitoring (Water Quality)	258	Day		$1,548,000
Sediment Removal QA	258	Day		$619,200
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$2,580,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$34,125,200
Engineering, Procurement & Construction Management:				4,095,024
Contractor Overhead/Profit:				5,118,780
Total Capital:				**$43,300,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	5,010,182	sf		$9,018,328
Mobilization	1	LS		$20,000
Clear and Grub	5,010,182	sf		$230,036
Berm Construction	92,850	cy		$557,099
Rough Grading	5,010,182	sf		$1,252,545
Liner Placement	5,010,182	sf		$7,515,273
Demob/Disposal	1	LS		$10,000
Regrade	92,850	cy		$557,099
Seed/Sod	556,687	sy		$556,687
Direct Capital:				$19,717,067
Engineering, Procurement & Construction Management:				2,366,048
Total Capital:				**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	2,991	gpm		$2,561,265
Water Treatment (Includes Operator)	1,107,174,048	gal		$442,870
Water Treatment QA	720	day		$144,000
Piping	20,000	ft		$1,340,000
Direct Capital:				$4,488,135
Engineering, Procurement & Construction Management:				538,576
Total Capital:				**$5,000,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Solidification	1,982,931	ton		$49,573,275
Lime Purchase	198,294	ton		$11,897,640
Sediment Loading	1,982,930	ton		$5,552,205
Sediment Hauling	1,982,930	ton		$9,294,987
Landfill Construction	1	LS		$5,611,941
Local Siting Fee	992,071	cy		$4,960,355
Closure	31	acres		$3,074,600
Direct Capital:				$89,965,003
Engineering, Procurement & Construction Management:				10,795,800
Total Capital:				**$100,800,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs				$4,131,432
Total Project Capital and O&M Cost				**$104,900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

TOTAL COST	**$179,800,000**

ALTERNATIVE C3: Dredge with Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	739	ac		$11,824,000
Dredging - 12 hour shifts	1413	Day	10.86923077	$8,054,100
Dredge Monitoring (Water Quality)	1413	Day		$4,239,000
Sediment Removal QA	1413	Day		$1,695,600
Site Restoration	1	Each		$600,000
Direct Capital:				$26,682,700
Engineering, Procurement & Construction Management:				3,201,924
Contractor Overhead/Profit:				4,002,405
Total Capital:				**$33,900,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	594,879	bdt	$47,590,332
Direct Capital:			$47,690,332
Engineering, Procurement & Construction Management:			5,722,840
Total Capital:			**$53,400,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$1,380,892
Water Treatment (Includes Operator)	1,297,331,997	gal	$518,933
Water Treatment QA	1,978	day	$395,600
Direct Capital:			$2,295,425
Engineering, Procurement & Construction Management:			275,451
Total Capital:			**$2,600,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	1,189,758	ton	$3,331,323
Soil Hauling	1,189,758	ton	$5,576,992
Tipping Fees (non-TSCA)	1,189,758	ton	$51,159,607
Tipping Fees (TSCA)	0	ton	$0
Direct Capital:			$60,067,922
Engineering, Procurement & Construction Management:			7,208,151
Total Capital:			**$67,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$161,700,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	739	ac		$11,824,000
Dredging - 12 hour shifts	1413	Day	10.86923077	$8,054,100
Dredge Monitoring (Water Quality)	1413	Day		$4,239,000
Sediment Removal QA	1413	Day		$1,695,600
Site Restoration	1	Each		$600,000
Direct Capital:				$26,682,700
Engineering, Procurement & Construction Management:				3,201,924
Contractor Overhead/Profit:				4,002,405
Total Capital:				**$33,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$752,984
Water Treatment (Includes Operator)	1,297,331,997	gal	$518,933
Water Treatment QA	1,978	day	$395,600
Direct Capital:			$1,667,517
Engineering, Procurement & Construction Management:			200,102
Total Capital:			**$1,900,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	27,778	sf	$50,000
Shot Rock/Rip Rap	9,200	lf	$7,360,000
Sheetpile Placement	276,000	sf	$5,244,000
Clean Soil Cap	170,000	cy	$1,700,000
Seeding	250,000	sy	$250,000
Mitigation	52	acre	$516,529
Direct Capital:			$15,120,529
Engineering, Procurement & Construction Management:			1,814,463
Total Capital:			**$16,934,992**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs			$15,026,734
Total Project Capital and O&M Cost			**$32,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$72,300,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	2	Each		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	739	ac		$11,824,000
Dredging - 2 12-hour shifts	258	Day	1.417582418	$7,327,200
Dredge Monitoring (Water Quality)	258	Day		$1,548,000
Sediment Removal QA	258	Day		$619,200
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$2,580,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$34,125,200
Engineering, Procurement & Construction Management:				4,095,024
Contractor Overhead/Profit:				5,118,780
Total Capital:				**$43,300,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	1,107,174,048	gal	$442,870
Water Treatment QA	720	day	$144,000
Piping	95,000	ft	$6,365,000
Direct Capital:			$9,513,135
Engineering, Procurement & Construction Management:			1,141,576
Total Capital:			**$10,700,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	1,982,930	ton	$47,590,332
Soil Loading	1,982,930	ton	$5,552,205
Soil Hauling	1,982,930	ton	$2,323,747
Direct Capital:			$55,466,284
Engineering, Procurement & Construction Management:			$6,655,954
Total Capital:			**$62,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$142,700,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge and Off-site Disposal

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	1,010,188	tons		$6,061,130
Sand Placement	721,563	cy		$4,329,379
Cobble Purchase and Placement	432,938	cy		$12,988,136
Cap Placement QA	1	LS		$100,000
Direct Capital:				$23,678,645
Engineering, Procurement & Construction Management:				2,841,437
Total Capital:				**$26,520,082**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$530,402	$7,980,581
Total Present Worth, Longer Term O&M Costs				$13,999,099
Total Project Capital and O&M Cost				**$40,500,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	1	Each	$100,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	739	ac	$11,824,000
Dredging - 12 hour shifts	558	Day	$3,180,600
Dredge Monitoring (Water Quality)	558	Day	$1,674,000
Sediment Removal QA	558	Day	$669,600
Site Restoration	1	Each	$600,000
Direct Capital:			$18,218,200
Engineering, Procurement & Construction Management:			2,186,184
Contractor Overhead/Profit:			2,732,730
Total Capital:			**$23,100,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	389	gpm		$684,675
Water Treatment (Includes Operator)	436,716,588	gal		$174,687
Water Treatment QA	781	Day		$156,200
Direct Capital:				$1,015,562
Engineering, Procurement & Construction Management:				121,867
Total Capital:				**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	782,153	ton		$19,553,825
Lime Purchase	78,216	ton		$4,692,960
Soil Loading	782,153	ton		$2,190,028
Soil Hauling	782,153	ton		$3,666,342
Tipping Fees (non-TSCA)	782,153	ton		$33,632,579
Direct Capital:				$63,735,735
Engineering, Procurement & Construction Management:				7,648,288
Total Capital:				**$71,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$143,700,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE
Action Level - 250 ppb

Material Handling Assumptions:								
Volume > 250 ppb	1,171,585	cy	665	ac	894,340	m3		Acres corresponds to dredge footprint area
Volume > 125 ppb	1,483,156	cy			1,132,180	m3		
Volume > 500 ppb	776,791	cy			592,970	m3		
Volume > 1,000 ppb	586,788	cy			447,930	m3		
Volume > 5000 ppb	186,348	cy			142,250	m3		
Volume > 50,000 ppb	0	cy			0	m3		
Solids Specific Gravity	2.47							
Fresh Water Density	62.4	lb/ft3						
In Situ Density	37.1%	w/w	19.3%	v/v	1.08	tons per cy		
Slurry Density (20% in situ)	9.0%	w/w	3.9%	v/v	0.89	tons per cy		Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	14.8%	v/v	1.03	tons per cy		Montgomery Watson
Dewatered Density (CDF or landfill)	50%	w/w	28.8%	v/v	1.20	tons per cy		Foth & VanDyke
Treated Density	93.7%	w/w	60.0%	v/v	1.33	tons per cy		
HTTD Treatment Capacity	2,198,917	cy			1,650,000	tons		
Cap Volume	760,521	cy			580,550	m3		
Vitrification Treatment Capacity	8,028,121	cy	in situ		6440000.00	tons		
Cost Estimating Parameters & Methodology:								
Interest Rate	6.0%							
Sales Tax	5.5%							Not Used
Engineering, Procurement and Construction Mgmt	12.0%							
Contractor Overhead and Profit - Dredging Only	15.0%							
Dredging								
Debris Sweep	$16,000	per acre						Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day						
Sediment Removal QA	$1,200	per day						
Hydraulic - 10-inch Cutterhead								
Site Preparation	$100,000	per dredge launch site						pj
Mobilization - Equipment	$135,000	per dredge						Ogden Beeman
Mobilization - Silt Curtain	$35,000							Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift						Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift						Ogden Beeman
Site Restoration	$600,000	per dredge launch site						pj
Hydraulic - 2 12-inch Cutterheads								
Site Preparation	$803,400	LS						Ogden Beeman
Mobilization - Equipment	$1,135,000	LS						Ogden Beeman
Mobilization - Silt Curtain	$35,000							Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift						Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift						Ogden Beeman
Winter Over Equipment	$285,000	per year						Ogden Beeman
Site Restoration	$600,000	per dredge launch site						
Length of Piping	95,000	ft			18	mi		Distance to Town of Holland (map provded by Fred Swed) 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft						Ogden Beeman
Number of Road Crossings	4	each						pj, review map
Cost per Road Crossing	$50,000	per crossing						pj, review map
Number of Booster Pumps	4	each						Ogden Beeman
Booster Pump Cost	$2,500	per day						Ogden Beeman
High Temperature Thermal Desorption								
Setup Staging Area	$50,000							pj
Mobilization/Site Prep	$150,000							Maxymillian
Sediment Treatment QA	$2	per ton						
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1						
Sand Purchase and Deliver	$6	per ton						Ole
Blending	$25	per ton						Ole
HTTD (includes off-gas treatment)	$75	per ton						Maxymillian
Stack Testing	$50,000	LS						Maxymillian
Place Treated Material	$3	per ton						
Vitrification								
Capital Costs	$36,000,000	LS						Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year						Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton						Unit Cost Study- Minergy
Capping								
Mobilization/Site Prep	$200,000							Ogden Beeman
Area	10,155,502	sf		943,500		m2		
Sand Cap Depth	1.7	feet						
Placement Rate	$6	per cy						Ogden Beeman
Sand Purchase	$6	per ton						Ole
Sand Density	1.4	tons per cy						
Armored Cap Depth	1.0	feet						
Cobbles	$30	per cy						Means
Cap Placement QA	$100,000	LS						Ogden Beeman
Long-term O&M	2%	of capital						pj
Long-term Monitoring	$400,000	per year						Anne LTM

	Arrowhead		Menasha			
Nearshore CDF						
Land Lease or Purchase	$1.8	per sf	$1.8			Ole
Length	8,000	lf	9,200			Baird
Capping Volume	190,000	cy	170,000			Baird
Seeding Area	280,000	sy	250,000			Baird
Sheetpile Wall Length	8,000	lf	9,200			Baird
Sheetpile Depth	30	ft	30			based on bathymetry
Sheetpile Cost	$19	per sf	$19			pj
Shot Rock Berm	$650	per lf	$550			Baird
Rip Rap	$215	per lf	$250			Baird
Place Treated Material	$2	per cy	$2			pj
Clean Soil Cap	$10	per cy	$10			Baird
Seeding	$1	per sy	$1			Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area (1050 cy dredge rate)	636,049	sf				2 days slurry + 13 wk solids * 2 cell
Perimeter (1050 cy dredge rate)	3,190	lf				assume square
Area (2885 cy dredge rate)	5,010,182	sf				2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter (2885 cy dredge rate)	8,953	lf				assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				pj
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Asphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Water Treatment						
Flow Rate (1 10-inch Dredge; settling pond)	389	gpm				assume operate 24/7
Unit, Purchase (1 10-inch Dredge; settling pond)	$684,675	LS				pj
Flow Rate (1 10-inch Dredge; CDF)	456	gpm				assume operate 24/7
Unit, Purchase (1 10-inch Dredge; CDF)	$752,984	LS				pj
Flow Rate (2 12-inch Dredges)	3,505	gpm				assume operate 24/7
Unit, Purchase (2 12-inch Dredges)	$2,561,265	LS				pj
Flow Rate (2-12-in Dredges; settling pond)	2,991	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	1,252	gpm				
Unit, Purchase (mechanical dewatering)	$1,380,892	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Off-Site Disposal (Existing NR 500 Commercial)						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer Facility Construction	1,000,000	LS				pj
Dedicated NR 500 Monofill						
Landfill Construction	$4,433,026					
Landfill Area	140	acres				
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				
Institutional Controls						
Public Education Program	$100,000					pj
O&M Plans	$20,000					pj
Deed Restrictions	$5,000					pj
Annual Costs						
Public Education Program	$30,000					pj
Maintaining O&M Plans	$800					pj
Reporting	$20,000					pj
Long-term Monitoring	$600,000					Anne LTM
Long-term Monitoring (no action)	$300,000					Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	665	ac		$10,640,000
Dredging - 12 hour shifts	1116	Day	8.584615385	$6,361,200
Dredge Monitoring (Water Quality)	1116	Day		$3,348,000
Sediment Removal QA	1116	Day		$1,339,200
Site Restoration	1	Each		$600,000
Direct Capital:				$22,558,400
Engineering, Procurement & Construction Management:				2,707,008
Contractor Overhead/Profit:				3,383,760
Total Capital:				**$28,600,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	389	gpm		$684,675
Water Treatment (Includes Operator)	874,587,113	gal		$349,835
Water Treatment QA	1,563	day		$312,600
Direct Capital:				$1,347,110
Engineering, Procurement & Construction Management:				161,653
Total Capital:				**$1,500,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	1,566,372	ton		$39,159,300
Lime Purchase	156,638	ton		$9,398,280
Soil Loading	1,566,372	ton		$4,385,842
Soil Hauling	1,566,372	ton		$7,342,369
Tipping Fees (non-TSCA)	1,566,372	ton		$67,353,996
Direct Capital:				$127,639,786
Engineering, Procurement & Construction Management:				15,316,774
Total Capital:				**$143,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$180,700,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	665	ac		$10,640,000
Dredging - 2 12-hour shifts	204	Day	1.120879121	$5,793,600
Dredge Monitoring (Water Quality)	204	Day		$1,224,000
Sediment Removal QA	204	Day		$489,600
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$2,040,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$29,610,600
Engineering, Procurement & Construction Management:				3,553,272
Contractor Overhead/Profit:				4,441,590
Total Capital:				**$37,600,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,505	gpm		$2,561,265
Water Treatment (Includes Operator)	1,024,798,087	gal		$409,919
Water Treatment QA	204	day		$81,600
Piping	20,000	ft		$1,340,000
Direct Capital:				$4,392,785
Engineering, Procurement & Construction Management:				527,134
Total Capital:				**$4,900,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$4,433,026
Local Siting Fee	783,664	cy		$3,918,320
Closure	24	acres		$2,428,711
Direct Capital:				$10,780,057
Engineering, Procurement & Construction Management:				1,293,607
Total Capital:				**$12,100,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs			$4,131,432
Total Project Capital and O&M Cost			**$16,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$63,200,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	665	ac		$10,640,000
Dredging - 2 12-hour shifts	204	Day	1.120879121	$5,793,600
Dredge Monitoring (Water Quality)	204	Day		$1,224,000
Sediment Removal QA	204	Day		$489,600
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$2,040,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$29,610,600
Engineering, Procurement & Construction Management:				3,553,272
Contractor Overhead/Profit:				4,441,590
Total Capital:				**$37,600,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	874,587,113	gal	$349,835
Water Treatment QA	569	day	$113,800
Piping	20,000	ft	$1,340,000
Direct Capital:			$4,364,900
Engineering, Procurement & Construction Management:			523,788
Total Capital:			**$4,900,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Solidification	1,566,372	ton		$39,159,300
Lime Purchase	156,638	ton		$9,398,280
Sediment Loading	1,566,371	ton		$4,385,839
Sediment Hauling	1,566,371	ton		$7,342,365
Landfill Construction	1	LS		$4,433,026
Local Siting Fee	783,664	cy		$3,918,320
Closure	24	acres		$2,428,711
Direct Capital:				$71,065,840
Engineering, Procurement & Construction Management:				8,527,901
Total Capital:				**$79,600,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs				$4,131,432
Total Project Capital and O&M Cost				**$83,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

TOTAL COST	**$152,800,000**

ALTERNATIVE C3: Dredge with Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	665	ac		$10,640,000
Dredging - 12 hour shifts	1116	Day	8.584615385	$6,361,200
Dredge Monitoring (Water Quality)	1116	Day		$3,348,000
Sediment Removal QA	1116	Day		$1,339,200
Site Restoration	1	Each		$600,000
Direct Capital:				$22,558,400
Engineering, Procurement & Construction Management:				2,707,008
Contractor Overhead/Profit:				3,383,760
Total Capital:				**$28,600,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	469,911	bdt	$37,592,907
Direct Capital:			$37,692,907
Engineering, Procurement & Construction Management:			4,523,149
Total Capital:			**$42,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$1,380,892
Water Treatment (Includes Operator)	1,024,798,087	gal	$409,919
Water Treatment QA	1,563	day	$312,600
Direct Capital:			$2,103,411
Engineering, Procurement & Construction Management:			252,409
Total Capital:			**$2,400,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	939,823	ton	$2,631,503
Soil Hauling	939,823	ton	$4,405,419
Tipping Fees (non-TSCA)	939,823	ton	$40,412,375
Tipping Fees (TSCA)	0	ton	$0
Direct Capital:			$47,449,297
Engineering, Procurement & Construction Management:			5,693,916
Total Capital:			**$53,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$130,800,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	665	ac		$10,640,000
Dredging - 12 hour shifts	1116	Day	8.584615385	$6,361,200
Dredge Monitoring (Water Quality)	1116	Day		$3,348,000
Sediment Removal QA	1116	Day		$1,339,200
Site Restoration	1	Each		$600,000
Direct Capital:				$22,558,400
Engineering, Procurement & Construction Management:				2,707,008
Contractor Overhead/Profit:				3,383,760
Total Capital:				**$28,600,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$752,984
Water Treatment (Includes Operator)	1,024,798,087	gal	$409,919
Water Treatment QA	1,563	day	$312,600
Direct Capital:			$1,475,503
Engineering, Procurement & Construction Management:			177,060
Total Capital:			**$1,700,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	27,778	sf	$50,000
Shot Rock/Rip Rap	9,200	lf	$7,360,000
Sheetpile Placement	276,000	sf	$5,244,000
Clean Soil Cap	170,000	cy	$1,700,000
Seeding	250,000	sy	$250,000
Mitigation	52	acre	$516,529
Direct Capital:			$15,120,529
Engineering, Procurement & Construction Management:			1,814,463
Total Capital:			**$16,934,992**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs			$15,026,734
Total Project Capital and O&M Cost			**$32,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$66,800,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	665	ac		$10,640,000
Dredging - 2 12-hour shifts	204	Day	1.120879121	$5,793,600
Dredge Monitoring (Water Quality)	204	Day		$1,224,000
Sediment Removal QA	204	Day		$489,600
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$2,040,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$29,610,600
Engineering, Procurement & Construction Management:				3,553,272
Contractor Overhead/Profit:				4,441,590
Total Capital:				**$37,600,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	874,587,113	gal	$349,835
Water Treatment QA	569	day	$113,800
Piping	95,000	ft	$6,365,000
Direct Capital:			$9,389,900
Engineering, Procurement & Construction Management:			1,126,788
Total Capital:			**$10,500,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	1,566,371	ton	$37,592,907
Soil Loading	1,566,371	ton	$4,385,839
Soil Hauling	1,566,371	ton	$1,835,591
Direct Capital:			$43,814,337
Engineering, Procurement & Construction Management:			$5,257,720
Total Capital:			**$49,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$123,800,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge and Off-site Disposal

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	877,636	tons		$5,265,816
Sand Placement	626,883	cy		$3,761,297
Cobble Purchase and Placement	376,130	cy		$11,283,892
Cap Placement QA	1	LS		$100,000
Direct Capital:				$20,611,005
Engineering, Procurement & Construction Management:				2,473,321
Total Capital:				**$23,084,326**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$461,687	$6,946,672
Total Present Worth, Longer Term O&M Costs				$12,965,191
Total Project Capital and O&M Cost				**$36,000,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	1	Each	$100,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	665	ac	$10,640,000
Dredging - 12 hour shifts	392	Day	$2,234,400
Dredge Monitoring (Water Quality)	392	Day	$1,176,000
Sediment Removal QA	392	Day	$470,400
Site Restoration	1	Each	$600,000
Direct Capital:			$15,390,800
Engineering, Procurement & Construction Management:			1,846,896
Contractor Overhead/Profit:			2,308,620
Total Capital:			**$19,500,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	389	gpm	$684,675
Water Treatment (Includes Operator)	306,859,461	gal	$122,744
Water Treatment QA	549	Day	$109,800
Direct Capital:			$917,219
Engineering, Procurement & Construction Management:			110,066
Total Capital:			**$1,000,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

SEDIMENT DISPOSAL (OFF-SITE)

Capital Items	Quantity	Units	Cost
Solidification	549,581	ton	$13,739,525
Lime Purchase	54,959	ton	$3,297,540
Soil Loading	549,581	ton	$1,538,827
Soil Hauling	549,581	ton	$2,576,161
Tipping Fees (non-TSCA)	549,581	ton	$23,631,983
Direct Capital:			$44,784,036
Engineering, Procurement & Construction Management:			5,374,084
Total Capital:			**$50,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$114,300,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE
Action Level - 500 ppb

