Erie Pier Process Re-use Facility Cost Analysis

Final Report

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BACKGROUND

Although many ports face Confined Disposal Facility (CDF) capacity pressure, the Duluth-Superior Port has an urgent need to implement an alternative plan to the status quo for dredged materials. This project was proposed to determine cost accounting and capital budgeting for a proposed Process Re-use Facility (PRF). Previous work, such as the US Army Corps of Engineers' *Dredged Material Management Plan (DMMP) for the Duluth- Superior Harbor, April 1999*, and the Duluth-Superior Metropolitan Interstate Council's *Erie Pier Management Plan, June 2007* identified possible re-uses for dredged material. The possible customer list included mineland reclamation projects, construction sites, road construction, daily landfill cover, topsoil creation and enhancement, habitat restoration, and habitat creation.

For budgetary purposes, it could be appropriate to assume that yearly, 48,000 yards of coarse material (sand) and 50,000 yards of fine material (clay and other material) are available from Erie Pier. In addition, Erie Pier contains a removable total accumulation of 1,250,000 yards of fine material. These and other assumptions were estimated with the help of the Duluth-Superior Harbor Technical Advisory Committee's Dredging Sub-committee.

DATA COLLECTION

A wide range of possible customers were considered, and feasible customers were determined from potential customers, through phone interviews, and data collection on landed cost, competition, and supply chain for various markets. Of special interest were long-term projects such as the 21st Avenue West Habitat Restoration. Potential customers were drawn from the industry sectors of Compost, Topsoil, Construction, Ground Cover, Soil Enrichment, Land Fill, and Mine Reclamation.

Discussion covered aspects of product markets for feasible partners and the demand market for Erie Pier fines. Given that transportation is the largest cost for any of the identified applications of dredged material from Erie Pier, estimations were offered to compare transportation time per project. Distances ranged from more than a hundred miles such as landfill cover at distant sites and reclamation at mines on the Iron Range to projects in direct proximity to Erie Pier and the Duluth-Superior Harbor, such as Sky Harbor Airport and the CN Railroad Ore Docks.

Discussion of possible projects also included the perception that the scale of the project (in cubic yards) is of interest, given the amount of material currently stock piled at the CDF. The estimation of project scale in terms of cubic yards was presented and ranked by demand in cubic yards. Based on assumptions suggested in phone interviews with possible customers, total cubic yards of demand per project ranged from nearly six thousand cubic yards (for small-scale mine reclamation test-projects) to a million cubic yards (for construction fill associated with power plant development).

Recurring projects are of interest given the finding that distance and time are greater drivers of cost than scale. Recurring projects lend themselves to getting the existing material out. Non-recurring projects assume the use of subsequent years' dredging (to avoid moving material twice). Erie Pier managers may need to establish an optimal steady-state between recurring and non-recurring re-use projects for fines material.

Although possible customers have alternatives to using Erie Pier materials, among the most competitive attributes of the fines materials are: 1) easy access to site from I-35 with the possibility of improved infrastructure so that rail could be used to transfer large quantities, 2) a product relatively free of contaminants such as heavy metals and present but manageable noxious weed infestation, and 3) the price for material as a commodity could be minimal, or zero for the customer.

Important competitive disadvantages of Erie Pier fines material include 1) the fact that customers may be unaware of materials and its availability, 2) seasonality of the site with regard to dewatering, dredging scheduled and climate related hardships, 3) regulation requirements, 4) application difficulties related to the clay component of the fines material, 5) tipping fees, and 6) the possible

need for public funding to improve the site and accessibility to materials.

COST ANALYSIS

Two estimates are presented in this analysis. The first estimate is for total cost of fixed and variable costs. The second estimate is for incremental or out-of-pocket costs for fixed and variable costs. These two analyses differentiate between 1) purchasing new equipment for the facility, and 2) using existing equipment.

Cost-Volume-Profit (or break-even without revenues) calculations are based on an identification of the total costs. We identify the cost per yard to move a specific amount at a specific distance, in order to estimate the least cost per yard. This calculation also suggests the appropriate subsidy to cover that cost.

The analyses show that the faster the trucks move, the farther out it is cost-effective to truck the material. A calculation for total cost and incremental cost shows at what point it is cost effective to switch to RailMate, which connects multiple semi-trailers to a train for a point-to-point road to rail delivery of commodity products. (As a practical limitation, this is feasible only if you have access to a railroad and the RailMate technology.): The Total Cost turning point to switch from truck to RailMate, at 40 MPH, intersects RailMate at 101.56 miles; and at 50 MPH, intersects RailMate at 128 miles. The Incremental Cost turning point to switch from truck to RailMate, at 40 MPH, intersects RailMate at 101.56 miles; at 50 MPH, intersects RailMate at 128 miles.

The total landed cost per yard for the RailMate System, or the cost per yard to move the material via the RailMate system for distances of 100, 150, and 200 miles (no data for 50 miles) is estimated at $19.44 per cubic yard. The total landed trucking cost per yard, or the cost per yard to move the material via a truck at a given average speed for a given distance, with one half hour of transit time to the move for loading and unloading, is estimated at between $16.33 and $49.67 for speeds of 25 MPH; at between $12.17 and $33.00 for speeds of 40 MPH; and between $10.78 and $27.44 for speeds of 50 MPH.

The incremental (out-of-pocket) landed cost per yard for the RailMate System, or the cost per yard to move the material via the RailMate system for distances of 100, 150, and 200 miles (no data for 50 miles) is estimated at $18.73 per cubic yard. The total landed trucking cost per yard, or the cost per yard to move the material via a truck at a given average speed for a given distance, with one half hour of transit time to the move for loading and unloading, is estimated at between $15.62 and $48.96 for speeds of 25 MPH; between $11.46 and $32.29 for speeds of 40 MPH; and between $10.07 and $26.73 for speeds of 50 MPH.

The cost analysis shows that the decision to use a particular transportation system will be predicated first by the distance of the customer from Erie Pier. At 200 miles total distance, it will always be more cost effective to utilize the RailMate system. At 150 miles, it will likewise be cost effective to use the RailMate system. At 100 miles, efficiency depends on the assumed speed of the truck. If the speed is less than 50 MPH, it is more cost effective to use the RailMate system. If one is using incremental costs, it is better to use a truck at any speed greater than 40 MPH and at 100 miles distance. At a total distance of 50 miles it appears to be more cost effective to use trucking, although there is no data on the cost of using RailMate at distances less than 100 miles.

The findings of the cost analysis are useful for an estimation of least cost alternatives. In evaluating whether to build a new CDF one must first consider the cost of a new facility. The USACE estimates that it would cost (in today's dollars) $30,000,000 to build a new CDF. However, this cost does not include externality costs, which could double or triple the estimated cost. These external costs are difficult to estimate and can be subjective in nature, and the cost benefit analysis necessary to estimate these external costs is not within the scope of this project. The cost of building a new facility also assumes, perhaps incorrectly, that it would be politically possible to situate a new CDF in the Duluth-Superior Harbor.

Presently there are not more than 1,500,000 cubic yards total of material in the Erie Pier facility. The estimation of least cost could suggest that a realistic scenario would be to remove 100,000 cubic yards per year. This would take a total of 15 years to draw down the quantity in Erie Pier to zero stored on site. Fifteen years is therefore used

as the discount period in doing present value calculations. An appropriate discount rate is 4%. This is consistent with historical trends. The most conservative estimate of annual operating costs to remove the 100,000 cubic yards and transport it a total of 200 miles is $2,673,000 per year.

The present value of an annuity of $2,673,000 at 4% for 15 years is $29,719,450. This would indicate that it is slightly less expensive to remove the materials than it is to build a new facility. If one considers externality costs, it is clear that the low-cost alternative is to remove the materials from the site and not wait to build a new facility.

In addition, the cost of imminent alternatives could include finding low-cost ways to take the current dredged material to other locations. This could assume no additional capital costs, no railroad spur, and no other new technologies, but the possible inclusion of RailMate. (In these scenarios, there would be no added fixed costs.)

CONCLUSIONS

The report considered the usefulness of this study for other Great Lakes ports. We note that the Duluth-Superior port may be unique in some ways from other ports. For instance, in the Duluth Harbor, dredged materials are not significantly polluted, the seasonality of port activity is a significant factor, and re-use projects have been already considered and in some cases plans are under discussion.

However, the following points from this study may be of interest to other ports on the Great Lakes:

- Transportation costs should be considered (almost) the entire cost.
- Feasible customers have competing suppliers.
- Given a CDF with a short remaining life, non-recurring projects of most interest will be long-term projects near the CDF (or new PRF), and include using largest amounts of material (wetlands and habitat creation).
- Timing of opportunities can be crucial; the business cycle of the customer is significant.
- Minimizing transportation time is the most cost effective principle.
- Cost-per-yard shows what the government (or other funder) might be willing to subsidize.
- Assume that choosing customer(s) who will take the maximum yards doesn't compare with the cost saving of using a closest customer.

Finally, without the availability of a complete impact study, we note that the largest economic impact may be attributed to a change in how Erie Pier and other Great Lakes ports view CDFs. Erie Pier should be viewed as a Process Re-use Facility, or PRF. This switch would result in turning a current environment disposal problem into an economic impact or benefit. The PDF would generate much more positive economic activities and benefits. The "greening" of the CDF will create products that will meet the demands of the construction, habitat creation and restoration, agriculture, forestry, and mining industries.

Dredging, processing and transporting the Erie Pier materials will generate direct, indirect and induced economic impacts. The direct impacts will be created in the dredging, processing and transportation sectors. Their expenditures will result in new business-to-business spending, or indirect impacts. These indirect impacts would include increased activity in sectors such as fuel supply and maintenance and repair services. In addition, the workers in these impacted industries would spend their wages and create new induced impacts.

A second phase of this project has been proposed to model and identify the most cost-effective way(s) to transport dredged materials to customers. ("Erie Pier Re-Use Facility Phase II: An Optimized Cost-Effective Strategy for Increased Transport and Handling of Dredged Materials.") The continuing study will investigate how to control operating costs for Erie Pier CDF by optimizing the handling and distribution of re-use of dredged material. The study will also propose optimal changes, additions, and improvements to the existing facility, and provide financial estimates of cost for suggested changes.

■

1 Introduction: Erie Pier Marketing Background

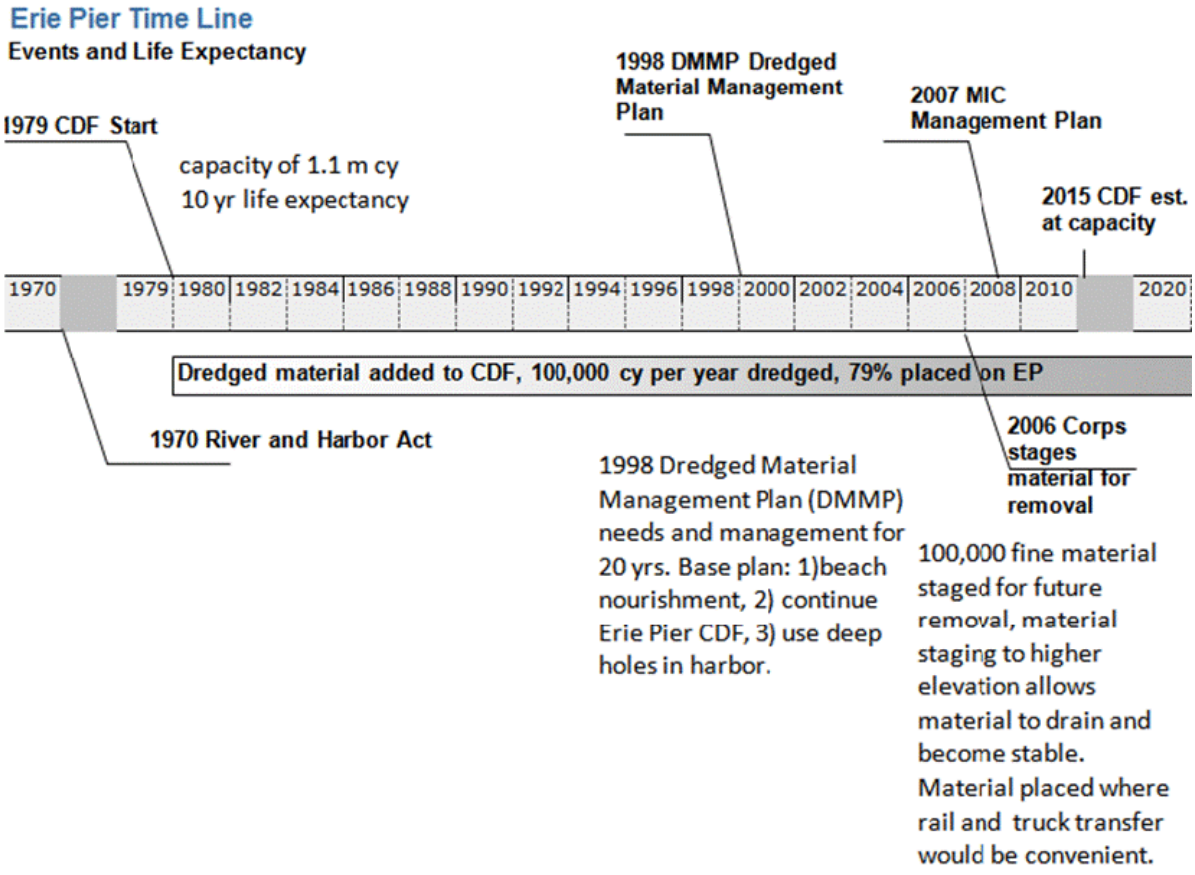
Great Lakes Maritime Research Institute Proposal

Although many ports face Confined Disposal Facility (CDF) capacity pressure, the Duluth-Superior Port has an urgent need to implement an alternative plan to the status quo for dredged materials. Growing constraints on options for placing dredged materials at the Erie Pier CDF has urged action on a plan for re-cycling material currently being placed at the pier. Costs and benefits from the perspective of all stakeholders help determine a safe and responsible solution; however, least cost must also be calculated.