Material Handling Assumptions:							
Volume > 500 ppb	776,791	cy	498	ac	592,970	m3	Acres corresponds to dredge
Volume > 125 ppb	1,483,156	cy			1,132,180	m3	footprint area
Volume > 250 ppb	1,171,585	cy			894,340	m3	
Volume > 1,000 ppb	586,788	cy			447,930	m3	
Volume > 5000 ppb	186,348	cy			142,250	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.47						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	37.1%	w/w	19.3%	v/v	1.08	tons per cy	
Slurry Density (20% in situ)	9.0%	w/w	3.9%	v/v	0.89	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	14.8%	v/v	1.03	tons per cy	Montgomery Watson
Dewatered Density (CDF or landfill)	50%	w/w	28.8%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.7%	w/w	60.0%	v/v	1.33	tons per cy	
HTTD Treatment Capacity	2,198,917	cy			1,650,000	tons	
Cap Volume	492,979	cy			376,320	m3	
Vitrification Treatment Capacity	8,028,121	cy	in situ		6440000.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Hydraulic - 2 12-inch Cutterheads							
Site Preparation	$803,400	LS					Ogden Beeman
Mobilization - Equipment	$1,135,000	LS					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift					Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift					Ogden Beeman
Winter Over Equipment	$285,000	per year					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					
Length of Piping	95,000	ft	18	mi			Distance to Town of Holland (map provded by Fred Swed) 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft					Ogden Beeman
Number of Road Crossings	4	each					pj, review map
Cost per Road Crossing	$50,000	per crossing					pj, review map
Number of Booster Pumps	4	each					Ogden Beeman
Booster Pump Cost	$2,500	per day					Ogden Beeman
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Capital Costs	$36,000,000	LS					Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year					Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	8,117,944	sf	754,200			m2	
Sand Cap Depth	1.7	feet					
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF	Arrowhead		Menasha			
Land Lease or Purchase	$1.8	per sf	$1.8			Ole
Length	8,000	lf	9,200			Baird
Capping Volume	190,000	cy	170,000			Baird
Seeding Area	280,000	sy	250,000			Baird
Sheetpile Wall Length	8,000	lf	9,200			Baird
Sheetpile Depth	30	ft	30			based on bathymetry
Sheetpile Cost	$19	per sf	$19			pj
Shot Rock Berm	$650	per lf	$550			Baird
Rip Rap	$215	per lf	$250			Baird
Place Treated Material	$2	per cy	$2			pj
Clean Soil Cap	$10	per cy	$10			Baird
Seeding	$1	per sy	$1			Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area (1050 cy dredge rate)	636,049	sf				2 days slurry + 13 wk solids * 2 cell
Perimeter (1050 cy dredge rate)	3,190	lf				assume square
Area (2885 cy dredge rate)	5,010,182	sf				2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter (2885 cy dredge rate)	8,953	lf				assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				pj
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Asphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Water Treatment						
Flow Rate (1 10-inch Dredge; settling pond)	389	gpm				assume operate 24/7
Unit, Purchase (1 10-inch Dredge; settling pond)	$684,675	LS				pj
Flow Rate (1 10-inch Dredge; CDF)	456	gpm				assume operate 24/7
Unit, Purchase (1 10-inch Dredge; CDF)	$752,984	LS				pj
Flow Rate (2 12-inch Dredges)	3,505	gpm				assume operate 24/7
Unit, Purchase (2 12-inch Dredges)	$2,561,265	LS				pj
Flow Rate (2-12-in Dredges; settling pond)	2,991	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	1,252	gpm				
Unit, Purchase (mechanical dewatering)	$1,380,892	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Off-Site Disposal (Existing NR 500 Commercial)						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer Facility Construction	1,000,000	LS				pj
Dedicated NR 500 Monofill						
Landfill Construction	$2,939,208					
Landfill Area	140	acres				
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				
Institutional Controls						
Public Education Program	$100,000					pj
O&M Plans	$20,000					pj
Deed Restrictions	$5,000					pj
Annual Costs						
Public Education Program	$30,000					pj
Maintaining O&M Plans	$800					pj
Reporting	$20,000					pj
Long-term Monitoring	$600,000					Anne LTM
Long-term Monitoring (no action)	$300,000					Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	498	ac		$7,968,000
Dredging - 12 hour shifts	740	Day	5.692307692	$4,218,000
Dredge Monitoring (Water Quality)	740	Day		$2,220,000
Sediment Removal QA	740	Day		$888,000
Site Restoration	1	Each		$600,000
Direct Capital:				$16,164,000
Engineering, Procurement & Construction Management:				1,939,680
Contractor Overhead/Profit:				2,424,600
Total Capital:				**$20,500,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	389	gpm		$684,675
Water Treatment (Includes Operator)	579,873,337	gal		$231,949
Water Treatment QA	1,036	day		$207,200
Direct Capital:				$1,123,825
Engineering, Procurement & Construction Management:				134,859
Total Capital:				**$1,300,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	1,038,544	ton		$25,963,600
Lime Purchase	103,855	ton		$6,231,300
Soil Loading	1,038,544	ton		$2,907,923
Soil Hauling	1,038,544	ton		$4,868,175
Tipping Fees (non-TSCA)	1,038,544	ton		$44,657,392
Direct Capital:				$84,628,390
Engineering, Procurement & Construction Management:				10,155,407
Total Capital:				**$94,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$124,200,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	498	ac		$7,968,000
Dredging - 2 12-hour shifts	135	Day	0.741758242	$3,834,000
Dredge Monitoring (Water Quality)	135	Day		$810,000
Sediment Removal QA	135	Day		$324,000
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$1,350,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$23,709,400
Engineering, Procurement & Construction Management:				2,845,128
Contractor Overhead/Profit:				3,556,410
Total Capital:				**$30,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,505	gpm		$2,561,265
Water Treatment (Includes Operator)	679,467,005	gal		$271,787
Water Treatment QA	135	day		$54,000
Piping	20,000	ft		$1,340,000
Direct Capital:				$4,227,052
Engineering, Procurement & Construction Management:				507,246
Total Capital:				**$4,700,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$2,939,208
Local Siting Fee	519,589	cy		$2,597,945
Closure	16	acres		$1,610,296
Direct Capital:				$7,147,450
Engineering, Procurement & Construction Management:				857,694
Total Capital:				**$8,000,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs				$4,131,432
Total Project Capital and O&M Cost				**$12,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$51,400,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	498	ac		$7,968,000
Dredging - 2 12-hour shifts	135	Day	0.741758242	$3,834,000
Dredge Monitoring (Water Quality)	135	Day		$810,000
Sediment Removal QA	135	Day		$324,000
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$1,350,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$23,709,400
Engineering, Procurement & Construction Management:				2,845,128
Contractor Overhead/Profit:				3,556,410
Total Capital:				**$30,100,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687

Direct Capital:	$19,717,067
Engineering, Procurement & Construction Management:	2,366,048
Total Capital:	**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	579,873,337	gal	$231,949
Water Treatment QA	377	day	$75,400
Piping	20,000	ft	$1,340,000

Direct Capital:	$4,208,615
Engineering, Procurement & Construction Management:	505,034
Total Capital:	**$4,700,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Solidification	1,038,544	ton	$25,963,600
Lime Purchase	103,855	ton	$6,231,300
Sediment Loading	1,038,544	ton	$2,907,922
Sediment Hauling	1,038,544	ton	$4,868,173
Landfill Construction	1	LS	$2,939,208
Local Siting Fee	519,589	cy	$2,597,945
Closure	16	acres	$1,610,296

Direct Capital:	$47,118,445
Engineering, Procurement & Construction Management:	5,654,213
Total Capital:	**$52,800,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389

Total Present Worth, Longer Term O&M Costs	$4,131,432
Total Project Capital and O&M Cost	**$56,900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**

TOTAL COST	**$118,300,000**

ALTERNATIVE C3: Dredge with Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	498	ac		$7,968,000
Dredging - 12 hour shifts	740	Day	5.692307692	$4,218,000
Dredge Monitoring (Water Quality)	740	Day		$2,220,000
Sediment Removal QA	740	Day		$888,000
Site Restoration	1	Each		$600,000
Direct Capital:				$16,164,000
Engineering, Procurement & Construction Management:				1,939,680
Contractor Overhead/Profit:				2,424,600
Total Capital:				**$20,500,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	311,563	bdt	$24,925,046
Direct Capital:			$25,025,046
Engineering, Procurement & Construction Management:			3,003,006
Total Capital:			**$28,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$1,380,892
Water Treatment (Includes Operator)	679,467,005	gal	$271,787
Water Treatment QA	1,036	day	$207,200
Direct Capital:			$1,859,879
Engineering, Procurement & Construction Management:			223,185
Total Capital:			**$2,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	623,126	ton	$1,744,753
Soil Hauling	623,126	ton	$2,920,904
Tipping Fees (non-TSCA)	623,126	ton	$26,794,425
Tipping Fees (TSCA)	0	ton	$0
Direct Capital:			$31,460,082
Engineering, Procurement & Construction Management:			3,775,210
Total Capital:			**$35,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$90,300,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	498	ac		$7,968,000
Dredging - 12 hour shifts	740	Day	5.692307692	$4,218,000
Dredge Monitoring (Water Quality)	740	Day		$2,220,000
Sediment Removal QA	740	Day		$888,000
Site Restoration	1	Each		$600,000
Direct Capital:				$16,164,000
Engineering, Procurement & Construction Management:				1,939,680
Contractor Overhead/Profit:				2,424,600
Total Capital:				**$20,500,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$752,984
Water Treatment (Includes Operator)	679,467,005	gal	$271,787
Water Treatment QA	1,036	day	$207,200
Direct Capital:			$1,231,971
Engineering, Procurement & Construction Management:			147,837
Total Capital:			**$1,400,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	27,778	sf	$50,000
Shot Rock/Rip Rap	9,200	lf	$7,360,000
Sheetpile Placement	276,000	sf	$5,244,000
Clean Soil Cap	170,000	cy	$1,700,000
Seeding	250,000	sy	$250,000
Mitigation	52	acre	$516,529
Direct Capital:			$15,120,529
Engineering, Procurement & Construction Management:			1,814,463
Total Capital:			**$16,934,992**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs			$15,026,734
Total Project Capital and O&M Cost			**$32,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$58,400,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	498	ac		$7,968,000
Dredging - 2 12-hour shifts	135	Day	0.741758242	$3,834,000
Dredge Monitoring (Water Quality)	135	Day		$810,000
Sediment Removal QA	135	Day		$324,000
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$1,350,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$23,709,400
Engineering, Procurement & Construction Management:				2,845,128
Contractor Overhead/Profit:				3,556,410
Total Capital:				**$30,100,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	579,873,337	gal	$231,949
Water Treatment QA	377	day	$75,400
Piping	95,000	ft	$6,365,000
Direct Capital:			$9,233,615
Engineering, Procurement & Construction Management:			1,108,034
Total Capital:			**$10,300,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	1,038,544	ton	$24,925,046
Soil Loading	1,038,544	ton	$2,907,922
Soil Hauling	1,038,544	ton	$1,217,043
Direct Capital:			$29,050,012
Engineering, Procurement & Construction Management:			$3,486,001
Total Capital:			**$32,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$99,500,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge and Off-site Disposal

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	701,551	tons		$4,209,304
Sand Placement	501,108	cy		$3,006,646
Cobble Purchase and Placement	300,665	cy		$9,019,938
Cap Placement QA	1	LS		$100,000
Direct Capital:				$16,535,888
Engineering, Procurement & Construction Management:				1,984,307
Total Capital:				**$18,520,194**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$370,404	$5,573,207
Total Present Worth, Longer Term O&M Costs				$11,591,726
Total Project Capital and O&M Cost				**$30,100,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	1	Each	$100,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	498	ac	$7,968,000
Dredging - 12 hour shifts	271	Day	$1,544,700
Dredge Monitoring (Water Quality)	271	Day	$813,000
Sediment Removal QA	271	Day	$325,200
Site Restoration	1	Each	$600,000
Direct Capital:			$11,520,900
Engineering, Procurement & Construction Management:			1,382,508
Contractor Overhead/Profit:			1,728,135
Total Capital:			**$14,600,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672

Direct Capital:	$2,784,842
Engineering, Procurement & Construction Management:	334,181
Total Capital:	**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	389	gpm	$684,675
Water Treatment (Includes Operator)	211,864,949	gal	$84,746
Water Treatment QA	379	Day	$75,800

Direct Capital:	$845,221
Engineering, Procurement & Construction Management:	101,427
Total Capital:	**$900,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

SEDIMENT DISPOSAL (OFF-SITE)

Capital Items	Quantity	Units	Cost
Solidification	379,447	ton	$9,486,175
Lime Purchase	37,945	ton	$2,276,700
Soil Loading	379,447	ton	$1,062,452
Soil Hauling	379,447	ton	$1,778,658
Tipping Fees (non-TSCA)	379,447	ton	$16,316,221

Direct Capital:	$30,920,205
Engineering, Procurement & Construction Management:	3,710,425
Total Capital:	**$34,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**
TOTAL COST	**$87,800,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE
Action Level - 1,000 ppb

Material Handling Assumptions:							
Volume > 1000 ppb	586,788	cy	328	ac	447,930	m3	Acres corresponds to dredge footprint area
Volume > 125 ppb	1,483,156	cy			1,132,180	m3	
Volume > 250 ppb	1,171,585	cy			894,340	m3	
Volume > 500 ppb	776,791	cy			592,970	m3	
Volume > 5000 ppb	186,348	cy			142,250	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.47						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	37.1%	w/w	19.3%	v/v	1.08	tons per cy	
Slurry Density (20% in situ)	9.0%	w/w	3.9%	v/v	0.89	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	14.8%	v/v	1.03	tons per cy	Montgomery Watson
Dewatered Density (CDF or landfill)	50%	w/w	28.8%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.7%	w/w	60.0%	v/v	1.33	tons per cy	
HTTD Treatment Capacity	2,198,917	cy			1,650,000	tons	
Cap Volume	416,370	cy			317,840	m3	
Vitrification Treatment Capacity	8,028,121	cy	in situ		6440000.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
<u>Dredging</u>							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Hydraulic - 2 12-inch Cutterheads							
Site Preparation	$803,400	LS					Ogden Beeman
Mobilization - Equipment	$1,135,000	LS					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift					Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift					Ogden Beeman
Winter Over Equipment	$285,000	per year					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					
Length of Piping	95,000	ft			18	mi	Distance to Town of Holland (map provded by Fred Swed) 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft					Ogden Beeman
Number of Road Crossings	4	each					pj, review map
Cost per Road Crossing	$50,000	per crossing					pj, review map
Number of Booster Pumps	4	each					Ogden Beeman
Booster Pump Cost	$2,500	per day					Ogden Beeman
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Capital Costs	$36,000,000	LS					Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year					Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	5,945,840	sf	552,400			m2	
Sand Cap Depth	1.7	feet					
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF	Arrowhead		Menasha				
Land Lease or Purchase	$1.8	per sf	$1.8				Ole
Length	8,000	lf	9,200				Baird
Capping Volume	190,000	cy	170,000				Baird
Seeding Area	280,000	sy	250,000				Baird
Sheetpile Wall Length	8,000	lf	9,200				Baird
Sheetpile Depth	30	ft	30				based on bathymetry
Sheetpile Cost	$19	per sf	$19				pj
Shot Rock Berm	$650	per lf	$550				Baird
Rip Rap	$215	per lf	$250				Baird
Place Treated Material	$2	per cy	$2				pj
Clean Soil Cap	$10	per cy	$10				Baird
Seeding	$1	per sy	$1				Baird
Mitigation	$10,000	per acre					Tim
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					Anne LTM
Long-term O&M	2%	of capital					pj
Solidification							
Percent Lime	10.0%	(w/w)					Montgomery Watson
Lime	$60	per ton	Mixing		$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)							
Land Lease or Purchase	$1.80	per sf					Ole
Area (1050 cy dredge rate)	636,049	sf					2 days slurry + 13 wk solids * 2 cell
Perimeter (1050 cy dredge rate)	3,190	lf					assume square
Area (2885 cy dredge rate)	5,010,182	sf					2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter (2885 cy dredge rate)	8,953	lf					assume square
Depth of Material in Dewatering Cell	8	feet					based on size at Arrowhead Park
Cell Retention Time	24	hours					Not Used
Cell Depth	10	feet					
Mobilization	$20,000	LS					pj
Clear and Grub	$2,000	per acre					pj
Berm Volume	10.4	cy per lf					2:1 slope, 8-foot top
Berm Construction	$6	per cy					pj
Rough Grading	$0.25	per sf					pj
Asphalt Liner	$1.50	per sf					pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS					pj
Regrade Berm Soils	$6	per cy					pj
Seed/Sod	$1	per sy					Baird
Dewatering - Mechanical							
Mobilization	$100,000						pj
Holding Pond-Centrifuge	$80	per bone dry ton					Global Dewatering
Water Treatment							
Flow Rate (1 10-inch Dredge; settling pond)	389	gpm					assume operate 24/7
Unit, Purchase (1 10-inch Dredge; settling pond)	$684,675	LS					pj
Flow Rate (1 10-inch Dredge; CDF)	456	gpm					assume operate 24/7
Unit, Purchase (1 10-inch Dredge; CDF)	$752,984	LS					pj
Flow Rate (2 12-inch Dredges)	3,505	gpm					assume operate 24/7
Unit, Purchase (2 12-inch Dredges)	$2,561,265	LS					pj
Flow Rate (2-12-in Dredges; settling pond)	2,991	gpm					assume operate 24/7
Flow Rate (mechanical dewatering)	1,252	gpm					
Unit, Purchase (mechanical dewatering)	$1,380,892	LS					
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet					Distance from town of Holland to river per map provided by Fred Swed
Disposal							
Off-Site Disposal (Existing NR 500 Commercial)							
Load Soil for Hauling	$2.80	per ton					pj
Round-trip Hauling	2	hours					pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours					pj
Tipping Fee (non-TSCA)	$43	per ton					St. Paul
Tipping Fee (TSCA)	$55	per ton					St. Paul
Truck Rate	$75	per hour					pj
Truck Load	32	tons					pj
Conveyer Facility Construction	1,000,000	LS					pj
Dedicated NR 500 Monofill							
Landfill Construction	$2,220,280						
Landfill Area	140	acres					
Local Siting Fee	$5	per cy					
Closure Cap	$100,000	per acre					
Operating Cost	$500,000	per year					
Post-closure Monitoring	$30,000	per year					
Institutional Controls							
Public Education Program	$100,000						pj
O&M Plans	$20,000						pj
Deed Restrictions	$5,000						pj
Annual Costs							
Public Education Program	$30,000						pj
Maintaining O&M Plans	$800						pj
Reporting	$20,000						pj
Long-term Monitoring	$600,000						Anne LTM
Long-term Monitoring (no action)	$300,000						Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	328	ac		$5,248,000
Dredging - 12 hour shifts	559	Day	4.3	$3,186,300
Dredge Monitoring (Water Quality)	559	Day		$1,677,000
Sediment Removal QA	559	Day		$670,800
Site Restoration	1	Each		$600,000
Direct Capital:				$11,652,100
Engineering, Procurement & Construction Management:				1,398,252
Contractor Overhead/Profit:				1,747,815
Total Capital:				**$14,800,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	389	gpm		$684,675
Water Treatment (Includes Operator)	438,036,771	gal		$175,215
Water Treatment QA	783	day		$156,600
Direct Capital:				$1,016,490
Engineering, Procurement & Construction Management:				121,979
Total Capital:				**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	784,517	ton		$19,612,925
Lime Purchase	78,452	ton		$4,707,120
Soil Loading	784,517	ton		$2,196,648
Soil Hauling	784,517	ton		$3,677,423
Tipping Fees (non-TSCA)	784,517	ton		$33,734,231
Direct Capital:				$63,928,347
Engineering, Procurement & Construction Management:				7,671,402
Total Capital:				**$71,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$95,100,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	328	ac		$5,248,000
Dredging - 2 12-hour shifts	102	Day	0.56043956	$2,896,800
Dredge Monitoring (Water Quality)	102	Day		$612,000
Sediment Removal QA	102	Day		$244,800
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$1,020,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$19,445,000
Engineering, Procurement & Construction Management:				2,333,400
Contractor Overhead/Profit:				2,916,750
Total Capital:				**$24,700,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,505	gpm		$2,561,265
Water Treatment (Includes Operator)	513,269,905	gal		$205,308
Water Treatment QA	102	day		$40,800
Piping	20,000	ft		$1,340,000
Direct Capital:				$4,147,373
Engineering, Procurement & Construction Management:				497,685
Total Capital:				**$4,600,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$2,220,280
Local Siting Fee	392,498	cy		$1,962,490
Closure	12	acres		$1,216,419
Direct Capital:				$5,399,189
Engineering, Procurement & Construction Management:				647,903
Total Capital:				**$6,000,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs			$4,131,432
Total Project Capital and O&M Cost			**$10,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$43,900,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	328	ac		$5,248,000
Dredging - 2 12-hour shifts	102	Day	0.56043956	$2,896,800
Dredge Monitoring (Water Quality)	102	Day		$612,000
Sediment Removal QA	102	Day		$244,800
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$1,020,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$19,445,000
Engineering, Procurement & Construction Management:				2,333,400
Contractor Overhead/Profit:				2,916,750
Total Capital:				**$24,700,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	438,036,771	gal	$175,215
Water Treatment QA	285	day	$57,000
Piping	20,000	ft	$1,340,000
Direct Capital:			$4,133,480
Engineering, Procurement & Construction Management:			496,018
Total Capital:			**$4,600,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Solidification	784,517	ton	$19,612,925
Lime Purchase	78,452	ton	$4,707,120
Sediment Loading	784,517	ton	$2,196,647
Sediment Hauling	784,517	ton	$3,677,422
Landfill Construction	1	LS	$2,220,280
Local Siting Fee	392,498	cy	$1,962,490
Closure	12	acres	$1,216,419
Direct Capital:			$35,593,303
Engineering, Procurement & Construction Management:			4,271,196
Total Capital:			**$39,900,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs			$4,131,432
Total Project Capital and O&M Cost			**$44,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$99,900,000**

ALTERNATIVE C3: Dredge with Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	328	ac		$5,248,000
Dredging - 12 hour shifts	559	Day	4.3	$3,186,300
Dredge Monitoring (Water Quality)	559	Day		$1,677,000
Sediment Removal QA	559	Day		$670,800
Site Restoration	1	Each		$600,000
Direct Capital:				$11,652,100
Engineering, Procurement & Construction Management:				1,398,252
Contractor Overhead/Profit:				1,747,815
Total Capital:				**$14,800,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	235,355	bdt	$18,828,399
Direct Capital:			$18,928,399
Engineering, Procurement & Construction Management:			2,271,408
Total Capital:			**$21,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$1,380,892
Water Treatment (Includes Operator)	513,269,905	gal	$205,308
Water Treatment QA	783	day	$156,600
Direct Capital:			$1,742,800
Engineering, Procurement & Construction Management:			209,136
Total Capital:			**$2,000,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	470,710	ton	$1,317,988
Soil Hauling	470,710	ton	$2,206,453
Tipping Fees (non-TSCA)	470,710	ton	$20,240,529
Tipping Fees (TSCA)	0	ton	$0
Direct Capital:			$23,764,970
Engineering, Procurement & Construction Management:			2,851,796
Total Capital:			**$26,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$69,100,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	328	ac		$5,248,000
Dredging - 12 hour shifts	559	Day	4.3	$3,186,300
Dredge Monitoring (Water Quality)	559	Day		$1,677,000
Sediment Removal QA	559	Day		$670,800
Site Restoration	1	Each		$600,000
Direct Capital:				$11,652,100
Engineering, Procurement & Construction Management:				1,398,252
Contractor Overhead/Profit:				1,747,815
Total Capital:				**$14,800,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$752,984
Water Treatment (Includes Operator)	513,269,905	gal	$205,308
Water Treatment QA	783	day	$156,600
Direct Capital:			$1,114,892
Engineering, Procurement & Construction Management:			133,787
Total Capital:			**$1,200,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	27,778	sf	$50,000
Shot Rock/Rip Rap	9,200	lf	$7,360,000
Sheetpile Placement	276,000	sf	$5,244,000
Clean Soil Cap	170,000	cy	$1,700,000
Seeding	250,000	sy	$250,000
Mitigation	52	acre	$516,529
Direct Capital:			$15,120,529
Engineering, Procurement & Construction Management:			1,814,463
Total Capital:			**$16,934,992**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs			$15,026,734
Total Project Capital and O&M Cost			**$32,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$52,500,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	328	ac		$5,248,000
Dredging - 2 12-hour shifts	102	Day	0.56043956	$2,896,800
Dredge Monitoring (Water Quality)	102	Day		$612,000
Sediment Removal QA	102	Day		$244,800
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$1,020,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$19,445,000
Engineering, Procurement & Construction Management:				2,333,400
Contractor Overhead/Profit:				2,916,750
Total Capital:				**$24,700,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	438,036,771	gal	$175,215
Water Treatment QA	285	day	$57,000
Piping	95,000	ft	$6,365,000
Direct Capital:			$9,158,480
Engineering, Procurement & Construction Management:			1,099,018
Total Capital:			**$10,300,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	784,517	ton	$18,828,399
Soil Loading	784,517	ton	$2,196,647
Soil Hauling	784,517	ton	$919,355
Direct Capital:			$21,944,401
Engineering, Procurement & Construction Management:			$2,633,328
Total Capital:			**$24,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$86,200,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge and Off-site Disposal

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	513,838	tons		$3,083,028
Sand Placement	367,027	cy		$2,202,163
Cobble Purchase and Placement	220,216	cy		$6,606,488
Cap Placement QA	1	LS		$100,000
Direct Capital:				$12,191,679
Engineering, Procurement & Construction Management:				1,463,001
Total Capital:				**$13,654,680**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$273,094	$4,109,048
Total Present Worth, Longer Term O&M Costs				$10,127,566
Total Project Capital and O&M Cost				**$23,800,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	1	Each	$100,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	328	ac	$5,248,000
Dredging - 12 hour shifts	163	Day	$929,100
Dredge Monitoring (Water Quality)	163	Day	$489,000
Sediment Removal QA	163	Day	$195,600
Site Restoration	1	Each	$600,000
Direct Capital:			$7,731,700
Engineering, Procurement & Construction Management:			927,804
Contractor Overhead/Profit:			1,159,755
Total Capital:			**$9,800,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	389	gpm	$684,675
Water Treatment (Includes Operator)	127,216,760	gal	$50,887
Water Treatment QA	228	Day	$45,600
Direct Capital:			$781,162
Engineering, Procurement & Construction Management:			93,739
Total Capital:			**$900,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

SEDIMENT DISPOSAL (OFF-SITE)

Capital Items	Quantity	Units	Cost
Solidification	227,844	ton	$5,696,100
Lime Purchase	22,785	ton	$1,367,100
Soil Loading	227,844	ton	$637,963
Soil Hauling	227,844	ton	$1,068,019
Tipping Fees (non-TSCA)	227,844	ton	$9,797,292
Direct Capital:			$18,566,474
Engineering, Procurement & Construction Management:			2,227,977
Total Capital:			**$20,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$62,900,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
LITTLE RAPIDS TO DE PERE
Action Level - 5,000 ppb

Material Handling Assumptions:							
Volume > 5000 ppb	186,348	cy	173	ac	142,250	m3	Acres corresponds to dredge footprint area
Volume > 125 ppb	1,483,156	cy			1,132,180	m3	
Volume > 250 ppb	1,171,585	cy			894,340	m3	
Volume > 500 ppb	776,791	cy			592,970	m3	
Volume > 1000 ppb	586,788	cy			447,930	m3	
Volume > 50,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.47						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	37.1%	w/w	19.3%	v/v	1.08	tons per cy	
Slurry Density (20% in situ)	9.0%	w/w	3.9%	v/v	0.89	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	14.8%	v/v	1.03	tons per cy	Montgomery Watson
Dewatered Density (CDF or landfill)	50%	w/w	28.8%	v/v	1.20	tons per cy	Foth & VanDyke
Treated Density	93.7%	w/w	60.0%	v/v	1.33	tons per cy	
HTTD Treatment Capacity	2,198,917	cy			1,650,000	tons	
Cap Volume	136,188	cy			103,960	m3	
Vitrification Treatment Capacity	8,028,121	cy	in situ		6440000.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Debris Sweep	$16,000	per acre					Ogden Beeman
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Hydraulic - 10-inch Cutterhead							
Site Preparation	$100,000	per dredge launch site					pj
Mobilization - Equipment	$135,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (10 hours)	$5,700	per shift					Ogden Beeman
Dredge Rate	1050	cy in situ per 10 hour shift					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					pj
Hydraulic - 2 12-inch Cutterheads							
Site Preparation	$803,400	LS					Ogden Beeman
Mobilization - Equipment	$1,135,000	LS					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift					Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift					Ogden Beeman
Winter Over Equipment	$285,000	per year					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					
Length of Piping	95,000	ft	18	mi			Distance to Town of Holland (map provded by Fred Swed) 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft					Ogden Beeman
Number of Road Crossings	4	each					pj, review map
Cost per Road Crossing	$50,000	per crossing					pj, review map
Number of Booster Pumps	4	each					Ogden Beeman
Booster Pump Cost	$2,500	per day					Ogden Beeman
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Capital Costs	$36,000,000	LS					Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year					Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	2,943,858	sf	273,500			m2	
Sand Cap Depth	1.7	feet					
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF	Arrowhead		Menasha			
Land Lease or Purchase	$1.8	per sf	$1.8			Ole
Length	8,000	lf	9,200			Baird
Capping Volume	190,000	cy	170,000			Baird
Seeding Area	280,000	sy	250,000			Baird
Sheetpile Wall Length	8,000	lf	9,200			Baird
Sheetpile Depth	30	ft	30			based on bathymetry
Sheetpile Cost	$19	per sf	$19			pj
Shot Rock Berm	$650	per lf	$550			Baird
Rip Rap	$215	per lf	$250			Baird
Place Treated Material	$2	per cy	$2			pj
Clean Soil Cap	$10	per cy	$10			Baird
Seeding	$1	per sy	$1			Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area (1050 cy dredge rate)	636,049	sf				2 days slurry + 13 wk solids * 2 cell
Perimeter (1050 cy dredge rate)	3,190	lf				assume square
Area (2885 cy dredge rate)	5,010,182	sf				2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter (2885 cy dredge rate)	8,953	lf				assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				pj
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Asphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Water Treatment						
Flow Rate (1 10-inch Dredge; settling pond)	389	gpm				assume operate 24/7
Unit, Purchase (1 10-inch Dredge; settling pond)	$684,675	LS				pj
Flow Rate (1 10-inch Dredge; CDF)	456	gpm				assume operate 24/7
Unit, Purchase (1 10-inch Dredge; CDF)	$752,984	LS				pj
Flow Rate (2 12-inch Dredges)	3,505	gpm				assume operate 24/7
Unit, Purchase (2 12-inch Dredges)	$2,561,265	LS				pj
Flow Rate (2-12-in Dredges; settling pond)	2,991	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	1,252	gpm				
Unit, Purchase (mechanical dewatering)	$1,380,892	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Off-Site Disposal (Existing NR 500 Commercial)						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer Facility Construction	1,000,000	LS				pj
Dedicated NR 500 Monofill						
Landfill Construction	$705,099					
Landfill Area	140	acres				
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				
Institutional Controls						
Public Education Program	$100,000					pj
O&M Plans	$20,000					pj
Deed Restrictions	$5,000					pj
Annual Costs						
Public Education Program	$30,000					pj
Maintaining O&M Plans	$800					pj
Reporting	$20,000					pj
Long-term Monitoring	$600,000					Anne LTM
Long-term Monitoring (no action)	$300,000					Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	173	ac		$2,768,000
Dredging - 12 hour shifts	178	Day	1.369230769	$1,014,600
Dredge Monitoring (Water Quality)	178	Day		$534,000
Sediment Removal QA	178	Day		$213,600
Site Restoration	1	Each		$600,000
Direct Capital:				$5,400,200
Engineering, Procurement & Construction Management:				648,024
Contractor Overhead/Profit:				810,030
Total Capital:				**$6,900,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672
Direct Capital:			$2,784,842
Engineering, Procurement & Construction Management:			334,181
Total Capital:			**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	389	gpm		$684,675
Water Treatment (Includes Operator)	139,108,188	gal		$55,643
Water Treatment QA	249	day		$49,800
Direct Capital:				$790,119
Engineering, Procurement & Construction Management:				94,814
Total Capital:				**$900,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	249,141	ton		$6,228,525
Lime Purchase	24,915	ton		$1,494,900
Soil Loading	249,141	ton		$697,595
Soil Hauling	249,141	ton		$1,167,848
Tipping Fees (non-TSCA)	249,141	ton		$10,713,063
Direct Capital:				$20,301,931
Engineering, Procurement & Construction Management:				2,436,232
Total Capital:				**$22,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$38,100,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	173	ac		$2,768,000
Dredging - 2 12-hour shifts	33	Day	0.181318681	$937,200
Dredge Monitoring (Water Quality)	33	Day		$198,000
Sediment Removal QA	33	Day		$79,200
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$330,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$13,735,800
Engineering, Procurement & Construction Management:				1,648,296
Contractor Overhead/Profit:				2,060,370
Total Capital:				**$17,400,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,505	gpm		$2,561,265
Water Treatment (Includes Operator)	163,000,121	gal		$65,200
Water Treatment QA	33	day		$13,200
Piping	20,000	ft		$1,340,000
Direct Capital:				$3,979,666
Engineering, Procurement & Construction Management:				477,560
Total Capital:				**$4,500,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$705,099
Local Siting Fee	124,646	cy		$623,230
Closure	4	acres		$386,300
Direct Capital:				$1,714,628
Engineering, Procurement & Construction Management:				205,755
Total Capital:				**$1,900,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs			$4,131,432
Total Project Capital and O&M Cost			**$6,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$32,400,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facility

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	173	ac		$2,768,000
Dredging - 2 12-hour shifts	33	Day	0.181318681	$937,200
Dredge Monitoring (Water Quality)	33	Day		$198,000
Sediment Removal QA	33	Day		$79,200
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$330,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$13,735,800
Engineering, Procurement & Construction Management:				1,648,296
Contractor Overhead/Profit:				2,060,370
Total Capital:				**$17,400,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	139,108,188	gal	$55,643
Water Treatment QA	91	day	$18,200
Piping	20,000	ft	$1,340,000
Direct Capital:			$3,975,109
Engineering, Procurement & Construction Management:			477,013
Total Capital:			**$4,500,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Solidification	249,141	ton	$6,228,525
Lime Purchase	24,915	ton	$1,494,900
Sediment Loading	249,140	ton	$697,593
Sediment Hauling	249,140	ton	$1,167,846
Landfill Construction	1	LS	$705,099
Local Siting Fee	124,646	cy	$623,230
Closure	4	acres	$386,300
Direct Capital:			$11,303,493
Engineering, Procurement & Construction Management:			1,356,419
Total Capital:			**$12,700,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$451,389
Total Present Worth, Longer Term O&M Costs			$4,131,432
Total Project Capital and O&M Cost			**$16,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST **$65,300,000**

ALTERNATIVE C3: Dredge with Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	173	ac		$2,768,000
Dredging - 12 hour shifts	178	Day	1.369230769	$1,014,600
Dredge Monitoring (Water Quality)	178	Day		$534,000
Sediment Removal QA	178	Day		$213,600
Site Restoration	1	Each		$600,000
Direct Capital:				$5,400,200
Engineering, Procurement & Construction Management:				648,024
Contractor Overhead/Profit:				810,030
Total Capital:				**$6,900,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	74,742	bdt	$5,979,371
Direct Capital:			$6,079,371
Engineering, Procurement & Construction Management:			729,525
Total Capital:			**$6,800,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$1,380,892
Water Treatment (Includes Operator)	163,000,121	gal	$65,200
Water Treatment QA	249	day	$49,800
Direct Capital:			$1,495,892
Engineering, Procurement & Construction Management:			179,507
Total Capital:			**$1,700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	149,484	ton	$418,556
Soil Hauling	149,484	ton	$700,708
Tipping Fees (non-TSCA)	149,484	ton	$6,427,824
Tipping Fees (TSCA)	0	ton	$0
Direct Capital:			$7,547,088
Engineering, Procurement & Construction Management:			905,651
Total Capital:			**$8,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$28,400,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$100,000
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Debris Sweep	173	ac		$2,768,000
Dredging - 12 hour shifts	178	Day	1.369230769	$1,014,600
Dredge Monitoring (Water Quality)	178	Day		$534,000
Sediment Removal QA	178	Day		$213,600
Site Restoration	1	Each		$600,000
Direct Capital:				$5,400,200
Engineering, Procurement & Construction Management:				648,024
Contractor Overhead/Profit:				810,030
Total Capital:				**$6,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	456	gpm	$752,984
Water Treatment (Includes Operator)	163,000,121	gal	$65,200
Water Treatment QA	249	day	$49,800
Direct Capital:			$867,984
Engineering, Procurement & Construction Management:			104,158
Total Capital:			**$1,000,000**

CDF CONSTRUCTION - MENASHA

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	27,778	sf	$50,000
Shot Rock/Rip Rap	9,200	lf	$7,360,000
Sheetpile Placement	276,000	sf	$5,244,000
Clean Soil Cap	170,000	cy	$1,700,000
Seeding	250,000	sy	$250,000
Mitigation	52	acre	$516,529
Direct Capital:			$15,120,529
Engineering, Procurement & Construction Management:			1,814,463
Total Capital:			**$16,934,992**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	338,700	$5,096,178
Total Present Worth, Longer Term O&M Costs			$15,026,734
Total Project Capital and O&M Cost			**$32,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

TOTAL COST	**$44,400,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (12-INCH CUTTERHEAD)

Capital Items	Quantity	Units		Cost
Site Preparation	1	Each		$803,400
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	173	ac		$2,768,000
Dredging - 2 12-hour shifts	33	Day	0.181318681	$937,200
Dredge Monitoring (Water Quality)	33	Day		$198,000
Sediment Removal QA	33	Day		$79,200
Piping	95,000	ft		$6,365,000
Road Crossings	4	Each		$200,000
Booster Pumps	4	Each		$330,000
Winter Over All Equipment	1	year		$285,000
Site Restoration	1	Each		$600,000
Direct Capital:				$13,735,800
Engineering, Procurement & Construction Management:				1,648,296
Contractor Overhead/Profit:				2,060,370
Total Capital:				**$17,400,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	5,010,182	sf	$9,018,328
Mobilization	1	LS	$20,000
Clear and Grub	5,010,182	sf	$230,036
Berm Construction	92,850	cy	$557,099
Rough Grading	5,010,182	sf	$1,252,545
Liner Placement	5,010,182	sf	$7,515,273
Demob/Disposal	1	LS	$10,000
Regrade	92,850	cy	$557,099
Seed/Sod	556,687	sy	$556,687
Direct Capital:			$19,717,067
Engineering, Procurement & Construction Management:			2,366,048
Total Capital:			**$22,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	2,991	gpm	$2,561,265
Water Treatment (Includes Operator)	139,108,188	gal	$55,643
Water Treatment QA	91	day	$18,200
Piping	95,000	ft	$6,365,000
Direct Capital:			$9,000,109
Engineering, Procurement & Construction Management:			1,080,013
Total Capital:			**$10,100,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	249,140	ton	$5,979,371
Soil Loading	249,140	ton	$697,593
Soil Hauling	249,140	ton	$291,961
Direct Capital:			$6,968,926
Engineering, Procurement & Construction Management:			$836,271
Total Capital:			**$7,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$61,900,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible, Dredge and Off-site Disposal

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	254,407	tons		$1,526,445
Sand Placement	181,720	cy		$1,090,318
Cobble Purchase and Placement	109,032	cy		$3,270,953
Cap Placement QA	1	LS		$100,000
Direct Capital:				$6,187,716
Engineering, Procurement & Construction Management:				742,526
Total Capital:				**$6,930,242**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$138,605	$2,085,489
Total Present Worth, Longer Term O&M Costs				$8,104,008
Total Project Capital and O&M Cost				**$15,000,000**

SEDIMENT REMOVAL (10-INCH CUTTERHEAD)

Capital Items	Quantity	Units	Cost
Site Preparation	1	Each	$100,000
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Debris Sweep	173	ac	$2,768,000
Dredging - 12 hour shifts	48	Day	$273,600
Dredge Monitoring (Water Quality)	48	Day	$144,000
Sediment Removal QA	48	Day	$57,600
Site Restoration	1	Each	$600,000
Direct Capital:			$4,113,200
Engineering, Procurement & Construction Management:			493,584
Contractor Overhead/Profit:			616,980
Total Capital:			**$5,200,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	636,049	sf	$1,144,889
Mobilization	1	LS	$20,000
Clear and Grub	636,049	sf	$29,203
Berm Construction	33,083	cy	$198,496
Rough Grading	636,049	sf	$159,012
Liner Placement	636,049	sf	$954,074
Demob/Disposal	1	LS	$10,000
Regrade	33,083	cy	$198,496
Seed/Sod	70,672	sy	$70,672

Direct Capital:	$2,784,842
Engineering, Procurement & Construction Management:	334,181
Total Capital:	**$3,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	389	gpm	$684,675
Water Treatment (Includes Operator)	37,444,306	gal	$14,978
Water Treatment QA	67	Day	$13,400

Direct Capital:	$713,053
Engineering, Procurement & Construction Management:	85,566
Total Capital:	**$800,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

SEDIMENT DISPOSAL (OFF-SITE)

Capital Items	Quantity	Units	Cost
Solidification	67,063	ton	$1,676,575
Lime Purchase	6,707	ton	$402,420
Soil Loading	67,063	ton	$187,776
Soil Hauling	67,063	ton	$314,358
Tipping Fees (non-TSCA)	67,063	ton	$2,883,709

Direct Capital:	$5,464,838
Engineering, Procurement & Construction Management:	655,781
Total Capital:	**$6,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000

Direct Capital:	$5,000
Engineering, Procurement & Construction Management:	600
Total Capital:	**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889

Total Present Worth, Longer Term O&M Costs	$4,513,889
Total Project Capital and O&M Cost	**$4,500,000**
TOTAL COST	**$34,700,000**

Table 7-10 Cost Summary for Remedial Alternatives - De Pere to Green Bay

125 ppb

Alternative	Dredge Volume (cy)	TSCA Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Bayport Closure[1]	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	---	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	---	$9,900,000	$1,980,000	$11,880,000
C1	6,868,500	240,778	---	$100,500,000	---	---	$700,000	---	---	$659,200,000	$4,500,000	$4,200,000	$769,100,000	$153,820,000	$922,920,000
C2A	6,868,500	240,778	$109,400,000	---	---	---	$7,700,000	---	---	$70,200,000	$4,500,000	$4,200,000	$196,000,000	$39,200,000	$235,200,000
C2B	6,868,500	240,778	$109,400,000	---	---	$19,900,000	$7,300,000	---	---	$419,200,000	$4,500,000	$4,200,000	$564,500,000	$112,900,000	$677,400,000
C3	6,868,500	240,778	$85,400,000	---	---	$217,700,000	$6,400,000	---	---	$277,000,000	$4,500,000	$4,200,000	$595,200,000	$119,040,000	$714,240,000
D	6,868,500	240,778	---	$100,500,000	---	---	$1,200,000	---	$39,200,000	$462,200,000	$4,500,000	$4,200,000	$611,800,000	$122,360,000	$734,160,000
E	6,868,500	240,778	$109,400,000	---	---	$19,900,000	$12,900,000	$253,600,000	---	---	$4,500,000	$4,200,000	$404,500,000	$80,900,000	$485,400,000
F	4,680,565	240,778	---	$69,500,000	$67,800,000	---	$1,100,000	---	$39,200,000	$246,300,000	$4,500,000	$4,200,000	$432,600,000	$86,520,000	$519,120,000

250 ppb

Alternative	Dredge Volume (cy)	TSCA Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Bayport Closure[1]	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	---	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	---	$9,900,000	$1,980,000	$11,880,000
C1	6,449,065	240,778	---	$94,600,000	---	---	$700,000	---	---	$619,100,000	$4,500,000	$4,200,000	$723,100,000	$144,620,000	$867,720,000
C2A	6,449,065	240,778	$104,500,000	---	---	---	$7,500,000	---	---	$66,200,000	$4,500,000	$4,200,000	$186,900,000	$37,380,000	$224,280,000
C2B	6,449,065	240,778	$104,500,000	---	---	$19,900,000	$7,100,000	---	---	$393,900,000	$4,500,000	$4,200,000	$534,100,000	$106,820,000	$640,920,000
C3	6,449,065	240,778	$81,500,000	---	---	$204,400,000	$6,200,000	---	---	$260,200,000	$4,500,000	$4,200,000	$561,000,000	$112,200,000	$673,200,000
D	6,449,065	240,778	---	$94,600,000	---	---	$1,100,000	---	$39,200,000	$422,800,000	$4,500,000	$4,200,000	$566,400,000	$113,280,000	$679,680,000
E	6,449,065	240,778	$104,500,000	---	---	$19,900,000	$12,800,000	$238,100,000	---	---	$4,500,000	$4,200,000	$384,000,000	$76,800,000	$460,800,000
F	4,433,446	240,778	---	$66,000,000	$66,200,000	---	$1,100,000	---	$39,200,000	$222,700,000	$4,500,000	$4,200,000	$403,900,000	$80,780,000	$484,680,000

500 ppb

Alternative	Dredge Volume (cy)	TSCA Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Bayport Closure[1]	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	---	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	---	$9,900,000	$1,980,000	$11,880,000
C1	6,169,458	240,778	---	$90,600,000	---	---	$600,000	---	---	$592,400,000	$4,500,000	$4,200,000	$692,300,000	$138,460,000	$830,760,000
C2A	6,169,458	240,778	$100,900,000	---	---	---	$7,300,000	---	---	$63,500,000	$4,500,000	$4,200,000	$180,400,000	$36,080,000	$216,480,000
C2B	6,169,458	240,778	$100,900,000	---	---	$19,900,000	$7,000,000	---	---	$377,000,000	$4,500,000	$4,200,000	$513,500,000	$102,700,000	$616,200,000
C3	6,169,458	240,778	$78,500,000	---	---	$195,600,000	$6,000,000	---	---	$249,000,000	$4,500,000	$4,200,000	$537,800,000	$107,560,000	$645,360,000
D	6,169,458	240,778	---	$90,600,000	---	---	$1,100,000	---	$39,200,000	$396,600,000	$4,500,000	$4,200,000	$536,200,000	$107,240,000	$643,440,000
E	6,169,458	240,778	$100,900,000	---	---	$19,900,000	$12,700,000	$227,800,000	---	---	$4,500,000	$4,200,000	$370,000,000	$74,000,000	$444,000,000
F	4,242,710	240,778	---	$63,300,000	$65,100,000	---	$1,100,000	---	$39,200,000	$204,500,000	$4,500,000	$4,200,000	$381,900,000	$76,380,000	$458,280,000

1000 ppb

Alternative	Dredge Volume (cy)	TSCA Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Bayport Closure[1]	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	---	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	---	$9,900,000	$1,980,000	$11,880,000
C1	5,879,529	240,778	---	$86,500,000	---	---	$600,000	---	---	$564,800,000	$4,500,000	$4,200,000	$660,600,000	$132,120,000	$792,720,000
C2A	5,879,529	240,778	$96,900,000	---	---	---	$7,200,000	---	---	$60,700,000	$4,500,000	$4,200,000	$173,500,000	$34,700,000	$208,200,000
C2B	5,879,529	240,778	$96,900,000	---	---	$19,900,000	$6,900,000	---	---	$359,400,000	$4,500,000	$4,200,000	$491,800,000	$98,360,000	$590,160,000
C3	5,879,529	240,778	$75,100,000	---	---	$186,400,000	$5,900,000	---	---	$237,400,000	$4,500,000	$4,200,000	$513,500,000	$102,700,000	$616,200,000
D	5,879,529	240,778	---	$86,500,000	---	---	$1,100,000	---	$39,200,000	$369,600,000	$4,500,000	$4,200,000	$505,100,000	$101,020,000	$606,120,000
E	5,879,529	240,778	$96,900,000	---	---	$19,900,000	$12,500,000	$217,100,000	---	---	$4,500,000	$4,200,000	$355,100,000	$71,020,000	$426,120,000
F	4,046,276	240,778	---	$60,500,000	$61,900,000	---	$1,100,000	---	$39,200,000	$185,700,000	$4,500,000	$4,200,000	$357,100,000	$71,420,000	$428,520,000

5000 ppb

Alternative	Dredge Volume (cy)	TSCA Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Capping	Dewatering	Water Treatment	Thermal Treatment	CDF Construction	Off-site Disposal	Institutional Controls	Bayport Closure[1]	Subtotal	20% Contingency	TOTAL
A	0	0	---	---	---	---	---	---	---	---	$4,500,000	---	$4,500,000	$900,000	$5,400,000
B	0	0	---	---	---	---	---	---	---	---	$9,900,000	---	$9,900,000	$1,980,000	$11,880,000
C1	4,517,391	240,778	---	$67,200,000	---	---	$500,000	---	---	$434,700,000	$4,500,000	$4,200,000	$511,100,000	$102,220,000	$613,320,000
C2A	4,517,391	240,778	$76,000,000	---	---	---	$6,500,000	---	---	$47,500,000	$4,500,000	$4,200,000	$138,700,000	$27,740,000	$166,440,000
C2B	4,517,391	240,778	$76,000,000	---	---	$19,900,000	$6,300,000	---	---	$277,100,000	$4,500,000	$4,200,000	$388,000,000	$77,600,000	$465,600,000
C3	4,517,391	240,778	$57,200,000	---	---	$143,200,000	$5,200,000	---	---	$182,900,000	$4,500,000	$4,200,000	$397,200,000	$79,440,000	$476,640,000
D	4,517,391	240,778	---	$67,200,000	---	---	$1,000,000	---	$39,200,000	$244,600,000	$4,500,000	$4,200,000	$360,700,000	$72,140,000	$432,840,000
E	4,517,391	240,778	$76,000,000	---	---	$19,900,000	$11,900,000	$166,800,000	---	---	$4,500,000	$4,200,000	$283,300,000	$56,660,000	$339,960,000
F	3,102,041	240,778	---	$47,100,000	$42,900,000	---	$1,000,000	---	$39,200,000	$95,500,000	$4,500,000	$4,200,000	$234,400,000	$46,880,000	$281,280,000

[1]Bayport closure costs are present value costs based on closure 40 years from the present.