This project was proposed to determine cost accounting and capital budgeting for a proposed Process Re-use Facility (PRF). This proposal should be seen as part of a larger effort to provide full cost benefit analysis for stakeholders. The methodology for this project was based on cost minimization rather than profit maximization. The ultimate goal of the recycle operation will be to get the dredged materials off the Erie Pier CDF under a break-even strategy. It is proposed that the findings from this project will be of use as a model for other ports for the Great Lakes.

The following time line for Erie Pier shows the history of the facility and the approaching deadline of reaching capacity at the CDF.

Figure 1. 1 Erie Pier CDF Time Line



Research Assumptions

The market for Erie Pier coarse material, as presented in previous reports and as presented by representatives of the USACE, and the HTAC Dredge Sub-committee, describes a commodity with many desirable characteristics (clean sand with many useful applications). Because of the desirable attributes of this commodity, the history of removing coarse material from Erie Pier and reusing the material is not part of the following discussion. It is assumed that the coarse material scheduled for deposit at Erie Pier will either be part of the beach nourishment application or offered for direct removal to contractors.

This study is based on the following assumptions for the physical description of the commodities, volume of materials, processing operations in place, and regulations that apply to dredged material at Erie Pier CDF.

Physical composition

Classification of possible commodities in this study is limited to "coarse" or "fines" material. According to previous reports (noted in figure 1.1 above) the dredged material placed at Erie Pier includes several other possible commodities, such as sand; gravel; clay (< 30% sand); clay (> 30% sand); rock; sandy soil; and mix (sand, silt, clay, organic). (See *Duluth-Superior Metropolitan Interstate Council. Erie Pier Management Plan, 2007*.) However, for the purposes of this study, and following direction from the Dredging Subcommittee of the Harbor Technical Advisory Committee (HTAC), and the United States Army Corps of Engineers (USACE), commodities are limited to coarse and fines. We also assume the levels of in-organics and metals inventoried in the MPCA sediment analysis are not

retrievable commodities.(See *Sediments Treatment - Erie Pier, Duluth, ECP ElectroChemical Remediation Technologies* at www.ecp-int.com and www.electropetroleum.com.)

Table 1. 1 Definition of Physical Composition of Dredged Material at Erie Pier

Material	*Description*	*Possible Commodities*
Coarse	sand	concrete mix backfill bituminous mix mortar
Fines	clay and other materials	backfill unclassified fill daily cover for landfill soil soil for habitat uses

Source: Duluth-Superior Metropolitan Interstate Council. *Erie Pier Management Plan*, June 2007; Harbor Technical Advisory Committee, and the Duluth Seaway Port Authority

Volume of material

Since 1980, the USACE has dredged 3.2 million yards from the Duluth-Superior harbor, including the 2007 dredging which will be complete in 2008.

For comparison purposes the following history of dredged coarse materials was of interest: The Duluth Seaway Port Authority has controlled the coarse material at Erie Pier since 1993. During the 14-year period from 1993 through 2007, a total of 415,131 yards were sold by the Port Authority for re-use. Over the years, about 131,000 yards of material were moved to Dakota Pier for re-use. Zenith Dredge controlled the coarse material prior to 1993, and received about 499,084 yards at Erie Pier during those years from Minnesota channels, and 322,704 yards from Wisconsin channels in the harbor, as follows:

Table 1.3 Total Coarse Material 1980–2006

Material re-use	*Cubic yards*	*source*
Beach nourishment	322,704	USACE
Zenith 1980-1993	821,788	USACE
Dakota Pier	130,747	USACE
DSPA 1993-2007	415,131	(actual record of sales)

Source: USACE; Harbor Technical Advisory Committee, and the Duluth Seaway Port Authority

The 2007 dredging contract included 108,561 yards of all coarse material. This contract was completed in 2008, and 108, 561 yards were sold for re-use.

With all 2007 yards included, the Corps will have dredged 3,200,180 yards of material since 1980, and approximately 1,500,000 yards of fine material have been placed in the CDF at Erie Pier. Total sales of fine material are *de minimis* at less than 4,000 yards over the period.

This history of the volume of coarse material dredging is in contrast to the history of fine material dredging. The USACE has calculated that a total of 1,209,021 yards of fine material are presently within Erie Pier, above an elevation of 603'. Additionally, if the dike were to be cut down from 620' to 603', then an additional 37,960 yards of material would be available. The sum (about 1,250,000) of these two numbers represents the total yards of material that should be considered to be available for re-use out of the present CDF.

Over 28 years the USACE has dredged an average of 114,300 yards of material per year from the channels. Of this, an average of about 64,000 yards of separated coarse material is available for re-use (including beach nourishment and other docks the material can be taken to), or about 48,000 yards per year (if 2007 is included), has been available for re-use from Erie Pier. About 1,347,000 yards of fine material have been moved to Erie Pier for re-sale, which translates to about 50,000 yards of new material available as new fine material from Erie Pier. In summary:

For budgetary purposes, it could be appropriate to assume that 48,000 yards of coarse material are available yearly and 50,000 yards of fine material are available yearly from Erie Pier, plus the total accumulation of removable material which is about 1,250,000 yards of fine material. (Dredging Subcommittee, Harbor Technical Advisory Committee, Duluth-Superior.)

We also assume that beneficial uses such as beach nourishment are contracted outside the purview of the Re-use Facility. Such uses are also often accomplished prior to placing dredged material at Erie Pier and do not change the expected volume of material as estimated above. For instance, there have been approximately 500,000 cubic yards of coarse material placed on beaches over the 28 year-history of Erie Pier (6 separate times).

Table 1. 2 Volume of Dredged Material at Erie Pier 1980–2006

Material	*Recurring yearly total*	*Total accumulation to date*
Coarse material	48,000	
Fines material	50,000	
Removable fines		1,250,000

Source: Dredging Subcommittee, Harbor Technical Advisory Committee, and the Duluth Seaway Port Authority

Processing

In order to estimate costs, it was necessary to determine the nature of current operations at the CDF. The following research assumptions pertain to aspects of processing material at Erie Pier:

We assume that the current washing operation for dredged material sorts it into coarse material (sand) and fines (clay and other material).

We assume that management of stockpiled materials and recent materials will be distinct.

We assume the U.S. Army Corps of Engineers will maintain the integrity of the current Re-use Facility under the definition of a Containment Disposal Facility, as previous to establishment of the Re-use functions, including surveys, dredging and maintenance packages.

We assume the U.S. Army Corps of Engineers will bear the cost of constructing changes to the Re-use Facility, and improvements to the current rudimentary sluicing process, to enable the sale of commodities identified for distribution.

We can assume from the results of the recent sediment analysis testing that material not contaminated.

Although there is a possibility of Tier 1 (residential) use, we assume Tier 2 (commercial and industrial) use is of most interest, and therefore the primary focus of this analysis.

Regulations

Minnesota: Assumption of a general (on-going) MPCA permit is assumed, in which repeated "identical limits and monitoring are more appropriately controlled by general permits." (*Duluth-Superior Metropolitan Interstate Council. Erie Pier Management Plan*, p. 15.)

Minnesota: We assume the Re-use Facility will market Tier 2 applications only.

Wisconsin: Although some WI regulations are more restrictive, material will be evaluated on a project by project basis.

We assume that Erie Pier dredged material contaminant levels do not exceed regulatory levels for hazardous waste, and that the evaluation recently reported does not require re-sampling.

We assume that the HTAC can confirm that according to regulation requirements, “viable options for re-use of somewhat polluted material include underlayment for road construction and paved parking lots, or

use in construction footings." (*Duluth-Superior Metropolitan Interstate Council. Erie Pier Management Plan*, p. 18.)

Noxious Weed Management: We assume that noxious weeds (and in particular purple loosestrife) can be managed. We assume that permits will be granted by St. Louis County to move the material contaminated by purple loosestrife as has been indicated to us by St. Louis County.

We do not assume that processes to control purple loosestrife will be part of the cost of the Re-use Facility. Rather, control is part of "dredging" cost.

We assume that newly dredged material will not be considered contaminated by purple loosestrife. Also, this will be verified on annual basis as determined necessary.

Other assumptions

Marketing history: In the past, the Port has marketed the coarse material by advertizing in the *Duluth News Tribune* asking for bids. The Port has sold much of the material directly to these interested customers or others who see an available pile of material, or who contact the Port.

It is not proposed that there will be additional material "processing" of the "fines" to meet a new potential product specification. The only "processing" is currently performed by the dredging contractor, and the work needs to be specified at the time the contractor bids on the annual dredging.

One unresolved assumption is the question of who will conduct the testing and who would pay for any noxious weed eradication that would be needed once the material leaves Erie Pier. (A sub-committee of the HTAC is addressing this assumption. This question addresses liability if the weeds show up several years later at a user location. The Port Authority envisions that the Corps of Engineers would do any follow up inspections. However, they would like to see a sale contract include this as the responsibility of the owner of the property on which the material is placed.)

With these assumptions in mind, the research team collected data to address the question of identifying potential partners and feasible customers for Erie Pier fines material.

2 Data Collection

Potential Partners

A wide range of possible customers were considered, and feasible customers were determined from potential customers, through phone interviews, and data collection on landed cost, competition, and supply chain for various markets.

The possible customer list included the following: mineland reclamation projects, construction sites, road construction, daily landfill cover, topsoil creation and enhancement, habitat restoration, and habitat creation. Of special interest were long-term projects such as the 21st Avenue West Habitat Restoration. These customers are drawn from several industry sectors: Compost, Topsoil, Construction, Ground Cover, Soil Enrichment, Land Fill, and Mine Reclamation.

Table 2. 1 Preliminary Potential Customers

Compost	Western Lake Superior Sanitary District
	City and Port of Green Bay
Topsoil	Wisconsin Landscape and Garden Centers
	Minnesota Landscape and Garden Centers
Construction Fill	Mn/DOT (project by project)
	WisDOT (project by project)
	Private contractors
	CN Ore Docks
	Sky Harbor Airport
	Hibbard Power Plant
Soil Enrichment	Wetlands Habitat W. 21st Ave.W. project (Duluth)
	Forestry culture project
	Farming, crops, St. Louis Co., MN
	Farming, crops, Carlton Co., MN
Land Fill	WI Waste Management (Superior)
	Duluth landfill
	Canyon landfill
	Other WI landfills
	Elk River landfill
Mine Reclamation	UTAC (United Taconite)
	Keewatin Taconite
	MINNTAC
	Hibbing Taconite Co
	USX Corporation
	U S Steel Corp
	Arcelor Mittal Minorca Mine
	Northshore Mining Co (Cleveland-Cliffs Inc)
	Millal Steel USA- Minorca mine

Markets, by Industry Sector

Possible customers for Erie Pier fines material were reviewed. A series of interviews conducted by BBER are summarized below. (BBER is grateful to the many firms who assisted with this market data. A list of contacts is provided at the back of this report.) Details from this information, along with data collection from secondary sources, helped suggest which of these possible markets have *feasible* customers for Erie Pier fines material.

BBER is grateful for consultation offered by the representatives of industries and agencies related to the markets for Erie Pier material. Phone interviews were conducted with Landfills/Waste Management, Safety/Environmental Coordinator at TransCanada; Operations Supervisor, Western Lake Superior Sanitary District; SEH, Consulting, Inc. and Manager of City of Superior Landfill; Engineers and Specialists at WisDOT; Agregate and Materials Engineers, Mn/DOT-Duluth; Forestry Program Director, UMD Natural Resources Research Institute; University of Minnesota Extension, St. Louis County, Virginia Office Extension; University of Minnesota Extension, Carlton County Extension; Minnesota Department of Natural Resources, Lands and Minerals – Hibbing; Iron Range Resources, Mine Reclamation Office at Iron World; Lakehead Trucking, Duluth; and Udeen Trucking, Superior. A summary of their comments on the feasibility of using Erie Pier materials in their operations follows below, presented by industry sector.

Landfills, Topsoil, and Compost

Landfill Cover, Minnesota

As an example of bulk processing for materials destined for traditional landfills as cover, the Waste Management, Inc. Voyageurs Industrial Landfill site in Canyon, MN accepts wood fiber "strands" or paper by-product from the NewPage Corporation paper plant, which is shipped to them around the clock every day of the week from the Duluth plant. The facility is a clean industrial/demolition debris landfill located on a 100-acre parcel in Section 2, Township 52 North, Range 17 West, near Canyon, Minnesota (St. Louis County). The landfill can accommodate about 70 tons per day, according to their management plan, which is based on the percentage of the total volume the site can accept. (Waste Management, Inc. also ships to the Superior, WI landfill, see below.) The Canyon landfill sometimes has more NewPage material than it can process, and therefore some material is buried.

Waste Management, Inc. is also shipping some NewPage material to their Elk River, MN facility. The Elk River landfill site can accept more than 70 tons daily and is a higher volume site than the Canyon site.

The rate to haul from NewPage (Duluth) to Elk River could be $30 per ton, which would include $20 transportation charge plus $10 handling and loading. Equipment needs might be End-Dumpers and Dump Trucks, which can hold 18-22 tons of material.

Landfill Cover, Superior, Wisconsin

Cover for the Superior landfill can be paper residue from the NewPage paper mill in Duluth and sand from a gravel pit in the City of Superior. To make a change in landfill cover materials the change would have to make financial sense to the City of Superior. The landfill uses, as a 6 inch daily cover, a mixture of 75% NewPage material and 25% sand. Waste Management, Inc. hauls the material from Duluth to Superior, and the landfill charges a tipping fee to accept the product. The landfill maintains an inventory of materials up to 1-2 days only. The tipping fee is approximately $100 per truckload. Tipping fees are relatively new, having started within the last two years.

The landfill operators have a memory of being contacted by Erie Pier years ago, but no use of dredged materials ensued. (The Public Works Director of Superior could be contacted to pursue this.) Representatives of the Superior landfill suggested private landfills might be potential customers, for instance, Lakeland Blacktop and Materials.

Purple loosestrife is not perceived as an issue or obstacle to landfill cover application by a representative landfill operator in Wisconsin.

Topsoil

These would be small businesses, requiring small quantities. Some evidence of attempting this application for dredged materials shows the enterprise has met with limited success. The topsoil retail and wholesale industry is very competitive. At the retail level , different size bags of topsoil are widely marketed at many lawn and garden outlets, and branded competition keeps prices and profit margins low. This results in a significant barrier to entry which would require investment in production, marketing, and distribution.

At the wholesale level, quantities for customers would likely be small truckloads. These relatively small quantities would mean costs (for Erie Pier). If Erie Pier has to handle small quantities, the PRF might not be able to recover their expenses. Therefore Erie Pier should not make this product a priority.

Construction Fill

Possibilities for use of Erie Pier fines for road construction fill were examined. Road construction application managers in Wisconsin and Minnesota were interviewed. In most cases, managers were interested in Erie Pier coarse material. It will be important to differentiate between true construction grade aggregate and Erie Pier coarse material, or sand. Furthermore, the discussion about Erie Pier fines material was limited to the possibility of embankment cover and other landscaping applications.

Construction Fill, Wisconsin Department of Transportation

Specific State of Wisconsin road construction projects might be identified as possible markets for Erie Pier fines, for instance the Wisconsin Highway 53 Corridor project from Superior to Rice Lake, currently being studied, possibly scheduled for 2015–25. This project will address dangerous or fatal crossings on Wisconsin roads. Also, smaller program projects might include Highway 2 in Ashland County, and Highway 8 in Barron County. There also might be other highway intersections that require material such as landscaping or embankment cover. Wisconsin's six-year plan for these and other program projects are described by the State on the WisDOT website.

For the determination of whether Erie Pier fines dredged materials could be used for road construction projects in Wisconsin, WisDOT contacts suggested that samples would have to be sent to Madison for testing for heavy metals. Wisconsin's specifications for road materials, according a State soil engineer with WisDOT, would have to be tested for hazardous materials including mercury and petroleum. The dredged material would also have to be sent to the State's center for ecological-testing in Madison. According to a second State soil engineer, Green Bay dredged materials have not been used as road construction fill. However, dredged material from the Fox River, collected as silty topsoil, has been put on a bayside topsoil site, where the Wisconsin Department of Natural Resources will only allow this topsoil to be used if it is buried under at least 6 inches of other soil. For this application, (as at Erie Pier) the coarse sand is separated out and sold to contractors.

Construction Fill, Minnesota Department of Transportation

As long as materials meet specifications and testing, contractors can get them from local sources. Mn/DOT indicated that contractors generally would not go beyond approximately 50 miles to haul materials for a work site.

However, for coarse material, when a larger area is being specified, Erie Pier materials may not be appropriate. Mn/DOT's Department of Materials and Research maintains the standards for project specifications. In the case of dredged material re-use, in the opinion of Mn/DOT representatives, it is thought that for contractors to use Erie Pier materials, cost of these materials would have to be very low or free because of hauling expense. An additional "mesh criteria" would exclude Erie Pier fines material.

Contractors also choose materials closest to the work site to keep costs down, and most contractors get their material from local sand and gravel pits. Material from these pits has to be tested. One project a Mn/DOT representative thought might be a possible use for Erie Pier dredged material in the Duluth area would be embankment bridge work on I-35 at the ore docks.

As has been discussed elsewhere, sand from the dredged materials is in demand. Mn/DOT agreed that Erie Pier coarse material at $2 per cubic yard from Erie Pier is priced about right.

Another possible application of the Erie Pier coarse materials (or clean sand) suggested by a Mn/DOT representative could be in the use of sand for septic systems and mound systems. In St. Louis County the sand would have to be approved for this use. Septic contractors may be an additional market for the sand.

Aggregate construction fill is not part of the Erie Pier inventory. This distinction should focus Erie Pier marketing efforts with road construction on such applications as the landscaping and cover of embankments. In summary, Erie Pier material could be used for borrow and embankment, as a feasible application. The key may be to advertise the product to contractors. This could be done through trade publications and other publications that local contractors read.

Soil Enrichment

Soil Enrichment, Forestry

Forestry researchers are familiar with Erie Pier material as used in mine reclamation. When asked if it would be a good product for a forestry soil additive, a representative of NRRI thought it would be an excellent additive in the Northwest Wisconsin forest zone, around the Solon Springs area. This use of dredged material is also perceived as a good opportunity for economic development by forestry researchers.

Soil Enrichment, Farming, St. Louis County, Minnesota

A Minnesota Extension agent reviewed the laboratory work on the fines material and concluded that the material is acceptable for soil enrichment use by farmers. The transport model for farmers using fines should figure use of Hwy 35 and Hwy 2, however, the hauling cost is the key element.

Further discussion with Minnesota Extension included the observation that the project would need to be managed over 5 or more years, and could be worked into a land application program, with some other creative outcomes. However, operational dollars are needed to make it happen. Given the hauling costs, Extension doesn't see this project implemented without a subsidy for farmers as end-users, but Extension expressed interest in working with Erie Pier on the project to move the fines.

Although the relationship with land owners is where to start, truckers are and will be the biggest project cost, according to Minnesota Extension. As a profit business, don't expect to "sell" fines to farmers. The fines could be introduced with a subsidy to farmers for space utilization of their fields. In order to partner with Minnesota Extension, it will be important to structure the project, to assign specific responsibilities, and to bring strategic people on board with expertise, selectively chosen, to "get the job done." For instance, an Ad Hoc committee of specific people with specific responsibilities could work. Also necessary would be an assumption that the organization would be run as a business, needing a CEO.

Landed cost in the case of farming means there will also be insurance issues, perhaps against tipped loads and the responsibilities of first response for accidents. There will also be load-up costs. Who pays the bills and how bills are submitted, would need to be specified for a variety of tasks.

Other possible costs associated with use of fines material by farmers, according to Minnesota Extension consultation include:
Subsidy—If they were paid, there *will* be farmers who are interested. An estimate of the cost to move (all) these fines could be something like $2 million.
Application—Farmers might start with an 80 (acre project). Farmers could spread as deep as 6 inches thick, and could thereby cover 1,000 acres. Tillage and seeding for the farmer is estimated by the U of MN Extension program at $150/day. Farmers would need fertilizer (possibly WLSSD might provide this, according to Extension). Farmers will have seasonality issues; winter is good for working with this material in the field but snow might stop trucking. Farmers will have moisture content questions about the fines material. Soils with silt and clay content can get "like concrete" if spread and left. On the other hand, sand gives tilth to silt, clay, and fines, and is desirable. Therefore, dredged material from Erie Pier which kept sand in the mix would be good for farmers in the Minnesota counties with clay soils.
Equipment—Farmers will need a bulldozer to move it around. Farmers also may need to till with a heavy spring tooth, or a chisel plow to mix the soil. Farmers might seed alpha, or a seed mix (as used in mine reclamation sites). U of MN Extension could be consulted for a recommendation.

The strategy is to pay farmers to use their land. Growing alpha would be an added incentive but the project for farmers would be about "space utilization," and the costs would be about time and labor.

Soil Enrichment, Farming, Carlton County, Minnesota

In some counties, Minnesota Extension works for farm clients with sandy soil. The agent advises on what crops/ seeds farmers should use, and also helps determine what application rate of fertilizer and other soil additives to use. A recent Extension re-use project was to take waste logs from Sappi paper plant in Cloquet and use them as fertilizer on Carlton County Farms. The Carlton County agent was aware of Erie Pier dredged materials but had never been contacted by the Port Authority.

The agent speculated that if Erie Pier materials were used on farmland it would require a beneficial use permit from the state on Minnesota. After reviewing documents describing the specifics of Erie Pier fines, the agent commented that the material looks good as an organic soil amendment to sandy soil to increase the water and nutritional capacity of the soil. He suggested that the fall season, after harvest, would be the best time to apply the material. This material could be marketed to farmers, and Erie Pier could possibly partner with topsoil manufacturers. However, there would also be an investment in other fertilizer. (The application rate might be 30 lbs of Nitrogen (N) per acre spreading load. The additional cost to apply the material into the soil could be about $55 per acre, and would include labor and equipment, assuming a $50 per hour labor rate for the farmer, and total application time of half an hour per acre.) Fertilizer application for Erie Pier fines would be less than required for the paper mill residue (50-60 pounds of N per acre).

Purple loosestrife would not be considered a problem because herbicides could be used. It was also noted that crops such as corn and soybeans will eliminate this noxious weed problem. Proper management is the key. The Extension agent mentioned farms in the area of Wrenshall, Blackfoot, and Holyoak, which are about 40-45 minutes away, as ideal customers.

An example of possible use might be: 60 tons of Erie Pier material which equals 50 cubic yards [60 x 0.83 = 49.8; 49.8 = 50 cy] could be applied ½" to ¾" deep. This assumes an application rate of 60 tons or 50 cubic yards per acre. Erie Pier material might weigh 2200-2400 lbs per cubic yard, which is similar to topsoil. Hauling the materials (max load might reach 25 cubic yards), might require a tarp on the material. If no tarp is used, material can only be loaded to 6" below the wall of the truck. Vehicles could be Tub Loaders, Belly trucks, or sideloaders. The most likely load size would be between 20-22 cubic yards.

Mine Reclamation

Mine Reclamation, Minnesota Department of Natural Resources (DNR)

The Minnesota DNR has followed efforts to use dredged materials for mine reclamation cover. According to the DNR, UTAC and Keetac have both looked at Erie Pier fines as cover material. The Keetac mine is considering wetland restoration. The DNR emphasized that any application must follow MPCA Rules. Most mining reclamation cover-applications are projects for rock flats after overburden has been removed. Vegetation is grown as cover. Operations of contractors can include adding fertilizer, transport, and spreading. Allocation of these tasks between the contractors and the mines is considered as a project-by-project proposition. The DNR agreed that Erie Pier material is appropriate for reclamation cover ("it works"). But there are problems with transportability. Specifically, the fine, sloppy, or wet attributes of the material make it difficult to handle. Finally, according to the DNR, any weed such as purple loosestrife is also a major concern, although herbicides can be applied to control the weeds.