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
DE PERE TO GREEN BAY
Action Level - 125 ppb

Material Handling Assumptions:							
Volume > 125 ppb	6,868,500	cy	1130	ac	5,243,130	m3	Acres corresponds to dredge footprint area
Volume > 250 ppb	6,449,065	cy			4,922,950	m3	
Volume > 500 ppb	6,169,458	cy			4,709,510	m3	
Volume > 1,000 ppb	5,879,529	cy			4,488,190	m3	
Volume > 5000 ppb	4,517,391	cy			3,448,390	m3	
Volume > 50,000 ppb	240,778	cy			183,800	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Slurry Density (20% in situ)	8.0%	w/w	3.6%	v/v	0.88	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	15.4%	v/v	1.02	tons per cy	Montgomery Watson
Dewatered Density (Hydraulic Dredging and CDF)	50.0%	w/w	29.8%	v/v	1.18	tons per cy	Foth & VanDyke
Dewatered Density (Mechanical Dredging)	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	2,136,771	cy	in situ		974,801	m3	
HTTD Treatment Capacity	1,577,177	cy	in situ		1,650,000	tons	
Cap Volume	2,187,936	cy			1,670,180	m3	
Vitrification Treatment Capacity	9,106,166	cy	in situ		6440000.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Debris Sweep	$16,000	per acre					Ogden Beeman
Hydraulic - 2 12-inch Cutterheads							
Site Preparation	$803,400	LS					Ogden Beeman
Mobilization - Equipment	$1,135,000	LS					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift					Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift					Ogden Beeman
Winter Over Equipment	$285,000	per year					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					
Length of Piping	95,000	ft			18	mi	Distance to Town of Holland (map provided by Fred Swed). 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft					Ogden Beeman
Number of Road Crossings	12	each					pj, review map
Cost per Road Crossing	$50,000	per crossing					pj, review map
Number of Booster Pumps	4	each					Ogden Beeman
Booster Pump Cost	$2,500	per day					Ogden Beeman
Mechanical - 8 cy bucket							
Dock Construction	$400,000	LS					pj
Mobilization - Equipment	$455,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$17,000	per shift					Ogden Beeman
Dredge Rate	1900	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					pj
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Offload Crane Mobilization	$50,000	LS					pj
Site Restoration	$500,000	LS					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Capital Costs	$36,000,000	LS					Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year					Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton					Unit Cost Study- Minergy

Capping						
Mobilization/Site Prep	$200,000					Ogden Beeman
Area	21,055,849	sf	1,956,200	m2		
Sand Cap Depth	1.7	feet				
Sand Purchase	$6	per ton				Ole
Placement Rate	$6	per cy				Ogden Beeman
Sand Density	1.4	tons per cy				
Armored Cap Depth	1.0	feet				
Cobbles	$30	per cy				Means
Sand Density	1.4	tons per cy				
Cap Placement QA	$100,000	LS				Ogden Beeman
Long-term O&M	2%	of capital				pj
Long-term Monitoring	$400,000	per year				Anne LTM
Nearshore CDF			Bayport			
Land Lease or Purchase	$1.80	per sf				Baird
Length	9,600	lf				Baird
Capping Volume	205,000	cy	2,178,000			Baird
Seeding Area	300,000	sy	2,178,000			Baird
Sheetpile Wall Length	9,600	lf				based on bathymetry
Sheetpile Depth	30	ft				pj
Sheetpile Cost	$19	per sf				Baird
Shot Rock Berm	$500	per lf				Baird
Rip Rap	$210	per lf				pj
Clean Soil Cap	$10	per cy				Baird
Seeding	$1	per sy				Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	4,491,228	sf	103.10			2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter	8,477	lf	2119.251741			assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Water Treatment						
Flow Rate (3 Mechanical Dredges)	57	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges)	$216,590	LS				pj
Flow Rate (3 Mechanical Dredges to CDF)	287	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges to CDF)	$570,498	LS				pj
Flow Rate (2 Hydraulic Dredges)	3,563	gpm				assume operate 24/7
Unit, Purchase (Hydraulic Dredge)	$2,586,470	LS				pj
Flow Rate (2 Hydraulic Dredges; settling pond)	3,110	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	3,563	gpm				
Unit, Purchase (mechanical dewatering)	$2,586,470	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Existing NR 500 Commercial Disposal Facility						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer System Construction	1,000,000	LS				pj
New Landfill Disposal (Dedicated NR 500 Monofill)						
Landfill Construction	$25,988,920					
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				

Institutional Controls		
Public Education Program	$100,000	pj
O&M Plans	$20,000	pj
Deed Restrictions	$5,000	pj
Annual Costs		
Public Education Program	$30,000	pj
Maintaining O&M Plans	$800	pj
Reporting	$20,000	pj
Long-term Monitoring	$600,000	Anne LTM
Long-term Monitoring (no action)	$300,000	Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	3	LS		$1,470,000
Watertight Barges	4	ea		$400,000
Offload Stockpile Area Prep.	1	LS		$75,000
Dredging - 12 hour shifts	3,615	Day	27.80769231	$61,455,000
Dredge Monitoring (Water Quality)	3,615	Day		$10,845,000
Sediment Removal QA	3,615	Day		$4,338,000
Offload Crane Mobilization	1	LS		$50,000
Site Restoration	1	ea		$500,000
Direct Capital:				$79,133,000
Engineering, Procurement & Construction Management:				9,495,960
Contractor Overhead/Profit:				11,869,950
Total Capital:				**$100,500,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	57	gpm		$216,590
Water Treatment (Includes Operator)	138,716,232	gal		$55,486
Water Treatment QA	1,687	day		$337,400
Direct Capital:				$609,476
Engineering, Procurement & Construction Management:				73,137
Total Capital:				**$700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	7,185,641	ton		$179,641,037
Lime Purchase	718,565	ton		$43,113,900
Soil Loading	7,185,641	ton		$20,119,796
Soil Hauling	7,185,641	ton		$33,682,694
Tipping Fees (non-TSCA)	6,933,746	ton		$298,151,076
Tipping Fees (TSCA)	251,896	ton		$13,854,253
Direct Capital:				$588,562,756
Engineering, Procurement & Construction Management:				70,627,531
Total Capital:				**$659,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**

TOTAL COST **$769,100,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1130	acre		$18,080,000
Dredging - 2 12 hour shifts/day	1191	Day	6.543956044	$33,824,400
Dredge Monitoring (Water Quality)	1191	Day		$7,146,000
Sediment Removal QA	1191	Day		$2,858,400
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,910,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$86,155,600
Engineering, Procurement & Construction Management:				10,338,672
Contractor Overhead/Profit:				12,923,340
Total Capital:				**$109,400,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Including Operator)	6,106,807,801	gal	$2,442,723
Water Treatment QA	1,191	Day	$476,400
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,845,593
Engineering, Procurement & Construction Management:			821,471
Total Capital:			**$7,700,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Landfill Construction	1	LS	$25,988,920
Local Siting Fee	4,104,792	cy	$20,523,960
Closure	127	acres	$12,721,463
Direct Capital:			$59,234,343
Engineering, Procurement & Construction Management:			7,108,121
Total Capital:			**$66,300,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs			$3,932,097
Total Project Capital and O&M Cost			**$70,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**
TOTAL COST			**$192,100,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facilities

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1130	acre		$18,080,000
Dredging - 2 12 hour shifts/day	1191	Day	6.543956044	$33,824,400
Dredge Monitoring (Water Quality)	1191	Day		$7,146,000
Sediment Removal QA	1191	Day		$2,858,400
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,910,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$86,155,600
Engineering, Procurement & Construction Management:				10,338,672
Contractor Overhead/Profit:				12,923,340
Total Capital:				**$109,400,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	5,330,439,162	gal	$2,132,176
Water Treatment QA	1,191	Day	$476,400
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,535,045
Engineering, Procurement & Construction Management:			784,205
Total Capital:			**$7,300,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Solidification	8,095,823	ton		$202,395,568
Lime Purchase	809,583	ton		$48,574,980
Sediment Loading	8,095,823	ton		$22,668,304
Sediment Hauling	8,095,823	ton		$37,949,169
Landfill Construction	1	LS		$25,988,920
Local Siting Fee	4,104,792	cy		$20,523,960
Closure	127	acres		$12,721,463
Direct Capital:				$370,822,364
Engineering, Procurement & Construction Management:				44,498,684
Total Capital:				**$415,300,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$419,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$564,500,000**

ALTERNATIVE C3: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1130	acre		$18,080,000
Dredging - 2 12 hour shifts/day	1191	Day	6.543956044	$33,824,400
Dredge Monitoring (Water Quality)	1191	Day		$7,146,000
Sediment Removal QA	1191	Day		$2,858,400
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$67,280,600
Engineering, Procurement & Construction Management:				8,073,672
Contractor Overhead/Profit:				10,092,090
Total Capital:				**$85,400,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	2,428,747	bdt	$194,299,745
Direct Capital:			$194,399,745
Engineering, Procurement & Construction Management:			23,327,969
Total Capital:			**$217,700,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Includes Operator)	6,106,807,801	gal	$2,442,723
Water Treatment QA	3,334	day	$666,800
Direct Capital:			$5,695,993
Engineering, Procurement & Construction Management:			683,519
Total Capital:			**$6,400,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	4,857,494	ton	$13,600,982
Soil Hauling	4,857,494	ton	$22,769,501
Tipping Fees (non-TSCA)	4,687,212	ton	$201,550,127
Tipping Fees (TSCA)	170,281	ton	$9,365,475
Direct Capital:			$247,286,086
Engineering, Procurement & Construction Management:			29,674,330
Total Capital:			**$277,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$595,200,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	3,615	Day	$61,455,000
Dredge Monitoring (Water Quality)	3,615	Day	$10,845,000
Sediment Removal QA	3,615	Day	$4,338,000
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$79,133,000
Engineering, Procurement & Construction Management:			9,495,960
Contractor Overhead/Profit:			11,869,950
Total Capital:			**$100,500,000**

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	312,357,784	gal	$124,943
Water Treatment QA	1,687	day	$337,400
Direct Capital:			$1,032,841
Engineering, Procurement & Construction Management:			123,941
Total Capital:			**$1,200,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	4,950,209	ton		$123,755,225
Lime Purchase	495,021	ton		$29,701,260
Soil Loading	4,950,209	ton		$13,860,585
Soil Hauling	4,950,209	ton		$23,204,105
Tipping Fees (non-TSCA)	4,698,313	ton		$202,027,479
Tipping Fees (TSCA)	365,647	ton		$20,110,606
Direct Capital:				$412,659,260
Engineering, Procurement & Construction Management:				49,519,111
Total Capital:				**$462,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$611,800,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEAD'S)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1130	acre		$18,080,000
Dredging - 2 12 hour shifts/day	1191	Day	6.543956044	$33,824,400
Dredge Monitoring (Water Quality)	1191	Day		$7,146,000
Sediment Removal QA	1191	Day		$2,858,400
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,910,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$86,155,600
Engineering, Procurement & Construction Management:				10,338,672
Contractor Overhead/Profit:				12,923,340
Total Capital:				**$109,400,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	5,330,439,162	gal	$2,132,176
Water Treatment QA	1,191	Day	$476,400
Piping	95,000	ft	$6,365,000
Direct Capital:			$11,560,045
Engineering, Procurement & Construction Management:			1,387,205
Total Capital:			**$12,900,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	8,095,823	ton	$194,299,745
Soil Loading	8,095,823	ton	$22,668,304
Soil Hauling	8,095,823	ton	$9,487,292
Direct Capital:			$226,455,341
Engineering, Procurement & Construction Management:			$27,174,641
Total Capital:			**$253,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$404,500,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible,Dredge to CDF and Off-site Disposal

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	1,819,641	tons		$10,917,848
Sand Placement	1,299,744	cy		$7,798,463
Cobble Purchase and Placement	779,846	cy		$23,395,388
Cap Placement QA	1	LS		$100,000
Direct Capital:				$42,411,699
Engineering, Procurement & Construction Management:				5,089,404
Total Capital:				**$47,501,103**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$950,022	$14,294,314
Total Present Worth, Longer Term O&M Costs				$20,312,833
Total Project Capital and O&M Cost				**$67,800,000**

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	2,464	Day	$41,888,000
Dredge Monitoring (Water Quality)	2,464	Day	$7,392,000
Sediment Removal QA	2,464	Day	$2,956,800
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$54,731,800
Engineering, Procurement & Construction Management:			6,567,816
Contractor Overhead/Profit:			8,209,770
Total Capital:			**$69,500,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	268,170,233	gal	$107,268
Water Treatment QA	1,687	day	$337,400
Direct Capital:			$1,015,166
Engineering, Procurement & Construction Management:			121,820
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	2,661,249	ton	$66,531,225
Lime Purchase	266,125	ton	$15,967,500
Soil Loading	2,661,249	ton	$7,451,497
Soil Hauling	2,661,249	ton	$12,474,605
Tipping Fees (non-TSCA)	2,409,353	ton	$103,602,198
Tipping Fees (TSCA)	251,896	ton	$13,854,255
Direct Capital:			$219,881,280
Engineering, Procurement & Construction Management:			26,385,754
Total Capital:			**$246,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			**$4,513,889**
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$432,600,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
DE PERE TO GREEN BAY
Action Level - 250 ppb

Material Handling Assumptions:							
Volume > 250 ppb	6,449,065	cy	1103	ac	4,922,950	m3	Acres corresponds to dredge footprint
Volume > 125 ppb	6,868,500	cy			5,243,130	m3	area
Volume > 500 ppb	6,169,458	cy			4,709,510	m3	
Volume > 1,000 ppb	5,879,529	cy			4,488,190	m3	
Volume > 5000 ppb	4,517,391	cy			3,448,390	m3	
Volume > 50,000 ppb	240,778	cy			183,800	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Slurry Density (20% in situ)	8.0%	w/w	3.6%	v/v	0.88	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	15.4%	v/v	1.02	tons per cy	Montgomery Watson
Dewatered Density (Hydraulic Dredging and CDF)	50.0%	w/w	29.8%	v/v	1.18	tons per cy	Foth & VanDyke
Dewatered Density (Mechanical Dredging)	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	2,136,771	cy	in situ		974,801	m3	
HTTD Treatment Capacity	1,577,177	cy	in situ		1,650,000	tons	
Cap Volume	2,015,618	cy			1,538,640	m3	
Vitrification Treatment Capacity	9,106,166	cy	in situ		6440000.00	tons	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Debris Sweep	$16,000	per acre					Ogden Beeman
Hydraulic - 2 12-inch Cutterheads							
Site Preparation	$803,400	LS					Ogden Beeman
Mobilization - Equipment	$1,135,000	LS					Ogden Beeman
Mobilization - Silt Curtain	$35,000						Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift					Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift					Ogden Beeman
Winter Over Equipment	$285,000	per year					Ogden Beeman
Site Restoration	$600,000	per dredge launch site					
Length of Piping	95,000	ft			18	mi	
							Distance to Town of Holland (map provided by Fred Swed). 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft					Ogden Beeman
Number of Road Crossings	12	each					pj, review map
Cost per Road Crossing	$50,000	per crossing					pj, review map
Number of Booster Pumps	4	each					Ogden Beeman
Booster Pump Cost	$2,500	per day					Ogden Beeman
Mechanical - 8 cy bucket							
Dock Construction	$400,000	LS					pj
Mobilization - Equipment	$455,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$17,000	per shift					Ogden Beeman
Dredge Rate	1900	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					pj
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Offload Crane Mobilization	$50,000	LS					pj
Site Restoration	$500,000	LS					pj
High Temperature Thermal Desorption							
Setup Staging Area	$50,000						pj
Mobilization/Site Prep	$150,000						Maxymillian
Sediment Treatment QA	$2	per ton					
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1					
Sand Purchase and Deliver	$6	per ton					Ole
Blending	$25	per ton					Ole
HTTD (includes off-gas treatment)	$75	per ton					Maxymillian
Stack Testing	$50,000	LS					Maxymillian
Place Treated Material	$3	per ton					
Vitrification							
Capital Costs	$36,000,000	LS					Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year					Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton					Unit Cost Study- Minergy
Capping							
Mobilization/Site Prep	$200,000						Ogden Beeman
Area	20,514,438	sf	1,905,900			m2	
Sand Cap Depth	1.7	feet					
Sand Purchase	$6	per ton					Ole
Placement Rate	$6	per cy					Ogden Beeman
Sand Density	1.4	tons per cy					
Armored Cap Depth	1.0	feet					
Cobbles	$30	per cy					Means
Sand Density	1.4	tons per cy					
Cap Placement QA	$100,000	LS					Ogden Beeman
Long-term O&M	2%	of capital					pj
Long-term Monitoring	$400,000	per year					Anne LTM

Nearshore CDF			Bayport			
Land Lease or Purchase	$1.80	per sf				Baird
Length	9,600	lf				Baird
Capping Volume	205,000	cy	2,178,000			Baird
Seeding Area	300,000	sy	2,178,000			Baird
Sheetpile Wall Length	9,600	lf				based on bathymetry
Sheetpile Depth	30	ft				pj
Sheetpile Cost	$19	per sf				Baird
Shot Rock Berm	$500	per lf				Baird
Rip Rap	$210	per lf				pj
Clean Soil Cap	$10	per cy				Baird
Seeding	$1	per sy				Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	4,491,228	sf	103.10			2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter	8,477	lf	2119.251741			assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Water Treatment						
Flow Rate (3 Mechanical Dredges)	57	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges)	$216,590	LS				pj
Flow Rate (3 Mechanical Dredges to CDF)	287	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges to CDF)	$570,498	LS				pj
Flow Rate (2 Hydraulic Dredges)	3,563	gpm				assume operate 24/7
Unit, Purchase (Hydraulic Dredge)	$2,586,470	LS				pj
Flow Rate (2 Hydraulic Dredges; settling pond)	3,110	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	3,563	gpm				
Unit, Purchase (mechanical dewatering)	$2,586,470	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Existing NR 500 Commercial Disposal Facility						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer System Construction	1,000,000	LS				pj
New Landfill Disposal (Dedicated NR 500 Monofill)						
Landfill Construction	$24,401,866					
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				
Institutional Controls						
Public Education Program	$100,000					pj
O&M Plans	$20,000					pj
Deed Restrictions	$5,000					pj
Annual Costs						
Public Education Program	$30,000					pj
Maintaining O&M Plans	$800					pj
Reporting	$20,000					pj
Long-term Monitoring	$600,000					Anne LTM
Long-term Monitoring (no action)	$300,000					Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs	**Years**		**Annual Cost**	
Long-term Monitoring (no action)	40		$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs	**Years**		**Annual Cost**	
Long-term Monitoring	40		$600,000	$9,027,778
Public Education Program	40		$30,000	$451,389
Maintaining O&M Plans	40		$800	$12,037
Reporting	40		$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	3	LS		$1,470,000
Watertight Barges	4	ea		$400,000
Offload Stockpile Area Prep.	1	LS		$75,000
Dredging - 12 hour shifts	3,395	Day	26.11538462	$57,715,000
Dredge Monitoring (Water Quality)	3,395	Day		$10,185,000
Sediment Removal QA	3,395	Day		$4,074,000
Offload Crane Mobilization	1	LS		$50,000
Site Restoration	1	ea		$500,000
Direct Capital:				$74,469,000
Engineering, Procurement & Construction Management:				8,936,280
Contractor Overhead/Profit:				11,170,350
Total Capital:				**$94,600,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	57	gpm	$216,590
Water Treatment (Includes Operator)	130,245,307	gal	$52,098
Water Treatment QA	1,584	day	$316,800
Direct Capital:			$585,488
Engineering, Procurement & Construction Management:			70,259
Total Capital:			**$700,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost	
Solidification	6,746,839	ton		$168,670,973	
Lime Purchase	674,684	ton		$40,481,040	
Soil Loading	6,746,839	ton		$18,891,149	
Soil Hauling	6,746,839	ton		$31,625,808	
Tipping Fees (non-TSCA)	6,494,943	ton		$279,282,567	$293,136,820
Tipping Fees (TSCA)	251,896	ton		$13,854,253	
Direct Capital:				$552,805,790	
Engineering, Procurement & Construction Management:				66,336,695	
Total Capital:				**$619,100,000**	

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$723,100,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1103	acre		$17,648,000
Dredging - 2 12 hour shifts/day	1118	Day	6.142857143	$31,751,200
Dredge Monitoring (Water Quality)	1118	Day		$6,708,000
Sediment Removal QA	1118	Day		$2,683,200
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,180,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$82,307,200
Engineering, Procurement & Construction Management:				9,876,864
Contractor Overhead/Profit:				12,346,080
Total Capital:				**$104,500,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,563	gpm		$2,586,470
Water Treatment (Including Operator)	5,733,885,955	gal		$2,293,554
Water Treatment QA	1,118	Day		$447,200
Piping	20,000	ft		$1,340,000
Direct Capital:				$6,667,224
Engineering, Procurement & Construction Management:				800,067
Total Capital:				**$7,500,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$24,401,866
Local Siting Fee	3,854,126	cy		$19,270,632
Closure	119	acres		$11,944,607
Direct Capital:				$55,617,105
Engineering, Procurement & Construction Management:				6,674,053
Total Capital:				**$62,300,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$66,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$183,000,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facilities

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1103	acre		$17,648,000
Dredging - 2 12 hour shifts/day	1118	Day	6.142857143	$31,751,200
Dredge Monitoring (Water Quality)	1118	Day		$6,708,000
Sediment Removal QA	1118	Day		$2,683,200
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,180,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$82,307,200
Engineering, Procurement & Construction Management:				9,876,864
Contractor Overhead/Profit:				12,346,080
Total Capital:				**$104,500,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	5,004,927,490	gal	$2,001,971
Water Treatment QA	1,118	Day	$447,200
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,375,641
Engineering, Procurement & Construction Management:			765,077
Total Capital:			**$7,100,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Solidification	7,601,439	ton	$190,035,963
Lime Purchase	760,144	ton	$45,608,640
Sediment Loading	7,601,439	ton	$21,284,028
Sediment Hauling	7,601,439	ton	$35,631,743
Landfill Construction	1	LS	$24,401,866
Local Siting Fee	3,854,126	cy	$19,270,632
Closure	119	acres	$11,944,607
Direct Capital:			$348,177,479
Engineering, Procurement & Construction Management:			41,781,297
Total Capital:			**$390,000,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs			$3,932,097
Total Project Capital and O&M Cost			**$393,900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$534,100,000**

ALTERNATIVE C3: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1103	acre		$17,648,000
Dredging - 2 12 hour shifts/day	1118	Day	6.142857143	$31,751,200
Dredge Monitoring (Water Quality)	1118	Day		$6,708,000
Sediment Removal QA	1118	Day		$2,683,200
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$64,162,200
Engineering, Procurement & Construction Management:				7,699,464
Contractor Overhead/Profit:				9,624,330
Total Capital:				**$81,500,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	2,280,432	bdt	$182,434,525
Direct Capital:			$182,534,525
Engineering, Procurement & Construction Management:			21,904,143
Total Capital:			**$204,400,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	3,563	gpm		$2,586,470
Water Treatment (Includes Operator)	5,733,885,955	gal		$2,293,554
Water Treatment QA	3,130	day		$626,000
Direct Capital:				$5,506,024
Engineering, Procurement & Construction Management:				660,723
Total Capital:				**$6,200,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Soil Loading	4,560,863	ton		$12,770,417
Soil Hauling	4,560,863	ton		$21,379,046
Tipping Fees (non-TSCA)	4,390,582	ton		$188,795,016
Tipping Fees (TSCA)	170,281	ton		$9,365,475
Direct Capital:				$232,309,953
Engineering, Procurement & Construction Management:				27,877,194
Total Capital:				**$260,200,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**

TOTAL COST	**$561,000,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	3,395	Day	$57,715,000
Dredge Monitoring (Water Quality)	3,395	Day	$10,185,000
Sediment Removal QA	3,395	Day	$4,074,000
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$74,469,000
Engineering, Procurement & Construction Management:			8,936,280
Contractor Overhead/Profit:			11,170,350
Total Capital:			**$94,600,000**

CDF CONSTRUCTION

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,700,000	sf	$4,860,000
Shot Rock/Rip Rap	9,600	lf	$6,816,000
Sheetpile Placement	288,000	sf	$5,472,000
Clean Soil Cap	205,000	cy	$2,050,000
Seeding	300,000	sy	$300,000
Mitigation	62	acre	$619,835
Direct Capital:			$20,117,835
Engineering, Procurement & Construction Management:			$2,414,140
Total Capital:			**$22,531,975**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs			**$16,711,012**
Total Project Capital and O&M Cost			**$39,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	303,886,859	gal	$121,555
Water Treatment QA	1,584	day	$316,800
Direct Capital:			$1,008,853
Engineering, Procurement & Construction Management:			121,062
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	4,511,406	ton	$112,785,150
Lime Purchase	451,141	ton	$27,068,460
Soil Loading	4,511,406	ton	$12,631,937
Soil Hauling	4,511,406	ton	$21,147,216
Tipping Fees (non-TSCA)	4,259,510	ton	$183,158,951
Tipping Fees (TSCA)	376,711	ton	$20,719,131
Direct Capital:			$377,510,845
Engineering, Procurement & Construction Management:			45,301,301
Total Capital:			**$422,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST **$566,400,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEAD'S)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1103	acre		$17,648,000
Dredging - 2 12 hour shifts/day	1118	Day	6.142857143	$31,751,200
Dredge Monitoring (Water Quality)	1118	Day		$6,708,000
Sediment Removal QA	1118	Day		$2,683,200
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$11,180,000
Winter Over All Equipment	7	yr		$1,995,000
Site Restoration	1	LS		$600,000
Direct Capital:				$82,307,200
Engineering, Procurement & Construction Management:				9,876,864
Contractor Overhead/Profit:				12,346,080
Total Capital:				**$104,500,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	5,004,927,490	gal	$2,001,971
Water Treatment QA	1,118	Day	$447,200
Piping	95,000	ft	$6,365,000
Direct Capital:			$11,400,641
Engineering, Procurement & Construction Management:			1,368,077
Total Capital:			**$12,800,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	7,601,439	ton	$182,434,525
Soil Loading	7,601,439	ton	$21,284,028
Soil Hauling	7,601,439	ton	$8,907,936
Direct Capital:			$212,626,488
Engineering, Procurement & Construction Management:			$25,515,179
Total Capital:			**$238,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units	Cost
Clean Soil Cap	2,178,000	cy	$21,780,000
Seeding	2,178,000	sy	$2,178,000
Mitigation	450	acre	$4,500,000
Present Worth of Direct Capital:			$2,766,749
Engineering, Procurement & Construction Management:			$332,010
Total Capital:			**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**

TOTAL COST **$384,000,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible,Dredge to CDF and Off-site Disposal

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	1,772,853	tons		$10,637,116
Sand Placement	1,266,323	cy		$7,597,940
Cobble Purchase and Placement	759,794	cy		$22,793,820
Cap Placement QA	1	LS		$100,000
Direct Capital:				$41,328,876
Engineering, Procurement & Construction Management:				4,959,465
Total Capital:				**$46,288,341**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$925,767	$13,929,362
Total Present Worth, Longer Term O&M Costs				$19,947,881
Total Project Capital and O&M Cost				**$66,200,000**

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	2,334	Day	$39,678,000
Dredge Monitoring (Water Quality)	2,334	Day	$7,002,000
Sediment Removal QA	2,334	Day	$2,800,800
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$51,975,800
Engineering, Procurement & Construction Management:			6,237,096
Contractor Overhead/Profit:			7,796,370
Total Capital:			**$66,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	263,179,430	gal	$105,272
Water Treatment QA	1,584	day	$316,800
Direct Capital:			$992,570
Engineering, Procurement & Construction Management:			119,108
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	2,402,720	ton		$60,068,000
Lime Purchase	240,272	ton		$14,416,320
Soil Loading	2,402,720	ton		$6,727,616
Soil Hauling	2,402,720	ton		$11,262,750
Tipping Fees (non-TSCA)	2,150,824	ton		$92,485,453
Tipping Fees (TSCA)	251,896	ton		$13,854,254
Direct Capital:				$198,814,392
Engineering, Procurement & Construction Management:				23,857,727
Total Capital:				**$222,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				**$4,513,889**
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$403,900,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
DE PERE TO GREEN BAY
Action Level - 500 ppb

Material Handling Assumptions:							
Volume > 500 ppb	6,169,458	cy	1083 ac		4,709,510	m3	Acres corresponds to dredge footprint area
Volume > 125 ppb	6,868,500	cy			5,243,130	m3	
Volume > 250 ppb	6,449,065	cy			4,922,950	m3	
Volume > 1,000 ppb	5,879,529	cy			4,488,190	m3	
Volume > 5000 ppb	4,517,391	cy			3,448,390	m3	
Volume > 50,000 ppb	240,778	cy			183,800	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Slurry Density (20% in situ)	8.0%	w/w	3.6%	v/v	0.88	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	15.4%	v/v	1.02	tons per cy	Montgomery Watson
Dewatered Density (Hydraulic Dredging and CDF)	50.0%	w/w	29.8%	v/v	1.18	tons per cy	Foth & VanDyke
Dewatered Density (Mechanical Dredging)	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	2,136,771	cy	in situ		974,801	m3	
HTTD Treatment Capacity	1,577,177	cy	in situ		1,650,000	tons	
Cap Volume	1,926,748	cy			1,470,800	m3	
Vitrification Treatment Capacity	9,106,166	cy	in situ		6440000.00	tons	

Cost Estimating Parameters & Methodology:					
Interest Rate	6.0%				
Sales Tax	5.5%				Not Used
Engineering, Procurement and Construction Mgmt	12.0%				
Contractor Overhead and Profit - Dredging Only	15.0%				
<u>Dredging</u>					
Dredge Monitoring (Water Quality)	$3,000	per day			
Sediment Removal QA	$1,200	per day			
Debris Sweep	$16,000	per acre			Ogden Beeman
Hydraulic - 2 12-inch Cutterheads					
Site Preparation	$803,400	LS			Ogden Beeman
Mobilization - Equipment	$1,135,000	LS			Ogden Beeman
Mobilization - Silt Curtain	$35,000				Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift			Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift			Ogden Beeman
Winter Over Equipment	$285,000	per year			Ogden Beeman
Site Restoration	$600,000	per dredge launch site			
Length of Piping	95,000	ft	18	mi	Distance to Town of Holland (map provided by Fred Swed). 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft			Ogden Beeman
Number of Road Crossings	12	each			pj, review map
Cost per Road Crossing	$50,000	per crossing			pj, review map
Number of Booster Pumps	4	each			Ogden Beeman
Booster Pump Cost	$2,500	per day			Ogden Beeman
Mechanical - 8 cy bucket					
Dock Construction	$400,000	LS			pj
Mobilization - Equipment	$455,000	per dredge			Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS			Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea			Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$17,000	per shift			Ogden Beeman
Dredge Rate	1900	cy in situ per 10 hour shift			Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area			pj
Free Water per cy Dredged (10%)	20	gal			Ogden Beeman
Offload Crane Mobilization	$50,000	LS			pj
Site Restoration	$500,000	LS			pj
High Temperature Thermal Desorption					
Setup Staging Area	$50,000				pj
Mobilization/Site Prep	$150,000				Maxymillian
Sediment Treatment QA	$2	per ton			
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1			
Sand Purchase and Deliver	$6	per ton			Ole
Blending	$25	per ton			Ole
HTTD (includes off-gas treatment)	$75	per ton			Maxymillian
Stack Testing	$50,000	LS			Maxymillian
Place Treated Material	$3	per ton			
Vitrification					
Capital Costs	$36,000,000	LS			Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year			Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton			Unit Cost Study- Minergy

Capping						
Mobilization/Site Prep	$200,000					Ogden Beeman
Area	20,132,328	sf	1,870,400	m2		
Sand Cap Depth	1.7	feet				
Sand Purchase	$6	per ton				Ole
Placement Rate	$6	per cy				Ogden Beeman
Sand Density	1.4	tons per cy				
Armored Cap Depth	1.0	feet				
Cobbles	$30	per cy				Means
Sand Density	1.4	tons per cy				
Cap Placement QA	$100,000	LS				Ogden Beeman
Long-term O&M	2%	of capital				pj
Long-term Monitoring	$400,000	per year				Anne LTM
Nearshore CDF			Bayport			
Land Lease or Purchase	$1.80	per sf				Baird
Length	9,600	lf				Baird
Capping Volume	205,000	cy	2,178,000			Baird
Seeding Area	300,000	sy	2,178,000			Baird
Sheetpile Wall Length	9,600	lf				based on bathymetry
Sheetpile Depth	30	ft				pj
Sheetpile Cost	$19	per sf				Baird
Shot Rock Berm	$500	per lf				Baird
Rip Rap	$210	per lf				pj
Clean Soil Cap	$10	per cy				Baird
Seeding	$1	per sy				Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	4,491,228	sf	103.10			2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter	8,477	lf	2119.251741			assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Water Treatment						
Flow Rate (3 Mechanical Dredges)	57	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges)	$216,590	LS				pj
Flow Rate (3 Mechanical Dredges to CDF)	287	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges to CDF)	$570,498	LS				pj
Flow Rate (2 Hydraulic Dredges)	3,563	gpm				assume operate 24/7
Unit, Purchase (Hydraulic Dredge)	$2,586,470	LS				pj
Flow Rate (2 Hydraulic Dredges; settling pond)	3,110	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	3,563	gpm				
Unit, Purchase (mechanical dewatering)	$2,586,470	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Existing NR 500 Commercial Disposal Facility						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer System Construction	1,000,000	LS				pj
New Landfill Disposal (Dedicated NR 500 Monofill)						
Landfill Construction	$23,343,896					
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				

<u>Institutional Controls</u>		
Public Education Program	$100,000	pj
O&M Plans	$20,000	pj
Deed Restrictions	$5,000	pj
<u>Annual Costs</u>		
Public Education Program	$30,000	pj
Maintaining O&M Plans	$800	pj
Reporting	$20,000	pj
Long-term Monitoring	$600,000	Anne LTM
Long-term Monitoring (no action)	$300,000	Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	3	LS		$1,470,000
Watertight Barges	4	ea		$400,000
Offload Stockpile Area Prep.	1	LS		$75,000
Dredging - 12 hour shifts	3,248	Day	24.98461538	$55,216,000
Dredge Monitoring (Water Quality)	3,248	Day		$9,744,000
Sediment Removal QA	3,248	Day		$3,897,600
Offload Crane Mobilization	1	LS		$50,000
Site Restoration	1	ea		$500,000
Direct Capital:				$71,352,600
Engineering, Procurement & Construction Management:				8,562,312
Contractor Overhead/Profit:				10,702,890
Total Capital:				**$90,600,000**

WATER TREATMENT

Capital Items	Quantity	Units		Cost
Unit Purchase	57	gpm		$216,590
Water Treatment (Includes Operator)	124,598,376	gal		$49,839
Water Treatment QA	1,516	day		$303,200
Direct Capital:				$569,629
Engineering, Procurement & Construction Management:				68,355
Total Capital:				**$600,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	6,454,322	ton		$161,358,055
Lime Purchase	645,433	ton		$38,725,980
Soil Loading	6,454,322	ton		$18,072,102
Soil Hauling	6,454,322	ton		$30,254,635
Tipping Fees (non-TSCA)	6,202,427	ton		$266,704,347
Tipping Fees (TSCA)	251,896	ton		$13,854,253
Direct Capital:				$528,969,373
Engineering, Procurement & Construction Management:				63,476,325
Total Capital:				**$592,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$692,300,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1083	acre		$17,328,000
Dredging - 2 12 hour shifts/day	1070	Day	5.879120879	$30,388,000
Dredge Monitoring (Water Quality)	1070	Day		$6,420,000
Sediment Removal QA	1070	Day		$2,568,000
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$10,700,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$79,455,800
Engineering, Procurement & Construction Management:				9,534,696
Contractor Overhead/Profit:				11,918,370
Total Capital:				**$100,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Including Operator)	5,485,286,920	gal	$2,194,115
Water Treatment QA	1,070	Day	$428,000
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,548,584
Engineering, Procurement & Construction Management:			785,830
Total Capital:			**$7,300,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Landfill Construction	1	LS		$23,343,896
Local Siting Fee	3,687,026	cy		$18,435,132
Closure	114	acres		$11,426,735
Direct Capital:				$53,205,763
Engineering, Procurement & Construction Management:				6,384,692
Total Capital:				**$59,600,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$63,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**

TOTAL COST	**$176,500,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facilities

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1083	acre		$17,328,000
Dredging - 2 12 hour shifts/day	1070	Day	5.879120879	$30,388,000
Dredge Monitoring (Water Quality)	1070	Day		$6,420,000
Sediment Removal QA	1070	Day		$2,568,000
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$10,700,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$79,455,800
Engineering, Procurement & Construction Management:				9,534,696
Contractor Overhead/Profit:				11,918,370
Total Capital:				**$100,900,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	4,787,933,264	gal	$1,915,173
Water Treatment QA	1,070	Day	$428,000
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,269,643
Engineering, Procurement & Construction Management:			752,357
Total Capital:			**$7,000,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Solidification	7,271,870	ton		$181,796,742
Lime Purchase	727,187	ton		$43,631,220
Sediment Loading	7,271,870	ton		$20,361,235
Sediment Hauling	7,271,870	ton		$34,086,889
Landfill Construction	1	LS		$23,343,896
Local Siting Fee	3,687,026	cy		$18,435,132
Closure	114	acres		$11,426,735
Direct Capital:				$333,081,849
Engineering, Procurement & Construction Management:				39,969,822
Total Capital:				**$373,100,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$377,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$513,500,000**

ALTERNATIVE C3: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1083	acre		$17,328,000
Dredging - 2 12 hour shifts/day	1070	Day	5.879120879	$30,388,000
Dredge Monitoring (Water Quality)	1070	Day		$6,420,000
Sediment Removal QA	1070	Day		$2,568,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$61,790,800
Engineering, Procurement & Construction Management:				7,414,896
Contractor Overhead/Profit:				9,268,620
Total Capital:				**$78,500,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	2,181,561	bdt	$174,524,872
Direct Capital:			$174,624,872
Engineering, Procurement & Construction Management:			20,954,985
Total Capital:			**$195,600,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Includes Operator)	5,485,286,920	gal	$2,194,115
Water Treatment QA	2,994	day	$598,800
Direct Capital:			$5,379,384
Engineering, Procurement & Construction Management:			645,526
Total Capital:			**$6,000,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	4,363,122	ton	$12,216,741
Soil Hauling	4,363,122	ton	$20,452,133
Tipping Fees (non-TSCA)	4,192,840	ton	$180,292,139
Tipping Fees (TSCA)	170,281	ton	$9,365,475
Direct Capital:			$222,326,488
Engineering, Procurement & Construction Management:			26,679,179
Total Capital:			**$249,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$537,800,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	3,248	Day	$55,216,000
Dredge Monitoring (Water Quality)	3,248	Day	$9,744,000
Sediment Removal QA	3,248	Day	$3,897,600
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$71,352,600
Engineering, Procurement & Construction Management:			8,562,312
Contractor Overhead/Profit:			10,702,890
Total Capital:			**$90,600,000**

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	298,239,928	gal	$119,296
Water Treatment QA	1,516	day	$303,200
Direct Capital:			$992,994
Engineering, Procurement & Construction Management:			119,159
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	4,218,890	ton		$105,472,250
Lime Purchase	421,889	ton		$25,313,340
Soil Loading	4,218,890	ton		$11,812,892
Soil Hauling	4,218,890	ton		$19,776,047
Tipping Fees (non-TSCA)	3,966,994	ton		$170,580,761
Tipping Fees (TSCA)	385,366	ton		$21,195,108
Direct Capital:				$354,150,398
Engineering, Procurement & Construction Management:				42,498,048
Total Capital:				**$396,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST **$536,200,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEAD'S)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1083	acre		$17,328,000
Dredging - 2 12 hour shifts/day	1070	Day	5.879120879	$30,388,000
Dredge Monitoring (Water Quality)	1070	Day		$6,420,000
Sediment Removal QA	1070	Day		$2,568,000
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$10,700,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$79,455,800
Engineering, Procurement & Construction Management:				9,534,696
Contractor Overhead/Profit:				11,918,370
Total Capital:				**$100,900,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	4,787,933,264	gal	$1,915,173
Water Treatment QA	1,070	Day	$428,000
Piping	95,000	ft	$6,365,000
Direct Capital:			$11,294,643
Engineering, Procurement & Construction Management:			1,355,357
Total Capital:			**$12,700,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	7,271,870	ton	$174,524,872
Soil Loading	7,271,870	ton	$20,361,235
Soil Hauling	7,271,870	ton	$8,521,722
Direct Capital:			$203,407,829
Engineering, Procurement & Construction Management:			$24,408,940
Total Capital:			**$227,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$370,000,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible,Dredge to CDF and Off-site Disposal

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	1,739,831	tons		$10,438,985
Sand Placement	1,242,736	cy		$7,456,418
Cobble Purchase and Placement	745,642	cy		$22,369,254
Cap Placement QA	1	LS		$100,000
Direct Capital:				$40,564,657
Engineering, Procurement & Construction Management:				4,867,759
Total Capital:				**$45,432,416**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$908,648	$13,671,792
Total Present Worth, Longer Term O&M Costs				$19,690,311
Total Project Capital and O&M Cost				**$65,100,000**

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	2,233	Day	$37,961,000
Dredge Monitoring (Water Quality)	2,233	Day	$6,699,000
Sediment Removal QA	2,233	Day	$2,679,600
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$49,834,600
Engineering, Procurement & Construction Management:			5,980,152
Contractor Overhead/Profit:			7,475,190
Total Capital:			**$63,300,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	259,327,325	gal	$103,731
Water Treatment QA	1,516	day	$303,200
Direct Capital:			$977,429
Engineering, Procurement & Construction Management:			117,291
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	2,203,177	ton	$55,079,425
Lime Purchase	220,318	ton	$13,219,080
Soil Loading	2,203,177	ton	$6,168,896
Soil Hauling	2,203,177	ton	$10,327,392
Tipping Fees (non-TSCA)	1,951,281	ton	$83,905,104
Tipping Fees (TSCA)	251,896	ton	$13,854,253
Direct Capital:			$182,554,150
Engineering, Procurement & Construction Management:			21,906,498
Total Capital:			**$204,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			**$4,513,889**
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$381,900,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
DE PERE TO GREEN BAY
Action Level - 1,000 ppb

Material Handling Assumptions:						
Volume > 1000 ppb	5,879,529	cy	1034 ac	4,488,190	m3	Acres corresponds to dredge
Volume > 125 ppb	6,868,500	cy		5,243,130	m3	footprint area
Volume > 250 ppb	6,449,065	cy		4,922,950	m3	
Volume > 500 ppb	6,169,458	cy		4,709,510	m3	
Volume > 5000 ppb	4,517,391	cy		3,448,390	m3	
Volume > 50,000 ppb	240,778	cy		183,800	m3	
Solids Specific Gravity	2.36					
Fresh Water Density	62.4	lb/ft3				
In Situ Density	33.8%	w/w	17.8% v/v	1.05	tons per cy	
Slurry Density (20% in situ)	8.0%	w/w	3.6% v/v	0.88	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	15.4% v/v	1.02	tons per cy	Montgomery Watson
Dewatered Density (Hydraulic Dredging and CDF)	50.0%	w/w	29.8% v/v	1.18	tons per cy	Foth & VanDyke
Dewatered Density (Mechanical Dredging)	33.8%	w/w	17.8% v/v	1.05	tons per cy	
Treated Density	93.4%	w/w	60.0% v/v	1.28	tons per cy	
CDF Capacity	2,136,771	cy	in situ	974,801	m3	
HTTD Treatment Capacity	1,577,177	cy	in situ	1,650,000	tons	
Cap Volume	1,833,253	cy		1,399,430	m3	
Vitrification Treatment Capacity	9,106,166	cy	in situ	6440000.00	tons	
Cost Estimating Parameters & Methodology:						
Interest Rate	6.0%					
Sales Tax	5.5%					Not Used
Engineering, Procurement and Construction Mgmt	12.0%					
Contractor Overhead and Profit - Dredging Only	15.0%					
<u>Dredging</u>						
Dredge Monitoring (Water Quality)	$3,000	per day				
Sediment Removal QA	$1,200	per day				
Debris Sweep	$16,000	per acre				Ogden Beeman
Hydraulic - 2 12-inch Cutterheads						
Site Preparation	$803,400	LS				Ogden Beeman
Mobilization - Equipment	$1,135,000	LS				Ogden Beeman
Mobilization - Silt Curtain	$35,000					Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift				Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift				Ogden Beeman
Winter Over Equipment	$285,000	per year				Ogden Beeman
Site Restoration	$600,000	per dredge launch site				
Length of Piping	95,000	ft		18	mi	Distance to Town of Holland (map provided by Fred Swed). 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft				Ogden Beeman
Number of Road Crossings	12	each				pj, review map
Cost per Road Crossing	$50,000	per crossing				pj, review map
Number of Booster Pumps	4	each				Ogden Beeman
Booster Pump Cost	$2,500	per day				Ogden Beeman
Mechanical - 8 cy bucket						
Dock Construction	$400,000	LS				pj
Mobilization - Equipment	$455,000	per dredge				Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS				Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea				Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$17,000	per shift				Ogden Beeman
Dredge Rate	1900	cy in situ per 10 hour shift				Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area				pj
Free Water per cy Dredged (10%)	20	gal				Ogden Beeman
Offload Crane Mobilization	$50,000	LS				pj
Site Restoration	$500,000	LS				pj
High Temperature Thermal Desorption						
Setup Staging Area	$50,000					pj
Mobilization/Site Prep	$150,000					Maxymillian
Sediment Treatment QA	$2	per ton				
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1				
Sand Purchase and Deliver	$6	per ton				Ole
Blending	$25	per ton				Ole
HTTD (includes off-gas treatment)	$75	per ton				Maxymillian
Stack Testing	$50,000	LS				Maxymillian
Place Treated Material	$3	per ton				
Vitrification						
Capital Costs	$36,000,000	LS				Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year				Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton				Unit Cost Study- Minergy

Capping						
Mobilization/Site Prep	$200,000					Ogden Beeman
Area	19,041,971	sf	1,769,100	m2		
Sand Cap Depth	1.7	feet				
Sand Purchase	$6	per ton				Ole
Placement Rate	$6	per cy				Ogden Beeman
Sand Density	1.4	tons per cy				
Armored Cap Depth	1.0	feet				
Cobbles	$30	per cy				Means
Sand Density	1.4	tons per cy				
Cap Placement QA	$100,000	LS				Ogden Beeman
Long-term O&M	2%	of capital				pj
Long-term Monitoring	$400,000	per year				Anne LTM
Nearshore CDF			Bayport			
Land Lease or Purchase	$1.80	per sf				Baird
Length	9,600	lf				Baird
Capping Volume	205,000	cy	2,178,000			Baird
Seeding Area	300,000	sy	2,178,000			Baird
Sheetpile Wall Length	9,600	lf				based on bathymetry
Sheetpile Depth	30	ft				pj
Sheetpile Cost	$19	per sf				Baird
Shot Rock Berm	$500	per lf				Baird
Rip Rap	$210	per lf				pj
Clean Soil Cap	$10	per cy				Baird
Seeding	$1	per sy				Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	4,491,228	sf	103.10			2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter	8,477	lf	2119.251741			assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Water Treatment						
Flow Rate (3 Mechanical Dredges)	57	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges)	$216,590	LS				pj
Flow Rate (3 Mechanical Dredges to CDF)	287	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges to CDF)	$570,498	LS				pj
Flow Rate (2 Hydraulic Dredges)	3,563	gpm				assume operate 24/7
Unit, Purchase (Hydraulic Dredge)	$2,586,470	LS				pj
Flow Rate (2 Hydraulic Dredges; settling pond)	3,110	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	3,563	gpm				
Unit, Purchase (mechanical dewatering)	$2,586,470	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Existing NR 500 Commercial Disposal Facility						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer System Construction	1,000,000	LS				pj
New Landfill Disposal (Dedicated NR 500 Monofill)						
Landfill Construction	$22,246,866					
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				

Institutional Controls		
Public Education Program	$100,000	pj
O&M Plans	$20,000	pj
Deed Restrictions	$5,000	pj
Annual Costs		
Public Education Program	$30,000	pj
Maintaining O&M Plans	$800	pj
Reporting	$20,000	pj
Long-term Monitoring	$600,000	Anne LTM
Long-term Monitoring (no action)	$300,000	Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	3	LS		$1,470,000
Watertight Barges	4	ea		$400,000
Offload Stockpile Area Prep.	1	LS		$75,000
Dredging - 12 hour shifts	3,095	Day	23.80769231	$52,615,000
Dredge Monitoring (Water Quality)	3,095	Day		$9,285,000
Sediment Removal QA	3,095	Day		$3,714,000
Offload Crane Mobilization	1	LS		$50,000
Site Restoration	1	ea		$500,000
Direct Capital:				$68,109,000
Engineering, Procurement & Construction Management:				8,173,080
Contractor Overhead/Profit:				10,216,350
Total Capital:				**$86,500,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	57	gpm	$216,590
Water Treatment (Includes Operator)	118,742,966	gal	$47,497
Water Treatment QA	1,445	day	$289,000
Direct Capital:			$553,087
Engineering, Procurement & Construction Management:			66,370
Total Capital:			**$600,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	6,151,006	ton	$153,775,150
Lime Purchase	615,101	ton	$36,906,060
Soil Loading	6,151,006	ton	$17,222,817
Soil Hauling	6,151,006	ton	$28,832,841
Tipping Fees (non-TSCA)	5,899,111	ton	$253,661,752
Tipping Fees (TSCA)	251,896	ton	$13,854,253
Direct Capital:			$504,252,872
Engineering, Procurement & Construction Management:			60,510,345
Total Capital:			**$564,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$660,600,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1034	acre		$16,544,000
Dredging - 2 12 hour shifts/day	1019	Day	5.598901099	$28,939,600
Dredge Monitoring (Water Quality)	1019	Day		$6,114,000
Sediment Removal QA	1019	Day		$2,445,600
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$10,190,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$76,285,000
Engineering, Procurement & Construction Management:				9,154,200
Contractor Overhead/Profit:				11,442,750
Total Capital:				**$96,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Including Operator)	5,227,509,847	gal	$2,091,004
Water Treatment QA	1,019	Day	$407,600
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,425,074
Engineering, Procurement & Construction Management:			771,009
Total Capital:			**$7,200,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Landfill Construction	1	LS	$22,246,866
Local Siting Fee	3,513,757	cy	$17,568,787
Closure	109	acres	$10,889,744
Direct Capital:			$50,705,397
Engineering, Procurement & Construction Management:			6,084,648
Total Capital:			**$56,800,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs			$3,932,097
Total Project Capital and O&M Cost			**$60,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**
TOTAL COST			**$169,600,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facilities

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1034	acre		$16,544,000
Dredging - 2 12 hour shifts/day	1019	Day	5.598901099	$28,939,600
Dredge Monitoring (Water Quality)	1019	Day		$6,114,000
Sediment Removal QA	1019	Day		$2,445,600
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$10,190,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$76,285,000
Engineering, Procurement & Construction Management:				9,154,200
Contractor Overhead/Profit:				11,442,750
Total Capital:				**$96,900,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	4,562,927,820	gal	$1,825,171
Water Treatment QA	1,019	Day	$407,600
Piping	20,000	ft	$1,340,000
Direct Capital:			$6,159,241
Engineering, Procurement & Construction Management:			739,109
Total Capital:			**$6,900,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Solidification	6,930,133	ton		$173,253,336
Lime Purchase	693,014	ton		$41,580,840
Sediment Loading	6,930,133	ton		$19,404,374
Sediment Hauling	6,930,133	ton		$32,485,000
Landfill Construction	1	LS		$22,246,866
Local Siting Fee	3,513,757	cy		$17,568,787
Closure	109	acres		$10,889,744
Direct Capital:				$317,428,947
Engineering, Procurement & Construction Management:				38,091,474
Total Capital:				**$355,500,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$359,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$491,800,000**