Water content is one of the most important aspects of the transportation, growing, and cost questions. (When is re-use material "soil," when is it "slurry," and when is it too "dusty" to handle?) Other handling questions include how many times does the material have to be handled, and for instance, how feasible are suggested uses of new equipment solutions like the ***RailMate,*** which connects multiple semi-trailers to a train for a point-to-point road to rail delivery of commodity products?

Competition consists of mining operations using their own overburden (or other available soils) to reclaim acres at little or no cost. However, fertilizer is usually added so trees and other plants will grow. Mining companies, of course, get by as cheaply as possible to meet the requirements of the State. When overburden is not available, firms do purchase soil, and prices vary depending on quantities, type of material, and hauling distance.

According to the DNR, UTAC has created wetlands and pond areas as part of mine reclamation. Again, according to the DNR, the mine reclamation needs a 2-foot deep application on some rock flats, and for this application biosolids from WLSSD have been a better product than Erie Pier dredged material. The biosolids are easier to handle (not as wet) and have more nourishment than Erie Pier material. UTAC is currently using biosolids, and the mine only pays to transport the biosolids to the reclamation sites; the biosolids commodity is no cost. However, interest in a project in which Erie Pier and WLSSD work on a joint top soil product was expressed. (See Appendix A for a brief review of mine reclamation projects.)

Mine Reclamation, Iron Range Resources

Iron Range Resources (IRR) was consulted for information on mine reclamation projects. There are six mining companies doing cover applications for creation or enhancement of wetlands. Many use their

overburden soil, and supplement this with 50 lbs. bags of fertilizer. This may be the competitive pricing Erie Pier will have to compete against. When asked about acres that are covered, IRR referred BBER to The MN DNR. Dan Jordan of IRR, has toured Erie Pier and met with Jim Sharrow (Duluth Port Authority). IRR liked the Erie Pier material, as described, but requested testing results for compounds; mercury was high on his list of possible problems. Jordan was aware of discussions about plans to rail aggregate and rock to Duluth and backhaul Erie Pier fines. Purple loosestrife is believed manageable with applications of the Rodeo® herbicide.

Mine Reclamation, WLSSD, Duluth, Minnesota

WLSSD has been involved in mine reclamation, using WLSSD's biosolids product called "Field Green." This product is created by WLSSD in a flow process which creates the dirt-like product (Field Green). By-products include odor and methane gas (which is recovered for heat). When shipped, the product has about a 20% moisture content.

Eveleth, Minnesota (UTAC) mine reclamation: A trial sample 150 foot strip of land with a thirty degree slope (like an embankment), proved very successful. Working with the DNR, WLSSD applied biosolids resulting in 265 tons of hay. This hay is used as mulch on tailings basins in current production, to keep the dust down. The long term plan is to have farmers lease the mine property and grow crops like alfalfa on the mine site. A problem with this application has been the (DNR standard) requirement of 90 % growth on reclaimed land. If users produce less than 90% cover, a second application is required. Reports show grass seeds, for instance, can spread hit-and-miss and require a second application of seed (100 lbs per acre), in the spring. WLSSD also is reviewing a second test in which farmers could grow alfalfa on another part of the UTAC property, using WLSSD biosolids.

Keewatin, Minnesota (Keetac) mine reclamation: In a very small project (30 foot strip of vegetation along the top of a dike), WLSSD, monitored by University of Minnesota Extension, is also applying biosolids.

WLSSD sees no need to add Erie Pier materials to their biosolids because the biosolids are working well alone on these trial sites. However, WLSSD did suggest that Erie Pier material might work well when the mine strips off overburden and when the mine has rocky areas to fill. Erie Pier material could be used to even out the reclamation area, followed by biosolids as a top dressing and as the nutrient.

WLSSD's *Master Plan* includes "business case evaluations" for mine reclamation applications. Their long term plan is to support UTAC and Keetac. University of Minnesota Carlton County Extension has consulted with WLSSD and farmers on application rates, and the extension agent is involved in the reclamation applications when farmers need to fix soil imbalance. WLSSD's *Master Plan* also includes a marketing study (done in 2005). Mine reclamation uses WLSSD's type B biosolids. About 20% of these biosolids go into mine reclamation (80% goes to horticulture).

For wetland reclamation WLSSD biosolids usually have too much nitrogen and can involve run-off problems. This suggests that the inert Erie Pier material might be a better wetland reclamation application than biosolids.

Operations: Trucking

Lakehead Trucking

As noted by Lakehead Trucking, a firm based in Duluth, Minnesota, the basic charge generally quoted for trucking a load is $2.25 per mile. This includes transportation only; the trucking customer must load and unload. For instance, a 40 mile trip (round trip, or 20 miles each way) would be 40 x $2.25 = $90, or $5

per cubic yard for 40 miles. A possible estimate of cost was discussed as:

Table 2. 2 Damp, Dry, or Wet, 60 Miles

	pounds per cubic yard	*cubic yards per load*	*total truckloads*
Damp	3,240	15	66,667
Dry	2,700	18	55,555
Wet packed	3,510	14	71,429

Udeen Trucking

Udeen Trucking, a firm based in Superior, Wisconsin, hauled dredged material from Erie Pier to Keewatin for the Keetac mine reclamation project. Udeen hauled 306 cubic yards of fines to the Keetac site. When contacted, Udeen gave some general rates. In Minnesota quad trucks could haul 14 cubic yards (note load restrictions apply). Also in Minnesota, a semi end dump tractor-trailer load would be 20 cubic yards. In Wisconsin, a quad truck could haul 17 cubic yards.

For example: Quad truck costs $90.00 per hour. End dump truck costs $100.00 per hour. Clock starts when truck arrives at job site. So a 50 mile trip might take 1.5 hours with some traffic. End truck = $100 x 1.5 hrs or $150.00. This does not include preparing material and loading and unloading. A 100 mile trip would cost $100 x 3.5 = $350.

Given the interview information above, and other secondary data from relevant reports and literature (see the Bibliography to this report), the following projects are suggested as the most feasible:

Table 2. 3 Short-term Potential and Feasible Customers

Erie Pier Fines Short-term Potential Customers and Feasible Customers

Industry sector	*Potential Customers*	*Contact*	*Possible Criteria*	*Feasible customers*
Compost	WLSSD (compost)	Hamel	no current interest	
	Green Bay (compost)	Meyers	distance too great	
Topsoil	WI		regulation, small quantities, market needs development, competition	
	MN		small quantities, market needs development, competition	
Construction Fill	MNDOT (project by project)	Garver	close, and can be sizable	✓
	WisDot (project by project)	King, Hanzel	no imminent projects	
Soil Enrichment	NRRI Tree culture project	Berguson	too preliminary, needs more research	
	Farming, alfalfa, St. Louis Co., MN	Dykhuis	close, additive for sandy soil appropriate	✓
	Farming, alfalfa, Carlton Co., MN	Salzer	good additive	✓
Land Fill	WI landfill (Superior)	Reichhoff	using waste paper by-product	
	Canyon landfill	Downing	using waste paper by-product	✓
	Elk River landfill	Downing	distance too great	✓
Mine Reclamation	UTAC (United Taconite)	DNR, NRRI, Jordan, Kanski	using biosolids	✓
	Keewatin Taconite	DNR, NRRI, Dewars	using biosolids	✓
	Other mines: MINNTAC, Hibbing Taconite Co., USX Corporation, U S Steel Corp., Arcelor Mittal Minorca Mine, Northshore Mining Co (Cleveland-Cliffs Inc), Millal Steel USA- minorca mine	no contact	no current interest	

Source: MIC, HTAC, BBER interviews

Table 2. 4 Long-term Potential and Feasible Customers

Erie Pier Fines Long-term Potential Customers and Feasible Customers

Industry sector	*Potential Customers*	*Contact*	*Possible Criteria*	*Feasible customers*
Construction Fill	CN Railroad Ore Docks	Brossart	large quantities, short distance	✓
	Sky Harbor Airport	Brossart	large quantities, short distance	✓
	Hibbard Power Plant	Brossart	large quantities, short distance	✓
Soil Enrichment	Wetlands Habitat W. 21st Ave.W. project (Duluth)	Brossart	large quantities, short distance	✓
Source: MIC, HTAC, BBER interviews				

3 Evaluation of Product Markets

The following discussion covers aspects of product markets for feasible partners and the demand market for Erie Pier fines. Given that transportation is the largest cost by far for any of the identified applications of dredged material from Erie Pier, the following estimations are offered to compare transportation time per project.

Estimated Travel Time

Note that for study purposes, three Mn/DOT scenarios were estimated: Mn/DOT Scenario 1 (projects 50 miles from Erie Pier), Mn/DOT Scenario 2 (projects 25 miles from Erie Pier), and Mn/DOT Scenario 3 (projects 10 miles from Erie Pier). Two farm projects were estimated (located in Wrenshall and Floodwood). Several landfill projects were estimated, including Canyon and Elk River in Minnesota, and Superior, Wisconsin. Distances were also estimated for mine reclamation projects, and the long-term large projects Sky Harbor, Hibbard Power Plant, CN Ore Docks, and the 21st Ave. Wetlands project.

Table 3. 1 Estimated Travel Time

Feasible customer	*Miles from Erie Pier*	*Hours (at 40 MPH)*
Short-term, possibly recurring projects:		
Waste Management, Inc., Elk River, MN (annual)	163.0	4.08
Keewatin Taconite (Keetac)	81.6	2.04
United Taconite (UTAC)	60.0	1.50
Mn/DOT Scenario 3	50.0	1.25
Floodwood Farmers	44.4	1.11
Waste Management, Inc., Canyon, MN (annual)	29.8	0.75
Mn/DOT Scenario 2	25.0	0.63
Wrenshall Farmers	22.8	0.57
Mn/DOT Scenario 1	10.0	0.25
Wisconsin waste management (Superior) (annual)	4.6	0.12
Long-term, possibly non-recurring projects:		
Sky Harbor Airport	7.4	0.19
Hibbard Power Plant	2.8	0.07
CN Railroad Ore Docks	2.2	0.06
21ST Ave. W project	1.2	0.03

Source: Google maps, BBER

Project scale

Discussion of possible projects has included the perception that the scale of the project is of interest, given the amount of material currently stock piled at Erie Pier. Projects that remove the largest amount of material from Erie Pier would seem to have an advantage. The following table is presented as a suggested estimate of possible quantities involved in recurring and non-recurring possible projects.

Although this list identifies an array of potential customers, a wide variety of assumptions are involved in estimating the demand for each customer's application of fines. Assumptions for possible project scale relied on information and suggestions from potential customers (as detailed above in the "Markets, by Industry Sector" section). It is important to note, however, actual total demand in cubic yards is unknown.