ALTERNATIVE C3: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1034	acre		$16,544,000
Dredging - 2 12 hour shifts/day	1019	Day	5.598901099	$28,939,600
Dredge Monitoring (Water Quality)	1019	Day		$6,114,000
Sediment Removal QA	1019	Day		$2,445,600
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$59,130,000
Engineering, Procurement & Construction Management:				7,095,600
Contractor Overhead/Profit:				8,869,500
Total Capital:				**$75,100,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	2,079,040	bdt	$166,323,203
Direct Capital:			$166,423,203
Engineering, Procurement & Construction Management:			19,970,784
Total Capital:			**$186,400,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Includes Operator)	5,227,509,847	gal	$2,091,004
Water Treatment QA	2,854	day	$570,800
Direct Capital:			$5,248,274
Engineering, Procurement & Construction Management:			629,793
Total Capital:			**$5,900,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	4,158,080	ton	$11,642,624
Soil Hauling	4,158,080	ton	$19,491,000
Tipping Fees (non-TSCA)	3,987,799	ton	$171,475,344
Tipping Fees (TSCA)	170,281	ton	$9,365,475
Direct Capital:			$211,974,444
Engineering, Procurement & Construction Management:			25,436,933
Total Capital:			**$237,400,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$513,500,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	3,095	Day	$52,615,000
Dredge Monitoring (Water Quality)	3,095	Day	$9,285,000
Sediment Removal QA	3,095	Day	$3,714,000
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$68,109,000
Engineering, Procurement & Construction Management:			8,173,080
Contractor Overhead/Profit:			10,216,350
Total Capital:			**$86,500,000**

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	292,384,518	gal	$116,954
Water Treatment QA	1,445	day	$289,000
Direct Capital:			$976,452
Engineering, Procurement & Construction Management:			117,174
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	3,915,574	ton		$97,889,350
Lime Purchase	391,558	ton		$23,493,480
Soil Loading	3,915,574	ton		$10,963,607
Soil Hauling	3,915,574	ton		$18,354,253
Tipping Fees (non-TSCA)	3,663,678	ton		$157,538,173
Tipping Fees (TSCA)	395,705	ton		$21,763,760
Direct Capital:				$330,002,623
Engineering, Procurement & Construction Management:				39,600,315
Total Capital:				**$369,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$505,100,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEAD'S)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	1034	acre		$16,544,000
Dredging - 2 12 hour shifts/day	1019	Day	5.598901099	$28,939,600
Dredge Monitoring (Water Quality)	1019	Day		$6,114,000
Sediment Removal QA	1019	Day		$2,445,600
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$10,190,000
Winter Over All Equipment	6	yr		$1,710,000
Site Restoration	1	LS		$600,000
Direct Capital:				$76,285,000
Engineering, Procurement & Construction Management:				9,154,200
Contractor Overhead/Profit:				11,442,750
Total Capital:				**$96,900,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	4,562,927,820	gal	$1,825,171
Water Treatment QA	1,019	Day	$407,600
Piping	95,000	ft	$6,365,000
Direct Capital:			$11,184,241
Engineering, Procurement & Construction Management:			1,342,109
Total Capital:			**$12,500,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	6,930,133	ton	$166,323,203
Soil Loading	6,930,133	ton	$19,404,374
Soil Hauling	6,930,133	ton	$8,121,250
Direct Capital:			$193,848,826
Engineering, Procurement & Construction Management:			$23,261,859
Total Capital:			**$217,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$355,100,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible,Dredge to CDF and Off-site Disposal

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs				**$16,711,012**
Total Project Capital and O&M Cost				**$39,200,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	1,645,602	tons		$9,873,614
Sand Placement	1,175,430	cy		$7,052,582
Cobble Purchase and Placement	705,258	cy		$21,157,745
Cap Placement QA	1	LS		$100,000
Direct Capital:				$38,383,942
Engineering, Procurement & Construction Management:				4,606,073
Total Capital:				**$42,990,015**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$859,800	$12,936,810
Total Present Worth, Longer Term O&M Costs				$18,955,329
Total Project Capital and O&M Cost				**$61,900,000**

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	2,130	Day	$36,210,000
Dredge Monitoring (Water Quality)	2,130	Day	$6,390,000
Sediment Removal QA	2,130	Day	$2,556,000
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$47,651,000
Engineering, Procurement & Construction Management:			5,718,120
Contractor Overhead/Profit:			7,147,650
Total Capital:			**$60,500,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	255,360,134	gal	$102,144
Water Treatment QA	1,445	day	$289,000
Direct Capital:			$961,642
Engineering, Procurement & Construction Management:			115,397
Total Capital:			**$1,100,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	1,997,673	ton	$49,941,825
Lime Purchase	199,768	ton	$11,986,080
Soil Loading	1,997,673	ton	$5,593,484
Soil Hauling	1,997,673	ton	$9,364,092
Tipping Fees (non-TSCA)	1,745,777	ton	$75,068,429
Tipping Fees (TSCA)	251,896	ton	$13,854,257
Direct Capital:			$165,808,168
Engineering, Procurement & Construction Management:			19,896,980
Total Capital:			**$185,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			**$4,513,889**
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$357,100,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
DE PERE TO GREEN BAY
Action Level - 5,000 ppb

Material Handling Assumptions:

Volume > 5000 ppb	4,517,391	cy	715	ac	3,448,390	m3	Acres corresponds to dredge
Volume > 125 ppb	6,868,500	cy			5,243,130	m3	footprint area
Volume > 250 ppb	6,449,065	cy			4,922,950	m3	
Volume > 500 ppb	6,169,458	cy			4,709,510	m3	
Volume > 1000 ppb	5,879,529	cy			4,488,190	m3	
Volume > 50,000 ppb	240,778	cy			183,800	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Slurry Density (20% in situ)	8.0%	w/w	3.6%	v/v	0.88	tons per cy	Ogden Beeman
Dewatered Density (settling pond)	30%	w/w	15.4%	v/v	1.02	tons per cy	Montgomery Watson
Dewatered Density (Hydraulic Dredging and CDF)	50.0%	w/w	29.8%	v/v	1.18	tons per cy	Foth & VanDyke
Dewatered Density (Mechanical Dredging)	33.8%	w/w	17.8%	v/v	1.05	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	2,136,771	cy	in situ		974,801	m3	
HTTD Treatment Capacity	1,577,177	cy	in situ		1,650,000	tons	
Cap Volume	1,415,350	cy			1,080,420	m3	
Vitrification Treatment Capacity	9,106,166	cy	in situ		6440000.00	tons	

Cost Estimating Parameters & Methodology:

Interest Rate	6.0%				
Sales Tax	5.5%				Not Used
Engineering, Procurement and Construction Mgmt	12.0%				
Contractor Overhead and Profit - Dredging Only	15.0%				
<u>Dredging</u>					
Dredge Monitoring (Water Quality)	$3,000	per day			
Sediment Removal QA	$1,200	per day			
Debris Sweep	$16,000	per acre			Ogden Beeman
Hydraulic - 2 12-inch Cutterheads					
Site Preparation	$803,400	LS			Ogden Beeman
Mobilization - Equipment	$1,135,000	LS			Ogden Beeman
Mobilization - Silt Curtain	$35,000				Ogden Beeman
Shift Rate (12 hours)	$14,200	per shift			Ogden Beeman
Dredge Rate	2885	cy in situ per 12 hour shift			Ogden Beeman
Winter Over Equipment	$285,000	per year			Ogden Beeman
Site Restoration	$600,000	per dredge launch site			
Length of Piping	95,000	ft	18	mi	Distance to Town of Holland (map provided by Fred Swed). 11 mi of hard piping plus 7 mi of floating pipe
Piping Purchase/Installation	$67	per ft			Ogden Beeman
Number of Road Crossings	12	each			pj, review map
Cost per Road Crossing	$50,000	per crossing			pj, review map
Number of Booster Pumps	4	each			Ogden Beeman
Booster Pump Cost	$2,500	per day			Ogden Beeman
Mechanical - 8 cy bucket					
Dock Construction	$400,000	LS			pj
Mobilization - Equipment	$455,000	per dredge			Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS			Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea			Ogden Beeman - JAG estimate
Shift Rate (10 hours)	$17,000	per shift			Ogden Beeman
Dredge Rate	1900	cy in situ per 10 hour shift			Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area			pj
Free Water per cy Dredged (10%)	20	gal			Ogden Beeman
Offload Crane Mobilization	$50,000	LS			pj
Site Restoration	$500,000	LS			pj
High Temperature Thermal Desorption					
Setup Staging Area	$50,000				pj
Mobilization/Site Prep	$150,000				Maxymillian
Sediment Treatment QA	$2	per ton			
Ratio of Amending Sand Volume to Dredge Vol.	0.25	:1			
Sand Purchase and Deliver	$6	per ton			Ole
Blending	$25	per ton			Ole
HTTD (includes off-gas treatment)	$75	per ton			Maxymillian
Stack Testing	$50,000	LS			Maxymillian
Place Treated Material	$3	per ton			
Vitrification					
Capital Costs	$36,000,000	LS			Unit Cost Study- Minergy
Operating Costs	$6,800,000	per year			Unit Cost Study- Minergy
Vitrification (Unit Cost includes Cap and Oper Costs)	$24.0	per ton			Unit Cost Study- Minergy

Capping						
Mobilization/Site Prep	$200,000					Ogden Beeman
Area	12,497,672	sf	1,161,100	m2		
Sand Cap Depth	1.7	feet				
Sand Purchase	$6	per ton				Ole
Placement Rate	$6	per cy				Ogden Beeman
Sand Density	1.4	tons per cy				
Armored Cap Depth	1.0	feet				
Cobbles	$30	per cy				Means
Sand Density	1.4	tons per cy				
Cap Placement QA	$100,000	LS				Ogden Beeman
Long-term O&M	2%	of capital				pj
Long-term Monitoring	$400,000	per year				Anne LTM
Nearshore CDF			Bayport			
Land Lease or Purchase	$1.80	per sf				Baird
Length	9,600	lf				Baird
Capping Volume	205,000	cy	2,178,000			Baird
Seeding Area	300,000	sy	2,178,000			Baird
Sheetpile Wall Length	9,600	lf				based on bathymetry
Sheetpile Depth	30	ft				pj
Sheetpile Cost	$19	per sf				Baird
Shot Rock Berm	$500	per lf				Baird
Rip Rap	$210	per lf				pj
Clean Soil Cap	$10	per cy				Baird
Seeding	$1	per sy				Baird
Mitigation	$10,000	per acre				Tim
	$10,000	per year				Tim
Long-term Monitoring	$650,000	per year				Anne LTM
Long-term O&M	2%	of capital				pj
Solidification						
Percent Lime	10.0%	(w/w)				Montgomery Watson
Lime	$60	per ton	Mixing	$25	per ton	pj, pug mill mixing
Dewatering - Mechanical						
Mobilization	$100,000					pj
Holding Pond-Centrifuge	$80	per bone dry ton				Global Dewatering
Dewatering - Upland Pond (2 cells)						
Land Lease or Purchase	$1.80	per sf				Ole
Area	4,491,228	sf	103.10			2 days slurry + 13 wk solids * 2 cells * 2 shifts per day
Perimeter	8,477	lf	2119.251741			assume square
Depth of Material in Dewatering Cell	8	feet				based on size at Arrowhead Park
Cell Retention Time	24	hours				Not Used
Cell Depth	10	feet				
Mobilization	$20,000	LS				
Clear and Grub	$2,000	per acre				pj
Berm Volume	10.4	cy per lf				2:1 slope, 8-foot top
Berm Construction	$6	per cy				pj
Rough Grading	$0.25	per sf				pj
Alphalt Liner	$1.50	per sf				pj, 2 2-inch lifts
Demob/Disposal	$10,000	LS				pj
Regrade Berm Soils	$6	per cy				pj
Seed/Sod	$1	per sy				Baird
Water Treatment						
Flow Rate (3 Mechanical Dredges)	57	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges)	$216,590	LS				pj
Flow Rate (3 Mechanical Dredges to CDF)	287	gpm				assume operate 24/7
Unit, Purchase (3 Mechanical Dredges to CDF)	$570,498	LS				pj
Flow Rate (2 Hydraulic Dredges)	3,563	gpm				assume operate 24/7
Unit, Purchase (Hydraulic Dredge)	$2,586,470	LS				pj
Flow Rate (2 Hydraulic Dredges; settling pond)	3,110	gpm				assume operate 24/7
Flow Rate (mechanical dewatering)	3,563	gpm				
Unit, Purchase (mechanical dewatering)	$2,586,470	LS				
Water Treatment (Including Operator)	$0.40	per 1,000 gallons				pj
Water Treatment QA	$200	per day				pj, 1 sample/day
Length of piping for treated water discharge	20,000	feet				Distance from town of Holland to river per map provided by Fred Swed
Disposal						
Existing NR 500 Commercial Disposal Facility						
Load Soil for Hauling	$2.80	per ton				pj
Round-trip Hauling	2	hours				pj
Round-trip Hauling (to Vitrification Facility)	0.5	hours				pj
Tipping Fee (non-TSCA)	$43	per ton				St. Paul
Tipping Fee (TSCA)	$55	per ton				St. Paul
Truck Rate	$75	per hour				pj
Truck Load	32	tons				pj
Conveyer System Construction	1,000,000	LS				pj
New Landfill Disposal (Dedicated NR 500 Monofill)						
Landfill Construction	$17,092,830					
Local Siting Fee	$5	per cy				
Closure Cap	$100,000	per acre				
Operating Cost	$500,000	per year				
Post-closure Monitoring	$30,000	per year				

Institutional Controls		
Public Education Program	$100,000	pj
O&M Plans	$20,000	pj
Deed Restrictions	$5,000	pj
Annual Costs		
Public Education Program	$30,000	pj
Maintaining O&M Plans	$800	pj
Reporting	$20,000	pj
Long-term Monitoring	$600,000	Anne LTM
Long-term Monitoring (no action)	$300,000	Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE C1: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Passive Dewatering)

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	3	LS		$1,470,000
Watertight Barges	4	ea		$400,000
Offload Stockpile Area Prep.	1	LS		$75,000
Dredging - 12 hour shifts	2,378	Day	18.29230769	$40,426,000
Dredge Monitoring (Water Quality)	2,378	Day		$7,134,000
Sediment Removal QA	2,378	Day		$2,853,600
Offload Crane Mobilization	1	LS		$50,000
Site Restoration	1	ea		$500,000
Direct Capital:				$52,908,600
Engineering, Procurement & Construction Management:				6,349,032
Contractor Overhead/Profit:				7,936,290
Total Capital:				**$67,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	57	gpm	$216,590
Water Treatment (Includes Operator)	91,233,227	gal	$36,493
Water Treatment QA	1,110	day	$222,000
Direct Capital:			$475,083
Engineering, Procurement & Construction Management:			57,010
Total Capital:			**$500,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	4,725,974	ton	$118,149,341
Lime Purchase	472,598	ton	$28,355,880
Soil Loading	4,725,974	ton	$13,232,726
Soil Hauling	4,725,974	ton	$22,153,001
Tipping Fees (non-TSCA)	4,474,078	ton	$192,385,360
Tipping Fees (TSCA)	251,896	ton	$13,854,253
Direct Capital:			$388,130,561
Engineering, Procurement & Construction Management:			46,575,667
Total Capital:			**$434,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units	Cost
Clean Soil Cap	2,178,000	cy	$21,780,000
Seeding	2,178,000	sy	$2,178,000
Mitigation	450	acre	$4,500,000
Present Worth of Direct Capital:			$2,766,749
Engineering, Procurement & Construction Management:			$332,010
Total Capital:			**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**

TOTAL COST **$511,100,000**

ALTERNATIVE C2A: Dredge Sediment with Combined Dewatering and Disposal Facility

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	715	acre		$11,440,000
Dredging - 2 12 hour shifts/day	783	Day	4.302197802	$22,237,200
Dredge Monitoring (Water Quality)	783	Day		$4,698,000
Sediment Removal QA	783	Day		$1,879,200
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$7,830,000
Winter Over All Equipment	5	yr		$1,425,000
Site Restoration	1	LS		$600,000
Direct Capital:				$59,851,200
Engineering, Procurement & Construction Management:				7,182,144
Contractor Overhead/Profit:				8,977,680
Total Capital:				**$76,000,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Including Operator)	4,016,428,155	gal	$1,606,571
Water Treatment QA	783	Day	$313,200
Piping	20,000	ft	$1,340,000
Direct Capital:			$5,846,241
Engineering, Procurement & Construction Management:			701,549
Total Capital:			**$6,500,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units	Cost
Landfill Construction	1	LS	$17,092,830
Local Siting Fee	2,699,709	cy	$13,498,544
Closure	84	acres	$8,366,866
Direct Capital:			$38,958,240
Engineering, Procurement & Construction Management:			4,674,989
Total Capital:			**$43,600,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Operations	10	$500,000	$3,680,044
Post Closure Monitoring	40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs			$3,932,097
Total Project Capital and O&M Cost			**$47,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**
TOTAL COST			**$138,700,000**

ALTERNATIVE C2B: Dredge Sediment with Separate Dewatering and Disposal Facilities

SEDIMENT REMOVAL (2 12-INCH CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	715	acre		$11,440,000
Dredging - 2 12 hour shifts/day	783	Day	4.302197802	$22,237,200
Dredge Monitoring (Water Quality)	783	Day		$4,698,000
Sediment Removal QA	783	Day		$1,879,200
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$7,830,000
Winter Over All Equipment	5	yr		$1,425,000
Site Restoration	1	LS		$600,000
Direct Capital:				$59,851,200
Engineering, Procurement & Construction Management:				7,182,144
Contractor Overhead/Profit:				8,977,680
Total Capital:				**$76,000,000**

SEDIMENT DEWATERING (GRAVITY - NR 213)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	3,505,812,959	gal	$1,402,325
Water Treatment QA	783	Day	$313,200
Piping	20,000	ft	$1,340,000
Direct Capital:			$5,641,995
Engineering, Procurement & Construction Management:			677,039
Total Capital:			**$6,300,000**

SEDIMENT DISPOSAL (Dedicated NR 500 Monofill)

Capital Items	Quantity	Units		Cost
Solidification	5,324,597	ton		$133,114,924
Lime Purchase	532,460	ton		$31,947,600
Sediment Loading	5,324,597	ton		$14,908,872
Sediment Hauling	5,324,597	ton		$24,959,048
Landfill Construction	1	LS		$17,092,830
Local Siting Fee	2,699,709	cy		$13,498,544
Closure	84	acres		$8,366,866
Direct Capital:				$243,888,684
Engineering, Procurement & Construction Management:				29,266,642
Total Capital:				**$273,200,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Operations		10	$500,000	$3,680,044
Post Closure Monitoring		40	$30,000	$252,053
Total Present Worth, Longer Term O&M Costs				$3,932,097
Total Project Capital and O&M Cost				**$277,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**

TOTAL COST	**$388,000,000**

ALTERNATIVE C3: Dredge Sediment With Disposal at Existing NR 500 Commercial Disposal Facility (Mechanical Dewatering)

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEADS)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	715	acre		$11,440,000
Dredging - 2 12 hour shifts/day	783	Day	4.302197802	$22,237,200
Dredge Monitoring (Water Quality)	783	Day		$4,698,000
Sediment Removal QA	783	Day		$1,879,200
Winter Over All Equipment	5	yr		$1,425,000
Site Restoration	1	LS		$600,000
Direct Capital:				$45,056,200
Engineering, Procurement & Construction Management:				5,406,744
Contractor Overhead/Profit:				6,758,430
Total Capital:				**$57,200,000**

SEDIMENT DEWATERING (MECHANICAL)

Capital Items	Quantity	Units	Cost
Mobilization/Site Prep	1	LS	$100,000
Dewatering	1,597,379	bdt	$127,790,327
Direct Capital:			$127,890,327
Engineering, Procurement & Construction Management:			15,346,839
Total Capital:			**$143,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,563	gpm	$2,586,470
Water Treatment (Includes Operator)	4,016,428,155	gal	$1,606,571
Water Treatment QA	2,193	day	$438,600
Direct Capital:			$4,631,641
Engineering, Procurement & Construction Management:			555,797
Total Capital:			**$5,200,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Soil Loading	3,194,758	ton	$8,945,323
Soil Hauling	3,194,758	ton	$14,975,429
Tipping Fees (non-TSCA)	3,024,477	ton	$130,052,503
Tipping Fees (TSCA)	170,281	ton	$9,365,475
Direct Capital:			$163,338,730
Engineering, Procurement & Construction Management:			19,600,648
Total Capital:			**$182,900,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**
TOTAL COST			**$397,200,000**

ALTERNATIVE D: Dredge Sediment, CDF and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	2,378	Day	$40,426,000
Dredge Monitoring (Water Quality)	2,378	Day	$7,134,000
Sediment Removal QA	2,378	Day	$2,853,600
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$52,908,600
Engineering, Procurement & Construction Management:			6,349,032
Contractor Overhead/Profit:			7,936,290
Total Capital:			**$67,200,000**

CDF CONSTRUCTION

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	2,700,000	sf	$4,860,000
Shot Rock/Rip Rap	9,600	lf	$6,816,000
Sheetpile Placement	288,000	sf	$5,472,000
Clean Soil Cap	205,000	cy	$2,050,000
Seeding	300,000	sy	$300,000
Mitigation	62	acre	$619,835
Direct Capital:			$20,117,835
Engineering, Procurement & Construction Management:			$2,414,140
Total Capital:			**$22,531,975**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	Cost
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs			**$16,711,012**
Total Project Capital and O&M Cost			**$39,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	264,874,779	gal	$105,950
Water Treatment QA	1,110	day	$222,000
Direct Capital:			$898,448
Engineering, Procurement & Construction Management:			107,814
Total Capital:			**$1,000,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units		Cost
Solidification	2,490,541	ton		$62,263,525
Lime Purchase	249,055	ton		$14,943,300
Soil Loading	2,490,541	ton		$6,973,515
Soil Hauling	2,490,541	ton		$11,674,411
Tipping Fees (non-TSCA)	2,238,645	ton		$96,261,755
Tipping Fees (TSCA)	477,989	ton		$26,289,406
Direct Capital:				$218,405,911
Engineering, Procurement & Construction Management:				26,208,709
Total Capital:				**$244,600,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$360,700,000**

ALTERNATIVE E: Dredge Sediment and Thermal Treatment

SEDIMENT REMOVAL (2 - 12-inch CUTTERHEAD'S)

Capital Items	Quantity	Units		Cost
Site Preparation	2	LS		$1,606,800
Mobilization - Equipment and Silt Curtain	1	LS		$1,170,000
Debris Sweep	715	acre		$11,440,000
Dredging - 2 12 hour shifts/day	783	Day	4.302197802	$22,237,200
Dredge Monitoring (Water Quality)	783	Day		$4,698,000
Sediment Removal QA	783	Day		$1,879,200
Piping	95,000	ft		$6,365,000
Road Crossings	12	ea		$600,000
Booster Pumps	4	ea		$7,830,000
Winter Over All Equipment	5	yr		$1,425,000
Site Restoration	1	LS		$600,000
Direct Capital:				$59,851,200
Engineering, Procurement & Construction Management:				7,182,144
Contractor Overhead/Profit:				8,977,680
Total Capital:				**$76,000,000**

SEDIMENT DEWATERING (GRAVITY)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,491,228	sf	$8,084,210
Mobilization	1	LS	$20,000
Clear and Grub	4,491,228	sf	$206,209
Berm Construction	87,910	cy	$527,458
Rough Grading	4,491,228	sf	$1,122,807
Liner Placement	4,491,228	sf	$6,736,842
Demob/Disposal	1	LS	$10,000
Regrade	87,910	cy	$527,458
Seed/Sod	499,025	sy	$499,025
Direct Capital:			$17,734,010
Engineering, Procurement & Construction Management:			2,128,081
Total Capital:			**$19,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	3,110	gpm	$2,586,470
Water Treatment (Including Operator)	3,505,812,959	gal	$1,402,325
Water Treatment QA	783	Day	$313,200
Piping	95,000	ft	$6,365,000
Direct Capital:			$10,666,995
Engineering, Procurement & Construction Management:			1,280,039
Total Capital:			**$11,900,000**

SEDIMENT TREATMENT (VITRIFICATION 2x375 t Standalone Storage Units)

Capital Items	Quantity	Units	Cost
Sediment Treatment	5,324,597	ton	$127,790,327
Soil Loading	5,324,597	ton	$14,908,872
Soil Hauling	5,324,597	ton	$6,239,762
Direct Capital:			$148,938,961
Engineering, Procurement & Construction Management:			$17,872,675
Total Capital:			**$166,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	972	$14,628
Long-term Monitoring	40	63,194	$950,842
Long-term O&M	40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs			**$1,056,130**
Total Project Capital and O&M Cost			**$4,200,000**
TOTAL COST			**$283,300,000**

ALTERNATIVE F: Cap Sediment to Maximum Extent Possible,Dredge to CDF and Off-site Disposal

CDF CONSTRUCTION

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	2,700,000	sf		$4,860,000
Shot Rock/Rip Rap	9,600	lf		$6,816,000
Sheetpile Placement	288,000	sf		$5,472,000
Clean Soil Cap	205,000	cy		$2,050,000
Seeding	300,000	sy		$300,000
Mitigation	62	acre		$619,835
Direct Capital:				$20,117,835
Engineering, Procurement & Construction Management:				$2,414,140
Total Capital:				**$22,531,975**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	450,639	$6,780,456
Total Present Worth, Longer Term O&M Costs			**$16,711,012**
Total Project Capital and O&M Cost			**$39,200,000**

CAPPING

Capital Items	Quantity	Units		Cost
Mobilization/Site Prep	1	LS		$200,000
Sand Purchase	1,080,046	tons		$6,480,275
Sand Placement	771,461	cy		$4,628,768
Cobble Purchase and Placement	462,877	cy		$13,886,303
Cap Placement QA	1	LS		$100,000
Direct Capital:				$25,295,345
Engineering, Procurement & Construction Management:				3,035,441
Total Capital:				**$28,330,786**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Monitoring/O&M			
Long-term Monitoring	40	$400,000	$6,018,519
Long-term O&M	40	$566,616	$8,525,468
Total Present Worth, Longer Term O&M Costs			$14,543,987
Total Project Capital and O&M Cost			**$42,900,000**

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	3	LS	$1,470,000
Watertight Barges	4	ea	$400,000
Offload Stockpile Area Prep.	1	LS	$75,000
Dredging - 12 hour shifts	1,633	Day	$27,761,000
Dredge Monitoring (Water Quality)	1,633	Day	$4,899,000
Sediment Removal QA	1,633	Day	$1,959,600
Offload Crane Mobilization	1	LS	$50,000
Site Restoration	1	ea	$500,000
Direct Capital:			$37,114,600
Engineering, Procurement & Construction Management:			4,453,752
Contractor Overhead/Profit:			5,567,190
Total Capital:			**$47,100,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	287	gpm	$570,498
Water Treatment (Includes Operator)	236,290,366	gal	$94,516
Water Treatment QA	1,110	day	$222,000
Direct Capital:			$887,014
Engineering, Procurement & Construction Management:			106,442
Total Capital:			**$1,000,000**

SEDIMENT DISPOSAL (Existing NR 500 Commercial Disposal Facility)

Capital Items	Quantity	Units	Cost
Solidification	1,009,840	ton	$25,246,000
Lime Purchase	100,984	ton	$6,059,040
Soil Loading	1,009,840	ton	$2,827,552
Soil Hauling	1,009,840	ton	$4,733,625
Tipping Fees (non-TSCA)	757,944	ton	$32,591,604
Tipping Fees (TSCA)	251,896	ton	$13,854,265
Direct Capital:			$85,312,086
Engineering, Procurement & Construction Management:			10,237,450
Total Capital:			**$95,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			**$4,513,889**
Total Project Capital and O&M Cost			**$4,500,000**

BAYPORT CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	2,178,000	cy		$21,780,000
Seeding	2,178,000	sy		$2,178,000
Mitigation	450	acre		$4,500,000
Present Worth of Direct Capital:				$2,766,749
Engineering, Procurement & Construction Management:				$332,010
Total Capital:				**$3,098,759**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	972	$14,628
Long-term Monitoring		40	63,194	$950,842
Long-term O&M		40	6,025	$90,659
Total Present Worth, Longer Term O&M Costs				**$1,056,130**
Total Project Capital and O&M Cost				**$4,200,000**
TOTAL COST				**$234,400,000**

Table 7-3 Cost Summary for Remedial Alternatives - Zone 2

500 ppb

Alternative	Dredge Volume (cy)	Mechanical Dredging	Water Treatment	CAD Construction	CDF Construction	Renard Island Closure	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
D	29,748,004	$327,500,000	$1,200,000	---	$476,000,000	$15,500,000	---	$4,500,000	$824,700,000	$164,940,000	$989,640,000
G	29,748,004	$327,500,000	$1,200,000	$358,700,000	---	$15,500,000	---	$4,500,000	$707,400,000	$141,480,000	$848,880,000

1000 ppb

Alternative	Dredge Volume (cy)	Mechanical Dredging	Water Treatment	CAD Construction	CDF Construction	Renard Island Closure	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
D	29,322,254	$322,900,000	$1,200,000	---	$470,000,000	$15,500,000	---	$4,500,000	$814,100,000	$162,820,000	$976,920,000
G	29,322,254	$322,900,000	$1,200,000	$353,700,000	---	$15,500,000	---	$4,500,000	$697,800,000	$139,560,000	$837,360,000

5000 ppb

Alternative	Dredge Volume (cy)	Mechanical Dredging	Water Treatment	CAD Construction	CDF Construction	Renard Island Closure	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	4,070,170	$48,700,000	$700,000	---	---	$15,500,000	$437,800,000	$4,500,000	$507,200,000	$101,440,000	$608,640,000
D	4,070,170	$48,700,000	$700,000	---	$97,100,000	$15,500,000	---	$4,500,000	$166,500,000	$33,300,000	$199,800,000
G	4,070,170	$48,700,000	$700,000	$54,600,000	---	$15,500,000	---	$4,500,000	$124,000,000	$24,800,000	$148,800,000

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
Zone 2
Action Level - 500 ppb

Material Handling Assumptions:							
Volume > 500 ppb	29,748,004	cy			22,708,400	m3	
Volume > 1,000 ppb	29,322,254	cy			22,383,400	m3	
Volume > 5,000 ppb	4,070,170	cy			3,107,000	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	49.5%	w/w	29.3%	v/v	1.18	tons per cy	
Slurry Density (20% in situ)	12.8%	w/w	5.9%	v/v	0.91	tons per cy	
Dewatered Density (settling pond)	49.5%	w/w	29.3%	v/v	1.18	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	29,336,664	cy			22,394,400	m3	
CAD Capacity	29,336,664	cy			22,394,400	m3	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Mechanical - 12 cy bucket							
Dock Construction	$400,000	LS					Ogden Beeman
Mobilization - Equipment	$315,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman (JAG estimate)
Shift Rate (10 hours)	$30,000	per shift					Ogden Beeman
Dredge Rate	4000	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Site Restoration	$670,000	LS					
Nearshore CDF			Renard Island				
Land Lease or Purchase	$1.80	per sf					Ole
Length	20,948	lf					Baird
Capping Volume	3,880,174	cy	290,400				Baird
Area	34,921,570	sf	2,613,600				Baird
Ground Treatment Volume	117,777	cy					
Ground Treatment	$25	per cy					
Dredge Volume	3,880,174	cy					
Fill Purchase/Placement	$30	per cy					
Sheetpile Area	2,513,814	sf					Baird
Sheetpile Cost	$19	per sf					Grant
Shot Rock Berm	$650	per lf					Baird
Rip Rap	$215	per lf					Baird
Place Treated Material	$2	per cy					
Clean Soil Cap	$10	per cy					Baird
Seeding	$1	per sy					Baird
Mitigation	$10,000	per acre					
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					
Long-term O&M	2%	of capital					
CAD							
Removal Volume	29,748,004	cy					
Area	50,199,757	sf					
Sand Cap Thickness	3	ft					
Mobilization/Site Prep	$200,000						
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Cap Placement QA	$100,000	LS					
Long-term O&M	2%	of capital					
Long-term Monitoring	$400,000	per year					
Water Treatment							
Flow Rate (7 dredges)	281	gpm					assume operate 24/7
Unit, Purchase	$562,869	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample per day
Institutional Controls							
Public Education Program	$100,000						pj
O&M Plans	$20,000						pj
Deed Restrictions	$5,000						pj
Annual Costs							
Public Education Program	$30,000						pj
Maintaining O&M Plans	$800						pj
Reporting	$20,000						pj
Long-term Monitoring	$600,000						Anne LTM
Long-term Monitoring (no action)	$300,000						Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	7	LS		$2,450,000
Watertight Barges	4	ea		$400,000
Dredging - 12 hour shifts	7,437	Day	57.20769231	$223,110,000
Dredge Monitoring (Water Quality)	7,437	Day		$22,311,000
Sediment Removal QA	7,437	Day		$8,924,400
Site Restoration	1	ea		$670,000
Direct Capital:				$257,865,400
Engineering, Procurement & Construction Management:				30,943,848
Contractor Overhead/Profit:				38,679,810
Total Capital:				**$327,500,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	600,790,689	gal	$240,316
Water Treatment QA	1,488	day	$297,600
Direct Capital:			$1,100,786
Engineering, Procurement & Construction Management:			132,094
Total Capital:			**$1,200,000**

CDF CONSTRUCTION (Cellular Cofferdam Design)

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	34,921,570	sf		$62,858,826
Ground Treatment	117,777	cy		$2,944,420
Dredging	3,695	day		$21,063,804
Fill Purchase/Placement	3,880,174	cy		$116,405,233
Shot Rock/Rip Rap	20,948	lf		$18,120,406
Sheetpile Placement	2,513,814	sf		$47,762,457
Clean Soil Cap	3,880,174	cy		$38,801,744
Seeding	3,880,174	sy		$3,880,174
Mitigation	802	acre		$8,016,889
Direct Capital:				$319,853,954
Engineering, Procurement & Construction Management:				$38,382,475
Total Capital:				**$358,236,429**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	7,164,729	$107,802,633
Total Present Worth, Longer Term O&M Costs				**$117,733,189**
Total Project Capital and O&M Cost				**$476,000,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	290,400	cy		$2,904,000
Seeding	290,400	sy		$290,400
Mitigation	60	acre		$600,000
Direct Capital:				$3,794,400
Engineering, Procurement & Construction Management:				$455,328
Total Capital:				**$4,249,728**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs				**$11,209,409**
Total Project Capital and O&M Cost				**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				**$4,513,889**
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$824,700,000**

ALTERNATIVE G: Dredge Sediment to CAD

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	7,437	Day	$223,110,000
Dredge Monitoring (Water Quality)	7,437	Day	$22,311,000
Sediment Removal QA	7,437	Day	$8,924,400
Site Restoration	1	ea	$670,000
Direct Capital:			$257,865,400
Engineering, Procurement & Construction Management:			30,943,848
Contractor Overhead/Profit:			38,679,810
Total Capital:			**$327,500,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	600,790,689	gal	$240,316
Water Treatment QA	1,488	day	$297,600
Direct Capital:			$1,100,786
Engineering, Procurement & Construction Management:			132,094
Total Capital:			**$1,200,000**

CAD CONSTRUCTION

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	1	LS	$170,000
Dredging - 12 hour shifts	28,332	Day	$161,492,400
Sand Purchase	7,808,851	tons	$46,853,106
Placement	5,577,751	cy	$33,466,505
Cap Placement QA	1	LS	$100,000
Direct Capital:			$242,082,011
Engineering, Procurement & Construction Management:			29,049,841
Total Capital:			**$271,131,852**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Monitoring/O&M			
Long-term Monitoring	40	$400,000	$6,018,519
Long-term O&M	40	$5,422,637	$81,590,607
Total Present Worth, Longer Term O&M Costs			$87,609,126
Total Project Capital and O&M Cost			**$358,700,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units	Cost
Clean Soil Cap	290,400	cy	$2,904,000
Seeding	290,400	sy	$290,400
Mitigation	60	acre	$600,000
Direct Capital:			$3,794,400
Engineering, Procurement & Construction Management:			$455,328
Total Capital:			**$4,249,728**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs			**$11,209,409**
Total Project Capital and O&M Cost			**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$707,400,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
Zone 2
Action Level - 1,000 ppb

Material Handling Assumptions:									
Volume > 1,000 ppb	29,322,254	cy				22,383,400	m3		
Volume > 500 ppb	29,748,004	cy				22,708,400	m3		
Volume > 5,000 ppb	4,070,170	cy				3,107,000	m3		
Solids Specific Gravity	2.36								
Fresh Water Density	62.4	lb/ft3							
In Situ Density	49.5%	w/w	29.3%	v/v		1.18	tons per cy		
Slurry Density (20% in situ)	12.8%	w/w	5.9%	v/v		0.91	tons per cy		
Dewatered Density (settling pond)	49.5%	w/w	29.3%	v/v		1.18	tons per cy		
Treated Density	93.4%	w/w	60.0%	v/v		1.28	tons per cy		
CDF Capacity	26,394,060	cy				22,394,400	m3		
CAD Capacity	29,336,664	cy				22,394,400	m3		
Cost Estimating Parameters & Methodology:									
Interest Rate	6.0%								
Sales Tax	5.5%								Not Used
Engineering, Procurement and Construction Mgmt	12.0%								
Contractor Overhead and Profit - Dredging Only	15.0%								
<u>Dredging</u>									
Dredge Monitoring (Water Quality)	$3,000	per day							
Sediment Removal QA	$1,200	per day							
Mechanical - 12 cy bucket									
Dock Construction	$400,000	LS							Ogden Beeman
Mobilization - Equipment	$315,000	per dredge							Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS							Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea							Ogden Beeman (JAG estimate)
Shift Rate (10 hours)	$30,000	per shift							Ogden Beeman
Dredge Rate	4000	cy in situ per 10 hour shift							Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area							
Free Water per cy Dredged (10%)	20	gal							Ogden Beeman
Site Restoration	$670,000	LS							
Nearshore CDF					<u>Renard Island</u>				
Land Lease or Purchase	$1.80	per sf							Ole
Length	20,798	lf							Baird
Capping Volume	3,824,642	cy			290,400				Baird
Area	34,421,776	sf			2,613,600				Baird
Ground Treatment Volume	116,931	cy							
Ground Treatment	$25	per cy							
Dredge Volume	3,824,642	cy							
Fill Purchase/Placement	$30	per cy							
Sheetpile Area	2,495,760	sf							Baird
Sheetpile Cost	$19	per sf							Grant
Shot Rock Berm	$650	per lf							Baird
Rip Rap	$215	per lf							Baird
Place Treated Material	$2	per cy							
Clean Soil Cap	$10	per cy							Baird
Seeding	$1	per sy							Baird
Mitigation	$10,000	per acre							
	$10,000	per year							Tim
Long-term Monitoring	$650,000	per year							
Long-term O&M	2%	of capital							
<u>CAD</u>									
Removal Volume	29,322,254	cy							
Area	49,481,304	sf							
Sand Cap Thickness	3	ft							
Mobilization/Site Prep	$200,000								
Placement Rate	$6	per cy							Ogden Beeman
Sand Purchase	$6	per ton							Ole
Sand Density	1.4	tons per cy							
Cap Placement QA	$100,000	LS							
Long-term O&M	2%	of capital							
Long-term Monitoring	$400,000	per year							
<u>Water Treatment</u>									
Flow Rate (7 dredges)	281	gpm							assume operate 24/7
Unit, Purchase	$562,869	LS							pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons							pj
Water Treatment QA	$200	per day							pj, 1 sample per day
<u>Institutional Controls</u>									
Public Education Program	$100,000								pj
O&M Plans	$20,000								pj
Deed Restrictions	$5,000								pj
<u>Annual Costs</u>									
Public Education Program	$30,000								pj
Maintaining O&M Plans	$800								pj
Reporting	$20,000								pj
Long-term Monitoring	$600,000								Anne LTM
Long-term Monitoring (no action)	$300,000								Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	7	LS		$2,450,000
Watertight Barges	4	ea		$400,000
Dredging - 12 hour shifts	7,331	Day	56.39230769	$219,930,000
Dredge Monitoring (Water Quality)	7,331	Day		$21,993,000
Sediment Removal QA	7,331	Day		$8,797,200
Site Restoration	1	ea		$670,000
Direct Capital:				$254,240,200
Engineering, Procurement & Construction Management:				30,508,824
Contractor Overhead/Profit:				38,136,030
Total Capital:				**$322,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	592,192,242	gal	$236,877
Water Treatment QA	1,467	day	$293,400
Direct Capital:			$1,093,146
Engineering, Procurement & Construction Management:			131,178
Total Capital:			**$1,200,000**

CDF CONSTRUCTION (Cellular Cofferdam Design)

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	34,421,776	sf		$61,959,198
Ground Treatment	116,931	cy		$2,923,274
Dredging	3,643	day		$20,762,341
Fill Purchase/Placement	3,824,642	cy		$114,739,255
Shot Rock/Rip Rap	20,798	lf		$17,990,270
Sheetpile Placement	2,495,760	sf		$47,419,440
Clean Soil Cap	3,824,642	cy		$38,246,418
Seeding	3,824,642	sy		$3,824,642
Mitigation	790	acre		$7,902,153
Direct Capital:				$315,766,990
Engineering, Procurement & Construction Management:				$37,892,039
Total Capital:				**$353,659,029**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	7,073,181	$106,425,175
Total Present Worth, Longer Term O&M Costs				**$116,355,731**
Total Project Capital and O&M Cost				**$470,000,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	290,400	cy		$2,904,000
Seeding	290,400	sy		$290,400
Mitigation	60	acre		$600,000
Direct Capital:				$3,794,400
Engineering, Procurement & Construction Management:				$455,328
Total Capital:				**$4,249,728**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs				**$11,209,409**
Total Project Capital and O&M Cost				**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				**$4,513,889**
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$814,100,000**

ALTERNATIVE G: Dredge Sediment to CAD

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	7,331	Day	$219,930,000
Dredge Monitoring (Water Quality)	7,331	Day	$21,993,000
Sediment Removal QA	7,331	Day	$8,797,200
Site Restoration	1	ea	$670,000
Direct Capital:			$254,240,200
Engineering, Procurement & Construction Management:			30,508,824
Contractor Overhead/Profit:			38,136,030
Total Capital:			**$322,900,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	592,192,242	gal	$236,877
Water Treatment QA	1,467	day	$293,400
Direct Capital:			$1,093,146
Engineering, Procurement & Construction Management:			131,178
Total Capital:			**$1,200,000**

CAD CONSTRUCTION

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Dredging - 12 hour shifts	27,926	Day		$159,178,200
Sand Purchase	7,697,092	tons		$46,182,550
Placement	5,497,923	cy		$32,987,536
Cap Placement QA	1	LS		$100,000
Direct Capital:				$238,618,286
Engineering, Procurement & Construction Management:				28,634,194
Total Capital:				**$267,252,480**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$5,345,050	$80,423,203
Total Present Worth, Longer Term O&M Costs				$86,441,722
Total Project Capital and O&M Cost				**$353,700,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	290,400	cy		$2,904,000
Seeding	290,400	sy		$290,400
Mitigation	60	acre		$600,000
Direct Capital:				$3,794,400
Engineering, Procurement & Construction Management:				$455,328
Total Capital:				**$4,249,728**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs				**$11,209,409**
Total Project Capital and O&M Cost				**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$697,800,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
Zone 2
Action Level - 5,000 ppb

Material Handling Assumptions:							
Volume > 5,000 ppb	4,070,170	cy			3,107,000	m3	
Volume > 500 ppb	29,322,254	cy			22,383,400	m3	
Volume > 1,000 ppb	29,748,004	cy			22,708,400	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	49.5%	w/w	29.3%	v/v	1.18	tons per cy	
Slurry Density (20% in situ)	12.8%	w/w	5.9%	v/v	0.91	tons per cy	
Dewatered Density (settling pond)	49.5%	w/w	29.3%	v/v	1.18	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	26,394,060	cy			22,394,400	m3	
CAD Capacity	29,336,664	cy			22,394,400	m3	

Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
Dredging							
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Mechanical - 12 cy bucket							
Dock Construction	$400,000	LS					Ogden Beeman
Mobilization - Equipment	$315,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman (JAG estimate)
Shift Rate (10 hours)	$30,000	per shift					Ogden Beeman
Dredge Rate	4000	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Site Restoration	$670,000	LS					
Nearshore CDF			Renard Island				
Land Lease or Purchase	$1.80	per sf					Ole
Length	7,749	lf					Baird
Capping Volume	530,892	cy	290,400				Baird
Area	4,778,026	sf	2,613,600				Baird
Ground Treatment Volume	43,565	cy					
Ground Treatment	$25	per cy					
Dredge Volume	530,892	cy					
Fill Purchase/Placement	$30	per cy					
Sheetpile Area	929,845	sf					Baird
Sheetpile Cost	$19	per sf					Grant
Shot Rock Berm	$650	per lf					Baird
Rip Rap	$215	per lf					Baird
Place Treated Material	$2	per cy					
Clean Soil Cap	$10	per cy					Baird
Seeding	$1	per sy					Baird
Mitigation	$10,000	per acre					
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					
Long-term O&M	2%	of capital					
Solidification							Tim
Percent Lime	10.0%	(w/w)					
Lime	$60	per ton	Mixing		$25	per ton	Ole
CAD							
Removal Volume	4,070,170	cy					
Area	6,868,412	sf					
Sand Cap Thickness	3	ft					
Mobilization/Site Prep	$200,000						
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Cap Placement QA	$100,000	LS					
Long-term O&M	2%	of capital					
Long-term Monitoring	$400,000	per year					
Water Treatment							
Flow Rate (7 dredges)	281	gpm					assume operate 24/7
Unit, Purchase	$562,869	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample per day

Disposal			
Off-Site Disposal			
Load Soil for Hauling	$2.80	per ton	pj
Round-trip Hauling	2	hours	pj
Tipping Fee (non-TSCA)	$43	per ton	St. Paul
Tipping Fee (TSCA)	$55	per ton	St. Paul
Truck Rate	$75	per hour	pj
Truck Load	32	tons	pj
Institutional Controls			
Public Education Program	$100,000		pj
O&M Plans	$20,000		pj
Deed Restrictions	$5,000		pj
Annual Costs			
Public Education Program	$30,000		pj
Maintaining O&M Plans	$800		pj
Reporting	$20,000		pj
Long-term Monitoring	$600,000		Anne LTM
Long-term Monitoring (no action)	$300,000		Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**
TOTAL COST				**$9,900,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	1,018	Day	$30,540,000
Dredge Monitoring (Water Quality)	1,018	Day	$3,054,000
Sediment Removal QA	1,018	Day	$1,221,600
Site Restoration	1	ea	$670,000
Direct Capital:			$38,335,600
Engineering, Procurement & Construction Management:			4,600,272
Contractor Overhead/Profit:			5,750,340
Total Capital:			**$48,700,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	82,201,153	gal	$32,880
Water Treatment QA	204	day	$40,800
Direct Capital:			$636,550
Engineering, Procurement & Construction Management:			76,386
Total Capital:			**$700,000**

CDF CONSTRUCTION (Cellular Cofferdam Design)

Capital Items	Quantity	Units	Cost
Land Lease or Purchase	4,778,026	sf	$8,600,446
Ground Treatment	43,565	cy	$1,089,124
Dredging	506	day	$2,881,984
Fill Purchase/Placement	530,892	cy	$15,926,752
Shot Rock/Rip Rap	7,749	lf	$6,702,630
Sheetpile Placement	929,845	sf	$17,667,049
Clean Soil Cap	530,892	cy	$5,308,917
Seeding	530,892	sy	$530,892
Mitigation	110	acre	$1,096,884
Direct Capital:			$59,804,678
Engineering, Procurement & Construction Management:			$7,176,561
Total Capital:			**$66,981,240**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	1,339,625	$20,156,392
Total Present Worth, Longer Term O&M Costs			**$30,086,948**
Total Project Capital and O&M Cost			**$97,100,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units	Cost
Clean Soil Cap	290,400	cy	$2,904,000
Seeding	290,400	sy	$290,400
Mitigation	60	acre	$600,000
Direct Capital:			$3,794,400
Engineering, Procurement & Construction Management:			$455,328
Total Capital:			**$4,249,728**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs			**$11,209,409**
Total Project Capital and O&M Cost			**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				**$4,513,889**
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$166,500,000**

ALTERNATIVE G: Dredge Sediment to CAD

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	1,018	Day	$30,540,000
Dredge Monitoring (Water Quality)	1,018	Day	$3,054,000
Sediment Removal QA	1,018	Day	$1,221,600
Site Restoration	1	ea	$670,000
Direct Capital:			$38,335,600
Engineering, Procurement & Construction Management:			4,600,272
Contractor Overhead/Profit:			5,750,340
Total Capital:			**$48,700,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	82,201,153	gal	$32,880
Water Treatment QA	204	day	$40,800
Direct Capital:			$636,550
Engineering, Procurement & Construction Management:			76,386
Total Capital:			**$700,000**