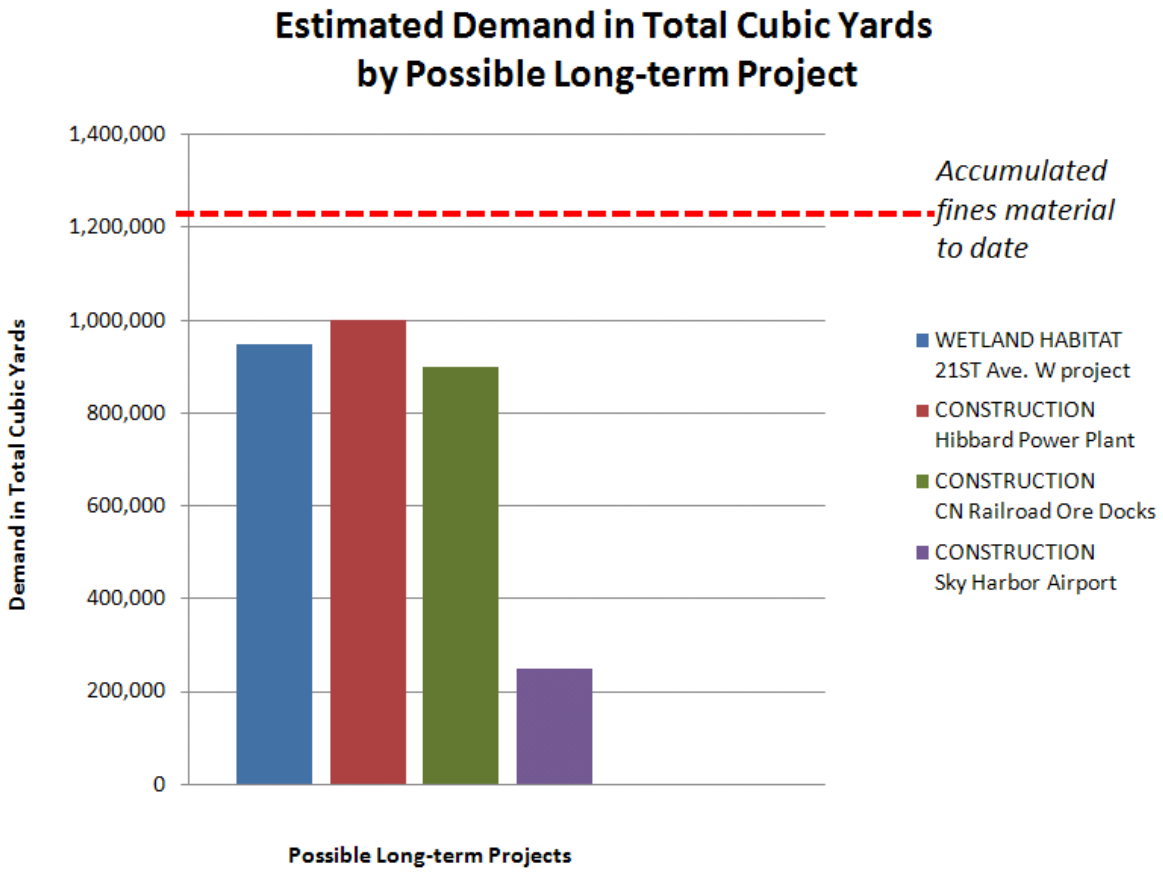
Table 3. 2 Project Scale

Feasible customer	*Total Cubic Yards**
Short-term, possibly recurring projects:	
Mn/DOT Scenario 3	100,000
Wrenshall Farmers (6")	64,560
Floodwood Farmers (6")	64,560
Mn/DOTScenario 2	50,000
Mn/DOTScenario 1	25,000
Wisconsin waste management (Superior) (annual)	21,207
Waste Management, Inc., Canyon, MN (annual)	21,207
Waste Management, Inc., Elk River, MN (annual)	21,207
Wrenshall Farmers (1")	10,760
Floodwood Farmers (1")	10,760
United Taconite (UTAC) 6"	8,873
United Taconite (UTAC) 6"	8,873
United Taconite (UTAC) 6"	8,873
Keewatin Taconite (Keetac) 6"	8,873
Keewatin Taconite (Keetac) 6"	8,873
Keewatin Taconite (Keetac) 6"	8,873
United Taconite (UTAC) 4"	5,916
United Taconite (UTAC) 4"	5,916
United Taconite (UTAC) 4"	5,916
Keewatin Taconite (Keetac) 4"	5,916
Keewatin Taconite (Keetac) 4"	5,916
Keewatin Taconite (Keetac) 4"	5,916
Long-term, possibly non-recurring projects:	
Hibbard Power Plant	1,000,000
21ST Ave. W project	950,000
CN Railroad Ore Docks	900,000
Sky Harbor Airport	250,000

* The estimation of project scale in terms of cubic yards is based on assumptions suggested in phone interviews with possible customers.

The graph below shows that given the currently stock-piled fines material and the capacity of Erie Pier, the existing material would not be able to supply more than one of the proposed big projects, as listed in Table 2.4. The question which of the proposed projects might be implemented first has not been addressed.

Figure 3. 1 Estimated Demand in Total Cubic Yards by Possible Long-term Project



Recurring and One-time need projects

In the above tables (Table 2.3 and Table 2.4), possible recurring and non-recurring projects have been shown separately. Recurring projects, such as those in Table 2.3, are of interest given the finding that distance and time can be greater drivers of cost than scale. Recurring projects help focus on removing the existing material as it accumulates. Between the non-recurring and recurring projects, planners may want to establish an optimal steady state.

Competition: Competitive Advantages and Disadvantages of Erie Pier Materials for Potential Customers

Potential and feasible customers have alternatives to using Erie Pier materials. Researchers identified competitive advantages and disadvantages for customers who could consider using Erie Pier fines material. Among the most competitive attributes of the fines materials are: 1) easy access to the site from I-35 with the possibility of improved infrastructure so that rail could be used to transfer large quantities,

2) a product relatively free of contaminants such as heavy metals and manageable noxious weed infestation, and 3) the price for material as a commodity could be minimal for the customer.

Important Competitive Disadvantages of Erie Pier fines material include: 1) customers may be unaware of materials and its availability, 2) seasonality of the site with regard to dewatering, dredging schedules and climate related hardships, 3) regulation requirements, 4) application difficulties related to the clay component of the fines material and moisture content, 5) tipping fees, 6) and the possible need for public funding to improve the site and accessibility to materials.

Figure 3. 2 Competition

Competitive Advantages of Erie Pier Material

- Large volume of material (1.25 million cubic yards, plus future dredged materials)
- Easy access to site from I-35
- Relatively free of contaminants such as heavy metals (recently tested)
- Price for material would be $0 or minimal
- Purple Loosestrife, although an issue, has most often been described as "manageable"
- Good soil additive, especially for sandy soils, adding fertility, could compliment WLSSD Biosolids
- Both customers and Erie Pier benefit
- Rail infrastructure may be proposed to transfer large quantities
- Future dredging could go right to the consumer (around the Harbor)
- Although public subsidy is suggested, some projects might be privately funded (this idea could be pursued in further market research)

Competitive Disadvantages of Erie Pier Material

- Purple Loosestrife and other noxious weeds require management
- Possible that customers may be unaware of materials and availability
- May compete/conflict with WLSSD Biosolids and other soils
- Seasonality of the Erie Pier site—business cycle of customers and dredging schedule may not coincide (also truck access depends on season)
- Minnesota and Wisconsin have differing regulations
- Application may be difficult because of the water and clay content
- Some additional soil fertilizer would still be required (for example, nitrogen)
- Customers have other options for purchasing acceptable materials (for example, mines can use their own overburden for reclamation)
- Tipping fees for landfills may apply
- RailMate infrastructure is still under development
- Public funding may be needed (subsidies might be necessary for operating or out-of-pocket expenses, and capital expenditures)
- Erie Pier may not have enough materials to satisfy the needs of all these projects
- Timelines are unknown, there are no currently scheduled project implementations
- Projects might face environmental permit issues

4 Cost Analysis

Cost Analysis for this project estimates 1) the cost to extend the life of the existing Erie Pier CDF, and 2) the cost to get the Erie Pier CDF dredged material off-site. The research team also estimated 3) the cost to situate the recycle center as a financially break-even proposition (in this case, we used Cost-Volume-Profit calculations, or break-even without revenues). Finally, the research team considered the USACE's requirement to determine 4) the least-cost alternative.

Fixed and Variable Costs

To address the research objectives above, conservative estimates of assumed values have been used. Fixed and Variable Total Cost Assumptions depend on identifying the nature of the costs involved, including the investment in equipment and estimation of depreciation, as well as other costs such as labor and fuel. Hours are our unit of measure. Fixed costs are represented by the purchase price of the equipment. However, depreciation is calculated on an hourly basis over the life of the machines, and therefore depreciation is treated as if it were a variable cost.

Two estimates are presented in this analysis. The first estimate is for total cost of fixed and variable costs. The second estimate is for incremental or out-of-pocket costs for fixed and variable costs. These two analyses differentiate between 1) purchasing new equipment for the facility, and 2) using existing equipment.

Estimation of Landed Cost Using Total Cost:

The following table presents the costing assumptions for total cost. We assume the purchase of new equipment. (Note, according to the USACE, operating costs at Erie Pier are $110.)

Table 4. 1 Fixed and Variable Total Cost Assumptions

Fixed and Variable Total Cost Assumptions	
Hourly Operating Costs (bulldozer and loader)	**$110.00**
Pay and Benefits	$54.00
Fuel	$24.00
Depreciation (per hour)	$32.00
Bulldozer Purchase Price	$200,000.00
Loader Purchase Price	$200,000.00
Useful Life of Machines (Hours)	12,500
Truck Cost per Hour	100
RailMate Cost per Cubic Yard	17
1 Truck holds 18 Cubic Yards (cy)	18
5 Trucks per hour can be loaded	5
Average Speed of Truck to Destination	50-40-25
Loading and Unloading Time of the Truck (hour)	0.5
Loading costs (assuming the material is stored and loaded)	**$2.44**
% of hourly rate which is Fixed Costs	29%
% of hourly rate which is Variable Costs	71%

Source: USACE, Nortrax, BBER , NRRI, RailMate

The estimation of landed cost for Erie Pier dredged material as a recycled commodity to be used in various applications includes calculations of transportation costs.

The following table compares transportation costs for trucking and RailMate modes, for four possible distances, and compares three speeds of travel. Costs estimated cover the cost per yard by truck, the landed cost per yard by RailMate, the total landed cost per yard by RailMate system, and the total landed trucking cost per yard.

Table 4. 2 Erie Pier Material Transportation Total Costs, Fixed and Variable

Erie Pier Material Transportation Total Costs, Fixed and Variable

Miles Driven by the Truck	***50***	***100***	***150***	***200***
Hours to Destination-Driving:				
Hours to and from destination				
25 MPH	2	4	6	8
40 MPH	1.25	2.5	3.75	5
50 MPH	1	2	3	4
Cost per Yard With Trucking: *These numbers represent the cost to move one cubic yard of material the given distance. ADD: One half hour of transit time to the move for loading and unloading. Assume trucking cost at $100/hr.*				
25 MPH	$13.89	$25.00	$36.11	$47.22
40 MPH	$9.72	$16.67	$23.61	$30.56
50 MPH	$8.33	$13.89	$19.44	$25.00
RailMate Cost Per Yard Landed:				
RailMate hauling charge per yard	no data	$17.00	$17.00	$17.00
Loading cost at Erie Pier	no data	$2.44	$2.44	$2.44

Source: USACE, Nortrax, BBER , NRRI, RailMate

Given the above assumptions, the following landed costs can be computed:

Table 4. 3 Fixed and Variable Transportation Total Landed Costs

Erie Pier Material Transportation Plus Moving and Loading Costs, Fixed and Variable

Miles Driven by the Truck	***50***	***100***	***150***	***200***
Total Landed Cost per Yard for RailMate System: *The cost per yard to move the material via the RailMate system.*	no data	$19.44	$19.44	$19.44
Total Trucking Cost Per Yard Landed: *The cost per yard to move the material via a truck at a given average speed for a given distance. ADD: One half hour of transit time to the move for loading and unloading.*				
25 MPH	$16.33	$27.44	$38.56	$49.67
40 MPH	$12.17	$19.11	$26.06	$33.00
50 MPH	$10.78	$16.33	$21.89	$27.44

Source: USACE, Nortrax, BBER , NRRI, RailMate

Estimation of Landed Cost Using Incremental (Out-of-Pocket) Cost:

As a cost minimization strategy, existing equipment could be used at Erie Pier. The next tables will calculate out-of-pocket expenditures for Erie Pier when funders would not have to purchase new equipment. (This is also the calculation that shows what subsidy would be needed to cover those costs.) This is to say, if the Port wants to get compensation for out-of-pocket costs (non capital reoccurring costs), these are the costs that need to be subsidized, returned, or recaptured.

The following table, like the table above for total cost assumptions, presents similar assumptions for deriving incremental costs.

Table 4. 4 Variable Incremental Cost Assumptions

Variable Incremental Cost Assumptions	
Hourly Operating Costs (bulldozer and loader)	**$110.00**
Pay and Benefits	$54.00
Fuel	$24.00
Depreciation (per hour)	**$32.00**
Bulldozer Purchase Price	$200,000.00
Loader Purchase Price	$200,000.00
Useful Life of Machines (Hours)	12,500
Truck Cost per Hour	100
RailMate Cost per Cubic Yard	17
1 Truck holds 18 Cubic Yards (cy)	18
5 Trucks per hour can be loaded	5
Average Speed of Truck to Destination	50-40-25
Loading and Unloading Time of the Truck (hour)	0.5
Loading costs (assuming the material is stored and loaded)	**$1.73**
% of hourly rate which is Fixed Costs	29%
% of hourly rate which is Variable Costs	71%

Source: USACE, Nortrax, BBER , NRRI, RailMate

Again, the estimation of landed cost for Erie Pier dredged material as a recycled commodity to be used in various applications includes calculations of transportation costs. The "Loading costs (assuming the material is stored and loaded)" presents the measureable difference between the Fixed and Variable Total Cost Assumptions and the Variable Incremental Cost Assumptions, as shown in Tables 4.1 and 4.4.