CAD CONSTRUCTION

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Dredging - 12 hour shifts	3,877	Day		$22,098,900
Sand Purchase	1,068,420	tons		$6,410,518
Placement	763,157	cy		$4,578,941
Cap Placement QA	1	LS		$100,000
Direct Capital:				$33,358,359
Engineering, Procurement & Construction Management:				4,003,003
Total Capital:				**$37,361,362**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$747,227	$11,243,003
Total Present Worth, Longer Term O&M Costs				$17,261,522
Total Project Capital and O&M Cost				**$54,600,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units		Cost
Clean Soil Cap	290,400	cy		$2,904,000
Seeding	290,400	sy		$290,400
Mitigation	60	acre		$600,000
Direct Capital:				$3,794,400
Engineering, Procurement & Construction Management:				$455,328
Total Capital:				**$4,249,728**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs				**$11,209,409**
Total Project Capital and O&M Cost				**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$124,000,000**

ALTERNATIVE C: Dredge and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	1,018	Day	$30,540,000
Dredge Monitoring (Water Quality)	1,018	Day	$3,054,000
Sediment Removal QA	1,018	Day	$1,221,600
Site Restoration	1	ea	$670,000
Direct Capital:			$38,335,600
Engineering, Procurement & Construction Management:			4,600,272
Contractor Overhead/Profit:			5,750,340
Total Capital:			**$48,700,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	281	gpm	$562,869
Water Treatment (Includes Operator)	82,201,153	gal	$32,880
Water Treatment QA	204	day	$40,800
Direct Capital:			$636,550
Engineering, Procurement & Construction Management:			76,386
Total Capital:			**$700,000**

SEDIMENT DISPOSAL (OFF-SITE)

Capital Items	Quantity	Units	Cost
Solidification	4,797,107	ton	$119,927,675
Lime Purchase	479,711	ton	$28,782,660
Soil Loading	4,797,107	ton	$13,431,900
Soil Hauling	4,797,107	ton	$22,486,439
Tipping Fees (non-TSCA)	4,797,107	ton	$206,275,594
Direct Capital:			$390,904,268
Engineering, Procurement & Construction Management:			46,908,512
Total Capital:			**$437,800,000**

RENARD ISLAND CLOSURE

Capital Items	Quantity	Units	Cost
Clean Soil Cap	290,400	cy	$2,904,000
Seeding	290,400	sy	$290,400
Mitigation	60	acre	$600,000
Direct Capital:			$3,794,400
Engineering, Procurement & Construction Management:			$455,328
Total Capital:			**$4,249,728**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Mitigation	40	10,000	$150,463
Long-term Monitoring	40	650,000	$9,780,093
Long-term O&M	40	84,995	$1,278,853
Total Present Worth, Longer Term O&M Costs			**$11,209,409**
Total Project Capital and O&M Cost			**$15,500,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units	Cost
Deed Restrictions	1	LS	$5,000
Direct Capital:			$5,000
Engineering, Procurement & Construction Management:			600
Total Capital:			**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			**$4,513,889**
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$507,200,000**

Table 7-3 Cost Summary for Remedial Alternatives - Zone 3A

500 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Dewatering	Water Treatment	CAD Construction	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
D	16,328,102	---	$181,800,000	---	$3,000,000	---	$285,000,000	---	$4,500,000	$474,300,000	$94,860,000	$569,160,000
G	16,328,102	---	$181,800,000	---	$3,000,000	$199,800,000	---	---	$4,500,000	$389,100,000	$77,820,000	$466,920,000

1000 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Dewatering	Water Treatment	CAD Construction	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
C	14,410	---	$4,600,000	---	$600,000	---	---	$1,300,000	$4,500,000	$11,000,000	$2,200,000	$13,200,000

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
Zone 3A
Action Level - 500 ppb

Material Handling Assumptions:							
Volume > 500 ppb	16,328,102	cy			12,464,200	m3	
Volume > 1,000 ppb	14,410	cy			11,000	m3	
Volume > 5,000 ppb	0	cy			0	m3	
Solids Specific Gravity	2.36						
Fresh Water Density	62.4	lb/ft3					
In Situ Density	28.5%	w/w	14.4%	v/v	1.01	tons per cy	
Slurry Density (20% in situ)	6.5%	w/w	2.9%	v/v	0.88	tons per cy	
Dewatered Density	50.0%	w/w	29.8%	v/v	1.18	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy	
CDF Capacity	26,500,893	cy			22,394,400	m3	
CAD Capacity	29,336,664	cy			22,394,400	m3	
Cost Estimating Parameters & Methodology:							
Interest Rate	6.0%						
Sales Tax	5.5%						Not Used
Engineering, Procurement and Construction Mgmt	12.0%						
Contractor Overhead and Profit - Dredging Only	15.0%						
<u>Dredging</u>							
Dredge Monitoring (Water Quality)	$3,000	per day					
Sediment Removal QA	$1,200	per day					
Mechanical - 12 cy bucket							
Dock Construction	$400,000	LS					Ogden Beeman
Mobilization - Equipment	$315,000	per dredge					Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS					Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea					Ogden Beeman (JAG estimate)
Shift Rate (10 hours)	$30,000	per shift					Ogden Beeman
Dredge Rate	4000	cy in situ per 10 hour shift					Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area					
Free Water per cy Dredged (10%)	20	gal					Ogden Beeman
Site Restoration	$670,000	LS					
Nearshore CDF							
Land Lease or Purchase	$1.80	per sf					Ole
Length	15,520	lf					Baird
Capping Volume	2,129,752	cy					Baird
Area	19,167,772	sy					Baird
Ground Treatment Volume	87,257	cy					
Ground Treatment	$25	per cy					
Dredge Volume	2,129,752	cy					
Fill Purchase/Placement	$30	per cy					
Sheetpile Area	1,862,396	sf					Baird
Sheetpile Cost	$19	per sf					Grant
Shot Rock Berm	$650	per lf					Baird
Rip Rap	$215	per lf					Baird
Place Treated Material	$2	per cy					
Clean Soil Cap	$10	per cy					Baird
Seeding	$1	per sy					Baird
Mitigation	$10,000	per acre					
	$10,000	per year					Tim
Long-term Monitoring	$650,000	per year					
Long-term O&M	2%	of capital					
<u>CAD</u>							
Removal Volume	16,328,102	cy					
Area	27,553,672	sf					
Sand Cap Thickness	3	ft					
Mobilization/Site Prep	$200,000						
Placement Rate	$6	per cy					Ogden Beeman
Sand Purchase	$6	per ton					Ole
Sand Density	1.4	tons per cy					
Cap Placement QA	$100,000	LS					
Long-term O&M	2%	of capital					
Long-term Monitoring	$400,000	per year					
<u>Water Treatment</u>							
Flow Rate (7 dredges)	1,727	gpm					assume operate 24/7
Unit, Purchase	$1,674,760	LS					pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons					pj
Water Treatment QA	$200	per day					pj, 1 sample per day
<u>Institutional Controls</u>							
Public Education Program	$100,000						pj
O&M Plans	$20,000						pj
Deed Restrictions	$5,000						pj
<u>Annual Costs</u>							
Public Education Program	$30,000						pj
Maintaining O&M Plans	$800						pj
Reporting	$20,000						pj
Long-term Monitoring	$600,000						Anne LTM
Long-term Monitoring (no action)	$300,000						Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring	40	$600,000	$9,027,778
Public Education Program	40	$30,000	$451,389
Maintaining O&M Plans	40	$800	$12,037
Reporting	40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs			$9,792,130
Total Project Capital and O&M Cost			**$9,900,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	7	LS		$2,450,000
Watertight Barges	4	ea		$400,000
Dredging - 12 hour shifts	4,083	Day	31.40769231	$122,490,000
Dredge Monitoring (Water Quality)	4,083	Day		$12,249,000
Sediment Removal QA	4,083	Day		$4,899,600
Site Restoration	1	ea		$670,000
Direct Capital:				$143,158,600
Engineering, Procurement & Construction Management:				17,179,032
Contractor Overhead/Profit:				21,473,790
Total Capital:				**$181,800,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	1,727	gpm	$1,674,760
Water Treatment (Includes Operator)	2,029,749,525	gal	$811,900
Water Treatment QA	817	day	$163,400
Direct Capital:			$2,650,060
Engineering, Procurement & Construction Management:			318,007
Total Capital:			**$3,000,000**

CDF CONSTRUCTION (Cellular Cofferdam Design)

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	19,167,772	sf		$34,501,989
Ground Treatment	87,257	cy		$2,181,417
Dredging	2,028	day		$11,561,513
Fill Purchase/Placement	2,129,752	cy		$63,892,573
Shot Rock/Rip Rap	15,520	lf		$13,424,770
Sheetpile Placement	1,862,396	sf		$35,385,521
Clean Soil Cap	2,129,752	cy		$21,297,524
Seeding	2,129,752	sy		$2,129,752
Mitigation	440	acre		$4,400,315
Direct Capital:				$188,775,376
Engineering, Procurement & Construction Management:				$22,653,045
Total Capital:				**$211,428,421**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	4,228,568	$63,624,296
Total Present Worth, Longer Term O&M Costs				**$73,554,852**
Total Project Capital and O&M Cost				**$285,000,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				**$4,513,889**
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$474,300,000**

ALTERNATIVE G: Dredge Sediment to CAD

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	4,083	Day	$122,490,000
Dredge Monitoring (Water Quality)	4,083	Day	$12,249,000
Sediment Removal QA	4,083	Day	$4,899,600
Site Restoration	1	ea	$670,000
Direct Capital:			$143,158,600
Engineering, Procurement & Construction Management:			17,179,032
Contractor Overhead/Profit:			21,473,790
Total Capital:			**$181,800,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	1,727	gpm	$1,674,760
Water Treatment (Includes Operator)	2,029,749,525	gal	$811,900
Water Treatment QA	817	day	$163,400
Direct Capital:			$2,650,060
Engineering, Procurement & Construction Management:			318,007
Total Capital:			**$3,000,000**

CAD CONSTRUCTION

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Dredging - 12 hour shifts	15,551	Day		$88,640,700
Sand Purchase	4,286,127	tons		$25,716,761
Placement	3,061,519	cy		$18,369,115
Cap Placement QA	1	LS		$100,000
Direct Capital:				$132,996,575
Engineering, Procurement & Construction Management:				15,959,589
Total Capital:				**$148,956,164**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Monitoring/O&M				
Long-term Monitoring		40	$400,000	$6,018,519
Long-term O&M		40	$2,979,123	$44,824,773
Total Present Worth, Longer Term O&M Costs				$50,843,292
Total Project Capital and O&M Cost				**$199,800,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$389,100,000**

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
Zone 3A
Action Level - 1,000 ppb

Material Handling Assumptions:

Volume > 1,000 ppb	14,410	cy				11,000	m3	
Volume > 500 ppb	16,328,102	cy				12,464,200	m3	
Volume > 5,000 ppb	0	cy				0	m3	
Solids Specific Gravity	2.36							
Fresh Water Density	62.4	lb/ft3						
In Situ Density	28.5%	w/w	14.4%	v/v		1.01	tons per cy	
Slurry Density (20% in situ)	6.5%	w/w	2.9%	v/v		0.88	tons per cy	
Dewatered Density	28.5%	w/w	14.4%	v/v		1.01	tons per cy	
Treated Density	93.4%	w/w	60.0%	v/v		1.28	tons per cy	

Cost Estimating Parameters & Methodology:

Interest Rate	6.0%				
Sales Tax	5.5%				Not Used
Engineering, Procurement and Construction Mgmt	12.0%				
Contractor Overhead and Profit - Dredging Only	15.0%				
Dredging					
Dredge Monitoring (Water Quality)	$3,000	per day			
Sediment Removal QA	$1,200	per day			
Mechanical - 12 cy bucket					
Dock Construction	$400,000	LS			Ogden Beeman
Mobilization - Equipment	$315,000	per dredge			Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS			Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea			Ogden Beeman (JAG estimate)
Shift Rate (10 hours)	$30,000	per shift			Ogden Beeman
Dredge Rate	4000	cy in situ per 10 hour shift			Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area			
Free Water per cy Dredged (10%)	20	gal			Ogden Beeman
Site Restoration	$670,000	LS			
Solidification					Tim
Percent Lime	10.0%	(w/w)			
Lime	$60	per ton	Mixing	$25 per ton	Ole
Water Treatment					
Flow Rate	286	gpm			assume operate 24/7
Unit, Purchase	$569,927	LS			pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons			pj
Water Treatment QA	$200	per day			pj, 1 sample per day
Disposal					
Off-Site Disposal					
Load Soil for Hauling	$2.80	per ton			
Round-trip Hauling	2	hours			
Tipping Fee (non-TSCA)	$43	per ton			
Tipping Fee (TSCA)	$55	per ton			
Truck Rate	$75	per hour			
Truck Load	32	tons			
Institutional Controls					
Public Education Program	$100,000				pj
O&M Plans	$20,000				pj
Deed Restrictions	$5,000				pj
Annual Costs					
Public Education Program	$30,000				pj
Maintaining O&M Plans	$800				pj
Reporting	$20,000				pj
Long-term Monitoring	$600,000				Anne LTM
Long-term Monitoring (no action)	$300,000				Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring		40	$600,000	$9,027,778
Public Education Program		40	$30,000	$451,389
Maintaining O&M Plans		40	$800	$12,037
Reporting		40	$20,000	$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE C: Dredge and Off-site Disposal

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	7	LS	$2,450,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	4	Day	$120,000
Dredge Monitoring (Water Quality)	4	Day	$12,000
Sediment Removal QA	4	Day	$4,800
Site Restoration	1	ea	$670,000
Direct Capital:			$3,656,800
Engineering, Procurement & Construction Management:			438,816
Contractor Overhead/Profit:			548,520
Total Capital:			**$4,600,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit Purchase	286	gpm	$569,927
Water Treatment (Includes Operator)	297,131	gal	$119
Water Treatment QA	1	day	$200
Direct Capital:			$570,246
Engineering, Procurement & Construction Management:			68,429
Total Capital:			**$600,000**

SEDIMENT DISPOSAL (OFF-SITE)

Capital Items	Quantity	Units	Cost
Solidification	14,494	ton	$362,350
Lime Purchase	1,450	ton	$87,000
Soil Loading	14,494	ton	$40,583
Soil Hauling	14,494	ton	$67,941
Tipping Fees (non-TSCA)	14,494	ton	$623,239
Direct Capital:			$1,181,113
Engineering, Procurement & Construction Management:			141,734
Total Capital:			**$1,300,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	Years	Annual Cost	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			**$4,513,889**
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$11,000,000**

Table 7-3 Cost Summary for Remedial Alternatives - Zone 3B
500 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Dewatering	Water Treatment	CAD Construction	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000
D	43,625,096	---	$478,200,000	---	$4,700,000	---	$667,700,000	---	$4,500,000	$1,155,100,000	$231,020,000	$1,386,120,000
G	43,625,096	---	$478,600,000	---	$4,700,000	$523,100,000	---	---	$4,500,000	$1,010,900,000	$202,180,000	$1,213,080,000

BASIS FOR PRELIMINARY COST ESTIMATES
SEDIMENT REMEDIATION
FOX RIVER, WISCONSIN
Zone 3B
Action Level - 500 ppb

Material Handling Assumptions:

Volume > 500 ppb	43,625,096	cy					33,301,600	m3
Volume > 1,000 ppb	0	cy					0	m3
Volume > 5,000 ppb	0	cy					0	m3
Solids Specific Gravity	2.36							
Fresh Water Density	62.4	lb/ft3						
In Situ Density	28.4%	w/w	14.4%	v/v	1.01	tons per cy		
Slurry Density (20% in situ)	6.5%	w/w	2.9%	v/v	0.88	tons per cy		
Dewatered Density	50.0%	w/w	29.8%	v/v	1.18	tons per cy		
Treated Density	93.4%	w/w	60.0%	v/v	1.28	tons per cy		
CDF Capacity	26,500,893	cy					22,394,400	m3
CAD Capacity	29,336,664	cy					22,394,400	m3

Cost Estimating Parameters & Methodology:

Interest Rate	6.0%		
Sales Tax	5.5%		Not Used
Engineering, Procurement and Construction Mgmt	12.0%		
Contractor Overhead and Profit - Dredging Only	15.0%		
Dredging			
Dredge Monitoring (Water Quality)	$3,000	per day	
Sediment Removal QA	$1,200	per day	
Mechanical - 7 dredges			
Dock Construction	$400,000	LS	Ogden Beeman
Mobilization - Equipment	$315,000	per dredge	Ogden Beeman
Mobilization - Silt Curtain	$35,000	LS	Ogden Beeman
Mobilization - Watertight Barge	$100,000	ea	Ogden Beeman (JAG estimate)
Shift Rate (10 hours)	$30,000	per shift	Ogden Beeman
Dredge Rate	4000	cy in situ per 10 hour shift	Ogden Beeman
Offload Stockpile Area Prep.	$75,000	per area	
Free Water per cy Dredged (10%)	20	gal	Ogden Beeman
Site Restoration	$670,000	LS	
Nearshore CDF			
Land Lease or Purchase	$1.80	per sf	Ole
Length	25,368	lf	Baird
Capping Volume	5,690,230	cy	Baird
Area	51,212,069	sy	Baird
Ground Treatment Volume	142,626	cy	
Ground Treatment	$25	per cy	
Dredge Volume	5,690,230	cy	
Fill Purchase/Placement	$30	per cy	
Sheetpile Area	3,044,194	sf	Baird
Sheetpile Cost	$19	per sf	Grant
Shot Rock Berm	$650	per lf	Baird
Rip Rap	$215	per lf	Baird
Place Treated Material	$2	per cy	
Clean Soil Cap	$10	per cy	Baird
Seeding	$1	per sy	Baird
Mitigation	$10,000	per acre	
	$10,000	per year	Tim
Long-term Monitoring	$650,000	per year	
Long-term O&M	2%	of capital	
CAD			
Removal Volume	43,625,096	cy	
Area	73,617,350	sf	
Sand Cap Thickness	3	ft	
Mobilization/Site Prep	$200,000		
Placement Rate	$6	per cy	Ogden Beeman
Sand Purchase	$6	per ton	Ole
Sand Density	1.4	tons per cy	
Cap Placement QA	$100,000	LS	
Long-term O&M	2%	of capital	
Long-term Monitoring	$400,000	per year	
Water Treatment			
Flow Rate (7 dredges)	1,729	gpm	assume operate 24/7
Unit, Purchase	$1,676,421	LS	pj
Water Treatment (Including Operator)	$0.40	per 1,000 gallons	pj
Water Treatment QA	$200	per day	pj, 1 sample per day
Institutional Controls			
Public Education Program	$100,000		pj
O&M Plans	$20,000		pj
Deed Restrictions	$5,000		pj
Annual Costs			
Public Education Program	$30,000		pj
Maintaining O&M Plans	$800		pj
Reporting	$20,000		pj
Long-term Monitoring	$600,000		Anne LTM
Long-term Monitoring (no action)	$300,000		Anne LTM

ALTERNATIVE A: No Action

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs	**Years**	**Annual Cost**		
Long-term Monitoring (no action)	40	$300,000		$4,513,889
Total Present Worth, Longer Term O&M Costs				$4,513,889
Total Project Capital and O&M Cost				**$4,500,000**

ALTERNATIVE B: Monitored Natural Recovery

MONITORING/INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Public Education Program	1	LS		$100,000
O&M Plans	1	LS		$20,000
Deed Restrictions	1	LS		$5,000
Direct Capital:				$125,000
Engineering, Procurement & Construction Management:				15,000
Total Capital:				**$140,000**
Present Worth of Longer Term Operating Costs	**Years**	**Annual Cost**		
Long-term Monitoring	40	$600,000		$9,027,778
Public Education Program	40	$30,000		$451,389
Maintaining O&M Plans	40	$800		$12,037
Reporting	40	$20,000		$300,926
Total Present Worth, Longer Term O&M Costs				$9,792,130
Total Project Capital and O&M Cost				**$9,900,000**

ALTERNATIVE D: Dredge Sediment to CDF

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	7	LS		$2,450,000
Watertight Barges	4	ea		$400,000
Dredging - 12 hour shifts	10,907	Day	83.9	$327,210,000
Dredge Monitoring (Water Quality)	10,907	Day		$32,721,000
Sediment Removal QA	10,907	Day		$13,088,400
Site Restoration	1	ea		$670,000
Direct Capital:				$376,539,400
Engineering, Procurement & Construction Management:				45,184,728
Contractor Overhead/Profit:				56,480,910
Total Capital:				**$478,200,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
Unit, Purchase	1,729	LS	$1,676,421
Water Treatment (Includes Operator)	5,432,013,966	gal	$2,172,806
Water Treatment QA	1,909	day	$381,800
Direct Capital:			$4,231,027
Engineering, Procurement & Construction Management:			507,723
Total Capital:			**$4,700,000**

CDF CONSTRUCTION (Cellular Cofferdam Design)

Capital Items	Quantity	Units		Cost
Land Lease or Purchase	51,212,069	sf		$92,181,725
Ground Treatment	142,626	cy		$3,565,653
Dredging	5,419	day		$30,889,820
Fill Purchase/Placement	5,690,230	cy		$170,706,897
Shot Rock/Rip Rap	25,368	lf		$21,943,566
Sheetpile Placement	3,044,194	sf		$57,839,688
Clean Soil Cap	5,690,230	cy		$56,902,299
Seeding	5,690,230	sy		$5,690,230
Mitigation	1,176	acre		$11,756,673
Direct Capital:				$451,476,551
Engineering, Procurement & Construction Management:				$54,177,186
Total Capital:				**$505,653,737**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Mitigation		40	10,000	$150,463
Long-term Monitoring		40	650,000	$9,780,093
Long-term O&M		40	10,113,075	$152,164,325
Total Present Worth, Longer Term O&M Costs				**$162,094,881**
Total Project Capital and O&M Cost				**$667,700,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**
Present Worth of Longer Term Operating Costs		**Years**	**Annual Cost**	
Long-term Monitoring (no action)		40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs				**$4,513,889**
Total Project Capital and O&M Cost				**$4,500,000**
TOTAL COST				**$1,155,100,000**

ALTERNATIVE G: Dredge Sediment to CAD

SEDIMENT REMOVAL (MECHANICAL DREDGING)

Capital Items	Quantity	Units	Cost
Mobilization - Equipment and Silt Curtain	8	LS	$2,800,000
Watertight Barges	4	ea	$400,000
Dredging - 12 hour shifts	10,907	Day	$327,210,000
Dredge Monitoring (Water Quality)	10,907	Day	$32,721,000
Sediment Removal QA	10,907	Day	$13,088,400
Site Restoration	1	ea	$670,000
Direct Capital:			$376,889,400
Engineering, Procurement & Construction Management:			45,226,728
Contractor Overhead/Profit:			56,533,410
Total Capital:			**$478,600,000**

WATER TREATMENT

Capital Items	Quantity	Units	Cost
820 gpm unit, Purchase	1	LS	$1,676,421
Water Treatment (Includes Operator)	5,432,013,966	gal	$2,172,806
Water Treatment QA	1,909	day	$381,800
Direct Capital:			$4,231,027
Engineering, Procurement & Construction Management:			507,723
Total Capital:			**$4,700,000**

CAD CONSTRUCTION

Capital Items	Quantity	Units		Cost
Mobilization - Equipment and Silt Curtain	1	LS		$170,000
Dredging - 12 hour shifts	41,548	Day		$236,823,600
Sand Purchase	11,451,588	tons		$68,709,526
Placement	8,179,706	cy		$49,078,233
Cap Placement QA	1	LS		$100,000
Direct Capital:				$354,881,359
Engineering, Procurement & Construction Management:				42,585,763
Total Capital:				**$397,467,122**

Present Worth of Longer Term Operating Costs	**Years**	**Annual Cost**	
Monitoring/O&M			
Long-term Monitoring	40	$400,000	$6,018,519
Long-term O&M	40	$7,949,342	$119,608,166
Total Present Worth, Longer Term O&M Costs			$125,626,685
Total Project Capital and O&M Cost			**$523,100,000**

INSTITUTIONAL CONTROLS

Capital Items	Quantity	Units		Cost
Deed Restrictions	1	LS		$5,000
Direct Capital:				$5,000
Engineering, Procurement & Construction Management:				600
Total Capital:				**$5,600**

Present Worth of Longer Term Operating Costs	**Years**	**Annual Cost**	
Long-term Monitoring (no action)	40	$300,000	$4,513,889
Total Present Worth, Longer Term O&M Costs			$4,513,889
Total Project Capital and O&M Cost			**$4,500,000**
TOTAL COST			**$1,010,900,000**

Table 7-3 Cost Summary for Remedial Alternatives - Zone 4
500 ppb

Alternative	Dredge Volume (cy)	Hydraulic Dredging	Mechanical Dredging	Dewatering	Water Treatment	CAD Construction	CDF Construction	Off-site Disposal	Institutional Controls	Subtotal	20% Contingency	TOTAL
A	0	---	---	---	---	---	---	---	$4,500,000	$4,500,000	$900,000	$5,400,000
B	0	---	---	---	---	---	---	---	$9,900,000	$9,900,000	$1,980,000	$11,880,000