The estimate above is for total cost of fixed and variable costs. The estimate below is for incremental or out-of-pocket costs for fixed and variable costs, and does not include purchasing and depreciating new equipment for the facility. Given this assumption, the following tables compare transportation costs for trucking and RailMate modes, for four possible distances, and compares three speeds of travel. Costs estimated cover the cost per yard by truck, the landed cost per yard by RailMate, the incremental landed cost per yard by RailMate system, and the total landed trucking cost per yard.

Table 4. 5 Variable Incremental Transportation Costs Assumptions

Erie Pier Material Transportation Incremental Costs, Fixed and Variable

Miles Driven by the Truck	*50*	*100*	*150*	*200*
Hours to Destination-Driving:				
Hours to and from Destination				
25 MPH	2	4	6	8
40 MPH	1.25	2.5	3.75	5
50 MPH	1	2	3	4
Cost per Yard With Trucking:				
These numbers represent the cost to move one cubic yard of material the given distance. ADD: One half hour of transit time to the move for loading and unloading.				
25 MPH	$13.89	$25.00	$36.11	$47.22
40 MPH	$9.72	$16.67	$23.61	$30.56
50 MPH	$8.33	$13.89	$19.44	$25.00
RailMate Cost Per Yard Landed:				
RailMate hauling charge per yard	no data	$17.00	$17.00	$17.00
Loading cost at Erie Pier	no data	$1.73	$1.73	$1.73

Source: USACE, Nortrax, BBER , NRRI, RailMate

Given these assumptions about out-of-pocket costs, the following calculations show landed costs for incremental transportation costs:

Table 4. 6 Variable Incremental Transportation Landed Costs

Erie Pier Material Transportation Incremental Costs, Fixed and Variable

Miles Driven by the Truck	*50*	*100*	*150*	*200*
Total Landed Cost per Yard for RailMate System:				
The cost per yard to move the material via the RailMate system.	no data	$18.73	$18.73	$18.73
Total Trucking Cost Per Yard Landed:				
The cost per yard to move the material via a truck at a given average speed for a given distance. ADD: One half hour of transit time to the move for loading and unloading.				
25 MPH	$15.62	$26.73	$37.84	$48.96
40 MPH	$11.46	$18.40	$25.34	$32.29
50 MPH	$10.07	$15.62	$21.18	$26.73

Source: USACE, Nortrax, BBER , NRRI, RailMate

These calculations are compared in the graphs below, which show both total costs and incremental costs, including three speeds of trucking costs compared to the constant RailMate cost over distances up to 200 miles.

Figure 4. 1 Erie Pier Dredged Material Total Landed Cost Per Yard

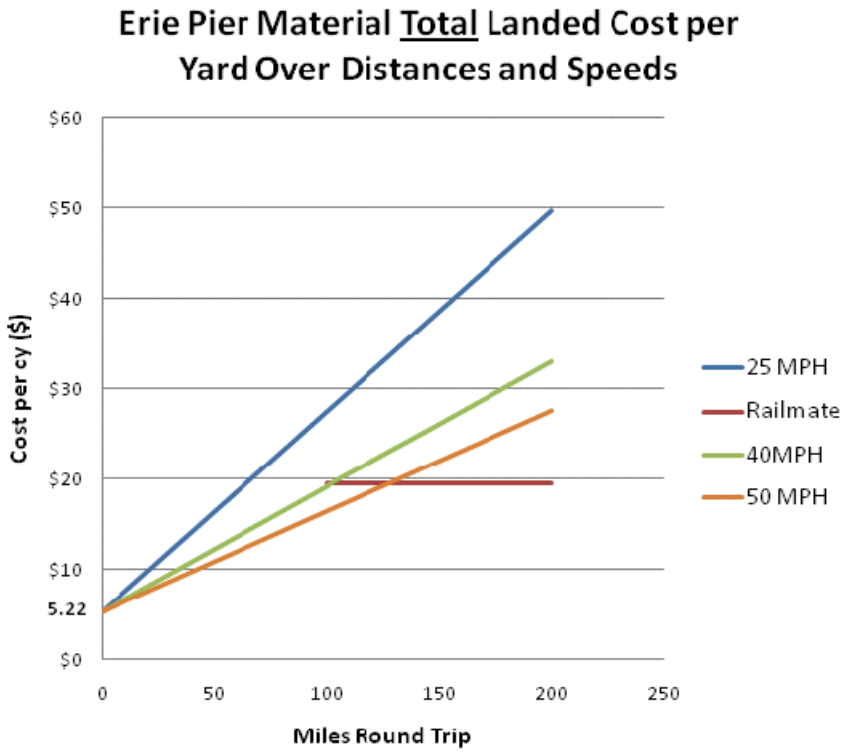
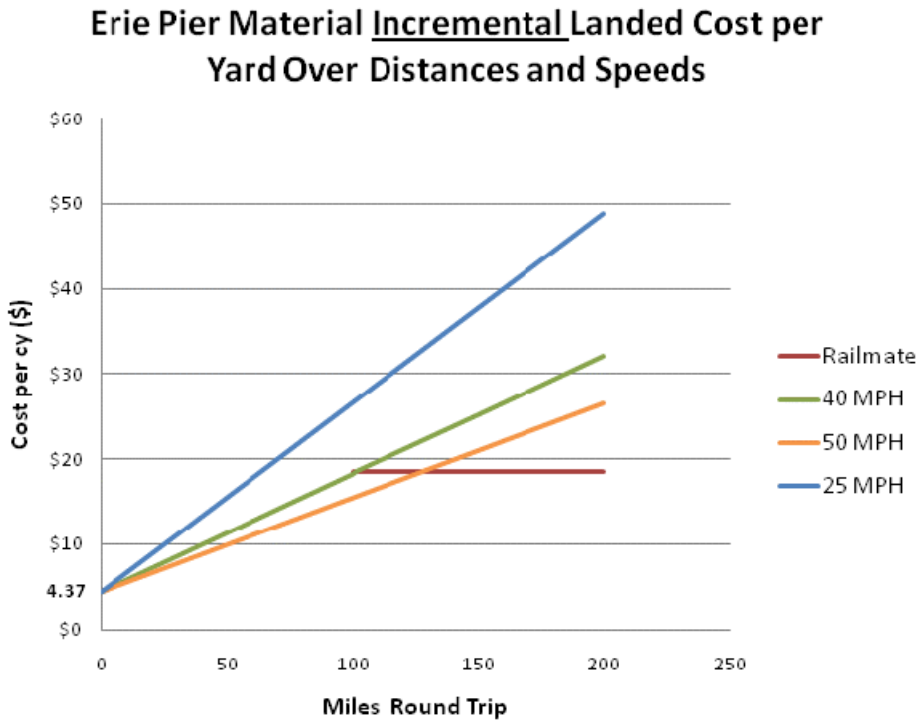


Figure 4. 2 Erie Pier Dredged Material Incremental Landed Cost Per Yard



Cost-Volume-Profit Calculations (Break-even without Revenues)

The Cost-Volume-Profit (CVP) calculations are based on our identification of the total costs. If we identify the cost per yard to move a specific amount at a specific distance, we know the least cost per yard and, for instance, can therefore ask for the appropriate subsidy to cover that cost.

The above graphs show that the faster the trucks move, the farther out it is cost-effective to truck the material. A detail of the graphs for total cost and incremental cost shows at what point it is cost effective to switch to RailMate. As a practical limitation, this is feasible only if you have access to a railroad and the RailMate technology.

The railroads view their rates as proprietary information. These rates are estimated on a customer-by-customer basis. It was noted that there is a scarcity of cars to carry material such as dredged material, and that railroads are reluctant to interrupt and/or impact the current system supplying service to the mining industry.

Table 4. 7 Total Cost Turning Point from Truck to RailMate

Total Cost turning point from truck to RailMate:	
40 MPH	intersects RailMate at 101.56 miles
50 MPH	intersects RailMate at 128 miles

Figure 4. 3 Total Landed Cost Per Yard with Cost-Volume-Profit Calculation

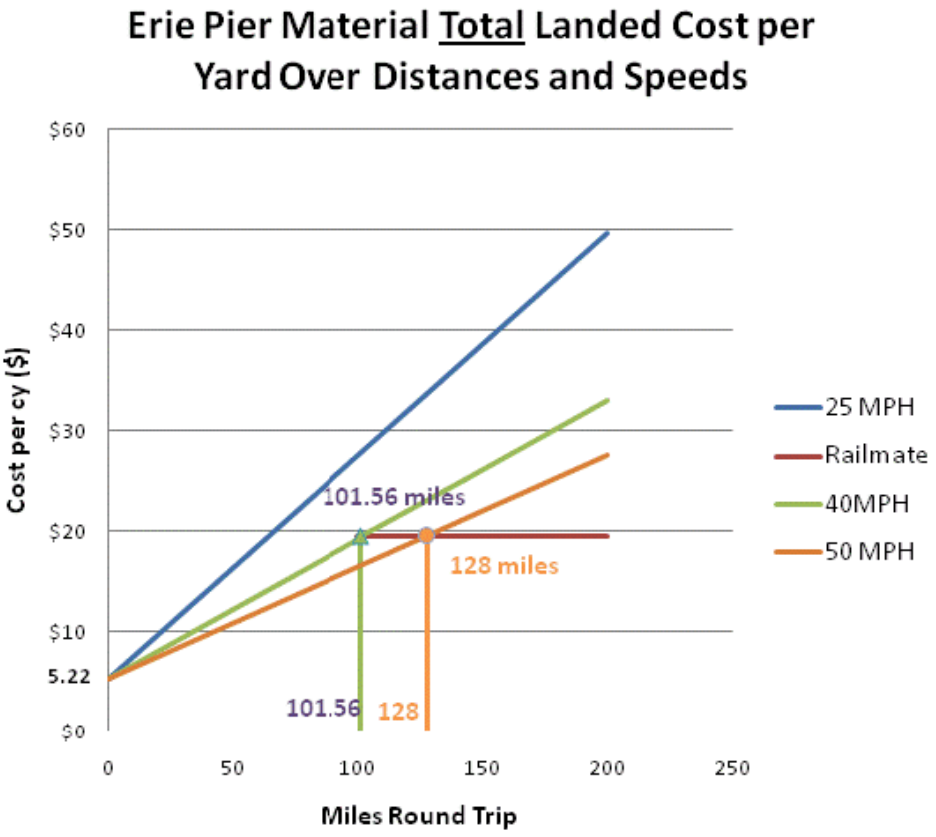
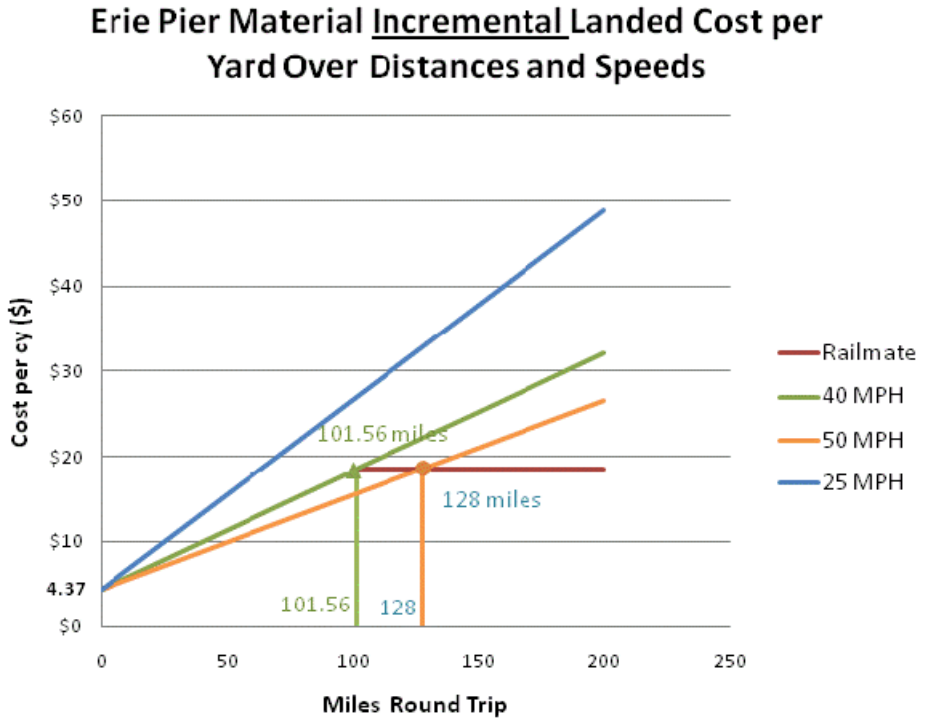


Table 4. 8 Incremental Cost Turning Point from Truck to RailMate

Incremental Cost turning point from truck to RailMate:	
40 MPH	intersects RailMate at 101.56 miles
50 MPH	intersects RailMate at 128 miles

Note: The point of intersection does not change when comparing total cost and incremental costs. We shift the cost/cy for trucking and RailMate by the same magnitude for all modes. Graphically they will intersect at the same points in both Figure 4.3 and Figure 4.4. Another way to look at this is to recognize that the fixed costs play an insignificant role in the estimation of total costs. The major cost remains the transportation cost.

Figure 4. 4 Incremental Landed Cost Per Yard with Cost-Volume-Profit Calculation



Efficiency

Another way of measuring the transportation costs is to utilize the metric (cost per ton mile). This measure utilizes the landed cost per ton at a given speed and at a given distance, and divides that number by the distance traveled. This measure is used extensively in the railroad industry. It is also a measure of efficiency.

From the tables below one can see that it is more efficient to move a given amount of material a greater distance at a given speed. For any one speed, the ratios decrease as the distance increases. Also, at any given distance, it is more efficient to move a given amount of material at a greater speed. Again, the ratios decrease at any given distance as the speed increases. A decreasing ratio is a measure of efficiency.

Table 4. 9 Total Cost per Ton Mile to Move the Dredged Materials

Total Cost

	Miles Driven in Total				Gain in	RailMate		
MPH	50	100	150	200	Efficiency:	100	150	200
25	0.3266	0.2744	0.2571	0.2484	24%	0.1873	0.1249	0.0937
40	0.2434	0.1911	0.1737	0.165	32%			
50	0.2156	0.1633	0.1459	0.1372	36%			

Source: Brannan, BBER, GAO, Association of American Railroads, RailMate

Railroad Rates: *The rates vary from 4 cents to 1 cent per ton mile. The average is about 3 cents per ton mile.*

Table 4. 10 Incremental Cost per Ton Mile to Move the Dredged Materials

Incremental Costs

	Miles Driven in Total				Gain in	RailMate		
MPH	50	100	150	200	Efficiency:	100	150	200
25	0.3124	0.2673	0.2523	0.2448	22%	0.1873	0.1249	0.0937
40	0.2292	0.184	0.1689	0.1615	30%			
50	0.2014	0.1562	0.1412	0.1337	34%			

Source: Brannan, BBER, GAO, Association of American Railroads, RailMate

Specifically Table 4.9 examines the changes in efficiency using the metric "total costs" (i.e. includes depreciation). Table 4.10 utilizes only variable or incremental costs. The trends are the same in both tables. If we examine Table 4.9 (Total Costs) at 50 MPH we can see that the cost per ton mile at 50 miles is .2156. That is, it would cost $1,078,000 to deliver 100,000 tons via truck, at a total distance of 50 miles (or 25 miles one way). If one goes out to 200 miles (400 miles round trip), the factor is .1372, which means that it would cost $2,744,000 to deliver 100,000 tons at 50 MPH. This represents a 36% gain in efficiency, or decrease in cost. This occurs because the rate of change in distance is greater than the rate of change in the cost. It is more efficient to take 100,000 cubic yards of material 200 miles (at a given speed of 50 MPH) than to take this material 50 miles. The cost per ton mile is calculated by dividing the landed cost per ton by the total distance.

The tables also show the impact of transporting the dredging materials via the RailMate or traditional railroad system. The traditional rail system assumes a significant investment in loading and unloading equipment. It also assumes a significant cost in moving the material to and from the railroad yards. The RailMate cost estimate assumes that trucking costs to the rail yard and to the final dumping site are immaterial.

The rate quoted for this study by RailMate was $17 per ton over a distance of between 100 to 200 miles. Even if one adds in the loading and storage costs, the RailMate system is more efficient than trucking at greater distances. At both 150 and 200 miles, the RailMate system is more efficient, no matter what the presumed speed of the truck. At 200 miles distance, RailMate will yield the lowest cost per ton mile. Using Table 4.10 (Incremental Costs), at 200 miles, the budgeted delivery cost via RailMate would be $1,874,000, versus $2,674,000 utilizing trucking at a speed of 50 MPH. Using the RailMate system at 200 miles would yield a total savings of $400,000. One can take the difference in the factors (.1337-.0937*200 miles*100,000 cubic yards of material) to determine the total cost savings of using RailMate over trucking.

Traditional rail shipping is more difficult to estimate. Railroad companies are reluctant to divulge the actual cost of shipping cargo from point A to point B. However, several articles give an overall estimate of the cost per ton mile.(See *United States General Accounting Office. Railroad Regulation, Changes in Freight Railroad Rates from 1997 through 2000*, GAO-02-524; and *Overview of America's Freight Railroads*, Association of American Railroads, Policy and Economics Department, May 2008.)

The cost range varies from a high of 4 cents per ton mile to a low of 1 cent per ton mile. If we assume an average rate of 3 cents per ton mile we can compare this rate with trucking and the RailMate system. At 3 cents per ton mile the traditional rail system will be greater than the RailMate system at 100, 150 and 200 miles distance. When compared with trucking, traditional rail costs are greater at distances exceeding 100 miles. It is only at a relatively slow speed (25 MPH) and at a shorter distance (50 miles) that rail traffic becomes more cost effective.

The decision of what transportation system to use will be predicated first by the distance of the customer from Erie Pier. At 200 miles total distance, it will always be more cost effective to utilize the RailMate system. At 150 miles, it will likewise be cost effective to use the RailMate system. At 100 miles, efficiency depends on the assumed speed of the truck. If the speed is less than 50 MPH, it is more cost effective to use the RailMate system. If one is using incremental costs, it is better to use a truck at any speed greater than 40 MPH and at 100 miles distance. At a total distance of 50 miles it appears to be more cost effective to use trucking, although there is no data on the cost of using RailMate at distances less than 100 miles.

Least Cost Alternative

Least cost alternatives for disposing of Erie Pier accumulated and annual dredged materials can include the possibility of continuing previous practice, the possibility of doing nothing about Erie Pier and anticipating construction of a new CDF, as well as considering the cost of imminent alternatives such as implementing the projects outlined above.

Past practice is described in the MIC's *Erie Pier Management Plan*. Least cost

> . . . follows the premise that the least cost alternatives to dredged material management are not necessarily the most cost effective methods. The currently identified least cost method of disposing of dredged materials, open water dumping, does not consider the environmental and social costs and does not consider the economic benefit of reuse. It is illegal to dispose of dredged materials in the waters of Minnesota and Wisconsin. The other two currently identified least cost alternatives are disposal in a CDF and beach nourishment. . . . Opportunities [for beach nourishment] are very limited. (p. 2)

The possibility of doing nothing can be described as pushing the problem into the future, or delaying the inevitable. The risk planners would take with this option is that the cost of adding another containment facility would be increased by postponing a decision.

In evaluating whether to build a new CDF one must first consider the cost of a new facility. The USACE estimates that it would cost (in today's dollars) $30,000,000 to build a new CDF.

Cost of a new CDF: the Itasca site, as identified in the 1998 DMMP, estimated a capacity of 1 million cy, a 10-13 year life, with a cost to develop of $6 to $8 million. CDFs built in other areas of the Great Lakes

with similar capacities to Erie Pier had construction costs ranging from $6 to $16 million when adjusted for inflation. The USACE estimates the cost of a new CDF could be as much as $30 million. This cost does not include externality costs which could double or triple the estimated cost. These external costs are difficult to estimate and can be subjective in nature. The cost benefit analysis necessary to estimate these costs is not within the scope of this project. The cost of building a new facility also assumes, perhaps incorrectly, that it would be politically possible to situate a new CDF in the Duluth-Superior Harbor.

Aside from the handling of new dredged material, presently there are not more than 1,500,000 cubic yards total of material in the Erie Pier facility. A realistic scenario could be to remove 100,000 cubic yards per year. This would take a total of 15 years to draw down the quantity in Erie Pier to zero stored on site. Fifteen years is therefore used as the discount period in doing present value calculations. An appropriate discount rate is 4%. This is consistent with historical trends. The most conservative estimate of annual operating costs to remove the 100,000 cubic yards and transport it a total of 200 miles is $2,673,000 per year.

The present value of an annuity of $2,673,000 at 4% for 15 years is $29,719,450. This would indicate that it is slightly less expensive to remove the materials than it is to build a new facility. If one considers externality costs, it is clear that the low-cost alternative is to remove the materials from the site and not wait to build a new facility.

An important related issue will be the social cost of an alternative such as a new CDF. This is usually presented as a cost benefit analysis. Although a detailed cost benefit analysis cannot be offered within the scope of this project, a short discussion of externalities and the possible greater cost would include the following. Cost benefit analysis is used to assess investment projects by considering both market and non-market social costs and benefits. This would include externalities. The analysis is usually done for those projects where there is a significant difference between expected private and public costs and benefits. Cost benefit analyses are used so that policy makers consider the impact of the project on the wider community. However, there are certain disadvantages associated with cost benefit analysis. Private costs (costs the firm for producing and supplying the good) can be estimated quite accurately, for instance, in the case of Erie Pier, the private cost of transferring dredged material to a project site would include trucking costs and any labor involved for loading and unloading, external costs and benefits, or externalities. (Costs and benefits to the third parties are not included in private costs and benefits, and are difficult to compute, since no price is attached to them.)

The possible external costs arising due to the production of a transfer station for dredged material could include visual pollution, congestion near the stations, and possibly noise pollution. External benefits might be no burden on the taxpayers for the construction of a new CDF, and the number of Re-use Facility jobs created in the community. Another benefit for the community—if the CDF is converted to a re-use facility—is the positive effects following from the conversion from a pollution problem to a beneficial use application.

In addition, the cost of imminent alternatives could include finding low-cost ways to take the current dredged material to other locations. This could assume no additional capital costs, no railroad spur, and no other new technologies, but the possible inclusion of RailMate. (In these scenarios, there would be no added fixed costs.

5 Conclusions

Summary of Findings from Cost Analysis

- **Fixed and Variable Costs.** Two estimates are presented in this analysis. The first estimate is for total cost of fixed and variable costs. The second estimate is for incremental or out-of-pocket costs for fixed and variable costs. These two analyses differentiate between 1) purchasing new equipment for the facility, and 2) using existing equipment.

- **Cost-Volume-Profit Calculations (Break-even without Revenues).** The Cost-Volume-Profit (CVP) calculations are based on our identification of the total costs. If we identify the cost per yard to move a specific amount at a specific distance, we know the least cost per yard and, for instance, can therefore ask for the appropriate subsidy to cover that cost.

  The analyses show that the faster the trucks move, the farther out it is cost-effective to truck the material. A calculation for total cost and incremental cost shows at what point it is cost effective to switch to RailMate. (As a practical limitation, this is feasible only if you have access to a railroad and the RailMate technology.) The Total Cost turning point from truck to RailMate, at 40 MPH, intersects RailMate at 101.56 miles; at 50 MPH, intersects RailMate at 128 miles. The Incremental Cost turning point from truck to RailMate, at 40 MPH, intersects RailMate at 101.56 miles; at 50 MPH, intersects RailMate at 128 miles.

  The Total Landed Cost per Yard for RailMate System, or the cost per yard to move the material via the RailMate system for distances of 100, 150, and 200 miles (no data for 50 miles) is estimated at $19.44 per cubic yard. Total Trucking Cost Per Yard Landed, or the cost per yard to move the material via a truck at a given average speed for a given distance, with one half hour of transit time to the move for loading and unloading, is estimated between $16.33 and $49.67 (25 MPH); between $12.17 and $33.00 (40 MPH); and between $10.78 and $27.44 (50 MPH).

  The Incremental (out-of-pocket) Landed Cost per Yard for RailMate System, or the cost per yard to move the material via the RailMate system for distances of 100, 150, and 200 miles (no data for 50 miles) is estimated at $18.73 per cubic yard. Total Trucking Cost Per Yard Landed, or the cost per yard to move the material via a truck at a given average speed for a given distance, with one half hour of transit time to the move for loading and unloading, is estimated between $15.62 and $48.96 (25 MPH); between $11.46 and $32.29 (40 MPH); and between $10.07 and $26.73 (50 MPH).

- **Efficiency.** The decision of what transportation system to use will be predicated first by the distance of the customer from Erie Pier. At 200 miles total distance, it will always be more cost effective to utilize the RailMate system. At 150 miles, it will likewise be cost effective to use the RailMate system. At 100 miles, efficiency depends on the assumed speed of the truck. If the speed is less than 50 MPH, it is more cost effective to use the RailMate system. If one is using

incremental costs, it is better to use a truck at any speed lgreater than 40 MPH and at 100 miles distance. At a total distance of 50 miles it appears to be more cost effective to use trucking, although there is no data on the cost of using RailMate at distances less than 100 miles.

- **Least Cost Alternative.** In evaluating whether to build a new CDF one must first consider the cost of a new facility. The USACE estimates that it would cost (in today's dollars) $30,000,000 to build a new CDF. This cost does not include externality costs which could double or triple the estimated cost. These external costs are difficult to estimate and can be subjective in nature. The cost benefit analysis necessary to estimate these costs is not within the scope of this project. The cost of building a new facility also assumes, perhaps incorrectly, that it would be politically possible to situate a new CDF in the Duluth-Superior Harbor.

  Presently there are about 1.5 million cubic yards of material in the Erie Pier facility. A realistic scenario could be to remove 100,000 cubic yards per year. This would take a total of 15 years to draw down the quantity in Erie Pier to zero stored on site. Fifteen years is therefore used as the discount period in doing present value calculations. An appropriate discount rate is 4%. This is consistent with historical trends. The most conservative estimate of annual operating costs to remove the 100,000 cubic yards and transport it a total of 200 miles is $2,673,000 per year.

  The present value of an annuity of $2,673,000 at 4% for 15 years is $29,719,450. This would indicate that it is slightly less expensive to remove the materials than it is to build a new facility. If one considers externality costs, it is clear that the low-cost alternative is to remove the materials from the site and not wait to build a new facility.

  In addition, the cost of imminent alternatives could include finding low-cost ways to take the current dredged material to other locations. This could assume no additional capital costs, no railroad spur, and no other new technologies, but the possible inclusion of RailMate. (In these scenarios, there would be no added fixed costs.

Usefulness of this study for other Great Lakes ports:

We note that the Duluth-Superior port is unique in some ways, for instance dredged materials are not significantly polluted, the seasonality of port activity is significant, and re-use projects have been already considered and in some cases plans are under discussion.

However, the following points from this study may be of interest to other ports on the Great Lakes:

- Transportation costs should be considered (almost) the entire cost.
- Feasible customers have competing suppliers.
- Given a CDF with a short remaining life, non-recurring projects of most interest will be long-term projects near the CDF (or new PRF), and include using largest amounts of material (wetlands and habitat creation).
- Timing of opportunities can be crucial; the business cycle of the customer is significant.
- Minimizing transportation time is the most cost effective principle.
- Cost-per-yard shows what the government (or other funder) might be willing to subsidize.
- Assume that choosing customer(s) who will take the maximum yards doesn't compare with the cost saving of using a closest customer.

Potential Economic Impacts of the Research Results

The largest economic impact that may be seen is how Erie Pier and other Great Lakes ports view CDFs. Erie Pier should be viewed as Process Reuse Facility or PRF. This switch would result in turning a current environment disposal problem into an economic impact or benefit. The PDF would generate much more positive economic activities and benefits. The "greening" of the CDF will create products that will meet the demands of the construction, habit creation and restoration, agriculture, forestry, and mining industries.

Dredging, processing and transporting the Erie Pier materials will generate direct, indirect and induced economic impacts. The direct impacts will be created in the dredging, processing and transportation sectors. Their expenditures will result in new business-to-business spending, or indirect impacts. These indirect impacts would include increased activity in sectors such as fuel supply and maintenance and repair services. In addition, the workers in these impacted industries would spend their wages and create new induced impacts.

For Further Study

A second phase of this project has been proposed to model and identify the most cost-effective way(s) to transport dredged materials to customers. ("Erie Pier Re-Use Facility Phase II: An Optimized Cost-Effective Strategy for Increased Transport and Handling of Dredged Materials.")The continuing study will investigate how to control operating costs for Erie Pier CDF by optimizing the handling and distribution of re-use of dredged material. The study will also propose optimal changes, additions, and improvements to the existing facility, and provide financial estimates of cost for suggested changes.

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6) United States Army Corps of Engineers. Dredged Material Management Plan (DMMP**)** for the Duluth-Superior Harbor, April 1999.

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Comparables; state-wide and national background:

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The literature also offered information specific to the Duluth-Superior Port activities and the Erie Pier planning process.

Duluth-Superior and Erie Pier background:

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The Metropolitan Interstate Council's planning report identified the issue of noxious weed contamination, for which there is specific documentation for review.

Background on purple loosestrife:

1) *Noxious Weed Management*, http://www.great-lakes.net/envt/flora-fauna/invasive/loosestf.html

2) *Purple Loosestrife*, http://www.leg.state.mn.us/leg/statutes.asp

3) Valppu, Seppo H. (Botanist/Consultant). United States Army Corps of Engineers Duluth Area Office. *Seed Bank Analysis and Germination Trial for Purple Loosestrife (Lythrum salicaria L.) Seeds in Sediment Samples from the Erie Pier Confined Disposal Facility (CDF) Duluth, Minnesota A Technical Report.* Submitted to The U. S. Army Corps of Engineers, July, 2007.

4) Wisconsin Statutes. http://www.legis.state.wi.us/statutes/Stat0023.pdf (Text from the 2005−06 Wisconsin Statistics database updated by the Revisor of Statutes.)

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- Phone interview with Rod Garver, Materials Engineer, Mn/DOT-Duluth, August 1, 2008.
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- Phone interview with Steve Dewars, Minnesota Department of Natural Resources, Lands and Minerals – Hibbing, July 10, 2008.
- Phone interview with Dan Jordan, Iron Range Resources, Mine Reclamation Office at Iron World, July 8, 2008.
- On-site WLSSD interview with Kathy Hamel, Operations Supervisor, Western Lake Superior Sanitary District, July 23, 2008.
- Phone interview with Greg Kaneski, Lakehead Trucking, August 11, 2008.
- Phone interview with Udeen Trucking, August 26, 2008. Note: Udeen Trucking hauled material to Keetac project. See *Use of Dredge Material As An Organic Substrate . . . Final Report, January 2000*.

Appendix A: Mine Reclamation Review

For a view of mine reclamation from 2001 to 2007, the DNR provided data collected for seven mining companies in northern Minnesota, which describe the acres of reclamation activity in terms of temporary and permanent tailings disposition, as well as use of overburden and rock.

Source: *Iron Mining Reclamation Activities, 2007 Summary*
Minnesota Department of Natural Resources, Division of Lands and Minerals, Reclamation Section, Hibbing, MN

Year 2007 Reclamation Completed, Mesabi Iron Range (acres)

Company	Overburden and rock	Tailings temporary	Tailings permanent	Trees planted
Cliffs Erie	255		140	
United Tac	11	150[1]	243[3] 42[4]	seed & seedlings 90 acres
Hibbing Taconite	16	1692[1] 295[2]		seed & seedlings < 10 acres
Arcelor Mittal	12		23	
Keewatin Tac	34	624[1] 712[2]	20[3] 60[4]	10,160
Northshore Mining	24	296[1]		17,800
Minntac	56.5	688[1] 160[2]		1300 seedlings
Total	408.5	3450[1] 1167[2]	263[3] 265	29,275 sdlgs + seed

[1] fine tailings acres mulched for dust control
[2] fine tailings stabilized with temporary vegetation
[3] tailings acres top-dressed with WLSSD biosolids
[4] biosolids were used in tailings reclamation

Year 2006 Reclamation Completed, Mesabi Iron Range

Company	Overburden and rock	Tailings temporary	Tailings permanent	Trees planted
Cliffs Erie	41.5		106	
United Tac				Seedlings and transplants
Hibbing Taconite		1692 [1] 295 [2]		seedlings and seed
Mittal Steel USA-Minorca Mine Inc.	105			
Keewatin Tac	38	927 [1] 330 [2]	230	
Northshore Mining	57	317 [1]	25	
Minntac	16.7	513 [2]		
Total	258.2	2936 [1], 1138 [2]	361	

[1] fine tailings acres mulched for dust control
[2] fine tailings stabilized with temporary vegetation
[3] tailings acres top-dressed with WLSSD biosolids
[4] diversion ditch and ash landfill at Milepost 7 basin
[5] biosolids were used in stockpile reclamation

Year 2005 Reclamation Completed, Mesabi Iron Range

Company	Overburden and rock	Tailings temporary	Tailings permanent	Trees planted
Cliffs Erie	20[5]			
United Tac	16.3	75[1]	20, 78[3]	
Hibbing Taconite	44	1307[1], 50[2]		j. pine seed
Ispat Inland	0			
Keewatin Tac		591[1], 262[2]	11	
Northshore Mining	26[4]	314[1]		
Minntac	71.8, 96.1[5]		3.7	
Total	178.1	2287[1], 312[2]	112.7	

[1] fine tailings acres mulched for dust control
[2] fine tailings stabilized with temporary vegetation
[3] tailings acres top-dressed with WLSSD biosolids
[4] diversion ditch and ash landfill at Milepost 7 basin
[5] biosolids were used in stockpile reclamation

Year 2004 Reclamation Completed, Mesabi Iron Range

Company	Overburden and rock	Tailings temporary	Tailings permanent	Trees planted
Cliffs Erie	60	125		
EVTAC/United Tac	0	60[1]	33, 350[3]	
Hibbing Taconite	20	130, 1380[1]		j. pine seed
Ispat Inland	0			
Keewatin Tac	3	422, 856[1]		
Northshore Mining	0	370[1]		
USS	41.4	52		
Total	124.4	729, 2296[1]	33, 350[3]	

[1] fine tailings acres mulched for dust control
[2] fine tailings stabilized with temporary vegetation
[3] fine tailings acres top-dressed with WLSSD biosolids

Year 2003 Reclamation Completed, Mesabi Iron Range

Company	Overburden and rock	Tailings temporary	Tailings permanent	Trees planted
Cliffs Erie	397		292	
EVTAC/United Tac		270[1]		
Hibbing Taconite	40	139[2] 1466[1]		
Ispat Inland			300	
Keewatin Tac	12.25	422[2] 991[1]		jack & red pine seed[4]
Northshore Mining		285[1]		
USS	47.2	285.6[1] 291.5[3]		jack & red pine seed[4]
Total	496.45	3297.6[1] 561[2]	592	

[1] fine tailings acres mulched for dust control
[2] fine tailings stabilized with temporary vegetation
[3] fine tailings acres top-dressed with WLSSD biosolids
[4] 2 parts jack pine seed to 1 part red pine seed

Year 2002 wetland impacts, and reclamation completed, Mesabi Range.

Wetland impacts from mining and reclamation by company in 2002 (acres)					
Company	Wetland impacts	Overburden and rock	Tailings temporary	Tailings permanent	Trees
Cliff's Erie	0	404		247	
EVTAC	0	20	224[1]	100.5	
Hibbing Taconite	27.8	44	325 / 1043[1]		Jack pine seed
Ispat Inland	0.76	20		170	
National Steel	0.6	20.2	159 / 281[1]	66	17,000 hybrid poplar
Northshore	0		75		
USX	3.07	52.4	623		
Auburn	0	56			
Totals:		616.6	1182 / 1548[1]	583.5	

[1]tailings acres mulched for dust control

Year 2001 Mineable Crude Ore Reserves, Production and Reclamation by Company, Mesabi Iron Range

Ore Reserves and Year 2001 Production (in millions of long tons unless otherwise noted)							Reclamation (acres)			
Company	Mineable Crude Ore Reserves	Crude Ore	Pellets	Rock (M.C.Y.[1])	Overburden (M..C.Y.)	Tailings	Overburden and rock	Tailings permanent	Tailings temporary	Trees planted
EVTAC	784.5	13.45	4.21	3.30	0.50	9.42	11	176	26	210 poplar
Hib-Tac	920.9	22.54	6.10	1.62	3.71	16.47	14		1600	j. pine seed
Ispat Inland	86.0	8.21	2.77	3.84	0.99	7.99				
LTV (Cliff's Erie)	1,300.4						240.5	831	667	
National Steel	831.2	16.83	4.42	1.57	1.66[2]	11.74			147	
Northshore	1,110.0	8.60	2.72	1.52	0	5.55			73	
USX	1,915.0	45.18	12.64	11.69	4.62	29.55	30.3	88	299	
Auburn Minerals		0.42	0.22[3] (ore)	0.05	0	0.13	10			
Totals:	6,948.0	115.23	33.08	23.59	11.48	80.85	305.8	1095	2812	210

[1]million cubic yards
[2]includes surface overburden and rock dump
[3]tons of ore shipped in 2001